CC NV INCORPORATED AREAS Volume I

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

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SECTION 2 ENGINEERING ANALYSES
SECTION 3 DRAFT FIS REPORT TEXT
SECTION 4 MAPPING INFORMATION
SECTION 5 REFERENCE MATERIALS
Data Collection Summary Memorandum
& Photo Log

Submitted by:	**Clark County Regional Flood Control District**
Study Contractor:	**Post, Buckley, Schuh & Jernigan, Inc.**
Date Submitted:	**February 27, 1996**

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SECTION 1

GENERAL DOCUMENTATION

1.1 Certification Forms for Study Contractors

1.2 Telephone Contact Reports

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1.1 Certification Forms for Study Contractors

FEDERAL EMERGENCY MANAGEMENT AGENCY **REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☒ Physical change
     - ☒ Existing
     - ☒ Proposed
   - ☐ Improved methodology
   - ☐ Improved data
   - ☐ Floodway revision
   - ☐ Other

   Explain
2. Flooding Source: **Range Wash**
3. Project Name/Identifier: **West Range Wash Dike, Range Wash/Sloan Channel Confluence Detention Basin**
4. FEMA zone designations affected: **ZONE A**
   (example: A, AH, AO. A1-30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX: 480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**1790 D**	**8/16/95**
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**2176 D**	**8/16/95**
320003	**Clark County**	**Clark**	**NV**	**32003C**	**2180 D**	**8/16/95**
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**2180 D**	**8/16/95**
320003	**Clark County**	**Clark**	**NV**	**32003C**	**2200 D**	**8/16/95**

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding

- ☒ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☐ Shallow Flooding *(e.g. Zones AO and AH)*
- ☐ Lakes

Affected by wind/wave action
- ☐ Yes
- ☐ No

Structures

- ☒ Channelization
- ☒ Levee/Floodwall
- ☐ Bridge/Culvert
- ☒ Dam
- ☐ Coastal
- ☒ Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☐ Other *(describe)*

Disciplines*

- ☒ Water Resources
  - ☒ Hydrology
  - ☒ Hydraulics
  - ☒ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)*

☐ Other (describe) _____ _____ **CIVIL ENGINEER**

*** Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☒ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM ☐ Yes ☒ No
   If yes, give reason:

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions

9. Does the state have jurisdiction over the floodway or its adoption by communities participating in the NFIP?
☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvements, or other development in the floodway? ☐ Yes ☐ No

1B If yes, does the development cause the 100-year water surface elevation to increase at any location by more that 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvements, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)?* ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGMENT

12. Having read NFIP Regulations, 44 CFR Ch.1, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgment and/or notification is required for all requests as outlined in Section 65.4 (b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g., levees, floodwalls, channelization, basins, dams)?
☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by **Clark County Regional Flood Control District** (entity) with a maximum interval of **12** months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by **City of North Las Vegas and Clark County Department of Public Works** (entity) to ensure the integrity and degree of flood protection of the structure

C. A formal plan of operation, including documentation of the flood warning system, specifications and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☒ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☒ performing ☒ overseeing compliance with the maintenance and operation plan of the **West Range Wash Dike, Range/Sloan Confluence Detention Basin**
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled " Appeals, Revisions, and Amendments to Flood Insurance Maps: A guide for Community Officials," dated January 1990, this request is for a:

X	a.	CLOMR	A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch.I, Parts 60, 65, and 72).*
X	b.	LOMR	A letter from FEMA officially revising the current NFIP map to show changes in floodplain, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(see 44 CFR Ch.I Parts 60 and 65.)*
	c.	PMR	A reprinted NFIP map incorporating changes to flood plains, floodways, or flood elevations Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch.I, Parts 60 and 65.)*
	d.	Other	Describe _____

8. FORMS INCLUDED

17. Form 2 entitled, "Certification By Registered Professional Engineer and/or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☒ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☒ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☒ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☐ Bridge/Culvert Form (Form 7)
• The request involves a new levee/floodwall system	☒ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☒ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The Minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No
Initial fee amount: $ _____

Check or money order only. Make check or money order payable to: National Flood Insurance Program. If paying by Visa or Mastercard please refer to the credit card information form which follows this form.

or

19. This request is for a project that is for public benefit and is primarily intended for flood loss reduction to insurable structures in identified flood hazard areas which were in existence prior to the commencement of construction of the flood control project. ☒ Yes ☐ No

or

20. This request is to correct map errors, to include the effects of natural changes within the areas of special flood hazard, or solely to provide more detailed data. ☐ Yes ☒ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Donald W. Davis
Signature of Revision Requester

Donald W. Davis, P.E., Project Manager
Printed Name and Title of Revision Requester

Post, Buckley, Schuh, and Jernigan, Inc.
Company Name

(702) 263-7275
Telephone No.

2/21/96
February 21, 1996
Date

Note: Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.

Randy Tarr
Signature of Community Official

RANDY TARR, P.E.
ADMINISTRATOR OF DEVELOPMENT AND FLOOD CONTROL
Printed Name and Title of Community Official

CITY OF NORTH LAS VEGAS
Community Name

2/22/96
Date

Does this request impact any other communities? ☒ Yes ☐ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

9. INITIAL REVIEW FEE

18. The Minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No
Initial fee amount: $ _____

Check or money order only. Make check or money order payable to: National Flood Insurance Program. If paying by Visa or Mastercard please refer to the credit card information form which follows this form.

or

19. This request is for a project that is for public benefit and is primarily intended for flood loss reduction to insurable structures in identified flood hazard areas which were in existence prior to the commencement of construction of the flood control project. ☒ Yes ☐ No

or

20. This request is to correct map errors, to include the effects of natural changes within the areas of special flood hazard, or solely to provide more detailed data. ☐ Yes ☒ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Donald W. Davis
Signature of Revision Requestor

Donald W. Davis, P.E., Project Manager
Printed Name and Title of Revision Requestor

Post, Buckley, Schuh, and Jernigan, Inc.
Company Name

(703) 263-7275
Telephone No.

2/21/96
February 21, 1996
Date

Note: Signature indicates that the community understands, from the revision requestor, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Robert Thomson Dir. Comm.
Printed Name and Title of Community Official

Clark County
Community Name

2/22/96
Date

Does this request impact any other communities? ☒ Yes ☐ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

9. INITIAL REVIEW FEE

18. The Minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No
Initial fee amount: $ _____

Check or money order only. Make check or money order payable to: **National Flood Insurance Program.** If paying by Visa or Mastercard please refer to the credit card information form which follows this form.

OR

19. This request is for a project that is for public benefit and is primarily intended for flood loss reduction to insurable structures in identified flood hazard areas which were in existence prior to the commencement of construction of the flood control project. ☒ Yes ☐ No

OR

20. This request is to correct map errors, to include the effects of natural changes within the areas of special flood hazard, or solely to provide more detailed data. ☐ Yes ☒ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Donald W. Davis
Signature of Revision Requester

Donald W. Davis, P.E., Project Manager
Printed Name and Title of Revision Requester

Post, Buckley, Schuh, and Jernigan, Inc.
Company Name

(702) 263-7275
Telephone No.

2/21/96
February 21, 1996
Date

Note: Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.

Kevin Eubanks
Signature of Community Official

Kevin Eubanks, Asst. General Mgr.
Printed Name and Title of Community Official

Clark County and Incorporated Areas
Community Name

February 22, 1996
Date

Does this request impact any other communities? ☒ Yes ☐ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2

2. I am licensed with an expertise in **water resources (hydrology, hydraulics)**
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)** structural, *geotechnical, land surveying.*]

3. I have **13** years experience in the expertise listed above.

4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.

5. I ☒ have ☐ have not visited and physically viewed the project.

6. In my opinion, the following analyses and/or designs, is/are being certified:
   West Range Wash Dike, Confluence Detention Basin, Sloan Channel Owens to Stewart, Channel Lamb to Alexander

7. Based upon the following review, the modifications in place have been constructed in general concordance with plans and specifications.

   Basis for above statement: (check all that apply)
   - a. ☐ Viewed all phases of actual construction.
   - b. ☒ Compared plans and specifications with as-built survey information.
   - c. ☒ Examined plans and specifications and compared with competed projects.
   - d. ☐ Other _____

8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under title 18 of the United States Code, Section 1001.

Name: **Donald W. Davis**
(please print or type)

Title: **Project Manager**
(please print or type)

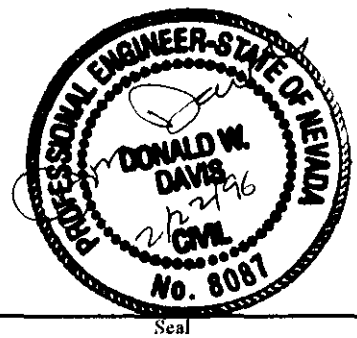
Registration No. **8087** Expiration Date: **12/31/96**

State **Nevada**

Type of License **Civil Engineer**

Donald W Davis
Signature

2/22/96
Date



Seal
(Optional)

* Specify Subdiscipline
Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

(One form for each flooding source)

Project Name / Identifier: **Range Wash FIS Restudy**

1. HYDROLOGIC ANALYSIS IN FIS

- ☒ Approximate study stream (Zone A)
- ☐ Detailed study stream (briefly explain methodology) _____

2. REASON FOR NEW HYDROLOGIC ANALYSIS

- ☐ No existing analysis
- ☒ Improved Data *(see data revision on page 3)*
- ☒ Changed physical conditions of watershed *(explain)* **Major flood control facilities have been constructed or are under construction, including a diversion dike to the North Las Vegas Detention Basin and the Range Wash/Sloan Channel Confluence Detention Basin**
- ☐ Alternative methodology *(justify why the revised model is better than model used in the effective **FIS**)*
- ☒ Evaluation of proposed conditions (CLOMRs only) (explain) **The Confluence Detention Basin is presently under construction**
- ☐ Other _____

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHA designated as Zone A.

3. APPROVAL OF ANALYSIS

- ☒ Approval of hydrologic analysis, including the resulting peak discharge value (s) has been provided by the appropriate local, state, or Federal Agency. (i.e., **Clark County Regional Flood Control District**)

  Attach evidence of approval.
- ☐ Approval of the hydrologic analysis is not required by any local, state, or Federal Agency.

4. REVIEW OF RESULTS

Stream: **Range Wash**

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.) w/o dike - w/ dike - w/ DB	FIS (cfs): w/o dike - w/ dike	Revised (cfs): w/ dike - w/ DB
West Tributary at Las Vegas Blvd	49 - 11, 8_R - N/A	6,300 - 2,900	1,550
Sloan Channel at Owens	138 - 89 - 85_R	8,000 - 5,200	1,940
Sloan Channel at Las Vegas Wash	151 - 102 - 16	8,300 - 6,000	4,000
$_R$: *Revised areas of Restudy*			

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in the 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION

Location of the nearest gage to project site *(along flooding source or similar watershed: specify)*

N/A

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
Basin Delineation	☐	☒	Changes due to development
Lag times	☐	☒	CCRFCD Criteria Manual
	☐	☐	
	☐	☐	
	☐	☐	

- Data source can be from Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal Agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.

- Attach documentation corroborating each data source *(i.e. certified statement, report, bibliographical reference to a published document)*. In each case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: _____

Gage Location (latitude and longitude): _____

	FIS:	Revised:
1. Number of years of data		
Systematic		
Historical		
2. Homogeneous data	☐ Yes ☐ No	☐ Yes ☐ No
3. Data adjustments	☐ Yes ☐ No	☐ Yes ☐ No
4. Number of high outliers		
Low outliers		
Zero events		
5. Generalized skew		
6. Station skew		
7. Adopted skew		
8. Probability distribution used (justify if log-Pearson III was not used)		
9. Transfer equations to ungaged sites		☐ Yes ☐ No
If yes, specify method		
10. Expected probability*	☐ Yes ☐ No	☐ Yes ☐ No
11. Comparison of results with other analyses	☐ Yes ☐ No	☐ Yes ☐ No
If yes, describe comparison		

*__FEMA__ does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A

Attach analysis including plot of flood frequency curve.

ATTACHMENT B: REGIONAL REGRESSION EQUATIONS

1. Bibliographic Reference:

_____

_____

_____

(attach a copy of title page, table of contents, and pertinent pages including equations)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

_____

_____

_____

		FIS:	Revised:
5.	Urbanized conditions calculations	☐ Yes ☐ No	☐ Yes ☐ No
6.	Percent of watershed urbanization	_____	_____
7.	Is the watershed controlled?	☐ Yes ☐ No	☐ Yes ☐ No
8.	Comparison with other analyses	☐ Yes ☐ No	☐ Yes ☐ No

If the answer to 5, 7, or 8, is yes, explain methodology in comments.
If data is not available, indicate by N/A.

Comments

_____

_____

_____

_____

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT C: PRECIPITATION / RUNOFF MODEL

		FIS:	Revised:
1.	*Method or model used:*	HEC-1	HEC-1
	Version:	Haested 5.2	4.0
	Date:	Aug. 1988	Sept. 1990
2.	Source of Rainfall Depth:	CCRFCD	CCRFCD
3.	Source of rainfall distribution	CCRFCD	CCRFCD
4.	Rainfall duration:	6 hours	6 hours
5.	Areal adjustment to precipitation (%):	CCRFCD DARFS	CCRFCD DARFS
6.	Maximum overland flow length	500 ft	500 ft
7.	Hydrograph development method:	SCS Unit Hydrograph	SCS Unit Hydrograph
8.	Loss rate method:	SCS	SCS
	Source of soils information	SCS	SCS
	Source of land use information	1990 Aerial Photos	1995 Aerial Photos
9.	Channel routing method:	Muskingum	Muskingum
10.	Reservoir routing	☐ Yes ☒ No	☒ Yes ☐ No
11.	Baseflow considerations:	☐ Yes ☒ No	☐ Yes ☒ No
	If yes, explain how baseflow was determined:		
12.	Snowmelt considerations:	☐ Yes ☒ No	☐ Yes ☒ No
13.	Model calibration:	☐ Yes ☒ No	☐ Yes ☒ No
	If yes, explain how calibration was performed		
14.	Future land use condition:		☐ Yes ☒ No
	If yes, explain why		

NOTE: FEMA policy is to base flooding on existing conditions.
If data is not available, indicate by N/A.

Attach precipitation / runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT D: CONFIDENCE LIMITS EVALUATION

Stream: _____

Select one location for Confidence Limits Evaluation *(describe location)*: _____

_____

Discharge for selected location.

Exceedance Probability		FIS		Revised	
10%	(10-year)	_____	cfs	_____	cfs
2%	(50-year)	_____	cfs	_____	cfs
1%	(100-year)	_____	cfs	_____	cfs
0.2%	(500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval: 5% limit _____ *cfs*

95% limit _____

50% Confidence Interval: 25% limit _____

75% limit _____

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**
(One form for each flooding source)

Project Name / Identifier: **Range Wash FIS Restudy**

1. REACH TO BE REVISED

Downstream limit: ***Confluence with Las Vegas Wash***
Upstream limit: **Elkhorn Road**

2. EFFECTIVE FIS

☐ Not studied

☒ Studied by approximate methods
Downstream limit of study: Confluence with Las Vegas Wash
Upstream limit of study: Elkhorn Road

☐ Studied by detailed methods
Downstream limit of study:
Upstream limit of study:

☐ Floodway delineated
Downstream limit of study:
Upstream limit of study:

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM. *(Check all that apply)*

☐ Not studied in FIS

☐ Improved hydrologic data / analysis. Explain: Basins have been delineated in more detail and reflect recent improvements by developers.

☐ Improved hydraulic analysis. Explain:

☒ Flood control structure. Explain: Range Wash Dike has been constructed, Confluence Detention Basin is under construction, Sloan Channel improvements have been constructed and are under construction.

☐ Other. Explain:

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

For areas which have detailed flooding:

Full input and output listings along with files on diskette (if available) for each of the models listed below (items 1, 2, 3, 4, and 5) and summary of the source of input parameters used in the models must be provided. The summary must include a complete description of any changes made from model to model (e.g. duplicate effective model to corrected effective model.) At a minimum, the Duplicate Effective (item 1) and the Revised or Post-Project Conditions (item 4) models must be submitted. See instructions for directions on when other models may be required.

For areas which do not have detailed flooding:

Only the 100-year flood profile is required. A hydraulic model is not required for areas which do not have detailed flooding; however, BFEs may not be added to the revised FIRM. If a hydraulic model is developed for the area, items 3 and 4 described below must be submitted.

If hydraulic models are not developed, hydraulic analyses for existing or pre-project conditions and revised or post-project conditions must be submitted. All calculations must be submitted for these analyses. (see item 6 below)

	Natural	Floodway
1. Duplicate Effective Model Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.	☐	☐
2. Corrected Effective Model The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.	☐	☐
3. Existing or Pre-Project Conditions Model The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.	☐	☐
4. Revised or Post-Project Conditions Model The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.	☐	☐
5. Other: Please attach a sheet describing all other models submitted	Natural	Floodway
6. Hydraulic Analyses (Only if Hydraulic Models are not developed)	☒	☒

Please Attach all calculations for the existing or pre-project conditions and the revised or post-project conditions. *Proceed to form 5, "Riverine/Coastal Mapping Form".*

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream limit	Downstream limit
10-year		
50-year		
100-year		
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined _____

3. Give range of friction loss coefficient *(Manning's "N")* Channel . . . . . _____

Overbanks . . . . . _____

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and the revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised

Explain: _____

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

5. Were natural channel banks selected as the location of the left and right channel banks in the model?

☐ Yes ☐ No If no, explain why not: _____

4. MODEL PARAMETERS (Cont'd)

6. Explain how reach lengths for channel and overbanks were determined:

_____

_____

_____

_____

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

   a. Water surface elevations higher than end points of cross sections? . . . . . ☐ Yes ☐ No

   b. Supercritical depth? . . . . . ☐ Yes ☐ No

   c. Critical depth? . . . . . ☐ Yes ☐ No

   d. Other unique situations . . . . . ☐ Yes ☐ No

   If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? . . . . . _____
   Specify location . . . . . _____

3. What is the distance between the cross-sections in 2 above? . . . . . _____

4. What is the maximum distance between cross-sections? . . . . . _____
   Specify location . . . . . _____

5. Floodway determination
   a. What is the maximum surcharge allowed by the community or State? . . . . . _____ foot
   b. What is the maximum surcharge for the revised conditions? . . . . . _____ foot
   Specify location . . . . . _____
   c. What is the maximum velocity? . . . . . _____ fps
   Specify location . . . . . _____

   d. Are there any negative surcharge values at any cross-section ☐ Yes ☐ No
   If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

Explain: _____

_____

_____

5. RESULTS (Cont'd)

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ☐ No
If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ☐ No
If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases. *(For example: State if the increase is due to fill placed within the floodway fringe or placed within the currently adopted floodway limits)*

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)* downstream of the project at cross-section _____ within _____ feet *(vertical)* and upstream of the project at cross section _____ within _____ feet *(vertical)*.

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section _____ within _____ feet *(vertical)* and upstream of the project at cross section _____ within _____ feet *(vertical)*.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord an top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets.

D. Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report.

Proceed to Riverine / Coastal Mapping Form

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy**

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable):*

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	☒ Yes	☐ No	☐ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	☐ Yes	☐ No	☒ N/A
C.	Revised 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	☒ Yes	☐ No	☐ N/A
E.	Stream alignments, road and dam alignments	☒ Yes	☐ No	☐ N/A
F.	Current community boundaries	☒ Yes	☐ No	☐ N/A
G.	Effective 100-~~and 500~~-year floodplain ~~and 100-year floodway~~ boundaries from the FIRM/~~FBFM~~ reduced or enlarged to the scale of the topographic work map	☒ Yes	☐ No	☐ N/A
H.	Tie-ins between the effective and revised 100- ~~and 500~~-year floodplains ~~and 100-year floodway~~ boundaries	☐ Yes	☐ No	☒ N/A
I.	The requestor's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
J.	The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
K.	Location and description of reference marks	☐ Yes	☐ No	☒ N/A
L.	Vertical datum (example: NGVD, NAVD etc.)	☒ Yes	☐ No	☐ N/A
M.	Coastal zone designations tie into adjacent areas not being revise	☐ Yes	☐ No	☒ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	☐ Yes	☐ No	☒ N/A

If any of the items above are marked no or N/A, please Explain:

Study includes the entire mapped reach of Range Wash by approximate methods no base flood elevations are determined.

2. What is the source and data of the updated topographic information *(example: orthophoto maps, July 1985; field survey, May 1979, beach profiles, June 1987, etc.)?* **Aerial Survey Topographic Mapping 3/15/95**

3. What is the scale and contour interval of the following work maps?

a. Effective FIS **1" = 400'** scale **4 ft** Contour interval

b. Revision Request **1" = 400'** scale **2 ft** Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.

Attach additional pages if needed.

1. MAPPING CHANGES (Cont'd)

5. Flood boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on the property other than the requestor's or community's? ☐ Yes ☒ No

If yes, please give the location of shift or increase and an explanation of the increase.

Shifted within community, due to more detailed and accurate topography

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ☒ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? **none**

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☒ Yes ☐ No

If yes, explain:

Shifted within community, due to more detailed and accurate topography

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? ☐ Yes ☐ No

If no, explain:

8. Manual or digital map submission:

☒ Manual
☒ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ☒ Existing ☐ Proposed **Fill is associated with Cibola Project Case No. 95-09-1021C**

2. Has fill been / will be placed in the regulatory floodway? . . . . . ☐ Yes ☒ No
If yes, please attach complete Riverine Hydraulic Analysis Form.

3. Has fill been / will be placed in the floodway fringe *(area between the floodway and 100-year floodplain boundaries)?* . . . . . ☒ Yes ☐ No

A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . ☐ Yes ☒ No

If yes, justify steeper slopes _____

B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . ☒ Yes ☐ No

If no, describe erosion protection provided _____

C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? ☒ Yes ☐ No

D. Can structures conceivably be constructed on the fill at any time in the future? ☒ Yes ☐ No

If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been / will be placed in a V-zone? ☐ Yes ☒ No

If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? ☐ Yes ☐ No

If yes, attach the coastal structures form.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.75 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy Channelization associated with Collins Buisness Park**

1. EXTENT OF CHANNELIZATION

Downstream limit: **Alexander Road**

Upstream limit: **Lamb Boulevard**

2. CHANNEL DESCRIPTION

1. Describe the inlet to the channel **3 - 9' x 6' RCB Culverts at Lamb Boulevard**

2. Briefly describe the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)* **Concrete lined trapezoidal channel, 32 ft base width, 5.5 ft deep, 2:1 side slopes,**

3. Describe the outlet from the channel **4 - 12' x 7' RCB Culverts at Alexander Road**

4. The channelization includes:

- ☐ Levees *(Attach Levee Form)*
- ☐ Drop structures
- ☐ Superelevated sections
- ☒ Transitions in cross section geometry
- ☐ Debris basin/detention basin
- ☐ Energy Dissipater
- ☐ Other

5. Attach the following:

a. Certified engineering drawings showing channel alignment and locations of inlet, outlet, and items checked in item 4

b. Typical cross sections and profiles of channel banks and invert

3. HYDRAULIC CONSIDERATIONS

1. What is the 100-year discharge? . . . . . **2,140 used in model** cfs

2. Do the cross sections in the hydraulic model match the typical cross sections in the plans? ☒ Yes ☒ No

3. Are the channel banks higher than the 100-year flood elevations everywhere? . . . . . ☒ Yes ☐ No

4. Are the channel banks higher than the 100-year flood energy grade lines everywhere? . . . ☒ Yes ☐ No

5. Is the land on both sides of the channel above the adjacent 100-year flood elevation at all points along the channel? . . . . . ☒ Yes ☐ No

6. What is the range of freeboard . . . . . **1.5** --- **2.8** feet

7. What is the range of the 100-year flood velocities? . . . . . **10.7** --- **16.9** ft/sec

8. What is the lining type? (both bottom and sides) **Concrete**
   Explain how the channel lining prevents erosion and maintains channel stability *(attach documentation)*

9. What is the design elevation in the channel based on?

   ☐ Subcritical flow
   ☐ Critical flow
   ☒ Supercritical flow
   ☐ Energy grade line

   Is 100-year flood profiles based on the above type of flow? . . . . . ☐ Yes ☒ No

   If no, explain: Profiles included in the Collins Buisness Park Improvement Plans are based on the above types of flow. No base flood elevations are determined for this area.

10. Is there the potential for a hydraulic jump at the following locations?

    Inlet to the channel . . . . . ☐ Yes ☒ No
    Outlet of the channel . . . . . ☐ Yes ☒ No
    At Drop Structures . . . . . ☐ Yes ☒ No
    At Transitions . . . . . ☐ Yes ☒ No
    At other locations. Explain

    If the answer to any of the above is yes, please explain how the hydraulic jump is controlled and the effects of the hydraulic jump on the stability of the channel.

    Explain:

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

   B. Based on the conditions of the watershed and stream bed, is there a potential for sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (bed) load?
   _____ cfs (attach gradation curve)

   Explain method used to estimate load _____

   _____

   _____

   _____

   _____

   B. Is the 100-year flood velocity anywhere within the channel less than the 100-year flood velocity of the inlet? ☒ Yes ☐ No

   C. Will sediment accumulate anywhere within the channel? ☐ Yes ☒ No

   D. Will deposition or scour occur at or near the inlet? ☐ Yes ☒ No

   E. Will deposition or scour occur at or near the outlet? ☒ Yes ☐ No

Attach documentation showing affects on the hydrologic and hydraulic analyses

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy Channelization associated with Sloan Channel**

1. EXTENT OF CHANNELIZATION

Downstream limit: **Stewart Avenue**

Upstream limit: **Owens Avenue**

2. CHANNEL DESCRIPTION

1. Describe the inlet to the channel
Continuation of Existing Concrete Channel

2. Briefly describe the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)* **Concrete lined trapezoidal channel, 60 ft base width, 6.6 ft deep, 2:1 side slopes,**

3. Describe the outlet from the channel
8 - 10' x 3.5' RCB Culverts at Stewart Ave.

4. The channelization includes:

- ☐ Levees *(Attach Levee Form)*
- ☐ Drop structures
- ☐ Superelevated sections
- ☒ Transitions in cross section geometry
- ☐ Debris basin/detention basin
- ☐ Energy Dissipater
- ☐ Other

5. Attach the following:

a. Certified engineering drawings showing channel alignment and locations of inlet, outlet, and items checked in item 4

b. Typical cross sections and profiles of channel banks and invert

3. HYDRAULIC CONSIDERATIONS

1. What is the 100-year discharge? . . . . . **3,300 used in model** cfs

2. Do the cross sections in the hydraulic model match the typical cross sections in the plans? ☒ Yes ☒ No

3. Are the channel banks higher than the 100-year flood elevations everywhere? . . . . . ☒ Yes ☐ No

4. Are the channel banks higher than the 100-year flood energy grade lines everywhere? . . . ☒ Yes ☐ No

5. *Is the land on both sides of the channel above the adjacent 100-year flood elevation* at all points along the channel? . . . . . ☒ Yes ☐ No

6. What is the range of freeboard . . . . . **1.5** --- **'1.67** feet

7. What is the range of the 100-year flood velocities? . . . . . **7** --- **18** ft/sec

8. What is the lining type? (both bottom and sides) **Concrete**
   Explain how the channel lining prevents erosion and maintains channel stability *(attach documentation)*

9. What is the design elevation in the channel based on?

   ☒ Subcritical flow
   ☐ *Critical flow*
   ☒ Supercritical flow
   ☐ Energy grade line

   Is 100-year flood profiles based on the above type of flow? . . . . . ☐ Yes ☒ No

   If no, explain: Profiles included in the Sloan Channel Predesign Report are based on the above types of flow. No base flood elevations are determined for this area.

10. Is there the potential for a hydraulic jump at the following locations?

    Inlet to the channel . . . . . ☐ Yes ☒ No
    Outlet of the channel . . . . . ☐ Yes ☒ No
    At Drop Structures . . . . . ☒ Yes ☐ No
    At Transitions . . . . . ☐ Yes ☒ No
    At other locations. Explain

    If the answer to any of the above is yes, please explain how the hydraulic jump is controlled and the effects of the hydraulic jump on the stability of the channel.

    Explain: **Jumps are mild at upstream end of road crossing structures and are contained within the concrete channel section**

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

   B. Based on the conditions of the watershed and stream bed, is there a potential for sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (bed) load?
   _____ cfs (attach gradation curve)

   Explain method used to estimate load _____

   _____

   _____

   _____

   _____

   B. Is the 100-year flood velocity anywhere within the channel less than the 100-year flood velocity of the inlet? ☒ Yes ☐ No

   C. Will sediment accumulate anywhere within the channel? ☐ Yes ☒ No

   D. Will deposition or scour occur at or near the inlet? ☐ Yes ☒ No

   E. Will deposition or scour occur at or near the outlet? ☒ Yes ☐ No

Attach documentation showing affects on the hydrologic and hydraulic analyses

FEDERAL EMERGENCY MANAGEMENT AGENCY **LEVEE/FLOODWALL SYSTEM ANALYSES FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.0. hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada, and Incorporated Areas, City of North Las Vegas

Flooding Source: Range Wash

Project Name/Identifier: Range Wash FIS Restudy – West Range Wash Dike

REACH TO BE REVISED

Dike Downstream limit: North Las Vegas Detention Basin

Upstream limit: Ridge of Mountain-Las Vegas Range

This Levee/Floodwall analysis is based on:

- ☐ *upgrading of an existing levee/floodwall system*
- ☒ a newly constructed levee/floodwall system
- ☐ reanalysis of an existing levee/floodwall system

LEVEE/FLOODWALL SYSTEM ELEMENTS

1. Levee elements and locations are:

☒ earthen embankment, dike, berm etc.	Station 4+00	to 320+00
☐ structural floodwall	Station	to
☐ *other (describe)*	Station	to

Structural Type:

- ☐ monolithic cast-in place reinforced concrete
- ☐ reinforced concrete masonry block
- ☐ sheet piling
- ☐ other (describe)

2. Has this levee/floodwall system been certified by a Federal agency to provide protection against the 100-year flood event?

☐ Yes ☒ No

If yes, by which agency?

If yes, complete only the interior drainage section on pages 7 and 8 of this form and the operation and maintenance section of *Revision Requestor and Community Official Form.*

3. Attach certified drawings containing the following information (indicate drawing sheet numbers):

a. Plan of the levee embankment and floodwall structures. Sheet Numbers F-1, F-2 D-1 through D-10

b. A profile of the levee/floodwall system showing the 100-year water surface elevation, levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers F-1, F-2 D-1 through D-10

c. A profile of the 100-year water surface elevation, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure device. Sheet Numbers N/A

d. A layout detail for the embankment protection measures. Sheet Numbers DT-1

e. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. Sheet Numbers DT-1

FREEBOARD

1. The minimum freeboard provided above the 100-year water surface elevation is:

Riverine

3.0 feet or more at the downstream end and throughout	☒ Yes	☐ No
3.5 feet or more at the upstream end	☐ Yes	☐ No
4.0 feet immediately upstream of all structures and constrictions	☐ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave for the 100-year stillwater surge elevation or maximum wave runup (whichever is greater).	☐ Yes	☐ No
2.0 feet above 100-year stillwater surge elevation	☐ Yes	☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Part 65.10 (b) (1) (ii) of the National Flood Insurance Program regulations.

If no is answered to any of the above, please explain where and why: _____

2. Tabulate the elevations at critical locations (tabulate values at each levee crest grade change)

Station	Location	100-Year Water Surface Elevation	Levee Crest	Freeboard (ft.)
	Upper end			
		4.4' deep (typ)	15.3' high (typ)	10.9
See Water Surface Profiles - Section 5 - Sediment Transport Documentation Notebook				
	Lower end			

(Extend table on an added sheet as needed and reference)

SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations?

☒ Yes ☐ No

B. Based on the conditions (such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions), is there a potential for debris and sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the freeboard for the levee/floodwall?

☒ Yes ☐ No

2. If the answer to either 1A or 1B is yes:

A. What is the estimated sediment (bed material) load?

_____cfs (attach gradation curve) 2,670,000 Tons/day - peak

Explain method used to estimate the sediment transport and the depth of scour and/or deposition

See Section 5 - 3 Range Wash Sediment Transport Documentation Notebook

B. Will sediment accumulate anywhere along the levee/floodwall (such as along any bends in the channel)?

☒ Yes ☐ No

If yes, what is the minimum freeboard at these locations? 10.7 feet.

CLOSURES

1. Openings through the levee system:

☐ exist ☒ do not exist

If openings exist, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as neded and reference)

Geotechnical and geologic data:

In addition to the required detail analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following levee system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers EM-1110-2-1906 Form 2086).

EMBANKMENT PROTECTION

1. The maximum levee slope landside is 3:1

2. The maximum levee slope floodside is 4:1

3. The range of *100-year riverine flood velocities along the levee?* 9 fps (min.)
   to 12 fps (max.)

4. Embankment material is protected by (describe the kind):
   Sediment Transport Equilibrium Analysis
   Dike base width ≈ 120' wide

5. Riprap Design Parameters: (Include references) ☐ Velocity; ☐ Tractive stress

Reach	Sideslope	Flow depth	Velocity	Curve or Straight	Stone Riprap D_{100}	D_{50}	Thickness	Depth of Toedown
Sta_____ to _____								
Sta_____ to _____								
Sta_____ to _____								

(Extend table on an added sheet as needed and reference)

6. Has a bedding/filter analysis and design been included ☐ Yes ☒ No

Describe the analysis used for other kinds of protection used (include copies of the design analysis):
see Sediment Transport Documentation Notebook in Section 5

Note: Attach engineering analysis to support construction plans.

1. Describe the basis for selection of critical location for analysis:
Dike has uniform cross-section

☐ Overall height: Sta_____, height 15.3 ft.

☐ Limiting foundation soil strength: See Geotechnical Investigation

Sta_____, depth_____to_____

strength Ø = _____degrees, c = _____psf

☐ slope: SS = 4 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

2. Specify the embankment stability analyses methodology used (e.g. circular arc, sliding block, infinite slope, etc.): SB-Slope, Version 3.0 program - Bishops simplified method of slices for circular failure surfaces

3. Summary of stability analysis results:

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	2.5	1.3
II	Sudden drawdown	1.8	1.0
III	Critical flood stage	1.7	1.4
IV	Steady seepage at flood stage	1.7	1.4
VI	Earthquake (Case I or III)	1.4	1.0

(Reference: U.S. Army Corps of Engineers EM-1110-2-1913 Table 6-1)

4. Was a seepage analysis for the embankment performed? ☐ Yes ☒ No

Describe methodology used:_____

5. Was a seepage analysis for the foundation performed? ☐ Yes ☒ No

Were uplift pressures at the embankment landside toe checked? ☐ Yes ☒ No

Were seepage exit gradients checked for piping potential? ☐ Yes ☒ No

6. The duration of 100-year flood hydrograph against the embankment is 8 Hrs.

Note: Attach engineering analysis to support construction plans.

1. Describe analysis submittal based on Code:

☐ UBC (1988) or ☐ Other (specify)_____

2. Stability analysis submitted provides for:
☐ Overturning; ☐ Sliding; If not, explain Top width of dike is 12' base width is approximately 120' - Stability not a problem - see Geotechnical Investigation

3. Loading included in the analyses were:

☐ Lateral earth @ P_A = _____psf; P_p = _____psf

☐ Surcharge--Slope @_____, ☐ surface_____psf

☐ Wind @ P_w = _____psf

☐ Seepage (Uplift); ☐ Earthquake @ P_{eq} = _____%g

☐ 100-year significant wave height_____ft.

☐ 100-year significant wave period_____sec.

4. Summary of Stability Analysis Results: Factors of Safety. Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min) Overturn	Criteria (Min) Sliding	Sta_____ To_____ Overturn	Sta_____ To_____ Sliding	Sta_____ To_____ Overturn	Sta_____ To_____ Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood & Impact	1.5	1.5				
Dead, Soil & Seismic	1.3	1.3				

(Ref: FEMA 114 Sept 1986; COE EM 1110-2-2502)

(Note: Extend table on an added sheet as needed and reference)

5. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load	Short Term Load
Computed design maximum	_____psf	_____psf
Maximum allowable	_____psf	_____psf

6. Foundation scour protection ☐ is, ☐ is not provided, (describe)

_____

Note: Attach engineering analysis to support construction plans.

SETTLEMENT

1. Anticipated potential settlement has been determined and incorporated into the specified construction elevations to maintain the established freeboard margin.
   ☒ Yes ☐ No
2. The computed range of settlement is negligible ft. to _____ ft.
3. Settlement of the levee crest is determined to be primarily from:
   - ☐ Foundation consolidation
   - ☒ Embankment compression
   - ☐ Other (describe) _____
4. *Differential settlement of floodwalls*
   ☒ has ☐ has not been accommodated in the structural design and construction.

Note: Attach engineering analysis to support construction plans.

INTERIOR DRAINAGE – N/A

1. Specify size of each interior watershed
   - Draining to pressure conduit _____
   - Draining to ponding area _____
2. Relationships Established
   - *Ponding elevation vs. storage* ☐ Yes ☐ No
   - Ponding elevation vs. gravity flow ☐ Yes ☐ No
   - Differential head vs. gravity flow ☐ Yes ☐ No
3. The river flow duration curve is enclosed ☐ Yes ☐ No
4. Specify the discharge capacity of the head pressure conduit _____
5. Which Flooding Conditions Were Analyzed?
   - Gravity flow (Interior Watershed) ☐ Yes ☐ No
   - Common storm (River Watershed) ☐ Yes ☐ No
   - Historical ponding probability ☐ Yes ☐ No
   - Coastal wave overtopping ☐ Yes ☐ No

   If no, explain why: _____
6. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection.
   ☐ Yes ☐ No

   If no, explain why: _____
7. The rate of seepage through the levee system for the 100-year flood is _____ cfs

1. The length of levee system used to drive this seepage rate is _____ ft.

2. Will a pumping plant(s) be used for interior drainage? ☐ Yes ☐ No

If yes, include the number of pumping plants: _____

For each pumping plant, list:	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operations be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: U.S. Army Corps of Engineers EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Note: Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

OTHER DESIGN CRITERIA

1. The following items have been addressed as stated:

Liquifaction ☐ is ☒ is not a problem.
Hydrocompaction ☐ is ☒ is not a problem
Heave differential movement due to soils of high shrink/swell
☐ is ☒ is not a problem.

2. For each of these problems, state the basic facts and corrective action taken.

_____

_____

_____

_____

If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?

☐ Yes ☐ No

Note: Attach supporting documentation

The planned/installed works are in full compliance with NFIP regulations, Section 44 CFR Ch. 1. 65.10

☒ Yes ☐ No

1. The operation plan incorporates all the provisions for closure devices as required in Section 65.10 (c) (1), of the NFIP regulations

N/A ☐ Yes ☐ No

2. The operation plan incorporates all the provisions for interior drainage as required in Section 65.10 (c) (2), of the NFIP regulations

N/A ☐ Yes ☐ No

If no to either of the above, please explain.

_____

_____

_____

_____

FEDERAL EMERGENCY MANAGEMENT AGENCY **DAM FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 0.5 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: Clark County, Nevada and Incorporated Areas, City of North Las Vegas

Flooding Source: Range Wash

Project Name/Identifier: Range Wash FIS Restudy - Range Wash/Sloan Channel Confluence Detention Basin

IDENTIFIER

Name of Dam: Range Wash/Sloan Channel Confluence Detention Basin

Location of dam along flood source (in terms of stream distance or cross section identifier):

5.5 miles upstream from Las Vegas Wash on the Range Wash

Check one of the following:

- ☐ Existing dam
- ☒ New dam
- ☐ Modifications of existing dam (describe modifications)_____

Was the dam designed by ____ Federal agency ____ State agency

For X Local government agency by X Private organization?

BACKGROUND

Does the dam have dedicated flood control storage? ☒ Yes ☐ No

Does the project involve revised hydrology? ☒ Yes ☐ No

If yes, complete Hydrologic Analysis Form and include calculations of the 100-year inflow flood hydrograph routed through the dam with the beginning pool at the normal pool elevation (spillway crest elevation for ungated spillway). Include any inflow hydrograph bulking by watershed sediment yield and provide necessary debris and sediment yield analysis.

Does the revised hydrology affect the 100-year water-surface elevation behind the dam or downstream of the dam? ☒ Yes ☐ No

If yes, complete the Riverine Hydraulic Analysis Form and complete the table shown on the following page.

	Stillwater Elevation Behind the Dam	
	FIS	Revised
10-year		
50-year		
100-year	N/A	1815.9
500-year		
Normal Pool Elevation		

Was long term sediment accumulation taken into consideration in determining the normal pool elevation? ☒ Yes ☐ No

Was the dam designed to withstand the hydrostatic and hydrodynamic forces associated with floods greater than the 100-year flood? ☒ Yes ☐ No

If no, and the dam has a reasonable probability of failure during the 100-year flood, please attach dam break analysis.

Provide the following data on the dam:

Height: 13.5' above ~~center~~ natural grade
Crest Elevation: 1821.5
100-year flood storage capacity: 1025 acre-ft
Freeboard (measured from 100-year water surface elevation): 5.6'

Spillway(s):

Type: ☐ gated ☒ ungated

Width: 2,200'
Height:
Crest Elevation: 1816.0

Outlet(s):

Type: ☐ gated ☒ ungated
2-LEVEL

	LOW	HIGH
Width:	5.6	114'
Height	4.0	
Diameter:		
Invert Elevation:	1798.8	1813.0

Explain flow regulation plan: Used for flood control) detention Normally empty.

Are the project features, including the emergency spillway, designed to accommodate the 100-year flood discharge without overtopping the dam? ☒ Yes ☐ No

Was the dam designed in accordance with all currently applicable local, State, and Federal regulations? ☒ Yes ☐ No

If no, please provide explanation.

FEMA may request a list of regulations that have been complied with and supporting documentation demonstrating compliance with these regulations.

Attach copy of formal operation and maintenance plan

Answer N/A to any questions which are not applicable

1.2 Telephone Contact Reports

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

CONTACT (TELEPHONE CONVERSATION) REPORTS INDEX

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

CONTACT REPORT DATE	FIRM / AGENCY CONTACTED
January 31, 1996	Clark County Regional Flood Control District
January 18, 1996	City of North Las Vegas
January 18, 1996	ESI Engineers and Surveyors Inc.
January 17, 1996	ESI Engineers and Surveyors Inc.
January 16, 1996	Clark County, Community Development
January 16, 1996	City of North Las Vegas
December 7, 1995	City of North Las Vegas
November 22,1995	City of North Las Vegas
November 9, 1995	City of North Las Vegas
September 22, 1995	Michael Baker Jr. Inc.
August 29, 1995	Michael Baker Jr. Inc.
August 28, 1995	Michael Baker Jr. Inc.
August 16, 1995	G.C. Wallace Inc.
August 2, 1995	City of North Las Vegas
August 1, 1995	Clark County Regional Flood Control District

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 31, 1996
Time: 2:50 PM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Kevin Eubanks	Communities:	Clark County City of North Las Vegas
Clark County Regional Flood Control District	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

Kevin indicated the Cibola development project is applying for a LOMR. He requested we add to our documentation to accommodate the LOMR. The estimated flow in Sloan Channel being used in the LOMR was 5,500 cfs. He would like us to determine the flow at the Cibola site based on the West Range Wash Dike in place, but without the Confluence Detention Basin by modifying our hydrologic model. We should indicate in our documentation that the flow was determined for the interim condition impacting the Cibola site.

The Cibola case number is 95-09-1021C

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 18, 1996
Time: 8:00 AM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Kelly Chuma	Communities:	Clark County City of North Las Vegas
City of North Las Vegas	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

Indicated to Kelly that there is a large ponding area upstream of the I-15 culvert located near Walnut Road. If the stage storage relationship created by the ponding area and capacity of the culvert is considered it will reduce flow to eliminate the floodplain area in Walnut Road. If development fills the impoundment area the floodplain in Walnut would likely occur.

Kelly indicated she would check on this subject. It may not be good to remove the floodplain if development will eliminate the ponding.

She indicated City of North Las Vegas was not very concerned about Walnut Road and was more concerned about Vandenberg Drive. She believed it may be beneficial to determine base flood elevations along Vandenberg to make it easier for each small developer in the area.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 18, 1996
Time: 8:00 AM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Dan Le	Communities:	Clark County City of North Las Vegas
ESI Engineers and Surveyors Inc.	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

The impovement plans for the Collins Business Park received yesterday did not include Phase II plans. The Phase II plans were requested, and the Drainage Study, which has recently been approved by Clark County Regional Flood Control District.

He said they would be ready for pick up this afternoon.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 17, 1996
Time: 9:00 AM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Donna	*Communities:*	Clark County City of North Las Vegas
ESI Engineers and Surveyors Inc.	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	*Karl Mohr*
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

The impovement plan for the Collins Business Park were requested

She said they would be ready for pick up this afternoon.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 16, 1996
Time: 9:00 AM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Mark	Communities:	Clark County City of North Las Vegas
Clark County **Community Development** **Map Room**	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

The improvemnt plans for Cibola or Magnolia Esates were requested.

The plans had not yet been filed, but he was able to locate them. He will have plans for Magnolia Estates ready for pick up this afternoon.

The Collins Business Park Plans were also requested. He suggested we contact ESI directly for a copy of those plans.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: January 16, 1996
Time: 8:00 AM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Kelly Chuma	Communities:	Clark County City of North Las Vegas
City of North Las Vegas	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

The Golden Triangle Drainage Study was requested.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: December 7, 1995
Time: 3:00 PM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Ms. Kelly Chuma	Communities:	Clark County City of North Las Vegas
City of North Las Vegas	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

The two previous drainage studies which used higher flows to the Industrial Park at Walnut Road used flows based on the capacity of the culverts crossing I-15. Kelly did not have any problems with the flows PBS&J developed.

She also did not have a problem with the 1470 cfs at Vandenberg Channel, but CCRFCD required a developer to use 1800 cfs based on the regulatory discharge in the adopted FIS.

She will inform us when the Golden Triangle Drainage Study is available.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: November 22, 1995
Time: 10:00 a.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Ms. Kelly Chuma, P.E.	Communities:	Clark County City of North Las Vegas
Development and Flood Control	State:	Nevada
City of North Las Vegas	Study Contractor :	PBS&J
2266 Civic Center Dr.	Regional Project Officer:	Karl Mohr
North Las Vegas, Nevada 89030	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
657-2295	Flooding Source(s):	Range Wash

NOTES:

REGARDING: Schedule

Kelly requested that we call her while we are analyzing the Vandenberg area because that is an important and sensitive area for the CNLV.

Kelly would like a schedule of completion for this restudy.

Kelly asked if we had reviewed the Golden Triangle Industrial Park drainage study. It is a large industrial park on the west side of the UPRR extending to Craig Road. The study has higher flowrates than the DRAFT Range Wash FIS, and the CNLV has accepted those flows. The study was done by ALCA and is approximately 1 1/2 years old. Kelly said that she is lending the study to someone shortly, and she will call us when she gets it back, so that we may review it.

Recorded By: Kathy Kingston Signed: _____

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: November 9, 1995
Time: 3:00 PM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Mr. Randy Tarr	Communities:	Clark County City of North Las Vegas
City of North Las Vegas	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

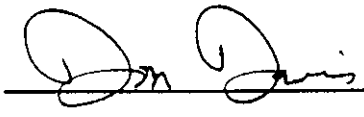
NOTES:

The areas of topographic mapping PBS&J would like to have expedited are:

Sections 5, 6, 7, and 8, of Township 20 South, Range 62 East, and

Sections 29, 30, and 31, of Township 19 South, Range 62 East.

Recorded By: Donald Davis

Signed: 

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: Sept. 22, 1995
Time: 1:30 PM

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Mr. Venkat	Communities:	Clark County City of North Las Vegas
Michael Baker Jr.	State:	Nevada
	Study Contractor:	PBS&J
	Regional Project Officer:	Karl Mohr
	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
	Flooding Source(s):	Range Wash

NOTES:

He has searched records for hydrologic and hydraulic data for the approximate study of the Range Wash and was not able to locate any information.

He has information on LOMRs for Lewis Homes projects prepared by Pentacore, with dates of January 1992, August 1992,April 1993, and June 1994. The information would be more readily available to us directly for Pentacore. The contact was Dean Rasmussen.

Recorded By: Donald Davis Signed: Don Davis

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: August 29, 1995
Time: 8:30 a.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:

Mr. Tony Appleby

Michael Baker Jr., Inc.
3601 Eisenhower Ave., Suite 600

Alexandria, VA 22304
(703) 317-6200 Fax:(703) 329-3023

PROJECT INFORMATION:

Communities:	Clark County City of North Las Vegas
State:	Nevada
Study Contractor :	PBS&J
Regional Project Officer:	Karl Mohr
Tech. Eval. Contractor:	Michael Baker Jr., Inc.
Flooding Source(s):	Range Wash

NOTES:

REGARDING: LOMRs and data used for the DFIRMs

Generally, records of LOMRs are the responsibility of the community. Michael Baker Jr. files LOMRs by their Case Number. They can provide us with LOMR information, but it may take a lot of research, which can get expensive.

Michael Baker Jr. can provide us with the hydraulic data. Once they receive a letter requesting the information, it can take about a week for someone to call us back with information on the time and cost needed to collect and send the data.

Recorded By: Kathy Kingston Signed: KJK

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: August 28, 1995
Time: 11:00 a.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:

Mr. Tom Smith, P.E.

Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600

Alexandria, VA 22304
(703) 960-8800

PROJECT INFORMATION:

Communities:	Clark County City of North Las Vegas
State:	Nevada
Study Contractor :	PBS&J
Regional Project Officer:	Karl Mohr
Tech. Eval. Contractor:	Michael Baker Jr., Inc.
Flooding Source(s):	Range Wash

NOTES:

REGARDING: LOMRs and data used for the DFIRMs

Contact Tony Appleby at the project library with a request, in writing, to obtain LOMRs or hydrologic/hydraulic data used to update the DFIRMs.

For the DFIRM project, the majority of the hydraulic analyses were done by whoever generated the information on the effective FIRMs. Very little hydraulic analysis was done for the DFIRMs. Two areas with new hydraulics include the Tropicana restudy, and a letter giving the best available data for the Las Vegas Wash near the Interstate. CCRFCD has done some revisions, and individual LOMRs have been included.

A revised FIS text gives information on references used for the new DFIRMs. The revised text is available from the Map Distribution Center, 1-800-358-9616.

Recorded By: Kathy Kingston Signed: KK

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: August 16, 1995
Time: 2:00 p.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Mr. Noel Laughlin, P.E.	Communities:	Clark County City of North Las Vegas
G.C. Wallace, Inc.	State:	Nevada
1555 S. Rainbow Blvd.	Study Contractor :	PBS&J
	Regional Project Officer:	Karl Mohr
Las Vegas, NV 89102	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
(702) 363-1200	Flooding Source(s):	Range Wash

NOTES:

REGARDING: Sloan Channel

- The portion of the Sloan Channel between Owens and Stewart is essentially done.
- The next portion for construction is between Stewart and Charleston. He estimates that the channel may be complete in about a year.
- The next phase for construction is between Charleston and the Las Vegas Wash. He does not know when construction will begin on this phase.

Mike Hand is the project coordinator at Clark County Public Works.

GCW is currently working on some of the Sloan Channel drawings. The set that the County has is a 90% complete set. The profile on the first sheet of that set is not quite right (the slope is right, but an elevation is not), so it will be fixed on the new drawings that will be plotted by GCW next week. Noel said he can get a copy of the new drawings to PBS&J when they are finished.

Noel can get us a disk copy of the HEC-2 model. He said that one cross-section has changed since that HEC-2 model was done, and that change may not be in the HEC-2 model.

GCW obtained a CLOMR on the Las Vegas Wash through the Desert Rose Golf Course. They also did a LOMR for the Sloan Channel from Charleston to Vegas Valley. I looked at the DFIRM, Map 32003C 2200 D, and it appears that the map does include those LOMRs.

GCW did the Stonebridge and Collage developments.

Recorded By: Kathy Kingston Signed: KK

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: August 2, 1995
Time: 2:00 p.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:

Ms. Kelly Chuma, P.E.

Development and Flood Control
City of North Las Vegas
2266 Civic Center Dr.
North Las Vegas, Nevada 89030
657-2295

PROJECT INFORMATION:

Communities:	Clark County City of North Las Vegas
State:	Nevada
Study Contractor :	PBS&J
Regional Project Officer:	Karl Mohr
Tech. Eval. Contractor:	Michael Baker Jr., Inc.
Flooding Source(s):	Range Wash

NOTES:

REGARDING: Data Collection

Regarding the aerial topography project currently in progress for the CNLV Corporate Boundaries, Kelly investigated the possibility of making the topography in the Range Wash study area available prior to the topography project completion date; however they are not able to expedite the panels in the Range Wash area, so the new topography will not be available until September or October.

CNLV is searching for the technical documentation on the effective FIRMS.

Kelly will loan PBS&J a copy of the *Western and Eastern Tributaries of Range Wash Flood Control Facility Plan*, by Boyle, dated 1991.

Kelly found some flooding photos showing damage in the Vandenberg area.

Kelly will obtain copies of the CNLV, 1981 topography sheets 4 and 5. If we need other plans, or any other topography, Marshall Hill is the person to contact at 657-2270.

To obtain As-built certifications, Steve Combs, the chief inspector, is the person to contact at 642-1827. PBS&J will provide him with a list of certifications needed. (Kelly does have some of the As-built certifications that we will need.)

Recorded By: Kathy Kingston Signed: KLK

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Date: August 1, 1995
Time: 11:50 a.m.

TELEPHONE CONVERSATION RECORD
FOR THE
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CONVERSATION WITH:	PROJECT INFORMATION:	
Mr. Steve Roberts, P.E.	Communities:	Clark County City of North Las Vegas
Clark County Regional Flood Control District	State:	Nevada
301 East Clark Avenue, Suite 301	Study Contractor :	PBS&J
	Regional Project Officer:	Karl Mohr
Las Vegas, Nevada 89101	Tech. Eval. Contractor:	Michael Baker Jr., Inc.
(702) 455-3139	Flooding Source(s):	Range Wash

NOTES:

REGARDING: ***Transbasin Diversion Hydrologic Evaluation***

The *Transbasin Diversion Hydrologic Evaluation* is a technical report that Black & Veatch did several years ago for the City of North Las Vegas. Its purpose was to determine whether the North Las Vegas Detention Basin could accept flow from the Range Wash Diversion Dike without being modified. The report also addressed an omission between hydrologic analyses prepared for the Range Wash by Boyle, and the *Flood Control Facilities Plan for the Northern Las Vegas Wash*, by Black & Veatch. The report is between five and seven pages, but 10 to 15 different storm centerings were developed to account for a variety of conditions and the lapse in analyses between the two firms. The *North Las Vegas Detention Basin Outlet Modification Report* covers the most intense storms, and has a small amount of reanalysis.

CCRFCD will provide PBS&J with a copy of the *Transbasin Diversion Hydrologic Evaluation* if it can be located.

Recorded By: Kathy Kingston Signed: KK

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone: (702) 263-7275 Fax: (702) 263-7200

1.3 Meeting Minutes/Reports

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

MEETING MINUTES / REPORTS INDEX

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

MINUTES/REPORT DATE	MEETING DATE	MEETING TYPE
January 26, 1996	January 23, 1996	Progress Meeting
December 14, 1995	December 12, 1995	Progress Meeting
November 27, 1995	November 9, 1995	Progress Meeting
October 18, 1995	October 5, 1995	Progress Meeting
August 29, 1995	August 24, 1995	Progress Meeting
August 10, 1995	July 27, 1995	Kick-off Meeting

MEETING MINUTES

PROJECT:	Range Wash Flood Insurance Study PBS&J Reference No. 51804.00	
DATE:	January 23, 1996	
TIME:	9:00 A.M.	
LOCATION:	Clark County Regional Flood Control District	
SUBJECT:	January Progress Meeting	
ATTENDEES:	Steve Parish	CCPW
	Kevin Eubanks	CCRFCD
	Randy Tarr	CNLV
	Don Davis	PBS&J
	Virginia Valentine	PBS&J
DISTRIBUTION:	Attendees	
	Kelly Chuma	CNLV
	Gale Fraser	CCRFCD
	Robert Thompson	CCPW
	Project File - 51804	Meeting Minutes File

HYDRAULICS AND FLOODPLAIN DELINEATIONS

- Don Davis explained the hydraulic analysis performed for the FIS and presented the Work Maps and flood hazard boundary delineations. The City of North Las Vegas, Clark County, and the CCRFCD will review the final submittal prior to PBS&J submitting to FEMA.

- Kevin mentioned that FEMA's criteria to end the flood hazard delineation on drainage areas less than one square mile and widths less than 20 feet may not apply to restudies with mapped flood hazard areas. It was agreed that the delineation in the study would be submitted according to this criteria.

- Don discussed the limits of the flood plain delineations by reach through the study area.

- Don explained flows in Walnut Road are presently reduced due to the culvert capacity at the I-15 crossing and the large ponding area upstream. The situation may change with development, and a larger flow may be directed toward Walnut.

- Randy Tarr would prefer that the area near I-15 and Walnut Road remain A Zone for regulatory purposes since no structures are effected. Randy is concerned that the area of surface detention north of I-15 will be filled in. If the removal of the downstream reach from the A Zone is dependent on the surface detention and I-15 culvert restriction, then North Las Vegas prefers that Walnut remain A Zone. Don will evaluate the floodplain delineation based on removal of the storage capacity and unrestricted flows.

- At Vandenburg 970 cfs goes over the culvert and 500 cfs goes through the culvert. The overflow spill does not appear to return to the channel until after it crosses Craig Road.

- In the main reach of the wash, the flows are confined to channel limits. Kevin would like the proposed and DFIRM 95 delineation maps on diskette to FEMA with the submittal.

- Kelly Chuma's request to develop elevations on Vandenburg Channel was discussed. It was generally felt that the current analysis would suffice for flood plain management purposes.

- On the downstream reach, Don explained the difference in the DFIRM 95 and the proposed delineation. Steve mentioned that the Cybola Channel has been revised. Don mentioned that impact of the Charleston Avenue improvements on the DFIRM 95 delineations.

- The Technical Support Data Notebook and the full documentation will be sent to Steve, Kevin, and Randy. Kevin suggested that one more meeting be held to review the submittal prior to submitting to FEMA.

NEXT MEETING DATE

- Tuesday, February 20, 1996 @ 9:00 A.M. at CCRFCD.

jj

MEETING MINUTES

PROJECT: Range Wash FIS Restudy
PBS&J Reference No. 51804.00

DATE: December 12, 1995

TIME: 9:00 a.m.

LOCATION: CCRFCD

SUBJECT: December Progress Meeting

ATTENDEES:

Kevin Eubanks, P.E.	CCRFCD
Randy Tarr, P.E.	CNLV
William Brandt, P.E.	CCPW
Steve Parrish, E.I.T.	CCPW
Virginia Valentine, P.E.	PBS&J
Don Davis, P.E.	PBS&J

SUMMARY OF DISCUSSION ON HYDROLOGY

The basin delineation upstream of the Vandenberg Channel was clarified. CNLV had inquired about a basin boundary located at the beginning of the channel. Two basins add together at this location. The separate basins pass under the railroad tracks at two separate locations upstream. The hydrologic model and delineation on the map are correct, however the node labels were labeled incorrectly on the map. The node labels for G1, F3, and F4, on the Hydrologic Subbasins Map (Figure 5B) will be revised.

The regulatory discharge, established by the previous FIS, at the Vandenberg Channel is 1,800 cfs. The flow from the PBS&J model is 1470 cfs. The PBS&J model subdivides the basin used in the FIS, such that portions of the flow go to Walnut Road and a swale along the railroad spur. If the flows to Walnut Road and the railroad spur are combined with the flow to the channel, the flow is approximately 1,800 cfs, corresponding very well to the previous FIS model.

The Lag times for basins less than one square mile were reviewed and revised. Two methods were used instead of the SCS NEH-4 Slope-Velocity Curve. For smaller basins, the average travel time velocity was estimated using the equations adopted by FEMA for a multiple channel flow regime used in alluvial fan analysis. When the basin size was approximately one square mile (greater than .75 square miles), the USBR Lag Equation was used. The average velocity was determined based on the time of concentration and the length of the water course. The revisions increased the travel time velocities for the smaller basins, but had little impact on the overall hydrologic analysis. The peak flows at key locations remained approximately the same. Tables summarizing revised velocity and Lag calculations and the revised table of Hydrologic Results are enclosed.

PBS&J

In the previous meeting it was noted that higher flows had been used at Walnut Road and the railroad spur. After reviewing the previous studies, Kelly Chuma informed PBS&J, the higher flows were not based on a hydrologic analysis, but were based on upstream culvert capacities. The developers had based there design on the maximum flow which could reach their site through culverts under Interstate 15. The flows from the PBS&J model were acceptable.

SUMMARY OF DISCUSSION ON TOPOGRAPHIC MAPPING

PBS&J received a large portion of the CNLV Topographic Mapping on December 11, 1995.

The remaining applicable area should be available during the week.

SUMMARY OF DISCUSSION ON FLOODPLAIN DELINEATION

The A Flood Zone delineation along the Vandenberg Channel will probably not change significantly. PBS&J will make preliminary evaluations to determine if a detailed hydraulic evaluation of the channel would be beneficial, and if it could be done within the present budget. Randy Tarr will provide the design plans for the road and channel to establish cross-sections. The topographic mapping may be used for slopes. Randy Tarr indicated the main issue was the flow developers should use as a basis for design.

The A Zone near the railroad spur will remain even though the tributary drainage area is less than one square mile. It will remain since it is a ponding area, and already mapped as an A Zone.

The A Zone which follows Walnut Road , Wendy Lane, Alexander Road, Lamb Boulevard and Faberge Avenue, will likely be eliminated due to a channel collecting flow along Craig Road and flows within the street less than one foot deep.

The A Zone in Bonanza Road will likely be eliminated due to a dike diverting most of the upstream flow. The dike has already been accepted by FEMA and is included in the DFIRMs.

The A Zone along the east side of Sloan Channel between Stewart Avenue and Charleston Boulevard will be eliminated based on the reduced flow due to the Confluence Detention Basin.

CCRFCD indicated Sloan Channel will soon be improved between Stewart and Charleston. If the A Zone cannot be eliminated based on the existing channel, the channel improvements may be included to obtain a CLOMR.

The Cibola/Magnolia Estates development is improving in the A Zone west of the channel and south of Stewart Avenue. Steve Parrish will provide a grading plan for the development.

MEETING MINUTES

SCHEDULE

A revised schedule is enclosed. The acquisition of topographic mapping has delayed the draft report submittal date approximately two weeks.

The draft report will be submitted at the next progress meeting.

The next progress meeting was scheduled for January 23, 1995, at 9:00 a.m., at the CCRFCD office.

jj

Distribution: Attendees
Kelly Chuma, CNLV
Kathy Kingston, PBS&J
Robert Thompson, CCPW
Gale Fraser, CCRFCD

ESTIMATION OF AVERAGE TRAVEL TIME VELOCITY

For LAG Calculation of Smaller Subbasins

TABLE A5.1

BASIN NAME	AREA (sq. mi)	LENGTH (ft)	SLOPE (ft/ft)	ROUGH. COEF.	EST. FLOW (cfs)	VELOCITY				
						DAWDY sing. chan. (fps)	FEMA mult. chan. (fps)	USBR (fps)	SCS CURVE (fps)	SELECTED (fps)
47C	0.856	8,400	0.0040	0.02	220	3.86	3.01	5.36	1.26	5.36
48A-M	0.715	12,500	0.0330	0.02	270	4.02	5.96	8.69	3.63	5.96
49A-M	0.693	10,500	0.0220	0.02	170	3.66	4.72	7.66	2.97	4.72
49C	0.426	11,000	0.0320	0.02	80	3.15	4.41	8.27	3.58	4.41
50B-M	0.628	12,500	0.0530	0.02	200	3.78	6.39	9.39	4.60	6.39
50A-M	0.207	6,500	0.0180	0.02	40	2.74	3.14	6.29	2.68	3.14
52A-M	0.286	7,000	0.0230	0.07	40	2.74	1.59	1.92	1.52	1.59
307B-M	0.677	12,500	0.0080	0.05	170	3.66	2.01	2.75	0.89	2.01
307C	0.671	11,700	0.0110	0.05	110	3.36	1.99	2.83	1.05	1.99
307D	0.924	19,000	0.0100	0.05	120	3.42	1.98	3.29	1.00	3.29
307E	0.766	9,000	0.0080	0.05	180	3.70	2.04	2.46	0.89	2.46
318A	0.940	8,200	0.0280	0.07	350	4.23	2.85	2.09	1.67	2.09
321M	0.691	8,000	0.0040	0.07	40	2.74	0.94	1.51	0.63	0.94
326A	0.231	5,200	0.0030	0.02	80	3.15	2.17	4.34	1.10	2.17
326B	0.907	12,000	0.0040	0.07	200	3.78	1.39	1.73	0.63	1.73
CON-D	0.249	5,000	0.0030	0.05	60	2.97	1.17	1.71	0.55	1.17
OR-1	0.279	5,500	0.3400	0.07	300	4.10	5.80	2.76	5.83	5.80
OR-3	0.205	6,000	0.0390	0.05	80	3.15	2.70	2.78	1.97	2.70
OR-4	0.448	8,500	0.2100	0.07	340	4.21	5.17	2.95	4.58	5.17
OR-5	0.373	6,500	0.0370	0.05	100	3.29	2.80	2.83	1.92	2.80
OR-6A	0.264	3,700	0.3100	0.07	280	4.05	5.55	2.37	5.57	5.55
OR-6B	0.160	3,200	0.1800	0.07	180	3.70	4.24	2.07	4.24	4.24
OR-6C	0.191	3,500	0.1100	0.07	180	3.70	3.66	1.96	3.32	3.66
OR-7	0.613	7,500	0.0310	0.05	140	3.52	2.88	2.89	1.76	2.88
OR-8	0.017	1,300	0.0380	0.05	8	1.99	1.54	1.65	1.95	1.54
OR-9	0.278	8,000	0.0310	0.05	60	2.97	2.35	2.95	1.76	2.35
OR-10	0.098	4,000	0.0340	0.07	30	2.59	1.67	1.69	1.84	1.67
OR-11	0.040	1,800	0.0030	0.02	12	2.16	1.37	3.03	1.10	1.37
OR-12	0.525	6,250	0.0100	0.02	120	3.42	3.43	5.64	2.00	3.43
OR-13	0.120	3,450	0.0040	0.02	70	3.07	2.29	3.96	1.26	2.29
OR-14	0.094	4,100	0.0150	0.02	20	2.39	2.52	5.22	2.45	2.52

SELECTION CRITERIA:

USBR Equation used for basins larger thna 1 sq. mile; Use also for basin approximately 1 sq. mile - basins greater than .75 sq. miles

FEMA multiple channel equation accounts for slope and roughness coefficient. Dawdy equation assumes critical flow. Use FEMA equation for basins less than .75 sq. miles. Subbasin flow is typically shallow with multiple collectors and subcritical.

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No. : 51804

RANGE WASH FLOOD INSURANCE RESTUDY
Existing Drainage Condition Basins
(Portions of Data obtained from the Orchards Hydrology, Pentacore, 1992)

DATE: December 8, 1995
FILE: excel\804\stdform4.xls
CALCULATED BY : Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA *(acres)* (3)	AREA *(sq.mi.)*	LENGTH *(ft)* (4)	SLOPE *(%)* (5)	T_i *(min)* (6)	LENGTH *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY *(fps)* (9)	T_t *(min)* (10)	$T_c = T_i + T_t$ *(min)* (11)	TOTAL LENGTH *(ft)* (12)	T_c = (L/180)+10 *(min)* (13)	*(min)* (14)	T_{lag}= $0.6T_c/60$ *(hrs)*	Point Rainfall 100-yr *(inches)*
OR-1	88	0.772	178.6	0.279	500	40.0	3.9	5000	34.0	5.80	14.4	18.2	5500	NA	18.2	0.18	3.00
OR-3	82	0.692	131.4	0.205	500	10.0	7.6	5500	3.9	2.70	34.0	41.6	6000	NA	41.6	0.42	3.00
OR-4	87	0.758	286.4	0.448	500	56.0	3.6	8000	21.0	5.17	25.8	29.4	8500	NA	29.4	0.29	3.00
OR-5	77	0.626	238.5	0.373	500	14.0	7.9	6000	3.7	2.80	35.7	43.6	6500	NA	43.6	0.44	3.00
OR-6A	88	0.772	169.1	0.264	500	52.0	3.5	3200	31.0	5.55	9.6	13.2	3700	NA	13.2	0.13	3.00
OR-6B	89	0.785	102.1	0.160	500	52.0	3.4	2700	18.0	4.24	10.6	14.0	3200	NA	14.0	0.14	3.00
OR-6C	87	0.758	122.1	0.191	500	37.0	4.1	3000	11.0	3.66	13.7	17.8	3500	NA	17.8	0.18	3.00
OR-7	77	0.626	392.0	0.613	500	12.0	8.3	7000	3.1	2.88	40.5	48.8	7500	NA	48.8	0.49	3.00
OR-8	77	0.626	10.8	0.017	500	8.0	9.5	800	3.8	1.54	8.7	18.2	1300	NA	18.2	0.18	3.00
OR-9	77	0.626	177.6	0.278	500	4.0	12.0	7500	3.1	2.35	53.2	65.2	8000	NA	65.2	0.65	3.00
OR-10	77	0.626	62.9	0.098	500	7.0	10.0	3500	3.4	1.67	34.9	44.9	4000	NA	44.9	0.45	3.00
OR-11	75	0.600	25.4	0.040	100	0.5	11.3	1700	0.4	1.37	20.7	32.0	1800	20.0	20.0	0.20	2.93
OR-12	76	0.613	335.9	0.525	100	1.0	8.8	6150	1.0	3.43	29.9	38.6	6250	44.7	38.6	0.39	2.93
OR-13	84	0.719	77.0	0.120	100	1.0	6.9	3350	0.4	2.29	24.4	31.2	3450	29.2	29.2	0.29	2.93
OR-14	75	0.600	60.0	0.094	500	0.5	25.3	3600	1.5	2.52	23.8	49.2	4100	32.8	32.8	0.33	2.93

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)
$K = 0.0132\,(CN) - 0.39$

REFERENCE: ***Hydrologic Analysis and Design***, Prentice Hall, Richard H. McCuen, 1989.

TcOrch

STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

RANGE WASH FLOOD INSURANCE RESTUDY

Existing Drainage Condition Basins

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No. : 51804

DATE: December 8, 1995
FILE: excel\804\stdform4.xls
CALCULATED BY : Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA *(acres)* (3)	AREA *(sq.mi.)*	LENGTH *(ft)* (4)	SLOPE *(%)* (5)	T_i *(min)* (6)	LENGTH *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY *(fps)* (9)	T_t *(min)* (10)	$T_c = T_i + T_t$ *(min)* (11)	TOTAL LENGTH *(ft)* (12)	$T_c = (L/180)+10$ *(min)* (13)	*(min)* (14)	$T_{lag} = 0.6T_c/60$ *(hrs)*	Point Rainfall 100-yr *(inches)*
47C	79	0.653	547.8	0.856	500	0.4	24.4	7900	0.4	5.36	24.6	49.0	8400	56.7	49.0	0.49	2.77
48A-M	83	0.706	457.7	0.715	500	3.3	10.7	12000	3.3	5.96	33.6	44.2	12500	79.4	44.2	0.44	2.93
49A-M	79	0.653	443.4	0.693	500	2.2	13.8	10000	2.2	4.72	35.3	49.2	10500	68.3	49.2	0.49	2.85
49C	76	0.613	272.8	0.426	500	3.2	13.3	10500	3.2	4.41	39.7	53.0	11000	71.1	53.0	0.53	2.85
50B-M	80	0.666	401.6	0.628	500	11.9	7.7	12000	11.9	6.39	31.3	39.0	12500	79.4	39.0	0.39	3.00
50A-M	73	0.574	132.3	0.207	500	1.8	17.4	6000	1.8	3.14	31.8	49.3	6500	46.1	46.1	0.46	2.85
52A-M	73	0.574	183.0	0.286	500	2.3	16.1	6500	2.3	1.59	68.1	84.2	7000	NA	84.2	0.84	2.85
307B-M	81	0.679	433.1	0.677	500	0.8	18.2	12000	0.8	2.01	99.5	117.7	12500	79.4	79.4	0.79	2.77
307C	77	0.626	429.5	0.671	500	1.1	18.5	11200	1.1	1.99	93.8	112.3	11700	NA	112.3	1.12	2.77
307D	77	0.626	591.6	0.924	500	1.0	19.1	18500	1.0	3.29	93.7	112.8	19000	NA	112.8	1.13	2.77
307E	79	0.653	490.2	0.766	500	0.8	19.4	8500	0.8	2.46	57.6	77.0	9000	60.0	60.0	0.60	2.77
318A	80	0.666	601.3	0.940	500	14.3	7.2	7700	14.3	2.09	61.4	68.6	8200	NA	68.6	0.69	2.93
321-M	67	0.494	442.5	0.691	500	0.4	33.1	7500	0.4	0.94	133.0	166.1	8000	NA	166.1	1.66	2.77

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)
$K = 0.0132\,(CN) - 0.39$

REFERENCE: ***Hydrologic Analysis and Design***, Prentice Hall, Richard H. McCuen, 1989.

STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No.: 51804

RANGE WASH FLOOD INSURANCE RESTUDY
Existing Drainage Condition Basins

DATE: December 8, 1995
FILE: excel\804\stdform4.xls
CALCULATED BY: Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA (acres) (3)	AREA (sq.mi.)	LENGTH (ft) (4)	SLOPE (%) (5)	T_i (min) (6)	LENGTH (ft) (7)	SLOPE (%) (8)	VELOCITY (fps) (9)	T_t (min) (10)	$T_c = T_i + T_t$ (min) (11)	TOTAL LENGTH (ft) (12)	T_c = (L/180)+10 (min) (13)	(min) (14)	T_{lag}= $0.6T_c/60$ (hrs)	Point Rainfall 100-yr (inches)
326A	79	0.653	147.7	0.231	500	0.3	26.9	4700	0.3	2.17	36.1	63.0	5200	38.9	38.9	0.39	2.85
326B	79	0.653	580.6	0.907	500	0.4	24.4	11500	0.4	1.73	110.8	135.2	12000	76.7	76.7	0.77	2.80
CON-DET	80	0.666	159.1	0.249	500	0.3	26.1	4500	0.3	1.17	64.1	90.2	5000	NA	90.2	0.90	2.85

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)
$K = 0.0132\,(CN) - 0.39$

REFERENCE: *Hydrologic Analysis and Design*, Prentice Hall, Richard H. McCuen, 1989.

STANDARD FORM 4

Table 1: Hydrologic Results

Flow Node	Node Description	Drainage Area (sq.mi.)	DARF	SDN	HEC-1 Model	100-Yr Peak Flow
G4	Channel at I-15 upstream (U/S) of Walnut	0.67	0.98	3	rfis-g7	170
G5	UPRR crossing at I-15 U/S of Walnut	0.92	0.97	3	rfis-g7	230
G6	Contributes to Zone A at Mitchell & Lone Mtn.	1.60	0.95	3	rfis-g7	380
G7	West branch of Zone A, Craig to LV Blvd.	2.36	0.93	3	rfis-g7	510
F4	12'x8' RCB at the UPRR	2.52	0.92	3	rfis-g7	530
F3	Two 21'x12' bridge openings at UPRR	5.53	0.90	3	rfis-g7	1060
G1	Three 15'x10' RCBs at I-15	8.05	0.88	3	rfis-g7	1470
G3	East branch of Zone A, Craig to LV Blvd.	8.72	0.87	3	rfis-g7	1550
G2	Seven 10'x7' RCBs at LV Blvd.	11.08	0.85	5	rfis-g2	1570
V1	Sloan Channel at Bonanza Road	7.55	0.88	3	rfis-v1	2570
V2	Sloan Channel downstream of Stewart Avenue	10.78	0.85	5	rfis-v2	2450
CC	Sloan Channel at Las Vegas Wash Confluence	17.11	0.81	5	rfis-cc	4190
CC	Sloan Channel at Las Vegas Wash Confluence	98.79	0.60	5	rfis-all	3150
DB.IN	Confluence Detention Basin	81.68	0.63	5	rfis-all	4180

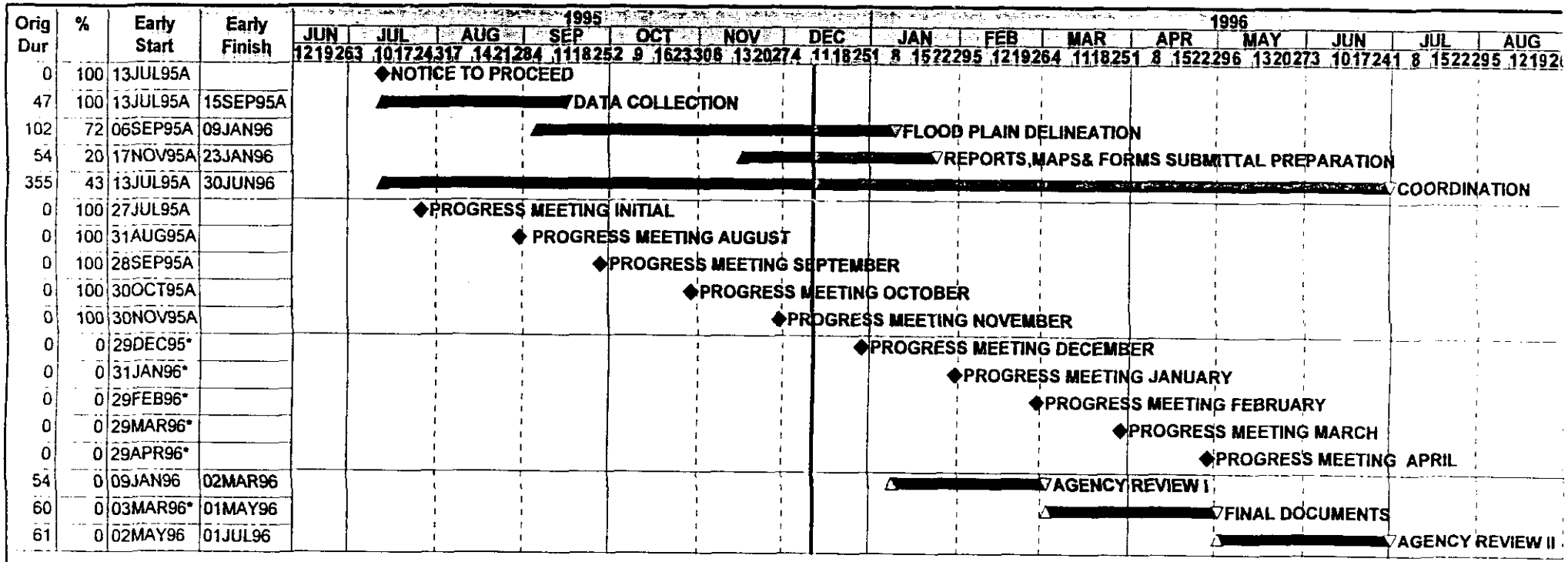


EXHIBIT "B"

Project Start	12JUN95
Project Finish	01JUL96
Data Date	12DEC95
Plot Date	13DEC95

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Early Bar
Progress Bar
Critical Activity

1804

RANGE WASH FLOOD INSURANCE
RESTUDY
PROJECT TIME SCHEDULE

Sheet 1 of 1

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

MEETING MINUTES

PROJECT: Range Wash FIS Restudy
PBS&J Reference No. 51804.00

DATE: November 9, 1995

TIME: 10:00 a.m.

LOCATION: CCRFCD

SUBJECT: November Progress Meeting

ATTENDEES:

Kevin Eubanks, P.E.	CCRFCD
Randy Tarr, P.E.	CNLV
Kelly Chuma, P.E.	CNLV
William Brandt, P.E.	CCPW
Steve Parrish, E.I.T.	CCPW
Virginia Valentine, P.E.	PBS&J
Don Davis, P.E.	PBS&J
Kathy Kingston, P.E.	PBS&J

SUMMARY OF DISCUSSION ON HYDROLOGY

- The hydrologic results were reviewed with flows shown on the JMM topographic maps.
- The node labels for G1, F3, and F4 on the Hydrologic Subbasins Map (Figure 5B) were shown at incorrect locations and will be revised.
- The flow to the upstream end of the Vandenberg Channel was 1,470 cfs. This value differs from the value currently accepted by the City of North Las Vegas (CNLV), which is 1,800 cfs. The difference may be attributable to the Lag time calculations. CNLV noted velocities from the SCS NEH-4 Slope-Velocity Curve (CCRFCD Manual Figure 602) are only to be used for preliminary analysis.
- Flows near the Walnut Industrial Park were also lower than previous studies. This study indicated two flows of 180 cfs each. Previous study had flows of 350 or 450 cfs.
- CNLV has been threatened with lawsuits regarding the Vandenberg Channel. It will be important to explain or resolve discrepancies from previous studies.

SUMMARY OF DISCUSSION ON TOPOGRAPHIC MAPPING

- CNLV Topographic Mapping Project is expected to be completed in early January.
- CNLV will fax a copy of the map coverage to PBS&J.

PBS&J

- Portions of the mapping project may be completed earlier. PBS&J and CNLV will coordinate to identify what sections of the mapping project should be expedited.

SUMMARY OF DISCUSSION ON FLOODPLAIN DELINEATION

- The Vandenberg Channel has a capacity of approximately 550 cfs. The flow of 1,470 would overtop the banks of the Channel. Even though the flow is less, the limits of flooding will probably not be significantly different from indicated on the current FEMA map. The area should be included in the Study based on a different flow rate, even if the limits of flooding are similar.

- The Flood Zone upstream of the Railroad near the Walnut Industrial Park has tributary areas less than one square mile and will be eliminated.

- The Flood Zone north of the Railroad tributary to Vandenberg Channel will be revised. The present Flood Zone is not associated with the major flow to this location.

- Flood Zone near Alexander is expected to be revised.

- Sloan Channel has apparent capacity to convey the flows.

- The area near Stewart may require special attention. There is a proposed development in the area called Magnolia Estates or Cibola. PBS&J will obtain the drainage study for the development.

- PBS&J transmitted a letter requesting additional services to do cross-section surveys.

SCHEDULE

- The schedule is on track for a January submittal of the draft document.

NEXT MEETING DATE

- The next progress meeting was scheduled for Tuesday, December 12, 9:00 a.m., at the CCRFCD office.

jj

Distribution: Attendees
Robert Thompson, P.E. CCPW

MEETING MINUTES

PROJECT: Range Wash FIS Restudy
PBS&J Reference No. 51804.00

DATE: October 5, 1995

TIME: 10:00 a.m.

LOCATION: CCRFCD

SUBJECT: October Progress Meeting

ATTENDEES:

Kevin Eubanks, P.E.	CCRFCD
William Brandt, P.E.	CCPW
Steve Parrish, E.I.T.	CCPW
Virginia Valentine, P.E.	PBS&J
Don Davis, P.E.	PBS&J
Kathy Kingston, P.E.	PBS&J

STATUS AND RESULTS OF HYDROLOGIC MODELING

- PBS&J will set up a meeting to present hydrology to CNLV.
- PBS&J used the Orchards hydrology as a basis for modeling the lower portion of the watershed. A small detention basin included in the Orchards model was excluded from this FIS model. Clark County said that the detention basin was a temporary basin for construction and that the Orchards channel was designed to handle the flow without it. There is another study on facilities for the Orchards development without the detention basin.
- The hydrologic results are close to the previous hydrology until the Orchards basins are used and flow rates are increased. The difference is mainly due to use of higher rainfall for that area.
- The design hydrology for the Confluence Detention Basin is part of the submittal to FEMA, so any differences in the models need to be explained.
- The PBS&J modeling shows that more intense storms centered downstream of the Confluence Detention Basin produce higher flow rates in the Sloan Channel than a storm over the entire watershed. The storm distribution has a significant impact on the flow values. The PBS&J models show a decrease in peak flow from the upstream Node V1 to the downstream Node V2 due to the storm distribution changing from SDN 3 to SDN 5.

- Clark County is concerned with the portion of the Sloan Channel that is currently under design and being considered to remain unlined. The County needs to know of any changes in design flow as soon as possible. Mike Hand is the Project Manager.

- Clark County has plans for the diversion channel for Hollywood Park, at the Northeast corner of Bonanza and Sloan.

- The hydrology report will be completed next week.

COMMENTS ON DATA COLLECTION REPORT

- No comments from CCRFCD or Clark County.

- PBS&J will check for comments by CNLV.

SURVEY CONTROL

PBS&J will contact CNLV to determine when their topography will be ready. At this time, it appears that the CNLV topography will be too late to allow proceeding without delay to the project schedule. PBS&J would like authorization to do fieldwork in key places where cross-sections are needed. Even if the CNLV topography is ready in time, cross-sections along the Sloan Channel may be needed. PBS&J will provide a letter giving a clear proposal on the work needed with a request for authorization of additional funds.

NEXT MEETING DATE

Thursday, November 9, 10:00 a.m., at CCRFCD.

jj

Distribution: Attendees

Randy Tarr, P.E.	CNLV
Robert Thompson, P.E.	CCPW

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Meeting Date: August 24, 1995
Time: 10:00 a.m.

MEETING MINUTES

PROJECT: **Range Wash FIS Restudy**

LOCATION: **PBS&J**

SUBJECT: **August Progress Meeting**

ATTENDEES:

Kevin Eubanks, P.E.	CCRFCD
William Brandt, P.E.	CCPW
Randy Tarr, P.E.	CNLV
Virginia Valentine, P.E.	PBS&J
Don Davis, P.E.	PBS&J
Scott Cooley, E.I.T.	PBS&J
Kathy Kingston, P.E.	PBS&J

DISTRIBUTION:

Attendees	
Robert Thompson, P.E.	CCPW
Kelly Chuma, P.E.	CNLV

SUMMARY OF DISCUSSION

I. SUBMITTALS

- PBS&J presented a Project Control Plan showing submittal dates, project personnel, budget, quality control plan, schedule, notice to proceed, and a copy of the contract.
- The hydrologic analysis will be submitted on October 2.

901 North Green Valley Parkway Las Vegas, Nevada 89014 Telephone : (702) 263-7275 Fax : (702) 263-7200

II. DATA COLLECTION/RESEARCH

- The photo documentation of the field visit is nearing completion.
- PBS&J will use the hydrology from the Confluence Detention Basin, with any necessary modifications such as storm centering and basin subdividing.
- PBS&J has collected channel plans for the majority of the improved Range Wash/Sloan Channel.
- PBS&J will call CNLV to search for the Vandenberg Channel Plans.
- PBS&J has collected several HEC-2 models for portions of the Sloan Channel.
- For the majority of the Range Wash upstream of Las Vegas Boulevard, PBS&J is planning to use the CNLV 2-foot contour topography that is currently being prepared and is expected to be complete within two months. The topography will be available in a digital GIS format.
- A drainage study has recently been prepared for a manufacturing site between Lone Mountain Road and Interstate 15, an area that is near the Range Wash. PBS&J will search for that drainage study.
- CCPW did maintenance for the portion of the Sloan Channel between Owens and Lake Mead. An invert may have been changed. PBS&J will contact Cheri Reeves at CCPW.

III. PROJECT SCOPE

- CCRFCD only wants this FIS to concentrate on those areas shown in Flood Zone A on the newly effective DFIRMs. The only documentation needed for submittal is that needed to change the Flood Zones.

IV. ENTITY COORDINATION

- Next Meeting: Thursday, October 5, 10:00 a.m., at CCRFCD.

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Job No.: 51804
Meeting Date: July 27, 1995
Time: 1:00 p.m.

MEETING MINUTES

PROJECT: **Range Wash FIS Restudy**

LOCATION: **PBS&J**

SUBJECT: **Kick-off Meeting**

ATTENDEES:

Kevin Eubanks, P.E.	CCRFCD
William Brandt, P.E.	CCPW
Kelly Chuma, P.E.	CNLV
Virginia Valentine, P.E.	PBS&J
Don Davis, P.E.	PBS&J
Sendhil Kolandaivel	PBS&J
Kathy Kingston, P.E.	PBS&J

DISTRIBUTION:

Attendees	
Randy Tarr, P.E.	CNLV

PROJECT POINTS OF CONTACT

PBS&J
Don Davis, P.E.
Kathy Kingston, P.E.
901 N. Green Valley Pkwy.
Suite 100
Henderson, NV 89014
(702) 263-7275

CCRFCD
Kevin Eubanks, P.E.
301 E. Clark Ave.
Suite 301
Las Vegas, NV 89101
(702) 455-3139

CNLV
Randy Tarr, P.E.
Development & Flood Control
2266 Civic Center Dr.
North Las Vegas, NV 89030
(702) 657-2264

CCPW
William Brandt, P.E.
Design Engineering
500 S. Grand Central Pkwy.
Las Vegas, NV 89155
(702) 455-6070

FEMA
Karl Mohr
Office of Risk Assessment
500 C Street Southwest
Room #434
Washington, D.C. 20427
(202) 646-2770

FEMAs TEC
Tom Smith, P.E.
Michael Baker Jr., Inc.
3601 Eisenhower Ave.
Suite 600
Alexandria, VA 22304
(703) 960-8800

SUMMARY OF DISCUSSION

Available Topography

- The CNLV Resources Division expects to have new aerial topography completed in two months. CNLV is to investigate making the portion of the topography near the Range Wash available sooner.

- Bill Brandt will search for sheets 44 and 45 of the FIS topography, dated 1984.

Available Hydrologic/Hydraulic Data

- Obtain a copy of the LOMR for Winterwood prepared by GCW.
- Contact Dennis Perry at Clark County to obtain copies of drainage studies for the recent developments near the Sloan Channel.
- Obtain Lewis Homes Peachtree data on bank protection for the Sloan Channel, by GCW.
- Obtain from CNLV, Western & Eastern Tributaries of Range Wash Flood Control Facility Plan (Boyle, 1991).
- Transbasin Diversion Hydrologic Evaluation may be available from Black & Veatch.
- "As-builts" for the Confluence Detention Basin will not be available by the time of submittal and will require a CLOMR.

Flood Hazard Data

- If that information may be useful, contact the repository at Michael Baker Jr. If there is a fee for this information, CCRFCD may be able to get the fee waived.

- CNLV and Clark County have some of that data.

Flooding

- Flooding occurred along Sloan Channel in 1984.
- The Vandenberg channel has had frequent flooding problems.
- Stonegate had recent flooding problems.
- Where the channel curves near Carey, water overtopped it and flooded a mobile home park.
- CNLV will investigate availability of flooding photographs.
- PBS&J may search CCRFCD photograph files.

GIS data

- PBS&J may use the recent GIS orthophotos to prepare base maps, but may use 1984 FIS topography for contours or more recent topography, rather than use the digital topography with 10-ft contour intervals.

- CCRFCD has an interlocal with GISMO, so the GIS information will have no fee for this project. PBS&J will draft a data request letter for Kevin Eubanks to sign.

Data for Range Wash Dike

- A copy of the CCRFCD Operations and Maintenance Manual and the Maintenance Work Program will be sent to FEMA.

- As-built certifications can be obtained from Steve Combs or Kelly Chuma at the CNLV.

Hydrology/Hydraulics

- CCRFCD indicated HEC-1 modeling based on Confluence Detention Basin models will be acceptable hydrology.

Project Schedule

- Attached.

Next Meeting

- August 24, 10:00 a.m., at CCRFCD.

1.4 General Correspondence

ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7548 W. SAHARA AVE. • LAS VEGAS, NEVADA 89117 • (702) 248-6415

LETTER OF TRANSMITTAL

TO: P.B.S.&J.

DATE: January 18, 1996

PROJECT: Collins Business Park Phase II

ATTN: _____

W.O.#: B165b

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LETTER OF TRANSMITTAL

TO: P.B.S.& J

(263-7200)

ATTN: Don Davis

DATE: January 17, 1996

PROJECT: Collins Business Park

W.O.#: B165

WE ARE FORWARDING THE ITEMS LISTED BELOW VIA:

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Department of Public Works

2266 Civic Center Drive
North Las Vegas, Nevada 89030
(702) 657-2200
FAX (702) 649-4696

James K. Seastrand
City Council
Theron H. Goynes
William E. Robinson
Mary J. Kincaid
John K. Rhodes
City Manager
Linda Hinson
Public Works Director
Gary W. Holler, P.E.

Development & Flood Control Division
Document Check-Out Form

1/17/96
(Date)

PBS&J
Firm Name

263-7275
Telephone Number

I agree to return these documents to Public Works by: 1/31/96

DON DAVIS
Print Name

J. L. Wiemann
Signature

The following documents have been checked out to the person noted above:

1. Hydrology Study - Golden Triangle 2nd Park
2. Hydrology Study - Review Response - Golden Triangle 2nd Park
3. Golden Triangle 2nd Park
4.

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

Gale Wm. Fraser, II, P.E.
General Manager / Chief Engineer

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November 20, 1995

Donald W. Davis, P.E.
Post, Buckley, Schuh & Jernigan, Inc.
901 North Green Valley Parkway, Suite 100
Henderson, Nevada 89014

Range Wash Flood Insurance Study
PBS&J # 51804.00

Dear Don:

I am writing in response to your request dated November 9, 1995, for $10,000 from the supplemental services portion of the contract to perform surveying services. During the November progress meeting we discussed the possibility of using new topographic mapping being developed by the City of North Las Vegas. The mapping for the study area will be available on December 8, 1995, according to Mr. Randy Tarr, Administrator of Development and Flood Control for the City of North Las Vegas. It is my recommendation to wait until the topography is ready and then reassess your surveying needs to complete the study. At that time you may resubmit a revised request if necessary.

If you should have any further questions, please feel free to call.

GALE WM. FRASER, II, P.E.
General Manager/Chief Engineer

BY:
Kevin Eubanks, P.E.
Assistant General Manager

KLE:jwp

CC: Virginia Valentine, PBS&J
Kathleen L. Kingston, PBS&J
Randy Tarr, City of North Las Vegas
William C. Brandt, Clark County Public Works
Steve Parish, Clark County Public Works

File: Range Wash FIS

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PBS&J

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

CONSTRUCTION SERVICES
ENGINEERING • PLANNING
SURVEYING

November 9, 1995

Mr. Kevin Eubanks, P.E.
Clark County Regional Flood Control District
301 E. Clark Avenue, Suite #301
Las Vegas, Nevada 89101

RE: RANGE WASH FLOOD INSURANCE STUDY RESTUDY

Dear Kevin:

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) is requesting an amount of ten thousand dollars *($10,000.00) from the supplemental services portion of our contract to perform surveying services.*

Topography with 2-foot contour interval, from the City of North Las Vegas, has not yet become available. It is not expected to be available until January.

The survey services would include surveyed cross-sections to perform normal depth calculations. The Montgomery 1984 topography could be used as a base map, supplemented by surveyed cross-sections in sufficient locations to determine depth and width of floodplain.

Sincerely,

Post, Buckley, Schuh & Jernigan, Inc.

Donald W. Davis, P.E.
Project Manager

jj

901 North Green Valley Parkway • Suite One Hundred • Henderson, Nevada 89014 • Telephone: 702/263-7275 • Fax: 702/263-7200

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

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Theron Goynes
City of North Las Vegas

Jan Laverty Jones
City of Las Vegas

David Wood
City of Henderson

Bruce L. Woodbury
Clark County

November 7, 1995

Donald W. Davis, P.E.
Post, Buckley, Schuh & Jernigan, Inc.
901 North Green Valley Parkway, Suite 100
Henderson, Nevada 89014

Range Wash Flood Insurance Study
PBS&J # 51804.00

Dear Don,

A review of the Draft Hydrology Study for the Range Wash Flood Insurance Restudy has been completed. The methods, format and results of the study were found acceptable to the District. Subsequent to addressing any comments that may be offered at our next progress meeting on November 9, 1995, PBS&J should continue on to the hydraulics component of the study.

Thank you for the timely submittal of this study. If you should have any further questions, please feel free to call.

GALE WM. FRASER, II, P.E.
General Manager/Chief Engineer

BY: _____
Kevin Eubanks, P.E.
Assistant General Manager

KLE:jwp

cc: Virginia Valentine, PBS&J
Kathleen L. Kingston, PBS&J
Randy Tarr, City of North Las Vegas
William C. Brandt, Clark County Public Works
Steve Parish, Clark County Public Works

File: Range Wash FIS

RECEIVED
NOV 0 8
PBS&J

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: October 19, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Kevin Eubanks, P.E.
Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Six copies of the DRAFT Hydrology Study for the Range Wash FIS Restudy.

Remarks:

If you have any questions, please call.

Signed by: Kathleen L. Kingston
Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: October 3, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Roy A. Davis III, P.E.
G.C. Wallace
1555 S. Rainbow Blvd.
Las Vegas, NV 89102

Regarding:

Range Wash
Flood Insurance Study

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

- **Las Vegas Wash/Sloan Channel LOMR file**

Remarks:

Thank you for loaning us this file!

Signed by: Kathleen L. Kingston

Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: September 26, 1995

Ref. No.: 51804

Transmittal:

To:

Mr. Kelly Wittwer, P.E.
Pentacore Engineering
6763 W. Charleston Blvd.
Las Vegas, NV 89102

Regarding:

Range Wash
Flood Insurance Study

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

- **Technical Drainage Study for Hollywood Highlands No. 5, May 1995**
- **Addendum 1, June, 1995**
- **Update, July, 1995**

Remarks:

Thank your for loaning us these reports so quickly.

Signed by: Kathleen Kingston

Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.
ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: September 11, 1995

Ref. No.: 51804

Transmittal:

To:

Mr. Kevin Eubanks
Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

We are returning all of the reports you lent us for the Range Wash FIS project.

The attached list summarizes the material we received from you.

Remarks:

Thank you for loaning these reports to us.

Signed by: Kathleen L. Kingston

Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

PROJECT: RANGE WASH FLOOD INSURANCE STUDY
DATE: MAY 2, 1995
FILE: REFLIST.XLS

LIST OF REFERENCES OBTAINED FROM THE CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

DATE	COMPANY	TITLE	NOTES
1992	Boyle	Range Wash Sediment Transport Documentation Notebook	Contains CLOMR information, sediment analyses, dike sizing criteria (hydrology, alluvial fan, slope stability)
October 1991	Boyle	*(Title missing)* Range Wash Diversion Dike	*Application for Transportation and Utility Systems and Facilities on Federal Lands* Range Wash Diversion Dike Project Description Legal Description Range Wash Diversion Channel
January 1992	Knight & Leavitt for Converse	A Plant Inventory of the West Range Diversion Dike Project Clark County, Nevada	Rare plant and riparian assessment
January 1992	Knight & Leavitt for Converse	A Cultural Resource Inventory of the West Range Diversion Dike Project Clark County, Nevada	Archaeology, history
November 1991	Converse Consultants prepared for Boyle	DRAFT Geotechnical Investigation Range Wash Flood Control Project Near Range Road North Las Vegas, Nevada	Soil Borings, Grain Size Distribution Slope Stability
January 1992	Converse Consultants prepared for Boyle	Geotechnical Investigation Range Wash Flood Control Project Near Range Road North Las Vegas, Nevada	Soil Borings, Grain Size Distribution Slope Stability, Soil Cement Mix
May 1992	Converse Consultants prepared for Boyle	Addendum No. 1 Rippability Study Observations Range Wash Flood Control Project North Las Vegas, Nevada	Rippability
June 1992	Converse Consultants prepared for Boyle	Addendum No. 2 Additional Slope Stability Analysis Range Wash Flood Control Project North Las Vegas, Nevada	Slope Stability

PROJECT: RANGE WASH FLOOD INSURANCE STUDY
DATE: MAY 2, 1995
FILE: REFLIST.XLS

LIST OF REFERENCES OBTAINED FROM THE CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

DATE	COMPANY	TITLE	NOTES
April 1993	Converse Consultants prepared for Boyle	Final Design Geotechnical Investigation Sloan Channel/ Confluence Detention Basin Near Nellis Air Force Base Clark County, Nevada	Boring Logs, Grain Size Distribution. Embankment Slope Stability, Seepage Control, Erosion Protection, Foundations Lateral Earth Pressures
May 1993	Converse Consultants prepared for Boyle	Facility Specific Environmental Analysis Range Wash/Sloan Channel Confluence Detention Basin North Las Vegas, Nevada	Air Quality, Groundwater, Cultural Resources Biological Resources (CCRFCD has two copies of this report)
October 16 1992	Boyle prepared for Clark County	Final Predesign Memorandum Confluence Detention Basin and Sloan Channel Improvements (and letter with comment responses)	Flood Control Alternatives, Hydrology Sloan Channel Diversion, Golf Course Channel Inlet Channel and Detention Basin Design Geotechnical and Environmental Analyses
October 5 1992	Clark County	Draft Predesign Memorandum Comments	COMMENTS
August 19 1992	CCRFCD	Draft Predesign Memorandum Comments	COMMENTS
December 1992	Clark County and Boyle Letters	Letter from Clark County to CCRFCD Range Wash/Sloan Channel Confluence Detention Basin Includes a Design Memo by Boyle for the Confluence Detention Basin	Spillway Issues Revised hydrology, revised design Two Level Outlet, Diversion, Costs PMF evaluation summary Drainage Figures, HEC-1, Spillway Calculations
June 1993	Boyle	Range Wash/Sloan Channel Confluence Detention Basin Calculations Summary	HEC-1 and HEC-2 Models Diversion Structure, Spillway, Outlet Works, Structural Calculations
September 1993	Clark County	Range Wash/Sloan Channel Phase I Nellis Air Force Base (NAFB) Channel	Contract Documents and Special Provisions (CCRFCD has two copies of this report)
October 19th & 27th 1993	Clark County	Range Wash/Sloan Channel Phase I Nellis Air Force Base (NAFB) Channel (Addendum 1 and Addendum 2)	Contract Documents and Special Provisions

PROJECT: RANGE WASH FLOOD INSURANCE STUDY
DATE: MAY 2, 1995
FILE: REFLIST.XLS

LIST OF REFERENCES OBTAINED FROM THE CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

DATE	COMPANY	TITLE	NOTES
April 1992	Boyle	DRAFT Contract Documents and Construction Specifications for Construction of West Range Wash Diversion Dike	Documents for bidding Contract, Scope of Work Specifications
April 1993	Boyle	Contract Documents and Construction Specifications for Construction of West Range Wash Diversion Dike	Documents for bidding Contract, Scope of Work Specifications
April 1992	Boyle	Letter to U.S. Army Corps of Engineers West Range Wash Diversion Dike	Reduced 95% plans water quality isses, rare plant and riparian, cultural resources
August 1993 revised October 1993	Black & Veatch	North Las Vegas Detention Basin Outlet Modification Report	Investigates the feasibility of modifying the outlet structure at the North Las Vegas Detention Basin to reduce peak flow from the detention basin. (Two computer disks are included in the report)
April 1993	G.C. Wallace	DRAFT Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash	Existing structures, local inflows, alternatives, Soil Study by Converse Consultants, March 1993
May 1993	G.C. Wallace	DRAFT Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash	Existing structures, local inflows, alternatives.
April 1993	G.C. Wallace	DRAFT Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash APPENDIX B	Methodology, Drainage Area, HEC-1 runs.

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: September 11, 1995

Ref. No.: 51804

Transmittal:

To:

Ms. Kelly Chuma, P.E.
City of North Las Vegas
2266 Civic Center Dr.
North Las Vegas, Nevada 89030

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Hydrologic Analysis Western and Eastern Tributaries of Range Wash, Boyle, April, 1990

Western and Eastern Tributaries of Range Wash, Flood Control Facility Plan, Boyle, June, 1991

Flood Damage photos, Vandenberg Channel, 1984

Remarks:

Thank you for loaning these reports and photos to us.

Signed by: Kathleen Kingston

Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: September 11, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Jerry Pruitt
G.C. Wallace
1555 S. Rainbow Blvd.
Las Vegas, NV 89102

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Drainage Study for Lewis Homes - Peachtree, March 1990

Drainage Study for Lewis Homes - Peachtree, May 1990

Drainage Study for Lewis Homes - Peachtree, January 1991

Addendum to the Drainage Study for Lewis Homes - Peachtree, July 1991

Remarks:

Thank you for loaning these reports to us.

Signed by: Kathy Kingston

Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

CONSTRUCTION SERVICES
ENGINEERING • PLANNING
SURVEYING

September 7, 1995

Mr. Tony Appleby
Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, Virginia 22304

RE: RANGE WASH FLOOD INSURANCE RESTUDY, CLARK COUNTY, NEVADA
PBS&J REFERENCE NO: 51804.00

Dear Mr. Appleby:

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), under contract with the Clark County Regional Flood Control District (CCRFCD), is preparing a Flood Insurance Restudy of the Range Wash, located in the City of North Las Vegas, and Clark County, Nevada. In particular areas we need the hydrologic and/or hydraulic data that was used to create the DFIRMs. The enclosed figures indicate the areas for which we need information from your project library.

Figure 4 is a copy of the DFIRM, Map Number 32003 C 2200 D, Clark County and Incorporated Areas, effective date August 16, 1995, that shows one of our areas of interest. Figure A is a copy of the older FIRMs, Maps Number 320003 1025B and 320003 1250B, Clark County, Nevada, effective date September 29, 1989. As the Flood Zone A in Figure 4 is similar to the Flood Zone A in Figure A in the area surrounded by Owens Ave., Beesley Dr., Charleston Blvd., and North Linn Ln., the information we need may be from the recently superseded Flood Insurance Study from 1989. Figure 3 is a copy of the DFIRMs, Map Numbers 32003C 1790D, 32003C 2180D and 32003C 2176D, Clark County and Incorporated Areas, effective date August 16, 1995, that shows our other area of interest.

Please call me with an estimate of the time and cost needed to collect and send us this information. Should you have any questions please feel free to call me, or Kathleen Kingston of our office, at (702) 263-7275.

Sincerely,

Post, Buckley, Schuh & Jernigan, Inc.

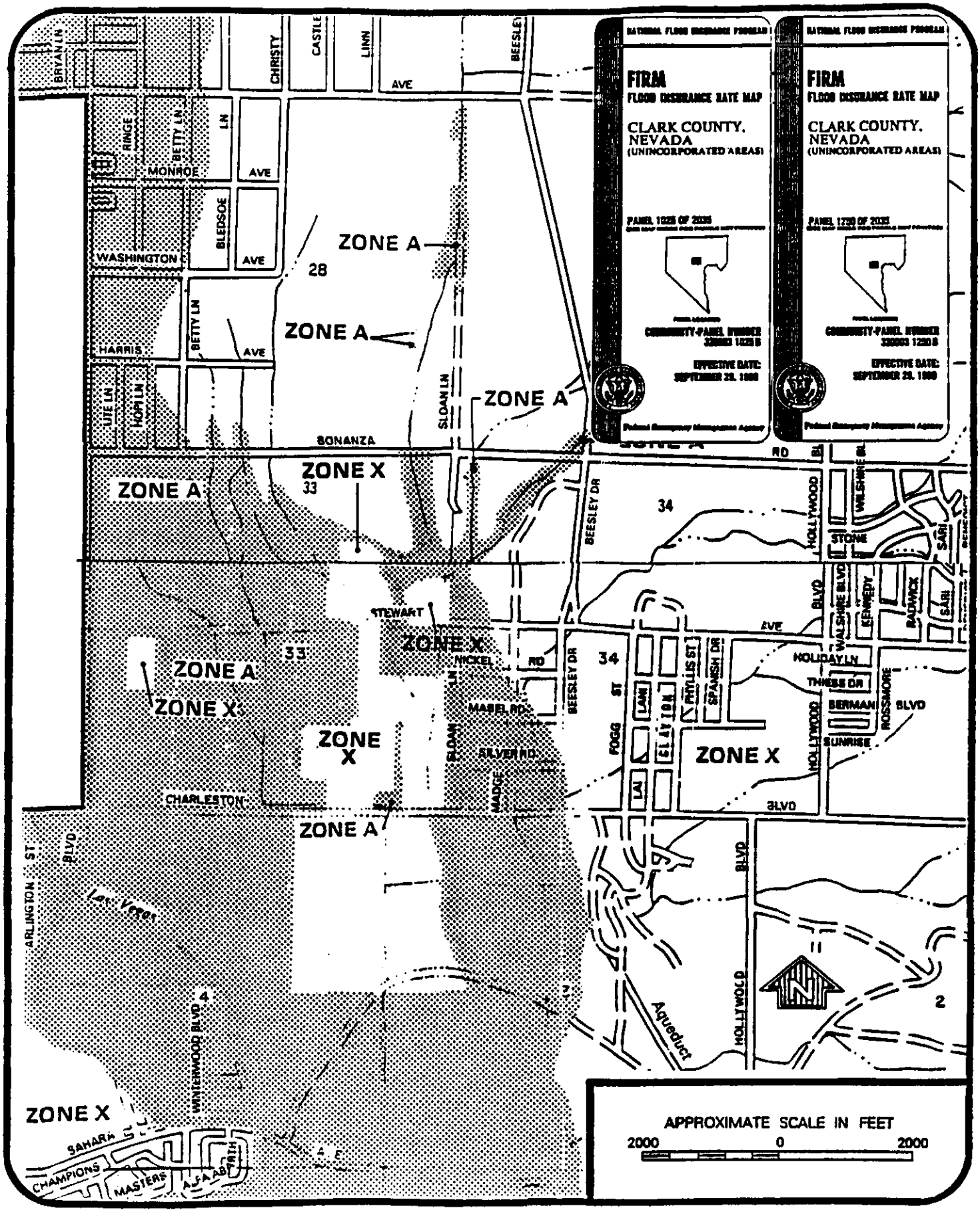
Don Davis, P.E.
Project Manager

jj

Enclosure

cc: Kathleen Kingston

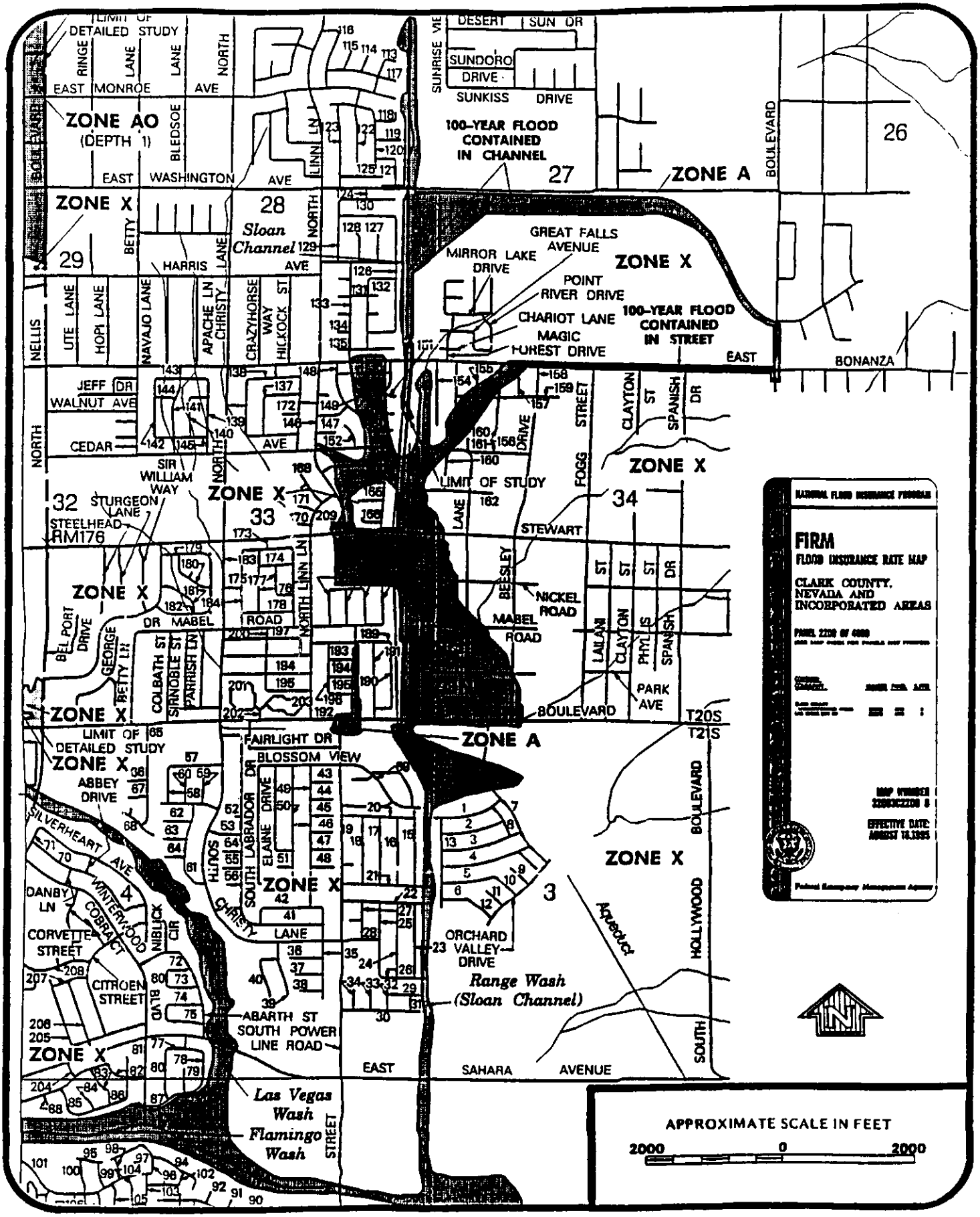
[WP2] C:\WP60\DOCS\DAVIS\BAKERLT1 804 September 7, 1995



FIRM 1989

FIGURE A

POST, BUCKLEY, SCHUH & JERNIGAN

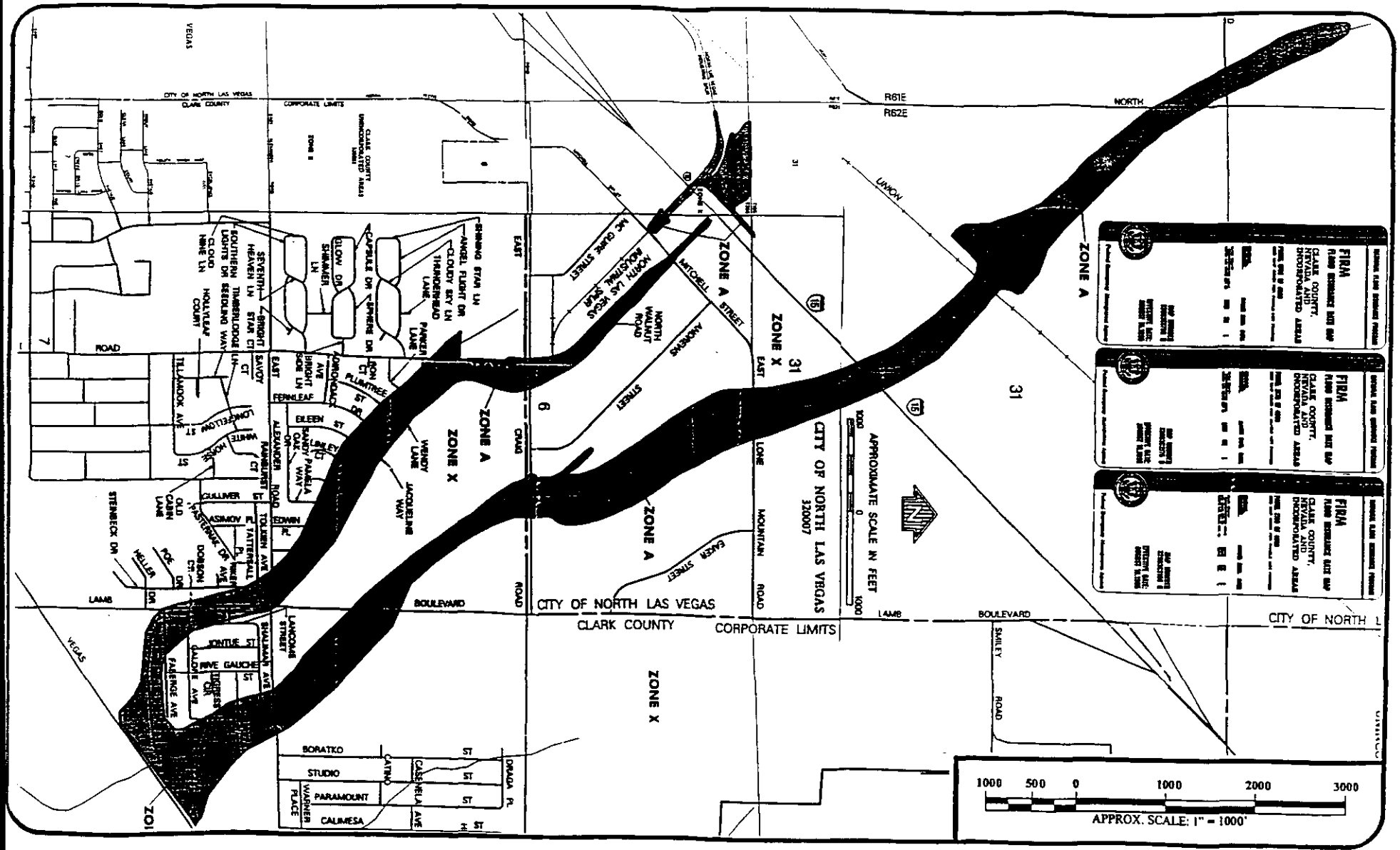


DFIRM 1995

FIGURE 4

POST, BUCKLEY, SCHUH & JERNIGAN

ENGINEERING · PLANNING · SURVEYING · CONSTRUCTION SERVICES



DFIRM 1995

FIGURE 3

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Date: September 1, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Kevin Eubanks, P.E.
Assistant General Manager
Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Vegas, NV 89101

Regarding:
Range Wash Flood Insurance Restudy

Transmitted:

- ☒ Herewith
- ☒ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☒ Your Use
- ☐ Information
- ☒ Return Original
- ☐ As Requested

The Following:

4 - Copies of the Data Collection Summary Memorandum with photo log for the Range Wash Flood Insurance Restudy.

Comments:

Signed by:

Donald W. Davis, P.E.

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.
ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: August 24, 1995 Ref. No.: 51804

Transmittal:

To:

Ms. Kelly Chuma, P.E.
City of North Las Vegas
2266 Civic Center Dr.
North Las Vegas, Nevada 89030

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Hydrologic Analysis Western and Eastern Tributaries of Range Wash, Boyle, April, 1990

Western and Eastern Tributaries of Range Wash, Flood Control Facility Plan, Boyle, June, 1991

Flood Damage photos, Vandenberg Channel, 1984

Remarks:

Thank you for loaning these reports and photos to us.

Signed by: _____
Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: August 23, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Jerry Pruitt
G.C. Wallace
1555 S. Rainbow Blvd.
Las Vegas, NV 89102

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Drainage Study for Lewis Homes - Peachtree, March 1990

Drainage Study for Lewis Homes - Peachtree, May 1990

Drainage Study for Lewis Homes - Peachtree, January 1991

Addendum to the Drainage Study for Lewis Homes - Peachtree, July 1991

Remarks:

Thank you for loaning these reports to us.

Signed by: _____
Kathleen L. Kingston

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

Department of Public Works

Quality Control Division
151 West Brooks, Suite F
North Las Vegas, Nevada 89030
(702) 642-1827
FAX (702) 642-2633

Mayor
James K. Seastrand
Councilmen
Theron H. Goynes
William R. Robinson
Mary J. Kincaid
John K. Rhodes
City Manager
Michael Dyal
Public Works Director
Gary W. Holler, P.E.

FAX TRANSMITTAL

DATE: 8-22-95

TO: PBSEJ
Kathy Kingston
263-7200

FROM: Steve Comby

CITY OF NORTH LAS VEGAS
QUALITY DIVISION
151 W. BROOKS, SUITE F
NORTH LAS VEGAS, NV 89030

PHONE: 642-1827

OF PAGES 8 PLUS COVER SHEET

SENT BY: Steve

FAX NUMBER: 702-642-2633

COMMENTS: Is this what you need? Questions? Kirk in the Engineering Div is preparing As-built Drawings for you

COPY TO FOLLOW IN THE MAIL: _____ YES ✓ NO

INSPECTIONS PHONE # 642-1827

INSPECTION SECTION PHONE # 642-1859

TEST LAB PHONE # 399-7726

Department of Public Works

Quality Control Division
151 West Brooks, Suite F
North Las Vegas, Nevada 89030
(702) 642-1827
FAX (702) 642-2633

Mayor
James K. Seastrand
Councilmen
Theron H. Goynes
William E. Robinson
Mary J. Kincaid
John K. Rhodes
City Manager
Michael Dyal
Public Works Director
Gary W. Haller, P.E.

November 2, 1994

Mr. Jason King, P.E.
Department of Conservation
And Natural Resources
Division of Water Resources
Capital Complex
123 W. Nye Lane
Carson City, Nevada 89710

RE: J-398; WEST RANGE WASH DIVERSION DIKE

Dear Mr. King:

As requested, enclosed is a copy of the as-built drawings and final grading report for the subject structure. In addition it is understood that no long-term storage shall be allowed behind this dike and no gates, valves or other water control appliances shall be allowed on the outlet works.

Should you have any further questions or require additional information, please contact me at (702) 642-1827.

Sincerely,

Stephen A. Combs
Chief Construction Inspector

cc. Stephen Roberts, Clark County Regional Flood Control District
Sterling Ditzworth, Boyle Engineering Corporation
C. E. (Gil) Gilpin, City of North Las Vegas Quality Control

FILE COPY

D:\king.ste

BOB MILLER
Governor

STATE OF NEVADA

PETER G. MORROS
Director

R. MICHAEL TURNIPSEED, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
Capitol Complex
123 W. Nye Lane
Carson City, Nevada 89710
(702) 687-4380

November 7, 1994

Mr. Stephen A. Combs
Chief Construction Inspector
City of North Las Vegas
Dept. of Public Works
151 W. Brooks, Ste. F
North Las Vegas, NV 89030

RECEIVED
NOV 09 1994
QUALITY CONTROL

Re: J-398; West Range Wash Diversion Dike

Dear Mr. Combs:

Thank you for the set of as-builts, compaction results and soil cement reports. The only discrepancy I found with the reports was that Section 2615 of the specifications state that the soil cement should have a 600 psi strength at 7 days. The soil cement reports submitted state 600 psi at 28 days. Most of the samples did in fact meet the 600 psi at 7 days but there were a couple that didn't. I don't believe this to be a problem, however I would like some clarification to the specification.

This letter is authorization to divert and impound flood waters behind the newly constructed embankments as mentioned above. The impoundment is only for short term only as the design provides for transport of flood waters to a detention facility and is not intended to behave like a storage impoundment.

A minimum of two (2) feet of freeboard shall be maintained at all times. The freeboard shall be measured from water surface to the crest. The structure should be periodically inspected for slumps, cracks, seepage, differential settlement and other deleterious conditions. This is particularly applicable after severe storms and significant seismic events.

FILE COPY

If you have any questions concerning this matter, please contact me at your earliest convenience.

Sincerely,

Jason King, P.E.
Engineering Branch Manager

cc: Stephen Roberts, CCRFCD
Sterling Ditsworth, Boyle Engineering Corp.

Department of Public Works

Quality Control Division
151 West Brooks, Suite F
North Las Vegas, Nevada 89030
(702) 642-1827
FAX (702) 642-2633

Mayor
James K. Seastrand
Councilmen
Theron H. Goynes
William E. Robinson
Mary J. Kincaid
John K. Rhodes
City Manager
Michael Dyal
Public Works Director
Gary W. Holler, P.E.

November 17, 1994

Mr. Jason King, P.E.
Engineering Branch Manager
Department of Conservation and Natural Resources
Division of Water Resources
Capital Complex
123 W. Nye Lane
Carson City, Nevada 89710

RE: J-398; WEST RANGE WASH DIVERSION DIKE

Dear Mr. King:

I am in receipt of your letter dated November 7, 1994. You are correct that Section 02615 of the specifications state that the soil cement should have a 600 P.S.I. strength at 7 days. Two samples were sightly below the required 600 P.S.I. at 7 days. One tested on 2/14/94 broke at 560 P.S.I. at 7 days, the second tested on 2/15/94 broke at 550 P.S.I. at 7 days.

A core taken at Station 22 + 00 (soil cement placed on the same day as the cylinder tested on 2/15/94) obtained a strength of 820 P.S.I. at 28 days. In our opinion, the soil cement will perform as intended.

The structure shall be inspected by City of North Las Vegas personnel periodically and after severe storms or significant seismic events.

If you have any questions concerning this matter please do not hesitate to contact me at (702) 642-1827.

Sincerely,

Stephen A. Combs
Chief Construction Inspector

SC/lp

cc: Stephen Roberts, Clark County Regional Flood Control District
Sterling Ditzworth, Boyle Engineering

FILE COPY

Converse Consultants Southwest, Inc.

Consulting Engineering and Applied Sciences

August 2, 1994

92-33377-01

City of North Las Vegas
151 West Brooks Avenue, Suite F
North Las Vegas, NV 89036

Attention: Mr. Gil Gilpin

Subject: Final Grading Report
West Range Wash Diversion Dike
North Las Vegas, Nevada

Gentlemen:

INTRODUCTION

This is to report the results of tests and observations made during the construction for the subject project. The intent of this report is to provide documentation of testing services to show that the field work as described below was performed in accordance with our recommendations.

- Our observation and testing for the period between January 3, 1994 and April 27, 1994
- The foundation materials covered by this report include the area of the structure footprint and approximately 5 feet outside the structure footprint.

The following plans, specifications and reports were used as our guideline and reference on this project:

- Soil and Foundation Investigation report for the subject project, dated January 8, 1992, (Converse Project No. 91-33298-01)
- Soil Cement Mix Designs report for the subject project, dated January 7, 1992, (Converse Project No. 91-33421-01)

SCOPE OF SERVICES

Our services were performed in accordance with your authorization dated July 29, 1991.

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Periodic tests and observations were provided by a representative of Converse Consultants Southwest, Inc. (Converse) to monitor the grading contractor for substantial compliance with the drawings and job requirements. The presence of our field representative at the site was to provide to the owner a source of professional advice, opinions and recommendations based upon the field representative's observations of the contractor's work, and did not include any superintending, supervision or direction of the actual work of the contractor or the contractor's workmen.

Field density tests were made during grading to determine the degree of compaction and moisture content. Where tests or field observations indicated insufficient density, additional compaction, with adjustment of the moisture content where necessary, was performed before the next layer was added.

Bulk samples of representative soil types were taken to our laboratory during grading for determination of maximum density-optimum moisture.

Two soil cement mix designs were performed in accordance with our proposal dated July 29, 1991. Soil cement used for the purpose of erosion protection was sampled during the project and brought to the lab in order to determine if minimum compressive strengths were being achieved in the field.

A slope stability analysis was performed in order to determine the minimum factor of safety for the dike and is part of the original Geotechnical Investigation, dated January 8, 1992 (Converse Project No. 91-33298-01). An additional Slope Stability Analysis was performed June 22, 1992 (Converse Project No. 91-33298-02) and a Rippability Study was done May 15, 1992 (Converse Project No. 91-33298-03).

OBSERVATIONS AND TEST RESULTS

The opinions and recommendations presented hereafter are based upon our tests and periodic observations of the grading procedures, and represent our engineering judgment as to the contractor's general compliance with the drawings and job specifications.

The grading operations were observed to be performed in the following general manner:

1. Vegetation, undocumented fill, rubble, trash, debris and any loose or disturbed soils should be removed from within the proposed dike, floodway and inlet structure areas.
2. The exposed native soils were scarified, moisture-conditioned as required, and recompacted to approximately 9 inches in depth.
3. Fill soils complying with the job requirements were placed in layers on the prepared surface, and each layer was compacted to the specified density before the next layer was added.

4. The minimum acceptable degree of compaction was 95 percent of the maximum density with a moisture content within 2% of optimum.

5. Maximum density and optimum moisture content were determined by the ASTM D1557-91 method.

6. All field density tests and their approximate locations are given in the enclosed Table I of the Table of Test Results. The approximate locations of the tests and the limits and depths of fill as observed during pad construction are shown on the project grading plans on file in our office.

7. The soil used in the compacted fill consisted of brown silty gravel with sand. A list of soil types encountered during testing and the maximum density-optimum moisture relation are given on Figure No. 1 through 4. Gradation results are given on Figures 5-7.

8. Core samples and compaction tests of the soil cement were taken during the construction in order to determine if the minimum compressive strength was achieved. The minimum acceptable degree of compaction for soil cement was 95 percent of the maximum density.

EROSION PROTECTION

The on-site granular soils are subject to erosion due to high water velocities. Therefore, erosion protection was required for inlet and bend areas, dike slopes, and along the floodway channel. Soil cement of 12 inch minimum thickness was used on the upstream slope of the dike. Erosion protection for the inlet area to the detention basin and for the transition from dike channel to floodway channel was also done by the use of soil cement.

Laboratory tests were performed on samples taken from the site as described in our letter dated January 7, 1992 (Converse Project No. 92-33421-01). The soil cement core samples were taken from the site as work progressed and brought to the lab in order to verify that minimum compressive strengths were being achieved. The results of these tests are included in the appendix of this report. Where applicable, the soil cement was placed in lifts and cored before the next lift was placed in order to determine if the minimum compressive strength was achieved.

CONCLUSIONS AND RECOMMENDATIONS

Based upon the results of the tests, observations of the construction procedures in the field, and our experience, it is our opinion that the compacted fill shown on the project grading plans has been placed in substantial compliance with the applicable portions of the job requirements and with the recommendations of Converse. Any fill added beyond the limits of above the grades shown should be placed under engineering observations and testing, and in accordance with the project requirements, if it is to be covered by the recommendations of this report.

The compacted fill discussed in this report was placed for support of a diversion dike. The foundation recommendations presented in the Geotechnical Investigation, dated January 8, 1992 (Converse Project No. 91-33298-01), are applicable to the diversion dike, floodway and inlet structure foundation materials.

The soil cement placed for erosion protection on the dike, floodway and inlet structure has also been placed in substantial compliance with applicable portions of the job requirements. The laboratory test results are included in appendices of this report.

CLOSURE

The conclusions and recommendations in this report are based on the results of our previous subsurface investigation and the observations of the construction procedures used during grading. If conditions are encountered during construction that appear to be different than those assumed in this report, this office shall be notified.

Our findings and conclusions have been obtained in accordance with accepted professional engineering practice in the field of Geotechnical Engineering. This warranty is in lieu of all other warranties, express or implied.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Robert W. Kukes

Robert W. Kukes
Project Manager

Reviewed and approved:

William W. Taylor, P.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
WILLIAM W. TAYLOR
CIVIL
NO. 6773
8/5/94

WWT:RWK:gm
102/7AG

Encl: Table I
Figure No. 1 - 7
Compressive Strength Data

Dist: 4/Addressee

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date: August 18, 1995 Ref. No.: 51804

Transmittal:

To:

Mr. Kelly Wittwer, P.E.
Pentacore Engineering
6763 W. Charleston Blvd.
Las Vegas, NV 89102

Regarding:

Range Wash F.I.S.

Transmitted:

- ☒ Herewith
- ☐ Via Carrier
- ☐ Fax

For:

- ☐ Review
- ☐ Checking
- ☐ Your Use
- ☐ Information
- ☐ Return Original
- ☐ As Requested

The Following:

Conceptual Master Drainage Report for Lewis Homes - Orchards.

Remarks:

Thank you for loaning this report to us.

Signed by: _____
KATHLEEN L. KINGSTON

cc:

901 North Green Valley Parkway, Suite 100 Henderson, Nevada 89014 Telephone :(702) 263-7275 Fax : (702) 263-7200

G.C. WALLACE, INC.
Engineering/Architecture

LETTER OF TRANSMITTAL

TO: [illegible] Date 5/16/95

Project No.

ATTENTION: KATHY KINGSTON

SUBJECT: PEACHTREE DRAINAGE STUDIES

Gentlemen: The following items are:

- _ Forwarded
- X Herein
- _ Returned
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By way of:

- _ First Class Mail
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ONE (1) COPY ADDENDUM TO THE D.S. JULY 1991
ONE (1) COPY D.S. JANUARY 1991
ONE (1) COPY D.S. MAY 1990
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These items are submitted:

- X At your request
- _ For your approval
- _ For your review and comments
- _ For your action
- _ For your files
- _ For your information

Acknowledgement of receipt:

- X Not required
- _ Acknowledgement required

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Date:
Time:

Remarks:

Very truly yours,

G.C. WALLACE, INC.

By: [signature]
JERRY PRUITT

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SUMMERLIN DIVISION / TELEPHONE: (702) 363-0991 / FAX: (702) 255-0576

TRANSMITTAL

CLARK COUNTY, NEVADA
DEPARTMENT OF PUBLIC WORKS
DESIGN ENGINEERING/CONSTRUCTION MANAGEMENT DIVISIONS
(702) 455-6050

TO: P,S+J

DATE: AUG 16, 1995

PROJECT: SLIM CHANNEL
CHEYENNE TO LV WASH

ATTENTION: TOM DAVIS

RE: PLANS

WE ARE FORWARDING THE FOLLOWING: ☒ Enclosed ☐ By Mail ☐ Separate Cover ☐ By Messenger
FOR PICK UP

NO. OF COPIES	DESCRIPTION
1	SLIM CHANNEL – CHEYENNE TO STEWART – CONSTRUCTION DRAWINGS (NOTE: MISTAKENLY STAMPED "PRELIMINARY" – THESE ARE CONSTRUCTION DRAWINGS)
1	11 X 17 PLANS – SLIM CHANNEL – STEWART TO LV WASH

REMARKS: PICK UP AT YOUR CONVENIENCE

THIS MATERIAL IS SENT FOR: ☒ Your Files ☐ Your Approval ☐ Your Revision ☐ Your Comments ☐ And Return

BY: MIKE HAND 455-6667

DESIGN ENGINEERING/CONSTRUCTION MANAGEMENT DIVISIONS
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CONSTRUCTION SERVICES
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August 10, 1995

Mr. Kevin C. Graczyk
GIS Database Administrator
Office of the County Manager
500 Grand Central Parkway
Las Vegas, Nevada 89155

RE: RELEASE OF GIS DATA FOR RANGE WASH F.I.S. RESTUDY

Dear Mr. Graczyk:

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) has been awarded the contract for the "Range Wash F.I.S. Restudy" project by Clark County Regional Flood Control District (CCRFCD). To effectively accomplish this task, we need to acquire certain GIS data maintained in the Clark County Central Repository. As CCRFCD is amongst the inter-local agencies, it is our understanding that the data will be distributed at no cost. The project area is shown in the enclosed map, and we hereby request copies of the following Arc/Info coverages and associated relate tables over the geographic extent of the project:

INDEX #	FILE	DESCRIPTION	TYPE
Assessor's Office (CRPCL):			
AO 3.1.1	AE*bbbss*	Assessor Easement	Cover
AO 3.2.1	CD*bbbss*	Condominium Detail	Cover
AO 3.4.1	LL*bbbss*	Lot Line	Cover
AO 3.5.1	PL*bbbss*	Parcel	Cover
AO 3.6.1	RE*bbbss*	Road Easement	Cover
	AOCONDO.XTR	Assessor's Condominium Extract File	Table
	AOEXTRACT	Assessor's Tax Roll Extract File	Table
Geography (CRGEO):			
GEO 3.1.1	NECON	Contours (Northeast)	Cover
	NWCON	Contours (Northwest)	Cover
Public Works (CRPW):			
PW 3.1.1	PE*bbb*	Public Works Easements.	Cover

901 North Green Valley Parkway • Suite One Hundred • Henderson, Nevada 89014 • Telephone: 702/263-7275 • Fax: 702/263-7200

Should you have any questions or comments, please contact either of us, or Mr. Kevin Eubanks, Assistant General Manager, CCRFCD at 455-3139.

Sincerely,

Post, Buckley, Schuh & Jernigan, Inc.

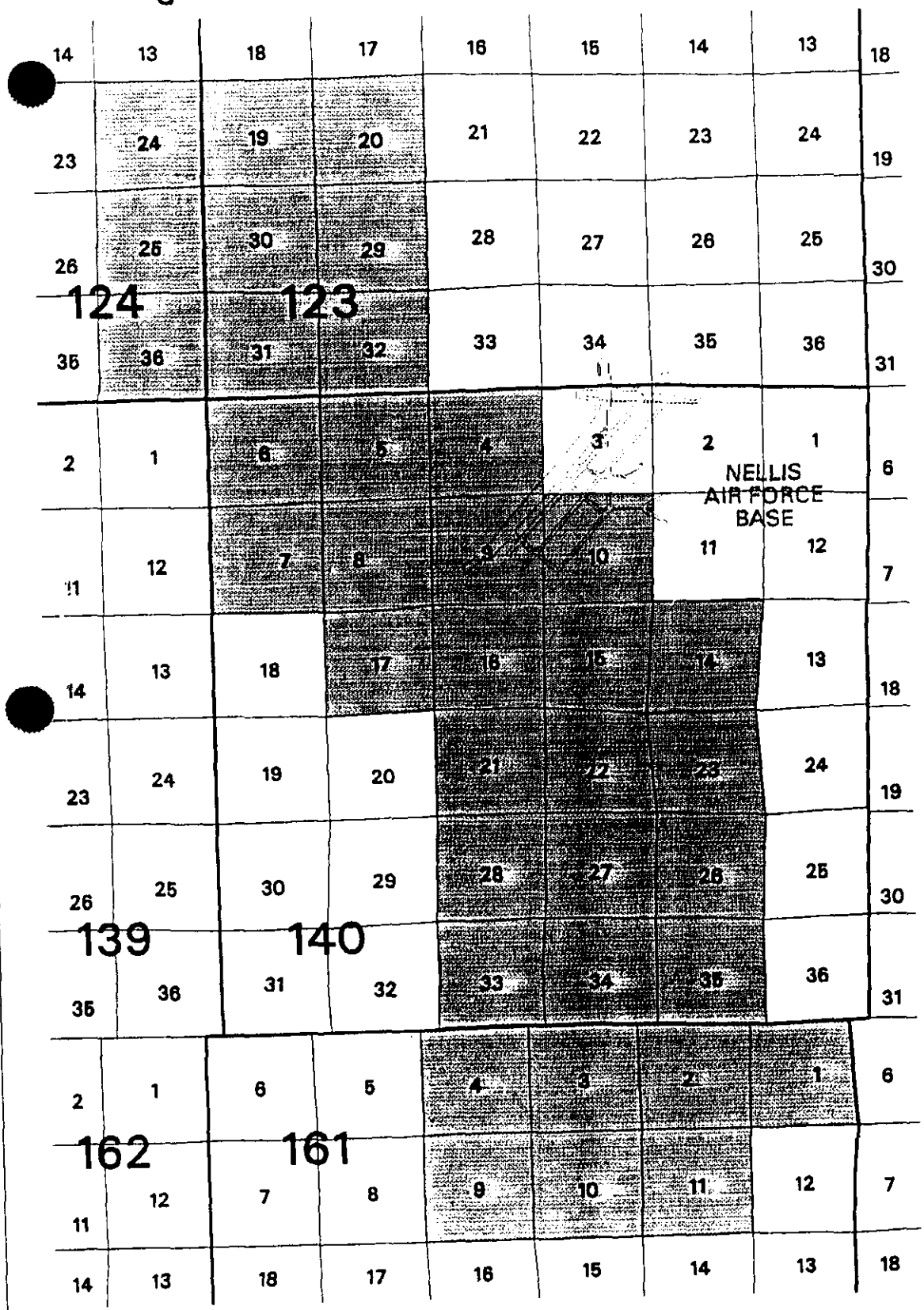
Donald Davis, P.E.
Project Manager

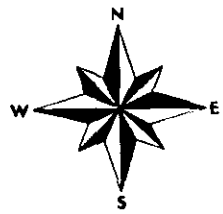
Sendhil Kolandaivel
GIS Analyst

jj

Enclosure

Range Wash FIS Restudy - Sections in Study Area





CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

POST, BUCKLEY, SCHUH & JERNIGAN, INC.
Geographic Information Systems

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

Gale Wm. Fraser, II, P.E.
General Manager / Chief Engineer

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Clark County

July 13, 1995

PBS

Virginia Valentine, Senior Vice-President
Post, Buckley, Schuh & Jernigan, Inc.
901 N. Green Valley Parkway, Suite 100
Henderson, Nevada 89014

Dear Ms. Valentine:

Enclosed please find an executed copy of the Agreement for Professional Services to prepare a Flood Insurance Restudy for the Range Wash in Clark County, dated July 13, 1995.

This letter will serve as the notice to proceed with the services described in the Agreement. Please coordinate your efforts with Kevin Eubanks of this office who will serve as the District's representative for the services.

Thank you for submitting the Agreement and Scope of Services in such a timely manner. We look forward to working with PBS & J. Please don't hesitate to contact me if you have any questions or require additional information.

Sincerely,

Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

Enclosure

GWF:mak

File: Range Wash FIS Restudy

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

SECTION 2

ENGINEERING ANALYSES

2.1 Hydrology Study

2.2 Hydraulic Analysis and Floodplain Delineation Summary

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

HYDROLOGIC ANALYSES INDEX

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

FLOODING SOURCE /STREAM NAME	HYDROLOGIC METHOD/ MODEL USED	METHOD/MODEL ANALYSIS DATE	PAPER COPY	FLOPPY DISKETTE
Range Wash	HEC-1	January 1996	2.1	INCLUDED

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

HYDRAULIC ANALYSES INDEX

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

HYDRAULIC ANALYSES INDEX

FLOODING SOURCE /STREAM NAME	HYDROLOGIC METHOD/ MODEL USED	METHOD/MODEL ANALYSIS DATE	PAPER COPY	FLOPPY DISKETTE
Range Wash	FLOWMASTER	January 1996	2.2	NOT INCLUDED
Range Wash	HY-8	January 1996	2.2	NOT INCLUDED

2.1 Hydrology Study

DRAFT
HYDROLOGY STUDY

FOR THE

RANGE WASH
FLOOD INSURANCE RESTUDY

Prepared for:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Prepared by:

Post, Buckley, Schuh & Jernigan, Inc.
901 North Green Valley Parkway
Henderson, Nevada 89014

October 1995
Revised January 1996
PBS&J, Inc. Job Number 51804

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RAINFALL AND STORM CENTERING

CURVE NUMBERS

LAG TIME CALCULATIONS

HYDROLOGIC PARAMETER SUMMARY

HYDROLOGIC ROUTING

HYDROLOGIC MODEL COMPARISONS

HEC-1 MODELS

RFIS-G7.OUT

RFIS-G2.OUT

RFIS-V1.OUT

RFIS-CC.OUT

RFIS-ALL.OUT

BON.OUT

STEW.OUT

NODB.OUT

I. INTRODUCTION

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), under contract with the Clark County Regional Flood Control District (CCRFCD), is preparing a Flood Insurance Restudy of the Range Wash, located within the City of North Las Vegas, and Clark County, Nevada. This hydrologic analysis is presented for review and approval of the 100-year peak flows presented herein.

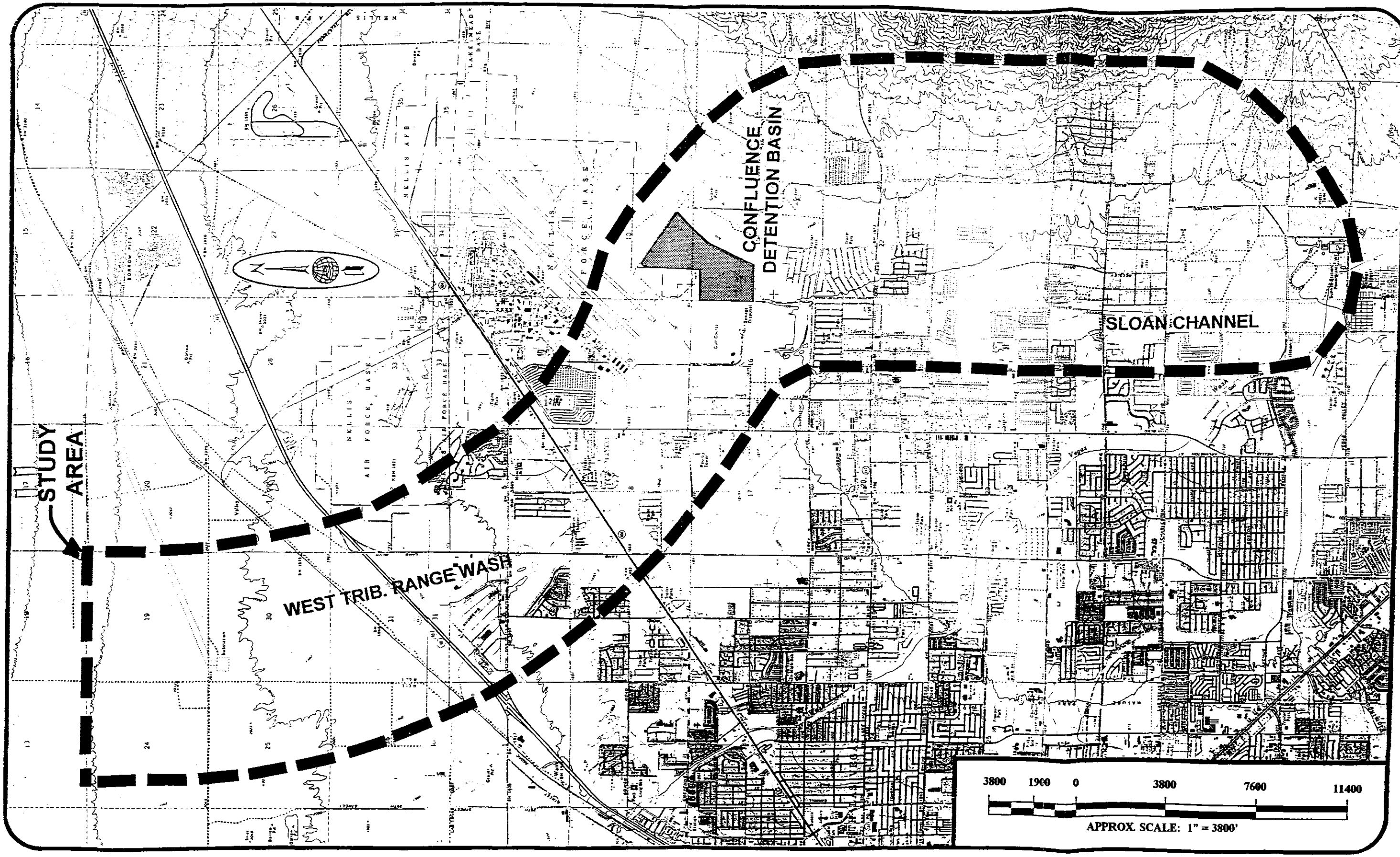
II. PROJECT DESCRIPTION

Figure 1 shows the approximate limits of the study area. **Figure 2** shows a schematic of the Range Wash system. The lower reach of the Range Wash is commonly known as the Sloan Channel. The scope of work for this restudy includes the Western Tributary of the Range Wash and the Sloan Channel. The Eastern Tributary is not included because no significant development is present and no Special Flood Hazard Areas are identified in the area.

The purpose of this restudy is to update the Special Flood Hazard Areas due to two major flood control facilities which reduce the 100-year flow to the Range Wash and Sloan Channel. The two major flood control facilities are the West Range Wash Diversion Dike (completed in 1994) and the Confluence Detention Basin (currently under construction). There are two areas of Flood Zone "A" which are to be evaluated, and reduced or eliminated, as part of this study.

The West Range Wash Diversion Dike, located near the Grand Teton Drive alignment, is the northern boundary of the study area. The dike has reduced the 100-year flow to the Range Wash by diverting upstream flows from a 48 square mile area to the North Las Vegas Detention Basin on the Las Vegas Wash. The North Las Vegas Detention Basin is currently being study by FEMA Region IX. The construction of this facility is expected to impact the Zone "A" area upstream of Las Vegas Boulevard. **Figure 3**, a copy of the DFIRMs, Map Numbers 32003 C 1790 D, 32003 C 2180 D and 332003 C 2176D, for Clark County and Incorporated Areas, effective date August 16, 1995, shows the Flood Zones "A" in this area.

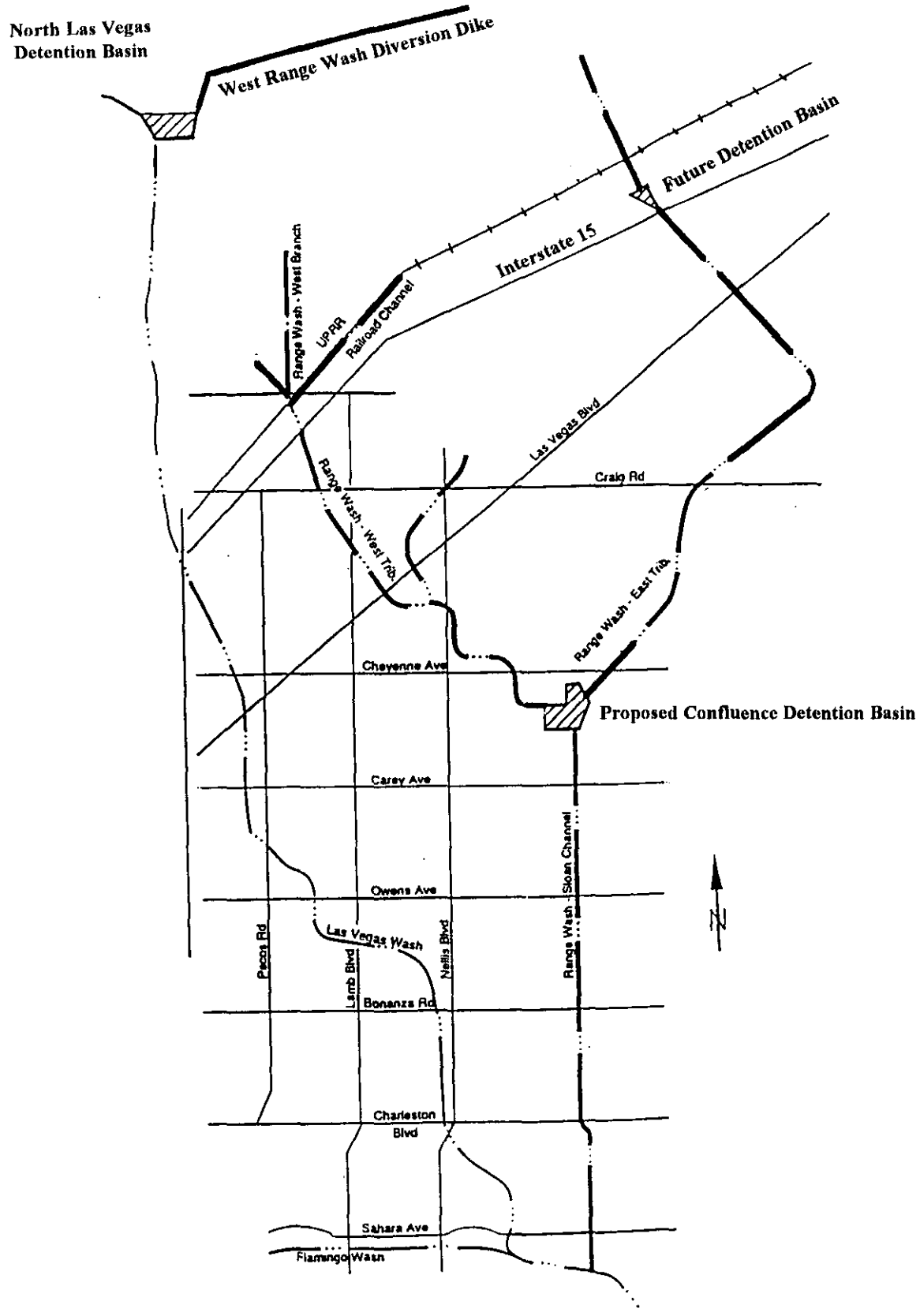
The Confluence Detention Basin, presently under construction, is located upstream of the Sloan Channel reach of the Range Wash system and is expected to reduce the 100-year peak flow to the Sloan Channel. Information on the Confluence Detention Basin is included in the hydrology for this restudy so that a Conditional Letter of Map Revision (CLOMR) may be obtained. **Figure 4**, a copy of the DFIRM, Map Number 32003 C 2200 D, for Clark County and Incorporated Areas, effective date August 16, 1995, shows the Flood Zones "A" associated with the Sloan Channel.



POST, BUCKLEY, SCHUH & JERNIGAN

FIGURE 1

LIMITS OF STUDY AREA



RANGE WASH SYSTEM

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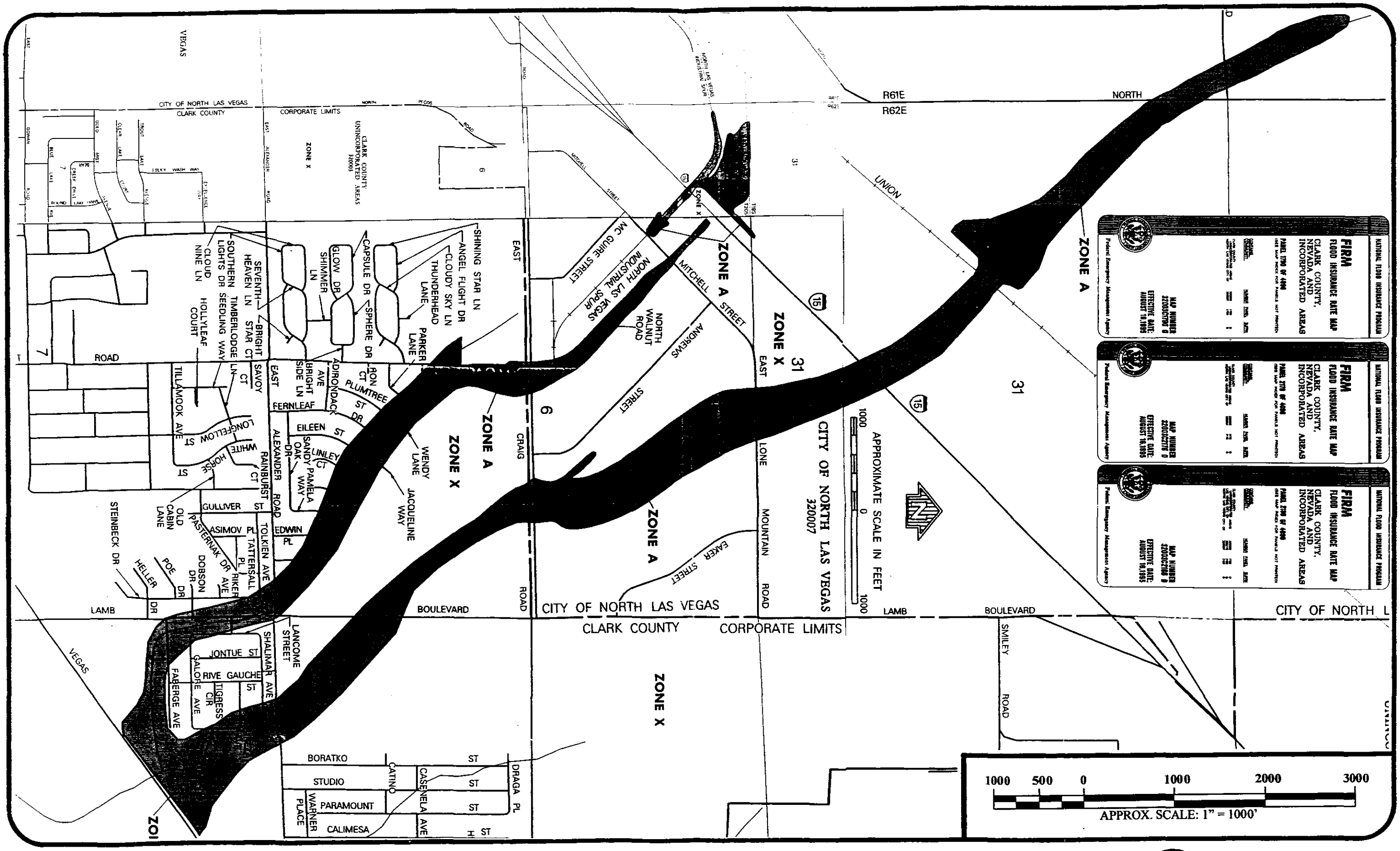
FIGURE 2



DFIRM 1995

UPPER WEST RANGE WASH

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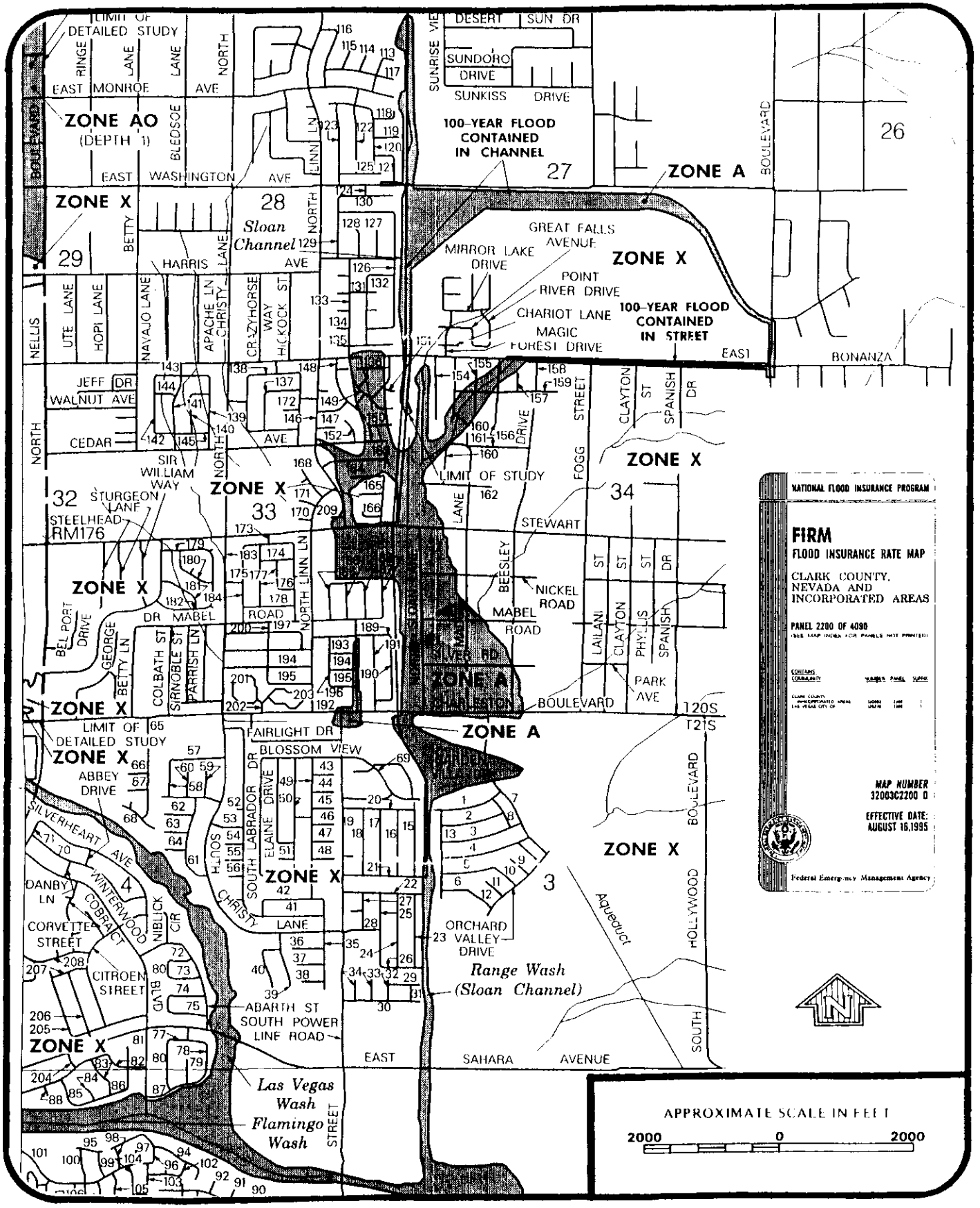
FIGURE 3



DFIRM 1995

LOWER RANGE WASH (SLOAN CHANNEL)

FIGURE 4

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III. HYDROLOGY STUDY METHODOLOGY

This section presents the criteria and methodology used in preparing the hydrologic analysis for the study area. The purpose of the hydrologic analysis is to establish and obtain approval of the 100-year peak flow rates to be used in the hydraulic analysis for floodplain delineation.

A. Previous Hydrology Studies

Previous hydrology studies used as a basis for this model are listed below:

- *Hydrologic Analysis, Western and Eastern Tributaries of Range Wash*, Boyle Engineering, April 1990 (Boyle, 4-90);
- *Final Predesign Memorandum, Confluence Detention Basin and Sloan Channel Improvements*; Boyle Engineering, October 1992 (Boyle, 10-92);
- *Conceptual Master Drainage Study for Lewis Homes - Orchards*; Pentacore Engineering; January 1992 (Pentacore, 1-92).

Hydrology for the Confluence Detention Basin (Boyle, 10-92), is similar to the hydrology for the Western and Eastern Tributaries of Range Wash (Boyle, 4-90), but with modifications to include the Confluence Detention Basin and the future East Range Wash Detention Basin. Hydrology for the Orchards 432-acre community is more detailed than the Confluence Detention Basin hydrology in the area between Charleston Boulevard and Sahara Avenue, as flows at several concentration points and drainage facilities for that development are quantified. The hydrology for this restudy is a modified version of these three models. The modifications include:

- Modeling the Confluence Detention Basin that is currently under construction, but excluding the future East Range Wash Detention Basin.
- Delineating slightly different or additional subbasins, to account for different or additional concentration points;
- Considering new flood control facilities that affect drainage basin boundaries;
- Calculating slightly different basin areas, as basins are digitized from USGS Quadrangles, and areas are computed using Geographical Information Systems (GIS) rather than a planimeter;

- Updating the land use for existing conditions (using recent GIS parcel information and aerial photographs as guides), and calculating some different curve numbers, lag times and flow routes, to account for the new development in some of the basins;

- Using a different method for calculating lag times. The Boyle models used the method presented in the *SCS National Engineering Handbook, Section 4 - Hydrology* (SCS, 1972). This study used methods specified in the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (described in detail in the **Appendix** of this report).

B. Drainage Basins

Figures 5A and **5B** show drainage basins and flow concentration points established for this study. **Figure 5A** is at a scale of 1" = 7500'; **Figure 5B** is at a scale of 1" = 3000' and shows the USGS topography used to delineate the drainage basins. The labeling system for the basins and nodes (flow concentration points) is similar to the systems used in the previous drainage studies. Basins that have been modified are either labeled with an "M" after them (example 44-M) or are given a new name.

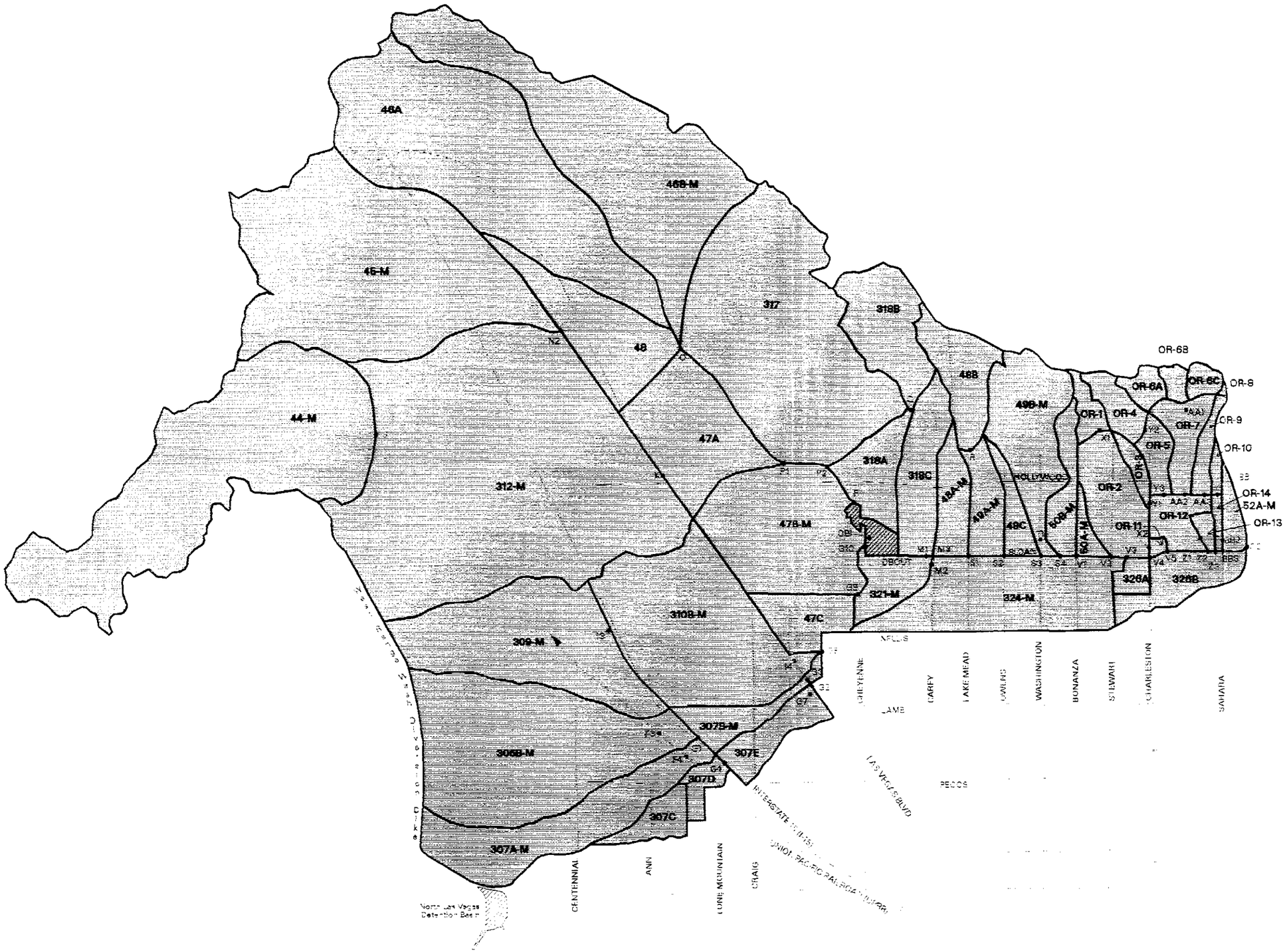
Some of the drainage basins that were significantly changed include those in the western portion of the Range Wash drainage area between the West Range Wash Diversion Dike and Las Vegas Boulevard. Those drainage basins were subdivided to obtain flows at various washes tributary to the Flood Zones "A" along Walnut Road and Vandenberg Drive (shown on **Figure 3**).

Nellis Boulevard is the revised western boundary of the watershed between Las Vegas Boulevard and Charleston Boulevard because Nellis Boulevard intercepts flows from the west. A 30-inch to 96-inch storm drain system in Nellis Boulevard discharges into the Las Vegas Wash at Bonanza Road.

C. Hydrologic Model

The hydrologic model is the HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center. The SCS Dimensionless Unit Hydrograph Method prescribed in the CCRFCD *Hydrologic Criteria and Drainage Design Manual* (CCRFCD Manual) was used to develop hydrographs for each basin. The rainfall, storm centering, runoff loss rate and lag time data in the hydrologic analysis were prepared in accordance with the CCRFCD Manual. The CCRFCD criteria tables used in determining the drainage basin parameters are included in the **Appendix**.

FIGURE 5A: Drainage Basins



LEGEND

Drainage Basins

Detention Basins

Concentration Point ID

49A-M Basin ID

GRAPHIC SCALE

2 1.5 1 0.5 0 1 2

(IN MILES)

SCALE:1 inch = 7500 feet

Figure 5B

See Technical Support Data Notebook
Section 4 - Mapping Information

D. Rainfall

The peak flows to be used in determining floodplains for this Flood Insurance Restudy are those that may be expected during a 100-year rainfall event. In accordance with the CCRFCD Manual, the 100-year recurrence interval storm was based on a single event with a six-hour duration.

The majority of the drainage basins lie within the McCarran Airport Rainfall Area. The 100-year point rainfall values for drainage basins within the McCarran Airport Rainfall Area were obtained from Table 505 in the CCRFCD Manual. Within the McCarran Airport Rainfall Area, the 100-year, six-hour duration adjusted point rainfall is 2.77 inches. Some drainage basins are located partially or totally out of the McCarran Airport Rainfall Area. The point rainfall values for those drainage basins range between 2.77 and 3.00 inches, and were obtained from Figure 506 and Table 501. Figure 506 is an isohyetal map reproduced from the National Oceanic and Atmospheric Administration (NOAA) Atlas 2, "Precipitation - Frequency Atlas of the Western United States, Volume VII - Nevada," dated 1973. Table 501 in the CCRFCD Manual gives precipitation adjustment ratios for the Clark County area used to multiply rainfall data obtained from the NOAA Atlas 2. The adjustment ratios were determined by the U.S. Corps of Engineers, Los Angeles District in 1988. In the Appendix, **Figure A1** shows the 100-year isohyets, and point rainfall values for each basin are summarized on **Table A7** in the **Appendix**.

E. Storm Distribution and Storm Centering

The CCRFCD Manual uses storm distributions established by the Los Angeles District of the Corps of Engineers. For contributing drainage areas less than ten square miles, Storm Distribution 3 (SDN 3) is used. For contributing drainage areas greater than ten square miles, Storm Distribution 5 (SDN 5) is used.

Table 502 in the Clark County Regional Flood Control District Manual gives six-hour depth-area-reduction-factors (DARFs) to be used in centering storms over large drainage areas. Since the NOAA Atlas 2 precipitation depths represent the rainfall frequency at an isolated point, and a storm that extends over a large area typically has more intense rainfall occurring near the center of the storm, a DARF is applied to adjust the point rainfall values downward to represent an average depth of rainfall over the entire storm area. In the **Appendix**, **Table A1** indicates storm centering by summarizing key concentration points, with contributing basin areas and DARFs.

Fourteen different storm centerings for several nodes of interest are modeled. Nine storm centerings are considered for the Flood Zone A area (shown on **Figure 3**) that extends from Las Vegas Boulevard to north of Losee Road. Five storm centerings are considered for the Flood Zone A in the Sloan Channel area (shown on **Figure 4**) that extends from Owens Avenue to the confluence with the Las Vegas Wash near Vegas Valley Drive.

Table 1, in the Section IV, Hydrologic Results portion of this study, describes each node of interest, its contributing drainage area, SDN, DARF, and 100-year peak flow, and indicates which HEC-1 model contains that flow.

F. Runoff Loss Rates

The U.S. Department of Agriculture Soil Conservation Service (SCS) curve number (CN) methodology was used to model rainfall volume losses due to initial wetting, interception, infiltration, depression storage and evapotranspiration. Table 602 in the CCRFCD Manual was the basis for determining composite curve numbers for drainage basins based on soil type and land use. GIS procedures were used to calculate the composite curve numbers by integrating the soils, land use, and drainage basin information.

Soils information was obtained from the Soil Conservation Service (SCS) *Soil Survey of the Las Vegas Valley Area, Nevada*, (1982). Soils information beyond the limits of the published survey were taken from maps included in the *Western and Eastern Tributaries of Range Wash, Flood Control Facility Plan* (Boyle, 1991). Soils information in that study was provided by Clark County Soil Conservation Service personnel. Table 15 in the SCS soil survey, entitled "Soil and Water Features," classifies soils as type A, B, C or D. **Figure A2**, included in the **Appendix**, shows the soils in the area.

Land use, obtained from Geographic Information System (GIS) parcel information and recent aerial photographs, was divided into seven broad categories based on hydrologic characteristics. **Figure A3**, included in the **Appendix**, shows the land use in the area.

Tables A2 and **A3** summarize the curve numbers used for each soil type and land use. **Table A7** summarizes the weighted curve numbers derived for the drainage basins. The methodology for calculating the curve numbers is given in the **Appendix**.

G. Lag Time

Lag times were calculated in accordance with the CCRFCD Manual. For drainage basins with areas less than one square mile, a CCRFCD Standard Form 4 was completed and the time of concentration is calculated. For drainage basins with areas over one square mile, the United States Bureau of Reclamation (USBR) method is used to calculate lag time for use in the SCS Dimensionless Unit Hydrograph Method. Lag time parameters are included in **Tables A5, A6** and **A7**, and equations are included in the **Appendix**.

The average basin slopes were determined using elevations from the USGS 7.5 Minute Topographic Quadrangles. For the Orchards drainage basins, slopes were determined using information from the Orchards hydrology study (Pentacore, 1-92). In determining the watershed length and average slope for drainage basins that begin with steep, mountainous areas, the 15-85 convention used by the Army Corps of Engineers (COE) is used. With this method, the watershed length and slope do not include either the steep mountainous path at the beginning 15+/- percent of the total basin length, or the flattest path of the basin, assumed to start at about 85+/- percent of the total basin length. With this type of situation, the resulting slope taken from the middle portion of the watershed better represents the average basin parameters. Slope calculations for the drainage basins are presented in **Table A4** in the **Appendix**.

H. Hydrologic Routing

The CCRFCD Manual recommends Muskingum routing for channels that are not well-defined, and Kinematic Wave routing for channels that are well-defined. The Muskingum method provides for some of the effects of channel storage, so some runoff attenuation occurs during the routing. The Kinematic Wave method is used for efficient drainage systems, so the hydrograph is translated, but not attenuated. Equations used to determine the parameters used in the Muskingum routing are included in the **Appendix**. The Muskingum parameters are summarized on **Table A8**, and the Kinematic Wave parameters are summarized on **Table A9** in the **Appendix**.

IV. HYDROLOGIC RESULTS

Table 1 summarizes the hydrologic results for this Flood Insurance Restudy by describing each node of interest, its contributing drainage area, SDN and DARF, presenting the 100-year peak flow, and indicating which HEC-1 model contains that flow. Nodes G1, G2, G3, G4, G7, F3 and F4 are the nodes of interest in the Upper West Range Wash Flood Zone A area (shown on **Figure 3**) that extends from Las Vegas Boulevard to north of Losee Road. Nodes DB.IN, V1, V2, 50B-M, STEW, and CC are the nodes of interest in the Lower Range Wash (Sloan Chanel) Flood Zone A area (shown on **Figure 4**) that extends from Owens Avenue to the confluence with the Las Vegas Wash near Vegas Valley Drive.

Hydrologic results show that for the Sloan Channel, the more intense storms that control the peak flow are those centered only on the drainage basins downstream of the Confluence Detention Basin.

The Cibola development (also known as Magnolia Estates) on the southwest corner of Stewart Avenue and the Sloan Channel, is seeking a LOMR for the interim condition, before the detention basin is completed. The Case Number is 95-09-1021C. To accommodate there LOMR application, an HEC-1 model was prepared to determine the existing flow at this site, without the detention basin completed. The flow of 5,030 cfs is less than the previously estimated flow of 5,500 cfs.

Table 1: Hydrologic Results

Flow Node	Node Description	Drainage Area (sq.mi.)	DARF	SDN	HEC-1 Model	100-Yr Peak Flow
G4	Channel at I-15 upstream (U/S) of Walnut	0.83	0.97	3	rfis-g7	320
G7	West branch of Zone A, Craig to LV Blvd.	1.60	0.95	3	rfis-g7	620
F4	12'x 8' RCB at the UPRR	2.52	0.92	3	rfis-g7	530
F3	Two 12'x 20' bridge openings at UPRR	5.53	0.90	3	rfis-g7	1060
G1	Three 15'x 10' RCBs at I-15	8.05	0.88	3	rfis-g7	1470
G3	East branch of Zone A, Craig to LV Blvd.	8.72	0.87	3	rfis-g7	1550
G2	Seven 12'x 6' RCBs at LV Blvd.	10.31	0.86	5	rfis-g2	1540
V1	Sloan Channel at Bonanza Road	7.55	0.88	3	rfis-v1	2570
V3	Sloan Channel downstream of Stewart Avenue	10.78	0.85	5	rfis-cc	2620
V3	Sloan D/S of Stewart w/o det. basin	91.69	0.62	5	nodb	5030
50B-M	Bonanza Road	0.63	0.98	3	bon	320
STEW	Stewart Avenue	3.03	0.92	3	stew	230
CC	Sloan Channel at Las Vegas Wash Confluence	16.22	0.81	5	rfis-cc	4000
CC	Sloan Channel at Las Vegas Wash Confluence	97.89	0.60	5	rfis-all	2990
DB.IN	Confluence Detention Basin	81.68	0.63	5	rfis-all	4180

V. COMPARISON TO PREVIOUS STUDIES

As outlined in the Previous Hydrology Study section of this report, hydrology for this report has been changed from previous reports mainly to account for different or additional flow concentration points, new development and flood control facilities in the existing condition subbasins, and a different method for calculating lag times.

The flowrates determined in this Flood Insurance Restudy are, in general, close to flowrates determined for existing conditions in previous studies, until the Orchards basins are used and flow rates are increased. The difference is mainly due to use of higher rainfall for the Orchards area. **Table A10** in the **Appendix** compares the hydrologic parameters used in the Confluence Detention Basin or Orchards hydrology with the hydrologic parameters used in this Flood Insurance Restudy. Because many subbasins in this Flood Insurance Restudy were changed, a direct comparison of hydrologic parameters could not always be made. In those cases, basin areas and lag times could not be compared, but curve numbers and rainfall could be approximately compared.

VI. BIBLIOGRAPHY

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APPENDIX

HYDROLOGIC PARAMETER DETERMINATION

CCRFCD CRITERIA

RAINFALL AND STORM CENTERING

CURVE NUMBERS

LAG TIME CALCULATIONS

HYDROLOGIC PARAMETER SUMMARY

HYDROLOGIC ROUTING

HYDROLOGIC MODEL COMPARISONS

HEC-1 MODELS

RFIS-G7.OUT

RFIS-G2.OUT

RFIS-V1.OUT

RFIS-CC.OUT

RFIS-ALL.OUT

BON.OUT

STEW.OUT

HYDROLOGIC PARAMETER DETERMINATION

HYDROLOGIC PARAMETER DETERMINATION

A. Curve Numbers

For each soil type, **Table A2** calculates curve numbers (based on CCRFCD Table 602) for open land in its natural condition (Open Natural), and for open land in good condition (Open Good, grass cover greater than 75%). These curve numbers are then used in **Table A3** as land use components. For each soil type, **Table A3** uses three land use components, (Open Natural, Open Good, and Impervious) to calculate curve numbers for seven land use classifications. **Table A3** shows the land use component percentages used for each land use classification. For example, in determining a weighted curve number for a golf course, the area is estimated to be 5% Open Natural, 90% Open Good, and 5% Impervious. A weighted curve number for each drainage basin was calculated, based on the areal components of each drainage basin. Calculations were performed using the GIS capabilities of integrating the digitized drainage basin, soil type and land use information with data from **Table A3**. **Table A7** summarizes the weighted curve numbers derived for the drainage basins.

B. Lag Time

Lag times were calculated in accordance with the CCRFCD Manual. For drainage basins with less than one square mile, a CCRFCD Standard Form 4 was completed and the time of concentration was calculated. For drainage basins with over one square mile, the United States Bureau of Reclamation (USBR) method is used to calculate lag time for use in the Soil Conservation Service (SCS) Dimensionless Unit Hydrograph Method.

The average basin slopes were determined using elevations from the USGS 7.5 Minute Topographic Quadrangles. For the Orchards drainage basins, slopes were determined using information from the Orchards hydrology study (Pentacore, 1-92). Calculations are summarized in **Tables A5** and **A7**.

In determining the watershed length and average slope for drainage basins that begin with steep, mountainous areas, the 15-85 convention used by the Army Corps of Engineers (COE) is used. With this method, the watershed length and slope do not include either the steep mountainous area at the beginning 15+/- percent of the total basin length, or at the flattest part of the basin, assumed to start at about 85+/- percent of the total basin length. With this type of situation, the resulting slope taken from the middle portion of the watershed better represents the average basin parameters. Lag time parameters for these basins are presented in **Tables A6** and **A7**.

1. Upland Method for Small Drainage Basins

For drainage basins with less than one square mile, the time of concentration is calculated as follows:

$$T_c = T_i + T_t$$

Where:

T_c = Time of concentration (minutes)

T_i = Initial, inlet or overland flow time (minutes)

T_t = Travel time in the ditch, gutter, etc.. (minutes)

The Lag time for basins under one square mile is calculated as follows:

$$T_{lag} = 0.6T_c \text{ (hours)}$$

Initial flow time is calculated as follows:

$$T_i = 1.8(1.1 - K)L_o^{1/2}/S^{1/3}$$

Where:

T_i = Initial overland flow time (minutes)

K = $0.0132 * CN - 0.39$

CN = Curve Number

L_o = Length of overland flow (max. 500 ft)

S = Average basin slope (percent)

Travel time is calculated as follows:

$$T_t = L_t/(60\ V)$$

Where:

T_t = Travel time in the ditch, gutter, etc.. (minutes)

L_t = Travel Length (feet)

V = Average velocity of flow (ft/s)

The average velocity was determined using the following equation, which produces results equivalent to CCRFCD Figure 602 for overland flow. The equation is found in *Hydrologic Analysis and Design*, by Richard H. McCuen, 1989. A copy of the reference is included in the CCRFCD Criteria section of this **Appendix**.

$$V = kS^{1/2}$$

Where:

V = Average velocity of flow (ft/s)

S = Average basin slope (percent)

k = A parameter that represents land cover

k	Land Use / Flow Regime
0.70	Short grass pasture (overland flow)
0.90	Cultivated straight row (overland flow)
1.00	Nearly bare and untilled (overland flow)
1.00	Alluvial fans in Western mountain regions
1.50	Grassed waterway
2.00	Paved area (sheet flow)
2.00	Small upland gullies

The CCRFCD Manual states that the time of concentration for the first design point in an urbanized basin using the Upland Method should not exceed the time of concentration calculated using the following equation:

$T_c = L/180 + 10$

Where:

T_c = Time of concentration at the first design point in an urban watershed (minutes)

L = Watershed Length (feet)

The lag time used for each urban drainage basin (with an area less than one square mile) was the lesser of the values obtained using the equations presented above. Calculations for these basins are presented on **Tables A4** and **A5**.

2. United States Bureau of Reclamation Method for Large Drainage Basins

The lag time for basins over one square mile is calculated as follows:

$$T_{lag} = 20\ K_n [L\ (L_c/S^{1/2})]^{1/3}$$

Where:

T_{lag} = Lag time (hours)

L = Watershed Length, length of longest watercourse (miles)

L_c = Length along longest watercourse measured upstream to a point opposite the centroid of the basin (miles)
(Note: Assume Lc is half of L)

S = Average slope of the longest watercourse (feet per mile)

K_n = Manning's roughness for the basin channels

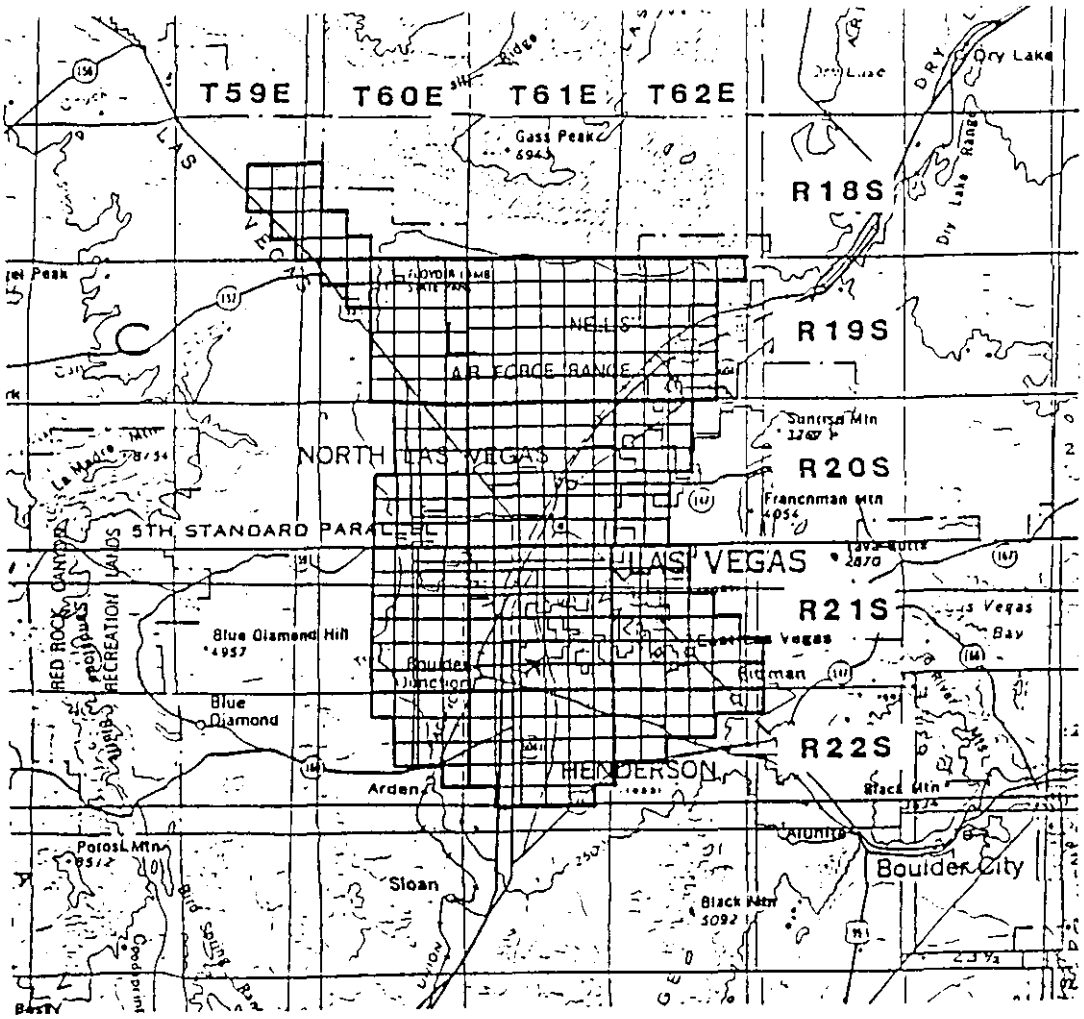
K_n	Water Course Description
0.015	In urbanized areas, streets, storm drains, improved channels
0.030	Well-defined, unimproved channels or washes, minimal vegetation)
0.050	Not well-defined, small rills and braided wash areas
0.050	Mountainous channels with large boulders and flow restrictions

For basins in which several runoff paths are scattered throughout the basin, and there is not one main tributary watercourse, a Manning's roughness of 0.06 is used, as velocities are anticipated to be slower due to runoff being distributed in several paths, instead of in one main watercourse.

USBR Lag calculations for basins over one square mile are presented on **Tables A6** and **A7**.

CCRFCD CRITERIA

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	22 South	62 East	1-10,17-18

Notes:
1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA

(IN INCHES)

	RECURRENCE INTERVAL					
TIME	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

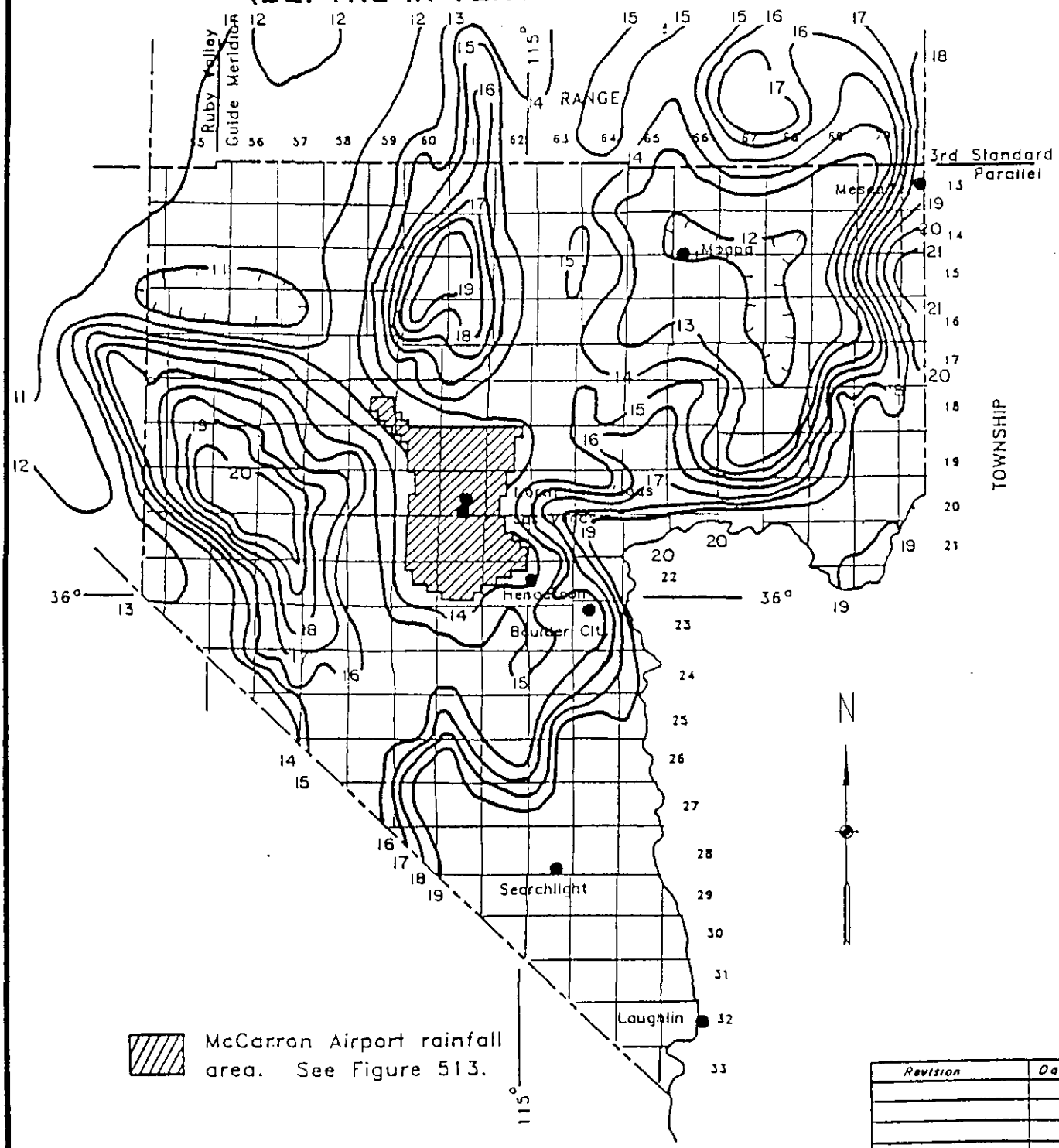
NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.

2. The 24 hour values presented above are for use with TR-55 only.

3. Table 501 adjustments not required.

Revision	Date

RAINFALL DEPTH-DURATION-FREQUENCY
10-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



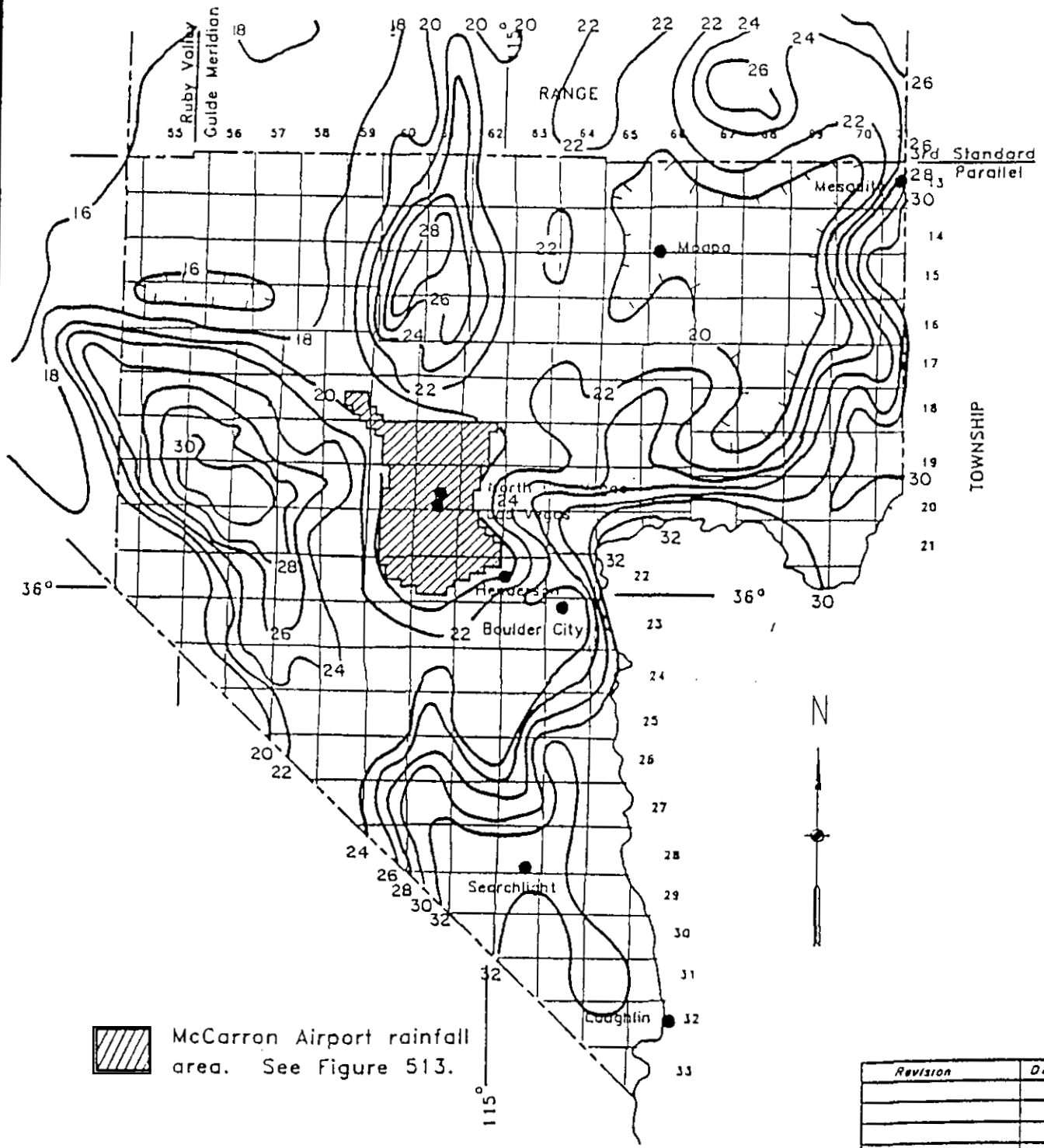
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 503

RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 506

PRECIPITATION ADJUSTMENT RATIOS

Recurrence Interval	Ratio to NOAA Atlas 2
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

NOTE:
1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted, by the above ratios.
3. Tables 505 and 506 require no adjustments.

Revision	Date

SIX HOUR DEPTH-AREA REDUCTION FACTORS

Drainage Area (Square Miles)	Six-Hour Depth-Area Reduction Factor
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

NOTES: 1. A graphical representation of these factors is presented in Figure 514.

2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

Revision	Date

SIX-HOUR STORM DISTRIBUTIONS

Storm Time (In Minutes)	Percent of Total Storm Depth SDN 3	SDN 5	Storm Time (In Minutes)	Percent of Total Storm Depth SDN 3	SDN 5
0	0.00	0.00	185	32.20	43.00
5	2.00	2.00	190	35.20	47.70
10	5.70	5.90	195	40.90	51.40
15	7.00	8.00	200	49.90	56.10
20	8.70	11.00	205	59.00	63.00
25	10.80	14.40	210	71.00	71.00
30	12.40	15.00	215	74.40	72.00
35	13.00	16.00	220	78.10	73.10
40	13.00	16.80	225	81.20	75.20
45	13.00	17.10	230	81.90	77.90
50	13.00	18.00	235	83.50	79.00
55	13.00	18.20	240	85.10	79.50
60	13.00	18.70	245	85.60	80.40
65	13.30	19.00	250	86.00	81.00
70	14.00	19.70	255	86.80	82.00
75	14.20	20.20	260	87.60	82.60
80	14.80	21.00	265	88.80	84.00
85	15.80	22.00	270	91.00	85.90
90	17.20	23.00	275	92.60	88.90
95	18.10	24.10	280	93.70	91.00
100	19.00	25.00	285	95.00	93.80
105	19.70	25.90	290	97.00	96.60
110	19.90	26.50	295	97.60	97.00
115	20.00	28.00	300	98.20	97.40
120	20.10	29.00	305	98.50	97.90
125	20.40	30.00	310	98.70	98.10
130	21.40	30.50	315	98.90	98.30
135	22.90	30.90	320	99.00	98.50
140	24.10	31.00	325	99.30	98.90
145	24.90	31.70	330	99.30	99.00
150	25.10	32.10	335	99.40	99.20
155	25.60	32.70	340	99.50	99.30
160	27.00	33.30	345	99.80	99.60
165	27.80	34.60	350	99.80	99.70
170	28.10	36.10	355	99.90	99.90
175	28.30	38.10	360	100.00	100.00
180	29.50	40.80			

Notes:
1. For drainage areas less than 10 square miles in size, use SDN 3.
2. For drainage areas equal to or greater than 10 square miles in size, use SDN 5.
3. A graphical representation of these values is presented on Figure 515.

Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

TABLE 503

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 603
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figure 603 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

REFERENCE:
SCS TR-55, USDA, June 1986.

Velocities for Upland Method of Estimating Tc

however, given the relatively small drainage areas used in calibrating the models, the coefficients probably reflect significant portions of overland flow travel time.

The SCS Lag Formula. The Soil Conservation Service (SCS) provided an equation for estimating the watershed lag, which was defined as the time in hours from the center of mass of the excess rainfall to the peak discharge; they also indicate that the time of concentration equals 1.67 times the lag. Equation 3-39 is intended for use on watersheds where overland flow dominates and was developed for nonurban watersheds. The SCS recommends that the lag equation be used for homogeneous watersheds 2000 acres and less. Two graphs were provided by SCS in TR-55 (1975) for correcting the lag formula for use in urban areas. One factor is based on the percentage of imperviousness and curve number and the other on the percentage of the hydraulic length modified and the curve number. The method primarily reflects overland flow. The runoff curve number CN can be obtained from Table 7-6.

Velocity Methods. The velocity methods are based on the concept that the travel time (T_t) is a function of the length of flow (L) and the velocity (V):

$$T_t = \frac{L}{V} \tag{3-42}$$

in which T_t, L, and V have units of seconds, feet, and ft/sec, respectively. The travel time is computed for the principal flow path. Where the principal flow path consists of segments that have different slopes or land cover, the principal flow path should be divided into segments and Eq. 3-42 used for each flow segment. The time of concentration is then the sum of the travel times:

$$t_c = \sum_{i=1}^{k} T_{ti} = \sum_{i=1}^{k} \frac{L_i}{V_i} \tag{3-43}$$

in which k is the number of segments and the subscript i refers to the flow segment.

The velocity of Eq. 3-42 is a function of the type of flow (overland, sheet, rill and gully flow, channel flow, pipe flow), the roughness of the flow path, and the slope of the flow path. Some methods also include a rainfall index such as the 2-year, 24-hr rainfall depth. Flow velocities in pipes and open channels can be computed using Manning's equation:

$$V = \frac{1.49}{n} R_h^{2/3} S^{0.5} \tag{3-44}$$

in which V is the velocity (ft/sec), n is the roughness coefficient, R_h is the hydraulic radius (feet), and S is the slope (ft/ft). A number of methods have been developed for estimating the velocity. Overland flow or sheet flow can be estimated using a relationship between the velocity and the slope:

$$V = kS^{0.5} \tag{3-45}$$

in which V is the velocity (ft/sec) and S is the slope (percent). The value of k is a function of the land cover, with values for five land covers (forest, trash fallow, short grass pasture, cultivated, and nearly bare) given in Table 3-12. These are also shown in Fig. 3-13.

TABLE 3-12 Coefficients of velocity versus slope relationship for estimating travel times with the velocity method

k	Land Use/Flow Regime
0.25	Forest with heavy ground litter; hay meadow (overlow flow)
0.50	Trash fallow or minimum tillage cultivation; contour or strip cropped, woodland (overland flow)
0.70	Short grass pasture (overland flow)
0.90	*Cultivated straight row (overland flow)*
1.00	Nearly bare and untilled (overland flow); alluvial fans in western mountain regions
1.50	Grassed waterway
2.00	Paved area (sheet flow); small upland gullies

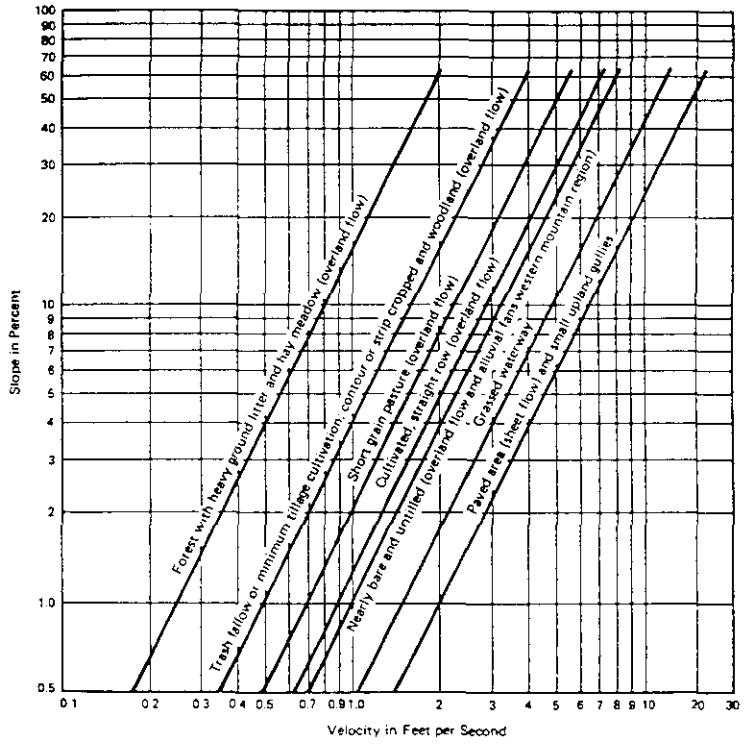
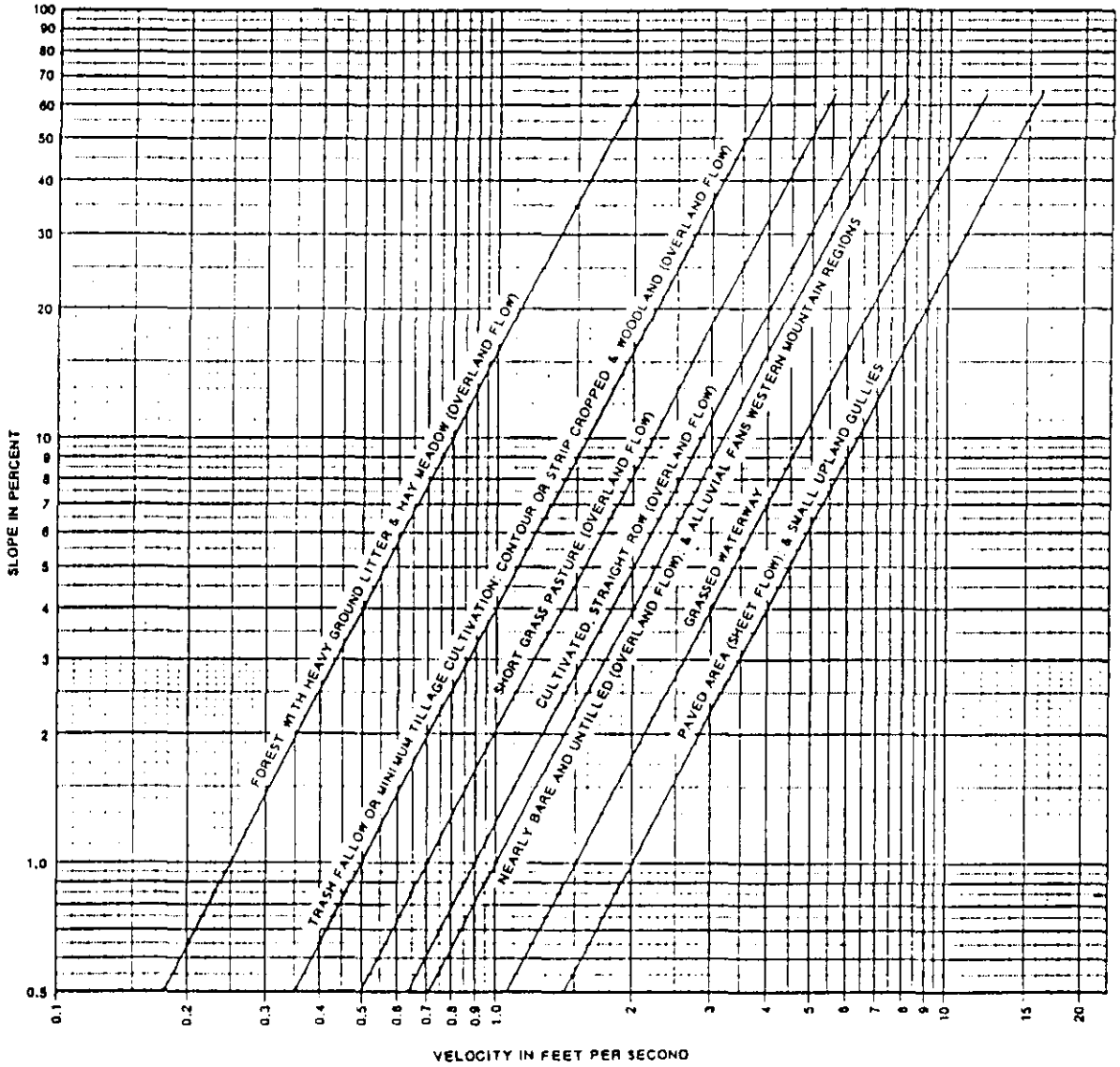


Fig. 3-13 Velocities for upland method of estimating T_0.

Reproduced From: Hydrologic Analysis and Design. Prentice Hall. Richard H. McCuen. 1989.

TRAVEL TIME VELOCITY



Revision	Date

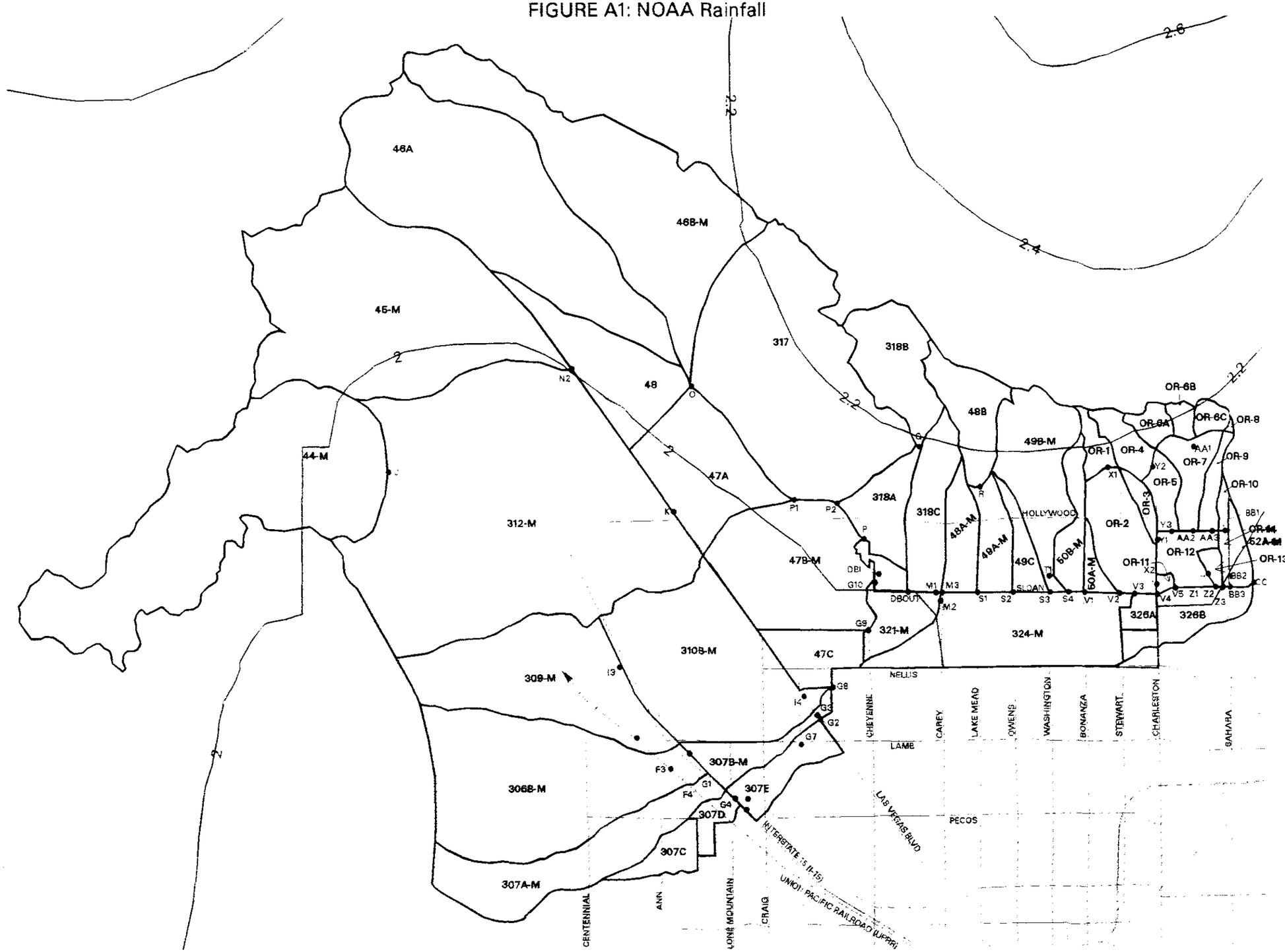
WRC ENGINEERING

REFERENCE: SCS National Engineering Handbook
Section 4, Hydrology, March, 1985

FIGURE 602

RAINFALL AND STORM CENTERING

FIGURE A1: NOAA Rainfall



LEGEND

Mc Carran Airport Rainfall Area

Drainage Basins

2 NOAA Atlas 2, 100-Y 6-H Isohyets (inches)

Concentration Point, ID

49A-M Basin ID

GRAPHIC SCALE

2 1.5 1 0.5 0 1 2

(IN MILES)

SCALE:1 inch = 7500 feet

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A1
STORM CENTERING

Flow Node	HEC-1 Model	Storm Centering Description	Contributing Drainage Basins	Contributing Drainage Area (sq.mi.)	Depth-Area Reduction Factor (DARF)	Storm Distribution Number	100-Year Peak Flow (cfs)
G4	rfis-g7	Channel at I-15 Upstream of Walnut	307C	0.67	0.98	3	180
G5	rfis-g7	UPRR Crossing at I-15	307D	0.92	0.97	3	180
G6	rfis-g7	Flow in Walnut	307C, 307D	1.60	0.95	3	300
G7	rfis-g7	West branch of existing flood zone A	307C, 307D, 307E	2.36	0.93	3	430
F4	rfis-g7	Flow at 12'x8' RCB at UPRR	307A-M	2.52	0.92	3	530
F3	rfis-g7	Flow at (2) 21'x12' bridge openings at UPRR	306B-M	5.53	0.90	3	1060
G1	rfis-g7	Flow at (3) 15'x10' RCBs at I-15	307A-M, 306B-M	8.05	0.88	3	1470
G3	rfis-g7	East branch of existing flood zone A	306B-M, 307A-M, 307B-M	8.72	0.87	3	1550
G2	rfis-g2	Existing flood zone A at Las Vegas Blvd.	307C, 307D, 307E 306B-M, 307A-M, 307B-M	11.08	0.85	5	1530

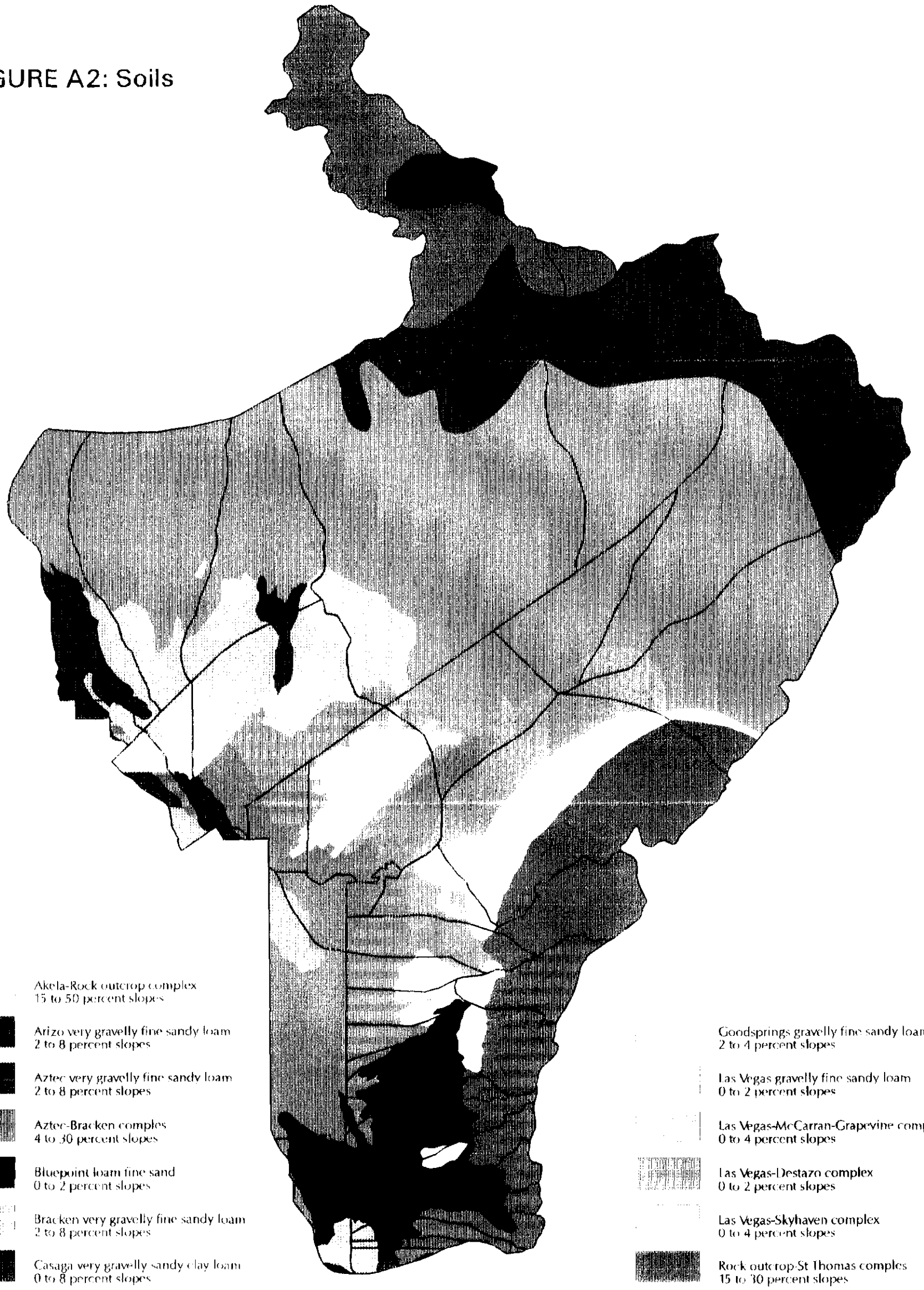
RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A1
STORM CENTERING

Flow Node	HEC-1 Model	Storm Centering Description	Contributing Drainage Basins	Contributing Drainage Area (sq.mi.)	Depth-Area Reduction Factor (DARF)	Storm Distribution Number	100-Year Peak Flow (cfs)
V1	**rfis-v1**	For basins downstream of Confluence Detention Basin, flow at Sloan Channel and Bonanza Road	318C, 321-M, 48A-M, 48B, 49A-M, 49C, 49B-M, 50B-M	7.55	**0.88**	**3**	**2490**
V2	**rfis-cc**	For basins downstream of Confluence Detention Basin, flow at Sloan Channel downstream of Stewart Avenue	318C, 321-M, 48A-M, 48B, 49A-M, 49C, 49B-M, 50B-M, 50A-M, 324-M	10.78	**0.85**	**5**	**2370**
CC	**rfis-cc**	For basins downstream of Confluence Detention Basin, flow at the Sloan Channel & Las Vegas Wash Confluence	318C, 321-M, 48A-M, 48B, 49A-M, 49C, 49B-M, 50B-M, 50A-M, 324-M 326A, OR-1 thru OR-14, 326B, 52A-M	17.11	**0.81**	**5**	**4030**
CC	**rfis-all**	For all basins, flow at the Sloan Channel & Las Vegas Wash Confluence	All Basins	98.79	**0.60**	**5**	**3100**
DB.IN	**rfis-all**	For basins upstream of the Confluence Detention Basin	306B-M, 307A-M, 307B-M, 307C, 307D, 307E, 390-M, 310B-M, 47C, 47B-M, 44-M, 312-M, 45-M, 48, 46A, 46B-M, 47A, 317, 318B,318A, CON-DET	81.68	**0.63**	**5**	**4180**

CURVE NUMBERS

FIGURE A2: Soils



Akela-Rock outcrop complex
15 to 50 percent slopes

Arizo very gravelly fine sandy loam
2 to 8 percent slopes

Aztec very gravelly fine sandy loam
2 to 8 percent slopes

Aztec-Bracken complex
4 to 30 percent slopes

Bluepoint loam fine sand
0 to 2 percent slopes

Bracken very gravelly fine sandy loam
2 to 8 percent slopes

Casaga very gravelly sandy clay loam
0 to 8 percent slopes

Caliza very gravelly sandy loam
2 to 8 percent slopes

Glencarb silt loam

Glencarb silt loam, flooded

Glencarb silty clay loam, wet

Glencarb very fine sandy loam, saline

Glencarb

Goodsprings gravelly fine sandy loam
2 to 4 percent slopes

Las Vegas gravelly fine sandy loam
0 to 2 percent slopes

Las Vegas-McCarran-Grapevine complex
0 to 4 percent slopes

Las Vegas-Destazo complex
0 to 2 percent slopes

Las Vegas-Skyhaven complex
0 to 4 percent slopes

Rock outcrop-St Thomas complex
15 to 30 percent slopes

Rock outcrop, limestone

Skyhaven very fine sandy loam
0 to 4 percent slopes

Urban land

Weiser extremely gravelly fine sandy loam
2 to 8 percent slopes

Weiser-Aztec complex
2 to 8 percent slopes

Weiser-Goodsprings complex
2 to 4 percent slopes

N
W E
S

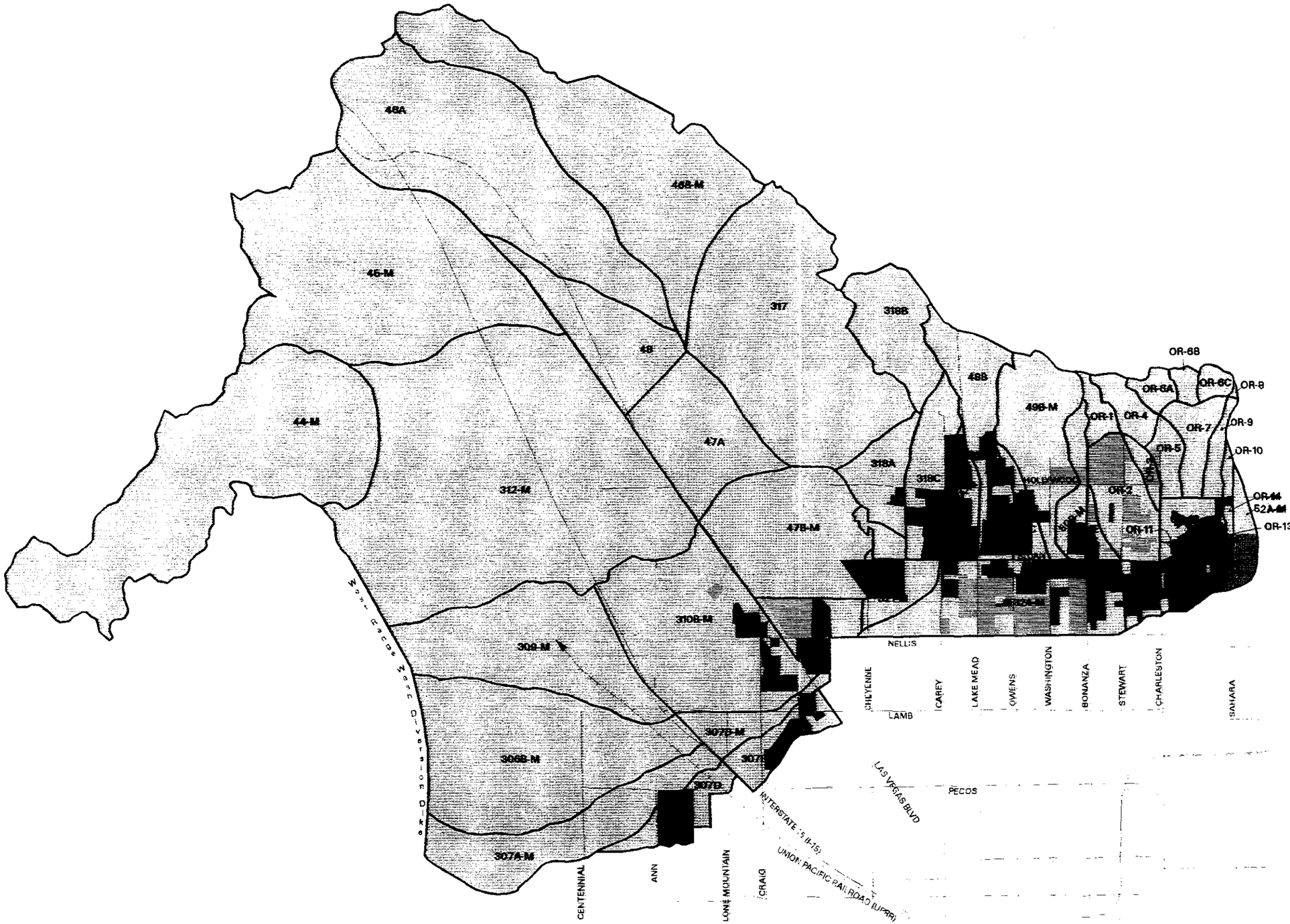
GRAPHIC SCALE

2 1.5 1 0.5 0 1 2

(IN MILES)

SCALE 1:90,000

FIGURE A3: Land Use



LEGEND

LAND USE CLASSIFICATION

- Parks/Golf Courses
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial/Industrial/ Public Facility
- Open - Desert Shrubs
- Open - Heavy Brush

Drainage Basins

49A-M Basin ID

GRAPHIC SCALE

2 1.5 1 0.5 0 1 2

(IN MILES)

SCALE:1 inch = 7500 feet

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A2

CURVE NUMBER CALCULATIONS FOR OPEN AREAS

SOIL MAP SYMBOL	SOIL COMPLEX NAME	COMPONENT SOIL NAMES	HYDRO-LOGIC GROUP	% OF TOTAL	CURVE NUMBERS							
					DESERT SHRUB						LAWNS-LANDSCAPED	
					POOR		FAIR		POOR TO FAIR	USED	GOOD	
					PART	SUM	PART	SUM	AVERAGE		PART	SUM
117	ARIZO	ARIZO	A	90	63	56.7	55	49.5			39	35.1
		AZTEC	B	5	77	3.85	72	3.6			61	3.05
		PITTMAN	C	5	85	4.25	81	4.05			74	3.7
						64.8		**57.15**	**61.0**	**61**		**41.85**
127	BLUEPOINT	BLUEPOINT	A	90	63	56.7	55	49.5			39	35.1
		CALIZA	B	5	77	3.85	72	3.6			61	3.05
		KNOB HILL	B	5	77	3.85	72	3.6			61	3.05
						64.4		**56.7**	**60.6**	**57**		**41.2**
132	BRACKEN	BRACKEN	A	90	63	56.7	55	49.5			39	35.1
		MCCARRAN	B	5	77	3.85	72	3.6			61	3.05
		GRAPEVINE	B	5	77	3.85	72	3.6			61	3.05
						64.4		**56.7**	**60.6**	**57**		**41.2**
140	CASAGA	CASAGA	C	85	85	72.25	81	68.85			74	62.9
		BRACKEN	A	10	63	6.3	55	5.5			39	3.9
		WEISER	B	5	77	3.85	72	3.6			61	3.05
						82.4		**77.95**	**80.2**	**80**		**69.85**
184	CALIZA	CALIZA	B	95	77	73.15	72	68.4			61	57.95
		AZTEC	B	5	77	3.85	72	3.6			61	3.05
						77		**72**	**74.5**	**75**		**61**
200	GLENCARB	GLENCARB	B	85	77	65.45	72	61.2			61	51.85
222		LAND	B	9	77	6.93	72	6.48			61	5.49
228		BLUEPOINT	A	3	63	1.89	55	1.65			39	1.17
		MCCARRAN	B	3	77	2.31	72	2.16			61	1.83
						76.58		**71.49**	**74.0**	**72**		**60.34**

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A2

CURVE NUMBER CALCULATIONS FOR OPEN AREAS

SOIL MAP SYMBOL	SOIL COMPLEX NAME	COMPONENT SOIL NAMES	HYDRO-LOGIC GROUP	% OF TOTAL	CURVE NUMBERS							
					DESERT SHRUB						LAWNS-LANDSCAPED	
					POOR		FAIR		POOR TO FAIR	USED	GOOD	
					PART	SUM	PART	SUM	AVERAGE		PART	SUM
236	GLENCARB	GLENCARB	B	85	77	65.45	72	61.2			61	51.85
		LAND	B	10	77	7.7	72	7.2			61	6.1
		MCCARRAN	B	5	77	3.85	72	3.6			61	3.05
						77		**72**	**74.5**	**72**		**61**
240	GOODSPRINGS	GOODSPRINGS	D	95	88	83.6	86	81.7			80	76
		JEAN	A	5	63	3.15	55	2.75			39	1.95
						86.75		**84.45**	**85.6**	**87**		**77.95**
300	LAS VEGAS	LAS VEGAS	D	90	88	79.2	86	77.4			80	72
		DESTAZO	B	5	77	3.85	72	3.6			61	3.05
		GRAPEVINE	B	5	77	3.85	72	3.6			61	3.05
						86.9		**84.6**	**85.8**	**87**		**78.1**
302	LAS VEGAS-MCCARRAN-GRAPEVINE	LAS VEGAS	D	40	88	35.2	76	30.4			80	32
		MCCARRAN	B	25	77	19.25	72	18			61	15.25
		GRAPEVINE	B	20	77	15.4	72	14.4			61	12.2
		BADLAND	D	5	88	4.4	86	4.3			80	4
		BLUEPOINT	A	5	63	3.15	55	2.75			39	1.95
		BRACKEN	A	5	63	3.15	55	2.75			39	1.95
						80.55		**72.6**	**76.6**	**80**		**67.35**
305	LAS VEGAS-DESTAZO	LAS VEGAS	D	60	88	52.8	86	51.6			80	48
		DESTAZO	B	25	77	19.25	72	18			61	15.25
		BLUEPOINT	A	5	63	3.15	55	2.75			39	1.95
		GLENCARB	B	5	77	3.85	72	3.6			61	3.05
		SKYHAVEN	C	5	85	4.25	81	4.05			74	3.7
						83.3		**80**	**81.7**	**83**		**71.95**

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A2

CURVE NUMBER CALCULATIONS FOR OPEN AREAS

SOIL MAP SYMBOL	SOIL COMPLEX NAME	COMPONENT SOIL NAMES	HYDRO-LOGIC GROUP	% OF TOTAL	CURVE NUMBERS							
					DESERT SHRUB						LAWNS-LANDSCAPED	
					POOR		FAIR		POOR TO FAIR	USED	GOOD	
					PART	SUM	PART	SUM	AVERAGE		PART	SUM
307	LAS VEGAS-SKYHAVEN	LAS VEGAS	D	60	88	52.8	86	51.6			80	48
		SKYHAVEN	C	30	85	25.5	81	24.3			74	22.2
		WEISER	B	10	77	7.7	72	7.2			61	6.1
						86		**83.1**	**84.6**	**84**		**76.3**
360	ROCK-ST. THOMAS	ROCK	D	50	90	45	89	44.5				
		ST. THOMAS	D	35	88	30.8	86	30.1				
		WEISER	B	10	77	7.7	75	7.5				
		BRACKEN	A	5	63	3.15	55	2.75				
						86.65		**84.85**	**85.8**	**87**		**87**
380	SKYHAVEN	SKYHAVEN	C	85	85	72.25	81	68.85			74	62.9
		DESTAZO	B	5	77	3.85	72	3.6			61	3.05
		GLENCARB	B	5	77	3.85	72	3.6			61	3.05
		LAS VEGAS	D	5	88	4.4	86	4.3			80	4
						84.35		**80.35**	**82.4**	**82**		**73**
415	AZTEC	AZTEC	B	90	77	69.3	72	64.8			61	54.9
		BRACKEN	B	5	77	3.85	72	3.6			61	3.05
		CALIZA	B	5	77	3.85	72	3.6			61	3.05
						77		**72**	**74.5**	**77**		**61**
419	AZTEC-BRACKEN	AZTEC	B	55	77	42.35	72	39.6			61	33.55
		BRACKEN	B	30	77	23.1	72	21.6			61	18.3
		ARIZO	A	5	63	3.15	55	2.75			39	1.95
		GOODSPRINGS	D	10	88	8.8	86	8.6			80	8
						77.4		**72.55**	**75.0**	**77**		**61.8**

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A2

CURVE NUMBER CALCULATIONS FOR OPEN AREAS

SOIL MAP SYMBOL	SOIL COMPLEX NAME	COMPONENT SOIL NAMES	HYDRO-LOGIC GROUP	% OF TOTAL	CURVE NUMBERS							
					DESERT SHRUB						LAWNS-LANDSCAPED	
					POOR		FAIR		POOR TO FAIR	USED	GOOD	
					PART	SUM	PART	SUM	AVERAGE		PART	SUM
510	AKELA-ROCK	AKELA	D	55	88	48.4	86	47.3				
		ROCK	D	35	90	31.5	89	31.15				
		CANUTIO	B	10	77	7.7	72	7.2				
						87.6		**85.65**	**86.6**	**88**		**88**
540	WEISER	WEISER	B	85	77	65.45	72	61.2			61	51.85
		GOODSPRINGS	D	10	88	8.8	86	8.6			80	8
		ARIZO	A	5	63	3.15	55	2.75			39	1.95
						77.4		**72.55**	**75.0**	**73**		**61.8**
542	WEISER-AZTEC	WEISER	B	55	77	42.35	72	39.6			61	33.55
		AZTEC	B	30	77	23.1	72	21.6			61	18.3
		GOODSPRINGS	D	10	88	8.8	86	8.6			80	8
		ARIZO	A	5	63	3.15	55	2.75			39	1.95
						77.4		**72.55**	**75.0**	**77**		**61.8**
545	WEISER-GOODSPRINGS	WEISER	B	60	77	46.2	72	43.2			61	36.6
		GOODSPRINGS	D	25	88	22	86	21.5			80	20
		SKYHAVEN	C	10	85	8.5	81	8.1			74	7.4
		LAS VEGAS	D	5	88	4.4	86	4.3			80	4
						81.1		**77.1**	**79.1**	**81**		**68**
540	URBAN	URBAN	C	100	85	85	81	81			74	74
						85		**81**	**83.0**	**83**		**74**
635	ROCK	ROCK	D	100	90	90	86	86				
						90		**86**	**88.0**	**90**		**90**

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A3

SOIL COMPLEX - LAND USE CURVE NUMBER MATRIX

MAP #	SOIL NAME	LAND USE COMPONENTS			LAND USE CLASSIFICATIONS						
		OPEN NATURAL	OPEN GOOD	IMPER-VIOUS	GOLF	LDR	MDR	HDR	COM	DESERT	BRUSH
		% —>			5	35	0	0	5	100	100
			% —>		90	40	62	35	20	0	0
				% —>	5	25	38	65	75	0	0
117	ARIZO	61	42	98	46	63	63	78	85	61	N/A
127	BLUEPOINT	57	41	98	45	61	63	78	85	57	N/A
132	BRACKEN	57	41	98	45	61	63	78	85	57	N/A
140	CASAGA	80	70	98	72	81	81	88	92	80	N/A
184	CALIZA	75	61	98	64	75	75	85	89	75	N/A
200	GLENCARB	72	60	98	63	74	74	85	89	72	67
206	GLENCARB	72	60	98	63	74	74	85	89	72	67
222	GLENCARB	72	60	98	63	74	74	85	89	72	67
228	GLENCARB	72	60	98	63	74	74	85	89	72	67
236	GLENCARB	74	61	98	64	75	75	85	89	74	N/A
240	GOODSPRINGS	87	78	98	79	86	86	91	93	87	N/A
300	LAS VEGAS	87	78	98	79	86	86	91	93	87	N/A
302	LAS VEGAS-MCCARRAN-GRAPEVINE	80	67	98	69	79	79	87	91	80	N/A
305	LAS VEGAS-DESTAZO	83	72	98	74	82	82	89	92	83	N/A
307	LAS VEGAS-SKYHAVEN	84	76	98	78	84	84	90	93	84	N/A
360	ROCK-ST. THOMAS	87	87	98	88	90	91	94	95	87	N/A
380	SKYHAVEN	82	73	98	75	82	83	89	92	82	N/A
415	AZTEC	77	61	98	64	76	75	85	90	77	N/A
419	AZTEC BRACKEN	77	62	98	65	76	76	85	90	77	N/A
510	AKELA-ROCK	88	88	98	89	91	92	95	96	88	N/A
540	WIESER	73	62	98	64	75	76	85	90	73	N/A
542	WEISER-AZTEC	77	62	98	65	76	76	85	90	77	N/A
545	WIESER-GOODSPRINGS	81	68	98	70	80	79	88	91	81	N/A
615	URBAN	83	74	98	76	83	83	90	92	83	N/A
635	ROCK	90	90	98	90	92	93	95	96	90	N/A

CLASSIFICATION	LAND USE DESCRIPTION
GOLF	GOLF COURSES, PARKS, LAWNS IN GOOD CONDITION
LDR	LOW DENSITY RESIDENTIAL
MDR	MEDIUM DENSITY RESIDENTIAL
HDR	HIGH DENSITY RESIDENTIAL
COM	COMMERCIAL, INDUSTRIAL, NON-PARK PUBLIC FACILITIES
DESERT	OPEN UNDEVELOPED DESERT LAND
BRUSH	OPEN UNDEVELOPED THICK BRUSH

LAG TIME CALCULATIONS

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A4.1

TIME OF CONCENTRATION SLOPES

DETERMINE SLOPE FOR DRAINAGE BASINS FOR USE IN THE TIME OF CONCENTRATION CALCULATIONS

Basin Name	*Representative* Reach Length (L) (Feet)	*Representative* Reach Length (L) (Miles)	*Beginning* Elevation of Path (Feet)	*Ending* Elevation of Path (Feet)	Average Slope (Ft/Ft)	Average Slope (%)
47C	8400	1.591	1855	1820	0.004	0.4
48A-M	12500	2.367	2200	1790	0.033	3.3
49A-M	10500	1.989	2010	1780	0.022	2.2
49C	11000	2.083	2120	1770	0.032	3.2
50B-M	8000	1.515	2200	1774	0.053	5.3
50A-M	6500	1.231	1860	1740	0.018	1.8
52A-M	7000	1.326	1860	1700	0.023	2.3
307B-M	12500	2.367	1950	1845	0.008	0.8
307C	11700	2.216	2045	1915	0.011	1.1
307D	6500	1.231	1980	1915	0.010	1.0
307E	9000	1.705	1920	1850	0.008	0.8
318A	8200	1.553	2060	1825	0.029	2.9
321-M	8000	1.515	1830	1795	0.004	0.4
326A	5200	0.985	1745	1730	0.003	0.3
326B	12000	2.273	1745	1700	0.004	0.4
CON-DET	5000	0.947	1825	1810	0.003	0.3
OR-11	1800	0.341	1730	1725	0.003	0.3

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A4.2

LAG TIME SLOPES

DETERMINE SLOPES FOR DRAINAGE BASINS FOR USE IN THE LAG TIME CALCULATIONS

Basin Name	Representative Reach Length (L) (Feet)	Representative Reach Length (L) (Miles)	Beginning Elevation of Path (Feet)	Ending Elevation of Path (Feet)	Average Slope (Ft/Ft)	Average Slope (%)
44-M	24000	4.545	3800	2600	0.050	5.0
45-M	28000	5.303	2800	2060	0.026	2.6
46A	34200	6.477	2520	1930	0.017	1.7
46B-M	35000	6.629	2400	1915	0.014	1.4
47A	14000	2.652	1935	1840	0.007	0.7
47B-M	16800	3.182	1895	1815	0.005	0.5
48	17700	3.352	2245	1915	0.019	1.9
48B	11800	2.235	2880	2010	0.074	7.4
49B-M	17700	3.352	3860	1765	0.118	11.8
306B-M	21600	4.091	2360	1925	0.020	2.0
307A-M	25000	4.735	2255	1925	0.013	1.3
309-M	19500	3.693	2365	1950	0.021	2.1
310B-M	19800	3.750	2025	1845	0.009	0.9
312-M	28800	5.455	2420	1900	0.018	1.8
317	21000	3.977	2200	1840	0.017	1.7
318B	11000	2.083	2600	2100	0.045	4.5
318C	10000	1.894	2100	1820	0.028	2.8
324-M	23500	4.451	1835	1740	0.004	0.4
OR-2	12000	2.273	2060	1730	0.028	2.8

ESTIMATION OF AVERAGE TRAVEL TIME VELOCITY

For LAG Calculation of Smaller Subbasins

TABLE A5.1

BASIN NAME	AREA (sq. mi)	LENGTH (ft)	SLOPE (ft/ft)	ROUGH. COEF.	EST. FLOW (cfs)	VELOCITY				
						DAWDY sing. chan. (fps)	FEMA mult. chan. (fps)	USBR (fps)	SCS CURVE (fps)	SELECTED (fps)
47C	0.856	8,400	0.0040	0.02	220	3.86	3.01	5.36	1.26	5.36
48A-M	0.715	12,500	0.0330	0.02	270	4.02	5.96	8.69	3.63	5.96
49A-M	0.693	10,500	0.0220	0.02	170	3.66	4.72	7.66	2.97	4.72
49C	0.426	11,000	0.0320	0.02	80	3.15	4.41	8.27	3.58	4.41
50B-M	0.628	12,500	0.0530	0.02	200	3.78	6.39	9.39	4.60	6.39
50A-M	0.207	6,500	0.0180	0.02	40	2.74	3.14	6.29	2.68	3.14
52A-M	0.286	7,000	0.0230	0.07	40	2.74	1.59	1.92	1.52	1.59
307B-M	0.677	12,500	0.0080	0.05	170	3.66	2.01	2.75	0.89	2.01
307C	0.503	7,200	0.0110	0.05	110	3.36	1.99	2.40	1.05	1.99
307E	0.766	9,000	0.0080	0.05	180	3.70	2.04	2.46	0.89	2.46
318A	0.940	8,200	0.0280	0.07	350	4.23	2.85	2.09	1.67	2.09
321M	0.691	8,000	0.0040	0.07	40	2.74	0.94	1.51	0.63	0.94
326A	0.231	5,200	0.0030	0.02	80	3.15	2.17	4.34	1.10	2.17
326B	0.907	12,000	0.0040	0.07	200	3.78	1.39	1.73	0.63	1.73
CON-D	0.249	5,000	0.0030	0.05	60	2.97	1.17	1.71	0.55	1.17
0R-1	0.279	5,500	0.3400	0.07	300	4.10	5.80	2.76	5.83	5.80
OR-3	0.205	6,000	0.0390	0.05	80	3.15	2.70	2.78	1.97	2.70
OR-4	0.448	8,500	0.2100	0.07	340	4.21	5.17	2.95	4.58	5.17
OR-5	0.373	6,500	0.0370	0.05	100	3.29	2.80	2.83	1.92	2.80
OR-6A	0.264	3,700	0.3100	0.07	280	4.05	5.55	2.37	5.57	5.55
OR-6B	0.160	3,200	0.1800	0.07	180	3.70	4.24	2.07	4.24	4.24
OR-6C	0.191	3,500	0.1100	0.07	180	3.70	3.66	1.96	3.32	3.66
OR-7	0.613	7,500	0.0310	0.05	140	3.52	2.88	2.89	1.76	2.88
OR-8	0.017	1,300	0.0380	0.05	8	1.99	1.54	1.65	1.95	1.54
OR-9	0.278	8,000	0.0310	0.05	60	2.97	2.35	2.95	1.76	2.35
OR-10	0.098	4,000	0.0340	0.07	30	2.59	1.67	1.69	1.84	1.67
OR-11	0.040	1,800	0.0030	0.02	12	2.16	1.37	3.03	1.10	1.37
OR-12	0.525	6,250	0.0100	0.02	120	3.42	3.43	5.64	2.00	3.43
OR-13	0.120	3,450	0.0040	0.02	70	3.07	2.29	3.96	1.26	2.29
OR-14	0.094	4,100	0.0150	0.02	20	2.39	2.52	5.22	2.45	2.52

SELECTION CRITERIA: USBR Equation used for basins larger thna 1 sq. mile; Use also for basin approximately 1 sq. mile - basins greater than .75 sq. miles

FEMA multiple channel equation accounts for slope and roughness coefficient. Dawdy equation assumes critical flow. Use FEMA equation for basins less than .75 sq. miles. Subbasin flow is typically shallow with multiple collectors and subcritical.

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No.: 51804

RANGE WASH FLOOD INSURANCE RESTUDY

Existing Drainage Condition Basins

(Portions of Data obtained from the Orchards Hydrology, *Pentacore, 1992*)

DATE: December 8, 1995
FILE: excel\804\stdform4.xls
CALCULATED BY: Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA (acres) (3)	AREA (sq.mi.)	LENGTH (ft) (4)	SLOPE (%) (5)	T_i (min) (6)	LENGTH (ft) (7)	SLOPE (%) (8)	VELOCITY (fps) (9)	T_t (min) (10)	$T_c = T_i + T_t$ (min) (11)	TOTAL LENGTH (ft) (12)	$T_c = (L/180)+10$ (min) (13)	(min) (14)	$T_{lag}= 0.6T_c/60$ (hrs)	Point Rainfall 100-yr (inches)
OR-1	88	0.772	178.6	0.279	500	40.0	3.9	5000	34.0	5.80	14.4	18.2	5500	NA	18.2	0.18	3.00
OR-3	82	0.692	131.4	0.205	500	10.0	7.6	5500	3.9	2.70	34.0	41.6	6000	NA	41.6	0.42	3.00
OR-4	87	0.758	286.4	0.448	500	56.0	3.6	8000	21.0	5.17	25.8	29.4	8500	NA	29.4	0.29	3.00
OR-5	77	0.626	238.5	0.373	500	14.0	7.9	6000	3.7	2.80	35.7	43.6	6500	NA	43.6	0.44	3.00
OR-6A	88	0.772	169.1	0.264	500	52.0	3.5	3200	31.0	5.55	9.6	13.2	3700	NA	13.2	0.13	3.00
OR-6B	89	0.785	102.1	0.160	500	52.0	3.4	2700	18.0	4.24	10.6	14.0	3200	NA	14.0	0.14	3.00
OR-6C	87	0.758	122.1	0.191	500	37.0	4.1	3000	11.0	3.66	13.7	17.8	3500	NA	17.8	0.18	3.00
OR-7	77	0.626	392.0	0.613	500	12.0	8.3	7000	3.1	2.88	40.5	48.8	7500	NA	48.8	0.49	3.00
OR-8	77	0.626	10.8	0.017	500	8.0	9.5	800	3.8	1.54	8.7	18.2	1300	NA	18.2	0.18	3.00
OR-9	77	0.626	177.6	0.278	500	4.0	12.0	7500	3.1	2.35	53.2	65.2	8000	NA	65.2	0.65	3.00
OR-10	77	0.626	62.9	0.098	500	7.0	10.0	3500	3.4	1.67	34.9	44.9	4000	NA	44.9	0.45	3.00
OR-11	75	0.600	25.4	0.040	100	0.5	11.3	1700	0.4	1.37	20.7	32.0	1800	20.0	20.0	0.20	2.93
OR-12	76	0.613	335.9	0.525	100	1.0	8.8	6150	1.0	3.43	29.9	38.6	6250	44.7	38.6	0.39	2.93
OR-13	84	0.719	77.0	0.120	100	1.0	6.9	3350	0.4	2.29	24.4	31.2	3450	29.2	29.2	0.29	2.93
OR-14	75	0.600	60.0	0.094	500	0.5	25.3	3600	1.5	2.52	23.8	49.2	4100	32.8	32.8	0.33	2.93

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)

$K = 0.0132\,(CN) - 0.39$

REFERENCE: ***Hydrologic Analysis and Design***, Prentice Hall, Richard H. McCuen, 1989.

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STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

RANGE WASH FLOOD INSURANCE RESTUDY

Existing Drainage Condition Basins

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No. : 51804

DATE: January 26,1996
FILE: excel\804\stdform4.xls
CALCULATED BY : Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA *(acres)* (3)	AREA *(sq.mi.)*	LENGTH *(ft)* (4)	SLOPE *(%)* (5)	T_i *(min)* (6)	LENGTH *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY *(fps)* (9)	T_t *(min)* (10)	$T_c = T_i + T_t$ *(min)* (11)	TOTAL LENGTH *(ft)* (12)	T_c = (L/180)+10 *(min)* (13)	*(min)* (14)	T_{lag}= $0.6T_c/60$ *(hrs)*	Point Rainfall 100-yr *(inches)*
47C	79	0.653	547.8	0.856	500	0.4	24.4	7900	0.4	5.36	24.6	49.0	8400	56.7	49.0	0.49	2.77
48A-M	83	0.706	457.7	0.715	500	3.3	10.7	12000	3.3	5.96	33.6	44.2	12500	79.4	44.2	0.44	2.93
49A-M	79	0.653	443.4	0.693	500	2.2	13.8	10000	2.2	4.72	35.3	49.2	10500	68.3	49.2	0.49	2.85
49C	76	0.613	272.8	0.426	500	3.2	13.3	10500	3.2	4.41	39.7	53.0	11000	71.1	53.0	0.53	2.85
50B-M	80	0.666	401.6	0.628	500	11.9	7.7	12000	11.9	6.39	31.3	39.0	12500	79.4	39.0	0.39	3.00
50A-M	73	0.574	132.3	0.207	500	1.8	17.4	6000	1.8	3.14	31.8	49.3	6500	46.1	46.1	0.46	2.85
52A-M	73	0.574	183.0	0.286	500	2.3	16.1	6500	2.3	1.59	68.1	84.2	7000	NA	84.2	0.84	2.85
307B-M	81	0.679	433.1	0.677	500	0.8	18.2	12000	0.8	2.01	99.5	117.7	12500	79.4	79.4	0.79	2.77
307C	77	0.626	321.9	0.503	500	1.1	18.5	7200	1.1	1.99	60.3	78.8	7700	NA	78.8	0.79	2.77
307D	88	0.772	207.0	0.323	500	1.0	13.2	6000	1.0	5.82	17.2	30.4	6500	46.1	30.4	0.30	2.77
307E	79	0.653	490.2	0.766	500	0.8	19.4	8500	0.8	2.46	57.6	77.0	9000	60.0	60.0	0.60	2.77
318A	80	0.666	601.3	0.940	500	14.3	7.2	7700	14.3	2.09	61.4	68.6	8200	NA	68.6	0.69	2.93
321-M	67	0.494	442.5	0.691	500	0.4	33.1	7500	0.4	0.94	133.0	166.1	8000	NA	166.1	1.66	2.77

$T_c = T_i + T_t$ $\quad T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$ (L in feet, S in percent)

$T_{lag} = 0.6T_c$ $\quad K = 0.0132\,(CN) - 0.39$

REFERENCE: *Hydrologic Analysis and Design*, Prentice Hall, Richard H. McCuen, 1989.

STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2

RANGE WASH FLOOD INSURANCE RESTUDY

Existing Drainage Condition Basins

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No.: 51804

DATE: December 8, 1995
FILE: excel\804\stdform4.xls
CALCULATED BY: Kathy Kingston

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASINS		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA *(acres)* (3)	AREA *(sq.mi.)*	LENGTH *(ft)* (4)	SLOPE *(%)* (5)	T_i *(min)* (6)	LENGTH *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY *(fps)* (9)	T_t *(min)* (10)	$T_c = T_i + T_t$ *(min)* (11)	TOTAL LENGTH *(ft)* (12)	T_c = (L/180)+10 *(min)* (13)	*(min)* (14)	T_{lag}= $0.6T_c/60$ *(hrs)*	Point Rainfall 100-yr *(inches)*
326A	79	0.653	147.7	0.231	500	0.3	26.9	4700	0.3	2.17	36.1	63.0	5200	38.9	38.9	0.39	2.85
326B	79	0.653	580.6	0.907	500	0.4	24.4	11500	0.4	1.73	110.8	135.2	12000	76.7	76.7	0.77	2.80
CON-DET	80	0.666	159.1	0.249	500	0.3	26.1	4500	0.3	1.17	64.1	90.2	5000	NA	90.2	0.90	2.85

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)
$K = 0.0132\,(CN) - 0.39$

REFERENCE: *Hydrologic Analysis and Design*, Prentice Hall, Richard H. McCuen, 1989.

STANDARD FORM 4

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A6

DRAINAGE BASIN LAG TIME CALCULATIONS

Per CCRFCD Hydrologic Criteria and Drainage Design Manual, Section 606.3

For drainage basins with areas greater than one square mile.

(USBR) $T_{lag} = 20*K_n(L*L_c/S^{0.5})^{0.33}$

Basin Name	Roughness Type	Manning's Roughness (K_n)	Reach Length (L) (Feet)	Reach Length (L) (Miles)	Centroid Length (L_c) (Miles)	Average Slope (Ft/Ft)	Average Slope (S) (Feet/Mile)	(USBR) Lag Time (T_{lag}) (Hours)
44-M	Mtn-Braid	0.060	33200	6.288	3.144	0.050	264	1.28
45-M	Mtn-Braid	0.060	28000	5.303	2.652	0.026	140	1.27
46A	Mtn-Braid	0.060	34200	6.477	3.239	0.017	91	1.56
46B-M	Mtn-Braid	0.060	35000	6.629	3.314	0.014	73	1.64
47A	Mtn-Braid	0.050	14000	2.652	1.326	0.007	36	0.84
47B-M	Defined	0.030	16800	3.182	1.591	0.005	25	0.60
48	Mtn-Braid	0.060	17700	3.352	1.676	0.019	98	0.99
48B	Mtn-Braid	0.050	11800	2.235	1.117	0.074	389	0.51
49B-M	Mtn-Braid	0.050	17700	3.352	1.676	0.118	625	0.61
306B-M	Mtn-Braid	0.050	21600	4.091	2.045	0.020	106	0.93
307A-M	Mtn-Braid	0.050	25000	4.735	2.367	0.013	70	1.10
309-M	Mtn-Braid	0.050	19500	3.693	1.847	0.021	112	0.86
310B-M	Mtn-Braid	0.050	19800	3.750	1.875	0.009	48	1.00
312-M	Mtn-Braid	0.060	28800	5.455	2.727	0.018	95	1.38
317	Mtn-Braid	0.050	31300	5.928	2.964	0.017	91	1.22
318B	Mtn-Braid	0.050	13400	2.538	1.269	0.045	240	0.60
318C	Mtn-Braid	0.050	17000	3.220	1.610	0.028	148	0.75
324-M	Defined	0.030	23500	4.451	2.225	0.004	21	0.77
OR-2	Mtn-Braid	0.050	12000	2.273	1.136	0.028	145	0.60

LAG804.XLS

Equation

RANGE WASH FLOOD INSURANCE RESTUDY

DRAINAGE BASIN LAG TIME CALCULATIONS

UNITED STATES BUREAU OF RECLAMATION (USBR) METHOD

for TABLE A6

For use in the SCS Dimensionless Unit Hydrograph Method

Per CCRFCD Hydrologic Criteria and Drainage Design Manual, Section 606.3

For drainage basins with areas greater than one square mile.

$$\text{(USBR) } T_{lag} = 20*K_n(L*L_c/S^{0.5})^{0.33}$$

T_{lag} = Lag time (hours)

K_n = Manning's roughness factor for the basin channels
From CCRFCD Table 604

K_n = 0.015 for urbanized areas where water courses consist of streets, storm sewers, and improved channels.

K_n = 0.030 where water courses are well-defined, unimproved channels or washes, and the watershed has minimal vegetation.

K_n = 0.050 where water courses are not well-defined, and consist of many small rills and braided wash areas. Runoff from the area combines slowly into channels. Includes mountainous channels with large boulders and flow restrictions.

L = Length of longest watercourse (miles)

L_c = Length along longest watercourse measured upstream to a point opposite the centroid of the basin (miles)
(Note: Assume L_c is half of L)

S = Average slope of the longest watercourse (feet per mile)

HYDROLOGIC PARAMETER SUMMARY

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A7.1

DRAINAGE BASIN HYDROLOGIC PARAMETER SUMMARY

(For the basins calculated using the Upland Method)

Basin Name	Area (Acres)	Area (Sq. Mi.)	Curve Number	100-year Point Rainfall (Inches)	Lag Time (Hours)
OR-1	178.6	0.279	89	3.00	0.18
OR-3	131.4	0.205	82	3.00	0.54
OR-4	286.4	0.448	88	3.00	0.33
OR-5	238.5	0.373	77	3.00	0.60
OR-6A	169.1	0.264	88	3.00	0.13
OR-6B	102.1	0.160	89	3.00	0.14
OR-6C	122.1	0.191	87	3.00	0.19
OR-7	392.0	0.613	77	3.00	0.75
OR-8	10.8	0.017	77	3.00	0.16
OR-9	177.6	0.278	77	3.00	0.83
OR-10	62.9	0.098	77	3.00	0.42
OR-11	25.4	0.040	75	2.85	0.20
OR-12	335.9	0.525	76	2.85	0.45
OR-13	77.0	0.120	84	2.85	0.29
OR-14	60.0	0.094	75	2.85	0.33

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A7.2

DRAINAGE BASIN HYDROLOGIC PARAMETER SUMMARY

(For the basins calculated using the Upland Method)

Basin Name	Area (Acres)	Area (Sq. Mi.)	Curve Number	100-year Point Rainfall (Inches)	Lag Time (Hours)
47C	547.8	0.856	79	2.77	0.57
48A-M	457.7	0.715	83	2.93	0.66
49A-M	443.4	0.693	79	2.85	0.68
49C	272.8	0.426	76	2.85	0.62
50B-M	401.6	0.628	80	3.00	0.37
50A-M	132.3	0.207	73	2.85	0.46
52A-M	183.0	0.286	73	2.85	0.87
307B-M	433.1	0.677	81	2.77	0.79
307C	429.5	0.671	77	2.77	1.07
307D	591.6	0.924	77	2.77	1.73
307E	490.2	0.766	79	2.77	0.60
318A	601.3	0.940	80	2.93	0.41
321-M	442.5	0.691	67	2.77	1.32
326A	147.7	0.231	79	2.85	0.39
326B	580.6	0.907	79	2.80	0.77
CON-DET	159.1	0.249	80	2.85	0.95

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A7.3

DRAINAGE BASIN HYDROLOGIC PARAMETER SUMMARY

(For the basins calculated using the USBR Lag Equation)

(Basin parameters calculated using the Upland Method are on the Standard Form 4)

Basin Name	Area (Acres)	Area (Sq. Mi.)	Curve Number	100-year Point Rainfall (Inches)	USBR Lag Time (Hours)
44-M	5226.5	8.17	84	2.85	1.28
45-M	5254.3	8.21	78	2.85	1.27
46A	4659.2	7.28	76	2.95	1.56
46B-M	4041.1	6.31	76	3.00	1.64
47A	1554.3	2.43	77	2.95	0.84
47B-M	2162.4	3.38	84	2.81	0.60
48	1327.4	2.07	73	2.85	0.99
48B	731.0	1.14	89	3.10	0.51
49B-M	1266.0	1.98	85	3.00	0.61
306B-M	3539.3	5.53	74	2.77	0.93
307A-M	1610.9	2.52	76	2.77	1.10
309-M	2545.2	3.98	75	2.77	0.86
310B-M	2927.5	4.57	82	2.77	1.00
312-M	8615.5	13.46	75	2.79	1.38
317	4555.7	7.12	84	3.08	1.22
318B	1018.6	1.59	87	3.15	0.60
318C	819.5	1.28	79	2.93	0.75
324-M	1937.4	3.03	72	2.85	0.77
OR-2	772.1	1.21	75	2.93	0.60

LAG804.XLS

HYDROLOGIC ROUTING

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A8
MUSKINGUM ROUTING CALCULATIONS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Route Name	Route Length (L) (feet)	Beginning Elevation of Path (feet)	Ending Elevation of Path (feet)	Average Route Slope (ft/ft)	Approx. 100-Year Flow Q (cfs)	Single Channel Dawdy Velocity V (ft/s)	Muskingum Storage Time Constant **K** (hours)	Muskingum Weighting Factor **X**	Time Increment t (minutes)	Time Increment T (hours)	Upper Boundary for Number of Steps	Lower Boundary for Number of Steps	Average Value for Number of Steps **NSTEPS**
G1-G2	9500	1920	1850	0.007	1600	6.6	**0.40**	**0.30**	5	0.083	6.7	2.9	**5**
I3-I4	15000	1960	1850	0.007	800	5.7	**0.73**	**0.20**	5	0.083	14.0	3.5	**9**
J-K	22000	2420	1900	0.024	1700	6.7	**0.92**	**0.15**	5	0.083	18.7	3.3	**11**
N2-O	9000	2060	1915	0.016	1700	6.7	**0.37**	**0.15**	5	0.083	7.6	1.3	**4**
Q-P	8000	3000	1820	0.148	800	5.7	**0.39**	**0.15**	5	0.083	7.9	1.4	**5**
Y2-Y3	5200	1920	1770	0.029	200	4.3	**0.33**	**0.15**	5	0.083	6.8	1.2	**4**
AA1-AA2	6000	1920	1770	0.025	500	5.2	**0.32**	**0.15**	5	0.083	6.5	1.1	**4**
R8-AA3	7500	2010	1760	0.033	14	2.6	**0.82**	**0.15**	5	0.083	16.6	2.9	**10**

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A8

MUSKINGUM ROUTING CALCULATIONS

(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Route Name	Route Length (L) (feet)	Beginning Elevation of Path (feet)	Ending Elevation of Path (feet)	Average Route Slope (ft/ft)	Manning Roughness n	Approx. 100-Year Flow Q (cfs)	Multiple Channel FEMA Velocity V (ft/s)	Muskingum Storage Time Constant **K** (hours)	Muskingum Weighting Factor **X**	Time Increment t (minutes)	Time Increment T (hours)	Upper Boundary for Number of Steps	Lower Boundary for Number of Steps	Average Value for Number of Steps **NSTEPS**
K-P1	11000	1900	1840	0.005	0.030	4000	3.8	**0.80**	**0.15**	5	0.083	16.4	2.9	**10**
O-P1	11500	1900	1840	0.005	0.030	4000	3.8	**0.85**	**0.15**	5	0.083	17.3	3.1	**10**
P1-P2	3200	1840	1830	0.003	0.030	4000	3.2	**0.28**	**0.15**	5	0.083	5.6	1.0	**3**
P2-P	3200	1830	1820	0.003	0.030	5000	3.4	**0.26**	**0.15**	5	0.083	5.3	0.9	**3**

SHALLOW UNCONFINED FLOW

FEMA MULTIPLE CHANNEL METHODOLOGY

$B = 36.1 * Q^{0.4}$

MANNING'S EQUATION FOR A WIDE CHANNEL

$y = [(Qn) / (1.49\ S^{1/2}\ B)]^{3/5}$

$V = Q/A = Q/By$

$\mathbf{V = (Q^{0.24} * S^{0.3})/(3.3*n)^{0.6}}$

B = Multiple Channel Width (feet)

V = Velocity (ft/s)

A = Flow Area (sq. ft.)

Q = Flow (cfs)

y = Depth (feet)

n = Manning's roughness coefficient

S = Slope (ft/ft)

EQUATIONS USED IN DETERMINING MUSKINGUM ROUTING PARAMETERS

Dawdy Equations for a Single Channel Alluvial Fan Analysis

$$V = 1.506 * Q^{1/5}$$

Where:

Q = Flow (cfs)
V = Velocity (ft/s)

Muskingum Storage Time Constant Equation

$$K = L/(3600V)$$

Where:
K = Muskingum Storage Time Constant (hours)
L = Channel Reach Length (feet)
V = Velocity (ft/s)

Muskingum Weighting Factor (X)
(From Section 608.1 in the CCRFCD Hydrologic Criteria and Drainage Design Manual)

The Weighting Factor accounts for the peak flow reduction caused by channel routing. It generally varies from 0 to 0.5, with 0 representing a reservoir type peak reduction, and 0.5 representing no peak reduction. In the Clark County area, values could range from 0.15 for channel reaches with some storage in overbanks but few obstructions such as would be found on alluvial fans, to 0.10 for inadequate channels in developed basins where overbank flows would encounter severe obstruction and consequently be significantly attenuated. The following table summarizes the attenuation types.

Attenuation Type	Muskingum Weighting Factor
Reservoir	0.00
None	0.50
Alluvial	0.15
Obstructed	0.10

EQUATIONS USED IN DETERMINING MUSKINGUM ROUTING PARAMETERS

Integer Number of Steps (NSTEPS)

The integer number of steps represents subreaches. Each subreach is such that the total travel time through the reach is approximately equal to K, the Muskingum Storage Time Constant. To ensure the method's computational stability and the accuracy of the computed hydrograph, the routing reach should be chosen so that the number of steps falls between the boundary values given by the following equations.

Upper Boundary for Number of Steps	Lower Boundary for Number of Steps	Average Value for Integer Number of Steps **NSTEPS** =
NSTEPS-U = (2 K (1-X)) / T	NSTEPS-L = (2 K X) / T	(NSTEPS-U + NSTEPS-L) / 2

Where:

NSTEPS = Average Value for Integer Number of Steps
NSTEPS-U = Upper Boundary for Steps
NSTEPS-L = Lower Boundary for Steps
K = Muskingum Storage Time Constant
X = Muskingum Weighting Factor
T = Time Increment (hours)

For this worksheet, the average value for number of steps is the value entered into the HEC-1 routing routine.
If HEC-1 routing errors occur, then the value is changed to a different interger that falls within the upper and lower boundaries.

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A9
KINEMATIC WAVE ROUTING PARAMETERS

Route Name	Route Description	Channel Length L (feet)	Beginning Elevation of Path (feet)	Ending Elevation of Path (feet)	Channel Slope S (ft/ft)	Manning's Roughness n	Channel Shape	Bottom Width or Diameter (feet)	Side Slopes
G6-G2	Walnut Road and Natural Wash	8600	1920	1850	0.008	0.020	TRAP	10	5
I4-G8	SLEB Concrete Channel	2300	1850	1845	0.002	0.014	TRAP	20	1.5
G8-G9	RWSL Channel	8400	1845	1820	0.003	0.014	TRAP	20	2
G9-DB.IN	NAFB Golf Course Channel	4000	1822	1815	0.002	0.030	TRAP	70	3
P1-P2	Channel	3200	1840	1830	0.003	0.014	TRAP	10	2
DBIN-OUT	West Swale in Detention Basin	2200	1810	1803	0.003	0.020	TRAP	0	50
DBOUT-M1	Sloan Channel, DB to Carey Ave.	2640	1810	1800	0.004	0.014	TRAP	20	2
M3-S1	Sloan Channel, Carey to Lake Mead	2640	1800	1790	0.004	0.014	TRAP	40	3
S1-S2	Sloan Channel, Lake Mead to Owens	2640	1790	1780	0.004	0.014	TRAP	50	2
R-S2	Natural Wash	10500	2010	1780	0.022	0.020	TRAP	10	5
S2-S3	Sloan Channel, Owens to Washington	2640	1780	1770	0.004	0.014	TRAP	60	2
V1-V2	Sloan Channel, Bonanza to Stewart	2640	1760	1740	0.008	0.014	TRAP	60	2
V3-V4	Sloan Channel, to Charleston	2000	1735	1730	0.003	0.030	TRAP	80	2
X1-X2	Streets and Natural Washes	10000	2060	1730	0.033	0.020	TRAP	20	10
V5-Z2	Sloan Chnl to Orchards Chnl Confluence	2800	1725	1710	0.005	0.030	TRAP	60	2
Y1-Z1	Orchards Streets	5500	1770	1710	0.011	0.016	TRAP	50	1
Y3-Z1	Orchards Streets	5000	1770	1710	0.012	0.016	TRAP	50	1
AA2-Z1	Orchards Streets	4500	1770	1710	0.013	0.016	TRAP	50	1
AA3-Z1	Orchards Streets	4500	1765	1710	0.012	0.016	TRAP	50	1
BB1-BB2	Sahara Ave., Hollywood to Sloan Channel	4000	1760	1705	0.014	0.016	TRAP	100	1
BB3-CC	Sloan Channel, Sahara to LV Wash	1700	1705	1695	0.006	0.025	TRAP	80	2

HYDROLOGIC MODEL COMPARISONS

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A10.1

DRAINAGE BASIN HYDROLOGIC PARAMETER COMPARISON

Compare parameters in the Orchards Study by Pentacore, 1-92, the Confluence Detention Basin by Boyle, 10-92, and this Range Wash Flood Insurance Restudy

Basin Name	FIS	Orchards	Confl.* Basins	FIS	Orchards	Confl.	FIS	Orchards	Confl.	FIS	Orchards	Confl.
	Area (Square Miles)			Curve Number			Lag Time (Hours)			100-Year Point Rainfall (Inches)		
OR-1	0.28	0.28	51B	89	88	87	0.18	0.18	---	3.00	3.15	2.85
OR-2	1.21	1.21	51A	75	81	---	0.60	1.14	---	2.93	3.15	2.85
OR-3	0.21	0.21	51D	82	81	---	0.54	0.53	---	3.00	3.15	2.85
OR-4	0.45	0.42	51C	88	88	87	0.33	0.32	---	3.00	3.15	2.93
OR-5	0.37	0.41	51D	77	77	---	0.60	0.58	---	3.00	3.15	2.85
OR-6A	0.26	0.26	52B	88	88	87	0.13	0.13	---	3.00	3.15	2.85
OR-6B	0.16	0.16	52B	89	88	87	0.14	0.14	---	3.00	3.15	2.85
OR-6C	0.19	0.18	52B	87	88	87	0.19	0.19	---	3.00	3.15	2.85
OR-7	0.61	0.60	52A	77	77	---	0.75	0.73	---	3.00	3.15	2.85
OR-8	0.02	0.02	52B	77	88	87	0.16	0.14	---	3.00	3.15	2.85
OR-9	0.28	0.29	52A	77	77	---	0.83	0.81	---	3.00	3.15	2.85
OR-10	0.10	0.10	52A	77	77	---	0.42	0.41	---	3.00	3.15	2.85
OR-11	0.04	---	52A	75	---	---	0.20	---	---	2.85	3.15	2.85
OR-12	0.52	---	52A	76	---	---	0.45	---	---	2.85	3.15	2.85
OR-13	0.12	---	52A	84	---	---	0.29	---	---	2.85	3.15	2.85
OR-14	0.09	---	52A	75	---	---	0.33	---	---	2.85	3.15	2.85

* The Orchards drainage basins are a portion of these larger basins used in the Confluence Det. Basin Hydrology Report

Compare

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A10.2

DRAINAGE BASIN HYDROLOGIC PARAMETER COMPARISON

Compare parameters in the Confluence Detention Basin by Boyle, 10-92
and this Range Wash Flood Insurance Restudy

Basin Name	Area (Square Miles) FIS	Area (Square Miles) Facility	Confl.* Basins	Curve Number FIS	Curve Number Confl.	Lag Time (Hours) FIS	Lag Time (Hours) Confl.	100-Year Point Rainfall (Inches) FIS	100-Year Point Rainfall (Inches) Confl.
47C	0.86	---	47	79	---	0.57	---	2.77	2.85
48A-M	0.72	---	48A	83	---	0.66	---	2.93	2.93
49A-M	0.69	---	49A	79	---	0.68	---	2.85	2.85
49C	0.43	---	49A	76	---	0.62	---	2.85	2.85
50B-M	0.63	---	50A/50B	80	---	0.37	---	3.00	2.85/3.00
50A-M	0.21	---	50A	73	---	0.46	---	2.85	2.85
52A-M	0.29	---	52A	73	---	0.87	---	2.85	2.85
307B-M	0.68	---	307B	81	---	0.79	---	2.77	2.85
307C	0.67	---	307A	77	78	1.07	---	2.77	2.85
307D	0.92	---	307A	77	78	1.73	---	2.77	2.85
307E	0.77	---	307B	79	---	0.60	---	2.77	2.85
318A	0.94	0.76	318A	80	---	0.41	---	2.93	2.93
321-M	0.69	---	321	67	---	1.32	---	2.77	2.85
326A	0.23	---	326	79	---	0.39	---	2.85	2.85
326B	0.91	---	326	79	---	0.77	---	2.80	2.85
CON-DET	0.25	---	---	80	---	0.95	---	2.85	---

* Most of the new FIS drainage basins are a portion of these larger basins used in the Confluence Det. Basin Hydrology Report

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Compare

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A10.3

DRAINAGE BASIN HYDROLOGIC PARAMETER COMPARISON

Compare parameters in the Confluence Detention Basin by Boyle, 10-92
and this Range Wash Flood Insurance Restudy

Basin Name	Area (Square Miles)		Confl.* Basins	Curve Number		Lag Time (Hours)		100-Year Point Rainfall (Inches)	
	FIS	Confl.		FIS	Confl.	FIS	Confl.	FIS	Confl.
44-M	8.17	7.23	44	84	79	1.28	1.22	2.85	2.85
45-M	8.21	10.73	45	78	76	1.27	1.31	2.85	2.85
46A	7.28	7.35	46A	76	77	1.56	1.60	2.95	3.00
46B-M	6.31	6.02	46B	76	77	1.64	1.71	3.00	3.00
47A	2.43	---	47	77	---	0.84	---	2.95	2.85
47B-M	3.38	---	47	84	---	0.60	---	2.81	2.85
48	2.07	2.07	048	73	76	0.99	1.97	2.85	2.85
48B	1.14	0.99	48B	89	87	0.51	0.24	3.10	3.00
49B-M	1.98	1.04	49B	85	87	0.61	0.25	3.00	2.93
306B-M	5.53	---	306B/307A	74	76/78	0.93	---	2.77	2.85
307A-M	2.52	---	307A	76	78	1.10	---	2.77	2.85
309-M	3.98	---	309B	75	79	0.86	---	2.77	2.85
310B-M	4.57	---	310B	82	---	1.00	---	2.77	2.85
312-M	13.46	6.77	312	75	77	1.38	2.83	2.79	2.85
317	7.12	7.66	317	84	80	1.22	0.97	3.08	3.15
318B	1.59	1.86	318B	87	87	0.60	0.37	3.15	3.15
318C	1.28	2.93	318C	79	---	0.75	---	2.93	2.93
324-M	3.03	1.40	324	72	---	0.77	---	2.85	2.85

* Most of the new FIS drainage basins are a portion of these larger basins used in the Confluence Det. Basin Hydrology Report

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HEC-1 MODELS

RFIS-G7.OUT

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*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/31/1996  TIME  10:18:05 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                    *DIAGRAM
*** FREE ***
         1          ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
         2          ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
         3          ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
         4          ID                              JOB. NO. 51804
         5          ID                          HEC-1 FILE: RFIS-G7.DAT
         6          ID                              JANUARY 1996
         7          ID
         8          ID          EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
         9          ID                    STORM CENTERING FOR NODES F4 AND F3
        10          ID              STORM CENTERING FOR NODES G4, G7, G1 AND G3
        11          ID
        12          ID   ********************************************************************************
        13          ID   *              FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                *
        14          ID   *                              RANGE WASH WATERSHED                            *
        15          ID   *                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
        16          ID   *                              JANUARY 1991                                    *
        17          ID   *                  PRESENT CONDITIONS, EXISTING FACILITIES                     *
        18          ID   *                   BASED ON RANGE WASH FACILITIES STUDY                       *
        19          ID   *                      BOYLE ENGINEERS CORP-JULY 1989                          *
        20          ID   *                                                                              *
        21          ID   *                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)                     *
        22          ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
        23          ID   ********************************************************************************
        24          ID   *                         100-YEAR, 6-HOUR STORM, AMC 2.0                      *
        25          ID   ********************************************************************************
        26          ID   *  STORM DISTRIBUTION 3 (SDN 3) FOR CONTRIBUTING AREA LESS THAN 10 SQ.MI. *
        27          ID   *     JR DARF RATIOS 0.97 AT G4, 0.95 AT G7, 0.92 AT F4,                       *
        28          ID   *     JR DARF RATIOS 0.90 AT F3, 0.88 AT G1, AND 0.87 AT G3.                   *
        29          ID   ********************************************************************************
        30          ID
        31          IT     05       0       0     200
        32          IO      5       0       0
        33          JR    PREC    1.00    0.97    0.95    0.92    0.90    0.88    0.87

        34          KK  306B-M
        35          KM   BASIN 306B-M CONTRIBUTES FLOW TO NODE F3, THE BRIDGE AT THE UPRR,
        36          KM   MPU FACILITY RWWB 0027,(2) 21'X12' BRIDGE OPENINGS.
        37          BA   5.528
        38          PB    2.77
        39          PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
        40          PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
        41          PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
        42          PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
        43          PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
        44          PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
        45          PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
        46          PC    .998    .999   1.000
        47          LS       0      74
        48          UD    0.93
                    *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK  307A-M
  50      KM   BASIN 307A-M CONTRIBUTES FLOW TO NODE F4, THE BOX CULVERT AT THE UPRR,
  51      KM   MPU FACILITY RWWE 0202, A 12'X8' RCB.
  52      BA   2.516
  53      PB    2.77
  54      LS       0      76
  55      UD    1.10
          *

  56      KK NODE.G1
  57      KM   COMBINE FLOW FROM F3 AND F4, NODE G1 IS THE BOX CULVERT AT INTERSTATE 15,
  58      KM   MPU FACILITY RWWE 0168, (3) 15'X10' RCBS.
  59      HC       2
          *

  60      KK   G1-G3
  61      KM   ROUTE FLOW FROM G1 THROUGH BASIN 307B-M TO G3.
  62      RM       5     .40      .3
          *

  63      KK  307B-M
  64      KM   BASIN 307B-M CONTRIBUTES FLOW TO NODE G3.
  65      BA   0.677
  66      PB    2.77
  67      LS       0      81
  68      UD    0.79
          *

  69      KK NODE.G3
  70      KM   COMBINE FLOW FROM G1 WITH FLOW FROM BASIN 307B-M.
  71      KM   NODE G3 REPRESENTS EAST TRIB TO NODE G2 AT LAS VEGAS BLVD.
  72      HC       2
          *

  73      KK    307C
  74      KM   307C MODIFIED DUE TO GOLDEN TRIANGLE INDUSTRIAL PARK
  75      KM   BASIN 307C CONTRIBUTES FLOW TO UPSTREAM OF INDUSTRIAL PARK
  76      BA    .503
  77      PB    2.77
  78      LS       0      77
  79      UD     .79
          *

  80      KK    TOG4
  81      KM   ROUTE FLOW THROUGH INDUSTRIAL PARK
  82      RK    6000   0.010   0.020       0    TRAP       3      50
          *

  83      KK    307D
  84      KM   AREA OF GOLDEN TRIANGLE INDUSTRIAL PARK
  85      BA    .323
  86      PB    2.77
  87      LS       0      88
  88      UD     .30
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK     G4
  90      KM   NODE G4 AT WALNUT AND MITCHELL
  91      KM   ASSUMES NO STORAGE OR CULVERT CAPACTIY RESTRICTION
  92      HC      2
          *

  93      KK   G4-G2
  94      KM   ROUTE FLOW FROM NODE G4 TO NODE G2.
  95      RK    8600   0.008   0.025       0    TRAP       3      50
          *

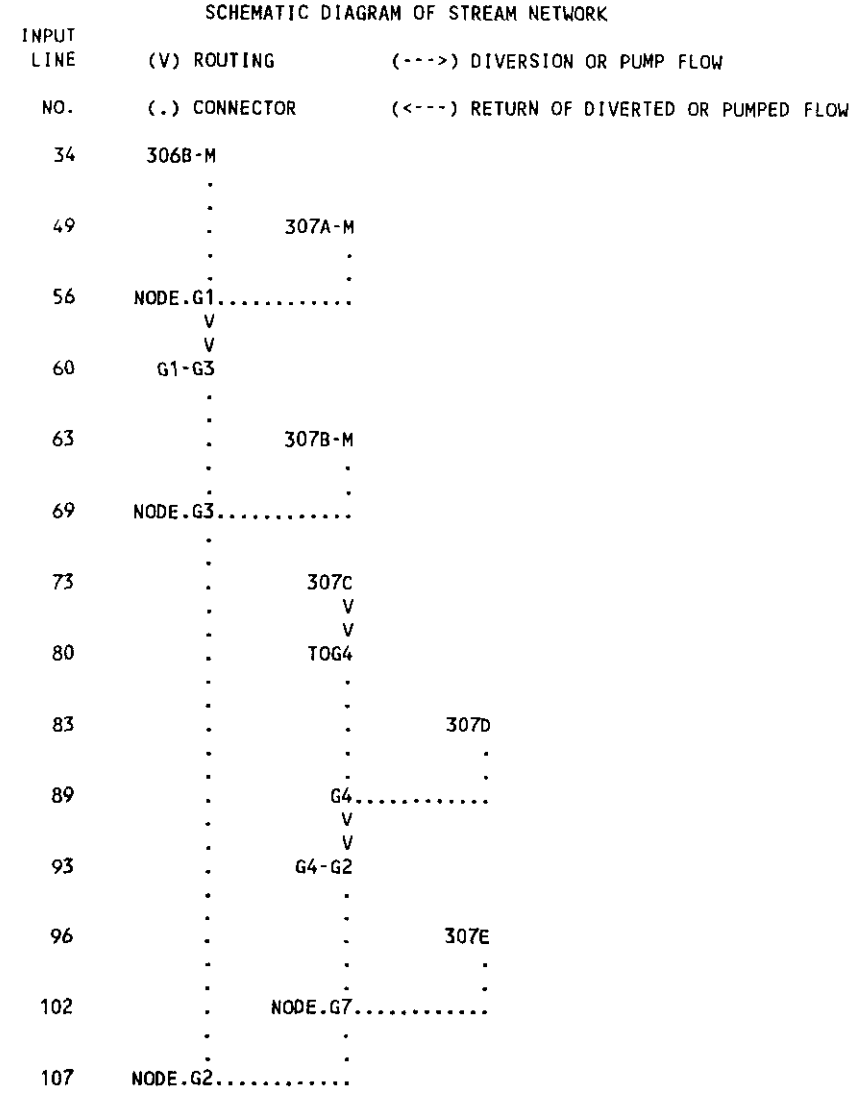
  96      KK    307E
  97      KM   BASIN 307E CONTRIBUTES FLOW TO NODE G7.
  98      BA   0.766
  99      PB    2.77
 100      LS       0      79
 101      UD    0.60
          *

 102      KK NODE.G7
 103      KM   COMBINE FLOW FROM NODE G4 AND BASIN 307E.
 104      KM   NODE G7, LOCATED NEAR THE ALEXANDER/LAMB INTERSECTION,
 105      KM   REPRESENTS THE TOTAL FLOW IN THE WESTERN TRIBUTARY TO NODE G2.
 106      HC      2
          *

 107      KK NODE.G2
 108      KM   COMBINE FLOW FROM NODES G3 AND G7; GIVES TOTAL FLOW TO G2.
 109      KM   NODE G2 IS MPU FACILITY RWSL 0745, (7) 10'X7' RCBS AT LAS VEGAS BLVD.
 110      HC      2
          *
 111      ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/31/1996  TIME  10:18:05 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFIS-G7.DAT
JANUARY 1996

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
STORM CENTERING FOR NODES F4 AND F3
STORM CENTERING FOR NODES G4, G7, G1 AND G3

```
*************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE          *
*                          RANGE WASH WATERSHED                         *
*               JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.         *
*                               JANUARY 1991                            *
*                  PRESENT CONDITIONS, EXISTING FACILITIES              *
*                  BASED ON RANGE WASH FACILITIES STUDY                 *
*                     BOYLE ENGINEERS CORP-JULY 1989                    *
*                                                                       *
*                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)              *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
*************************************************************************
*                        100-YEAR, 6-HOUR STORM, AMC 2.0                *
*************************************************************************
*  STORM DISTRIBUTION 3 (SDN 3) FOR CONTRIBUTING AREA LESS THAN 10 SQ.MI. *
*     JR DARF RATIOS 0.97 AT G4, 0.95 AT G7, 0.92 AT F4,                *
*     JR DARF RATIOS 0.90 AT F3, 0.88 AT G1, AND 0.87 AT G3.            *
*************************************************************************
```

```
32 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME         1635  ENDING TIME
                   ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                    TOTAL TIME BASE   16.58 HOURS

      ENGLISH UNITS
           DRAINAGE AREA         SQUARE MILES
           PRECIPITATION DEPTH   INCHES
           LENGTH, ELEVATION     FEET
           FLOW                  CUBIC FEET PER SECOND
           STORAGE VOLUME        ACRE-FEET
           SURFACE AREA          ACRES
           TEMPERATURE           DEGREES FAHRENHEIT

   JP          MULTI-PLAN OPTION
                    NPLAN          1  NUMBER OF PLANS

   JR          MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                  1.00       .97       .95       .92       .90       .88       .87
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
					1.00	.97	.95	.92	.90	.88	.87
HYDROGRAPH AT											
+	306B-M	5.53	1	FLOW	1368.	1274.	1213.	1123.	1064.	1006.	977.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT											
+	307A-M	2.52	1	FLOW	632.	592.	565.	526.	501.	476.	463.
				TIME	4.67	4.67	4.67	4.67	4.67	4.75	4.75
2 COMBINED AT											
+	NODE.G1	8.04	1	FLOW	1979.	1848.	1762.	1634.	1551.	1469.	1428.
				TIME	4.58	4.58	4.58	4.58	4.58	4.58	4.58
ROUTED TO											
+	G1-G3	8.04	1	FLOW	1952.	1823.	1738.	1613.	1531.	1450.	1410.
				TIME	5.00	5.00	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT											
+	307B-M	.68	1	FLOW	285.	270.	260.	244.	234.	224.	219.
				TIME	4.25	4.25	4.25	4.25	4.25	4.33	4.33
2 COMBINED AT											
+	NODE.G3	8.72	1	FLOW	2135.	1995.	1903.	1767.	1679.	1592.	1549.
				TIME	4.92	4.92	4.92	4.92	5.00	5.00	5.00
HYDROGRAPH AT											
+	307C	.50	1	FLOW	169.	159.	152.	142.	135.	128.	125.
				TIME	4.33	4.33	4.33	4.33	4.33	4.33	4.33
ROUTED TO											
+	TOG4	.50	1	FLOW	168.	158.	151.	141.	134.	128.	124.
				TIME	4.50	4.50	4.50	4.58	4.58	4.58	4.58
HYDROGRAPH AT											
+	307D	.32	1	FLOW	332.	317.	308.	294.	284.	275.	270.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT											
+	G4	.83	1	FLOW	343.	321.	311.	296.	286.	276.	271.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO											
+	G4-G2	.83	1	FLOW	336.	314.	305.	289.	278.	269.	266.
				TIME	4.08	4.08	4.08	4.17	4.17	4.17	4.17
HYDROGRAPH AT											
+	307E	.77	1	FLOW	348.	328.	315.	295.	282.	269.	263.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08
2 COMBINED AT											
+	NODE.G7	1.59	1	FLOW	684.	642.	620.	581.	555.	534.	526.
				TIME	4.08	4.08	4.08	4.08	4.17	4.17	4.08
2 COMBINED AT											
+	NODE.G2	10.31	1	FLOW	2538.	2376.	2271.	2113.	2010.	1910.	1860.
				TIME	4.92	4.92	4.92	4.92	4.92	5.00	5.00

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
TOG4	MANE	5.00	168.69	269.03	.91	5.00	168.34	270.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2454E+02 EXCESS= .0000E+00 OUTFLOW= .2454E+02 BASIN STORAGE= .1632E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97									
TOG4	MANE	4.56	158.09	270.72	.86	5.00	157.68	270.00	.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2307E+02 EXCESS= .0000E+00 OUTFLOW= .2306E+02 BASIN STORAGE= .1897E-03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= .95									
TOG4	MANE	4.55	151.34	274.19	.82	5.00	151.10	270.00	.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2211E+02 EXCESS= .0000E+00 OUTFLOW= .2210E+02 BASIN STORAGE= .1840E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .92									
TOG4	MANE	4.62	141.04	270.90	.77	5.00	140.68	275.00	.77

TINUITY SUMMARY (AC-FT) - INFLOW= .2068E+02 EXCESS= .0000E+00 OUTFLOW= .2067E+02 BASIN STORAGE= .1994E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .90									
TOG4	MANE	4.73	134.64	273.09	.74	5.00	133.94	275.00	.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1974E+02 EXCESS= .0000E+00 OUTFLOW= .1974E+02 BASIN STORAGE= .1884E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .88									
TOG4	MANE	4.76	127.85	275.24	.70	5.00	127.83	275.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1882E+02 EXCESS= .0000E+00 OUTFLOW= .1881E+02 BASIN STORAGE= .2419E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .87									
TOG4	MANE	4.71	124.42	271.16	.68	5.00	124.40	275.00	.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1836E+02 EXCESS= .0000E+00 OUTFLOW= .1835E+02 BASIN STORAGE= .1808E-03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.00									
G4-G2	MANE	5.00	335.65	244.23	1.19	5.00	335.58	245.00	1.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5237E+02 EXCESS= .0000E+00 OUTFLOW= .5235E+02 BASIN STORAGE= .5019E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97									
G4-G2	MANE	5.00	316.24	248.67	1.13	5.00	313.82	245.00	1.13

NTINUITY SUMMARY (AC-FT) - INFLOW= .4963E+02 EXCESS= .0000E+00 OUTFLOW= .4978E+02 BASIN STORAGE= .4991E-02 PERCENT ERROR= -.3

```
          FOR PLAN = 1  RATIO=  .95
             G4-G2  MANE          5.00    305.45    244.58      1.09      5.00    305.23    245.00        1.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4786E+02 EXCESS= .0000E+00 OUTFLOW= .4792E+02 BASIN STORAGE= .4287E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .92
             G4-G2  MANE          4.73    293.33    247.74      1.03      5.00    288.66    250.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4519E+02 EXCESS= .0000E+00 OUTFLOW= .4531E+02 BASIN STORAGE= .5048E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .90
             G4-G2  MANE          4.83    279.72    246.17       .99      5.00    278.10    250.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4342E+02 EXCESS= .0000E+00 OUTFLOW= .4361E+02 BASIN STORAGE= .4781E-02 PERCENT ERROR=   -.5


          FOR PLAN = 1  RATIO=  .88
             G4-G2  MANE          4.84    272.60    247.92       .95      5.00    268.89    250.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4170E+02 EXCESS= .0000E+00 OUTFLOW= .4183E+02 BASIN STORAGE= .4838E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .87
             G4-G2  MANE          4.79    270.09    248.55       .93      5.00    266.06    250.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4083E+02 EXCESS= .0000E+00 OUTFLOW= .4098E+02 BASIN STORAGE= .4214E-02 PERCENT ERROR=   -.4


*** NORMAL END OF HEC-1 ***
```

RFIS-G2.OUT

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1996  TIME  09:37:02 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X         X     X        XX
X     X  X         X                X
XXXXXXX  XXXX      X        XXXXX   X
X     X  X         X                X
X     X  X         X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

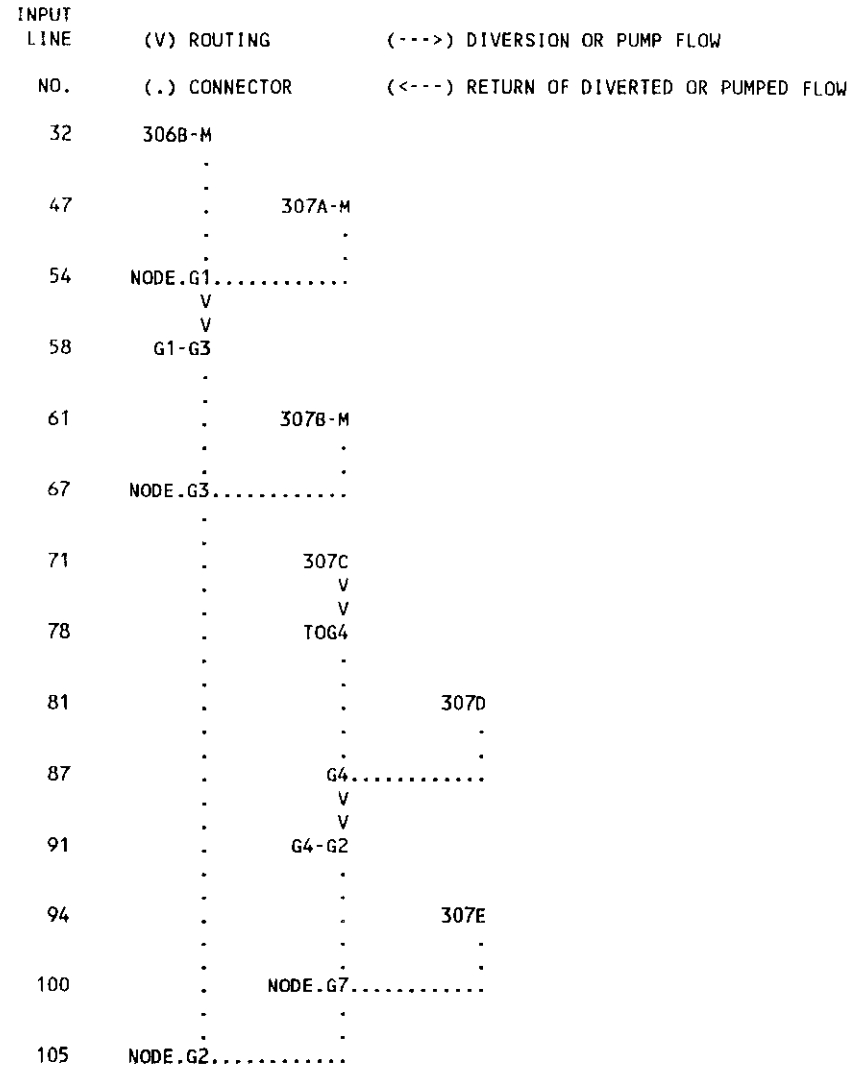
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                              JOB. NO. 51804
    5     ID                          HEC-1 FILE: RFIS-G2.DAT
    6     ID                               DECEMBER 1995
    7     ID
    8     ID             EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
    9     ID               STORM CENTERING FOR NODE G2 AT LAS VEGAS BOULEVARD
   10     ID
   11     ID   ********************************************************************************
   12     ID   *              FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                *
   13     ID   *                              RANGE WASH WATERSHED                            *
   14     ID   *                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
   15     ID   *                                  JANUARY 1991                                *
   16     ID   *                   PRESENT CONDITIONS, EXISTING FACILITIES                    *
   17     ID   *                    BASED ON RANGE WASH FACILITIES STUDY                      *
   18     ID   *                       BOYLE ENGINEERS CORP-JULY 1989                         *
   19     ID   *                                                                              *
   20     ID   *                   (CONVERTED RK TO RM IN UPLAND SUBAREAS)                    *
   21     ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
   22     ID   ********************************************************************************
   23     ID   *                          100-YEAR, 6-HOUR STORM, AMC 2.0                     *
   24     ID   ********************************************************************************
   25     ID   *STORM DISTRIBUTION 5 (SDN 5) FOR CONTRIBUTING AREA GREATER THAN 10 SQ.MI.*
   26     ID   *                              JR DARF RATIO 0.86 AT G2                        *
   27     ID   ********************************************************************************
   28     ID
   29     IT      05       0       0     200
   30     IO       5       0       0
   31     JR    PREC    0.86

   32     KK  306B-M
   33     KM   BASIN 306B-M CONTRIBUTES FLOW TO NODE F3, THE BRIDGE AT THE UPRR,
   34     KM   MPU FACILITY RWWB 0027,(2) 21'X12' BRIDGE OPENINGS.
   35     BA   5.528
   36     PB    2.77
   37     PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   38     PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   39     PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   40     PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   41     PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   42     PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   43     PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   44     PC    .997    .999   1.00
   45     LS       0      74
   46     UD    0.93
          •
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  47      KK  307A-M
  48      KM   BASIN 307A-M CONTRIBUTES FLOW TO NODE F4, THE BOX CULVERT AT THE UPRR,
  49      KM   MPU FACILITY RWWE 0202, A 12'X8' RCB.
  50      BA   2.516
  51      PB    2.77
  52      LS       0      76
  53      UD    1.10
          *

  54      KK NODE.G1
  55      KM   COMBINE FLOW FROM F3 AND F4, NODE G1 IS THE BOX CULVERT AT INTERSTATE 15,
  56      KM   MPU FACILITY RWWE 0168, (3) 15'X10' RCBS.
  57      HC       2
          *

  58      KK   G1-G3
  59      KM   ROUTE FLOW FROM G1 THROUGH BASIN 307B-M TO G3.
  60      RM       5     .40      .3
          *

  61      KK  307B-M
  62      KM   BASIN 307B-M CONTRIBUTES FLOW TO NODE G3.
  63      BA   0.677
  64      PB    2.77
  65      LS       0      81
  66      UD    0.79
          *

  67      KK NODE.G3
  68      KM   COMBINE FLOW FROM G1 WITH FLOW FROM BASIN 307B-M.
  69      KM   NODE G3 REPRESENTS EAST TRIB TO NODE G2 AT LAS VEGAS BLVD.
  70      HC       2
          *

  71      KK    307C
  72      KM   307C MODIFIED DUE TO GOLDEN TRIANGLE INDUSTRIAL PARK
  73      KM   BASIN 307C CONTRIBUTES FLOW TO UPSTREAM OF INDUSTRIAL PARK
  74      BA    .503
  75      PB    2.77
  76      LS       0      77
  77      UD     .79
          *

  78      KK    TOG4
  79      KM   ROUTE FLOW THROUGH INDUSTRIAL PARK
  80      RK    6000   0.010   0.020       0    TRAP       3      50
          *

  81      KK    307D
  82      KM   AREA OF GOLDEN TRIANGLE INDUSTRIAL PARK
  83      BA    .323
  84      PB    2.77
  85      LS       0      88
  86      UD     .30
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  87      KK      G4
  88      KM   NODE G4 AT WALNUT AND MITCHELL
  89      KM   ASSUMES NO STORAGE OR CULVERT CAPACTIY RESTRICTION
  90      HC       2
          *

  91      KK   G4-G2
  92      KM   ROUTE FLOW FROM NODE G4 TO NODE G2.
  93      RK    8600   0.008   0.025       0    TRAP       3      50
          *

  94      KK    307E
  95      KM   BASIN 307E CONTRIBUTES FLOW TO NODE G7.
  96      BA   0.766
  97      PB    2.77
  98      LS       0      79
  99      UD    0.60
          *

 100      KK NODE.G7
 101      KM   COMBINE FLOW FROM NODE G4 AND BASIN 307E.
 102      KM   NODE G7, LOCATED NEAR THE ALEXANDER/LAMB INTERSECTION,
 103      KM   REPRESENTS THE TOTAL FLOW IN THE WESTERN TRIBUTARY TO NODE G2.
 104      HC       2
          *

 105      KK NODE.G2
 106      KM   COMBINE FLOW FROM NODES G3 AND G7; GIVES TOTAL FLOW TO G2.
 107      KM   NODE G2 IS MPU FACILITY RWSL 0745, (7) 10'X7' RCBS AT LAS VEGAS BLVD.
 108      HC       2
          *
 109      ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  01/29/1996  TIME  09:37:02 *
*                                       *
*****************************************
```


```
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFIS-G2.DAT
DECEMBER 1995

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
STORM CENTERING FOR NODE G2 AT LAS VEGAS BOULEVARD

```
**************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE           *
*                          RANGE WASH WATERSHED                          *
*               JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.          *
*                               JANUARY 1991                             *
*                PRESENT CONDITIONS, EXISTING FACILITIES                 *
*                 BASED ON RANGE WASH FACILITIES STUDY                   *
*                    BOYLE ENGINEERS CORP-JULY 1989                      *
*                                                                        *
*                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)               *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
**************************************************************************
*                        100-YEAR, 6-HOUR STORM, AMC 2.0                 *
**************************************************************************
*STORM DISTRIBUTION 5 (SDN 5) FOR CONTRIBUTING AREA GREATER THAN 10 SQ.MI.*
*                           JR DARF RATIO 0.86 AT G2                     *
**************************************************************************
```

```
 30 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      1    0  ENDING DATE
                    NDTIME         1635  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
                      TOTAL TIME BASE    16.58 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN          1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .86
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.86
HYDROGRAPH AT					
+	306B-M	5.53	1	FLOW	754.
				TIME	4.50
HYDROGRAPH AT					
+	307A-M	2.52	1	FLOW	367.
				TIME	5.33
2 COMBINED AT					
+	NODE.G1	8.04	1	FLOW	1113.
				TIME	5.33
ROUTED TO					
+	G1-G3	8.04	1	FLOW	1106.
				TIME	5.75
HYDROGRAPH AT					
+	307B-M	.68	1	FLOW	167.
				TIME	4.25
2 COMBINED AT					
+	NODE.G3	8.72	1	FLOW	1228.
				TIME	5.00
HYDROGRAPH AT					
+	307C	.50	1	FLOW	95.
				TIME	4.25
ROUTED TO					
+	TOG4	.50	1	FLOW	95.
				TIME	4.50
HYDROGRAPH AT					
+	307D	.32	1	FLOW	188.
				TIME	3.67
2 COMBINED AT					
+	G4	.83	1	FLOW	195.
				TIME	3.67
ROUTED TO					
+	G4-G2	.83	1	FLOW	191.
				TIME	4.17
HYDROGRAPH AT					
+	307E	.77	1	FLOW	192.
				TIME	4.00
2 COMBINED AT					
+	NODE.G7	1.59	1	FLOW	380.
				TIME	4.08
2 COMBINED AT					
+	NODE.G2	10.31	1	FLOW	1535.
				TIME	5.25

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .86									
TOG4	MANE	5.00	94.85	271.10	.67	5.00	94.56	270.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1791E+02 EXCESS= .0000E+00 OUTFLOW= .1792E+02 BASIN STORAGE= .2283E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .86									
G4-G2	MANE	5.00	194.39	247.10	.91	5.00	191.26	250.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3999E+02 EXCESS= .0000E+00 OUTFLOW= .4010E+02 BASIN STORAGE= .4155E-02 PERCENT ERROR= -.3

*** NORMAL END OF HEC-1 ***

RFIS-V1.OUT

```
*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990               *
*           VERSION 4.0                 *
*                                       *
*  RUN DATE  12/11/1995  TIME  12:49:39 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
          *DIAGRAM
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                              JOB. NO. 51804
    5     ID                          HEC-1 FILE: RFIS-V1.DAT
    6     ID                               DECEMBER 1995
    7     ID
    8     ID                    EXISTING CONDITIONS DOWNSTREAM OF THE
    9     ID             CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION.
   10     ID             STORM CENTERING FOR NODE V1, AT SLOAN CHANNEL AND BONANZA.
   11     ID
   12     ID   ********************************************************************************
   13     ID   *             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                 *
   14     ID   *                          RANGE WASH WATERSHED                                *
   15     ID   *                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
   16     ID   *                              JANUARY 1991                                    *
   17     ID   *                   PRESENT CONDITIONS, EXISTING FACILITIES                    *
   18     ID   *                    BASED ON RANGE WASH FACILITIES STUDY                      *
   19     ID   *                       BOYLE ENGINEERS CORP-JULY 1989                         *
   20     ID   *                                                                              *
   21     ID   *                    (CONVERTED RK TO RM IN UPLAND SUBAREAS)                   *
   22     ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
   23     ID   ********************************************************************************
   24     ID   *                      100-YEAR, 6-HOUR STORM, AMC 2.0                         *
   25     ID   ********************************************************************************
   26     ID   *  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI.     *
   27     ID   *  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN,     *
   28     ID   *    JR DARF RATIO 0.88 FOR NODE V1, AT SLOAN CHANNEL AND BONANZA ROAD.       *
   29     ID   ********************************************************************************
   30     ID
   31     IT     05       0       0     200
   32     IO      5       0       0
   33     JR   PREC    0.88

   34     KK   318C
   35     KM   BASIN 318C CONTRIBUTES FLOW TO NODE M1.
   36     KM   NODE M1 GIVES THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
   37     KM   THE CONFLUENCE WITH THE RANGE WASH CHANNEL.
   38     BA    1.28
   39     PB    2.93
   40     PC   .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   41     PC   .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   42     PC   .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   43     PC   .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   44     PC   .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   45     PC   .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   46     PC   .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   47     PC   .997    .999   1.00
   48     LS     0      79
   49     UD  0.75
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  50      KK   321-M
  51      KM   BASIN 321-M CONTRIBUTES FLOW TO THE RANGE WASH CHANNEL UPSTREAM OF
  52      KM   ITS CONFLUENCE WITH THE SLOAN CHANNEL.
  53      BA   0.691
  54      PB    2.77
  55      LS       0      67
  56      UD    1.66
          *

  57      KK NODE.M3
  58      KM   COMBINE FLOWS FROM M1 AND M2 AT NODE M3.
  59      KM   NODE M3 IS THE TOTAL FLOW AT THE CONFLUENCE OF THE SLOAN CHANNEL
  60      KM   AND THE RANGE WASH CHANNEL AT SLOAN AND CAREY AVENUE.
  61      HC       2
          *

  62      KK   M3-S1
  63      KM   ROUTE FLOW FROM NODE M3 THROUGH THE SLOAN CHANNEL TO NODE S1.
  64      RK    2640   0.004   0.015       0    TRAP      40       3
          *

  65      KK   48A-M
  66      KM   BASIN 48A-M CONTRIBUTES FLOW TO NODE S1.
  67      BA   0.715
  68      PB    2.93
  69      LS       0      83
  70      UD    0.44
          *

  71      KK      S1
  72      KM   COMBINE FLOW FROM M3 WITH FLOW FROM BASIN 48A-M.
  73      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT LAKE MEAD BLVD.
  74      HC       2
          *

  75      KK   S1-S2
  76      KM   ROUTE FLOW FROM S1 THROUGH THE SLOAN CHANNEL TO S2.
  77      RK    2640   0.002   0.015       0    TRAP      50       2
          *

  78      KK     48B
  79      KM   BASIN 48B CONTRIBUTES FLOW TO NODE R.
  80      BA   1.142
  81      PB    3.10
  82      LS       0      89
  83      UD    0.51
          *

  84      KK    R-S2
  85      KM   ROUTE FLOW FROM R THROUGH BASIN 49A-M TO NODE S2.
  86      RK   10500   0.022    0.02       0    TRAP      10      20
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  87      KK   49A-M
  88      KM   BASIN 49A-M CONTRIBUTES FLOW TO NODE S2.
  89      BA   0.693
  90      PB    2.85
  91      LS       0      79
  92      UD    0.49
          *

  93      KK NODE.S2
  94      KM   COMBINE FLOW FROM NODES S1 AND R WITH FLOW FROM BASIN 49A-M AT NODE S2.
  95      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT OWENS AVENUE.
  96      HC       3
          *

  97      KK   S2-S3
  98      KM   ROUTE FLOW FROM S2 THROUGH THE SLOAN CHANNEL TO S3.
  99      RK    2640   0.004   0.014       0    TRAP      60       2
          *

 100      KK     49C
 101      KM   BASIN 49C CONTRIBUTES FLOW TO NODE S3.
 102      BA   0.426
 103      PB    2.85
 104      LS       0      76
 105      UD    0.53
          *

 106      KK NODE.S3
 107      KM   COMBINE FLOW FROM S2 WITH FLOW FROM BASIN 49C AT NODE S3.
 108      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT WASHINGTON AVE.
 109      HC       2
          *

 110      KK   49B-M
 111      KM   BASIN 49B-M CONTRIBUTES FLOW TO NODE T1.
 112      KM   NODE T1 REPRESENTS THE TOTAL FLOW TO THE DIVERSION CHANNEL ALONG
 113      KM   WASHINGTON AVE. JUST UPSTREAM OF THE SLOAN CHANNEL.
 114      BA   1.977
 115      PB    3.00
 116      LS       0      85
 117      UD    0.61
          *

 118      KK NODE.S4
 119      KM   COMBINE FLOW FROM S3 WITH FLOW FROM T1 AT NODE S4.
 120      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT HARRIS AVE.
 121      HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  122     KK   50B-M
  123     KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
  124     BA   0.628
  125     PB    3.00
  126     LS       0      80
  127     UD    0.39
          *

  128     KK NODE.V1
  129     KM   COMBINE FLOW FROM S4 WITH FLOW FROM BASIN 50B-M AT NODE V1.
  130     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT BONANZA RD.
  131     HC       2
          *
  132     ZZ
```

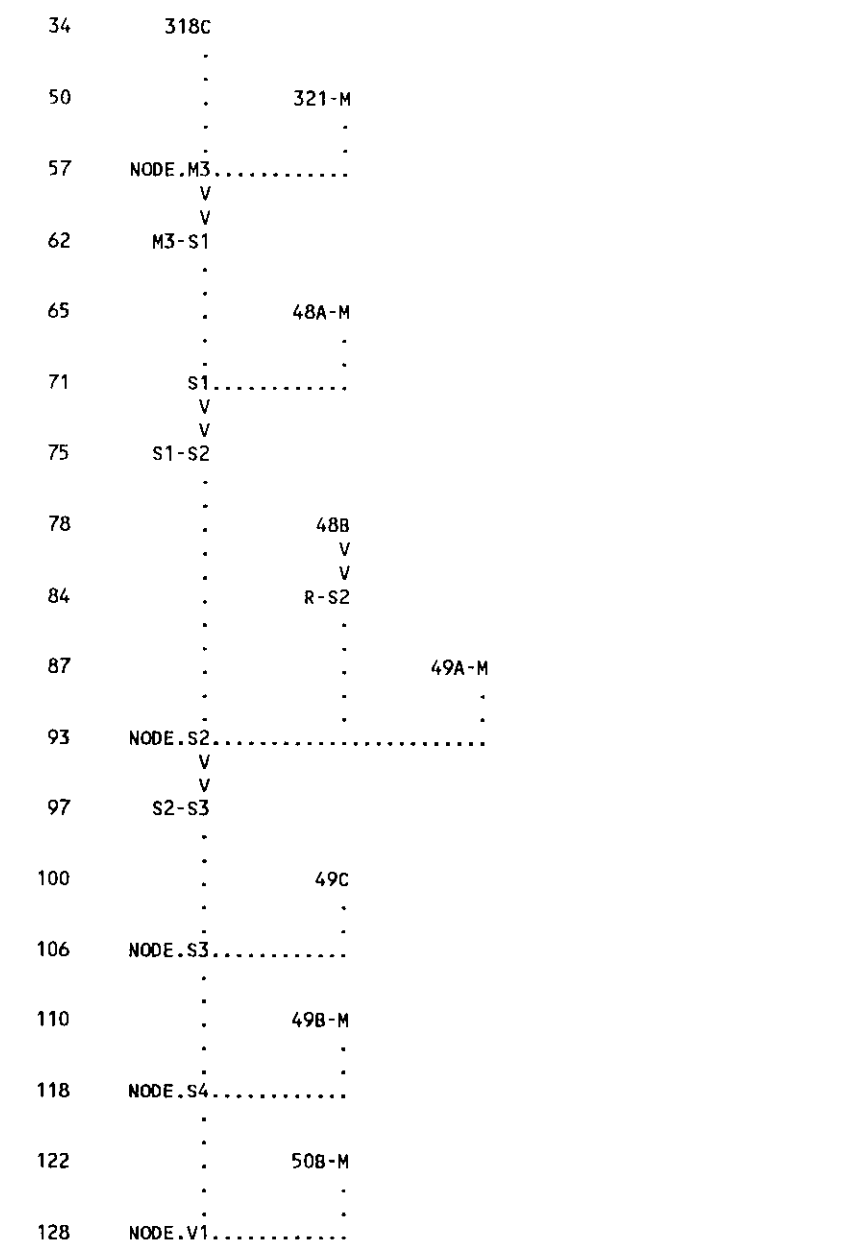
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  12/11/1995  TIME  12:49:39 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFIS-V1.DAT
DECEMBER 1995

EXISTING CONDITIONS DOWNSTREAM OF THE
CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION.
STORM CENTERING FOR NODE V1, AT SLOAN CHANNEL AND BONANZA.

```
**************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE           *
*                          RANGE WASH WATERSHED                          *
*                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.         *
*                                JANUARY 1991                            *
*                PRESENT CONDITIONS, EXISTING FACILITIES                 *
*                 BASED ON RANGE WASH FACILITIES STUDY                   *
*                    BOYLE ENGINEERS CORP-JULY 1989                      *
*                                                                        *
*                (CONVERTED RK TO RM IN UPLAND SUBAREAS)                 *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
**************************************************************************
*                    100-YEAR, 6-HOUR STORM, AMC 2.0                     *
**************************************************************************
*  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI. *
*  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
*    JR DARF RATIO 0.88 FOR NODE V1, AT SLOAN CHANNEL AND BONANZA ROAD.  *
**************************************************************************
```

```
32 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME         1635  ENDING TIME
                   ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                    TOTAL TIME BASE    16.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT
```

```
JP          MULTI-PLAN OPTION
                NPLAN           1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
              RATIOS OF PRECIPITATION
              .88
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .88
HYDROGRAPH AT					
+	318C	1.28	1	FLOW	334.
				TIME	4.17
HYDROGRAPH AT					
+	321-M	.69	1	FLOW	50.
				TIME	5.92
2 COMBINED AT					
+	NODE.M3	1.97	1	FLOW	347.
				TIME	4.25
ROUTED TO					
+	M3-S1	1.97	1	FLOW	346.
				TIME	4.25
HYDROGRAPH AT					
+	48A-M	.71	1	FLOW	308.
				TIME	3.83
2 COMBINED AT					
+	S1	2.69	1	FLOW	583.
				TIME	4.00
ROUTED TO					
+	S1-S2	2.69	1	FLOW	583.
				TIME	4.08
HYDROGRAPH AT					
+	48B	1.14	1	FLOW	658.
				TIME	3.92
ROUTED TO					
+	R-S2	1.14	1	FLOW	653.
				TIME	4.00
HYDROGRAPH AT					
+	49A-M	.69	1	FLOW	214.
				TIME	3.92
3 COMBINED AT					
+	NODE.S2	4.52	1	FLOW	1436.
				TIME	4.00
ROUTED TO					
+	S2-S3	4.52	1	FLOW	1433.
				TIME	4.08
HYDROGRAPH AT					
+	49C	.43	1	FLOW	104.
				TIME	4.00
2 COMBINED AT					
+	NODE.S3	4.95	1	FLOW	1534.
				TIME	4.08
HYDROGRAPH AT					
+	49B-M	1.98	1	FLOW	833.
				TIME	4.00

```
  2 COMBINED AT
+                NODE.S4       6.92     1   FLOW        2358.
                                               TIME        4.08

 HYDROGRAPH AT
+                  50B-M        .63     1   FLOW         253.
                                               TIME        3.75

  2 COMBINED AT
+                NODE.V1       7.55     1   FLOW        2573.
                                               TIME        4.00
```

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	INTERPOLATED TO COMPUTATION INTERVAL PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .88									
M3-S1	MANE	1.52	347.21	257.66	.69	5.00	346.14	255.00	.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7297E+02 EXCESS= .0000E+00 OUTFLOW= .7299E+02 BASIN STORAGE= .9342E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .88									
S1-S2	MANE	1.68	583.06	244.16	.81	5.00	582.97	245.00	.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1155E+03 EXCESS= .0000E+00 OUTFLOW= .1155E+03 BASIN STORAGE= .6342E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .88									
R-S2	MANE	4.36	657.03	242.30	1.66	5.00	652.85	240.00	1.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1009E+03 EXCESS= .0000E+00 OUTFLOW= .1011E+03 BASIN STORAGE= .3307E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .88									
S2-S3	MANE	.94	1435.44	242.10	1.03	5.00	1432.67	245.00	1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2477E+03 EXCESS= .0000E+00 OUTFLOW= .2478E+03 BASIN STORAGE= .9093E-02 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

RFIS-CC.OUT

```
*****************************************
*                                       *
*    FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*          SEPTEMBER 1990               *
*           VERSION 4.0                 *
*                                       *
*  RUN DATE  01/12/1996  TIME  09:54:56 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
          *DIAGRAM
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                   BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                                JOB. NO. 51804
    5     ID                            HEC-1 FILE: RFIS-CC.DAT
    6     ID                                 DECEMBER 1995
    7     ID
    8     ID                      EXISTING CONDITIONS DOWNSTREAM OF THE
    9     ID             CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION.
   10     ID           STORM CENTERING FOR NODE V2, AT SLOAN CHANNEL DOWNSTREAM OF STEWART,
   11     ID           AND FOR NODE CC, AT THE SLOAN CHANNEL AND LAS VEGAS WASH CONFLUENCE.
   12     ID
   13     ID   ********************************************************************************
   14     ID   *              FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                *
   15     ID   *                              RANGE WASH WATERSHED                            *
   16     ID   *                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
   17     ID   *                                   JANUARY 1991                               *
   18     ID   *                   PRESENT CONDITIONS, EXISTING FACILITIES                   *
   19     ID   *                    BASED ON RANGE WASH FACILITIES STUDY                     *
   20     ID   *                       BOYLE ENGINEERS CORP-JULY 1989                        *
   21     ID   *                                                                             *
   22     ID   *                    (CONVERTED RK TO RM IN UPLAND SUBAREAS)                  *
   23     ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
   24     ID   ********************************************************************************
   25     ID   *                      100-YEAR, 6-HOUR STORM, AMC 2.0                        *
   26     ID   ********************************************************************************
   27     ID   * STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
   28     ID   *  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
   29     ID   *  JR DARF RATIO 0.85 FOR NODE V2, AT SLOAN CHANNEL DOWNSTREAM OF STEWART *
   30     ID   *  AND 0.82 FOR NODE CC, AT THE SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE.  *
   31     ID   ********************************************************************************
   32     ID
   33     IT     05       0       0     200
   34     IO      5       0       0
   35     JR    PREC    0.85    0.82

   36     KK    318C
   37     KM   BASIN 318C CONTRIBUTES FLOW TO NODE M1.
   38     KM   NODE M1 GIVES THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
   39     KM   THE CONFLUENCE WITH THE RANGE WASH CHANNEL.
   40     BA    1.28
   41     PB    2.93
   42     PC   .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   43     PC   .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   44     PC   .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   45     PC   .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   46     PC   .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   47     PC   .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   48     PC   .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   49     PC   .997    .999   1.00
   50     LS     0      79
   51     UD   0.75
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  52      KK   321-M
  53      KM   BASIN 321-M CONTRIBUTES FLOW TO THE RANGE WASH CHANNEL UPSTREAM OF
  54      KM   ITS CONFLUENCE WITH THE SLOAN CHANNEL.
  55      BA   0.691
  56      PB    2.77
  57      LS       0      67
  58      UD    1.66
          *

  59      KK NODE.M3
  60      KM   COMBINE FLOWS FROM M1 AND M2 AT NODE M3.
  61      KM   NODE M3 IS THE TOTAL FLOW AT THE CONFLUENCE OF THE SLOAN CHANNEL
  62      KM   AND THE RANGE WASH CHANNEL AT SLOAN AND CAREY AVENUE.
  63      HC       2
          *

  64      KK   M3-S1
  65      KM   ROUTE FLOW FROM NODE M3 THROUGH THE SLOAN CHANNEL TO NODE S1.
  66      RK    2640   0.004   0.015       0    TRAP      40       3
          *

  67      KK   48A-M
  68      KM   BASIN 48A-M CONTRIBUTES FLOW TO NODE S1.
  69      BA   0.715
  70      PB    2.93
  71      LS       0      83
  72      UD    0.44
          *

  73      KK      S1
  74      KM   COMBINE FLOW FROM M3 WITH FLOW FROM BASIN 48A-M.
  75      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT LAKE MEAD BLVD.
  76      HC       2
          *

  77      KK   S1-S2
  78      KM   ROUTE FLOW FROM S1 THROUGH THE SLOAN CHANNEL TO S2.
  79      RK    2640   0.002   0.015       0    TRAP      50       2
          *

  80      KK     48B
  81      KM   BASIN 48B CONTRIBUTES FLOW TO NODE R.
  82      BA   1.142
  83      PB    3.10
  84      LS       0      89
  85      UD    0.51
          *

  86      KK    R-S2
  87      KM   ROUTE FLOW FROM R THROUGH BASIN 49A-M TO NODE S2.
  88      RK   10500   0.022    0.02       0    TRAP      10      20
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK   49A-M
  90      KM   BASIN 49A-M CONTRIBUTES FLOW TO NODE S2.
  91      BA   0.693
  92      PB    2.85
  93      LS      0      79
  94      UD    0.49
          *

  95      KK NODE.S2
  96      KM   COMBINE FLOW FROM NODES S1 AND R WITH FLOW FROM BASIN 49A-M AT NODE S2.
  97      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT OWENS AVENUE.
  98      HC      3
          *

  99      KK   S2-S3
 100      KM   ROUTE FLOW FROM S2 THROUGH THE SLOAN CHANNEL TO S3.
 101      RK    2640   0.004   0.014       0    TRAP      60       2
          *

 102      KK     49C
 103      KM   BASIN 49C CONTRIBUTES FLOW TO NODE S3.
 104      BA   0.426
 105      PB    2.85
 106      LS      0      76
 107      UD    0.53
          *

 108      KK NODE.S3
 109      KM   COMBINE FLOW FROM S2 WITH FLOW FROM BASIN 49C AT NODE S3.
 110      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT WASHINGTON AVE.
 111      HC      2
          *

 112      KK   49B-M
 113      KM   BASIN 49B-M CONTRIBUTES FLOW TO NODE T1.
 114      KM   NODE T1 REPRESENTS THE TOTAL FLOW TO THE DIVERSION CHANNEL ALONG
 115      KM   WASHINGTON AVE. JUST UPSTREAM OF THE SLOAN CHANNEL.
 116      BA   1.977
 117      PB    3.00
 118      LS      0      85
 119      UD    0.61
          *

 120      KK NODE.S4
 121      KM   COMBINE FLOW FROM S3 WITH FLOW FROM T1 AT NODE S4.
 122      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT HARRIS AVE.
 123      HC      2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  124     KK   50B-M
  125     KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
  126     BA   0.628
  127     PB    3.00
  128     LS       0      80
  129     UD    0.39
          *

  130     KK NODE.V1
  131     KM   COMBINE FLOW FROM S4 WITH FLOW FROM BASIN 50B-M AT NODE V1.
  132     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT BONANZA RD.
  133     HC       2
          *

  134     KK   V1-V2
  135     KM   ROUTE FLOWS FROM V1 THROUGH THE SLOAN CHANNEL TO NODE V2.
  136     RK    2640   0.008   0.014       0    TRAP      60       2
          *

  137     KK   50A-M
  138     KM   BASIN 50A-M CONTRIBUTES FLOW TO NODE V2.
  139     BA   0.207
  140     PB    2.85
  141     LS       0      73
  142     UD    0.46
          *

  143     KK NODE.V2
  144     KM   COMBINE FLOW FROM V1 WITH FLOW FROM BASIN 50A-M AT NODE V2.
  145     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT STEWART AVE.
  146     HC       2
          *

  147     KK   324-M
  148     KM   BASIN 324-M CONTRIBUTES FLOW TO NODE V3.
  149     BA   3.026
  150     PB    2.85
  151     LS       0      72
  152     UD    0.77
          *

  153     KK    STEW
  154     KM   DIVERT FLOWS WHICH CONTINUE IN CHRISTY & LINN LANES, ETC
  155     KM   FLOW IN STEWART GOES TO SLOAN CHANNEL
  156     KM   FLOW IN CHRISTY GOES TOWARD LAS VEGAS WASH
  157     DT      CL
  158     DI       0      15     600
  159     DQ       0       0     330
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  160     KK NODE.V3
  161     KM   COMBINE FLOW FROM V2 WITH FLOW FROM BASIN 324-M AT NODE V3.
  162     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL
  163     KM   SOUTH OF STEWART AVE.
  164     HC       2
          *

  165     KK   V3-V4
  166     KM   ROUTE V3 THROUGH THE SLOAN CHANNEL TO V4.
  167     RK    2000   0.003    0.03       0    TRAP      80       2
          *

  168     KK     CLR
  169     KM   RETREIVE FLOW IN CHRISTY AND LINN LANES
  170     DR       CL
          *

  171     KK    LINN
  172     KM   FLOW IN LINN LANE GOES TO BASIN 326-A THEN TO SLOAN CHANNEL
  173     KM   FLOW IN CHRISTY GOES TO LAS VEGAS WASH
  174     DT   CHRIS
  175     DI       0     100     500
  176     DQ       0      78     390
          *

  177     KK   326-A
  178     KM   BASIN 326-A CONTRIBUTES FLOW TO NODE V4.
  179     KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. WEST OF SLOAN CHANNEL.
  180     BA   0.231
  181     PB    2.85
  182     LS       0      79
  183     UD    0.39
          *

  184     KK  326-AL
  185     KM   BASIN 326-A AND FLOW IN LINN LANE
  186     HC       2
          *

  187     KK    OR-1
  188     KM   ORCHARDS OFFSITE DRAINAGE BASIN 01; CONTRIBUTES FLOW TO NODE X1.
  189     KM   * BASINS WITH THE "OR" PREFIX ARE TAKEN FROM THE "CONCEPTUAL MASTER        *
  190     KM   * DRAINAGE STUDY FOR LEWIS HOMES - ORCHARDS," BY PENTACORE, JANUARY, 1992. *
  191     KM   * THE MAJORITY OF THE ORCHARDS SITE IS CONSTRUCTED; HOWEVER, THE PLANNED   *
  192     KM   * ORCHARDS DETENTION BASIN IS NOT CONSTRUCTED. HYDROLOGY FROM THE ORCHARDS *
  193     KM   * DRAINAGE STUDY HAS BEEN MODIFIED TO REPRESENT APPROXIMATE EXISTING       *
  194     KM   * CONDITIONS, RATHER THAN FULLY DEVELOPED CONDITIONS.                      *
  195     PB    3.00
  196     BA   0.279
  197     LS       0      89
  198     UD    0.18
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  199     KK   X1-X2
  200     KM   ROUTE X1 THROUGH BASIN OR-2 TO NODE X2.
  201     RK   10000   0.033    0.02       0    TRAP      20      10
          *

  202     KK    OR-2
  203     KM   ORCHARDS OFFSITE DRAINAGE BASIN 02; CONTRIBUTES FLOW TO NODE X2.
  204     BA   1.206
  205     PB    2.93
  206     LS       0      75
  207     UD    0.60
          *

  208     KK NODE.X2
  209     KM   COMBINE FLOW FROM X1 AND BASIN OR-2 AT NODE X2.
  210     KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. EAST OF SLOAN CHANNEL.
  211     HC       2
          *

  212     KK NODE.V4
  213     KM   COMBINE FLOW FROM V3, X2 AND BASIN 326-A.
  214     KM   GIVES TOTAL FLOW TO THE SLOAN CHANNEL AT CHARLESTON BLVD.
  215     HC       3
          *

  216     KK   OR-11
  217     KM   ORCHARDS ONSITE BASIN OR-11 CONTRIBUTES FLOW TO NODE V5.
  218     BA  0.0428
  219     PB    2.85
  220     LS       0      75
  221     UD    0.20
          *

  222     KK NODE.V5
  223     KM   COMBINE FLOW FROM V4 AND BASIN OR-11.
  224     KM   TOTAL FLOW TO THE SLOAN CHANNEL APPROX. 1500 FT. SOUTH OF CHARLESTON BLVD.
  225     HC       2
          *

  226     KK   V5-Z2
  227     KM   ROUTE V5 THROUGH SLOAN CHANNEL TO THE ORCHARDS CHANNEL CONFLUENCE AT Z2.
  228     RK    2800   0.005    0.03       0    TRAP      60       2
          *

  229     KK    OR-3
  230     KM   ORCHARDS OFFSITE DRAINAGE BASIN 03.
  231     KM   GIVES FLOW TO NODE Y1, LOCATED AT CHARLESTON WEST OF HOLLYWOOD.
  232     BA   0.205
  233     PB    3.00
  234     LS       0      82
  235     UD    0.42
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  236     KK   Y1-Z1
  237     KM   ROUTE NODE Y1 THROUGH BASIN OR-12 TO NODE Z1.
  238     RK    5500   0.011   0.016       0    TRAP      50       1
          *

  239     KK    OR-4
  240     KM   ORCHARDS OFFSITE DRAINAGE BASIN O4.
  241     KM   CONTRIBUTES FLOW TO NODE Y2.
  242     BA   0.448
  243     PB    3.00
  244     LS       0      88
  245     UD    0.29
          *

  246     KK   Y2-Y3
  247     KM   ROUTE NODE Y2 THROUGH BASIN OR-5 TO NODE Y3.
  248     RM       4    0.33    0.15
          *

  249     KK    OR-5
  250     KM   ORCHARDS OFFSITE DRAINAGE BASIN O5.
  251     KM   CONTRIBUTES FLOW TO NODE Y3.
  252     BA   0.373
  253     PB    3.00
  254     LS       0      77
  255     UD    0.44
          *

  256     KK      Y3
  257     KM   COMBINE FLOWS FROM Y2 AND BASIN OR-5 AT HOLLYWOOD.
  258     HC       2
          *

  259     KK   Y3-Z1
  260     KM   ROUTE Y3 THROUGH BASIN OR-12 TO NODE Z1.
  261     RK    5000   0.012   0.016       0    TRAP      50       1
          *

  262     KK   OR-6A
  263     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6A.
  264     BA   0.264
  265     PB    3.00
  266     LS       0      88
  267     UD     .13
          *

  268     KK   OR-6B
  269     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6B,
  270     BA   0.160
  271     PB    3.00
  272     LS       0      89
  273     UD     .14
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  274     KK   OR-6C
  275     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6C.
  276     BA   0.191
  277     PB    3.00
  278     LS       0      87
  279     UD     .18
          *

  280     KKNODE.AA1
  281     KM   COMBINE FLOWS FROM BASINS OR-6A, OR-6B & OR-6C.
  282     HC       3
          *

  283     KK AA1-AA2
  284     KM   ROUTE AA1 THROUGH BASIN OR-7 TO NODE AA2.
  285     RM       4    0.32    0.15
          *

  286     KK    OR-7
  287     KM   ORCHARDS OFFSITE DRAINAGE BASIN O7.
  288     BA   0.613
  289     PB    3.00
  290     LS       0      77
  291     UD    0.49
          *

  292     KKNODE.AA2
  293     KM   COMBINE AA1 WITH FLOW FROM BASIN OR-7 AT NODE AA2.
  294     HC       2
          *

  295     KK  AA2-Z1
  296     KM   ROUTE AA2 THROUGH BASIN OR-12 TO NODE Z1.
  297     RK    4500   0.013   0.016       0    TRAP      50       1
          •

  298     KK    OR-8
  299     KM   ORCHARDS OFFSITE BASIN O8; CONTRIBUTES FLOW TO NODE AA3.
  300     BA   0.017
  301     PB    3.00
  302     LS       0      77
  303     UD    0.18
          *

  304     KK  R8-AA3
  305     KM   ROUTE FLOW FROM BASIN OR-8 THROUGH BASIN OR-9 TO NODE AA3 AT HOLLYWOOD.
  306     RM      10    0.82    0.15
          *
```

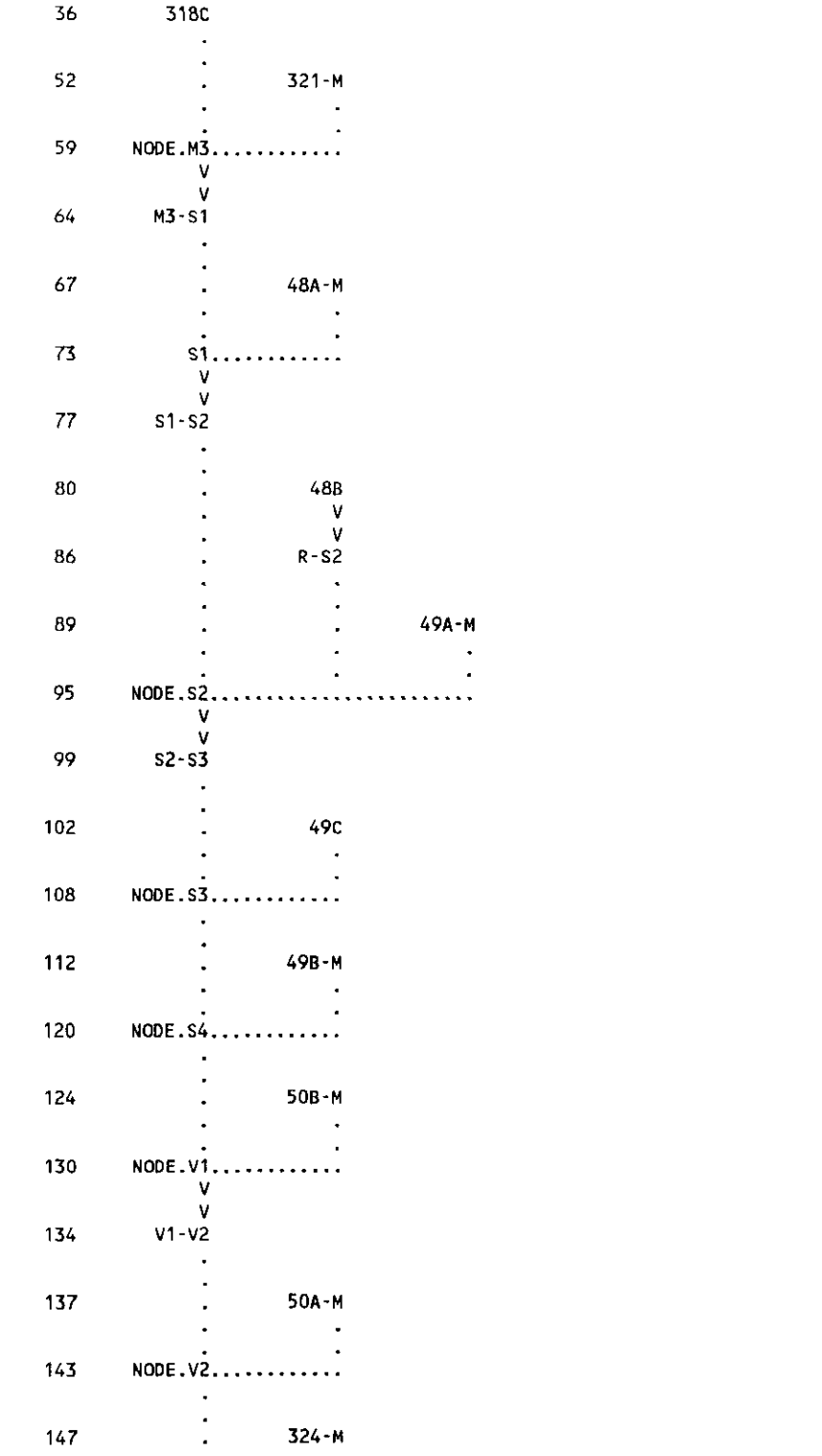
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

307       KK    OR-9
308       KM   ORCHARDS OFFSITE DRAINAGE BASIN O9; CONTRIBUTES FLOW TO NODE AA3.
309       BA   0.278
310       PB    3.00
311       LS       0      77
312       UD    0.65
          *

313       KKNODE.AA3
314       KM   COMBINE FLOWS FROM BASINS OR-8 AND OR-9 AT NODE AA3.
315       HC       2
          *

316       KK  AA3-Z1
317       KM   ROUTE AA3 THROUGH BASIN OR-12 TO NODE Z1.
318       RK    4500   0.012   0.016       0    TRAP      50       1
          *

319       KK   OR-12
320       KM   ORCHARDS ONSITE DRAINAGE BASIN 12; CONTRIBUTES FLOW TO NODE Z1.
321       BA   0.525
322       PB    2.85
323       LS       0      76
324       UD    0.39
          *

325       KK NODE.Z1
326       KM   COMBINE FLOW FROM NODES Y1, Y3, AA2, AA3 AND BASIN OR-12 AT NODE Z1.
327       KM   NODE Z1 REPRESENTS THE TOTAL FLOW IN THE CONCRETE-LINED ORCHARDS CHANNEL
328       KM   TRIBUTARY TO THE SLOAN CHANNEL.
329       HC       5
          *

330       KK NODE.Z2
331       KM   COMBINE FLOW FROM NODES V5 AND Z1.
332       KM   TOTAL FLOW IN THE SLOAN CHANNEL AT ITS CONFLUENCE WITH THE ORCHARDS CHANNEL.
333       HC       2
          *

334       KK   OR-13
335       KM   ORCHARDS ONSITE DRAINAGE BASIN OR-13; CONTRIBUTES FLOW TO NODE Z3.
336       BA   0.120
337       PB    2.85
338       LS       0      84
339       UD    0.29
          *

340       KK NODE.Z3
341       KM   COMBINE FLOW FROM NODES Z2 AND BASIN OR-13 AT NODE Z3.
342       KM   NODE Z3 IS THE TOTAL FLOW IN THE SLOAN CHANNEL AT APPROXIMATELY
343       KM   450 FEET SOUTH OF THE ORCHARDS CHANNEL CONFLUENCE.
344       HC       2
          *
```

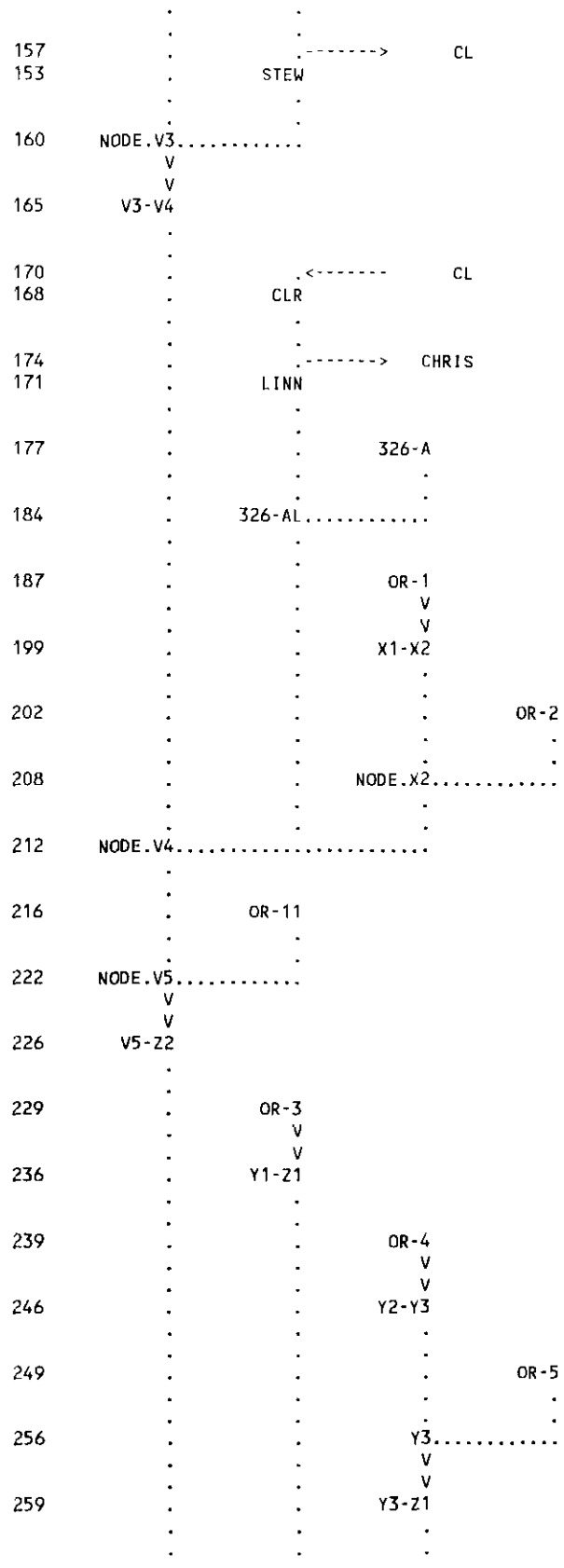
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

345       KK   OR-10
346       KM   ORCHARDS OFFSITE DRAINAGE BASIN O10.
347       KM   CONTRIBUTES FLOW TO NODE BB1, LOCATED AT THE HOLLYWOOD/SAHARA INTERSECTION.
348       BA  0.0984
349       PB   3.00
350       LS      0      77
351       UD   0.45
          *

352       KK BB1-BB2
353       KM   ROUTE BB1 THROUGH SAHARA AVENUE TO NODE BB2.
354       RK    4000   0.014   0.016       0    TRAP     100       1
          *

355       KK   OR-14
356       KM   ORCHARDS ONSITE DRAINAGE BASIN 14; CONTRIBUTES FLOW TO NODE BB2.
357       BA  0.0937
358       PB   2.85
359       LS      0      75
360       UD   0.33
          *

361       KKNODE.BB2
362       KM   NODE BB2 REPRESENTS THE TOTAL FLOW IN SAHARA AVE. EAST OF THE SLOAN CHANNEL.
363       HC      2
          *

364       KKNODE.BB3
365       KM   COMBINE FLOW FROM Z3 WITH FLOW FROM BB2.
366       KM   NODE BB3 IS THE TOTAL FLOW IN SLOAN CHANNEL AT SAHARA AVE.
367       HC      2
          *

368       KK  BB3-CC
369       KM   ROUTE BB3 THROUGH THE SLOAN CHANNEL TO NODE CC.
370       RK    1700   0.006   0.025       0    TRAP      80       2
          •

371       KK   52A-M
372       KM   BASIN 52A-M CONTRIBUTES FLOW TO NODE CC.
373       BA   0.286
374       PB   2.85
375       LS      0      73
376       UD   0.84
          *

377       KK NODE.CC
378       KM   COMBINE FLOW FROM  NODE BB3 WITH FLOW FROM BASINS 326-B AND 52A-M.
379       KM   NODE CC REPRESENTS THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
380       KM   ITS CONFLUENCE WITH THE LAS VEGAS WASH.
381       HC      2
          *
382       ZZ
```

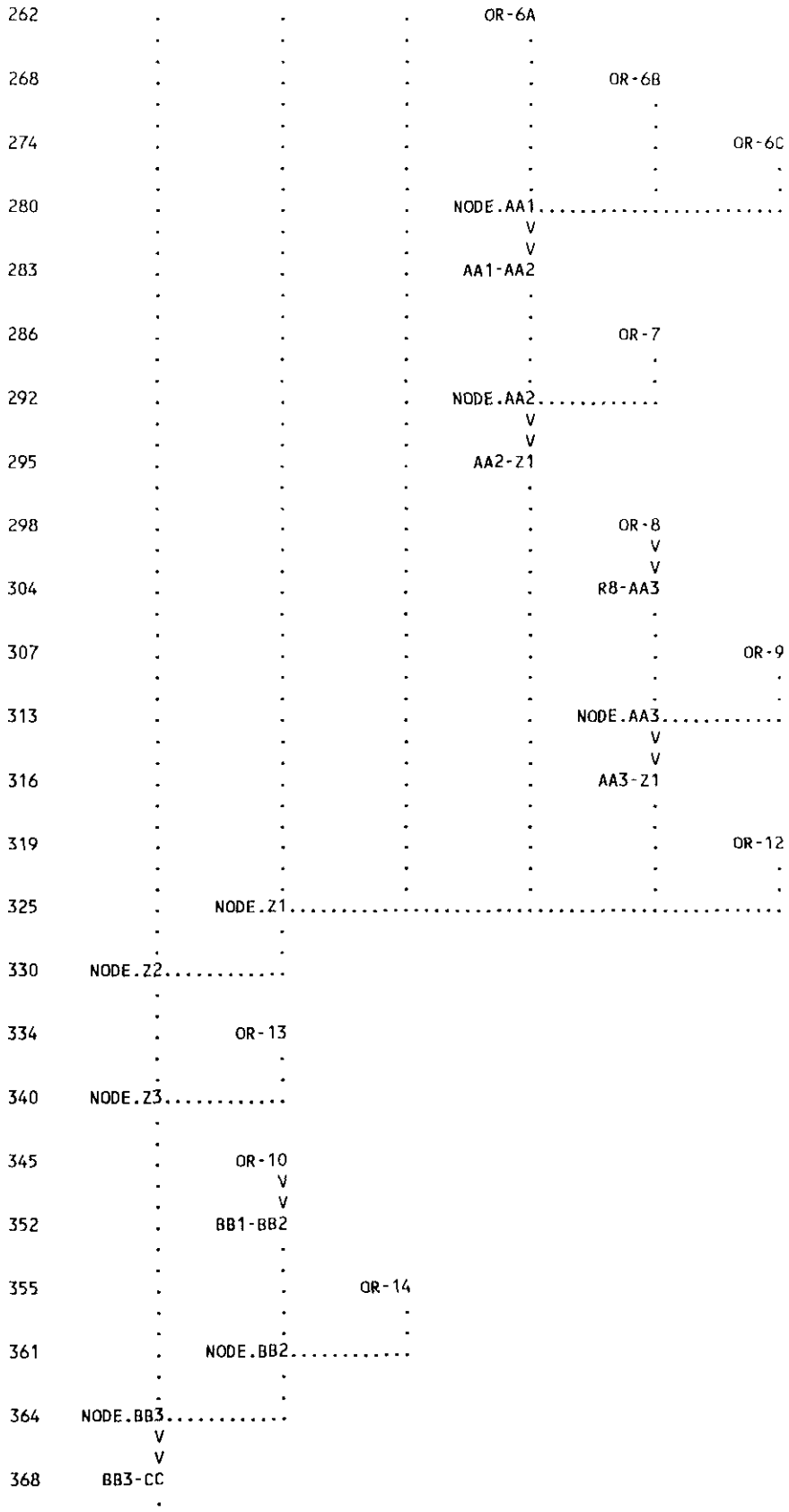
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (.) CONNECTOR (---->) DIVERSION OR PUMP FLOW (<----) RETURN OF DIVERTED OR PUMPED FLOW




157
153
STEW
160
NODE.V3
165
V3-V4
170
168
CLR
174
171
LINN
CHRIS
177
326-A
184
326-AL
187
OR-1
199
X1-X2
202
OR-2
208
NODE.X2
212
NODE.V4
216
OR-11
222
NODE.V5
226
V5-Z2
229
OR-3
236
Y1-Z1
239
OR-4
246
Y2-Y3
249
OR-5
256
Y3
259
Y3-Z1


262
OR-6A
268
OR-6B
274
OR-6C
280
NODE.AA1
283
AA1-AA2
286
OR-7
292
NODE.AA2
295
AA2-Z1
298
OR-8
304
R8-AA3
307
OR-9
313
NODE.AA3
316
AA3-Z1
319
OR-12
325
NODE.Z1
330
NODE.Z2
334
OR-13
340
NODE.Z3
345
OR-10
352
BB1-BB2
355
OR-14
361
NODE.BB2
364
NODE.BB3
368
BB3-CC

```
                .
371             .       52A-M
                .         .
                .         .
377     NODE.CC............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)*
*            SEPTEMBER 1990          *
*             VERSION 4.0            *
*                                    *
*  RUN DATE  01/12/1996  TIME  09:54:56*
*                                    *
**************************************
```


```
**************************************
*                                    *
*    U.S. ARMY CORPS OF ENGINEERS    *
*    HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET         *
*        DAVIS, CALIFORNIA 95616     *
*            (916) 756-1104          *
*                                    *
**************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFIS-CC.DAT
DECEMBER 1995

EXISTING CONDITIONS DOWNSTREAM OF THE
CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION.
STORM CENTERING FOR NODE V2, AT SLOAN CHANNEL DOWNSTREAM OF STEWART,
AND FOR NODE CC, AT THE SLOAN CHANNEL AND LAS VEGAS WASH CONFLUENCE.

```
**************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE           *
*                          RANGE WASH WATERSHED                          *
*                 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.        *
*                                JANUARY 1991                            *
*                   PRESENT CONDITIONS, EXISTING FACILITIES              *
*                    BASED ON RANGE WASH FACILITIES STUDY                *
*                       BOYLE ENGINEERS CORP-JULY 1989                   *
*                                                                        *
*                   (CONVERTED RK TO RM IN UPLAND SUBAREAS)              *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
**************************************************************************
*                      100-YEAR, 6-HOUR STORM, AMC 2.0                   *
**************************************************************************
* STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
*  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
*  JR DARF RATIO 0.85 FOR NODE V2, AT SLOAN CHANNEL DOWNSTREAM OF STEWART *
*  AND 0.82 FOR NODE CC, AT THE SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE.  *
**************************************************************************
```

```
34 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE     1   0  ENDING DATE
                     NDTIME        1635  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL      .08 HOURS
                       TOTAL TIME BASE    16.58 HOURS

       ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT

   JP          MULTI-PLAN OPTION
                     NPLAN          1  NUMBER OF PLANS

   JR          MULTI-RATIO OPTION
                   RATIOS OF PRECIPITATION
                   .85       .82
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .85	RATIO 2 .82
HYDROGRAPH AT						
+	318C	1.28	1	FLOW	312.	290.
				TIME	4.25	4.25
HYDROGRAPH AT						
+	321-M	.69	1	FLOW	45.	41.
				TIME	5.92	5.92
2 COMBINED AT						
+	NODE.M3	1.97	1	FLOW	323.	299.
				TIME	4.25	4.25
ROUTED TO						
+	M3-S1	1.97	1	FLOW	322.	298.
				TIME	4.25	4.25
HYDROGRAPH AT						
+	48A-M	.71	1	FLOW	290.	272.
				TIME	3.83	3.83
2 COMBINED AT						
+	S1	2.69	1	FLOW	545.	507.
				TIME	4.00	4.08
ROUTED TO						
+	S1-S2	2.69	1	FLOW	545.	507.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	48B	1.14	1	FLOW	627.	596.
				TIME	3.92	3.92
ROUTED TO						
+	R-S2	1.14	1	FLOW	621.	589.
				TIME	4.00	4.08
HYDROGRAPH AT						
+	49A-M	.69	1	FLOW	200.	185.
				TIME	3.92	3.92
3 COMBINED AT						
+	NODE.S2	4.52	1	FLOW	1352.	1268.
				TIME	4.00	4.08
ROUTED TO						
+	S2-S3	4.52	1	FLOW	1351.	1268.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	49C	.43	1	FLOW	96.	88.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.S3	4.95	1	FLOW	1445.	1355.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	49B-M	1.98	1	FLOW	788.	742.
				TIME	4.00	4.00

2 COMBINED AT						
+	NODE.S4	6.92	1	FLOW	2225.	2090.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	50B-M	.63	1	FLOW	237.	221.
				TIME	3.75	3.75
2 COMBINED AT						
+	NODE.V1	7.55	1	FLOW	2420.	2270.
				TIME	4.00	4.00
ROUTED TO						
+	V1-V2	7.55	1	FLOW	2409.	2262.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	50A-M	.21	1	FLOW	40.	36.
				TIME	3.92	3.92
2 COMBINED AT						
+	NODE.V2	7.76	1	FLOW	2446.	2296.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	324-M	3.03	1	FLOW	407.	368.
				TIME	4.33	4.33
DIVERSION TO						
+	CL	3.03	1	FLOW	221.	199.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	STEW	3.03	1	FLOW	186.	169.
				TIME	4.33	4.33
2 COMBINED AT						
+	NODE.V3	10.78	1	FLOW	2618.	2450.
				TIME	4.08	4.08
ROUTED TO						
+	V3-V4	10.78	1	FLOW	2610.	2442.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	CLR	.00	1	FLOW	221.	199.
				TIME	4.33	4.33
DIVERSION TO						
+	CHRIS	.00	1	FLOW	172.	155.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	LINN	.00	1	FLOW	49.	44.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	326-A	.23	1	FLOW	74.	68.
				TIME	3.75	3.75
2 COMBINED AT						
+	326-AL	.23	1	FLOW	106.	97.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-1	.28	1	FLOW	231.	220.
				TIME	3.58	3.58
ROUTED TO						
+	X1-X2	.28	1	FLOW	220.	206.
				TIME	3.75	3.75

HYDROGRAPH AT						
+	OR-2	1.21	1	FLOW	254.	233.
				TIME	4.08	4.08
2 COMBINED AT						
+	NODE.X2	1.49	1	FLOW	408.	376.
				TIME	3.75	3.75
3 COMBINED AT						
+	NODE.V4	12.50	1	FLOW	3072.	2870.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-11	.04	1	FLOW	14.	13.
				TIME	3.58	3.58
2 COMBINED AT						
+	NODE.V5	12.54	1	FLOW	3078.	2876.
				TIME	4.08	4.08
ROUTED TO						
+	V5-Z2	12.54	1	FLOW	3060.	2855.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-3	.20	1	FLOW	84.	79.
				TIME	3.83	3.83
ROUTED TO						
+	Y1-Z1	.20	1	FLOW	83.	77.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-4	.45	1	FLOW	293.	278.
				TIME	3.67	3.67
ROUTED TO						
+	Y2-Y3	.45	1	FLOW	258.	245.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-5	.37	1	FLOW	111.	102.
				TIME	3.83	3.83
2 COMBINED AT						
+	Y3	.82	1	FLOW	362.	342.
				TIME	4.00	4.00
ROUTED TO						
+	Y3-Z1	.82	1	FLOW	359.	339.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-6A	.26	1	FLOW	223.	212.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6B	.16	1	FLOW	140.	133.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6C	.19	1	FLOW	146.	138.
				TIME	3.58	3.58
3 COMBINED AT						
+	NODE.AA1	.62	1	FLOW	508.	483.
				TIME	3.58	3.58
ROUTED TO						
+	AA1-AA2	.62	1	FLOW	408.	387.

				TIME	3.83	3.83
HYDROGRAPH AT						
+	OR-7	.61	1	FLOW	173.	160.
				TIME	3.92	3.92
2 COMBINED AT						
+	NODE.AA2	1.23	1	FLOW	578.	544.
				TIME	3.83	3.83
ROUTED TO						
+	AA2-Z1	1.23	1	FLOW	572.	539.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-8	.02	1	FLOW	8.	7.
				TIME	3.58	3.58
ROUTED TO						
+	R8-AA3	.02	1	FLOW	5.	5.
				TIME	4.42	4.42
HYDROGRAPH AT						
+	OR-9	.28	1	FLOW	68.	63.
				TIME	4.08	4.08
2 COMBINED AT						
+	NODE.AA3	.29	1	FLOW	72.	66.
				TIME	4.17	4.17
ROUTED TO						
+	AA3-Z1	.29	1	FLOW	71.	66.
				TIME	4.25	4.25
HYDROGRAPH AT						
+	OR-12	.52	1	FLOW	137.	126.
				TIME	3.83	3.83
5 COMBINED AT						
+	NODE.Z1	3.07	1	FLOW	1177.	1101.
				TIME	3.92	3.92
2 COMBINED AT						
+	NODE.Z2	15.62	1	FLOW	4163.	3891.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-13	.12	1	FLOW	60.	56.
				TIME	3.67	3.67
2 COMBINED AT						
+	NODE.Z3	15.74	1	FLOW	4195.	3921.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-10	.10	1	FLOW	29.	27.
				TIME	3.83	3.83
ROUTED TO						
+	BB1-BB2	.10	1	FLOW	29.	27.
				TIME	4.00	4.08
HYDROGRAPH AT						
+	OR-14	.09	1	FLOW	25.	23.
				TIME	3.75	3.75
2 COMBINED AT						
+	NODE.BB2	.19	1	FLOW	48.	44.
				TIME	3.92	4.00
2 COMBINED AT						

+	NODE.BB3	15.93	1	FLOW	4241.	3964.
				TIME	4.08	4.08
ROUTED TO						
+	BB3-CC	15.93	1	FLOW	4237.	3959.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	52A-M	.29	1	FLOW	40.	36.
				TIME	4.33	4.42
2 COMBINED AT						
+	NODE.CC	16.22	1	FLOW	4272.	3990.
				TIME	4.08	4.08

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .85									
M3-S1	MANE	1.68	322.74	257.86	.64	5.00	321.79	255.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6771E+02 EXCESS= .0000E+00 OUTFLOW= .6772E+02 BASIN STORAGE= .9168E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .82									
M3-S1	MANE	1.73	298.79	257.22	.60	5.00	297.91	255.00	.60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6258E+02 EXCESS= .0000E+00 OUTFLOW= .6259E+02 BASIN STORAGE= .8285E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .85									
S1-S2	MANE	1.72	544.60	244.89	.75	5.00	544.60	245.00	.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1077E+03 EXCESS= .0000E+00 OUTFLOW= .1077E+03 BASIN STORAGE= .6011E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .82									
S1-S2	MANE	1.73	506.81	245.43	.70	5.00	506.78	245.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1001E+03 EXCESS= .0000E+00 OUTFLOW= .1001E+03 BASIN STORAGE= .5599E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .85									
R-S2	MANE	4.46	624.64	240.81	1.58	5.00	621.18	240.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9583E+02 EXCESS= .0000E+00 OUTFLOW= .9603E+02 BASIN STORAGE= .2964E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .82									
R-S2	MANE	4.54	593.72	241.41	1.49	5.00	589.08	245.00	1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9084E+02 EXCESS= .0000E+00 OUTFLOW= .9100E+02 BASIN STORAGE= .3480E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .85									
S2-S3	MANE	.99	1351.53	242.33	.97	5.00	1351.22	245.00	.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2328E+03 EXCESS= .0000E+00 OUTFLOW= .2329E+03 BASIN STORAGE= .9229E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .82									
S2-S3	MANE	.99	1268.16	245.48	.90	5.00	1268.07	245.00	.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2181E+03 EXCESS= .0000E+00 OUTFLOW= .2181E+03 BASIN STORAGE= .8398E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .85									
V1-V2	MANE	.67	2419.16	241.61	1.01	5.00	2409.21	245.00	1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4070E+03 EXCESS= .0000E+00 OUTFLOW= .4070E+03 BASIN STORAGE= .1041E-01 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .82
             V1-V2  MANE          .61    2269.59     241.59       .95      5.00    2262.06     245.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3815E+03 EXCESS= .0000E+00 OUTFLOW= .3815E+03 BASIN STORAGE= .1066E-01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .85
             V3-V4  MANE         1.18    2614.11     247.01       .78      5.00    2610.32     245.00         .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4507E+03 EXCESS= .0000E+00 OUTFLOW= .4508E+03 BASIN STORAGE= .2760E-01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .82
             V3-V4  MANE         1.20    2447.30     247.22       .73      5.00    2441.87     245.00         .73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4216E+03 EXCESS= .0000E+00 OUTFLOW= .4217E+03 BASIN STORAGE= .2788E-01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .85
             X1-X2  MANE         4.27     229.82     223.45      1.51      5.00     219.70     225.00        1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2230E+02 EXCESS= .0000E+00 OUTFLOW= .2254E+02 BASIN STORAGE= .2110E-03 PERCENT ERROR=  -1.1

          FOR PLAN = 1  RATIO=  .82
             X1-X2  MANE         4.24     209.83     221.69      1.43      5.00     205.56     225.00        1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2113E+02 EXCESS= .0000E+00 OUTFLOW= .2129E+02 BASIN STORAGE= .1659E-03 PERCENT ERROR=   -.8

          FOR PLAN = 1  RATIO=  .85
             V5-Z2  MANE         1.18    3075.27     247.18       .80      5.00    3060.30     245.00         .80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5348E+03 EXCESS= .0000E+00 OUTFLOW= .5350E+03 BASIN STORAGE= .3889E-01 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .82
             V5-Z2  MANE         1.12    2873.14     247.49       .75      5.00    2854.86     245.00         .75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4997E+03 EXCESS= .0000E+00 OUTFLOW= .4999E+03 BASIN STORAGE= .3920E-01 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .85
             Y1-Z1  MANE         3.99      83.27     238.87      1.04      5.00      83.14     235.00        1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1131E+02 EXCESS= .0000E+00 OUTFLOW= .1134E+02 BASIN STORAGE= .1712E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .82
             Y1-Z1  MANE         4.04      77.97     235.57       .97      5.00      77.49     235.00         .97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1059E+02 EXCESS= .0000E+00 OUTFLOW= .1063E+02 BASIN STORAGE= .1776E-02 PERCENT ERROR=   -.4

          FOR PLAN = 1  RATIO=  .85
             Y3-Z1  MANE         2.13     360.97     242.90      1.13      5.00     359.37     245.00        1.13

INUITY SUMMARY (AC-FT) - INFLOW= .4939E+02 EXCESS= .0000E+00 OUTFLOW= .4946E+02 BASIN STORAGE= .1313E-02 PERCENT ERROR=   -.2
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          FOR PLAN = 1  RATIO=  .82
            Y3-Z1  MANE          2.17    340.80    244.17      1.06      5.00    338.70    245.00        1.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4642E+02 EXCESS= .0000E+00 OUTFLOW= .4650E+02 BASIN STORAGE= .1471E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .85
            AA2-Z1  MANE          1.52    576.80    232.93      1.10      5.00    572.49    235.00        1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7186E+02 EXCESS= .0000E+00 OUTFLOW= .7197E+02 BASIN STORAGE= .1299E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .82
            AA2-Z1  MANE          1.63    540.39    234.43      1.03      5.00    539.02    235.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6749E+02 EXCESS= .0000E+00 OUTFLOW= .6759E+02 BASIN STORAGE= .1101E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .85
            AA3-Z1  MANE          3.45     71.41    256.18       .77      5.00     71.33    255.00         .77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1214E+02 EXCESS= .0000E+00 OUTFLOW= .1216E+02 BASIN STORAGE= .1216E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .82
            AA3-Z1  MANE          3.45     66.15    256.72       .72      5.00     65.98    255.00         .72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1126E+02 EXCESS= .0000E+00 OUTFLOW= .1127E+02 BASIN STORAGE= .1284E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .85
            BB1-BB2  MANE         5.00     28.84    240.58       .78      5.00     28.66    240.00         .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4051E+01 EXCESS= .0000E+00 OUTFLOW= .4070E+01 BASIN STORAGE= .1893E-02 PERCENT ERROR=   -.5


          FOR PLAN = 1  RATIO=  .82
            BB1-BB2  MANE         5.00     26.55    244.95       .72      5.00     26.54    245.00         .72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3754E+01 EXCESS= .0000E+00 OUTFLOW= .3767E+01 BASIN STORAGE= .2057E-02 PERCENT ERROR=   -.4


          FOR PLAN = 1  RATIO=  .85
            BB3-CC  MANE           .55   4239.29    245.74       .84      5.00   4237.45    245.00         .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7117E+03 EXCESS= .0000E+00 OUTFLOW= .7118E+03 BASIN STORAGE= .3026E-01 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .82
            BB3-CC  MANE           .64   3961.05    245.72       .78      5.00   3958.59    245.00         .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6655E+03 EXCESS= .0000E+00 OUTFLOW= .6655E+03 BASIN STORAGE= .2962E-01 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
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RFIS-ALL.OUT

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*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1996  TIME  09:50:25 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
          *DIAGRAM
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID              FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                              JOB. NO. 51804
    5     ID                          HEC-1 FILE: RFIS-ALL.DAT
    6     ID                               JANUARY 1996
    7     ID
    8     ID       EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE, AND ALSO
    9     ID       WITH THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
   10     ID   STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR THE CONFLUENCE DETENTION BASIN
   11     ID
   12     ID   ********************************************************************************
   13     ID   *             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                 *
   14     ID   *                          RANGE WASH WATERSHED                                *
   15     ID   *               JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.                *
   16     ID   *                                JANUARY 1991                                  *
   17     ID   *                  PRESENT CONDITIONS, EXISTING FACILITIES                    *
   18     ID   *                   BASED ON RANGE WASH FACILITIES STUDY                      *
   19     ID   *                      BOYLE ENGINEERS CORP-JULY 1989                         *
   20     ID   *                                                                             *
   21     ID   *                   (CONVERTED RK TO RM IN UPLAND SUBAREAS)                   *
   22     ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
   23     ID   ********************************************************************************
   24     ID   *                      100-YEAR, 6-HOUR STORM, AMC 2.0                        *
   25     ID   ********************************************************************************
   26     ID   * STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
   27     ID   *    JR DARF RATIO 0.630 AT THE CONFLUENCE DETENTION BASIN, NODE DB.IN    *
   28     ID   * JR DARF RATIO 0.601 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
   29     ID   ********************************************************************************
   30     ID
   31     IT     05       0       0     200
   32     IO      5       0       0
   33     JR   PREC    0.60     .63

   34     KK  306B-M
   35     KM   BASIN 306B-M CONTRIBUTES FLOW TO NODE F3, THE BRIDGE AT THE UPRR,
   36     KM   MPU FACILITY RWWB 0027,(2) 21'X12' BRIDGE OPENINGS.
   37     BA   5.528
   38     PB    2.77
   39     PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   40     PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   41     PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   42     PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   43     PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   44     PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   45     PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   46     PC    .997    .999   1.00
   47     LS       0      74
   48     UD    0.93
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK  307A-M
  50      KM   BASIN 307A-M CONTRIBUTES FLOW TO NODE F4, THE BOX CULVERT AT THE UPRR,
  51      KM   MPU FACILITY RWWE 0202, A 12'X8' RCB.
  52      BA   2.516
  53      PB    2.77
  54      LS       0      76
  55      UD    1.10
          *

  56      KK NODE.G1
  57      KM   COMBINE FLOW FROM F3 AND F4, NODE G1 IS THE BOX CULVERT AT INTERSTATE 15,
  58      KM   MPU FACILITY RWWE 0168, (3) 15'X10' RCBS.
  59      HC       2
          *

  60      KK   G1-G3
  61      KM   ROUTE FLOW FROM G1 THROUGH BASIN 307B-M TO G3.
  62      RM       5     .40      .3
          *

  63      KK  307B-M
  64      KM   BASIN 307B-M CONTRIBUTES FLOW TO NODE G3.
  65      BA   0.677
  66      PB    2.77
  67      LS       0      81
  68      UD    0.79
          *

  69      KK NODE.G3
  70      KM   COMBINE FLOW FROM G1 WITH FLOW FROM BASIN 307B-M.
  71      KM   NODE G3 REPRESENTS EAST TRIB TO NODE G2 AT LAS VEGAS BLVD.
  72      HC       2
          *

  73      KK    307C
  74      KM   307C MODIFIED DUE TO GOLDEN TRIANGLE INDUSTRIAL PARK
  75      KM   BASIN 307C CONTRIBUTES FLOW TO UPSTREAM OF INDUSTRIAL PARK
  76      BA    .503
  77      PB    2.77
  78      LS       0      77
  79      UD     .79
          *

  80      KK    TOG4
  81      KM   ROUTE FLOW THROUGH INDUSTRIAL PARK
  82      RK    6000   0.010   0.020       0    TRAP       3      50
          *

  83      KK    307D
  84      KM   AREA OF GOLDEN TRIANGLE INDUSTRIAL PARK
  85      BA    .323
  86      PB    2.77
  87      LS       0      88
  88      UD     .30
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK      G4
  90      KM    NODE G4 AT WALNUT AND MITCHELL
  91      KM    ASSUMES NO STORAGE OR CULVERT CAPACTIY RESTRICTION
  92      HC       2
          *

  93      KK    G4-G2
  94      KM    ROUTE FLOW FROM NODE G4 TO NODE G2.
  95      RK     8600   0.008   0.025       0    TRAP       3      50
          *

  96      KK     307E
  97      KM    BASIN 307E CONTRIBUTES FLOW TO NODE G7.
  98      BA    0.766
  99      PB     2.77
 100      LS        0      79
 101      UD     0.60
          *

 102      KK NODE.G7
 103      KM    COMBINE FLOW FROM NODE G4 AND BASIN 307E.
 104      KM    NODE G7, LOCATED NEAR THE ALEXANDER/LAMB INTERSECTION,
 105      KM    REPRESENTS THE TOTAL FLOW IN THE WESTERN TRIBUTARY TO NODE G2.
 106      HC       2
          *

 107      KK NODE.G2
 108      KM    COMBINE FLOW FROM NODES G3 AND G7; GIVES TOTAL FLOW TO G2.
 109      KM    NODE G2 IS MPU FACILITY RWSL 0745, (7) 10'X7' RCBS AT LAS VEGAS BLVD.
 110      HC       2
          *

 111      KK    G2-G8
 112      KM    ROUTE FLOW TO NODE G8
 113      RK     2500    .003    .015       0    TRAP      20       2
          *

 114      KK    309-M
 115      KM    BASIN 309-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
 116      KM    AND THEN CROSSING BENEATH I-15.
 117      KM    SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
 118      KM    MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0303, 0201, 0182, 0121, & 0085.
 119      KM    MPU FACILITIES AT I-15 ARE LABELED IS15 1917 AND IS15 1968.
 120      KM    NODE I3 IS LOCATED ARBITRARILY NEAR THE MIDDLE OF BASIN 309-M FOR
 121      KM    MODELING PURPOSES ONLY AND IS NOT THE ONLY CONCENTRATION POINT FOR 309-M.
 122      BA    3.976
 123      PB     2.77
 124      LS        0      75
 125      UD     0.86
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  126     KK   I3-I4
  127     KM   ROUTE FLOW FROM I3 THROUGH BASIN 310B-M TO I4.
  128     RM       9     .73      .2
          *

  129     KK  310B-M
  130     KM   BASIN 310B-M CONTRIBUTES FLOW TO NODE I4.
  131     BA   4.573
  132     PB    2.77
  133     LS       0      82
  134     UD     1.0
          *

  135     KK NODE.I4
  136     KM   COMBINE FLOW FROM NODE I3 AND BASIN 310B-M AT NODE I4.
  137     KM   NODE I4 IS MPU FACILITY SLEB 0044, (6) 10'X7' RCBS AT LAS VEGAS BLVD.
  138     KM   AT THE ENTRANCE TO THE CONCRETE LINED CHANNEL THAT EXTENDS THROUGH THE
  139     KM   TRAILER PARKS.
  140     HC       2
          *

  141     KK   I4-G8
  142     KM   ROUTE FLOW FROM I4 THROUGH THE CONCRETE CHANNEL TO G8.
  143     RK    2300   0.002   0.015       0    TRAP      20     1.5
          *

  144     KK NODE.G8
  145     KM   COMBINE FLOW FROM I4 AND G2 TO GIVE THE TOTAL FLOW AT NODE G8.
  146     KM   NODE G8 IS THE CONFLUENCE OF THE CONCRETE LINED CHANNELS, LABELED AS
  147     KM   MPU FACILITIES RWSL 0672 AND SLEB 0000.
  148     HC       2
          *

  149     KK   G8-G9
  150     KM   ROUTE FLOW FROM G8 THROUGH THE CONCRETE CHANNEL TO G9.
  151     RK    8400   0.003   0.015       0    TRAP      20       2
          *

  152     KK     47C
  153     KM   BASIN 47C CONTRIBUTES FLOW TO THE PORTION OF THE CONCRETE CHANNEL
  154     KM   LOCATED UPSTREAM OF THE DIVERSION STRUCTURE.
  155     BA   0.856
  156     PB    2.77
  157     LS       0      79
  158     UD     .49
          *

  159     KK NODE.G9
  160     KM   COMBINE FLOW FROM G8 WITH FLOW FROM BASIN 47C.
  161     KM   NODE G9 REPRESENTS THE TOTAL FLOW IN THE CONCRETE CHANNEL, LABELED
  162     KM   MPU FACILITY RWSL 0576, LOCATED JUST UPSTREAM OF THE DIVERSION STRUCTURE.
  163     HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  164     KK     DIV
  165     KM   FLOW DIVERSION STRUCTURE; SOME FLOW IS DIVERTED INTO THE CHANNEL THAT
  166     KM   EXTENDS THROUGH THE NELLIS AIR FORCE BASE GOLF COURSE.  FLOW IN THE NAFB
  167     KM   GOLF COURSE CHANNEL WILL THEN ENTER THE CONFLUENCE DETENTION BASIN.
  168     DT   RANGE
  169     DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
  170     DQ       0     850     900     950    1000    1050    1100    1200    1300    1400
          *

  171     KKG9-DB.IN
  172     KM   ROUTE FLOW FROM G9 THROUGH THE GOLF COURSE CHANNEL TO THE ENTRANCE
  173     KM   OF THE CONFLUENCE DETENTION BASIN, LABELED DB.IN.
  174     RK    4000   0.002    0.03       0    TRAP      70       3
          *

  175     KK   47B-M
  176     KM   MAJORITY OF BASIN 47B-M CONTRIBUTES FLOW TO THE NAFB GOLF COURSE CHANNEL;
  177     KM   PORTION OF 47B-M CONTRIBUTES FLOW DIRECTLY TO THE CONFLUENCE DETENTION BASIN.
  178     BA   3.378
  179     PB    2.81
  180     LS       0      84
  181     UD    0.60
          *

  182     KK     G10
  183     KM   COMBINE FLOW FROM GOLF WITH FLOW FROM BASIN 47B-M.
  184     KM   GIVES TOTAL FLOW TO THE NAFB GOLF COURSE CHANNEL.
  185     HC       2
          *

  186     KK   DBINW
  187     KM   ROUTE WEST TRIBUTARY THOUGH DET BASIN AREA
  188     RM       2     .16      .3
          *

  189     KK    44-M
  190     KM   BASIN 44-M CONTRIBUTES FLOW TO NODE J.
  191     KM   NODE J IS LOCATED NEAR THE CENTER OF BASIN 44-M FOR MODELING PURPOSES ONLY.
  192     BA   8.164
  193     PB    2.85
  194     LS       0      84
  195     UD    1.28
          *

  196     KK     J-K
  197     KM   ROUTE FLOW FROM NODE J THROUGH BASIN 312-M TO NODE K.
  198     RM      11    0.92    0.15
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  199     KK   312-M
  200     KM   BASIN 312-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
  201     KM   THEN CROSSING BENEATH I-15, AND THEN CROSSING BENEATH LAS VEGAS BLVD.
  202     KM   SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
  203     KM   MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0057, 0038, 0806, 0826, ETC.
  204     KM   MPU FACILITIES AT I-15 ARE LABELED IS15 2108, 2143, 2189, 2205, ETC.
  205     KM   THE MAJORITY OF FLOW FROM BASIN 312-M CONCENTRATES AT NODE K.
  206     BA  13.457
  207     PB   2.79
  208     LS      0      75
  209     UD   1.38
          *

  210     KK  NODE.K
  211     KM   COMBINE FLOW FROM J WITH FLOW FROM BASIN 312-M AT NODE K.
  212     HC      2
          *

  213     KK   K-P1
  214     KM   ROUTE FLOW FROM NODE K THROUGH BASIN 47A TO NODE P1.
  215     RM     10     .80     .15
          *

  216     KK   45-M
  217     KM   BASIN 45-M CONTRIBUTES FLOW TO NODE N2.
  218     BA   8.207
  219     PB   2.85
  220     LS      0      78
  221     UD   1.27
          *

  222     KK   N2-O
  223     KM   ROUTE FLOW FROM N2 THROUGH BASIN 48 TO NODE O.
  224     RM      4    0.37    0.15
          *

  225     KK     48
  226     KM   BASIN 48 CONTRIBUTES FLOW TO NODE O.
  227     BA   2.07
  228     PB   2.85
  229     LS      0      73
  230     UD   0.99
          *

  231     KK    46A
  232     KM   BASIN 46A CONTRIBUTES FLOW TO NODE O.
  233     BA   7.278
  234     PB   2.95
  235     LS      0      76
  236     UD   1.56
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  237     KK   46B-M
  238     KM   BASIN 46B-M CONTRIBUTES FLOW TO NODE O.
  239     BA   6.312
  240     PB    3.00
  241     LS       0      76
  242     UD    1.64
          *

  243     KK  NODE.O
  244     KM   COMBINE FLOW FROM N2 AND BASINS 48, 46A, AND 46B-M AT NODE O.
  245     HC       4
          *

  246     KK    O-P1
  247     KM   ROUTE FLOW FROM NODE O THROUGH BASIN 47A TO NODE P1.
  248     RM      10    0.85    0.15
          *

  249     KK     47A
  250     KM   BASIN 47A CONTRIBUTES FLOW TO NODE P1.
  251     BA   2.428
  252     PB    2.95
  253     LS       0      77
  254     UD    0.84
          *

  255     KK NODE.P1
  256     KM   COMBINE FLOW FROM NODES K AND O WITH FLOW FROM BASIN 47A AT NODE P1.
  257     HC       3
          *

  258     KK   P1-P2
  259     KM   ROUTE FROM NODE P1 TO NODE P2.
  260     RM       3     .28     .15
          *

  261     KK     317
  262     KM   BASIN 317 CONTRIBUTES FLOW TO NODE P2.
  263     BA   7.116
  264     PB   3.075
  265     LS       0      84
  266     UD    1.22
          *

  267     KK NODE.P2
  268     KM   COMBINE FLOW FROM P1 WITH FLOW FROM BASIN 317 AT NODE P2.
  269     HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  270     KK    P2-P
  271     KM   ROUTE FROM NODE P2 TO NODE P.
  272     RM       3     .26    0.15
          *

  273     KK    P2DB
  274     KM   STORAGE AREA NORTH OF HOLLYWOOD CULVERTS
  275     KM   CULVERTS AT HOLLYWOOD ARE 11 8X4 RCB CELLS
  276     RS       1    ELEV    24.5
  277     SV       0    0.05    1.04     4.4    11.8    24.7    44.8    73.6
  278     SQ       0     145     434     867    1420    2090    2850    5360
  279     SE    24.5      25      26      27      28      29      30      31
          *

  280     KK    318B
  281     KM   BASIN 318B CONTRIBUTES FLOW TO NODE Q.
  282     BA   1.591
  283     PB   3.145
  284     LS       0      87
  285     UD    0.60
          *

  286     KK     Q-P
  287     KM   ROUTE FLOW FROM NODE Q THROUGH BASIN 318A TO NODE P.
  288     RM       5    0.39    0.15
          *

  289     KK    318A
  290     KM   BASIN 318A CONTRIBUTES FLOW TO NODE P.
  291     BA   0.939
  292     PB    2.93
  293     LS       0      80
  294     UD    0.69
          *

  295     KK  NODE.P
  296     KM   COMBINE FLOWS FROM NODE P2, AND BASINS 318A AND 318B AT NODE P.
  297     KM   FLOW AT NODE P ENTERS THE CONFLUENCE DETENTION BASIN.
  298     HC       3
          *

  299     KK     PSV
  300     KM   STORAGE AREA UPSTREAM OF BASIN INFLOW STRUCTURE
  301     RS       1    ELEV      16
  302     SV       0     1.9    7.65    17.2    30.6    45.9    61.2
  303     SQ       0     330     990    1930    3140    4610    6370
  304     SE      16      17      18      19      20      21      22
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

305       KK DBIN-ER
306       KM   INFLOW TO DET BASIN FROM EAST TRIBUTARY
307       KM   ROUTE FLOW THROUGH THE CONFLUENCE DETENTION BASIN.
308       RM       4     .36     .15
          *

309       KK CON-DET
310       KM   BASIN AREA OF THE CONFLUENCE DETENTION BASIN.
311       BA   0.249
312       PB    2.85
313       LS       0      80
314       UD    0.90
          *

315       KK    DBIN
316       KM   COMBINE FLOW FROM NODES G10 AND P AND BASIN CON-DET.
317       KM   GIVES TOTAL FLOW TO THE CONFLUENCE DETENTION BASIN.
318       HC       3
319       KO       3
          *

320       KK  DB.OUT
321       KM   CONFLUENCE DETENTION BASIN
322       RS       1    ELEV       2
323       SV       0     3.2     9.9    21.4    39.2     102     217     563     708     864
324       SV    1025    1041    1056    1088    1119    1151
325       SQ       0      54     153     214     238     280     317     367     688    1263
326       SQ    1938    2147    2528    3608    5005    6661
327       SE       2       3       4       5       6       8      10      13      14      15
328       SE      16    16.1    16.2    16.4    16.6    16.8
329       KO       3
          *

330       KKDBOUT-M1
331       KM   ROUTE DB.OUT OUTFLOW TO NODE M1.
332       RK    2640   0.002   0.015       0    TRAP      20       2
          *

333       KK    318C
334       KM   BASIN 318C CONTRIBUTES FLOW TO NODE M1.
335       BA    1.28
336       PB    2.93
337       LS       0      79
338       UD    0.75
          *

339       KK NODE.M1
340       KM   COMBINE THE DETENTION BASIN OUTFLOW WITH FLOW FROM BASIN 318C.
341       KM   NODE M1 GIVES THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
342       KM   THE CONFLUENCE WITH THE RANGE WASH CHANNEL.
343       HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  344     KK   321-M
  345     KM   BASIN 321-M CONTRIBUTES FLOW TO THE RANGE WASH CHANNEL UPSTREAM OF
  346     KM   ITS CONFLUENCE WITH THE SLOAN CHANNEL.
  347     BA   0.691
  348     PB    2.77
  349     LS       0      67
  350     UD    1.66
          *

  351     KKRNG.CHNL
  352     KM   RETRIEVE THE FLOW THAT SPLIT INTO THE RANGE WASH CHANNEL THAT EXTENDS
  353     KM   SOUTHEASTERLY THROUGH THE NAFB.
  354     DR   RANGE
          *

  355     KK NODE.M2
  356     KM   COMBINE FLOW FROM BASIN 321-M WITH RETRIEVED FLOW IN THE RANGE WASH CHANNEL.
  357     KM   GIVES TOTAL FLOW IN THE RANGE WASH CHANNEL JUST UPSTREAM OF ITS CONFLUENCE
  358     KM   WITH THE SLOAN CHANNEL.
  359     HC       2
          *

  360     KK NODE.M3
  361     KM   COMBINE FLOWS FROM M1 AND M2 AT NODE M3.
  362     KM   NODE M3 IS THE TOTAL FLOW AT THE CONFLUENCE OF THE SLOAN CHANNEL
  363     KM   AND THE RANGE WASH CHANNEL AT SLOAN AND CAREY AVENUE.
  364     HC       2
          *

  365     KK   M3-S1
  366     KM   ROUTE FLOW FROM NODE M3 THROUGH THE SLOAN CHANNEL TO NODE S1.
  367     RK    2640   0.004   0.015       0    TRAP      40       3
          *

  368     KK   48A-M
  369     KM   BASIN 48A-M CONTRIBUTES FLOW TO NODE S1.
  370     BA   0.715
  371     PB    2.93
  372     LS       0      83
  373     UD    0.44
          *

  374     KK      S1
  375     KM   COMBINE FLOW FROM M3 WITH FLOW FROM BASIN 48A-M.
  376     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT LAKE MEAD BLVD.
  377     HC       2
          *

  378     KK   S1-S2
  379     KM   ROUTE FLOW FROM S1 THROUGH THE SLOAN CHANNEL TO S2.
  380     RK    2640   0.002   0.015       0    TRAP      50       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 381      KK     48B
 382      KM   BASIN 48B CONTRIBUTES FLOW TO NODE R.
 383      BA   1.142
 384      PB    3.10
 385      LS       0      89
 386      UD    0.51
          *

 387      KK     R-S2
 388      KM   ROUTE FLOW FROM R THROUGH BASIN 49A-M TO NODE S2.
 389      RK   10500   0.022    0.02       0    TRAP      10      20
          *

 390      KK   49A-M
 391      KM   BASIN 49A-M CONTRIBUTES FLOW TO NODE S2.
 392      BA   0.693
 393      PB    2.85
 394      LS       0      79
 395      UD    0.49
          *

 396      KK NODE.S2
 397      KM   COMBINE FLOW FROM NODES S1 AND R WITH FLOW FROM BASIN 49A-M AT NODE S2.
 398      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT OWENS AVENUE.
 399      HC       3
          *

 400      KK   S2-S3
 401      KM   ROUTE FLOW FROM S2 THROUGH THE SLOAN CHANNEL TO S3.
 402      RK    2640   0.004   0.014       0    TRAP      60       2
          *

 403      KK     49C
 404      KM   BASIN 49C CONTRIBUTES FLOW TO NODE S3.
 405      BA   0.426
 406      PB    2.85
 407      LS       0      76
 408      UD    0.53
          *

 409      KK NODE.S3
 410      KM   COMBINE FLOW FROM S2 WITH FLOW FROM BASIN 49C AT NODE S3.
 411      KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT WASHINGTON AVE.
 412      HC       2
          *

 413      KK   49B-M
 414      KM   BASIN 49B-M CONTRIBUTES FLOW TO NODE T1.
 415      KM   NODE T1 REPRESENTS THE TOTAL FLOW TO THE DIVERSION CHANNEL ALONG
 416      KM   WASHINGTON AVE. JUST UPSTREAM OF THE SLOAN CHANNEL.
 417      BA   1.977
 418      PB    3.00
 419      LS       0      85
 420      UD    0.61
          *
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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 421          KK NODE.S4
 422          KM   COMBINE FLOW FROM S3 WITH FLOW FROM T1 AT NODE S4.
 423          KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT HARRIS AVE.
 424          HC       2
              *

 425          KK   50B-M
 426          KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
 427          BA   0.628
 428          PB    3.00
 429          LS       0      80
 430          UD    0.39
              *

 431          KK NODE.V1
 432          KM   COMBINE FLOW FROM S4 WITH FLOW FROM BASIN 50B-M AT NODE V1.
 433          KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT BONANZA RD.
 434          HC       2
              *

 435          KK   V1-V2
 436          KM   ROUTE FLOWS FROM V1 THROUGH THE SLOAN CHANNEL TO NODE V2.
 437          RK    2640   0.008   0.014       0    TRAP      60       2
              *

 438          KK   50A-M
 439          KM   BASIN 50A-M CONTRIBUTES FLOW TO NODE V2.
 440          BA   0.207
 441          PB    2.85
 442          LS       0      73
 443          UD    0.46
              *

 444          KK NODE.V2
 445          KM   COMBINE FLOW FROM V1 WITH FLOW FROM BASIN 50A-M AT NODE V2.
 446          KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT STEWART AVE.
 447          HC       2
              *

 448          KK   324-M
 449          KM   BASIN 324-M CONTRIBUTES FLOW TO NODE V3.
 450          BA   3.026
 451          PB    2.85
 452          LS       0      72
 453          UD    0.77
              *

 454          KK    STEW
 455          KM   DIVERT FLOWS WHICH CONTINUE IN CHRISTY & LINN LANES, ETC
 456          KM   FLOW IN STEWART GOES TO SLOAN CHANNEL
 457          KM   FLOW IN CHRISTY GOES TOWARD LAS VEGAS WASH
 458          DT      CL
 459          DI       0      15     600
 460          DQ       0       0     330
              *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  461     KK NODE.V3
  462     KM   COMBINE FLOW FROM V2 WITH FLOW FROM BASIN 324-M AT NODE V3.
  463     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL
  464     KM   SOUTH OF STEWART AVE.
  465     HC       2
          *

  466     KK   V3-V4
  467     KM   ROUTE V3 THROUGH THE SLOAN CHANNEL TO V4.
  468     RK    2000   0.003    0.03       0    TRAP      80       2
          *

  469     KK     CLR
  470     KM   RETREIVE FLOW IN CHRISTY AND LINN LANES
  471     DR       CL
          *

  472     KK    LINN
  473     KM   FLOW IN LINN LANE GOES TO BASIN 326-A THEN TO SLOAN CHANNEL
  474     KM   FLOW IN CHRISTY GOES TO LAS VEGAS WASH
  475     DT   CHRIS
  476     DI       0     100     500
  477     DQ       0      78     390
          *

  478     KK   326-A
  479     KM   BASIN 326-A CONTRIBUTES FLOW TO NODE V4.
  480     KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. WEST OF SLOAN CHANNEL.
  481     BA   0.231
  482     PB    2.85
  483     LS       0      79
  484     UD    0.39
          *

  485     KK  326-AL
  486     KM   BASIN 326-A AND FLOW IN LINN LANE
  487     HC       2
          *

  488     KK    OR-1
  489     KM   ORCHARDS OFFSITE DRAINAGE BASIN 01; CONTRIBUTES FLOW TO NODE X1.
  490     KM   * BASINS WITH THE "OR" PREFIX ARE TAKEN FROM THE "CONCEPTUAL MASTER        *
  491     KM   * DRAINAGE STUDY FOR LEWIS HOMES - ORCHARDS," BY PENTACORE, JANUARY, 1992. *
  492     KM   * THE MAJORITY OF THE ORCHARDS SITE IS CONSTRUCTED; HOWEVER, THE PLANNED   *
  493     KM   * ORCHARDS DETENTION BASIN IS NOT CONSTRUCTED. HYDROLOGY FROM THE ORCHARDS *
  494     KM   * DRAINAGE STUDY HAS BEEN MODIFIED TO REPRESENT APPROXIMATE EXISTING       *
  495     KM   * CONDITIONS, RATHER THAN FULLY DEVELOPED CONDITIONS.                      *
  496     PB    3.00
  497     BA   0.279
  498     LS       0      89
  499     UD    0.18
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

500       KK   X1-X2
501       KM   ROUTE X1 THROUGH BASIN OR-2 TO NODE X2.
502       RK   10000   0.033    0.02       0    TRAP      20      10
          *

503       KK    OR-2
504       KM   ORCHARDS OFFSITE DRAINAGE BASIN 02; CONTRIBUTES FLOW TO NODE X2.
505       BA   1.206
506       PB    2.93
507       LS       0      75
508       UD    0.60
          *

509       KK NODE.X2
510       KM   COMBINE FLOW FROM X1 AND BASIN OR-2 AT NODE X2.
511       KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. EAST OF SLOAN CHANNEL.
512       HC       2
          *

513       KK NODE.V4
514       KM   COMBINE FLOW FROM V3, X2 AND BASIN 326-A.
515       KM   GIVES TOTAL FLOW TO THE SLOAN CHANNEL AT CHARLESTON BLVD.
516       HC       3
          *

517       KK   OR-11
518       KM   ORCHARDS ONSITE BASIN OR-11 CONTRIBUTES FLOW TO NODE V5.
519       BA  0.0428
520       PB    2.85
521       LS       0      75
522       UD    0.20
          *

523       KK NODE.V5
524       KM   COMBINE FLOW FROM V4 AND BASIN OR-11.
525       KM   TOTAL FLOW TO THE SLOAN CHANNEL APPROX. 1500 FT. SOUTH OF CHARLESTON BLVD.
526       HC       2
          *

527       KK   V5-Z2
528       KM   ROUTE V5 THROUGH SLOAN CHANNEL TO THE ORCHARDS CHANNEL CONFLUENCE AT Z2.
529       RK    2800   0.005    0.03       0    TRAP      60       2
          *

530       KK    OR-3
531       KM   ORCHARDS OFFSITE DRAINAGE BASIN 03.
532       KM   GIVES FLOW TO NODE Y1, LOCATED AT CHARLESTON WEST OF HOLLYWOOD.
533       BA   0.205
534       PB    3.00
535       LS       0      82
536       UD    0.42
          *
```

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  537         KK   Y1-Z1
  538         KM   ROUTE NODE Y1 THROUGH BASIN OR-12 TO NODE Z1.
  539         RK    5500   0.011   0.016       0    TRAP      50       1
              *

  540         KK    OR-4
  541         KM   ORCHARDS OFFSITE DRAINAGE BASIN O4.
  542         KM   CONTRIBUTES FLOW TO NODE Y2.
  543         BA   0.448
  544         PB    3.00
  545         LS       0      88
  546         UD    0.29
              *

  547         KK   Y2-Y3
  548         KM   ROUTE NODE Y2 THROUGH BASIN OR-5 TO NODE Y3.
  549         RM       4    0.33    0.15
              *

  550         KK    OR-5
  551         KM   ORCHARDS OFFSITE DRAINAGE BASIN O5.
  552         KM   CONTRIBUTES FLOW TO NODE Y3.
  553         BA   0.373
  554         PB    3.00
  555         LS       0      77
  556         UD    0.44
              *

  557         KK      Y3
  558         KM   COMBINE FLOWS FROM Y2 AND BASIN OR-5 AT HOLLYWOOD.
  559         HC       2
              *

  560         KK   Y3-Z1
  561         KM   ROUTE Y3 THROUGH BASIN OR-12 TO NODE Z1.
  562         RK    5000   0.012   0.016       0    TRAP      50       1
              *

  563         KK   OR-6A
  564         KM   ORCHARDS OFFSITE DRAINAGE BASIN O6A.
  565         BA   0.264
  566         PB    3.00
  567         LS       0      88
  568         UD     .13
              *

  569         KK   OR-6B
  570         KM   ORCHARDS OFFSITE DRAINAGE BASIN O6B,
  571         BA   0.160
  572         PB    3.00
  573         LS       0      89
  574         UD     .14
              *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  575     KK   OR-6C
  576     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6C.
  577     BA   0.191
  578     PB    3.00
  579     LS       0      87
  580     UD     .18
          *

  581     KKNODE.AA1
  582     KM   COMBINE FLOWS FROM BASINS OR-6A, OR-6B & OR-6C.
  583     HC       3
          *

  584     KK AA1-AA2
  585     KM   ROUTE AA1 THROUGH BASIN OR-7 TO NODE AA2.
  586     RM       4    0.32    0.15
          *

  587     KK    OR-7
  588     KM   ORCHARDS OFFSITE DRAINAGE BASIN O7.
  589     BA   0.613
  590     PB    3.00
  591     LS       0      77
  592     UD    0.49
          *

  593     KKNODE.AA2
  594     KM   COMBINE AA1 WITH FLOW FROM BASIN OR-7 AT NODE AA2.
  595     HC       2
          *

  596     KK  AA2-Z1
  597     KM   ROUTE AA2 THROUGH BASIN OR-12 TO NODE Z1.
  598     RK    4500   0.013   0.016       0    TRAP      50       1
          *

  599     KK    OR-8
  600     KM   ORCHARDS OFFSITE BASIN O8; CONTRIBUTES FLOW TO NODE AA3.
  601     BA   0.017
  602     PB    3.00
  603     LS       0      77
  604     UD    0.18
          *

  605     KK  R8-AA3
  606     KM   ROUTE FLOW FROM BASIN OR-8 THROUGH BASIN OR-9 TO NODE AA3 AT HOLLYWOOD.
  607     RM      10    0.82    0.15
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

608       KK    OR-9
609       KM    ORCHARDS OFFSITE DRAINAGE BASIN 09; CONTRIBUTES FLOW TO NODE AA3.
610       BA    0.278
611       PB     3.00
612       LS        0      77
613       UD    0.65
          *

614       KKNODE.AA3
615       KM    COMBINE FLOWS FROM BASINS OR-8 AND OR-9 AT NODE AA3.
616       HC        2
          *

617       KK  AA3-Z1
618       KM    ROUTE AA3 THROUGH BASIN OR-12 TO NODE Z1.
619       RK     4500   0.012   0.016       0    TRAP      50       1
          *

620       KK    OR-12
621       KM    ORCHARDS ONSITE DRAINAGE BASIN 12; CONTRIBUTES FLOW TO NODE Z1.
622       BA    0.525
623       PB     2.85
624       LS        0      76
625       UD    0.39
          *

626       KK NODE.Z1
627       KM    COMBINE FLOW FROM NODES Y1, Y3, AA2, AA3 AND BASIN OR-12 AT NODE Z1.
628       KM    NODE Z1 REPRESENTS THE TOTAL FLOW IN THE CONCRETE-LINED ORCHARDS CHANNEL
629       KM    TRIBUTARY TO THE SLOAN CHANNEL.
630       HC        5
          *

631       KK NODE.Z2
632       KM    COMBINE FLOW FROM NODES V5 AND Z1.
633       KM    TOTAL FLOW IN THE SLOAN CHANNEL AT ITS CONFLUENCE WITH THE ORCHARDS CHANNEL.
634       HC        2
          *

635       KK    OR-13
636       KM    ORCHARDS ONSITE DRAINAGE BASIN OR-13; CONTRIBUTES FLOW TO NODE Z3.
637       BA    0.120
638       PB     2.85
639       LS        0      84
640       UD    0.29
          *

641       KK NODE.Z3
642       KM    COMBINE FLOW FROM NODES Z2 AND BASIN OR-13 AT NODE Z3.
643       KM    NODE Z3 IS THE TOTAL FLOW IN THE SLOAN CHANNEL AT APPROXIMATELY
644       KM    450 FEET SOUTH OF THE ORCHARDS CHANNEL CONFLUENCE.
645       HC        2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

646       KK   OR-10
647       KM   ORCHARDS OFFSITE DRAINAGE BASIN O10.
648       KM   CONTRIBUTES FLOW TO NODE BB1, LOCATED AT THE HOLLYWOOD/SAHARA INTERSECTION.
649       BA  0.0984
650       PB    3.00
651       LS       0      77
652       UD    0.45
          *

653       KK BB1-BB2
654       KM   ROUTE BB1 THROUGH SAHARA AVENUE TO NODE BB2.
655       RK    4000   0.014   0.016       0    TRAP     100       1
          *

656       KK   OR-14
657       KM   ORCHARDS ONSITE DRAINAGE BASIN 14; CONTRIBUTES FLOW TO NODE BB2.
658       BA  0.0937
659       PB    2.85
660       LS       0      75
661       UD    0.33
          *

662       KKNODE.BB2
663       KM   NODE BB2 REPRESENTS THE TOTAL FLOW IN SAHARA AVE. EAST OF THE SLOAN CHANNEL.
664       HC       2
          *

665       KKNODE.BB3
666       KM   COMBINE FLOW FROM Z3 WITH FLOW FROM BB2.
667       KM   NODE BB3 IS THE TOTAL FLOW IN SLOAN CHANNEL AT SAHARA AVE.
668       HC       2
          *

669       KK  BB3-CC
670       KM   ROUTE BB3 THROUGH THE SLOAN CHANNEL TO NODE CC.
671       RK    1700   0.006   0.025       0    TRAP      80       2
          *

672       KK   52A-M
673       KM   BASIN 52A-M CONTRIBUTES FLOW TO NODE CC.
674       BA   0.286
675       PB    2.85
676       LS       0      73
677       UD    0.84
          *

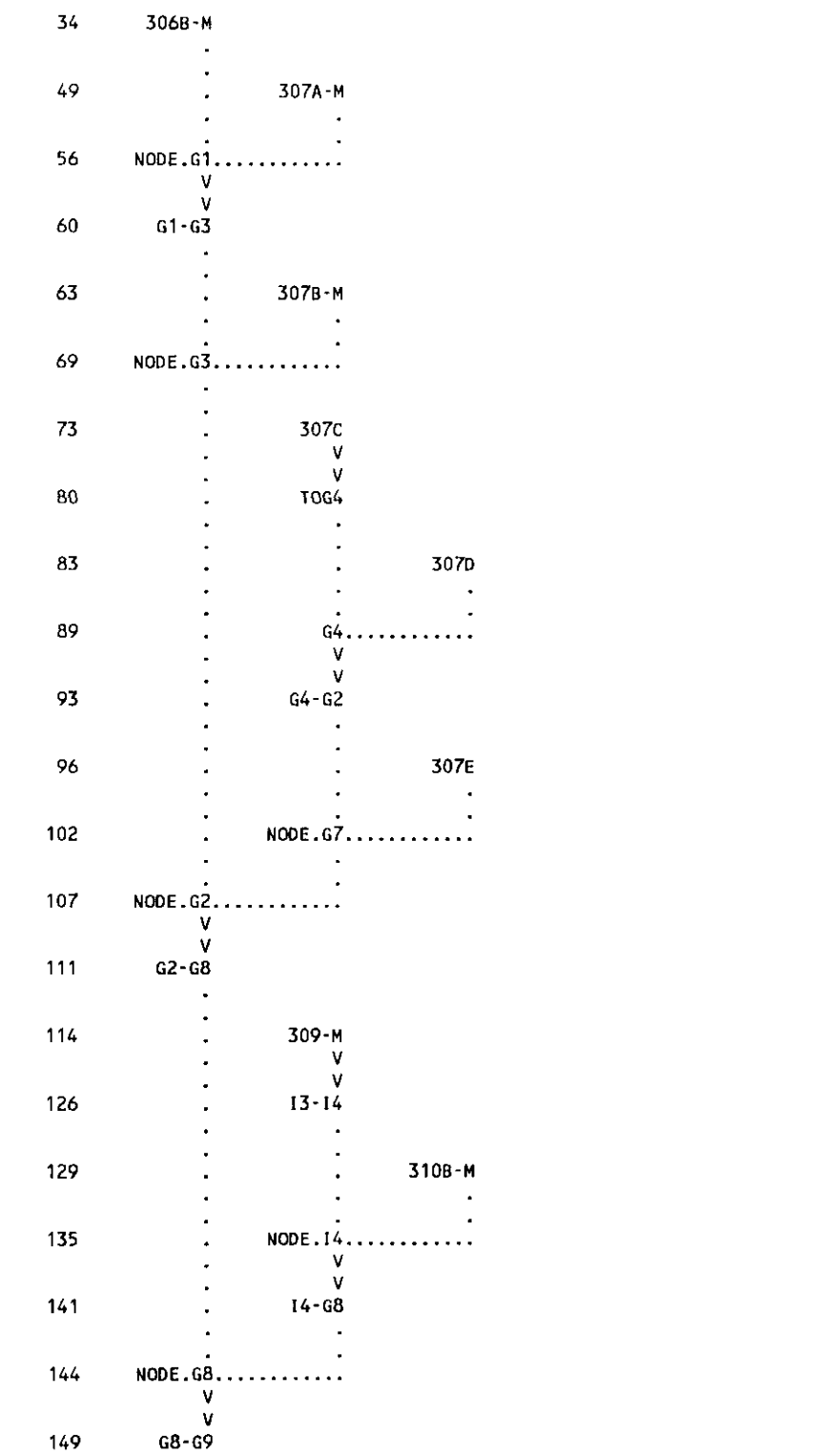
678       KK NODE.CC
679       KM   COMBINE FLOW FROM  NODE BB3 WITH FLOW FROM BASINS 326-B AND 52A-M.
680       KM   NODE CC REPRESENTS THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
681       KM   ITS CONFLUENCE WITH THE LAS VEGAS WASH.
682       HC       2
          *
683       ZZ
```

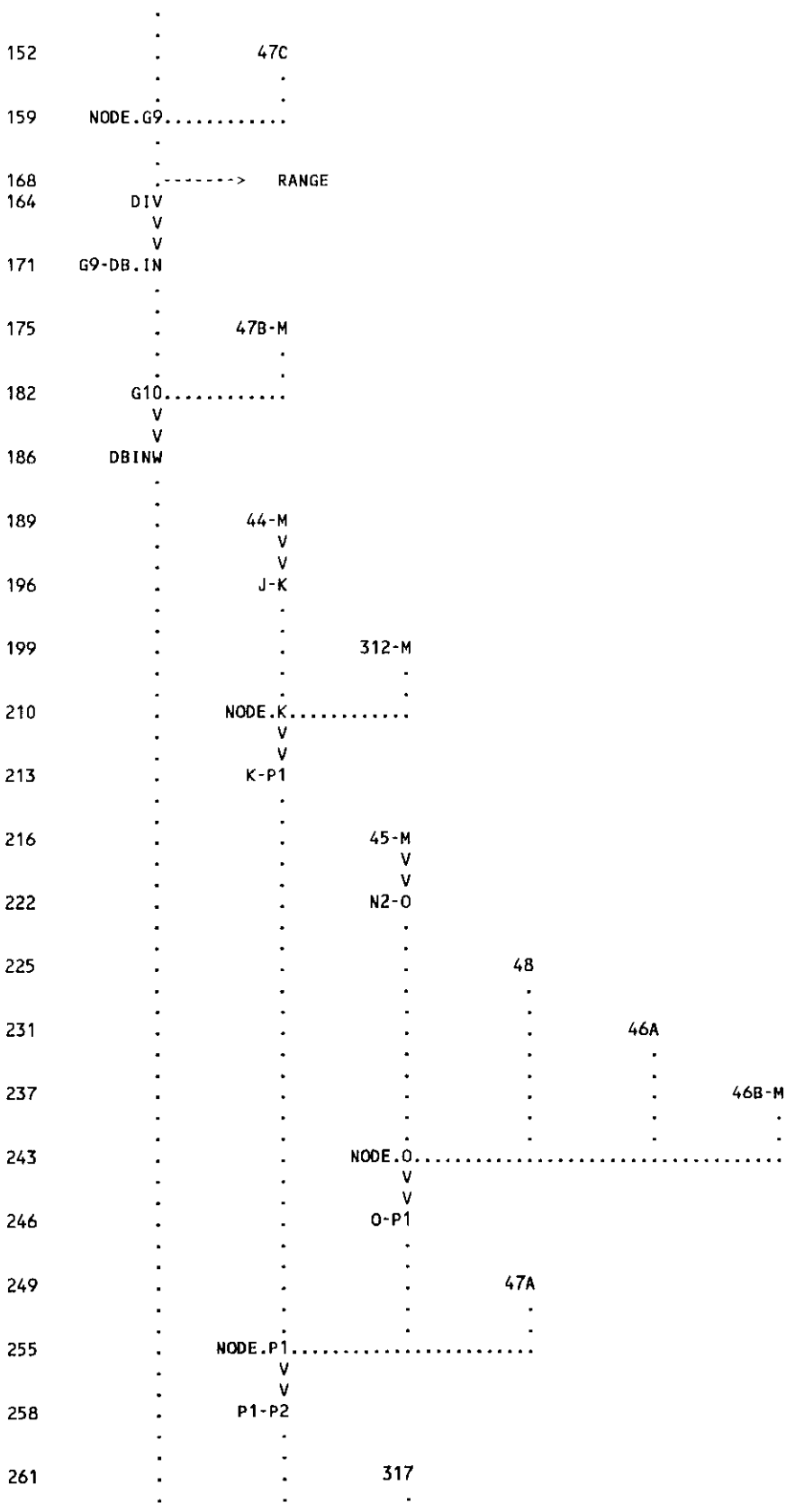
1

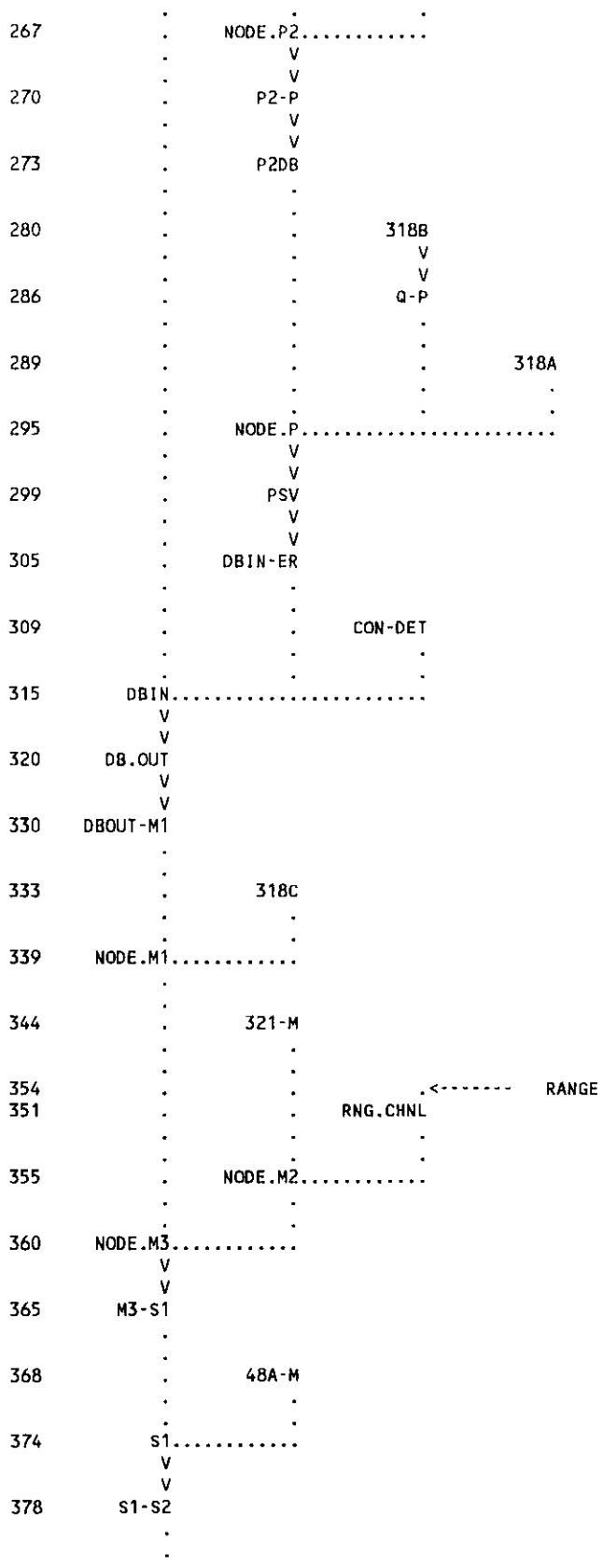
SCHEMATIC DIAGRAM OF STREAM NETWORK

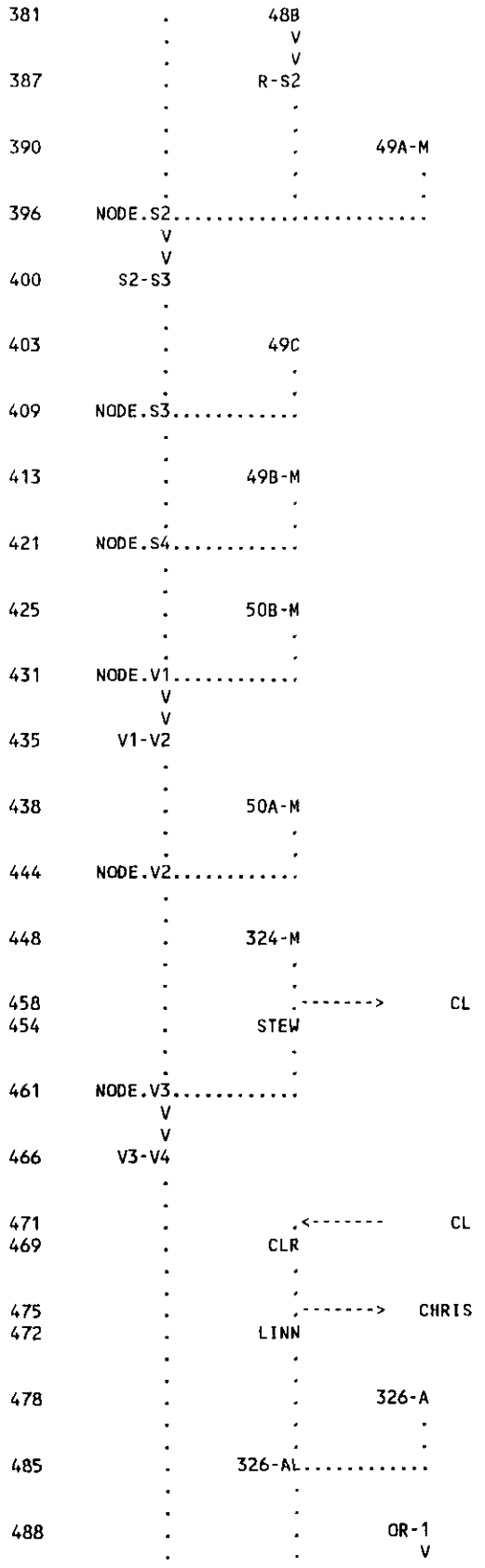
INPUT LINE NO.

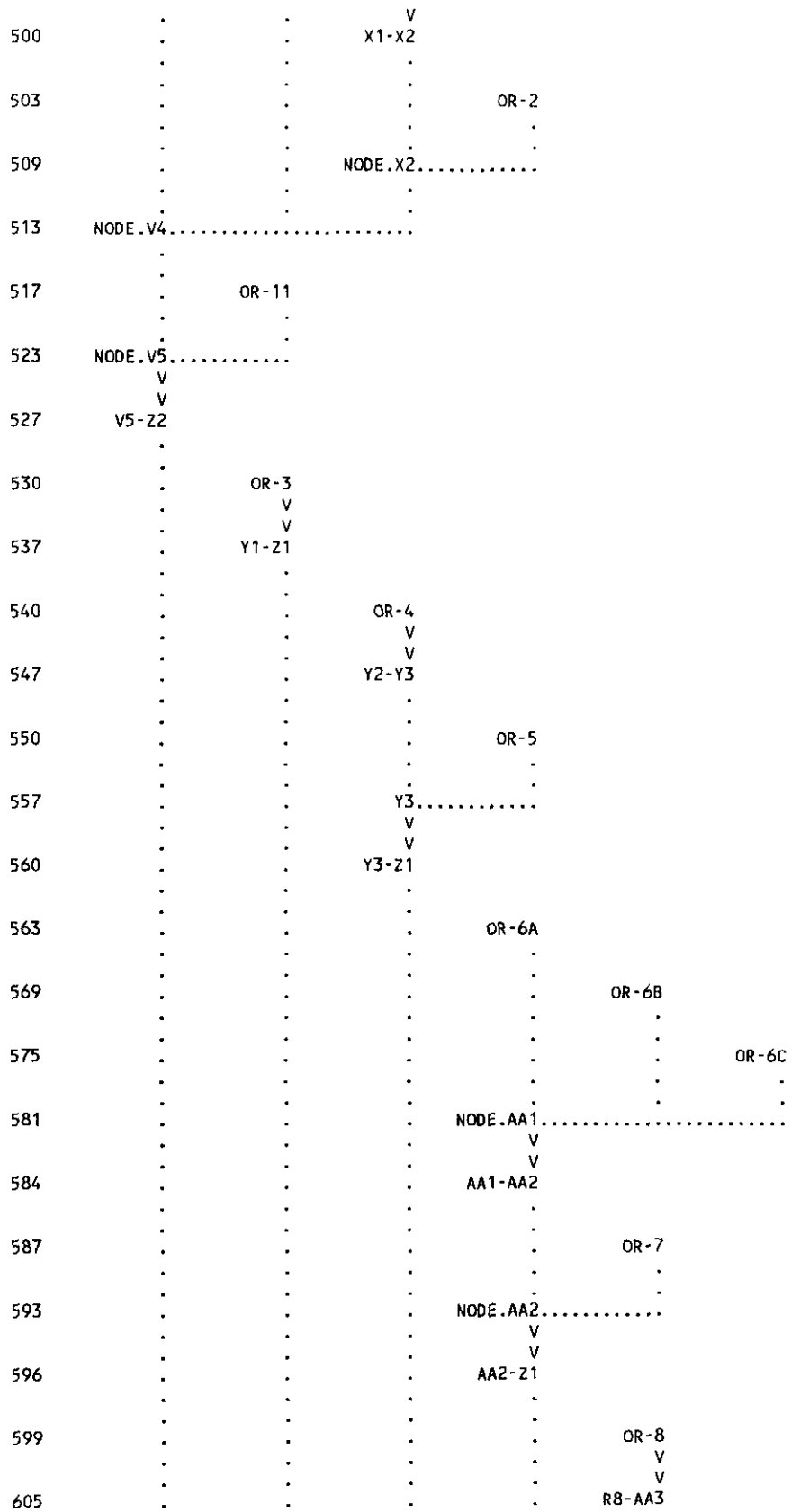
(V) ROUTING (.) CONNECTOR (---->) DIVERSION OR PUMP FLOW (<----) RETURN OF DIVERTED OR PUMPED FLOW

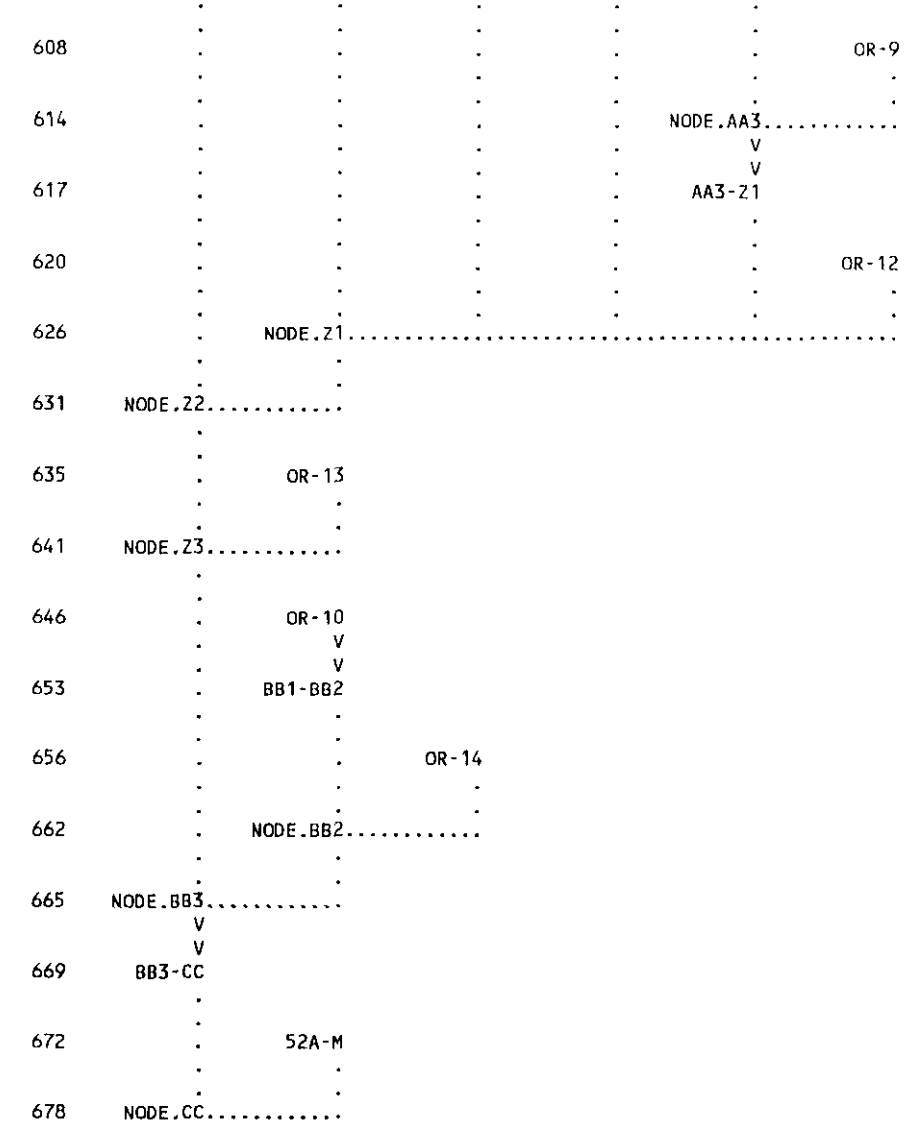



152
47C
159
NODE.G9
168
RANGE
164
DIV
171
G9-DB.IN
175
47B-M
182
G10
186
DBINW
189
44-M
196
J-K
199
312-M
210
NODE.K
213
K-P1
216
45-M
222
N2-O
225
48
231
46A
237
46B-M
243
NODE.O
246
O-P1
249
47A
255
NODE.P1
258
P1-P2
261
317


267
NODE.P2
270
P2-P
273
P2DB
280
318B
286
Q-P
289
318A
295
NODE.P
299
PSV
305
DBIN-ER
309
CON-DET
315
DBIN
320
DB.OUT
330
DBOUT-M1
333
318C
339
NODE.M1
344
321-M
354
<-------
RANGE
351
RNG.CHNL
355
NODE.M2
360
NODE.M3
365
M3-S1
368
48A-M
374
S1
378
S1-S2


381
48B
387
R-S2
390
49A-M
396
NODE.S2
400
S2-S3
403
49C
409
NODE.S3
413
49B-M
421
NODE.S4
425
50B-M
431
NODE.V1
435
V1-V2
438
50A-M
444
NODE.V2
448
324-M
458
CL
454
STEW
461
NODE.V3
466
V3-V4
471
CL
469
CLR
475
CHRIS
472
LINN
478
326-A
485
326-AL
488
OR-1


500
X1-X2
503
OR-2
509
NODE.X2
513
NODE.V4
517
OR-11
523
NODE.V5
527
V5-Z2
530
OR-3
537
Y1-Z1
540
OR-4
547
Y2-Y3
550
OR-5
557
Y3
560
Y3-Z1
563
OR-6A
569
OR-6B
575
OR-6C
581
NODE.AA1
584
AA1-AA2
587
OR-7
593
NODE.AA2
596
AA2-Z1
599
OR-8
605
R8-AA3



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/29/1996  TIME  09:50:25 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFIS-ALL.DAT
JANUARY 1996

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE, AND ALSO
WITH THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR THE CONFLUENCE DETENTION BASIN

```
*********************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                  *
*                          RANGE WASH WATERSHED                                 *
*                 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
*                                 JANUARY 1991                                  *
*                   PRESENT CONDITIONS, EXISTING FACILITIES                     *
*                    BASED ON RANGE WASH FACILITIES STUDY                       *
*                       BOYLE ENGINEERS CORP-JULY 1989                          *
*                                                                               *
*                   (CONVERTED RK TO RM IN UPLAND SUBAREAS)                     *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
*********************************************************************************
*                        100-YEAR, 6-HOUR STORM, AMC 2.0                        *
*********************************************************************************
* STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
*    JR DARF RATIO 0.630 AT THE CONFLUENCE DETENTION BASIN, NODE DB.IN    *
* JR DARF RATIO 0.601 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
*********************************************************************************
```

```
32 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME         1635  ENDING TIME
                  ICENT            19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                    TOTAL TIME BASE   16.58 HOURS

      ENGLISH UNITS
           DRAINAGE AREA         SQUARE MILES
           PRECIPITATION DEPTH   INCHES
           LENGTH, ELEVATION     FEET
           FLOW                  CUBIC FEET PER SECOND
           STORAGE VOLUME        ACRE-FEET
           SURFACE AREA          ACRES
           TEMPERATURE           DEGREES FAHRENHEIT
```

```
JP          MULTI-PLAN OPTION
                NPLAN           1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
                .60       .63

    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


*** *** *** *
```

HYDROGRAPH AT STATION DBIN
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
(CFS)	(HR)					
		(CFS)				
4183.	7.50		2805.	1085.	1085.	1085.
		(INCHES)	.322	.345	.345	.345
		(AC-FT)	1391.	1488.	1488.	1488.

CUMULATIVE AREA = 80.91 SQ MI

*** ***

```
**************
*            *
*    DB.OUT  *
*            *
**************
```

OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC 2.00 INITIAL CONDITION
X .00 WORKING R AND D COEFFICIENT

SV	STORAGE	.0	3.2	9.9	21.4	39.2	102.0	217.0	563.0	708.0	864.0
		1025.0	1041.0	1056.0	1088.0	1119.0	1151.0				
SQ	DISCHARGE	0.	54.	153.	214.	238.	280.	317.	367.	688.	1263.
		1938.	2147.	2528.	3608.	5005.	6661.				
SE	ELEVATION	2.00	3.00	4.00	5.00	6.00	8.00	10.00	13.00	14.00	15.00
		16.00	16.10	16.20	16.40	16.60	16.80				

*** *** *** *** ***

HYDROGRAPH AT STATION DB.OUT
FOR PLAN 1, RATIO = .60

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
(CFS)	(HR)					
		(CFS)				
1506.	9.58		1078.	551.	551.	551.
		(INCHES)	.124	.175	.175	.175
		(AC-FT)	535.	755.	755.	755.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
(AC-FT)	(HR)				
922.	9.58	811.	462.	462.	462.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
(FEET)	(HR)				
15.36	9.58	14.66	10.39	10.39	10.39

CUMULATIVE AREA = 80.91 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DB.OUT
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
(CFS)	(HR)					
		(CFS)				
1871.	9.42		1347.	666.	666.	666.
		(INCHES)	.155	.211	.211	.211
		(AC-FT)	668.	913.	913.	913.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
(AC-FT)	(HR)				
1009.	9.42	880.	500.	500.	500.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
(FEET)	(HR)				
15.90	9.42	15.09	10.70	10.70	10.70

CUMULATIVE AREA = 80.91 SQ MI

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .60	RATIO 2 .63
HYDROGRAPH AT						
+	306B-M	5.53	1	FLOW	321.	365.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	307A-M	2.52	1	FLOW	163.	184.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.G1	8.04	1	FLOW	483.	548.
				TIME	5.42	5.42
ROUTED TO						
+	G1-G3	8.04	1	FLOW	478.	542.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	307B-M	.68	1	FLOW	76.	85.
				TIME	4.33	4.25
2 COMBINED AT						
+	NODE.G3	8.72	1	FLOW	527.	597.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	307C	.50	1	FLOW	39.	44.
				TIME	5.33	5.33
ROUTED TO						
+	TOG4	.50	1	FLOW	39.	44.
				TIME	5.67	5.67
HYDROGRAPH AT						
+	307D	.32	1	FLOW	105.	114.
				TIME	3.67	3.67
2 COMBINED AT						
+	G4	.83	1	FLOW	105.	114.
				TIME	3.67	3.67
ROUTED TO						
+	G4-G2	.83	1	FLOW	101.	110.
				TIME	4.25	4.17
HYDROGRAPH AT						
+	307E	.77	1	FLOW	82.	93.
				TIME	4.08	4.08
2 COMBINED AT						
+	NODE.G7	1.59	1	FLOW	181.	202.
				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.G2	10.31	1	FLOW	663.	751.
				TIME	5.50	5.50
ROUTED TO						
+	G2-G8	10.31	1	FLOW	662.	750.
				TIME	5.58	5.50

HYDROGRAPH AT						
+	309-M	3.98	1	FLOW	258.	291.
				TIME	5.42	5.33
ROUTED TO						
+	I3-I4	3.98	1	FLOW	249.	282.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	310B-M	4.57	1	FLOW	490.	547.
				TIME	4.58	4.58
2 COMBINED AT						
+	NODE.I4	8.55	1	FLOW	690.	773.
				TIME	5.33	5.33
ROUTED TO						
+	I4-G8	8.55	1	FLOW	689.	772.
				TIME	5.42	5.33
2 COMBINED AT						
+	NODE.G8	18.86	1	FLOW	1348.	1518.
				TIME	5.50	5.50
ROUTED TO						
+	G8-G9	18.86	1	FLOW	1347.	1516.
				TIME	5.58	5.58
HYDROGRAPH AT						
+	47C	.86	1	FLOW	101.	115.
				TIME	4.00	3.92
2 COMBINED AT						
+	NODE.G9	19.72	1	FLOW	1396.	1575.
				TIME	5.50	5.50
DIVERSION TO						
+	RANGE	19.72	1	FLOW	1040.	1078.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	DIV	19.72	1	FLOW	357.	498.
				TIME	5.50	5.50
ROUTED TO						
+	G9-DB.IN	19.72	1	FLOW	357.	497.
				TIME	5.67	5.58
HYDROGRAPH AT						
+	47B-M	3.38	1	FLOW	591.	654.
				TIME	4.08	4.00
2 COMBINED AT						
+	G10	23.10	1	FLOW	736.	927.
				TIME	5.33	5.25
ROUTED TO						
+	DBINW	23.10	1	FLOW	729.	920.
				TIME	5.50	5.42
HYDROGRAPH AT						
+	44-M	8.16	1	FLOW	999.	1097.
				TIME	5.25	5.25
ROUTED TO						
+	J-K	8.16	1	FLOW	987.	1085.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	312-M	13.46	1	FLOW	748.	853.
				TIME	5.67	5.67

2 COMBINED AT						
+	NODE.K	21.62	1	FLOW	1704.	1905.
				TIME	5.83	5.83
ROUTED TO						
+	K-P1	21.62	1	FLOW	1678.	1875.
				TIME	6.67	6.67
HYDROGRAPH AT						
+	45-M	8.21	1	FLOW	642.	720.
				TIME	5.50	5.50
ROUTED TO						
+	N2-O	8.21	1	FLOW	637.	714.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	48	2.07	1	FLOW	116.	132.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	46A	7.28	1	FLOW	488.	552.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	46B-M	6.31	1	FLOW	432.	488.
				TIME	5.83	5.83
4 COMBINED AT						
+	NODE.O	23.87	1	FLOW	1661.	1875.
				TIME	5.75	5.75
ROUTED TO						
+	O-P1	23.87	1	FLOW	1626.	1837.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	47A	2.43	1	FLOW	215.	239.
				TIME	5.33	5.33
3 COMBINED AT						
+	NODE.P1	47.92	1	FLOW	3356.	3773.
				TIME	6.58	6.58
ROUTED TO						
+	P1-P2	47.92	1	FLOW	3334.	3746.
				TIME	6.92	6.83
HYDROGRAPH AT						
+	317	7.12	1	FLOW	1020.	1119.
				TIME	5.00	4.92
2 COMBINED AT						
+	NODE.P2	55.03	1	FLOW	3736.	4198.
				TIME	6.67	6.67
ROUTED TO						
+	P2-P	55.03	1	FLOW	3720.	4181.
				TIME	6.92	6.92
ROUTED TO						
+	P2DB	55.03	1	FLOW	3701.	4159.
				TIME	7.08	7.08
			** PEAK STAGES IN FEET **			
			1	STAGE	30.34	30.52
				TIME	7.08	7.08
HYDROGRAPH AT						
+	318B	1.59	1	FLOW	431.	469.

				TIME	4.00	4.00
ROUTED TO						
+	Q-P	1.59	1	FLOW	411.	447.
				TIME	4.42	4.42
HYDROGRAPH AT						
+	318A	.94	1	FLOW	119.	134.
				TIME	4.17	4.17
3 COMBINED AT						
+	NODE.P	57.56	1	FLOW	3734.	4198.
				TIME	7.08	7.00
ROUTED TO						
+	PSV	57.56	1	FLOW	3719.	4181.
				TIME	7.17	7.17
			** PEAK STAGES IN FEET **			
			1	STAGE	20.39	20.71
				TIME	7.17	7.17
ROUTED TO						
+	DBIN-ER	57.56	1	FLOW	3695.	4158.
				TIME	7.58	7.50
HYDROGRAPH AT						
+	CON-DET	.25	1	FLOW	25.	28.
				TIME	4.42	4.42
3 COMBINED AT						
+	DBIN	80.91	1	FLOW	3715.	4183.
				TIME	7.50	7.50
ROUTED TO						
+	DB.OUT	80.91	1	FLOW	1506.	1871.
				TIME	9.58	9.42
			** PEAK STAGES IN FEET **			
			1	STAGE	15.36	15.90
				TIME	9.58	9.42
ROUTED TO						
+	DBOUT-M1	80.91	1	FLOW	1506.	1871.
				TIME	9.58	9.50
HYDROGRAPH AT						
+	318C	1.28	1	FLOW	141.	159.
				TIME	4.25	4.25
2 COMBINED AT						
+	NODE.M1	82.19	1	FLOW	1506.	1871.
				TIME	9.58	9.50
HYDROGRAPH AT						
+	321-M	.69	1	FLOW	13.	16.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	RNG.CHNL	.00	1	FLOW	1040.	1078.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M2	.69	1	FLOW	1050.	1090.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M3	82.88	1	FLOW	1526.	1898.
				TIME	9.58	9.42
ROUTED TO						

+	M3-S1	82.88	1	FLOW	1526.	1897.
				TIME	9.58	9.42
HYDROGRAPH AT						
+	48A-M	.71	1	FLOW	147.	163.
				TIME	3.83	3.83
2 COMBINED AT						
+	S1	83.59	1	FLOW	1548.	1897.
				TIME	5.25	9.42
ROUTED TO						
+	S1-S2	83.59	1	FLOW	1547.	1897.
				TIME	5.25	9.50
HYDROGRAPH AT						
+	48B	1.14	1	FLOW	372.	402.
				TIME	3.92	3.92
ROUTED TO						
+	R-S2	1.14	1	FLOW	369.	398.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	49A-M	.69	1	FLOW	88.	100.
				TIME	4.00	3.92
3 COMBINED AT						
+	NODE.S2	85.43	1	FLOW	1846.	1941.
				TIME	5.25	5.25
ROUTED TO						
+	S2-S3	85.43	1	FLOW	1842.	1938.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	49C	.43	1	FLOW	38.	44.
				TIME	5.17	4.08
2 COMBINED AT						
+	NODE.S3	85.85	1	FLOW	1879.	1979.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	49B-M	1.98	1	FLOW	423.	465.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.S4	87.83	1	FLOW	2183.	2308.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	50B-M	.63	1	FLOW	112.	125.
				TIME	3.83	3.83
2 COMBINED AT						
+	NODE.V1	88.46	1	FLOW	2252.	2384.
				TIME	5.25	5.17
ROUTED TO						
+	V1-V2	88.46	1	FLOW	2252.	2383.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	50A-M	.21	1	FLOW	16.	18.
				TIME	5.08	5.08
2 COMBINED AT						
+	NODE.V2	88.67	1	FLOW	2266.	2399.
				TIME	5.25	5.25

HYDROGRAPH AT						
+	324-M	3.03	1	FLOW	172.	196.
				TIME	5.33	5.33
DIVERSION TO						
+	CL	3.03	1	FLOW	89.	102.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	STEW	3.03	1	FLOW	83.	94.
				TIME	5.33	5.33
2 COMBINED AT						
+	NODE.V3	91.69	1	FLOW	2348.	2492.
				TIME	5.25	5.25
ROUTED TO						
+	V3-V4	91.69	1	FLOW	2344.	2489.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	CLR	.00	1	FLOW	89.	102.
				TIME	5.33	5.33
DIVERSION TO						
+	CHRIS	.00	1	FLOW	69.	80.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	LINN	.00	1	FLOW	19.	23.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	326-A	.23	1	FLOW	33.	37.
				TIME	3.83	3.83
2 COMBINED AT						
+	326-AL	.23	1	FLOW	45.	50.
				TIME	5.08	5.08
HYDROGRAPH AT						
+	OR-1	.28	1	FLOW	138.	149.
				TIME	3.58	3.58
ROUTED TO						
+	X1-X2	.28	1	FLOW	132.	147.
				TIME	3.75	3.75
HYDROGRAPH AT						
+	OR-2	1.21	1	FLOW	102.	114.
				TIME	5.17	5.17
2 COMBINED AT						
+	NODE.X2	1.49	1	FLOW	191.	218.
				TIME	3.75	3.75
3 COMBINED AT						
+	NODE.V4	93.41	1	FLOW	2535.	2700.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-11	.04	1	FLOW	5.	6.
				TIME	3.67	3.58
2 COMBINED AT						
+	NODE.V5	93.45	1	FLOW	2537.	2701.
				TIME	5.25	5.25
ROUTED TO						
+	V5-Z2	93.45	1	FLOW	2533.	2699.
				TIME	5.25	5.25

HYDROGRAPH AT						
+	OR-3	.20	1	FLOW	42.	47.
				TIME	3.83	3.83
ROUTED TO						
+	Y1-Z1	.20	1	FLOW	42.	46.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-4	.45	1	FLOW	170.	184.
				TIME	3.67	3.67
ROUTED TO						
+	Y2-Y3	.45	1	FLOW	149.	162.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-5	.37	1	FLOW	47.	54.
				TIME	3.92	3.92
2 COMBINED AT						
+	Y3	.82	1	FLOW	195.	214.
				TIME	4.00	4.00
ROUTED TO						
+	Y3-Z1	.82	1	FLOW	194.	213.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-6A	.26	1	FLOW	131.	142.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6B	.16	1	FLOW	84.	91.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6C	.19	1	FLOW	83.	91.
				TIME	3.58	3.58
3 COMBINED AT						
+	NODE.AA1	.62	1	FLOW	299.	323.
				TIME	3.58	3.58
ROUTED TO						
+	AA1-AA2	.62	1	FLOW	237.	257.
				TIME	3.83	3.83
HYDROGRAPH AT						
+	OR-7	.61	1	FLOW	73.	84.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.AA2	1.23	1	FLOW	306.	337.
				TIME	3.83	3.83
ROUTED TO						
+	AA2-Z1	1.23	1	FLOW	305.	335.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-8	.02	1	FLOW	3.	4.
				TIME	3.58	3.58
ROUTED TO						
+	R8-AA3	.02	1	FLOW	2.	3.
				TIME	4.50	4.42
HYDROGRAPH AT						
+	OR-9	.28	1	FLOW	29.	33.

				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.AA3	.29	1	FLOW	30.	35.
				TIME	4.17	4.17
ROUTED TO						
+	AA3-Z1	.29	1	FLOW	30.	35.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	OR-12	.52	1	FLOW	53.	62.
				TIME	3.83	3.83
5 COMBINED AT						
+	NODE.Z1	3.07	1	FLOW	595.	660.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.Z2	96.52	1	FLOW	2955.	3158.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-13	.12	1	FLOW	31.	34.
				TIME	3.67	3.67
2 COMBINED AT						
+	NODE.Z3	96.64	1	FLOW	2966.	3170.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-10	.10	1	FLOW	12.	14.
				TIME	3.92	3.92
ROUTED TO						
+	BB1-BB2	.10	1	FLOW	12.	14.
				TIME	4.17	4.17
HYDROGRAPH AT						
+	OR-14	.09	1	FLOW	9.	11.
				TIME	5.00	3.75
2 COMBINED AT						
+	NODE.BB2	.19	1	FLOW	18.	21.
				TIME	4.17	4.08
2 COMBINED AT						
+	NODE.BB3	96.84	1	FLOW	2982.	3188.
				TIME	5.25	5.25
ROUTED TO						
+	BB3-CC	96.84	1	FLOW	2977.	3184.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	52A-M	.29	1	FLOW	17.	19.
				TIME	5.42	5.33
2 COMBINED AT						
+	NODE.CC	97.12	1	FLOW	2994.	3203.
				TIME	5.25	5.25

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .60									
TOG4	MANE	5.00	39.19	336.64	.28	5.00	39.16	340.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7504E+01 EXCESS= .0000E+00 OUTFLOW= .7511E+01 BASIN STORAGE= .2096E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .63									
TOG4	MANE	4.96	43.86	339.89	.32	5.00	43.85	340.00	.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8546E+01 EXCESS= .0000E+00 OUTFLOW= .8554E+01 BASIN STORAGE= .1587E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .60									
G4-G2	MANE	5.00	102.75	254.14	.45	5.00	101.45	255.00	.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1959E+02 EXCESS= .0000E+00 OUTFLOW= .1962E+02 BASIN STORAGE= .4971E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .63									
G4-G2	MANE	5.00	112.20	252.97	.49	5.00	109.66	250.00	.49

NUITY SUMMARY (AC-FT) - INFLOW= .2172E+02 EXCESS= .0000E+00 OUTFLOW= .2178E+02 BASIN STORAGE= .4302E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .60									
G2-G8	MANE	1.15	663.03	332.26	.26	5.00	662.09	335.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1426E+03 EXCESS= .0000E+00 OUTFLOW= .1426E+03 BASIN STORAGE= .3231E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63									
G2-G8	MANE	1.07	750.21	332.30	.30	5.00	749.63	330.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1628E+03 EXCESS= .0000E+00 OUTFLOW= .1628E+03 BASIN STORAGE= .3475E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
I4-G8	MANE	1.18	689.46	322.92	.34	5.00	689.31	325.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1553E+03 EXCESS= .0000E+00 OUTFLOW= .1553E+03 BASIN STORAGE= .2674E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63									
I4-G8	MANE	1.07	773.18	321.85	.38	5.00	772.15	320.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1747E+03 EXCESS= .0000E+00 OUTFLOW= .1748E+03 BASIN STORAGE= .2894E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
G8-G9	MANE	2.85	1346.94	336.85	.30	5.00	1346.73	335.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2979E+03 EXCESS= .0000E+00 OUTFLOW= .2979E+03 BASIN STORAGE= .2175E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

G8-G9	MANE	2.77	1517.09	334.45	.34	5.00	1516.42	335.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3376E+03 EXCESS= .0000E+00 OUTFLOW= .3376E+03 BASIN STORAGE= .2165E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

G9-DB.IN	MANE	4.97	356.69	339.96	.04	5.00	356.67	340.00	.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4038E+02 EXCESS= .0000E+00 OUTFLOW= .4082E+02 BASIN STORAGE= .1135E-01 PERCENT ERROR= -1.1

FOR PLAN = 1 RATIO= .63

G9-DB.IN	MANE	4.54	497.45	335.00	.06	5.00	497.45	335.00	.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6315E+02 EXCESS= .0000E+00 OUTFLOW= .6361E+02 BASIN STORAGE= .9550E-02 PERCENT ERROR= -.8

FOR PLAN = 1 RATIO= .60

DBOUT-M1	MANE	1.02	1505.77	576.23	.17	5.00	1505.59	575.00	.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7548E+03 EXCESS= .0000E+00 OUTFLOW= .7531E+03 BASIN STORAGE= .2135E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .63

DBOUT-M1	MANE	1.05	1871.47	567.09	.21	5.00	1871.30	570.00	.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9126E+03 EXCESS= .0000E+00 OUTFLOW= .9105E+03 BASIN STORAGE= .2247E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

M3-S1	MANE	.95	1526.45	575.56	.24	5.00	1526.44	575.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1055E+04 EXCESS= .0000E+00 OUTFLOW= .1053E+04 BASIN STORAGE= .2089E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

M3-S1	MANE	.85	1897.59	566.58	.28	5.00	1896.92	565.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1235E+04 EXCESS= .0000E+00 OUTFLOW= .1233E+04 BASIN STORAGE= .2209E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

S1-S2	MANE	1.21	1547.48	317.08	.24	5.00	1546.52	315.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1073E+04 EXCESS= .0000E+00 OUTFLOW= .1070E+04 BASIN STORAGE= .2744E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

S1-S2	MANE	1.08	1896.91	567.47	.28	5.00	1896.82	570.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1256E+04 EXCESS= .0000E+00 OUTFLOW= .1253E+04 BASIN STORAGE= .2907E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

R-S2	MANE	4.98	370.33	242.91	.91	5.00	368.68	245.00	.91

INUITY SUMMARY (AC-FT) - INFLOW= .5561E+02 EXCESS= .0000E+00 OUTFLOW= .5572E+02 BASIN STORAGE= .2862E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .63

R-S2	MANE	5.00	400.29	243.38	.99	5.00	398.23	245.00	.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6024E+02 EXCESS= .0000E+00 OUTFLOW= .6034E+02 BASIN STORAGE= .2707E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .60

S2-S3	MANE	.88	1845.05	317.27	.25	5.00	1841.96	315.00	.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1139E+04 EXCESS= .0000E+00 OUTFLOW= .1137E+04 BASIN STORAGE= .2253E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

S2-S3	MANE	.85	1940.68	316.39	.29	5.00	1938.02	315.00	.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1328E+04 EXCESS= .0000E+00 OUTFLOW= .1325E+04 BASIN STORAGE= .2394E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

V1-V2	MANE	.69	2251.71	315.41	.26	5.00	2251.61	315.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1227E+04 EXCESS= .0000E+00 OUTFLOW= .1225E+04 BASIN STORAGE= .1818E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

V1-V2	MANE	.74	2384.19	311.63	.30	5.00	2383.03	315.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1425E+04 EXCESS= .0000E+00 OUTFLOW= .1423E+04 BASIN STORAGE= .1931E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

V3-V4	MANE	1.08	2346.93	317.49	.25	5.00	2343.77	315.00	.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1243E+04 EXCESS= .0000E+00 OUTFLOW= .1239E+04 BASIN STORAGE= .3352E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63

V3-V4	MANE	1.15	2491.12	317.00	.29	5.00	2488.90	315.00	.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1443E+04 EXCESS= .0000E+00 OUTFLOW= .1439E+04 BASIN STORAGE= .3568E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

X1-X2	MANE	4.80	135.30	223.85	.87	5.00	132.35	225.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1287E+02 EXCESS= .0000E+00 OUTFLOW= .1297E+02 BASIN STORAGE= .1748E-03 PERCENT ERROR= -.8

FOR PLAN = 1 RATIO= .63

X1-X2	MANE	4.67	147.61	224.76	.94	5.00	146.65	225.00	.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1395E+02 EXCESS= .0000E+00 OUTFLOW= .1405E+02 BASIN STORAGE= .1863E-03 PERCENT ERROR= -.7

FOR PLAN = 1 RATIO= .60

V5-Z2	MANE	1.23	2535.63	317.53	.26	5.00	2532.93	315.00	.26

INUITY SUMMARY (AC-FT) - INFLOW= .1277E+04 EXCESS= .0000E+00 OUTFLOW= .1273E+04 BASIN STORAGE= .3663E+01 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .63
            V5-Z2  MANE          1.14    2701.03     316.99        .30       5.00    2699.36     315.00         .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1482E+04 EXCESS= .0000E+00 OUTFLOW= .1479E+04 BASIN STORAGE= .3886E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
            Y1-Z1  MANE          5.00      42.04     240.20        .52       5.00      41.95     240.00         .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5695E+01 EXCESS= .0000E+00 OUTFLOW= .5712E+01 BASIN STORAGE= .2231E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .63
            Y1-Z1  MANE          4.94      46.31     241.60        .58       5.00      46.17     240.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6313E+01 EXCESS= .0000E+00 OUTFLOW= .6325E+01 BASIN STORAGE= .1720E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            Y3-Z1  MANE          2.62     194.07     244.59        .60       5.00     193.84     245.00         .60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2615E+02 EXCESS= .0000E+00 OUTFLOW= .2620E+02 BASIN STORAGE= .1252E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .63
            Y3-Z1  MANE          2.53     213.14     244.38        .66       5.00     212.72     245.00         .66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2873E+02 EXCESS= .0000E+00 OUTFLOW= .2878E+02 BASIN STORAGE= .1784E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            AA2-Z1  MANE         1.98     305.27     234.44        .58       5.00     304.82     235.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3769E+02 EXCESS= .0000E+00 OUTFLOW= .3774E+02 BASIN STORAGE= .1153E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .63
            AA2-Z1  MANE         1.92     336.39     233.90        .63       5.00     335.30     235.00         .63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4148E+02 EXCESS= .0000E+00 OUTFLOW= .4156E+02 BASIN STORAGE= .1253E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            AA3-Z1  MANE         4.75      30.35     259.60        .35       5.00      30.34     260.00         .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5431E+01 EXCESS= .0000E+00 OUTFLOW= .5446E+01 BASIN STORAGE= .1301E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .63
            AA3-Z1  MANE         4.49      34.70     258.30        .39       5.00      34.66     260.00         .39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6142E+01 EXCESS= .0000E+00 OUTFLOW= .6150E+01 BASIN STORAGE= .1459E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .60
            BB1-BB2  MANE        5.00      12.24     251.72        .35       5.00      12.15     250.00         .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1812E+01 EXCESS= .0000E+00 OUTFLOW= .1827E+01 BASIN STORAGE= .1888E-02 PERCENT ERROR=   -.9

          FOR PLAN = 1  RATIO=  .63
```

```
          BB1-BB2  MANE          5.00      14.00     251.15        .39       5.00      13.92     250.00          .39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2049E+01 EXCESS= .0000E+00 OUTFLOW= .2061E+01 BASIN STORAGE= .1768E-02 PERCENT ERROR=   -.7


          FOR PLAN = 1  RATIO=  .60
            BB3-CC  MANE           .73    2980.36     316.46        .26       5.00    2976.91     315.00          .26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1362E+04 EXCESS= .0000E+00 OUTFLOW= .1360E+04 BASIN STORAGE= .2081E+01 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .63
            BB3-CC  MANE           .61    3187.06     315.89        .30       5.00    3184.35     315.00          .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1577E+04 EXCESS= .0000E+00 OUTFLOW= .1575E+04 BASIN STORAGE= .2211E+01 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
```

BON.OUT

```
*****************************************
*                                       *
*     FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*           SEPTEMBER 1990              *
*            VERSION 4.0                *
*                                       *
*  RUN DATE  01/18/1996  TIME  07:51:37 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                                JOB. NO. 51804
    5     ID                            HEC-1 FILE: BON.DAT
    6     ID                                 JANUARY 1996
    7     ID
    8     ID   ********************************************************************************
    9     ID   *                     100-YEAR, 6-HOUR STORM, AMC 2.0                          *
   10     ID   ********************************************************************************
   11     ID   *  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI. *
   12     ID   *  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
   13     ID   *    JR DARF RATIO 0.98 FOR .6 SQ. MILE AREA TO BONANZA & SLOAN            *
   14     ID   ********************************************************************************
   15     ID
   16     IT     05       0       0     200
   17     IO      5       0       0
   18     JR   PREC    0.98

   19     KK   50B-M
   20     KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
   21     BA   0.627
   22     PB    3.00
   23     PC   .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   24     PC   .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   25     PC   .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   26     PC   .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   27     PC   .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   28     PC   .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   29     PC   .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   30     PC   .997    .999   1.00
   31     LS     0      80
   32     UD  0.37
   33     ZZ
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/18/1996  TIME  07:51:37 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: BON.DAT
JANUARY 1996

```
*************************************************************************
*                    100-YEAR, 6-HOUR STORM, AMC 2.0                    *
*************************************************************************
*  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI. *
*  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
*    JR DARF RATIO 0.98 FOR .6 SQ. MILE AREA TO BONANZA & SLOAN           *
*************************************************************************
```

```
17 IO          OUTPUT CONTROL VARIABLES
                    IPRNT           5  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME        0000  STARTING TIME
                      NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME        1635  ENDING TIME
                   ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   16.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

    JP       MULTI-PLAN OPTION
                  NPLAN           1  NUMBER OF PLANS

    JR       MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
                .98
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.98
HYDROGRAPH AT					
+	50B-M	.63	1	FLOW	318.
				TIME	3.75

*** NORMAL END OF HEC-1 ***

STEW.OUT

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/18/1996  TIME  11:23:05 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
    1     ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
    2     ID              FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
    3     ID                 BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
    4     ID                              JOB. NO. 51804
    5     ID                          HEC-1 FILE: STEW.DAT
    6     ID                               JANUARY 1996
    7     ID
    8     ID  ********************************************************************************
    9     ID  *                    100-YEAR, 6-HOUR STORM, AMC 2.0                           *
   10     ID  ********************************************************************************
   11     ID  *  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI. *
   12     ID  *  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
   13     ID  *    JR DARF RATIO 0.92 FOR 3 SQ. MILE AREA TO STEWART AVENUE.             *
   14     ID  ********************************************************************************
   15     ID
   16     IT     05       0       0     200
   17     IO      5       0       0
   18     JR   PREC    0.92

   19     KK   324-M
   20     KM   BASIN 324-M CONTRIBUTES FLOW TO NODE V3.
   21     BA   3.026
   22     PB    2.85
   23     PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
   24     PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
   25     PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
   26     PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
   27     PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
   28     PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
   29     PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
   30     PC    .997    .999   1.00
   31     LS      0      72
   32     UD   0.77

   33     KK    STEW
   34     KM   DIVERT FLOWS WHICH CONTINUE IN CHRISTY & LINN LANES, ETC
   35     KM   FLOW IN STEWART GOES TO SLOAN CHANNEL
   36     KM   FLOW IN CHRISTY GOES TOWARD LAS VEGAS WASH
   37     DT     CL
   38     DI      0      15     600
   39     DQ      0       0     330
   40     ZZ
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/18/1996  TIME  11:23:05 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: STEW.DAT
JANUARY 1996

```
*************************************************************************
*                      100-YEAR, 6-HOUR STORM, AMC 2.0                  *
*************************************************************************
*  STORM DISTRIBUTION 3 (SDN 3) FOR TOTAL BASIN AREA LESS  THAN 10 SQ.MI. *
*  ONLY FOR DRAINAGE BASINS DOWNSTREAM OF CONFLUENCE THE DETENTION BASIN, *
*    JR DARF RATIO 0.92 FOR 3 SQ. MILE AREA TO STEWART AVENUE.            *
*************************************************************************
```

```
17 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1    0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ          200  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1    0  ENDING DATE
                  NDTIME         1635  ENDING TIME
                   ICENT           19  CENTURY MARK

                COMPUTATION INTERVAL      .08 HOURS
                     TOTAL TIME BASE   16.58 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                     .92
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.92
HYDROGRAPH AT					
+	324-M	3.03	1	FLOW	503.
				TIME	4.25
DIVERSION TO					
+	CL	3.03	1	FLOW	275.
				TIME	4.25
HYDROGRAPH AT					
+	STEW	3.03	1	FLOW	228.
				TIME	4.25

*** NORMAL END OF HEC-1 ***

NODB.OUT

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/01/1996  TIME  13:52:40 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
      LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
                *DIAGRAM
*** FREE ***
         1      ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
         2      ID              FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
         3      ID                  BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
         4      ID                               JOB. NO. 51804
         5      ID                           HEC-1 FILE: NODB.DAT
         6      ID                                JANUARY 1996
         7      ID
         8      ID       THIS RUN TO EVALUATE THE CIBOLA SITE UNDER INTERIM CONDTION
         9      ID       BEFORE THE CONFLUENCE DETENTION BASIN IS COMPLETED
        10      ID
        11      ID       EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE,
        12      ID       WITHOUT THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
        13      ID       STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR SLOAN AT STEWART AVENUE
        14      ID
        15      ID   ********************************************************************************
        16      ID   *              FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                  *
        17      ID   *                           RANGE WASH WATERSHED                                 *
        18      ID   *                 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.               *
        19      ID   *                                 JANUARY 1991                                   *
        20      ID   *                   PRESENT CONDITIONS, EXISTING FACILITIES                      *
        21      ID   *                    BASED ON RANGE WASH FACILITIES STUDY                        *
        22      ID   *                       BOYLE ENGINEERS CORP-JULY 1989                           *
        23      ID   *                                                                                *
        24      ID   *                    (CONVERTED RK TO RM IN UPLAND SUBAREAS)                     *
        25      ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
        26      ID   ********************************************************************************
        27      ID   *                      100-YEAR, 6-HOUR STORM, AMC 2.0                           *
        28      ID   ********************************************************************************
        29      ID   * STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
        30      ID   *    JR DARF RATIO 0.620 AT STEWART AVENUE , NODE V2                             *
        31      ID   *  JR DARF RATIO 0.60 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
        32      ID   ********************************************************************************
        33      ID
        34      IT     05       0       0     200
        35      IO      5       0       0
        36      JR   PREC    0.62     .60

        37      KK  306B-M
        38      KM   BASIN 306B-M CONTRIBUTES FLOW TO NODE F3, THE BRIDGE AT THE UPRR,
        39      KM   MPU FACILITY RWWB 0027,(2) 21'X12' BRIDGE OPENINGS.
        40      BA   5.528
        41      PB    2.77
        42      PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
        43      PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
        44      PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
        45      PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
        46      PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
        47      PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
        48      PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
        49      PC    .997    .999   1.00
        50      LS       0      74
        51      UD    0.93
                *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  52      KK  307A-M
  53      KM   BASIN 307A-M CONTRIBUTES FLOW TO NODE F4, THE BOX CULVERT AT THE UPRR,
  54      KM   MPU FACILITY RWWE 0202, A 12'X8' RCB.
  55      BA   2.516
  56      PB    2.77
  57      LS       0      76
  58      UD    1.10
          *

  59      KK NODE.G1
  60      KM   COMBINE FLOW FROM F3 AND F4, NODE G1 IS THE BOX CULVERT AT INTERSTATE 15,
  61      KM   MPU FACILITY RWWE 0168, (3) 15'X10' RCBS.
  62      HC       2
          *

  63      KK   G1-G3
  64      KM   ROUTE FLOW FROM G1 THROUGH BASIN 307B-M TO G3.
  65      RM       5     .40      .3
          *

  66      KK  307B-M
  67      KM   BASIN 307B-M CONTRIBUTES FLOW TO NODE G3.
  68      BA   0.677
  69      PB    2.77
  70      LS       0      81
  71      UD    0.79
          *

  72      KK NODE.G3
  73      KM   COMBINE FLOW FROM G1 WITH FLOW FROM BASIN 307B-M.
  74      KM   NODE G3 REPRESENTS EAST TRIB TO NODE G2 AT LAS VEGAS BLVD.
  75      HC       2
          *

  76      KK    307C
  77      KM   307C MODIFIED DUE TO GOLDEN TRIANGLE INDUSTRIAL PARK
  78      KM   BASIN 307C CONTRIBUTES FLOW TO UPSTREAM OF INDUSTRIAL PARK
  79      BA    .503
  80      PB    2.77
  81      LS       0      77
  82      UD     .79
          *

  83      KK    TOG4
  84      KM   ROUTE FLOW THROUGH INDUSTRIAL PARK
  85      RK    6000   0.010   0.020       0    TRAP       3      50
          *

  86      KK    307D
  87      KM   AREA OF GOLDEN TRIANGLE INDUSTRIAL PARK
  88      BA    .323
  89      PB    2.77
  90      LS       0      88
  91      UD     .30
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  92      KK      G4
  93      KM   NODE G4 AT WALNUT AND MITCHELL
  94      KM   ASSUMES NO STORAGE OR CULVERT CAPACTIY RESTRICTION
  95      HC       2
          *

  96      KK   G4-G2
  97      KM   ROUTE FLOW FROM NODE G4 TO NODE G2.
  98      RK    8600   0.008   0.025       0    TRAP       3      50
          *

  99      KK    307E
 100      KM   BASIN 307E CONTRIBUTES FLOW TO NODE G7.
 101      BA   0.766
 102      PB    2.77
 103      LS       0      79
 104      UD    0.60
          *

 105      KK NODE.G7
 106      KM   COMBINE FLOW FROM NODE G4 AND BASIN 307E.
 107      KM   NODE G7, LOCATED NEAR THE ALEXANDER/LAMB INTERSECTION,
 108      KM   REPRESENTS THE TOTAL FLOW IN THE WESTERN TRIBUTARY TO NODE G2.
 109      HC       2
          *

 110      KK NODE.G2
 111      KM   COMBINE FLOW FROM NODES G3 AND G7; GIVES TOTAL FLOW TO G2.
 112      KM   NODE G2 IS MPU FACILITY RWSL 0745, (7) 10'X7' RCBS AT LAS VEGAS BLVD.
 113      HC       2
          *

 114      KK   G2-G8
 115      KM   ROUTE FLOW TO NODE G8
 116      RK    2500    .003    .015       0    TRAP      20       2
          *

 117      KK   309-M
 118      KM   BASIN 309-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
 119      KM   AND THEN CROSSING BENEATH I-15.
 120      KM   SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
 121      KM   MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0303, 0201, 0182, 0121, & 0085.
 122      KM   MPU FACILITIES AT I-15 ARE LABELED IS15 1917 AND IS15 1968.
 123      KM   NODE I3 IS LOCATED ARBITRARILY NEAR THE MIDDLE OF BASIN 309-M FOR
 124      KM   MODELING PURPOSES ONLY AND IS NOT THE ONLY CONCENTRATION POINT FOR 309-M.
 125      BA   3.976
 126      PB    2.77
 127      LS       0      75
 128      UD    0.86
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  129     KK   I3-I4
  130     KM   ROUTE FLOW FROM I3 THROUGH BASIN 310B-M TO I4.
  131     RM       9     .73      .2
          *

  132     KK  310B-M
  133     KM   BASIN 310B-M CONTRIBUTES FLOW TO NODE I4.
  134     BA   4.573
  135     PB    2.77
  136     LS       0      82
  137     UD     1.0
          *

  138     KK NODE.I4
  139     KM   COMBINE FLOW FROM NODE I3 AND BASIN 310B-M AT NODE I4.
  140     KM   NODE I4 IS MPU FACILITY SLEB 0044, (6) 10'X7' RCBS AT LAS VEGAS BLVD.
  141     KM   AT THE ENTRANCE TO THE CONCRETE LINED CHANNEL THAT EXTENDS THROUGH THE
  142     KM   TRAILER PARKS.
  143     HC       2
          *

  144     KK   I4-G8
  145     KM   ROUTE FLOW FROM I4 THROUGH THE CONCRETE CHANNEL TO G8.
  146     RK    2300   0.002   0.015       0    TRAP      20     1.5
          *

  147     KK NODE.G8
  148     KM   COMBINE FLOW FROM I4 AND G2 TO GIVE THE TOTAL FLOW AT NODE G8.
  149     KM   NODE G8 IS THE CONFLUENCE OF THE CONCRETE LINED CHANNELS, LABELED AS
  150     KM   MPU FACILITIES RWSL 0672 AND SLEB 0000.
  151     HC       2
          *

  152     KK   G8-G9
  153     KM   ROUTE FLOW FROM G8 THROUGH THE CONCRETE CHANNEL TO G9.
  154     RK    8400   0.003   0.015       0    TRAP      20       2
          *

  155     KK     47C
  156     KM   BASIN 47C CONTRIBUTES FLOW TO THE PORTION OF THE CONCRETE CHANNEL
  157     KM   LOCATED UPSTREAM OF THE DIVERSION STRUCTURE.
  158     BA   0.856
  159     PB    2.77
  160     LS       0      79
  161     UD     .49
          *

  162     KK NODE.G9
  163     KM   COMBINE FLOW FROM G8 WITH FLOW FROM BASIN 47C.
  164     KM   NODE G9 REPRESENTS THE TOTAL FLOW IN THE CONCRETE CHANNEL, LABELED
  165     KM   MPU FACILITY RWSL 0576, LOCATED JUST UPSTREAM OF THE DIVERSION STRUCTURE.
  166     HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  167     KK    DIV
  168     KM   FLOW DIVERSION STRUCTURE; SOME FLOW IS DIVERTED INTO THE CHANNEL THAT
  169     KM   EXTENDS THROUGH THE NELLIS AIR FORCE BASE GOLF COURSE.  FLOW IN THE NAFB
  170     KM   GOLF COURSE CHANNEL WILL THEN ENTER THE CONFLUENCE DETENTION BASIN.
  171     DT   RANGE
  172     DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
  173     DQ       0     850     900     950    1000    1050    1100    1200    1300    1400
          *

  174     KKG9-DB.IN
  175     KM   ROUTE FLOW FROM G9 THROUGH THE GOLF COURSE CHANNEL TO THE ENTRANCE
  176     KM   OF THE CONFLUENCE DETENTION BASIN, LABELED DB.IN.
  177     RK    4000   0.002    0.03       0    TRAP      70       3
          *

  178     KK   47B-M
  179     KM   MAJORITY OF BASIN 47B-M CONTRIBUTES FLOW TO THE NAFB GOLF COURSE CHANNEL;
  180     KM   PORTION OF 47B-M CONTRIBUTES FLOW DIRECTLY TO THE CONFLUENCE DETENTION BASIN.
  181     BA   3.378
  182     PB    2.81
  183     LS       0      84
  184     UD    0.60
          *

  185     KK     G10
  186     KM   COMBINE FLOW FROM GOLF WITH FLOW FROM BASIN 47B-M.
  187     KM   GIVES TOTAL FLOW TO THE NAFB GOLF COURSE CHANNEL.
  188     HC       2
          *

  189     KK   DBINW
  190     KM   ROUTE WEST TRIBUTARY THOUGH DET BASIN AREA
  191     RM       2     .16      .3
          *

  192     KK    44-M
  193     KM   BASIN 44-M CONTRIBUTES FLOW TO NODE J.
  194     KM   NODE J IS LOCATED NEAR THE CENTER OF BASIN 44-M FOR MODELING PURPOSES ONLY.
  195     BA   8.164
  196     PB    2.85
  197     LS       0      84
  198     UD    1.28
          *

  199     KK     J-K
  200     KM   ROUTE FLOW FROM NODE J THROUGH BASIN 312-M TO NODE K.
  201     RM      11    0.92    0.15
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  202     KK   312-M
  203     KM   BASIN 312-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
  204     KM   THEN CROSSING BENEATH I-15, AND THEN CROSSING BENEATH LAS VEGAS BLVD.
  205     KM   SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
  206     KM   MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0057, 0038, 0806, 0826, ETC.
  207     KM   MPU FACILITIES AT I-15 ARE LABELED IS15 2108, 2143, 2189, 2205, ETC.
  208     KM   THE MAJORITY OF FLOW FROM BASIN 312-M CONCENTRATES AT NODE K.
  209     BA  13.457
  210     PB   2.79
  211     LS      0      75
  212     UD   1.38
          *

  213     KK  NODE.K
  214     KM   COMBINE FLOW FROM J WITH FLOW FROM BASIN 312-M AT NODE K.
  215     HC      2
          *

  216     KK   K-P1
  217     KM   ROUTE FLOW FROM NODE K THROUGH BASIN 47A TO NODE P1.
  218     RM     10     .80     .15
          *

  219     KK   45-M
  220     KM   BASIN 45-M CONTRIBUTES FLOW TO NODE N2.
  221     BA   8.207
  222     PB   2.85
  223     LS      0      78
  224     UD   1.27
          *

  225     KK   N2-O
  226     KM   ROUTE FLOW FROM N2 THROUGH BASIN 48 TO NODE O.
  227     RM      4    0.37    0.15
          *

  228     KK     48
  229     KM   BASIN 48 CONTRIBUTES FLOW TO NODE O.
  230     BA   2.07
  231     PB   2.85
  232     LS      0      73
  233     UD   0.99
          *

  234     KK    46A
  235     KM   BASIN 46A CONTRIBUTES FLOW TO NODE O.
  236     BA   7.278
  237     PB   2.95
  238     LS      0      76
  239     UD   1.56
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  240     KK   46B-M
  241     KM   BASIN 46B-M CONTRIBUTES FLOW TO NODE O.
  242     BA   6.312
  243     PB    3.00
  244     LS       0      76
  245     UD    1.64
          *

  246     KK  NODE.O
  247     KM   COMBINE FLOW FROM N2 AND BASINS 48, 46A, AND 46B-M AT NODE O.
  248     HC       4
          *

  249     KK    O-P1
  250     KM   ROUTE FLOW FROM NODE O THROUGH BASIN 47A TO NODE P1.
  251     RM      10    0.85    0.15
          *

  252     KK     47A
  253     KM   BASIN 47A CONTRIBUTES FLOW TO NODE P1.
  254     BA   2.428
  255     PB    2.95
  256     LS       0      77
  257     UD    0.84
          *

  258     KK NODE.P1
  259     KM   COMBINE FLOW FROM NODES K AND O WITH FLOW FROM BASIN 47A AT NODE P1.
  260     HC       3
          *

  261     KK   P1-P2
  262     KM   ROUTE FROM NODE P1 TO NODE P2.
  263     RM       3     .28     .15
          *

  264     KK     317
  265     KM   BASIN 317 CONTRIBUTES FLOW TO NODE P2.
  266     BA   7.116
  267     PB   3.075
  268     LS       0      84
  269     UD    1.22
          *

  270     KK NODE.P2
  271     KM   COMBINE FLOW FROM P1 WITH FLOW FROM BASIN 317 AT NODE P2.
  272     HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  273     KK    P2-P
  274     KM   ROUTE FROM NODE P2 TO NODE P.
  275     RM       3     .26    0.15
          *

  276     KK    318B
  277     KM   BASIN 318B CONTRIBUTES FLOW TO NODE Q.
  278     BA   1.591
  279     PB   3.145
  280     LS       0      87
  281     UD    0.60
          *

  282     KK     Q-P
  283     KM   ROUTE FLOW FROM NODE Q THROUGH BASIN 318A TO NODE P.
  284     RM       5    0.39    0.15
          *

  285     KK    318A
  286     KM   BASIN 318A CONTRIBUTES FLOW TO NODE P.
  287     BA   0.939
  288     PB    2.93
  289     LS       0      80
  290     UD    0.69
          *

  291     KK  NODE.P
  292     KM   COMBINE FLOWS FROM NODE P2, AND BASINS 318A AND 318B AT NODE P.
  293     KM   FLOW AT NODE P ENTERS THE CONFLUENCE DETENTION BASIN.
  294     HC       3
          *

  295     KK DBIN-ER
  296     KM   INFLOW TO DET BASIN FROM EAST TRIBUTARY
  297     KM   ROUTE FLOW THROUGH THE CONFLUENCE DETENTION BASIN.
  298     RM       4     .36     .15
          *

  299     KK CON-DET
  300     KM   BASIN AREA OF THE CONFLUENCE DETENTION BASIN.
  301     BA   0.249
  302     PB    2.85
  303     LS       0      80
  304     UD    0.90
          *

  305     KK    DBIN
  306     KM   COMBINE FLOW FROM NODES G10 AND P AND BASIN CON-DET.
  307     KM   GIVES TOTAL FLOW TO THE CONFLUENCE DETENTION BASIN SITE.
  308     HC       3
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  309     KKDBOUT-M1
  310     KM   ROUTE DB.OUT OUTFLOW TO NODE M1.
  311     KM   NOTE DETENTION BASIN HAS NOT BEEN INCLUDED IN THIS RUN
  312     RK    2640   0.002   0.015       0    TRAP      20       2
          *

  313     KK    318C
  314     KM   BASIN 318C CONTRIBUTES FLOW TO NODE M1.
  315     BA    1.28
  316     PB    2.93
  317     LS       0      79
  318     UD    0.75
          *

  319     KK NODE.M1
  320     KM   COMBINE THE DETENTION BASIN OUTFLOW WITH FLOW FROM BASIN 318C.
  321     KM   NODE M1 GIVES THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
  322     KM   THE CONFLUENCE WITH THE RANGE WASH CHANNEL.
  323     HC       2
          *

  324     KK   321-M
  325     KM   BASIN 321-M CONTRIBUTES FLOW TO THE RANGE WASH CHANNEL UPSTREAM OF
  326     KM   ITS CONFLUENCE WITH THE SLOAN CHANNEL.
  327     BA   0.691
  328     PB    2.77
  329     LS       0      67
  330     UD    1.66
          *

  331     KKRNG.CHNL
  332     KM   RETRIEVE THE FLOW THAT SPLIT INTO THE RANGE WASH CHANNEL THAT EXTENDS
  333     KM   SOUTHEASTERLY THROUGH THE NAFB.
  334     DR   RANGE
          *

  335     KK NODE.M2
  336     KM   COMBINE FLOW FROM BASIN 321-M WITH RETRIEVED FLOW IN THE RANGE WASH CHANNEL.
  337     KM   GIVES TOTAL FLOW IN THE RANGE WASH CHANNEL JUST UPSTREAM OF ITS CONFLUENCE
  338     KM   WITH THE SLOAN CHANNEL.
  339     HC       2
          *

  340     KK NODE.M3
  341     KM   COMBINE FLOWS FROM M1 AND M2 AT NODE M3.
  342     KM   NODE M3 IS THE TOTAL FLOW AT THE CONFLUENCE OF THE SLOAN CHANNEL
  343     KM   AND THE RANGE WASH CHANNEL AT SLOAN AND CAREY AVENUE.
  344     HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  345     KK   M3-S1
  346     KM   ROUTE FLOW FROM NODE M3 THROUGH THE SLOAN CHANNEL TO NODE S1.
  347     RK    2640   0.004   0.015       0    TRAP      40       3
          *

  348     KK   48A-M
  349     KM   BASIN 48A-M CONTRIBUTES FLOW TO NODE S1.
  350     BA   0.715
  351     PB    2.93
  352     LS       0      83
  353     UD    0.44
          *

  354     KK      S1
  355     KM   COMBINE FLOW FROM M3 WITH FLOW FROM BASIN 48A-M.
  356     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT LAKE MEAD BLVD.
  357     HC       2
          *

  358     KK   S1-S2
  359     KM   ROUTE FLOW FROM S1 THROUGH THE SLOAN CHANNEL TO S2.
  360     RK    2640   0.002   0.015       0    TRAP      50       2
          *

  361     KK     48B
  362     KM   BASIN 48B CONTRIBUTES FLOW TO NODE R.
  363     BA   1.142
  364     PB    3.10
  365     LS       0      89
  366     UD    0.51
          *

  367     KK    R-S2
  368     KM   ROUTE FLOW FROM R THROUGH BASIN 49A-M TO NODE S2.
  369     RK   10500   0.022    0.02       0    TRAP      10      20
          *

  370     KK   49A-M
  371     KM   BASIN 49A-M CONTRIBUTES FLOW TO NODE S2.
  372     BA   0.693
  373     PB    2.85
  374     LS       0      79
  375     UD    0.49
          *

  376     KK NODE.S2
  377     KM   COMBINE FLOW FROM NODES S1 AND R WITH FLOW FROM BASIN 49A-M AT NODE S2.
  378     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT OWENS AVENUE.
  379     HC       3
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

380       KK   S2-S3
381       KM   ROUTE FLOW FROM S2 THROUGH THE SLOAN CHANNEL TO S3.
382       RK    2640   0.004   0.014       0    TRAP      60       2
          *

383       KK     49C
384       KM   BASIN 49C CONTRIBUTES FLOW TO NODE S3.
385       BA   0.426
386       PB    2.85
387       LS       0      76
388       UD    0.53
          *

389       KK NODE.S3
390       KM   COMBINE FLOW FROM S2 WITH FLOW FROM BASIN 49C AT NODE S3.
391       KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT WASHINGTON AVE.
392       HC       2
          *

393       KK   49B-M
394       KM   BASIN 49B-M CONTRIBUTES FLOW TO NODE T1.
395       KM   NODE T1 REPRESENTS THE TOTAL FLOW TO THE DIVERSION CHANNEL ALONG
396       KM   WASHINGTON AVE. JUST UPSTREAM OF THE SLOAN CHANNEL.
397       BA   1.977
398       PB    3.00
399       LS       0      85
400       UD    0.61
          *

401       KK NODE.S4
402       KM   COMBINE FLOW FROM S3 WITH FLOW FROM T1 AT NODE S4.
403       KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT HARRIS AVE.
404       HC       2
          *

405       KK   50B-M
406       KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
407       BA   0.628
408       PB    3.00
409       LS       0      80
410       UD    0.39
          *

411       KK NODE.V1
412       KM   COMBINE FLOW FROM S4 WITH FLOW FROM BASIN 50B-M AT NODE V1.
413       KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT BONANZA RD.
414       HC       2
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  415     KK   V1-V2
  416     KM   ROUTE FLOWS FROM V1 THROUGH THE SLOAN CHANNEL TO NODE V2.
  417     RK    2640   0.008   0.014       0    TRAP      60       2
          *

  418     KK   50A-M
  419     KM   BASIN 50A-M CONTRIBUTES FLOW TO NODE V2.
  420     BA   0.207
  421     PB    2.85
  422     LS       0      73
  423     UD    0.46
          *

  424     KK NODE.V2
  425     KM   COMBINE FLOW FROM V1 WITH FLOW FROM BASIN 50A-M AT NODE V2.
  426     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT STEWART AVE.
  427     HC       2
          *

  428     KK   324-M
  429     KM   BASIN 324-M CONTRIBUTES FLOW TO NODE V3.
  430     BA   3.026
  431     PB    2.85
  432     LS       0      72
  433     UD    0.77
          *

  434     KK    STEW
  435     KM   DIVERT FLOWS WHICH CONTINUE IN CHRISTY & LINN LANES, ETC
  436     KM   FLOW IN STEWART GOES TO SLOAN CHANNEL
  437     KM   FLOW IN CHRISTY GOES TOWARD LAS VEGAS WASH
  438     DT      CL
  439     DI       0      15     600
  440     DQ       0       0     330
          *

  441     KK NODE.V3
  442     KM   COMBINE FLOW FROM V2 WITH FLOW FROM BASIN 324-M AT NODE V3.
  443     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL
  444     KM   SOUTH OF STEWART AVE.
  445     HC       2
          *

  446     KK   V3-V4
  447     KM   ROUTE V3 THROUGH THE SLOAN CHANNEL TO V4.
  448     RK    2000   0.003    0.03       0    TRAP      80       2
          *

  449     KK     CLR
  450     KM   RETREIVE FLOW IN CHRISTY AND LINN LANES
  451     DR      CL
          *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

452       KK    LINN
453       KM   FLOW IN LINN LANE GOES TO BASIN 326-A THEN TO SLOAN CHANNEL
454       KM   FLOW IN CHRISTY GOES TO LAS VEGAS WASH
455       DT   CHRIS
456       DI       0     100     500
457       DQ       0      78     390
          *

458       KK   326-A
459       KM   BASIN 326-A CONTRIBUTES FLOW TO NODE V4.
460       KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. WEST OF SLOAN CHANNEL.
461       BA   0.231
462       PB    2.85
463       LS       0      79
464       UD    0.39
          *

465       KK  326-AL
466       KM   BASIN 326-A AND FLOW IN LINN LANE
467       HC       2
          *

468       KK    OR-1
469       KM   ORCHARDS OFFSITE DRAINAGE BASIN 01; CONTRIBUTES FLOW TO NODE X1.
470       KM   * BASINS WITH THE "OR" PREFIX ARE TAKEN FROM THE "CONCEPTUAL MASTER        *
471       KM   * DRAINAGE STUDY FOR LEWIS HOMES - ORCHARDS," BY PENTACORE, JANUARY, 1992. *
472       KM   * THE MAJORITY OF THE ORCHARDS SITE IS CONSTRUCTED; HOWEVER, THE PLANNED   *
473       KM   * ORCHARDS DETENTION BASIN IS NOT CONSTRUCTED. HYDROLOGY FROM THE ORCHARDS *
474       KM   * DRAINAGE STUDY HAS BEEN MODIFIED TO REPRESENT APPROXIMATE EXISTING       *
475       KM   * CONDITIONS, RATHER THAN FULLY DEVELOPED CONDITIONS.                      *
476       PB    3.00
477       BA   0.279
478       LS       0      89
479       UD    0.18
          *

480       KK   X1-X2
481       KM   ROUTE X1 THROUGH BASIN OR-2 TO NODE X2.
482       RK   10000   0.033    0.02       0    TRAP      20      10
          *

483       KK    OR-2
484       KM   ORCHARDS OFFSITE DRAINAGE BASIN 02; CONTRIBUTES FLOW TO NODE X2.
485       BA   1.206
486       PB    2.93
487       LS       0      75
488       UD    0.60
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

489       KK NODE.X2
490       KM   COMBINE FLOW FROM X1 AND BASIN OR-2 AT NODE X2.
491       KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. EAST OF SLOAN CHANNEL.
492       HC       2
          *

493       KK NODE.V4
494       KM   COMBINE FLOW FROM V3, X2 AND BASIN 326-A.
495       KM   GIVES TOTAL FLOW TO THE SLOAN CHANNEL AT CHARLESTON BLVD.
496       HC       3
          *

497       KK   OR-11
498       KM   ORCHARDS ONSITE BASIN OR-11 CONTRIBUTES FLOW TO NODE V5.
499       BA  0.0428
500       PB   2.85
501       LS      0      75
502       UD   0.20
          *

503       KK NODE.V5
504       KM   COMBINE FLOW FROM V4 AND BASIN OR-11.
505       KM   TOTAL FLOW TO THE SLOAN CHANNEL APPROX. 1500 FT. SOUTH OF CHARLESTON BLVD.
506       HC       2
          *

507       KK   V5-Z2
508       KM   ROUTE V5 THROUGH SLOAN CHANNEL TO THE ORCHARDS CHANNEL CONFLUENCE AT Z2.
509       RK    2800   0.005    0.03       0    TRAP      60       2
          *

510       KK    OR-3
511       KM   ORCHARDS OFFSITE DRAINAGE BASIN O3.
512       KM   GIVES FLOW TO NODE Y1, LOCATED AT CHARLESTON WEST OF HOLLYWOOD.
513       BA   0.205
514       PB    3.00
515       LS      0      82
516       UD   0.42
          *

517       KK   Y1-Z1
518       KM   ROUTE NODE Y1 THROUGH BASIN OR-12 TO NODE Z1.
519       RK    5500   0.011   0.016       0    TRAP      50       1
          •

520       KK    OR-4
521       KM   ORCHARDS OFFSITE DRAINAGE BASIN O4.
522       KM   CONTRIBUTES FLOW TO NODE Y2.
523       BA   0.448
524       PB    3.00
525       LS      0      88
526       UD   0.29
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  527     KK   Y2-Y3
  528     KM   ROUTE NODE Y2 THROUGH BASIN OR-5 TO NODE Y3.
  529     RM      4    0.33    0.15
          *

  530     KK    OR-5
  531     KM   ORCHARDS OFFSITE DRAINAGE BASIN O5.
  532     KM   CONTRIBUTES FLOW TO NODE Y3.
  533     BA   0.373
  534     PB    3.00
  535     LS       0      77
  536     UD    0.44
          *

  537     KK      Y3
  538     KM   COMBINE FLOWS FROM Y2 AND BASIN OR-5 AT HOLLYWOOD.
  539     HC       2
          *

  540     KK   Y3-Z1
  541     KM   ROUTE Y3 THROUGH BASIN OR-12 TO NODE Z1.
  542     RK    5000   0.012   0.016       0    TRAP      50       1
          *

  543     KK   OR-6A
  544     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6A.
  545     BA   0.264
  546     PB    3.00
  547     LS       0      88
  548     UD     .13
          *

  549     KK   OR-6B
  550     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6B,
  551     BA   0.160
  552     PB    3.00
  553     LS       0      89
  554     UD     .14
          *

  555     KK   OR-6C
  556     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6C.
  557     BA   0.191
  558     PB    3.00
  559     LS       0      87
  560     UD     .18
          *

  561     KKNODE.AA1
  562     KM   COMBINE FLOWS FROM BASINS OR-6A, OR-6B & OR-6C.
  563     HC       3
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

564       KK AA1-AA2
565       KM   ROUTE AA1 THROUGH BASIN OR-7 TO NODE AA2.
566       RM       4    0.32    0.15
          *

567       KK    OR-7
568       KM   ORCHARDS OFFSITE DRAINAGE BASIN O7.
569       BA   0.613
570       PB    3.00
571       LS       0      77
572       UD    0.49
          *

573       KKNODE.AA2
574       KM   COMBINE AA1 WITH FLOW FROM BASIN OR-7 AT NODE AA2.
575       HC       2
          *

576       KK  AA2-Z1
577       KM   ROUTE AA2 THROUGH BASIN OR-12 TO NODE Z1.
578       RK    4500   0.013   0.016       0    TRAP      50       1
          *

579       KK    OR-8
580       KM   ORCHARDS OFFSITE BASIN O8; CONTRIBUTES FLOW TO NODE AA3.
581       BA   0.017
582       PB    3.00
583       LS       0      77
584       UD    0.18
          *

585       KK  R8-AA3
586       KM   ROUTE FLOW FROM BASIN OR-8 THROUGH BASIN OR-9 TO NODE AA3 AT HOLLYWOOD.
587       RM      10    0.82    0.15
          *

588       KK    OR-9
589       KM   ORCHARDS OFFSITE DRAINAGE BASIN O9; CONTRIBUTES FLOW TO NODE AA3.
590       BA   0.278
591       PB    3.00
592       LS       0      77
593       UD    0.65
          *

594       KKNODE.AA3
595       KM   COMBINE FLOWS FROM BASINS OR-8 AND OR-9 AT NODE AA3.
596       HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  597     KK  AA3-Z1
  598     KM   ROUTE AA3 THROUGH BASIN OR-12 TO NODE Z1.
  599     RK    4500   0.012   0.016       0    TRAP      50       1
          *

  600     KK   OR-12
  601     KM   ORCHARDS ONSITE DRAINAGE BASIN 12; CONTRIBUTES FLOW TO NODE Z1.
  602     BA   0.525
  603     PB    2.85
  604     LS       0      76
  605     UD    0.39
          *

  606     KK NODE.Z1
  607     KM   COMBINE FLOW FROM NODES Y1, Y3, AA2, AA3 AND BASIN OR-12 AT NODE Z1.
  608     KM   NODE Z1 REPRESENTS THE TOTAL FLOW IN THE CONCRETE-LINED ORCHARDS CHANNEL
  609     KM   TRIBUTARY TO THE SLOAN CHANNEL.
  610     HC       5
          *

  611     KK NODE.Z2
  612     KM   COMBINE FLOW FROM NODES V5 AND Z1.
  613     KM   TOTAL FLOW IN THE SLOAN CHANNEL AT ITS CONFLUENCE WITH THE ORCHARDS CHANNEL.
  614     HC       2
          *

  615     KK   OR-13
  616     KM   ORCHARDS ONSITE DRAINAGE BASIN OR-13; CONTRIBUTES FLOW TO NODE Z3.
  617     BA   0.120
  618     PB    2.85
  619     LS       0      84
  620     UD    0.29
          *

  621     KK NODE.Z3
  622     KM   COMBINE FLOW FROM NODES Z2 AND BASIN OR-13 AT NODE Z3.
  623     KM   NODE Z3 IS THE TOTAL FLOW IN THE SLOAN CHANNEL AT APPROXIMATELY
  624     KM   450 FEET SOUTH OF THE ORCHARDS CHANNEL CONFLUENCE.
  625     HC       2
          *

  626     KK   OR-10
  627     KM   ORCHARDS OFFSITE DRAINAGE BASIN O10.
  628     KM   CONTRIBUTES FLOW TO NODE BB1, LOCATED AT THE HOLLYWOOD/SAHARA INTERSECTION.
  629     BA  0.0984
  630     PB    3.00
  631     LS       0      77
  632     UD    0.45
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  633     KK BB1-BB2
  634     KM   ROUTE BB1 THROUGH SAHARA AVENUE TO NODE BB2.
  635     RK    4000   0.014   0.016       0    TRAP     100       1
          *

  636     KK   OR-14
  637     KM   ORCHARDS ONSITE DRAINAGE BASIN 14; CONTRIBUTES FLOW TO NODE BB2.
  638     BA  0.0937
  639     PB   2.85
  640     LS      0      75
  641     UD   0.33
          *

  642     KKNODE.BB2
  643     KM   NODE BB2 REPRESENTS THE TOTAL FLOW IN SAHARA AVE. EAST OF THE SLOAN CHANNEL.
  644     HC       2
          *

  645     KKNODE.BB3
  646     KM   COMBINE FLOW FROM Z3 WITH FLOW FROM BB2.
  647     KM   NODE BB3 IS THE TOTAL FLOW IN SLOAN CHANNEL AT SAHARA AVE.
  648     HC       2
          *

  649     KK  BB3-CC
  650     KM   ROUTE BB3 THROUGH THE SLOAN CHANNEL TO NODE CC.
  651     RK    1700   0.006   0.025       0    TRAP      80       2
          *

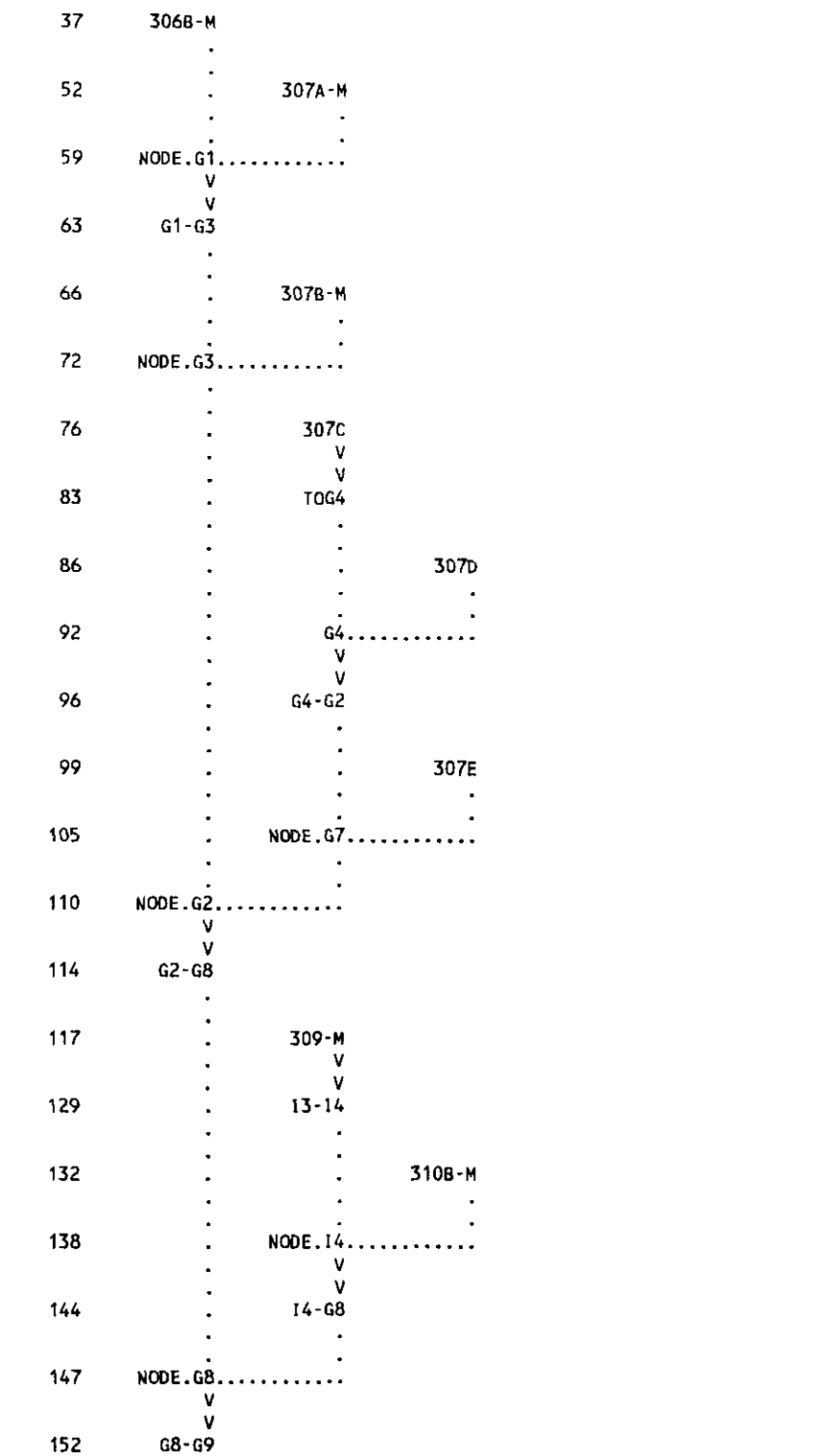
  652     KK   52A-M
  653     KM   BASIN 52A-M CONTRIBUTES FLOW TO NODE CC.
  654     BA   0.286
  655     PB    2.85
  656     LS      0      73
  657     UD    0.84
          *

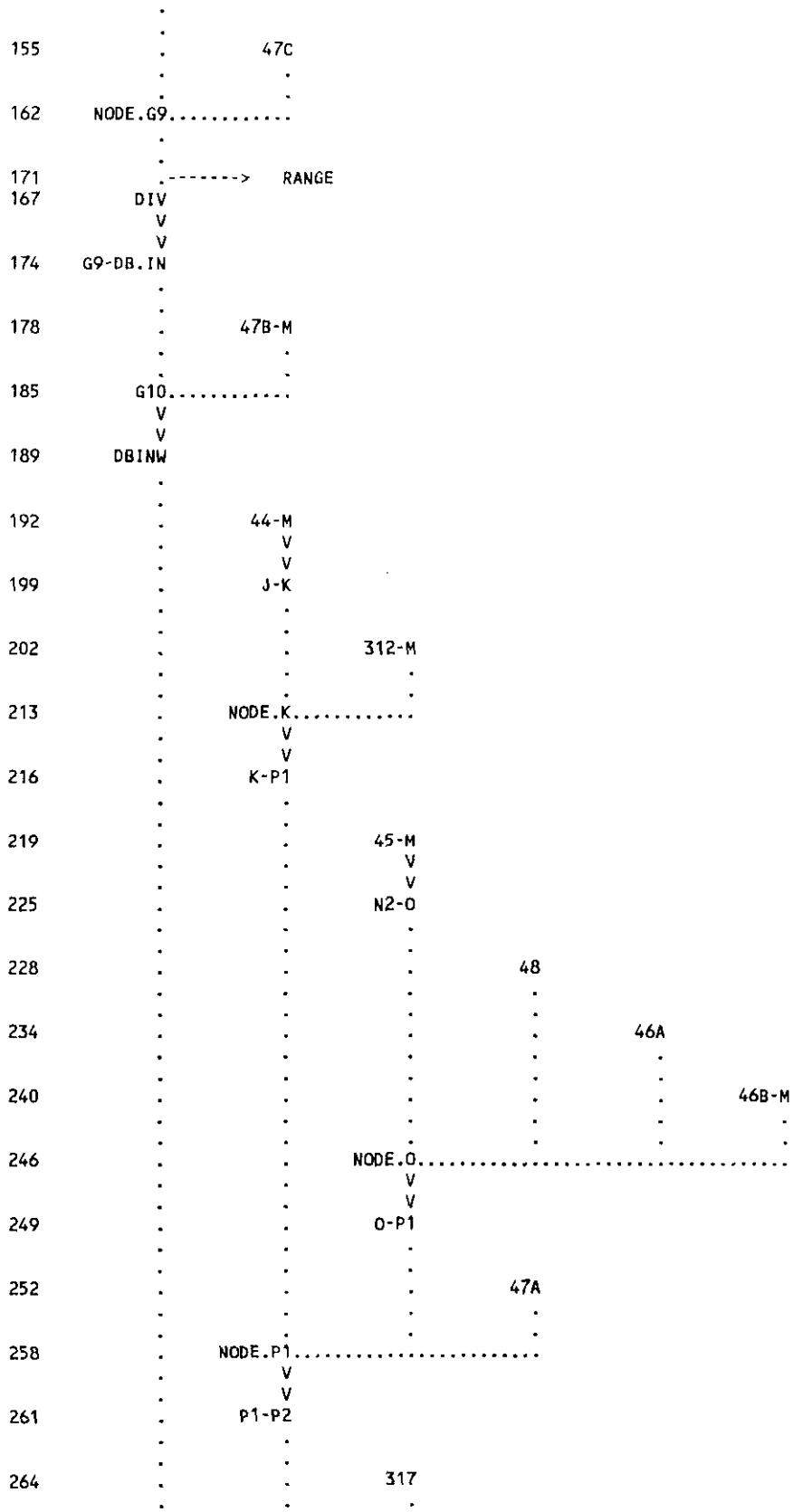
  658     KK NODE.CC
  659     KM   COMBINE FLOW FROM  NODE BB3 WITH FLOW FROM BASINS 326-B AND 52A-M.
  660     KM   NODE CC REPRESENTS THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
  661     KM   ITS CONFLUENCE WITH THE LAS VEGAS WASH.
  662     HC       2
          *
  663     ZZ
```

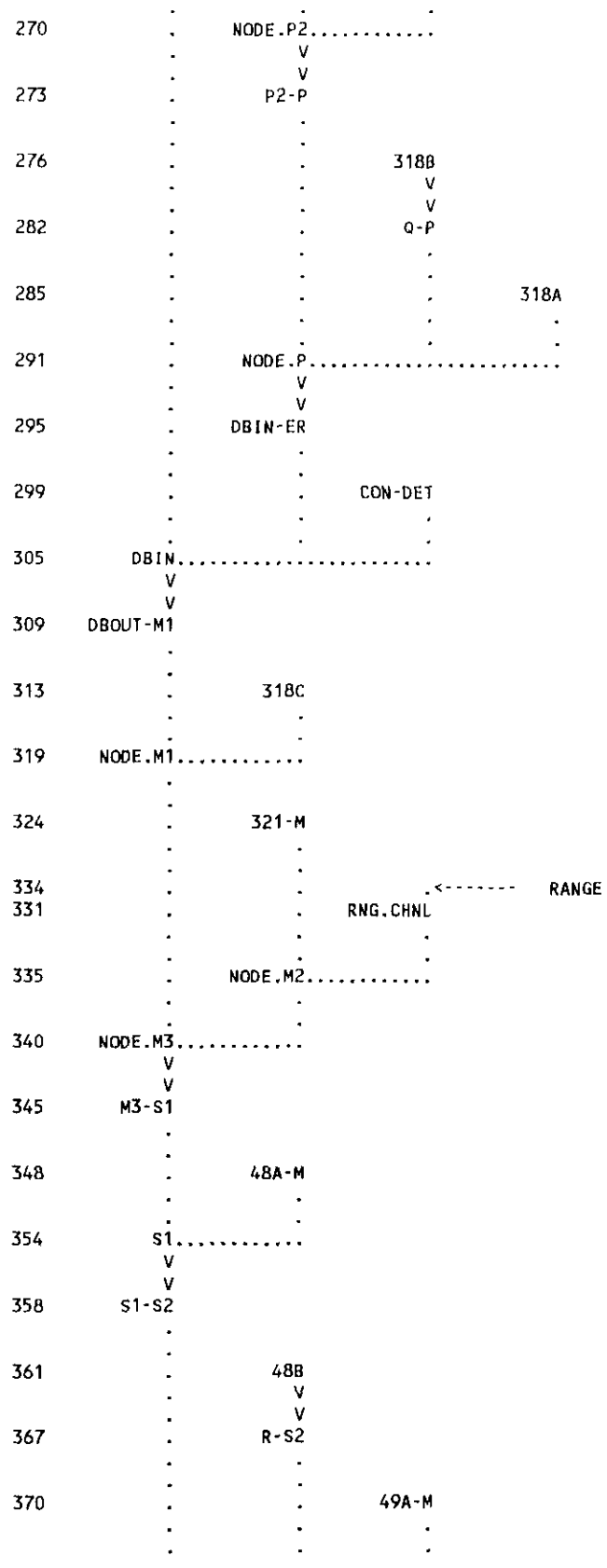
SCHEMATIC DIAGRAM OF STREAM NETWORK

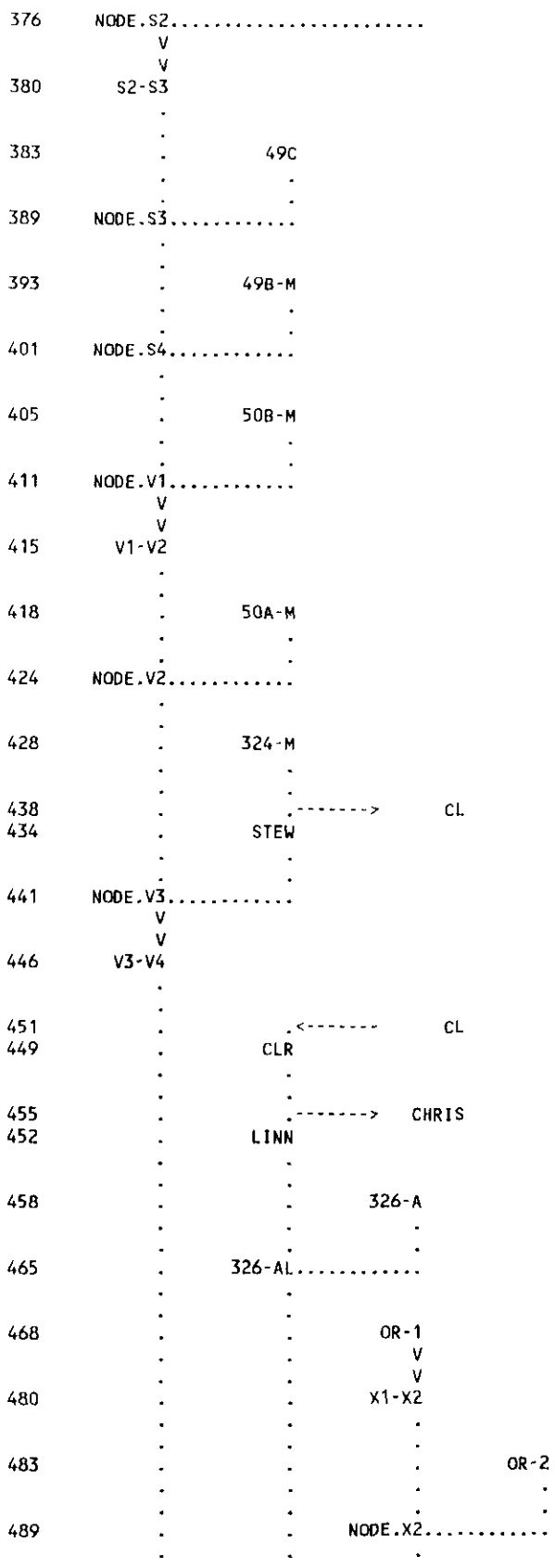
INPUT LINE NO.

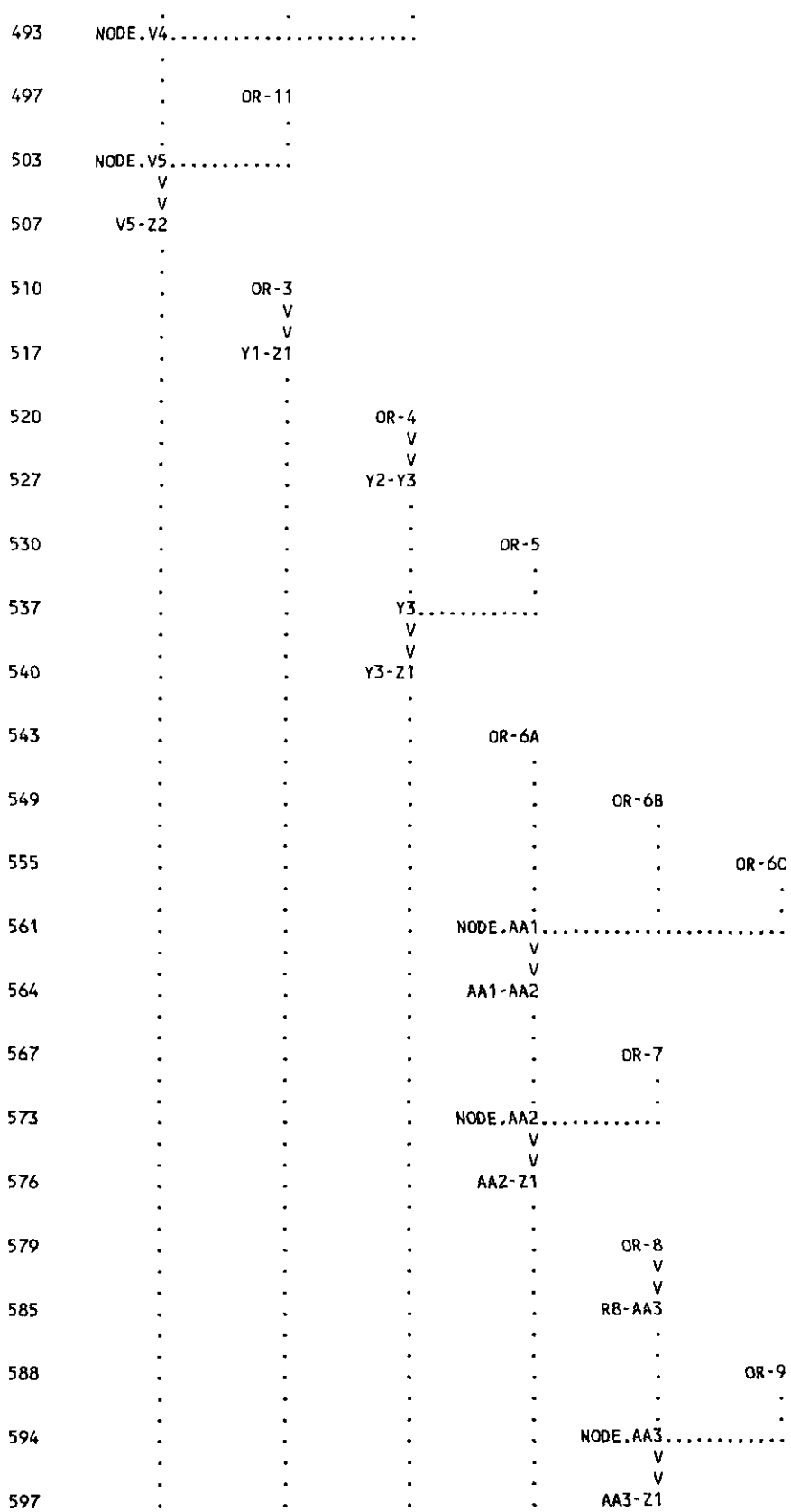
(V) ROUTING (.) CONNECTOR (---->) DIVERSION OR PUMP FLOW (<----) RETURN OF DIVERTED OR PUMPED FLOW

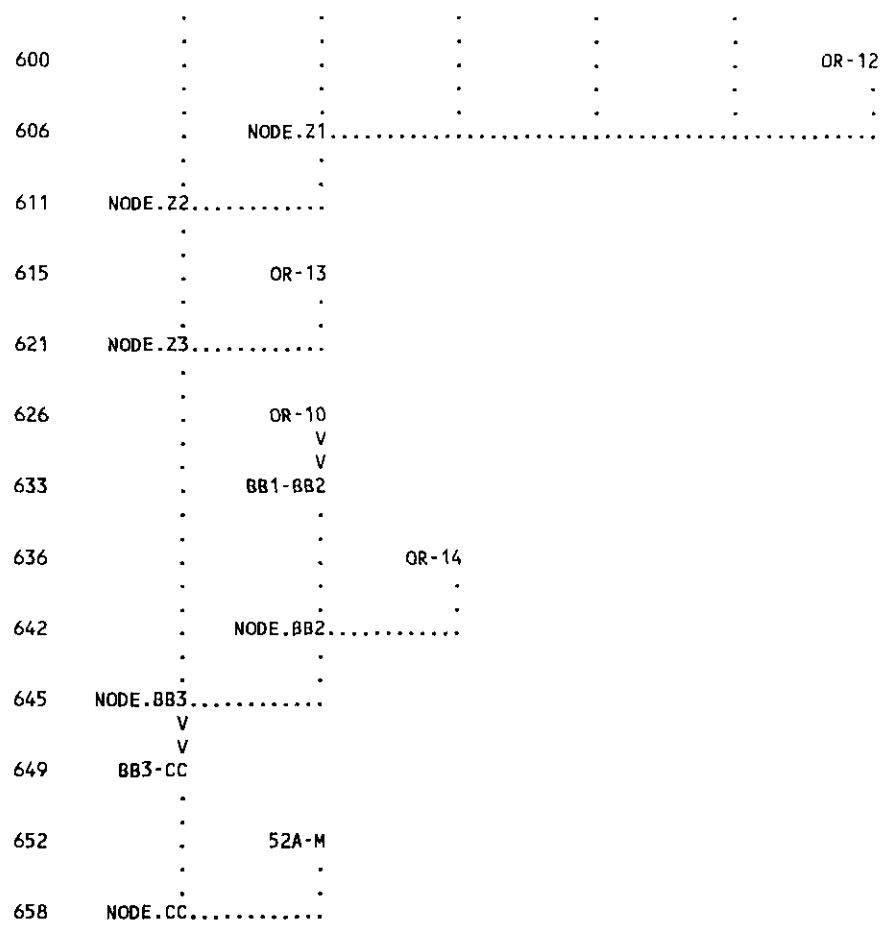



155
47C
162
NODE.G9
171
RANGE
167
DIV
174
G9-DB.IN
178
47B-M
185
G10
189
DBINW
192
44-M
199
J-K
202
312-M
213
NODE.K
216
K-P1
219
45-M
225
N2-O
228
48
234
46A
240
46B-M
246
NODE.O
249
O-P1
252
47A
258
NODE.P1
261
P1-P2
264
317


270
NODE.P2
273
P2-P
276
318B
282
Q-P
285
318A
291
NODE.P
295
DBIN-ER
299
CON-DET
305
DBIN
309
DBOUT-M1
313
318C
319
NODE.M1
324
321-M
334
RANGE
331
RNG.CHNL
335
NODE.M2
340
NODE.M3
345
M3-S1
348
48A-M
354
S1
358
S1-S2
361
48B
367
R-S2
370
49A-M


376 NODE.S2
380 S2-S3
383 49C
389 NODE.S3
393 49B-M
401 NODE.S4
405 50B-M
411 NODE.V1
415 V1-V2
418 50A-M
424 NODE.V2
428 324-M
438 CL
434 STEW
441 NODE.V3
446 V3-V4
451 CL
449 CLR
455 CHRIS
452 LINN
458 326-A
465 326-AL
468 OR-1
480 X1-X2
483 OR-2
489 NODE.X2


493
NODE.V4
497
OR-11
503
NODE.V5
507
V5-Z2
510
OR-3
517
Y1-Z1
520
OR-4
527
Y2-Y3
530
OR-5
537
Y3
540
Y3-Z1
543
OR-6A
549
OR-6B
555
OR-6C
561
NODE.AA1
564
AA1-AA2
567
OR-7
573
NODE.AA2
576
AA2-Z1
579
OR-8
585
R8-AA3
588
OR-9
594
NODE.AA3
597
AA3-Z1


600
OR-12
606
NODE.Z1
611
NODE.Z2
615
OR-13
621
NODE.Z3
626
OR-10
633
BB1-BB2
636
OR-14
642
NODE.BB2
645
NODE.BB3
649
BB3-CC
652
52A-M
658
NODE.CC

*) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  02/01/1996  TIME  13:52:40 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104               *
*                                       *
*****************************************
```

RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: NODB.DAT
JANUARY 1996

THIS RUN TO EVALUATE THE CIBOLA SITE UNDER INTERIM CONDTION
BEFORE THE CONFLUENCE DETENTION BASIN IS COMPLETED

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE,
WITHOUT THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR SLOAN AT STEWART AVENUE

```
*************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE          *
*                          RANGE WASH WATERSHED                         *
*                 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.       *
*                                JANUARY 1991                           *
*                   PRESENT CONDITIONS, EXISTING FACILITIES             *
*                    BASED ON RANGE WASH FACILITIES STUDY               *
*                       BOYLE ENGINEERS CORP-JULY 1989                  *
*                                                                       *
*                    (CONVERTED RK TO RM IN UPLAND SUBAREAS)            *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
*************************************************************************
*                      100-YEAR, 6-HOUR STORM, AMC 2.0                  *
*************************************************************************
* STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
*     JR DARF RATIO 0.620 AT STEWART AVENUE , NODE V2                   *
*  JR DARF RATIO 0.60 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
*************************************************************************
```

```
35 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                    NMIN           5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                      NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       1635  ENDING TIME
                   ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL      .08 HOURS
                     TOTAL TIME BASE    16.58 HOURS

       ENGLISH UNITS
            DRAINAGE AREA         SQUARE MILES
            PRECIPITATION DEPTH   INCHES
            LENGTH, ELEVATION     FEET
```

```
          FLOW                    CUBIC FEET PER SECOND
          STORAGE VOLUME          ACRE-FEET
          SURFACE AREA            ACRES
          TEMPERATURE             DEGREES FAHRENHEIT

JP          MULTI-PLAN OPTION
                NPLAN             1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
              RATIOS OF PRECIPITATION
              .62       .60

    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .62	RATIO 2 .60
HYDROGRAPH AT						
+	306B-M	5.53	1	FLOW	350.	321.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	307A-M	2.52	1	FLOW	177.	163.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.G1	8.04	1	FLOW	526.	483.
				TIME	5.42	5.42
ROUTED TO						
+	G1-G3	8.04	1	FLOW	521.	478.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	307B-M	.68	1	FLOW	82.	76.
				TIME	4.33	4.33
2 COMBINED AT						
+	NODE.G3	8.72	1	FLOW	574.	527.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	307C	.50	1	FLOW	42.	39.
				TIME	5.33	5.33
ROUTED TO						
+	TOG4	.50	1	FLOW	42.	39.
				TIME	5.67	5.67
HYDROGRAPH AT						
+	307D	.32	1	FLOW	111.	105.
				TIME	3.67	3.67
2 COMBINED AT						
+	G4	.83	1	FLOW	111.	105.
				TIME	3.67	3.67
ROUTED TO						
+	G4-G2	.83	1	FLOW	108.	101.
				TIME	4.17	4.25
HYDROGRAPH AT						
+	307E	.77	1	FLOW	89.	82.
				TIME	4.08	4.08
2 COMBINED AT						
+	NODE.G7	1.59	1	FLOW	196.	181.
				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.G2	10.31	1	FLOW	721.	663.
				TIME	5.50	5.50
ROUTED TO						
+	G2-G8	10.31	1	FLOW	719.	662.
				TIME	5.50	5.58
HYDROGRAPH AT						

+	309-M	3.98	1	FLOW	280.	258.
				TIME	5.33	5.42
ROUTED TO						
+	I3-I4	3.98	1	FLOW	271.	249.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	310B-M	4.57	1	FLOW	528.	490.
				TIME	4.58	4.58
2 COMBINED AT						
+	NODE.I4	8.55	1	FLOW	745.	690.
				TIME	5.33	5.33
ROUTED TO						
+	I4-G8	8.55	1	FLOW	744.	689.
				TIME	5.42	5.42
2 COMBINED AT						
+	NODE.G8	18.86	1	FLOW	1460.	1348.
				TIME	5.50	5.50
ROUTED TO						
+	G8-G9	18.86	1	FLOW	1459.	1347.
				TIME	5.58	5.58
HYDROGRAPH AT						
+	47C	.86	1	FLOW	110.	101.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.G9	19.72	1	FLOW	1515.	1396.
				TIME	5.50	5.50
DIVERSION TO						
+	RANGE	19.72	1	FLOW	1065.	1040.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	DIV	19.72	1	FLOW	450.	357.
				TIME	5.50	5.50
ROUTED TO						
+	G9-DB.IN	19.72	1	FLOW	448.	357.
				TIME	5.58	5.67
HYDROGRAPH AT						
+	47B-M	3.38	1	FLOW	633.	591.
				TIME	4.00	4.08
2 COMBINED AT						
+	G10	23.10	1	FLOW	861.	736.
				TIME	5.25	5.33
ROUTED TO						
+	DBINW	23.10	1	FLOW	854.	729.
				TIME	5.42	5.50
HYDROGRAPH AT						
+	44-M	8.16	1	FLOW	1064.	999.
				TIME	5.25	5.25
ROUTED TO						
+	J-K	8.16	1	FLOW	1052.	987.
				TIME	6.08	6.17
HYDROGRAPH AT						
+	312-M	13.46	1	FLOW	817.	748.
				TIME	5.67	5.67

2 COMBINED AT						
+	NODE.K	21.62	1	FLOW	1837.	1704.
				TIME	5.83	5.83
ROUTED TO						
+	K-P1	21.62	1	FLOW	1808.	1678.
				TIME	6.67	6.67
HYDROGRAPH AT						
+	45-M	8.21	1	FLOW	694.	642.
				TIME	5.50	5.50
ROUTED TO						
+	N2-O	8.21	1	FLOW	688.	637.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	48	2.07	1	FLOW	127.	116.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	46A	7.28	1	FLOW	531.	488.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	46B-M	6.31	1	FLOW	469.	432.
				TIME	5.83	5.83
4 COMBINED AT						
+	NODE.O	23.87	1	FLOW	1803.	1661.
				TIME	5.75	5.75
ROUTED TO						
+	O-P1	23.87	1	FLOW	1766.	1626.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	47A	2.43	1	FLOW	231.	215.
				TIME	5.33	5.33
3 COMBINED AT						
+	NODE.P1	47.92	1	FLOW	3632.	3356.
				TIME	6.58	6.58
ROUTED TO						
+	P1-P2	47.92	1	FLOW	3607.	3334.
				TIME	6.92	6.92
HYDROGRAPH AT						
+	317	7.12	1	FLOW	1086.	1020.
				TIME	4.92	5.00
2 COMBINED AT						
+	NODE.P2	55.03	1	FLOW	4042.	3736.
				TIME	6.67	6.67
ROUTED TO						
+	P2-P	55.03	1	FLOW	4025.	3720.
				TIME	6.92	6.92
HYDROGRAPH AT						
+	318B	1.59	1	FLOW	456.	431.
				TIME	4.00	4.00
ROUTED TO						
+	Q-P	1.59	1	FLOW	435.	411.
				TIME	4.42	4.42
HYDROGRAPH AT						
+	318A	.94	1	FLOW	129.	119.
				TIME	4.17	4.17

3 COMBINED AT						
+	NODE.P	57.56	1	FLOW	4075.	3767.
				TIME	6.92	6.92
ROUTED TO						
+	DBIN-ER	57.56	1	FLOW	4054.	3746.
				TIME	7.25	7.25
HYDROGRAPH AT						
+	CON-DET	.25	1	FLOW	27.	25.
				TIME	4.42	4.42
3 COMBINED AT						
+	DBIN	80.91	1	FLOW	4107.	3787.
				TIME	7.17	7.17
ROUTED TO						
+	DBOUT-M1	80.91	1	FLOW	4107.	3785.
				TIME	7.17	7.25
HYDROGRAPH AT						
+	318C	1.28	1	FLOW	153.	141.
				TIME	4.25	4.25
2 COMBINED AT						
+	NODE.M1	82.19	1	FLOW	4116.	3794.
				TIME	7.17	7.17
HYDROGRAPH AT						
+	321-M	.69	1	FLOW	15.	13.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	RNG.CHNL	.00	1	FLOW	1065.	1040.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M2	.69	1	FLOW	1077.	1050.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M3	82.88	1	FLOW	4915.	4515.
				TIME	6.58	6.58
ROUTED TO						
+	M3-S1	82.88	1	FLOW	4913.	4515.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	48A-M	.71	1	FLOW	158.	147.
				TIME	3.83	3.83
2 COMBINED AT						
+	S1	83.59	1	FLOW	4918.	4520.
				TIME	6.58	6.58
ROUTED TO						
+	S1-S2	83.59	1	FLOW	4915.	4519.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	48B	1.14	1	FLOW	392.	372.
				TIME	3.92	3.92
ROUTED TO						
+	R-S2	1.14	1	FLOW	391.	369.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	49A-M	.69	1	FLOW	96.	88.

				TIME	3.92	4.00
3 COMBINED AT						
+	NODE.S2	85.43	1	FLOW	4957.	4559.
				TIME	6.58	6.58
ROUTED TO						
+	S2-S3	85.43	1	FLOW	4954.	4559.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	49C	.43	1	FLOW	42.	38.
				TIME	4.08	5.17
2 COMBINED AT						
+	NODE.S3	85.85	1	FLOW	4958.	4562.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	49B-M	1.98	1	FLOW	451.	423.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.S4	87.83	1	FLOW	4997.	4600.
				TIME	6.58	6.50
HYDROGRAPH AT						
+	50B-M	.63	1	FLOW	121.	112.
				TIME	3.83	3.83
2 COMBINED AT						
+	NODE.V1	88.46	1	FLOW	5000.	4604.
				TIME	6.58	6.50
ROUTED TO						
+	V1-V2	88.46	1	FLOW	4998.	4602.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	50A-M	.21	1	FLOW	17.	16.
				TIME	5.08	5.08
2 COMBINED AT						
+	NODE.V2	88.67	1	FLOW	4999.	4603.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	324-M	3.03	1	FLOW	188.	172.
				TIME	5.33	5.33
DIVERSION TO						
+	CL	3.03	1	FLOW	98.	89.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	STEW	3.03	1	FLOW	91.	83.
				TIME	5.33	5.33
2 COMBINED AT						
+	NODE.V3	91.69	1	FLOW	5027.	4631.
				TIME	6.58	6.50
ROUTED TO						
+	V3-V4	91.69	1	FLOW	5025.	4630.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	CLR	.00	1	FLOW	98.	89.
				TIME	5.33	5.33
DIVERSION TO						

+	CHRIS	.00	1	FLOW	76.	69.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	LINN	.00	1	FLOW	21.	19.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	326-A	.23	1	FLOW	36.	33.
				TIME	3.83	3.83
2 COMBINED AT						
+	326-AL	.23	1	FLOW	48.	45.
				TIME	5.08	5.08
HYDROGRAPH AT						
+	OR-1	.28	1	FLOW	145.	138.
				TIME	3.58	3.58
ROUTED TO						
+	X1-X2	.28	1	FLOW	136.	132.
				TIME	3.75	3.75
HYDROGRAPH AT						
+	OR-2	1.21	1	FLOW	110.	102.
				TIME	5.17	5.17
2 COMBINED AT						
+	NODE.X2	1.49	1	FLOW	204.	191.
				TIME	3.83	3.75
3 COMBINED AT						
+	NODE.V4	93.41	1	FLOW	5047.	4651.
				TIME	6.58	6.50
HYDROGRAPH AT						
+	OR-11	.04	1	FLOW	6.	5.
				TIME	3.58	3.67
2 COMBINED AT						
+	NODE.V5	93.45	1	FLOW	5047.	4651.
				TIME	6.58	6.50
ROUTED TO						
+	V5-Z2	93.45	1	FLOW	5044.	4651.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	OR-3	.20	1	FLOW	45.	42.
				TIME	3.83	3.83
ROUTED TO						
+	Y1-Z1	.20	1	FLOW	45.	42.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-4	.45	1	FLOW	179.	170.
				TIME	3.67	3.67
ROUTED TO						
+	Y2-Y3	.45	1	FLOW	158.	149.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-5	.37	1	FLOW	51.	47.
				TIME	3.92	3.92
2 COMBINED AT						
+	Y3	.82	1	FLOW	208.	195.
				TIME	4.00	4.00

ROUTED TO						
+	Y3-Z1	.82	1	FLOW	206.	194.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-6A	.26	1	FLOW	139.	131.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6B	.16	1	FLOW	89.	84.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6C	.19	1	FLOW	88.	83.
				TIME	3.58	3.58
3 COMBINED AT						
+	NODE.AA1	.62	1	FLOW	315.	299.
				TIME	3.58	3.58
ROUTED TO						
+	AA1-AA2	.62	1	FLOW	250.	237.
				TIME	3.83	3.83
HYDROGRAPH AT						
+	OR-7	.61	1	FLOW	80.	73.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.AA2	1.23	1	FLOW	326.	306.
				TIME	3.83	3.83
ROUTED TO						
+	AA2-Z1	1.23	1	FLOW	325.	305.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-8	.02	1	FLOW	4.	3.
				TIME	3.58	3.58
ROUTED TO						
+	R8-AA3	.02	1	FLOW	2.	2.
				TIME	4.42	4.50
HYDROGRAPH AT						
+	OR-9	.28	1	FLOW	32.	29.
				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.AA3	.29	1	FLOW	33.	30.
				TIME	4.17	4.17
ROUTED TO						
+	AA3-Z1	.29	1	FLOW	33.	30.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	OR-12	.52	1	FLOW	59.	53.
				TIME	3.83	3.83
5 COMBINED AT						
+	NODE.Z1	3.07	1	FLOW	638.	595.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.Z2	96.52	1	FLOW	5303.	4903.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	OR-13	.12	1	FLOW	33.	31.
				TIME	3.67	3.67

2 COMBINED AT						
+	NODE.Z3	96.64	1	FLOW	5310.	4910.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	OR-10	.10	1	FLOW	13.	12.
				TIME	3.92	3.92
ROUTED TO						
+	BB1-BB2	.10	1	FLOW	13.	12.
				TIME	4.17	4.17
HYDROGRAPH AT						
+	OR-14	.09	1	FLOW	10.	9.
				TIME	3.75	5.00
2 COMBINED AT						
+	NODE.BB2	.19	1	FLOW	21.	18.
				TIME	4.08	4.17
2 COMBINED AT						
+	NODE.BB3	96.84	1	FLOW	5326.	4924.
				TIME	5.42	5.42
ROUTED TO						
+	BB3-CC	96.84	1	FLOW	5323.	4920.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	52A-M	.29	1	FLOW	19.	17.
				TIME	5.33	5.42
2 COMBINED AT						
+	NODE.CC	97.12	1	FLOW	5342.	4938.
				TIME	5.42	5.42

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .62									
TOG4	MANE	5.00	42.28	337.72	.31	5.00	42.13	340.00	.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8194E+01 EXCESS= .0000E+00 OUTFLOW= .8195E+01 BASIN STORAGE= .1626E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
TOG4	MANE	5.00	39.19	336.64	.28	5.00	39.16	340.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7504E+01 EXCESS= .0000E+00 OUTFLOW= .7511E+01 BASIN STORAGE= .2096E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .62									
G4-G2	MANE	5.00	108.42	254.61	.48	5.00	108.04	250.00	.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2100E+02 EXCESS= .0000E+00 OUTFLOW= .2102E+02 BASIN STORAGE= .4582E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .60									
G4-G2	MANE	5.00	102.75	254.14	.45	5.00	101.45	255.00	.45

INUITY SUMMARY (AC-FT) - INFLOW= .1959E+02 EXCESS= .0000E+00 OUTFLOW= .1962E+02 BASIN STORAGE= .4971E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .62									
G2-G8	MANE	1.02	720.39	332.38	.28	5.00	719.32	330.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1559E+03 EXCESS= .0000E+00 OUTFLOW= .1560E+03 BASIN STORAGE= .3458E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
G2-G8	MANE	1.15	663.03	332.26	.26	5.00	662.09	335.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1426E+03 EXCESS= .0000E+00 OUTFLOW= .1426E+03 BASIN STORAGE= .3231E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .62									
I4-G8	MANE	1.14	745.01	322.37	.37	5.00	744.23	325.00	.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1682E+03 EXCESS= .0000E+00 OUTFLOW= .1682E+03 BASIN STORAGE= .3500E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
I4-G8	MANE	1.18	689.46	322.92	.34	5.00	689.31	325.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1553E+03 EXCESS= .0000E+00 OUTFLOW= .1553E+03 BASIN STORAGE= .2674E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .62									
G8-G9	MANE	2.76	1459.29	333.98	.32	5.00	1458.78	335.00	.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3241E+03 EXCESS= .0000E+00 OUTFLOW= .3242E+03 BASIN STORAGE= .2111E-01 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .60
             G8-G9  MANE          2.85    1346.94     336.85        .30       5.00    1346.73     335.00          .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2979E+03 EXCESS= .0000E+00 OUTFLOW= .2979E+03 BASIN STORAGE= .2175E-01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .62
          G9-DB.IN  MANE          4.69     449.14     338.99        .05       5.00     448.36     335.00          .05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5517E+02 EXCESS= .0000E+00 OUTFLOW= .5565E+02 BASIN STORAGE= .1109E-01 PERCENT ERROR=    -.9

          FOR PLAN = 1  RATIO=  .60
          G9-DB.IN  MANE          4.97     356.69     339.96        .04       5.00     356.67     340.00          .04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4038E+02 EXCESS= .0000E+00 OUTFLOW= .4082E+02 BASIN STORAGE= .1135E-01 PERCENT ERROR=   -1.1

          FOR PLAN = 1  RATIO=  .62
          DBOUT-M1  MANE           .76    4106.74     430.48        .33       5.00    4106.67     430.00          .33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1428E+04 EXCESS= .0000E+00 OUTFLOW= .1428E+04 BASIN STORAGE= .7172E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .60
          DBOUT-M1  MANE           .80    3786.88     431.45        .30       5.00    3785.32     435.00          .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1313E+04 EXCESS= .0000E+00 OUTFLOW= .1313E+04 BASIN STORAGE= .6759E-02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .62
             M3-S1  MANE           .68    4914.31     396.18        .40       5.00    4912.82     395.00          .40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1746E+04 EXCESS= .0000E+00 OUTFLOW= .1746E+04 BASIN STORAGE= .2031E-01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .60
             M3-S1  MANE           .76    4514.76     395.48        .37       5.00    4514.75     395.00          .37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1615E+04 EXCESS= .0000E+00 OUTFLOW= .1615E+04 BASIN STORAGE= .1938E-01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .62
             S1-S2  MANE           .84    4917.47     396.32        .40       5.00    4914.64     395.00          .40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1768E+04 EXCESS= .0000E+00 OUTFLOW= .1768E+04 BASIN STORAGE= .4621E-01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .60
             S1-S2  MANE           .80    4519.57     396.02        .37       5.00    4519.06     395.00          .37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1636E+04 EXCESS= .0000E+00 OUTFLOW= .1636E+04 BASIN STORAGE= .4367E-01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .62
              R-S2  MANE          5.00     391.65     244.76        .97       5.00     391.16     245.00          .97

INUITY SUMMARY (AC-FT) - INFLOW= .5869E+02 EXCESS= .0000E+00 OUTFLOW= .5889E+02 BASIN STORAGE= .2499E-03 PERCENT ERROR=    -.3
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FOR PLAN = 1 RATIO= .60

R-S2	MANE	4.98	370.33	242.91	.91	5.00	368.68	245.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5561E+02 EXCESS= .0000E+00 OUTFLOW= .5572E+02 BASIN STORAGE= .2862E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .62

S2-S3	MANE	.73	4956.74	396.29	.40	5.00	4954.47	395.00	.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1842E+04 EXCESS= .0000E+00 OUTFLOW= .1841E+04 BASIN STORAGE= .5185E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

S2-S3	MANE	.74	4558.69	395.40	.37	5.00	4558.52	395.00	.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1705E+04 EXCESS= .0000E+00 OUTFLOW= .1705E+04 BASIN STORAGE= .5090E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .62

V1-V2	MANE	.57	4999.25	395.84	.41	5.00	4998.40	395.00	.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1938E+04 EXCESS= .0000E+00 OUTFLOW= .1938E+04 BASIN STORAGE= .4870E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

V1-V2	MANE	.48	4603.80	391.00	.38	5.00	4602.04	395.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1795E+04 EXCESS= .0000E+00 OUTFLOW= .1795E+04 BASIN STORAGE= .5042E-01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .62

V3-V4	MANE	.81	5027.23	396.54	.40	5.00	5024.88	395.00	.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1957E+04 EXCESS= .0000E+00 OUTFLOW= .1957E+04 BASIN STORAGE= .1244E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60

V3-V4	MANE	.93	4631.06	392.23	.37	5.00	4630.03	395.00	.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1813E+04 EXCESS= .0000E+00 OUTFLOW= .1812E+04 BASIN STORAGE= .1261E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .62

X1-X2	MANE	4.77	137.86	222.71	.92	5.00	135.73	225.00	.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1359E+02 EXCESS= .0000E+00 OUTFLOW= .1365E+02 BASIN STORAGE= .1822E-03 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .60

X1-X2	MANE	4.80	135.30	223.85	.87	5.00	132.35	225.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1287E+02 EXCESS= .0000E+00 OUTFLOW= .1297E+02 BASIN STORAGE= .1748E-03 PERCENT ERROR= -.8

FOR PLAN = 1 RATIO= .62

V5-Z2	MANE	1.02	5045.98	396.62	.40	5.00	5044.05	395.00	.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1999E+04 EXCESS= .0000E+00 OUTFLOW= .1998E+04 BASIN STORAGE= .1563E+00 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .60
            V5-Z2  MANE         1.08   4651.17    393.12       .37      5.00   4650.80    395.00         .37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1851E+04 EXCESS= .0000E+00 OUTFLOW= .1851E+04 BASIN STORAGE= .1659E+00 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .62
            Y1-Z1  MANE         4.97     45.03    239.46       .56      5.00     44.93    240.00         .56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6105E+01 EXCESS= .0000E+00 OUTFLOW= .6131E+01 BASIN STORAGE= .2005E-02 PERCENT ERROR=   -.5

          FOR PLAN = 1  RATIO=  .60
            Y1-Z1  MANE         5.00     42.04    240.20       .52      5.00     41.95    240.00         .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5695E+01 EXCESS= .0000E+00 OUTFLOW= .5712E+01 BASIN STORAGE= .2231E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .62
            Y3-Z1  MANE         2.56    206.60    244.33       .64      5.00    206.24    245.00         .64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2786E+02 EXCESS= .0000E+00 OUTFLOW= .2791E+02 BASIN STORAGE= .1823E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            Y3-Z1  MANE         2.62    194.07    244.59       .60      5.00    193.84    245.00         .60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2615E+02 EXCESS= .0000E+00 OUTFLOW= .2620E+02 BASIN STORAGE= .1252E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .62
            AA2-Z1  MANE        1.94    324.98    235.11       .61      5.00    324.84    235.00         .61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4020E+02 EXCESS= .0000E+00 OUTFLOW= .4027E+02 BASIN STORAGE= .1068E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            AA2-Z1  MANE        1.98    305.27    234.44       .58      5.00    304.82    235.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3769E+02 EXCESS= .0000E+00 OUTFLOW= .3774E+02 BASIN STORAGE= .1153E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .62
            AA3-Z1  MANE        4.53     33.25    260.51       .38      5.00     33.20    260.00         .38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5902E+01 EXCESS= .0000E+00 OUTFLOW= .5909E+01 BASIN STORAGE= .1476E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
            AA3-Z1  MANE        4.75     30.35    259.60       .35      5.00     30.34    260.00         .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5431E+01 EXCESS= .0000E+00 OUTFLOW= .5446E+01 BASIN STORAGE= .1301E-02 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .62
            BB1-BB2  MANE       5.00     13.32    248.62       .38      5.00     13.30    250.00         .38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1969E+01 EXCESS= .0000E+00 OUTFLOW= .1987E+01 BASIN STORAGE= .1581E-02 PERCENT ERROR=  -1.0

          FOR PLAN = 1  RATIO=  .60
```

```
          BB1-BB2  MANE          5.00      12.24     251.72        .35       5.00      12.15     250.00          .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1812E+01 EXCESS= .0000E+00 OUTFLOW= .1827E+01 BASIN STORAGE= .1888E-02 PERCENT ERROR=   -.9


          FOR PLAN = 1  RATIO=  .62
            BB3-CC  MANE           .55    5324.92     325.92        .41       5.00    5323.29     325.00          .41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2094E+04 EXCESS= .0000E+00 OUTFLOW= .2094E+04 BASIN STORAGE= .1135E+00 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .60
            BB3-CC  MANE           .58    4923.59     326.18        .38       5.00    4920.44     325.00          .38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1940E+04 EXCESS= .0000E+00 OUTFLOW= .1940E+04 BASIN STORAGE= .1083E+00 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
```

2.2 Hydraulic Analysis and Floodplain Delineation Summary

DRAFT
HYDRAULIC ANALYSIS AND FLOODPLAIN DELINEATION SUMMARY

FOR THE

RANGE WASH
FLOOD INSURANCE RESTUDY

Prepared for:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Prepared by:

Post, Buckley, Schuh & Jernigan, Inc.
901 North Green Valley Parkway
Henderson, Nevada 89014

January 1996
PBS&J, Inc. Job Number 51804

HYDRAULIC ANALYSIS AND FLOODPLAIN DELINEATION SUMMARY

General

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), under contract with the Clark County Regional Flood Control District (CCRFCD), is preparing a Flood Insurance Restudy of the Range Wash, located within the City of North Las Vegas, and Clark County, Nevada. This report summarizes the hydraulic calculations for delineating the 100-year floodplain by approximate methods.

The purpose of this restudy is to update the Special Flood Hazard Areas due to two major flood control facilities which reduce the 100-year flow to the Range Wash and Sloan Channel. The two major flood control facilities are the West Range Wash Diversion Dike (completed in 1994) and the Confluence Detention Basin (currently under construction).

There are two areas of Flood Zone "A" which were evaluated, and reduced or eliminated, as part of this study. The first area is associated with the West Tributary of the Range Wash. The current flood hazard zones and the proposed revised flood hazard zones are shown in **Figure 1**. The second area is along the Sloan Channel. **Figure 2** shows current and proposed flood hazard zones for this area. **(Note: See Section 4 Mapping Information for Figures 1-3.)**

The West Range Wash Diversion Dike, located near the Grand Teton Drive alignment, is the northern boundary of the study area. The dike has reduced the 100-year flow to the Range Wash by diverting upstream flows from a 48 square mile area to the North Las Vegas Detention Basin. Documentation for this facility is included in the Reference Materials Section of the Technical Support Data Notebook (TSDN).

The Confluence Detention Basin, presently under construction, is located upstream of the Sloan Channel reach of the Range Wash system and will reduce the 100-year peak flow to the Sloan Channel. Documentation for this facility is also included in the Reference Materials Section of the TSDN.

Channel improvements have also been constructed on the Sloan Channel between Owens and Stewart Avenues. Channel improvements are under construction on the West Tributary Channel between Lamb Boulevard and Alexander Avenue as part of the Collins Business Park. Documentation for these channel improvement projects is included in the TSDN.

Hydraulic Analyses were performed for the purpose of delineating the approximate 100-year floodplain boundaries. Base flood elevations are not determined for approximate methods. Analyses of the hydraulic characteristics of channels and flow paths were performed using normal depth calculations.

Normal depths were calculated using FlowMaster for Windows Version 5.11 distributed by Haestad Methods. Depths at culverts were determined using HY-8 Version 3.2, a non proprietary software package developed by the Federal Highway Administration and Pennsylvania State University for hydraulic designs of highway culverts.

The revised flood hazard areas may be divided into three areas: The Walnut Branch of the West Tributary, The Vandenberg Branch of the West Tributary, and the Sloan Channel Area.

The Walnut Road Branch

The current Flood Insurance Rate Maps (FIRM) indicate an A Zone along Walnut Road. The A Zone continues from Walnut Road following Maple Hill Road, Alexander Road, Lamb Road, and Faberge Avenue until it meets the main wash.

To evaluate the flows along the Walnut Road Branch, Subbasin 307E was subdivided into smaller basins. The two foot contour interval maps available from North Las Vegas, with flight date of March 3, 1995, were used to subdivide the basin. Flows were estimated based on the cfs/acre of the total basin. The more detailed subbasin map, with flow from each subbasin, is shown in **Figure 3**.

The culvert on Interstate 15 (I-15) upstream of Walnut Road creates a ponding area between I-15 and the Union Pacific Railroad (UPRR). This ponding area will continue to be an A Zone. Approximately 320 cfs reaches the I-15 culvert. The culvert detains flows in an impoundment area and would reduce the downstream peak flow. The City of North Las Vegas did not want to have a downstream flood hazard area removed, if it was dependent on the storage of the impoundment area. The ponding area will not be maintained and is expected to be filled by development in the near future. Therefore, no retention effect was considered.

The area in Walnut Road between Mitchell Street and the railroad crossing near Craig Road is continued to be mapped as an A Zone, with depth of slightly more than one foot and a width of approximately 190 feet (See Cross-Section A on the Work Maps and in the calculations). Approximately 300 cfs is estimated to flow in the street section and 20 cfs in the stormdrain system.

The railroad crossing near Craig Road produces a hump in the road, and removal of the normal crown. This causes a barrier to flow in the street. The majority of flow is diverted along the north side of the railroad tracks. Calculations for the flow split are included in this summary (See Cross-Section B). The tributary area between I-15 and the railroad tracks adds approximately 60 cfs to the flow, for a total flow of 380 cfs. At the railroad crossing, 235 cfs

flows along the railroad tracks, 125 cfs continues in the Walnut Road street section, and 20 cfs in the stormdrain.

The flows continuing in Walnut Road are less than a foot deep and contained within the street section, therefore, the A Zone does not continue in Walnut Road downstream of the railroad tracks (See Cross-Section C).

A flow of 15 cfs is assumed to flow to the intersection of Walnut Road and Craig Road from the west. A negligible amount of flow would go east in Craig Road. A flow of 140 cfs is assumed to cross Craig Road and continue in Walnut Road (See Cross-Section D).

There is a channel, just to the South of Craig Road, which conveys flow east to the main wash. The stormdrain empties into this channel. The curb in Walnut Road ends at the beginning of the channel causing flow on the east side of the street to spill into the channel. A flow of 70 cfs remains in the west side of the street, 45 cfs spills to the channel, 25 cfs continues in the east side of the street. Calculations for the flow split at this location are included in the summary calculations (See Cross-Section E). The flows in the street are less than one foot deep and not mapped as an A Zone.

Approximately 35 cfs flows to the intersection of Walnut Road and Maple Hill Road from the west, making a total street flow of 120 cfs. This flow follows Walnut Road. It is less than one foot deep and confined to the street section (See Cross-Section F). It is not mapped as an A Zone.

The flow increases to approximately 200 cfs at Alexander Road. There is a sump in Alexander Road west of Lamb Boulevard. A stormdrain system drains the sump, with a 48-inch pipe conveying flows east to the main wash. The pipe capacity is estimated to be 90 cfs. The sump area is assumed to spill equally to Lamb Boulevard and Steinbeck Street. A flow of 55 cfs is assumed in Steinbeck Street (See Cross-Section G) and in the west side of Lamb Boulevard. The depth of water in the sump location will be greater than one foot deep, but it will be a small area confined to the street section, approximately 100 feet wide, therefore it will not be shown as an A Zone. The flows in Steinbeck Street and in Lamb Boulevard are less than one foot deep.

The flows form Steinbeck Street, Lamb Boulevard and other tributary areas collect into Faberge Avenue. The estimated flow in Faberge Avenue is 175 cfs. This flow is contained in the street and is less than one foot deep (See Cross-Section H). There is an 18-foot wide channel at the end of Faberge Avenue which conveys the flow to the main wash (See Cross-Section I).

The flow which followed the railroad tracks, near Craig Road, is confined by a wall on the south side of the tracks, until it reaches Andrews Street. The tracks end at Andrews Street. The flow follows Andrews Street to Craig Road. The flow is too large to be contained within the street section. It flows to the main wash at the sag in Craig Road, at the downstream end of the Vandenberg Channel.

The Vandenberg Branch

The Vandenberg Branch has two branches upstream of the UPRR. The current FIRM shows an A Zone following the western branch approximately 5,000 feet upstream of the UPRR. The dike has reduced flows to this area and the hydrologic analysis indicates a flow for this branch of 530 cfs. Flows are contained within the well defined wash with a width of approximately 50 feet, and therefore, it is not mapped as an A Zone (See Cross-Sections J, K, and L) .

The Eastern Branch has an estimated flow of 1,060 cfs which collects at a bridge crossing of the UPRR. Upstream of the railroad, the washes are not significant to be mapped as A Zones.

Both branches collect and pond along the railroad and are shown as A Zones on the Work Maps.

The branches come together upstream of Vandenberg Drive. Vandenberg Drive has a trapezoidal channel located in the center median. The channel has an 8 foot wide base width. There is 50 foot wide paved street section on each side of the channel. The pavement slopes away from the channel on a 2% grade. There are several box culvert crossings in the channel. The channel begins at Lone Mountain Road where there are 2 10' x 3' box culvert cells. Approximately 500 cfs passes through the culvert and 970 cfs overtops and flows along the east side of Vandenberg Drive. Another culvert has 2 - 9'x 3' cells and restricts the flow in the channel to approximately 400 cfs. Culvert calculations, and normal depth calculations for cross-sections in the overbank area, are included in this summary and shown on the Work Maps (See Cross-Sections O - R).

Flows along Vandenberg Drive cross Craig Road and enter the natural wash. Flows are fairly confined downstream of Craig Road. There is not an existing A Zone downstream of Las Vegas Boulevard where the channel is improved and concrete lined. Channel cross-sections and culvert calculations along the reach between Craig Road and Las Vegas Boulevard are included in this summary and indicated on the Work Maps (See Cross-Sections S - W). A portion of the channel is presently under construction between Lamb Boulevard and Alexander Road. HEC-2 Water Surface Profile calculations for this reach are included in the Reference Materials Section of the TSDN. The reach of improved channel between Lamb Boulevard and Alexander Road is not shown as an A Zone, since flows are confined within the channel.

Sloan Channel Area

The detention basin will reduce flows so that they will be contained within the Sloan Channel. The A Zones along the Sloan Channel may be eliminated with one exception. There is and A Zone along Washington Avenue, east of Sloan Channel that is not impacted by new improvements.

The Channel along Washington Avenue intercepts flows which formerly reached Bonanza Road. The A Zone in Bonanza Road and following a southwest path to the Sloan Channel may be eliminated. There is a 72 -inch Stormdrain in Bonanza and full street improvements which have more capacity than the 100-year flow. The street and pipe capacity is 840 cfs, the 100-year flow is 320 cfs.

The drainage study for the Cibola (Also known as Magnolia Estates) private development on Stewart Avenue west of Sloan Channel is included in the TSDN. The study was used to estimate the flow splits and flows in the streets in that vicinity. The flows in that study correspond to the flows developed for the FIS Restudy. Calculations indicate flows in Battle Mountain Drive are less than 1 foot deep. Flows in Stewart Avenue west of Battle Mountain concentrate on the south side of the street with a depth of approximately 1.8 feet deep in the south side gutter. The improvements along Stewart include raising the grade of the proposed site to confine this flow to the street and then direct it into the Sloan Channel. Although there is a small segment of Stewart Avenue, between Battle Mountain Drive and Sloan Channel, where the depth will be greater than one foot deep, it is not mapped as an A Zone because it will be confined to the street section, only 80 feet wide with an average depth less than one foot of 0.87 feet..

There is a small isolated A Zone located along Charleston Boulevard west of the Sloan Channel. This A Zone may be eliminated due to full street improvements and Stormdrain in Charleston Boulevard.

Normal depth calculations for typical sections of Sloan Channel are included in this summary. HEC-2 Water Surface Profile calculations are included in the Predesign Report for the Channel included in the TSDN.

HYDRAULIC ANALYSIS AND FLOODPLAIN DELINEATION SUMMARY

CALCULATIONS

CALCULATION SUMMARY CONTENTS

HY-8 Analysis	7 x 4 Culvert at I-15	
FlowMaster Analysis	Walnut Road Stromdrain Pipe	
FlowMaster Analysis	Walnut Road	Cross-Section A
Split Flow Analysis	Walnut Road at Railroad Crossing	Cross-Section B
FlowMaster Analysis	Walnut Rd. Between RR and Craig Rd.	Cross-Section C
FlowMaster Analysis	Walnut Road South of Craig Road	Cross-Section D
Split Flow Analysis	Walnut Rd. & Channel Along Craig Rd.	Cross-Section E
FlowMaster Analysis	Maple Hill Road	Cross-Section F
FlowMaster Analysis	Alexander Road Stormdrain Pipe	
FlowMaster Analysis	Steinbeck Street	Cross-Section G
FlowMaster Analysis	Faberge Avenue	Cross-Section H
FlowMaster Analysis	Faberge Outfall Channel	Cross-Section I
FlowMaster Analysis	Western Wash of Vandenberg Branch	Cross-Section J
FlowMaster Analysis	Western Wash of Vandenberg Branch	Cross-Section K
FlowMaster Analysis	Western Wash of Vandenberg Branch	Cross-Section L
HY-8 Analysis	12 x 8 Culvert at RR on Western Wash	
HY-8 Analysis	2-12' Span RR Bridge on Eastern Wash	
FlowMaster Analysis	Eastern Wash of Vandenberg Branch	Cross-Section M
HY-8 Analysis	3-15 x 10 I-15 Culvert U/S of Vandenberg Dr.	
FlowMaster Analysis	Combined Wash U/S of Vandenberg Dr.	
HY-8 Analysis	2-10 x 3 Culvert at Lone Mountain Road	
FlowMaster Analysis	Overbank Area Along Vandenberg Dr.	Cross-Section O
HY-8 Analysis	2- 9 x 3 Culvert in Vandenberg Channel	
FlowMaster Analysis	Overbank Area Along Vandenberg Dr.	Cross-Section P
FlowMaster Analysis	Overbank Area Along Vandenberg Dr.	Cross-Section Q
FlowMaster Analysis	Overbank Area Along Vandenberg Dr.	Cross-Section R
FlowMaster Analysis	Range Wash Between Craig & Lamb	Cross-Section S
FlowMaster Analysis	Range Wash Between Craig & Lamb	Cross-Section T
HY-8 Analysis	3 - 9 x 6 Culvert at Lamb Blvd.	
FlowMaster Analysis	Range Wash Between Lamb & Alexander	Cross-Section U
HY-8 Analysis	4 - 12 x 7 Culvert at Alexander Road	
FlowMaster Analysis	Between Alexander & Las Vegas Blvd.	Cross-Section V
FlowMaster Analysis	Between Alexander & Las Vegas Blvd.	Cross-Section W
HY-8 Analysis	7 - 12 x 6 Culvert at Las Vegas Blvd.	
FlowMaster Analysis	Sloan Channel South of Stewart Ave.	
FlowMaster Analysis	Sloan Channel South of Charleston Blvd.	
FlowMaster Analysis	Bonanza Road Stormdrain Pipe	
FlowMaster Analysis	Bonanza Road Street Capacity	
FlowMaster Analysis	Battle Mountain Drive North of Stewart Ave.	
FlowMaster Analysis	Stewart Ave. West of Sloan Channel	

7 x 4 CULVERT AT INTERSTATE - 15
UPSTREAM OF WALNUT ROAD

CURRENT DATE: 01-10-1996
CURRENT TIME: 12:14:19

FILE DATE: 01-10-1996
FILE NAME: I15

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	18.80	18.00	200.00	1 RCB	7.00	4.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

FILE: I15 CULVERT HEADWATER ELEVATION (FT) DATE: 01-10-1996

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	18.80	0.00	0.00	0.00	0.00	0.00	32.00
38	20.55	0.00	0.00	0.00	0.00	0.00	32.09
76	21.41	0.00	0.00	0.00	0.00	0.00	32.14
114	22.21	0.00	0.00	0.00	0.00	0.00	32.18
152	22.95	0.00	0.00	0.00	0.00	0.00	32.22
190	23.73	0.00	0.00	0.00	0.00	0.00	32.25
228	24.58	0.00	0.00	0.00	0.00	0.00	32.28
266	25.54	0.00	0.00	0.00	0.00	0.00	32.32
300	26.53	0.00	0.00	0.00	0.00	0.00	32.34
342	27.93	0.00	0.00	0.00	0.00	0.00	32.37
380	29.37	0.00	0.00	0.00	0.00	0.00	32.40

CURRENT DATE: 01-10-1996
CURRENT TIME: 12:14:19

FILE DATE: 01-10-1996
FILE NAME: I15

CULVERT # 1

PERFORMANCE CURVE FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	18.80	18.00	0.00	-0.80	0-NF	0.00	18.80	0.00	0.00
38	20.55	18.46	1.67	1.75	6-FF	0.00	0.00	0.00	5.58
76	21.41	18.68	2.61	2.23	6-FF	0.00	0.00	0.00	7.43
114	22.21	18.85	3.41	2.78	6-FF	0.00	0.00	0.00	8.40
152	22.95	18.99	4.15	3.44	6-FF	0.00	0.00	0.00	9.14
190	23.73	19.11	4.93	4.20	6-FF	0.00	0.00	0.00	9.72
228	24.58	19.22	5.78	5.08	6-FF	0.00	0.00	0.00	10.20
266	25.54	19.32	6.74	6.21	2-M2	0.00	0.00	0.00	10.67
300	26.53	19.41	7.73	6.96	7-FF	0.00	0.00	0.00	11.11
342	27.93	19.50	9.13	8.32	4-FF	0.00	0.00	0.00	12.21
380	29.37	19.59	10.57	9.52	4-FF	0.00	0.00	0.00	13.57

El. inlet face invert 18.80 ft El. outlet invert 18.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** *SITE DATA* ***** *CULVERT INVERT* **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	18.80
OUTLET STATION (FT)	200.00
OUTLET ELEVATION (FT)	18.00
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0040
CULVERT LENGTH ALONG SLOPE (FT)	200.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	7.00 FT
BARREL RISE	4.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-10-1996
CURRENT TIME: 12:14:19

FILE DATE: 01-10-1996
FILE NAME: I15

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	12.00
SIDE SLOPE H/V (X:1)	6.0
CHANNEL SLOPE V/H (FT/FT)	0.020
MANNING'S N (.01-0.1)	0.020
CHANNEL INVERT ELEVATION (FT)	18.00
CULVERT NO.1 OUTLET INVERT ELEVATION	18.00 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	18.00	0.000	0.00	0.00
38.00	18.46	1.447	5.58	0.58
76.00	18.68	1.488	6.96	0.85
114.00	18.85	1.508	7.87	1.06
152.00	18.99	1.520	8.58	1.23
190.00	19.11	1.530	9.15	1.39
228.00	19.22	1.537	9.64	1.53
266.00	19.32	1.543	10.08	1.65
300.00	19.41	1.548	10.42	1.76
342.00	19.50	1.553	10.81	1.88
380.00	19.59	1.557	11.13	1.98

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	150.00
CREST LENGTH (FT)	500.00
OVERTOPPING CREST ELEVATION (FT)	32.00

WALNUT PIPE
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	WALNUT PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.006700	ft/ft
Depth	2.00	ft
Diameter	24.00	in

Results		
Discharge	18.52	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.55	ft
Percent Full	100.00	
Critical Slope	0.007493	ft/ft
Velocity	5.89	ft/s
Velocity Head	0.54	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	19.92	cfs
Full Flow Capacity	18.52	cfs
Full Flow Slope	0.006700	ft/ft

WALNUT ROAD
Worksheet for Irregular Channel

A

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	WALNUT ROAD
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft
Discharge	300.00	cfs

Elevation range: 7.25 ft to 10.00 ft.

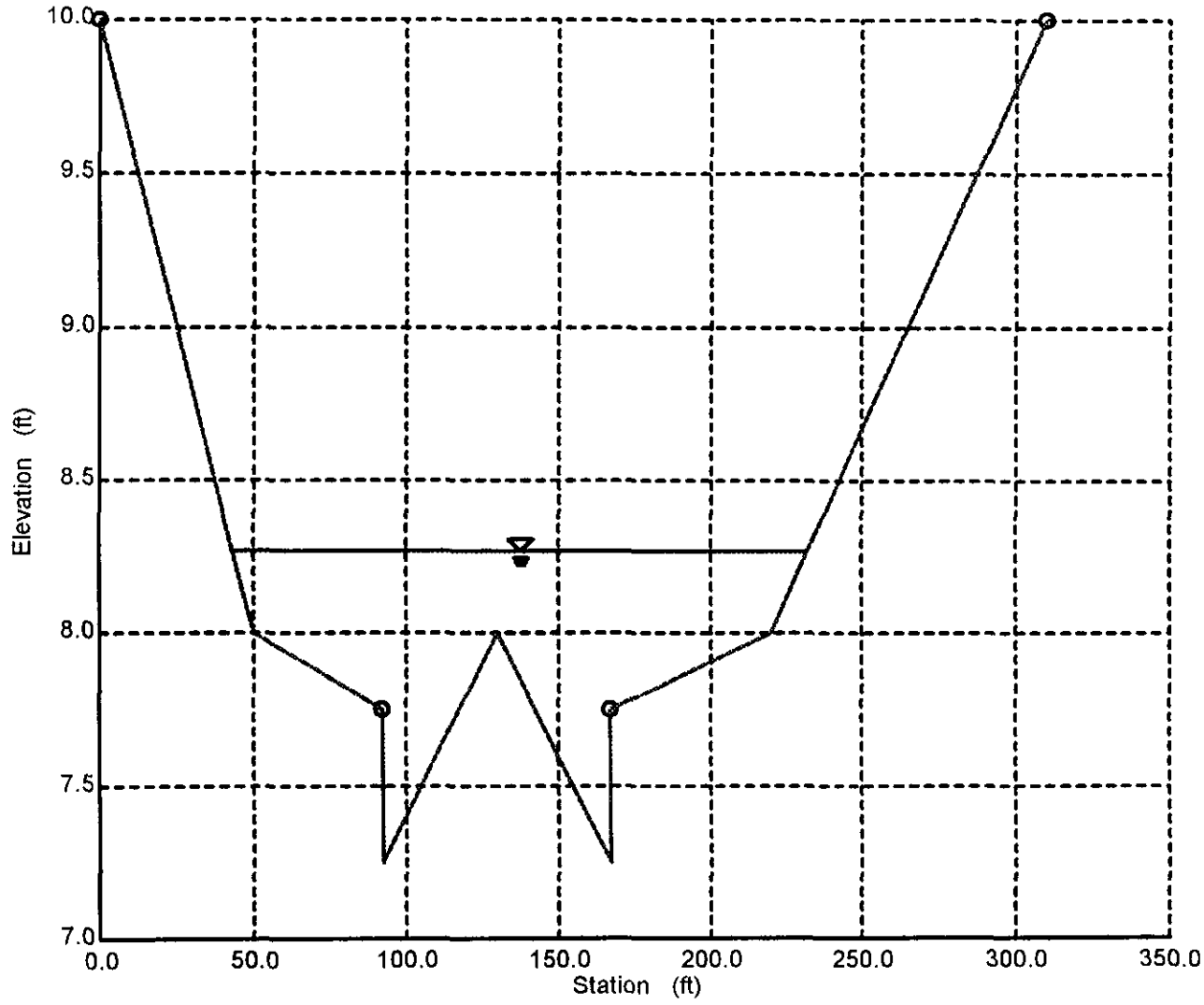
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	10.00	0.00	92.50	0.020
50.00	8.00	92.50	167.51	0.016
92.50	7.75	167.51	310.00	0.020
92.51	7.25			
130.00	8.00			
167.50	7.25			
167.51	7.75			
220.00	8.00			
310.00	10.00			

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	8.27	ft
Flow Area	87.63	ft²
Wetted Perimeter	189.60	ft
Top Width	188.59	ft
Height	1.02	ft
Critical Depth	8.23	ft
Critical Slope	0.005139	ft/ft
Velocity	3.42	ft/s
Velocity Head	0.18	ft
Specific Energy	8.45	ft
Froude Number	0.89	
Flow is subcritical.		

WALNUT ROAD
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	WALNUT ROAD
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	8.27	ft
Discharge	300.00	cfs



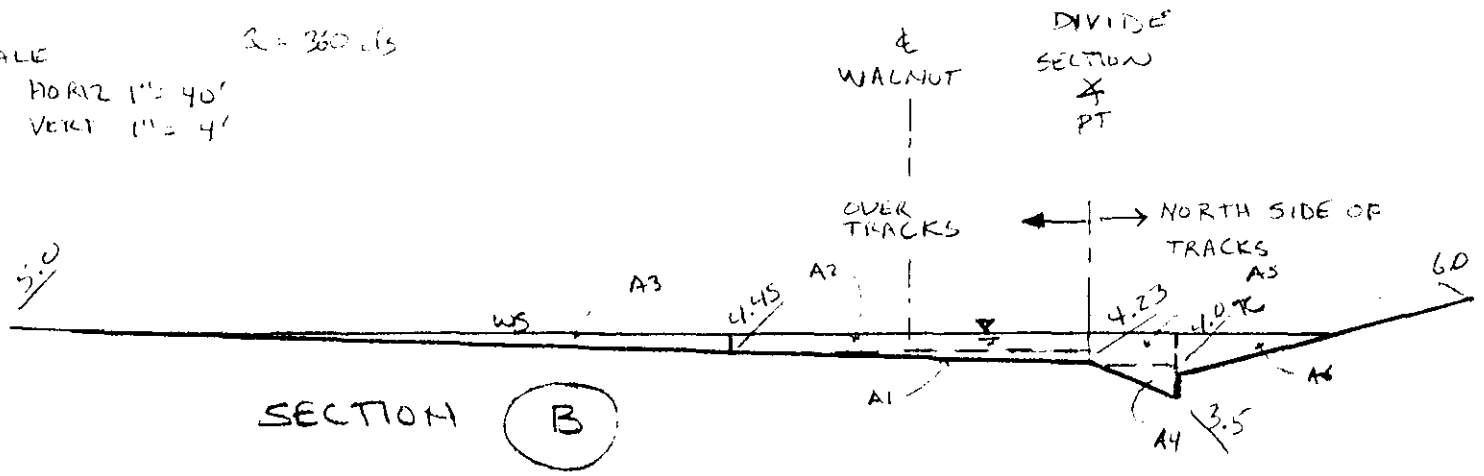
PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

COMP. BY: Don Davis
CHK. BY:
DATE: 1/30/96
SHEET NO.:
JOB NO.: 51804

Object: Range Wash FIS
Flow Split - Walnut Road & Railroad Tracks

SCALE
HORIZ 1" = 40'
VERT 1" = 4'

Q = 360 cfs



SECTION (B)

OVER TRACKS
IN WALNUT

A1 $4.45 - 4.23 = .22$

$\frac{1}{2}(.22)(75) = 8.25$

$A2 = (WS - 4.45)(75)$

$A3 = \frac{1}{2}(WS - 4.45)^2 (1/.003)$

$A_T = A1 + A2 + A3$

$TW = \frac{WS - 4.23}{.003}$

$y_{av} = \frac{A_T}{TW}$

$V_c = (gy)^{1/2}$

$Q_W = A_T V$

NORTH SIDE

A4 $4.23 - 3.48 = .75$

$.75(18)(\frac{1}{2}) = 6.75$

$A5 = (WS - 4.23)(18)$

$A6 = \frac{1}{2}(WS - 4.00)^2 (1/.033)$

$A_T = A_4 + A_5 + A_6$

$TW = 18 + \left(\frac{WS - 4}{.033}\right)$

$y_{av} = \frac{A_T}{TW}$

$V = (gy)^{1/2}$

$Q_N = A_T V$

$Q_T = Q_W + Q_N = 360$

SPREAD SHEET RESULTS

$Q_W = 170$

$Q_N = 190$

RANGE WASH FIS

FLOW SPLIT AT RAILROAD TRACKS

	TRIAL WATER SURFACE	AREAS			TOTAL AREAS	TOP WIDTHS	DEPTHS	VELOCIT	FLOW
w	WS	A1	A2	A3	AT w	TW w	y w	V w	Q w
WALNUT ROAD	4.80	8.25	26.55	20.88	55.68	191.32	0.29	3.06	170.44
n	WS	A4	A5	A6	AT n	TW n	y n	V n	Q n
NORTH SIDE TRACKS	4.80	6.75	10.33	9.79	26.87	17.39	1.55	7.05	189.56

Q t

360

Q target

360

DIFF

3.88E-05

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

COMP. BY: _____
CHK. BY: _____
DATE: _____
SHEET NO.: _____
JOB NO.: _____

Project: Range Wash FIS
Flow Split - Walnut Road & Railroad (Cont.)

FLOW ALSO FOLLOWS SOUTH SIDE OF TRACKS

ASSUME 1/2 FLOW EAST OF ℄ FOLLOWS SOUTH SIDE OF TRACKS

$y = (4.80 - 4.23) = .57$

1/2 STREET WIDTH = 37.5

$A = (37.5)(.57) = 21.38$

$V = \left((32.2)(.57)\right)^{1/2} = 4.28$

$Q = AV = (21.38)(4.28) = 91.6$

1/2 FLOW = 45.8 cfs

TOTAL FLOW ALONG TRACKS
= 190 + 45 = 235

FLOW IN WALNUT TO CRAIG
= 125

WALNUT BETWEEN RR & CRAIG
Worksheet for Irregular Channel

C

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	WALNUT BETWEEN RR & CRAIG
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.010000	ft/ft
Elevation range: 3.25 ft to 5.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	5.00	0.00	5.00	0.020
5.00	3.86	5.00	91.00	0.016
10.50	3.75	91.00	96.00	0.020
10.51	3.25			
48.00	4.00			
85.50	3.25			
85.51	3.75			
91.00	3.86			
96.00	5.00			

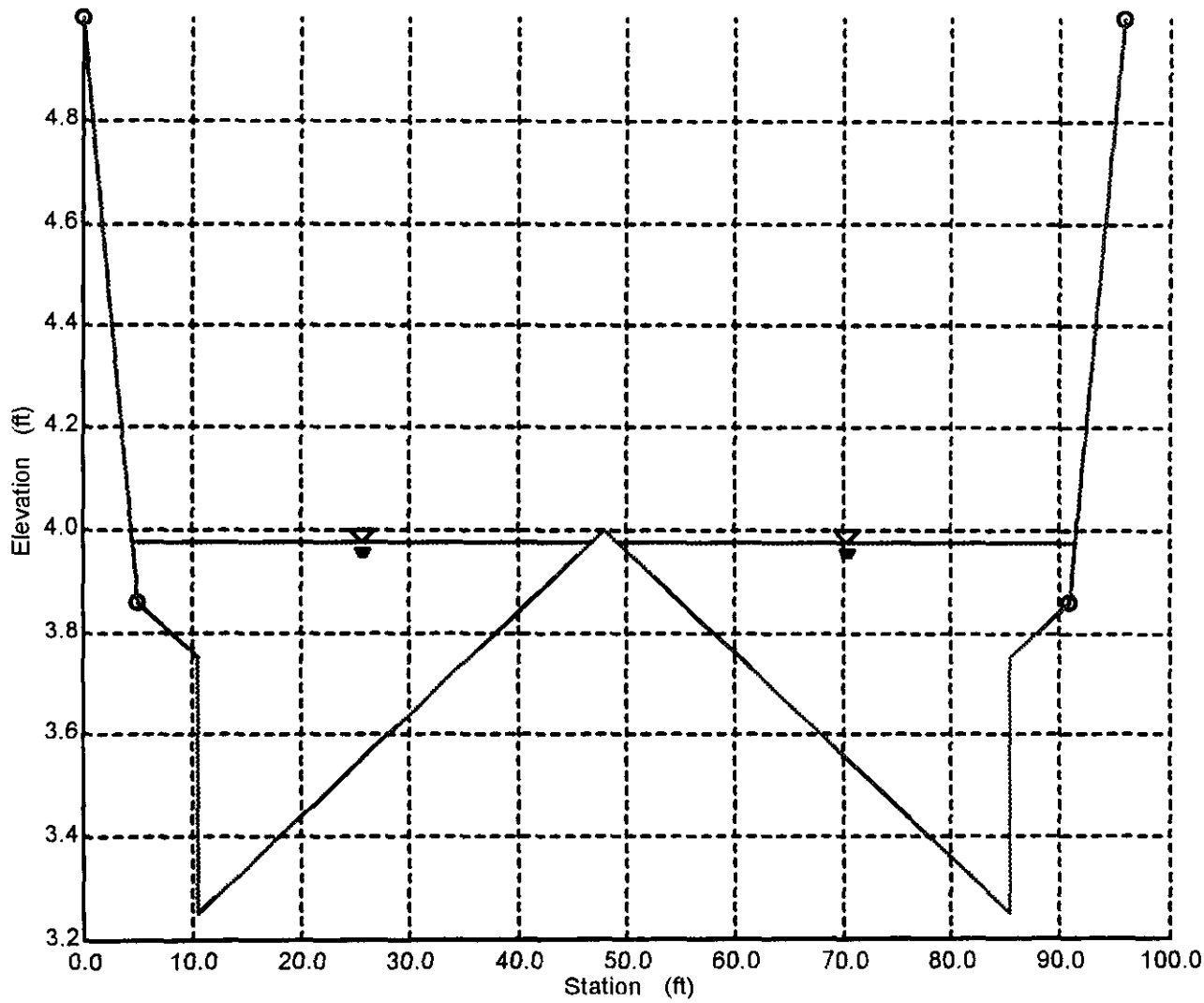
Discharge	125.00	cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	3.98	ft
Flow Area	28.26	ft²
Wetted Perimeter	85.60	ft
Top Width	84.57	ft
Height	0.73	ft
Critical Depth	4.05	ft
Critical Slope	0.005204	ft/ft
Velocity	4.42	ft/s
Velocity Head	0.30	ft
Specific Energy	4.28	ft
Froude Number	1.35	
Flow is supercritical.		
Flow is divided.		

WALNUT BEWTEEN RR & CRAIG
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	WALNUT BETWEEN RR & CRAIG
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	*Water Elevation*

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.010000	ft/ft
Water Surface Elevation	3.98	ft
Discharge	125.00	cfs



WALNUT SOUTH OF CRAIG
Worksheet for Irregular Channel

(D)

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	WALNUT JUST SOUTH OF CRAIG ROAD
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.013000	ft/ft

Elevation range: 97.31 ft to 100.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	100.00	0.00	165.00	0.016
60.00	97.92			
65.50	97.81			
65.51	97.31			
100.00	98.00			
134.50	97.31			
134.51	97.81			
140.00	97.92			
165.00	98.50			

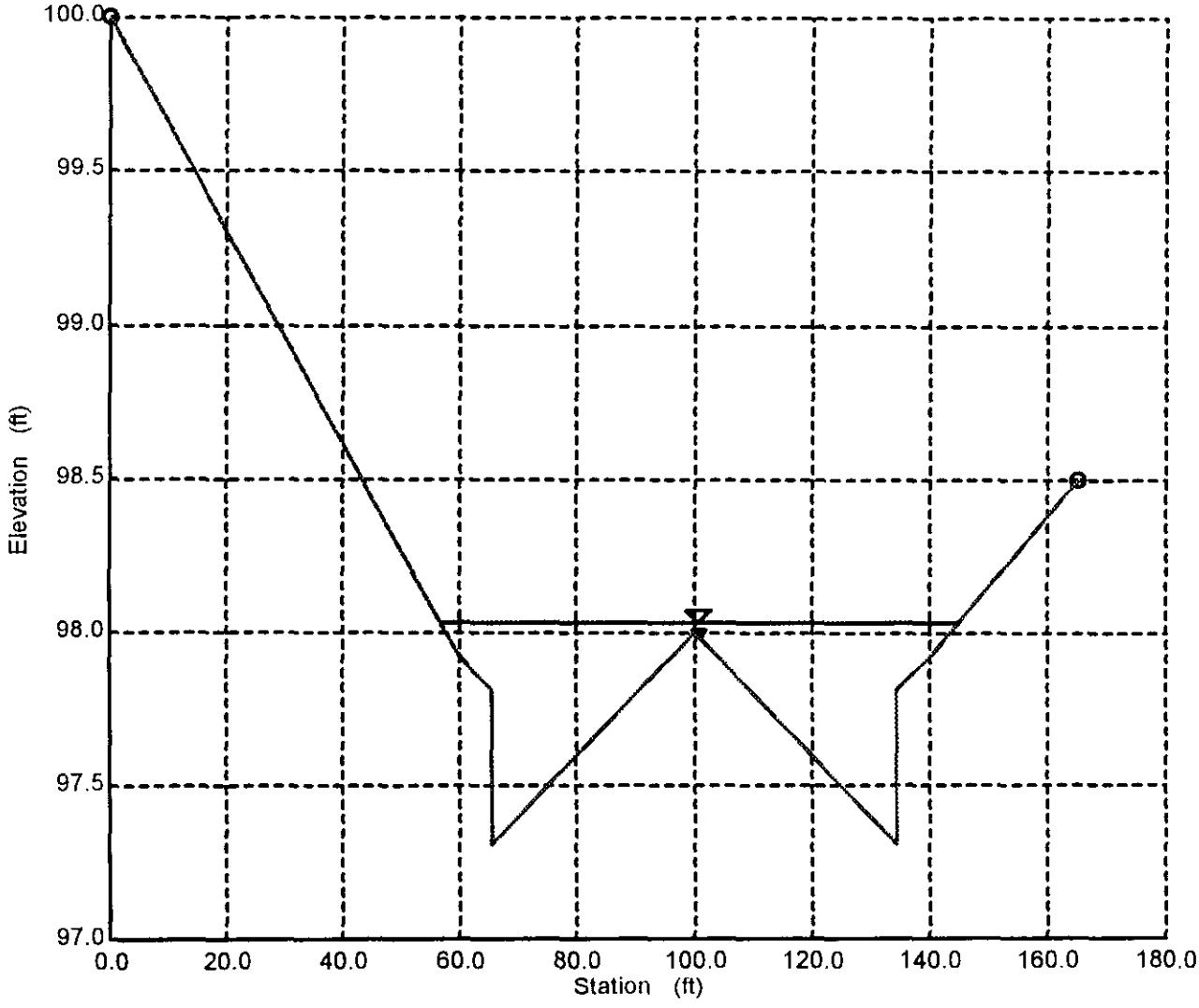
Discharge	140.00	cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	98.03	ft
Flow Area	28.36	ft²
Wetted Perimeter	89.10	ft
Top Width	88.10	ft
Height	0.72	ft
Critical Depth	98.15	ft
Critical Slope	0.005119	ft/ft
Velocity	4.94	ft/s
Velocity Head	0.38	ft
Specific Energy	98.41	ft
Froude Number	1.53	
Flow is supercritical.		

WALNUT SOUTH OF CRAIG
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	WALNUT JUST SOUTH OF CRAIG ROAD
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.013000	ft/ft
Water Surface Elevation	98.03	ft
Discharge	140.00	cfs



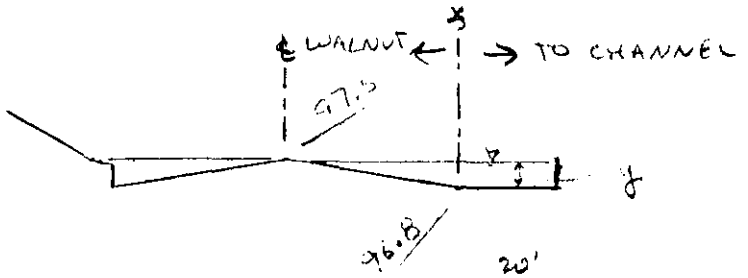
PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

COMP. BY: Dan Nunn
CHK. BY: _____
DATE: 1/26/96
SHEET NO.: _____
JOB NO.: 51804

Object: Range Wash FIS
Flow Split to Channel along Gravel Road

Q TOTAL IN STREET = 140 cfs

70 cfs each side of street



SECTION (E)

EAST SIDE WALNUT

$A = \frac{1}{2} 50 y^2$

$TW = 50y$

$y_{avg} = \frac{A}{TW}$

$V_w = (g\ y_{avg})^{1/2}$

$Q_w = AV$

TO CHANNEL

$A = 20y$

$TW = 20$

$V_c = (gy)^{1/2}$

$Q_c = AV$

$Q_w + Q_c = 70$

SPREADSHEET RESULTS

$Q_c \approx 45$ cfs

$Q_w \approx 25$ cfs

RANGE WASH FIS

FLOW SPLIT AT CHANNEL SOUTH OF CRAIG ROAD

	TRIAL WATER SURFACE	INV ELEV	DEPTH	AREA	TOP WIDTHS	AVE. DEPTHS	VELOCITY	FLOW
w	WS		y	A w	TW w	y w	V w	Q w
WALNUT ROAD	97.36	96.80	0.56	7.71	27.76	0.28	2.99	23.04
c	WS		y	A c	TW c	y c	V c	Q c
CRAIG CHANNEL	97.36	96.80	0.56	11.10	20.00	0.56	4.23	46.96

Q total

69.99999

Q target

70

DIFF

-7.7E-06

MAPLE HILL ROAD
Worksheet for Irregular Channel

F

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	MAPPLE HILL
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.008500	ft/ft

Elevation range: 86.50 ft to 90.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	90.00	0.00	30.00	0.025
20.00	88.00	30.00	90.00	0.016
30.00	87.10	90.00	110.00	0.025
35.50	87.00			
35.51	86.50			
60.00	87.00			
84.50	86.50			
84.51	87.00			
90.00	87.10			
110.00	90.00			

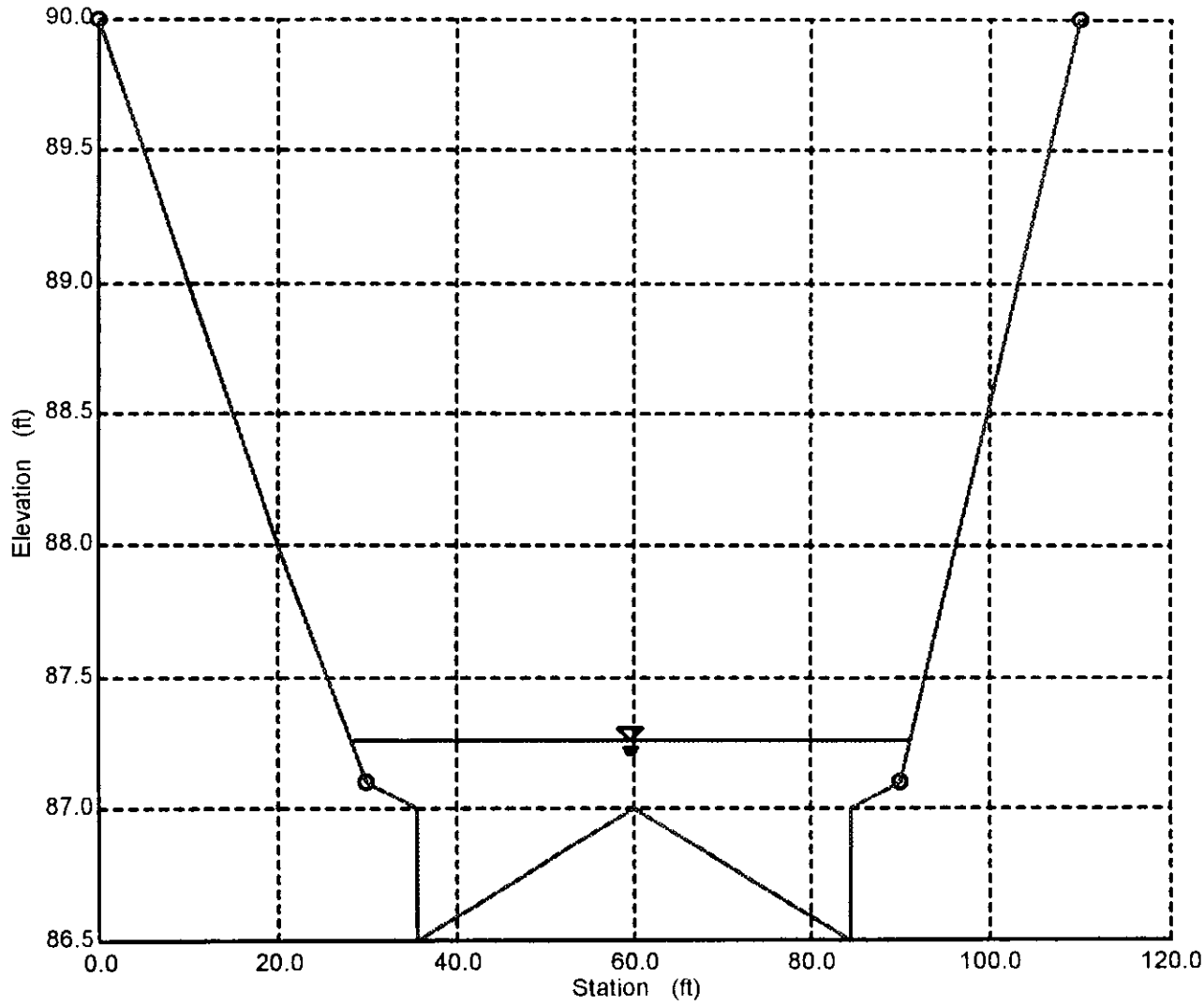
Discharge	130.00	cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	87.26	ft
Flow Area	27.43	ft²
Wetted Perimeter	63.86	ft
Top Width	62.85	ft
Height	0.76	ft
Critical Depth	87.34	ft
Critical Slope	0.004816	ft/ft
Velocity	4.74	ft/s
Velocity Head	0.35	ft
Specific Energy	87.61	ft
Froude Number	1.26	
Flow is supercritical.		

MAPLE HILL ROAD
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	MAPPLE HILL
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.008500	ft/ft
Water Surface Elevation	87.26	ft
Discharge	130.00	cfs



PIPE IN ALEXANDER
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	PIPE IN ALEXANDER
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.004000	ft/ft
Depth	4.00	ft
Diameter	48.00	in

Results		
Discharge	90.84	cfs
Flow Area	12.57	ft^2
Wetted Perimeter	12.57	ft
Top Width	0.12e-6	ft
Critical Depth	2.89	ft
Percent Full	100.00	
Critical Slope	0.005264	ft/ft
Velocity	7.23	ft/s
Velocity Head	0.81	ft
Specific Energy	4.81	ft
Froude Number	0.12e-3	
Maximum Discharge	97.72	cfs
Full Flow Capacity	90.84	cfs
Full Flow Slope	0.004000	ft/ft
Flow is subcritical.		

STEINBECK STREET
Worksheet for Irregular Channel

G

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	STEINBECK STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft
Discharge	55.00	cfs

Elevation range: 70.00 ft to 71.00 ft.

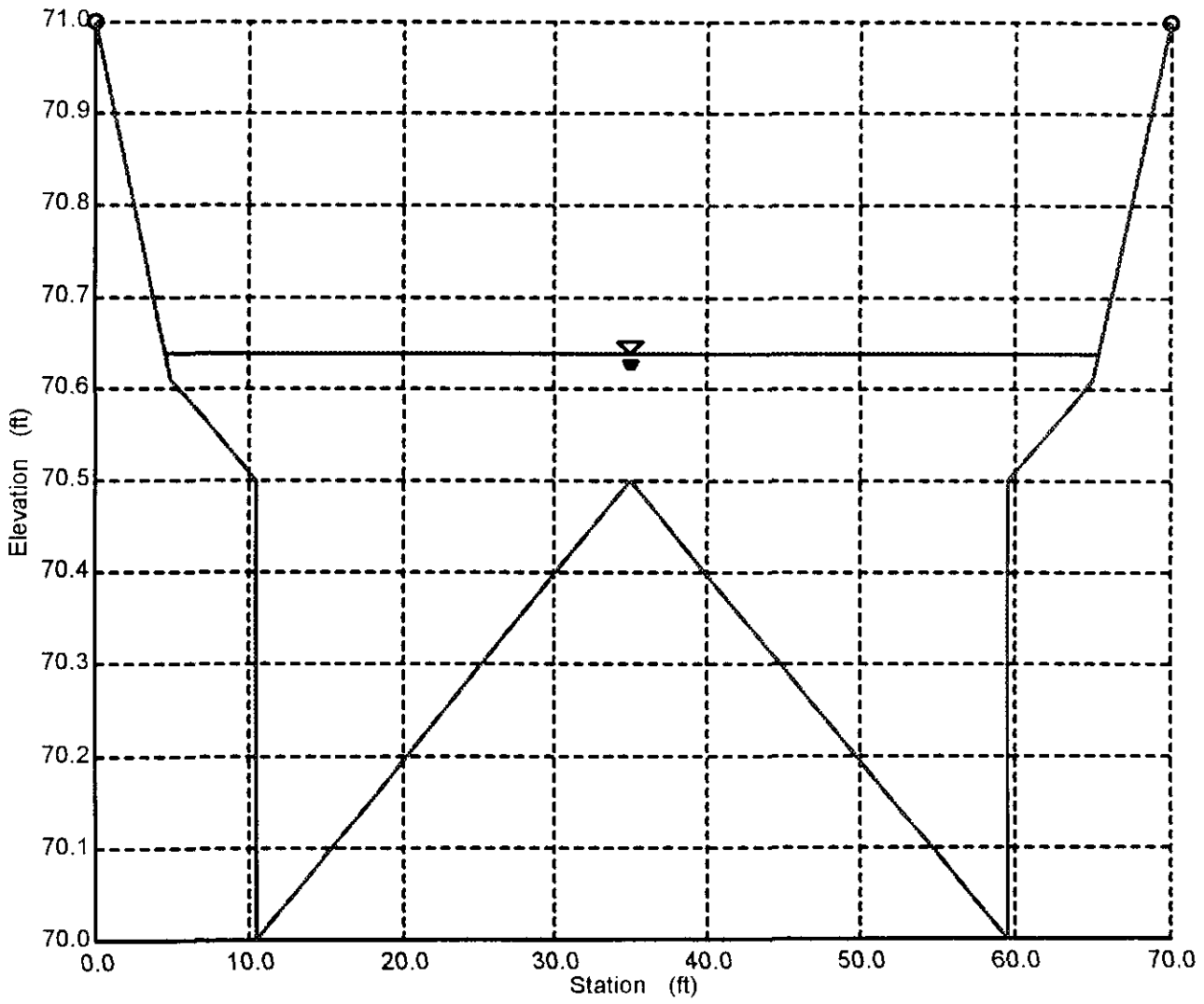
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	71.00	0.00	70.00	0.016
5.00	70.61			
10.50	70.50			
10.51	70.00			
35.00	70.50			
59.50	70.00			
59.51	70.50			
65.00	70.61			
70.00	71.00			

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	70.64	ft
Flow Area	19.91	ft²
Wetted Perimeter	61.70	ft
Top Width	60.70	ft
Height	0.64	ft
Critical Depth	70.60	ft
Critical Slope	0.005699	ft/ft
Velocity	2.76	ft/s
Velocity Head	0.12	ft
Specific Energy	70.76	ft
Froude Number	0.85	
Flow is subcritical.		

STEINBECK STREET
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	STEINBECK STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	70.64	ft
Discharge	55.00	cfs



FABERGE AVENUE
Worksheet for Irregular Channel

(H)

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	FABERGE AVE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft
Discharge	175.00	cfs

Elevation range: 57.50 ft to 60.00 ft.

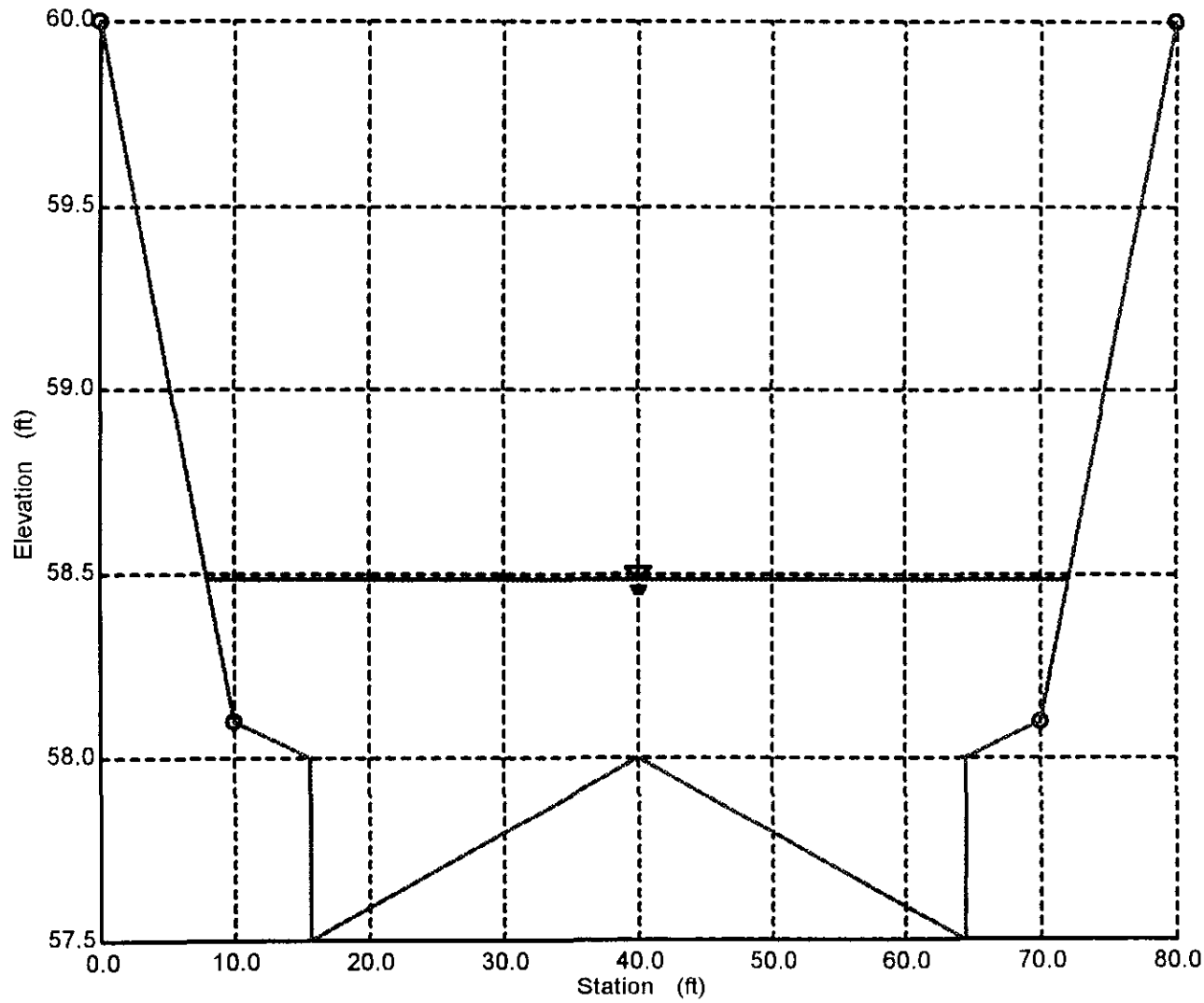
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.00	0.00	10.00	0.025
10.00	58.10	10.00	70.00	0.016
15.50	58.00	70.00	80.00	0.025
15.51	57.50			
40.00	58.00			
64.50	57.50			
64.51	58.00			
70.00	58.10			
80.00	60.00			

Results		
Wtd. Mannings Coefficient	0.017	
Water Surface Elevation	58.49	ft
Flow Area	41.71	ft²
Wetted Perimeter	65.14	ft
Top Width	64.07	ft
Height	0.99	ft
Critical Depth	58.45	ft
Critical Slope	0.004811	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	58.76	ft
Froude Number	0.92	
Flow is subcritical.		

FABERGE AVENUE
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	FABERGE AVE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.017	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	58.49	ft
Discharge	175.00	cfs



FABERGE OUTFALL CHANNEL
Worksheet for Rectangular Channel

(I)

Project Description	
Project File	c:\haestad\fmw\range2.fm2
Worksheet	FABERGE OUTFALL CHANNEL
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.010000	ft/ft
Bottom Width	18.00	ft
Discharge	175.00	cfs

Results		
Depth	0.94	ft
Flow Area	17.00	ft^2
Wetted Perimeter	19.89	ft
Top Width	18.00	ft
Critical Depth	1.43	ft
Critical Slope	0.002660	ft/ft
Velocity	10.29	ft/s
Velocity Head	1.65	ft
Specific Energy	2.59	ft
Froude Number	0.00	

WEST VANDENBERG SECTION 1
Worksheet for Irregular Channel

J

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.009000	ft/ft
Elevation range: 58.00 ft to 64.00 ft.		
Discharge	530.00	cfs

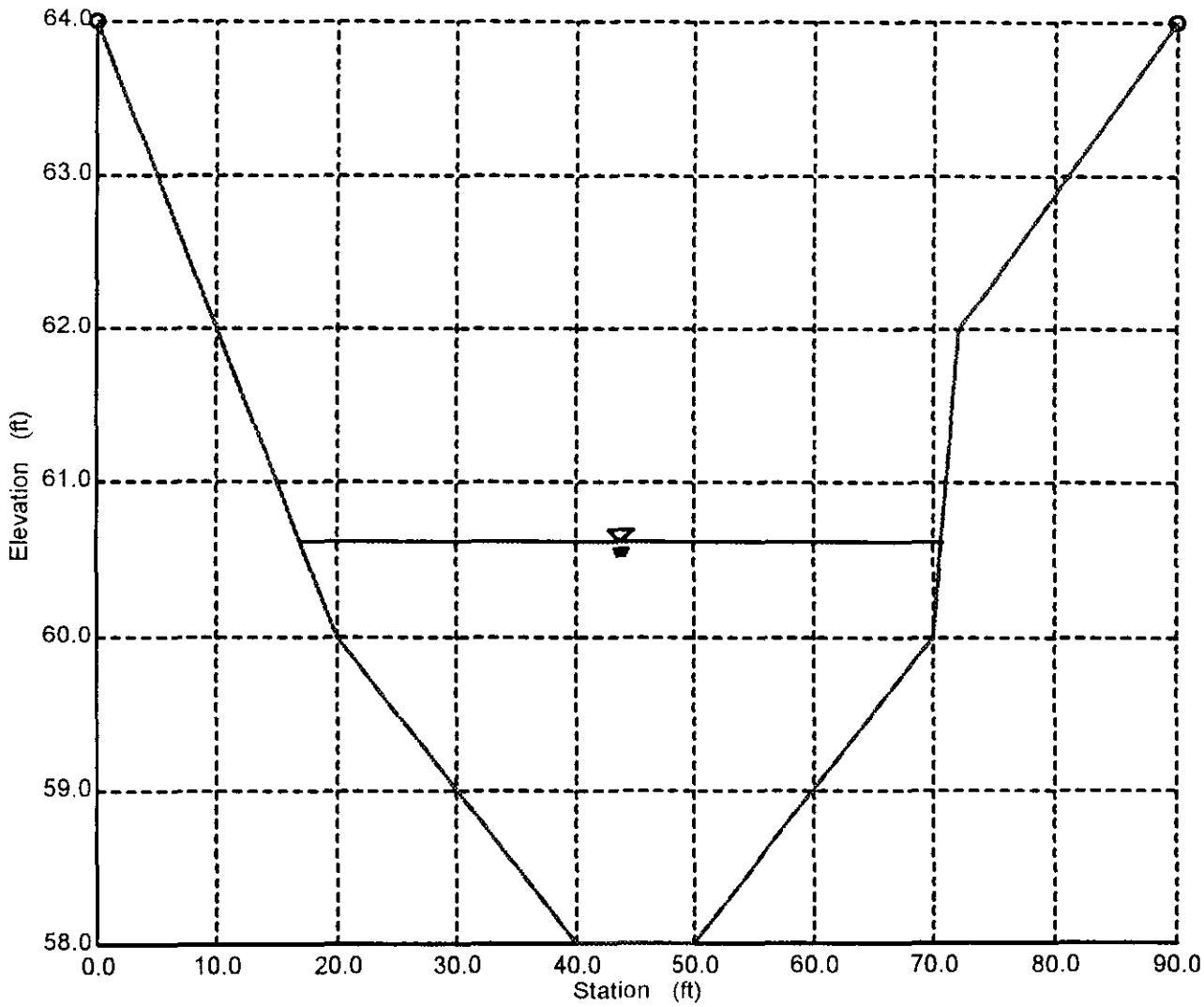
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	64.00	0.00	90.00	0.035
20.00	60.00			
40.00	58.00			
50.00	58.00			
70.00	60.00			
72.00	62.00			
90.00	64.00			

Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	60.62	ft
Flow Area	92.33	ft²
Wetted Perimeter	54.26	ft
Top Width	53.74	ft
Height	2.62	ft
Critical Depth	60.33	ft
Critical Slope	0.015818	ft/ft
Velocity	5.74	ft/s
Velocity Head	0.51	ft
Specific Energy	61.14	ft
Froude Number	0.77	
Flow is subcritical.		

WEST VANDENBERG SECTION 1
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.035	
Channel Slope	0.009000	ft/ft
Water Surface Elevation	60.62	ft
Discharge	530.00	cfs



WEST VANDENBERG SECTION 2
Worksheet for Irregular Channel

K

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

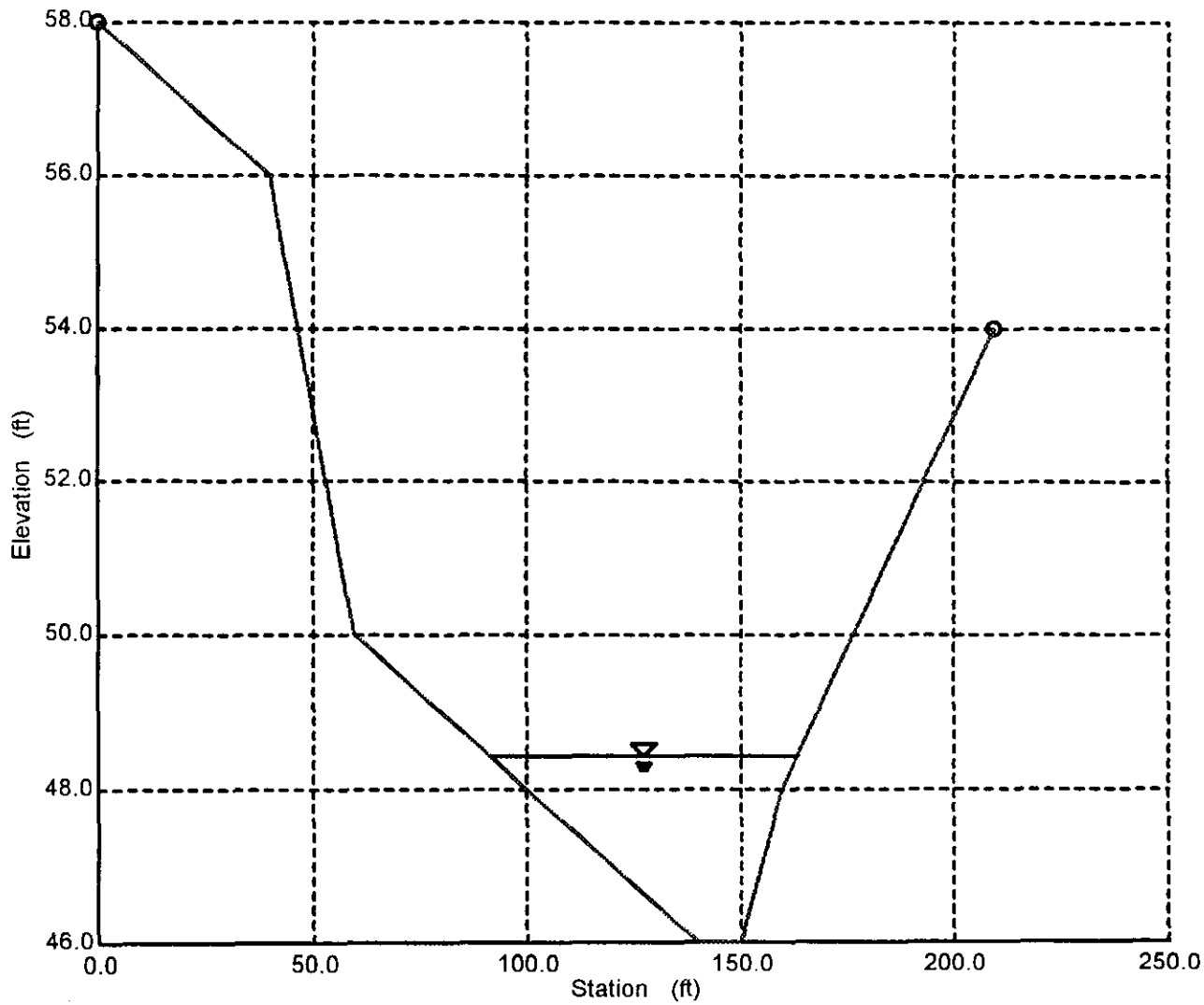
Input Data				
Channel Slope	0.008000 ft/ft			
Elevation range: 46.00 ft to 58.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	58.00	0.00	210.00	0.030
40.00	56.00			
60.00	50.00			
100.00	48.00			
140.00	46.00			
150.00	46.00			
160.00	48.00			
210.00	54.00			
Discharge	530.00 cfs			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	48.42	ft
Flow Area	97.76	ft²
Wetted Perimeter	72.21	ft
Top Width	71.92	ft
Height	2.42	ft
Critical Depth	48.21	ft
Critical Slope	0.012202	ft/ft
Velocity	5.42	ft/s
Velocity Head	0.46	ft
Specific Energy	48.88	ft
Froude Number	0.82	
Flow is subcritical.		

WEST VANDENBERG SECTION 2
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	48.42	ft
Discharge	530.00	cfs



WEST VANDENBERG SEC 3
Worksheet for Irregular Channel

(L)

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG SEC 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.008000	ft/ft
Discharge	530.00	cfs

Elevation range: 42.00 ft to 50.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	50.00	0.00	100.00	0.035
30.00	44.00			
40.00	42.00			
60.00	42.30			
80.00	42.10			
100.00	50.00			

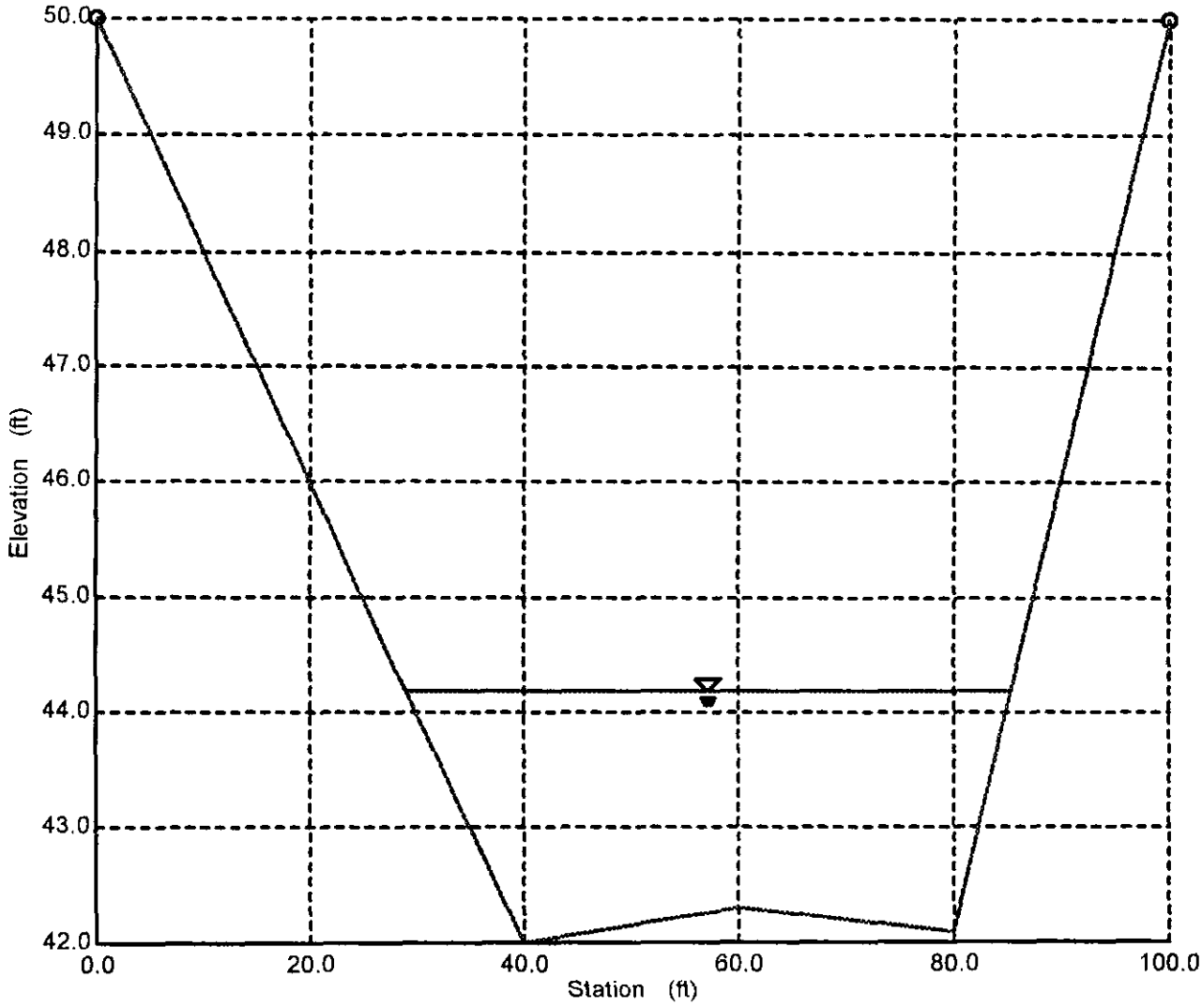
Results		
Wtd. Mannings Coefficient	0.035	
Water Surface Elevation	44.18	ft
Flow Area	97.38	ft²
Wetted Perimeter	56.76	ft
Top Width	56.14	ft
Height	2.18	ft
Critical Depth	43.81	ft
Critical Slope	0.015966	ft/ft
Velocity	5.44	ft/s
Velocity Head	0.46	ft
Specific Energy	44.64	ft
Froude Number	0.73	

Flow is subcritical.

WEST VANDENBERG SEC 3
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	WEST VANDENBERG SEC 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.035	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	44.18	ft
Discharge	530.00	cfs



12 x 8 CULVERT AT U.P. RAILROAD
WEST BRANCH UPSTREAM OF VANDENBERG DRIVE

CURRENT DATE: 01-15-1996
CURRENT TIME: 17:30:19

FILE DATE: 01-15-1996
FILE NAME: RR2

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	32.50	32.00	50.00	1 RCB	12.00	8.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: RR2 DATE: 01-15-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
32.50	0	0	0	0	0	0	0	0	1
36.43	53	53	0	0	0	0	0	0	1
36.70	106	106	0	0	0	0	0	0	1
36.95	159	159	0	0	0	0	0	0	1
37.19	212	212	0	0	0	0	0	0	1
37.42	265	265	0	0	0	0	0	0	1
37.67	318	318	0	0	0	0	0	0	1
37.91	371	371	0	0	0	0	0	0	1
38.20	424	424	0	0	0	0	0	0	1
38.66	477	477	0	0	0	0	0	0	1
39.11	530	530	0	0	0	0	0	0	1
46.00	1293	1293	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RR2 DATE: 01-15-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
32.50	0.00	0	0	0.00
36.43	0.00	53	0	0.00
36.70	0.00	106	0	0.00
36.95	0.00	159	0	0.00
37.19	0.00	212	0	0.00
37.42	0.00	265	0	0.00
37.67	0.00	318	0	0.00
37.91	0.00	371	0	0.00
38.20	0.00	424	0	0.00
38.66	0.00	477	0	0.00
39.11	0.00	530	0	0.00

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-15-1996
CURRENT TIME: 17:30:19

FILE DATE: 01-15-1996
FILE NAME: RR2

CULVERT # 1

PERFORMANCE CURVE FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	32.50	32.00	0.00	-0.50	0-NF	0.00	32.50	0.00	0.00
53	36.43	32.71	1.44	3.93	6-FF	0.00	0.00	0.00	5.21
106	36.70	33.06	2.30	4.20	6-FF	0.00	0.00	0.00	6.56
159	36.95	33.34	3.00	4.45	6-FF	0.00	0.00	0.00	7.51
212	37.19	33.57	3.63	4.69	6-FF	0.00	0.00	0.00	8.27
265	37.42	33.77	4.20	4.92	6-FF	0.00	0.00	0.00	8.91
318	37.67	33.96	4.73	5.17	6-FF	0.00	0.00	0.00	9.46
371	37.91	34.13	5.23	5.41	6-FF	0.00	0.00	0.00	9.96
424	38.20	34.29	5.70	5.67	6-FF	0.00	0.00	0.00	13.15
477	38.66	34.44	6.16	5.93	6-FF	0.00	0.00	0.00	13.56
530	39.11	34.58	6.61	6.21	6-FF	0.00	0.00	0.00	13.95

El. inlet face invert 32.50 ft El. outlet invert 32.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	32.50
OUTLET STATION (FT)	50.00
OUTLET ELEVATION (FT)	32.00
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0100
CULVERT LENGTH ALONG SLOPE (FT)	50.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	12.00 FT
BARREL RISE	8.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-15-1996 FILE DATE: 01-15-1996
CURRENT TIME: 17:30:19 FILE NAME: RR2

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	15.00
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (FT/FT)	0.010
MANNING'S N (.01-0.1)	0.025
CHANNEL INVERT ELEVATION (FT)	32.00
CULVERT NO.1 OUTLET INVERT ELEVATION	32.00 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	32.00	0.000	0.00	0.00
53.00	32.71	0.907	4.34	0.44
106.00	33.06	0.940	5.49	0.66
159.00	33.34	0.956	6.27	0.83
212.00	33.57	0.966	6.86	0.98
265.00	33.77	0.973	7.35	1.11
318.00	33.96	0.978	7.77	1.22
371.00	34.13	0.982	8.14	1.33
424.00	34.29	0.986	8.46	1.43
477.00	34.44	0.989	8.76	1.52
530.00	34.58	0.991	9.03	1.61

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	20.00
CREST LENGTH (FT)	100.00
OVERTOPPING CREST ELEVATION (FT)	46.00

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2 - 12 FT WIDE BRIDGE CELLS AT U. P. RAILROAD
EAST BRANCH UPSTREAM OF VANDENBERG DRIVE

CURRENT DATE: 01-15-1996
CURRENT TIME: 17:59:03

FILE DATE: 01-15-1996
FILE NAME: RR1

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	39.10	39.00	20.00	2 RCB	12.00	12.00	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: RR1 DATE: 01-15-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
39.10	0	0	0	0	0	0	0	0	1
45.43	106	106	0	0	0	0	0	0	1
45.68	212	212	0	0	0	0	0	0	1
45.91	318	318	0	0	0	0	0	0	1
46.11	424	424	0	0	0	0	0	0	1
46.30	530	530	0	0	0	0	0	0	1
46.49	636	636	0	0	0	0	0	0	1
46.68	742	742	0	0	0	0	0	0	1
46.86	848	848	0	0	0	0	0	0	1
47.04	954	954	0	0	0	0	0	0	1
47.23	1060	1060	0	0	0	0	0	0	1
48.00	1498	1498	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RR1 DATE: 01-15-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
39.10	0.00	0	0	0.00
45.43	0.00	106	0	0.00
45.68	0.00	212	0	0.00
45.91	0.00	318	0	0.00
46.11	0.00	424	0	0.00
46.30	0.00	530	0	0.00
46.49	0.00	636	0	0.00
46.68	0.00	742	0	0.00
46.86	0.00	848	0	0.00
47.04	0.00	954	0	0.00
47.23	0.00	1060	0	0.00

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-15-1996
CURRENT TIME: 17:59:03

FILE DATE: 01-15-1996
FILE NAME: RR1

CULVERT # 1

PERFORMANCE CURVE FOR 2 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	39.10	39.00	0.00	-0.10	0-NF	0.00	39.10	0.00	0.00
106	45.43	39.93	1.42	6.33	6-FF	0.00	0.00	0.00	4.74
212	45.68	40.38	2.14	6.58	6-FF	0.00	0.00	0.00	6.38
318	45.91	40.74	2.81	6.81	6-FF	0.00	0.00	0.00	7.51
424	46.11	41.04	3.40	7.01	6-FF	0.00	0.00	0.00	8.27
530	46.30	41.30	3.93	7.20	6-FF	0.00	0.00	0.00	8.91
636	46.49	41.54	4.45	7.39	6-FF	0.00	0.00	0.00	9.46
742	46.68	41.76	4.93	7.58	6-FF	0.00	0.00	0.00	9.96
848	46.86	41.97	5.38	7.76	6-FF	0.00	0.00	0.00	10.42
954	47.04	42.16	5.82	7.94	6-FF	0.00	0.00	0.00	10.83
1060	47.23	42.34	6.22	8.13	6-FF	0.00	0.00	0.00	11.22

El. inlet face invert 39.10 ft El. outlet invert 39.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	39.10
OUTLET STATION (FT)	20.00
OUTLET ELEVATION (FT)	39.00
NUMBER OF BARRELS	2.00
SLOPE (V-FT/H-FT)	0.0050
CULVERT LENGTH ALONG SLOPE (FT)	20.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	12.00 FT
BARREL RISE	12.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 01-15-1996 FILE DATE: 01-15-1996
CURRENT TIME: 17:59:03 FILE NAME: RR1

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	30.00
SIDE SLOPE H/V (X:1)	5.0
CHANNEL SLOPE V/H (FT/FT)	0.004
MANNING'S N (.01-0.1)	0.025
CHANNEL INVERT ELEVATION (FT)	39.00
CULVERT NO.1 OUTLET INVERT ELEVATION	39.00 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	39.00	0.000	0.00	0.00
106.00	39.93	0.600	3.28	0.23
212.00	40.38	0.621	4.15	0.35
318.00	40.74	0.632	4.73	0.43
424.00	41.04	0.638	5.17	0.51
530.00	41.30	0.643	5.54	0.58
636.00	41.54	0.647	5.85	0.63
742.00	41.76	0.650	6.13	0.69
848.00	41.97	0.652	6.37	0.74
954.00	42.16	0.654	6.60	0.79
1060.00	42.34	0.656	6.80	0.83

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	20.00
CREST LENGTH (FT)	200.00
OVERTOPPING CREST ELEVATION (FT)	48.00

EAST VANDENBERG - BETWEEN RR & I-15
Worksheet for Irregular Channel

M

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	EAST VANDENBERG BETWEEN RR & I15
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.006700	ft/ft
Elevation range: 30.00 ft to 40.00 ft.		
Discharge	1,060.00	cfs

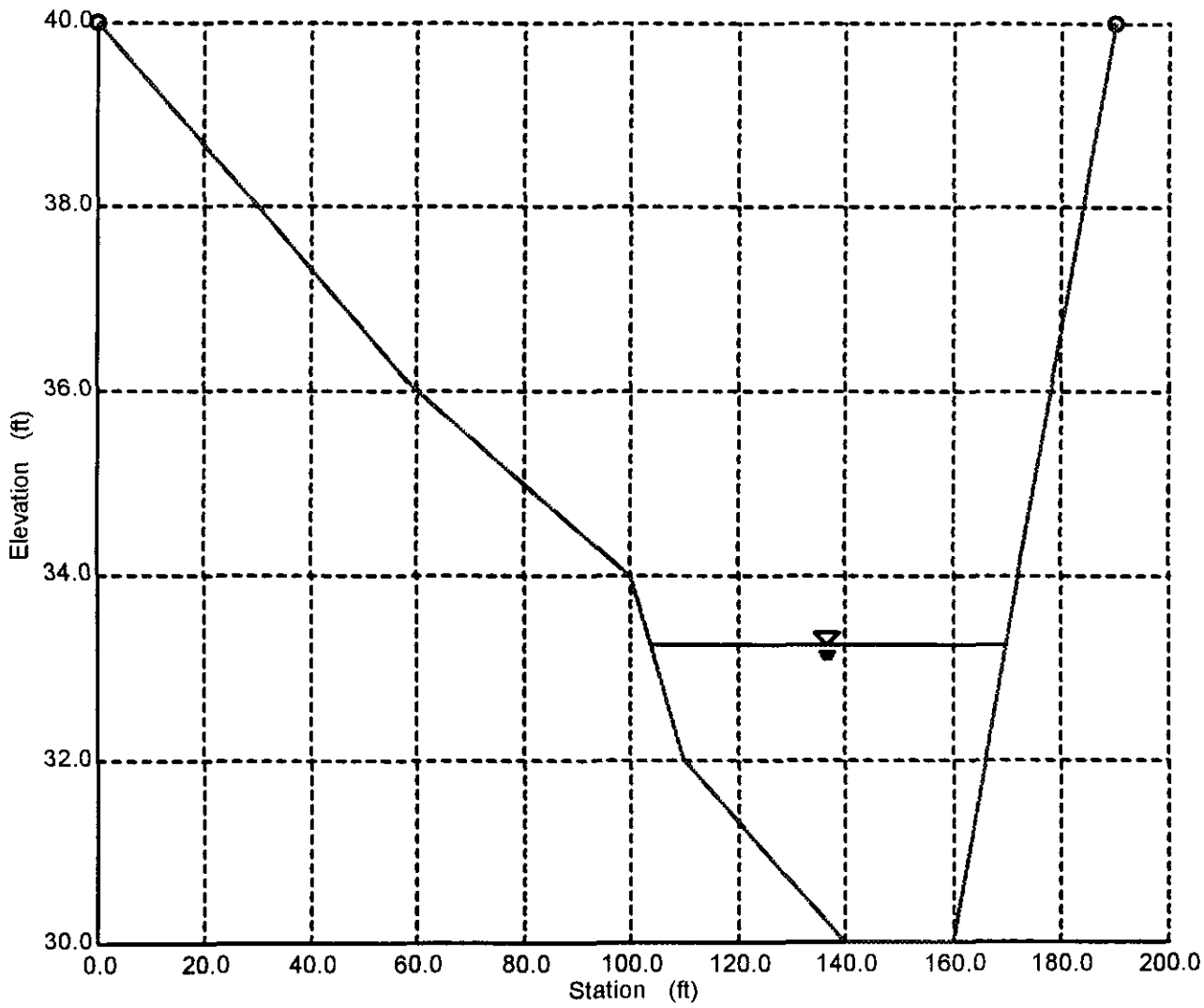
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	40.00	0.00	190.00	0.030
30.00	38.00			
60.00	36.00			
100.00	34.00			
110.00	32.00			
140.00	30.00			
160.00	30.00			
190.00	40.00			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	33.24	ft
Flow Area	151.29	ft²
Wetted Perimeter	66.60	ft
Top Width	65.88	ft
Height	3.24	ft
Critical Depth	32.91	ft
Critical Slope	0.010446	ft/ft
Velocity	7.01	ft/s
Velocity Head	0.76	ft
Specific Energy	34.00	ft
Froude Number	0.82	
Flow is subcritical.		

EAST VANDENBERG - BETWEEN RR & I-15
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	EAST VANDENBERG BETWEEN RR & I15
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.006700	ft/ft
Water Surface Elevation	33.24	ft
Discharge	1,060.00	cfs



3 - 15 x 10 CULVERTS AT INTERSTATE 15 UPSTREAM OF VANDENBERG DRIVE

CURRENT DATE: 01-16-1996
CURRENT TIME: 07:54:46

FILE DATE: 01-16-1996
FILE NAME: I15VAN

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	19.50	18.50	250.00	3 RCB	15.00	10.00	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: I15VAN DATE: 01-16-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
19.50	0	0	0	0	0	0	0	0	1
23.85	147	147	0	0	0	0	0	0	1
24.06	294	294	0	0	0	0	0	0	1
24.25	441	441	0	0	0	0	0	0	1
24.42	588	588	0	0	0	0	0	0	1
24.59	735	735	0	0	0	0	0	0	1
24.76	882	882	0	0	0	0	0	0	1
24.92	1029	1029	0	0	0	0	0	0	1
25.09	1176	1176	0	0	0	0	0	0	1
25.25	1323	1323	0	0	0	0	0	0	1
25.42	1470	1470	0	0	0	0	0	0	1
28.00	2881	2881	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: I15VAN DATE: 01-16-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
19.50	0.00	0	0	0.00
23.85	0.00	147	0	0.00
24.06	0.00	294	0	0.00
24.25	0.00	441	0	0.00
24.42	0.00	588	0	0.00
24.59	0.00	735	0	0.00
24.76	0.00	882	0	0.00
24.92	0.00	1029	0	0.00
25.09	0.00	1176	0	0.00
25.25	0.00	1323	0	0.00
25.42	0.00	1470	0	0.00

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-16-1996
CURRENT TIME: 07:54:46

FILE DATE: 01-16-1996
FILE NAME: I15VAN

CULVERT # 1

PERFORMANCE CURVE FOR 3 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	19.50	18.50	0.00	-1.00	0-NF	0.00	19.50	0.00	0.00
147	23.85	19.34	1.29	4.35	6-FF	0.00	0.00	0.00	3.87
294	24.06	19.76	1.89	4.56	6-FF	0.00	0.00	0.00	5.17
441	24.25	20.10	2.48	4.75	6-FF	0.00	0.00	0.00	6.14
588	24.42	20.38	3.00	4.92	6-FF	0.00	0.00	0.00	6.95
735	24.59	20.63	3.46	5.09	6-FF	0.00	0.00	0.00	7.66
882	24.76	20.86	3.92	5.26	6-FF	0.00	0.00	0.00	8.30
1029	24.92	21.07	4.34	5.42	6-FF	0.00	0.00	0.00	8.89
1176	25.09	21.27	4.74	5.59	6-FF	0.00	0.00	0.00	9.42
1323	25.25	21.46	5.12	5.75	6-FF	0.00	0.00	0.00	9.80
1470	25.42	21.63	5.48	5.92	6-FF	0.00	0.00	0.00	10.15

El. inlet face invert 19.50 ft El. outlet invert 18.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	19.50
OUTLET STATION (FT)	250.00
OUTLET ELEVATION (FT)	18.50
NUMBER OF BARRELS	3.00
SLOPE (V-FT/H-FT)	0.0040
CULVERT LENGTH ALONG SLOPE (FT)	250.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	15.00 FT
BARREL RISE	10.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-16-1996 FILE DATE: 01-16-1996
CURRENT TIME: 07:54:46 FILE NAME: I15VAN

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	50.00
SIDE SLOPE H/V (X:1)	6.0
CHANNEL SLOPE V/H (FT/FT)	0.004
MANNING'S N (.01-0.1)	0.025
CHANNEL INVERT ELEVATION (FT)	18.50
CULVERT NO.1 OUTLET INVERT ELEVATION	18.50 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	18.50	0.000	0.00	0.00
147.00	19.34	0.606	3.16	0.21
294.00	19.76	0.633	4.04	0.32
441.00	20.10	0.647	4.64	0.40
588.00	20.38	0.656	5.10	0.47
735.00	20.63	0.662	5.49	0.53
882.00	20.86	0.667	5.82	0.59
1029.00	21.07	0.671	6.11	0.64
1176.00	21.27	0.674	6.37	0.69
1323.00	21.46	0.677	6.61	0.74
1470.00	21.63	0.680	6.82	0.78

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	500.00
CREST LENGTH (FT)	100.00
OVERTOPPING CREST ELEVATION (FT)	28.00

NORTH OF VANDENBERG CHANNEL
Worksheet for Irregular Channel

N

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	NORTH OF VANDENBERG
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.002500	ft/ft
Elevation range: 17.50 ft to 24.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	23.80	0.00	240.00	0.025
100.00	22.00			
105.00	20.00			
140.00	18.00			
145.00	17.50			
165.00	17.50			
170.00	18.00			
190.00	20.00			
220.00	22.00			
240.00	24.00			

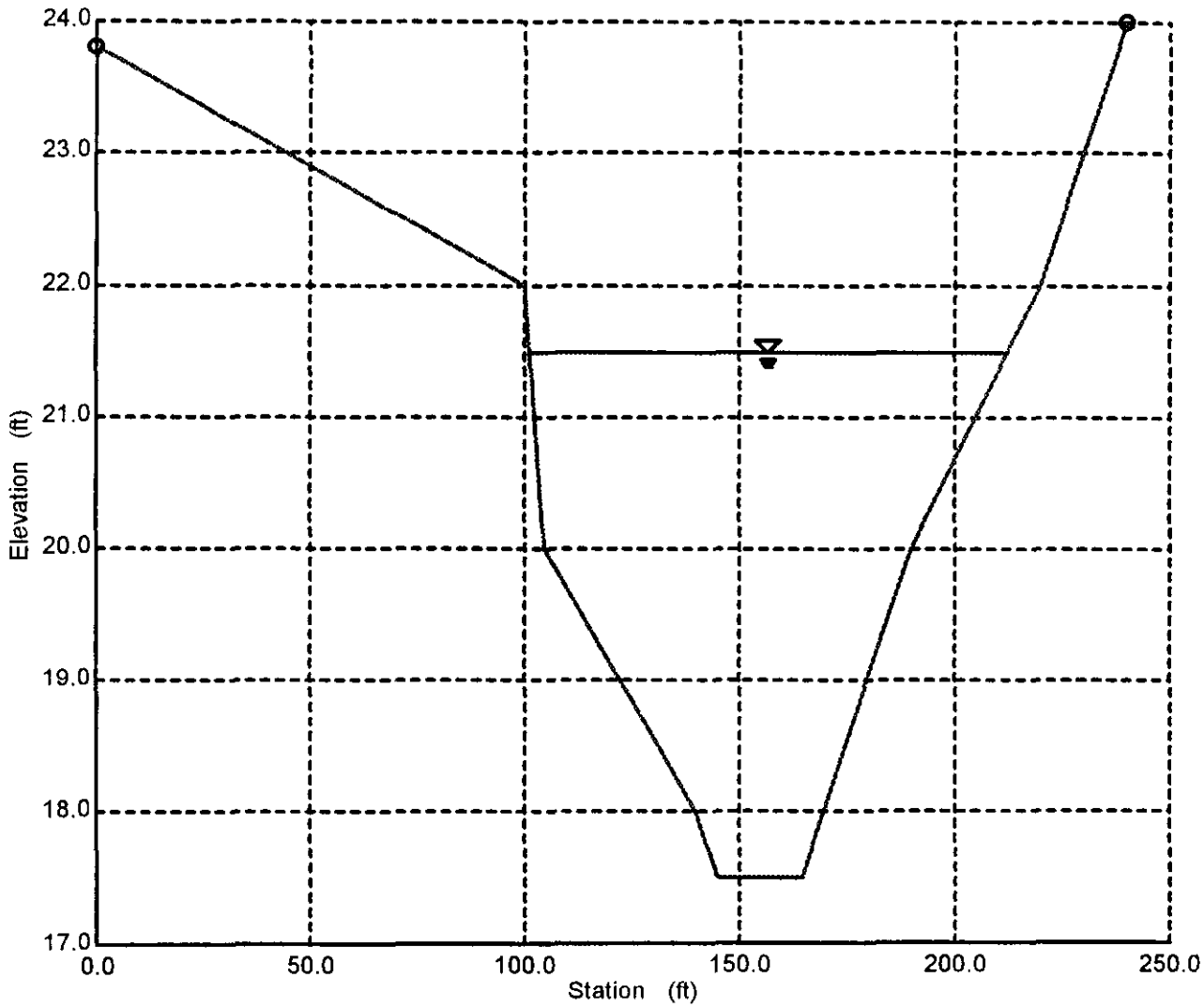
Discharge	1,470.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	21.48	ft
Flow Area	272.53	ft²
Wetted Perimeter	111.45	ft
Top Width	110.91	ft
Height	3.98	ft
Critical Depth	20.65	ft
Critical Slope	0.007346	ft/ft
Velocity	5.39	ft/s
Velocity Head	0.45	ft
Specific Energy	21.93	ft
Froude Number	0.61	
Flow is subcritical.		

NORTH OF VANDENBERG CHANNEL
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	NORTH OF VANDENBERG
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.002500	ft/ft
Water Surface Elevation	21.48	ft
Discharge	1,470.00	cfs



2 - 10 x 3 CULVERTS AT LONE MOUNTAIN ROAD
UPSTREAM END OF VANDENBERG CHANNEL

CURRENT DATE: 01-16-1996
CURRENT TIME: 11:19:09

FILE DATE: 12-26-1995
FILE NAME: VAND1

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	13.50	13.23	90.00	2 RCB	10.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: VAND1 DATE: 12-26-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
13.50	0	0	0	0	0	0	0	0	1
15.64	147	147	0	0	0	0	0	0	1
16.85	294	294	0	0	0	0	0	0	1
18.34	441	441	0	0	0	0	0	0	1
19.29	588	501	0	0	0	0	0	86	4
19.30	600	503	0	0	0	0	0	93	3
19.64	882	502	0	0	0	0	0	373	5
19.77	1029	499	0	0	0	0	0	526	5
19.87	1176	494	0	0	0	0	0	673	4
19.97	1323	490	0	0	0	0	0	826	4
20.06	1470	485	0	0	0	0	0	979	4
19.00	502	502	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: VAND1 DATE: 12-26-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
13.50	0.00	0	0	0.00
15.64	0.00	147	0	0.00
16.85	0.00	294	0	0.00
18.34	0.00	441	0	0.00
19.29	-0.01	588	0	0.07
19.30	-0.00	600	4	0.65
19.64	-0.00	882	7	0.78
19.77	-0.01	1029	4	0.40
19.87	-0.00	1176	9	0.75
19.97	-0.01	1323	8	0.58
20.06	-0.01	1470	6	0.44

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-16-1996 FILE DATE: 12-26-1995
CURRENT TIME: 15:08:10 FILE NAME: VAND1

CULVERT # 1

PERFORMANCE CURVE FOR 2 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	13.00	12.50	0.00	-0.36	0-NF	0.00	13.00	0.00	0.00
147	15.01	14.35	2.01	1.91	6-FF	0.00	0.00	0.00	6.76
294	16.21	15.18	3.21	2.60	5-S2	0.00	0.00	0.00	8.38
405	17.16	15.82	4.16	4.14	4-FF	0.00	0.00	0.00	6.75
420	17.42	16.00	4.30	4.42	4-FF	0.00	0.00	0.00	7.00
422	17.43	16.00	4.32	4.43	4-FF	0.00	0.00	0.00	7.03
456	17.67	16.00	4.66	4.67	4-FF	0.00	0.00	0.00	7.61
468	17.79	16.00	4.79	4.76	4-FF	0.00	0.00	0.00	7.80
477	17.88	16.00	4.88	4.83	4-FF	0.00	0.00	0.00	7.96
485	17.97	16.00	4.97	4.89	4-FF	0.00	0.00	0.00	8.09
493	18.05	16.00	5.05	4.95	4-FF	0.00	0.00	0.00	8.21

El. inlet face invert 13.00 ft El. outlet invert 12.64 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	13.00
OUTLET STATION (FT)	90.00
OUTLET ELEVATION (FT)	12.64
NUMBER OF BARRELS	2.00
SLOPE (V-FT/H-FT)	0.0040
CULVERT LENGTH ALONG SLOPE (FT)	90.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	10.00 FT
BARREL RISE	3.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-16-1996 FILE DATE: 12-26-1995
CURRENT TIME: 15:08:10 FILE NAME: VAND1

TAILWATER

TAILWATER RATING CURVE

FLOW(CFS)	W.S.E.(FT)
0	12.50
147	14.35
294	15.18
441	15.82
588	16.00
600	16.00
882	16.00
1029	16.00
1176	16.00
1323	16.00
1470	16.00

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH (FT) 90.00
***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X (FT)	Y (FT)
1	0.00	20.00
2	100.00	18.00
3	200.00	17.00
4	350.00	17.00
5	600.00	18.00
6	800.00	19.00

VANDENBERG SECTION 1
Worksheet for Irregular Channel

(O)

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC. 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.010000	ft/ft
Discharge	970.00	cfs

Elevation range: 12.00 ft to 14.00 ft.

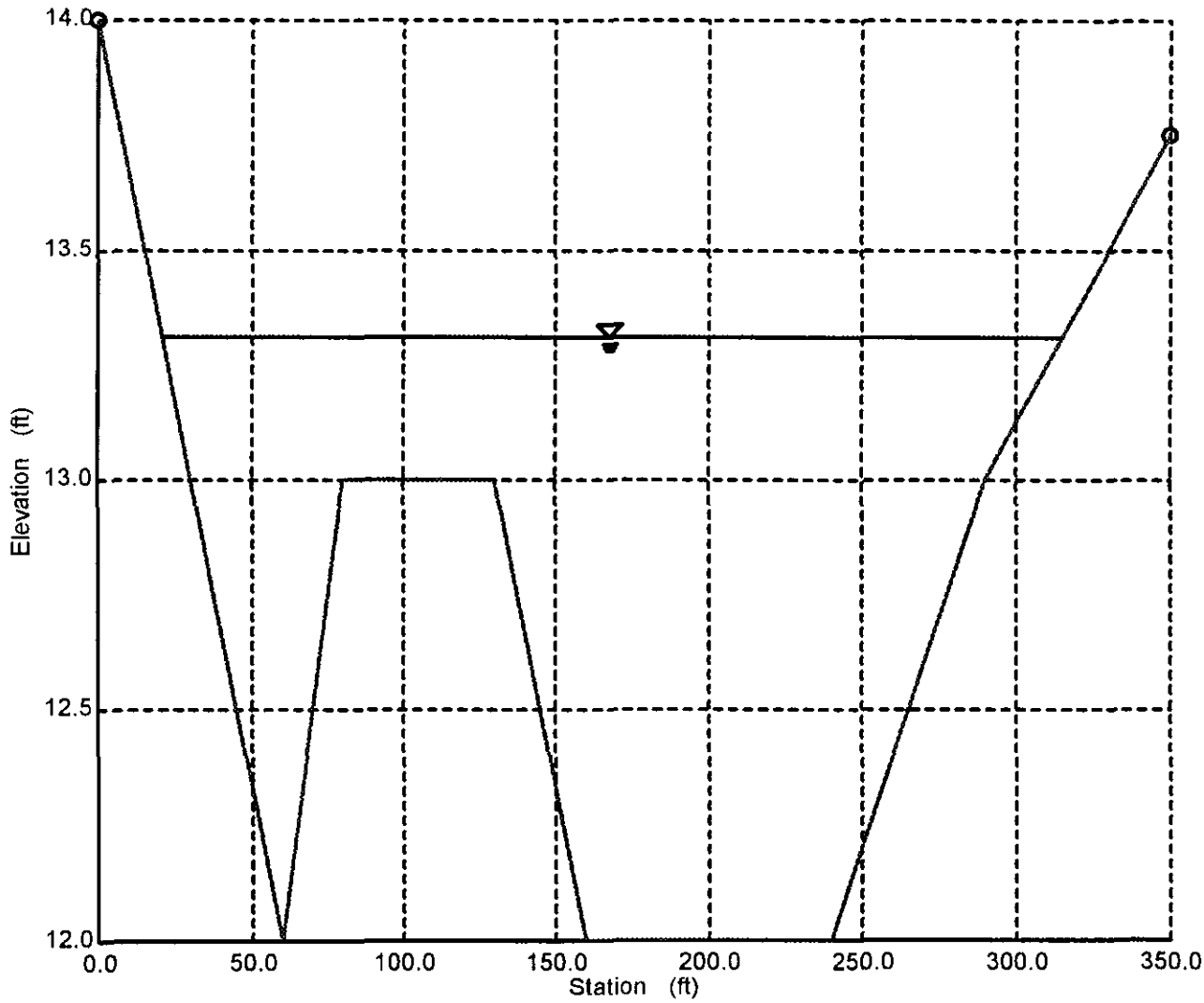
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	14.00	0.00	350.00	0.030
60.00	12.00			
80.00	13.00			
130.00	13.00			
160.00	12.00			
240.00	12.00			
290.00	13.00			
350.00	13.75			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	13.31	ft
Flow Area	230.39	ft²
Wetted Perimeter	293.99	ft
Top Width	293.92	ft
Height	1.31	ft
Critical Depth	13.21	ft
Critical Slope	0.014676	ft/ft
Velocity	4.21	ft/s
Velocity Head	0.28	ft
Specific Energy	13.58	ft
Froude Number	0.84	
Flow is subcritical.		

VANDENBERG SECTION 1
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC. 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.010000	ft/ft
Water Surface Elevation	13.31	ft
Discharge	970.00	cfs



2 - 9 x 3 CULVERTS ON VANDENBERG CHANNEL

CURRENT DATE: 01-16-1996
CURRENT TIME: 11:20:54

FILE DATE: 12-26-1995
FILE NAME: VAND2

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	25.04	24.92	90.00	2 RCB	9.00	3.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: VAND2 DATE: 12-26-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
25.04	0	0	0	0	0	0	0	0	1
26.15	50	50	0	0	0	0	0	0	1
26.78	100	100	0	0	0	0	0	0	1
27.26	150	150	0	0	0	0	0	0	1
27.73	200	200	0	0	0	0	0	0	1
28.16	250	250	0	0	0	0	0	0	1
28.58	300	300	0	0	0	0	0	0	1
29.06	350	350	0	0	0	0	0	0	1
29.70	400	350	0	0	0	0	0	19	12
29.89	450	400	0	0	0	0	0	62	12
30.06	500	400	0	0	0	0	0	115	11
29.54	350	350	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: VAND2 DATE: 12-26-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
25.04	0.00	0	0	0.00
26.15	0.00	50	0	0.00
26.78	0.00	100	0	0.00
27.26	0.00	150	0	0.00
27.73	0.00	200	0	0.00
28.16	0.00	250	0	0.00
28.58	0.00	300	0	0.00
29.06	0.00	350	0	0.00
29.70	-0.00	400	31	7.67
29.89	0.00	450	-12	-2.60
30.06	0.00	500	-15	-2.91

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-16-1996
CURRENT TIME: 11:20:54

FILE DATE: 12-26-1995
FILE NAME: VAND2

CULVERT # 1

PERFORMANCE CURVE FOR 2 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	25.04	24.92	0.00	-0.12	0-NF	0.00	25.04	0.00	0.00
50	26.15	25.82	1.07	1.11	3-M1	0.00	0.00	0.00	3.10
100	26.78	26.26	1.68	1.74	3-M1	0.00	0.00	0.00	4.16
150	27.26	26.60	2.19	2.22	3-M2	0.00	0.00	0.00	4.96
200	27.73	26.89	2.65	2.69	3-M2	0.00	0.00	0.00	5.63
250	28.16	27.15	3.09	3.12	3-M2	0.00	0.00	0.00	6.22
300	28.58	27.39	3.54	3.52	3-M2	0.00	0.00	0.00	6.76
350	29.06	27.60	4.02	3.91	3-M2	0.00	0.00	0.00	7.26
350	29.06	27.80	4.02	3.91	3-M2	0.00	0.00	0.00	6.76
400	29.58	27.98	4.54	4.54	4-FF	0.00	0.00	0.00	7.41
400	29.76	28.16	4.54	4.72	4-FF	0.00	0.00	0.00	7.41

El. inlet face invert 25.04 ft El. outlet invert 24.92 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	25.04
OUTLET STATION (FT)	90.00
OUTLET ELEVATION (FT)	24.92
NUMBER OF BARRELS	2.00
SLOPE (V-FT/H-FT)	0.0013
CULVERT LENGTH ALONG SLOPE (FT)	90.00

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	9.00 FT
BARREL RISE	3.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-16-1996 FILE DATE: 12-26-1995
CURRENT TIME: 11:20:54 FILE NAME: VAND2

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	8.00
SIDE SLOPE H/V (X:1)	1.5
CHANNEL SLOPE V/H (FT/FT)	0.005
MANNING'S N (.01-0.1)	0.015
CHANNEL INVERT ELEVATION (FT)	24.92
CULVERT NO.1 OUTLET INVERT ELEVATION	24.92 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	24.92	0.000	0.00	0.00
50.00	25.82	1.114	5.98	0.30
100.00	26.26	1.140	7.48	0.45
150.00	26.60	1.153	8.48	0.57
200.00	26.89	1.160	9.25	0.67
250.00	27.15	1.164	9.87	0.75
300.00	27.39	1.168	10.40	0.83
350.00	27.60	1.170	10.87	0.90
400.00	27.80	1.172	11.28	0.97
450.00	27.98	1.174	11.66	1.03
500.00	28.16	1.175	12.00	1.09

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	90.00
CREST LENGTH (FT)	100.00
OVERTOPPING CREST ELEVATION (FT)	29.54

VANDENBERG SECTION 2
Worksheet for Irregular Channel

P

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.006700	ft/ft
Discharge	1,020.00	cfs

Elevation range: 5.50 ft to 8.00 ft.

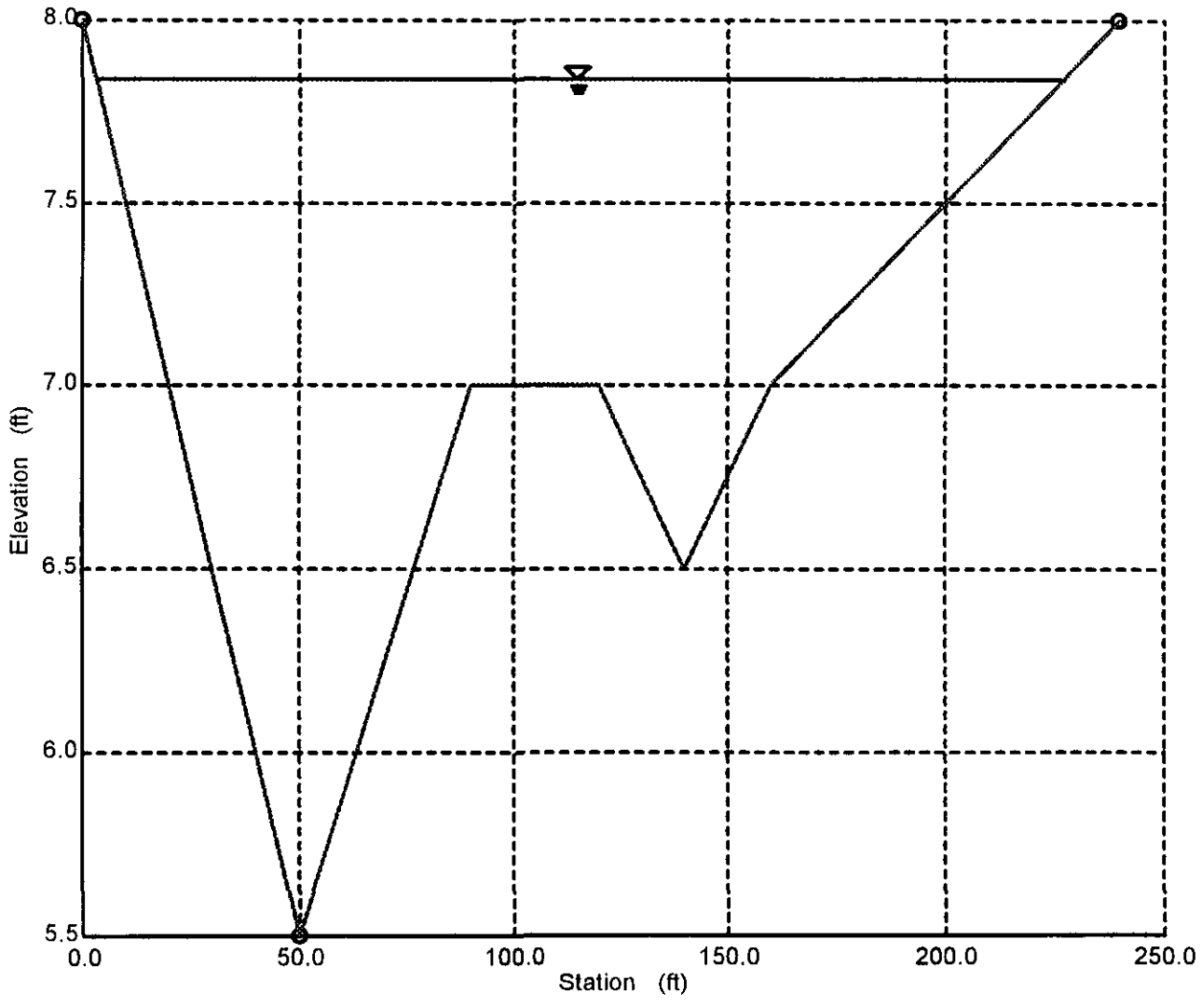
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	8.00	0.00	50.00	0.018
50.00	5.50	50.00	240.00	0.030
90.00	7.00			
120.00	7.00			
140.00	6.50			
160.00	7.00			
240.00	8.00			

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	7.84	ft
Flow Area	215.33	ft²
Wetted Perimeter	224.08	ft
Top Width	223.98	ft
Height	2.34	ft
Critical Depth	7.72	ft
Critical Slope	0.009319	ft/ft
Velocity	4.74	ft/s
Velocity Head	0.35	ft
Specific Energy	8.19	ft
Froude Number	0.85	
Flow is subcritical.		

VANDENBERG SECTION 2
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.006700	ft/ft
Water Surface Elevation	7.84	ft
Discharge	1,020.00	cfs



VANDENBERG SECTION 3
Worksheet for Irregular Channel

Q

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SECTION 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.008000	ft/ft
Elevation range: 1.00 ft to 4.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	4.00	0.00	60.00	0.018
60.00	2.00	60.00	230.00	0.030
75.00	1.00			
90.00	2.00			
230.00	4.00			

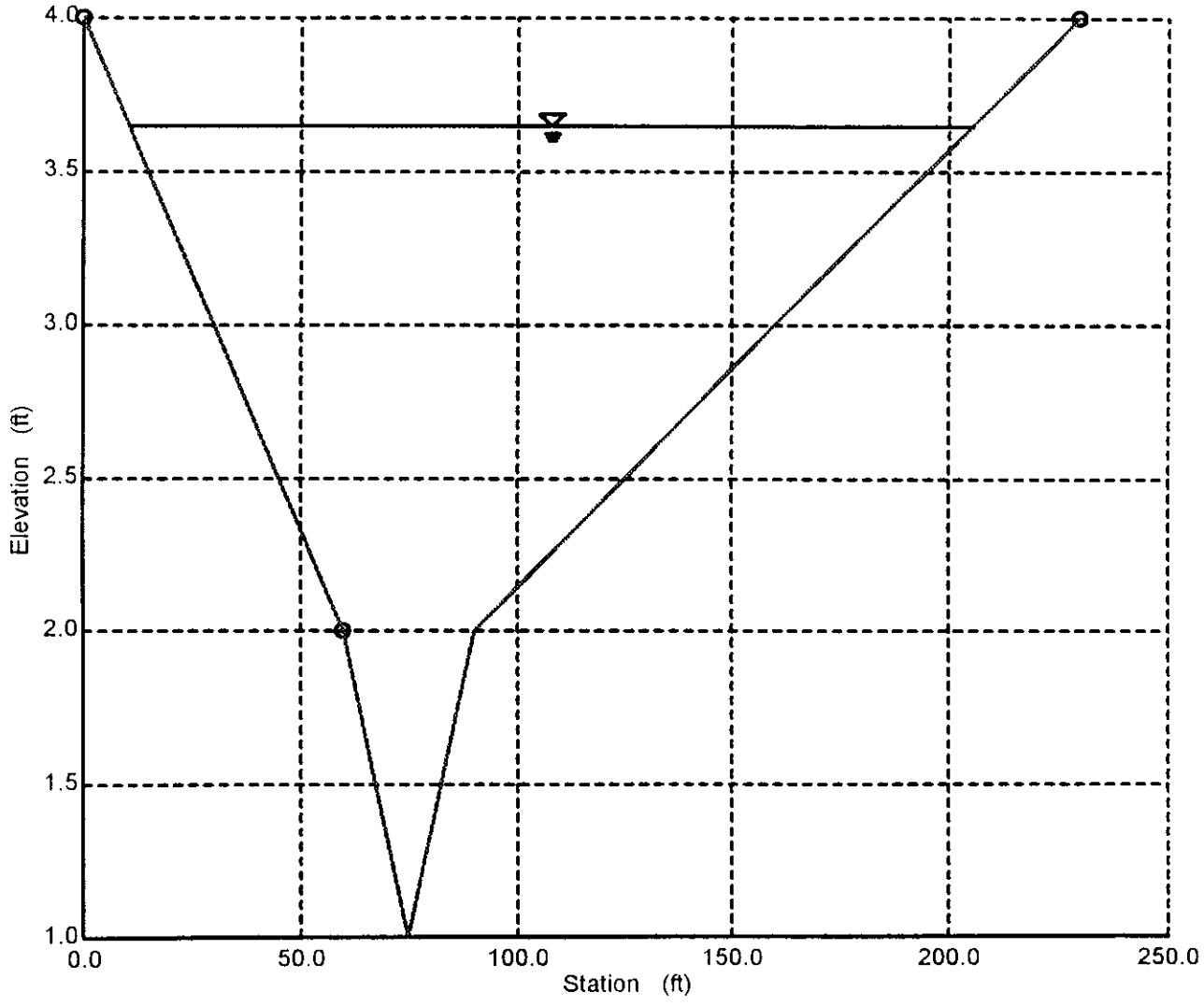
Discharge	1,020.00	cfs

Results		
Wtd. Mannings Coefficient	0.027	
Water Surface Elevation	3.65	ft
Flow Area	200.86	ft²
Wetted Perimeter	195.23	ft
Top Width	195.12	ft
Height	2.65	ft
Critical Depth	3.55	ft
Critical Slope	0.010502	ft/ft
Velocity	5.08	ft/s
Velocity Head	0.40	ft
Specific Energy	4.05	ft
Froude Number	0.88	
Flow is subcritical.		

VANDENBERG SECTION 3
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SECTION 3
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.027	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	3.65	ft
Discharge	1,020.00	cfs



VANDENBERG SECTION 4
Worksheet for Irregular Channel

R

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.008000	ft/ft
Elevation range: 97.50 ft to 102.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	102.00	0.00	60.00	0.018
40.00	100.00	60.00	350.00	0.030
60.00	98.00			
100.00	97.50			
150.00	98.00			
210.00	98.00			
230.00	97.50			
250.00	98.00			
350.00	100.00			

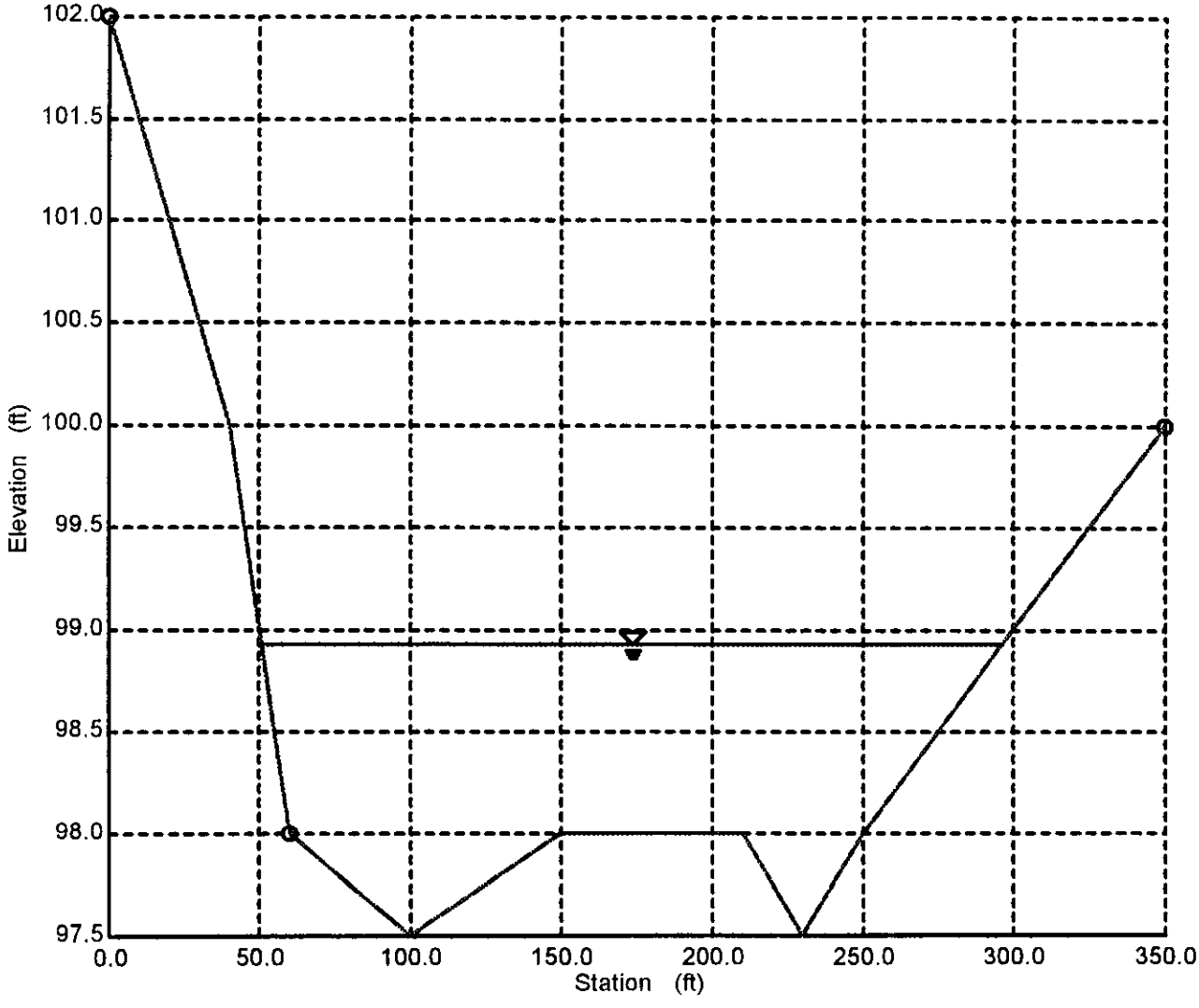
Discharge	1,020.00	cfs

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	98.93	ft
Flow Area	234.37	ft²
Wetted Perimeter	245.68	ft
Top Width	245.61	ft
Height	1.43	ft
Critical Depth	98.77	ft
Critical Slope	0.013615	ft/ft
Velocity	4.35	ft/s
Velocity Head	0.29	ft
Specific Energy	99.22	ft
Froude Number	0.79	
Flow is subcritical.		

VANDENBERG SECTION 4
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range1.fm2
Worksheet	VANDENBERG SEC 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.008000	ft/ft
Water Surface Elevation	98.93	ft
Discharge	1,020.00	cfs



RANGE WASH - CRAIG TO LAMB - SEC 1
Worksheet for Irregular Channel

(S)

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - CRAIG TO LAMB SEC 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.005000	ft/ft
Discharge	1,550.00	cfs

Elevation range: 78.00 ft to 90.00 ft.

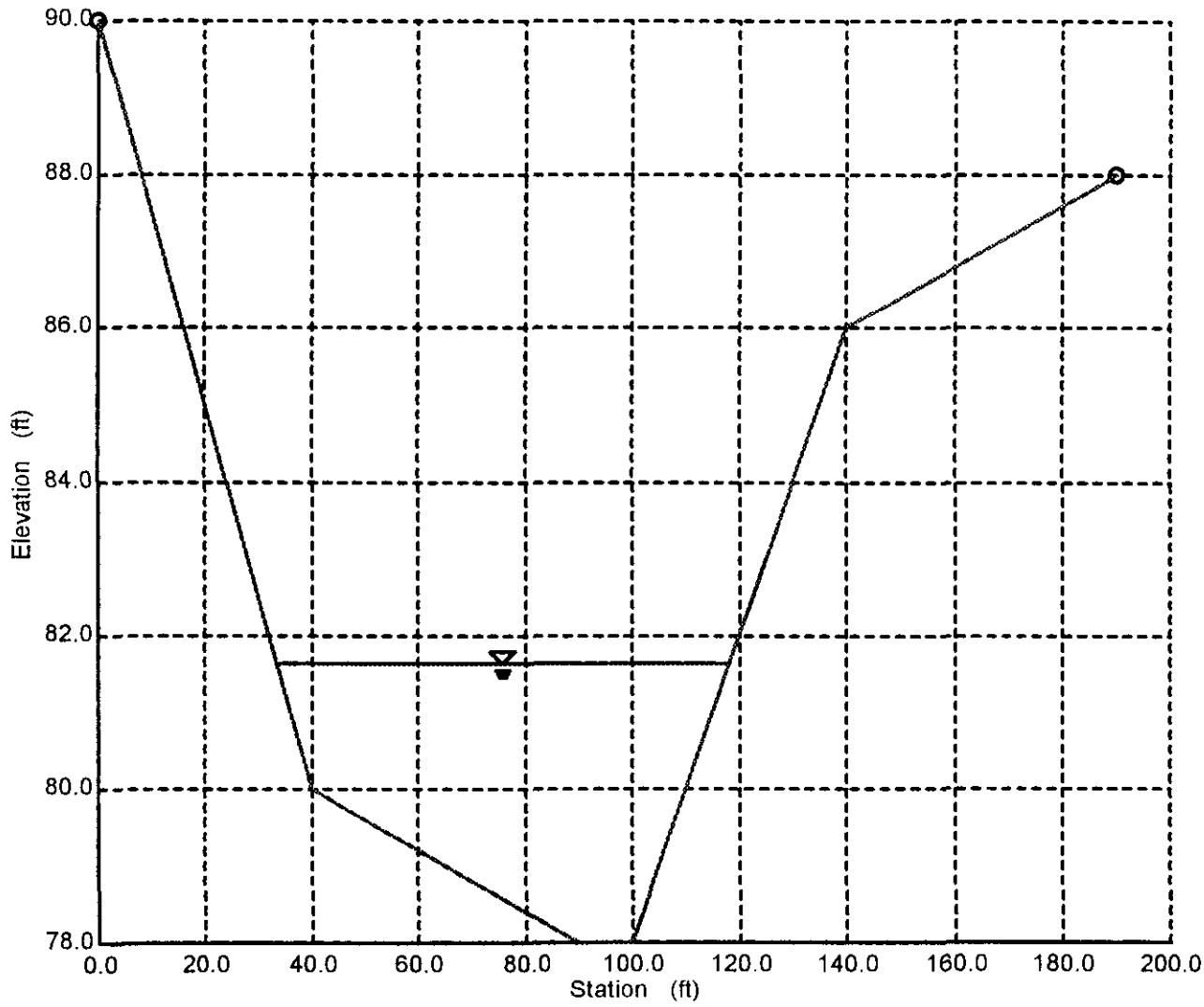
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	90.00	0.00	190.00	0.025
40.00	80.00			
90.00	78.00			
100.00	78.00			
110.00	80.00			
140.00	86.00			
190.00	88.00			

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	81.62	ft
Flow Area	205.21	ft²
Wetted Perimeter	85.18	ft
Top Width	84.58	ft
Height	3.62	ft
Critical Depth	81.35	ft
Critical Slope	0.007035	ft/ft
Velocity	7.55	ft/s
Velocity Head	0.89	ft
Specific Energy	82.51	ft
Froude Number	0.85	
Flow is subcritical.		

RANGE WASH - CRAIG TO LAMB - SEC 1
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - CRAIG TO LAMB SEC 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.005000	ft/ft
Water Surface Elevation	81.62	ft
Discharge	1,550.00	cfs



RANGE WASH - CRAIG TO LAMB - SEC 2
Worksheet for Irregular Channel

T

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - CRAIG TO LAMB - SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.006700	ft/ft

Elevation range: 74.00 ft to 82.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	82.00	0.00	300.00	0.025
150.00	80.00			
180.00	76.00			
200.00	74.00			
210.00	74.00			
220.00	76.00			
230.00	78.00			
231.00	80.00			
300.00	81.00			

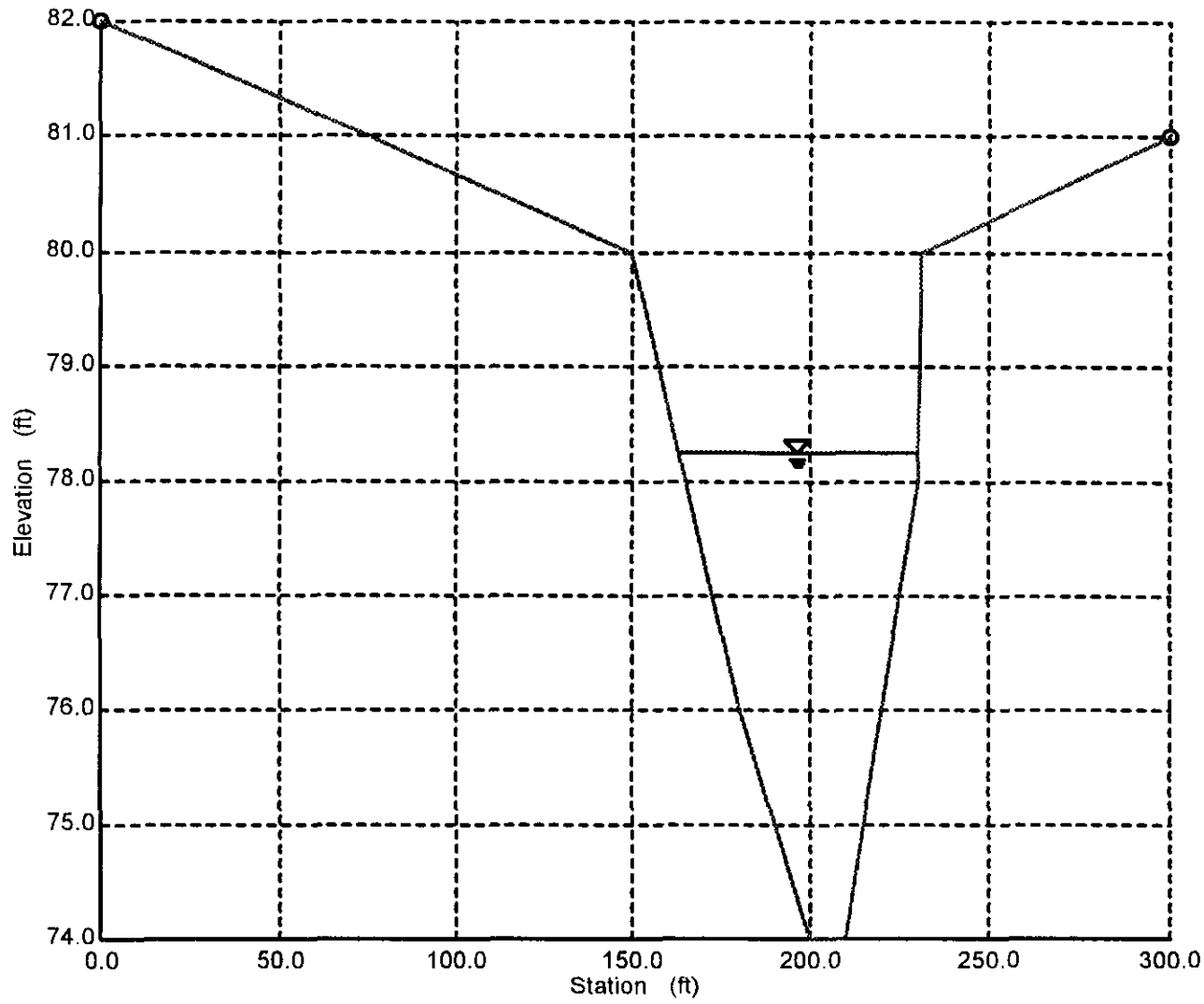
Discharge	1,550.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	78.25	ft
Flow Area	171.58	ft²
Wetted Perimeter	67.81	ft
Top Width	67.01	ft
Height	4.25	ft
Critical Depth	78.24	ft
Critical Slope	0.006768	ft/ft
Velocity	9.03	ft/s
Velocity Head	1.27	ft
Specific Energy	79.52	ft
Froude Number	1.00	
Flow is subcritical.		

RANGE WASH - CRAIG TO LAMB - SEC 2
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - CRAIG TO LAMB - SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.006700	ft/ft
Water Surface Elevation	78.25	ft
Discharge	1,550.00	cfs



3 - 9 x 6 CULVERTS AT LAMB

CURRENT DATE: 01-15-1996
CURRENT TIME: 13:22:07

FILE DATE: 01-12-1996
FILE NAME: LAMB

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	70.00	69.00	100.01	3 RCB	9.00	6.00	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: LAMB DATE: 01-12-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
70.00	0	0	0	0	0	0	0	0	1
72.53	155	155	0	0	0	0	0	0	1
72.90	310	310	0	0	0	0	0	0	1
73.55	465	465	0	0	0	0	0	0	1
74.28	620	620	0	0	0	0	0	0	1
74.96	775	775	0	0	0	0	0	0	1
75.60	930	930	0	0	0	0	0	0	1
76.25	1085	1085	0	0	0	0	0	0	1
76.90	1240	1240	0	0	0	0	0	0	1
77.59	1395	1395	0	0	0	0	0	0	1
78.18	1550	1520	0	0	0	0	0	30	4
78.00	1482	1482	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: LAMB DATE: 01-12-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
70.00	0.00	0	0	0.00
72.53	0.00	155	0	0.00
72.90	0.00	310	0	0.00
73.55	0.00	465	0	0.00
74.28	0.00	620	0	0.00
74.96	0.00	775	0	0.00
75.60	0.00	930	0	0.00
76.25	0.00	1085	0	0.00
76.90	0.00	1240	0	0.00
77.59	0.00	1395	0	0.00
78.18	-0.00	1550	0	0.01

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-15-1996
CURRENT TIME: 13:22:07

FILE DATE: 01-12-1996
FILE NAME: LAMB

CULVERT # 1

PERFORMANCE CURVE FOR 3 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	70.00	69.00	0.00	-1.00	0-NF	0.00	70.00	0.00	0.00
155	72.53	69.90	1.72	2.53	6-FF	0.00	0.00	0.00	5.68
310	72.90	70.34	2.73	2.90	6-FF	0.00	0.00	0.00	7.16
465	73.55	70.69	3.55	3.28	6-FF	0.00	0.00	0.00	10.59
620	74.28	70.99	4.28	3.68	6-FF	0.00	0.00	0.00	11.48
775	74.96	71.25	4.96	4.12	6-FF	0.00	0.00	0.00	12.26
930	75.60	71.49	5.60	4.59	6-FF	0.00	0.00	0.00	12.89
1085	76.25	71.71	6.25	5.10	6-FF	0.00	0.00	0.00	13.45
1240	76.90	71.92	6.90	5.66	6-FF	0.00	0.00	0.00	13.93
1395	77.59	72.11	7.59	6.26	6-FF	0.00	0.00	0.00	14.38
1520	78.18	72.29	8.18	6.77	6-FF	0.00	0.00	0.00	14.72

El. inlet face invert 70.00 ft El. outlet invert 69.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	70.00
OUTLET STATION (FT)	100.00
OUTLET ELEVATION (FT)	69.00
NUMBER OF BARRELS	3.00
SLOPE (V-FT/H-FT)	0.0100
CULVERT LENGTH ALONG SLOPE (FT)	100.01

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	9.00 FT
BARREL RISE	6.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 01-15-1996
CURRENT TIME: 13:22:07

FILE DATE: 01-12-1996
FILE NAME: LAMB

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	30.00
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (FT/FT)	0.010
MANNING'S N (.01-0.1)	0.025
CHANNEL INVERT ELEVATION (FT)	69.00
CULVERT NO.1 OUTLET INVERT ELEVATION	69.00 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	69.00	0.000	0.00	0.00
155.00	69.90	0.957	5.14	0.56
310.00	70.34	0.995	6.54	0.84
465.00	70.69	1.015	7.49	1.05
620.00	70.99	1.028	8.22	1.24
775.00	71.25	1.036	8.82	1.40
930.00	71.49	1.043	9.34	1.55
1085.00	71.71	1.048	9.80	1.69
1240.00	71.92	1.053	10.20	1.82
1395.00	72.11	1.057	10.57	1.94
1550.00	72.29	1.060	10.91	2.05

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	500.00
CREST LENGTH (FT)	150.00
OVERTOPPING CREST ELEVATION (FT)	78.00

RANGE WASH CHANNEL - LAMB TO ALEXANDER
Worksheet for Trapezoidal Channel

U

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - LAMB TO ALEXANDER
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.007800	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	32.00	ft
Discharge	1,550.00	cfs

Results		
Depth	2.71	ft
Flow Area	101.62	ft²
Wetted Perimeter	44.14	ft
Top Width	42.86	ft
Critical Depth	3.84	ft
Critical Slope	0.002335	ft/ft
Velocity	15.25	ft/s
Velocity Head	3.62	ft
Specific Energy	6.33	ft
Froude Number	1.75	
Flow is supercritical.		

4 - 12 x 7 CULVERTS AT ALEXANDER ROAD

CURRENT DATE: 01-15-1996
CURRENT TIME: 14:24:06

FILE DATE: 01-15-1996
FILE NAME: ALEX

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	60.00	58.80	50.01	4 RCB	12.00	7.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: ALEX DATE: 01-15-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
60.00	0	0	0	0	0	0	0	0	1
62.65	155	155	0	0	0	0	0	0	1
62.86	310	310	0	0	0	0	0	0	1
63.05	465	465	0	0	0	0	0	0	1
63.23	620	620	0	0	0	0	0	0	1
63.41	775	775	0	0	0	0	0	0	1
63.59	930	930	0	0	0	0	0	0	1
63.89	1085	1085	0	0	0	0	0	0	1
64.23	1240	1240	0	0	0	0	0	0	1
64.57	1395	1395	0	0	0	0	0	0	1
64.89	1550	1550	0	0	0	0	0	0	1
67.00	2599	2599	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: ALEX DATE: 01-15-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
60.00	0.00	0	0	0.00
62.65	0.00	155	0	0.00
62.86	0.00	310	0	0.00
63.05	0.00	465	0	0.00
63.23	0.00	620	0	0.00
63.41	0.00	775	0	0.00
63.59	0.00	930	0	0.00
63.89	0.00	1085	0	0.00
64.23	0.00	1240	0	0.00
64.57	0.00	1395	0	0.00
64.89	0.00	1550	0	0.00

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-15-1996
CURRENT TIME: 14:24:06

FILE DATE: 01-15-1996
FILE NAME: ALEX

CULVERT # 1

PERFORMANCE CURVE FOR 4 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	60.00	58.80	0.00	-1.20	0-NF	0.00	60.00	0.00	0.00
155	62.65	59.65	1.07	2.65	6-FF	0.00	0.00	0.00	3.80
310	62.86	60.09	1.70	2.86	6-FF	0.00	0.00	0.00	5.03
465	63.05	60.44	2.22	3.05	6-FF	0.00	0.00	0.00	5.92
620	63.23	60.74	2.70	3.23	6-FF	0.00	0.00	0.00	6.66
775	63.41	61.01	3.13	3.41	6-FF	0.00	0.00	0.00	7.30
930	63.59	61.26	3.53	3.59	6-FF	0.00	0.00	0.00	7.86
1085	63.89	61.50	3.89	3.77	6-FF	0.00	0.00	0.00	13.79
1240	64.23	61.72	4.23	3.95	6-FF	0.00	0.00	0.00	14.21
1395	64.57	61.93	4.57	4.13	6-FF	0.00	0.00	0.00	14.62
1550	64.89	62.13	4.89	4.32	6-FF	0.00	0.00	0.00	14.97

El. inlet face invert 60.00 ft El. outlet invert 58.80 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	60.00
OUTLET STATION (FT)	50.00
OUTLET ELEVATION (FT)	58.80
NUMBER OF BARRELS	4.00
SLOPE (V-FT/H-FT)	0.0240
CULVERT LENGTH ALONG SLOPE (FT)	50.01

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	12.00 FT
BARREL RISE	7.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 01-15-1996 FILE DATE: 01-15-1996
CURRENT TIME: 14:24:06 FILE NAME: ALEX

TAILWATER

******* REGULAR CHANNEL CROSS SECTION ****************

BOTTOM WIDTH (FT)	48.00
SIDE SLOPE H/V (X:1)	2.0
CHANNEL SLOPE V/H (FT/FT)	0.005
MANNING'S N (.01-0.1)	0.025
CHANNEL INVERT ELEVATION (FT)	58.80
CULVERT NO.1 OUTLET INVERT ELEVATION	58.80 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	58.80	0.000	0.00	0.00
155.00	59.65	0.701	3.67	0.27
310.00	60.09	0.742	4.77	0.40
465.00	60.44	0.764	5.55	0.51
620.00	60.74	0.780	6.16	0.61
775.00	61.01	0.792	6.68	0.69
930.00	61.26	0.801	7.13	0.77
1085.00	61.50	0.808	7.53	0.84
1240.00	61.72	0.814	7.89	0.91
1395.00	61.93	0.820	8.22	0.98
1550.00	62.13	0.824	8.53	1.04

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH (FT)	50.00
CREST LENGTH (FT)	50.00
OVERTOPPING CREST ELEVATION (FT)	67.00

RANGE WASH - ALEX. TO LV BLVD - SEC 1
Worksheet for Irregular Channel

V

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - ALEX. TO LV BLVD - SEC 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.006000	ft/ft
Discharge	1,550.00	cfs

Elevation range: 56.00 ft to 62.00 ft.

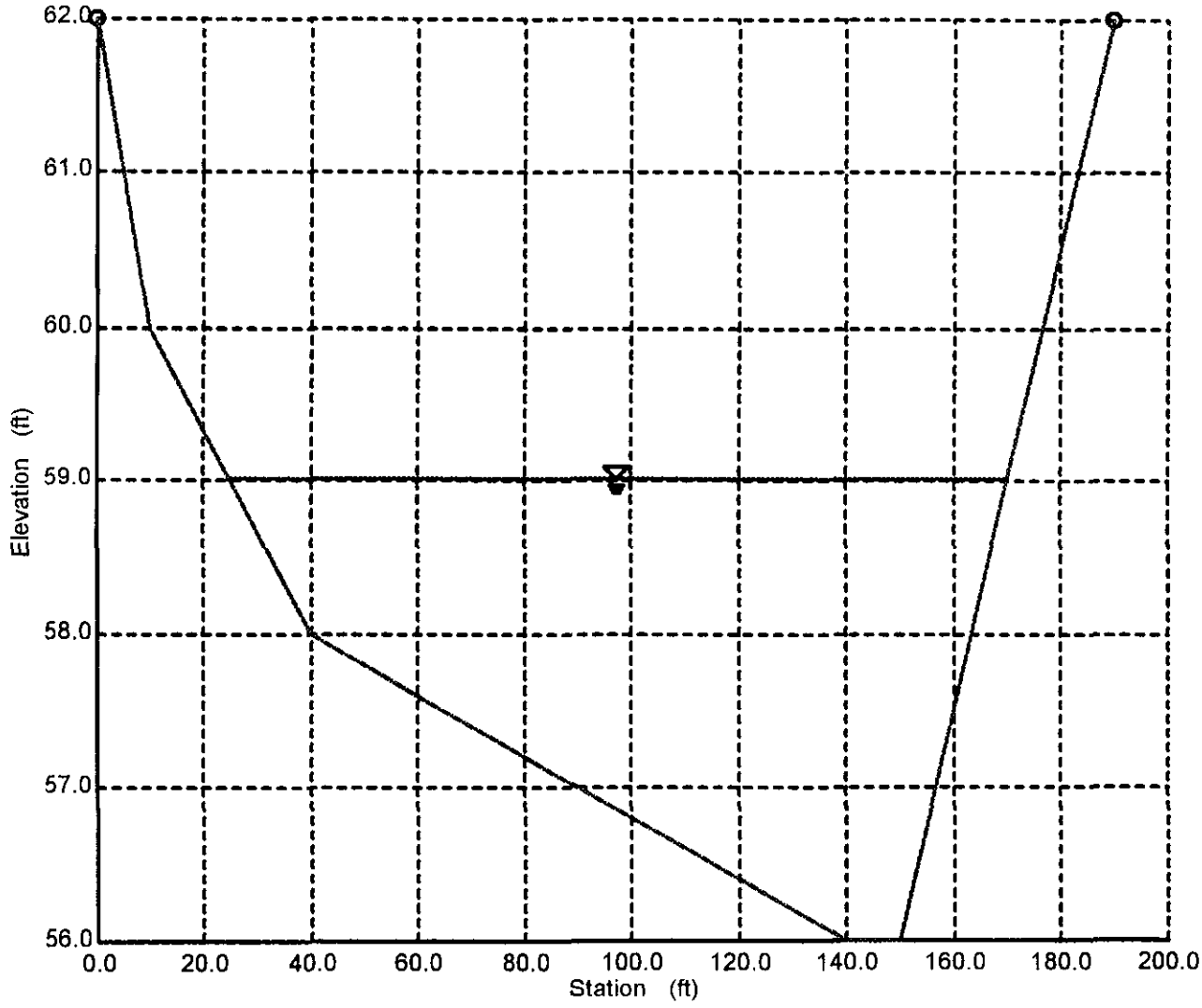
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	62.00	0.00	190.00	0.030
10.00	60.00			
40.00	58.00			
140.00	56.00			
150.00	56.00			
190.00	62.00			

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	59.01	ft
Flow Area	268.46	ft²
Wetted Perimeter	145.42	ft
Top Width	145.14	ft
Height	3.01	ft
Critical Depth	58.64	ft
Critical Slope	0.011281	ft/ft
Velocity	5.77	ft/s
Velocity Head	0.52	ft
Specific Energy	59.52	ft
Froude Number	0.75	
Flow is subcritical.		

RANGE WASH - ALEX. TO LV BLVD - SEC 1
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	RANGE WASH - ALEX. TO LV BLVD - SEC 1
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.006000	ft/ft
Water Surface Elevation	59.01	ft
Discharge	1,550.00	cfs



RANGE WASH - ALEX TO LV BLVD - SEC 2
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	ALEX TO LV BLVD SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.005000	ft/ft
Discharge	1,550.00	cfs

Elevation range: 53.00 ft to 60.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.00	0.00	270.00	0.030
40.00	58.00			
50.00	56.00			
100.00	54.00			
140.00	53.00			
150.00	53.00			
180.00	54.00			
240.00	56.00			
270.00	60.00			

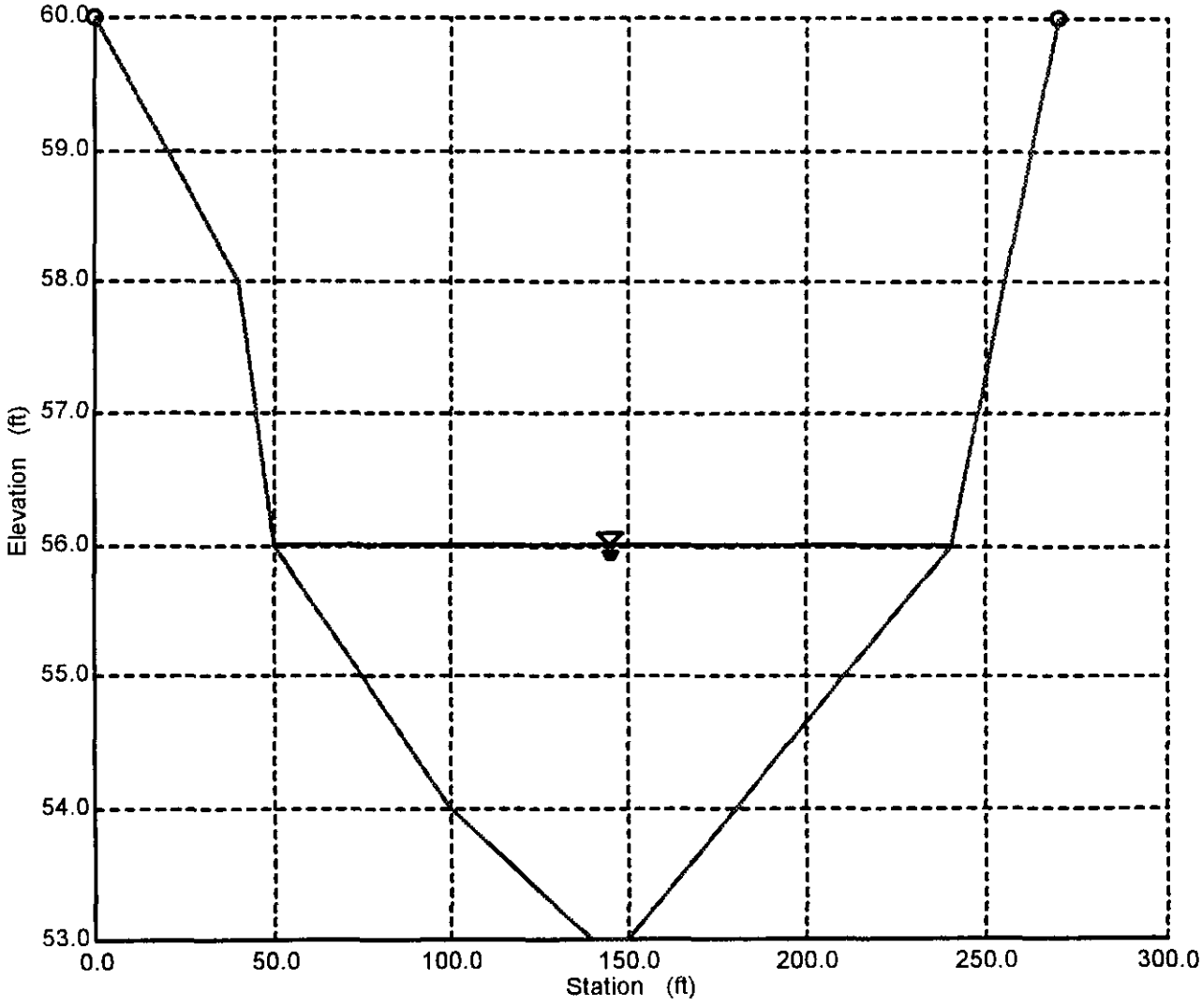
Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	56.00	ft
Flow Area	315.66	ft²
Wetted Perimeter	190.15	ft
Top Width	190.04	ft
Height	3.00	ft
Critical Depth	55.52	ft
Critical Slope	0.011711	ft/ft
Velocity	4.91	ft/s
Velocity Head	0.37	ft
Specific Energy	56.38	ft
Froude Number	0.67	

Flow is subcritical.

RANGE WASH - ALEX TO LV BLVD - SEC 2
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	ALEX TO LV BLVD SEC 2
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.005000	ft/ft
Water Surface Elevation	56.00	ft
Discharge	1,550.00	cfs



7 - 12 x 6 CULVERTS AT LAS VEGAS BLVD.

CURRENT DATE: 01-15-1996
CURRENT TIME: 15:01:56

FILE DATE: 01-15-1996
FILE NAME: LASV

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS / SHAPE / MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	51.00	50.00	100.01	7 RCB	12.00	6.00	.015	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: LASV DATE: 01-15-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
51.00	0	0	0	0	0	0	0	0	1
53.24	155	155	0	0	0	0	0	0	1
53.38	310	310	0	0	0	0	0	0	1
53.51	465	465	0	0	0	0	0	0	1
53.63	620	620	0	0	0	0	0	0	1
53.75	775	775	0	0	0	0	0	0	1
53.86	930	930	0	0	0	0	0	0	1
53.97	1085	1085	0	0	0	0	0	0	1
54.08	1240	1240	0	0	0	0	0	0	1
54.21	1395	1395	0	0	0	0	0	0	1
54.43	1550	1550	0	0	0	0	0	0	1
61.00	6468	6468	0	0	0	0	0	0	OVERTOPPING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: LASV DATE: 01-15-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
51.00	0.00	0	0	0.00
53.24	0.00	155	0	0.00
53.38	0.00	310	0	0.00
53.51	0.00	465	0	0.00
53.63	0.00	620	0	0.00
53.75	0.00	775	0	0.00
53.86	0.00	930	0	0.00
53.97	0.00	1085	0	0.00
54.08	0.00	1240	0	0.00
54.21	0.00	1395	0	0.00
54.43	0.00	1550	0	0.00

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 01-15-1996
CURRENT TIME: 15:01:56

FILE DATE: 01-15-1996
FILE NAME: LASV

CULVERT # 1

PERFORMANCE CURVE FOR 7 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	51.00	49.00	0.00	-1.00	0-NF	0.00	51.00	0.00	0.00
155	53.24	49.85	0.77	2.24	6-FF	0.00	0.00	0.00	3.89
310	53.38	50.28	1.19	2.38	6-FF	0.00	0.00	0.00	4.91
465	53.51	50.62	1.56	2.51	6-FF	0.00	0.00	0.00	5.62
620	53.63	50.92	1.88	2.63	6-FF	0.00	0.00	0.00	6.18
775	53.75	51.18	2.19	2.75	6-FF	0.00	0.00	0.00	6.66
930	53.86	51.42	2.47	2.86	6-FF	0.00	0.00	0.00	7.08
1085	53.97	51.64	2.74	2.97	6-FF	0.00	0.00	0.00	7.45
1240	54.08	51.85	2.99	3.08	6-FF	0.00	0.00	0.00	7.79
1395	54.21	52.04	3.21	3.20	6-FF	0.00	0.00	0.00	10.72
1550	54.43	52.23	3.43	3.31	6-FF	0.00	0.00	0.00	10.98

El. inlet face invert 51.00 ft El. outlet invert 50.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	51.00
OUTLET STATION (FT)	100.00
OUTLET ELEVATION (FT)	50.00
NUMBER OF BARRELS	7.00
SLOPE (V-FT/H-FT)	0.0100
CULVERT LENGTH ALONG SLOPE (FT)	100.01

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	12.00 FT
BARREL RISE	6.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.015
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	1:1 BEVEL
INLET DEPRESSION	NONE

CURRENT DATE: 01-15-1996 FILE DATE: 01-15-1996
CURRENT TIME: 15:01:56 FILE NAME: LASV

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH (FT)	20.00
SIDE SLOPE H/V (X:1)	2.0
CHANNEL SLOPE V/H (FT/FT)	0.010
MANNING'S N (.01-0.1)	0.015
CHANNEL INVERT ELEVATION (FT)	49.00
CULVERT NO.1 OUTLET INVERT ELEVATION	50.00 FT

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
0.00	49.00	0.000	0.00	0.00
155.00	49.85	1.598	8.37	0.53
310.00	50.28	1.667	10.71	0.80
465.00	50.62	1.702	12.31	1.01
620.00	50.92	1.724	13.55	1.20
775.00	51.18	1.739	14.58	1.36
930.00	51.42	1.752	15.47	1.51
1085.00	51.64	1.762	16.25	1.65
1240.00	51.85	1.769	16.94	1.78
1395.00	52.04	1.775	17.57	1.90
1550.00	52.23	1.781	18.15	2.01

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	50.00
CREST LENGTH (FT)	1000.00
OVERTOPPING CREST ELEVATION (FT)	61.00

SLOAN CHANNEL SOUTH OF STEWART
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	*SLOAN CHANNEL SOUTH OF STEWART*
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft
Elevation range: 25.00 ft to 33.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	33.00	0.00	100.00	0.025
25.00	25.00			
35.00	25.00			
75.00	26.00			
100.00	33.00			

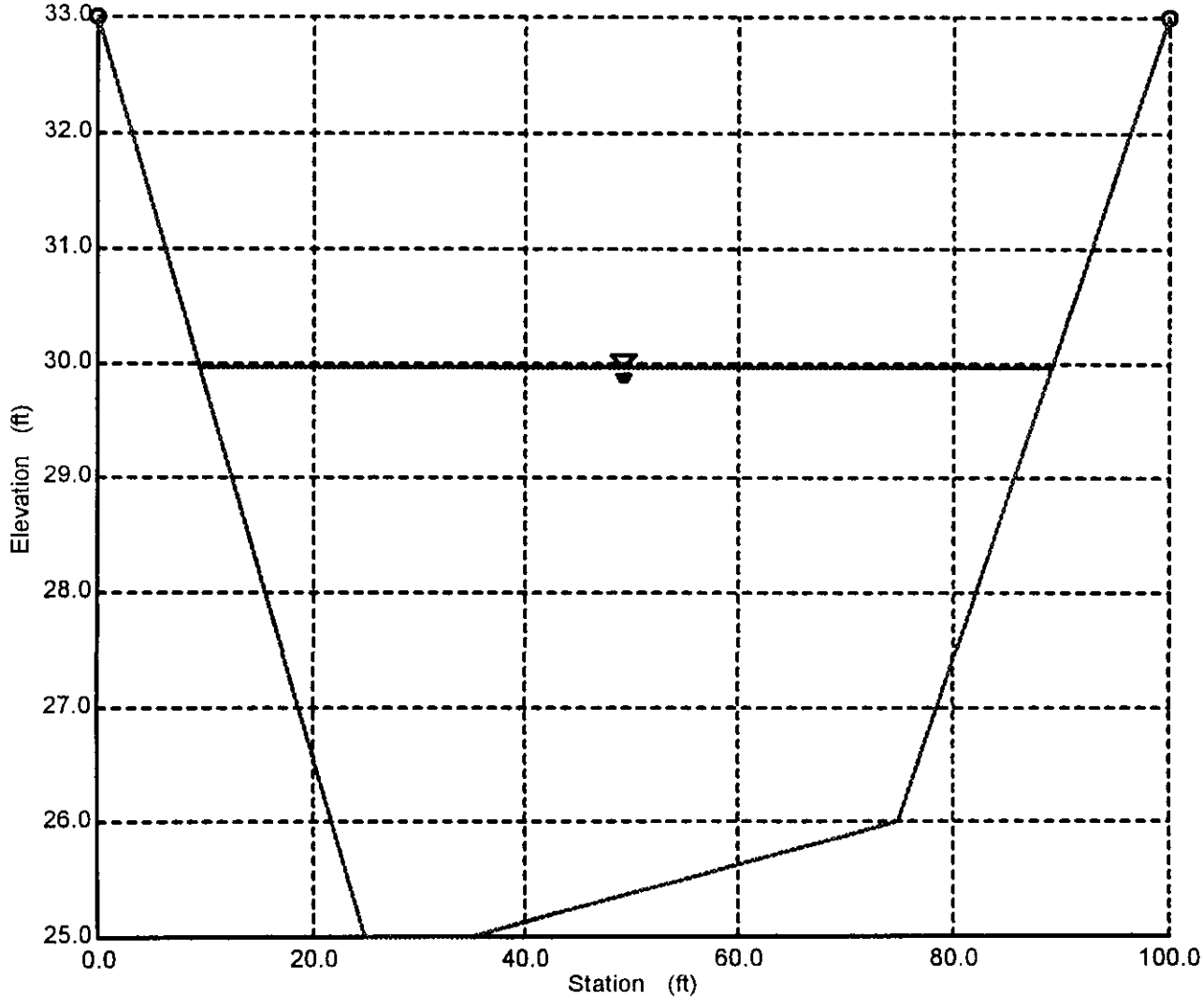
Discharge	2,620.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	29.96	ft
Flow Area	294.65	ft²
Wetted Perimeter	80.99	ft
Top Width	79.66	ft
Height	4.96	ft
Critical Depth	29.43	ft
Critical Slope	0.006226	ft/ft
Velocity	8.89	ft/s
Velocity Head	1.23	ft
Specific Energy	31.19	ft
Froude Number	0.82	
Flow is subcritical.		

SLOAN CHANNEL SOUTH OF STEWART
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	SLOAN CHANNEL SOUTH OF STEWART
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	29.96	ft
Discharge	2,620.00	cfs



SLOAN CHANNEL SOUTH OF CHARLESTON
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	SLOAN CHANNEL SOUTH OF CHARLESTON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft

Elevation range: 5.00 ft to 16.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	15.00	0.00	120.00	0.025
40.00	6.00			
70.00	5.00			
80.00	5.00			
90.00	6.00			
120.00	16.00			

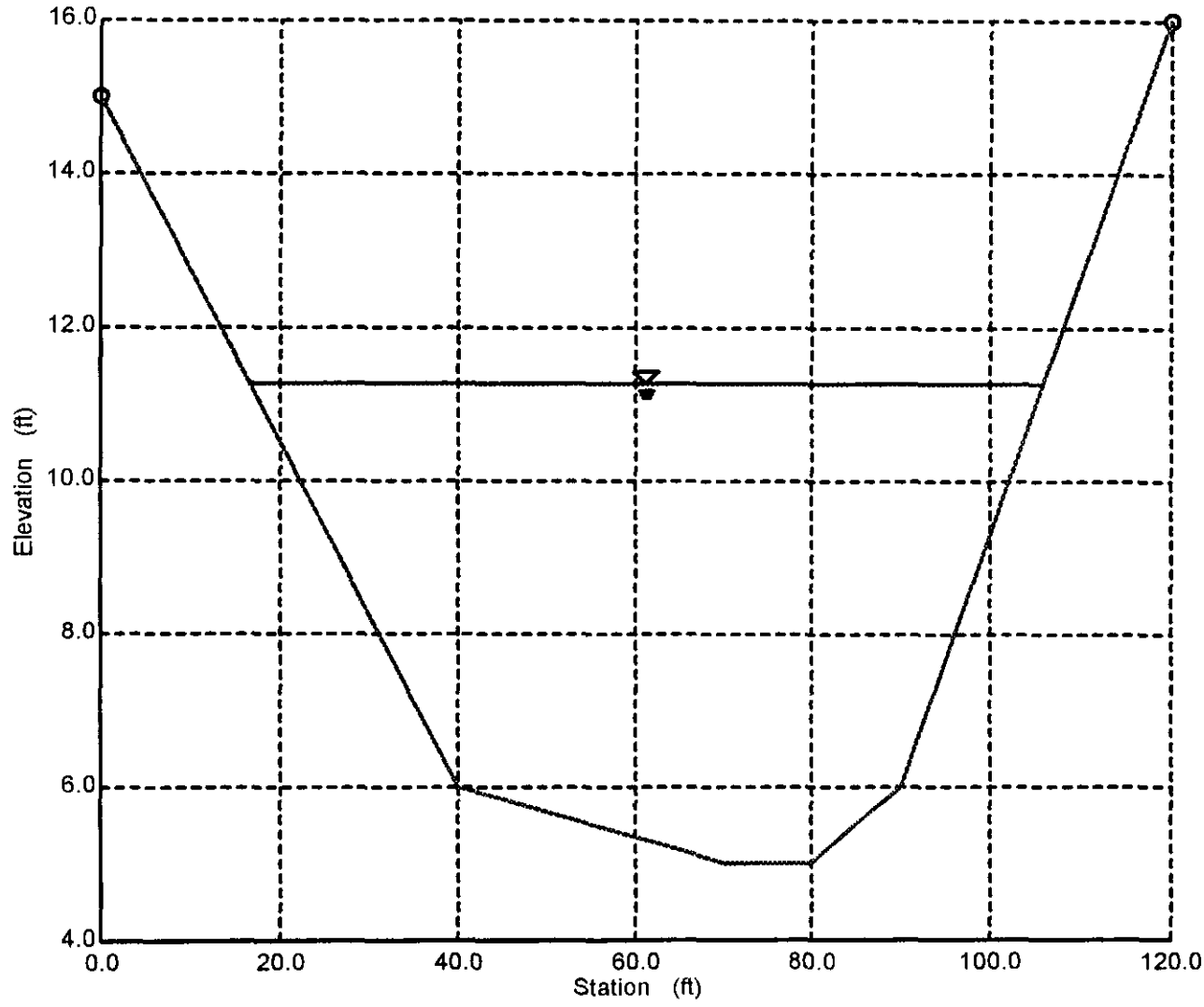
Discharge	3,990.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	11.27	ft
Flow Area	396.87	ft²
Wetted Perimeter	90.74	ft
Top Width	89.23	ft
Height	6.27	ft
Critical Depth	10.71	ft
Critical Slope	0.005816	ft/ft
Velocity	10.05	ft/s
Velocity Head	1.57	ft
Specific Energy	12.84	ft
Froude Number	0.84	
Flow is subcritical.		

SLOAN CHANNEL SOUTH OF CHARLESTON
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	SLOAN CHANNEL SOUTH OF CHARLESTON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	*Water Elevation*

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	11.27	ft
Discharge	3,990.00	cfs



BONANZA PIPE CAPACITY
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	BONANZA PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.012500	ft/ft
Depth	6.00	ft
Diameter	72.00	in

Results		
Discharge	473.47	cfs
Flow Area	28.27	ft²
Wetted Perimeter	18.85	ft
Top Width	0.15e-6	ft
Critical Depth	5.60	ft
Percent Full	100.00	
Critical Slope	0.010805	ft/ft
Velocity	16.75	ft/s
Velocity Head	4.36	ft
Specific Energy	10.36	ft
Froude Number	0.21e-3	
Maximum Discharge	509.32	cfs
Full Flow Capacity	473.47	cfs
Full Flow Slope	0.012500	ft/ft
Flow is subcritical.		

BONANZA STREET CAPACTIY
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	BONANZA STREET CAPACITY
Flow Element	Irregular Channel
Method	*Manning's Formula*
Solve For	Discharge

Input Data		
Channel Slope	0.012500	ft/ft
Water Surface Elevation	57.11	ft

Elevation range: 56.11 ft to 60.00 ft.

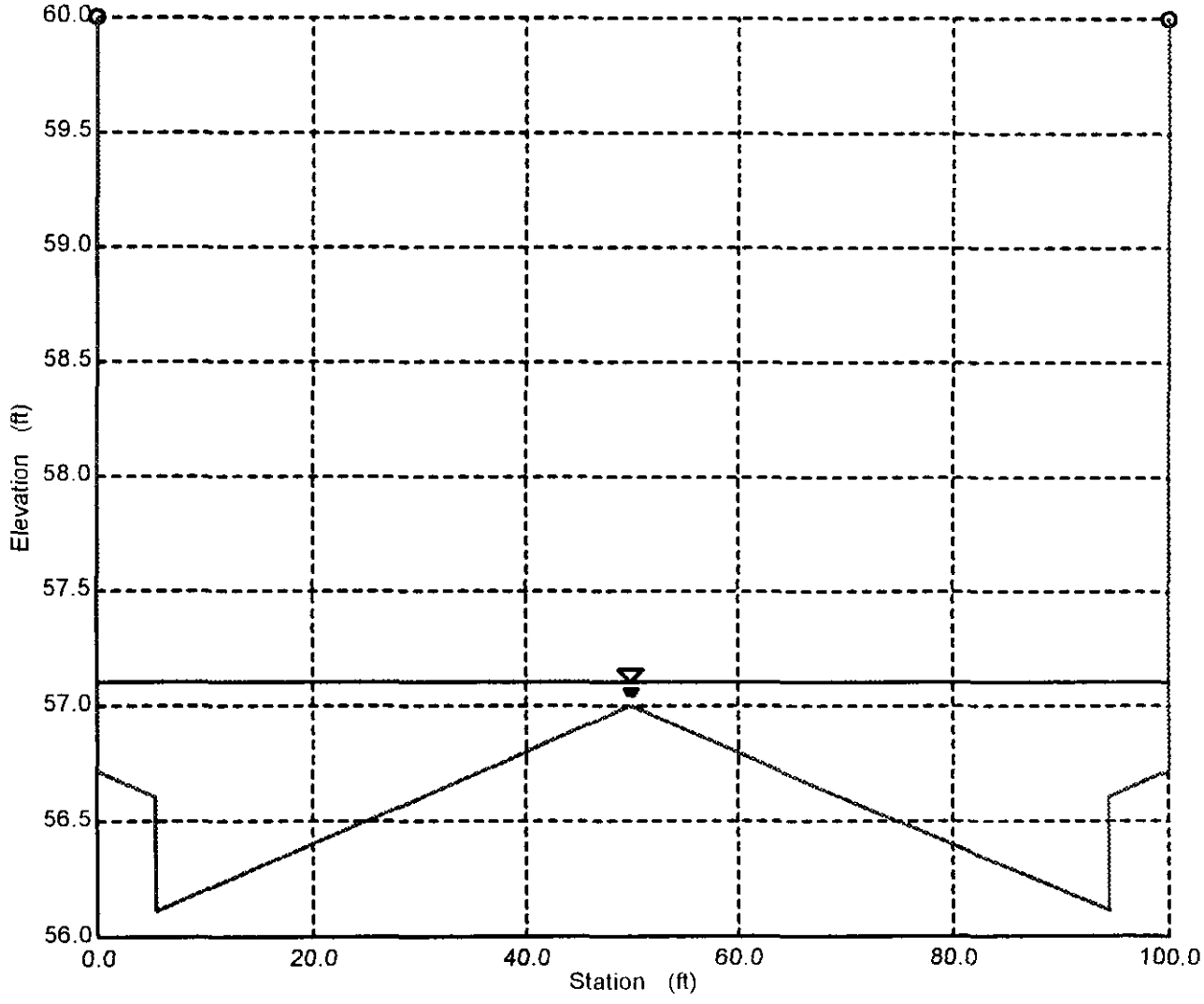
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	60.00	0.00	100.00	0.016
0.00	56.72			
5.50	56.61			
5.51	56.11			
50.00	57.00			
94.50	56.11			
94.51	56.61			
100.00	56.72			
100.00	60.00			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	370.81	cfs
Flow Area	54.30	ft²
Wetted Perimeter	101.78	ft
Top Width	100.00	ft
Height	1.00	ft
Critical Depth	57.32	ft
Critical Slope	0.004221	ft/ft
Velocity	6.83	ft/s
Velocity Head	0.72	ft
Specific Energy	57.83	ft
Froude Number	1.63	
Flow is supercritical.		

BONANZA STREET CAPACITY
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	BONANZA STREET CAPACITY
Flow Element	*Irregular Channel*
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.012500	ft/ft
Water Surface Elevation	57.11	ft
Discharge	370.81	cfs



BATTLE MOUNTAIN DRIVE - NORTH OF STEWART
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	BATTLE MOUNTAIN DRIVE - NORTH OF STEWART
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.004000	ft/ft
Elevation range: 44.50 ft to 46.00 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	46.00	0.00	70.00	0.016
5.50	45.11			
10.50	45.00			
10.50	44.50			
35.00	45.00			
59.50	44.50			
59.51	45.00			
65.00	45.11			
70.00	46.00			

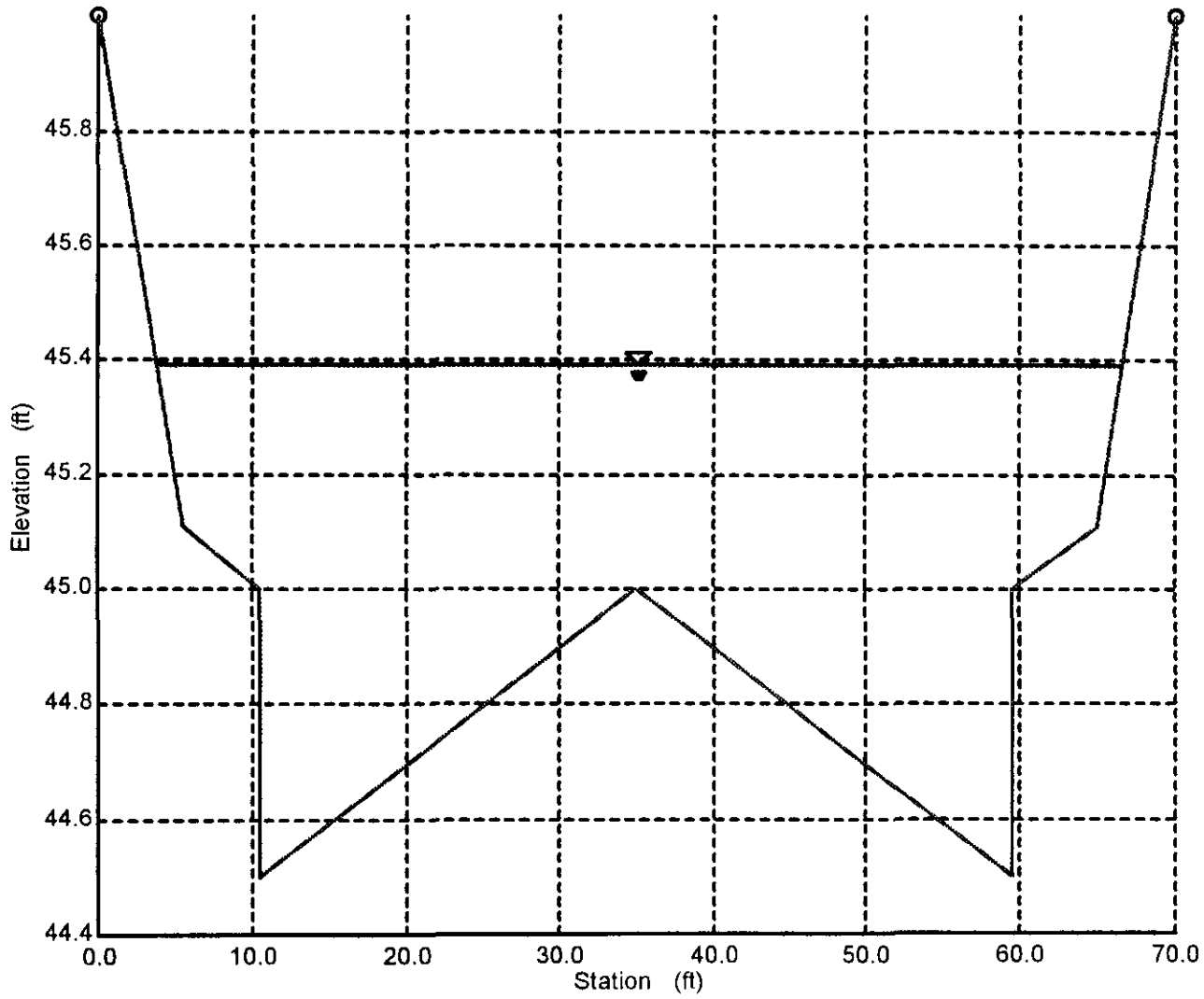
Discharge	140.00	cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	45.39	ft
Flow Area	35.35	ft²
Wetted Perimeter	63.85	ft
Top Width	62.81	ft
Height	0.89	ft
Critical Depth	45.36	ft
Critical Slope	0.004688	ft/ft
Velocity	3.96	ft/s
Velocity Head	0.24	ft
Specific Energy	45.63	ft
Froude Number	0.93	
Flow is subcritical.		

BATTLE MOUNTAIN DRIVE - NORTH OF STEWART
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range3.fm2
Worksheet	BATTLE MOUNTAIN DRIVE - NORTH OF STEWART
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	45.39	ft
Discharge	140.00	cfs



STEWART AVENUE WEST OF SLOAN CHANNEL
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	STEWART AVENUE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.001600	ft/ft
Discharge	230.00	cfs

Elevation range: 38.56 ft to 43.00 ft.

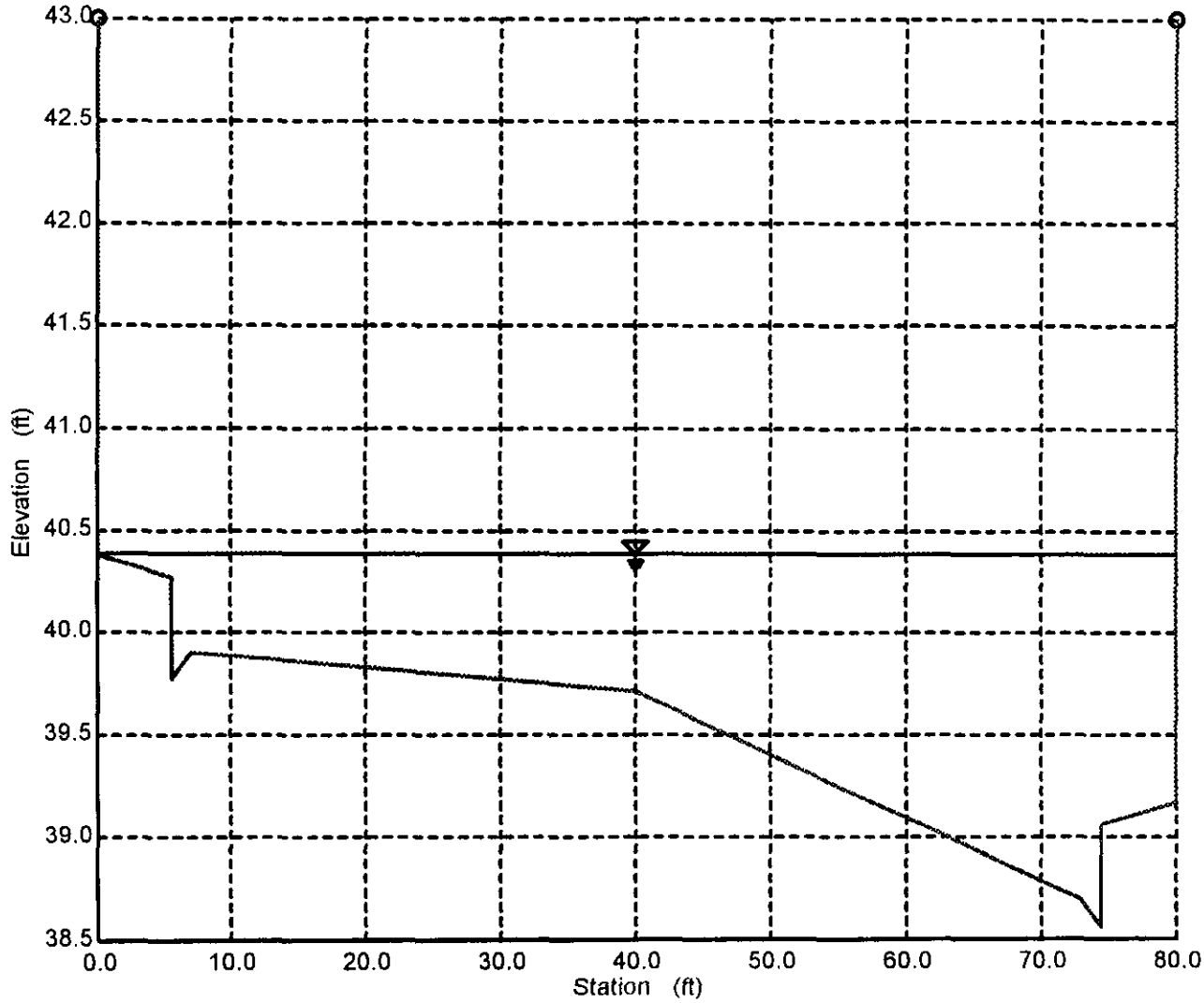
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	43.00	0.00	80.00	0.016
0.00	40.38			
5.50	40.27			
5.51	39.77			
7.00	39.90			
40.00	39.71			
73.00	38.69			
74.50	38.56			
74.51	39.06			
80.00	39.17			
80.00	43.00			

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	40.39	ft
Flow Area	69.36	ft^2
Wetted Perimeter	82.24	ft
Top Width	80.00	ft
Height	1.83	ft
Critical Depth	40.13	ft
Critical Slope	0.004411	ft/ft
Velocity	3.32	ft/s
Velocity Head	0.17	ft
Specific Energy	40.56	ft
Froude Number	0.63	
Flow is subcritical.		

STEWART AVENUE WEST OF SLOAN CHANNEL
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\range4.fm2
Worksheet	STEWART AVENUE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.001600	ft/ft
Water Surface Elevation	40.39	ft
Discharge	230.00	cfs



SECTION 3

DRAFT FIS REPORT TEXT

DRAFT

FLOOD INSURANCE STUDY RESTUDY

RANGE WASH

CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

JANUARY, 1996

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1.0 INTRODUCTION

1.1 Purpose of Study

This report presents the findings of the Range Wash Flood Insurance Study (FIS) Restudy. The purpose of this study was to update the Special Flood Hazard Areas, due to two major flood control facilities and miscellaneous development and improvements for the Range Wash in the City of North Las Vegas and Unincorporated Areas of Clark County, Nevada (**Figure 1**). The results of this flood risk study will be used to update the Flood Insurance Rate Maps (FIRM) for Clark County, Nevada and Incorporated Areas. The FIRMs are distributed by the Federal Emergency Management Agency (FEMA) to aid in the administration of the National Flood Insurance Program (NFIP). This program was established with the passage of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 to enable property owners to purchase insurance protection against losses from flooding.

1.2 Authority and Acknowledgments

Post, Buckley, Schuh & Jernigan (PBS&J) was authorized by the Clark County Regional Flood Control District (CCRFCD) to perform a study using approximate methods of the Range Wash on July 13, 1995.

1.3 Coordination

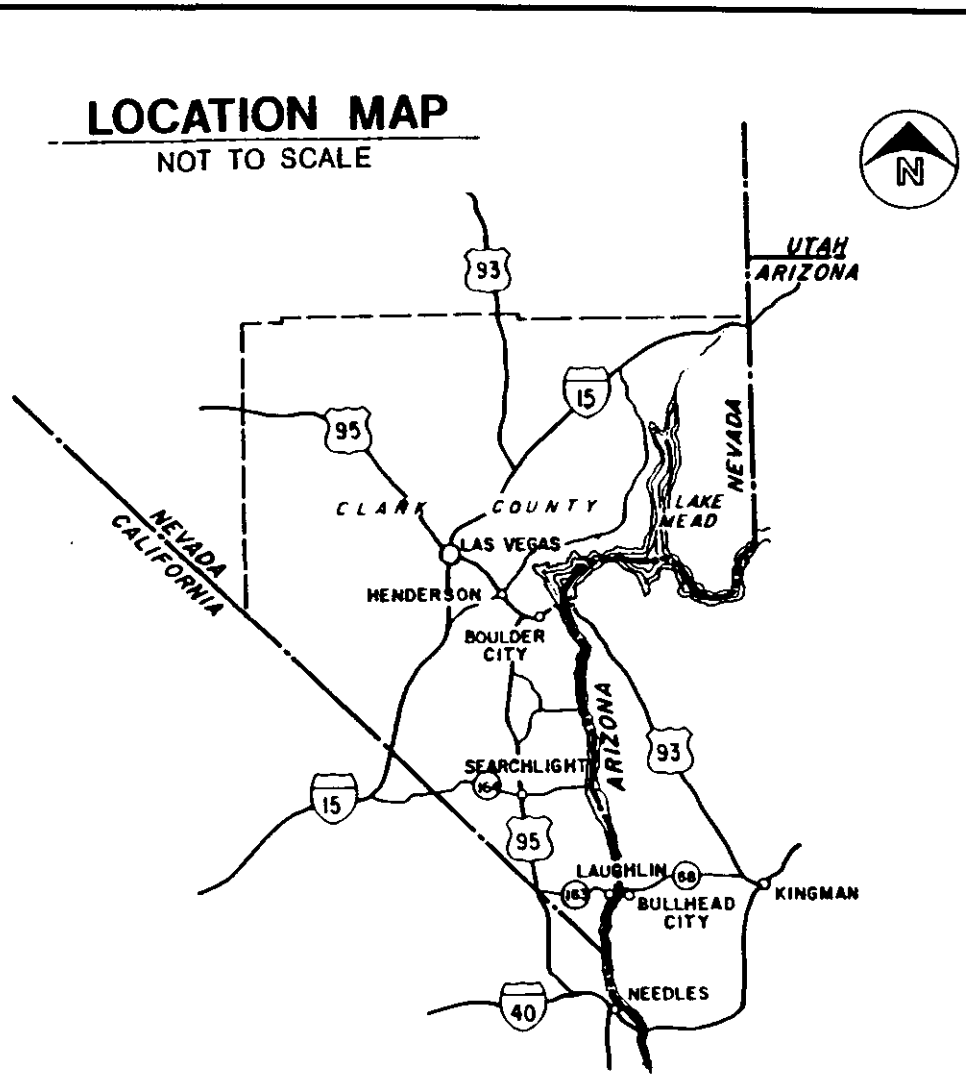
The area of study was identified during the project kick-off meeting on July 27, 1995 in which representatives of the CCRFCD, City of North Las Vegas (CNLV), Clark County Public Works Department (CCPW) and PBS&J attended.

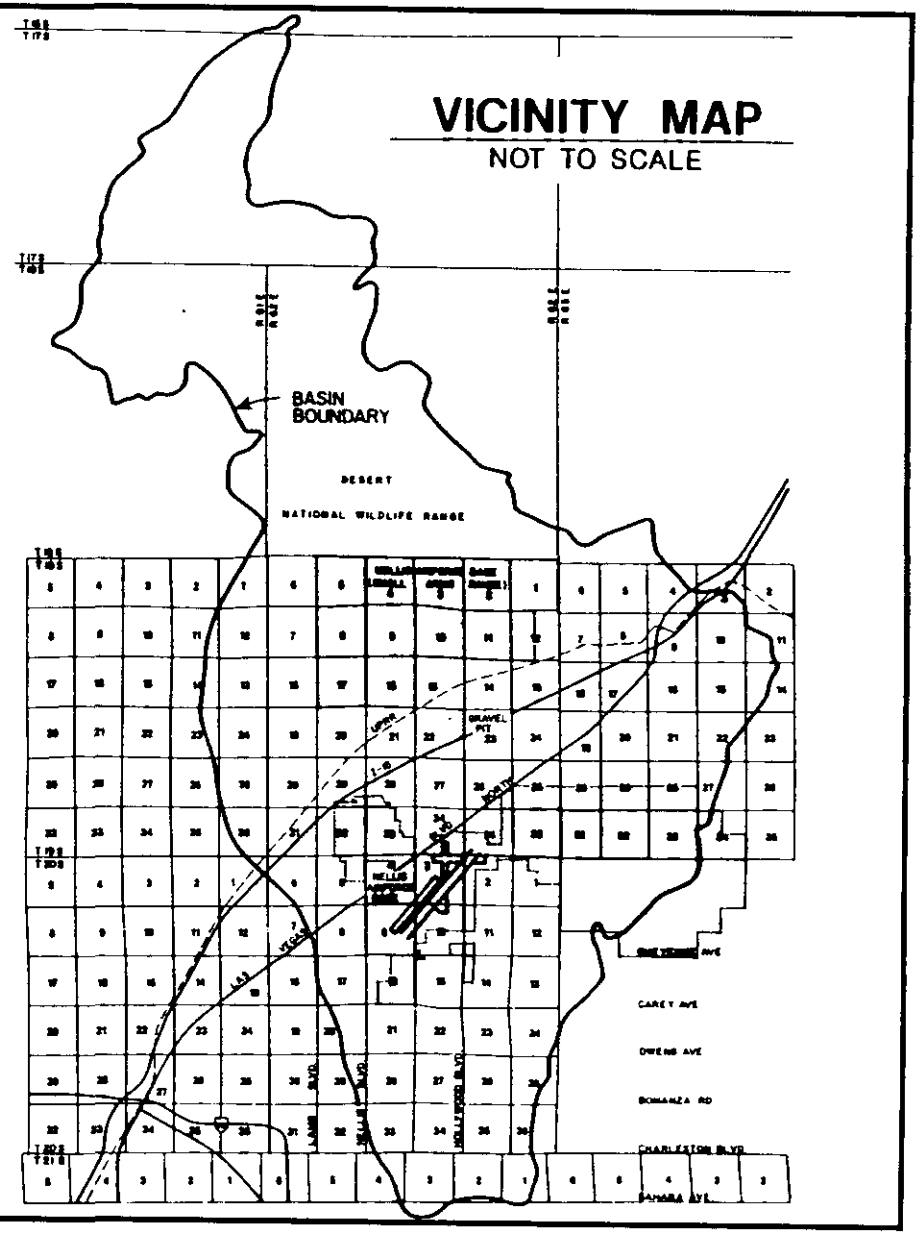
The results of the hydrologic analysis were coordinated with the CCRFCD, CNLV, and Clark County. Throughout the project, coordination meetings were held to discuss progress, hydrologic results and the floodplain delineation.

2.0 AREA STUDIED

2.1 Scope of Study

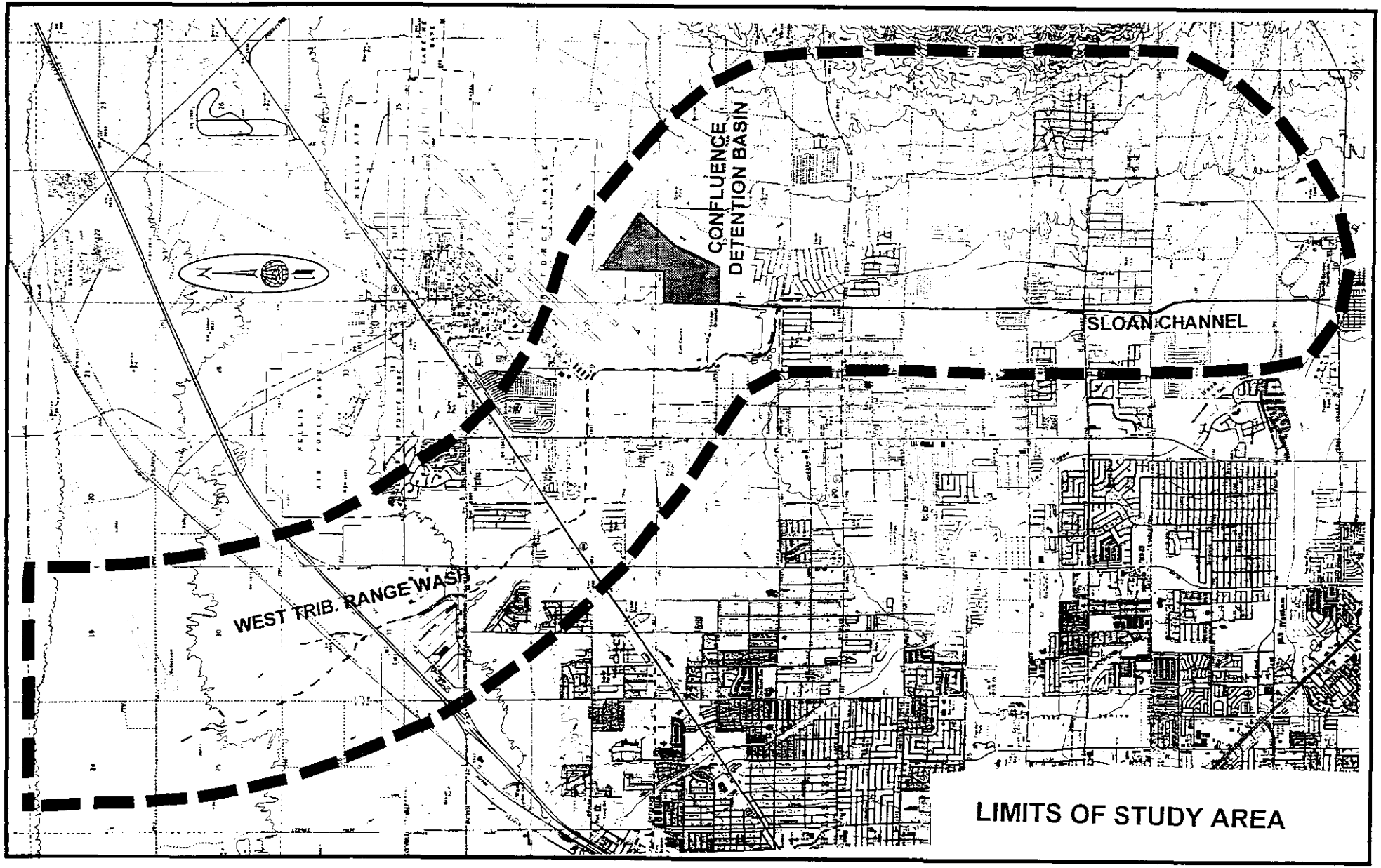
This study presents the findings of hydrologic and hydraulic analysis for the Range Wash located in City of North Las Vegas, and areas of Unicorporated Clark County, Nevada. The limits of Study Area are shown in **Figure 2**.





PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

FIGURE 1



PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

FIGURE 2

The Range Wash system is shown schematically in **Figure 3**.

The areas of special flood hazard areas of the previous FIS are divided into two areas, an upper reach on the West Tributary, and a lower reach on the Sloan Channel. See **Figures 4 and 5.** The results of the flood hazard delineation analysis are shown on **Figures 6 and 7.**

The scope included performing field reconnaissance, data collection and review, hydrologic analysis, hydraulic analysis and special flood hazard area delineation by approximate methods.

2.2 Community Description

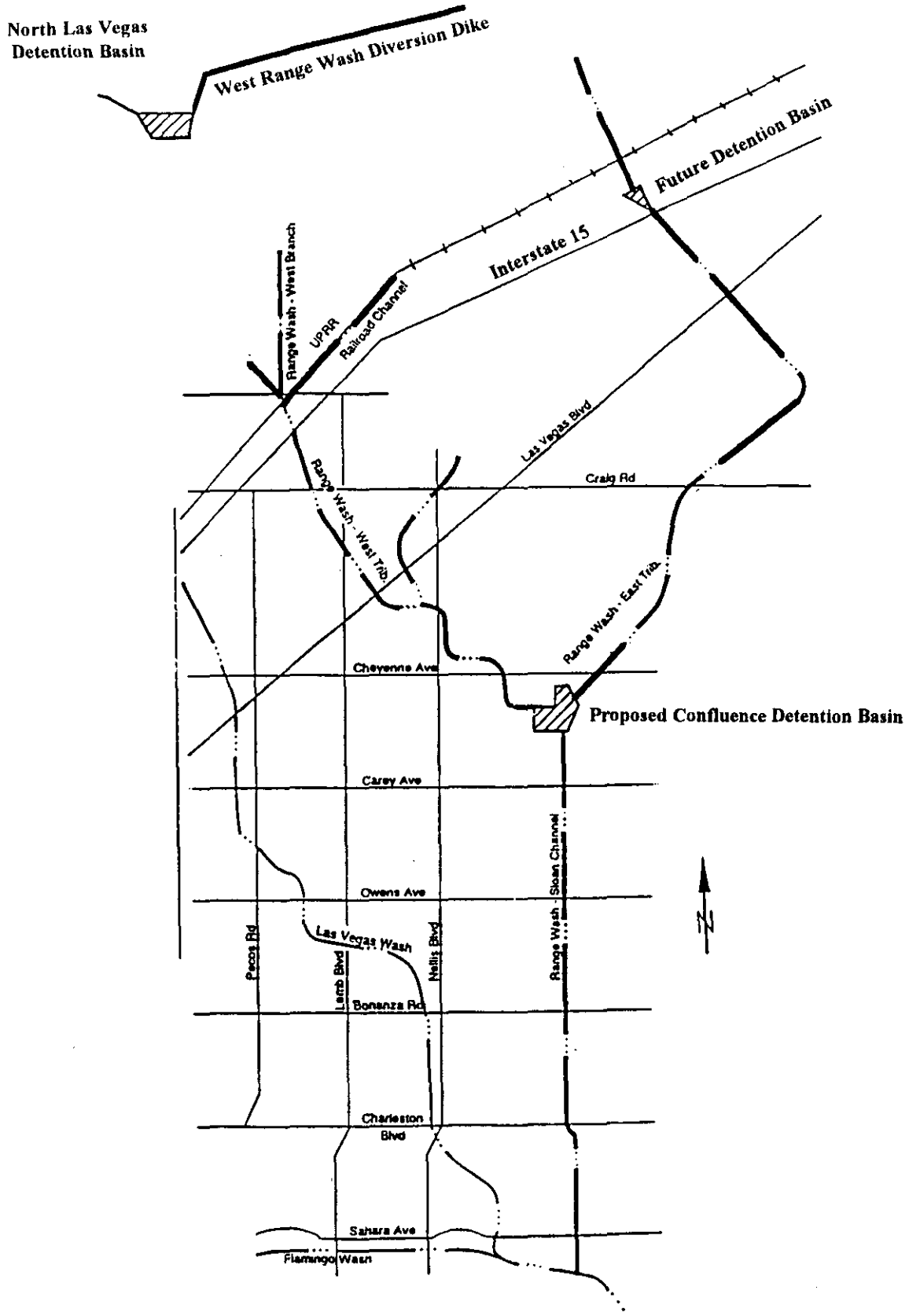
The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley. The basin lies entirely within Clark County, Nevada and includes portions of City of North Las Vegas, Nellis Air Force Base, and portions of Unincorporated Clark County.

The Range Wash is a major tributary to the Las Vegas Wash. The basin is bound on the north by the Las Vegas and Sheep Range Mountains and on the East by the Frenchman Mountains.

The total watershed is approximately 150 square miles. Approximately 48 square miles of the West Tributary area is diverted by the West Range Wash Dike to the North Las Vegas Detention Basin and Las Vegas Wash System. There is approximately 24 square miles of the West Tributary downstream of the dike to the Confluence Detention Basin. There is approximately 58 square miles in the East Tributary to the Detention Basin. There are approximately 17 square miles below the detention basin to the confluence with the Las Vegas Wash (Reference 2).

The basin can be characterized by three distinct land types: Mountainous, alluvial fan, and urban developed. The mountainous regions of the watershed are steep and rocks with limited vegetation. The alluvial fan areas are characterized by alluvial deposits and numerous channels of limited capacity. The vegetation consists of desert shrubs and grasses. The Range Wash Dike diverts flows from the northern mountain region and upper portion of the fan of the West Tributary. A large portion of the fan below the dike remains presently undeveloped (Reference 2).

The majority of existing development is a mixture of residential and light commercial. The area in the vicinity of I-15 and UPRR is zoned industrial. Nellis Air Force Base development includes base housing, parks and golf courses, base office buildings, airfields and related services (References 2 & 25).



RANGE WASH SYSTEM

POST, BUCKLEY, SCHUH & JERNIGAN

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

FIGURE 3

FIGURE 4

POST, BUCKLEY, SCHUH & JERNIGAN
ENGINEERING · PLANNING · SURVEYING · CONSTRUCTION SERVICES

DFIRM 1995

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 1790 OF 4090
MAP NUMBER 32003C1790 B
EFFECTIVE DATE: AUGUST 18,1995
Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 2175 OF 4090
MAP NUMBER 32003C2175 B
EFFECTIVE DATE: AUGUST 18,1995
Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 2180 OF 4090
MAP NUMBER 32003C2180 B
EFFECTIVE DATE: AUGUST 18,1995
Federal Emergency Management Agency

APPROX. SCALE: 1" = 1000'
3000 2000 1000 0 500 1000

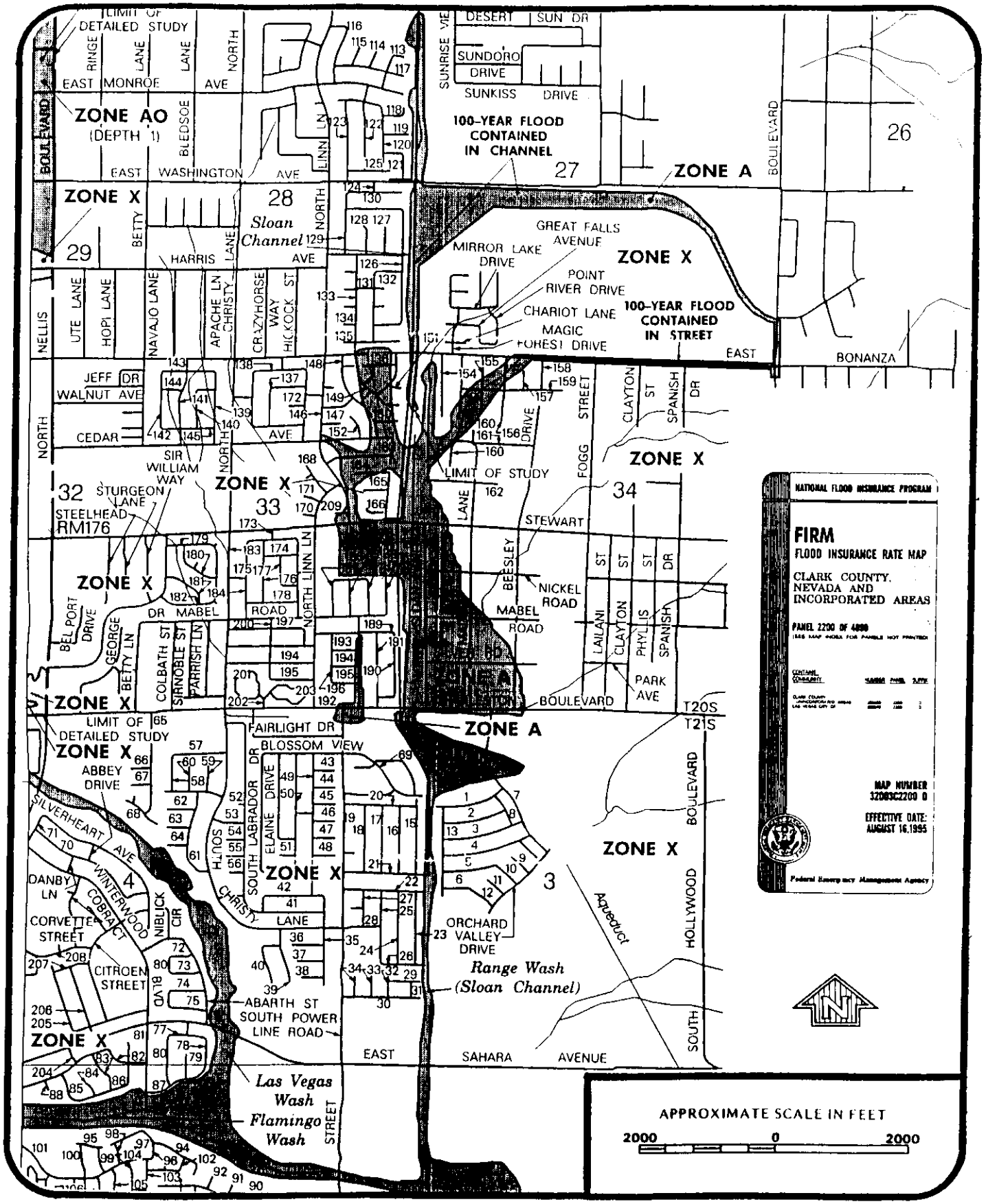
APPROXIMATE SCALE IN FEET
1000 0 1000

CITY OF NORTH LAS VEGAS
320007

CLARK COUNTY
UNINCORPORATED AREAS
320003

ZONE A
ZONE X

NORTH
R61E
R62E
UNION
BOULEVARD
LAMB
SMILEY ROAD
CORPORATE LIMITS
CITY OF NORTH LAS VEGAS
CLARK COUNTY
EAST LONE MOUNTAIN ROAD
ZONE A STREET
MITCHELL STREET
ANDREWS STREET
EAKER STREET
NORTH WALNUT ROAD
NORTH LAS VEGAS INDUSTRIAL SPUR
MC GUIRE STREET
EAST CRAIG ROAD
EAST ALEXANDER ROAD
SHINING STAR LN
ANGEL FLIGHT DR
CLOUDY SKY LN
THUNDERHEAD LANE
PARKER LANE
WENDY LANE
JACQUELINE WAY
CAPSULE DR
SPHERE DR
GLOW DR
SHIMMER LN
BRIGHT SIDE LN
ADIRONDACK AVE
RON CT
PLUMTREE ST
DR
EILEEN ST
LINLEY CT
SANDY OAK DR
PAMELA WAY
FERNLEAF
EDWIN PL
SEVENTH HEAVEN LN
BRIGHT STAR CT
SAVOY CT
SOUTHERN LIGHTS DR
TIMBERLODGE SEEDLING WAY
CLOUD NINE LN
HOLLYLEAF COURT
TILLAMOOK AVE
LONGFELLOW ST
WHITE HORSE ST
RAINBURST CT
GULLIVER ST
ASIMOV PL
TATTERSALL PL
RIKER AVE
PASTERNAK DR
DOBSON DR
POE DR
HELLER DR
STEINBECK DR
OLD CABIN LANE
TOLKIEN AVE
LANCOME STREET
SHALIMAR AVE
JONTUE ST
RIVE GAUCHE ST
TIGRESS CIR
GALORE AVE
FABERGE AVE
DRAGA PL
CASENELA AVE
CATINO
BORATKO
STUDIO
PARAMOUNT
CALIMESA
WARNER PLACE
ZOI

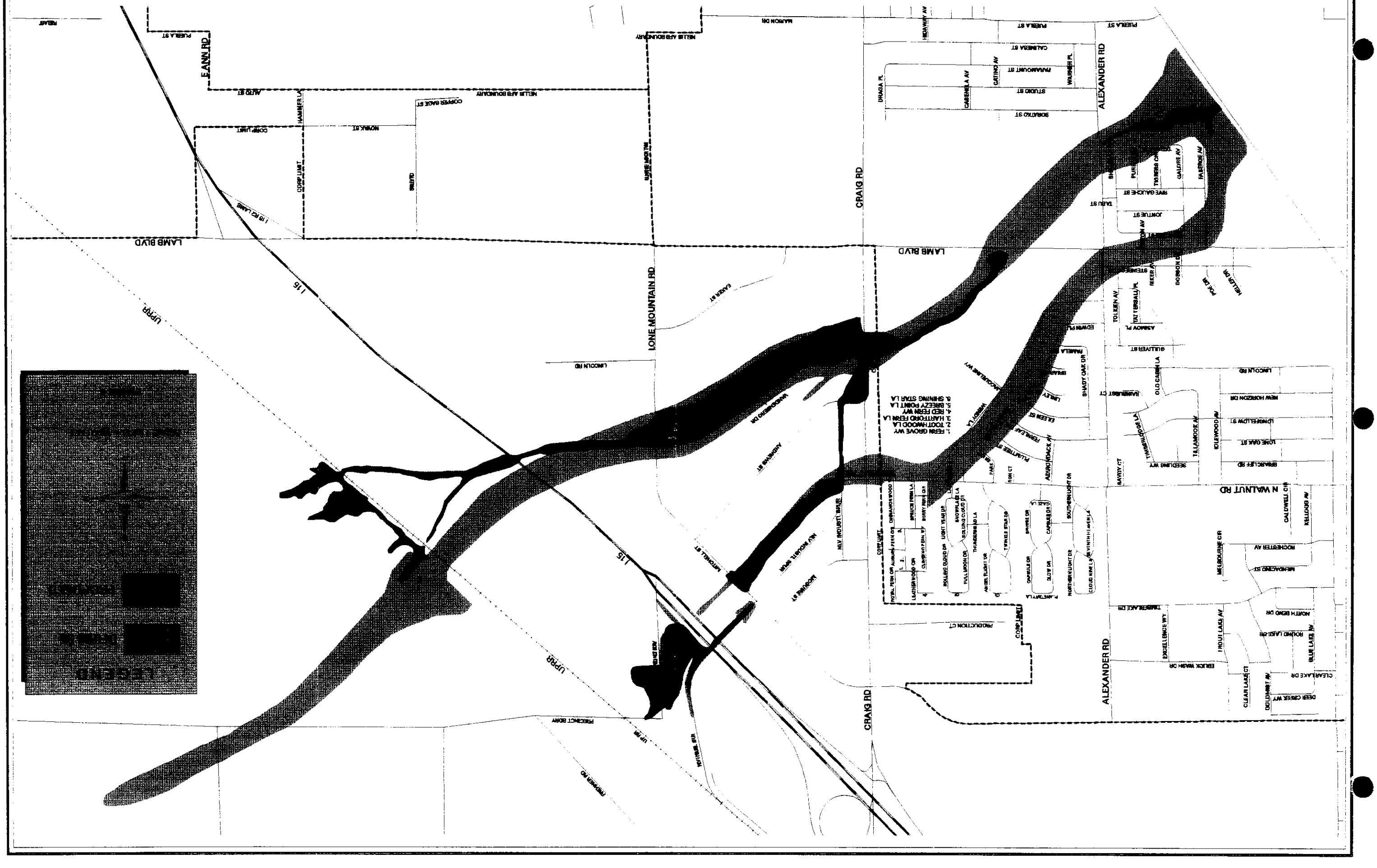


DFIRM 1995

FIGURE 5

POST, BUCKLEY, SCHUH & JERNIGAN

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES


LEGEND
E ANN RD
LAMB BLVD
LONE MOUNTAIN RD
CRAIG RD
ALEXANDER RD
N WALNUT RD
I 15
UPRR
CORP LIMIT
NELLIS AFB BOUNDARY
PUEBLA ST
ALTO ST
HAMMER LN
COPPER LIMIT
COPPER BASE ST
NOVAK ST
OLSEN
LINCOLN RD
EAGAN ST
HIGHWAY AV
CALABRIA ST
PANAMOUNT ST
STUDIO ST
BORATTO ST
DRAGA PL
CABRINI LA AV
GATINO AV
WARNER PL
ALEXANDER RD
RIVE GAUCHE ST
JOINTUE ST
TABU ST
GALLERIE AV
FAUBERGE AV
PURE
SHE
STEINBECK AV
DO BROWN DR
POE LN
HELLER DR
TOLKIEN AV
TATTERSALL PL
ASHBOY PL
GULLIVER ST
EDWIN PL
RAMEA
BRIAN
SHADY OAK DR
LAKE ST
FERN ST
PLUMTREE ST
PARK LAKE
ADIRONDACK AV
IOM CT
SHADOW LANE WY
1. FERN GROVE WY
2. TOOT HWOOD LA
3. HARTFORD FERN LA
4. RED FERN WY
5. BREEZY POINT LA
6. SHINING STAR LA
ROYAL FERN DR
AUBURN FERN CT
CINNAMON WOOD
SPRUCE FERN LA
LEATHERWOOD DR
CLOVERLEAF FERN CT
BERRY FERN DR
ROLLING CLOUD DR
LIGHT YEAR DR
SNOWFLAKE LA
FULL MOON DR
SURLING CLOUD DR
THUNDERBIRD LA
ANGEL FLIGHT DR
TWINKLE STAR DR
SPHERE DR
CAPSULE DR
CAPSULE CT
LAKE VISTA LA
ALTO DR
SOUTHERN LIGHT DR
NORTHERN LIGHT DR
CLOUD NINE LA
SEVENTH HEAVEN LA
PRODUCTION CT
CORP LIMIT
NEW HOUSE SPUR
NEW MOUNT SPUR
MONROE ST
MONROE LN
MONROE DR
PRESCOTT RD
PRESCOTT BDRY
NEW BNDY
UPRR
CALDWELL CIR
CALDWELL AV
ROCHESTER AV
MELBOURNE CIR
MELBOURNE AV
TIMBER LAKE DR
NORTH BEND DR
ROLLING LAKE DR
BLUE LAKE AV
CLEAR LAKE DR
DEER CREEK WY
DOLLMART AV
CLEAR LAKE CT
EXCELLENCE WY
BLACK WASH DR
INDUSTRIAL AV
TIMBERLODGE LA
SEEDLING WY
TILLAMOOK AV
IDLEWOOD AV
LONE OAK ST
LONGFELLOW ST
BRIARCLIFF RD
NEW HORIZON DR
LINCOLN RD
OLD CABIN LA
TAMARUST CT
SHADOW LANE WY
BAYOU CT

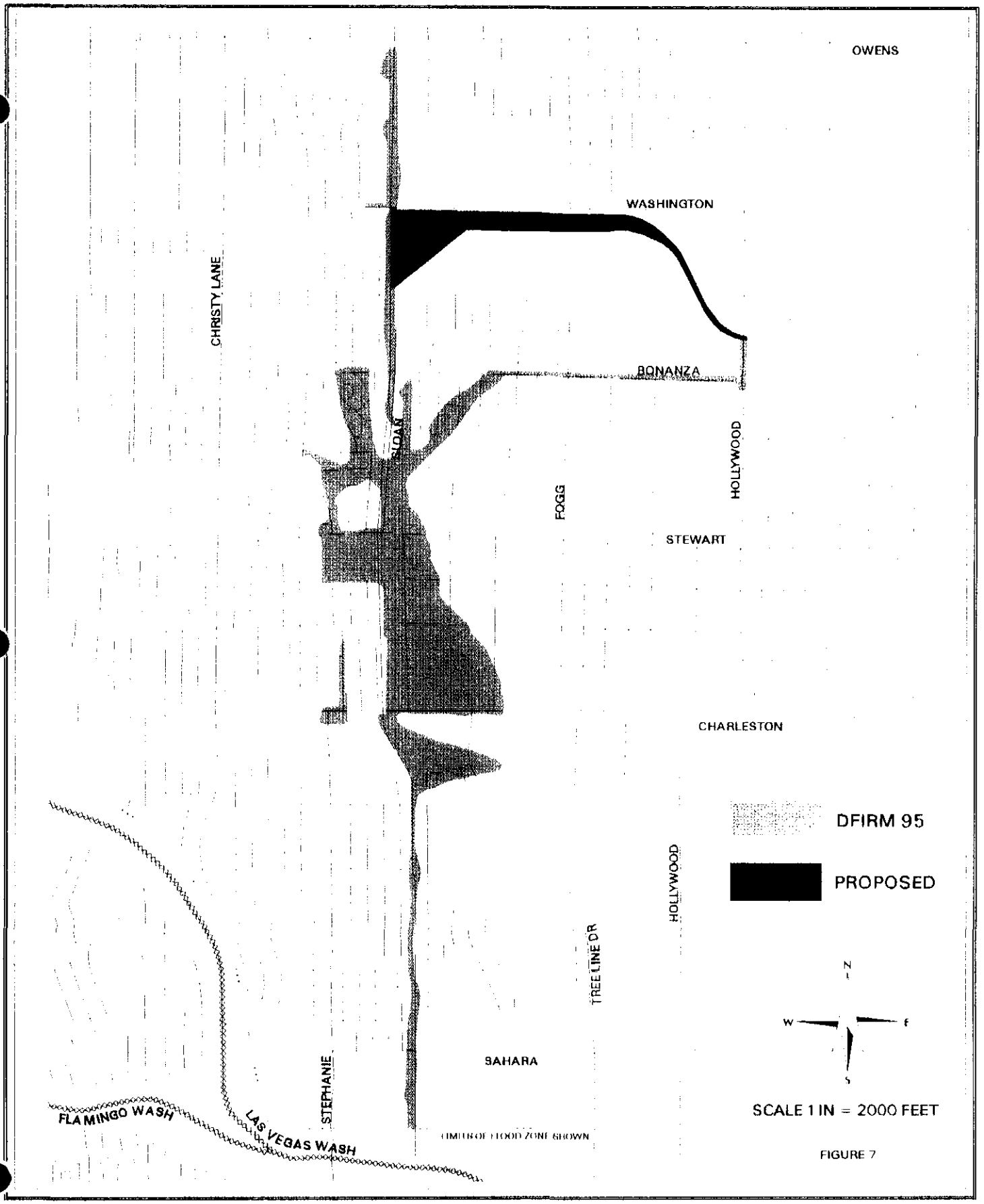

OWENS
WASHINGTON
CHRISTY LANE
BONANZA
SLOAN
HOLLYWOOD
FOGG
STEWART
CHARLESTON
DFIRM 95
PROPOSED
HOLLYWOOD
TREE LINE DR
N
W
E
S
SAHARA
STEPHANIE
FLAMINGO WASH
LAS VEGAS WASH
LIMIT OF FLOOD ZONE SHOWN
SCALE 1 IN = 2000 FEET

FIGURE 7

The East Tributary of the Range Wash is in undeveloped areas and is in a natural condition. The West Tributary is lined south of Las Vegas Boulevard to the Confluence with the Sloan Channel (References 21 & 22). There are improvements of limited capacity upstream of Las Vegas Boulevard. The Confluence Detention Basin is presently under construction (Reference 8). The Sloan Channel south of the detention basin is concrete lined to Bonanza Road and designed to Stewart Avenue (Reference 18). The channel is graded to its confluence with the Las Vegas Wash.

The climate in the Las Vegas area is arid with hot summers and mild winters. It is characterized by episodic rainfall and wide extremes in daily temperatures. Average daily minimum/maximum winter temperatures range from approximately 33/56 °F in the valley areas to about 17/35 °F in the mountains. This summer temperatures range from approximately 76/105 °F in the valley areas to 55/80 °F in the mountains (Reference 11).

The average annual precipitation in the Las Vegas Valley is approximately 4.2". During the winter period (October through April, inclusive), the primary source of moisture to this area is the Pacific Ocean. Precipitation results from frontal systems; and the events are low-intensity and long-duration. During the summer period (May through September, inclusive), the primary moisture sources are the Pacific Ocean, the Gulf of Mexico, and upwind land surfaces as well as reservoirs (Reference 11).

The soils are primarily classified as hydrologic soil group Type B on alluvial fan areas and D in mountainous areas (References 2 & 31).

2.3 Principle Flood Problems

The typical flood-producing storm causing flooding problems are associated with summer thunderstorms of short duration and high intensity which result in significant runoff rates. These storms result from tropical depressions from the south. Summer or winter general storms of longer duration and lower intensity have not contributed to significant discharges in the past.

Major flooding and damages along the Range wash occurred during a summer thunderstorm of July 28, 1984. In that storm 2.5 to 3.0 inches of rain fell over a large area including the Range Wash watershed (Reference 11). An upper reach of the West Tributary known as the Vandenberg Channel had inadequate capacity and road crossing were blocked by debris. An unlined portion of the Sloan Channel was breached due to inadequate capacity and embankment failure. Street flooding with damage to vehicles and residences occured at Mobile Home Park at Carey Avenue and Sloan Lane and along Linn Lane and Christy Lane.

2.4 Flood Protection Measures

Flows to the Vandenberg Channel have been reduced by the Range Wash Dike. Flow to Sloan Channel is reduced by the dike and the Confluence Detention Basin. More of the Sloan Channel has recently been concrete lined from Owens Avenue to Bonanza Road. Storm drain facilities have been constructed with street improvements in Bonanza Road, Nellis Boulevard and Charleston Boulevard.

The Range Wash Dike is designed for a 100-year flow of approximately 7,000 cfs including allowances for sediment and impact. The dike is 15 feet high with a 120 feet wide channel on the upstream side (Reference 6).

The Confluence Detention Basin has a storage volume of approximately 1,025 acre feet. It has a two level outlet that works in conjunction with a diversion structure on the West Tributary. The inflow under fully developed conditions is approximately 4,800 cfs. The outflow is limited to approximately 360 cfs until the basin is within 3 feet of the emergency spillway crest, at this location a secondary outlet begins operation increasing the outflow rate to approximately 1,800 cfs. The higher rate occurs after downstream hydrograph peaks have subsided (References 4,5 & 8).

3.0 ENGINEERING METHODS

3.1 Hydrologic Analyses

A hydrologic analysis was performed to determine 100-year discharges to estimate the limits of flooding. The hydrologic analysis was performed by using a rainfall runoff simulation model. The model used was the Corps of Engineers HEC-1 September 1990 version. The generated flows were consistent with previous studies and established regulatory discharges. The modeling procedures, calculations and results are included in the hydrologic report. The flows at key locations are summarized in Table 1.

3.2 Hydraulic Analyses

Hydraulic Analyses were performed for the purpose of delineating the approximate 100-year floodplain boundaries. Base flood elevations are not determined for approximate methods. Analyses of the hydraulic characteristics of channels and flow paths were performed using normal depth calculations.

Table 1: Summary of Discharges

Flooding Source & Location	Drainage Area (sq. mi.)	100-Yr Peak Discharges
West Tributary Range Wash		
Mitchell St. & Walnut Rd.	0.83	320
12'x 8' RCB at the UPRR U/S of Vandenberg	2.52	530
2 - 21'x 12' bridge cells at UPRR U/S of Vandenberg	5.53	1060
3- 15'x10' RCBs at I-15 U/S of Vandenberg	8.05	1470
7 - 10'x7' RCBs at LV Blvd.	11.08	1550
Range Wash		
Confluence Detention Basin	81.68	4180
Sloan Channel		
Sloan Channel at Bonanza Road	7.55	2570
Sloan Channel at Stewart Avenue	10.78	2620
Sloan Channel at Las Vegas Wash	17.11	4000

Normal depths were calculated using FlowMaster for Windows Version 5.11 distributed by Haestad Methods. Depths at culverts were determined using HY-8 Version 3.2, a non proprietary software package developed by the Federal Highway Administration and Pennsylvania State University for hydraulic designs of highway culverts.

4.0 FLOODPLAIN MANAGEMENT APPLICATION

The 100-year flood hazard boundaries were delineated on aerial-topographic maps at a scale of 1:4,800 (1" = 400') and a contour interval of 2 feet for the upper West Tributary area. The floodplain delineation determinations for the Sloan Channel area were based on improvement plans with a scale of 1" = 40' and one foot contour interval.

5.0 INSURANCE APPLICATION

5.1 Flood Insurance Zones

Areas within the 100-year flood boundary are termed "Special Flood Hazard Areas (SFHAs)." A 100-year flood refers to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year. The areas within the 100-year floodplain are further subdivided into insurance risk rate zones. The SFHAs designated in the study area are defined below.

Zone A Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations determined.

Areas outside the 500-year floodplain and are termed "minimal flood hazard areas." The areas of subject to minimal flood hazard are designated as:

Zone X Areas of minimal flood hazard from the principle source of flood in the area determined to be outside the 500-year floodplain. Flood insurance is available in participating communities but is not required by regulation.

5.2 Flood Insurance Rate Map

Using the results of this FIS, a Flood Insurance Rate Map (FIRM) will be prepared that depicts the SFHAs described in Section 5.0. FEMA publishes the FIRM and distributes it to a wide range of users. Private citizens, community officials, insurance agents and brokers, lending institutions, and Federal agencies use the FIRM to determine the degree of flood hazard in specific areas of the community so

that actuarial premium rates can be assigned and full insurance coverage obtained for properties at risk.

6.0 OTHER STUDIES

This study is intended to update and supersede the portion of the previous FIS that pertains to the study area. The previous controlling study was the "Las Vegas Valley Flood Insurance Study," prepared by James M. Montgomery, Consulting Engineers, Inc. for Clark County Regional Flood Control District, August 1991.

The chief difference from the previous study, is the inclusion of the Confluence Detention Basin. Subbasins have also been subdivided on the West Tributary to provide more detailed flow values at specific locations.

Studies which were reviewed for the incorporation of new improvements, for defining basin characteristics and descriptions, and for developing the hydrology, are listed in the references.

7.0 REFERENCES

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25. JMM, 1991, The Master Plan Update of the Las Vegas Valley, prepared by James M. Montgomery, August , 1991.

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31. SCS, 1985, *Soil Survey of Las Vegas Valley Area Nevada, Part of Clark County*, prepared by Soil Conservation Service, July, 1985.

32. USGS, *7.5 Minute Topographic Quadrangles, Valley, Las Vegas NE, Gass Peak NE, Apex, Frenchman Mountain*, prepared by United States Department of the Interior Geological Survey.

SECTION 4

MAPPING INFORMATION

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

MAPPING INFORMATION INDEX

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

TYPE OF MAP	MAP DATE	NO. OF SHEETS	EXHIBIT NO.
Graphic	February 5, 1996	1	Figure 1
Graphic	February 5, 1996	1	Figure 2
Subbasin Delineation	February 5, 1996	1	Figure 3
Index	February 7, 1996	1	Figure 4
Index	February 7, 1996	1	Figure 5
Basin Delineation	February 5, 1996	1	Figure 5B
Work Maps	February 1, 1996	3	Sheets 24, 29, 35

Study Contractor: Post, Buckley, Schuh & Jernigan, Inc.

MAPPING INFORMATION

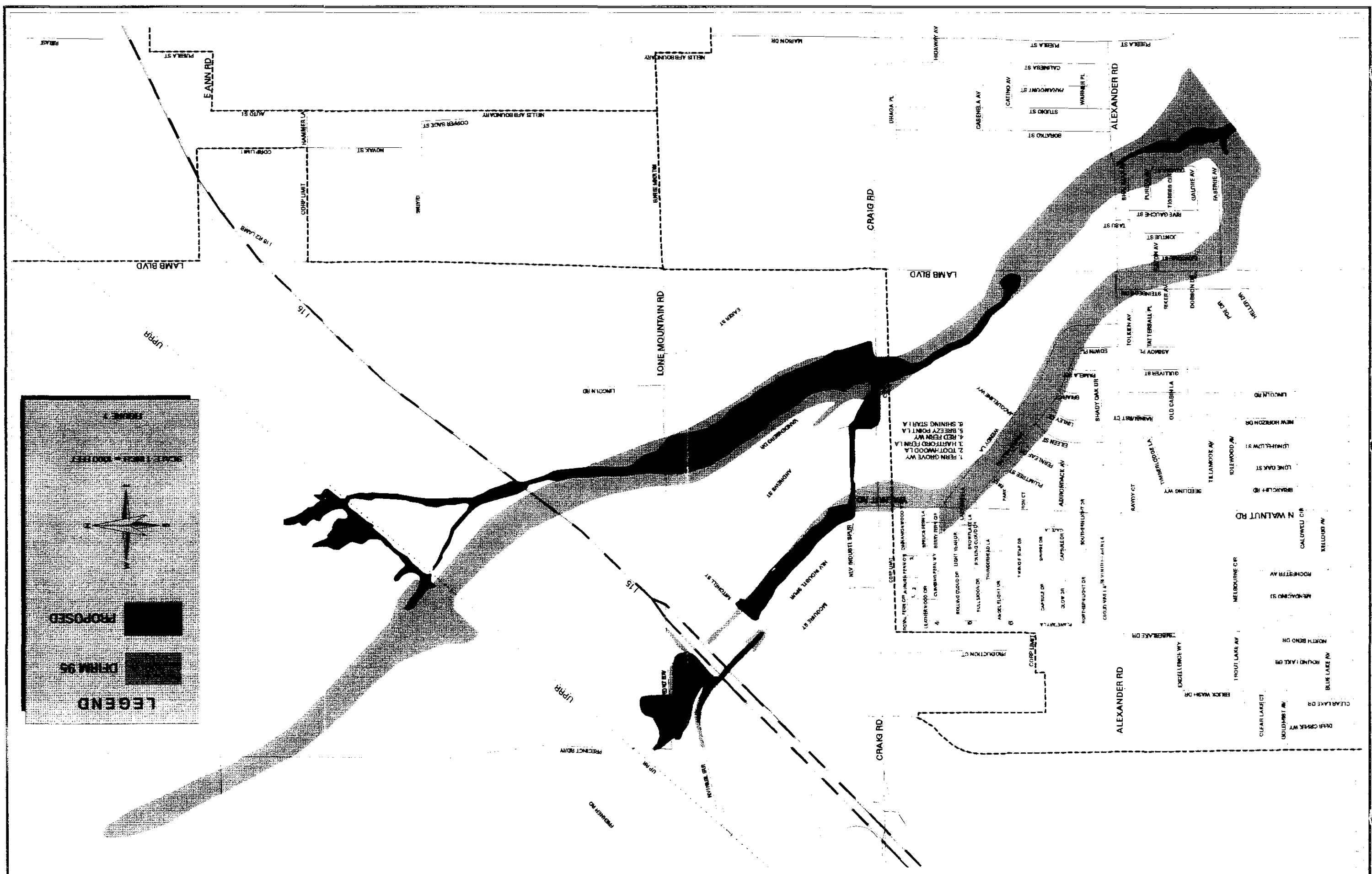
WORK MAP DELINEATION SUMMARY

Clark County, Nevada and Incorporated Areas

FLOOD INSURANCE STUDY RESTUDY

The 100-year flood hazard boundaries were delineated on aerial-topographic maps at a scale of 1:4,800 (1" = 400') and a contour interval of 2 feet for the upper West Tributary area. Cross-section characteristics were verified by field observations

The floodplain delineation determinations for the Sloan Channel area were based on improvement plans with a scale of 1" = 40' and one foot contour interval. There were no flooplain areas determined in the Sloan Channel area - flows were contained within streets or flood control facilities.


LEGEND
PROPOSED
CRAIG RD
LONE MOUNTAIN RD
ALEXANDER RD
LAMB BLVD
E ANN RD
N WALNUT RD
US 95
I 15

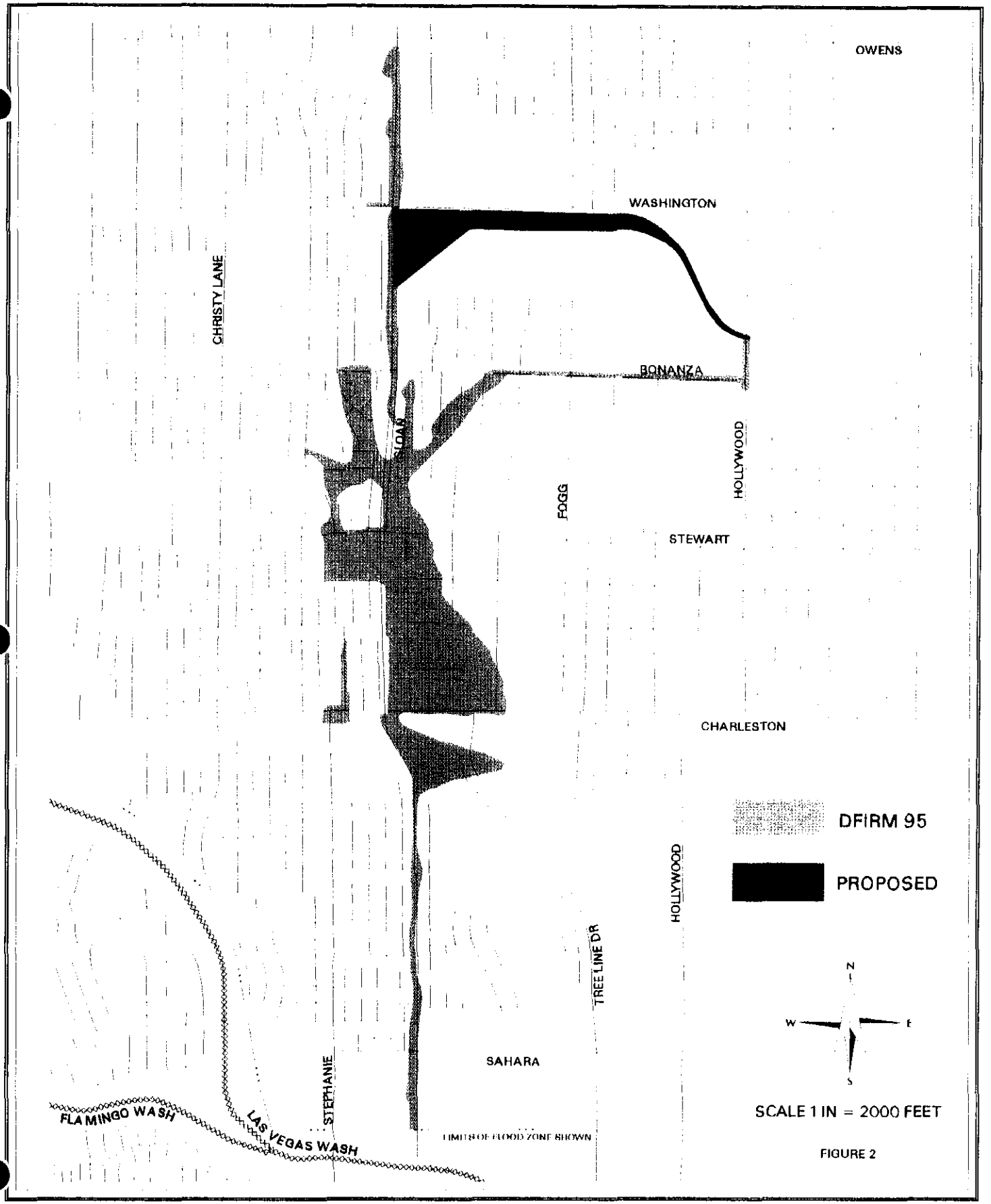
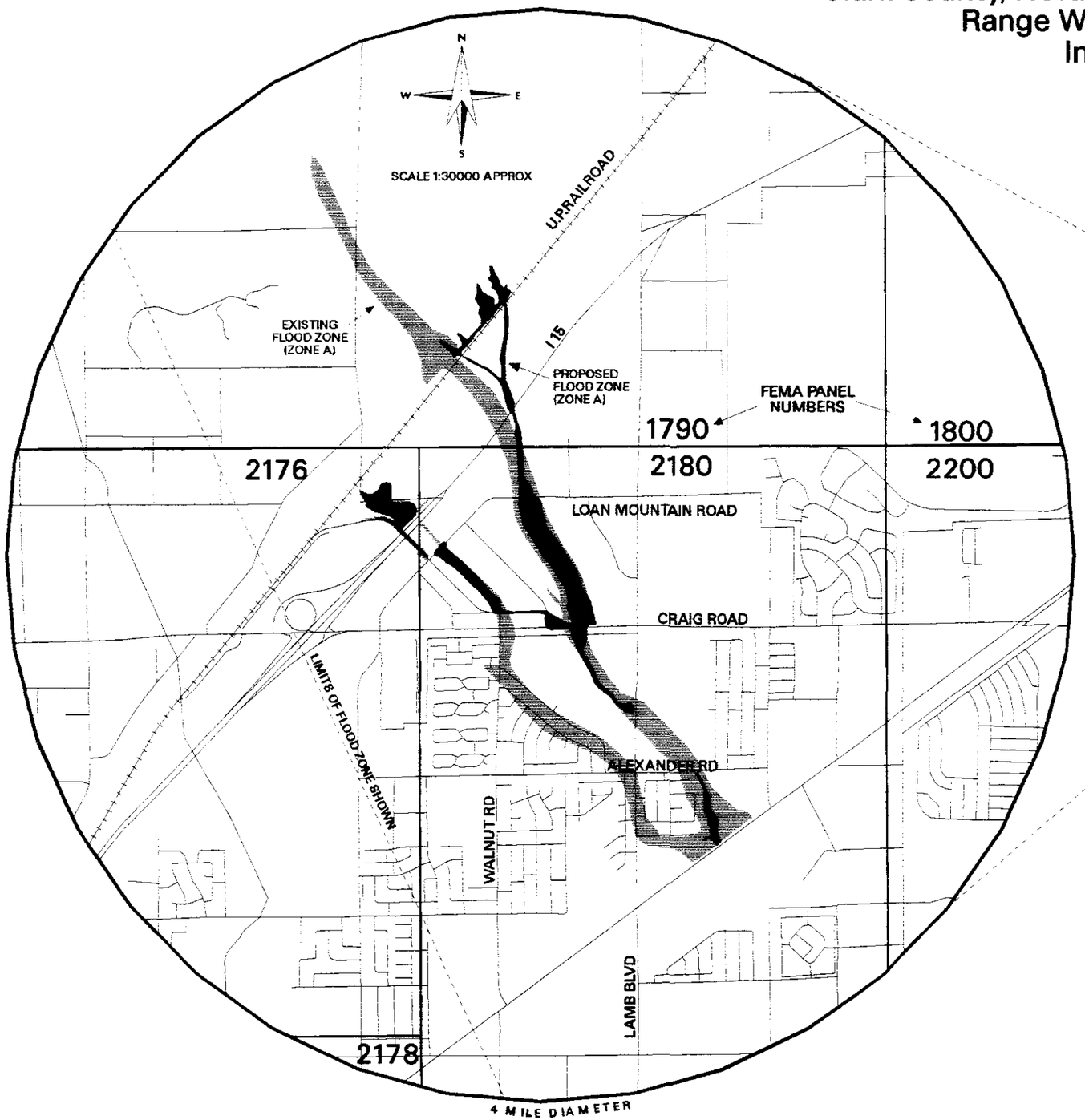

OWENS
WASHINGTON
CHRISTY LANE
BONANZA
SLOAN
HOLLYWOOD
FOGG
STEWART
CHARLESTON
HOLLYWOOD
TREE LINE DR
SAHARA
STEPHANIE
FLAMINGO WASH
LAS VEGAS WASH
LIMIT OF FLOOD ZONE SHOWN
DFIRM 95
PROPOSED
N
W
E
S
SCALE 1 IN = 2000 FEET

FIGURE 2

Clark County, Nevada and Incorporated Areas
Range Wash FIS Restudy
Index Map



FEMA Flood Insurance Rate Map Panels
Clark County, Nevada
August 1995

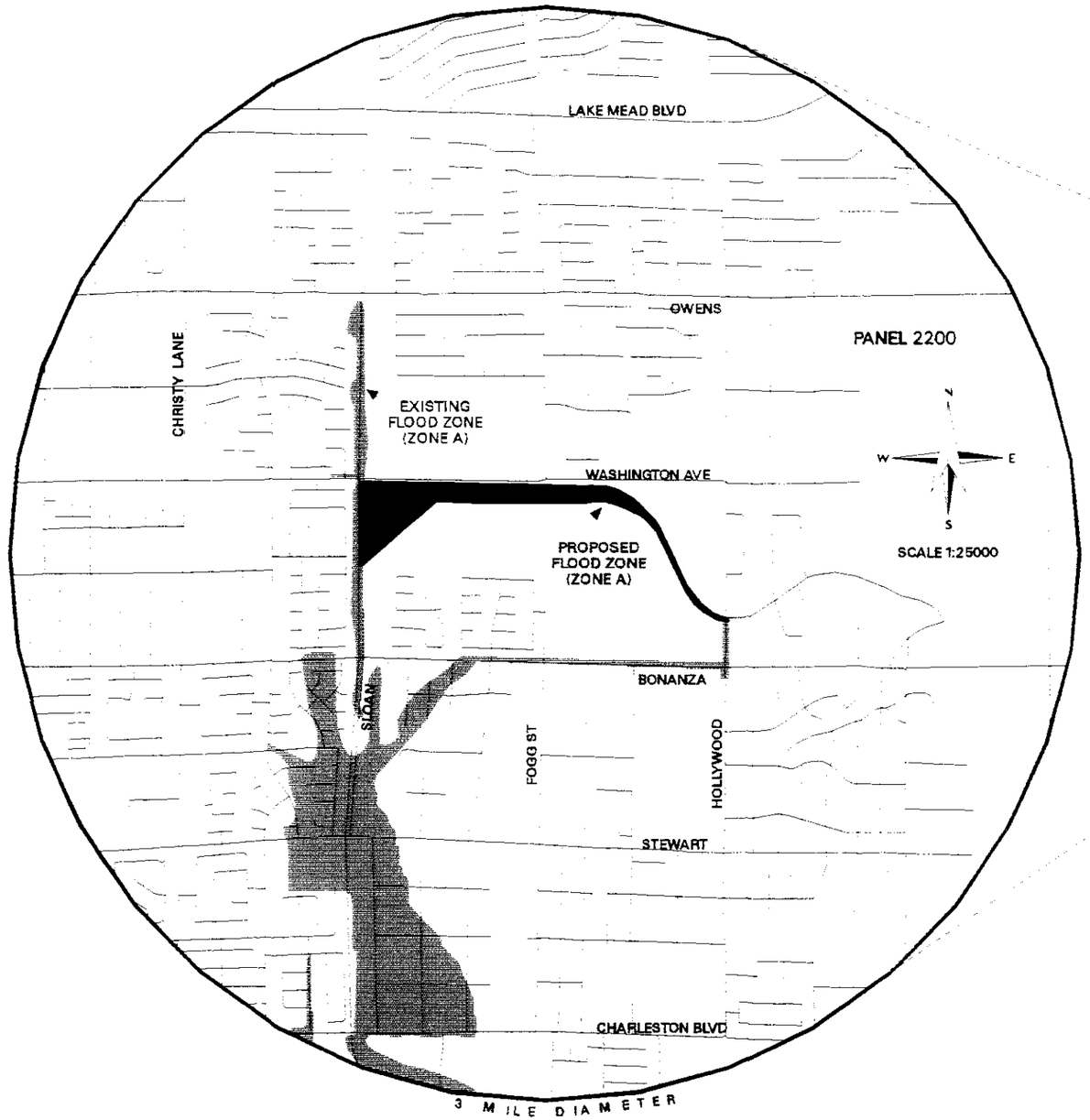
25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	385	
														380	395	
	450	475	500	525	550	575	600	625	650	675	690 700 695	725	750	775	800	
825	850	875	900	925	950	975	1000	1025	1050	1075	1100		1150	1175	1200	
1225	1250	1275	1300	1325	1350	1375	1400	1425	1450	1475	1500	1525	1550	1575	1600	
1625	1650	1675	1700	1725			1800	1825	1850	1875	1900	1925	1950	1975	2000	
2025	2050	2075	2100	2125				2225	2250	2275	2300	2325	2350	2375	2400	
2425	2450	2475	2500	2525					2650	2675			2700	2725	2750	
2775	2800	2825	2850	2875	2900	2925	2950	2975		3025						
		3050	3075	3100	3125	3150	3175	3200	3225	3250						
			3275	3300	3325	3350	3375	3400	3425	3450						
				3475	3500	3525	3550	3575	3600	3625						
					3650	3675	3700	3725	3750	3775	3800					
							3825	3850	3875	3900	3925					
								3950	3975							
									4050							

FIGURE 4

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

PBSJ
POST, BUCKLEY, SCHUH & JERNIGAN, INC.
Geographic Information Systems

Clark County, Nevada and Incorporated Areas
Range Wash FIS Restudy
Index Map



FEMA Flood Insurance Rate Map Panels
Clark County, Nevada
August 1995

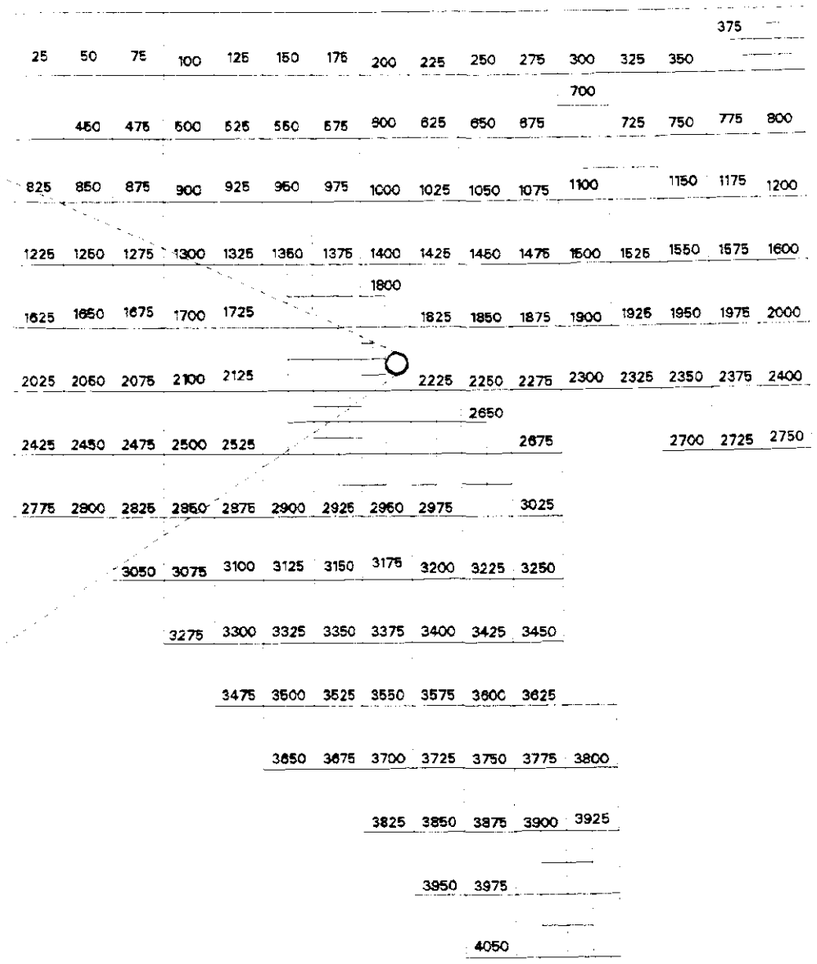


FIGURE 5

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

PBS&J
POST, BUCKLEY, SCHUH & JERNIGAN, INC.
Geographic Information Systems

SECTION 5

MISCELLANEOUS REFERENCE MATERIALS

5.1 Data Collection Summary Memorandum
& Photo Log

VOLUME 2

5.2 Range Wash Dike
Sediment Transport Documentation Notebook

VOLUME 3

5.3 Range Wash Dike Documentation Continued

VOLUME 4

5.4 Confluence Detention Basin Documentation

VOLUME 5

5.5 Sloan Channel & Developer Improvements
Documentation

VOLUME 6

5.6 Drawings - Exhibits A-E

5.1 Data Collection Summary Memorandum & Photo Log

.804

DATA COLLECTION SUMMARY MEMORANDUM

For The

RANGE WASH FLOOD INSURANCE RESTUDY

Prepared for:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Prepared by:

Post, Buckley, Schuh & Jernigan, Inc.
901 North Green Valley Parkway, Suite 100
Henderson, Nevada 89014

August 31, 1995
PBS&J Job Number 51804

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2. Range Wash System 3
3. DFIRM 1995 Western Tributary of Range Wash 4
4. DFIRM 1995 Sloan Channel 5

APPENDIX

1. Photograph Index
2. Data Collection Tables
Hydrologic Information
Hydraulic Information
Improvement Plans
LOMRs
3. Photograph Log

I. INTRODUCTION

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J), under contract with the Clark County Regional Flood Control District (CCRFCD), is preparing a Flood Insurance Restudy of the Range Wash, located within the City of North Las Vegas, and Clark County, Nevada. This summary memorandum presents information obtained from field reviews and the data collection and review effort, findings and recommendations for proceeding with the restudy, and a preliminary bibliography.

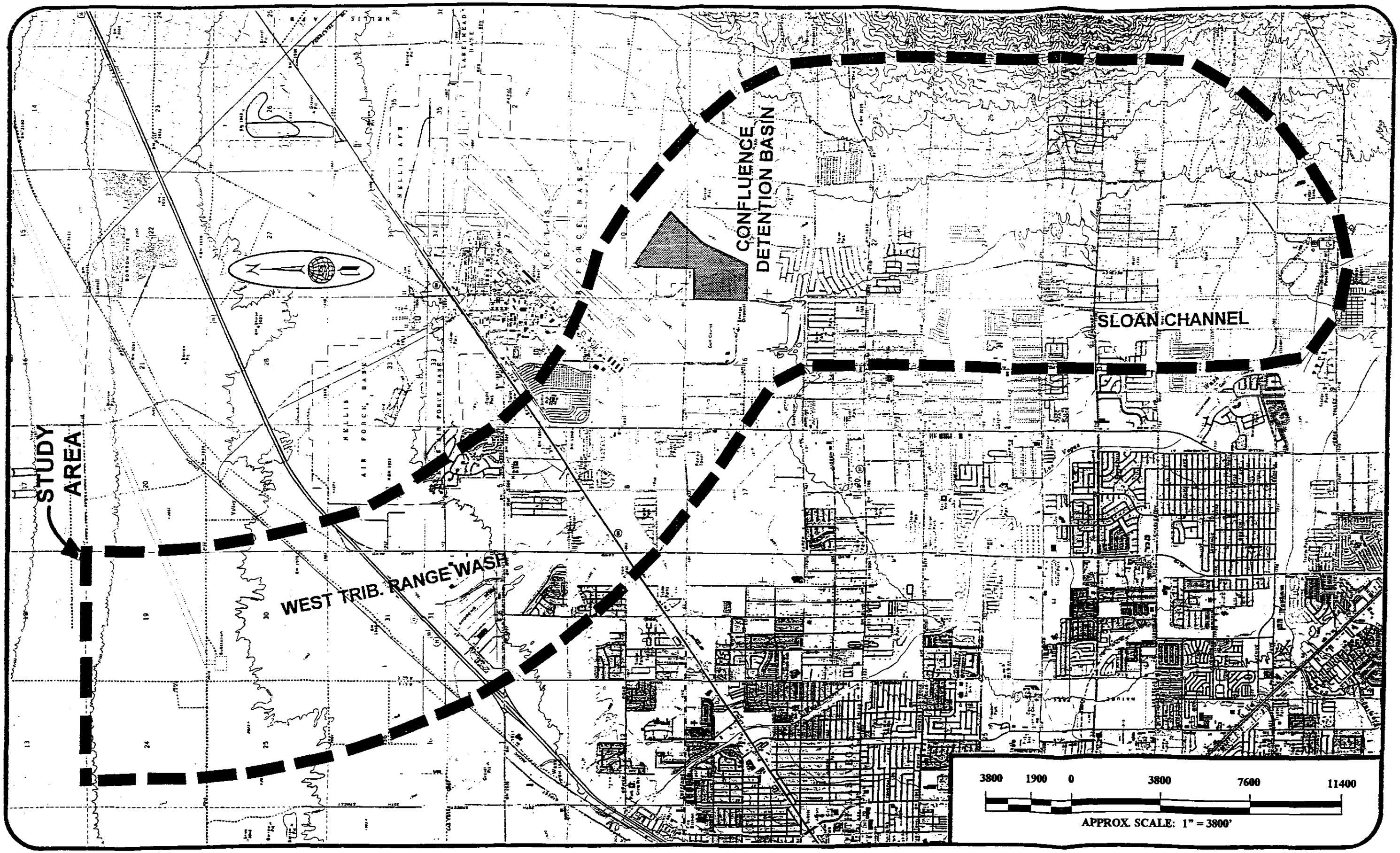
II. PROJECT DESCRIPTION

Figure 1 shows the approximate limits of the Range Wash study area. **Figure 2** shows a schematic of the Range Wash system. The lower reach of the Range Wash is commonly known as the Sloan Channel. The scope of work for this restudy includes the Western Tributary of the Range Wash and the Sloan Channel. The Eastern Tributary is not included because there is no significant development or present Special Flood Hazard Areas in this area.

The purpose of this restudy is to update the Special Flood Hazard Areas due to two major flood control facilities which reduce the 100-year flow to the Range Wash and Sloan Channel. The two major flood control facilities are the West Range Wash Diversion Dike and the Confluence Detention Basin. There are two areas of Flood Zone "A" which are to be evaluated, and reduced or eliminated, as part of this study.

The West Range Wash Diversion Dike, located near the Grand Teton Drive alignment, is the northern boundary of the study area. The dike has reduced the 100-year flow to the Range Wash by diverting a significant amount of upstream flows to the North Las Vegas Detention Basin. The construction of this facility is expected to impact the Zone "A" upstream of Las Vegas Boulevard. **Figure 3**, a copy of the DFIRMs, Map Numbers 32003 C 1790 D, 32003 C 2180 D and 332003 C 2176D, for Clark County and Incorporated Areas, effective date August 16, 1995, shows the Flood Zones "A" in this area.

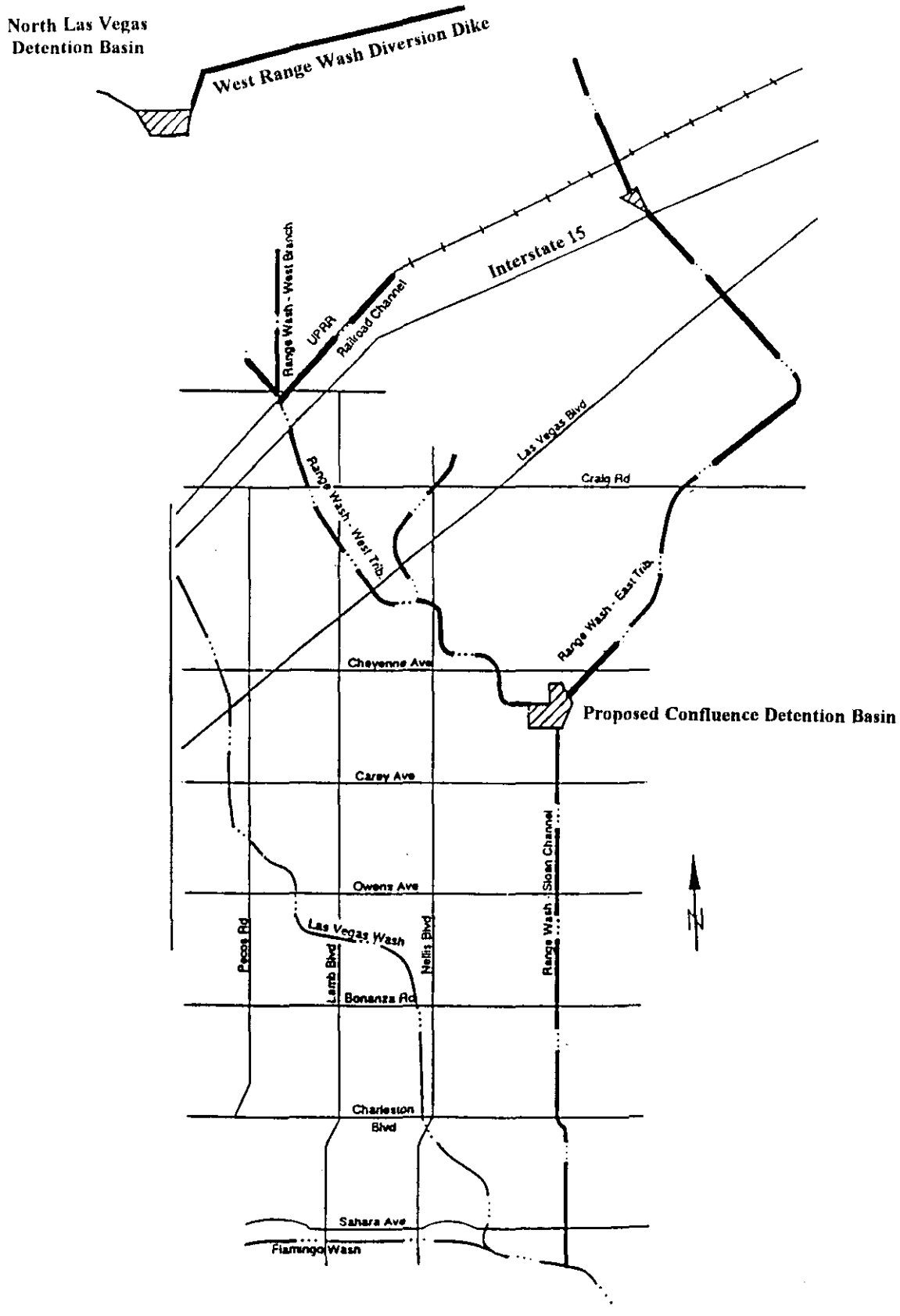
The Confluence Detention Basin, presently under construction, is located upstream of the Sloan Channel reach of the Range Wash system and is expected to reduce the 100-year peak flow to the Sloan Channel. Information on the Confluence Detention Basin will be provided in this restudy so that a CLOMR may be obtained. **Figure 4**, a copy of the DFIRM, Map Number 32003 C 2200 D, for Clark County and Incorporated Areas, effective date August 16, 1995, shows the Flood Zones "A" associated with the Sloan Channel.



POST, BUCKLEY, SCHUH & JERNIGAN

FIGURE 1

LIMITS OF STUDY AREA



RANGE WASH SYSTEM

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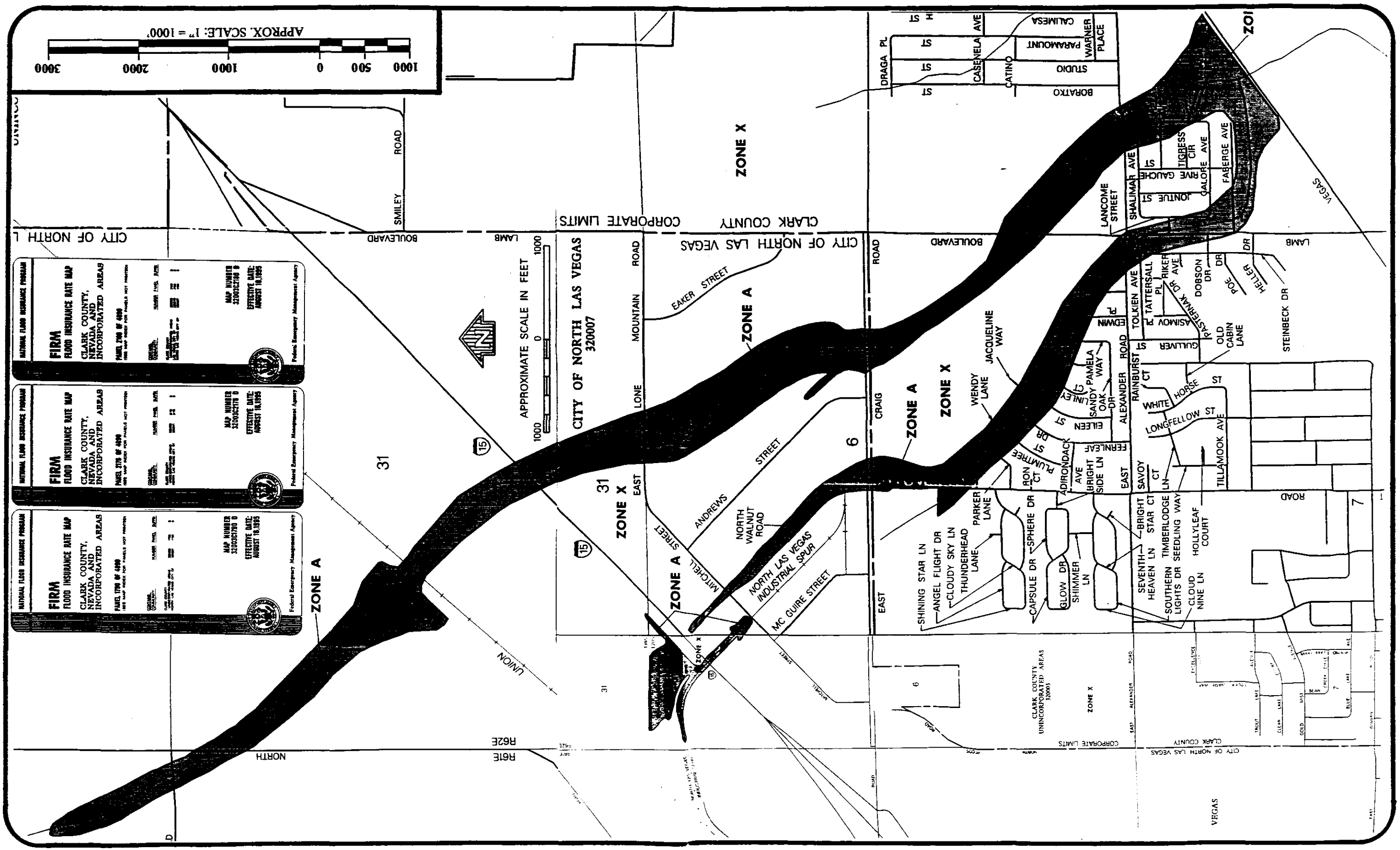
ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

FIGURE 2

FIGURE 3

DFIRM 1995



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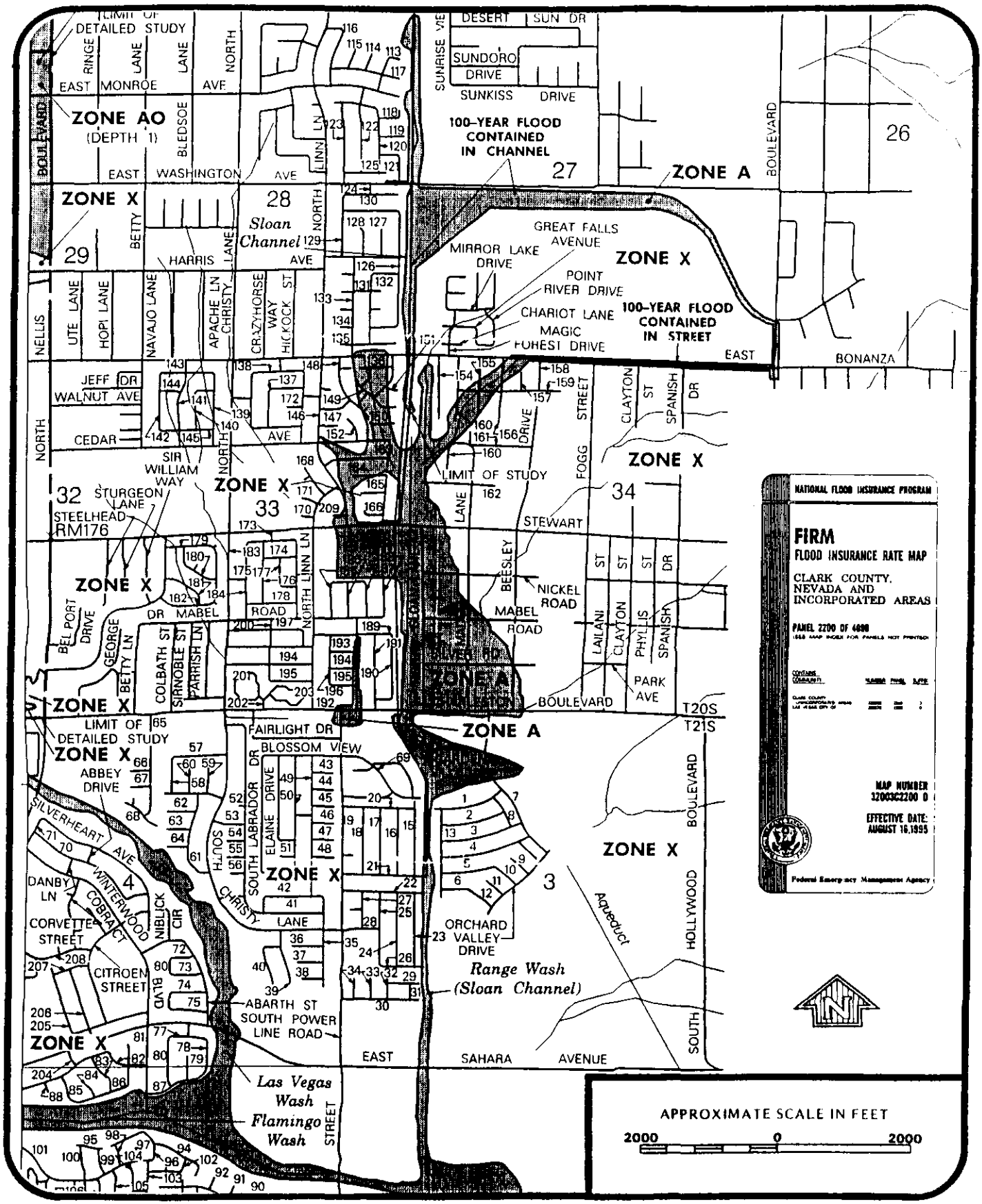

DFIRM 1995

FIGURE 4

POST, BUCKLEY, SCHUH & JERNIGAN

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

III. FIELD REVIEW

PBS&J has investigated existing conditions in the field and has prepared a **Photograph Log** included as **Appendix 3**. The photograph log documents the major hydraulic structures and bridges, channel improvements, and natural channels within the Range Wash system. It contains copies of figures from the CCRFCD Master Plan Update (MPU) of the Las Vegas Valley, dated 1991. The MPU figures are provided as an aid to referencing each flood control facility. The MPU labeling system is familiar to local engineers and entities. The MPU shows proposed as well as existing flood control facilities. Only existing facilities are considered in this restudy, with the exception of the Confluence Detention Basin, which is presently under a construction contract.

The log also contains photographs showing flood damage from a 1984 storm in the Vandenberg Channel area.

The photograph log contains the majority of the photographs obtained from the field reconnaissance investigation. A photograph index, included in **Appendix 1** of this memorandum, provides a complete list of each photograph taken, along with its description, MPU facility label, and identification number.

IV. DATA COLLECTION AND REVIEW

Data has been collected and reviewed for the entire study area. Detailed evaluation of hydraulics and facility capacities will focus on eliminated or reducing the Zone "A" Special Flood Hazard Areas. Where there are no present flood hazard areas or evident problems the existing facilities are assumed to have sufficient capacity without further review. Tables included in **Appendix 2** give names of the documents or improvement plans collected to date, and give a brief description of the area and the information that may be useful for this restudy.

V. FINDINGS AND RECOMMENDATIONS

This section presents the data recommended for use in this Range Wash restudy. A description of the data is located in tables found in **Appendix 2.**

Hydrologic Data

After reviewing the hydrologic models obtained, the recent hydrology performed for the Confluence Detention Basin is the most comprehensive, and may be used with modifications such as subdividing particular basins, modeling different storm centerings, and determining whether any recent development may change the land use enough to modify the existing curve numbers. The hydrology for the lower reach of Sloan Channel may be supplemented with hydrologic models prepared for the Hollywood Highlands and Orchards housing developments.

Hydraulic Data

The following is a summary of the information obtained after reviewing the hydraulic models and the improvement plans:

- The G.C. Wallace Sloan Channel 90% Review Plans has recent topography along the existing channel (1995) for hydraulically modeling the Sloan Channel from the Las Vegas Wash Confluence to Stewart Avenue.

- "As-builts" and hydraulic analysis recently completed by G.C. Wallace for the new concrete-lined portion of Sloan Channel from Stewart Avenue to Owens Avenue may be used to reduce flood zones in this area.

- Sloan Channel from Owens Avenue to Lake Mead Boulevard has sufficient capacity, and has been recently been modeled by PBS&J for the Lake Mead/RV Storage project (1995).

- Sloan Channel from Lake Mead Boulevard to Carey Avenue has sufficient capacity. "As-builts" for the Sloan Flood Control Channel Unit 1, by Kercheval & Associates (1982) were reviewed.

- The hydraulic model by Boyle (1993) for the Nellis Air Force Base (NAFB) Golf Course Channel may be used to document diversion to the Confluence Detention Basin.

- The improvement plans and the hydraulic model contained in the Calculations Summary Range Wash/Sloan Channel Confluence Detention Basin, by Boyle (1993)may be used to obtain the CLOMR for the Confluence Detention Basin.

- The channel traversing the NAFB and for the channel extending from the NAFB to Las Vegas Boulevard has sufficient capacity. The Sloan Channel Plan and Profile by James M. Montgomery (1984) were reviewed.

- New 2-ft contour topography for the City of North Las Vegas (CNLV Topo) that is expected to be completed in October, 1995 will be used to model the natural, unlined Range Wash from Las Vegas Boulevard to Lamb Boulevard.

- The hydraulic model (with modifications for the new RCB at Lamb) and topography for the Lamb Industrial Park, by PBS&J (1992) may be used for the natural, unlined Range Wash from Lamb Boulevard to Craig Road.

- Channel plans and CNLV Topo will be used to model the Vandenberg Channel from Craig Road to Lone Mountain Road.

- CNLV Topo will be used to model the natural, unlined Range Wash from Lone Mountain Road to the West Range Diversion Dike

- "As-builts" and the documentation in the Range Wash Sediment Transportation Documentation Notebook (1992, 1993) will be used to document the West Range Wash Diversion Dike

Supplemental Services

The review of the hydrologic, hydraulic, and sediment transport data indicates supplemental services to perform additional work in these areas will not be warranted. PBS&J expects to perform the revisions to hydrology and necessary hydraulic analysis within the allotted budget for floodplain delineation. The Range Wash Sediment Transportation Documentation Notebook is expected to provide sufficient information for the dike to be accepted by FEMA. There remains a possibility FEMA or the TEC may request additional information and analysis.

The CNLV Topo is expected to provide adequate topography for floodplain delineation in the flood hazard areas north of Las Vegas Boulevard. Supplemental Services for aerial survey and mapping will not be required.

Ground surveys are expected to be required to evaluate the un-lined portion of Sloan Channel between Stewart Avenue and Charleston Boulevard. This reach of the channel

is associated with a broad Zone "A" flood hazard area. The un-improved channel is not expected to have sufficient capacity to contain the flows, even with consideration for the Confluence Detention Basin. The area downstream of the detention basin includes an urbanized watershed and runoff from Sunrise and Frenchman Mountains. There is topography available for this reach from the design drawings for Sloan Channel improvements. Field surveys will be required to verify this topography in this critical area. Deposition or maintenance grading may have changed the channel topography. Survey work will also be required to tie in the datum of different sources of topography. Field surveys will also be required to establish cross-sections at critical structures or other limiting cross-section areas. The cost to perform survey work under the Supplemental Services portion of the agreement is not expected to exceed ten thousand dollars ($10,000).

VI. PRELIMINARY BIBLIOGRAPHY

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(Boyle, 10-92); Final Predesign Memorandum Confluence Detention Basin and Sloan Channel Improvements; Boyle Engineering Corporation; October 16, 1992.

(Boyle, 6-93); Range Wash/Sloan Channel Confluence Detention Basin Calculations Summary; Boyle Engineering Corporation; June, 1993.

(Church, 6-92); Hydrology Study for the Lamb Industrial Park; Church Engineering, Inc.; June, 1992.

(G.C. Wallace, 4-93); Draft Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash; G.C. Wallace, Inc.; April, 1993.

(G.C. Wallace, 4-93); Draft Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash, APPENDIX B; G.C. Wallace, Inc.; April, 1993.

(G.C. Wallace, 5-93); Draft Predesign Memorandum Sloan Channel - Owens Avenue to the Las Vegas Wash; G.C. Wallace, Inc.; May, 1993.

(G.C. Wallace, '95); Sloan Channel 90% Review Plans Stewart Ave. to Las Vegas Wash; G.C. Wallace, Inc.; 1995.

(G.C. Wallace, 6-94); Improvement Plans for Sloan Channel from Owens Avenue to Stewart Avenue; G.C. Wallace, Inc.; June 3, 1994.

(JMM, '84); Sloan Channel Plan and Profile; James M. Montgomery; 1984.

(JMM, '84); Sloan Channel Phase 2 Plan and Profile; James M. Montgomery; 1984.

(JMM, 9-84); Combined Flood Boundary & Floodway Map & Flood Insurance Rate Map; 4-foot contour interval topography; James M. Montgomery; September 9, 1984.

(Kercheval, 5-80); 1982 Construction of Sloan Flood Control Channel Unit 1 from Lake Mead Blvd. to Carey Ave. and RCB at Judson Ave.; Kercheval & Associates; May 16, 1980.

(PBS&J, 3-95); Lake Mead/RV Storage Phase II Grading Plan; Post, Buckley, Schuh & Jernigan Inc.; March 15, 1995.

APPENDIX 1

Photograph Index

RANGE WASH FLOOD INSURANCE RESTUDY

PHOTOGRAPH INDEX
Complete Listing of Reconnaissance Photos

Flooding Source:	Range Wash	Study Contractor:	PBS&J
Communities:	City of North Las Vegas	Project Officer:	Karl Mohr
	Clark County	Tech. Eval. Contractor:	Michael Baker Jr.
State:	Nevada	Date:	August, 1995

LEGEND

D/S	Downstream	MPU	CCRFCD '91 Master Plan Update
L.V.	Las Vegas	LVMD	Las Vegas Wash - Middle
MHP	Mobil Home Park	LVRW	Range Wash - Las Vegas Wash Diversion
N.L.V.	North Las Vegas		
NAFB	Nellis Air Force Base	LVUP	Upper Las Vegas Wash
RCB	Reinforced Concrete Box Culvert	RWSL	Range Wash - Sloan
RCP	Reinforced Concrete Pipe Culvert	RWWB	Range Wash - West Branch
SS	Side Slopes	RWWE	Range Wash - West Tributary
U/S	Upstream	SLEB	Sloan Channel, East Branch
UPRR	Union Pacific Rail Road	SLNO	Sloan Channel, North

Note: Photos are (in general) arranged in order from Downstream to Upstream

FLOODING OR FLOODING DAMAGE PHOTOGRAPHS

VANDENBERG CHANNEL

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
84-6	RWWE 0139	(2) 10' x 6' RCBs	South	Downstream	Lone Mountain Rd.
84-5	RWWE 0126	Conc. Chnl. 10' x 6'; 1.5:1 SS	North	Upstream	Vandenberg Dr.
84-4	RWWE 0125	(2) 10' x 4' RCBs	South	Downstream	Vandenberg Dr.
84-3	RWWE 0105	(2) 10' x 4' RCBs	South	Downstream	Vandenberg Dr.
84-2	---	Overflow, east side of Vandenberg Dr.	South	Downstream	Vandenberg/Craig
84-1	---	Overflow on Craig Road from Channel	West	---	Craig Road

LAS VEGAS WASH AT CONFLUENCE OF SLOAN CHANNEL

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-1	LVMD 0827	L.V. Wash (Unlined/lined Transition)	West	Upstream	U/S of Confluence
6-2	LVMD 0827	Sloan Chan. Confluence w/L.V. Wash	East	Downstream	N. of Veg. Valley Dr.
6-3	RWSL 0000	Sloan Chan. Confluence w/L.V. Wash	North	Upstream	N. of Veg. Valley Dr.
6-4	RWSL 0000	Sloan Chan. Confluence w/L.V. Wash	North	Upstream	N. of Veg. Valley Dr.

UNLINED SLOAN CHANNEL FROM LAS VEGAS WASH TO SAHARA AVENUE

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-5	RWSL 0000	Sloan Chan. Confluence w/L.V. Wash	Southeast	Downstream	N. of Veg. Valley Dr.
6-6	RWSL 0000	Sloan Chan. (Unlined/lined Trans.)	North	Upstream	N. of Veg. Valley Dr.
6-7	RWSL 0000	Sloan Chan. (Unlined/lined Trans.)	North	Upstream	N. of Veg. Valley Dr.
6-8	RWSL 0000	Sloan Channel	Northeast	Upstream	S. of Sahara Ave.
6-9	RWSL 0000	Sloan Chan. (Unlined/lined Trans.)	South	Downstream	N. of Veg. Valley Dr.
6-10	RWSL 0000	(3) 15' x 6' and (2) Irregular	North	Upstream	Sahara Avenue
		Shaped Bridge Openings			

UNLINED SLOAN CHANNEL FROM SAHARA AVENUE TO CHARLESTON BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-11	RWSL 0000	Heavy Vegetation in Sloan Channel	North	Upstream	N. of Sahara Ave.
6-12	RWSL 0000	Heavy Vegetation in Sloan Channel	North	Upstream	N. of Sahara Ave.
6-13	RWSL 0000	Sloan Channel Bridge Crossing	South	Downstream	Sahara Avenue
6-14	RWSL 0000	Confluence with Orchards Channel	East	Upstream	Orchards Homes
6-15	RWSL 0000	Confluence with Orchards Channel	North	Upstream	Orchards Homes
6-16	RWSL 0000	(4) 10' x 4' Bridge Openings	East	Upstream	Orchard Valley Rd.
6-17	RWSL 0000	Sloan Channel	South	Downstream	S. of Charleston
6-18	---	36" RCP From Orchards	East	Upstream	S. of Charleston
6-19	RWSL 0000	Sloan Channel	South	Upstream	S. of Charleston
6-20	RWSL 0134	(1) 31' x 7' and (2) Irregular	North	Upstream	Charleston Blvd.
		Shaped Bridge Openings			
6-21	---	54" RCP from Charleston Blvd.	Northwest	Upstream	Charleston Blvd.
6-22	---	60" RCP from Charleston Blvd.	Northwest	Upstream	Charleston Blvd.
6-23	RWSL 0000	Sloan Channel	South	Downstream	S. of Charleston

UNLINED SLOAN CHANNEL FROM CHARLESTON BLVD. TO STEWART AVE.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-24	RWSL 0135	Sloan Channel	North	Upstream	N. of Charleston
6-25	RWSL 0134	(1) 31' x 7' and (2) Irregular	South	Downstream	Charleston Blvd.
		Shaped Bridge Openings			
7-1	RWSL 0134	Sloan Channel Bridge Crossing	South	Downstream	Charleston Blvd.
7-2	---	(2) 24" RCP's	West	Upstream	N. of Charleston
7-3	RWSL 0135	Sloan Channel	Northwest	Upstream	S. of Stewart Ave.
7-4	RWSL 0135	Sloan Channel at Stewart Ave.	South	Downstream	S. of Stewart Ave.
7-5	RWSL 0188	(8) 10' x 3.5' Bridge Openings	North	Upstream	Stewart Avenue

CONCRETE-LINED SLOAN CHANNEL FROM STEWART AVE. TO LAKE MEAD BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
7-6	RWSL 0188	(8) 10' x 3.5' Bridge Openings	South	Downstream	Stewart Avenue
7-7	RWSL 0189	Sloan Channel at Stewart Ave.	North	Upstream	N. of Stewart
7-8	RWSL 0238	(5) 10' x 5' Bridge Openings	North	Upstream	Bonanza Rd.
7-9	---	7.5 x 4.8 Elyptical RCP	Northeast	Upstream	Bonanza Rd.
7-10	RWSL 0238	(5) 10' x 5' Bridge Openings	South	Downstream	Bonanza Rd.
7-11	RWSL 0239	Sloan Channel	North	Upstream	N. of Bonanza Rd.
7-12	RWSL 0288	(1) 31' x 7' and (2) Irregular	North	Upstream	Washington Ave.
		Shaped Bridge Openings			
7-13	---	60" RCP	Northeast	Upstream	Washington Ave.
7-14	RWSL 0288	(1) 31' x 7' and (2) Irregular	South	Downstream	Washington Ave.
		Shaped Bridge Openings			
7-15	RWSL 0339	(6) 9' x 5' Bridge Openings	North	Upstream	Owens Ave.
7-16	RWSL 0314	Sloan Channel	South	Downstream	S. of Owens Ave.
7-17	---	6.2' x 4.0' RCP	Northeast	Upstream	Owens Ave.
7-18	RWSL 0339	(6) 9' x 5' Bridge Openings	South	Downstream	Owens Ave.
7-19	RWSL 0340	Sloan Channel (Owens Bridge)	South	Downstream	N. of Owens Ave.
7-20	RWSL 0365	Sloan Channel	North	Upstream	S. of Lake Mead
7-21	---	Drainage Easement	Northeast	Upstream	S. of Lake Mead
7-22	RWSL 0389	(5) 12' x 5' Bridge Openings	North	Upstream	Lake Mead Blvd.
7-23	---	(1) 60" & (1) 69" x 48" RCP's	Northeast	Upstream	Lake Mead Blvd.

CONCRETE-LINED SLOAN CHANNEL FROM LAKE MEAD BLVD. TO CAREY AVE.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
7-24	RWSL 0389	(5) 12' x 5' Bridge Openings	South	Downstream	Lake Mead Blvd.
7-25	RWSL 0390	Sloan Channel	North	Upstream	N. of Lake Mead
8-1	RWSL 0415	(4) 12' x 5.5' Bridge Openings	South	Downstream	Judson Avenue
8-2	RWSL 0390	Sloan Channel	South	Downstream	S. of Judson
8-3	RWSL 0415	(4) 12' x 5.5' Bridge Openings	North	Upstream	Judson Avenue
8-4	RWSL 0416	Sloan Channel	North	Upstream	N. of Judson
8-5	RWSL 0416	Channel Bend	North	Upstream	Carey Avenue
8-6	---	24" Tributary to Sloan Channel	West	Upstream	Carey Avenue
8-7	RWSL 0447	Channel Bend (Limit of NAFB)	Northwest	Upstream	Carey Avenue
8-8	RWSL 0446	Northern Tributary to Sloan Channel	North	Upstream	Carey Avenue
8-9	RWSL 0416	Northern & Western Tributaries to	Southeast	Downstream	Carey Avenue
		Sloan Channel			
8-10	---	Swale on NAFB -- Tributary to	North	Upstream	Carey Avenue
		Sloan Channel			
8-11	RWSL 0446	Northern Tributary to Sloan Channel	North	Upstream	Carey Avenue
		and Swale on NAFB			
8-12	RWSL 0447	Western Tributary to Sloan Channel	West	Upstream	Carey Avenue
8-13	RWSL 0446	Northern Tributary to Sloan Channel	North	Upstream	Carey Avenue
		and Swale on NAFB			
8-14	RWSL 0416	Northern & Western Tributaries to	Northwest	Upstream	Carey Avenue
		Sloan Channel			
8-15	---	Overall View of Three Tributaries	Northwest	Upstream	Carey Avenue
		to Sloan Channel at Carey Ave.			

NAFB CHANNEL FROM SLOAN LN. TO CHRISTY LN. ALIGNMENT

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-37	RWSL 0047	Confluence with Sloan Channel	South	Downstream	Carey Avenue
5-36	RWSL 0047	Confluence with Sloan Channel	South	Downstream	Carey Avenue
5-35	RWSL 0047	Confluence with Sloan Channel	Southeast	Downstream	Carey Avenue
5-34	RWSL 0047	Confluence with Sloan Channel	Southeast	Downstream	Carey Avenue
5-33	RWSL 0047	Transition Lined/Unlined Channel	Southeast	Downstream	Carey Avenue
5-32	RWSL 0047	Erosion of Channel (North of Bend)	South	Downstream	North of Carey
5-31	RWSL 0047	Erosion of Channel	Southwest	Downstream	North of Carey
5-30	RWSL 0047	Erosion of Channel (South of Bend)	South	Downstream	S. of Golf Course
5-29	RWSL 0047	Channel Bend	Southeast	Downstream	S. of Golf Course
5-28	RWSL 0047	Channel Bend	Southeast	Downstream	S. of Golf Course
5-27	RWSL 0047	Erosion Hole in West Bank	Southeast	Downstream	E. of Christy Ln.
5-26	RWSL 0047	Channel Bend	Northwest	Upstream	E. of Christy Ln.
5-25	RWSL 0047	Erosion Hole in West Bank	West	Upstream	E. of Christy Ln.

AFB GOLF COURSE CHANNEL FROM CONFLUENCE DETENTION BASIN TO KINLEY RD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-24	RWSL 0502	Detention Basin	Northeast	Upstream	E. of NAFB
5-23	RWSL 0502	Detention Basin	South	Downstream	E. of NAFB
5-22	RWSL 0523	East Bridge (West of Bend)	West	Upstream	Golf Course
5-21	---	Northern Tributary	Northwest	Upstream	E. of Golf Course
5-20	RWSL 0523	Channel East of East Bridge	East	Downstream	E. of Golf Course
5-19	RWSL 0523	Eastern Golf Course Bridge	West	Upstream	Golf Course
5-18	RWSL 0524	Channel West of East Bridge	East	Downstream	Golf Course
5-17	RWSL 0524	Channel Bend	East	Downstream	Golf Course
5-16	RWSL 0524	Unlined Channel Bend	Southeast	Downstream	Golf Course
5-15	RWSL 0524	Western Golf Course Bridge	Southeast	Downstream	Golf Course
5-14	RWSL 0524	Channel South of Cheyenne Bridge	Southeast	Downstream	N.W. of Golf Course
5-13	RWSL 0559	Kinley Bridge	Northwest	Upstream	N.W. of Golf Course
5-12	RWSL 0559	Kinley Bridge	South	Downstream	N.W. of Golf Course
5-11	RWSL 0559	Kinley Bridge	Southeast	Downstream	N.W. of Golf Course
5-10	RWSL 0559	Kinley Bridge	East	Downstream	N.W. of Golf Course

NAFB CHANNEL FROM CHRISTY LN. ALIGNMENT TO NELLIS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-9	---	(1) 24" RCP	West	Upstream	E. of Christy Lane
5-8	RWSL 0576	Confluence with Kinley Tributary	North	Upstream	E. of Christy Lane
5-7	SLNO 0000	Flap Gate at Kinley Confluence	Northeast	Upstream	E. of Christy Lane
5-6	SLNO 0000	Kinley Tributary	Southwest	Downstream	E. of Channel
5-5	SLNO 0000	Kinley Tributary	South	Downstream	E. of Channel
5-4	SLNO 0008	Box Culverts Across Kinley Tributary	East	Upstream	Duffer Dr.
5-3	RWSL 0576	Unlined Channel Bend	East	Downstream	S. of Duffer Dr.
5-2	RWSL 0609	Unlined Channel Bend	West	Upstream	E. of Nellis
5-1	RWSL 0609	Unlined Channel Bend	South	Downstream	E. of Nellis
5-0	RWSL 0609	Unlined Channel	South	Downstream	S. of I Street
5-00	RWSL 0063	(3) 10' X 7' RCB's	North	Upstream	I Street
4-25	RWSL 0063	(3) 10' X 7' RCB's	South	Downstream	I Street
4-24	---	Small Tributary	East	Upstream	I Street
4-23	RWSL 0064	Channel Bend	East	Downstream	N. of I Street
4-22	---	Small Tributary	North	Upstream	N. of I Street
4-21	RWSL 0671	(3) 10' X 7' RCB's	West	Upstream	Nellis Blvd.

CONCRETE-LINED SLOAN CHANNEL FROM NELLIS BLVD. TO LAS VEGAS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
1-12	RWSL 0671	(3) 10' x 7' RCB's	East	Downstream	Nellis Boulevard
8-16	RWSL 0671	(3) 10' x 7' RCB's	East	Downstream	Nellis Boulevard
4-21	RWSL 0671	(3) 10' x 7' RCB's	West	Upstream	Nellis Boulevard
1-15	RWSL 0727	(3) 10' x 8' RCB's	West	Upstream	Marion Drive
1-16	RWSL 0727	(3) 10' x 8' RCB's	East	Downstream	Marion Drive
1-17	RWSL/SLEB	Confluence of RWSL & SLEB	West	Upstream	Lamont Street
1-18	RWSL/SLEB	Confluence of RWSL & SLEB	West	Upstream	Lamont Street
1-22	RWSL 0745	(7) 10' x 7' RCBs	Southeast	Downstream	Las Vegas Blvd.
1-23	RWSL 0745	Looking U/S from within the RCB	Northwest	Upstream	Las Vegas Blvd.
1-24	RWSL 0745	(7) 10' x 7' RCBs	Northwest	Upstream	Las Vegas Blvd.

CONCRETE-LINED SLOAN CHANNEL (EAST BRANCH) SOUTH OF LAS VEGAS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
1-13	SLEB 0015	(3) 10' x 6' RCB's	South	Downstream	Storyville MHP
1-14	SLEB 0015	(3) 10' x 6' RCB's	North	Upstream	Storyville MHP
1-19	SLEB 0044	(6) 10' x 7' RCBs	Northwest	Upstream	Las Vegas Blvd.
1-20	SLEB 0044	Looking U/S from within the RCB	Northwest	Upstream	Las Vegas Blvd.
1-21	SLEB 0044	(6) 10' x 7' RCBs	Southeast	Downstream	Las Vegas Blvd.

UNDEVELOPED WASH FROM LAS VEGAS BLVD. TO CRAIG RD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
1-25	RWWE 0000	Natural wash contributing to RCBs	South	Downstream	N. of Las Vegas Bl.
2-1	RWWE 0000	Natural wash contributing to RCBs	South	Downstream	N. of Las Vegas Bl.
2-2	RWWE 0000	Natural desert S. of Alexander RCBs	North	Upstream	S. of Alexander
2-3	RWWE 0026	(4) 10' x 9' RCBs	Northwest	Upstream	Alexander Road
2-4	RWWE 0026	(4) 10' x 9' RCBs	East	Downstream	Alexander Road
2-5	---	Overflow Channel near RCBs	East	---	Alexander Road
8-17	RWWE 0027	Overflow Channel near RCBs	West	Upstream	Alexander Road
2-6	RWWE 0027	Northern Tributary to Alexander RCBs	Northwest	Upstream	N. of Alexander
8-18	RWWE 0027	Northern Tributary to Alexander RCBs	Northwest	Upstream	N. of Alexander
2-7	---	Western Tributary to Alexander RCBs	West	Upstream	Parallel to Alex. Rd.
2-8	---	RCP at U/S of W. Trib. to Alexander	West	Upstream	Alexander/Lamb
2-9	RWWE 0054	(3) 8' x 4' RCBs	West	Upstream	Lamb Boulevard
2-10	RWWE 0054	(3) 8' x 4' RCBs	East	Downstream	Lamb Boulevard
8-19	RWWE 0054	(3) 8' x 4' RCBs	East	Downstream	Lamb Boulevard
8-20	RWWE 0055	Natural Wash	Northwest	Upstream	W. of Lamb Blvd.
2-11	RWWE 0088	(2) 8' x 4' RCBs	North	Upstream	Craig Road
8-21	RWWE 0055	Natural Wash	South	Downstream	S. of Craig Rd.
2-12	RWWE 0088	Erosion at RCBs from flow in Craig Rd.	Northwest	Upstream	Craig Road
8-22	RWWE 0088	Erosion at RCBs from flow in Craig Rd.	Northwest	Upstream	Craig Road
2-13	RWWE 0088	(2) 8' x 4' RCBs	South	Downstream	Craig Road

VANDENBERG CHANNEL FROM CRAIG ROAD TO LONE MOUNTAIN ROAD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
2-14	RWWE 0096	(2) 10' x 4' RCBs & 20' x 6' 2:1SS Chnl	North	Upstream	Vandenberg Dr.
2-15	RWWE 0096	(2) 10' x 4' RCBs & 20' x 6' 2:1SS Chnl	South	Downstream	Vandenberg Dr.
8-24	RWWE 0097	Damaged Channel	East	---	N. of RCB's
8-25	RWWE 0097	Damaged Channel	East	---	N. of RCB's
2-16	RWWE 0105	(2) 10' x 3' RCBs & 20' x 6' 2:1SS Chnl	North	Upstream	Vandenberg Dr.
2-17	RWWE 0105	(2) 10' x 3' RCBs & 20' x 6' 2:1SS Chnl	South	Downstream	Vandenberg Dr.
2-18	RWWE 0125	(2) 9' x 3' RCBs & 20' x 6' 2:1SS Chnl.	North	Upstream	Vandenberg Dr.
2-19	RWWE 0125	(2) 9' x 3' RCBs & 20' x 6' 2:1SS Chnl.	South	Downstream	Vandenberg Dr.

UNDEVELOPED WASH FROM LONE MOUNTAIN RD. TO INTERSTATE 15

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
2-20	RWWE 0139	(2) 10' x 3' RCBs	North	Upstream	Lone Mountain Rd.
2-21	RWWE 0140	From road looking upstream at channel	North	Upstream	Lone Mountain Rd.
8-23	RWWE 0140	From road looking upstream at channel	North	Upstream	Lone Mountain Rd.
2-22	RWWE 0139	(2) 10' x 3' RCBs	South	Downstream	Lone Mountain Rd.
2-23	RWWE 0168	(3) 15' x 10' RCBs	Northwest	Upstream	Interstate 15
2-24	RWWE 0168	(3) 15' x 10' RCBs	Southeast	Downstream	Interstate 15
2-25	RWWE 0168	Looking U/S from within the RCB	Northwest	Upstream	Interstate 15
3-1	RWWE 0168	Looking U/S from within the RCB	Northwest	Upstream	Interstate 15
3-2	RWWE 0168	(3) 15' x 10' RCBs	Southeast	Downstream	Interstate 15

UNDEVELOPED WEST BRANCH OF RANGE WASH AT THE UPRR CROSSING

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
3-3	RWWE 0202	(1) 12' x 8' RCB	Northwest	Upstream	UPRR
3-4	RWWE 0202	(1) 12' x 8' RCB	Southeast	Downstream	UPRR

UNDEVELOPED EAST BRANCH OF RANGE WASH AT THE UPRR CROSSING

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
3-5	RWWB 0027	(2) 21' x 12' Bridge Openings	Southeast	Downstream	UPRR
3-6	RWWB 0027	(2) 21' x 12' Bridge Openings	Northwest	Upstream	UPRR

RANGE WASH FROM THE UPRR TO NORTH LAS VEGAS DETENTION BASIN

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
9-1	RWWE 0203	Pecos Rd. dip section	Southeast	Downstream	S. of Ann Rd.
9-2	RWWE 0203	Pecos Rd. dip section	Northeast	Upstream	S. of Ann Rd.
9-3	---	Ann Rd. dip section	North	Upstream	E. of Pecos Rd.
9-4	---	Ann Rd. dip section	South	Downstream	E. of Pecos Rd.
9-5	---	Centenial Pkwy. dip section	South	Downstream	Centenial Pkwy.
9-6	LVRW 0000	Range Wash tributary to det. basin	North	Upstream	N.L.V. Det. Basin
9-7	LVUP 0405	North Las Vegas Detention Basin	South	Downstream	Southeast Corner
9-8	LVUP 0405	North Las Vegas Detention Basin	West	Downstream	Southwest Corner
9-9	LVRW 0000	Range Wash tributary to det. basin	Southwest	Downstream	Diversion Dike
9-10	LVRW 0057	Range Wash diversion dike	Northeast	Upstream	N.E. of Det. Basin
9-11	LVRW 0057	Range Wash diversion dike	East	Upstream	N.E. of Det. Basin

FLOOD HAZARD "A" ZONE AREA FROM MITCHEL STREET TO FREHNER ROAD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
10-1	---	I-15 overpass (flood zone area)	East	---	UPRR crossing
10-2	---	I-15 overpass (flood zone area)	West	---	UPRR crossing
10-3	---	I-15 overpass (flood zone area)	East	---	UPRR crossing
10-4	---	Levee along flood zone boundary	South	---	W. of I-15
10-5	UPRR 2203	(1) 9 x 9 RCB	West	Upstream	UPRR crossing
10-6	---	Frehner Road crossing over RCB	West	Upstream	Frehner Rd.
10-7	---	Zone "A" flood hazard area	Southwest	---	W. of I-15
10-8	---	(1) 4 x 7 RCB	East	Downstream	I-15 crossing
10-9	---	Construction area	West	---	W. of I-15
10-10	---	Zone "A" flood hazard area	South	---	W. of I-15
10-11	---	(1) 4 x 7 RCB	West	Upstream	I-15 crossing
10-12	---	End of channel east of I-15	West	Upstream	Mitchel Street
10-13	---	Entrance to channel east of I-15	Southeast	Downstream	E. of I-15
10-14	---	Channel east of I-15	East	Downstream	E. of I-15

MISCELLANEOUS STREET IMPROVEMENTS AND DEVELOPMENT IMPACTS

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
12-1	---	Cibola Development Site Grading	West	---	Stewart Ave.
12-2	---	Cibola Development Site Grading	West	---	Along Sloan Chan.
12-3	---	Bonanza Road St. Improvements	East	---	Sloan Chan.
12-4	---	Bonanza Road St. Improvements	East	---	Sloan Chan.
12-5	---	Walnut Road St. Improvements	Southeast	---	Mitchell St.
12-6	---	Railroad Tracks	North	---	Mitchell St.
12-7	---	Impoundment Area West of Walnut Rd.	Southeast	---	UPRR near Walnut
12-8	---	Golden Triangle Industrial Park	Northwest	---	Frehner Rd.
12-9	---	Golden Triangle Industrial Park	Northwest	---	Frehner Rd.
12-10	---	Golden Triangle Industrial Park	Northwest	---	Frehner Rd.
12-11	---	Golden Triangle Industrial Park	West	---	Park RR Spur.
12-12	---	Channel along Craig Rd.	East	D/S	South of Craig
13-1	---	Walnut Road	South	---	RR Spur.
13-2	---	Railroad Spur	East	---	Walnut Road
13-3	---	Railroad Spur	West	---	Walnut Road
13-4	---	Craig Road	West	---	Walnut Road
13-5	---	Andrews Street	Southeast	---	End of RR Spur
13-6	---	Andrews Street	Southwest	---	End of RR Spur
13-7	---	Andrews Street	Southwest	---	End of RR Spur
13-8	---	Maple Hill Road	Southeast	---	Near Walnut Rd.
13-9	---	Alexander Road Sump	East	---	Lamb Blvd.
13-10	---	Alexander Road Sump	West	---	Lamb Blvd.
13-11		Regrading East of Alexander Rd RCB	East	---	Alexander Rd.
13-12	RWWE 0027	Channel Construction	Northwest	U/S	Alexander Rd.
13-13	---	Charleston Blvd. St. Improvements	West	---	A Zone Area
13-14	---	Charleston Blvd. St. Improvements	West	---	Sloan Channel

APPENDIX 2

Data Collection Tables

Hydrologic Information

Hydraulic Information

Improvement Plans

LOMRs

RANGE WASH FIS

HYDROLOGIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
4-90	Boyle	Hydrologic Analysis Western and Eastern Tributaries of Range Wash	This hydrologic analysis has been used as the basis for studies prepared more recently. Recent studies have modified this model.	Use the more recent hydrology from the Confluence Detention Basin study
6-91	Boyle	Western and Eastern Tributaries of Range Wash Flood Control Facility Plan	Report presented options for the Range Wash HEC-1 based on Boyle, 1990 Hydrology	Use the more recent hydrology from the Confluence Detention Basin study
8-91	JMM	Las Vegas Valley Flood Insurance Study	HEC-1 based on Boyle, 1990 Hydrology West Range Diversion Dike is assumed to be existing in the MPU model.	Use the more recent hydrology from the Confluence Detention Basin study
1-92, 4-92	Pentacore	Conceptual Drainage Study for Orchards	HEC-1 from Frenchman Mtns. to Hollywood and also from Stewart to Charleston	Update model as needed
3-90,5-90 1-91, 7-91	GCWallace	Peachtree LOMRs, 3-13-92, 7-13-92	This project was the first part of the Orchards Master Plan, and the HEC-1 is for interim.	Use more recent HEC-1 from the Orchards
7-92	Boyle	Range Wash Sediment Transport Documentation Notebook	Sediment analysis for the Range Wash Dike Hydrology for the Range Wash	Include in the TSDN to document Range Wash Dike
6-93	Boyle	Calculations Summary Range Wash/Sloan Channel Confluence Detention Basin	HEC-1 for existing conditions with detention basin improvements	Use and revise this model for FIS Restudy hydrology Subdivide some drainage basins

RANGE WASH FIS

HYDRAULIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
10/4/93	GCWallace	Sloan Channel 90% Review Plans	Improvements have not been constructed	Existing topography
		Stewart Ave. to Las Vegas Wash		supplemented with ground survey
		Sahara to Las Vegas Wash	Channel is unlined until just U/S of the	may be used to
		Sheets C-13 through C-12	confluence with the Las Vegas Wash	develop hydraulic analysis
			No HEC-2 information for existing channel	Channel Improvements
				will not be constructed
				for inclusion in FIS Restudy
10/4/93	GCWallace	Sloan Channel 90% Review Plans	Improvements have not been constructed	Channel Improvements
		Stewart Ave. to Las Vegas Wash		will not be constructed
		Charleston to Sahara		for inclusion in FIS Restudy
		Sheets C-12 through C-7		
1/92, 4/92	Pentacore	Conceptual Drainage Study for Orchards	HEC-2 Sloan Channel, Charleston to Sahara	HEC-2 is based on topography
			(Approximately 1 mile, Unlined)	obtained in November, 1990
3/90	GCWallace	Peachtree	Has HEC-2 for Sloan Channel from	Compare with more recent
			Charleston to Sahara	HEC-2 for Orchards
3/25/85	Clark County	1985 Construction Plans for	11 Plans Sheets	Infromation will be used to
	Public Works	Charleston Boulevard Bridge		hydraulically model bridge
		at Sloan Channel		May reduce upstream Zone "A"

RANGE WASH FIS

HYDRAULIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
5/21/86	Boyle	Sloan Channel Improvements	Improvements have not been constructed	Compare to more recent
	(11 Sheets)	Charleston Boulevard to Las Vegas Wash	Includes topography existing in 1986	topography and ground surveys
		Confluence		
5/21/86	Boyle	Sloan Channel Improvements	Improvements have not been constructed	Compare to more recent
	(7 Sheets)	Stewart Avenue to Charleston Boulevard	Includes topography existing in 1986	topography and ground surveys
5/21/86	Boyle	Sloan Channel Improvements	Channel was constructed per Final Plans	Use G.C. Wallace Plans
	(7 Sheets)	Bonanza Road to Stewart Avenue	updated by G.C. Wallace	
5/21/86	Boyle	Sloan Channel Improvements	Channel was constructed per Final Plans	Use G.C. Wallace Plans
	(6 Sheets)	Washington Avenue to Bonanza Road	updated by G.C. Wallace	
5/21/86	Boyle	Sloan Channel Improvements	Channel was constructed per Final Plans	Use G.C. Wallace Plans
	(12 Sheets)	Owens Avenue to Washington Avenue	updated by G.C. Wallace	

RANGE WASH FIS

HYDRAULIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
1995	GCWallace	Sloan Channel 90% Review Plans	Improvements have not been constructed	Existing topography
		Stewart Ave. to Las Vegas Wash		supplemented with ground survey
		Stewart to Charleston	No HEC-2 information on unlined channel	may be used
		Sheets C-7 through C-5		
				Channel Improvements will not be
				constructed for inclusion in FIS
6/3/94	GCWallace	Improvement Plans for Sloan Channel	HEC-2 Sloan Channel, Owens to Stewart	Include in FIS
	(14 Sheets)	from Owens Avenue to Stewart Avenue		
3/15/95	PBS&J	Lake Mead/RV Storage	HEC-2 Model for channel at Storage Site	Channel has capactiy
		Phase II Grading Plan		No existing Zone "A"
				Lake Mead to Owens
1995	PBS&J	Letter and Calculations	HEC-2 Model for adjacent section of channel	
		1982 Construction of	Plans reviewed but no calculations	Channel has capactiy
5-16-80	Kercheval	Sloan Flood Control Channel Unit 1		No existing Zone "A"
	& Assoc.	from Lake Mead Blvd. to Carey Ave.		Lake Mead to Owens
		and RCB at Judson Ave.		
6-93	Boyle	Calculations Summary	HEC-2 Model for	Diverts flow to detention basin
		Range Wash/Sloan Channel	NAFB Golf Course Channel	Include in FIS
		Confluence Detention Basin		

RANGE WASH FIS

HYDRAULIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
1983	James M. Montgomery	Sloan Channel Plan and Profile Sta. 0+00 to 124+53.11 Sheets 3 through 8	Nellis to Carey through NAFB Plans reviewed but no calculations	Channel has capactiy No existing Zone "A"
1984	James M. Montgomery	Sloan Channel - Phase 2 - Plan and Profile Sta. 165+77.84 to 124+53.11 Sheets 8, 9 & 10	Las Vegas Blvd. to Nellis Plans reviewed but no calculations	Channel has capactiy No existing Zone "A"
1984	James M. Montgomery	Sloan Channel - Phase 2 - Plan and Profile Sta. 2+00 to 22+85.48 Sheet 11	Local tributary concrete channel between Las Vegas Blvd. and Nellis Plans reviewed but no calculations	Channel has capactiy No existing Zone "A"
9/14/84	James M. Montgomery	Combined Flood Boundary & Floodway Map & Flood Insurance Rate Map	4-ft contour interval topography	Some of this topo may be used, supplemented with ground survey and more recent topography
6/92	Church Eng.	Hydrology Study, Lamb Industrial Park	Range Wash, Lamb Blvd. to Craig Rd. HEC-2 Existing when Q-100 = 7000 cfs & when (2) 12'x4' RCBs were at Lamb 1-ft contour interval topography	Update with new Q-100 and with (3) 9'x6' RCBs at Lamb Blvd.
9/26/81	City of North Las Vegas	City of North Las Vegas 2-ft contour interval topography	I-15 to Pecos and the area between Lone Mountain, Lamb, Craig, and I-15	Use new digital CNLV Topo available in October

RANGE WASH FIS

HYDRAULIC ANALYSES INFORMATION

REPORT/ PLANS DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	COMMENTS
Expected	City of North	Aerial Mapping Project	Digital 2-ft contour interval	Use for modeling natural washes
Oct. '95	Las Vegas	for areas near and within the CNLV	topography for CNLV hydrologic area	upstream of Las Vegas Blvd.
1/25/93	Boyle	West Range Wash Diversion Dike	Northern boundary of this FIS Restudy	Diverts flow to the
1/28/93		20 Sheets		North Las Vegas Det. Basin
				Include in FIS
7/27/92	Boyle	Range Wash Sediment Transport	Water Surface Profile, Dike Height Computation	Include in FIS
		Documentation Notebook	Dike Slope Stability Analysis	

RANGE WASH FIS

AS-BUILT INFORMATION

PLANS DATE	ENGINEER	PLANS NAME	ENTITY
1/25/93	Boyle	West Range Wash Diversion Dike	City of North Las Vegas
1/28/93	Engineering	(20 Sheets)	
	Corporation		
6/3/94	GCWallace	Improvement Plans for Sloan Channel	Clark County
		from Owens Avenue to Stewart Avenue	
		(14 Sheets)	
7/1/94	Boyle	Sloan Channel/Range Wash	Clark County
		NAFB Golf Course Channel	

RANGE WASH FIS

DFIRM INFORMATION

DATE	DFIRM PANEL	CROSS-REFERENCE TO OLD FIRMS	AREA DESCRIPTION
8/16/95	1790 of 4090	Clark County, 320003 1790 D	Within T19S R61E and T19S R62E
	32003C1790 D	North Las Vegas, 320007 1790 D	Front Boy pages 5, 6, 16, and 17
8/16/95	2176 of 4090	Clark County, 320003 2176 D	Within T19S R61E and T19S R62E
	32003C2176 D	North Las Vegas, 320007 2176 D	And Within T20S R61E and T20S R62E
			Front Boy pages 16, 17, 26, 27
8/16/95	2180 of 4090	Clark County, 320003 2180 D	Within T19S R62E and T20S R62E
	32003C2180 D	Las Vegas, 325276 2180 D	Front Boy pages 17, 27and 37
		North Las Vegas, 320007 2180 D	
8/16/95	2200 of 4090	Clark County, 320003 2200 D	Within T19S R62E, T20S R62E, and T21S R62E
	32003C2200 D	Las Vegas, 325276 2200 D	Front Boy pages 27, 37 and 47

RANGE WASH FIS

LOMR INFORMATION

LOMR DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	CASE NUMBER
13-Mar-92	GCWallace	Peachtree		92-09-070G
4-May-92	GCWallace	Peachtree		92-09-097G
30-Jun-92	GCWallace	Peachtree		92-09-142G
13-Jul-92	GCWallace	Peachtree		92-09-136G
20-Jul-92	GCWallace	Peachtree		92-09-160G
30-Jul-92	GCWallace	Peachtree		92-09-151G
8-Sep-92	GCWallace	Peachtree		92-09-182G
10-Sep-92	GCWallace	Peachtree		92-09-184G
30-Dec-92	GCWallace	Peachtree		93-09-113A
30-Dec-92	GCWallace	Peachtree		93-09-084A
4-Feb-93	GCWallace	Peachtree		93-09-184A
19-Feb-93	GCWallace	Peachtree		93-09-181A
16-Mar-93	GCWallace	Peachtree		93-09-253A
18-Mar-93	GCWallace	Peachtree		93-09-268A
4-May-93	GCWallace	Peachtree		93-09-378A
24-Jun-93	GCWallace	Peachtree		93-09-506A
26-Jul-93	GCWallace	Peachtree		93-09-585A
28-Sep-93	GCWallace	Peachtree		93-09-715A
29-Nov-93	GCWallace	Peachtree		94-09-028A
19-Jul-91		Sheaker Heights	Reissue LOMR from 12/5/88	
23-Mar-90		Winterwood Sunrise, Parcels 1, 2 & 3		T-218-70-R-(REI)
26-Dec-89	VTN	Daybreak		IA-RA-TO (218-65)

RANGE WASH FIS

LOMR INFORMATION

LOMR DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	CASE NUMBER
11-Nov-94	EMS	**Las Vegas Wash**	**Stewart to Charleston**	94-09-605P
8-Jun-94	Pentacore	**Hollywood Highlands**	**Diversion Channel, starting at Hollywood & Bonanza Diverts flow to the Sloan Channel**	94-09-224P
14-Jan-94	GCWallace	**Upper Las Vegas Wash Detention Basin and Berm/Channel and Gowan Detention Basin**	**Las Vegas Wash and Range Wash (Sloan Channel)**	94-09-065P
3-Feb-94 RE: LOMR 14-Jan-94	Letter from GCWallace	Las Vegas Wash and Range Wash (Sloan Channel)	Subdivisions no longer in SFHA: Stonebridge, Pacific Collage, Tapestry	
25-Oct-89	GCWallace	Sunrise Valley		IA-RA-TO (218-65)
19-Jan-90	GCWallace	Sunrise Valley		T-218-65-R
3-May-90	GCWallace	Sunrise Valley		T-218-65-R
29-Jun-90	GCWallace	Sunrise Valley		T-218-65-R
16-Jul-90	GCWallace	Sunrise Valley		T-218-65-R
27-Jul-90	GCWallace	Sunrise Valley		T-218-65-R
4-May-93	Pentacore	Sunrise Valley Garden Homes		93-09-377A
19-May-93		Sunrise Valley Garden Homes	(Reissue LOMR from 12/5/88))	93-09-429A

RANGE WASH FIS

LOMR INFORMATION

LOMR DATE	ENGINEER	REPORT NAME	DESCRIPTION OF AREA & ANALYSIS	CASE NUMBER
18-Dec-91	GCWallace	Stonebridge		92-09-031G
6-Feb-92	GCWallace	Stonebridge		92-09-054G
11-Feb-92	GCWallace	Stonebridge		92-09-065G
11-Feb-92	GCWallace	Stonebridge		92-09-062G
13-Mar-92	GCWallace	Stonebridge		92-09-075G
30-Dec-92	GCWallace	Stonebridge		93-09-094A
7-Jan-93	GCWallace	Stonebridge		93-09-134A
9-Feb-93	GCWallace	Stonebridge		93-09-197A
19-May-93	GCWallace	Stonebridge		93-09-440A
27-Sep-93	GCWallace	Stonebridge		93-09-699A
5-Nov-93	GCWallace	Stonebridge		93-09-766A
26-Jul-93	Pentacore	Orchards		93-09-594A
6-Oct-93	Pentacore	Orchards		93-09-731A
26-Oct-93	Pentacore	Orchards		93-09-017A
10-Nov-93	Pentacore	Orchards		93-09-795A

APPENDIX 3

Photograph Log

RANGE WASH FLOOD INSURANCE RESTUDY

PHOTOGRAPH LOG

Flooding Source:	Range Wash	Study Contractor:	PBS&J
Communities:	City of North Las Vegas	Project Officer:	Karl Mohr
	Clark County	Tech. Eval. Contractor:	Michael Baker Jr.
State:	Nevada	Date:	August, 1995

LEGEND

D/S	Downstream	MPU	CCRFCD '91 Master Plan Update
L.V.	Las Vegas	LVMD	Las Vegas Wash - Middle
MHP	Mobil Home Park	LVRW	Range Wash - Las Vegas Wash Diversion
N.L.V.	North Las Vegas		
NAFB	Nellis Air Force Base	LVUP	Upper Las Vegas Wash
RCB	Reinforced Concrete Box Culvert	RWSL	Range Wash - Sloan
RCP	Reinforced Concrete Pipe Culvert	RWWB	Range Wash - West Branch
SS	Side Slopes	RWWE	Range Wash - West Tributary
U/S	Upstream	SLEB	Sloan Channel, East Branch
UPRR	Union Pacific Rail Road	SLNO	Sloan Channel, North

Note: Photos are (in general) arranged in order from Downstream to Upstream

FLOODING OR FLOODING DAMAGE PHOTOGRAPHS

VANDENBERG CHANNEL

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
84-6	RWWE 0139	(2) 10' x 6' RCBs	South	Downstream	Lone Mountain Rd.
84-5	RWWE 0126	Conc. Chnl. 10' x 6'; 1.5:1 SS	North	Upstream	Vandenberg Dr.
84-4	RWWE 0125	(2) 10' x 4' RCBs	South	Downstream	Vandenberg Dr.
84-3	RWWE 0105	(2) 10' x 4' RCBs	South	Downstream	Vandenberg Dr.
84-2	---	Overflow, east side of Vandenberg Dr.	South	Downstream	Vandenberg/Craig
84-1	---	Overflow on Craig Road from Channel	West	---	Craig Road

LAS VEGAS WASH AT CONFLUENCE OF SLOAN CHANNEL

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-1	LVMD 0827	L.V. Wash (Unlined/lined Transition)	West	Upstream	U/S of Confluence
6-4	RWSL 0000	Sloan Can. Confluence w/L.V. Wash	North	Upstream	N. of Veg. Valley Dr.

UNLINED SLOAN CHANNEL FROM LAS VEGAS WASH TO SAHARA AVENUE

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-5	RWSL 0000	Sloan Chan. Confluence w/L.V. Wash	Southeast	Downstream	N. of Veg. Valley Dr.
6-6	RWSL 0000	Sloan Chan. (Unlined/lined Trans.)	North	Upstream	N. of Veg. Valley Dr.
6-10	RWSL 0000	(3) 15' x 6' and (2) Irregular	North	Upstream	Sahara Avenue
		Shaped Bridge Openings			

UNLINED SLOAN CHANNEL FROM SAHARA AVENUE TO CHARLESTON BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-12	RWSL 0000	Heavy Vegetation in Sloan Channel	North	Upstream	N. of Sahara Ave.
6-13	RWSL 0000	Sloan Channel Bridge Crossing	South	Downstream	Sahara Avenue
6-14	RWSL 0000	Confluence with Orchards Channel	East	Upstream	Orchards Homes
6-15	RWSL 0000	Confluence with Orchards Channel	North	Upstream	Orchards Homes
6-16	RWSL 0000	(4) 10' x 4' Bridge Openings	East	Upstream	Orchard Valley Rd.
6-17	RWSL 0000	Sloan Channel	South	Downstream	S. of Charleston
6-19	RWSL 0000	Sloan Channel	South	Upstream	S. of Charleston
6-20	RWSL 0134	(1) 31' x 7' and (2) Irregular	North	Upstream	Charleston Blvd.
		Shaped Bridge Openings			
6-23	RWSL 0000	Sloan Channel	South	Downstream	S. of Charleston

UNLINED SLOAN CHANNEL FROM CHARLESTON BLVD. TO STEWART AVE.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
6-24	RWSL 0135	Sloan Channel	North	Upstream	N. of Charleston
7-3	RWSL 0135	Sloan Channel	Northwest	Upstream	S. of Stewart Ave.
7-5	RWSL 0188	(8) 10' x 3.5' Bridge Openings	North	Upstream	Stewart Avenue

CONCRETE-LINED SLOAN CHANNEL FROM STEWART AVE. TO LAKE MEAD BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
7-7	RWSL 0189	Sloan Channel at Stewart Ave.	North	Upstream	N. of Stewart
7-8	RWSL 0238	(5) 10' x 5' Bridge Openings	North	Upstream	Bonanza Rd.
7-11	RWSL 0239	Sloan Channel	North	Upstream	N. of Bonanza Rd.
7-12	RWSL 0288	(1) 31' x 7' and (2) Irregular	North	Upstream	Washington Ave.
		Shaped Bridge Openings			
7-15	RWSL 0339	(6) 9' x 5' Bridge Openings	North	Upstream	Owens Ave.
7-19	RWSL 0340	Sloan Channel (Owens Bridge)	South	Downstream	N. of Owens Ave.
7-20	RWSL 0365	Sloan Channel	North	Upstream	S. of Lake Mead
7-21	---	Drainage Easement	Northeast	Upstream	S. of Lake Mead
7-22	RWSL 0389	(5) 12' x 5' Bridge Openings	North	Upstream	Lake Mead Blvd.

CONCRETE-LINED SLOAN CHANNEL FROM LAKE MEAD BLVD. TO CAREY AVE.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
8-2	RWSL 0390	Sloan Channel	South	Downstream	S. of Judson
8-3	RWSL 0415	(4) 12' x 5.5' Bridge Openings	North	Upstream	Judson Avenue
8-4	RWSL 0416	Sloan Channel	North	Upstream	N. of Judson
8-5	RWSL 0416	Channel Bend	North	Upstream	Carey Avenue
8-14	RWSL 0416	Northern & Western Tributaries to	Northwest	Upstream	Carey Avenue
		Sloan Channel			
8-8	RWSL 0446	Northern Tributary to Sloan Channel	North	Upstream	Carey Avenue
8-13	RWSL 0446	Northern Tributary to Sloan Channel	North	Upstream	Carey Avenue
		and Swale on NAFB			
8-7	RWSL 0447	Channel Bend (Limit of NAFB)	Northwest	Upstream	Carey Avenue
8-12	RWSL 0447	Western Tributary to Sloan Channel	West	Upstream	Carey Avenue

NAFB CHANNEL FROM SLOAN LN. TO CHRISTY LN. ALIGNMENT

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-32	RWSL 0047	Erosion of Channel (North of Bend)	South	Downstream	North of Carey
5-31	RWSL 0047	Erosion of Channel	Southwest	Downstream	North of Carey
5-30	RWSL 0047	Erosion of Channel (South of Bend)	South	Downstream	S. of Golf Course
5-29	RWSL 0047	Channel Bend	Southeast	Downstream	S. of Golf Course
5-28	RWSL 0047	Channel Bend	Southeast	Downstream	S. of Golf Course
5-26	RWSL 0047	Channel Bend	Northwest	Upstream	E. of Christy Ln.
5-25	RWSL 0047	Erosion Hole in West Bank	West	Upstream	E. of Christy Ln.

AFB GOLF COURSE CHANNEL FROM CONFLUENCE DETENTION BASIN TO KINLEY RD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-24	RWSL 0502	Detention Basin	Northeast	Upstream	E. of NAFB
5-22	RWSL 0523	East Bridge (West of Bend)	West	Upstream	Golf Course
5-21	---	Northern Tributary	Northwest	Upstream	E. of Golf Course
5-20	RWSL 0523	Channel East of East Bridge	East	Downstream	E. of Golf Course
5-19	RWSL 0523	Eastern Golf Course Bridge	West	Upstream	Golf Course
5-18	RWSL 0524	Channel West of East Bridge	East	Downstream	Golf Course
5-17	RWSL 0524	Channel Bend	East	Downstream	Golf Course
5-16	RWSL 0524	Unlined Channel Bend	Southeast	Downstream	Golf Course
5-15	RWSL 0524	Western Golf Course Bridge	Southeast	Downstream	Golf Course
5-14	RWSL 0524	Channel South of Cheyenne Bridge	Southeast	Downstream	N.W. of Golf Course
5-13	RWSL 0559	Kinley Bridge	Northwest	Upstream	N.W. of Golf Course
5-10	RWSL 0559	Kinley Bridge	East	Downstream	N.W. of Golf Course

NAFB CHANNEL FROM CHRISTY LN. ALIGNMENT TO NELLIS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
5-5	SLNO 0000	Kinley Tributary	South	Downstream	E. of Channel
5-8	RWSL 0576	Confluence with Kinley Tributary	North	Upstream	E. of Christy Lane
5-3	RWSL 0576	Unlined Channel Bend	East	Downstream	S. of Duffer Dr.
5-1	RWSL 0609	NAFB Channel Bridge Crossing at I St.	North	Upstream	E. of Nellis
4-21	RWSL 0671	(3) 10' X 7' RCB's	West	Upstream	Nellis Blvd.

CONCRETE-LINED SLOAN CHANNEL FROM NELLIS BLVD. TO LAS VEGAS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
8-16	RWSL 0671	(3) 10' x 7' RCB's	East	Downstream	Nellis Boulevard
1-17	RWSL/SLEB	Confluence of RWSL & SLEB	West	Upstream	Lamont Street
1-15	RWSL 0727	(3) 10' x 8' RCBs	West	Upstream	Marion Drive
1-24	RWSL 0745	(7) 10' x 7' RCBs	Northwest	Upstream	Las Vegas Blvd.
1-22	RWSL 0745	(7) 10' x 7' RCBs	Southeast	Downstream	Las Vegas Blvd.

CONCRETE-LINED SLOAN CHANNEL (EAST BRANCH) SOUTH OF LAS VEGAS BLVD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
1-14	SLEB 0015	(3) 10' x 6' RCBs	North	Upstream	Storyville MHP
1-13	SLEB 0015	(3) 10' x 6' RCBs	South	Downstream	Storyville MHP
1-19	SLEB 0044	(6) 10' x 7' RCBs	Northwest	Upstream	Las Vegas Blvd.
1-21	SLEB 0044	(6) 10' x 7' RCBs	Southeast	Downstream	Las Vegas Blvd.

UNDEVELOPED WASH FROM LAS VEGAS BLVD. TO CRAIG RD.

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
2-1	RWWE 0000	Natural wash contributing to RCBs	South	Downstream	N. of Las Vegas Bl.
2-2	RWWE 0000	Natural desert S. of Alexander RCBs	North	Upstream	S. of Alexander
2-3	RWWE 0026	(4) 10' x 9' RCBs	Northwest	Upstream	Alexander Road
2-4	RWWE 0026	(4) 10' x 9' RCBs	East	Downstream	Alexander Road
2-5	---	Overflow Channel near RCBs	East	---	Alexander Road
8-17	RWWE 0027	Overflow Channel near RCBs	West	Upstream	Alexander Road
2-6	RWWE 0027	Northern Tributary to Alexander RCBs	Northwest	Upstream	N. of Alexander
8-18	RWWE 0027	Northern Tributary to Alexander RCBs	Northwest	Upstream	N. of Alexander
2-7	---	Western Tributary to Alexander RCBs	West	Upstream	Parallel to Alex. Rd.
2-8	---	RCP at U/S of W. Trib. to Alexander	West	Upstream	Alexander/Lamb
8-19	RWWE 0054	(3) 8' x 4' RCBs	East	Downstream	Lamb Boulevard
8-20	RWWE 0055	Natural Wash	Northwest	Upstream	W. of Lamb Blvd.
8-21	RWWE 0055	Natural Wash	South	Downstream	S. of Craig Rd.
2-11	RWWE 0088	(2) 8' x 4' RCBs	North	Upstream	Craig Road
8-22	RWWE 0088	Erosion at RCBs from flow in Craig Rd.	Northwest	Upstream	Craig Road
2-13	RWWE 0088	(2) 8' x 4' RCBs	South	Downstream	Craig Road

VANDENBERG CHANNEL FROM CRAIG ROAD TO LONE MOUNTAIN ROAD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
2-15	RWWE 0096	(2) 10' x 4' RCBs & 20' x 6' 2:1SS Chnl	South	Downstream	Vandenberg Dr.
8-24	RWWE 0097	Damaged Channel	East	---	N. of RCB's
2-16	RWWE 0105	(2) 10' x 3' RCBs & 20' x 6' 2:1SS Chnl	North	Upstream	Vandenberg Dr.
2-18	RWWE 0125	(2) 9' x 3' RCBs & 20' x 6' 2:1SS Chnl.	North	Upstream	Vandenberg Dr.

UNDEVELOPED WASH FROM LONE MOUNTAIN RD. TO INTERSTATE 15

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
2-20	RWWE 0139	(2) 10' x 3' RCBs	North	Upstream	Lone Mountain Rd.
8-23	RWWE 0140	From road looking u/s at channel	North	Upstream	Lone Mountain Rd.
2-22	RWWE 0139	(2) 10' x 3' RCBs	South	Downstream	Lone Mountain Rd.
2-23	RWWE 0168	(3) 15' x 10' RCBs	Northwest	Upstream	Interstate 15
3-2	RWWE 0168	(3) 15' x 10' RCBs	Southeast	Downstream	Interstate 15

UNDEVELOPED WEST BRANCH OF RANGE WASH AT THE UPRR CROSSING

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
3-4	RWWE 0202	(1) 12' x 8' RCB	Southeast	Downstream	UPRR

UNDEVELOPED EAST BRANCH OF RANGE WASH AT THE UPRR CROSSING

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
3-6	RWWB 0027	(2) 21' x 12' Bridge Openings	Northwest	Upstream	UPRR

RANGE WASH FROM THE UPRR TO NORTH LAS VEGAS DETENTION BASIN

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
9-1	RWWE 0203	Pecos Rd. dip section	Southeast	Downstream	S. of Ann Rd.
9-3	---	Ann Rd. dip section	North	Upstream	E. of Pecos Rd.
9-5	---	Centennial Pkwy. dip section	South	Downstream	Centennial Pkwy.
9-7	LVUP 0405	North Las Vegas Detention Basin	South	Downstream	Southeast Corner
9-9	LVRW 0000	Range Wash tributary to det. basin	Southwest	Downstream	Diversion Dike

FLOOD HAZARD "A" ZONE AREA FROM MITCHEL STREET TO FREHNER ROAD

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
10-1	---	I-15 overpass (flood zone area)	East	---	UPRR crossing
10-2	---	I-15 overpass (flood zone area)	West	---	UPRR crossing
10-5	UPRR 2203	(1) 9 x 9 RCB	West	Upstream	UPRR crossing
10-6	---	Frehner Road crossing over RCB	West	Upstream	Frehner Rd.
10-7	---	Zone "A" flood hazard area	Southwest	---	W. of I-15
10-8	---	(1) 4 x 7 RCB	East	Downstream	I-15 crossing
10-14	---	Channel east of I-15	East	Downstream	E. of I-15
10-12	---	End of channel east of I-15	West	Upstream	Mitchel Street

MISCELLANEOUS STREET IMPROVEMENTS AND DEVELOPMENT IMPACTS

Photo Number	MPU Label	Facility Description	View	Looking U/S or D/S	Location
12-1	---	Cibola Development Site Grading	West	---	Stewart Ave.
12-3	---	Bonanza Road St. Improvements	East	---	Sloan Chan.
12-4	---	Bonanza Road St. Improvements	East	---	Sloan Chan.
12-5	---	Walnut Road St. Improvements	Southeast	---	Mitchell St.
12-8	---	Golden Triangle Industrial Park	Northwest	---	Frehner Rd.
12-9	---	Golden Triangle Industrial Park	Northwest	---	Frehner Rd.
13-1	---	Walnut Road	South	---	RR Spur.
13-2	---	Railroad Spur	East	---	Walnut Road
13-3	---	Railroad Spur	West	---	Walnut Road
13-5	---	Andrews Street	Southeast	---	End of RR Spur
13-6	---	Andrews Street	Southwest	---	End of RR Spur
13-8	---	Maple Hill Road	Southeast	---	Near Walnut Rd.
13-9	---	Alexander Road Sump	East	---	Lamb Blvd.
13-10	---	Alexander Road Sump	West	---	Lamb Blvd.
13-11		Regrading East of Alexander Rd RCB	East	---	Alexander Rd.
13-12	RWWE 0027	Channel Construction	Northwest	U/S	Alexander Rd.
13-13	---	Charleston Blvd. St. Improvements	West	---	A Zone Area
13-14	---	Charleston Blvd. St. Improvements	West	---	Sloan Channel

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

45 SUBAREA DESIGNATION

SUBAREA DELINEATION

RANGE WASH
HYDROLOGIC SUBAREAS

FIGURE S-1

JMM James M. Montgomery
Consulting Engineers, Inc.

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- PROPOSED MASTER PLAN FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

MATCH LINE

MOCCASIN RD.

LVUP 0446

GRAND TETON DR.

LVRW 0057 LVRW

MATCH LINE

LOSEE RD.

PECOS RD.

LAMB BLVD.

LVRW 0292 LVRW

RWEA 0872

MATCH LINE

N

0 1500 3000 4500

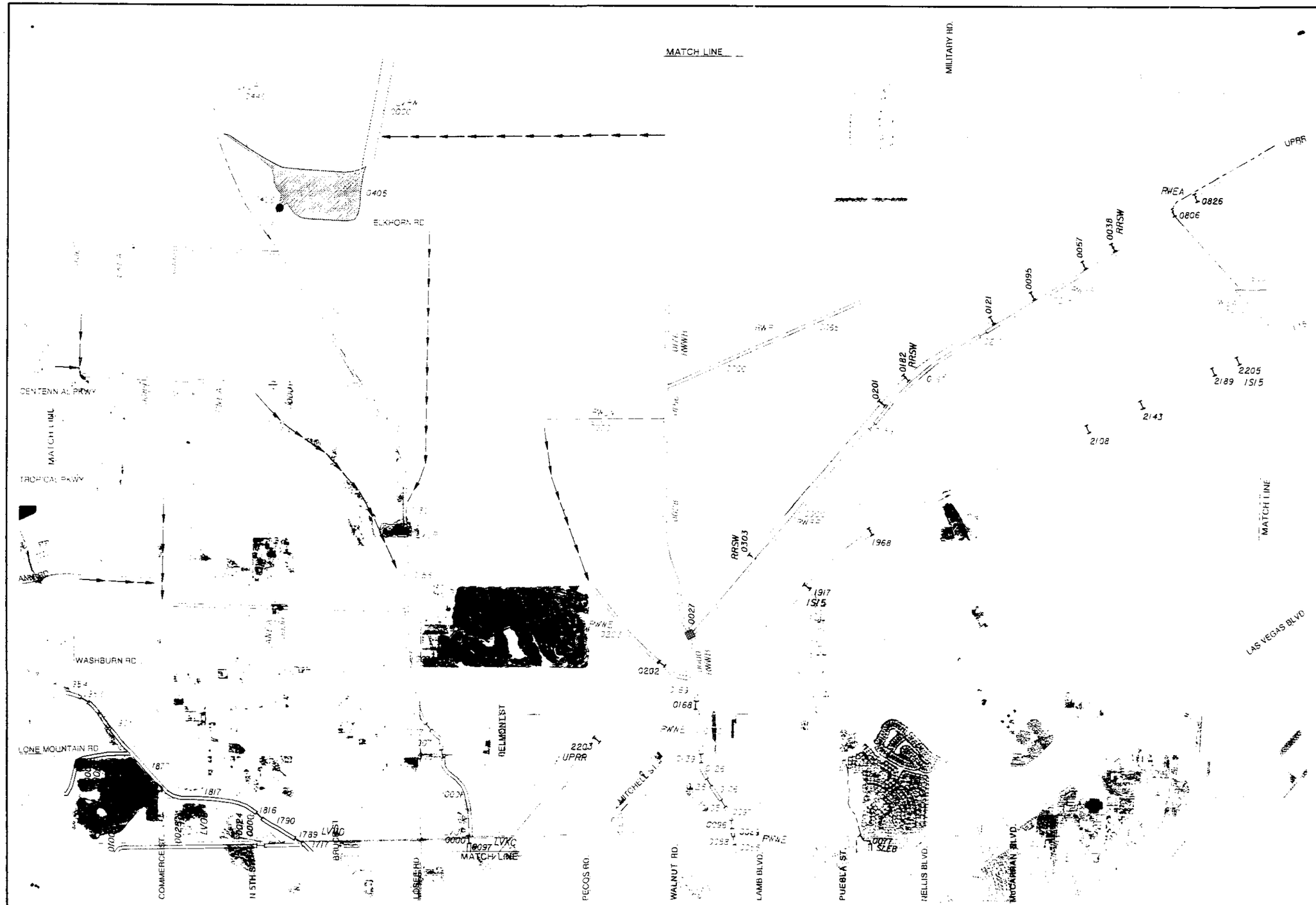
(APPROXIMATE)

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
	25	26	

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE F-3

James M. Montgomery Consulting Engineers, Inc.
Las Vegas, Nevada



1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
	25	26	

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

0 500 1000 2000 (APPROXIMATE)

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE F-7

JMM James M. Montgomery Consulting Engineers, Inc.

Las Vegas, Nevada

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- PROPOSED MASTER PLAN FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

0 1500 3000 4500
(APPROXIMATE)

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE F-11

James M. Montgomery Consulting Engineers, Inc.
Las Vegas, Nevada

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
	25	26	

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

0 1500 3000 4500
(APPROXIMATE)

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE F-15

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
	25	26	

JMM James M. Montgomery Consulting Engineers, Inc.
Las Vegas, Nevada

FLOOD DAMAGE PHOTOGRAPHS
VANDENBERG CHANNEL AREA
1984

UPSTREAM FLOWS HAVE SINCE BEEN REDUCED
DUE TO CONSTRUCTION OF THE RANGE WASH DIVERSION DIKE

PHOTO: 84-5 VIEW: NORTH, UPSTREAM MPU: RWWE 0126
BROKEN LINING, VANDENBERG CHANNEL 10' W x 6' D; 1.5:1 SS

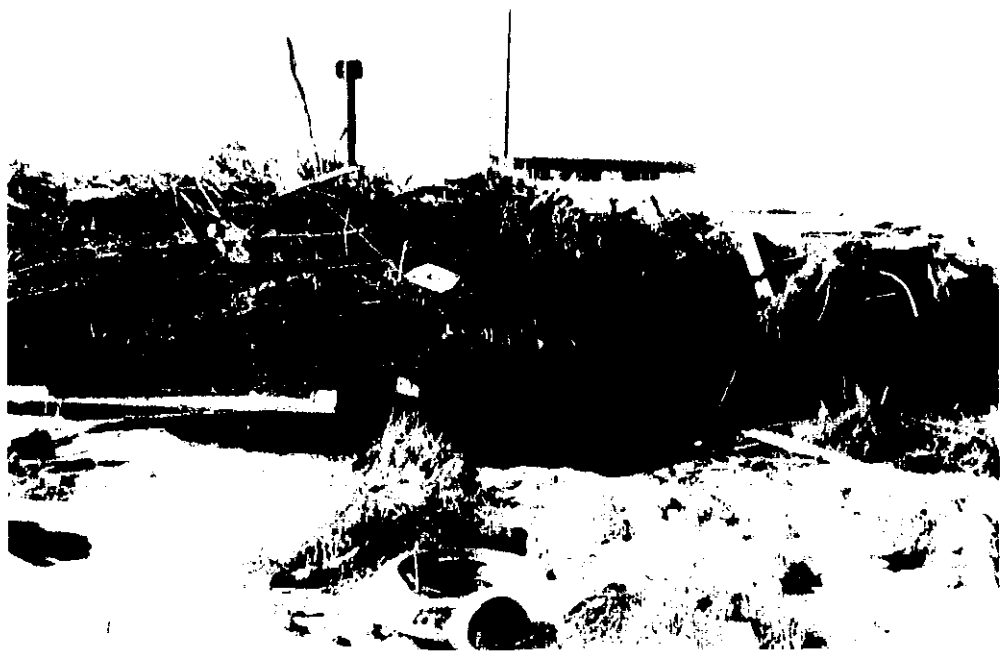


PHOTO: 84-6 VIEW: SOUTH, DOWNSTREAM MPU: RWWE 0139
(2) 10' x 4' RCBs AT LONE MOUNTAIN ROAD AND VANDENBERG DRIVE
UPSTREAM BEGINNING OF THE VANDENBERG CHANNEL

FLOOD DAMAGE PHOTOGRAPHS

VANDENBERG CHANNEL AREA

1984

UPSTREAM FLOWS HAVE SINCE BEEN REDUCED
DUE TO CONSTRUCTION OF THE RANGE WASH DIVERSION DIKE

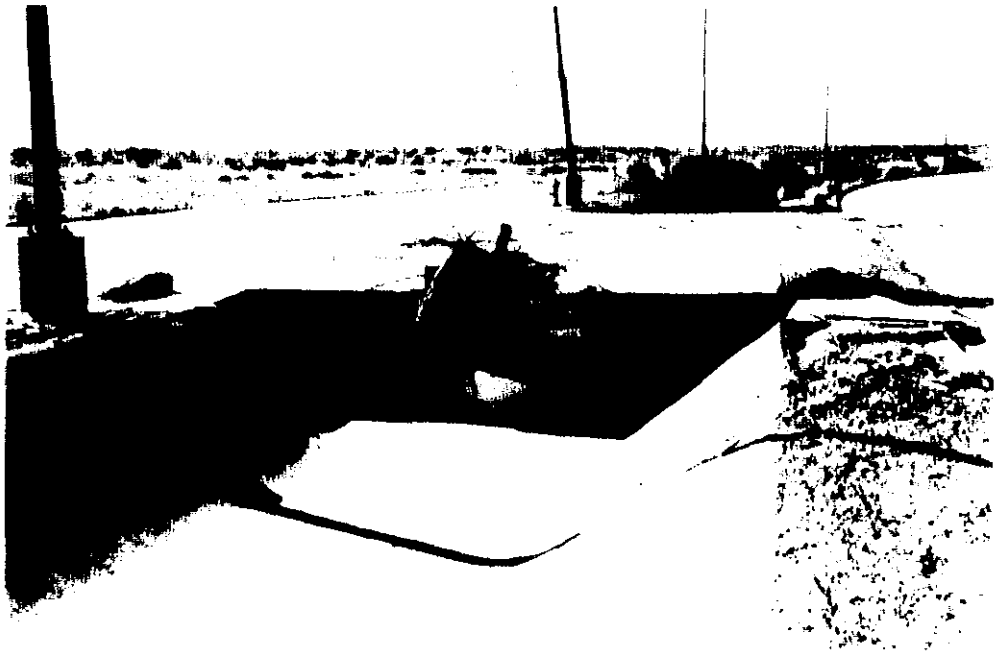


PHOTO 84-3 VIEW SOUTH, DOWNSTREAM MPU: RWWE 0105
VANDENBERG CHANNEL 10' W x 6' D; 1.5:1 SS (2) 10' x 4' RCBs

PHOTO 84-4 VIEW: SOUTH, DOWNSTREAM MPU RWWE 0125
VANDENBERG CHANNEL: 10' W x 6' D; 1.5:1 SS (2) 10' x 4' RCBs

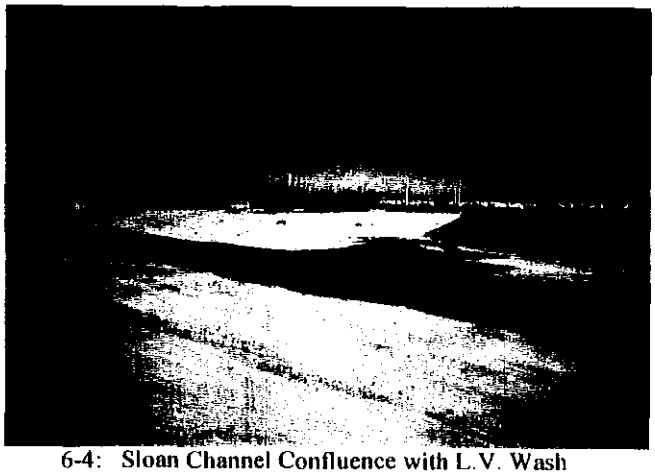
FLOOD DAMAGE PHOTOGRAPHS
VANDENBERG CHANNEL AREA
1984

UPSTREAM FLOWS HAVE SINCE BEEN REDUCED
DUE TO CONSTRUCTION OF THE RANGE WASH DIVERSION DIKE

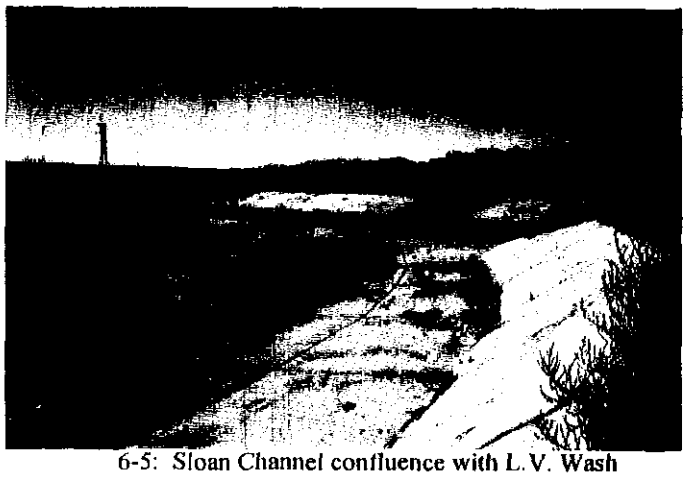
PHOTO 84-1 VIEW: WEST
DEBRIS FROM OVERFLOW ONTO CRAIG ROAD

PHOTO 84-2 VIEW: SOUTH, DOWNSTREAM
EROSION FROM OVERFLOW, EAST SIDE OF VANDENBERG DRIVE

6-1: L.V. Wash (unlined/lined transition)
Upstream view

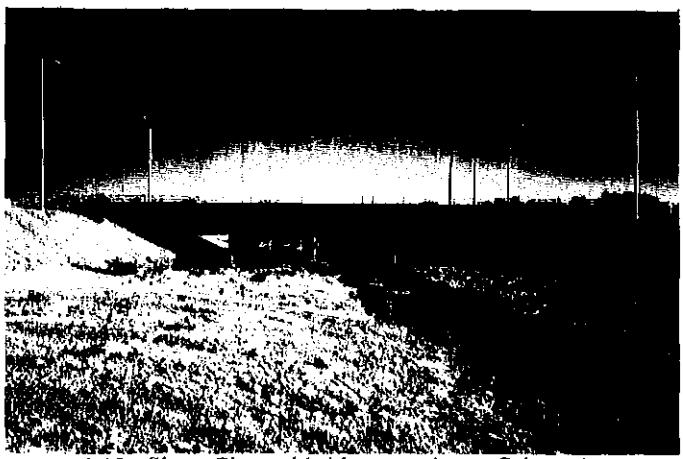


6-4: Sloan Channel Confluence with L.V. Wash
Downstream view



6-5: Sloan Channel confluence with L.V. Wash
Downstream view

6-6: Sloan Channel (unlined/lined transition)
Upstream view



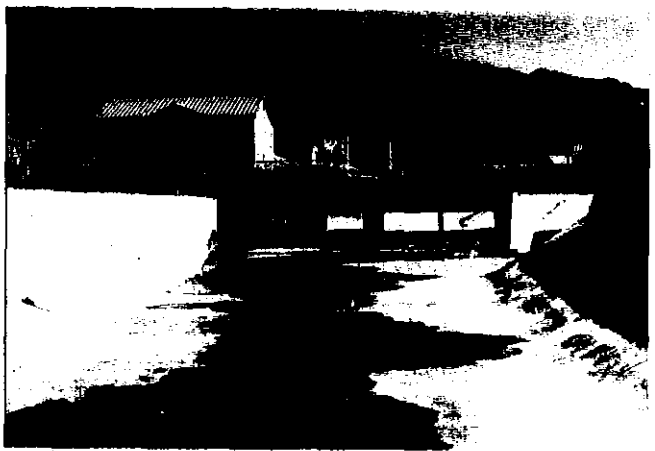
6-10: Sloan Channel bridge crossing at Sahara Avenue
Upstream view

6-12: Heavy vegetation in Sloan Channel at Sahara Ave.
Upstream view

6-13: Sloan Channel bridge crossing at Sahara Ave.
Downstream view

6-14: Orchards Channel confluence with Sloan Channel
Upstream view

6-15: Orchards Channel confluence with Sloan Channel
Upstream view

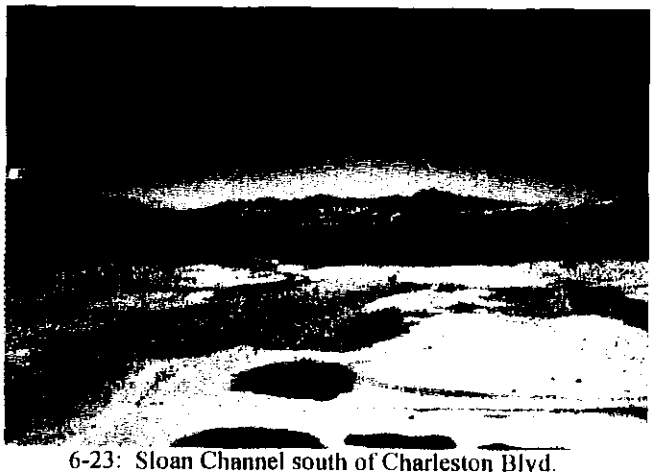


6-16: Orchards Channel bridge crossing at Orchard Valley
Upstream view

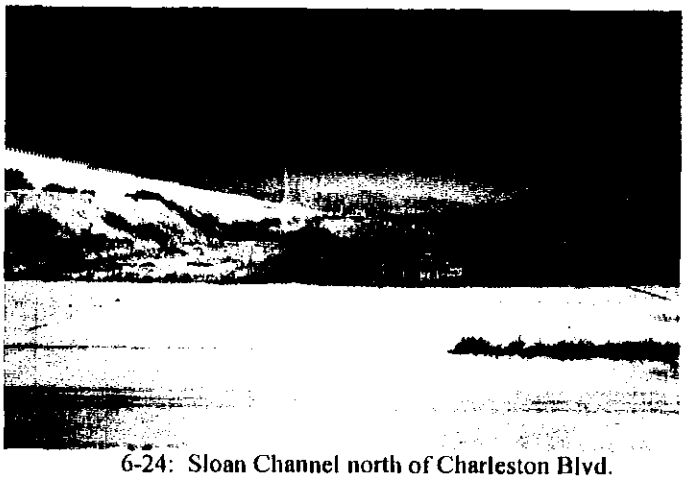
6-17: Sloan Channel south of Charleston Blvd.
Downstream view

6-19: Sloan Channel south of Charleston Blvd.
Upstream view

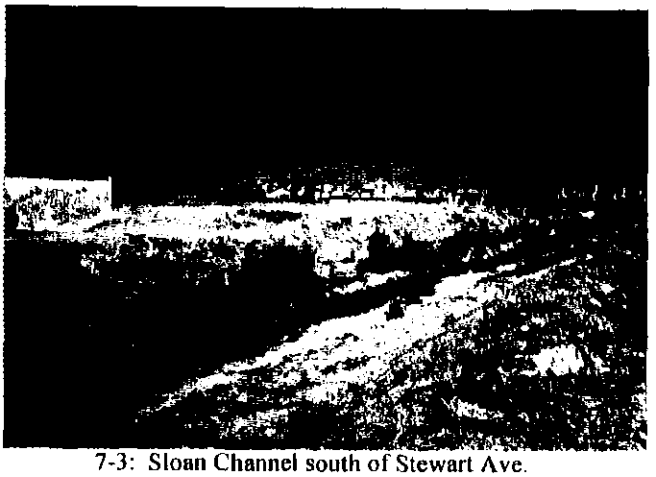
6-20: Sloan Channel bridge crossing at Charleston Blvd.
Upstream view



6-23: Sloan Channel south of Charleston Blvd.
Downstream view



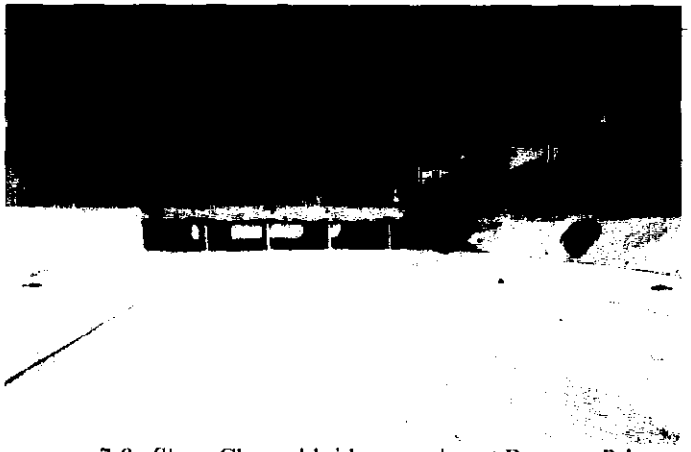
6-24: Sloan Channel north of Charleston Blvd.
Upstream view



7-3: Sloan Channel south of Stewart Ave.
Upstream view

7-5: Sloan Channel bridge crossing at Stewart Ave.
Upstream view

7-7: Sloan Channel north of Stewart Ave.
Upstream view

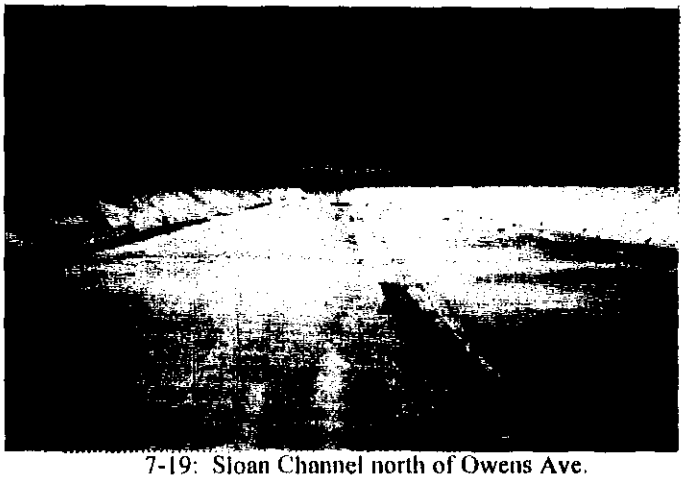


7-8: Sloan Channel bridge crossing at Bonanza Rd.
Upstream view

7-11: Sloan Channel north of Bonanza Rd.
Upstream view

7-12: Sloan Channel bridge crossing at Washington Ave.
Upstream view

7-15: Sloan Channel bridge crossing at Owens Ave.
Upstream view



7-19: Sloan Channel north of Owens Ave.
Downstream view

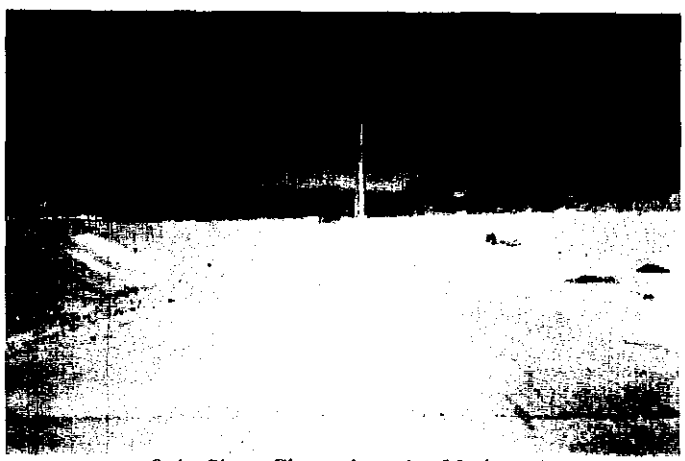
7-20: Sloan Channel south of Lake Mead Blvd.
Upstream view

7-21: *Drainage Easement confluence with Sloan Channel* South of Lake Mead Blvd.

7-22: *Sloan Channel bridge crossing at Lake Mead Blvd.* Upstream view

8-2: Sloan Channel south of Judson Ave. Downstream view

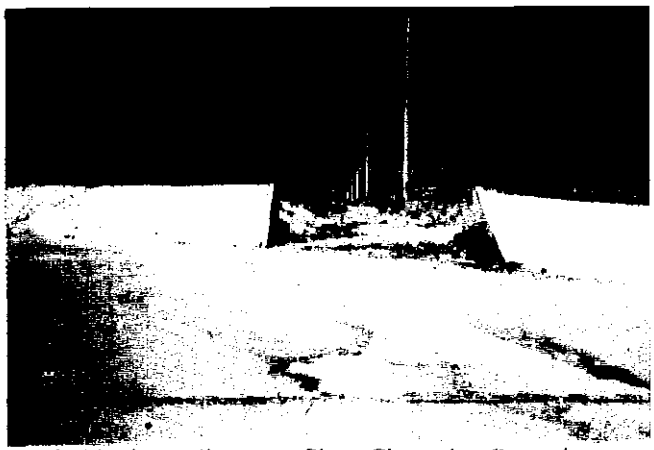
8-3: Sloan Channel bridge crossing at Judson Ave. Upstream view



8-4: Sloan Channel north of Judson Ave. Upstream view

8-5 Sloan Channel bend at Carey Ave. Upstream view

8-14: Sloan Channel at Carey Ave.
Upstream view



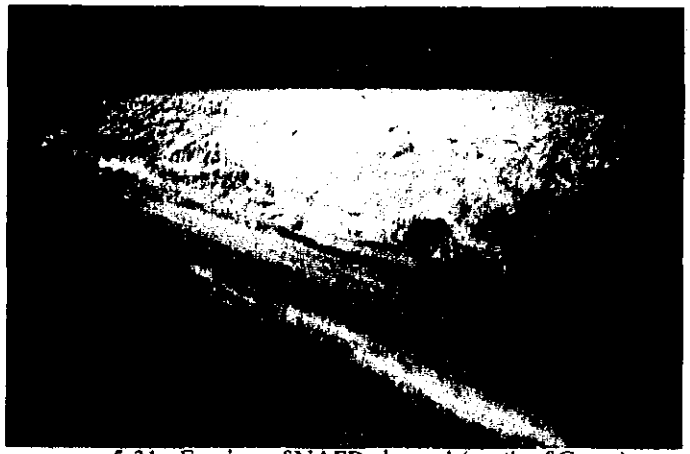
8-8: Northern tributary to Sloan Channel at Carey Ave.
Upstream view

8-13: Northern tributary to Sloan Channel at Carey Ave.
Upstream view

8-7: Northwest tributary to Sloan Channel at Carey Ave
Upstream view

8-12: Northwest tributary to Sloan Channel at NAFB
Upstream view

5-32: Erosion of NAFB channel
Downstream view



5-31: Erosion of NAFB channel (north of Carey)
Downstream view

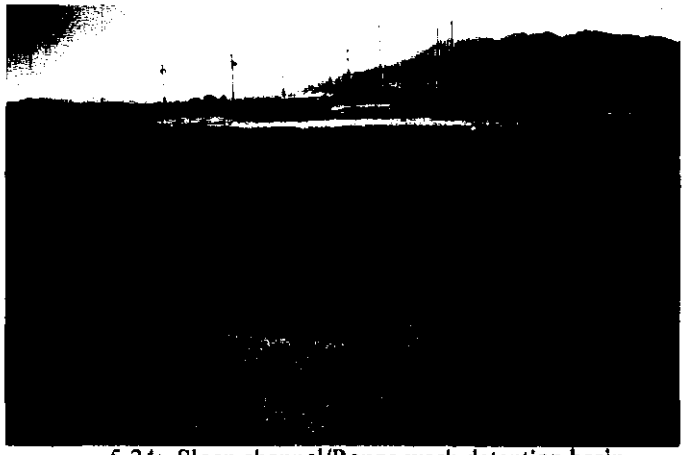
5-30: Erosion of NAFB channel (south of golf course)
Downstream view

5-29: NAFB channel bend (south of golf course)
Downstream view

5-28: NAFB channel bend (south of golf course)
Downstream view

5-26: NAFB channel bend (east of Christy Ln.)
Upstream view

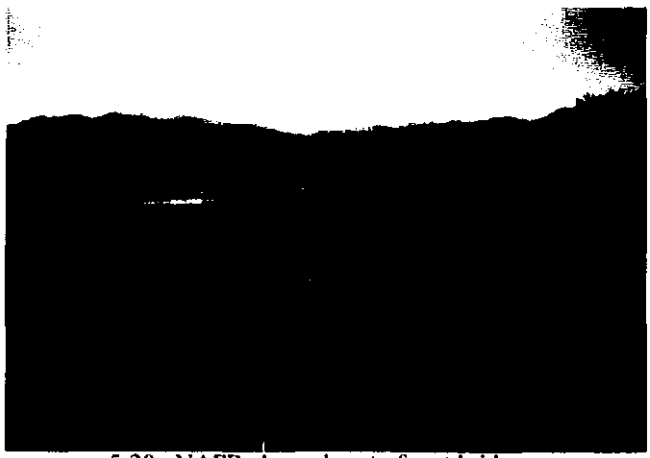
5-25: Erosion hole in NAFB channel (east of Christy Ln.)
Upstream view



5-24: Sloan channel/Range wash detention basin
Upstream view

5-22: East golf course bridge
Upstream view

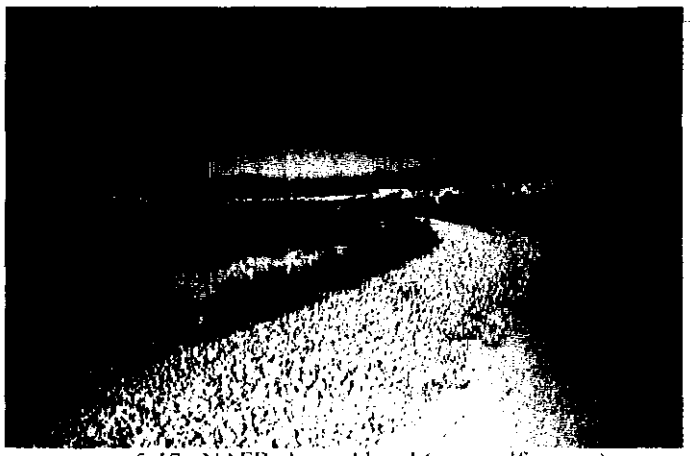
5-21: North tributary to NAFB Channel (E. of golf course)
Upstream view



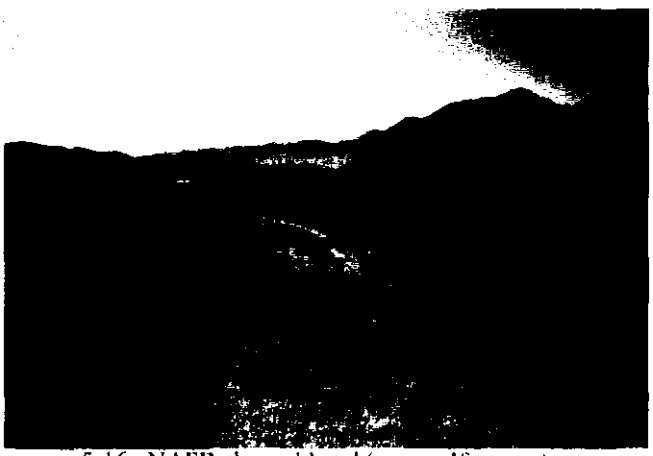
5-20: NAFB channel east of east bridge
Downstream view

5-19: East golf course bridge
Upstream view

5-18: NAFB channel west of east bridge
Downstream view



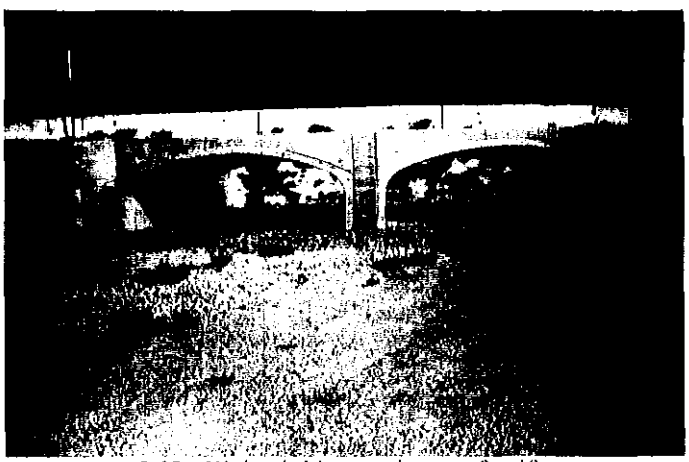
5-17: NAFB channel bend (near golf course)
Downstream view



5-16: NAFB channel bend (near golf course)
Downstream view

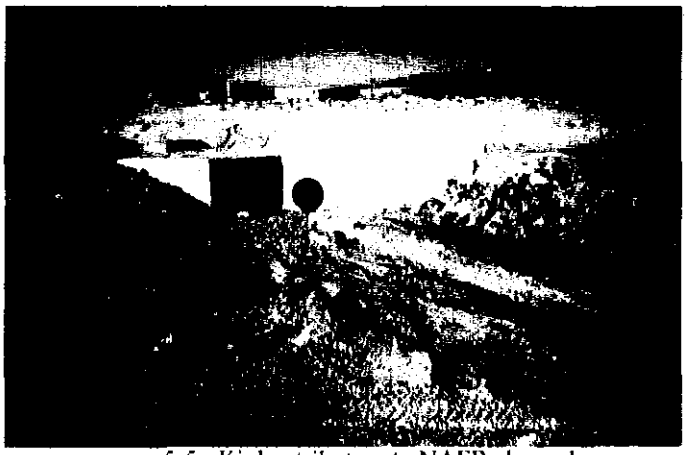
5-15: West golf course bridge
Downstream view

5-14: NAFB channel south of Cheyenne bridge
Downstream view



5-13: Kinley bridge northwest of golf course
Upstream view

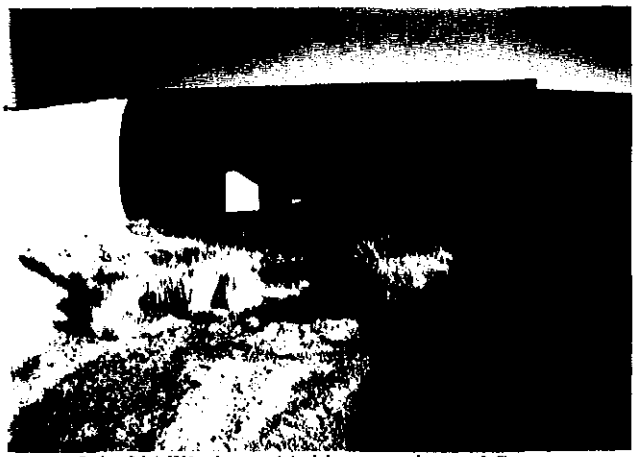
5-10: Kinley bridge northwest of golf course
Downstream view



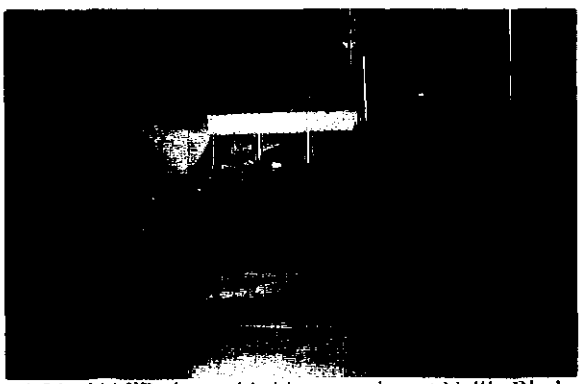
5-5: Kinley tributary to NAFB channel
Downstream view

5-8: Kinley tributary confluence with NAFB channel
Upstream view

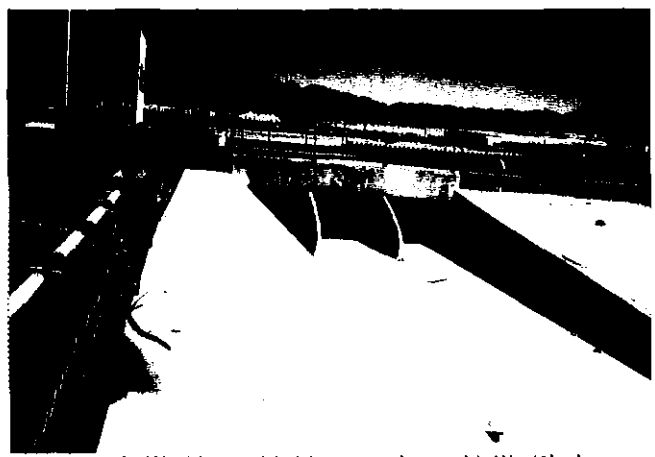
5-3: NAFB channel bend south of Duffer Dr.
Downstream view



5-1: NAFB channel bridge crossing at I St.
Upstream view



4-21: NAFB channel bridge crossing at Nellis Blvd.
Upstream view



8-16: R.W. Channel bridge crossing at Nellis Blvd.
Downstream view

1-17: Confluence of master plan facilities RWSL & SLEB
Upstream view

1-14: Sloan Channel east branch bridge crossing
Upstream view

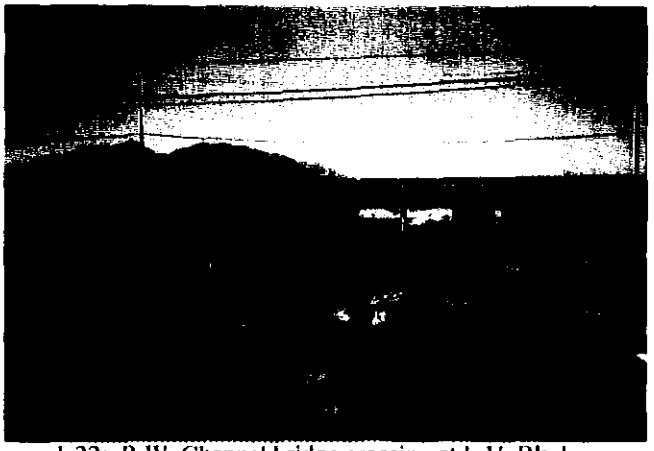
1-13: Sloan Channel east branch bridge crossing
Downstream view

1-19: Sloan Channel east branch crossing at L.V. Blvd.
Upstream view

1-21: Sloan Channel east branch crossing at L.V. Blvd.
Downstream view

1-15: R.W. Channel bridge crossing at Marion Dr.
Upstream view

1-24: R.W. Channel bridge crossing at L.V. Blvd.
Upstream view

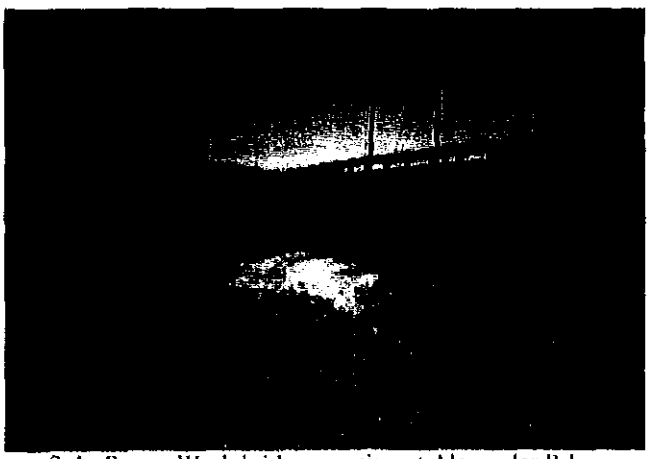


1-22: R.W. Channel bridge crossing at L.V. Blvd.
Downstream view

2-1: Natural wash contributing to RCB's at L.V. Blvd
Downstream view

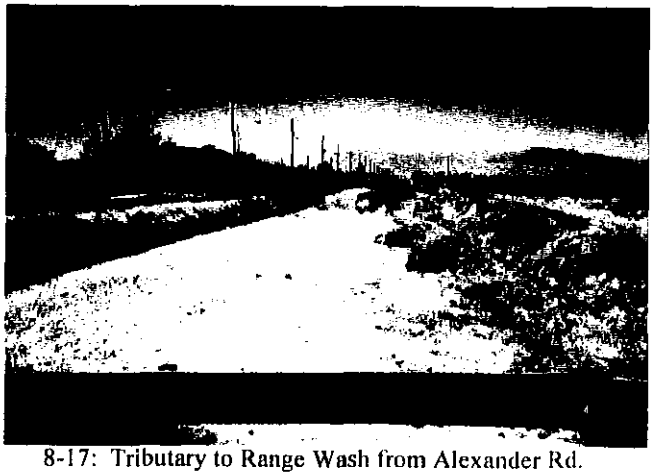
2-2: Natural wash north of L.V. Blvd. south of Alexander
Upstream view

2-3: Range Wash bridge crossing at Alexander Rd.
Upstream view

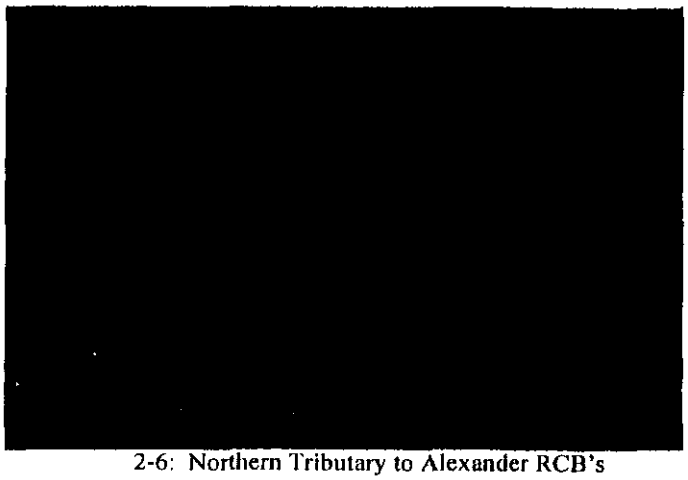


2-4: Range Wash bridge crossing at Alexander Rd
Downstream view

2-5: Tributary to Range Wash at Alexander Rd. Crossing
Upstream view

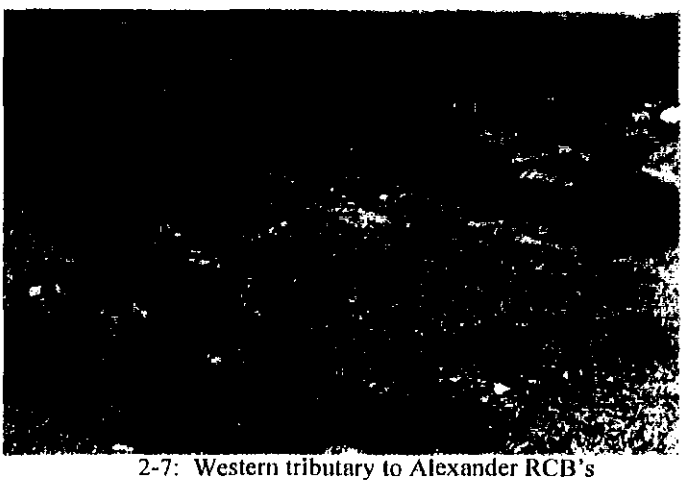


8-17: Tributary to Range Wash from Alexander Rd.
Downstream view

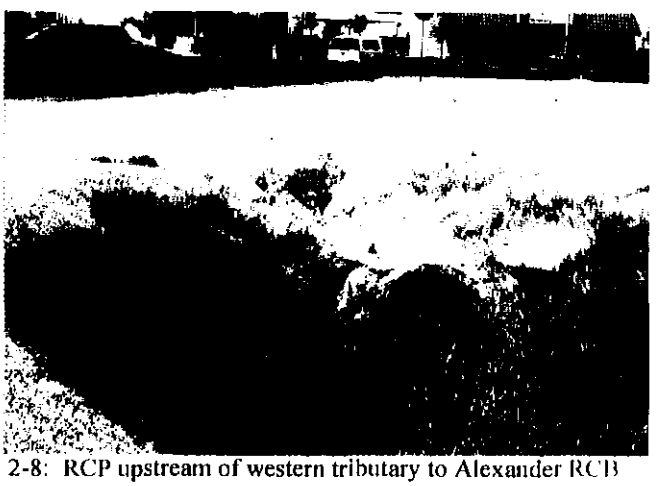


2-6: Northern Tributary to Alexander RCB's
Upstream view

8-18: Northern Tributary to Alexander RCB's
Upstream view



2-7: Western tributary to Alexander RCB's
Upstream view

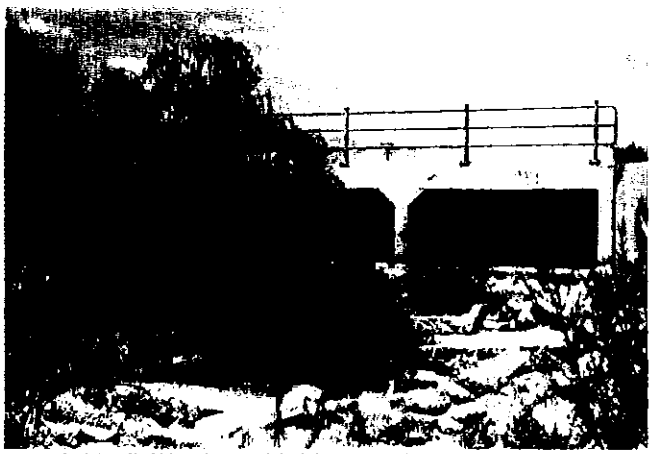


2-8: RCP upstream of western tributary to Alexander RCB
Upstream view

8-19: R.W. Channel bridge crossing at Lamb Blvd.
Downstream view

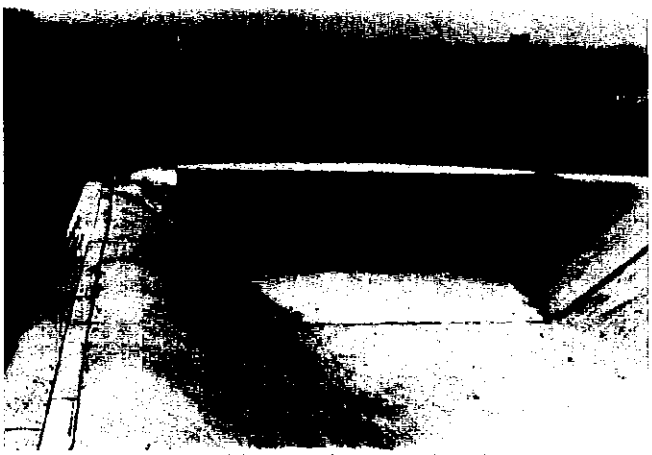
8-20: Natural Range Wash west of Lamb Blvd.
Upstream view

8-21: Natural Range Wash south of Craig Rd.
Downstream view



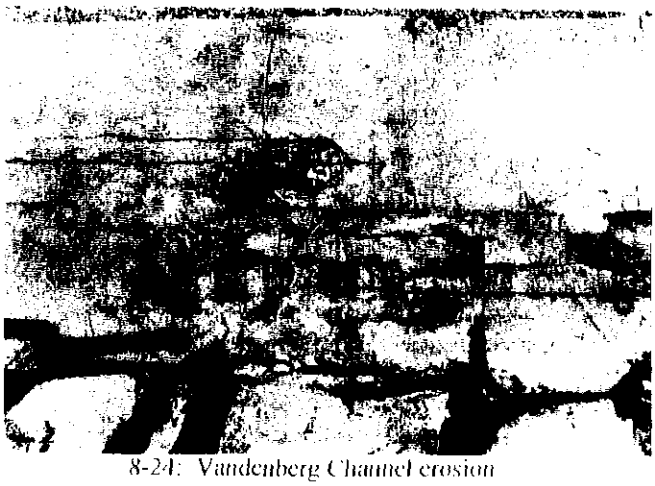
2-11: R.W. Channel bridge crossing at Craig Rd
Upstream view

8-22: Erosion from runoff from Craig Rd. at RCB's
Upstream view

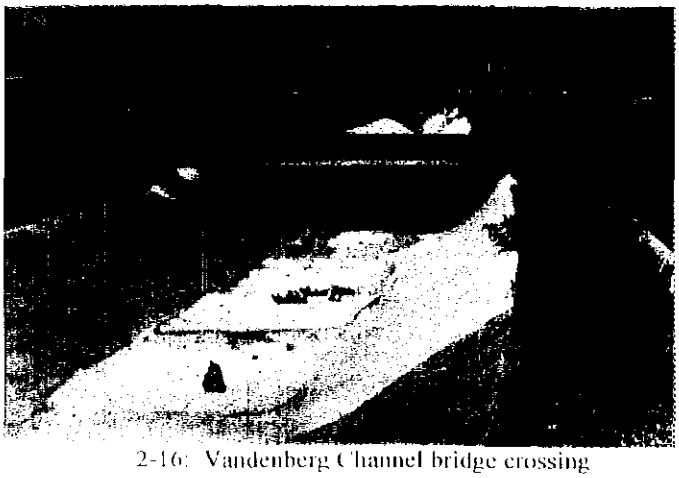


2-13: Bridge crossing at Craig Rd.
Downstream view

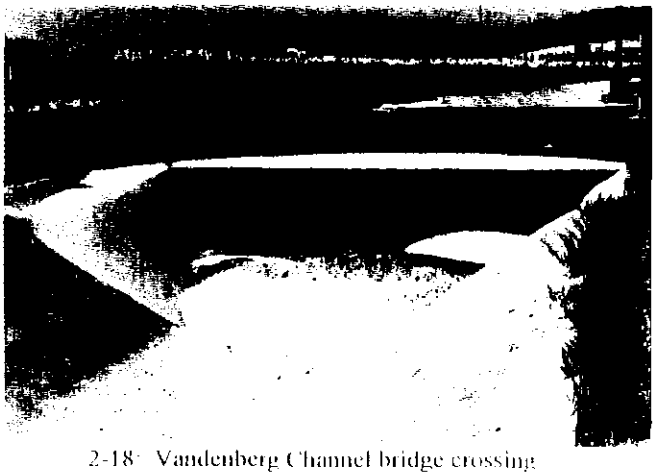
2-15: Vandenberg Channel north of Craig Rd.
Downstream view



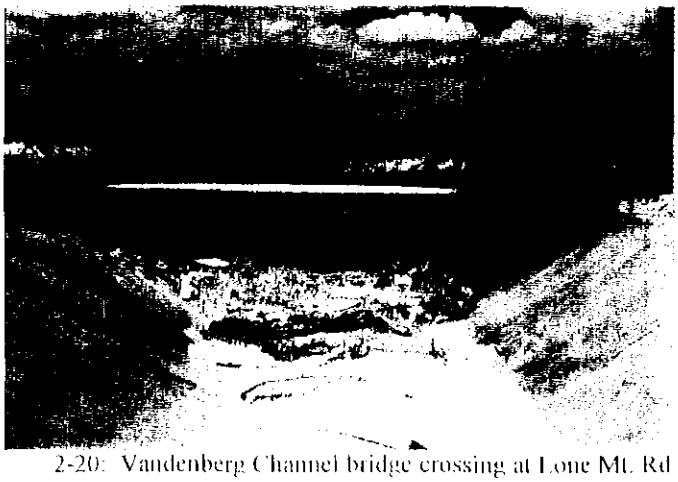
8-24: Vandenberg Channel erosion



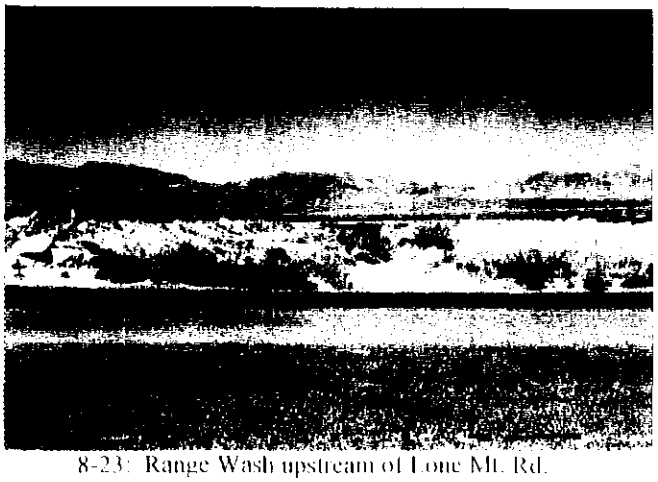
2-16: Vandenberg Channel bridge crossing
Upstream view



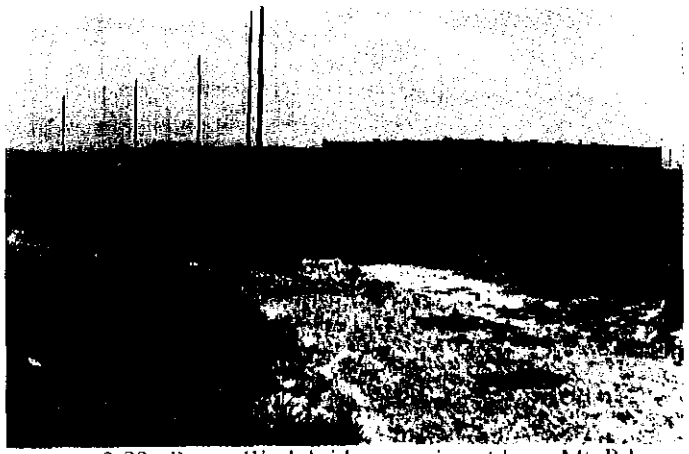
2-18: Vandenberg Channel bridge crossing
Upstream view



2-20: Vandenberg Channel bridge crossing at Lone Mt. Rd
Upstream view



8-23: Range Wash upstream of Lone Mt. Rd.
Upstream view



2-22: Range Wash bridge crossing at Lone Mt. Rd.
Downstream view

2-23: Range Wash bridge crossing at I-15
Upstream view

3-2: Range Wash bridge crossing at I-15
Downstream view

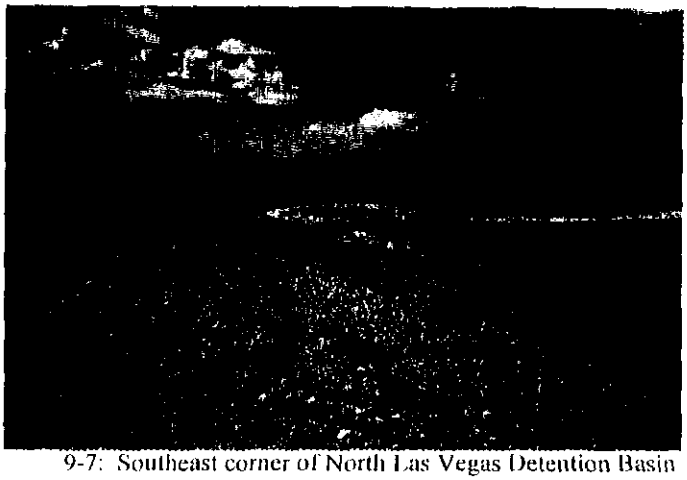
3-4: Range Wash railroad bridge crossing (south)
Downstream view

3-6: Range Wash railroad bridge crossing (north)
Downstream view

9-1: Pecos Rd. Dip section through Range Wash
Downstream view

9-3: Ann Rd. dip section through Range Wash
Downstream view

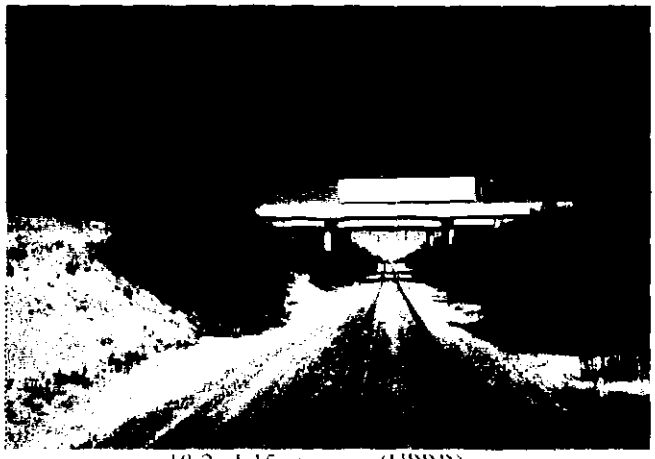
9-5. Centennial Pkwy. dip section through Range Wash
Downstream view



9-7: Southeast corner of North Las Vegas Detention Basin

9-9: Range Wash just north of Detention Basin
Downstream view

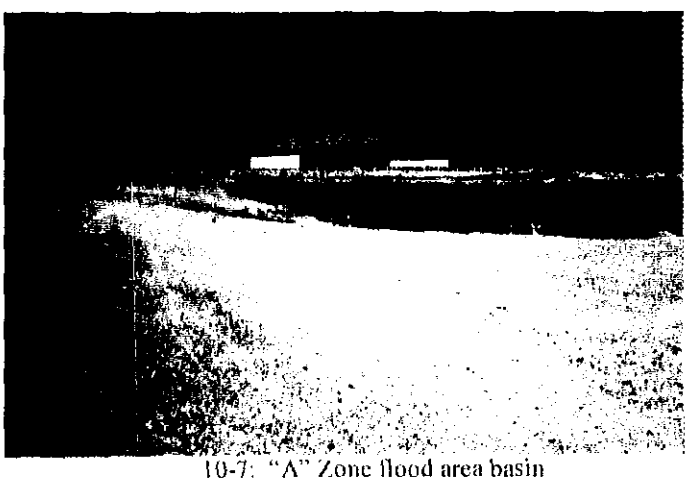
10-1: I-15 overpass (UPRR)
Looking east



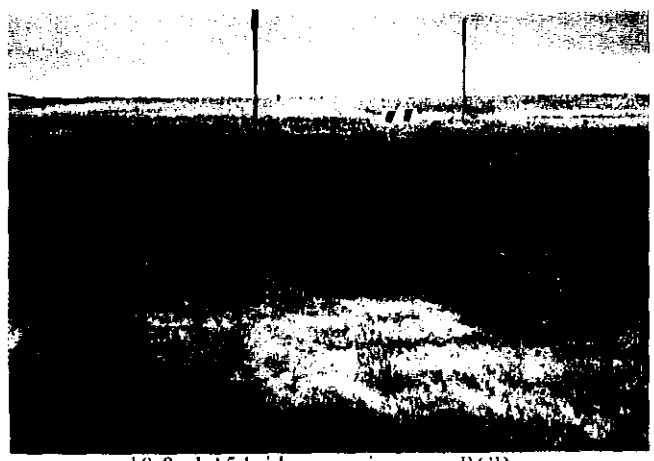
10-2: I-15 overpass (UPRR)
Looking west

10-5: UPRR crossing over box culvert
Upstream view

10-6: Frehner Road crossing over RCB
Upstream view

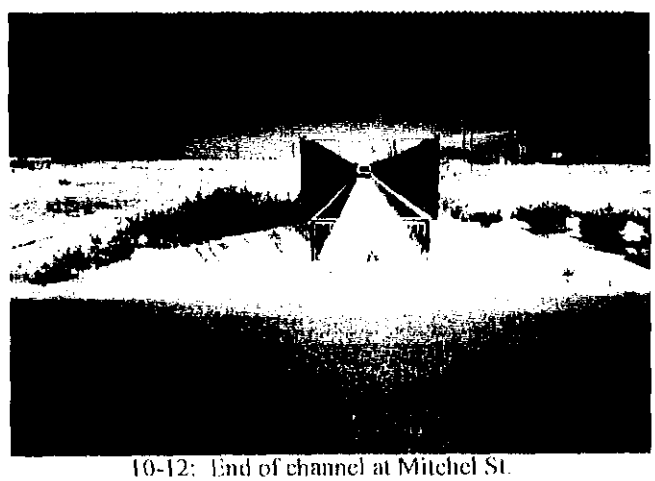


10-7: "A" Zone flood area basin
Looking Southwest



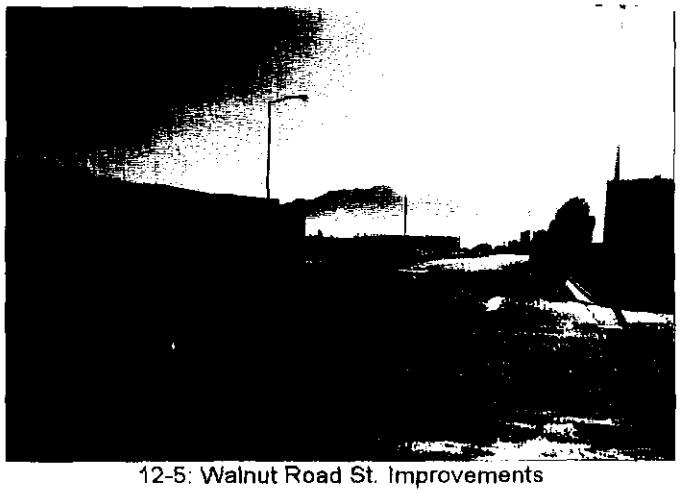
10-8: I-15 bridge crossing over RCB
Downstream view

10-14: Wingwall entrance to channel west of Mitchel St.
Downstream view

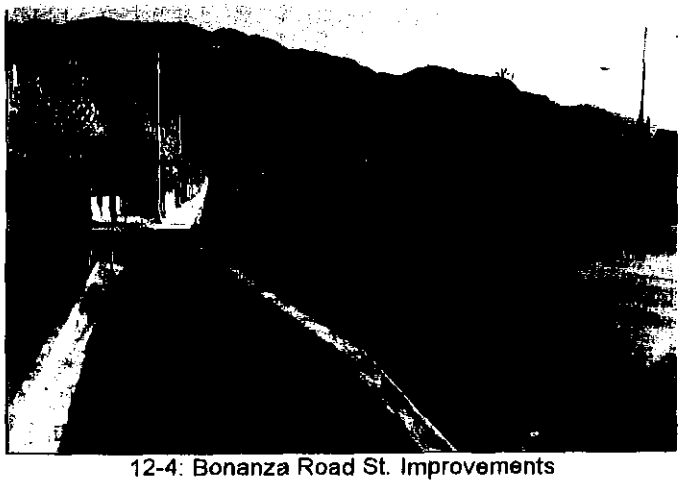


10-12: End of channel at Mitchel St.
Upstream view

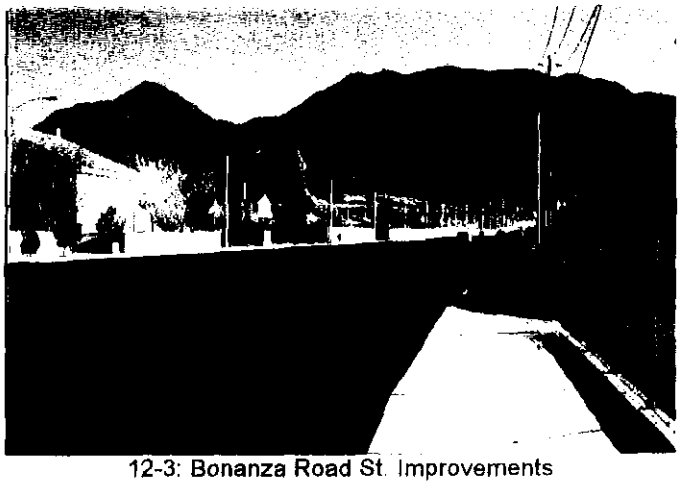
12-1: Cibola Development Site Grading
at Stewart Avenue



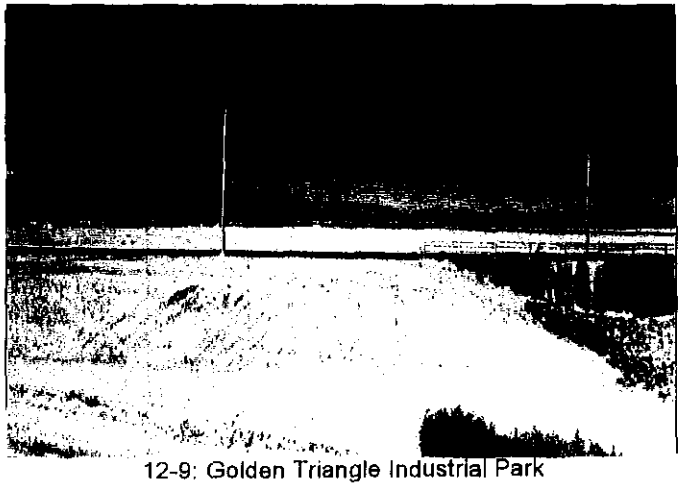
12-5: Walnut Road St. Improvements
at Mitchell Street



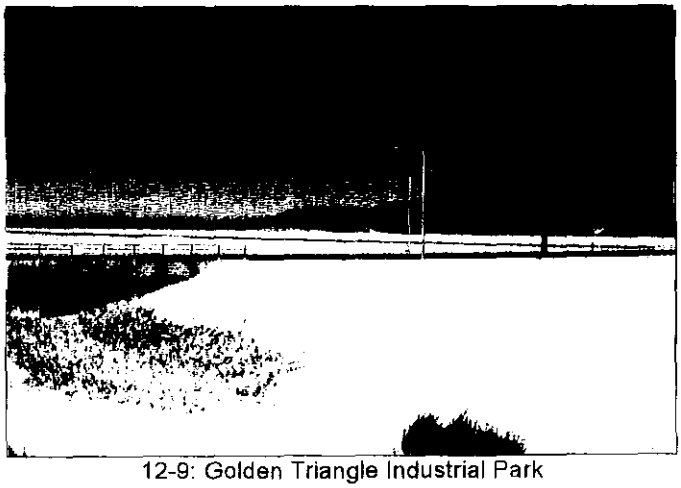
12-4: Bonanza Road St. Improvements



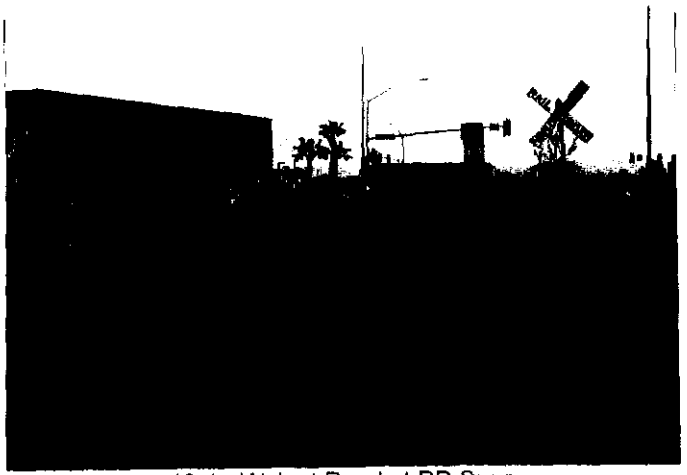
12-3: Bonanza Road St. Improvements



12-9: Golden Triangle Industrial Park

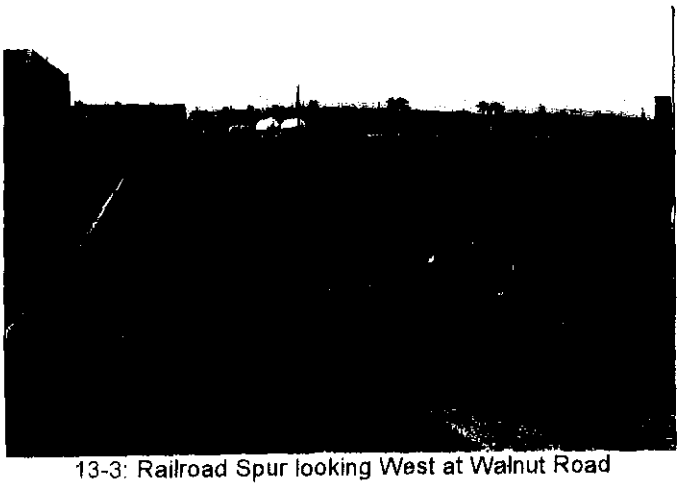


12-9: Golden Triangle Industrial Park

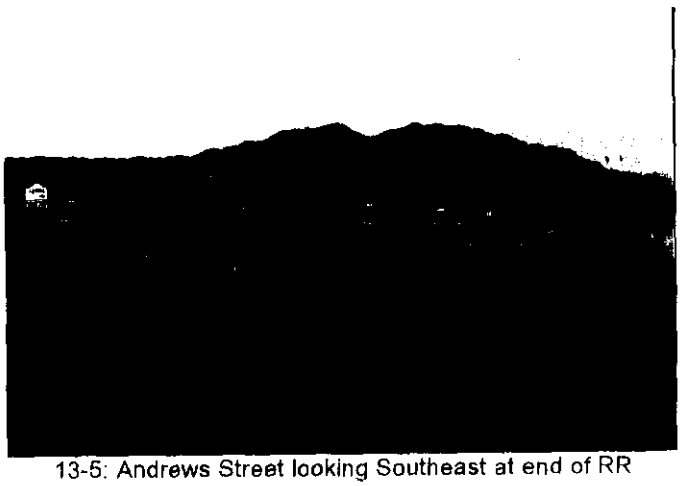


13-1: Walnut Road at RR Spur

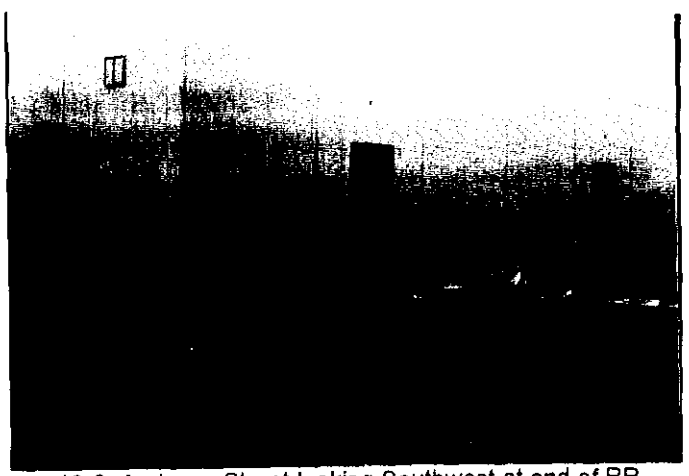
13-2: Railroad Spur looking East at Walnut Road



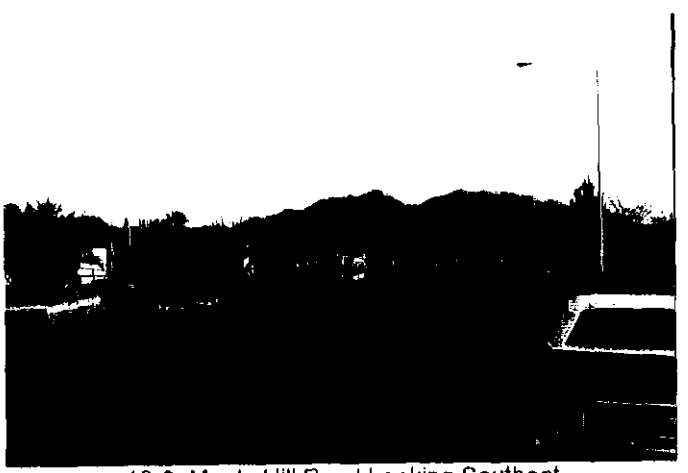
13-3: Railroad Spur looking West at Walnut Road



13-5: Andrews Street looking Southeast at end of RR



13-6: Andrews Street looking Southwest at end of RR

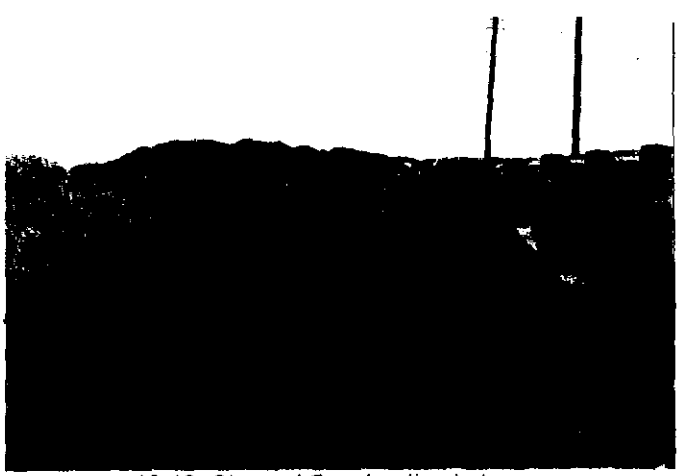


13-8: Maple Hill Road Looking Southeat

13-9: Alexander Road sump looking West

13-10: Alexander Road sump looking East

13-11: Regrading East of Alexander Rd RCB



13-12: Channel Construction between Lamb and Alexander

13-13: Charleston Blvd. St. Improvements at A Zone

13-14: Charleston Blvd. St. Improvements at Channel

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

Range Wash Flood Insurance Restudy

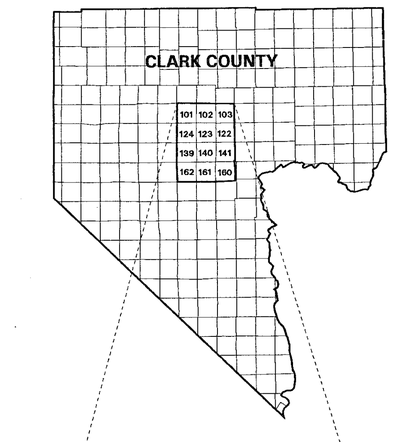
FIGURE 5B
Hydrologic Subbasins

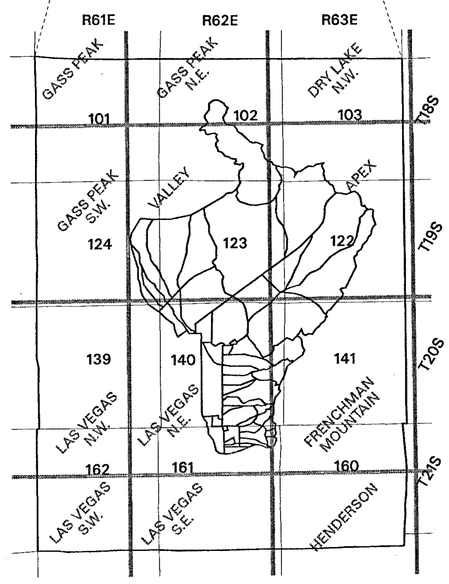
LEGEND

45-M — Drainage Basins, ID

G8 — Concentration Point, ID

KEY





N
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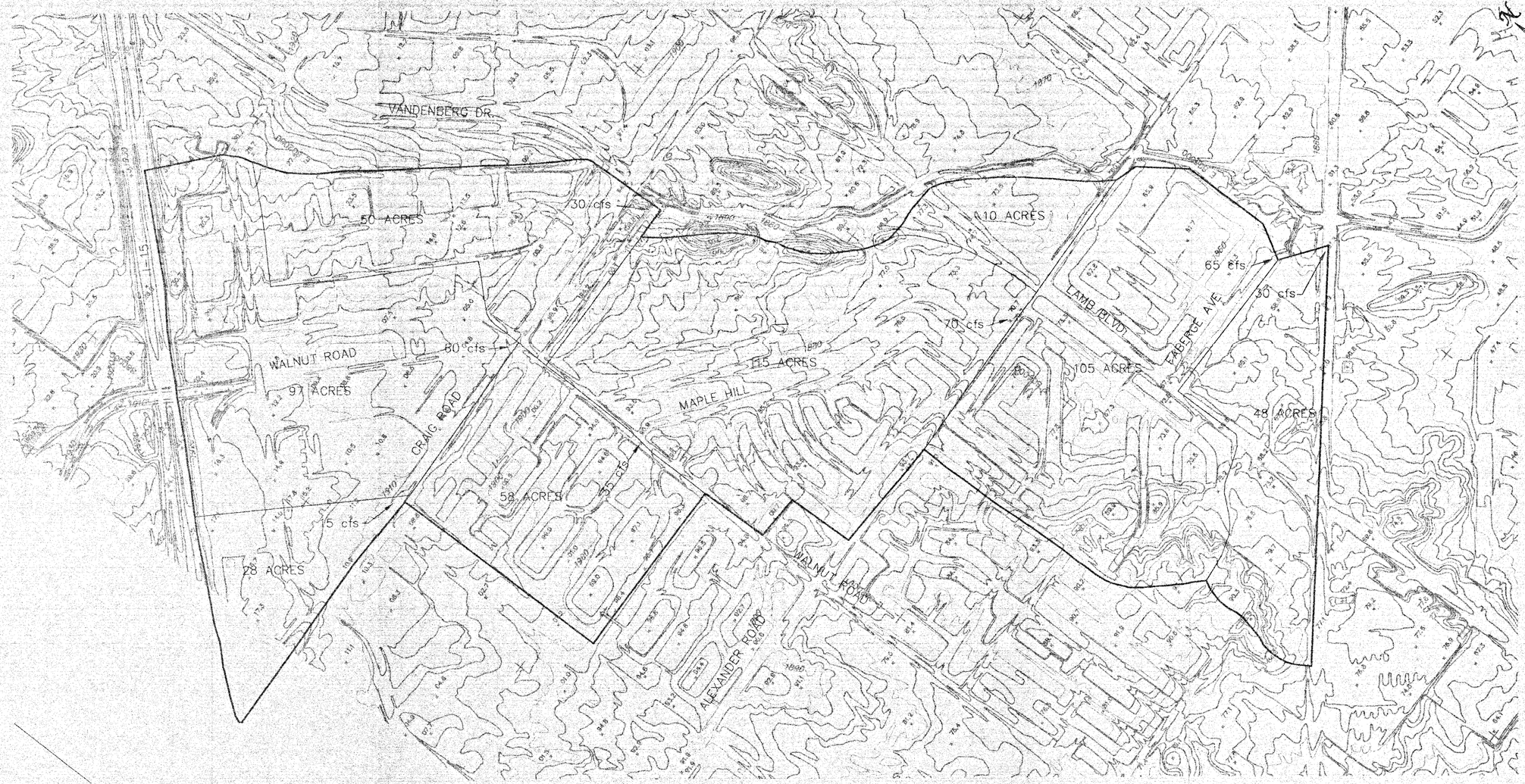
GRAPHIC SCALE

6000 4500 3000 1500 0 3000 6000
(IN FEET)
SCALE:1 inch = 3000 feet

POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING PLANNING SURVEYING CONSTRUCTION SERVICES

901, N. Green Valley Pkwy, Suite 100, Henderson, NV 89014
Phone: (702)263-7275 Fax: (702)263-7200



LEGEND

- BASIN BOUNDRY
- SUBBASIN BOUNDRY
- 30 cfs → SUBBASIN RUNOFF

FIGURE 3
SUBBASIN DELINEATION OF BASIN 307E
RANGE WASH FIS STUDY

CITY OF NORTH LAS VEGAS AND UNINCORPORATED
CLARK COUNTY, NEVADA

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901 Green Valley Parkway
Suite 100
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Fax: 702/263-7200
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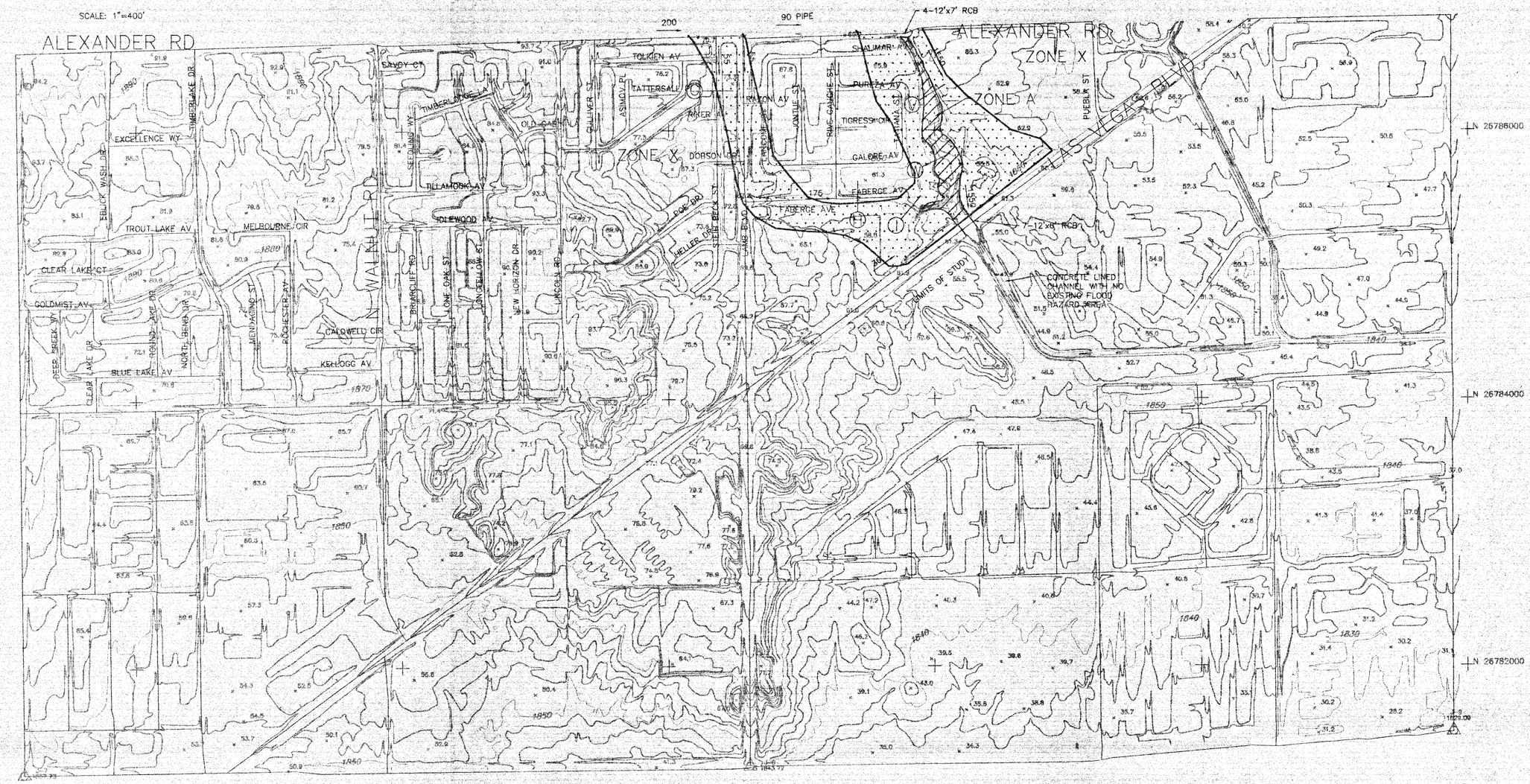
P103 Mon Feb 5 15:46:21 1996 POST, BUCKLEY, SCHUH & JERNIGAN, INC. CYLE

N

SCALE: 1"=400'

JOINS SHEET 29



LEGEND

- APPROXIMATE (100-YEAR) FLOOD PLAIN BOUNDRY PROPOSED
- EFFECTIVE FLOOD PLAIN BOUNDRY
- (A) CROSS SECTION
- 530 100-YEAR DISCHARGE

WORK MAP
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CITY OF NORTH LAS VEGAS AND UNICORPORATED
CLARK COUNTY, NEVADA

KENNEY AERIAL MAPPING INC.
PHOENIX, ARIZONA/LAS VEGAS, NEVADA

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PROFESSIONAL ENGINEER STATE OF NEVADA
DONALD W. DAVIS
CIVIL
No. 8087
2/24/96

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CONTROL SURVEY BY:
CITY OF NORTH LAS VEGAS
SURVEY DIVISION

ELEVATIONS: CITY OF NORTH LAS VEGAS VERTICAL CONTROL
GRID SYSTEM: NEVADA STATE PLANE COORDINATES

CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

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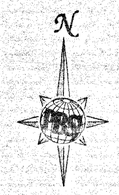

SCALE: 1"=400'

LEGEND

- APPROXIMATE (100-YEAR) FLOOD PLAIN BOUNDRY PROPOSED
- EFFECTIVE FLOOD PLAIN BOUNDRY
- (A) CROSS SECTION
- 530 100-YEAR DISCHARGE

WORK MAP
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

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CLARK COUNTY, NEVADA

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CITY OF NORTH LAS VEGAS
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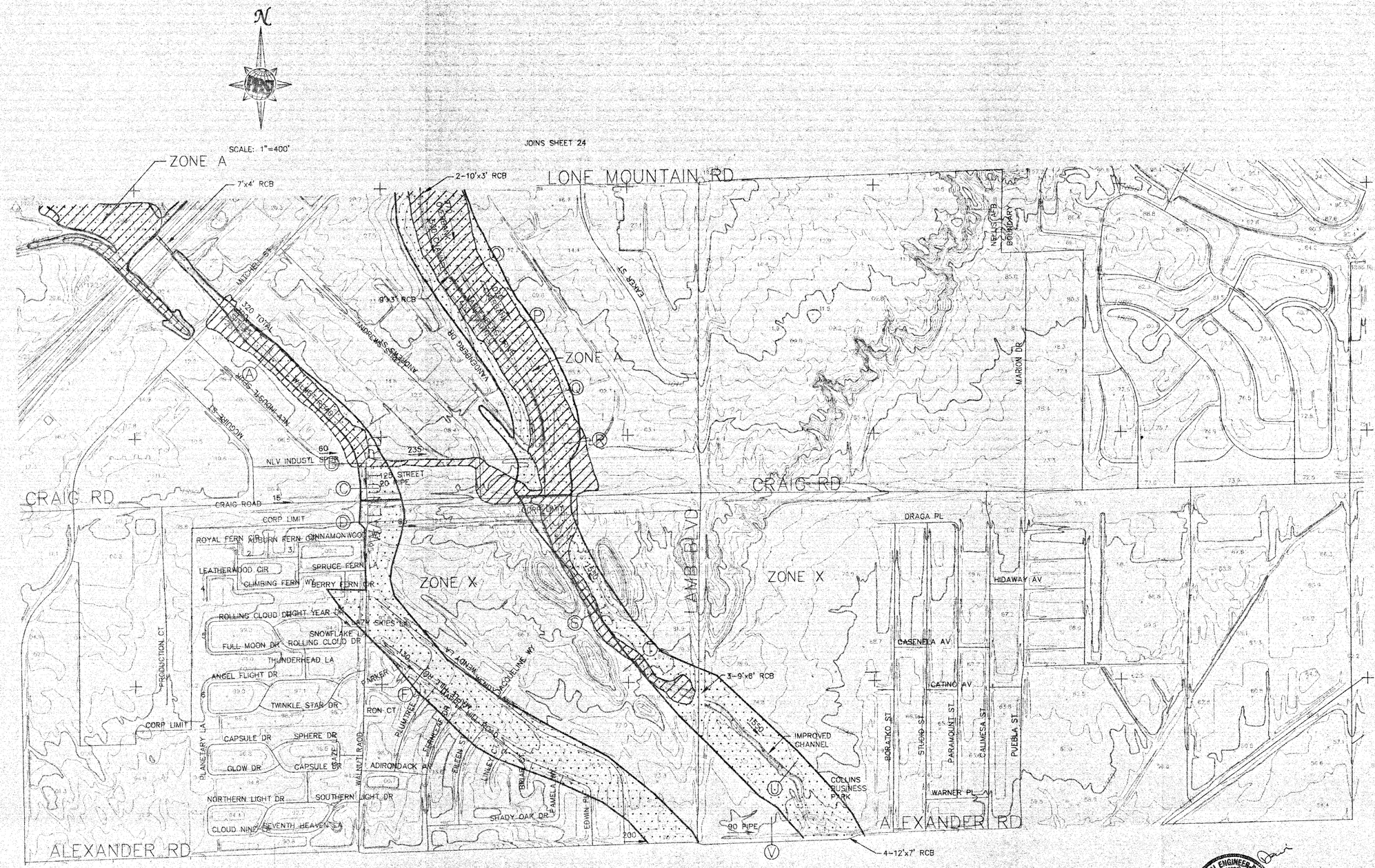

LEGEND

- APPROXIMATE (100-YEAR) FLOOD PLAIN BOUNDRY PROPOSED
- EFFECTIVE FLOOD PLAIN BOUNDRY
- (A) CROSS SECTION
- 530 100-YEAR DISCHARGE

KENNEY AERIAL MAPPING INC.

WORK MAP
RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

CITY OF NORTH LAS VEGAS AND UNICORPORATED
CLARK COUNTY, NEVADA

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GRID SYSTEM: NEVADA STATE PLANE COORDINATES

CITY OF NORTH LAS VEGAS
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OF 47 SHEETS

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CCNV INCORPORATED AREAS VOLUME II

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

VOLUME 2

SECTION 5 REFERENCE MATERIALS
Range Wash Dike
Sediment Transport Documentation Notebook

Submitted by:	Clark County Regional Flood Control District
Study Contractor:	*Post, Buckley, Schuh & Jernigan, Inc.*
Date Submitted:	February 27, 1996

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5.2.2	Memorandum of Understanding and Other Correspondence
5.2.3	Hydrology
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JUL [illegible] 1992

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17. OTHER TOPICS

OFFICE COPY
Regional Flood Control District

OFFICE COPY
Regional Flood Control District

JUL [illegible] 1992

Boyle Engineering Corporation consulting engineers

Suite 300
1785 East Sahara Avenue
Las Vegas, Nevada 89104

702 / 731-5511
FAX 702 / 731-5095

Federal Emergency Management Agency
Federal Insurance Administration
Risk Studies Division
500 C Street, SW, Room 422
Washington, DC 20472

July 27, 1992

Attention: Mr. William R. Locke, Chief

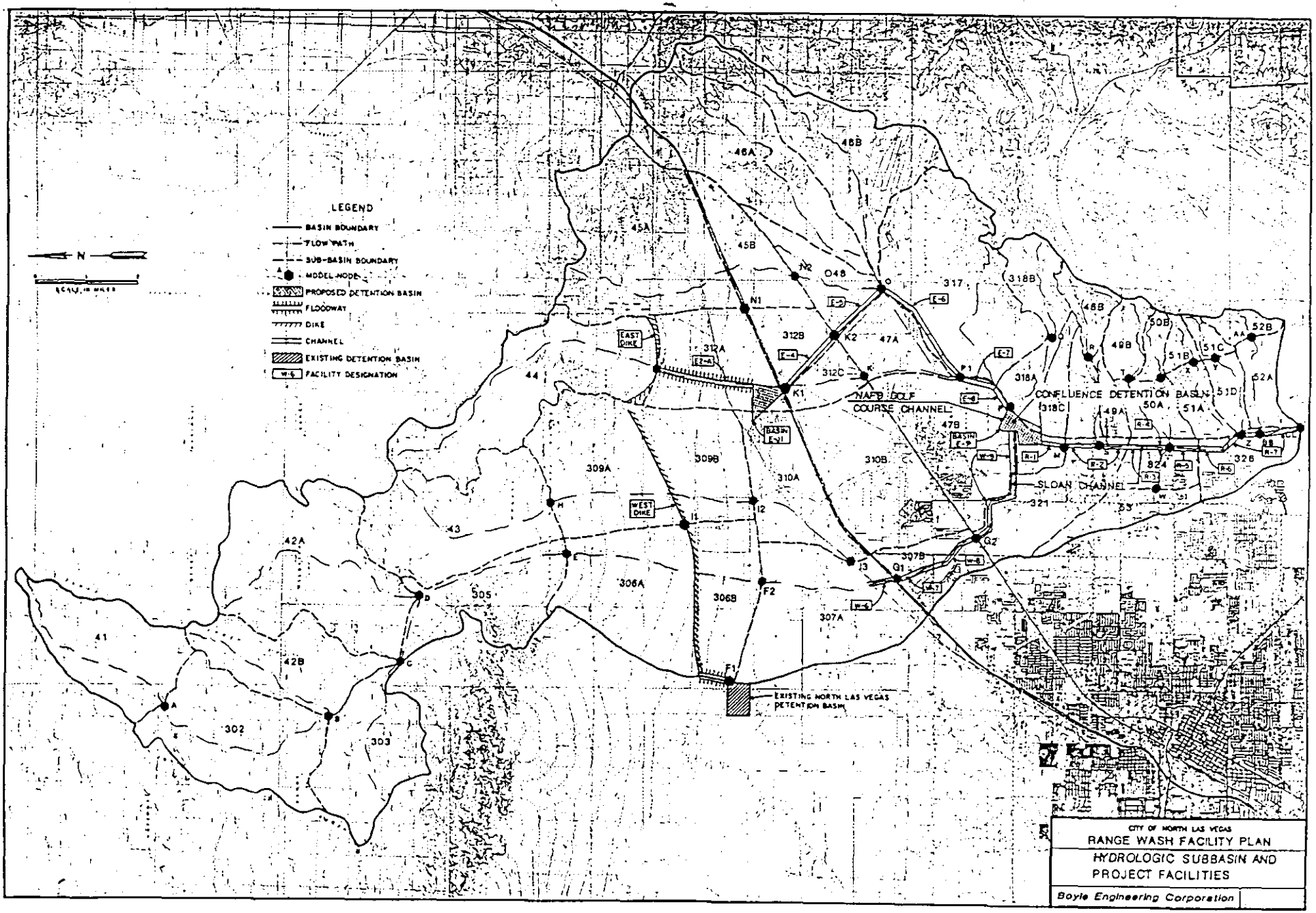
Supporting Documentation for Review of Hydrologic Changes Resulting from the Construction of the Range Wash Diversion Dike for the City of North Las Vegas

The City of North Las Vegas is proposing the construction of a diversion dike to intercept and divert flows from the Range Wash Drainage Basin. The attached figures depict a schematic view of the dike and its relation to the city. This diversion of flows results in reduced discharges to mapped floodplains within the City of North Las Vegas and results in a reduction of flood hazards to the citizens of North Las Vegas and unincorporated Clark County. Boyle Engineering Corporation, with the assistance of Dr. Richard French, has prepared the attached submittal related to the Diversion Dike.

This submittal is intended to provide information necessary for the review of the diversion dike design. Because the diversion dike is an integral part of changes to the hydrologic system, any changes to the hydrologic model are contingent on review and acceptance of the proposed dike. We have included hydrologic results which illustrate the flow reduction of the dike, however a concurrent study is being completed by another consulting engineering firm which is intended to address the specific hydrologic impacts of the diversion dike. Therefore, no detailed presentation of the hydrology (beyond the pertinent printouts supporting design discharges) is included in this presentation. Once this structure has been reviewed and accepted, a more comprehensive hydrologic submittal will be made.

We are submitting plans and specifications for the diversion dike and a notebook of supporting computations. To expedite FEMA's review, we have identified the various elements required for submittal based on "Data Request Checklist for Conditional Revision to Flood Insurance Study (FIS)/Flood Insurance Rate Map (FIRM) by Conditional Letter of Map Revision (CLOMR)". We will address each item explicitly and comment on where the information can be found if it is relevant to this submittal.

1. This project is being performed for the City of North Las Vegas and the Clark County Regional Flood Control District. The construction of the diversion dike is for public benefit and primarily intended for flood loss reduction to existing development in identified flood hazard areas in the communities of North Las Vegas and Clark County. As indicated in

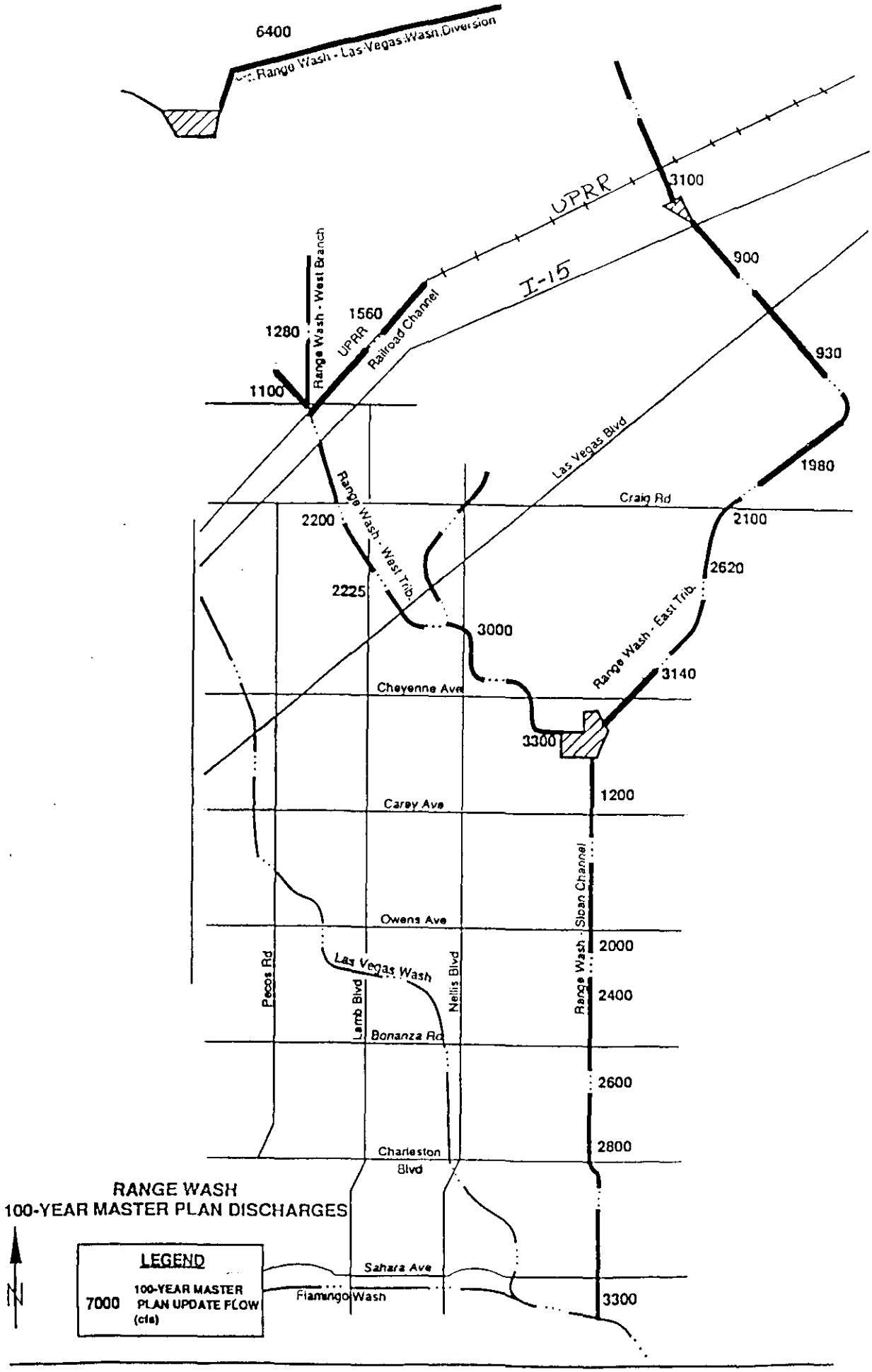


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

HYDROLOGIC SUBBASIN AND PROJECT FACILITIES

Boyle Engineering Corporation


6400
Range Wash - Las Vegas Wash Diversion
UPRR
3100
I-15
900
930
1980
2100
2620
3140
1200
2000
2400
2600
2800
3300
1560
1280
1100
2200
2225
3000
Range Wash - West Branch
UPRR Railroad Channel
Las Vegas Blvd
Craig Rd
Range Wash - West Trib.
Range Wash - East Trib.
Cheyenne Ave
Carey Ave
Owens Ave
Bonanza Rd
Charleston Blvd
Sahara Ave
Flamingo Wash
Las Vegas Wash
Pecos Rd
Lamb Blvd
Nellis Blvd
Range Wash - Sloan Channel
RANGE WASH
100-YEAR MASTER PLAN DISCHARGES
N
LEGEND
7000
100-YEAR MASTER PLAN UPDATE FLOW (cfs)

2. This project involves the construction of a diversion dike across the Range Wash Alluvial Fan. It intercepts flow from the upper portions of the Range Wash Basin and diverts them to an adjacent detention facility. The resulting reduction in downstream discharges reduces flood hazards to existing properties within the City of North Las Vegas and Clark County. Construction plans identifying the alignment and character of the diversion dike are submitted with this application as is a detailed notebook entitled Range Wash Sediment Transport Documentation Notebook which presents the computations used in sizing the diversion dike. Hydrologic impacts have been estimated as part of the design of the diversion dike, however another engineering consultant is preparing detailed hydrologic information as part of revision to the Flood Insurance Study.

3. A letter is attached from the City of North Las Vegas and the Clark County Regional Flood Control District indicating they are sponsoring this design and are requesting FEMA review in accordance with Section 65.4 (B) of the NFIP Regulations.

4-15. The items requested in Sections 4 through 15 relate to the specific revisions to the Community's FIRM map. Because any revisions are subject to changes in the hydrologic model resulting from the construction of the diversion dike, the preparation of this information is premature at this time. Subsequent to the review and acceptance of the diversion dike, a detailed hydrologic evaluation (performed by another engineering consultant) and revisions to the existing community FIRM will be performed. This present submittal is solely intended to solicit comment and acceptance of the diversion dike which is the foundation for changes to the hydrologic system.

16. Construction plans for the diversion dike are submitted herewith.

17. The diversion dike is a levee by FEMA definition and in accordance with Section 65.10 of the NFIP Regulation the following items have been addressed.

    a. A minimum freeboard of 3 feet has been provided in accordance with 65.10 (b) (1). No road bridges or other structures are intended to cross the proposed levee and therefore no additional freeboard has been provided.

       A detailed sediment transport analysis has been performed which identifies the anticipated deposition along the diversion dike alignment. In addition to the 3 feet of freeboard, the total deposition depth has been included in the height of the levee.

       Because water may enter the diversion dike perpendicular to its alignment, an additional freeboard equal to the required velocity head has also been incorporated in the sizing of the dike.

These three freeboard components have been added above the computed water surface depth along the diversion dike. The total dike height of 15.3 feet includes a water depth of 4.4 feet and total freeboard of 10.9 feet. The enclosed notebook entitled Range Wash Sediment Transport Documentation Notebook presents the computations developed in support of the dike sizing. The notebook is extensively annotated and provides a detailed description of its contents.

b. No structures are intended to penetrate the levee.

c. The sediment transport analysis indicates that flow characteristics along the dike will result in deposition prior to reaching equilibrium. As such, no embankment erosion protection is proposed. Should minor anomalies occur in the hydraulic characteristics which result in minor local scour, the size of the dike will limit any possible adverse impacts. As shown on Drawing DT-1 of the plan set, the dike has a top width of 12 feet and slopes of 4:1 and 3:1 at the upstream and downstream faces. At the anticipated design height of 15.3 feet, the width at the toe of the dike will be a minimum of 100 feet. Any localized scour will not compromise the stability of the embankment or the effectiveness of the system.

Because the dike has been evaluated using an equilibrium sediment transport model, no generalized bed or slope scour is anticipated. Therefore, no extraordinary protection measures are required for the embankment.

d. A geotechnical analysis of slope stability has been performed by Converse Consultants Southwest, Inc. and is attached to the submittal in Part 16 of the notebook. This analysis indicates satisfactory factors of safety for slope stability under conditions representing end of construction, sudden drawdown, and static end dynamic steady seepage conditions. In all cases the factor of safety is above those stipulated in "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers (1973).

e. In the project geotechnical report, Converse estimated that "embankment settlement due to consolidation of fill and foundation materials should be negligible" due to the granular nature of the materials.

f. The alignment of the dike traverses the alluvial fan and will intercept all upstream flows. Downstream flows travel away from the dike and will require no additional drainage.

18-19. This submittal does not relate to frontal dune construction or placement of fill in the floodplain.

20.

a. A detailed sediment transport analysis has been performed which quantifies discharges and volumes of water and sediment associated with the 100-year flood at the dike location. This discharge and associated sediment is slightly higher than the quantities identified at the apex and is more representative of actual conditions to be encountered. The engineering analysis is consistent with the general criteria of FEMA and is documented in the Sediment Transport Documentation Notebook enclosed with this submittal.

b. The enclosed documentation demonstrates that the diversion dike has been designed to accommodate the estimated 100-year peak discharge as well as associated sediment and hydrodynamic and hydrostatic forces.

c. A detailed sediment transport analysis was performed along the dike to identify the impacts of flow along the diversion dike. Because the system is a depositional feature and is at equilibrium subsequent to the deposition, no generalized erosion or scour is anticipated. Any limited localized erosion or scour will not compromise the integrity of the diversion dike since its base width at the toe is in excess of 100 feet.

d. The nature of the diversion dike alignment demands that the facility be designed to withstand discharges impacting the dike perpendicular to its alignment. This impact has been included in the evaluation of the required freeboard as well as in the depth of anticipated deposition.

e. The diversion dike and its associated channel are designed to collect and divert concentrated flood waters and their associated sediment load. This discharge will be conveyed, at approximately equilibrium conditions, along the dike and ultimately into the North Las Vegas Detention Basin. We anticipate no adverse impacts on adjacent properties. All discharges and sediment will be confined to the diversion dike right-of-way or undeveloped federal lands.

f. The engineering analysis used to identify peak discharges and sediment loads along the dike includes runoff from local areas beneath the apex of the alluvial fan.

g. Design and maintenance of the diversion dike will be performed in accordance with the Clark County Regional Flood Control District's Operations and Maintenance Manual. Sedimentation monuments and depth gages will be provided to assist maintenance crews in identifying appropriate maintenance intervals.

All facilities onto which flood waters will be diverted are publically owned. These include the alignment of the diversion dike as well as the downstream North Las Vegas Detention Basin.

h. The City of North Las Vegas and the Clark County Regional Flood Control District have secured the necessary right-of-way for construction as well as permanent easements for the maintenance of these facilities. The downstream terminus of the project is within the North Las Vegas Detention Facility which is owned and operated by the Clark County Regional Flood Control District and the City of North Las Vegas.

We hope this summary assists your review of the attached submittal. We encourage you to call should you have any questions regarding the project scope or the technical content of our submittal. If so, please feel free to call Gerald Simpson, Boyle Project Manager (702) 731-5511 or Mark Glidden, Project Technical Director (303) 987-3443).

BOYLE ENGINEERING CORPORATION

Mark W. Glidden

Mark W. Glidden, P.E.
Senior Engineer by WGH

Enclosure: Checklist
Range Wash Sediment Transport Documentation Notebook

cc: Walter Hines/Boyle
Gale Fraser/CCRFCD
Gil Gilpin/North Las Vegas

DN-N07-300-10/kmc
rangewash/ltr630

CHECKLIST USED IN PROCESSING CONDITIONAL LETTERS OF MAP REVISION (CLOMRs)

Federal Emergency Management Agency

Washington, D.C. 20472

DATA REQUEST CHECKLIST
FOR CONDITIONAL LETTER OF MAP REVISION

Requestor: _____ Case No.: _____

Community: _____ Date: _____

Re: _____

The items checked below in Column 1 are required to process your request for a conditional Letter of Map Revision (LOMR). Items checked in Column 2 have been received and should not be resubmitted unless specifically requested.

(1) Required	(2) Received	
_____	_____	1. Written description of the scope of the proposed project and the methodology used to analyze the project's effects
		2. Hydraulic backwater models of the 100-year flood for the following:
_____	_____	a. Existing conditions (cross sections to reflect conditions prior to construction of the project)
_____	_____	b. Proposed conditions (same cross sections as the existing conditions model, reflecting the proposed project)
		3. Hydraulic backwater models of the 10-, 50-, 100-, and 500-year floods for the following:
_____	_____	a. Duplicate of the effective FIS model
_____	_____	b. Existing conditions (effective FIS model including cross sections through the project site; cross sections should reflect conditions prior to construction of project)
_____	_____	c. Proposed conditions (existing conditions model reflecting the proposed project)
		4. Floodway hydraulic backwater models of the following:
_____	_____	a. Duplicate of effective
_____	_____	b. Existing conditions

(1) Required	(2) Received		
_____	_____	c. Proposed conditions	
_____	_____	5. Copy of the Flood Insurance Rate Map with the project area indicated	
_____	_____	6. Topographic mapping of the entire area covered by the proposed conditions model, indicating the locations of all cross sections used in the hydraulic model and delineating the proposed 100-year floodplain boundary	
		7. Topographic mapping of the entire area covered by the proposed conditions model, indicating the locations of all cross sections used in the hydraulic model and delineating:	
_____	_____	a. The proposed 100- and 500-year floodplain boundaries	
_____	_____	b. The proposed floodway boundary	
_____	_____	8. Other: _____	
		_____	
		_____	
		_____	
		_____	
_____	_____	9. Community acknowledgment of the conditional LOMR request (form enclosed for community's use, if desired)	
		10. Initial fee for conditional LOMR	
_____	_____	a. New bridge or culvert (no channelization)	$420
_____	_____	b. Channel modifications only	$480
_____	_____	c. Channel modification and new bridge or culvert	$630
_____	_____	d. Levees, berms, or other structural measures	$810
_____	_____	e. Structural measures on alluvial fans	$1200

(1) Required	(2) Received	
_____	_____	f. Fee exemption certification in compliance with Section 72.5 of National Flood Insurance Program Regulations

The items checked in Column 1 should be sent within 30 days to the following address:

Federal Emergency Management Agency
Federal Insurance Administration
Office of Risk Assessment
500 C Street, SW., Room 422
Washington, D.C. 20472

Attention: Mr. Charles A. Lindsey

Any initial fee for the request, in the form of a check or money order made payable to the National Flood Insurance Program, should be sent by Registered Mail, Return Receipt Requested. The case number referenced above should be included on the check or money order for identification purposes

DATA REQUEST CHECKLIST FOR CONDITIONAL REVISION TO
FLOOD INSURANCE STUDY (FIS)/FLOOD INSURANCE RATE MAP (FIRM)
BY CONDITIONAL LETTER OF MAP REVISION (CLOMR)

Date: _____

Requestor: _____ Community: _____

Re: _____ Case Number: _____

To help you prepare the required supporting data for your request for a conditional revision, we are enclosing copies of the following:

_____ "National Flood Insurance Program and Related Regulations," dated October 1, 1988

_____ Appeals, Revisions, and Amendments to Flood Insurance Maps, A Guide for Community Officials, dated September 1985

_____ (Other)

The data identified below as "Required" must be submitted for our review. The data identified as "Received" should not be resubmitted. References to the sections of the National Flood Insurance Program (NFIP) regulations that establish specific requirements for supporting data are included as appropriate in the checklist entries. All analyses submitted must be certified by a registered professional engineer. All topographic data submitted must be certified by a registered professional engineer or licensed land surveyor. The meaning of "certification" as it applies to the types of required supporting data is given in Section 65.2(b) of the NFIP regulations.

Description of Data		Required	Received
1. Payment of initial fee for conditional revision according to the following schedule:			
a. New bridge or culvert (no channelization)	$420	_____	_____
b. Channel modifications only	$480	_____	_____
c. Channel modification and new bridge or culvert	$630	_____	_____

Description of Data		Required	Received
d. Levees, berms, or other structural measures	$810		
e. Structural measures on alluvial fans	$1,200		
f. Additional initial fee			

As provided for by Section 72.5 of the NFIP regulations, Federal, State, and local governments and their agencies shall be exempt from the fee requirement for projects they sponsor if the Administrator determines or the requestor certifies that the project is for public benefit and primarily intended for reducing flood losses to existing development, as opposed to planned development, in identified flood hazard areas. If applicable, therefore, a fee exemption certification may be submitted in lieu of the required fee.

The fee or fee exemption certification is to be sent to the following address:

Federal Emergency Management Agency
Federal Insurance Administration
Office of Risk Assessment
Technical Operations Division
500 C. Street, SW., Room 422
Washington, D.C. 20472

Attention: Mr. Charles Lindsey

Payment must be made in the form of a check or money order made payable to the National Flood Insurance Program, and must be sent by Registered Mail, Return Receipt Requested. Please include the case number shown on the first page of this checklist on your check or money order.

2. A concise description of the nature and extent of the requested revision

3. Evidence that the Chief Executive Officer (CEO) of the affected community, or an official designated by the CEO, was asked to submit the request (See Section 65.4 of the NFIP regulations.)

Description of Data	Required	Received
4. A general description of the proposed hydrologic conditions on which the conditional revision request is based (See Section 65.6(c)(1)(i) of the NFIP regulations.)		
5. A general description of the proposed hydraulic conditions, including channel modifications or other projects, on which the conditional revision request is based (See Section 65.6(c)(2)(i) of the NFIP regulations.)		
6. New hydrologic analysis, including a brief description of the methodology used, for the _____ -year flood(s) for _____ (See Section 65.6(a)(7) of the NFIP regulations.)		
7. Evidence that the appropriate local, State, or Federal agency (i.e., _____) has approved the new hydrologic analysis, including the resulting peak discharge values		
8. Printouts (including full input and output listings) from a calibration model, produced by the requestor, that duplicates the hydraulic computer model used to determine the _____ -year water-surface elevations shown for _____ in the effective FIS report and on the effective FIRM (See Section 65.6(a)(8) of the NFIP regulations.) The calibration model may be either the FIS model, reproduced on the requestor's equipment, or a model that yields computed water-surface profiles that duplicate the flood profiles shown for _____ in the effective FIS report.		
9. Printouts (including full input and output listings) from a calibration model, produced by the requestor, that duplicates the hydraulic computer model used to determine the limits of the 100-year floodway shown for _____ on the effective Flood Boundary and Floodway		

Description of Data	Required	Received
Map (FBFM)/FIRM (See Section 65.6(a)(8) of the NFIP regulations.) The calibration model may be either the FIS floodway model, reproduced on the requestor's equipment, or a model that yields the computed floodway widths and water-surface elevations presented in the Floodway Data Table for _____ in the effective FIS report.	_____	_____
10. Printouts (including full input and output listings) from a revised hydraulic model for the _____ -year water-surface elevations on _____. The revised model must be created from the calibration model (Item 8) and must meet the requirement(s) listed below.	_____	_____
____ The model must be based on the same peak discharge values used in the calibration model (Item 8).		
____ The model must be based on the peak discharge values determined in the new hydrologic analysis (Item 6).		
____ The model must account for the effects of the proposed hydraulic conditions on which the conditional revision request is based.		
In addition, the revised model must account for the effects of any encroachments that have occurred in the 100-year floodplain since the FIS hydraulic model was developed and must cover a sufficient length of _____ so that the water-surface elevations computed at cross sections upstream and downstream of the revised reach will match those shown at the same cross sections on the Flood Profiles in the effective FIS report within approximately 0.5 foot. All changes to the input data in the calibration model (Item 8) must be highlighted on the printouts. (See Section 65.6(a)(9) of the NFIP regulations.)		

Description of Data	Required	Received
11. A hydraulic analysis, including a brief description of the methodology used, for the 100-year flood on _____ (See Section 65.6(a)(9) of the NFIP regulations.)	_____	_____
12. Printouts (including full input and output listings) from a revised hydraulic model for the 100-year floodway on _____. The revised model must be created from the calibration model (Item 9) and must meet the requirements listed below.	_____	_____
____ The model must be based on the 100-year peak discharge value(s) used in the calibration model (Item 9).		
____ The model must be based on the 100-year peak discharge value(s) determined in the new hydrologic analysis (Item 6).		
____ The model must account for the effects of the proposed hydraulic conditions on which the conditional revision request is based.		

In addition, the revised model must account for the effects of any encroachments that have occurred in the 100-year floodplain since the FIS floodway model was developed and must cover a sufficient length of _____ so that the water-surface elevations and floodway widths computed at cross sections upstream and downstream of the revised reach will match those shown at the same cross sections on the Flood Profiles and Floodway Data Table in the effective FIS report. The revised model must be based on the equal conveyance reduction method unless agreements have been made with affected property owners that an alternative method would be used. The net effect of the proposed hydraulic conditions, the encroachments that have occurred since the FIS floodway model was developed, and the revised floodway limits must not increase the computed 100-year water-surface elevations by more than 1.0 foot above those computed in the calibration model (Item 8) or those computed in the revised model (Item 10), whichever are lower. (See Section 65.7(b)(4) of the NFIP regulations.)

Description of Data	Required	Received
13. Documentation, as shown below, concerning the approval of the revised floodway (See Sections 65.7(b)(1), (2), and (3) of the NFIP regulations.)	_____	_____
____ Copy of the public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions		
____ Copy of a letter notifying the appropriate State agency of the floodway revision		
____ Documentation of the approval of the revised floodway by the appropriate State agency		
14. Corporate limit map and/or annexation ordinances that reflect the current community boundaries	_____	_____
15. A topographic map that shows the proposed _____ and _____ boundaries, the locations and alignments of all cross sections used in the revised hydraulic models (Items 10 and 12), stream alignments, road alignments, and the community boundaries. The revised _____ and _____ boundaries must tie into those shown on the effective FIRM/FIRM and FBFM upstream and downstream of the revised reach. The scale and topographic definition of the map must be sufficient to provide reasonable accuracy, and the map must be certified by a registered professional engineer. (See Section 65.6(a)(11) and 65.7(b)(5) of the NFIP regulations.)	_____	_____
16. Construction plans, certified by a registered professional engineer, for all project elements, specifically _____ _____ _____.	_____	_____

Description of Data	Required	Received

17. The following data concerning the ability of the _____ proposed to be built along _____ to meet the minimum design and maintenance requirements established for levee systems in Section 65.10 of the NFIP regulations:

a. **Freeboard** -- Evidence which shows that the levee(s) will meet the minimum freeboard require-ments set forth in Section 65.10(b)(1) of the NFIP regulations _____ _____

b. **Closures** -- Evidence which shows that all drainage structures that will penetrate the levee(s) will be fitted with closure devices that will be (1) structural parts of the levee(s) during operation and (2) are designed according to sound engineering practice, as set forth in Section 65.10(b)(2) of the NFIP regulations _____ _____

c. **Embankment Protection** -- An engineering analysis which demonstrates that no appreciable erosion of the levee embankment(s) can be expected during the 100-year flood. The analysis must be performed according to the guidelines set forth in Section 65.10(b)(3) of the NFIP regulations. _____ _____

d. **Stability** -- An engineering analysis that evaluates the stability of the levee embankment(s) and foundation(s). The analysis must be performed according to the guidelines set forth in Section 65.10(b)(4) of the NFIP regulations. _____ _____

e. **Settlement** -- An engineering analysis that assesses the potential for and magnitude of losses of freeboard that may result from settlement of the levee(s) and that demonstrates that the minimum required freeboard will be maintained. The analysis must be performed according to the guidelines set forth in Section 65.10(b)(5) of the NFIP regulations. _____ _____

Description of Data	Required	Received
f. **Interior Drainage** -- An engineering analysis of the potential hazards associated with floodwaters that originate on the landward side of the levee(s) and that would be prevented by the levee(s) from flowing into _____. The analysis must be performed according to the guidelines set forth in Section 65.10(b)(6) of the NFIP regulations.	_____	_____

Description of Data	Required	Received
18. Data which show that any primary frontal dune (as defined in Section 59.1 of the NFIP regulations) that is to be considered an effective barrier to the 100-year flood surge and associated wave action is either a natural dune or an artificial (designed and constructed) dune that is well established and has long standing vegetative cover. It must also be shown that the cross sectional area of the portion of the dune seaward of the dune crest, measured perpendicular to the shoreline above the 100-year stillwater elevation, is greater than 540 square feet. As an alternative to the data described above, authoritative historical documentation may be submitted which shows that the primary frontal dune at a specific site has withstood previous 100-year storm surges and associated wave action. (See Section 65.11 of the NFIP regulations.)	_____	_____
19. The following data concerning the proposed placement of fill in the [100-year floodplain of _____, where no regulatory floodway has been established/regulatory floodway of _____], which we have determined could cause a rise in the computed 100-year water-surface elevations greater than that allowed by Section 60.3 [(c)(10)/(d)(3)] (See Section 65.12 of the NFIP regulations.):		
a. Community Request — A request from the affected community for the Federal Emergency Management Agency's conditional approval of the proposed change, accompanied by the appropriate initial fee or a request for an exemption from the fee, whichever is appropriate. (See Item 1 of this checklist.)	_____	_____
b. Evaluation of Alternatives — An evaluation of alternative actions that would not result in a rise in the computed 100-year water-surface elevations greater than that allowed by Section 60.3 [(c)(10)/(d)(3)]. The evaluation must demonstrate that the alternatives are not feasible.	_____	_____

Description of Data	Required	Received
c. *Legal Notice* -- Documentation of individual legal notice to all property owners affected by the proposed action, both within and outside the community, that explains the effect of the proposed action on their properties.	_____	_____
d. Concurrence of Other Communities -- Evidence that the CEOs of other communities affected by the proposed action concur in that action.	_____	_____
e. Certification Concerning Structures — Certification that no structures are in the areas that will be affected by the increased 100-year water-surface elevations.	_____	_____
f. Flood Elevation Revision Request — A request for a revision to the existing computed 100-year water-surface elevations, submitted according to the procedures outlined in Section 65.6 of the NFIP regulations. The required technical supporting data are listed as Items _____ of this checklist.	_____	_____
g. Floodway Revision Request — A request for a revision to the regulatory floodway, submitted according to the procedures outlined in Section 65.7 of the NFIP regulations. The required technical supporting data are listed as Items _____ of this checklist.	_____	_____
20. The following data concerning the effect of _____ on the alluvial fan Special Flood Hazard Area:		
a. Engineering analyses that quantify the design discharges and the volumes of water, debris, and sediment associated with the 100-year flood at the apex of the fan under current watershed conditions and under potential adverse conditions (e.g., deforestation of the watershed by fire). The potential for debris flow and sediment movement must		

Description of Data	Required	Received
be assessed with an engineering method acceptable to the Federal Emergency Management Agency. The assessment should consider the characteristics and availability of sediment in the drainage basin above the apex and on the alluvial fan.		
b. Engineering analyses which show that _____ will accommodate the estimated 100-year peak discharge, consisting of the total volume of water, debris, and sediment determined in Item a. above, and the associated hydrodynamic and hydrostatic forces.		
c. Engineering analyses which show that _____ has/have been designed to withstand the potential erosion and scour forces.		
d. Engineering analyses or evidence which shows that _____ will provide protection against flows that migrate or suddenly move to the project site from other portions of the fan.		
e. Engineering analysis that assesses the methods by which concentrated floodwater and the associated sediment load will be disposed of and the effect of those methods on adjacent properties.		
f. Engineering analyses which demonstrate that flooding from local runoff, or sources other than the fan apex, will be insignificant or will otherwise be accommodated by appropriate flood control or drainage measures.		
g. Evidence that the effect of _____ on flood hazards in all areas of the fan (including those not protected by _____) and the design and maintenance requirements for the various elements of _____ were reviewed and approved by the community, State, or local agency that has jurisdiction over flood control activities in the community.		

Description of Data	Required	Received
b. Assurance from the community that appropriate easements have been secured from those who own property onto which flood waters will be diverted.		

1. SUMMARY MEMORANDUM

WEST RANGE WASH DIVERSION DIKE

SEDIMENT TRANSPORT ANALYSIS AND DIKE SIZING CRITERIA

SUMMARY MEMORANDUM

INTRODUCTION

The West Range Wash Diversion Dike is intended to intercept and divert flows from the headwaters of the western tributary of Range Wash and direct them to the North Las Vegas Detention Basin. Construction drawings for this facility are attached hereto for your information and review. The dike alignment which traverses the West Range Wash alluvial fan was established in a previous project undertaken by Boyle for the City of North Las Vegas (1991 Facility Planning Study). The efforts presented in the present study were undertaken to determine an appropriate dike height which satisfies the design requirements stipulated by FEMA. These requirements include consideration of depth of flow, scour or deposition potential, hydrostatic and hydrodynamic head, flooding depth and appropriate freeboard for the 100-year peak flow.

The methodologies and results presented in this report follow the general procedures proposed in the Memorandum of Understanding (MOU) dated September 27, 1991 (See Part 2. Memorandum of Understanding). Changes in the selected methodologies have been made only where required to develop information which was previously assumed to be available from other sources. Boyle Engineering Corporation and Dr. Richard French have worked closely on the formulation and execution of the approaches presented herein. A comprehensive Design Notebook containing the calculations, graphs and computer output has been produced and is attached hereto for review. Various sections of the Design Notebook are referenced herein.

The major steps utilized in the dike design are summarized below:

- o Review Hydrology
- o Determine Average Annual Sediment Yield
- o Compute Event Specific Yield
  - Inflow Sediment Load
  - Fan Equilibrium Flow Using Dawdy/FEMA
  - Integrate to Verify Average Annual Yield
- o Model Fan/Dike System
  - HEC-6/Yang
  - Alluvial Fan Transport
  - Dike Equilibrium Transport
  - Transition Section
  - Deposition/Scour Evaluation
- o Water Surface Profile
  - HEC-2
  - Profile with Deposition/Scour
- o Dike Height Determination

HYDROLOGY

The hydrology utilized in this evaluation is consistent with the revised Flood Insurance Study hydrology recently developed for the 1991 Flood Control Master Plan Update of the Las Vegas Valley undertaken by the Clark County Regional Flood Control District (CCRFCD). The Flood Insurance Study hydrologic model for the Range Wash Basin was based on a computer model developed by Boyle as part of their Facility Planning Study. Because the construction of the West Range Wash Diversion Dike is imminent, the FIS hydrologic model recognizes the existence of the dike (i.e., those portions of the Range Wash basin below the diversion dike are

included in the FIS model of the lower basin). The flows diverted by the dike will discharge into the North Las Vegas detention basin and do not impact any floodplains other than the obvious reduction of flow in the lower Range Wash basin.

A baseline model of the watershed above the dike was developed to estimate dike design flows. The modeling methodology and basic assumptions are consistent with those in the *Flood Insurance Study*. A *100-year peak discharge of 7,028 cfs was used in this analysis (Note* this is approximately 10% higher than noted in the 1991 CCRFCD Master Plan). Other recurrence intervals were also simulated for use in this analysis including the 2, 5, 10, 25, and 50-year events. Peak flows and total hydrographs have been developed for each. (See Part 3. Hydrology in the Design Notebook).

AVERAGE ANNUAL SEDIMENT YIELD

The average annual sediment yield at the apex of the fan is the starting point for all subsequent sediment transport evaluations of the Range Wash systems. The MOU indicates that the average annual yield will be used as the basis for the estimation of 2, 5, 10, 25, 50, and 100-year event yield since no specific estimates were available within the Range Wash Basin which related yield to a recorded discharge. It was concluded that a reliable estimate of average annual sediment yield could be developed and used for the development of specific event yields. For this evaluation the PSIA Methodology was used to estimate sediment yield at the dike location. The details of this methodology are presented in the 1991 Facilities Planning Study and are included in Part 4. Ave. Annual Yield of the Design Notebook. The average annual yield value calculated for the West Tributary of Range Wash was 16 AF (0.4 AF/Sq. Mi/Yr). This was compared to regional estimates developed by the Corps of Engineers in their Las Vegas Valley Feasibility Study. There was good correlation with the COE range of 0.3 to 0.5 AF/Sq. Mi/Yr. *Consequently, an average annual sediment yield at the dike location of 16* AF was used.

EVENT SPECIFIC YIELD

The approach utilized in developing event specific yields differed somewhat from that proposed in the MOU. A defensible relationship between the 100-year event yield and the average annual sediment yield could not be identified after a review of the available literature. Various values of the relationship between 100-year event yield and the average annual yield were identified in the literature but none could be transferred directly to the Range Wash basin. As a result, it was necessary to undertake an iterative process to determine the sediment yield from the 100-year event. The process began with the estimation of the equilibrium sediment transport down the alluvial fan surface for various recurrence intervals. These values were then integrated to establish an average annual sediment yield based on the fan's ability to deliver sediment. This yield estimate was compared to the PSIA estimate of average annual sediment yield. When both estimates matched, the individual event yield was assumed to be correct and was used for future analyses and ultimately to size the dike. The following paragraph describes this process in greater detail.

The HEC-6 computer program was used to simulate sediment transport through the entire fan/dike system. Yang's formulation of sediment transport equations presented in HEC-6 was used to compute transport capacity. An article published in the Journal of Hydraulic Engineering (Comparisons of Selected Bed-Material Load Formulas, Yang and Wan; ASCE 117(8), 973-989) compares several sediment transport equations for various sediment concentrations, slopes and Froude numbers. For conditions similar to those encountered along the dike (steep slopes and Froude numbers near one), Yang's formulation was determined to provide the best results when compared to measured results. Yang's methodology is commonly accepted, as demonstrated by its inclusion in HEC-6, and appears to be the most appropriate formulation for application on Range Wash (See Part 5. Yang Paper in Design Notebook.)

The process of establishing the event specific yield required several key assumptions which had to be tested. A critical assumption was the determination of material size distributions for both the inflowing sediment load generated in the basin above the apex and the fan surface materials. Eight surface samples were taken on the alluvial fan to estimate the particle sizes to be used as the bed material distribution in the transport model. This particle size distribution could not be used as inflow to the system since no fine materials were found on the alluvial fan surface and yet the upstream watershed provides an abundant source of fine particles which are washed through the system. To estimate the fine particle portion of the total sediment load, samples from the valley floor further downstream in the Las Vegas Wash system were used. (See Part 6. Particle Size Distribution).

Critical assumptions were evaluated during this calibration and integration process to determine their sensitivity and reasonableness. These variables included the roughness coefficient, the inflow sediment volume estimate, the temperature of the inflow, and the particle size distribution of the inflowing materials. The results of the sensitivity analysis indicate that the estimate of average annual yield as a function of each specific yield was relatively insensitive to minor changes in variables with the exception of the percentage of fine particles in the inflow. The final percentage of fine particles, those less than 0.064 millimeters, was 38% and compared favorably with particle size distribution of materials farther downstream in the Las Vegas Valley.

The description of channel cross section geometry in HEC-6 requires a fixed channel bank. The channel bed may move vertically (scour and deposition), but no lateral changes in cross-section are possible. The Dawdy/FEMA assumption (Flood Frequency Estimates on Alluvial Fans, ASCE Journal of the Hydraulics Division, 105(11), 1407-1413) for alluvial fan flooding was used in this study. This assumption establishes a channel geometry on an alluvial fan which is a function of discharge (See Part 7. Fan Geometry). Because HEC-6 does not allow for lateral changes in the channel cross-section, it was necessary to run the fan model with a constant

cross section. Therefore, a series of constant discharges and fixed cross sections were modeled to establish alluvial fan flow characteristics and equilibrium sediment transport. For the 100-year peak example see the Design Notebook Part 8. Fan Equilibrium. The model was tested against hand computations for simple verification (See Part 9. Model Confirmation).

The equilibrium sediment transport values for each discharge were aggregated into an event hydrograph and a total sediment volume for each event was determined. The individual event sediment yield estimates were integrated to determine an average annual sediment yield for comparison to the previously computed PSIA methodology estimate of average annual sediment yield. This integration was performed by plotting a curve of total sediment yield for each event against the probability of the event recurrence and determining the area beneath the curve which represents average annual sediment yield. (See Part 10. Ave. Annual Yield in Design Notebook).

FAN/DIKE SYSTEM ANALYSIS

The previously described hydrograph and event specific sediment inflow was used to evaluate the effects of the West Range Wash Dike system on the sediment transport of the 100-year event. HEC-6 requires that a hydrograph and a sediment rating curve be input into the model as a boundary condition. The sediment yield rating curve was developed based on the fan equilibrium transport capacity computations used to develop the event specific yield estimates described above.

The HEC-6 model began at the apex of the alluvial fan with the apex flow hydrograph and an assumed sediment load. (See Part 11. System Model). Flows down the alluvial fan were modeled using the previously described channel of constant cross-section. Flows were modeled down the fan where they reached equilibrium and were eventually intercepted by the West Range Wash Dike. The model cross-section was modified to reflect the geometry of the channel along the upstream toe of the dike and the slope along the dike as it traverses the fan.

A 120 foot wide unlined channel with 3:1 side slopes was assumed along the upstream toe of the dike. Two longitudinal bed slopes were simulated which represented the extremes of the conditions encountered along the dike. (0.5 percent and 1.0 percent).

HEC-6 determines the equilibrium sediment transport down the fan and, based on a comparison with the computed equilibrium sediment transport along the dike, the total volume of deposition is computed for each time step. Because of intermediate computational instabilities, it was not possible to determine the total volume of deposition which occurred at the peak flow by interpreting HEC-6 directly. An intermediate computation based on a mass curve of sediment transport was required which determined that 37% of the total deposition occurred at the peak discharge. (See Part 12. Deposition Percentage).

HEC-6 computes equilibrium transport at each cross-section and cannot distribute deposition through a channel reach. The methodology presented in "Design of Small Dams" U.S. Department of the Interior, Bureau of Reclamation, 1977, for evaluating the geometry and longitudinal length of a scour hole was modified slightly and applied here to estimate the length of deposition and the maximum depth of the deposited materials at the 100-yr peak flow (See Part 13. Transition Model). This methodology was compared to a parabolic vertical curve of a comparable length and resulted in a good correlation for the maximum depth. A transition length of approximately 1,100 feet and a depth of deposition of 5.6 feet was computed.

WATER SURFACE PROFILE DETERMINATION

The computed transition and deposition were incorporated into a HEC-2 run to determine the water surface through the transition section. A horizontal transition between the rectangular Dawdy/FEMA cross-section on the fan and the trapezoidal cross-section of the channel along the dike was assumed to occur over the length of the vertical transition. The HEC-2 model was used to compute a water surface profile for the 100-year peak flow. (See Part 14. Water-Surface Profile in Design Notebook).

DIKE HEIGHT DETERMINATION

Dike height is a combination of several factors. The depth of deposition was determined from the previously described deposition computations. The water surface was determined from the HEC-2 simulation. A hydrodynamic head (flow impacting the dike perpendicular to its alignment) was determined by computing the total energy head for flows down the fan and for flows along the dike and using the larger of the two values. Freeboard is three (3) feet. See Part 15 of Design Notebook for explanation of final dike height determination.

The total dike height is therefore:

Deposition	5.6 feet
Depth of Flow	4.6 feet
Velocity Head	2.3 feet
Freeboard	3.0 feet
Total	15.3 feet

2. MEMORANDUM OF UNDERSTANDING AND OTHER CORRESPONDENCE

MEMORANDUM OF UNDERSTANDING

AND OTHER CORRESPONDENCE

This Memorandum of Understanding was prepared on September 24, 1991. Boyle presented our scope of work to the Clark County Regional Flood Control District and the City of North Las Vegas. In some cases changes were required to reflect additional data needs or due to necessary refinements resulting from the level of detail of available data. These differences are discussed in greater detail in the appropriate section.

The memorandum of understanding was transmitted, along with a cover letter to Mr. Alan Johnson of the Federal Emergency Management Agency. The intent was to solicit FEMA's comments regarding the proposed scope and the applicability of those methodologies. FEMA responded on October 22, 1992 with a letter indicating that they did not have jurisdiction to review our methodology or to comment on our approach. Subsequent communication between the Regional Flood Control District, City of North Las Vegas and FEMA have convinced FEMA authorities that the proposed diversion dike construction does impact mapped floodplains and therefore will be reviewed. This correspondence is enclosed for review.

MEMORANDUM OF UNDERSTANDING

September 24, 1991

MEMORANDUM

TO: City of North Las Vegas
Clark County Regional Flood Control District

FROM: Boyle Engineering Corporation

SUBJECT: **West Range Wash Diversion Dike**
Evaluation and Design Methodologies
Memorandum of Understanding

INTRODUCTION

The methodologies proposed for the design of the West Range Wash Diversion Dike are presented in this Memorandum of Understanding. They address the technical aspects of hydrologic, hydraulic and sediment analyses and Federal Emergency Management Agency (FEMA) Regulations. They are based on our experience with the Range Wash Facility Plan, with various projects in the Las Vegas Valley and with the FEMA requirements regarding facilities on alluvial fans. We have also enlisted the consultation and support of Dr. Richard French to assist with some of the more complex alluvial fan issues.

This project has been discussed with FEMA on several occasions and with representatives of Baker Engineers. While this site is not in a mapped A Zone or in any mapped flood hazard area, the City of North Las Vegas and Boyle recognize the potential alluvial flooding hazard. The design of these facilities is intended to meet the requirements for a Letter Of Map Revision.

Regardless of the approaches developed, that coordination between the City of North Las Vegas, CCRFCD and Boyle will be an important component of the project. This is likely to expedite the reviews and approvals by FEMA. To accomplish this, frequent and on-going dialogue among the project participants and FEMA is anticipated.

DESIGN CONCEPT

The general concept of the Range Wash Diversion Dike is to intercept flows on the alluvial fan and convey them in a controlled fashion to the North Las Vegas Detention Basin. Because of the probablistic nature of alluvial fan flooding, the design discharge will be the full 100-year apex discharge along the entire diversion dike alignment. This should result in a stable conveyance facility with adequate freeboard to meet FEMA's requirements and which will require minimum maintenance to remain functional.

FEMA has indicated that this design concept is consistent with their desire to adopt basin wide control measures. We have also obtained the FEMA check list for review of Conditional Letters of Map Revision (CLOMR) and intend to address the expressed items.

FACILITY PLAN ASSUMPTIONS

The alignment and sizing of the diversion dike presented in the Range Wash Facility Plan is based on the conveyance of the peak 100-year apex discharge. The average annual sediment yield was converted to a 100-year sediment volume and distributed throughout the runoff hydrograph assuming a linear relationship to hydrograph flows. The diversion dike alignment was established to maintain a slope, which in combination with an upstream channel, was capable of conveying flows consistent with the Dawdy/FEMA regime concept. The depth of flow was computed using the channel size and slope and was adjusted using a bulking factor to account for sediment.

The height of the dike was then determined by adding the dynamic head (energy head) plus three feet of channel freeboard to the computed flow depth plus bulking factor adjustment. A soil cement lining was proposed for the upstream face and was extended into native materials as protection against scour.

CHANNEL ALIGNMENT

The channel alignment identified in the facilities plan is the starting point for the final design effort. The identified alignment has a consistent slope of 0.8 percent across the fan. The approach which will be utilized in the final design will be to minimize adjustments to the dike alignment and refine the channel geometry as necessary to achieve a stable design. If it is not possible to maintain equilibrium along the proposed alignment, changes in the channel alignment will be evaluated.

HYDROLOGY

Final design will use the Flood Insurance Study hydrologic evaluations prepared for CCRFCD. The 100-year peak apex discharge and volume will be used.

SEDIMENT YIELD

The final design will utilize the results of the Pacific Southwest Interagency Committee (PSIAC) method analysis performed for the Facility Plan. For FEMA's benefit, a comparison of the PSIAC method estimates and those of other studies will be provided.

The annual yield estimated by the PSIAC method will be converted to an event yield using factors developed in conjunction with Dr. Richard French. The conversion of these values will be appropriately documented with references to technical literature and past reports.

A particle size distribution of the sediment yield will be developed by taking surface sediment samples on the alluvial fan. These alluvial fan surface materials were deposited during alluvial flooding events and should represent the sediment load being carried to the fan. The particle size distribution will be developed by taking three surface samples within a 20-foot radius and mixing them to develop one composite sample. The sample will include gravel or cobble materials if present on the surface. These samples will be taken at five sites across the fan.

To relate the total sediment load to a specific event hydrograph, the total volume will distributed through the hydrograph by using a linear relation to actual flow. In this way, a actual hydrograph representing both instantaneous discharge and sediment delivery can be developed.

TRANSPORT

We propose to utilize a steady state routing model to evaluate the sediment transport capacity of the channel adjacent to the diversion dike. Adjustments will then be made to the cross section geometry or the dike alignment to result in a stable conveyance.

The 100-year hydrograph representing both discharge and sediment will be the basis of design. The upstream boundary condition for the sediment transport analysis will be assumed to be the entire inflow hydrograph. Once a design is established, the facilities will be evaluated using a 10-year event to identify potential concerns regarding operation and maintenance.

Bed material site distribution and cross section geometry are input variables for the transport model. The cross section geometry is defined based on the preliminary designs provided in the Facility Plan. Bed material will be based on the existing materials along the dike alignment. The bed material particle size distribution will be determined by taking samples along the alignment at the surface, three feet below the surface and six feet below the existing ground surface. These will then be used to develop the actual bed material particle size distribution with the channel in place. Sampling will be performed at ten sites along the dike alignment.

The model used to estimate transport capacity will be based on Yang's formulation for total bed material transport. Based on a recent article in the Journal of Hydraulic Engineering, it appears that Yang's formulation is most accurate at predicting sediment transport for steep slopes (S > .5%) in sandy soils and with Froude numbers in the range of .5 to 4.0. For FEMA's benefit, we will also compare the results of those predicted by HEC-6.

The inflow hydrograph will be routed through the channel along the diversion dike in 15 minute time increments to establish sediment transport capacity and changes in channel geometry and invert elevation. The cross section geometry will be refined to achieve equilibrium sediment transport. If required, changes in alignment will be made to adjust the slope and thereby transport capacity.

This information will define the potential for deposition and scour along the length of the dike. This information, in combination with computed water surface elevations, will establish the levee height necessary to convey the 100-year event.

TOTAL DIKE HEIGHT

In addition to the diversion dike height necessary to convey the flow and account for potential deposition, FEMA requires that three feet of freeboard be provided. In addition, the hydrodynamic head must be included in the determination of overall height. The energy head of the flow approaching the dike in a perpendicular direction will be added. The velocity and cross section of flow down the fan will be based on the assumptions provided by the Dawdy/FEMA regime equation.

STRUCTURAL INTEGRITY

The upstream face of the West Range Wash Diversion Dike will be lined with soil cement paving. This will protect the embankment against scour or erosion and will provide a factor of safety against seepage through the embankment. The soil cement lining will extend from the top of the levee down to the invert and will be embedded beneath the invert and the estimated scour depth.

A stability analysis will be performed for the dike cross section. The stability analysis will include static saturated conditions, rapid drawdown conditions, and a seismic event. The computed factor of safety will be somewhat conservative since the upstream lining will provide protection against embankment saturation and the transient nature of flood flows will further reduce the risk of saturation.

Provisions will be made to accommodate potential settlement based on the results of a geotechnical analysis. The recommendations provided by the geotechnical engineer with regard to compaction requirements and potential long-term settlement will be incorporated.

SUBMITTAL TO FEMA

The results of the analysis and design performed on the West Range Wash Diversion Dike will be submitted to FEMA in a manner consistent with their check list for Conditional Revision to Flood Insurance Study (FIS)/Flood Insurance Rate Map (FIRM) by Conditional Letter of Map Revision (CLOMR). While this form is not appropriate at the present time since no existing FIS or FIRM exists, it will facilitate FEMA review and will provide the City of North Las Vegas and CCRFCD with a greater level of comfort that the facilities will ultimately be accepted by FEMA. No assurances can be made that the facilities will meet the long-term requirements of the flood insurance program. In fact, the understanding of alluvial fan hydraulics and flood hazard is not great. It is possible that as FEMA's understanding improves, changes in the existing requirements maybe proposed and may affect the regulatory benefit realized by the diversion dike. Regardless of the regulatory status of the diversion dike, it will provide a tangible benefit to downstream properties by collecting and diverting uncontrolled alluvial fan discharges from the upper watershed away from potentially developable areas and into the North Las Vegas Detention Basin.

cc: Dr. Richard French

DN-N07-300-10/kmc
rangewas/n0730010/memo912

OTHER CORRESPONDENCE

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

PUBLIC WORKS
SATELLITE OFFICE

APR 7 – 1992

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Virginia Sas-Valentine, P.E.
Chief Engineer/General Manager

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Clark County

April 2, 1992

Mr. Gil Gilpin
City of North Las Vegas
2200 Civic Center Drive
North Las Vegas, NV 89030

RE: WEST RANGE WASH DIVERSION DIKE

Dear Mr. Gilpin:

Transmitted herewith is correspondence received from the Federal Emergency Management Agency (FEMA) regarding their role in reviewing the design of the West Range Wash Diversion Project. FEMA has reconsidered their role in the review of this project. More specifically, FEMA will review an application for a Conditional Letter of Map Revision (CLOMR) because the project will impact Special Flood Hazard Areas (SFHA). The hydrologic impacts to SFHA is stated in the reported titled "Las Vegas Valley Flood Insurance Study Hydrology Report," dated September 1991, by James M. Montgomery.

Important in FEMA's letter is that they will consider waiving the review fees for a CLOMR since the project will protect existing development. I understand both the City of North Las Vegas and Clark County, the affected communities, would need to request the review fees be waived.

Boyle Engineering has supplied a draft of the estimated fees to prepare and submit a CLOMR. I would suggest that we meet to discuss the work required for the CLOMR submittal.

Sincerely,

GALE WM. FRASER, II, P.E.
Assistant General Manager

Enclosure

GWF:caj

FILE: NLV.03.C.91

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

DENVER
RECEIVED
MAR 30 1992

Federal Emergency Management Agency
Washington, D.C. 20472

MAR 26 1992

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Gale Wm. Fraser, II, P.E.
Assistant General Manager
Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Dear Mr. Fraser:

This is to acknowledge receipt of your January 15, 1992, letter regarding the proposed West Range Wash Diversion Dike project and to confirm information discussed with you at the February 25, 1992, meeting and by telephone on March 10, 1992. Your letter was in reply to our October 22, 1991, letter to Mr. Mark Glidden, Boyle Engineering. We had informed Mr. Glidden that because the West Range Wash Diversion Dike project was not located in an identified Special Flood Hazard Area (SFHA), we would not review this project. In your letter, you requested that we reconsider our role in reviewing this project because of the impact that it will have on identified flood hazards in the City of North Las Vegas and in the Unincorporated Areas of Clark County, Nevada.

As discussed during the February 25, 1992, meeting with you, we will review this project because of its impact on existing SFHAs. We were informed at this meeting that Boyle Engineering would prepare the data required for a Conditional Letter of Map Revision (CLOMR). In addition, we also discussed the possibility of waiving the review fees for this project. During a telephone conversation on March 10, 1992, between you and a representative of our Technical Evaluation Contractor, it was confirmed that the data necessary to process a CLOMR for this project will be submitted and that upon receipt of these data, we will initiate a review. It was also verified that if the purpose of this project is primarily to protect existing development, then the affected communities would request that the review fees be waived.

We appreciate the opportunity to work with you so that the Flood Insurance Rate Maps for communities in Clark County reflect the best available flood risk information.

If you have any questions regarding this request, please call Mr. Karl Mohr of my staff in Washington, DC, at (202) 646-2770.

Sincerely,

William R. Locke
Chief, Risk Studies Division
Federal Insurance Administration

cc: Mr. Mark Glidden, P.E.
Boyle Engineering Corporation

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

BOYLE ENGINEERING
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Virginia Bax-Valentine, P.E.
Chief Engineer/General Manager

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Clark County

February 26, 1992

Mr. Gil Gilpin
City of North Las Vegas
Public Works Department
2200 Civic Center Drive
P.O. Box 4086
North Las Vegas, NV 89036

West Range Wash Diversion Dike
50 Percent plans and Sediment Transport Analysis

Dear Mr. Gilpin:

I have completed my review of the referenced documents received February 11, 1992. Our meeting on February 18, 1992 was very informative and demonstrated that Boyle Engineering is properly addressing the key issues of sediment transport analysis relative to design considerations and acceptance of the design by FEMA. During recent discussions with Karl Mohr with FEMA's Washington office it was suggested that in order to receive FEMA's attention in reviewing and accepting this project design, it may be necessary to formally apply for a Conditional Letter of Map Revision (CLOMR). Mr. Mohr expressed FEMA's budgetary reluctance to review this project without such an application.

A CLOMR application can be pursued at any time at the City of North Las Vegas' direction. We may want to have a meeting to coordinate this effort prior to expending any time or resources. The CLOMR application must state that this project is a public flood control facility being undertaken to reduce flood impacts to existing residential structures. Identifying the project purpose as such will preclude payment of review fees in association with the CLOMR. Furthermore, the CLOMR application should be submitted as data to support the expected reduced flow rates caused by the project to aid FEMA's current review of the FIS Hydrology Report. If this approach fails to receive FEMA's attention, the CLOMR may have to identify an actual change to a specific floodplain caused by the project.

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

The District does not have any comments to offer at this time with regard to the contents of the plans or sediment transport analysis. As discussed in our meeting, the final edition of the sediment transport analysis should have a complete narrative and report format to be suitable for submittal to FEMA at the appropriate time. The project is physically straight forward. The plans will be reviewed for constructability and completeness at the 90 percent submittal of the plans and special provisions.

Please be aware that $4,000,000 is programmed on the Bond Project List for the construction of this project. Recent discussions with you indicate that this will be sufficient for construction of the entire project as it is presently designed. As discussed in our meeting, it may be worthwhile to peruse participation of Nellis construction forces to further reduce the cost of the project. As the project development nears solicitation of construction funding from the District, please note the following requirements:

a) Revised cost estimate;

b) Approved 90 percent plans and specifications;

c) Proof of right of entry for construction; BLM applications are proceeding on schedule as we have discussed;

d) Proof that all applicable federal, state and local permits have been obtained;

e) Project presentation agenda item; and

f) Interlocal contract agenda item.

If you should have any questions or if I can be of any assistance, please give me a call.

VIRGINIA BAX-VALENTINE, P.E.
General Manager/Chief Engineer

BY: _____
Kevin Eubanks, P.E.
Senior Engineer

CC: Walter Hines, Boyle Engineering
Mark Glidden, Boyle Engineering
John Murchie, City of North Las Vegas

KLE:fmm

GG2-26:DRAINAGE

NLV.03.C.91

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

BOYLE ENGINEERING
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JAN 20 1992

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Chief Engineer/General Manager

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City of Mesquite

Bruce L. Woodbury
Clark County

January 15, 1992

Mr. William R. Locke
Chief of Risk Studies Division
Federal Insurance Administration
Federal Emergency Management Agency
500 C Street S.W.
Washington, D.C. 20472

Dear Mr. Locke:

The District is implementing flood control projects that will provide 100-year flood protection to the residences within the District. Some projects are not located in Federal Emergency Management Agency (FEMA) designated Special Flood Hazard Areas (SFHA), but all projects have some affect on downstream SFHA. The West Range Wash Diversion Dike project is one of the projects, not located in a SFHA, that will have a dramatic affect in reducing flood flows in SFHA along the Range Wash system in the northeast portion of the Las Vegas Valley. This project is being funded by the District, project management is being provided by the City of North Las Vegas and the design is being performed by Boyle Engineering Corporation (Boyle).

The report titled Clark County Regional Flood Control District, Las Vegas Valley Flood Insurance Study Hydrology Report (FIS Report), which has been previously transmitted to FEMA and will be the hydrologic documentation to guide flood insurance restudy efforts within the Las Vegas Valley, demonstrates the effects the West Range Wash Diversion Dike will have on downstream SFHA. A comparison of Table 2-2 (without West Range Wash Diversion) and Table 2-3 (with West Range Wash Diversion) in the FIS Report demonstrates the effectiveness of the project in reducing the 100-year discharges at downstream locations. The following values were obtained from the FIS Report:

	100-Year Discharge	
Location	Table 2-2 w/o diversion	Table 2-3 w/diversion
West. Trib. @ Carey (Node G1)	7,719 cfs	3,900 cfs
Main Channel @ Owens 7774(Node S)	7,876 cfs	5,200 cfs

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3129 • FAX (702) 455-3258

The District understands that Boyle has requested FEMA to provide review comments during the design of the project and that FEMA responded, based upon FEMA's limited resources and budgetary constraints, that FEMA can only comment on flood control projects that affect designated SFHA. The above information from the FIS Report demonstrates the effects this project will have on designated SFHA. The District, when the project is completed and a restudy of the SFHA on the Range Wash is performed, will take into account the flood reducing capabilities of the project on the Range Wash. It may be that Boyle over simplified the flood reduction aspects the project will have on the Range Wash and its associated SFHA when requesting review by FEMA.

I respectfully request that FEMA reconsider their role in the review of this project as the design progresses. This request is made on behalf of the City of North Las Vegas and is further emphasized by the correspondence transmitted herewith. Review by FEMA at this time would greatly facilitate future restudy efforts on the Range Wash.

Sincerely,

Gale Wm. Fraser, II, P.E.
Assistant General Manager

Enclosure

cc: Mr. Gary Holler, North Las Vegas Public Works Department
Mr. James Bell, North Las Vegas Public Works Department
Mr. John Murchie, North Las Vegas Public Works Department
Mr. Mark Glidden, Boyle Engineering - Denver
Mr. Walter Hines, Boyle Engineering - Las Vegas

GWF:fmm

WL1-15:LTR

NLV.03.C.91

NLV.03.C.91

January 8, 1992

Mr. Gale Wm. Fraser, II, P.E.
Clark County Regional Flood Control District
301 E. Clark Avenue, Ste. 300
Las Vegas, NV 89101

Dear Gale:

You have received a letter from Mark Glidden of Boyle Engineering dated December 20, 1991 (enclosed). The letter is a "response to FEMA's Jurisdiction Determination" on the Range Wash Diversion Dike. FEMA has indicated that it doesn't have the time or inclination to review the proposed design of the diversion dike.

As you know, the dike is a critical element of future F.I.S. amendments proposed for the eastern portion of Las Vegas Valley. It appears that because FEMA and the CCRFCD are partners in the F.I.S. amendments, FEMA could be influenced to at least preliminary review the design concept and issue a threshold approval. It will be beneficial to all concerned governmental agencies especially Clark County and North Las Vegas and will greatly facilitate the F.I.S. amendment process.

It would be appreciated if the CCRFCD would act on the City's behalf and contact Mr. William R. Locke, Chief of the Risk Studies Division for the Flood Insurance Administration in an attempt to convince him of the importance of a design concept approval.

Mr. Glidden and City staff members are available to discuss this issue at any level including a visit to Mr. Locke's office in Washington D.C. if necessary.

Thank you for your consideration in this matter.

Very truly yours,

John L. Murchie
Adm. of Development & Flood Control

ja/jm9/CCRFCD.ltr

cc: James A. Bell, P.E.
Mark Glidden, P.E.

City of
North Las Vegas

2200 Civic Center Drive
P.O. Box 4086
North Las Vegas, Nevada 89036
(702) 649-5811

Mayor
James K. Seastrand

Councilmen
Theron H. Goynes
Mary J. Kincaid
William E. Robinson
W. Brent Hardy

City Manager
Michael Dyal

Boyle Engineering Corporation

Suite 200
165 South Union
Lakewood, Colorado 80228

consulting engineers

Telephone: 303/987-3443
FAX: 303/987-3908

CITY OF NORTH LAS VEGAS
Attention: Mr. Jim Bell,
City Engineer
2200 Civic Center Drive
North Las Vegas, NV 89030

December 20, 1991

Response to FEMA Jurisdiction Determination

On October 22, 1991 Mr. William R. Locke, Chief of the Risk Studies Division for the Federal Insurance Administration sent Mark Glidden a letter responding to Boyle's request for review comments on the Memorandum of Understanding for the West Range Wash Diversion Dike Project. In this letter, Mr. Locke states"...projects to reduce flood hazards that are not identified on National Flood Insurance Program (NFIP) maps are not under our purview. Considering our limited resources and budgetary constraints, we can only comment on flood-control projects that affect designated Special Flood Hazard Areas."

Their response references our Memorandum of Understanding, transmitted with the letter of September 27, 1991, in which we indicate that the Diversion Dike is not in a designated Special Flood Hazard Area, however it does cross what appears to be an alluvial fan which is certainly of considerable interest to FEMA. It appears that our over simplification of the impacts of the West Range Wash Diversion Dike may have misled FEMA into believing that the facilities would not have an impact of identified flood hazards.

In reviewing the existing Flood Insurance Rate Maps for the City of North Las Vegas, Nevada dated December 15, 1983 and those for Clark County dated September 29, 1989, it is clear that the West Range Wash Diversion Dike does in fact reduce flood hazards along areas identified by the National Flood Insurance Program. In fact, the Vandenberg Channel and adjacent facilities, as identified on community panel number 320007 0004 C of the City of North Las Vegas Flood Insurance Rate Map, would be impacted by the diversion of alluvial fan flows. Facilities identified on the Clark County Flood Insurance Rate Map panels 320003 1025 B and 320003 1250 B are also impacted. They include the Vandenberg Channel and the Sloan Channel through unincorporated Clark County.

The purpose of the West Range Wash Diversion Dike is to divert flow generated in the mountainous regions north of the City of Las Vegas and prevent them from reaching the more developed areas of the City as well as those areas of unincorporated Clark County. Our Range Wash Facility Plan indicates that the Dike achieves this purpose and results in a reduction in the identified flood hazard area as shown on the National Flood Insurance Rate Maps. The Clark

County Regional Flood Control District has recognized these benefits. They have instructed their consultant performing the hydrologic study for the Flood Insurance Study update to incorporate the impacts of the Dike into their modeling effort. Therefore, FEMA may be forced to recognize and evaluate the impacts of the Diversion Dike when reviewing the Flood Insurance Study Hydrologic Evaluation.

The West Range Wash Diversion Dike is an integral, and critical, part of the facilities proposed to control flooding in the Range Wash Basin and to protect the citizens of North Las Vegas and Clark County. The impacts of this entire system, including the Dike, will eventually be included in a submittal to FEMA requesting a Map Revision. Given the cost and importance of the Dike to this overall system, we consider it critical that FEMA enter into formal consultations regarding the hydrologic, hydraulic, alluvial fan and sediment transport issues used to design the alignment, slope and capacity of this facility at the earliest possible time.

Hopefully this letter will provide you with ample support and justification to ask FEMA to reconsider their determination that a review of our proposed methodologies and the resulting facilities is beyond their purview. If we can provide you with any additional information please do not hesitate to contact us.

BOYLE ENGINEERING CORPORATION

Mark W. Glidden, P.E.
Senior Engineer

cc: Walter Hines/Boyle - Las Vegas
Richard French/Sediment Transport Specialist
Gale Fraser/Clark County Regional Flood Control District

DN-N07-300-10/kmc
rangewas/n0730010/ltr1212

BOYLE ENGINEERING
DENVER
RECEIVED
OCT 25 1991

FILE

Federal Emergency Management Agency

Washington, D.C. 20472

OCT 22 1991

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Mark W. Glidden, P.E.
Senior Engineer, Boyle
Engineering Corporation
165 South Union, Suite 200
Lakewood, Colorado 80228

Dear Mr. Glidden:

With your letter dated September 27, 1991, to Mr. Alan A. Johnson of my staff, you enclosed a Memorandum of Understanding with the City of North Las Vegas and the Clark County Regional Flood Control District. The memorandum presents the methodologies that Boyle Engineering Corporation is proposing for the design of the West Range Wash Diversion Dike. You asked that we review the memorandum and inform you of whether the approaches and methodologies proposed are consistent with our requirements.

The memorandum states that the project site is not in a mapped A Zone or in any mapped flood hazard area. Although we appreciate your efforts to coordinate with us during the initial stages of the proposed project, projects to reduce flood hazards that are not identified on National Flood Insurance Program (NFIP) maps are not under our purview. Considering our limited resources and budgetary constraints, we can only comment on flood-control projects that affect designated Special Flood Hazard Areas.

Although we cannot provide the review you requested, we are available to answer any questions you may have about the NFIP in general. If we can assist you in that manner, please call Mr. Karl F. Mohr of my staff at (202) 646-2770.

Sincerely,

William R. Locke

William R. Locke
Chief, Risk Studies Division
Federal Insurance Administration

cc: Mr. Gale Wm. Fraser II, P.E.
Clark County Regional Flood
Control District

The Honorable James K. Seastrand
Mayor, City of North Las Vegas

Boyle Engineering Corporation

consulting engineers

Suite 200
165 South Union
Lakewood, Colorado 80228

Telephone: 303/987-3443
FAX: 303/987-3908

September 27, 1991

Allen A. Johnson
Hydraulic Engineer
Federal Emergency Management Agency
National Flood Insurance Program
500 C Street, SW
Washington, DC 20472

Proposed Methodologies for West Range Wash Diversion Dike Design

Over the past several months we have spoken to you on several occasions regarding a project being proposed within the City of North Las Vegas. This project involves drainage facilities to protect portions of the City of North Las Vegas from flows generated within the Range Wash Drainage Basin. Headwaters of the western tributary of Range Wash are in a mountainous area and flows discharge onto what appears to be an alluvial fan. The City retained Boyle Engineering Corporation to prepare a Facilities Planning Study to identify facilities which address flooding within the Range Wash Basin. During the course of this study several discussions were held with FEMA.

After evaluating the findings presented in the facilities plan, the City has elected to proceed with the design of a diversion dike which collects flows from the alluvial fan and conveys them to an existing storm water detention facility. The diversion dike enables the City to take advantage of excess capacity in the storm water detention facility and, through control of flows across the alluvial fan, protects downstream properties from flood damage. This approach is consistent with FEMA's objective of providing fan wide control of flooding in areas subjected to alluvial fan flows.

Boyle recognizes the importance of proceeding with a sound technical approach which is consistent with FEMA's guidelines and expectations. We also understand the importance of on-going communication with FEMA and FEMA's Study Contractor to minimize potential misunderstandings and delays. It is our hope that through these on-going communications, the final submittal of the Diversion Dike Design and supporting calculations will be more complete and comprehensive and reduce the effort required by FEMA and their Study Contractor for review. Toward this end, we are enclosing with this letter a Memorandum of Understanding with the City of North Las Vegas and the Clark County Regional Flood Control District presenting our approach to the evaluation and design methodologies for the Diversion Dike.

This Memorandum of Understanding presents our proposed approach to the evaluation of the alluvial fan hydrology, hydraulics and sediment transport as well as our approach to the physical design of the facilities. As you will note, our approach is comprehensive and will focus on what we understand to be the critical areas of interest to FEMA. During the course of the project we anticipate discussing our findings on a regular basis with you or your Study Contractor.

While we recognize that it is difficult to comment on an approach without a comprehensive understanding of the issues and concerns within the watershed, we request that you inform us if some of the approaches or methodologies proposed are inconsistent with the latest FEMA requirements. Any input you could provide us at this time regarding the reasonableness of our proposed approach will be greatly appreciated.

Thank you very much for taking the time to provide us with your insight into FEMA's technical and regulatory requirements. We look forward to having the opportunity to discuss this project with you in more detail in the near future. Should you have any questions regarding this project or any of the specific elements of the project, please feel free to contact Mark Glidden in our Denver office (303) 987-3443 or Walter Hines in our Las Vegas office (702) 731-5511.

BOYLE ENGINEERING CORPORATION

Mark Glidden

Mark W. Glidden, P.E.
Senior Engineer

Enclosure: Memorandum of Understanding

cc: Walter Hines, Boyle (w/enclo)
Gil Gilpin, City of North Las Vegas, (w/enclo)
Gale Fraser, Clark County Regional Flood Control District, (w/enclo)

DN-N07-300-10/kmc
rangewas/n0730010/ltr926

September 24, 1991

MEMORANDUM

TO: City of North Las Vegas
Clark County Regional Flood Control District

FROM: Boyle Engineering Corporation

SUBJECT: **West Range Wash Diversion Dike**
Evaluation and Design Methodologies
Memorandum of Understanding

INTRODUCTION

The methodologies proposed for the design of the West Range Wash Diversion Dike are presented in this Memorandum of Understanding. They address the technical aspects of hydrologic, hydraulic and sediment analyses and Federal Emergency Management Agency (FEMA) Regulations. They are based on our experience with the Range Wash Facility Plan, with various projects in the Las Vegas Valley and with the FEMA requirements regarding facilities on alluvial fans. We have also enlisted the consultation and support of Dr. Richard French to assist with some of the more complex alluvial fan issues.

This project has been discussed with FEMA on several occasions and with representatives of Baker Engineers. While this site is not in a mapped A Zone or in any mapped flood hazard area, the City of North Las Vegas and Boyle recognize the potential alluvial flooding hazard. The design of these facilities is intended to meet the requirements for a Letter Of Map Revision.

Regardless of the approaches developed, that coordination between the City of North Las Vegas, CCRFCD and Boyle will be an important component of the project. This is likely to expedite the reviews and approvals by FEMA. To accomplish this, frequent and on-going dialogue among the project participants and FEMA is anticipated.

DESIGN CONCEPT

The general concept of the Range Wash Diversion Dike is to intercept flows on the alluvial fan and convey them in a controlled fashion to the North Las Vegas Detention Basin. Because of the probablistic nature of alluvial fan flooding, the design discharge will be the full 100-year apex discharge along the entire diversion dike alignment. This should result in a stable conveyance facility with adequate freeboard to meet FEMA's requirements and which will require minimum maintenance to remain functional.

FEMA has indicated that this design concept is consistent with their desire to adopt basin wide control measures. We have also obtained the FEMA check list for review of Conditional Letters of Map Revision (CLOMR) and intend to address the expressed items.

FACILITY PLAN ASSUMPTIONS

The alignment and sizing of the diversion dike presented in the Range Wash Facility Plan is based on the conveyance of the peak 100-year apex discharge. The average annual sediment yield was converted to a 100-year sediment volume and distributed throughout the runoff hydrograph assuming a linear relationship to hydrograph flows. The diversion dike alignment was established to maintain a slope, which in combination with an upstream channel, was capable of conveying flows consistent with the Dawdy/FEMA regime concept. The depth of flow was computed using the channel size and slope and was adjusted using a bulking factor to account for sediment.

The height of the dike was then determined by adding the dynamic head (energy head) plus three feet of channel freeboard to the computed flow depth plus bulking factor adjustment. A soil cement lining was proposed for the upstream face and was extended into native materials as protection against scour.

CHANNEL ALIGNMENT

The channel alignment identified in the facilities plan is the starting point for the final design effort. The identified alignment has a consistent slope of 0.8 percent across the fan. The approach which will be utilized in the final design will be to minimize adjustments to the dike alignment and refine the channel geometry as necessary to achieve a stable design. If it is not possible to maintain equilibrium along the proposed alignment, changes in the channel alignment will be evaluated.

HYDROLOGY

Final design will use the Flood Insurance Study hydrologic evaluations prepared for CCRFCD. The 100-year peak apex discharge and volume will be used.

SEDIMENT YIELD

The final design will utilize the results of the Pacific Southwest Interagency Committee (PSIAC) method analysis performed for the Facility Plan. For FEMA's benefit, a comparison of the PSIAC method estimates and those of other studies will be provided.

The annual yield estimated by the PSIAC method will be converted to an event yield using factors developed in conjunction with Dr. Richard French. The conversion of these values will be appropriately documented with references to technical literature and past reports.

A particle size distribution of the sediment yield will be developed by taking surface sediment samples on the alluvial fan. These alluvial fan surface materials were deposited during alluvial flooding events and should represent the sediment load being carried to the fan. The particle size distribution will be developed by taking three surface samples within a 20-foot radius and mixing them to develop one composite sample. The sample will include gravel or cobble materials if present on the surface. These samples will be taken at five sites across the fan.

To relate the total sediment load to a specific event hydrograph, the total volume will distributed through the hydrograph by using a linear relation to actual flow. In this way, a actual hydrograph representing both instantaneous discharge and sediment delivery can be developed.

TRANSPORT

We propose to utilize a steady state routing model to evaluate the sediment transport capacity of the channel adjacent to the diversion dike. Adjustments will then be made to the cross section geometry or the dike alignment to result in a stable conveyance.

The 100-year hydrograph representing both discharge and sediment will be the basis of design. The upstream boundary condition for the sediment transport analysis will be assumed to be the entire inflow hydrograph. Once a design is established, the facilities will be evaluated using a 10-year event to identify potential concerns regarding operation and maintenance.

Bed material site distribution and cross section geometry are input variables for the transport model. The cross section geometry is defined based on the preliminary designs provided in the Facility Plan. Bed material will be based on the existing materials along the dike alignment. The bed material particle size distribution will be determined by taking samples along the alignment at the surface, three feet below the surface and six feet below the existing ground surface. These will then be used to develop the actual bed material particle size distribution with the channel in place. Sampling will be performed at ten sites along the dike alignment.

The model used to estimate transport capacity will be based on Yang's formulation for total bed material transport. Based on a recent article in the Journal of Hydraulic Engineering, it appears that Yang's formulation is most accurate at predicting sediment transport for steep slopes (S > .5%) in sandy soils and with Froude numbers in the range of .5 to 4.0. For FEMA's benefit, we will also compare the results of those predicted by HEC-6.

The inflow hydrograph will be routed through the channel along the diversion dike in 15 minute time increments to establish sediment transport capacity and changes in channel geometry and invert elevation. The cross section geometry will be refined to achieve equilibrium sediment transport. If required, changes in alignment will be made to adjust the slope and thereby transport capacity.

This information will define the potential for deposition and scour along the length of the dike. This information, in combination with computed water surface elevations, will establish the levee height necessary to convey the 100-year event.

TOTAL DIKE HEIGHT

In addition to the diversion dike height necessary to convey the flow and account for potential deposition, FEMA requires that three feet of freeboard be provided. In addition, the hydrodynamic head must be included in the determination of overall height. The energy head of the flow approaching the dike in a perpendicular direction will be added. The velocity and cross section of flow down the fan will be based on the assumptions provided by the Dawdy/FEMA regime equation.

STRUCTURAL INTEGRITY

The upstream face of the West Range Wash Diversion Dike will be lined with soil cement paving. This will protect the embankment against scour or erosion and will provide a factor of safety against seepage through the embankment. The soil cement lining will extend from the top of the levee down to the invert and will be embedded beneath the invert and the estimated scour depth.

A stability analysis will be performed for the dike cross section. The stability analysis will include static saturated conditions, rapid drawdown conditions, and a seismic event. The computed factor of safety will be somewhat conservative since the upstream lining will provide protection against embankment saturation and the transient nature of flood flows will further reduce the risk of saturation.

Provisions will be made to accommodate potential settlement based on the results of a geotechnical analysis. The recommendations provided by the geotechnical engineer with regard to compaction requirements and potential long-term settlement will be incorporated.

SUBMITTAL TO FEMA

The results of the analysis and design performed on the West Range Wash Diversion Dike will be submitted to FEMA in a manner consistent with their check list for Conditional Revision to Flood Insurance Study (FIS)/Flood Insurance Rate Map (FIRM) by Conditional Letter of Map Revision (CLOMR). While this form is not appropriate at the present time since no existing FIS or FIRM exists, it will facilitate FEMA review and will provide the City of North Las Vegas and CCRFCD with a greater level of comfort that the facilities will ultimately be accepted by FEMA. No assurances can be made that the facilities will meet the long-term requirements of the flood insurance program. In fact, the understanding of alluvial fan hydraulics and flood hazard is not great. It is possible that as FEMA's understanding improves, changes in the existing requirements maybe proposed and may affect the regulatory benefit realized by the diversion dike. Regardless of the regulatory status of the diversion dike, it will provide a tangible benefit to downstream properties by collecting and diverting uncontrolled alluvial fan discharges from the upper watershed away from potentially developable areas and into the North Las Vegas Detention Basin.

cc: Dr. Richard French

DN-N07-300-10/kmc
rangewas/n0730010/memo912

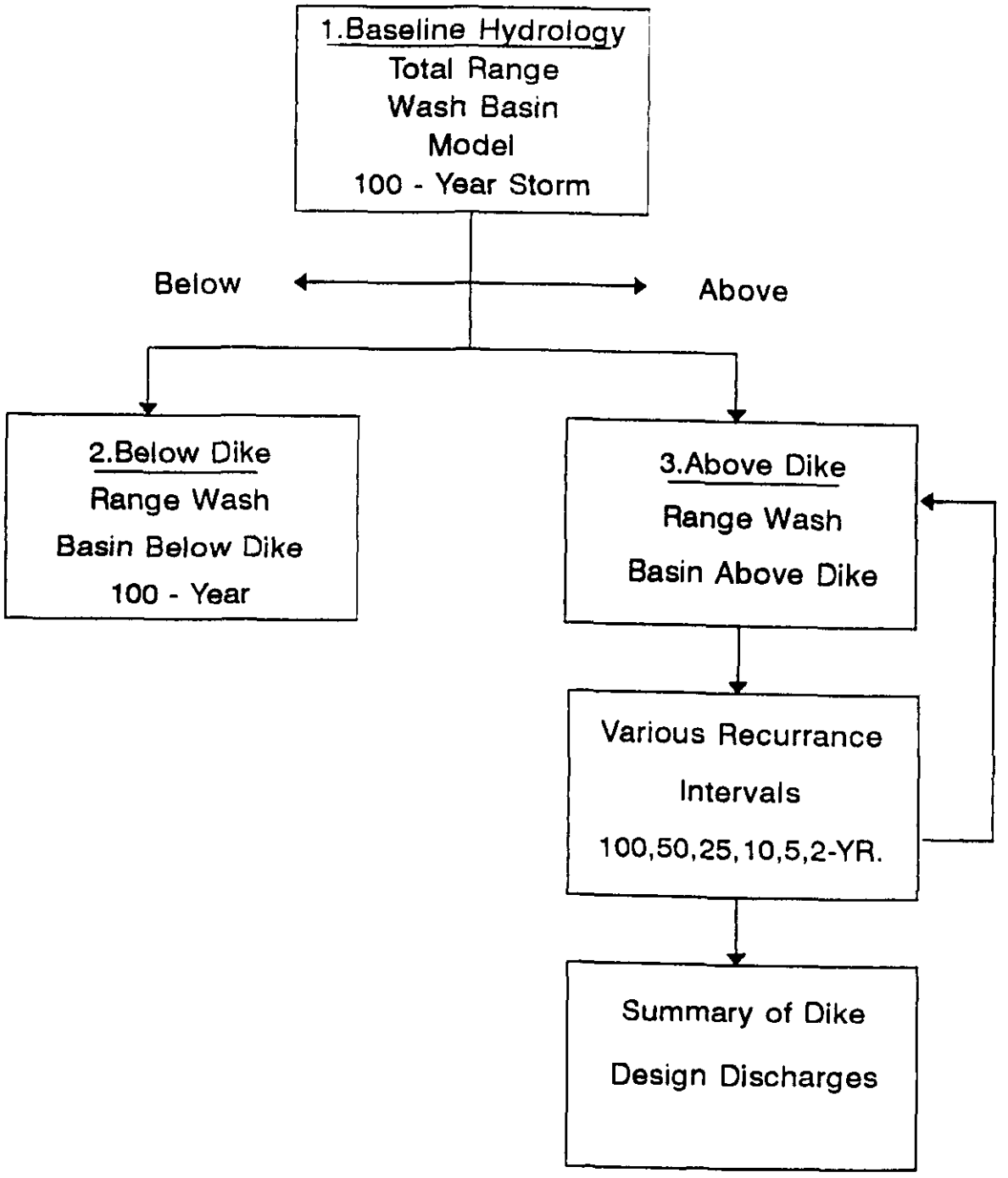
3. HYDROLOGY

HYDROLOGY

The basis for the hydrology used in sizing the diversion dike was a model developed by James M. Montgomery (JMM) Consulting Engineers for the Clark County Regional Flood Control District. This model was used both for the Regional Flood Control District's Master Plan Update and for the Flood Insurance Study revision being undertaken currently. The particular model used was one for the Range Wash Basin and included all watersheds above Range Wash's confluence with the Las Vegas Wash.

The model utilized is a HEC-1 model which combines the SCS dimensionless unit hydrograph simulation for undeveloped basins and kinematic wave simulation for developed watersheds. Routing is accomplished using the Muskingam method or kinematic wave. Rainfall was developed using the information contained in the Clark County Regional Flood Control District's Drainage Design Manual and past studies.

The HEC-1 model used to identify the discharges along the proposed diversion dike is a modified version of the JMM Model. The dike was superimposed on the model and those basins tributary to the dike were modeled separately. Modifications to drainage basin area for those subbasins traversed by the dike were made. In addition, a depth area reduction factor reflecting the total tributary area above the dike was used to adjust point rainfall depths. This revised model is included in the packet as is JMM's original HEC-1 model for the entire Range Wash Basin. For comparative purposes the HEC-1 model developed by JMM for the basins below the dike is included. A summary of the hydrographs used for the design of the Range Wash Diversion Dike is included in this section.


1.Baseline Hydrology
Total Range
Wash Basin
Model
100 - Year Storm
Below
Above
2.Below Dike
Range Wash
Basin Below Dike
100 - Year
3.Above Dike
Range Wash
Basin Above Dike
Various Recurrance
Intervals
100,50,25,10,5,2-YR.
Summary of Dike
Design Discharges

BASELINE HYDROLOGY

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         FEBRUARY 1981                 *
*         REVISED 02 AUG 88             *
*                                       *
*  RUN DATE  07/02/1990  TIME  09:41:54 *
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*                       *
*   U.S. ARMY CORPS OF EN(
*  THE HYDROLOGIC ENGINEER
*        609 SECOND STRE
*     DAVIS, CALIFORNIA
*                       *
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Applicability of the (2007) HC1 for the version of this file (VEGXX1.HC1) is for use with (2007) HC1 (6U.exe) 9/12/90 RD

JMM
BASELINE
RANGE WASH
HYDROLOGY
ENTIRE BASIN
BEFORE DIVERSION

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X     X  XXXXXXX   XXXXX          X
X     X  X         X     X        XX
X     X  X         X              X
XXXXXXX  XXXX      X        XXXXX X
X     X  X         X              X
X     X  X         X     X        X
X     X  XXXXXXX   XXXXX          XXX
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:::                                      :::
:::  Full Microcomputer Implementation   :::
:::                 by                   :::
:::       Haestad Methods, Inc.          :::
:::                                      :::
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37 Brookside Road * Waterbury, Connecticut 06708 * (203) 755-1666

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRU
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSI
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID              CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
    2     ID                        RANGE WASH WATERSHED
    3     ID                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
    4     ID                              JUNE 1990
    5     ID                100-YR, 6-HR STORM    PB CARD FOR DARF = 0.55
    6     ID               PRESENT CONDITIONS, EXISTING FACILITIES
    7     ID                              AMC 2.0
    8     ID                BASED ON RANGE WASH FACILITIES STUDY
    9     ID                  BOYLE ENGINEERS CORP-JULY 1989
   10     ID               (CONVERTED RK TO RM IN UPLAND SUBAREAS)
   11     ID                DARF                                    JR CARD
   12     ID                .55       FOR NODE CC AND NODE S        1.00
   13     ID                .64       FOR NODE [illegible]G1        1.164
   14     ID                .68       FOR NODE G, AND NODE P        1.236
   15     ID                .71       FOR NODE F[illegible] AND NODE P1     1.291
   16     ID                .77       FOR NODE I2                   1.400
   17     ID                .83       FOR NODE I1                   1.509
   18     IT      05        0       0      120
   19     IO       5        0       0
   20     JR    PREC      1.0   1.164   1.236   1.291   1.400   1.509

   21     KK      41    SUB-BASIN 41 HYDROGRAPH
   22     KM            SCS RUNOFF COMPUTATION, SUB-41
   23     BA    4.73
   24     PB    1.89
   25     PC     0.0     2.0     5.90    8.00    11.0    14.40   15.00   16.00   16.80   17.10
   26     PC    18.0    18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   27     PC    25.0    25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   28     PC   32.10    32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   29     PC    56.1    63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   30     PC    81.0    82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   31     PC    97.9    98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   32     PC    99.9   100.00
   33     LS       0       79
   34     UD     .66

   35     KK     A-B     ROUTE FLOW TO NODE B
   36     RM       4     .36     .15

   37     KK     302    SUB-BASIN 302 HYDROGRAPH
   38     KM            SCS RUNOFF COMPUTATION,
   39     BA    6.14
   40     PB    1.81
   41     LS       0       79
   42     UD     .82

   43     KK  NODE B   COMBINE FLOW AT NODE B
   44     HC       2

   45     KK     B-C     ROUTE FLOW TO NODE C
   46     RM       2     .18     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 47       KK      303    SUB-BASIN 303 HYDROGRAPH
 48       KM             SCS RUNOFF COMPUTATION
 49       BA     4.49
 50       PB     1.69
 51       LS        0      85
 52       UD      .65

 53       KK      42B    SUB-BASIN 42B HYDROGRAPH
 54       KM             SCS RUNOFF COMPUTATION
 55       BA     4.08
 56       PB     1.73
 57       LS        0      79
 58       UD      .65

 59       KK   NODE C  COMBINE FLOW AT NODE B
 60       HC        3

 61       KK     C-D      ROUTE FLOW TO NODE D
 62       RM        1     .10     .15

 63       KK      42A    SUB-BASIN 42A HYDROGRAPH
 64       KM             SCS RUNOFF COMPUTATION
 65       BA     8.23
 66       PB     1.73
 67       LS        0      79
 68       UD      .81

 69       KK   NODE D  COMBINE FLOW AT NODE D
 70       HC        2

 71       KK     D-E      ROUTE FLOW TO NODE E
 72       RM        4     .34     .15

 73       KK      305    SUB-BASIN 305 HYDROGRAPH
 74       KM             SCS RUNOFF COMPUTATION
 75       BA     3.99
 76       PB     1.57
 77       LS        0      85
 78       UD      .76

 79       KK   NODE E  COMBINE FLOW AT NODE E
 80       HC        2

 81       KK     E-F      ROUTE FLOW TO NODE F
 82       RM        5     .46     .10

 83       KK      306    SUB-BASIN 306 HYDROGRAPH
 84       KM             SCS RUNOFF COMPUTATION
 85       BA     9.04
 86       PB     1.57
 87       LS        0      76
 88       UD      2.0
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 89       KK  NODE F  COMBINE FLOW AT NODE F
 90       HC       2

 91       KK    F-F1    ROUTE FLOW TO NODE F1
 92       RM       5    2.42     .10

 93       KK    307A    SU-BASIN 307A HYDROGRAPH
 94       BA    5.65
 95       PB    1.57
 96       LS       0     78
 97       UD     .44

 98       KK  NOD-F1    COMBINE FLOW AT NODE F1
 99       HC       2

100       KK    F1-G    ROUTE FLOW TO G
101       RK   12000    .0075     .03            TRAP      40     1.5

102       KK    307B    SUB-BASIN 307B HYDROGRAPH
103       KM            KINEMATIC WAVE RUNOFF COMPUTATION
104       BA    2.42
105       PB    1.57
106       LS       0     78       0       0      97
107       UK     800   .0123     .20      59
108       UK      60    .015     .10      41
109       RK    2640   .0075   .0375   0.125    TRAP      40      1
110       RK    3080   .0075   .0375     .30    TRAP      40      1
111       RK   12000    .075     .03            TRAP      40     1.5      NO

112       KK       G    COMBINE FLOW AT NODE G
113       HC       2

114       KK    G-G1    ROUTE FLOW TO G1
115       RK    2700   .0035    .015            TRAP      12     1.5

116       KK      43    SUB-BASIN 43 HYDROGRAPH
117       KM            SCS RUNOFF COMPUTATION
118       BA    6.40
119       PB    1.57
120       LS       0     79
121       UD     .88

122       KK     H-I     ROUTE FLOW TO NODE I
123       RM       7    .72     .10

124       KK     309    SUB-BASIN 309 HYDROGRAPH
125       KM            SCS RUNOFF COMPUTATION
126       BA    9.24
127       PB    1.57
128       LS       0     79
129       UD    1.51
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  130     KK  NODE I  COMBINE FLOW AT NODE I
  131     HC       2

  132     KK    I-I1     ROUTE FLOW FROM NODE I TO NODE I1
  133     RM       1    .11     .10

  134     KK    310A
  135     BA    1.29
  136     PB    1.57
  137     LS       0     79
  138     UD     .09

  139     KK  NOD-I1    COMBINE FLOW AT NODE I1
  140     HC       2

  141     KK   I1-I2    ROUTE FLOW I2
  142     RM       6     .52     .10

  143     KK    310B    SUB-BASIN 310B HYDROGRAPH
  144     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  145     BA    7.85
  146     PB    1.57
  147     LS       0     78       0       0      97
  148     UK     800   .015     .20      87
  149     UK      60   .020     .10      13
  150     RK   15000   .012    .030     .86    TRAP      20       3
  151     RK   15800   .006    .025            TRAP      80       1      NO

  152     KK   NODI2  COMBINE FLOW AT I2
  153     HC       2

  154     KK   I2-G1  ROUTE FLOW TO G1
  155     RK    2100    .002    .015            TRAP      15     1.5

  156     KK  NOD-G1  COMBINE ALL FLOW AT NODE G1
  157     KM          COMBINE EAST AND WEST BRANCH CHANNELS
  158     HC       2

  159     KK    G1-M     ROUTE FLOW FROM G1 TO NODE M
  160     RK   13100  0.0035    .023            TRAP      50       1

  161     KK      44    SUB-BASIN 44 HYDROGRAPH
  162     KM            SCS RUNOFF COMPUTATION
  163     BA    7.23
  164     PB    1.57
  165     LS       0     79
  166     UD    1.22

  167     KK     J-K     ROUTE FLOW FROM J TO NODE K
  168     RM       8    .58     .10
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

169       KK      312    SUB-BASIN 312 HYDROGRAPH
170       KM             SCS RUNOFF COMPUTATION
171       BA     0.77
172       PB     1.57
173       LS        0      77
174       UD     2.83

175       KK  NODE K   COMBINE FLOW AT NODE K
176       HC        2

177       KK      K-P     ROUTE FLOW FROM NODE K TO NODE P
178       RM       12    1.03      .15

179       KK       45    SUB-BASIN  45 HYDROGRAPH
180       KM             SCS RUNOFF COMPUTATION
181       BA    10.73
182       PB     1.57
183       LS        0      76        0        0        0        0
184       UD     1.31

185       KK      N-O     ROUTE FLOW TO NODE O
186       RM        5     .38      .15

187       KK      048    SUB-BASIN 048 HYDROGRAPH
188       KM             SCS RUNOFF COMPUTATION
189       BA     2.07
190       PB     1.57
191       LS        0      76
192       UD     1.97

193       KK      46A    SUB-BASIN 46A HYDROGRAPH
194       KM             SCS RUNOFF COMPUTATION
195       BA     7.35
196       PB     1.65
197       LS        0      77
198       UD     1.60

199       KK      46B    SUB-BASIN 46B HYDROGRAPH
200       KM             SCS RUNOFF COMPUTATION
201       BA     6.02
202       PB     1.65
203       LS        0      77
204       UD     1.71

205       KK  NODE O   COMBINE FLOW AT NODE O
206       HC        4

207       KK     O-P1     ROUTE FLOW FROM NODE O TO NODE P1
208       RM        8    0.68      .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
239       KK       P1    COMBINE FLOW AT P1
240       HC        2

241       KK     P1-P      ROUTE FROM P1 TO P
242       RM        6     .48      .15

243       KK      317    SUB-BASIN 317 HYDROGRAPH
244       KM             SCS RUNOFF COMPUTATION
245       BA     7.66
246       PB     1.73
247       LS        0      80
248       UD      .97

249       KK     318B    SUB-BASIN 318B HYDROGRAPH
250       KM             SCS RUNOFF COMPUTATION
251       BA     1.86
252       PB     1.73
253       LS        0      87
254       UD      .37

255       KK      Q-P      ROUTE FLOW TO NODE P
256       RM        4     .26      .15

257       KK     318A    SUB-BASIN 318A HYDROGRAPH
258       KM             KINEMATIC WAVE RUNOFF COMPUTATION
259       BA     2.19
260       PB     1.61
261       LS        0      78        0        0       97
262       UK      700    .020      .30       89
263       UK       50    .025      .10       11
264       RK     2000    .035    .0375      .06                30       50
265       RK     7000    .014      .05      .55                30       50
266       RK     9200   .0043      .03              TRAP       30        1

267       KK   NODE P    COMBINE FLOWS AT NODE P
268       HC        4

269       KK      P-M      ROUTE FLOW TO NODE M
270       RK     7400   .0034     0.03              TRAP       80        1

271       KK      047    SUB-BASIN 047 HYDROGRAPH
272       KM             KINEMATIC WAVE RUNOFF COMPUTATION
273       BA     7.40
274       PB     1.57
275       LS        0      78        0        0       97
276       UK      800    .008      .20       74
277       UK       80    .012      .10       26
278       RK     7000    .007     .050     1.23                30       50
279       RK    22000    .005      .03              TRAP       40        1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

250       KK  NODE M    COMBINE FLOWS AT NODE M
251       HC        3

252       KK      M-S     ROUTE FLOW TO NODE S (SLOAN CHANNEL)
253       RK     4600   .0028   0.023            TRAP       80        1

254       KK      48B   SUB-BASIN  48B HYDROGRAPH
255       KM            SCS RUNOFF COMPUTATION
256       BA      .99
257       PB     1.65
258       LS        0      87        0        0        0        0
259       UD      .24

260       KK      R-S     ROUTE FLOW TO NODE S
261       RK     9100   .0316   0.035            TRAP       80        1

262       KK      48A   SUB-BASIN 48A HYDROGRAPH
263       KM            KINEMATIC WAVE RUNOFF COMPUTATION
264       BA      .49
265       PB     1.61
266       LS        0      78        0        0       97
267       UK      700    .025      .30       77
268       UK       60    0.03      .10       23
269       RK      800     .02     .050     0.12                30       50
270       RK     9000    .033      .02             TRAP       20        1       NO

271       KK      321   SUB-BASIN 321 HYDROGRAPH
272       KM            KINEMATIC WAVE RUNOFF COMPUTATION
273       BA     3.42
274       PB     1.57
275       LS        0      78        0        0       97
276       UK      800    .010      .30       78
277       UK       50   0.020      .10       22
278       RK     3500    .006     .050     0.14                30       50
279       RK     7400   .0014     .050     0.58                30       50
280       RK    21200   .0035     .035             TRAP       70        1       NO

281       KK      49A   SUB-BASIN 49A HYDROGRAPH
282       KM            KINEMATIC WAVE RUNOFF COMPUTATION
283       BA     0.60
284       PB     1.57
285       LS        0      78        0        0       97
286       UK      700    .034      .30       80
287       UK       60     .04      .10       20
288       RK     1000    .003     .050     0.12                30       50
289       RK     9200    .034     .035             TRAP       20        1       NO

290       KK  NODE S    COMBINE ALL FLOWS AT S
291       HC        S
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

292       KK     S-V      ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)
293       RK    6800   .0038    .023             TRAP      80        1
294       KK     324     SUB-BASIN 324 HYDROGRAPH
295       KM             KINEMATIC WAVE RUNOFF COMPUTATION
296       BA    1.40
297       PB    1.57
298       LS       0      77       0       0      97
299       UK     800     .01     .30      74
300       UK      60     .01     .10      26
301       RK    1300    .004     .05    0.07    TRAP      30       50
302       RK    2500   .0017     .05    0.28              30       50
303       RK    7000    .005    .035             TRAP      70        1      NO
304       KK     49B     SUB-BASIN  49B HYDROGRAPH
305       KM             SCS RUNOFF COMPUTATION
306       BA    1.04
307       PB    1.61
308       LS       0      87       0       0       0       0
309       UD     .25
310       KK     T-V      ROUTE FLOWS TO NODE V
311       RM       3     .52     .10
312       KK  NODE V     COMBINE ALL FLOWS AT NODE V
313       HC       3
314       KK     50B     SUB-BASIN  50B HYDROGRAPH
315       KM             SCS RUNOFF COMPUTATION
316       BA     .55
317       PB    1.65
318       LS       0      87       0       0       0       0
319       UD     .17
320       KK     U-V      ROUTE FLOWS TO NODE V
321       RM       3     .43     .10
322       KK     50A     SUB-BASIN 50A HYDROGRAPH
323       KM             KINEMATIC WAVE RUNOFF COMPUTATION
324       BA    1.78
325       PB    1.57
326       LS       0      78       0       0      97       0
327       UK     800    .025     .30      89
328       UK      60     .03     .10      11
329       RK    3000    .010    .050    0.45              30       50
330       RK    7500    .029    .035             TRAP      40        1      NO
331       KK      53     SUB-BASIN 53 HYDROGRAPH
332       KM             KINEMATIC WAVE RUNOFF COMPUTATION
333       BA    1.44
334       PB    1.57
335       LS       0      77       0       0      97       0
336       UK     600    .010     .30      70
337       UK      50    .010     .10      30
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

338       RK    1300    .0033    .050    .053    TRAP      30      50
339       RK    3100    .0017    .050    .21     TRAP      30      50
340       RK   12300    .0033    .02             TRAP      20       1       NO

341       KK     W-V      ROUTE FLOWS TO NODE V
342       RM       3     .36      .10

343       KK  NODE V     COMBINE ALL FLOWS AT NODE V
344       HC       4

345       KK     V-Z      ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
346       RK    7780    .0041    .23             TRAP      80       1

347       KK     51B     SUB-BASIN  51B HYDROGRAPH
348       KM             SCS RUNOFF COMPUTATION
349       BA     0.47
350       PB     1.57
351       LS        0      87       0       0       0       0
352       UD      .13

353       KK     X-Z      ROUTE FLOWS TO NODE Z
354       RM       3     .54      .10

355       KK     51A     SUB-BASIN 51A HYDROGRAPH
356       KM             KINEMATIC WAVE RUNOFF COMPUTATION
357       BA      .99
358       PB     1.61
359       LS        0      78       0       0      97       0
360       UK      600     .03      .30      86
361       UK       60    .030      .10      14
362       RK     2500   .0075     .050    .100    TRAP      30      50
363       RK     8000   .0400     .025            TRAP      50       1       NO

364       KK     51C     SUB-BASIN  51C HYDROGRAPH
365       KM             SCS RUNOFF COMPUTATION
366       BA     0.43
367       PB     1.61
368       LS        0      87       0       0       0       0
369       UD      .19

370       KK     Y-Z      ROUTE FLOWS TO NODE Z
371       RM       3     .54      .10

372       KK     51D     SUB-BASIN 51D HYDROGRAPH
373       KM             KINEMATIC WAVE RUNOFF COMPUTATION
374       BA      .83
375       PB     1.57
376       LS        0      78       0       0      97       0
377       UK      600     .03      .30      88
378       UK       60    .035      .10      12
379       RK     2500   .0240     .050    .080            30      50
380       RK     8000   .0300     .025            TRAP      50       1
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```
.ONE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

381       KK  NODE Z      COMBINE ALL FLOWS AT NODE Z
382       HC        5

383       KK    Z-BB      ROUTE FLOWS TO NODE BB (SLOAN CHANNEL)
384       RK    2680   .0044    .023             TRAP      80        1

385       KK     52B    SUB-BASIN  52B HYDROGRAPH
386       KM            SCS RUNOFF COMPUTATION
387       BA    0.70
388       PB    1.57
389       LS       0      87       0        0        0        0
390       UD     .11

391       KK   AA-BB      ROUTE FLOWS TO NODE BB
392       RM       4     .62     .10

393       KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
394       HC       2

395       KK     52A    SUB-BASIN 52A HYDROGRAPH
396       KM            KINEMATIC WAVE RUNOFF COMPUTATION
397       BA    1.18
398       PB    1.57
399       LS       0      78       0        0       97        0
400       UK     600    .025     .30       93
401       UK      60    .035     .10        7
402       RK    2000    .025    .050      .24               30       50
403       RK   11200    .028    .035               TRAP      30        1       NO

404       KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
405       HC       2

406       KK   BB-CC      ROUTE FLOWS TO NODE CC
407       RK    4000    .055    .023             TRAP      80        1

408       KK     326    SUB-BASIN 326 HYDROGRAPH
409       KM            KINEMATIC WAVE RUNOFF COMPUTATION
410       BA    1.71
411       PB    1.57
412       LS       0      78       0        0       97        0
413       UK     700    .010     .30       80
414       UK      60   .0100     .10       20
415       RK    1800   .0035    .050      .11               30       50
416       RK    4000   .0014    .050      .43               30       50
417       RK   12500   .0038    .035               TRAP      80        1

418       KK   NO.CC      COMBINE ALL FLOWS AT NODE CC
419       HC       2
420       ZZ
```

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*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE (HEC-1)     *
*        FEBRUARY 1981                  *
*       REVISED 02 AUG 88               *
*                                       *
*  RUN DATE  07/02/1990  TIME  09:41:54 *
*                                       *
*****************************************
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*                      *
*  U.S. ARMY CORPS OF ENG
*  THE HYDROLOGIC ENGINEERI
*        609 SECOND STREE
*     DAVIS, CALIFORNIA 95
*                      *
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CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
RANGE WASH WATERSHED
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
JUNE 1990
100-YR, 6-HR STORM PB CARD FOR DARF = 0.55
PRESENT CONDITIONS, EXISTING FACILITIES
AMC 2.0
BASED ON RANGE WASH FACILITIES STUDY
BOYLE ENGINEERS CORP-JULY 1989
(CONVERTED RK TO RM IN UPLAND SUBAREAS)

DARF		JR CARD
.55	FOR NODE CC AND NODE S	1.00
.64	FOR NODE G-G1	1.164
.68	FOR NODE G AND NODE P	1.236
.71	FOR NODE F1 AND NODE P1	1.291
.77	FOR NODE I2	1.400
.83	FOR NODE I1	1.509

19 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		120	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		0955	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 9.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

MULTI-PLAN OPTION

MPLAN NUMBER OF PLANS

MULTI-RATIO OPTION

RATIOS OF PRECIPITATION

1.00 1.16 1.24 1.29 1.40 1.51

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT	41	4.73	1	FLOW	670.	951.	1083.	1186.	1397.	1615.
				TIME	4.17	4.17	4.08	4.08	4.08	4.08
ROUTED TO	A-B	4.73	1	FLOW	640.	911.	1037.	1135.	1335.	1541.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT	302	6.14	1	FLOW	690.	994.	1135.	1246.	1473.	1709.
				TIME	4.33	4.33	4.33	4.33	4.25	4.25
2 COMBINED AT	NODE B	10.87	1	FLOW	1311.	1879.	2142.	2348.	2767.	3200.
				TIME	4.42	4.42	4.42	4.42	4.42	4.42
ROUTED TO	B-C	10.87	1	FLOW	1289.	1845.	2105.	2308.	2722.	3149.
				TIME	4.67	4.58	4.58	4.58	4.58	4.58
HYDROGRAPH AT	303	4.49	1	FLOW	823.	1102.	1229.	1328.	1526.	1728.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT	42B	4.08	1	FLOW	466.	677.	777.	856.	1018.	1184.
				TIME	4.17	4.17	4.08	4.08	4.08	4.08
3 COMBINED AT	NODE C	19.44	1	FLOW	2289.	3237.	3678.	4023.	4724.	5446.
				TIME	4.42	4.33	4.33	4.33	4.33	4.33
ROUTED TO	C-D	19.44	1	FLOW	2272.	3207.	3640.	3982.	4678.	5395.
				TIME	4.50	4.50	4.50	4.42	4.42	4.42
HYDROGRAPH AT	42A	8.23	1	FLOW	829.	1209.	1386.	1525.	1814.	2113.
				TIME	4.33	4.33	4.33	4.33	4.25	4.25
2 COMBINED AT	NODE D	27.67	1	FLOW	3077.	4389.	4997.	5473.	6443.	7442.
				TIME	4.42	4.42	4.42	4.42	4.42	4.42
ROUTED TO	D-E	27.67	1	FLOW	3015.	4283.	4879.	5345.	6294.	7272.
				TIME	4.83	4.75	4.75	4.75	4.75	4.75
HYDROGRAPH AT	305	3.99	1	FLOW	577.	781.	875.	949.	1097.	1249.
				TIME	4.25	4.25	4.17	4.17	4.17	4.17
2 COMBINED AT	NODE E	31.66	1	FLOW	3450.	4867.	5527.	6043.	7093.	8173.
				TIME	4.83	4.75	4.75	4.75	4.75	4.75
ROUTED TO	E-F	31.66	1	FLOW	3396.	4760.	5399.	5900.	6917.	7964.
				TIME	5.42	5.33	5.25	5.25	5.25	5.25
GRAPH AT	306	9.04	1	FLOW	384.	579.	673.	747.	902.	1064.
				TIME	6.25	6.17	6.17	6.17	6.08	6.08
2 COMBINED AT	NODE F	40.70	1	FLOW	3727.	5210.	5926.	6486.	7633.	8827.
				TIME	5.83	5.33	5.33	5.33	5.25	5.25

ROUTED TO	F-F1	40.70	1	FLOW	3714.	5173.	5870.	6419.	7542.	9709.
				TIME	6.17	5.92	5.83	5.83	5.75	5.75
HYDROGRAPH AT	307A	5.65	1	FLOW	530.	819.	955.	1064.	1292.	1530.
				TIME	5.92	5.92	5.92	5.83	5.83	5.83
2 COMBINED AT	NOD-F1	46.35	1	FLOW	3796.	5357.	6092.	6672.	7855.	9080.
				TIME	5.92	5.75	5.67	5.67	5.67	5.58
ROUTED TO	F1-G	46.35	1	FLOW	3796.	5354.	6091.	6668.	7852.	9078.
				TIME	6.08	5.83	5.83	5.83	5.75	5.75
HYDROGRAPH AT	307B	2.42	1	FLOW	494.	622.	691.	731.	817.	911.
				TIME	5.83	5.75	5.75	5.75	5.75	5.75
2 COMBINED AT	G	48.77	1	FLOW	3915.	5543.	6305.	6902.	8115.	9374.
				TIME	6.00	5.83	5.75	5.75	5.75	5.67
ROUTED TO	G-G1	48.77	1	FLOW	3914.	5542.	6301.	6899.	8114.	9368.
				TIME	6.00	5.83	5.75	5.75	5.75	5.67
HYDROGRAPH AT	43	6.40	1	FLOW	497.	707.	820.	908.	1091.	1283.
				TIME	5.33	4.42	4.42	4.42	4.33	4.33
ROUTED TO	H-I	6.40	1	FLOW	478.	667.	771.	854.	1025.	1202.
				TIME	6.00	5.25	5.25	5.17	5.17	5.17
HYDROGRAPH AT	309	9.24	1	FLOW	607.	868.	990.	1087.	1284.	1488.
				TIME	5.67	5.67	5.58	5.58	5.58	5.58
2 COMBINED AT	NODE I	15.64	1	FLOW	1073.	1526.	1741.	1912.	2269.	2646.
				TIME	5.83	5.67	5.58	5.50	5.42	5.33
ROUTED TO	I-I1	15.64	1	FLOW	1070.	1523.	1739.	1910.	2265.	2639.
				TIME	5.92	5.75	5.67	5.67	5.50	5.42
HYDROGRAPH AT	310A	1.29	1	FLOW	269.	398.	458.	506.	602.	702.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	NOD-I1	16.93	1	FLOW	1082.	1542.	1760.	1932.	2295.	2678.
				TIME	5.92	5.75	5.67	5.67	5.42	5.42
ROUTED TO	I1-I2	16.93	1	FLOW	1070.	1530.	1749.	1921.	2280.	2657.
				TIME	6.33	6.25	6.17	6.08	6.00	5.92
HYDROGRAPH AT	310B	7.85	1	FLOW	432.	728.	877.	996.	1231.	1469.
				TIME	5.75	5.58	5.50	5.42	5.33	5.25
2 COMBINED AT	NODI2	24.78	1	FLOW	1461.	2178.	2525.	2800.	3350.	3904.
				TIME	6.17	5.75	5.67	5.58	5.50	5.42
ROUTED TO	I2-G1	24.78	1	FLOW	1460.	2176.	2525.	2798.	3347.	3902.
				TIME	6.17	5.83	5.67	5.58	5.50	5.50
2 COMBINED AT	NOD-G1	73.55	1	FLOW	5369.	7719.	8820.	9677.	11422.	13203.
				TIME	6.08	5.83	5.75	5.75	5.67	5.67
ROUTED TO	G1-M	73.55	1	FLOW	5367.	7717.	8817.	9673.	11417.	13196.
				TIME	6.17	5.92	5.83	5.83	5.75	5.75

HYDROGRAPH AT	44	7.23	1	FLOW	510.	721.	820.	899.	1061.	1232.
				TIME	5.50	5.42	5.33	5.33	5.25	5.17
ROUTED TO	J-K	7.23	1	FLOW	503.	714.	814.	893.	1055.	1225.
				TIME	6.08	5.92	5.92	5.83	5.75	5.75
HYDROGRAPH AT	312	6.77	1	FLOW	247.	368.	427.	473.	568.	669.
				TIME	7.00	7.00	6.92	6.92	6.92	6.83
2 COMBINED AT	NODE K	14.00	1	FLOW	710.	1024.	1172.	1289.	1530.	1782.
				TIME	6.25	6.17	6.17	6.17	6.08	6.08
ROUTED TO	K-P	14.00	1	FLOW	695.	1005.	1152.	1268.	1507.	1756.
				TIME	7.25	7.17	7.17	7.17	7.17	7.08
HYDROGRAPH AT	45	10.73	1	FLOW	565.	837.	968.	1071.	1285.	1511.
				TIME	5.67	5.58	5.50	5.50	5.42	5.42
ROUTED TO	N-O	10.73	1	FLOW	559.	830.	960.	1063.	1277.	1501.
				TIME	6.00	5.92	5.92	5.83	5.83	5.75
HYDROGRAPH AT	048	2.07	1	FLOW	89.	134.	155.	173.	208.	246.
				TIME	6.25	6.17	6.17	6.08	6.08	6.08
HYDROGRAPH AT	46A	7.35	1	FLOW	447.	650.	746.	822.	978.	1141.
				TIME	5.83	5.75	5.75	5.67	5.67	5.67
HYDROGRAPH AT	46B	6.02	1	FLOW	354.	516.	593.	653.	777.	908.
				TIME	5.92	5.83	5.83	5.83	5.75	5.75
COMBINED AT	NODE O	26.17	1	FLOW	1440.	2119.	2444.	2700.	3228.	3783.
				TIME	5.92	5.83	5.83	5.83	5.75	5.75
ROUTED TO	O-P1	26.17	1	FLOW	1414.	2084.	2406.	2659.	3183.	3732.
				TIME	6.58	6.50	6.50	6.50	6.42	6.42
2 COMBINED AT	P1	40.17	1	FLOW	2046.	3005.	3462.	3824.	4571.	5353.
				TIME	6.75	6.67	6.67	6.67	6.58	6.58
ROUTED TO	P1-P	40.17	1	FLOW	2028.	2980.	3433.	3791.	4534.	5309.
				TIME	7.25	7.17	7.17	7.17	7.08	7.08
HYDROGRAPH AT	317	7.66	1	FLOW	765.	1095.	1249.	1370.	1616.	1872.
				TIME	5.42	4.50	4.50	4.50	4.50	4.42
HYDROGRAPH AT	318B	1.86	1	FLOW	548.	714.	789.	846.	962.	1079.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO	Q-P	1.86	1	FLOW	513.	669.	740.	794.	903.	1013.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	318A	2.19	1	FLOW	114.	196.	236.	268.	334.	403.
				TIME	6.08	5.83	5.75	5.67	5.50	5.42
4 COMBINED AT	NODE P	51.88	1	FLOW	2227.	3270.	3766.	4158.	4965.	5811.
				TIME	7.08	7.00	6.92	6.92	6.83	6.83
ROUTED TO	P-M	51.88	1	FLOW	2225.	3269.	3763.	4157.	4963.	5810.
				TIME	7.25	7.08	7.08	7.00	7.00	6.92
HYDROGRAPH AT	047	7.40	1	FLOW	622.	800.	888.	958.	1106.	1313.

				TIME	4.42	4.33	4.33	4.33	4.25	5.42
COMBINED AT	NODE M	132.83	1	FLOW	7664.	11040.	12643.	13905.	16471.	19120.
				TIME	6.50	6.08	6.00	6.00	5.92	5.83
ED TO	M-S	132.83	1	FLOW	7662.	11040.	12640.	13903.	16471.	19114.
				TIME	6.50	6.17	6.08	6.00	5.92	5.83
HYDROGRAPH AT	48B	.99	1	FLOW	323.	420.	464.	498.	566.	635.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO	R-S	.99	1	FLOW	308.	420.	445.	475.	555.	622.
				TIME	3.83	3.83	3.83	3.83	3.75	3.75
HYDROGRAPH AT	48A	.49	1	FLOW	76.	94.	103.	111.	127.	146.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	321	3.42	1	FLOW	166.	232.	267.	296.	361.	433.
				TIME	6.92	6.83	6.83	6.75	6.75	6.67
HYDROGRAPH AT	49A	.60	1	FLOW	62.	78.	90.	100.	118.	134.
				TIME	3.75	3.75	5.08	5.08	5.00	5.00
S COMBINED AT	NODE S	138.33	1	FLOW	7876.	11340.	12983.	14281.	16924.	19654.
				TIME	6.50	6.17	6.08	6.00	5.92	5.83
ROUTED TO	S-V	138.33	1	FLOW	7875.	11338.	12980.	14277.	16917.	19647.
				TIME	6.58	6.25	6.08	6.08	6.00	5.92
HYDROGRAPH AT	324	1.40	1	FLOW	120.	152.	166.	179.	203.	228.
				TIME	4.42	4.42	4.33	4.33	4.33	4.33
HYDROGRAPH AT	49B	1.04	1	FLOW	321.	420.	464.	499.	568.	637.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO	T-V	1.04	1	FLOW	229.	301.	333.	359.	410.	461.
				TIME	4.17	4.17	4.17	4.08	4.08	4.08
3 COMBINED AT	NODE V	140.77	1	FLOW	7942.	11473.	13151.	14475.	17178.	19965.
				TIME	6.58	6.17	6.08	6.00	5.92	5.83
HYDROGRAPH AT	50B	.55	1	FLOW	211.	274.	303.	325.	369.	413.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	U-V	.55	1	FLOW	143.	188.	208.	223.	255.	286.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT	50A	1.78	1	FLOW	95.	160.	195.	226.	289.	351.
				TIME	5.25	5.25	5.25	5.17	5.17	5.08
HYDROGRAPH AT	53	1.44	1	FLOW	130.	164.	181.	194.	222.	253.
				TIME	4.67	4.58	4.50	4.50	4.50	4.50
ROUTED TO	W-V	1.44	1	FLOW	126.	158.	174.	187.	213.	243.
				TIME	5.00	4.92	4.92	4.92	4.92	4.83
OMBINED AT	NODE V	144.54	1	FLOW	8102.	11732.	13456.	14811.	17584.	20451.
				TIME	6.50	6.08	6.00	6.00	5.92	5.83
ROUTED TO	V-Z	144.54	1	FLOW	8101.	11732.	13454.	14808.	17582.	20445.
				TIME	6.83	6.42	6.33	6.25	6.17	6.08

DROGRAPH AT	51B	.47	1	FLOW	173.	226.	250.	268.	304.	341.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
TED TO	X-Z	.47	1	FLOW	105.	138.	153.	165.	188.	212.
				TIME	4.00	4.00	4.00	4.0	4.00	4.00
YDROGRAPH AT	51A	.99	1	FLOW	75.	120.	140.	155.	182.	207.
				TIME	5.33	5.17	5.17	5.08	5.08	5.00
YDROGRAPH AT	51C	.43	1	FLOW	150.	196.	217.	233.	266.	298.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	Y-Z	.43	1	FLOW	97.	128.	141.	152.	174.	195.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08
YDROGRAPH AT	51D	.83	1	FLOW	58.	96.	114.	125.	147.	169.
				TIME	5.25	5.17	5.08	5.08	5.00	5.00
3 COMBINED AT	NODE Z	147.26	1	FLOW	8163.	11845.	13587.	14962.	17767.	20669.
				TIME	6.83	6.42	6.33	6.25	6.17	6.08
ROUTED TO	Z-BB	147.26	1	FLOW	8163.	11843.	13587.	14959.	17765.	20663.
				TIME	6.83	6.42	6.33	6.25	6.17	6.08
HYDROGRAPH AT	52B	.70	1	FLOW	269.	352.	390.	419.	477.	536.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50
ROUTED TO	AA-BB	.70	1	FLOW	156.	206.	228.	246.	281.	316.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08
MBINED AT	NO.BB	147.96	1	FLOW	8166.	11857.	13605.	14982.	17796.	20704.
				TIME	6.83	6.42	6.33	6.25	6.17	6.08
HYDROGRAPH AT	52A	1.18	1	FLOW	70.	124.	148.	168.	199.	230.
				TIME	5.42	5.25	5.17	5.08	5.00	5.00
2 COMBINED AT	NO.BB	149.14	1	FLOW	8203.	11918.	13675.	15061.	17888.	20812.
				TIME	6.75	6.42	6.33	6.25	6.17	6.08
ROUTED TO	BB-CC	149.14	1	FLOW	8203.	11917.	13675.	15059.	17886.	20808.
				TIME	6.83	6.42	6.33	6.25	6.17	6.08
HYDROGRAPH AT	326	1.71	1	FLOW	94.	127.	146.	163.	203.	246.
				TIME	5.75	5.83	6.00	6.08	6.08	6.08
2 COMBINED AT	NO.CC	150.85	1	FLOW	8282.	12040.	13819.	15222.	18089.	21054.
				TIME	6.75	6.42	6.33	6.25	6.17	6.08

*** NORMAL END OF HEC-1 ***

NORMAL END OF HEC-1

HYDROLOGY BELOW DIKE

HEC-1 Model

Master Plan Update

Range Wash Basin below Dike

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*DIAGRAM
ID          CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE                          ID 036
ID                    RANGE WASH WATERSHED                                      ID 036
ID          JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.                     ID 036
ID                         JANUARY 1991                                         ID 036
ID          100-YR, 6-HR STORM    PB CARD FOR DARF = 0.55                       ID 036
ID          PRESENT CONDITIONS, EXISTING FACILITIES                             ID 036
ID                         AMC 2.0                                              ID 036
ID          BASED ON RANGE WASH FACILITIES STUDY                                ID 036
ID            BOYLE ENGINEERS CORP-JULY 1989                                    ID 036
ID          (CONVERTED RK TO RM IN UPLAND SUBAREAS)                             ID 036
ID                                                                              ID 036
ID  MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)   ID 036
ID                                                                              ID 036
ID  RATIO #   DARF      NODE ID              AREA (SQ MI)        JR CARD        ID 036
ID                                                             (RATIO TO 0.55) ID 036
ID     1      0.61      NODE CC & S          89.0, 101.5          1.109        ID 036
ID     2      0.70      NODE P & P1          51.9, 40.2           1.264        ID 036
ID     3      0.77      NODE G1              24.2                 1.400        ID 036
ID     4      0.85      NODE G, I2, & F1     11.4, 12.8, 9.0      1.552        ID 036
ID     5      0.92      NODE F & I1          3.4, 4.9             1.664        ID 036
ID                                                                              ID 036
IT   05       0       0      120                                               IT 040
IO    5       0       0                                                        IO 039
JR  PREC   1.109   1.264   1.400   1.552   1.664                                JR 043
KK  306B   SUB-BASIN 306B HYDROGRAPH                                           KK 045
KM         SCS RUNOFF COMPUTATION                                              KM 046
BA  3.37                                                                       BA 008
PB  1.57                                                                       PB 069
     0.0    2.0    5.90   8.00   11.0   14.40  15.00  16.00  16.80  17.10PC   070
PC  18.0   18.20  18.70  19.00  19.70  20.20  21.00  22.00  23.00  24.00PC   070
PC  25.0   25.90  26.50  28.00  29.00  30.00  30.50  30.90  31.00  31.70PC   070
PC 32.10   32.70  33.30  34.60  36.10  38.10  40.80  43.00  47.70  51.40PC   070
PC  56.1   63.00  71.00  72.00  73.10  75.20  77.90  79.00  79.50  80.40PC   070
PC  81.0   82.00  82.60  84.00  85.90  88.90  91.00  93.80  96.60  97.40PC   070
PC  97.9   98.10  98.30  98.50  98.90  99.00  99.20  99.30  99.60  99.70PC   070
PC  99.9  100.00                                                          PC 070
LS     0     76                                                          LS 056
UD  0.75                                                                   UD 111
KK  F-F1   ROUTE FLOW TO NODE F1                                           KK 045
RM     5   0.42     .10                                                    RM 089
KK  307A   SU-BASIN 307A HYDROGRAPH                                        KK 045
BA  5.65                                                                   BA 008
PB  1.57                                                                   PB 069
LS     0     78                                                          LS 056
UD   .44                                                                   UD 111
KKNOD-F1   COMBINE FLOW AT NODE F1                                         KK 045
HC     2                                                                   HC 031
KK  F1-G   ROUTE FLOW TO G                                                 KK 045
RK 12000  .0075     .03          TRAP     40     1.5                       RK 087
KK  307B   SUB-BASIN 307B HYDROGRAPH                                       KK 045
KM         KINEMATIC WAVE RUNOFF COMPUTATION                               KM 046
BA  2.42                                                                   BA 008
PB  1.57                                                                   PB 069
     0     78      0       0      97                                       LS 056
    800  .0123    .20     59                                               UK 113
UK   60   .015    .10     41                                               UK 113
RK 2640   .0075  .0375   0.125  TRAP     40      1                         RK 087
RK 3080   .0075  .0375    .30   TRAP     40      1                         RK 087
RK 12000  .075    .03          TRAP     40     1.5     NO                  RK 087
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KK      G    COMBINE FLOW AT NODE G
HC      2
KK    G-G1   ROUTE FLOW TO G1
RK   [illegible]700  .0035    .015            TRAP      12      1.5
KK    [illegible]098   SUB-BASIN 309B HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA   3.64
PB   1.57
LS      0      79
UD   0.59
KK    I-I1     ROUTE FLOW FROM NODE I TO NODE I1
RM      1     .11     .10
KK    310A
BA   1.29
PB   1.57
LS      0      79
UD    .09
KKNOD-I1   COMBINE FLOW AT NODE I1
HC      2
KK  I1-I2    ROUTE FLOW I2
RM      6     .52     .10
KK    3108   SUB-BASIN 310B HYDROGRAPH
KM           KINEMATIC WAVE RUNOFF COMPUTATION
BA   7.85
PB   1.57
LS      0      78       0       0      97
UK    800    .015     .20      87
UK     60    .020     .10      13
[illegible]  [illegible]5000  .012    .030    .86    TRAP      20       3
[illegible]   800    .006    .025            TRAP      80       1      NO
[illegible]  JD12  COMBINE FLOW AT I2
HC      2
KK  I2-G1  ROUTE FLOW TO G1
RK   2100    .002    .015            TRAP      15      1.5
KKNOD-G1   COMBINE ALL FLOW AT NODE G1
KM           COMBINE EAST AND WEST BRANCH CHANNELS
HC      2
KK   G1-M      ROUTE FLOW FROM G1 TO NODE M
RK  13100  0.0035    .023            TRAP      50       1
KK     44    SUB-BASIN 44 HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA   7.23
PB   1.57
LS      0      79
UD   1.22
KK    J-K      ROUTE FLOW FROM J TO NODE K
RM      8     .58     .10
KK    312    SUB-BASIN 312 HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA   6.77
PB   1.57
LS      0      77
UD   2.83
KKNODE K   COMBINE FLOW AT NODE K
[illegible]      2
[illegible]    K-P      ROUTE FLOW FROM NODE K TO NODE P
RM     12    1.03     .15
KK     45    SUB-BASIN  45 HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  10.73

KK           045
HC           031
KK           045
RK           087
KK           045
KM           046
BA           008
PB           069
LS           056
UD           111
KK           045
RM           089
KK           045
BA           008
PB           069
LS           056
UD           111
KK           045
HC           031
KK           045
RM           089
KK           045
KM           046
BA           008
PB           069
LS           056
UK           113
UK           113
RK           087
RK           087
KK           045
HC           031
KK           045
RK           087
KK           045
KM           046
HC           031
KK           045
RK           087
KK           045
KM           046
BA           008
PB           069
LS           056
UD           111
KK           045
RM           089
KK           045
KM           046
BA           008
PB           069
LS           056
UD           111
KK           045
HC           031
KK           045
RM           089
KK           045
KM           046
BA           008
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PB  1.57
LS     0      76        0        0        0        0
UD  1.31
       N-O      ROUTE FLOW TO NODE O
        5     .38      .15
KK    048    SUB-BASIN 048 HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  2.07
PB  1.57
LS     0      76
UD  1.97
KK    46A    SUB-BASIN 46A HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  7.35
PB  1.65
LS     0      77
UD  1.60
KK    46B    SUB-BASIN 46B HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  6.02
PB  1.65
LS     0      77
UD  1.71
KKNODE O     COMBINE FLOW AT NODE O
HC     4
KK   O-P1      ROUTE FLOW FROM NODE O TO NODE P1
RM     8     0.68      .15
KK     P1    COMBINE FLOW AT P1
HC     2
       P1-P      ROUTE FROM P1 TO P
        6     .48      .15
KK    317    SUB-BASIN 317 HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  7.66
PB  1.73
LS     0      80
UD   .97
KK   318B    SUB-BASIN 318B HYDROGRAPH
KM           SCS RUNOFF COMPUTATION
BA  1.86
PB  1.73
LS     0      87
UD   .37
KK   Q-P       ROUTE FLOW TO NODE P
RM     4     .26      .15
KK   318A    SUB-BASIN 318A HYDROGRAPH
KM           KINEMATIC WAVE RUNOFF COMPUTATION
BA  2.19
PB  1.61
LS     0      78        0        0       97
UK   700    .020      .30       89
UK    50    .025      .10       11
RK  2000    .035    .0375      .06              30       50
RK  7000    .014      .05      .55              30       50
RK  7200   .0043      .03             TRAP     30        1
       E P   COMBINE FLOWS AT NODE P
HC     4
KK   P-M      ROUTE FLOW TO NODE M
RK  7400   .0034    0.03             TRAP     80        1
KK    047    SUB-BASIN 047 HYDROGRAPH
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PB          069
LS          056
UD          111
KK          045
RM          089
KK          045
KM          046
BA          008
PB          069
LS          056
UD          111
KK          045
KM          046
BA          008
PB          069
LS          056
UD          111
KK          045
KM          046
BA          008
PB          069
LS          056
UD          111
KK          045
HC          031
KK          045
RM          089
KK          045
HC          031
KK          045
RM          089
KK          045
KM          046
BA          008
PB          069
LS          056
UD          111
KK          045
KM          046
BA          008
PB          069
LS          056
UD          111
KK          045
RM          089
KK          045
KM          046
BA          008
PB          069
LS          056
UK          113
UK          113
RK          087
RK          087
RK          087
KK          045
HC          031
KK          045
RK          087
KK          045
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KM          KINEMATIC WAVE RUNOFF COMPUTATION                                  KM  046
BA  7.40                                                                       BA  008
PB  1.57                                                                       PB  069
      0      78       0       0      97                                       LS  056
    800    .008     .20      74                                               UK  113
     80    .012     .10      26                                               UK  113
RK  7000   .007    .050    1.23              30      50                       RK  087
RK 22000   .005     .03            TRAP      40       1                       RK  087
KKNODE M   COMBINE FLOWS AT NODE M                                            KK  045
HC     3                                                                       HC  031
KK   M-S     ROUTE FLOW TO NODE S (SLOAN CHANNEL)                             KK  045
RK  4600  .0028   0.023            TRAP      80       1                       RK  087
KK   48B    SUB-BASIN  48B HYDROGRAPH                                         KK  045
KM          SCS RUNOFF COMPUTATION                                             KM  046
BA   .99                                                                       BA  008
PB  1.65                                                                       PB  069
LS     0      87       0       0       0       0                              LS  056
UD   .24                                                                       UD  111
KK   R-S     ROUTE FLOW TO NODE S                                             KK  045
RK  9100  .0316   0.035            TRAP      80       1                       RK  087
KK   48A    SUB-BASIN 48A HYDROGRAPH                                         KK  045
KM          KINEMATIC WAVE RUNOFF COMPUTATION                                  KM  046
BA   .49                                                                       BA  008
PB  1.61                                                                       PB  069
LS     0      78       0       0      97                                       LS  056
UK   700    .025     .30      77                                               UK  113
UK    60    0.03     .10      23                                               UK  113
RK   800     .02    .050    0.12              30      50                       RK  087
RK  9000    .033     .02            TRAP      20       1      NO               RK  087
KK   321    SUB-BASIN 321 HYDROGRAPH                                         KK  045
            KINEMATIC WAVE RUNOFF COMPUTATION                                  KM  046
BA  3.42                                                                       BA  008
PB  1.57                                                                       PB  069
LS     0      78       0       0      97                                       LS  056
UK   800    .010     .30      78                                               UK  113
UK    50   0.020     .10      22                                               UK  113
RK  3500    .006    .050    0.14              30      50                       RK  087
RK  7400   .0014    .050    0.58              30      50                       RK  087
RK 21200   .0035    .035            TRAP      70       1      NO               RK  087
KK   49A    SUB-BASIN 49A HYDROGRAPH                                         KK  045
KM          KINEMATIC WAVE RUNOFF COMPUTATION                                  KM  046
BA  0.60                                                                       BA  008
PB  1.57                                                                       PB  069
LS     0      78       0       0      97                                       LS  056
UK   700    .034     .30      80                                               UK  113
UK    60     .04     .10      20                                               UK  113
RK  1000    .003    .050    0.12              30      50                       RK  087
RK  9200    .034    .035            TRAP      20       1      NO               RK  087
KKNODE S   COMBINE ALL FLOWS AT S                                             KK  045
HC     5                                                                       HC  031
KK   S-V     ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)                           KK  045
RK  6800   .0038    .023            TRAP      80       1                       RK  087
KK   324    SUB-BASIN 324 HYDROGRAPH                                         KK  045
KM          KINEMATIC WAVE RUNOFF COMPUTATION                                  KM  046
   1.40                                                                        BA  008
   .57                                                                         PB  069
LS     0      77       0       0      97                                       LS  056
UK   800    .01     .30      74                                               UK  113
UK    60    .01     .10      26                                               UK  113
RK  1300    .004    .05    0.07    TRAP      30      50                       RK  087
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RK  2500   .0017     .05     0.28                30      50
RK  7000    .005     .035             TRAP       70       1     NO
KK   49B   SUB-BASIN  49B HYDROGRAPH
           SCS RUNOFF COMPUTATION
[redacted]  .04
PB  1.61
LS     0     87        0       0       0        0
UD   .25
KK   T-V     ROUTE FLOWS TO NODE V
RM     3     .52      .10
KKNODE V   COMBINE ALL FLOWS AT NODE V
HC     3
KK   50B   SUB-BASIN  50B HYDROGRAPH
KM         SCS RUNOFF COMPUTATION
BA   .55
PB  1.65
LS     0     87        0       0       0        0
UD   .17
KK   U-V     ROUTE FLOWS TO NODE V
RM     3     .43      .10
KK   50A   SUB-BASIN 50A HYDROGRAPH
KM         KINEMATIC WAVE RUNOFF COMPUTATION
BA  1.78
PB  1.57
LS     0     78        0       0      97        0
UK   800    .025      .30      89
UK    60     .03      .10      11
RK  3000    .010     .050    0.45                30      50
[redacted]  7500    .029     .035             TRAP       40       1     NO
[redacted]    53   SUB-BASIN 53 HYDROGRAPH
[redacted]         KINEMATIC WAVE RUNOFF COMPUTATION
BA  1.44
PB  1.57
LS     0     77        0       0      97        0
UK   600    .010      .30      70
UK    50    .010      .10      30
RK  1300   .0033     .050    .053    TRAP       30      50
RK  3100   .0017     .050     .21    TRAP       30      50
RK 12300   .0033      .02             TRAP       20       1     NO
KK   W-V     ROUTE FLOWS TO NODE V
RM     3     .36      .10
KKNODE V   COMBINE ALL FLOWS AT NODE V
HC     4
KK   V-Z     ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
RK  7780   .0041      .23             TRAP       80       1
KK   51B   SUB-BASIN  51B HYDROGRAPH
KM         SCS RUNOFF COMPUTATION
BA  0.47
PB  1.57
LS     0     87        0       0       0        0
UD   .13
KK   X-Z     ROUTE FLOWS TO NODE Z
RM     3     .54      .10
KK   51A   SUB-BASIN 51A HYDROGRAPH
[redacted]         KINEMATIC WAVE RUNOFF COMPUTATION
[redacted]  .99
PB  1.61
LS     0     78        0       0      97        0
UK   600    .03      .30      86
UK    60   .030      .10      14
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RK    087
RK    087
KK    045
KM    046
BA    008
PB    069
LS    056
UD    111
KK    045
RM    089
KK    045
HC    031
KK    045
KM    046
BA    008
PB    069
LS    056
UD    111
KK    045
RM    089
KK    045
KM    046
BA    008
PB    069
LS    056
UK    113
UK    113
RK    087
RK    087
KK    045
KM    046
BA    008
PB    069
LS    056
UK    113
UK    113
RK    087
RK    087
RK    087
KK    045
RM    089
KK    045
HC    031
KK    045
RK    087
KK    045
KM    046
BA    008
PB    069
LS    056
UD    111
KK    045
RM    089
KK    045
KM    046
BA    008
PB    069
LS    056
UK    113
UK    113
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RK  2500   .0075    .050    .100    TRAP      30       50                          RK              087
RK  8000   .0400    .025            TRAP      50        1       NO                 RK              087
KK   51C   SUB-BASIN  51C HYDROGRAPH                                              KK              045
           SCS RUNOFF COMPUTATION                                                  KM              046
[redacted].43                                                                      BA              008
PB  1.61                                                                           PB              069
LS     0     87       0       0       0        0                                  LS              056
UD   .19                                                                           UD              111
KK   Y-Z     ROUTE FLOWS TO NODE Z                                                 KK              045
RM     3    .54     .10                                                           RM              089
KK   51D   SUB-BASIN 51D HYDROGRAPH                                               KK              045
KM         KINEMATIC WAVE RUNOFF COMPUTATION                                       KM              046
BA   .83                                                                           BA              008
PB  1.57                                                                           PB              069
LS     0     78       0       0      97        0                                  LS              056
UK   600    .03     .30      88                                                   UK              113
UK    60   .035     .10      12                                                   UK              113
RK  2500  .0240    .050    .080             30       50                          RK              087
RK  8000  .0300    .025            TRAP      50        1                          RK              087
KKNODE Z     COMBINE ALL FLOWS AT NODE Z                                         KK              045
HC     5                                                                           HC              031
KK  Z-BB     ROUTE FLOWS TO NODE BB (SLOAN CHANNEL)                               KK              045
RK  2680  .0044    .023            TRAP      80        1                          RK              087
KK   52B   SUB-BASIN  52B HYDROGRAPH                                              KK              045
KM         SCS RUNOFF COMPUTATION                                                  KM              046
BA  0.70                                                                           BA              008
PB  1.57                                                                           PB              069
LS     0     87       0       0       0        0                                  LS              056
[redacted]  .11                                                                    UD              111
[redacted]-BB     ROUTE FLOWS TO NODE BB                                           KK              045
[redacted]     4    .62     .10                                                   RM              089
KK NO.BB     COMBINE ALL FLOWS AT NODE BB                                        KK              045
HC     2                                                                           HC              031
KK   52A   SUB-BASIN 52A HYDROGRAPH                                               KK              045
KM         KINEMATIC WAVE RUNOFF COMPUTATION                                       KM              046
BA  1.18                                                                           BA              008
PB  1.57                                                                           PB              069
LS     0     78       0       0      97        0                                  LS              056
UK   600   .025     .30      93                                                   UK              113
UK    60   .035     .10       7                                                   UK              113
RK  2000   .025    .050     .24             30       50                          RK              087
RK 11200   .028    .035            TRAP      30        1       NO                 RK              087
KK NO.BB     COMBINE ALL FLOWS AT NODE BB                                        KK              045
HC     2                                                                           HC              031
KK BB-CC     ROUTE FLOWS TO NODE CC                                              KK              045
RK  4000   .055    .023            TRAP      80        1                          RK              087
KK   326   SUB-BASIN 326 HYDROGRAPH                                               KK              045
KM         KINEMATIC WAVE RUNOFF COMPUTATION                                       KM              046
BA  1.71                                                                           BA              008
PB  1.57                                                                           PB              069
LS     0     78       0       0      97        0                                  LS              056
UK   700   .010     .30      80                                                   UK              113
UK    60  .0100     .10      20                                                   UK              113
RK  1800  .0035    .050     .11             30       50                          RK              087
[redacted]000  .0014    .050     .43             30       50                     RK              087
[redacted]500  .0038    .035            TRAP      80        1                    RK              087
KK NO.CC     COMBINE ALL FLOWS AT NODE CC                                        KK              045
HC     2                                                                           HC              031
ZZ                                                                                 ZZ              126
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**************************************
*                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*           SEPTEMBER 1990           *
*            VERSION 4.0             *
*                                    *
* RUN DATE  07/01/1992  TIME  13:23:49 *
*                                    *
**************************************
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U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104


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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID                CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
    2     ID                        RANGE WASH WATERSHED
    3     ID              JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
    4     ID                        JANUARY 1991
    5     ID               100-YR, 6-HR STORM    PB CARD FOR DARF = 0.55
    6     ID              PRESENT CONDITIONS, EXISTING FACILITIES
    7     ID                        AMC 2.0
    8     ID               BASED ON RANGE WASH FACILITIES STUDY
    9     ID                 BOYLE ENGINEERS CORP-JULY 1989
   10     ID              (CONVERTED RK TO RM IN UPLAND SUBAREAS)
   11     ID
   12     ID    MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)
   13     ID
   14     ID    RATIO #   DARF     NODE ID          AREA (SQ MI)        JR CARD
   15     ID                                                          (RATIO TO 0.55)
   16     ID       1      0.61     NODE CC & S      89.0, 101.5          1.109
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17        ID     2       0.70     NODE P & P1          51.9, 40.2            1.264
18        ID     3       0.77     NODE G1              24.2                  1.400
19        ID     4       0.85     NODE G, I2, & F1     11.4, 12.8, 9.0       1.552
20        ID     5       0.92     NODE F & I1          3.4, 4.9              1.664
21        IO
22        IT    05        0       0     120
23        IO     5        0       0
24        JR   PREC    1.109   1.264   1.400   1.552   1.664

25        KK   306B    SUB-BASIN 306B HYDROGRAPH
26        KM           SCS RUNOFF COMPUTATION
27        BA   3.37
28        PB   1.57
29        PC    0.0     2.0     5.90    8.00    11.0    14.40   15.00   16.00   16.80   17.10
30        PC   18.0    18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
31        PC   25.0    25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
32        PC  32.10    32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
33        PC   56.1    63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
34        PC   81.0    82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
35        PC   97.9    98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
36        PC   99.9   100.00
37        LS      0       76
38        UD   0.75

39        KK   F-F1     ROUTE FLOW TO NODE F1
40        RM      5    0.42     .10

41        KK   307A    SU-BASIN 307A HYDROGRAPH
42        BA   5.65
43        PB   1.57
44        LS      0       78
45        UD    .44
```



```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

46        KK  NOD-F1    COMBINE FLOW AT NODE F1
47        HC       2

48        KK    F1-G    ROUTE FLOW TO G
49        RK   12000   .0075     .03            TRAP      40     1.5

50        KK    307B    SUB-BASIN 307B HYDROGRAPH
51        KM            KINEMATIC WAVE RUNOFF COMPUTATION
52        BA    2.42
53        PB    1.57
54        LS       0      78       0       0      97
55        UK     800   .0123     .20      59
56        UK      60    .015     .10      41
57        RK    2640   .0075   .0375   0.125    TRAP      40       1
58        RK    3080   .0075   .0375     .30    TRAP      40       1
59        RK   12000    .075     .03            TRAP      40     1.5      NO

60        KK       G    COMBINE FLOW AT NODE G
61        HC       2

62        KK    G-G1    ROUTE FLOW TO G1
63        RK    2700   .0035    .015            TRAP      12     1.5
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 64          KK    309B    SUB-BASIN 309B HYDROGRAPH
 65          KM            SCS RUNOFF COMPUTATION
 66          BA    3.64
 67          PB    1.57
 68          LS       0      79
 69          UD    0.59

 70          KK    I-I1      ROUTE FLOW FROM NODE I TO NODE I1
 71          RM       1     .11     .10

 72          KK    310A
 73          BA    1.29
 74          PB    1.57
 75          LS       0      79
 76          UD     .09

 77          KK  NOD-I1    COMBINE FLOW AT NODE I1
 78          HC       2

 79          KK   I1-I2    ROUTE FLOW I2
 80          RM       6     .52     .10

 81          KK    310B    SUB-BASIN 310B HYDROGRAPH
 82          KM            KINEMATIC WAVE RUNOFF COMPUTATION
 83          BA    7.85
 84          PB    1.57
 85          LS       0      78       0       0      97
 86          UK     800    .015     .20      87
 87          UK      60    .020     .10      13
 88          RK   15000    .012    .030    .86    TRAP      20       3
 89          RK   15800    .006    .025           TRAP      80       1      NO
1                                    HEC-1 INPUT                                    PAGE  3

LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10


 90          KK   NODI2  COMBINE FLOW AT I2
 91          HC       2

 92          KK   I2-G1  ROUTE FLOW TO G1
 93          RK    2100    .002    .015           TRAP      15     1.5

 94          KK  NOD-G1  COMBINE ALL FLOW AT NODE G1
 95          KM          COMBINE EAST AND WEST BRANCH CHANNELS
 96          HC       2

 97          KK    G1-M      ROUTE FLOW FROM G1 TO NODE M
 98          RK   13100  0.0035    .023           TRAP      50       1

 99          KK      44    SUB-BASIN 44 HYDROGRAPH
100          KM            SCS RUNOFF COMPUTATION
101          BA    7.23
102          PB    1.57
103          LS       0      79
104          UD    1.22

105          KK     J-K      ROUTE FLOW FROM J TO NODE K
106          RM       8     .58     .10

107          KK     312    SUB-BASIN 312 HYDROGRAPH
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108          KM           SCS RUNOFF COMPUTATION
109          BA    6.77
110          PB    1.57
111          LS       0      77
112          UD    2.83

113          KK  NODE K   COMBINE FLOW AT NODE K
114          HC       2

115          KK     K-P     ROUTE FLOW FROM NODE K TO NODE P
116          RM      12    1.03     .15

117          KK      45    SUB-BASIN  45 HYDROGRAPH
118          KM            SCS RUNOFF COMPUTATION
119          BA   10.73
120          PB    1.57
121          LS       0      76       0       0       0       0
122          UD    1.31

123          KK     N-O     ROUTE FLOW TO NODE O
124          RM       5     .38     .15

125          KK     048    SUB-BASIN 048 HYDROGRAPH
126          KM            SCS RUNOFF COMPUTATION
127          BA    2.07
128          PB    1.57
129          LS       0      76
130          UD    1.97
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LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

131          KK     46A    SUB-BASIN 46A HYDROGRAPH
132          KM            SCS RUNOFF COMPUTATION
133          BA    7.35
134          PB    1.65
135          LS       0      77
136          UD    1.60

137          KK     46B    SUB-BASIN 46B HYDROGRAPH
138          KM            SCS RUNOFF COMPUTATION
139          BA    6.02
140          PB    1.65
141          LS       0      77
142          UD    1.71

143          KK  NODE O   COMBINE FLOW AT NODE O
144          HC       4

145          KK    O-P1     ROUTE FLOW FROM NODE O TO NODE P1
146          RM       8    0.68     .15

147          KK      P1   COMBINE FLOW AT P1
148          HC       2

149          KK    P1-P     ROUTE FROM P1 TO P
150          RM       6     .48     .15

151          KK     317    SUB-BASIN 317 HYDROGRAPH
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152          KM           SCS RUNOFF COMPUTATION
153          BA    7.66
154          PB    1.73
155          LS       0      80
156          UD     .97

157          KK    318B    SUB-BASIN 318B HYDROGRAPH
158          KM            SCS RUNOFF COMPUTATION
159          BA    1.86
160          PB    1.73
161          LS       0      87
162          UD     .37

163          KK     Q-P      ROUTE FLOW TO NODE P
164          RM       4     .26     .15

165          KK    318A    SUB-BASIN 318A HYDROGRAPH
166          KM            KINEMATIC WAVE RUNOFF COMPUTATION
167          BA    2.19
168          PB    1.61
169          LS       0      78       0       0      97
170          UK     700    .020     .30      89
171          UK      50    .025     .10      11
172          RK    2000    .035   .0375     .06              30      50
173          RK    7000    .014     .05     .55              30      50
174          RK    9200   .0043     .03             TRAP     30       1
1                                        HEC-1 INPUT                                    PAGE  5

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10


175          KK  NODE P   COMBINE FLOWS AT NODE P
176          HC       4

177          KK     P-M      ROUTE FLOW TO NODE M
178          RK    7400   .0034    0.03             TRAP     80       1

179          KK     047    SUB-BASIN 047 HYDROGRAPH
180          KM            KINEMATIC WAVE RUNOFF COMPUTATION
181          BA    7.40
182          PB    1.57
183          LS       0      78       0       0      97
184          UK     800    .008     .20      74
185          UK      80    .012     .10      26
186          RK    7000    .007    .050    1.23              30      50
187          RK   22000    .005     .03             TRAP     40       1

188          KK  NODE M   COMBINE FLOWS AT NODE M
189          HC       3

190          KK     M-S      ROUTE FLOW TO NODE S (SLOAN CHANNEL)
191          RK    4600   .0028   0.023             TRAP     80       1

192          KK     488    SUB-BASIN  488 HYDROGRAPH
193          KM            SCS RUNOFF COMPUTATION
194          BA     .99
195          PB    1.65
196          LS       0      87       0       0       0       0
197          UD     .24
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198          KK     R-S      ROUTE FLOW TO NODE S
199          RK    9100   .0316   0.035              TRAP      80       1

200          KK     48A    SUB-BASIN 48A HYDROGRAPH
201          KM            KINEMATIC WAVE RUNOFF COMPUTATION
202          BA     .49
203          PB    1.61
204          LS       0      78        0        0       97
205          UK     700    .025      .30       77
206          UK      60    0.03      .10       23
207          RK     800     .02     .050     0.12                 30       50
208          RK    9000    .033      .02              TRAP      20       1       NO

209          KK     321    SUB-BASIN 321 HYDROGRAPH
210          KM            KINEMATIC WAVE RUNOFF COMPUTATION
211          BA    3.42
212          PB    1.57
213          LS       0      78        0        0       97
214          UK     800    .010      .30       78
215          UK      50   0.020      .10       22
216          RK    3500    .006     .050     0.14                 30       50
217          RK    7400   .0014     .050     0.58                 30       50
218          RK   21200   .0035     .035              TRAP      70       1       NO
1                                        HEC-1 INPUT                                                    PAGE  6

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

219          KK     49A    SUB-BASIN 49A HYDROGRAPH
220          KM            KINEMATIC WAVE RUNOFF COMPUTATION
221          BA    0.60
222          PB    1.57
223          LS       0      78        0        0       97
224          UK     700    .034      .30       80
225          UK      60     .04      .10       20
226          RK    1000    .003     .050     0.12                 30       50
227          RK    9200    .034     .035              TRAP      20       1       NO

228          KK   NODE S   COMBINE ALL FLOWS AT S
229          HC       5

230          KK     S-V      ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)
231          RK    6800   .0038     .023              TRAP      80       1

232          KK     324    SUB-BASIN 324 HYDROGRAPH
233          KM            KINEMATIC WAVE RUNOFF COMPUTATION
234          BA    1.40
235          PB    1.57
236          LS       0      77        0        0       97
237          UK     800     .01      .30       74
238          UK      60     .01      .10       26
239          RK    1300    .004      .05     0.07    TRAP      30       50
240          RK    2500   .0017      .05     0.28              30       50
241          RK    7000    .005     .035              TRAP      70       1       NO

242          KK     498    SUB-BASIN  498 HYDROGRAPH
243          KM            SCS RUNOFF COMPUTATION
244          BA    1.04
245          PB    1.61
246          LS       0      87        0        0        0        0
```

```
247          UD      .25

248          KK      T-V       ROUTE FLOWS TO NODE V
249          RM        3      .52      .10

250          KK   NODE V     COMBINE ALL FLOWS AT NODE V
251          HC        3

252          KK      50B     SUB-BASIN  50B HYDROGRAPH
253          KM              SCS RUNOFF COMPUTATION
254          BA      .55
255          PB     1.65
256          LS        0      87       0       0       0       0
257          UD      .17

258          KK      U-V       ROUTE FLOWS TO NODE V
259          RM        3      .43      .10
1                                        HEC-1 INPUT                                                    PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


260          KK      50A     SUB-BASIN 50A HYDROGRAPH
261          KM              KINEMATIC WAVE RUNOFF COMPUTATION
262          BA     1.78
263          PB     1.57
264          LS        0      78       0       0      97       0
265          UK      800    .025     .30      89
266          UK       60     .03     .10      11
267          RK     3000    .010    .050    0.45              30      50
268          RK     7500    .029    .035            TRAP      40       1      NO

269          KK       53     SUB-BASIN 53 HYDROGRAPH
270          KM              KINEMATIC WAVE RUNOFF COMPUTATION
271          BA     1.44
272          PB     1.57
273          LS        0      77       0       0      97       0
274          UK      600    .010     .30      70
275          UK       50    .010     .10      30
276          RK     1300   .0033    .050    .053    TRAP      30      50
277          RK     3100   .0017    .050     .21    TRAP      30      50
278          RK    12300   .0033     .02            TRAP      20       1      NO

279          KK      W-V       ROUTE FLOWS TO NODE V
280          RM        3      .36      .10

281          KK   NODE V     COMBINE ALL FLOWS AT NODE V
282          HC        4

283          KK      V-Z       ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
284          RK     7780   .0041      .23            TRAP      80       1

285          KK      51B     SUB-BASIN  51B HYDROGRAPH
286          KM              SCS RUNOFF COMPUTATION
287          BA     0.47
288          PB     1.57
289          LS        0      87       0       0       0       0
290          UD      .13

291          KK      X-Z       ROUTE FLOWS TO NODE Z
```

```
292          RM       3     .54     .10

293          KK     51A     SUB-BASIN 51A HYDROGRAPH
294          KM             KINEMATIC WAVE RUNOFF COMPUTATION
295          BA     .99
296          PB    1.61
297          LS       0      78       0       0      97       0
298          UK     600     .03     .30      86
299          UK      60    .030     .10      14
300          RK    2500   .0075    .050    .100    TRAP      30      50
301          RK    8000   .0400    .025            TRAP      50       1      NO
1                                        HEC-1 INPUT                                                    PAGE  8

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

302          KK     51C     SUB-BASIN  51C HYDROGRAPH
303          KM             SCS RUNOFF COMPUTATION
304          BA    0.43
305          PB    1.61
306          LS       0      87       0       0       0       0
307          UD     .19

308          KK     Y-Z      ROUTE FLOWS TO NODE Z
309          RM       3     .54     .10

310          KK     51D     SUB-BASIN 51D HYDROGRAPH
311          KM             KINEMATIC WAVE RUNOFF COMPUTATION
312          BA     .83
313          PB    1.57
314          LS       0      78       0       0      97       0
315          UK     600     .03     .30      88
316          UK      60    .035     .10      12
317          RK    2500   .0240    .050    .080              30      50
318          RK    8000   .0300    .025            TRAP      50       1

319          KK  NODE Z      COMBINE ALL FLOWS AT NODE Z
320          HC       5

321          KK    Z-BB      ROUTE FLOWS TO NODE BB (SLOAN CHANNEL)
322          RK    2680   .0044    .023            TRAP      80       1

323          KK     52B     SUB-BASIN  52B HYDROGRAPH
324          KM             SCS RUNOFF COMPUTATION
325          BA    0.70
326          PB    1.57
327          LS       0      87       0       0       0       0
328          UD     .11

329          KK   AA-BB      ROUTE FLOWS TO NODE BB
330          RM       4     .62     .10

331          KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
332          HC       2

333          KK     52A     SUB-BASIN 52A HYDROGRAPH
334          KM             KINEMATIC WAVE RUNOFF COMPUTATION
335          BA    1.18
336          PB    1.57
337          LS       0      78       0       0      97       0
```

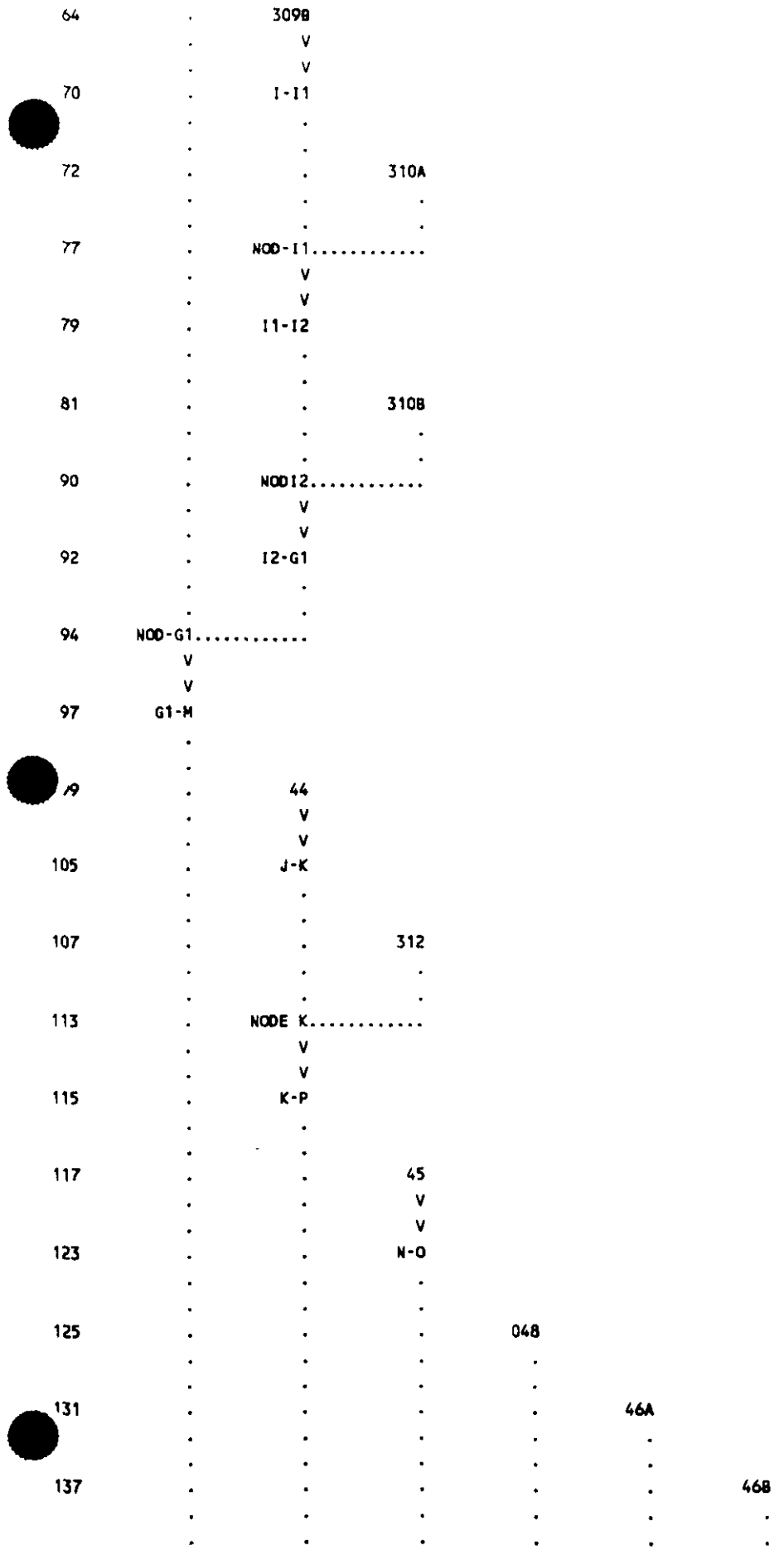
```
338          UK     600    .025     .30      93
339          UK      60    .035     .10       7
340          RK    2000    .025    .050     .24                30      50
341          RK   11200    .028    .035             TRAP       30       1      NO
```

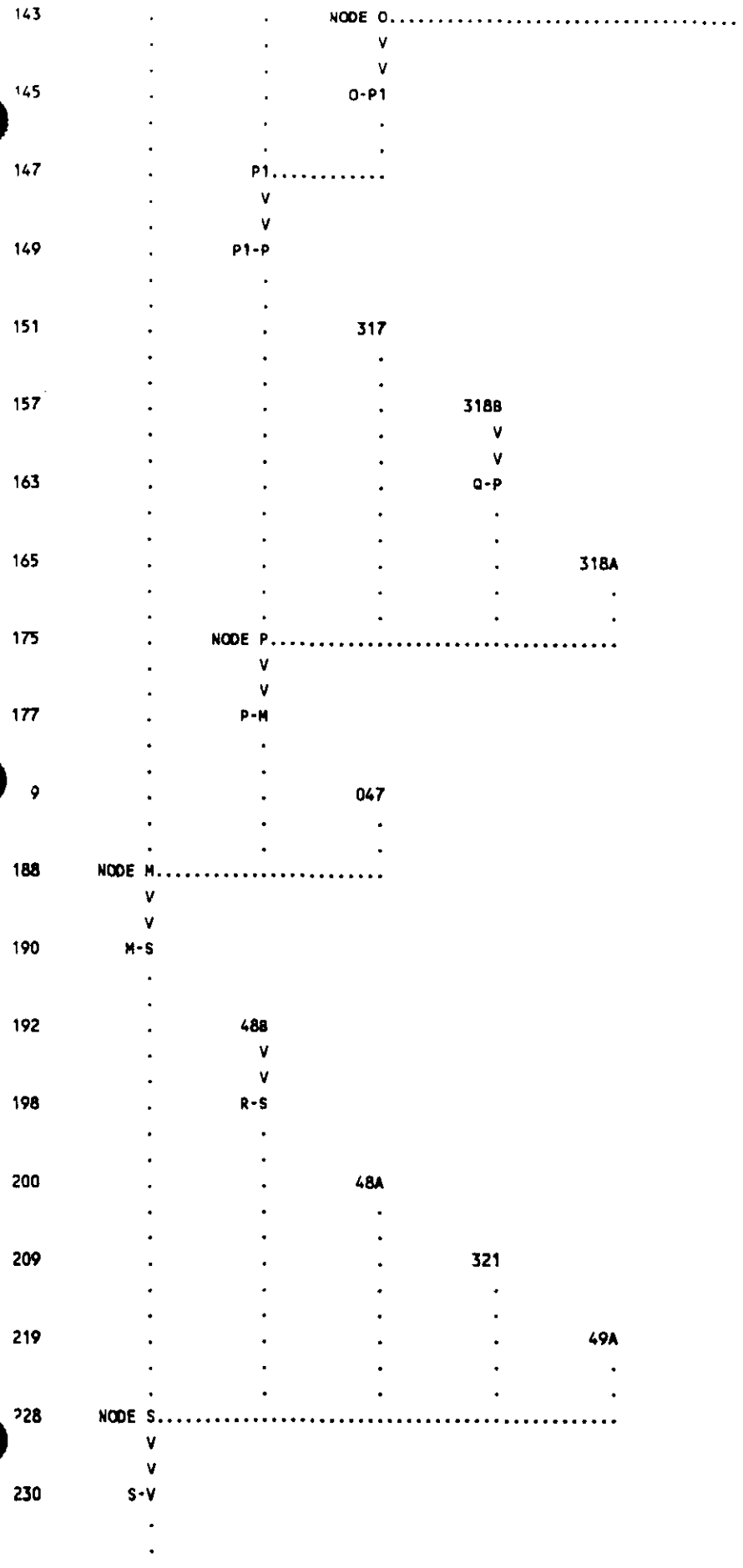


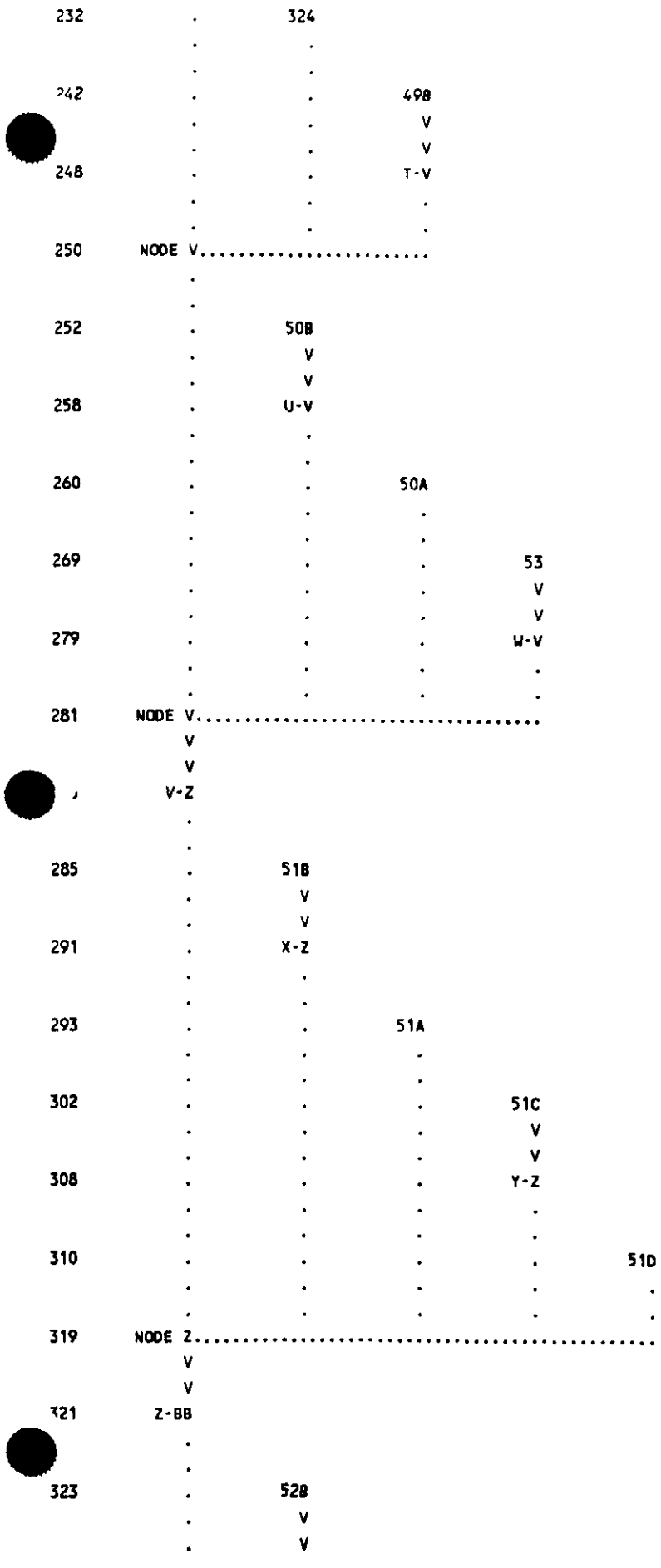
```
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

342          KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
343          HC        2

344          KK   BB-CC      ROUTE FLOWS TO NODE CC
345          RK    4000    .055    .023             TRAP       80       1

346          KK     326    SUB-BASIN 326 HYDROGRAPH
347          KM            KINEMATIC WAVE RUNOFF COMPUTATION
348          BA    1.71
349          PB    1.57
350          LS       0      78       0        0       97        0
351          UK     700    .010     .30       80
352          UK      60   .0100     .10       20
353          RK    1800   .0035    .050      .11                30      50
354          RK    4000   .0014    .050      .43                30      50
355          RK   12500   .0038    .035             TRAP       80       1

356          KK   NO.CC      COMBINE ALL FLOWS AT NODE CC
357          HC        2
358          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

NO.       (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

 25         306B
              V
              V
 39         F-F1
              .
              .
 41           .          307A
              .            .
              .            .
 46       NOD-F1............
              V
              V
 48         F1-G
              .
              .
 50           .          307B
              .            .
              .            .
 60           G............
              V
              V
 62         G-G1
              .
              .
```


64
309B
V
V
70
I-I1
72
310A
77
NOD-I1
V
V
79
I1-I2
81
310B
90
NODI2
V
V
92
I2-G1
94
NOD-G1
V
V
97
G1-M
A9
44
V
V
105
J-K
107
312
113
NODE K
V
V
115
K-P
117
45
V
V
123
N-O
125
048
131
46A
137
46B


143
NODE O
145
O-P1
147
P1
149
P1-P
151
317
157
318B
163
Q-P
165
318A
175
NODE P
177
P-M
9
047
188
NODE M
190
M-S
192
488
198
R-S
200
48A
209
321
219
49A
228
NODE S
230
S-V


232
324
242
498
248
T-V
250
NODE V
252
50B
258
U-V
260
50A
269
53
279
W-V
281
NODE V
V-Z
285
51B
291
X-Z
293
51A
302
51C
308
Y-Z
310
51D
319
NODE Z
321
Z-BB
323
52B

```
329          .        AA-BB
             .          .
             .          .
331      NO.BB.............
             .
             .
333          .        52A
             .          .
             .          .
342      NO.BB.............
             V
             V
344      BB-CC
             .
             .
346          .        326
             .          .
             .          .
356      NO.CC.............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*           SEPTEMBER 1990              *
*            VERSION 4.0                *
*                                       *
*  RUN DATE  07/01/1992  TIME  13:23:49 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```

CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
RANGE WASH WATERSHED
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
JANUARY 1991
100-YR, 6-HR STORM PB CARD FOR DARF = 0.55
PRESENT CONDITIONS, EXISTING FACILITIES
AMC 2.0
BASED ON RANGE WASH FACILITIES STUDY
BOYLE ENGINEERS CORP-JULY 1989
(CONVERTED RK TO RM IN UPLAND SUBAREAS)

MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)

RATIO #	DARF	NODE ID	AREA (SQ MI)	JR CARD (RATIO TO 0.55)
1	0.61	NODE CC & S	89.0, 101.5	1.109
2	0.70	NODE P & P1	51.9, 40.2	1.264
3	0.77	NODE G1	24.2	1.400
4	0.85	NODE G, I2, & F1	11.4, 12.8, 9.0	1.552
5	0.92	NODE F & I1	3.4, 4.9	1.664

```
23 IO          OUTPUT CONTROL VARIABLES
                    IPRNT         5  PRINT CONTROL
                    IPLOT         0  PLOT CONTROL
```

```
                QSCAL          0.  HYDROGRAPH PLOT SCALE

IT          HYDROGRAPH TIME DATA
                NMIN           5  MINUTES IN COMPUTATION INTERVAL
                IDATE      1   0  STARTING DATE
                ITIME        0000  STARTING TIME
                  NQ         120  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE      1   0  ENDING DATE
               NDTIME        0955  ENDING TIME
               ICENT           19  CENTURY MARK

            COMPUTATION INTERVAL      .08 HOURS
                TOTAL TIME BASE    9.92 HOURS

     ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT

JP          MULTI-PLAN OPTION
                NPLAN           1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
              RATIOS OF PRECIPITATION
             1.11      1.26      1.40      1.55      1.66


    *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2


    *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


    *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


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*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 2

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION				
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
					1.11	1.26	1.40	1.55	1.66
HYDROGRAPH AT									
+	3068	3.37	1	FLOW	280.	383.	501.	642.	751.
				TIME	5.33	4.25	4.25	4.25	4.25
ROUTED TO									
+	F-F1	3.37	1	FLOW	270.	366.	478.	613.	717.
				TIME	5.67	4.75	4.67	4.67	4.67
HYDROGRAPH AT									
+	307A	5.65	1	FLOW	718.	1009.	1292.	1626.	1882.
				TIME	3.92	3.92	3.83	3.83	3.83
2 COMBINED AT									
	NOO-F1	9.02	1	FLOW	883.	1167.	1428.	1790.	2082.
				TIME	5.08	5.08	5.08	3.92	3.92
ROUTED TO									
+	F1-G	9.02	1	FLOW	876.	1165.	1412.	1784.	2069.

				TIME	5.25	5.25	5.25	4.08	4.08
HYDROGRAPH AT									
	307B	2.42	1	FLOW	573.	708.	824.	951.	1057.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT									
+	G	11.44	1	FLOW	1196.	1582.	1942.	2403.	2764.
				TIME	5.25	5.25	4.00	4.00	3.92
ROUTED TO									
+	G-G1	11.44	1	FLOW	1189.	1581.	1934.	2399.	2759.
				TIME	5.25	5.25	4.00	4.00	4.00
HYDROGRAPH AT									
+	309B	3.64	1	FLOW	444.	615.	774.	966.	1112.
				TIME	4.08	4.08	4.00	4.00	4.00
ROUTED TO									
+	I-11	3.64	1	FLOW	434.	602.	759.	945.	1086.
				TIME	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT									
•	310A	1.29	1	FLOW	354.	482.	602.	743.	850.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT									
+	NOD-I1	4.93	1	FLOW	534.	693.	876.	1094.	1261.
				TIME	4.83	4.83	3.92	3.92	3.92
D TO									
+	I1-I2	4.93	1	FLOW	500.	660.	830.	1032.	1187.
				TIME	5.17	4.67	4.58	4.58	4.58
HYDROGRAPH AT									
+	310B	7.85	1	FLOW	628.	944.	1239.	1568.	1789.
				TIME	5.67	5.42	5.33	5.17	5.17
2 COMBINED AT									
+	NOD12	12.78	1	FLOW	1081.	1569.	2030.	2544.	2896.
				TIME	5.42	5.33	5.25	5.17	5.08
ROUTED TO									
+	I2-G1	12.78	1	FLOW	1080.	1565.	2024.	2539.	2895.
				TIME	5.42	5.33	5.25	5.17	5.17
2 COMBINED AT									
+	NOD-G1	24.22	1	FLOW	2247.	3125.	3942.	4882.	5527.
				TIME	5.33	5.25	5.25	5.17	5.17
ROUTED TO									
+	G1-M	24.22	1	FLOW	2233.	3111.	3928.	4859.	5510.
				TIME	5.50	5.42	5.33	5.33	5.25
HYDROGRAPH AT									
	44	7.23	1	FLOW	647.	860.	1061.	1301.	1488.
				TIME	5.50	5.33	5.25	5.08	5.00
ROUTED TO									
+	J-K	7.23	1	FLOW	641.	854.	1055.	1295.	1480.

				TIME	6.00	5.92	5.75	5.67	5.58
HYDROGRAPH AT									
	312	6.77	1	FLOW	326.	450.	568.	709.	818.
				TIME	7.00	6.92	6.92	6.83	6.83
2 COMBINED AT									
+	NODE K	14.00	1	FLOW	914.	1232.	1530.	1883.	2154.
				TIME	6.25	6.17	6.08	6.08	6.08
ROUTED TO									
+	K-P	14.00	1	FLOW	897.	1211.	1507.	1857.	2126.
				TIME	7.25	7.17	7.17	7.08	7.08
HYDROGRAPH AT									
+	45	10.73	1	FLOW	742.	1020.	1285.	1602.	1847.
				TIME	5.58	5.50	5.42	5.42	5.33
ROUTED TO									
+	N-O	10.73	1	FLOW	735.	1012.	1277.	1593.	1837.
				TIME	6.00	5.92	5.83	5.75	5.75
HYDROGRAPH AT									
+	048	2.07	1	FLOW	118.	164.	208.	261.	302.
				TIME	6.17	6.08	6.08	6.00	6.00
HYDROGRAPH AT									
+	46A	7.35	1	FLOW	579.	784.	978.	1207.	1381.
				TIME	5.75	5.75	5.67	5.67	5.67
[redacted]OGRAPH AT									
+	46B	6.02	1	FLOW	459.	623.	777.	960.	1100.
				TIME	5.83	5.83	5.75	5.75	5.75
4 COMBINED AT									
+	NODE O	26.17	1	FLOW	1881.	2573.	3228.	4007.	4605.
				TIME	5.92	5.83	5.75	5.75	5.67
ROUTED TO									
+	O-P1	26.17	1	FLOW	1851.	2534.	3183.	3954.	4548.
				TIME	6.58	6.50	6.42	6.42	6.33
2 COMBINED AT									
+	P1	40.17	1	FLOW	2670.	3645.	4571.	5669.	6515.
				TIME	6.75	6.67	6.58	6.58	6.50
ROUTED TO									
•	P1-P	40.17	1	FLOW	2646.	3614.	4534.	5622.	6465.
				TIME	7.17	7.17	7.08	7.00	7.00
HYDROGRAPH AT									
+	317	7.66	1	FLOW	980.	1310.	1616.	1976.	2250.
				TIME	4.50	4.50	4.50	4.42	4.42
[redacted]ROGRAPH AT									
	318B	1.86	1	FLOW	658.	818.	962.	1125.	1246.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO									
+	Q-P	1.86	1	FLOW	616.	767.	903.	1057.	1171.

				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT									
	318A	2.19	1	FLOW	167.	253.	336.	432.	500.
				TIME	5.92	5.67	5.50	5.42	5.33
4 COMBINED AT									
+	NODE P	51.88	1	FLOW	2907.	3964.	4966.	6154.	7069.
				TIME	7.00	6.92	6.83	6.83	6.75
ROUTED TO									
+	P-M	51.88	1	FLOW	2905.	3962.	4963.	6153.	7067.
				TIME	7.08	7.00	6.92	6.92	6.83
HYDROGRAPH AT									
+	047	7.40	1	FLOW	736.	925.	1104.	1405.	1638.
				TIME	4.33	4.33	4.25	5.42	5.33
3 COMBINED AT									
+	NODE M	83.50	1	FLOW	4894.	6743.	8505.	10517.	12000.
				TIME	5.58	5.58	5.50	5.42	5.42
ROUTED TO									
+	M-S	83.50	1	FLOW	4887.	6737.	8488.	10513.	11970.
				TIME	5.67	5.58	5.58	5.50	5.50
HYDROGRAPH AT									
+	488	.99	1	FLOW	387.	482.	566.	662.	734.
				TIME	3.67	3.67	3.67	3.67	3.67
ED TO									
+	R-S	.99	1	FLOW	382.	471.	550.	650.	725.
				TIME	3.83	3.83	3.75	3.75	3.75
HYDROGRAPH AT									
+	48A	.49	1	FLOW	88.	108.	128.	152.	175.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT									
+	321	3.42	1	FLOW	208.	283.	362.	464.	548.
				TIME	6.83	6.83	6.75	6.58	6.50
HYDROGRAPH AT									
+	49A	.60	1	FLOW	72.	95.	118.	141.	154.
				TIME	3.75	5.08	5.00	5.00	5.00
5 COMBINED AT									
+	NODE S	89.00	1	FLOW	5164.	7119.	8963.	11125.	12692.
				TIME	5.58	5.58	5.58	5.50	5.42
ROUTED TO									
+	S-V	89.00	1	FLOW	5163.	7113.	8963.	11101.	12687.
				TIME	5.67	5.67	5.58	5.50	5.50
ROGRAPH AT									
	324	1.40	1	FLOW	141.	172.	203.	240.	269.
				TIME	4.42	4.33	4.33	4.33	4.25
HYDROGRAPH AT									
+	49B	1.04	1	FLOW	386.	482.	568.	665.	738.

				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO									
	T-V	1.04	1	FLOW	277.	346.	410.	482.	536.
				TIME	4.17	4.17	4.08	4.08	4.08
3 COMBINED AT									
+	NODE V	91.44	1	FLOW	5389.	7397.	9333.	11576.	13231.
				TIME	5.67	5.67	5.58	5.50	5.50
HYDROGRAPH AT									
•	50B	.55	1	FLOW	253.	314.	369.	431.	477.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	U-V	.55	1	FLOW	172.	216.	255.	299.	332.
				TIME	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT									
+	50A	1.78	1	FLOW	136.	213.	293.	377.	432.
				TIME	5.25	5.25	5.17	5.08	5.00
HYDROGRAPH AT									
+	53	1.44	1	FLOW	152.	188.	223.	266.	302.
				TIME	4.58	4.50	4.50	4.50	4.42
ROUTED TO									
•	W-V	1.44	1	FLOW	147.	181.	214.	255.	294.
				TIME	5.00	4.92	4.92	4.83	5.83
[redacted]OMBINED AT									
+	NODE V	95.21	1	FLOW	5685.	7809.	9832.	12208.	13938.
				TIME	5.67	5.58	5.58	5.50	5.50
ROUTED TO									
+	V-Z	95.21	1	FLOW	5679.	7790.	9819.	12185.	13905.
				TIME	6.00	5.92	5.83	5.75	5.75
HYDROGRAPH AT									
•	51B	.47	1	FLOW	208.	259.	304.	356.	394.
				TIME	3.58	3.58	3.58	3.58	3.58
ROUTED TO									
+	X-Z	.47	1	FLOW	127.	159.	188.	222.	247.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT									
+	51A	.99	1	FLOW	106.	149.	183.	216.	242.
				TIME	5.25	5.17	5.08	5.00	5.00
HYDROGRAPH AT									
+	51C	.43	1	FLOW	181.	225.	266.	311.	345.
				TIME	3.58	3.58	3.58	3.58	3.58
[redacted]TED TO									
	Y-Z	.43	1	FLOW	117.	147.	174.	204.	227.
				TIME	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT									
•	51D	.83	1	FLOW	83.	120.	148.	177.	196.

				TIME	5.25	5.08	5.08	5.00	5.00
5 COMBINED AT									
	NODE Z	97.93	1	FLOW	5839.	8004.	10092.	12535.	14330.
				TIME	6.00	5.92	5.83	5.75	5.67
ROUTED TO									
+	Z-BB	97.93	1	FLOW	5833.	7994.	10086.	12525.	14307.
				TIME	6.00	5.92	5.83	5.75	5.67
HYDROGRAPH AT									
•	52B	.70	1	FLOW	324.	404.	477.	559.	621.
				TIME	3.50	3.50	3.50	3.50	3.50
ROUTED TO									
+	AA-BB	.70	1	FLOW	189.	237.	281.	330.	367.
				TIME	4.08	4.08	4.08	4.08	4.08
2 COMBINED AT									
+	NO.BB	98.63	1	FLOW	5865.	8042.	10154.	12621.	14435.
				TIME	6.00	5.92	5.83	5.75	5.67
HYDROGRAPH AT									
+	52A	1.18	1	FLOW	105.	159.	200.	243.	271.
				TIME	5.25	5.17	5.00	5.00	5.00
2 COMBINED AT									
+	NO.BB	99.81	1	FLOW	5940.	8138.	10272.	12765.	14604.
				TIME	6.00	5.92	5.83	5.75	5.67
ED TO									
+	BB-CC	99.81	1	FLOW	5934.	8130.	10267.	12758.	14588.
				TIME	6.00	5.92	5.83	5.75	5.67
HYDROGRAPH AT									
+	326	1.71	1	FLOW	115.	155.	203.	266.	316.
				TIME	5.75	6.00	6.08	6.00	5.92
2 COMBINED AT									
+	NO.CC	101.52	1	FLOW	6048.	8285.	10467.	13018.	14897.
				TIME	6.00	5.92	5.83	5.75	5.67

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.11									
	F1-G MANE	5.00	883.08	316.31	.32	5.00	876.12	315.00	.32

INUITY SUMMARY (AC-FT) - INFLOW= .1563E+03 EXCESS= .0000E+00 OUTFLOW= .1562E+03 BASIN STORAGE= .5133E+00 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= 1.26									
	F1-G MANE	5.00	1165.83	315.20	.45	5.00	1164.97	315.00	.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2163E+03 EXCESS= .0000E+00 OUTFLOW= .2164E+03 BASIN STORAGE= .4267E+00 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= 1.40

F1-G	MANE	4.88	1420.23	312.94	.57	5.00	1411.63	315.00	.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2739E+03 EXCESS= .0000E+00 OUTFLOW= .2737E+03 BASIN STORAGE= .5852E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.55

F1-G	MANE	4.49	1784.66	245.38	.71	5.00	1783.76	245.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3431E+03 EXCESS= .0000E+00 OUTFLOW= .3432E+03 BASIN STORAGE= .5102E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.66

F1-G	MANE	4.30	2071.98	241.77	.82	5.00	2068.89	245.00	.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3969E+03 EXCESS= .0000E+00 OUTFLOW= .3968E+03 BASIN STORAGE= .5575E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.11

307B	MANE	3.15	504.13	227.90	.63	5.00	497.04	230.00	.63

.NUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8636E+02 OUTFLOW= .8133E+02 BASIN STORAGE= .2423E+01 PERCENT ERROR= 3.0

FOR PLAN = 1 RATIO= 1.11

307B	MANE	2.94	580.89	228.57	.75	5.00	572.82	225.00	.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1014E+03 OUTFLOW= .9616E+02 BASIN STORAGE= .2452E+01 PERCENT ERROR= 2.8

FOR PLAN = 1 RATIO= 1.26

307B	MANE	2.78	710.28	224.36	.92	5.00	708.44	225.00	.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1239E+03 OUTFLOW= .1184E+03 BASIN STORAGE= .2497E+01 PERCENT ERROR= 2.4

FOR PLAN = 1 RATIO= 1.40

307B	MANE	2.62	824.22	225.16	1.07	5.00	823.72	225.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1444E+03 OUTFLOW= .1387E+03 BASIN STORAGE= .2589E+01 PERCENT ERROR= 2.1

FOR PLAN = 1 RATIO= 1.55

307B	MANE	2.51	956.56	222.74	1.26	5.00	950.73	225.00	1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1681E+03 OUTFLOW= .1622E+03 BASIN STORAGE= .2726E+01 PERCENT ERROR= 1.9

FOR PLAN = 1 RATIO= 1.66

3078	MANE	2.36	1077.53	222.92	1.40	5.00	1056.88	225.00	1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1860E+03 OUTFLOW= .1801E+03 BASIN STORAGE= .2634E+01 PERCENT ERROR= 1.8

FOR PLAN = 1 RATIO= 1.11

G-G1	MANE	.87	1193.91	316.97	.41	5.00	1188.55	315.00	.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2522E+03 EXCESS= .0000E+00 OUTFLOW= .2520E+03 BASIN STORAGE= .2312E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

G-G1	MANE	.84	1581.45	315.84	.55	5.00	1581.17	315.00	.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3348E+03 EXCESS= .0000E+00 OUTFLOW= .3346E+03 BASIN STORAGE= .2408E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

G-G1	MANE	.73	1939.75	241.04	.68	5.00	1933.58	240.00	.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4122E+03 EXCESS= .0000E+00 OUTFLOW= .4121E+03 BASIN STORAGE= .2437E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.55

G-G1	MANE	.76	2401.29	241.44	.83	5.00	2398.85	240.00	.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5053E+03 EXCESS= .0000E+00 OUTFLOW= .5051E+03 BASIN STORAGE= .2558E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

G-G1	MANE	.77	2763.14	236.68	.94	5.00	2759.06	240.00	.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5763E+03 EXCESS= .0000E+00 OUTFLOW= .5761E+03 BASIN STORAGE= .2574E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.11

3108	MANE	4.61	432.82	344.70	.34	5.00	432.72	345.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1644E+03 OUTFLOW= .1426E+03 BASIN STORAGE= .1237E+02 PERCENT ERROR= 5.7

FOR PLAN = 1 RATIO= 1.11

3108	MANE	4.71	628.67	339.81	.44	5.00	628.45	340.00	.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2034E+03 OUTFLOW= .1825E+03 BASIN STORAGE= .1219E+02 PERCENT ERROR= 4.3

FOR PLAN = 1 RATIO= 1.26

3108	MANE	4.82	943.85	329.18	.57	5.00	943.55	325.00	.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2634E+03 OUTFLOW= .2401E+03 BASIN STORAGE= .1314E+02 PERCENT ERROR= 3.8

FOR PLAN = 1 RATIO= 1.40

3108	MANE	5.00	1242.79	317.53	.71	5.00	1239.37	320.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3198E+03 OUTFLOW= .2952E+03 BASIN STORAGE= .1309E+02 PERCENT ERROR= 3.6

FOR PLAN = 1 RATIO= 1.55

3108	MANE	4.85	1574.81	312.07	.87	5.00	1567.99	310.00	.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3865E+03 OUTFLOW= .3625E+03 BASIN STORAGE= .1295E+02 PERCENT ERROR= 2.8

FOR PLAN = 1 RATIO= 1.66

3108	MANE	4.61	1790.44	306.49	.98	5.00	1788.86	310.00	.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4377E+03 OUTFLOW= .4122E+03 BASIN STORAGE= .1361E+02 PERCENT ERROR= 2.7

FOR PLAN = 1 RATIO= 1.11

I2-G1	MANE	.96	1080.79	326.84	.41	5.00	1079.63	325.00	.41

INUITY SUMMARY (AC-FT) - INFLOW= .2810E+03 EXCESS= .0000E+00 OUTFLOW= .2805E+03 BASIN STORAGE= .5427E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

I2-G1	MANE	.78	1568.51	321.77	.55	5.00	1564.93	320.00	.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3747E+03 EXCESS= .0000E+00 OUTFLOW= .3742E+03 BASIN STORAGE= .5630E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

I2-G1	MANE	.71	2028.53	316.76	.68	5.00	2024.23	315.00	.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4639E+03 EXCESS= .0000E+00 OUTFLOW= .4635E+03 BASIN STORAGE= .5720E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.55

I2-G1	MANE	.74	2543.00	311.19	.84	5.00	2538.80	310.00	.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5704E+03 EXCESS= .0000E+00 OUTFLOW= .5698E+03 BASIN STORAGE= .5845E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

I2-G1	MANE	.70	2896.08	306.66	.96	5.00	2894.58	310.00	.96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6520E+03 EXCESS= .0000E+00 OUTFLOW= .6515E+03 BASIN STORAGE= .5939E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.11

G1-M	MANE	4.88	2245.26	327.89	.41	5.00	2233.25	330.00	.41

NUITY SUMMARY (AC-FT) - INFLOW= .5325E+03 EXCESS= .0000E+00 OUTFLOW= .5253E+03 BASIN STORAGE= .7115E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

G1-M	MANE	4.33	3110.79	326.88	.54	5.00	3110.69	325.00	.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7087E+03 EXCESS= .0000E+00 OUTFLOW= .7011E+03 BASIN STORAGE= .7394E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

G1-M	MANE	3.98	3936.94	321.96	.67	5.00	3928.43	320.00	.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8754E+03 EXCESS= .0000E+00 OUTFLOW= .8675E+03 BASIN STORAGE= .7559E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.55

G1-M	MANE	3.71	4874.67	318.19	.83	5.00	4859.11	320.00	.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1075E+04 EXCESS= .0000E+00 OUTFLOW= .1068E+04 BASIN STORAGE= .7572E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

G1-M	MANE	3.56	5516.76	316.06	.95	5.00	5509.90	315.00	.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1228E+04 EXCESS= .0000E+00 OUTFLOW= .1222E+04 BASIN STORAGE= .7484E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.11

318A	MANE	4.77	114.74	362.76	.33	5.00	114.71	365.00	.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4599E+02 OUTFLOW= .3896E+02 BASIN STORAGE= .3500E+01 PERCENT ERROR= 7.7

FOR PLAN = 1 RATIO= 1.11

318A	MANE	5.04	167.10	353.26	.43	5.00	167.10	355.00	.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5714E+02 OUTFLOW= .4999E+02 BASIN STORAGE= .3668E+01 PERCENT ERROR= 6.1

FOR PLAN = 1 RATIO= 1.26

318A	MANE	5.26	253.99	342.62	.57	5.00	253.26	340.00	.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7432E+02 OUTFLOW= .6689E+02 BASIN STORAGE= .3740E+01 PERCENT ERROR= 5.0

FOR PLAN = 1 RATIO= 1.40

318A	MANE	4.78	336.44	334.51	.71	5.00	336.18	330.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9049E+02 OUTFLOW= .8262E+02 BASIN STORAGE= .3848E+01 PERCENT ERROR= 4.5

FOR PLAN = 1 RATIO= 1.55

318A	MANE	4.42	432.01	324.98	.87	5.00	432.00	325.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1096E+03 OUTFLOW= .1015E+03 BASIN STORAGE= .3916E+01 PERCENT ERROR= 3.8

FOR PLAN = 1 RATIO= 1.66

318A	MANE	5.00	500.30	320.01	1.00	5.00	500.30	320.00	.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1243E+03 OUTFLOW= .1163E+03 BASIN STORAGE= .3826E+01 PERCENT ERROR= 3.3

FOR PLAN = 1 RATIO= 1.11

P-M	MANE	3.44	2905.44	425.68	.36	5.00	2904.78	425.00	.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9989E+03 EXCESS= .0000E+00 OUTFLOW= .9846E+03 BASIN STORAGE= .1596E+02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.26

P-M	MANE	3.04	3962.99	422.01	.48	5.00	3962.19	420.00	.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1358E+04 EXCESS= .0000E+00 OUTFLOW= .1342E+04 BASIN STORAGE= .1874E+02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.40

P-M	MANE	2.83	4964.75	417.08	.61	5.00	4963.19	415.00	.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1701E+04 EXCESS= .0000E+00 OUTFLOW= .1679E+04 BASIN STORAGE= .2150E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.55

P-M	MANE	2.64	6152.90	415.36	.76	5.00	6152.82	415.00	.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2110E+04 EXCESS= .0000E+00 OUTFLOW= .2089E+04 BASIN STORAGE= .2372E+02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.66

P-M	MANE	2.50	7067.94	410.79	.87	5.00	7066.75	410.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2427E+04 EXCESS= .0000E+00 OUTFLOW= .2399E+04 BASIN STORAGE= .2620E+02 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.11

047	MANE	4.81	622.14	265.34	.46	5.00	621.93	265.00	.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2056E+03 OUTFLOW= .1799E+03 BASIN STORAGE= .1555E+02 PERCENT ERROR= 5.0

FOR PLAN = 1 RATIO= 1.11

047	MANE	5.00	737.43	260.71	.56	5.00	736.02	260.00	.55

INUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2467E+03 OUTFLOW= .2201E+03 BASIN STORAGE= .1610E+02 PERCENT ERROR= 4.3

FOR PLAN = 1 RATIO= 1.26

047	MANE	4.72	926.30	259.54	.71	5.00	925.16	260.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3089E+03 OUTFLOW= .2808E+03 BASIN STORAGE= .1674E+02 PERCENT ERROR= 3.7

FOR PLAN = 1 RATIO= 1.40

047	MANE	5.00	1106.34	255.43	.85	5.00	1104.40	255.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3665E+03 OUTFLOW= .3373E+03 BASIN STORAGE= .1760E+02 PERCENT ERROR= 3.2

FOR PLAN = 1 RATIO= 1.55

047	MANE	4.76	1405.06	323.35	1.02	5.00	1404.94	325.00	1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4338E+03 OUTFLOW= .4032E+03 BASIN STORAGE= .1806E+02 PERCENT ERROR= 2.9

FOR PLAN = 1 RATIO= 1.66

047	MANE	5.00	1643.49	322.89	1.15	5.00	1638.29	320.00	1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4851E+03 OUTFLOW= .4548E+03 BASIN STORAGE= .1805E+02 PERCENT ERROR= 2.5

FOR PLAN = 1 RATIO= 1.11

M-S	MANE	1.69	4892.41	338.25	.39	5.00	4886.61	340.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1725E+04 EXCESS= .0000E+00 OUTFLOW= .1716E+04 BASIN STORAGE= .1132E+02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.26

M-S	MANE	1.45	6741.39	337.36	.52	5.00	6736.71	335.00	.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2318E+04 EXCESS= .0000E+00 OUTFLOW= .2306E+04 BASIN STORAGE= .1300E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

M-S	MANE	1.28	8500.60	332.27	.64	5.00	8488.05	335.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2881E+04 EXCESS= .0000E+00 OUTFLOW= .2868E+04 BASIN STORAGE= .1431E+02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.55

M-S	MANE	1.19	10515.62	328.08	.79	5.00	10512.92	330.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3553E+04 EXCESS= .0000E+00 OUTFLOW= .3537E+04 BASIN STORAGE= .1588E+02 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO= 1.66
               M-S  MANE          1.14  11994.08    327.73        .91       5.00  11969.63    330.00         .91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4072E+04 EXCESS= .0000E+00 OUTFLOW= .4057E+04 BASIN STORAGE= .1681E+02 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO= 1.11
               R-S  MANE          5.00    386.31    229.47        .78       5.00    381.66    230.00         .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4091E+02 EXCESS= .0000E+00 OUTFLOW= .4140E+02 BASIN STORAGE= .8537E-01 PERCENT ERROR=   -1.4

          FOR PLAN = 1  RATIO= 1.26
               R-S  MANE          4.70    475.47    225.66        .98       5.00    471.14    230.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5138E+02 EXCESS= .0000E+00 OUTFLOW= .5172E+02 BASIN STORAGE= .7454E-01 PERCENT ERROR=    -.8

          FOR PLAN = 1  RATIO= 1.40
               R-S  MANE          4.44    562.28    226.71       1.16       5.00    549.53    225.00        1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6092E+02 EXCESS= .0000E+00 OUTFLOW= .6135E+02 BASIN STORAGE= .7474E-01 PERCENT ERROR=    -.8

          FOR PLAN = 1  RATIO= 1.55
               R-S  MANE          4.15    659.04    226.19       1.37       5.00    650.40    225.00        1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7192E+02 EXCESS= .0000E+00 OUTFLOW= .7238E+02 BASIN STORAGE= .8599E-01 PERCENT ERROR=    -.8

          FOR PLAN = 1  RATIO= 1.66
               R-S  MANE          3.98    730.76    225.75       1.53       5.00    724.98    225.00        1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8021E+02 EXCESS= .0000E+00 OUTFLOW= .8066E+02 BASIN STORAGE= .9664E-01 PERCENT ERROR=    -.7

          FOR PLAN = 1  RATIO= 1.11
               48A  MANE          3.88     77.84    216.25        .49       5.00     75.79    215.00         .49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1345E+02 OUTFLOW= .1273E+02 BASIN STORAGE= .2684E+00 PERCENT ERROR=    3.4

          FOR PLAN = 1  RATIO= 1.11
               48A  MANE          3.60     88.66    217.43        .59       5.00     88.33    215.00         .59

.NUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1621E+02 OUTFLOW= .1546E+02 BASIN STORAGE= .2796E+00 PERCENT ERROR=    2.9

          FOR PLAN = 1  RATIO= 1.26
               48A  MANE          3.30    109.78    215.92        .75       5.00    108.23    215.00         .75
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2040E+02 OUTFLOW= .1961E+02 BASIN STORAGE= .2811E+00 PERCENT ERROR= 2.5

FOR PLAN = 1 RATIO= 1.40

48A	MANE	3.16	129.15	216.43	.90	5.00	128.07	215.00	.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2429E+02 OUTFLOW= .2346E+02 BASIN STORAGE= .2958E+00 PERCENT ERROR= 2.2

FOR PLAN = 1 RATIO= 1.55

48A	MANE	2.93	152.58	213.67	1.07	5.00	152.01	215.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2883E+02 OUTFLOW= .2801E+02 BASIN STORAGE= .2695E+00 PERCENT ERROR= 1.9

FOR PLAN = 1 RATIO= 1.66

48A	MANE	2.86	175.68	215.32	1.20	5.00	174.73	215.00	1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3230E+02 OUTFLOW= .3143E+02 BASIN STORAGE= .3131E+00 PERCENT ERROR= 1.7

FOR PLAN = 1 RATIO= 1.11

321	MANE	5.05	166.11	413.56	.29	5.00	166.09	415.00	.28

.INUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8784E+02 OUTFLOW= .5221E+02 BASIN STORAGE= .2743E+02 PERCENT ERROR= 9.3

FOR PLAN = 1 RATIO= 1.11

321	MANE	5.27	208.06	411.77	.37	5.00	207.98	410.00	.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1062E+03 OUTFLOW= .6696E+02 BASIN STORAGE= .3051E+02 PERCENT ERROR= 8.2

FOR PLAN = 1 RATIO= 1.26

321	MANE	5.33	283.40	406.96	.50	5.00	283.30	410.00	.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1341E+03 OUTFLOW= .9193E+02 BASIN STORAGE= .3337E+02 PERCENT ERROR= 6.6

FOR PLAN = 1 RATIO= 1.40

321	MANE	5.12	361.68	404.21	.64	5.00	361.59	405.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1601E+03 OUTFLOW= .1161E+03 BASIN STORAGE= .3490E+02 PERCENT ERROR= 5.7

FOR PLAN = 1 RATIO= 1.55

321	MANE	5.11	464.52	397.49	.79	5.00	464.27	395.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1906E+03 OUTFLOW= .1437E+03 BASIN STORAGE= .3739E+02 PERCENT ERROR= 5.0

FOR PLAN = 1 RATIO= 1.66

321	MANE	5.18	547.92	392.17	.91	5.00	547.77	390.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2139E+03 OUTFLOW= .1668E+03 BASIN STORAGE= .3719E+02 PERCENT ERROR= 4.6

FOR PLAN = 1 RATIO= 1.11

49A	MANE	4.57	62.43	226.73	.43	5.00	61.87	225.00	.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1478E+02 OUTFLOW= .1387E+02 BASIN STORAGE= .3954E+00 PERCENT ERROR= 3.5

FOR PLAN = 1 RATIO= 1.11

49A	MANE	5.00	72.87	226.03	.53	5.00	72.48	225.00	.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1795E+02 OUTFLOW= .1704E+02 BASIN STORAGE= .3688E+00 PERCENT ERROR= 3.0

FOR PLAN = 1 RATIO= 1.26

49A	MANE	5.00	95.07	305.85	.68	5.00	94.99	305.00	.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2278E+02 OUTFLOW= .2179E+02 BASIN STORAGE= .4045E+00 PERCENT ERROR= 2.6

FOR PLAN = 1 RATIO= 1.40

49A	MANE	4.62	118.16	301.78	.82	5.00	117.82	300.00	.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2728E+02 OUTFLOW= .2626E+02 BASIN STORAGE= .4199E+00 PERCENT ERROR= 2.2

FOR PLAN = 1 RATIO= 1.55

49A	MANE	4.34	141.68	297.93	.98	5.00	140.76	300.00	.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3257E+02 OUTFLOW= .3151E+02 BASIN STORAGE= .4320E+00 PERCENT ERROR= 1.9

FOR PLAN = 1 RATIO= 1.66

49A	MANE	4.23	156.85	222.28	1.11	5.00	154.45	300.00	1.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3662E+02 OUTFLOW= .3552E+02 BASIN STORAGE= .4451E+00 PERCENT ERROR= 1.8

FOR PLAN = 1 RATIO= 1.11

S-V	MANE	2.10	5162.76	339.13	.39	5.00	5162.60	340.00	.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1852E+04 EXCESS= .0000E+00 OUTFLOW= .1836E+04 BASIN STORAGE= .1731E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

S-V	MANE	1.91	7113.50	339.80	.52	5.00	7112.55	340.00	.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2488E+04 EXCESS= .0000E+00 OUTFLOW= .2467E+04 BASIN STORAGE= .1975E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

S-V	MANE	1.72	8962.72	336.28	.65	5.00	8962.59	335.00	.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3091E+04 EXCESS= .0000E+00 OUTFLOW= .3074E+04 BASIN STORAGE= .2134E+02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.55

S-V	MANE	1.57	11122.03	333.22	.80	5.00	11101.32	330.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3811E+04 EXCESS= .0000E+00 OUTFLOW= .3790E+04 BASIN STORAGE= .2347E+02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.66

S-V	MANE	1.46	12689.11	329.15	.91	5.00	12687.06	330.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4367E+04 EXCESS= .0000E+00 OUTFLOW= .4342E+04 BASIN STORAGE= .2507E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.11

324	MANE	4.92	120.51	269.19	.41	5.00	120.24	265.00	.41

'NUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3749E+02 OUTFLOW= .3088E+02 BASIN STORAGE= .3400E+01 PERCENT ERROR= 8.6

FOR PLAN = 1 RATIO= 1.11

324	MANE	4.59	141.03	262.88	.51	5.00	140.98	265.00	.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4502E+02 OUTFLOW= .3822E+02 BASIN STORAGE= .3524E+01 PERCENT ERROR= 7.3

FOR PLAN = 1 RATIO= 1.26

324	MANE	4.99	173.30	261.92	.66	5.00	172.31	260.00	.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5645E+02 OUTFLOW= .4927E+02 BASIN STORAGE= .3740E+01 PERCENT ERROR= 6.1

FOR PLAN = 1 RATIO= 1.40

324	MANE	4.69	202.93	261.56	.80	5.00	202.79	260.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6708E+02 OUTFLOW= .5952E+02 BASIN STORAGE= .3924E+01 PERCENT ERROR= 5.4

FOR PLAN = 1 RATIO= 1.55

324	MANE	4.45	240.98	256.49	.96	5.00	240.22	260.00	.96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7951E+02 OUTFLOW= .7194E+02 BASIN STORAGE= .3889E+01 PERCENT ERROR= 4.6

FOR PLAN = 1 RATIO= 1.66

324	MANE	5.24	270.92	257.29	1.09	5.00	269.34	255.00	1.09

INUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8901E+02 OUTFLOW= .8130E+02 BASIN STORAGE= .3870E+01 PERCENT ERROR= 4.3

FOR PLAN = 1 RATIO= 1.11

50A	MANE	5.22	94.99	317.17	.33	5.00	94.75	315.00	.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3541E+02 OUTFLOW= .3149E+02 BASIN STORAGE= .1717E+01 PERCENT ERROR= 6.2

FOR PLAN = 1 RATIO= 1.11

50A	MANE	4.56	136.33	315.72	.42	5.00	136.20	315.00	.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4409E+02 OUTFLOW= .4001E+02 BASIN STORAGE= .1790E+01 PERCENT ERROR= 5.2

FOR PLAN = 1 RATIO= 1.26

50A	MANE	3.92	213.53	312.56	.56	5.00	212.74	315.00	.56

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5749E+02 OUTFLOW= .5328E+02 BASIN STORAGE= .1867E+01 PERCENT ERROR= 4.1

FOR PLAN = 1 RATIO= 1.40

50A	MANE	3.46	293.75	309.11	.69	5.00	292.55	310.00	.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7012E+02 OUTFLOW= .6575E+02 BASIN STORAGE= .1813E+01 PERCENT ERROR= 3.6

FOR PLAN = 1 RATIO= 1.55

50A	MANE	3.10	377.29	304.83	.85	5.00	376.92	305.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8506E+02 OUTFLOW= .8052E+02 BASIN STORAGE= .1940E+01 PERCENT ERROR= 3.1

FOR PLAN = 1 RATIO= 1.66

50A	MANE	3.07	432.53	302.17	.97	5.00	432.16	300.00	.97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9656E+02 OUTFLOW= .9193E+02 BASIN STORAGE= .1957E+01 PERCENT ERROR= 2.8

FOR PLAN = 1 RATIO= 1.11

53	MANE	4.75	130.43	276.34	.47	5.00	130.34	280.00	.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4168E+02 OUTFLOW= .3622E+02 BASIN STORAGE= .3209E+01 PERCENT ERROR= 5.4

FOR PLAN = 1 RATIO= 1.11

53	MANE	5.24	152.61	273.91	.57	5.00	152.47	275.00	.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4969E+02 OUTFLOW= .4391E+02 BASIN STORAGE= .3387E+01 PERCENT ERROR= 4.8

FOR PLAN = 1 RATIO= 1.26

53	MANE	4.93	188.26	270.40	.73	5.00	188.03	270.00	.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6180E+02 OUTFLOW= .5597E+02 BASIN STORAGE= .3499E+01 PERCENT ERROR= 3.8

FOR PLAN = 1 RATIO= 1.40

53	MANE	4.57	223.17	269.54	.87	5.00	223.03	270.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7301E+02 OUTFLOW= .6700E+02 BASIN STORAGE= .3581E+01 PERCENT ERROR= 3.3

FOR PLAN = 1 RATIO= 1.55

53	MANE	5.37	266.82	269.07	1.04	5.00	266.26	270.00	1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .8609E+02 OUTFLOW= .7990E+02 BASIN STORAGE= .3583E+01 PERCENT ERROR= 3.0

FOR PLAN = 1 RATIO= 1.66

53	MANE	5.00	303.51	267.33	1.17	5.00	302.17	265.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9605E+02 OUTFLOW= .8959E+02 BASIN STORAGE= .3783E+01 PERCENT ERROR= 2.8

FOR PLAN = 1 RATIO= 1.11

V-Z	MANE	5.48	5682.41	362.09	.37	5.00	5678.58	360.00	.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2019E+04 EXCESS= .0000E+00 OUTFLOW= .1898E+04 BASIN STORAGE= .1181E+03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.26

V-Z	MANE	4.96	7790.46	353.47	.51	5.00	7789.83	355.00	.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2704E+04 EXCESS= .0000E+00 OUTFLOW= .2579E+04 BASIN STORAGE= .1292E+03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.40

V-Z	MANE	5.57	9826.89	350.87	.63	5.00	9818.88	350.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3354E+04 EXCESS= .0000E+00 OUTFLOW= .3217E+04 BASIN STORAGE= .1341E+03 PERCENT ERROR= .1

FOR PLAN = 1 RATIO= 1.55

V-Z	MANE	5.09	12191.37	344.21	.78	5.00	12185.28	345.00	.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4129E+04 EXCESS= .0000E+00 OUTFLOW= .3985E+04 BASIN STORAGE= .1443E+03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

V-Z	MANE	4.91	13930.03	343.76	.90	5.00	13904.81	345.00	.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4727E+04 EXCESS= .0000E+00 OUTFLOW= .4582E+04 BASIN STORAGE= .1508E+03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.11

51A	MANE	4.86	75.46	321.28	.39	5.00	75.28	320.00	.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2238E+02 OUTFLOW= .2081E+02 BASIN STORAGE= .6707E+00 PERCENT ERROR= 4.0

FOR PLAN = 1 RATIO= 1.11

51A	MANE	4.33	105.65	314.10	.49	5.00	105.65	315.00	.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2756E+02 OUTFLOW= .2589E+02 BASIN STORAGE= .7198E+00 PERCENT ERROR= 3.5

FOR PLAN = 1 RATIO= 1.26

51A	MANE	3.79	149.14	310.28	.64	5.00	149.11	310.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3550E+02 OUTFLOW= .3383E+02 BASIN STORAGE= .6923E+00 PERCENT ERROR= 2.8

FOR PLAN = 1 RATIO= 1.40

51A	MANE	3.45	182.60	303.45	.78	5.00	182.56	305.00	.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4295E+02 OUTFLOW= .4114E+02 BASIN STORAGE= .7411E+00 PERCENT ERROR= 2.5

FOR PLAN = 1 RATIO= 1.55

51A	MANE	3.28	217.05	302.21	.94	5.00	216.09	300.00	.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5172E+02 OUTFLOW= .4985E+02 BASIN STORAGE= .7501E+00 PERCENT ERROR= 2.2

FOR PLAN = 1 RATIO= 1.66

51A	MANE	3.07	241.74	300.34	1.07	5.00	241.51	300.00	1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5845E+02 OUTFLOW= .5657E+02 BASIN STORAGE= .7502E+00 PERCENT ERROR= 1.9

FOR PLAN = 1 RATIO= 1.11

51D	MANE	4.43	58.32	317.81	.35	5.00	58.09	315.00	.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1695E+02 OUTFLOW= .1567E+02 BASIN STORAGE= .4962E+00 PERCENT ERROR= 4.6

FOR PLAN = 1 RATIO= 1.11

51D	MANE	5.00	83.53	311.87	.44	5.00	83.04	315.00	.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2103E+02 OUTFLOW= .1969E+02 BASIN STORAGE= .5174E+00 PERCENT ERROR= 3.9

FOR PLAN = 1 RATIO= 1.26

51D	MANE	4.52	120.67	306.52	.59	5.00	120.01	305.00	.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2733E+02 OUTFLOW= .2592E+02 BASIN STORAGE= .5308E+00 PERCENT ERROR= 3.2

FOR PLAN = 1 RATIO= 1.40

51D	MANE	4.16	148.60	301.04	.72	5.00	148.20	305.00	.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3326E+02 OUTFLOW= .3184E+02 BASIN STORAGE= .5213E+00 PERCENT ERROR= 2.7

FOR PLAN = 1 RATIO= 1.55

51D	MANE	3.91	176.74	299.33	.88	5.00	176.64	300.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4026E+02 OUTFLOW= .3875E+02 BASIN STORAGE= .5514E+00 PERCENT ERROR= 2.4

FOR PLAN = 1 RATIO= 1.66

51D	MANE	3.70	196.35	301.35	1.00	5.00	196.16	300.00	1.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4565E+02 OUTFLOW= .4412E+02 BASIN STORAGE= .5504E+00 PERCENT ERROR= 2.1

FOR PLAN = 1 RATIO= 1.11

Z-BB	MANE	.80	5837.08	361.75	.38	5.00	5833.10	360.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1973E+04 EXCESS= .0000E+00 OUTFLOW= .1965E+04 BASIN STORAGE= .8615E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

Z-BB	MANE	.81	8000.08	356.02	.51	5.00	7994.29	355.00	.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2664E+04 EXCESS= .0000E+00 OUTFLOW= .2656E+04 BASIN STORAGE= .9648E+01 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.40

Z-BB	MANE	.67	10089.39	351.04	.64	5.00	10086.33	350.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3334E+04 EXCESS= .0000E+00 OUTFLOW= .3325E+04 BASIN STORAGE= .1038E+02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.55

Z-BB	MANE	.69	12530.49	345.74	.79	5.00	12525.14	345.00	.79

INUITY SUMMARY (AC-FT) - INFLOW= .4121E+04 EXCESS= .0000E+00 OUTFLOW= .4109E+04 BASIN STORAGE= .1130E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

Z-BB	MANE	.53	14328.16	340.98	.90	5.00	14306.61	340.00	.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4728E+04 EXCESS= .0000E+00 OUTFLOW= .4716E+04 BASIN STORAGE= .1191E+02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.11

52A	MANE	5.00	70.24	325.90	.30	5.00	70.24	325.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2099E+02 OUTFLOW= .1898E+02 BASIN STORAGE= .8995E+00 PERCENT ERROR= 5.3

FOR PLAN = 1 RATIO= 1.11

52A	MANE	5.00	105.38	315.75	.39	5.00	105.08	315.00	.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .2653E+02 OUTFLOW= .2448E+02 BASIN STORAGE= .8599E+00 PERCENT ERROR= 4.5

FOR PLAN = 1 RATIO= 1.26

52A	MANE	4.61	159.74	308.77	.52	5.00	158.79	310.00	.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .3514E+02 OUTFLOW= .3288E+02 BASIN STORAGE= .9760E+00 PERCENT ERROR= 3.6

FOR PLAN = 1 RATIO= 1.40

52A	MANE	4.34	201.59	303.23	.65	5.00	200.33	300.00	.65

NUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4329E+02 OUTFLOW= .4107E+02 BASIN STORAGE= .8829E+00 PERCENT ERROR= 3.1

FOR PLAN = 1 RATIO= 1.55

52A	MANE	5.00	243.02	301.24	.81	5.00	242.58	300.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5298E+02 OUTFLOW= .5072E+02 BASIN STORAGE= .9227E+00 PERCENT ERROR= 2.5

FOR PLAN = 1 RATIO= 1.66

52A	MANE	4.90	271.33	297.11	.92	5.00	270.70	300.00	.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6045E+02 OUTFLOW= .5802E+02 BASIN STORAGE= .1016E+01 PERCENT ERROR= 2.3

FOR PLAN = 1 RATIO= 1.11

BB-CC	MANE	.53	5938.15	361.25	.38	5.00	5933.77	360.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2015E+04 EXCESS= .0000E+00 OUTFLOW= .2009E+04 BASIN STORAGE= .5993E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.26

BB-CC	MANE	.52	8136.66	355.97	.51	5.00	8130.40	355.00	.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2720E+04 EXCESS= .0000E+00 OUTFLOW= .2714E+04 BASIN STORAGE= .6713E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40

BB-CC	MANE	.46	10269.99	350.84	.64	5.00	10266.75	350.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3403E+04 EXCESS= .0000E+00 OUTFLOW= .3397E+04 BASIN STORAGE= .7232E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.55

BB-CC	MANE	.48	12761.83	345.67	.79	5.00	12757.77	345.00	.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4207E+04 EXCESS= .0000E+00 OUTFLOW= .4200E+04 BASIN STORAGE= .7830E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.66

BB-CC	MANE	.44	14601.39	340.80	.91	5.00	14588.43	340.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4827E+04 EXCESS= .0000E+00 OUTFLOW= .4819E+04 BASIN STORAGE= .8250E+01 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.11

326	MANE	5.12	93.61	344.81	.34	5.00	93.61	345.00	.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .4212E+02 OUTFLOW= .3071E+02 BASIN STORAGE= .7891E+01 PERCENT ERROR= 8.4

FOR PLAN = 1 RATIO= 1.11

326	MANE	5.23	114.78	344.33	.43	5.00	114.77	345.00	.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .5115E+02 OUTFLOW= .3897E+02 BASIN STORAGE= .8445E+01 PERCENT ERROR= 7.3

FOR PLAN = 1 RATIO= 1.26

326	MANE	5.06	155.07	361.13	.57	5.00	155.03	360.00	.57

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .6491E+02 OUTFLOW= .5205E+02 BASIN STORAGE= .9016E+01 PERCENT ERROR= 5.9

FOR PLAN = 1 RATIO= 1.40

326	MANE	4.94	203.07	367.26	.71	5.00	202.95	365.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .7776E+02 OUTFLOW= .6492E+02 BASIN STORAGE= .8965E+01 PERCENT ERROR= 5.0

FOR PLAN = 1 RATIO= 1.55

326	MANE	4.99	265.74	360.35	.87	5.00	265.68	360.00	.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .9283E+02 OUTFLOW= .7937E+02 BASIN STORAGE= .9435E+01 PERCENT ERROR= 4.3

FOR PLAN = 1 RATIO= 1.66

326	MANE	5.00	315.61	355.01	1.00	5.00	315.61	355.00	.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .0000E+00 EXCESS= .1044E+03 OUTFLOW= .9093E+02 BASIN STORAGE= .9306E+01 PERCENT ERROR= 3.9

*** NORMAL END OF HEC-1 ***

HYDROLOGY ABOVE DIKE

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:21 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

100-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
         LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                   *DIAGRAM
             1     ID                    EAST AND WEST RANGE WASHES
             2     ID                      100-YR, 6-HR STORM
             3     ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
             4     ID                    BOYLE ENGINEERING CORPORATION
             5     ID                    STORM A (DARF=0.68)
             6     ID                 MODIFIED A4IN TO MATCH JMM'S FILE
             7     ID                 NEW FUTURE DEVELOPMENT IN 306, 307, 310
             8     ID                   DARF     JR CARD
             9     ID                   .55       1.00
            10     ID                   .64       1.164
            11     ID                   .68       1.236
            12     ID                   .71       1.291
            13     ID                   .77       1.400
            14     ID                   .83       1.509
            15     IT      05      0       0       200
            16     IO       5      0       0
            17     JR    PREC    1.0   1.164   1.236   1.291   1.400   1.509
            18     VS   NLVDP
            19     VV    2.13
```

```
20          KK      41  SUB-BASIN 41 HYDROGRAPH
21          KM          SCS RUNOFF COMPUTATION, SUB-41
22          BA    4.73
23          PB    1.89
24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.00
30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
31          PC   99.90  100.00  100.00
32          LS       0      79
33          UD     .66

34          KK     A-B     ROUTE FLOW TO NODE B
35          RM       4     .36     .15

36          KK     302  SUB-BASIN 302 HYDROGRAPH
37          KM          SCS RUNOFF CALCULATIONS
38          BA    6.14
39          PB    1.81
40          LS       0      79
41          UD     .82

42          KK   NODEB  COMBINE FLOW AT NODE B
43          HC       2
```



```
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

44          KK     B-C  ROUTE FLOW TO NODE C
45          RM       2     .18     .15

46          KK     303   SUB-BASIN 303 HYDROGRAPH
47          KM           SCS RUNOFF COMPUTATION
48          BA    4.49
49          PB    1.69
50          LS       0      85
51          UD     .65

52          KK     42B  SUB-BASIN 42B HYDROGRAPH
53          KM          SCS RUNOFF COMPUTATION
54          BA    4.08
55          PB    1.73
56          LS       0      79
57          UD     .65

58          KK   NODEC  COMBINE FLOW AT NODE C
59          HC       3

60          KK     C-D   ROUTE FLOW TO NODE D
61          RM       1     .10     .15

62          KK     42A   SUB-BASIN 42A HYDROGRAPH
63          KM           SCS RUNOFF COMPUTATION
64          BA    8.23
65          PB    1.73
66          LS       0      79
```

```
 67          UD     .81

 68          KK    NODED  COMBINE FLOW AT NODE D
 69          HC       2

 70          KK     D-E   ROUTE FLOW TO NODE E
 71          RM       4      .34      .15

 72          KK     305   SUB-BASIN 305 HYDROGRAPH
 73          KM           SCS RUNOFF COMPUTATION
 74          BA    3.99
 75          PB    1.57
 76          LS       0       85
 77          UD     .76

 78          KK    NODEE COMBINE FLOWS AT NODE E
 79          HC       2

 80          KK    E-F1  ROUTE FLOWS TO NODE F1
 81          RM       5      .46      .10
1                                    HEC-1 INPUT                                    PAGE  3

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10


 82          KK    306A  SUB-BASIN 306A HYDROGRAPH
 83          KM           SCS RUNOFF COMPUTATION
 84          BA     4.5
 85          PB    1.57
 86          LS       0       76
 87          UD    1.54

 88          KK    NODEF1 COMBINE FLOWS AT NODE F1
 89          HC       2

 90          KK      43   SUB-BASIN 43 HYDROGRAPH
 91          KM           SCS RUNOFF COMPUTATION
 92          BA    6.40
 93          PB    1.57
 94          LS       0       79
 95          UD     .88

 96          KK    H-I1ROUTE FLOWS TO NODE I1
 97          RM       7      .72      .10

 98          KK    309A   SUB-BASIN 309A HYDROGRAPH
 99          KM           SCS RUNOFF COMPUTATION
100          BA     5.6
101          PB    1.57
102          LS       0       79
103          UD    1.51

104          KK      I1   COMBINE FLOWS AT NODE I1
105          HC       2

106          KK    I1-F1   ROUTE FLOWS TO NODE F1
107          RK   19360      .01     .022        0     TRAP      120        3

108          KK    NLVDP
109          HC       2
```

110 ZZ

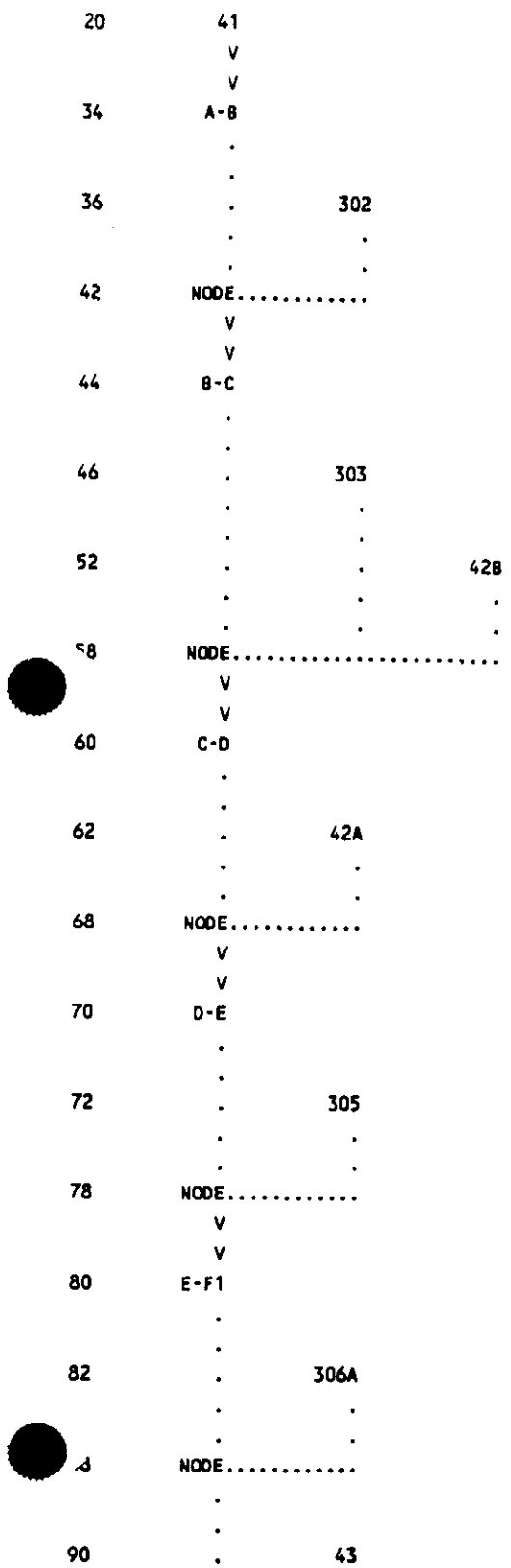
1

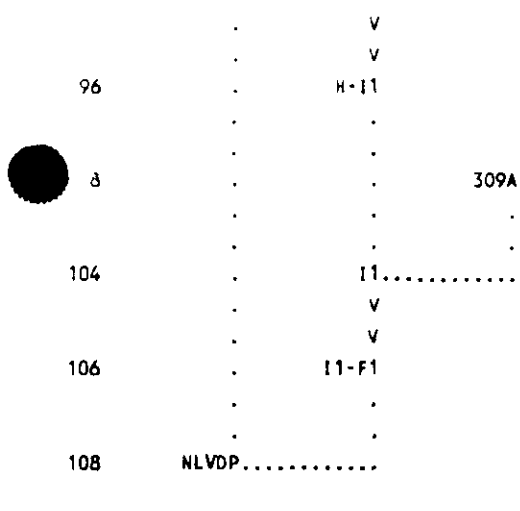
SCHEMATIC DIAGRAM OF STREAM NETWORK

UT

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:21 *
*                                       *
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED A4IN TO MATCH JMM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR *MULTI-RATIO OPTION*
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	670.	951.	1083.	1186.	1397.	1615.
				TIME	4.17	4.17	4.08	4.08	4.08	4.08
ROUTED TO										
+	A-B	4.73	1	FLOW	640.	911.	1037.	1135.	1335.	1541.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT										
+	302	6.14	1	FLOW	690.	994.	1135.	1246.	1473.	1709.
				TIME	4.33	4.33	4.33	4.33	4.25	4.25
2 COMBINED AT										
+	NODE	10.87	1	FLOW	1311.	1879.	2142.	2348.	2767.	3200.
				TIME	4.42	4.42	4.42	4.42	4.42	4.42
ROUTED TO										
•	B-C	10.87	1	FLOW	1289.	1845.	2105.	2308.	2722.	3149.
				TIME	4.67	4.58	4.58	4.58	4.58	4.58
OGRAPH AT										
	303	4.49	1	FLOW	823.	1102.	1229.	1328.	1526.	1728.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT										

+	42B	4.08	1	FLOW	466.	677.	777.	856.	1018.	1184.
				TIME	4.17	4.17	4.08	4.08	4.08	4.08
COMBINED AT										
	NODE	19.44	1	FLOW	2289.	3237.	3678.	4023.	4724.	5446.
				TIME	4.42	4.33	4.33	4.33	4.33	4.33
ROUTED TO										
+	C-D	19.44	1	FLOW	2272.	3207.	3640.	3982.	4678.	5395.
				TIME	4.50	4.50	4.50	4.42	4.42	4.42
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	829.	1209.	1386.	1525.	1814.	2113.
				TIME	4.33	4.33	4.33	4.33	4.25	4.25
2 COMBINED AT										
+	NODE	27.67	1	FLOW	3077.	4389.	4997.	5473.	6443.	7442.
				TIME	4.42	4.42	4.42	4.42	4.42	4.42
ROUTED TO										
+	D-E	27.67	1	FLOW	3015.	4283.	4879.	5345.	6294.	7272.
				TIME	4.83	4.75	4.75	4.75	4.75	4.75
HYDROGRAPH AT										
+	305	3.99	1	FLOW	577.	781.	875.	949.	1097.	1249.
				TIME	4.25	4.25	4.17	4.17	4.17	4.17
2 COMBINED AT										
+	NODE	31.66	1	FLOW	3450.	4867.	5527.	6043.	7093.	8173.
				TIME	4.83	4.75	4.75	4.75	4.75	4.75
[redacted]ED TO										
+	E-F1	31.66	1	FLOW	3396.	4759.	5399.	5899.	6917.	7964.
				TIME	5.42	5.33	5.25	5.25	5.25	5.25
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	221.	331.	383.	425.	512.	602.
				TIME	5.83	5.75	5.67	5.67	5.67	5.67
2 COMBINED AT										
+	NODE	36.16	1	FLOW	3599.	5066.	5750.	6292.	7397.	8536.
				TIME	5.50	5.33	5.33	5.25	5.25	5.25
HYDROGRAPH AT										
+	43	6.40	1	FLOW	496.	707.	820.	908.	1091.	1283.
				TIME	5.33	4.42	4.42	4.42	4.33	4.33
ROUTED TO										
+	H-I1	6.40	1	FLOW	477.	667.	771.	854.	1025.	1202.
				TIME	6.00	5.25	5.25	5.17	5.17	5.17
HYDROGRAPH AT										
+	309A	5.60	1	FLOW	367.	525.	599.	658.	777.	901.
				TIME	5.67	5.67	5.58	5.58	5.58	5.58
[redacted]OMBINED AT										
	I1	12.00	1	FLOW	835.	1183.	1350.	1487.	1772.	2073.
				TIME	5.83	5.67	5.50	5.42	5.25	5.25
ROUTED TO										

			FLOW
	PLAN		1
	RATIO		1.24
	DAY	MON HRMN	
1	1	0000	.00
2	1	0005	.00
3	1	0010	.00
4	1	0015	.00
5	1	0020	.00
6	1	0025	.00
7	1	0030	.00
8	1	0035	.00
9	1	0040	.00
10	1	0045	.00
11	1	0050	.00
12	1	0055	.00
13	1	0100	.00
14	1	0105	.00
15	1	0110	.00
16	1	0115	.00
17	1	0120	.02
18	1	0125	.05
19	1	0130	.12
20	1	0135	.28
21	1	0140	.59
22	1	0145	1.13
23	1	0150	2.04
	1	0155	3.47
	1	0200	5.60
26	1	0205	8.62
27	1	0210	12.74
28	1	0215	18.17
29	1	0220	25.08
30	1	0225	33.63
31	1	0230	43.91
32	1	0235	55.95
33	1	0240	69.72
34	1	0245	85.11
35	1	0250	101.96
36	1	0255	120.05
37	1	0300	139.21
38	1	0305	159.36
39	1	0310	180.77
40	1	0315	203.85
41	1	0320	229.85
42	1	0325	260.74
43	1	0330	299.61
44	1	0335	349.65
45	1	0340	416.21
46	1	0345	504.85
47	1	0350	623.11
48	1	0355	778.36
49	1	0400	978.14
	1	0405	1228.25

1TABLE 1	STATION	NLVDP
(CONT.)		FLOW
	PLAN	1

+	I1-F1	12.00	1	FLOW	834.	1182.	1350.	1486.	1772.	2070.
				TIME	6.25	6.00	5.83	5.75	5.58	5.50

COMBINED AT

	NLVDP	48.16	1	FLOW	4388.	6168.	7028.	7702.	9095.	10536.
				TIME	5.83	5.42	5.42	5.33	5.33	5.33

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
I1-F1	MANE	5.00	834.34	377.55	.29	5.00	833.78	375.00	.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1867E+03 EXCESS= .0000E+00 OUTFLOW= .1864E+03 BASIN STORAGE= .4235E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.16									
I1-F1	MANE	5.00	1182.41	364.42	.42	5.00	1182.22	360.00	.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2718E+03 EXCESS= .0000E+00 OUTFLOW= .2716E+03 BASIN STORAGE= .4528E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.24									
I1-F1	MANE	5.00	1350.36	349.72	.49	5.00	1350.33	350.00	.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3123E+03 EXCESS= .0000E+00 OUTFLOW= .3121E+03 BASIN STORAGE= .4600E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.29									
I1-F1	MANE	5.00	1486.89	342.54	.54	5.00	1486.34	345.00	.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3445E+03 EXCESS= .0000E+00 OUTFLOW= .3441E+03 BASIN STORAGE= .4270E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.40									
I1-F1	MANE	4.66	1772.22	334.53	.64	5.00	1772.09	335.00	.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4109E+03 EXCESS= .0000E+00 OUTFLOW= .4105E+03 BASIN STORAGE= .4355E+00 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.51									
I1-F1	MANE	5.00	2070.54	328.20	.75	5.00	2070.30	330.00	.75

INUITY SUMMARY (AC-FT) - INFLOW= .4806E+03 EXCESS= .0000E+00 OUTFLOW= .4803E+03 BASIN STORAGE= .4983E+00 PERCENT ERROR= .0

1TABLE 1 STATION NLVDP

RATIO 1.24

PER	DAY	MON	HRMN	
	1		0410	1532.33
	1		0415	1889.80
53	1		0420	2295.77
54	1		0425	2741.64
55	1		0430	3219.17
56	1		0435	3741.64
57	1		0440	4315.06
58	1		0445	4916.51
59	1		0450	5491.25
60	1		0455	5983.71
61	1		0500	6369.63
62	1		0505	6653.68
63	1		0510	6847.06
64	1		0515	6962.69
65	1		0520	7019.44
66	1		0525	7028.39
67	1		0530	7008.97
68	1		0535	6973.97
69	1		0540	6932.63
70	1		0545	6889.00
71	1		0550	6841.71
72	1		0555	6786.31
73	1		0600	6715.31
74	1		0605	6620.75
75	1		0610	6495.33
	1		0615	6333.76
	1		0620	6134.58
	1		0625	5897.96
79	1		0630	5626.44
80	1		0635	5326.15
81	1		0640	5004.81
82	1		0645	4668.75
83	1		0650	4325.48
84	1		0655	3981.70
85	1		0700	3643.20
86	1		0705	3314.57
87	1		0710	3000.13
88	1		0715	2703.66
89	1		0720	2427.33
90	1		0725	2171.81
91	1		0730	1937.45
92	1		0735	1723.88
93	1		0740	1532.24
94	1		0745	1359.59
95	1		0750	1204.49
96	1		0755	1066.96
97	1		0800	944.66
98	1		0805	835.26
99	1		0810	740.04
100	1		0815	655.04

1	STATION	NLVDP
(.)		FLOW
	PLAN	1
	RATIO	1.24

PER	DAY	MON	HRMN	
101	1		0820	581.08
[illegible]	1		0825	515.65
[illegible]	1		0830	458.10
[illegible]	1		0835	407.57
105	1		0840	363.41
106	1		0845	324.40
107	1		0850	290.86
108	1		0855	261.97
109	1		0900	235.87
110	1		0905	212.39
111	1		0910	190.88
112	1		0915	172.93
113	1		0920	156.25
114	1		0925	141.80
115	1		0930	129.09
116	1		0935	117.20
117	1		0940	107.41
118	1		0945	98.34
119	1		0950	89.91
120	1		0955	83.06
121	1		1000	76.57
122	1		1005	70.42
123	1		1010	65.51
124	1		1015	60.83
125	1		1020	56.32
126	1		1025	52.47
127	1		1030	49.02
[illegible]	1		1035	45.67
[illegible]	1		1040	42.42
[illegible]	1		1045	39.86
131	1		1050	37.36
132	1		1055	34.92
133	1		1100	32.56
134	1		1105	30.70
135	1		1110	28.88
136	1		1115	27.09
137	1		1120	25.34
138	1		1125	23.93
139	1		1130	22.62
140	1		1135	21.33
141	1		1140	20.06
142	1		1145	18.80
143	1		1150	17.85
144	1		1155	16.91
145	1		1200	15.98
146	1		1205	15.05
147	1		1210	14.14
148	1		1215	13.39
149	1		1220	12.71
150	1		1225	12.04

1TABLE 1	STATION	NLVDP
(CONT.)		FLOW
[illegible]	PLAN	1
[illegible]	RATIO	1.24

PER	DAY	MON	HRMN

151	1	1230	11.39
152	1	1235	10.75
153	1	1240	10.14
[illegible]	1	1245	9.70
[illegible]	1	1250	9.27
[illegible]	1	1255	8.85
157	1	1300	8.43
158	1	1305	8.02
159	1	1310	7.60
160	1	1315	7.25
161	1	1320	6.96
162	1	1325	6.68
163	1	1330	6.40
164	1	1335	6.12
165	1	1340	5.84
166	1	1345	5.56
167	1	1350	5.30
168	1	1355	5.11
169	1	1400	4.92
170	1	1405	4.73
171	1	1410	4.54
172	1	1415	4.35
173	1	1420	4.17
174	1	1425	3.98
175	1	1430	3.79
176	1	1435	3.66
177	1	1440	3.54
178	1	1445	3.42
179	1	1450	3.29
[illegible]	1	1455	3.17
[illegible]	1	1500	3.05
[illegible]	1	1505	2.92
183	1	1510	2.80
184	1	1515	2.68
185	1	1520	2.58
186	1	1525	2.51
187	1	1530	2.43
188	1	1535	2.35
189	1	1540	2.28
190	1	1545	2.20
191	1	1550	2.12
192	1	1555	2.04
193	1	1600	1.97
194	1	1605	1.89
195	1	1610	1.81
196	1	1615	1.76
197	1	1620	1.72
198	1	1625	1.67
199	1	1630	1.62
200	1	1635	1.58

MAX	7028.39
MIN	.00
AVE	1139.71

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:29 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*          (916) 756-1104               *
*                                       *
*****************************************
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```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX          XXX
```

HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

50-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                    *DIAGRAM
         1          ID                    EAST AND WEST RANGE WASHES
         2          ID                      50-YR, 6-HR STORM
         3          ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
         4          ID                  BOYLE ENGINEERING CORPORATION
         5          ID                    STORM A (DARF=0.68)
         6          ID                MODIFIED  TO MATCH JMM'S FILE
         7          ID               NEW FUTURE DEVELOPMENT IN 306, 307, 310
         8          ID                  DARF     JR CARD
         9          ID                  .55       1.00
        10          ID                  .64       1.164
        11          ID                  .68       1.236
        12          ID                  .71       1.291
        13          ID                  .77       1.400
        14          ID                  .83       1.509
        15          IT      05      0       0      200
        16          IO       5      0       0
        17          JR    PREC    1.0   1.164   1.236   1.291   1.400   1.509
        18          VS   NLVDP
        19          VV    2.13
```

```
 20          KK      41  SUB-BASIN 41 HYDROGRAPH
 21          KM          SCS RUNOFF COMPUTATION, SUB-41
 22          BA    4.73
 23          PB    1.68
 24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
 25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
 26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
 27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
 28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
 29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
 30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
 31          PC   99.90  100.00  100.00
 32          LS       0      79
 33          UD     .66

 34          KK     A-B     ROUTE FLOW TO NODE B
 35          RM       4     .36     .15

 36          KK     302  SUB-BASIN 302 HYDROGRAPH
 37          KM          SCS RUNOFF CALCULATIONS
 38          BA    6.14
 39          PB    1.61
 40          LS       0      79
 41          UD     .82

 42          KK   NODEB  COMBINE FLOW AT NODE B
 43          HC       2
```



```
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 44          KK     B-C  ROUTE FLOW TO NODE C
 45          RM       2     .18     .15

 46          KK     303   SUB-BASIN 303 HYDROGRAPH
 47          KM          SCS RUNOFF COMPUTATION
 48          BA    4.49
 49          PB    1.53
 50          LS       0      85
 51          UD     .65

 52          KK     42B  SUB-BASIN 42B HYDROGRAPH
 53          KM          SCS RUNOFF COMPUTATION
 54          BA    4.08
 55          PB    1.53
 56          LS       0      79
 57          UD     .65

 58          KK   NODEC  COMBINE FLOW AT NODE C
 59          HC       3

 60          KK     C-D   ROUTE FLOW TO NODE D
 61          RM       1     .10     .15

 62          KK     42A   SUB-BASIN 42A HYDROGRAPH
 63          KM          SCS RUNOFF COMPUTATION
 64          BA    8.23
 65          PB    1.53
 66          LS       0      79
```

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   67          UD     .81

   68          KK    NODED  COMBINE FLOW AT NODE D
   69          HC       2

   70          KK     D-E   ROUTE FLOW TO NODE E
   71          RM       4      .34      .15

   72          KK     305   SUB-BASIN 305 HYDROGRAPH
   73          KM           SCS RUNOFF COMPUTATION
   74          BA    3.99
   75          PB    1.38
   76          LS       0       85
   77          UD     .76

   78          KK    NODEE COMBINE FLOWS AT NODE E
   79          HC       2

   80          KK    E-F1  ROUTE FLOWS TO NODE F1
   81          RM       5     .46      .10
1                                      HEC-1 INPUT                                                    PAGE  3

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   82          KK    306A  SUB-BASIN 306A HYDROGRAPH
   83          KM           SCS RUNOFF COMPUTATION
   84          BA     4.5
   85          PB    1.38
   86          LS       0       76
   87          UD    1.54

   88          KK    NODEF1 COMBINE FLOWS AT NODE F1
   89          HC       2

   90          KK      43   SUB-BASIN 43 HYDROGRAPH
   91          KM           SCS RUNOFF COMPUTATION
   92          BA    6.40
   93          PB    1.38
   94          LS       0       79
   95          UD     .88

   96          KK    H-I1ROUTE FLOWS TO NODE I1
   97          RM       7     .72      .10

   98          KK    309A   SUB-BASIN 309A HYDROGRAPH
   99          KM           SCS RUNOFF COMPUTATION
  100          BA     5.6
  101          PB    1.38
  102          LS       0       79
  103          UD    1.51

  104          KK      I1   COMBINE FLOWS AT NODE I1
  105          HC       2

  106          KK   I1-F1   ROUTE FLOWS TO NODE F1
  107          RK   19360      .01     .022        0     TRAP      120        3

  108          KK   NLVDP
  109          HC       2
```

110 ZZ

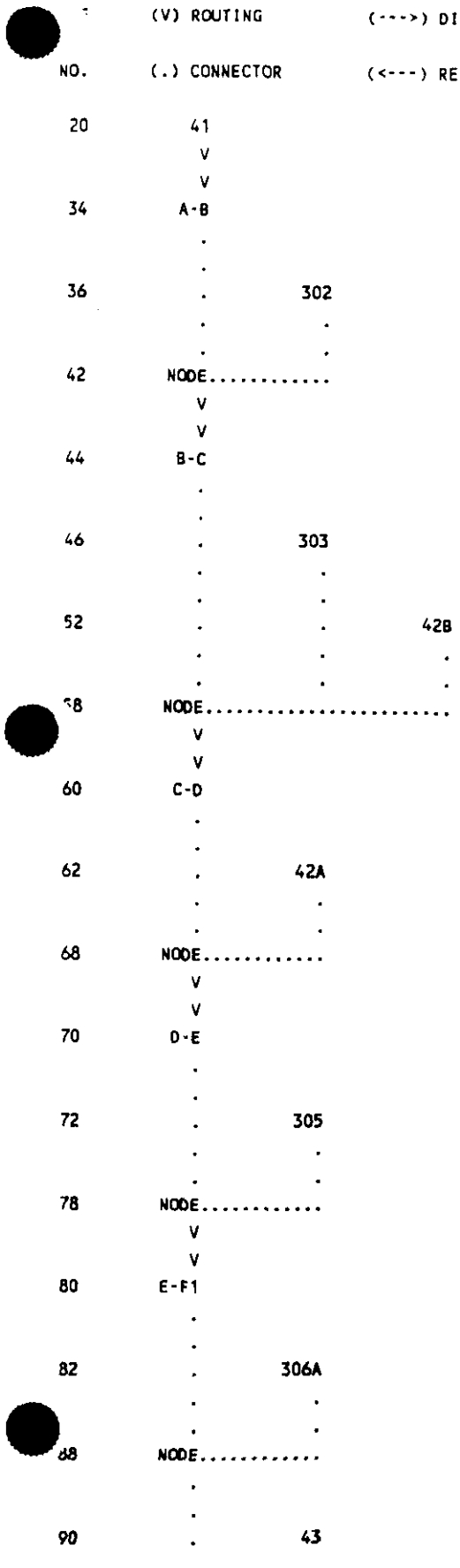
1

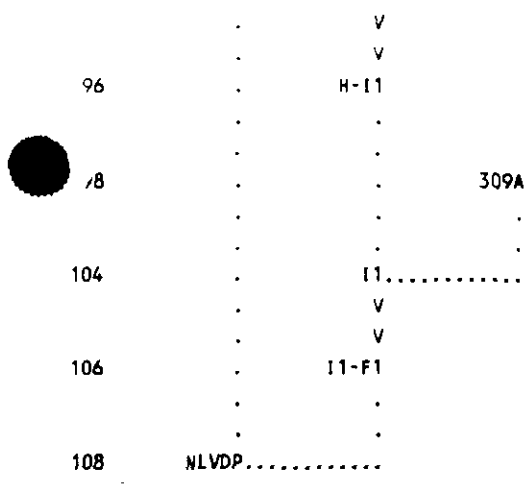
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:29 *
*                                       *
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
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*          (916) 756-1104               *
*                                       *
*****************************************
```

EAST AND WEST RANGE WASHES
50-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED TO MATCH JMM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 6.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	495.	728.	836.	922.	1099.	1283.
				TIME	4.17	4.17	4.17	4.17	4.08	4.08
ROUTED TO										
+	A-B	4.73	1	FLOW	471.	695.	801.	883.	1052.	1227.
				TIME	4.58	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT										
+	302	6.14	1	FLOW	516.	753.	871.	964.	1154.	1351.
				TIME	5.33	4.33	4.33	4.33	4.33	4.25
2 COMBINED AT										
+	NODE	10.87	1	FLOW	963.	1428.	1648.	1821.	2175.	2542.
				TIME	4.50	4.42	4.42	4.42	4.42	4.42
ROUTED TO										
+	B-C	10.87	1	FLOW	948.	1402.	1618.	1788.	2137.	2499.
				TIME	4.67	4.67	4.58	4.58	4.58	4.58
:OGRAPH AT										
	303	4.49	1	FLOW	670.	913.	1024.	1111.	1286.	1464.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT										

+	428	4.08	1	FLOW	331.	502.	583.	647.	780.	920.
				TIME	5.25	4.17	4.17	4.17	4.08	4.08
7 COMBINED AT										
	NODE	19.44	1	FLOW	1735.	2502.	2873.	3164.	3759.	4375.
				TIME	5.25	4.33	4.33	4.33	4.33	4.33
ROUTED TO										
•	C-D	19.44	1	FLOW	1726.	2484.	2849.	3135.	3721.	4332.
				TIME	5.33	4.50	4.50	4.50	4.42	4.42
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	621.	894.	1040.	1155.	1391.	1639.
				TIME	5.33	4.33	4.33	4.33	4.33	4.25
2 COMBINED AT										
+	NODE	27.67	1	FLOW	2347.	3356.	3865.	4265.	5084.	5932.
				TIME	5.33	4.42	4.42	4.42	4.42	4.42
ROUTED TO										
+	D-E	27.67	1	FLOW	2313.	3284.	3775.	4163.	4964.	5794.
				TIME	5.67	4.83	4.83	4.75	4.75	4.75
HYDROGRAPH AT										
+	305	3.99	1	FLOW	435.	605.	683.	744.	868.	996.
				TIME	4.25	4.25	4.25	4.25	4.17	4.17
2 COMBINED AT										
+	NODE	31.66	1	FLOW	2634.	3738.	4287.	4721.	5607.	6525.
				TIME	5.58	4.83	4.75	4.75	4.75	4.75
ROUTED TO										
+	E-F1	31.66	1	FLOW	2609.	3673.	4203.	4618.	5475.	6365.
				TIME	5.92	5.33	5.33	5.33	5.25	5.25
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	151.	236.	277.	311.	380.	453.
				TIME	5.92	5.75	5.75	5.75	5.75	5.67
2 COMBINED AT										
+	NODE	36.16	1	FLOW	2760.	3889.	4455.	4904.	5822.	6786.
				TIME	5.92	5.42	5.33	5.33	5.25	5.25
HYDROGRAPH AT										
+	43	6.40	1	FLOW	368.	523.	596.	662.	811.	967.
				TIME	5.42	5.33	5.33	4.42	4.42	4.42
ROUTED TO										
+	H-I1	6.40	1	FLOW	350.	503.	575.	632.	763.	909.
				TIME	6.08	6.00	6.00	5.92	5.25	5.17
HYDROGRAPH AT										
+	309A	5.60	1	FLOW	264.	389.	449.	497.	594.	697.
				TIME	5.75	5.67	5.67	5.67	5.58	5.58
[redacted]MBINED AT										
+	I1	12.00	1	FLOW	607.	883.	1014.	1119.	1338.	1579.
				TIME	5.92	5.83	5.75	5.75	5.58	5.33
ROUTED TO										

+	I1-F1	12.00	1	FLOW	607.	882.	1014.	1119.	1338.	1578.
				TIME	6.42	6.25	6.17	6.08	5.92	5.67

? COMBINED AT

	NLVDP	48.16	1	FLOW	3322.	4705.	5383.	5937.	7085.	8287.
				TIME	6.00	5.83	5.58	5.50	5.42	5.33

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
I1-F1	MANE	5.00	606.67	384.95	.20	5.00	606.66	385.00	.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1314E+03 EXCESS= .0000E+00 OUTFLOW= .1311E+03 BASIN STORAGE= .4385E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.16									
I1-F1	MANE	5.00	882.18	373.87	.31	5.00	881.97	375.00	.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1980E+03 EXCESS= .0000E+00 OUTFLOW= .1977E+03 BASIN STORAGE= .4481E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.24									
I1-F1	MANE	4.82	1013.98	368.58	.36	5.00	1013.88	370.00	.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2302E+03 EXCESS= .0000E+00 OUTFLOW= .2299E+03 BASIN STORAGE= .4721E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.29									
I1-F1	MANE	5.00	1118.52	363.06	.40	5.00	1118.51	365.00	.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2558E+03 EXCESS= .0000E+00 OUTFLOW= .2556E+03 BASIN STORAGE= .4592E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.40									
I1-F1	MANE	5.00	1338.21	355.58	.48	5.00	1338.21	355.00	.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3092E+03 EXCESS= .0000E+00 OUTFLOW= .3089E+03 BASIN STORAGE= .5299E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.51									
I1-F1	MANE	4.77	1577.97	337.66	.57	5.00	1577.94	340.00	.57

INUITY SUMMARY (AC-FT) - INFLOW= .3657E+03 EXCESS= .0000E+00 OUTFLOW= .3653E+03 BASIN STORAGE= .4246E+00 PERCENT ERROR= .0

1TABLE 1 STATION NLVDP

			FLOW
		PLAN	1
		RATIO	1.24

	DAY	MON	HRMN	
1	1		0000	.00
2	1		0005	.00
3	1		0010	.00
4	1		0015	.00
5	1		0020	.00
6	1		0025	.00
7	1		0030	.00
8	1		0035	.00
9	1		0040	.00
10	1		0045	.00
11	1		0050	.00
12	1		0055	.00
13	1		0100	.00
14	1		0105	.00
15	1		0110	.00
16	1		0115	.00
17	1		0120	.00
18	1		0125	.00
19	1		0130	.00
20	1		0135	.01
21	1		0140	.02
22	1		0145	.07
23	1		0150	.19
	1		0155	.44
	1		0200	.93
26	1		0205	1.78
27	1		0210	3.16
28	1		0215	5.28
29	1		0220	8.31
30	1		0225	12.44
31	1		0230	17.77
32	1		0235	24.35
33	1		0240	32.13
34	1		0245	40.98
35	1		0250	50.68
36	1		0255	61.00
37	1		0300	71.73
38	1		0305	82.78
39	1		0310	94.35
40	1		0315	106.83
41	1		0320	121.21
42	1		0325	139.05
43	1		0330	162.77
44	1		0335	194.86
45	1		0340	239.47
46	1		0345	300.94
47	1		0350	385.20
48	1		0355	498.10
[illegible]	1		0400	645.73
	1		0405	832.97

1TABLE 1		STATION	NLVDP
(CONT.)			FLOW
		PLAN	1

RATIO 1.24

PER	DAY	MON	HRMN	
	1		0410	1063.09
	1		0415	1336.15
53	1		0420	1648.38
54	1		0425	1992.01
55	1		0430	2356.10
56	1		0435	2726.42
57	1		0440	3088.83
58	1		0445	3440.52
59	1		0450	3808.13
60	1		0455	4212.92
61	1		0500	4607.24
62	1		0505	4914.60
63	1		0510	5121.73
64	1		0515	5249.84
65	1		0520	5325.97
66	1		0525	5365.36
67	1		0530	5382.39
68	1		0535	5382.58
69	1		0540	5376.54
70	1		0545	5367.56
71	1		0550	5354.51
72	1		0555	5333.07
73	1		0600	5297.46
74	1		0605	5240.65
75	1		0610	5156.90
	1		0615	5041.72
	1		0620	4894.07
78	1		0625	4714.79
79	1		0630	4506.80
80	1		0635	4273.39
81	1		0640	4020.76
82	1		0645	3755.60
83	1		0650	3483.55
84	1		0655	3210.14
85	1		0700	2940.39
86	1		0705	2678.28
87	1		0710	2427.13
88	1		0715	2189.68
89	1		0720	1967.85
90	1		0725	1762.46
91	1		0730	1573.92
92	1		0735	1402.62
93	1		0740	1247.63
94	1		0745	1108.03
95	1		0750	982.78
96	1		0755	871.19
97	1		0800	772.38
98	1		0805	684.38
99	1		0810	606.24
100	1		0815	538.06

E 1 STATION NLVDP
(CONT.) FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
101	1		0820	477.53
102	1		0825	424.13
	1		0830	377.66
	1		0835	336.28
105	1		0840	300.59
106	1		0845	269.21
107	1		0850	241.13
108	1		0855	216.78
109	1		0900	195.03
110	1		0905	176.10
111	1		0910	159.07
112	1		0915	144.35
113	1		0920	130.84
114	1		0925	119.64
115	1		0930	109.21
116	1		0935	100.04
117	1		0940	91.56
118	1		0945	83.90
119	1		0950	77.25
120	1		0955	70.98
121	1		1000	65.64
122	1		1005	60.77
123	1		1010	56.14
124	1		1015	52.35
125	1		1020	48.73
126	1		1025	45.24
127	1		1030	42.39
	1		1035	39.65
	1		1040	36.98
	1		1045	34.70
131	1		1050	32.61
132	1		1055	30.55
133	1		1100	28.61
134	1		1105	26.98
135	1		1110	25.49
136	1		1115	24.01
137	1		1120	22.57
138	1		1125	21.27
139	1		1130	20.14
140	1		1135	19.03
141	1		1140	17.94
142	1		1145	16.91
143	1		1150	16.07
144	1		1155	15.23
145	1		1200	14.39
146	1		1205	13.56
147	1		1210	12.87
148	1		1215	12.23
149	1		1220	11.60
150	1		1225	10.97

1TABLE 1	STATION	NLVDP
(CONT.)		FLOW
	PLAN	1
	RATIO	1.24

PER	DAY	MON	HRMN

151	1	1230	10.36
152	1	1235	9.88
153	1	1240	9.43
154	1	1245	9.01
	1	1250	8.58
	1	1255	8.16
157	1	1300	7.79
158	1	1305	7.47
159	1	1310	7.16
160	1	1315	6.85
161	1	1320	6.54
162	1	1325	6.23
163	1	1330	5.97
164	1	1335	5.74
165	1	1340	5.52
166	1	1345	5.29
167	1	1350	5.07
168	1	1355	4.85
169	1	1400	4.63
170	1	1405	4.46
171	1	1410	4.31
172	1	1415	4.15
173	1	1420	4.00
174	1	1425	3.85
175	1	1430	3.70
176	1	1435	3.54
177	1	1440	3.39
178	1	1445	3.27
179	1	1450	3.16
	1	1455	3.05
	1	1500	2.95
182	1	1505	2.84
183	1	1510	2.73
184	1	1515	2.63
185	1	1520	2.52
186	1	1525	2.43
187	1	1530	2.36
188	1	1535	2.28
189	1	1540	2.21
190	1	1545	2.14
191	1	1550	2.07
192	1	1555	1.99
193	1	1600	1.92
194	1	1605	1.85
195	1	1610	1.78
196	1	1615	1.73
197	1	1620	1.69
198	1	1625	1.64
199	1	1630	1.59
200	1	1635	1.54

MAX	5382.58
MIN	.00
AVE	875.67

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:36 *
*                                       *
*****************************************
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

25-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
      LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                *DIAGRAM
          1     ID                    EAST AND WEST RANGE WASHES
          2     ID                      25-YR, 6-HR STORM
          3     ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
          4     ID                  BOYLE ENGINEERING CORPORATION
          5     ID                    STORM A (DARF=0.68)
          6     ID                MODIFIED  TO MATCH JMM'S FILE
          7     ID                NEW FUTURE DEVELOPMENT IN 306, 307, 310
          8     ID                  DARF    JR CARD
          9     ID                  .55     1.00
         10     ID                  .64     1.164
         11     ID                  .68     1.236
         12     ID                  .71     1.291
         13     ID                  .77     1.400
         14     ID                  .83     1.509
         15     IT     05      0      0     200
         16     IO      5      0      0
         17     JR    PREC    1.0   1.164  1.236  1.291  1.400  1.509
         18     VS    NLVDP
         19     VV    2.13
```

```
20          KK      41  SUB-BASIN 41 HYDROGRAPH
21          KM          SCS RUNOFF COMPUTATION, SUB-41
22          BA    4.73
23          PB    1.40
24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
31          PC   99.90  100.00  100.00
32          LS       0      79
33          UD     .66

34          KK     A-B     ROUTE FLOW TO NODE B
35          RM       4     .36     .15

36          KK     302  SUB-BASIN 302 HYDROGRAPH
37          KM          SCS RUNOFF CALCULATIONS
38          BA    6.14
39          PB    1.34
40          LS       0      79
41          UD     .82

42          KK   NODEB  COMBINE FLOW AT NODE B
43          HC       2
```



```
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

44          KK     B-C  ROUTE FLOW TO NODE C
45          RM       2     .18     .15

46          KK     303   SUB-BASIN 303 HYDROGRAPH
47          KM          SCS RUNOFF COMPUTATION
48          BA    4.49
49          PB    1.25
50          LS       0      85
51          UD     .65

52          KK     42B  SUB-BASIN 42B HYDROGRAPH
53          KM          SCS RUNOFF COMPUTATION
54          BA    4.08
55          PB    1.28
56          LS       0      79
57          UD     .65

58          KK   NODEC  COMBINE FLOW AT NODE C
59          HC       3

60          KK     C-D   ROUTE FLOW TO NODE D
61          RM       1     .10     .15

62          KK     42A   SUB-BASIN 42A HYDROGRAPH
63          KM           SCS RUNOFF COMPUTATION
64          BA    8.23
65          PB    1.28
66          LS       0      79
```

```
   67          UD      .81

   68          KK     NODED  COMBINE FLOW AT NODE D
   69          HC        2

   70          KK      D-E   ROUTE FLOW TO NODE E
   71          RM        4      .34      .15

   72          KK      305   SUB-BASIN 305 HYDROGRAPH
   73          KM             SCS RUNOFF COMPUTATION
   74          BA     3.99
   75          PB     1.16
   76          LS        0       85
   77          UD      .76

   78          KK     NODEE COMBINE FLOWS AT NODE E
   79          HC        2

   80          KK     E-F1  ROUTE FLOWS TO NODE F1
   81          RM        5      .46      .10
1                                      HEC-1 INPUT                                          PAGE  3

 LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10


   82          KK     306A  SUB-BASIN 306A HYDROGRAPH
   83          KM             SCS RUNOFF COMPUTATION
   84          BA      4.5
   85          PB     1.16
   86          LS        0       76
   87          UD     1.54

   88          KK     NODEF1 COMBINE FLOWS AT NODE F1
   89          HC        2

   90          KK       43   SUB-BASIN 43 HYDROGRAPH
   91          KM             SCS RUNOFF COMPUTATION
   92          BA     6.40
   93          PB     1.16
   94          LS        0       79
   95          UD      .88

   96          KK     H-I1ROUTE FLOWS TO NODE I1
   97          RM        7      .72      .10

   98          KK     309A   SUB-BASIN 309A HYDROGRAPH
   99          KM             SCS RUNOFF COMPUTATION
  100          BA      5.6
  101          PB     1.16
  102          LS        0       79
  103          UD     1.51

  104          KK       I1   COMBINE FLOWS AT NODE I1
  105          HC        2

  106          KK    I1-F1   ROUTE FLOWS TO NODE F1
  107          RK    19360      .01     .022        0     TRAP      120        3

  108          KK    NLVDP
  109          HC        2
```

110 ZZ

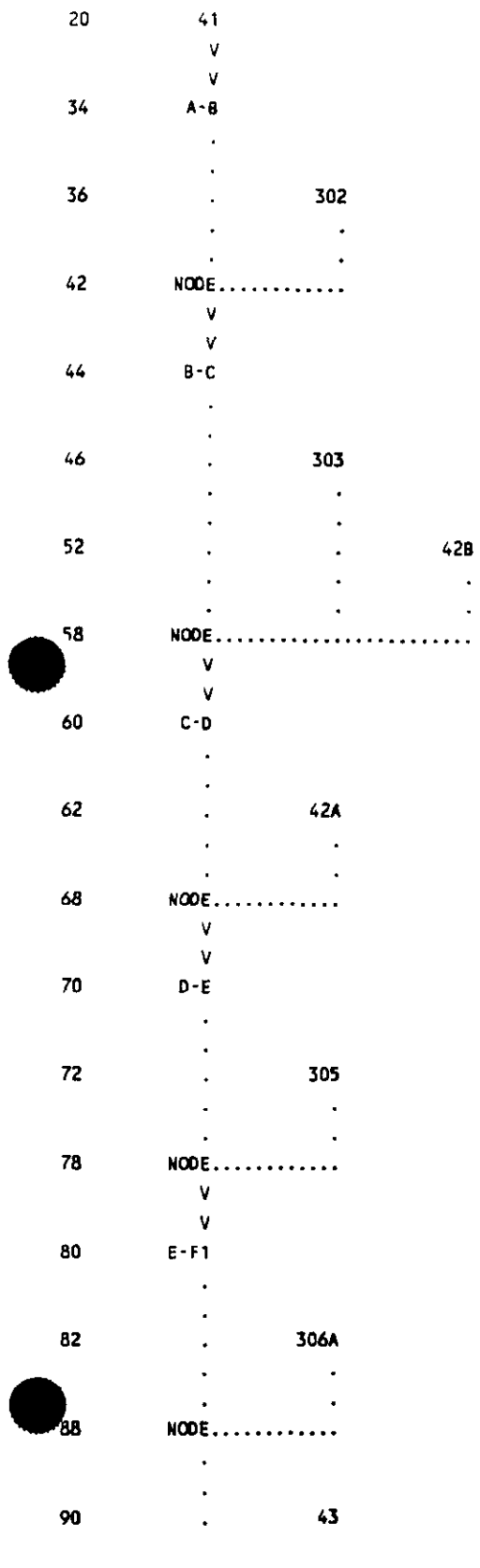
1

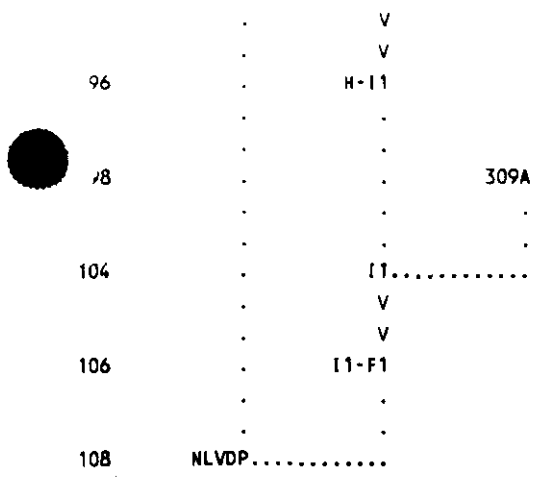
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

E (V) ROUTING (---->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:36 *
*                                       *
*****************************************
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*                                       *
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*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

EAST AND WEST RANGE WASHES
25-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED TO MATCH JHM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 IO *OUTPUT CONTROL VARIABLES*

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	313.	455.	536.	600.	732.	869.
				TIME	5.25	4.17	4.17	4.17	4.17	4.17
ROUTED TO										
+	A-B	4.73	1	FLOW	299.	433.	510.	572.	699.	833.
				TIME	5.58	4.58	4.50	4.50	4.50	4.50
HYDROGRAPH AT										
•	302	6.14	1	FLOW	337.	481.	549.	613.	755.	904.
				TIME	5.33	5.33	5.33	4.33	4.33	4.33
2 COMBINED AT										
+	NODE	10.87	1	FLOW	623.	883.	1041.	1168.	1434.	1713.
				TIME	5.50	4.50	4.50	4.42	4.42	4.42
ROUTED TO										
+	B-C	10.87	1	FLOW	615.	872.	1026.	1151.	1408.	1681.
				TIME	5.67	5.58	4.67	4.67	4.67	4.58
OGRAPH AT										
+	303	4.49	1	FLOW	422.	600.	684.	749.	882.	1019.
				TIME	4.17	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT										

+	42B	4.08	1	FLOW	219.	312.	364.	412.	510.	614.
				TIME	5.25	5.25	4.17	4.17	4.17	4.17
3 COMBINED AT										
	NODE	19.44	1	FLOW	1142.	1610.	1834.	2048.	2490.	2955.
				TIME	5.33	5.25	4.42	4.42	4.42	4.33
ROUTED TO										
+	C-D	19.44	1	FLOW	1136.	1601.	1820.	2032.	2472.	2931.
				TIME	5.42	5.33	5.33	4.50	4.50	4.50
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	404.	585.	669.	735.	909.	1095.
				TIME	5.33	5.33	5.33	5.33	4.33	4.33
2 COMBINED AT										
+	NODE	27.67	1	FLOW	1538.	2186.	2488.	2742.	3356.	4000.
				TIME	5.42	5.33	5.33	4.50	4.42	4.42
ROUTED TO										
+	D-E	27.67	1	FLOW	1510.	2154.	2454.	2691.	3284.	3906.
				TIME	5.75	5.67	5.67	4.83	4.83	4.83
HYDROGRAPH AT										
+	305	3.99	1	FLOW	284.	414.	474.	522.	618.	719.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25
2 COMBINED AT										
+	NODE	31.66	1	FLOW	1727.	2459.	2801.	3088.	3748.	4443.
				TIME	5.58	5.58	5.50	4.83	4.83	4.75
[illegible]TED TO										
+	E-F1	31.66	1	FLOW	1696.	2431.	2779.	3057.	3684.	4354.
				TIME	6.00	5.92	5.92	5.83	5.33	5.33
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	83.	141.	170.	193.	243.	297.
				TIME	6.00	5.92	5.83	5.83	5.75	5.75
2 COMBINED AT										
+	NODE	36.16	1	FLOW	1779.	2572.	2949.	3250.	3907.	4626.
				TIME	6.00	5.92	5.92	5.83	5.42	5.33
HYDROGRAPH AT										
+	43	6.40	1	FLOW	233.	349.	404.	447.	536.	633.
				TIME	5.42	5.42	5.42	5.42	5.33	4.42
ROUTED TO										
+	H-I1	6.40	1	FLOW	219.	332.	385.	428.	516.	608.
				TIME	6.08	6.08	6.00	6.00	6.00	5.92
HYDROGRAPH AT										
+	309A	5.60	1	FLOW	159.	248.	292.	327.	400.	477.
				TIME	5.83	5.75	5.75	5.75	5.67	5.67
[illegible]MBINED AT										
	I1	12.00	1	FLOW	374.	573.	669.	746.	906.	1076.
				TIME	6.00	6.00	5.92	5.92	5.83	5.75
ROUTED TO										

+	I1-F1	12.00	1	FLOW	374.	572.	668.	745.	905.	1075.
				TIME	6.67	6.50	6.42	6.33	6.25	6.17

2 COMBINED AT

	NLVDP	48.16	1	FLOW	2095.	3100.	3576.	3959.	4749.	5618.
				TIME	6.08	6.00	6.00	5.92	5.75	5.50

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
	I1-F1 MANE	5.00	373.93	400.72	.12	5.00	373.90	400.00	.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7689E+02 EXCESS= .0000E+00 OUTFLOW= .7661E+02 BASIN STORAGE= .4258E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.16									
	I1-F1 MANE	5.00	572.69	388.80	.19	5.00	571.98	390.00	.19

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1233E+03 EXCESS= .0000E+00 OUTFLOW= .1230E+03 BASIN STORAGE= .4682E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.24									
	I1-F1 MANE	4.74	668.79	382.05	.23	5.00	668.44	385.00	.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1463E+03 EXCESS= .0000E+00 OUTFLOW= .1460E+03 BASIN STORAGE= .4861E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.29									
	I1-F1 MANE	5.00	745.45	380.60	.26	5.00	745.27	380.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1648E+03 EXCESS= .0000E+00 OUTFLOW= .1646E+03 BASIN STORAGE= .4403E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.40									
	I1-F1 MANE	5.00	904.88	372.04	.32	5.00	904.76	375.00	.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2036E+03 EXCESS= .0000E+00 OUTFLOW= .2033E+03 BASIN STORAGE= .4677E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.51									
	I1-F1 MANE	4.63	1075.70	367.65	.38	5.00	1075.17	370.00	.38

INUITY SUMMARY (AC-FT) - INFLOW= .2452E+03 EXCESS= .0000E+00 OUTFLOW= .2449E+03 BASIN STORAGE= .4600E+00 PERCENT ERROR= -.1

1TABLE 1 STATION NLVDP

			FLOW
	PLAN		1
	RATIO		1.24

	DAY	MON	HRMN	
1	1		0000	.00
2	1		0005	.00
3	1		0010	.00
4	1		0015	.00
5	1		0020	.00
6	1		0025	.00
7	1		0030	.00
8	1		0035	.00
9	1		0040	.00
10	1		0045	.00
11	1		0050	.00
12	1		0055	.00
13	1		0100	.00
14	1		0105	.00
15	1		0110	.00
16	1		0115	.00
17	1		0120	.00
18	1		0125	.00
19	1		0130	.00
20	1		0135	.00
21	1		0140	.00
22	1		0145	.00
23	1		0150	.00
	1		0155	.00
	1		0200	.01
26	1		0205	.04
27	1		0210	.10
28	1		0215	.26
29	1		0220	.56
30	1		0225	1.10
31	1		0230	1.97
32	1		0235	3.26
33	1		0240	5.05
34	1		0245	7.39
35	1		0250	10.29
36	1		0255	13.69
37	1		0300	17.55
38	1		0305	21.82
39	1		0310	26.51
40	1		0315	31.79
41	1		0320	38.06
42	1		0325	46.13
43	1		0330	57.27
44	1		0335	72.90
45	1		0340	95.46
46	1		0345	127.70
47	1		0350	173.41
48	1		0355	236.55
[illegible]	1		0400	321.38
	1		0405	431.59

1TABLE 1	STATION	NLVDP
(CONT.)		FLOW
	PLAN	1

RATIO 1.24

PER	DAY	MON	HRMN	
	1		0410	569.93
	1		0415	737.15
53	1		0420	931.52
54	1		0425	1148.71
55	1		0430	1382.11
56	1		0435	1622.87
57	1		0440	1860.82
58	1		0445	2085.64
59	1		0450	2288.50
60	1		0455	2462.71
61	1		0500	2608.59
62	1		0505	2746.66
63	1		0510	2925.00
64	1		0515	3135.50
65	1		0520	3295.07
66	1		0525	3385.52
67	1		0530	3442.01
68	1		0535	3482.19
69	1		0540	3514.48
70	1		0545	3541.84
71	1		0550	3562.82
72	1		0555	3575.70
73	1		0600	3576.16
74	1		0605	3559.75
75	1		0610	3522.46
	1		0615	3461.24
	1		0620	3375.05
78	1		0625	3264.95
79	1		0630	3133.07
80	1		0635	2981.99
81	1		0640	2815.91
82	1		0645	2638.90
83	1		0650	2455.38
84	1		0655	2269.36
85	1		0700	2084.48
86	1		0705	1903.75
87	1		0710	1729.77
88	1		0715	1564.57
89	1		0720	1409.64
90	1		0725	1265.76
91	1		0730	1133.32
92	1		0735	1012.30
93	1		0740	902.37
94	1		0745	803.06
95	1		0750	714.18
96	1		0755	634.82
97	1		0800	564.04
98	1		0805	500.94
99	1		0810	445.28
100	1		0815	396.13

E 1 STATION NLVDP
(CONT.) FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
101	1		0820	352.52
102	1		0825	314.17
[illegible]	1		0830	280.55
[illegible]	1		0835	250.66
105	1		0840	224.76
106	1		0845	201.66
107	1		0850	181.59
108	1		0855	163.68
109	1		0900	147.94
110	1		0905	133.85
111	1		0910	121.55
112	1		0915	110.44
113	1		0920	100.72
114	1		0925	91.89
115	1		0930	84.10
116	1		0935	77.11
117	1		0940	70.81
118	1		0945	65.40
119	1		0950	60.30
120	1		0955	55.96
121	1		1000	51.85
122	1		1005	48.14
123	1		1010	44.85
124	1		1015	41.69
125	1		1020	38.98
126	1		1025	36.45
127	1		1030	33.99
[illegible]	1		1035	31.96
[illegible]	1		1040	30.00
130	1		1045	28.07
131	1		1050	26.48
132	1		1055	24.94
133	1		1100	23.43
134	1		1105	22.11
135	1		1110	20.90
136	1		1115	19.70
137	1		1120	18.56
138	1		1125	17.62
139	1		1130	16.68
140	1		1135	15.75
141	1		1140	14.91
142	1		1145	14.17
143	1		1150	13.44
144	1		1155	12.72
145	1		1200	12.06
146	1		1205	11.49
147	1		1210	10.92
148	1		1215	10.35
149	1		1220	9.80
150	1		1225	9.35

1TABLE 1	STATION	NLVDP
[illegible]NT.)		FLOW
	PLAN	1
	RATIO	1.24

PER	DAY	MON	HRMN

151	1	1230	8.92
152	1	1235	8.50
153	1	1240	8.08
154	1	1245	7.71
	1	1250	7.40
	1	1255	7.09
157	1	1300	6.78
158	1	1305	6.47
159	1	1310	6.18
160	1	1315	5.95
161	1	1320	5.71
162	1	1325	5.48
163	1	1330	5.25
164	1	1335	5.02
165	1	1340	4.83
166	1	1345	4.66
167	1	1350	4.48
168	1	1355	4.31
169	1	1400	4.14
170	1	1405	3.96
171	1	1410	3.82
172	1	1415	3.69
173	1	1420	3.56
174	1	1425	3.43
175	1	1430	3.30
176	1	1435	3.17
177	1	1440	3.05
178	1	1445	2.95
179	1	1450	2.86
	1	1455	2.76
	1	1500	2.67
182	1	1505	2.57
183	1	1510	2.48
184	1	1515	2.38
185	1	1520	2.31
186	1	1525	2.24
187	1	1530	2.17
188	1	1535	2.10
189	1	1540	2.03
190	1	1545	1.96
191	1	1550	1.89
192	1	1555	1.82
193	1	1600	1.77
194	1	1605	1.72
195	1	1610	1.67
196	1	1615	1.62
197	1	1620	1.57
198	1	1625	1.52
199	1	1630	1.47
200	1	1635	1.42

MAX	3576.16
MIN	.00
AVE	570.80

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:43 *
*                                       *
*****************************************
```

```
*************************************
*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*          609 SECOND STREET        *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

10-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                       *DIAGRAM
             1         ID                    EAST AND WEST RANGE WASHES
             2         ID                       10-YR, 6-HR STORM
             3         ID           FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
             4         ID                    BOYLE ENGINEERING CORPORATION
             5         ID                       STORM A (DARF=0.68)
             6         ID                  MODIFIED  TO MATCH JMM'S FILE
             7         ID                  NEW FUTURE DEVELOPMENT IN 306, 307, 310
             8         ID                    DARF    JR CARD
             9         ID                    .55      1.00
            10         ID                    .64      1.164
            11         ID                    .68      1.236
            12         ID                    .71      1.291
            13         ID                    .77      1.400
            14         ID                    .83      1.509
            15         IT      05      0       0      200
            16         IO       5      0       0
            17         JR    PREC     1.0   1.164   1.236   1.291   1.400   1.509
            18         VS   NLVDP
            19         VV    2.13
```

```
20          KK      41  SUB-BASIN 41 HYDROGRAPH
21          KM          SCS RUNOFF COMPUTATION, SUB-41
22          BA    4.73
23          PB    1.09
24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
31          PC   99.90  100.00  100.00
32          LS       0      79
33          UD     .66

34          KK     A-B     ROUTE FLOW TO NODE B
35          RM       4     .36     .15

36          KK     302  SUB-BASIN 302 HYDROGRAPH
37          KM          SCS RUNOFF CALCULATIONS
38          BA    6.14
39          PB    1.04
40          LS       0      79
41          UD     .82

42          KK   NODEB  COMBINE FLOW AT NODE B
43          HC       2
```



```
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

44          KK     B-C  ROUTE FLOW TO NODE C
45          RM       2     .18     .15

46          KK     303   SUB-BASIN 303 HYDROGRAPH
47          KM           SCS RUNOFF COMPUTATION
48          BA    4.49
49          PB    0.99
50          LS       0      85
51          UD     .65

52          KK     42B  SUB-BASIN 42B HYDROGRAPH
53          KM          SCS RUNOFF COMPUTATION
54          BA    4.08
55          PB    1.02
56          LS       0      79
57          UD     .65

58          KK   NODEC  COMBINE FLOW AT NODE C
59          HC       3

60          KK     C-D   ROUTE FLOW TO NODE D
61          RM       1     .10     .15

62          KK     42A   SUB-BASIN 42A HYDROGRAPH
63          KM           SCS RUNOFF COMPUTATION
64          BA    8.23
65          PB    1.02
66          LS       0      79
```

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 67          UD     .81

 68          KK    NODED  COMBINE FLOW AT NODE D
 69          HC        2

 70          KK     D-E   ROUTE FLOW TO NODE E
 71          RM        4      .34      .15

 72          KK      305   SUB-BASIN 305 HYDROGRAPH
 73          KM             SCS RUNOFF COMPUTATION
 74          BA     3.99
 75          PB     0.92
 76          LS        0       85
 77          UD      .76

 78          KK    NODEE COMBINE FLOWS AT NODE E
 79          HC        2

 80          KK    E-F1  ROUTE FLOWS TO NODE F1
 81          RM        5      .46      .10
1                                      HEC-1 INPUT                                          PAGE  3

LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 82          KK    306A  SUB-BASIN 306A HYDROGRAPH
 83          KM            SCS RUNOFF COMPUTATION
 84          BA     4.5
 85          PB    0.89
 86          LS        0       76
 87          UD    1.54

 88          KK    NODEF1 COMBINE FLOWS AT NODE F1
 89          HC        2

 90          KK      43   SUB-BASIN 43 HYDROGRAPH
 91          KM             SCS RUNOFF COMPUTATION
 92          BA     6.40
 93          PB     0.95
 94          LS        0       79
 95          UD      .88

 96          KK    H-I1ROUTE FLOWS TO NODE I1
 97          RM        7      .72      .10

 98          KK    309A   SUB-BASIN 309A HYDROGRAPH
 99          KM             SCS RUNOFF COMPUTATION
100          BA     5.6
101          PB    0.89
102          LS        0       79
103          UD    1.51

104          KK      I1   COMBINE FLOWS AT NODE I1
105          HC        2

106          KK   I1-F1   ROUTE FLOWS TO NODE F1
107          RK   19360      .01     .022        0    TRAP      120        3

108          KK   NLVDP
109          HC        2
```

110 ZZ

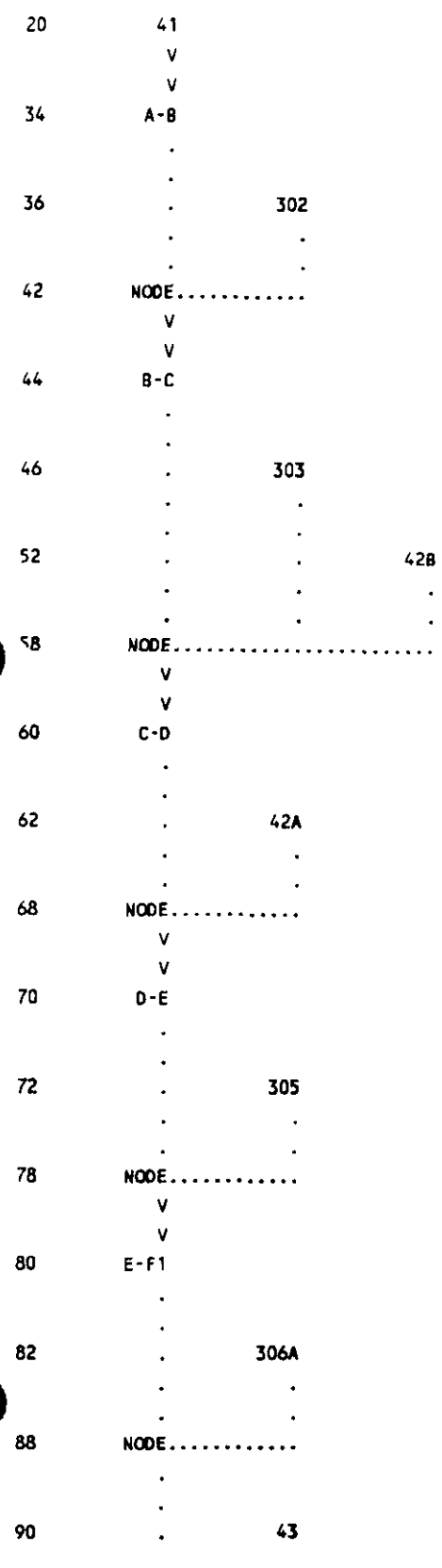
1

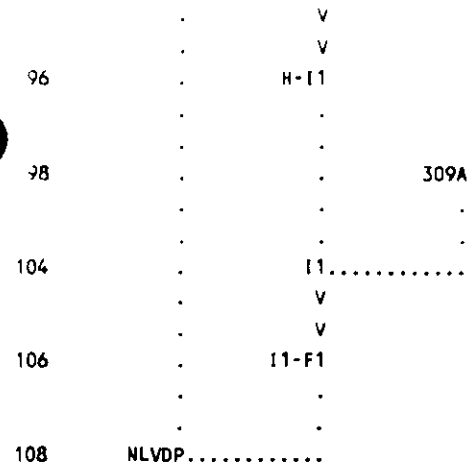
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

E (V) ROUTING (----->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<-----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:43 *
*                                       *
*****************************************
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```

EAST AND WEST RANGE WASHES
10-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED TO MATCH JMM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	164.	247.	286.	316.	380.	467.
				TIME	5.25	5.25	5.25	5.25	5.25	4.17
ROUTED TO										
+	A-B	4.73	1	FLOW	156.	236.	273.	303.	364.	444.
				TIME	5.67	5.58	5.58	5.58	5.58	4.58
HYDROGRAPH AT										
+	302	6.14	1	FLOW	167.	259.	303.	339.	412.	488.
				TIME	5.42	5.42	5.33	5.33	5.33	5.33
2 COMBINED AT										
+	NODE	10.87	1	FLOW	315.	484.	565.	628.	758.	902.
				TIME	5.50	5.50	5.50	5.50	5.42	4.50
ROUTED TO										
+	B-C	10.87	1	FLOW	310.	478.	557.	620.	749.	888.
				TIME	5.67	5.67	5.67	5.67	5.58	4.67
OGRAPH AT										
+	303	4.49	1	FLOW	229.	343.	400.	445.	538.	636.
				TIME	5.25	4.17	4.17	4.17	4.08	4.08
HYDROGRAPH AT										

+	42B	4.08	1	FLOW	116.	180.	211.	235.	284.	336.
				TIME	5.25	5.25	5.25	5.25	5.25	4.17
3 COMBINED AT										
	NODE	19.44	1	FLOW	605.	915.	1062.	1178.	1417.	1670.
				TIME	5.33	5.33	5.33	5.33	5.25	5.25
ROUTED TO										
+	C-D	19.44	1	FLOW	601.	909.	1055.	1171.	1410.	1662.
				TIME	5.50	5.42	5.42	5.42	5.42	5.33
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	211.	331.	389.	435.	530.	629.
				TIME	5.42	5.33	5.33	5.33	5.33	5.33
2 COMBINED AT										
+	NODE	27.67	1	FLOW	811.	1239.	1443.	1604.	1938.	2291.
				TIME	5.42	5.42	5.42	5.42	5.33	5.33
ROUTED TO										
+	D-E	27.67	1	FLOW	792.	1214.	1415.	1574.	1908.	2257.
				TIME	5.75	5.75	5.75	5.67	5.67	5.67
HYDROGRAPH AT										
+	305	3.99	1	FLOW	162.	228.	269.	302.	370.	441.
				TIME	5.33	5.33	4.25	4.25	4.25	4.25
2 COMBINED AT										
	NODE	31.66	1	FLOW	914.	1394.	1622.	1805.	2183.	2580.
				TIME	5.67	5.67	5.67	5.58	5.58	5.58
ROUTED TO										
+	E-F1	31.66	1	FLOW	889.	1363.	1590.	1772.	2151.	2553.
				TIME	6.17	6.08	6.08	6.00	6.00	5.92
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	24.	52.	67.	80.	108.	138.
				TIME	6.25	6.08	6.00	6.00	5.92	5.92
2 COMBINED AT										
+	NODE	36.16	1	FLOW	913.	1415.	1657.	1852.	2259.	2691.
				TIME	6.17	6.08	6.08	6.00	6.00	5.92
HYDROGRAPH AT										
+	43	6.40	1	FLOW	123.	203.	241.	272.	336.	404.
				TIME	5.50	5.42	5.42	5.42	5.42	5.42
ROUTED TO										
+	H-I1	6.40	1	FLOW	115.	190.	227.	257.	319.	385.
				TIME	6.17	6.17	6.08	6.08	6.08	6.00
HYDROGRAPH AT										
+	309A	5.60	1	FLOW	61.	109.	134.	154.	198.	245.
				TIME	6.00	5.92	5.92	5.83	5.83	5.75
COMBINED AT										
+	I1	12.00	1	FLOW	175.	298.	359.	408.	512.	624.
				TIME	6.17	6.08	6.08	6.00	6.00	5.92
ROUTED TO										

+	I1-F1	12.00	1	FLOW	174.	297.	358.	408.	512.	623.
				TIME	7.00	6.75	6.67	6.58	6.50	6.42
COMBINED AT										
	NLVDP	48.16	1	FLOW	941.	1645.	1955.	2205.	2722.	3274.
				TIME	6.50	6.17	6.08	6.08	6.08	6.00

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
I1-F1	MANE	5.00	174.27	417.64	.05	5.00	174.13	420.00	.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3213E+02 EXCESS= .0000E+00 OUTFLOW= .3183E+02 BASIN STORAGE= .3747E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.16									
I1-F1	MANE	5.00	297.28	406.53	.09	5.00	297.13	405.00	.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5883E+02 EXCESS= .0000E+00 OUTFLOW= .5850E+02 BASIN STORAGE= .3972E+00 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= 1.24									
I1-F1	MANE	5.00	358.32	399.43	.11	5.00	358.15	400.00	.11

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7260E+02 EXCESS= .0000E+00 OUTFLOW= .7235E+02 BASIN STORAGE= .3904E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.29									
I1-F1	MANE	5.00	407.94	395.38	.13	5.00	407.74	395.00	.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8389E+02 EXCESS= .0000E+00 OUTFLOW= .8361E+02 BASIN STORAGE= .4504E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.40									
I1-F1	MANE	5.00	511.97	392.08	.17	5.00	511.58	390.00	.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1081E+03 EXCESS= .0000E+00 OUTFLOW= .1079E+03 BASIN STORAGE= .4718E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.51									
I1-F1	MANE	5.00	623.24	383.82	.21	5.00	623.17	385.00	.21

NUITY SUMMARY (AC-FT) - INFLOW= .1347E+03 EXCESS= .0000E+00 OUTFLOW= .1344E+03 BASIN STORAGE= .4386E+00 PERCENT ERROR= -.1

1TABLE 1 STATION NLVDP

			FLOW
	PLAN		1
	RATIO		1.24
	DAY MON	HRMN	
1	1	0000	.00
2	1	0005	.00
3	1	0010	.00
4	1	0015	.00
5	1	0020	.00
6	1	0025	.00
7	1	0030	.00
8	1	0035	.00
9	1	0040	.00
10	1	0045	.00
11	1	0050	.00
12	1	0055	.00
13	1	0100	.00
14	1	0105	.00
15	1	0110	.00
16	1	0115	.00
17	1	0120	.00
18	1	0125	.00
19	1	0130	.00
20	1	0135	.00
21	1	0140	.00
22	1	0145	.00
23	1	0150	.00
	1	0155	.00
	1	0200	.00
26	1	0205	.00
27	1	0210	.00
28	1	0215	.00
29	1	0220	.00
30	1	0225	.00
31	1	0230	.00
32	1	0235	.00
33	1	0240	.01
34	1	0245	.03
35	1	0250	.06
36	1	0255	.13
37	1	0300	.25
38	1	0305	.48
39	1	0310	.88
40	1	0315	1.57
41	1	0320	2.73
42	1	0325	4.68
43	1	0330	7.96
44	1	0335	13.21
45	1	0340	21.51
46	1	0345	34.16
47	1	0350	52.89
48	1	0355	79.60
[illegible]	1	0400	116.36
	1	0405	165.19

1TABLE 1	STATION		NLVDP
(CONT.)			FLOW
	PLAN		1

RATIO 1.24

PER	DAY	MON	HRMN	
	1		0410	227.75
	1		0415	304.86
53	1		0420	396.24
54	1		0425	500.30
55	1		0430	614.24
56	1		0435	733.99
57	1		0440	854.61
58	1		0445	970.99
59	1		0450	1078.57
60	1		0455	1173.76
61	1		0500	1254.69
62	1		0505	1320.98
63	1		0510	1373.90
64	1		0515	1415.77
65	1		0520	1449.95
66	1		0525	1480.42
67	1		0530	1513.43
68	1		0535	1574.13
69	1		0540	1679.74
70	1		0545	1787.25
71	1		0550	1863.50
72	1		0555	1911.11
73	1		0600	1940.47
74	1		0605	1955.15
75	1		0610	1954.86
	1		0615	1938.60
	1		0620	1906.26
78	1		0625	1858.32
79	1		0630	1795.02
80	1		0635	1719.10
81	1		0640	1632.99
82	1		0645	1539.06
83	1		0650	1439.78
84	1		0655	1337.52
85	1		0700	1233.25
86	1		0705	1130.90
87	1		0710	1031.64
88	1		0715	936.73
89	1		0720	847.15
90	1		0725	763.46
91	1		0730	686.04
92	1		0735	614.94
93	1		0740	550.19
94	1		0745	491.51
95	1		0750	438.57
96	1		0755	390.99
97	1		0800	348.50
98	1		0805	310.81
99	1		0810	277.21
100	1		0815	247.31

.E 1	STATION		NLVDP
(CONT.)			FLOW
	PLAN		1
	RATIO		1.24

PER	DAY	MON	HRMN	
101	1		0820	221.18
102	1		0825	197.93
[illegible]	1		0830	177.33
	1		0835	159.37
105	1		0840	143.31
106	1		0845	129.27
107	1		0850	116.78
108	1		0855	105.73
109	1		0900	95.99
110	1		0905	87.25
111	1		0910	79.59
112	1		0915	72.65
113	1		0920	66.55
114	1		0925	61.00
115	1		0930	56.06
116	1		0935	51.63
117	1		0940	47.58
118	1		0945	44.06
119	1		0950	40.71
120	1		0955	37.90
121	1		1000	35.24
122	1		1005	32.84
123	1		1010	30.72
124	1		1015	28.69
125	1		1020	26.93
126	1		1025	25.30
127	1		1030	23.70
[illegible]	1		1035	22.35
	1		1040	21.13
130	1		1045	19.94
131	1		1050	18.77
132	1		1055	17.78
133	1		1100	16.83
134	1		1105	15.90
135	1		1110	15.07
136	1		1115	14.31
137	1		1120	13.56
138	1		1125	12.83
139	1		1130	12.23
140	1		1135	11.62
141	1		1140	11.03
142	1		1145	10.47
143	1		1150	10.00
144	1		1155	9.52
145	1		1200	9.05
146	1		1205	8.61
147	1		1210	8.23
148	1		1215	7.85
149	1		1220	7.48
150	1		1225	7.11

1TABLE 1	STATION	NLVDP
[illegible]ONT.)		FLOW
	PLAN	1
	RATIO	1.24

PER	DAY	MON	HRMN

151	1	1230	6.82
152	1	1235	6.53
153	1	1240	6.25
154	1	1245	5.97
	1	1250	5.72
	1	1255	5.50
157	1	1300	5.29
158	1	1305	5.07
159	1	1310	4.86
160	1	1315	4.66
161	1	1320	4.50
162	1	1325	4.33
163	1	1330	4.17
164	1	1335	4.00
165	1	1340	3.84
166	1	1345	3.71
167	1	1350	3.59
168	1	1355	3.46
169	1	1400	3.33
170	1	1405	3.21
171	1	1410	3.09
172	1	1415	2.99
173	1	1420	2.90
174	1	1425	2.80
175	1	1430	2.70
176	1	1435	2.61
177	1	1440	2.51
178	1	1445	2.43
179	1	1450	2.36
	1	1455	2.29
	1	1500	2.21
182	1	1505	2.14
183	1	1510	2.07
184	1	1515	2.00
185	1	1520	1.94
186	1	1525	1.88
187	1	1530	1.83
188	1	1535	1.77
189	1	1540	1.72
190	1	1545	1.66
191	1	1550	1.61
192	1	1555	1.56
193	1	1600	1.52
194	1	1605	1.48
195	1	1610	1.44
196	1	1615	1.40
197	1	1620	1.35
198	1	1625	1.31
199	1	1630	1.27
200	1	1635	1.24

MAX	1955.15
MIN	.00
AVE	299.75

*** NORMAL END OF HEC-1 ***

```
**************************************
*                                    *
*   FLOOD HYDROGRAPH PACKAGE (HEC-1) *
*         SEPTEMBER 1990             *
*           VERSION 4.0              *
*                                    *
* RUN DATE 06/05/1992 TIME 09:07:51  *
*                                    *
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**************************************
*                                    *
*   U.S. ARMY CORPS OF ENGINEERS     *
*   HYDROLOGIC ENGINEERING CENTER    *
*        609 SECOND STREET           *
*      DAVIS, CALIFORNIA 95616       *
*         (916) 756-1104             *
*                                    *
**************************************
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X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX          XXX
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HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

5-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                    *DIAGRAM
         1          ID                    EAST AND WEST RANGE WASHES
         2          ID                         5-YR, 6-HR STORM
         3          ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
         4          ID                    BOYLE ENGINEERING CORPORATION
         5          ID                    STORM A (DARF=0.68)
         6          ID                 MODIFIED  TO MATCH JMM'S FILE
         7          ID                 NEW FUTURE DEVELOPMENT IN 306, 307, 310
         8          ID                   DARF    JR CARD
         9          ID                   .55      1.00
        10          ID                   .64      1.164
        11          ID                   .68      1.236
        12          ID                   .71      1.291
        13          ID                   .77      1.400
        14          ID                   .83      1.509
        15          IT     05      0       0      200
        16          IO      5      0       0
        17          JR   PREC    1.0   1.164   1.236   1.291   1.400   1.509
        18          VS  NLVDP
        19          VV   2.13
```

```
20          KK      41  SUB-BASIN 41 HYDROGRAPH
21          KM          SCS RUNOFF COMPUTATION, SUB-41
22          BA    4.73
23          PB    0.91
24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
31          PC   99.90  100.00  100.00
32          LS       0      79
33          UD     .66

34          KK     A-B     ROUTE FLOW TO NODE B
35          RM       4     .36     .15

36          KK     302  SUB-BASIN 302 HYDROGRAPH
37          KM          SCS RUNOFF CALCULATIONS
38          BA    6.14
39          PB    0.87
40          LS       0      79
41          UD     .82

42          KK   NODEB  COMBINE FLOW AT NODE B
43          HC       2
```



```
LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

44          KK     B-C  ROUTE FLOW TO NODE C
45          RM       2     .18     .15

46          KK     303   SUB-BASIN 303 HYDROGRAPH
47          KM          SCS RUNOFF COMPUTATION
48          BA    4.49
49          PB    0.81
50          LS       0      85
51          UD     .65

52          KK     42B  SUB-BASIN 42B HYDROGRAPH
53          KM          SCS RUNOFF COMPUTATION
54          BA    4.08
55          PB    0.83
56          LS       0      79
57          UD     .65

58          KK   NODEC  COMBINE FLOW AT NODE C
59          HC       3

60          KK     C-D   ROUTE FLOW TO NODE D
61          RM       1     .10     .15

62          KK     42A   SUB-BASIN 42A HYDROGRAPH
63          KM           SCS RUNOFF COMPUTATION
64          BA    8.23
65          PB    0.83
66          LS       0      79
```

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 67          UD     .81

 68          KK    NODED  COMBINE FLOW AT NODE D
 69          HC       2

 70          KK     D-E   ROUTE FLOW TO NODE E
 71          RM       4      .34      .15

 72          KK     305   SUB-BASIN 305 HYDROGRAPH
 73          KM            SCS RUNOFF COMPUTATION
 74          BA    3.99
 75          PB    0.75
 76          LS       0       85
 77          UD     .76

 78          KK    NODEE COMBINE FLOWS AT NODE E
 79          HC       2

 80          KK    E-F1  ROUTE FLOWS TO NODE F1
 81          RM       5      .46      .10
1                                      HEC-1 INPUT                                                    PAGE  3

LINE        ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10


 82          KK    306A  SUB-BASIN 306A HYDROGRAPH
 83          KM            SCS RUNOFF COMPUTATION
 84          BA     4.5
 85          PB    0.75
 86          LS       0       76
 87          UD    1.54

 88          KK    NODEF1 COMBINE FLOWS AT NODE F1
 89          HC       2

 90          KK      43   SUB-BASIN 43 HYDROGRAPH
 91          KM            SCS RUNOFF COMPUTATION
 92          BA    6.40
 93          PB    0.75
 94          LS       0       79
 95          UD     .88

 96          KK    H-I1ROUTE FLOWS TO NODE I1
 97          RM       7      .72      .10

 98          KK    309A   SUB-BASIN 309A HYDROGRAPH
 99          KM            SCS RUNOFF COMPUTATION
100          BA     5.6
101          PB    0.75
102          LS       0       79
103          UD    1.51

104          KK      I1   COMBINE FLOWS AT NODE I1
105          HC       2

106          KK    I1-F1   ROUTE FLOWS TO NODE F1
107          RK   19360      .01     .022        0    TRAP      120        3

108          KK    NLVDP
109          HC       2
```

110 ZZ

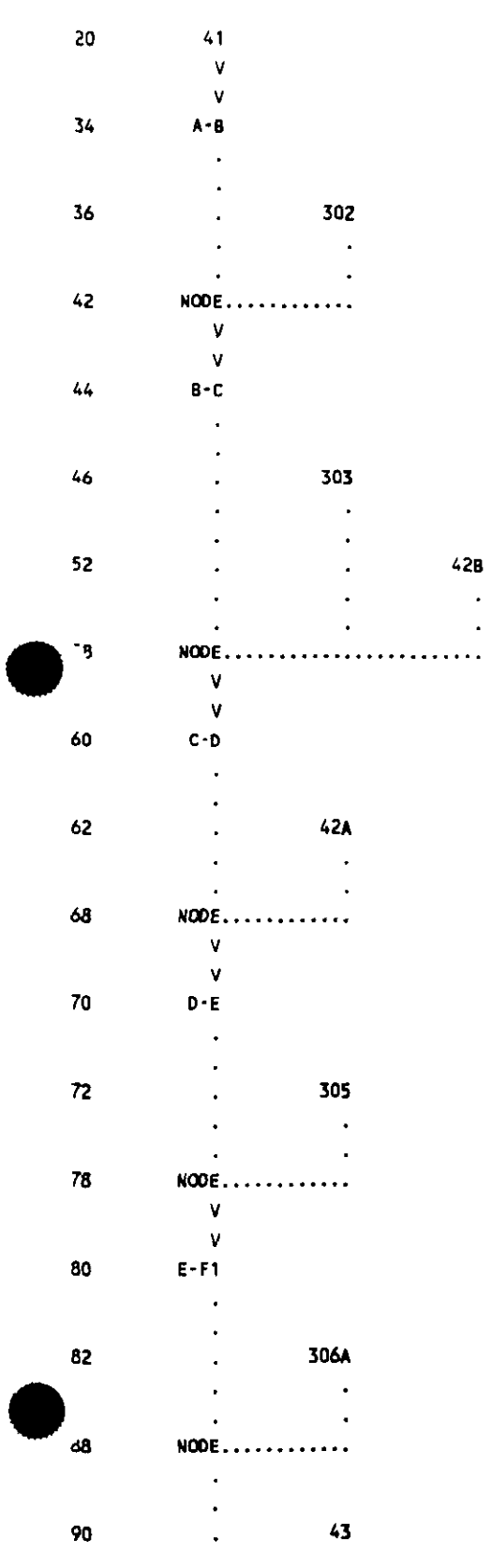
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

(V) ROUTING (----->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<-----) RETURN OF DIVERTED OR PUMPED FLOW



```
                .          V
                .          V
     96         .        H-I1
                .          .
                .          .
     98         .          .          309A
                .          .            .
                .          .            .
    104         .          I1.............
                .          V
                .          V
    106         .       I1-F1
                .          .
                .          .
    108.      NLVDP.............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*          SEPTEMBER 1990               *
*           VERSION 4.0                 *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:51 *
*                                       *
*****************************************
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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104              *
*                                       *
*****************************************
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EAST AND WEST RANGE WASHES
5-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED TO MATCH JMM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 10 OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	*HYDROGRAPH PLOT SCALE*

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	91.	150.	179.	202.	249.	299.
				TIME	5.33	5.25	5.25	5.25	5.25	5.25
ROUTED TO										
+	A-B	4.73	1	FLOW	86.	143.	170.	192.	238.	286.
				TIME	5.67	5.67	5.58	5.58	5.58	5.58
HYDROGRAPH AT										
+	302	6.14	1	FLOW	88.	153.	185.	210.	263.	320.
				TIME	5.42	5.42	5.42	5.42	5.33	5.33
2 COMBINED AT										
+	NODE	10.87	1	FLOW	171.	290.	348.	394.	491.	593.
				TIME	5.58	5.50	5.50	5.50	5.50	5.50
ROUTED TO										
+	B-C	10.87	1	FLOW	168.	285.	342.	388.	484.	586.
				TIME	5.75	5.67	5.67	5.67	5.67	5.67
OGRAPH AT										
+	303	4.49	1	FLOW	142.	205.	234.	263.	329.	399.
				TIME	5.25	5.25	5.25	4.17	4.17	4.17
HYDROGRAPH AT										

+	42B	4.08	1	FLOW	55.	98.	119.	135.	170.	207.
				TIME	5.33	5.25	5.25	5.25	5.25	5.25
3 COMBINED AT										
	NODE	19.44	1	FLOW	328.	540.	644.	728.	902.	1086.
				TIME	5.42	5.42	5.33	5.33	5.33	5.33
ROUTED TO										
+	C-D	19.44	1	FLOW	325.	537.	640.	722.	896.	1080.
				TIME	5.50	5.50	5.50	5.42	5.42	5.42
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	97.	176.	215.	246.	312.	382.
				TIME	5.42	5.42	5.42	5.42	5.42	5.33
2 COMBINED AT										
+	NODE	27.67	1	FLOW	421.	710.	853.	968.	1207.	1461.
				TIME	5.50	5.50	5.42	5.42	5.42	5.42
ROUTED TO										
+	D-E	27.67	1	FLOW	410.	694.	834.	947.	1183.	1433.
				TIME	5.83	5.83	5.75	5.75	5.75	5.75
HYDROGRAPH AT										
+	305	3.99	1	FLOW	95.	143.	165.	183.	219.	266.
				TIME	5.33	5.33	5.33	5.33	5.33	4.25
2 COMBINED AT										
•	NODE	31.66	1	FLOW	478.	800.	959.	1087.	1355.	1639.
				TIME	5.75	5.75	5.67	5.67	5.67	5.67
ROUTED TO										
+	E-F1	31.66	1	FLOW	461.	778.	933.	1059.	1325.	1607.
				TIME	6.25	6.17	6.17	6.08	6.08	6.08
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	5.	21.	30.	38.	55.	76.
				TIME	6.50	6.25	6.17	6.17	6.08	6.00
2 COMBINED AT										
+	NODE	36.16	1	FLOW	466.	799.	963.	1097.	1380.	1683.
				TIME	6.25	6.17	6.17	6.08	6.08	6.08
HYDROGRAPH AT										
+	43	6.40	1	FLOW	43.	89.	113.	132.	173.	217.
				TIME	5.58	5.50	5.50	5.50	5.42	5.42
ROUTED TO										
+	H-I1	6.40	1	FLOW	39.	82.	105.	123.	162.	204.
				TIME	6.33	6.25	6.17	6.17	6.17	6.08
HYDROGRAPH AT										
+	309A	5.60	1	FLOW	25.	56.	72.	85.	114.	147.
				TIME	6.17	6.08	6.00	6.00	5.92	5.83
[redacted]MBINED AT										
+	I1	12.00	1	FLOW	64.	138.	176.	207.	274.	348.
				TIME	6.25	6.17	6.17	6.17	6.08	6.08
ROUTED TO										

+	I1-F1	12.00	1	FLOW	64.	137.	175.	206.	274.	347.
				TIME	7.50	7.08	7.00	6.92	6.75	6.67

2 COMBINED AT

	NLVDP	48.16	1	FLOW	466.	799.	999.	1203.	1582.	1968.
				TIME	6.25	6.17	6.42	6.33	6.17	6.17

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
I1-F1	MANE	5.00	64.01	451.03	.02	5.00	63.86	450.00	.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1061E+02 EXCESS= .0000E+00 OUTFLOW= .1118E+02 BASIN STORAGE= .3460E+00 PERCENT ERROR= -8.7

FOR PLAN = 1 RATIO= 1.16									
I1-F1	MANE	5.00	137.35	426.64	.04	5.00	137.12	425.00	.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2486E+02 EXCESS= .0000E+00 OUTFLOW= .2451E+02 BASIN STORAGE= .4032E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.24									
I1-F1	MANE	5.00	175.03	421.50	.05	5.00	175.02	420.00	.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3276E+02 EXCESS= .0000E+00 OUTFLOW= .3242E+02 BASIN STORAGE= .4110E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.29									
I1-F1	MANE	5.00	206.37	413.11	.06	5.00	206.11	415.00	.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3942E+02 EXCESS= .0000E+00 OUTFLOW= .3911E+02 BASIN STORAGE= .3990E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.40									
I1-F1	MANE	5.00	273.96	406.28	.08	5.00	273.55	405.00	.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5413E+02 EXCESS= .0000E+00 OUTFLOW= .5381E+02 BASIN STORAGE= .4330E+00 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= 1.51									
I1-F1	MANE	5.00	347.29	400.57	.11	5.00	347.13	400.00	.11

'INUITY SUMMARY (AC-FT) - INFLOW= .7074E+02 EXCESS= .0000E+00 OUTFLOW= .7042E+02 BASIN STORAGE= .4461E+00 PERCENT ERROR= -.2

1TABLE 1 STATION NLVDP

			FLOW
	PLAN		1
	RATIO		1.24
	DAY	MON HRMN	
1	1	0000	.00
2	1	0005	.00
3	1	0010	.00
4	1	0015	.00
5	1	0020	.00
6	1	0025	.00
7	1	0030	.00
8	1	0035	.00
9	1	0040	.00
10	1	0045	.00
11	1	0050	.00
12	1	0055	.00
13	1	0100	.00
14	1	0105	.00
15	1	0110	.00
16	1	0115	.00
17	1	0120	.00
18	1	0125	.00
19	1	0130	.00
20	1	0135	.00
21	1	0140	.00
22	1	0145	.00
23	1	0150	.00
	1	0155	.00
	1	0200	.00
26	1	0205	.00
27	1	0210	.00
28	1	0215	.00
29	1	0220	.00
30	1	0225	.00
31	1	0230	.00
32	1	0235	.00
33	1	0240	.00
34	1	0245	.00
35	1	0250	.00
36	1	0255	.00
37	1	0300	.00
38	1	0305	.00
39	1	0310	.00
40	1	0315	.02
41	1	0320	.08
42	1	0325	.27
43	1	0330	.73
44	1	0335	1.75
45	1	0340	3.81
46	1	0345	7.62
47	1	0350	14.06
48	1	0355	24.13
'o	1	0400	38.92
	1	0405	59.48

1TABLE 1	STATION	NLVOP
(CONT.)		FLOW
	PLAN	1

RATIO 1.24

PER	DAY	MON	HRMN	
[redacted]	1		0410	86.67
.	1		0415	120.98
53	1		0420	162.38
54	1		0425	210.35
55	1		0430	263.74
56	1		0435	320.87
57	1		0440	379.57
58	1		0445	437.56
59	1		0450	492.73
60	1		0455	543.45
61	1		0500	588.79
62	1		0505	628.64
63	1		0510	663.65
64	1		0515	695.00
65	1		0520	724.21
66	1		0525	752.81
67	1		0530	781.97
68	1		0535	812.32
69	1		0540	843.67
70	1		0545	875.04
71	1		0550	904.72
72	1		0555	930.56
73	1		0600	950.24
74	1		0605	961.73
75	1		0610	964.57
'	1		0615	966.37
[redacted]	1		0620	981.33
78	1		0625	998.90
79	1		0630	995.07
80	1		0635	969.39
81	1		0640	931.39
82	1		0645	887.09
83	1		0650	837.10
84	1		0655	783.67
85	1		0700	728.69
86	1		0705	673.33
87	1		0710	618.71
88	1		0715	565.13
89	1		0720	513.89
90	1		0725	465.66
91	1		0730	420.64
92	1		0735	379.00
93	1		0740	340.77
94	1		0745	305.92
95	1		0750	274.31
96	1		0755	245.79
97	1		0800	220.18
98	1		0805	197.30
99	1		0810	176.90
100	1		0815	158.74

[redacted] E 1 STATION NLVDP
(CONT.) FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
101	1		0820	142.61
02	1		0825	128.33
	1		0830	115.73
	1		0835	104.55
105	1		0840	94.59
106	1		0845	85.84
107	1		0850	78.05
108	1		0855	71.07
109	1		0900	64.95
110	1		0905	59.45
111	1		0910	54.50
112	1		0915	50.15
113	1		0920	46.16
114	1		0925	42.64
115	1		0930	39.41
116	1		0935	36.52
117	1		0940	33.90
118	1		0945	31.51
119	1		0950	29.36
120	1		0955	27.40
121	1		1000	25.64
122	1		1005	24.02
123	1		1010	22.54
124	1		1015	21.20
125	1		1020	19.95
126	1		1025	18.83
127	1		1030	17.74
	1		1035	16.80
	1		1040	15.89
130	1		1045	15.05
131	1		1050	14.28
132	1		1055	13.52
133	1		1100	12.87
134	1		1105	12.22
135	1		1110	11.62
136	1		1115	11.07
137	1		1120	10.53
138	1		1125	10.03
139	1		1130	9.58
140	1		1135	9.15
141	1		1140	8.71
142	1		1145	8.32
143	1		1150	7.95
144	1		1155	7.59
145	1		1200	7.25
146	1		1205	6.94
147	1		1210	6.64
148	1		1215	6.34
149	1		1220	6.08
150	1		1225	5.82

1TABLE 1	STATION	NLVDP
NT.)		FLOW
	PLAN	1
	RATIO	1.24

PER	DAY	MON	HRMN

151	1	1230	5.57
152	1	1235	5.34
153	1	1240	5.13
154	1	1245	4.93
	1	1250	4.72
	1	1255	4.55
157	1	1300	4.38
158	1	1305	4.21
159	1	1310	4.04
160	1	1315	3.90
161	1	1320	3.76
162	1	1325	3.62
163	1	1330	3.48
164	1	1335	3.36
165	1	1340	3.25
166	1	1345	3.14
167	1	1350	3.02
168	1	1355	2.92
169	1	1400	2.82
170	1	1405	2.73
171	1	1410	2.64
172	1	1415	2.55
173	1	1420	2.47
174	1	1425	2.39
175	1	1430	2.32
176	1	1435	2.24
177	1	1440	2.16
178	1	1445	2.10
179	1	1450	2.04
	1	1455	1.98
	1	1500	1.92
182	1	1505	1.85
183	1	1510	1.80
184	1	1515	1.75
185	1	1520	1.70
186	1	1525	1.65
187	1	1530	1.60
188	1	1535	1.56
189	1	1540	1.51
190	1	1545	1.47
191	1	1550	1.43
192	1	1555	1.39
193	1	1600	1.35
194	1	1605	1.31
195	1	1610	1.28
196	1	1615	1.24
197	1	1620	1.21
198	1	1625	1.18
199	1	1630	1.15
200	1	1635	1.12

MAX	998.90
MIN	.00
AVE	158.67

*** NORMAL END OF HEC-1 ***

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:59 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

HEC-1 MODEL

UPDATED VERSION

RANGE WASH BASIN

ABOVE DIKE

2-YR

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
        LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
                      *DIAGRAM
            1         ID                    EAST AND WEST RANGE WASHES
            2         ID                        2-YR, 6-HR STORM
            3         ID              FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
            4         ID                      BOYLE ENGINEERING CORPORATION
            5         ID                      STORM A (DARF=0.68)
            6         ID                    MODIFIED  TO MATCH JMM'S FILE
            7         ID                    NEW FUTURE DEVELOPMENT IN 306, 307, 310
            8         ID                      DARF    JR CARD
            9         ID                      .55     1.00
           10         ID                      .64     1.164
           11         ID                      .68     1.236
           12         ID                      .71     1.291
           13         ID                      .77     1.400
           14         ID                      .83     1.509
           15         IT     05       0       0      200
           16         IO      5       0       0
           17         JR    PREC     1.0   1.164   1.236   1.291   1.400   1.509
           18         VS   NLVDP
           19         VV    2.13
```

```
 20          KK      41  SUB-BASIN 41 HYDROGRAPH
 21          KM          SCS RUNOFF COMPUTATION, SUB-41
 22          BA    4.73
 23          PB    0.60
 24          PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
 25          PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
 26          PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
 27          PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
 28          PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
 29          PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
 30          PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
 31          PC   99.90  100.00  100.00
 32          LS       0      79
 33          UD     .66

 34          KK     A-B     ROUTE FLOW TO NODE B
 35          RM       4     .36     .15

 36          KK     302  SUB-BASIN 302 HYDROGRAPH
 37          KM          SCS RUNOFF CALCULATIONS
 38          BA    6.14
 39          PB    0.60
 40          LS       0      79
 41          UD     .82

 42          KK   NODEB  COMBINE FLOW AT NODE B
 43          HC       2
```



```
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 44          KK     B-C  ROUTE FLOW TO NODE C
 45          RM       2     .18     .15

 46          KK     303   SUB-BASIN 303 HYDROGRAPH
 47          KM           SCS RUNOFF COMPUTATION
 48          BA    4.49
 49          PB    0.60
 50          LS       0      85
 51          UD     .65

 52          KK     42B  SUB-BASIN 42B HYDROGRAPH
 53          KM          SCS RUNOFF COMPUTATION
 54          BA    4.08
 55          PB    0.60
 56          LS       0      79
 57          UD     .65

 58          KK   NODEC  COMBINE FLOW AT NODE C
 59          HC       3

 60          KK     C-D   ROUTE FLOW TO NODE D
 61          RM       1     .10     .15

 62          KK     42A   SUB-BASIN 42A HYDROGRAPH
 63          KM           SCS RUNOFF COMPUTATION
 64          BA    8.23
 65          PB    0.60
 66          LS       0      79
```

```
 67          UD     .81

 68          KK     NODED  COMBINE FLOW AT NODE D
 69          HC       2

 70          KK     D-E    ROUTE FLOW TO NODE E
 71          RM       4      .34      .15

 72          KK     305    SUB-BASIN 305 HYDROGRAPH
 73          KM             SCS RUNOFF COMPUTATION
 74          BA    3.99
 75          PB    0.55
 76          LS       0       85
 77          UD     .76

 78          KK     NODEE COMBINE FLOWS AT NODE E
 79          HC       2

 80          KK     E-F1   ROUTE FLOWS TO NODE F1
 81          RM       5      .46      .10
```



```
LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 82          KK     306A   SUB-BASIN 306A HYDROGRAPH
 83          KM             SCS RUNOFF COMPUTATION
 84          BA     4.5
 85          PB    0.55
 86          LS       0       76
 87          UD    1.54

 88          KK     NODEF1 COMBINE FLOWS AT NODE F1
 89          HC       2

 90          KK      43    SUB-BASIN 43 HYDROGRAPH
 91          KM            SCS RUNOFF COMPUTATION
 92          BA    6.40
 93          PB    0.55
 94          LS       0       79
 95          UD     .88

 96          KK     H-I1ROUTE FLOWS TO NODE I1
 97          RM       7      .72      .10

 98          KK     309A   SUB-BASIN 309A HYDROGRAPH
 99          KM            SCS RUNOFF COMPUTATION
100          BA     5.6
101          PB    0.55
102          LS       0       79
103          UD    1.51

104          KK      I1    COMBINE FLOWS AT NODE I1
105          HC       2

106          KK    I1-F1   ROUTE FLOWS TO NODE F1
107          RK    19360     .01     .022        0    TRAP      120        3

108          KK    NLVDP
109          HC       2
```

110 ZZ

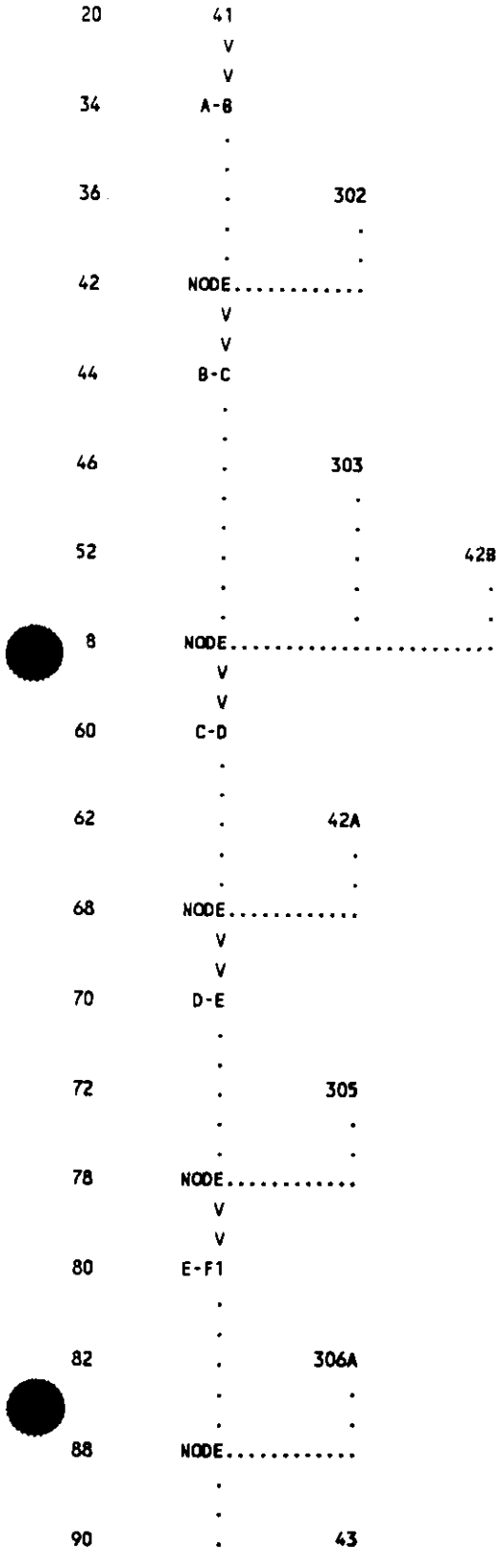
1

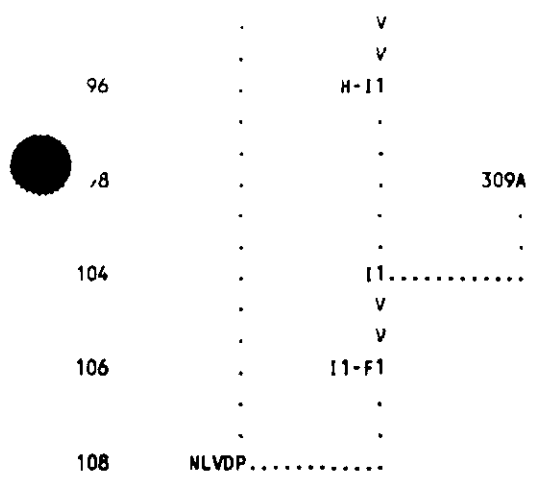
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT

E (V) ROUTING (---->) DIVERSION OR PUMP FLOW

NO. (.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  06/05/1992  TIME  09:07:59 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104               *
*                                       *
*****************************************
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EAST AND WEST RANGE WASHES
2-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
BOYLE ENGINEERING CORPORATION
STORM A (DARF=0.68)
MODIFIED TO MATCH JMM'S FILE
NEW FUTURE DEVELOPMENT IN 306, 307, 310

DARF	JR CARD
.55	1.00
.64	1.164
.68	1.236
.71	1.291
.77	1.400
.83	1.509

16 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NLVDP								
VV	VARIABLE CODE	2.13	.00	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 1.16 1.24 1.29 1.40 1.51

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

*** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION= 1

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
					1.00	1.16	1.24	1.29	1.40	1.51
HYDROGRAPH AT										
+	41	4.73	1	FLOW	4.	24.	36.	45.	66.	89.
				TIME	5.58	5.42	5.33	5.33	5.33	5.33
ROUTED TO										
+	A-8	4.73	1	FLOW	4.	23.	34.	43.	63.	85.
				TIME	5.92	5.75	5.75	5.67	5.67	5.67
HYDROGRAPH AT										
	302	6.14	1	FLOW	5.	27.	40.	51.	76.	103.
				TIME	5.75	5.50	5.50	5.50	5.42	5.42
2 COMBINED AT										
+	NODE	10.87	1	FLOW	8.	48.	72.	92.	135.	183.
				TIME	5.83	5.67	5.67	5.58	5.58	5.58

ROUTED TO										
+	B-C	10.87	1	FLOW	8.	47.	71.	90.	133.	180.
				TIME	6.08	5.83	5.83	5.75	5.75	5.75
[redacted]ROGRAPH AT										
+	303	4.49	1	FLOW	56.	94.	112.	126.	155.	186.
				TIME	5.25	5.25	5.25	5.25	5.25	5.25
HYDROGRAPH AT										
+	42B	4.08	1	FLOW	4.	21.	31.	40.	58.	77.
				TIME	5.50	5.33	5.33	5.33	5.33	5.25
3 COMBINED AT										
+	NODE	19.44	1	FLOW	61.	141.	188.	227.	311.	404.
				TIME	5.33	5.42	5.42	5.42	5.42	5.42
ROUTED TO										
+	C-D	19.44	1	FLOW	60.	139.	186.	224.	308.	400.
				TIME	5.42	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT										
+	42A	8.23	1	FLOW	6.	36.	54.	69.	102.	139.
				TIME	5.75	5.50	5.50	5.50	5.42	5.42
2 COMBINED AT										
+	NODE	27.67	1	FLOW	66.	175.	240.	294.	410.	538.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50
[redacted]ED TO										
	D-E	27.67	1	FLOW	63.	169.	232.	285.	398.	524.
				TIME	5.83	5.83	5.83	5.83	5.83	5.83
HYDROGRAPH AT										
+	305	3.99	1	FLOW	32.	58.	71.	81.	103.	126.
				TIME	5.42	5.33	5.33	5.33	5.33	5.33
2 COMBINED AT										
+	NODE	31.66	1	FLOW	89.	212.	283.	343.	473.	617.
				TIME	5.67	5.75	5.75	5.75	5.75	5.75
ROUTED TO										
+	E-F1	31.66	1	FLOW	85.	203.	272.	330.	456.	596.
				TIME	6.17	6.25	6.25	6.25	6.17	6.17
HYDROGRAPH AT										
+	306A	4.50	1	FLOW	0.	0.	1.	2.	7.	15.
				TIME	.08	7.17	6.75	6.58	6.42	6.33
2 COMBINED AT										
+	NODE	36.16	1	FLOW	85.	203.	273.	332.	463.	611.
				TIME	6.17	6.25	6.25	6.25	6.17	6.17
HYDROGRAPH AT										
[redacted]	43	6.40	1	FLOW	0.	12.	21.	30.	49.	72.
				TIME	6.33	5.67	5.67	5.58	5.58	5.50
ROUTED TO										
+	H-I1	6.40	1	FLOW	0.	11.	19.	27.	45.	66.
				TIME	7.08	6.42	6.42	6.33	6.25	6.25

HYDROGRAPH AT

+	309A	5.60	1	FLOW	0.	7.	12.	17.	30.	44.
				TIME	6.92	6.42	6.33	6.25	6.17	6.08

COMBINED AT

+	I1	12.00	1	FLOW	1.	17.	32.	45.	75.	110.
				TIME	7.08	6.42	6.33	6.33	6.25	6.25

ROUTED TO

+	I1-F1	12.00	1	FLOW	1.	17.	32.	45.	74.	109.
				TIME	15.25	8.58	8.00	7.75	7.42	7.25

2 COMBINED AT

+	NLVDP	48.16	1	FLOW	85.	203.	273.	332.	463.	611.
				TIME	6.17	6.25	6.25	6.25	6.17	6.17

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL			
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
I1-F1	MANE	5.00	.52	915.46	.00	5.00	.52	915.00	.00

NUITY SUMMARY (AC-FT) - INFLOW= .8055E-01 EXCESS= .0000E+00 OUTFLOW= .5838E-01 BASIN STORAGE= .2082E+00 PERCENT ERROR=-231.0

FOR PLAN = 1 RATIO= 1.16									
I1-F1	MANE	5.00	17.31	512.78	.01	5.00	17.29	515.00	.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2726E+01 EXCESS= .0000E+00 OUTFLOW= .3427E+01 BASIN STORAGE= .3079E+00 PERCENT ERROR= -37.0

FOR PLAN = 1 RATIO= 1.24									
I1-F1	MANE	5.00	31.68	481.15	.01	5.00	31.60	485.00	.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5006E+01 EXCESS= .0000E+00 OUTFLOW= .5994E+01 BASIN STORAGE= .3267E+00 PERCENT ERROR= -26.3

FOR PLAN = 1 RATIO= 1.29									
I1-F1	MANE	5.00	44.60	468.56	.01	5.00	44.51	465.00	.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7181E+01 EXCESS= .0000E+00 OUTFLOW= .7945E+01 BASIN STORAGE= .3452E+00 PERCENT ERROR= -15.4

FOR PLAN = 1 RATIO= 1.40									
I1-F1	MANE	5.00	74.41	449.07	.02	5.00	74.39	445.00	.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1255E+02 EXCESS= .0000E+00 OUTFLOW= .1294E+02 BASIN STORAGE= .3746E+00 PERCENT ERROR= -6.1

FOR PLAN = 1 RATIO= 1.51

11-F1	MANE	5.00	109.28	434.45	.03	5.00	109.19	435.00	.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1926E+02 EXCESS= .0000E+00 OUTFLOW= .1897E+02 BASIN STORAGE= .3949E+00 PERCENT ERROR= -.5

1TABLE 1 STATION NLVDP
FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
1	1		0000	.00
2	1		0005	.00
3	1		0010	.00
4	1		0015	.00
5	1		0020	.00
6	1		0025	.00
7	1		0030	.00
8	1		0035	.00
9	1		0040	.00
10	1		0045	.00
11	1		0050	.00
12	1		0055	.00
13	1		0100	.00
	1		0105	.00
	1		0110	.00
16	1		0115	.00
17	1		0120	.00
18	1		0125	.00
19	1		0130	.00
20	1		0135	.00
21	1		0140	.00
22	1		0145	.00
23	1		0150	.00
24	1		0155	.00
25	1		0200	.00
26	1		0205	.00
27	1		0210	.00
28	1		0215	.00
29	1		0220	.00
30	1		0225	.00
31	1		0230	.00
32	1		0235	.00
33	1		0240	.00
34	1		0245	.00
35	1		0250	.00
36	1		0255	.00
37	1		0300	.00
38	1		0305	.00
	1		0310	.00
	1		0315	.00
41	1		0320	.00
42	1		0325	.00
43	1		0330	.01
44	1		0335	.04

45	1	0340	.16
46	1	0345	.47
47	1	0350	1.16
48	1	0355	2.45
	1	0400	4.60
	1	0405	7.93

1TABLE 1 STATION NLVOP
(CONT.) FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
51	1		0410	12.70
52	1		0415	19.11
53	1		0420	27.19
54	1		0425	36.81
55	1		0430	47.68
56	1		0435	59.38
57	1		0440	71.36
58	1		0445	83.07
59	1		0450	94.06
60	1		0455	104.02
61	1		0500	112.90
62	1		0505	120.93
63	1		0510	128.58
64	1		0515	136.47
65	1		0520	145.24
	1		0525	155.48
	1		0530	167.53
68	1		0535	181.45
69	1		0540	196.90
70	1		0545	213.21
71	1		0550	229.40
72	1		0555	244.37
73	1		0600	256.98
74	1		0605	266.27
75	1		0610	271.58
76	1		0615	272.62
77	1		0620	269.47
78	1		0625	262.53
79	1		0630	252.40
80	1		0635	239.77
81	1		0640	225.35
82	1		0645	209.78
83	1		0650	193.61
84	1		0655	177.30
85	1		0700	161.19
86	1		0705	145.55
87	1		0710	130.57
88	1		0715	116.40
89	1		0720	103.14
90	1		0725	90.87
[illegible]	1		0730	79.63
	1		0735	69.41
93	1		0740	60.22
94	1		0745	52.00
95	1		0750	69.15
96	1		0755	69.43

97	1	0800	64.33
98	1	0805	59.47
99	1	0810	54.91
100	1	0815	50.71

[redacted]			
SCE 1		STATION	NLVDP
(CONT.)			FLOW
		PLAN	1
		RATIO	1.24

PER	DAY	MON	HRMN	
101	1		0820	46.60
102	1		0825	42.89
103	1		0830	39.58
104	1		0835	36.56
105	1		0840	33.82
106	1		0845	31.34
107	1		0850	29.08
108	1		0855	27.03
109	1		0900	25.17
110	1		0905	23.48
111	1		0910	21.96
112	1		0915	20.57
113	1		0920	19.29
114	1		0925	18.13
115	1		0930	17.05
116	1		0935	16.07
117	1		0940	15.16
[redacted]	1		0945	14.32
	1		0950	13.54
120	1		0955	12.82
121	1		1000	12.16
122	1		1005	11.54
123	1		1010	10.96
124	1		1015	10.43
125	1		1020	9.92
126	1		1025	9.45
127	1		1030	9.02
128	1		1035	8.60
129	1		1040	8.21
130	1		1045	7.84
131	1		1050	7.49
132	1		1055	7.17
133	1		1100	6.86
134	1		1105	6.57
135	1		1110	6.29
136	1		1115	6.03
137	1		1120	5.78
138	1		1125	5.54
139	1		1130	5.32
140	1		1135	5.11
141	1		1140	4.91
142	1		1145	4.71
[redacted]	1		1150	4.53
	1		1155	4.36
[redacted]	1		1200	4.19
146	1		1205	4.03
147	1		1210	3.88
148	1		1215	3.74

149	1	1220	3.60
150	1	1225	3.47

TABLE 1 STATION NLVDP
T.) FLOW
PLAN 1
RATIO 1.24

PER	DAY	MON	HRMN	
151	1		1230	3.35
152	1		1235	3.23
153	1		1240	3.12
154	1		1245	3.01
155	1		1250	2.90
156	1		1255	2.80
157	1		1300	2.71
158	1		1305	2.62
159	1		1310	2.53
160	1		1315	2.45
161	1		1320	2.37
162	1		1325	2.29
163	1		1330	2.22
164	1		1335	2.15
165	1		1340	2.08
166	1		1345	2.02
167	1		1350	1.95
168	1		1355	1.89
169	1		1400	1.84
	1		1405	1.78
	1		1410	1.73
172	1		1415	1.68
173	1		1420	1.63
174	1		1425	1.58
175	1		1430	1.54
176	1		1435	1.49
177	1		1440	1.45
178	1		1445	1.41
179	1		1450	1.37
180	1		1455	1.33
181	1		1500	1.29
182	1		1505	1.26
183	1		1510	1.23
184	1		1515	1.19
185	1		1520	1.16
186	1		1525	1.13
187	1		1530	1.10
188	1		1535	1.07
189	1		1540	1.04
190	1		1545	1.02
191	1		1550	.99
192	1		1555	.97
193	1		1600	.94
194	1		1605	.92
[illegible]	1		1610	.90
	1		1615	.87
[illegible]	1		1620	.85
198	1		1625	.83
199	1		1630	.81
200	1		1635	.79

MAX	272.62
MIN	.00
AVE	38.35

*** NORMAL END OF HEC-1 ***

SUMMARY OF DIKE DESIGN FLOWS

SUMMARY OF HYDROGRAPHS

RANGE WASH

RANGE WASH HYDROLOGY
FN: HYDNEW.CAL
DATE: 06/04/92 BY: TBR

HYDROGRPAHS FROM HEC1 FILES FOR
ABOVE DIKE, MODIFIED TO MATCH JN

(DISCHARGE IN CFS)

TIME (MIN)	2 YR DIKE	5 YR DIKE	10 YR DIKE	25 YR DIKE	50 YR DIKE	100 YR DIKE
0	.00	.00	.00	.00	.00	.00
5	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00
15	.00	.00	.00	.00	.00	.00
20	.00	.00	.00	.00	.00	.00
25	.00	.00	.00	.00	.00	.00
30	.00	.00	.00	.00	.00	.00
35	.00	.00	.00	.00	.00	.00
40	.00	.00	.00	.00	.00	.00
45	.00	.00	.00	.00	.00	.00
50	.00	.00	.00	.00	.00	.00
55	.00	.00	.00	.00	.00	.00
60	.00	.00	.00	.00	.00	.00
65	.00	.00	.00	.00	.00	.00
70	.00	.00	.00	.00	.00	.00
75	.00	.00	.00	.00	.00	.00
80	.00	.00	.00	.00	.00	.02
85	.00	.00	.00	.00	.00	.05
90	.00	.00	.00	.00	.00	.12
95	.00	.00	.00	.00	.01	.28
100	.00	.00	.00	.00	.02	.59
105	.00	.00	.00	.00	.07	1.13
110	.00	.00	.00	.00	.19	2.04
115	.00	.00	.00	.00	.44	3.47
120	.00	.00	.00	.01	.93	5.60
125	.00	.00	.00	.04	1.78	8.62
130	.00	.00	.00	.10	3.16	12.74
135	.00	.00	.00	.26	5.28	18.17
140	.00	.00	.00	.56	8.31	25.08
145	.00	.00	.00	1.10	12.44	33.63
150	.00	.00	.00	1.97	17.77	43.91
155	.00	.00	.00	3.26	24.35	55.95
160	.00	.00	.01	5.05	32.13	69.72
165	.00	.00	.03	7.39	40.98	85.11
170	.00	.00	.06	10.29	50.68	101.96
175	.00	.00	.13	13.69	61.00	120.05
180	.00	.00	.25	17.55	71.73	139.21
185	.00	.00	.48	21.82	82.78	159.36
190	.00	.00	.88	26.51	94.35	180.77
195	.00	.02	1.57	31.79	106.83	203.85

200	.00	.08	2.73	38.06	121.21	229.85
205	.00	.27	4.68	46.13	139.05	260.74
210	.01	.73	7.96	57.27	162.77	299.61
215	.04	1.75	13.21	72.90	194.86	349.65
220	.16	3.81	21.51	95.46	239.47	416.21
225	.47	7.62	34.16	127.70	300.94	504.85
230	1.16	14.06	52.89	173.41	385.20	623.11
235	2.45	24.13	79.60	236.55	498.10	778.36
240	4.60	38.92	116.36	321.38	645.73	978.14
245	7.93	59.48	165.19	431.59	832.97	1228.25
250	12.70	86.67	227.75	569.93	1063.09	1532.33
255	19.11	120.98	304.86	737.15	1336.15	1889.80
260	27.19	162.38	396.24	931.52	1648.38	2295.77
265	36.81	210.35	500.30	1148.71	1992.01	2741.64
270	47.68	263.74	614.24	1382.11	2356.10	3219.17
275	59.38	320.87	733.99	1622.87	2726.42	3741.64
280	71.36	379.57	854.61	1860.82	3088.83	4315.06
285	83.07	437.56	970.99	2085.64	3440.52	4916.51
290	94.06	492.73	1078.57	2288.50	3808.13	5491.25
295	104.02	543.45	1173.76	2462.71	4212.92	5983.71
300	112.90	588.79	1254.69	2608.59	4607.24	6369.63
305	120.93	628.64	1320.98	2746.66	4914.60	6653.68
310	128.58	663.65	1373.90	2925.00	5121.73	6847.06
315	136.47	695.00	1415.77	3135.50	5249.84	6962.69
320	145.24	724.21	1449.95	3295.07	5325.97	7019.44
325	155.48	752.81	1480.42	3385.52	5365.36	7028.39
330	167.53	781.97	1513.43	3442.01	5382.39	7008.97
335	181.45	812.32	1574.13	3482.19	5382.58	6973.97
340	196.90	843.67	1679.74	3514.48	5376.54	6932.63
345	213.21	875.04	1787.25	3541.84	5367.56	6889.00
350	229.40	904.72	1863.50	3562.82	5354.51	6841.71
355	244.37	930.56	1911.11	3575.70	5333.07	6786.31
360	256.98	950.24	1940.47	3576.16	5297.46	6715.31
365	266.27	961.73	1955.15	3559.75	5240.65	6620.75
370	271.58	964.57	1954.86	3522.46	5156.90	6495.33
375	272.62	966.37	1938.60	3461.24	5041.72	6333.76
380	269.47	981.33	1906.26	3375.05	4894.07	6134.58
385	262.53	998.90	1858.32	3264.95	4714.79	5897.96
390	252.40	995.07	1795.02	3133.07	4506.80	5626.44
395	239.77	969.39	1719.10	2981.99	4273.39	5326.15
400	225.35	931.39	1632.99	2815.91	4020.76	5004.81
405	209.78	887.09	1539.06	2638.90	3755.60	4668.75
410	193.61	837.10	1439.78	2455.38	3483.55	4325.48
415	177.30	783.67	1337.52	2269.36	3210.14	3981.70
420	161.19	728.69	1233.25	2084.48	2940.39	3643.20
425	145.55	673.33	1130.90	1903.75	2678.28	3314.57
430	130.57	618.71	1031.64	1729.77	2427.13	3000.13
435	116.40	565.13	936.73	1564.57	2189.68	2703.66
440	103.14	513.89	847.15	1409.64	1967.85	2427.33
445	90.87	465.66	763.46	1265.76	1762.46	2171.81
450	79.63	420.64	686.04	1133.32	1573.92	1937.45
455	69.41	379.00	614.94	1012.30	1402.62	1723.88
460	60.22	340.77	550.19	902.37	1247.63	1532.24
465	52.00	305.92	491.51	803.06	1108.03	1359.59
470	69.15	274.31	438.57	714.18	982.78	1204.49
475	69.43	245.79	390.99	634.82	871.19	1066.96
480	64.33	220.18	348.50	564.04	772.38	944.66
485	59.47	197.30	310.81	500.94	684.38	835.26
490	54.91	176.90	277.21	445.28	606.24	740.04
495	50.71	158.74	247.31	396.13	538.06	655.04

500	46.60	142.61	221.18	352.52	477.53	581.08
505	42.89	128.33	197.93	314.17	424.13	515.65
510	39.58	115.73	177.33	280.55	377.66	458.10
515	36.56	104.55	159.37	250.66	336.28	407.57
520	33.82	94.59	143.31	224.76	300.59	363.41
525	31.34	85.84	129.27	201.66	269.21	324.40
530	29.08	78.05	116.78	181.59	241.13	290.86
535	27.03	71.07	105.73	163.68	216.78	261.97
540	25.17	64.95	95.99	147.94	195.03	235.87
545	23.48	59.45	87.25	133.85	176.10	212.39
550	21.96	54.50	79.59	121.55	159.07	190.88
555	20.57	50.15	72.65	110.44	144.35	172.93
560	19.29	46.16	66.55	100.72	130.84	156.25
565	18.13	42.64	61.00	91.89	119.64	141.80

4. AVERAGE ANNUAL YIELD

AVERAGE ANNUAL SEDIMENT YIELD

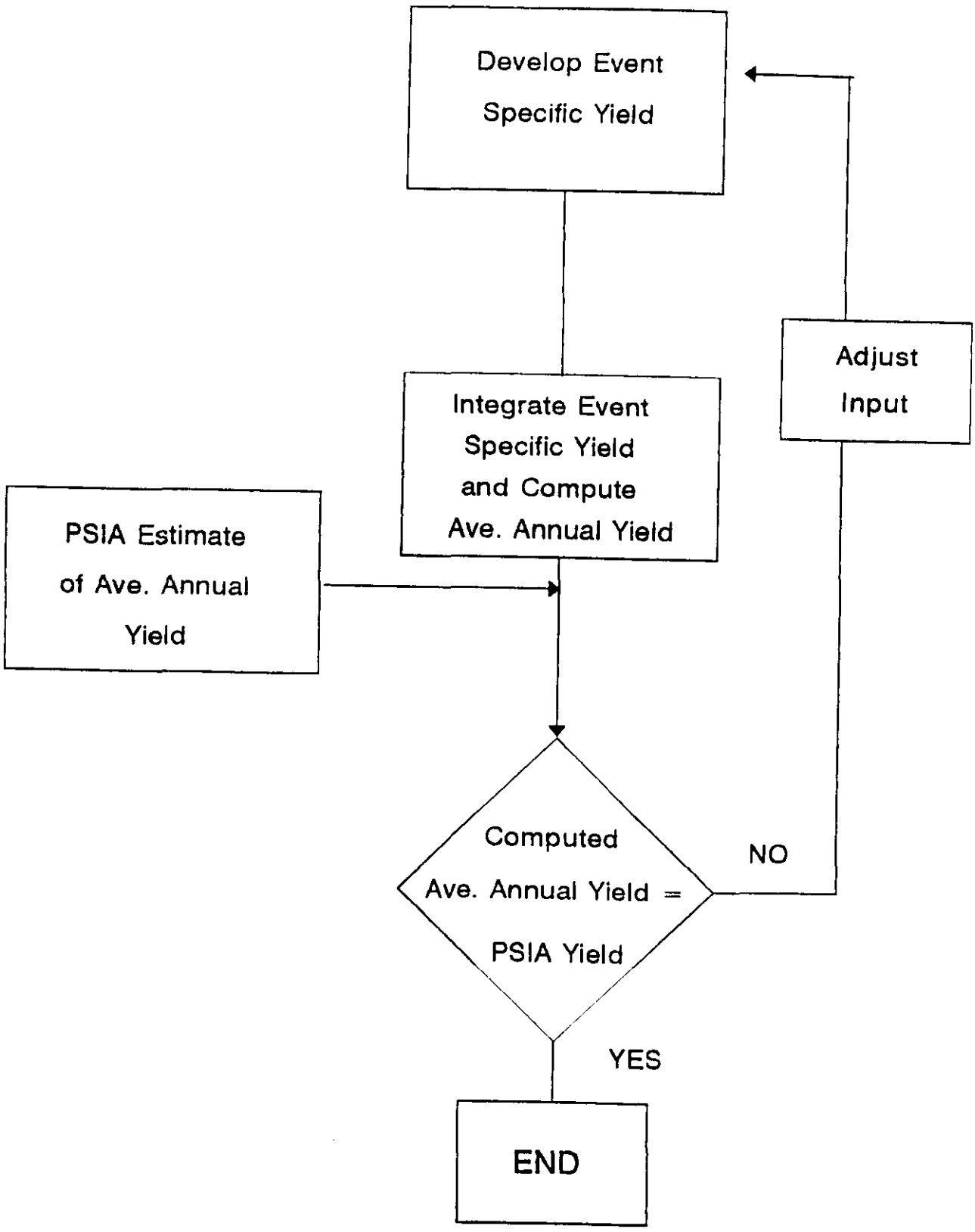
The foundation for the estimate of average annual sediment yield is the work prepared for the 1991 Facility Planning Study. In this report, prepared by Boyle Engineering Corporation, an estimate of average annual sediment yield was developed using the Pacific Southwest Interagency (PSI) Methodology. This methodology has been applied successfully to watersheds throughout the southwestern United States and was deemed most appropriate for the Range Wash Area. In addition, the information necessary to develop an estimate using PSI is easily derived from available sources or field observations. A copy of the sediment yield section from the Facilities Planning Study, and a copy of the Pacific Southwest Interagency Committees presentation of the PSI methodology is included.

The results developed for the Facilities Planning Study were compared to the Corps of Engineers Feasibility Study for the Las Vegas Valley. In this report, the COE estimated a range of an average annual yield for the Range Wash Basin between 0.3 and 0.5 AF/square mile/year. They also provided a graphic which relates drainage basin area to average annual sediment yield. The estimates for the eastern and western tributaries of Range Wash are plotted on this curve and demonstrate that Boyle's estimates from the Facilities Planning Study are slightly higher but well within the margin of error of the COE's study.

As previously mentioned, the foundation for subsequent estimates of sediment yield by event is the average annual sediment yield. Boyle's initial intended approach was to identify a relationship between average annual yield and event specific yield through a review of the published literature. After reviewing several references, reports, and published articles, it

become clear that no defensible relationship could be identified which could be applied to the Range Wash basin. As such, a deviation from the memorandum of understanding was necessary.

Boyle adopted an approach which estimated a yield for a series of specific events and integrated the yield versus probability relationship to arrive at an average annual estimate. This estimate of average annual yield was compared to the PSI estimate of average annual yield. Adjustments in the assumptions used to develop the event specific yields were made as required. When the two estimates matched, it was assumed that the event specific yields represented sediment yield from the Range Wash basin.


Develop Event Specific Yield
Adjust Input
Integrate Event Specific Yield and Compute Ave. Annual Yield
PSIA Estimate of Ave. Annual Yield
Computed Ave. Annual Yield = PSIA Yield
NO
YES
END

SEDIMENT YIELD ANALYSIS - 1991 FACILITIES PLAN

From 1991 Facility Planning Study

SEDIMENT YIELD ANALYSIS

Methodology

The sediment yield analysis of the Range Wash Study Area was performed using the Pacific Southwest Interagency (PSIA) methodology. This methodology is intended for broad planning purposes rather than specific project planning. The PSIA methodology considers climate and physical factors of the area, as well as evidence of past erosion, to determine a sediment yield classification for the area in question. The factors consideration: geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport. The factors are each assigned a numeric value based on information obtained from a rating which is used to estimate unit sediment yield.

Basin Discretization

Three watershed subdivisions were selected for analysis using the PSIA methodology: Western Range Wash tributary to the detention facility identified in the master plan (Node F of the Hydrologic analysis); Eastern Range Wash tributary to the detention facility identified in the master plan (Node P1 of the Hydrologic analysis), and; both Washes above their confluence Node M of the Hydrologic analysis).

Factors Affecting Sediment Yield

The sediment yield analysis factors are summarized below:

Surface Geology: The exposed rock of the study area is predominantly limestone and dolomite, somewhat fractured and weathered. Rock is only exposed in the steep upland areas.

Soils: Soils of the area are generally very gravely with a distinct erosion pavement. Soil material is fine sandy loam with occasional caliche layers and high percentage of rock fragments. A larger extent of caliche was found near the surface in the Eastern Range Wash area than in the western area.

Climate: The Las Vegas Valley has an arid climate with infrequent convective storms and little freeze-thaw occurrence.

Runoff: The Range Wash watersheds produce moderate runoff peak flows and volumes.

Topography: The steep upland slopes have high relief with extensive alluvial fan development at their base. A larger percentage of the western tributary has steep slopes than of the eastern tributary.

Ground Cover: Vegetative ground cover is less than 20 percent. An extensive erosion pavement of rock fragments covers most of the study area.

Land Uses: The majority of the study area is virtually undisturbed except for occasional roads, and mining exploration.

Upland Erosion: The erosion pavement is evidence of upland erosion as are the numerous rills and gullies on the alluvial fans.

Channel Erosion and Sediment Transport: Eroding channel backs are evident where flow is collected either naturally or by man caused means (e.g., roads). Flow is intermittent and of short duration. The eastern tributary is channelized to a slightly higher degree than the western tributary area. The fan above the western ponding area has no well defined channel.

Results

The factors described above were assigned a numeric value representing their relative contribution to the sediment yield of the part of the basin in question. These numeric values were summed and a rating was established. Using curves provided by the PSIA methodology, a unit sediment yield was estimated.

Table II-8 presents a summary of the numeric values assigned to each analysis factor and an estimate of the total average annual sediment production which can be expected at each point of interest.

TABLE II-8

SEDIMENT YIELD ANALYSIS SUMMARY

	Western Tributary	Eastern Tributary	Confluence
PSIA Factor Ratings			
Geology	2	2	2
Soils	7	5	6
Climate	2	2	2
Runoff	5	5	5
Topography	11	8	6
Ground Cover	3	3	3
Land Use	-10	-10	-10
Upland Erosion	12	10	10
Channel Condition	10	18	15
Summary Ratings	42	43	38
Unit Sediment Yield (af/sq mi/yr)	.40	.42	.37
Drainage Area (sq mi)	41	40	133
Sediment Yield			
Estimated Average Annual Sediment Yield (af/yr)	16	17	49

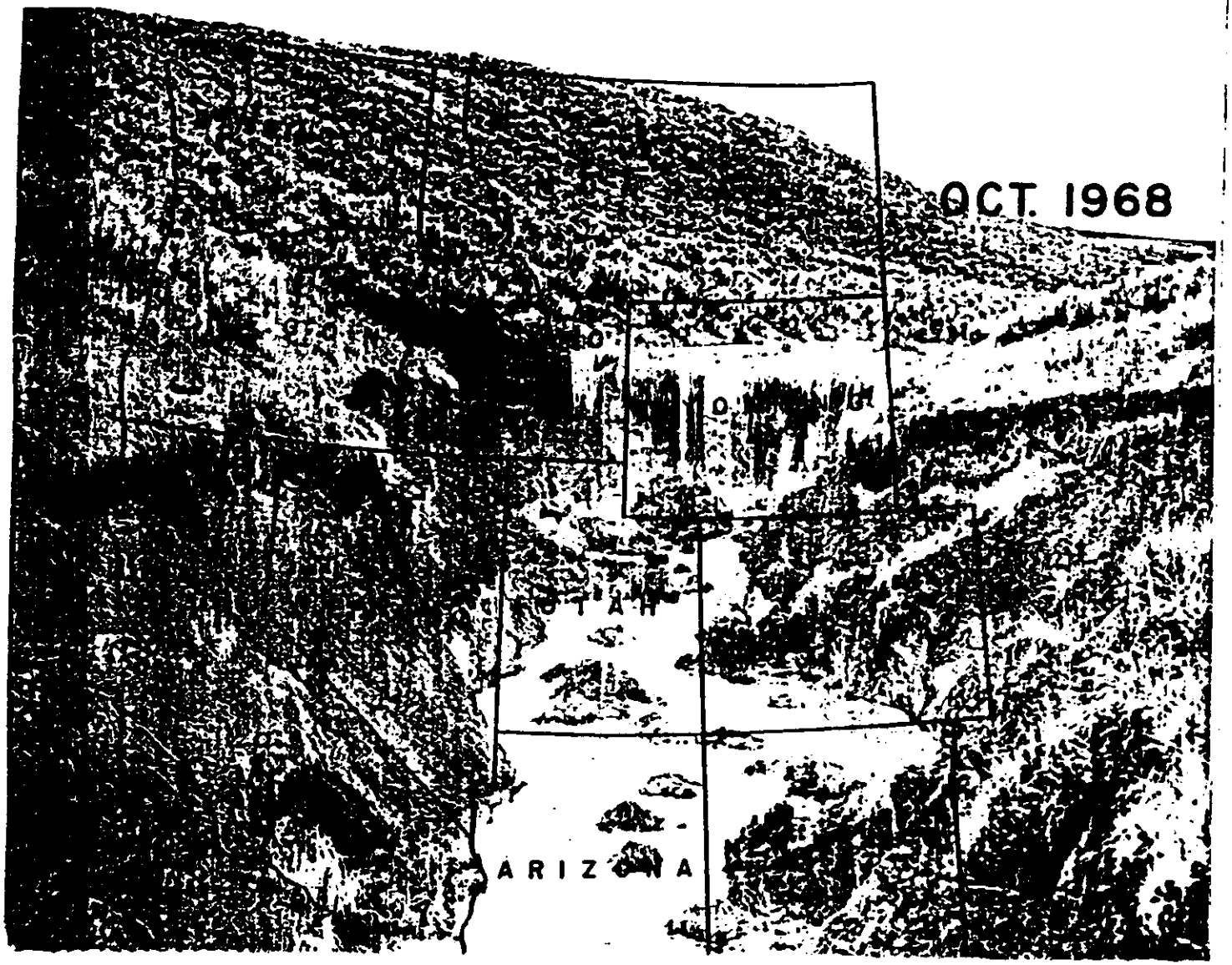
Comparisons with Past Studies

The average annual sediment yield for the three watershed subdivisions is estimated to range from 0.37 af/sq.mi./yr to 0.42 af/sq.mi./yr. The COE feasibility study developed, and presented, a curve of estimated average annual sediment delivery rates to detention basins within the Las Vegas Valley. These curves present sediment delivery per year per square mile versus basin area for areas similar to those found in Range Wash. The COE Feasibility Study estimates were 0.35 af/sq.mi./yr to 0.40 af/sq.mi./yr. This is very close to the values determined in this effort. Differences may be attributed to slightly higher rainfall in the Range Wash watershed than in the Valley as a whole.

PSIA METHODOLOGY

Pacific Southwest
INTER-AGENCY COMMITTEE

Report of the Water Management Subcommittee



OCT. 1968

PSIAC Methodology Description

PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE

REPORT

of the

WATER MANAGEMENT SUBCOMMITTEE

on

FACTORS AFFECTING SEDIMENT YIELD IN THE PACIFIC SOUTHWEST AREA

and

SELECTION AND EVALUATION OF MEASURES FOR REDUCTION OF EROSION AND SEDIMENT YIELD

October 1968

FACTORS AFFECTING SEDIMENT YIELD IN THE PACIFIC SOUTHWEST AREA

Recommendations of the Water Management Subcommittee
Sedimentation Task Force, PSIAC
October 1968

Introduction

The material that follows is suggested for use in the evaluation of sediment yield in the Pacific Southwest. It is intended as an aid to the estimation of sediment yield for the variety of conditions encountered in this area.

The classifications and companion guide material are intended for broad planning purposes only, rather than for specific projects where more intensive investigations of sediment yield would be required. For these purposes it is recommended that map delineations be for areas no smaller than 10 square miles.

It is suggested that actual measurements of sediment yield be used to the fullest extent possible. This descriptive material and the related numerical evaluation system would best serve its purpose as a means of delineating boundaries between sediment yield areas and in extrapolation of existing data to areas where none is available.

This may involve a plotting of known sediment yield data on work maps. Prepared materials such as geologic and soil maps, topographic, climatic, vegetative type and other references would be used as aids in delineation of boundaries separating yield classifications. A study of the general relationships between known sediment yield rates and the watershed conditions that produce them would be of substantial benefit in projecting data to areas without information.

Sediment Yield Classification

It is recommended that sediment yields in the Pacific Southweat area be divided into five classes of average annual yield in acre-feet per square mile. These are as follows:

Classification	1	$>$ 3.0	acre-feet/square mile
	2	1.0 - 3.0	" "
	3	0.5 - 1.0	" "
	4	0.2 - 0.5	" "
	5	$<$ 0.2	" "

Nine factors are recommended for consideration in determining the sediment yield classification. These are geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport.

Although only the high, moderate and low sediment yield levels are shown on the attached table, interpolation between these levels may be made.

Surface Geology

Over much of the southwest area, the effect of surface geology on erosion is readily apparent. The weaker and softer rocks are more easily eroded and generally yield more sediment than do the harder more resistant types. Sandstones and similar coarse-textured rocks that disintegrate to form permeable soils erode less than shales and related mudstones and siltstones under the same conditions of precipitation. On the other hand, because of the absence of cementing agents in some soils derived from sandstone, large storms may produce some of the highest sediment yields known.

The widely distributed marine shales, such as the Mancos and shale members of the Moenkopi Formation, constitute a group of highly erodible formations. The very large areal extent of the shales and their outwash deposits gives them a rank of special importance in relation to erosion. Few of the shale areas are free from erosion. Occasionally, because of slope or cover conditions, metamorphic rocks and highly fractured and deeply weathered granites and granodiorites produce high sediment yield. Limestone and volcanic outcrop areas are among the most stable found within the western lands. The principal reason for this appears to be the excellent infiltration characteristics, which allow most precipitation to percolate into the underlying rock.

In some areas all geologic formations are covered with alluvial or colluvial material which may have no relation to the underlying geology. In such areas the geologic factor would have no influence and should be assigned a value of 0 in the rating.

Soils

Soil formation in the Pacific Southwest generally has not had climatic conditions conducive to rapid development. Therefore, the soils are in an immature stage of development and consist essentially of physically weathered rock materials. The presence of sodium carbonate (black alkali) in a soil tends to cause the soil particles to disperse and renders such a soil susceptible to erosion.

There are essentially three inorganic properties--sand, silt, and clay--which may in any combination give soil its physical characteristics. Organic substances plus clay provide the binding material which tends to hold the soil separates together and form aggregates. Aggregate formation and stability of these aggregates are the resistant properties of soil against erosion. Unstable aggregates or single grain soil materials can be very erodible.

Snow appears to have a minor effect on upland slope erosion since raindrop impact is absent and runoff associated with snow melt is generally in resistant mountain systems.

Frontal storms in which periods of moderate to high intensity precipitation occur can produce the highest sediment yields within the Southwest. In humid and subhumid areas the impact of frontal storms on sediment may be greatest on upland slopes and unstable geologic areas where slides and other downhill soil movement can readily occur.

Convective thunderstorm activity in the Southwest has its greatest influence on erosion and sedimentation in Arizona and New Mexico and portions of the adjoining states. High rainfall intensities on low density cover or easily dispersed soils produces high sediment yields. The average annual sediment yield is usually kept within moderate bounds by infrequent occurrence of thunderstorms in any one locality.

High runoff of rare frequency may cause an impact on average annual sediment yield for a long period of time in a watershed that is sensitive to erosion, or it may have little effect in an insensitive watershed. For example, sediment that has been collecting in the bottom of a canyon and on side slopes for many years of low and moderate flows may be swept out during the rare event, creating a large change in the indicated sediment yield rate for the period of record.

In some areas the action of freezing and thawing becomes important in the erosion process. Impermeable ice usually forms in areas of fine textured soils where a supply of moisture is available before the advent of cold weather. Under these conditions the ice often persists throughout the winter and is still present when the spring thaw occurs. In some instances water tends to run over the surface of the ice and not detach soil particles, but it is possible for the ice in a surface layer to thaw during a warm period and create a very erodible situation. Spring rains with ice at shallow depth may wash away the loose material on the surface.

In some areas of the Pacific Southwest, particularly those underlain by marine shale, freezing and thawing alters the texture of soil near the surface, and thus changes the infiltration characteristics. These areas generally do not receive enough snow or have cold enough temperatures to build a snow pack for spring melt. Later in the year soil in a loosened condition is able to absorb a large part of the early rainfall. As rains occur during the summer, the soil becomes compacted on the surface, thus allowing more water to run off and affording a greater chance for erosion.

Topography

Watershed slopes, relief, floodplain development, drainage patterns, orientation and size are basic items to consider in connection with topography. However, their influence is closely associated with geology, soils, and cover.

The Pacific Southwest is made up of land with all classes of ground cover. The high mountain areas generally have the most vegetation, while many areas in the desert regions have practically none. The abundance of vegetation is related in a large degree to precipitation. If vegetative ground cover is destroyed in areas where precipitation is high, abnormally high erosion rates may be experienced.

Differences in vegetative type have a variable effect on erosion and sediment yield, even though percentages of total ground cover may be the same. For instance, in areas of pinyon-juniper forest having the same percentage of ground cover as an area of grass, the absence of understory in some of the pinyon-juniper stands would allow a higher erosion rate than in the area of grass.

Land Use

The use of land has a widely variable impact on sediment yield, depending largely on the susceptibility of the soil and rock to erosion, the amount of stress exerted by climatic factors and the type and intensity of use. Factors other than the latter have been discussed in appropriate places in this guide.

In almost all instances use either removes or reduces the amount of natural vegetative cover which reflects the varied relationships within the environment. Activities which remove all vegetation for parts of each year for several years or permanently are cultivation, urban development and road construction. Grazing, logging, mining, and fires artifically induce permanent or temporary reduction in cover density.

High erosion hazard sites, because of the geology, soils, climate, etc., are also of high hazard from the standpoint of type and intensity of use. For example, any use which reduces cover density on a steep slope with erodible soils and severe climatic conditions will strongly affect sediment yield. The extent of this effect will depend on the area and intensity of use relative to the availability of sediment from other causes. Construction of roads or urban development with numerous cut and fill slopes through a large area of widespread sheet or gully erosion will probably not cause a change in sediment yield classification. Similar construction and continued disturbance in an area of good vegetative response to a favorable climate can raise yield by one or more classifications.

Use of the land has its greatest potential impact on sediment yield where a delicate balance exists under natural conditions. Alluvial valleys of fine, easily dispersed soils from shales and sandstones are highly vulnerable to erosion where intensive grazing and trailing by livestock have occurred. Valley trenching has developed in many of these valleys and provides a large part of the sediment in high yield classes from these areas.

Channel Erosion and Sediment Transport

If a stream is ephemeral, runoff in traversing the dry alluvial bed may be drastically reduced by transmission losses (absorption by channel alluvium). This decrease in the volume of flow results in a decreased potential to move sediment. Sediment may be deposited in the streambed from one or a series of relatively small flows only to be picked up and moved on in a subsequent larger flow. Sediment concentrations, determined from field measurements at consecutive stations, have generally been shown to increase many fold for instances of no tributary inflow. Thus, although water yield per unit area will decrease with increasing drainage area, the sediment yield per unit area may remain nearly constant or may even increase with increasing drainage area.

In instances of convective precipitation in a watershed with perennial flow, the role of transmission losses is not as significant as in watersheds with ephemeral flow, but other channel factors, such as the shape of the channel, may be important.

For frontal storm runoff the flow durations are generally much longer than for convective storms, and runoff is often generated from the entire basin. In such instances, sediment removed from the land surfaces is generally carried out of the area by the runoff. Stream channel degradation and/or aggradation must be considered in such cases, as well as bank scour. Because many of the stream beds in the Pacific Southwest are composed of fine-grained alluvium in well defined channels, the potential for sediment transport is limited only by the amount and duration of runoff. Large volumes of sediment may thus be moved by these frontal storms because of the longer flow durations.

The combination of frontal storms of long duration with high intensity and limited areal-extent convective activity will generally be in the highest class for sediment movement in the channels. Storms of this type generally produce both the high peak flows and the long durations necessary for maximum sediment transport.

Sediment yield may be substantially affected by the degree of channel development in a watershed. This development can be described by the channel cross sections, as well as by geomorphic parameters such as drainage density, channel gradients and width-depth ratio. The effect of these geomorphic parameters is difficult to evaluate primarily because of the scarcity of sediment transport data in the Pacific Southwest.

If the cross section of a stream is such as to keep the flow within defined banks, then the sediment from an upstream point is generally transported to a downstream point without significant losses. Confinement of the flow within alluvial banks can result in a high erosional capability of a flood flow, especially the flows with long return periods. In most channels with wide floodplains, deposition on the floodplain during floods is often significant, and the transport is thus less than that for a within bank flow. The effect of this transport capability can be explained in terms of tractive

TABLE 2 - EVALUATION OF MEASURES

Sediment Yield Levels	Climatic Environment	F. GROUND COVER		G. LAND USE		H. UPLAND EROSION		I. CHANNEL EROSION & SEDIMENT TRANSPORT	
		Extensive Treatment	Intensive Treatment	Extensive Treatment	Intensive Treatment	Extensive Treatment	Intensive Treatment	Extensive Treatment	Intensive Treatment
High	Arid	8	5	8	5	20	15		
	Semi-arid	5	0	5	0	15	10		
	Sub-humid	0	-5	0	-5	10	5		
	Humid	-5	-10	-5	-10	5	0		
								20	5
Moderate	Arid	0	-3	0	-3	10	7		
	Semi-arid	-3	-5	-3	-5	7	5		
	Sub-humid	-5	-7	-5	-7	5	3		
	Humid	-7	-10	-7	-10	3	0		
								5	0

TABLE I - MANAGEMENT AND LAND TREATMENT MEASURES RECOMMENDED FOR REDUCTION OF EROSION AND SEDIMENT YIELD UNDER VARIOUS SITE CONDITIONS

Measures	Climatic Environment				Soils *			Upland Slope Topography		
	Arid	Semi-Arid	Sub-Humid	Humid	Fine Textured	Medium Textured	Coarse Textured	Steep	Moderate	Gentle
	A	B	C	D						
Forest and Range Lands										
Brush control	x	x			x	x	x		x	x
Contour furrowing and trenching		x	x		C	B		x	x	
Contour terracing		x	x			x	x	x	x	
Critical area planting		x	x	x	x	x		x	x	
Fire prevention and suppression		x	x	x	x	x	x	x	x	
Livestock exclusion	x	x	x	x	x	x	x	x	x	x
Proper grazing use - trespass control	x	x	x	x	x	x	x	x	x	x
Range seeding		x	x		C	B			x	x
Rotation-deferred grazing		x	x		x	x	x	x	x	x
Tree and shrub planting		x	x	x		x	x		x	x
Cultivated Land										
Chiseling and subsoiling			x	x		x			x	x
Contour farming		x	x	x	x	x	x		x	x
Contour terracing		x	x	x	C-D	x			x	x
Critical area planting		x	x	x	x	x		x	x	
Crop residue and mulching		x	x		x	x		x	x	x
Field diversion		x	x		x	x			x	x
Proper cropping and use		x	x	x	x	x	x		x	x
Strip cropping		x	x		x	x	x		x	x

* Mechanical treatments are not applicable on shallow soils.

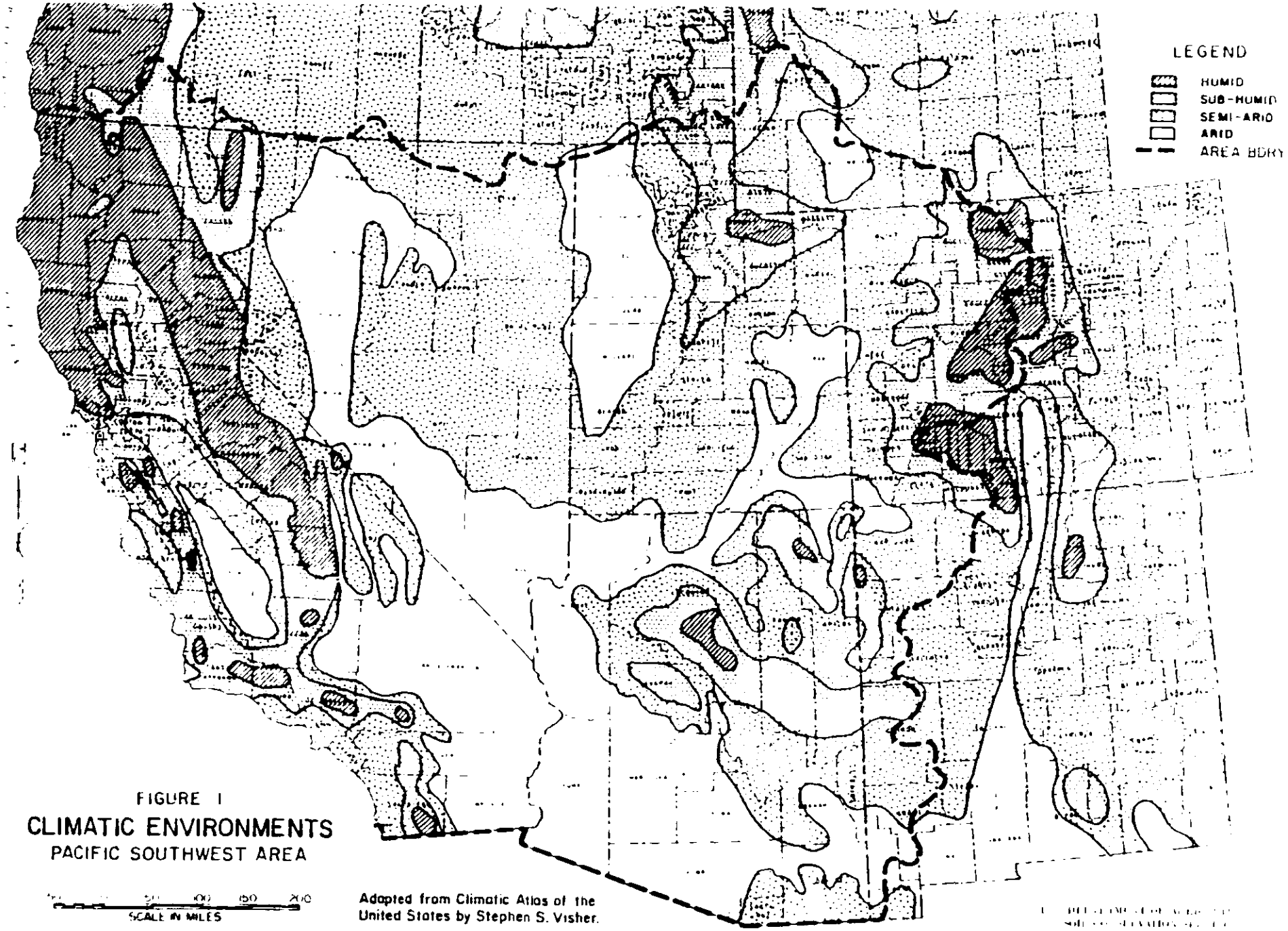


FIGURE 1

CLIMATIC ENVIRONMENTS

PACIFIC SOUTHWEST AREA

Adapted from Climatic Atlas of the United States by Stephen S. Visher.

Use of the Rating Chart of Factors Affecting Sediment Yield in the Pacific Southwest

The following is the sediment yield classification originally presented on page 2.

Classification	Rating	Sediment Yield AF/sq.mi.
1	> 100	3.0
2	75 - 100	1.0 - 3.0
3	50 - 75	0.5 - 1.0
4	25 - 50	0.2 - 0.5
5	0 - 25	< 0.2

In most instances high values for the A through G factors should correspond to high values for the H and/or I factors.

An example of the use of the rating chart is as follows:

A watershed of 15 square miles in western Colorado has the following characteristics and sediment yield levels:

	Factors	Sediment Yield Level	Rating
A	Surface geology	Marine shales	10
B	Soils	Easily dispersed, high shrink-swell characteristics	10
C	Climate	Infrequent convective storms, freeze-thaw occurrence	7
D	Runoff	High peak flows; low volumes	5
E	Topography	Moderate slopes	10
F	Ground cover	Sparse, little or no litter	10
G	Land use	Intensively grazed	10
H	Upland erosion	More than 50% rill and gully erosion	25
I	Channel erosion	Occasionally eroding banks and bed but short flow duration	5
		Total	92

This total rating of 92 would indicate that the sediment yield is in Classification 2. This compares with a sediment yield of 1.96 acre-feet per square mile as the average of a number of measurements in this area.

FACTORS AFFECTING SEDIMENT YIELD IN THE PACIFIC SOUTHWEST

Sediment Yield Levels	A SURFACE GEOLOGY	B SOILS	C CLIMATE	D RUNOFF	E TOPOGRAPHY	F GROUND COVER	G LAND USE	H UPLAND EROSION	I CHANNEL EROSION & SEDIMENT TRANSPORT
High	(10)* a. Marine shales and related mudstones and siltstones.	(10) a. Fine textured; easily dispersed; saline-alkaline; high shrink-swell characteristics. b. Single grain silts and fine sands	(10) a. Storms of several days' duration with short periods of intense rainfall. b. Frequent intense convective storms c. Freeze-thaw occurrence	(10) a. High peak flows per unit area b. Large volume of flow per unit area	(20) a. Steep upland slopes (in excess of 30%) High relief; little or no floodplain development	(10) Ground cover does not exceed 20% a. Vegetation sparse, little or no litter b. No rock in surface soil	(10) a. More than 50% cultivated b. Almost all of area intensively grazed c. All of area recently burned	(25) a. More than 50% of the area characterized by rill and gully or landslide erosion	(25) a. Eroding banks continuously at frequent intervals with large depths and long flow duration b. Active headcuts and degradation in tributary channels
**									
Moderate	(5) a. Rocks of medium hardness b. Moderately weathered c. Moderately fractured	(5) a. Medium textured soil b. Occasional rock fragments c. Caliche layers	(5) a. Storms of moderate duration and intensity b. Infrequent convective storms	(5) a. Moderate peak flows b. Moderate volume of flow per unit area	(10) a. Moderate upland slopes (less than 30%) b. Moderate fan or floodplain development	(0) Cover not exceeding 60% a. Noticeable litter b. If trees present understory not well developed	(0) a. Less than 25% cultivated b. 50% or less recently logged c. Less than 50% intensively grazed d. Ordinary road and other construction	(10) a. About 25% of the area characterized by rill and gully or landslide erosion b. Wind erosion with deposition in stream channels	(10) a. Moderate flow depths, medium flow duration with occasionally eroding banks or bed
**									
Low	(0) a. Massive, hard formations	(0) a. High percentage of rock fragments b. Aggregated clays c. High in organic matter	(0) a. Humid climate with rainfall of low intensity b. Precipitation in form of snow c. Arid climate, low intensity storms d. Arid climate; rare convective storms	(0) a. Low peak flows per unit area b. Low volume of runoff per unit area c. Rare runoff events	(0) a. Gentle upland slopes (less than 5%) b. Extensive alluvial plains	(-10) a. Area completely protected by vegetation, rock fragments, litter little opportunity for rainfall to reach erodible material	(-10) a. No cultivation b. No recent logging c. Low intensity grazing	(0) a. No apparent signs of erosion	(0) a. Wide shallow channels with flat gradients, short flow duration b. Channels in massive rock, large boulders, or well vegetated c. Artificially constructed channels

* THE NUMBERS IN SPECIFIC BOXES INDICATE VALUES TO BE ASSIGNED APPROPRIATE CHARACTERISTICS. THE SMALL LETTERS a, b, c, REFER TO INDEPENDENT CHARACTERISTICS TO WHICH FULL VALUE MAY BE ASSIGNED.

** IF EXPERIENCE SO INDICATES, INTERPOLATION BETWEEN THE 5 SEDIMENT YIELD LEVELS MAY BE MADE.

COE FEASIBILITY STUDY SEDIMENTATION CURVE

COE Feasibility Study

VII. SEDIMENT YIELD

General

7-01 There is limited sediment yield data in the study area. The information available for Clark County shows no specific trends or is based on studies conducted for other areas which have somewhat different watershed and channel conditions. An average annual sediment yield vs. drainage area relationship developed by B&V based on information from Corps reports, (discussed in their report, ref. 28) was used to determine the average annual yield in acre-feet for each of the proposed detention basins. Estimated average annual sediment delivery rates to detention basins considered in the Las Vegas Wash basin range from 0.3 to 0.8 acre-feet per square mile. Sediment yield rates as a function of drainage area, as developed in Corps of Engineers reports for the Las Vegas and Phoenix areas, are shown on plate 46. The sediment yield rates for the Las Vegas and Henderson detention basins (proposed in 1959, ref. 1) were based on the Trilby Wash Dam rate reported by the Soil Conservation Service. From these points, an upper limit line was drawn to derive a recommended minimum average annual sediment yield for planning and design purposes.

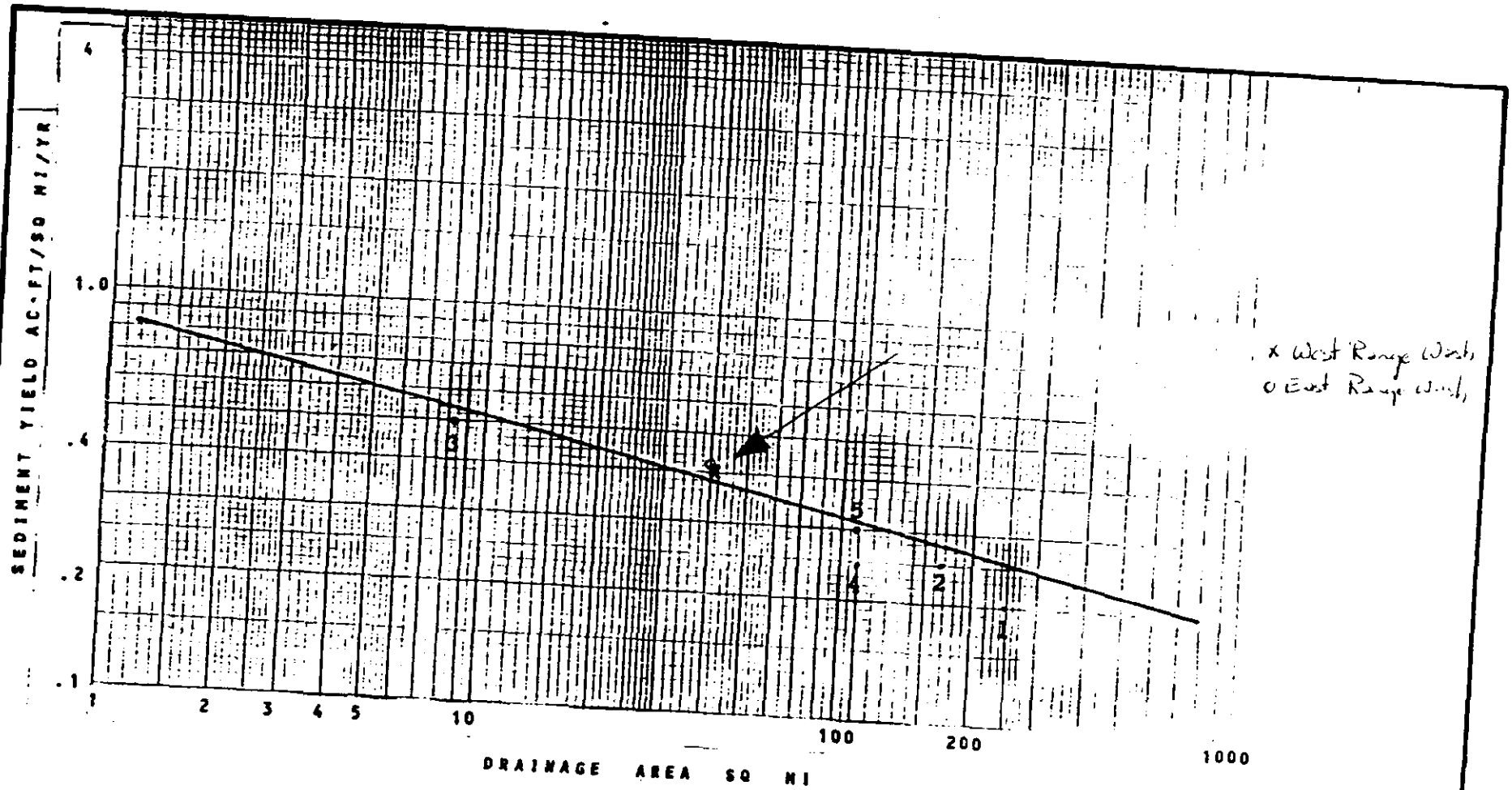
7-02 The values recommended by B&V, were checked against the values that would be determined using the publication, "Factors Affecting Sediment Yield and Measures for the Reduction of Erosion and Sediment Yield," Pacific Southwest Inter-Agency Committee, Oct. 1968 (ref. 34). The average annual sediment yield derived using this report gave values of the range of 0.3 to 0.7 acre-feet per square mile. Therefore, the B&V recommended line seems reasonable and was adopted to determine the sediment yield rates for each of the proposed detention basins. The results are given in table 40.

Table 40. Average Annual Sediment Yield.

Detention Basin	Contributing Drainage Area $mi.^2$	Annual Yield Rate* $ac\text{-}ft/mi.^2$	Average Annual Rate ac-ft
Upper Flamingo	16.01	0.46	7
Lower Flamingo(1)	96.54	0.31	30
Lower Flamingo(2)	30	0.40	12
Tropicana	8.07	0.54	4
Upper Blue Diamond	55.58	0.35	19
Lower Blue Diamond(1)	66.18	0.34	23
Upper Blue Diamond(2)	10.6	0.51	5
Duck #1	49.03	0.36	18
Duck #2	32.38	0.40	13
Duck #3(1)	36.19	0.39	14
Duck #3(2)	3.81	0.65	3
Duck #4	7.37	0.55	4
Duck #5(1)	79.24	0.33	26
Duck #5(2)	30.21	0.40	12
Angel Park	22.24	0.44	8
Gowan(1)	66.11	0.34	22
Gowan(2)	43.87	0.37	16
Fantasy Park	0.75	0.80	1
Pittman	50.60	0.36	18
Pittman West Trib.	22.80	0.44	10
HENDERSON			
S. Tributary	13.93	0.48	7
Equestrian Drive	6.77	0.56	4
Newport Drive	5.50	0.59	3
RANGE WASH			
West Tributary	57.23	0.35	20
East Tributary N. Br.	7.37	0.55	4
East Range(1)	41.81	0.37	15
East Range(2)	34.44	0.39	13
Kyle Canyon	62.34	0.34	21
North Las Vegas(1)	400	0.23	92
North Las Vegas(2)	337.66	0.24	81

Farther DIS in system

(1) Assuming no sediment trapped in upstream basins.
(2) Assuming upstream basins with 100% trap efficiency.
* See plate 46.

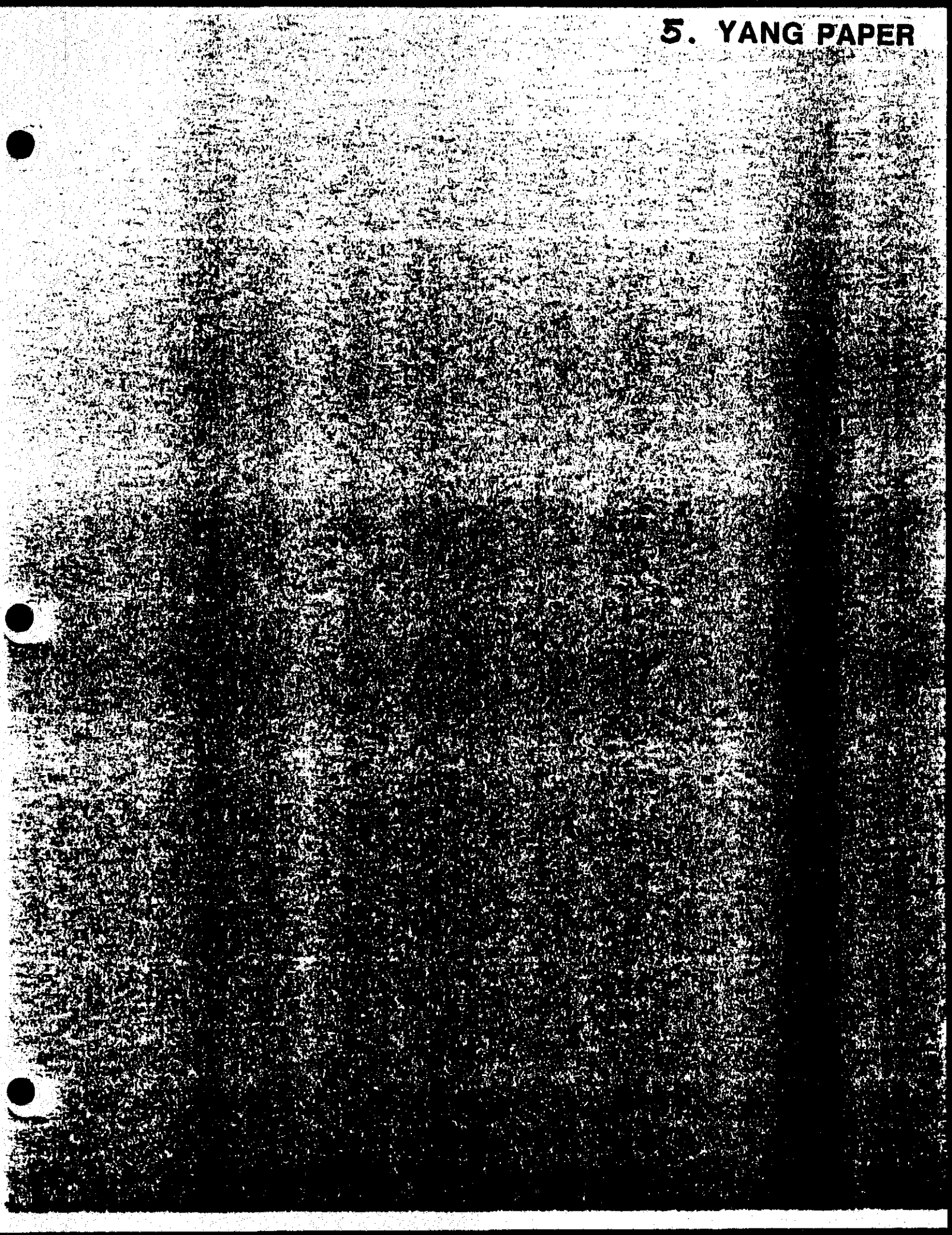


		REPORT DATE
1	TRILBY WASH DAM, PHOENIX, AZ	1959
2	LAS VEGAS DETENTION BASIN	1959
3	HENDERSON DETENTION BASIN	1959
4	CAVE CREEK DAM, PHOENIX, AZ	1974 (EARLY 1970)
5	CAVE CREEK DAM, PHOENIX, AZ	1974 (LATE 1970)

LAS VEGAS WASH AND TRIBUTARIES, NEVADA
FEASIBILITY STUDY

AVERAGE ANNUAL SEDIMENT YIELD RATE
VS
DRAINAGE AREA

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS



YANG PAPER

The basis for establishing the event specific yield is the ability of the alluvial fan to transport materials generated in the watershed. The basic assumption is that at the location of the dike, flows down the fan will have reached their equilibrium sediment carrying capacity. The distance between the fan apex and the dike is several miles. Over that reach, particles which cannot be transported will have been deposited or other materials from the fan surface will have been scoured to satisfy the carrying capacity. This computation was necessary for several reasons:

- To estimate the total sediment load by event for use in the average annual yield computation using the integration process.

- To establish a sediment transport versus discharge relationship

- To estimate a particle size distribution of the sediment

The relationship used to simulate sediment transport capacity was one developed by Yang. Several different equations can be used to model stream sediment carrying capacity. The application of a particular equation is typically a function of the hydraulic characteristics of the channel and the characteristics of the sediment being transported. In 1991 C.T. Yang and S. Wan published a study in the ASCE Hydraulics Journal entitled "Comparisons of Selected Bed Material Load Formulas". This paper presented the results of their study which compared several different transport equation for various conditions of channel hydraulics. A review of this publication indicated that for channel conditions similar to the Range Wash Channel (steep

slopes, Froude numbers near one and coarse particles) Yang's formulation provided the most reliable results.

The use of Yang's formulation is not inconsistent with the standard of practice. Yang's methodology has long been acknowledged as an appropriate approach. This is demonstrated by its inclusion as one of the computational options available in HEC-6.

5. Flow concentration can occur on riprap-protected embankments. Flow concentrations of 1.33 to 3.33 were observed.

6. Riprap design criteria for sizing riprap subjected to overtopping flow conditions is presented based on near-prototype test data.

Acknowledgments

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Comparisons of Selected Bed-Material Load Formulas

By Chih Ted Yang,[1] Fellow, ASCE, and Shenggan Wan[2]

Abstract: Comparisons are made of the overall accuracy as well as the accuracy within different ranges of sediment concentration, Froude number, and slope for seven bed material load formulas. Four formulas that can compute bed-material load transport by size fraction are used to determine the particle size distribution of the bed materials in transportation. One thousand, one-hundred-nineteen sets of laboratory data and 319 sets of river data in the sand size range are used to evaluate and compare the accuracy of these formulas. The overall accuracy of formulas in descending order are those of Yang, Engelund and Hansen, Ackers and White (d_{50}), Laursen, Ackers and White (d_{35}), Colby, Einstein, and Toffaleti formulas when applied to laboratory flumes. The accuracy in descending order when applied to natural rivers are the formulas by Yang, Toffaleti, Einstein, Ackers and White (d_{50}), Colby, Laursen, Engelund and Hansen, and Ackers and White (d_{35}). However, these ratings may vary depending on the values of sediment concentration, Froude number, and slope of the data used in the comparison. The study also indicates that Yang's formula by size fraction can accurately predict the size distribution of bed material in transportation, while Einstein's hiding and lifting correction factors overcorrected the effect of nonuniform size distribution of bed material on total bed-material transport.

Introduction

There are numerous sediment transport formulas developed by different investigators for the prediction of bed load, suspended load, and total bed-material load in alluvial channels. Comparisons of the accuracy of these formulas were made by Yang and Stall (1973), White et al. (1975), Yang (1976), Alonso (1980), Brownlie (1981), Yang and Molinas (1982), the ASCE Task Committee ("Relationships between Morphology" 1982), Yang (1988), Vetter (1989), and the German Association for Water Resources and Land Improvement (1990), among others. These comparisons emphasize the overall accuracy of formulas without given detailed information of the hydraulic and sediment conditions under which measurements were made. Depending on the conditions under which data were collected for comparisons, the same formula could have different ratings of accuracy. This often causes confusion in the profession in the selection of formulas for solving engineering problems.

Measured sediment concentration, Froude number, and slope are used as parameters to define the hydraulic and sediment conditions. The analyses in this paper are limited to total bed-material load formulas due to the lack of general criteria to separate bed load from suspended load. Comparisons between computed bed-material size distribution and size distribution of bed materials in bed and in transportation are also made in this paper. The computer programs published by Stevens and Yang (1989) are used herein for

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the comparison of formulas. Data used for comparisons in this paper are limited to sediment transport in the sand size range.

Bed-Material Load Formulas

The selection of formulas for comparison in this paper is based on: (1) The formula's theoretical basis; (2) the extent of testing by the original author and independent investigators; and (3) the extent of use by engineers and researchers. The bed-material load formulas selected for comparison in this paper are those proposed by Einstein (1950), Laursen (1958), Engelund and Hansen (1967), Toffaleti (1968), Colby (1964), Ackers and White (1973), and Yang (1973). Among these formulas, those developed by Einstein, Laursen, Toffaleti, and Yang can be used to compute bed-material load or concentration by size fraction to determine the particle size distribution of the bed materials in transport. The representative sediment diameter for Ackers and White's formula can either be the median particle diameter (d_{50}) or the particle size of which 35% are final (d_{35}). The representative sediment diameter for Yang's formula is d_{50}. It should be pointed out that in addition to his 1973 equation for sand transport, Yang proposed an equation in 1979 for sand transport in which the critical unit stream power required at incipient motion can be neglected (Yang 1979). He also proposed an equation for gravel transport in 1984 (Yang 1984). Due to the range of data available for comparison, only Yang's 1973 formula is selected for comparison in this paper. Detailed descriptions of formulas used in this paper are published by Stevens and Yang (1989).

Accuracy of Formulas

A total of 1,438 sets of laboratory and river data are used in this paper to determine the accuracies of bed-material load formulas. They include 1,119 sets of laboratory data collected by Guy, Simons, and Richardson (1966), Gilbert (1914), Nomicos (1956), Vanoni and Brooks (1957), Kennedy (1961), Stein (1965), Williams (1967), White and Day (1982), and Schneider (unpublished material, 1971). Total bed-material concentrations were measured directly for these laboratory data that eliminate the uncertainty of unmeasured load near the bed surface.

A total of 319 sets of river data were also used in the analyses. These river data were collected from the Niobrara River (Colby and Hembree 1955), the Middle Loup River (Hubbell and Matejka 1959), the Rio Grande River (Nordin 1964), the Mississippi River (Jordan 1965), and Mountain Creek (Einstein 1944). Data judged by their original investigators as of questionable accuracy were excluded from our analyses. To ensure the accuracy of field data, only those sets of data with hydraulic and sediment measurements made within a 24-hr period are used. Total bed-material load was measured from the Niobrara River, the Middle Loup River, and the Mountain Creek. The amount of unmeasured load near the riverbed for the Rio Grande River and the Mississippi River remains to be determined. Table 1 summarizes the hydraulic and sediment data from laboratory flumes and natural rivers analyzed in this paper.

The basic parameter used in this paper for the determination of the accuracy of a formula is the discrepancy ratio, which is defined as

TABLE 1. Summary of Laboratory and River Data

Author (1)	Velocity (ft/sec) (2)	Depth (ft) (3)	Slope (×1,000) (4)	Temperature (°F) (5)	Median diameter (mm) (6)	Concentration (ppm by weight) (7)	Number of data sets (8)
(a) Laboratory Data							
Guy et al.	0.74–6.34	0.30–1.33	0.16–19.28	44.6–93.7	0.19–0.93	29–50,000	285
Gilbert	1.03–5.08	0.037–0.562	1.60–27.9	68.0	0.305–7.01	77–35,340	637
Nomicos	0.80–2.66	0.241	2.0–3.9	77.0–78.8	0.152	300–5,600	12
Vanoni and Brooks	0.77–2.53	0.238–0.553	1.02–2.80	69.3–77.9	0.137	37–3,000	14
Kennedy	1.65–4.65	0.074–0.346	1.70–27.2	75.7–86.2	0.233–0.549	500–58,500	41
Stein	1.69–5.25	0.59–0.99	0.61–10.8	68.0–84.0	0.40	638–24,260	42
Williams	1.27–3.49	0.10–0.517	1.10–22.2	53.4–87.4	1.35	16–3,739	37
Schneider	1.67–6.45	1.01–2.82	0.10–4.97	68.7–72.3	0.25	18–17,352	31
White and Day	1.45–2.44	0.35–0.62	0.445–3.66	53.6–55.4	1.55–1.75	2–1,050	20
(b) River Data							
Colby and Hembree	2.05–3.83	0.97–2.86	1.04–2.08	33.0–83.0	0.27	219–4,430	49
Hubbell and Matejka	1.59–3.69	0.56–2.05	0.581–1.57	37.0–78.0	0.130–0.766	270–1,790	79
Nordin	2.05–7.82	1.09–4.80	0.74–0.89	57.0–80.0	0.29	781–9,970	59
Jordan	2.15–7.26	18.5–40.4	0.0428–0.105	35.0–78.0	0.22–0.78	20–307	51
Einstein	1.20–2.58	0.27–1.26	1.37–1.92	59.0–77.9	0.925	12–1,244	81

Note: 1 ft = 30.48 cm, and °F = 9/5 °C + 32

$$R = \frac{C_c}{C_m} \qquad (1)$$

where C_c = computed bed-material concentration from a formula in parts per million by weight; and C_m = measured bed-material concentration in parts per million by weight. The mean value $\bar{R}$ and standard deviation σ are defined as

$$\bar{R} = \frac{\sum_{i=1}^{j} R_i}{j} \qquad (2)$$

and

$$\sigma = \sqrt{\frac{\sum_{i=1}^{j} (R_i - \bar{R})^2}{j-1}} \qquad (3)$$

In addition to $\bar{R}$ and σ, the percentages of data that can be found within ±25%, and ±50%, and ±75% of the computed concentrations from a given formula are also computed as additional indications of the accuracy of a formula. Data are regrouped into different ranges of dimensionless parameters, i.e., measured concentration C_m, Froude number F_r, and slope S. It is assumed that energy slope can be replaced by water surface slope without causing much error. The discrepancy ratios associated with each of the given parameters are defined in Table 2. Detailed results of comparisons are shown in Tables 3–8, and the summary of comparison is given in Table 9. Some of these comparisons are plotted on Figs. 1–3.

Based on the summary results shown in Table 9, the Yang (d_{50}) formula

TABLE 2. Definitions of Discrepancy Ratios Based on Different Parameters

Source (1)	C_* (2)	F_* (3)	S (4)
Laboratory data	R_{11}	R_{12}	R_{13}
River data	R_{21}	R_{22}	R_{23}

has the highest degree of accuracy and least deviation from measured laboratory and river data. The accuracy of formulas for laboratory application in descending order are Yang (d_{50}), Engelund and Hansen, Ackers and White (d_{50}), Laursen, Ackers and White (d_{35}), Colby, Einstein, and Toffaleti. These results also suggest that formulas proposed by Colby, Einstein, and Toffaleti may not be suitable for laboratory or small river application. The accuracy

TABLE 3. Comparison of Accuracy of Formulas According to Concentration, Using Laboratory Data

Author of formula (1)	DISCREPANCY RATIO, R_{11}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) C_* = 2–1,000 ppm						
Laursen	1.70	26	51	72	2.97	261
Engelund and Hansen	1.92	26	54	68	2.94	261
Colby	0.71	20	43	70	0.83	169
Ackers and White (d_{50})	1.15	43	69	85	0.74	257
Ackers and White (d_{35})	1.63	34	64	76	1.43	261
Yang (d_{50})	1.31	39	67	82	1.01	261
Einstein	1.70	18	37	56	1.45	261
Toffaleti	0.92	13	29	47	2.53	210
(b) C_* = 1,000–7,500 ppm						
Laursen	1.21	45	64	83	0.75	532
Engelund and Hansen	0.95	38	74	93	0.49	532
Colby	0.73	35	68	91	0.55	394
Ackers and White (d_{50})	1.26	38	70	85	0.64	532
Ackers and White (d_{35})	1.39	38	64	77	0.74	532
Yang (d_{50})	1.02	56	86	96	0.41	532
Einstein	2.60	12	20	28	1.39	532
Toffaleti	0.28	6	17	31	0.40	430
(c) C_* = 7,500–50,000 ppm						
Laursen	1.14	63	84	92	0.54	325
Engelund and Hansen	0.77	33	73	97	0.32	325
Colby	0.48	7	43	88	0.26	294
Ackers and White (d_{50})	1.22	45	78	90	0.52	325
Ackers and White (d_{35})	1.36	38	67	84	0.59	325
Yang (d_{50})	0.89	57	91	99	0.28	325
Einstein	2.22	8	18	27	0.83	325
Toffaleti	0.20	6	12	25	0.24	298

TABLE 4. Comparison of Accuracy of Formulas According to Froude Number, Using Laboratory Data

Author of formula (1)	DISCREPANCY RATIO, R_{12}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) F_* = 0.18–0.50						
Laursen	1.32	22	46	78	2.83	226
Engelund and Hansen	2.08	26	51	64	3.03	226
Colby	0.64	18	39	68	0.71	184
Ackers and White (d_{50})	0.99	41	73	91	0.61	222
Ackers and White (d_{35})	1.42	35	70	83	1.29	226
Yang (d_{50})	1.27	41	69	83	1.03	226
Einstein	1.02	25	45	68	0.82	226
Toffaleti	0.86	14	30	47	2.44	214
(b) F_* = 0.50–1.00						
Laursen	1.18	49	72	87	1.05	302
Engelund and Hansen	1.01	45	81	92	0.44	302
Colby	0.71	26	60	89	0.58	219
Ackers and White (d_{50})	1.19	45	72	86	0.56	302
Ackers and White (d_{35})	1.42	44	65	76	0.84	302
Yang (d_{50})	1.02	54	86	95	0.43	302
Einstein	2.32	18	33	43	1.36	302
Toffaleti	0.36	8	20	33	0.51	249
(c) F_* = 1.00–4.00						
Laursen	1.36	53	72	83	0.78	591
Engelund and Hansen	0.82	31	70	95	0.38	591
Colby	0.61	22	58	91	0.45	455
Ackers and White (d_{50})	1.32	39	72	85	0.65	591
Ackers and White (d_{35})	1.45	34	62	78	0.73	591
Yang (d_{50})	0.98	56	87	97	0.39	591
Einstein	2.74	4	10	17	1.27	591
Toffaleti	0.20	5	11	26	0.29	476

of formulas for river application in descending order are Yang (d_{50}), Toffaleti, Einstein, Ackers and White (d_{50}), Colby, Laursen, Engelund and Hansen, and Ackers and White (d_{35}). The summary river data comparison shows that all eight bed-material load formulas have discrepancy ratios greater than one. This seems reasonable because of the 319 sets of river data used in the comparison, 110 sets did not include bed-material load in the unmeasured zone near the riverbed. The gaging station at the Niobrara River near Cody, Nebraska, is one of the few river stations with total bed-material load measured accurately.

Stevens and Yang (1989) made a comparison between the computed and measured results from the Niobrara River. Their comparison, as shown in Fig. 4, indicates that computed results from the Yang (d_{50}) formula agree with measurements very well. Fig. 4 also shows that the Engelund and Hansen formula overpredicts the total bed-material load while the Laursen, Colby,

TABLE 5. Comparison of Accuracy of Formulas According to Energy Slope, Using Laboratory Data

Author of formula (1)	DISCREPANCY RATIO, R_{13}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) S = 0.0001–0.0010						
Laursen	2.54	24	38	59	4.79	74
Engelund and Hansen	2.37	35	51	55	2.02	74
Colby	1.09	25	56	79	0.94	61
Ackers and White (d_{50})	1.24	37	71	86	0.74	70
Ackers and White (d_{35})	2.04	23	51	69	1.78	74
Yang (d_{50})	1.31	22	59	70	0.85	74
Einstein	0.81	19	34	64	0.70	74
Toffaleti	1.74	19	39	65	4.08	74
(b) S = 0.0010–0.0100						
Laursen	1.12	46	69	86	0.97	691
Engelund and Hansen	1.22	39	76	87	1.78	691
Colby	0.65	28	59	85	0.48	570
Ackers and White (d_{50})	1.24	38	68	85	0.66	691
Ackers and White (d_{35})	1.46	34	62	75	0.90	691
Yang (d_{50})	1.10	55	84	94	0.69	691
Einstein	2.10	17	32	43	1.32	691
Toffaleti	0.34	9	20	35	0.47	616
(c) S = 0.0100–0.0300						
Laursen	1.39	50	70	82	0.74	352
Engelund and Hansen	0.68	23	60	97	0.27	352
Colby	0.49	7	41	87	0.43	227
Ackers and White (d_{50})	1.18	47	80	89	0.57	352
Ackers and White (d_{35})	1.26	45	73	88	0.59	352
Yang (d_{50})	0.89	55	87	98	0.30	352
Einstein	2.90	2	6	12	1.27	352
Toffaleti	0.12	1	5	16	0.20	249

TABLE 6. Comparison of Accuracy of Formulas Acccording to Concentration, Using River Data

Author of formula (1)	DISCREPANCY RATIO, R_{21}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) C_m = 2–1,000 ppm						
Laursen	1.66	29	53	69	2.05	173
Engelund and Hansen	2.08	20	42	54	1.52	230
Colby	1.77	29	53	68	2.24	155
Ackers and White (d_{50})	1.51	27	51	68	0.98	230
Ackers and White (d_{35})	2.15	17	35	53	1.90	173
Yang (d_{50})	1.32	36	58	76	0.83	230
Einstein	1.48	27	55	75	1.65	173
Toffaleti	1.32	30	54	73	1.47	173
(b) C_m = 1,000–5,000 ppm						
Laursen	1.28	38	50	61	1.27	64
Engelund and Hansen	1.07	38	62	89	0.75	89
Colby	1.02	51	73	86	0.60	79
Ackers and White (d_{50})	1.22	30	63	76	0.84	89
Ackers and White (d_{35})	1.95	14	30	45	1.94	64
Yang (d_{50})	0.76	34	64	88	0.50	89
Einstein	1.10	22	39	73	1.18	64
Toffaleti	1.35	28	48	67	1.35	64

TABLE 7. Comparison of Accuracy of Formulas According to Froude Number, Using River Data

Author of formula (1)	DISCREPANCY RATIO, R_{23}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) F_r = 0.08–0.50						
Laursen	1.58	29	51	68	2.01	191
Engelund and Hansen	1.91	23	44	59	1.49	265
Colby	1.59	34	56	72	2.06	183
Ackers and White (d_{50})	1.41	27	52	69	0.97	265
Ackers and White (d_{35})	2.05	17	33	52	1.92	191
Yang (d_{50})	1.21	35	57	77	0.82	265
Einstein	1.36	24	51	75	1.63	191
Toffaleti	1.27	31	53	70	1.46	191
(b) F_r = 0.50–1.00						
Laursen	1.48	41	54	63	1.18	46
Engelund and Hansen	1.29	39	67	85	0.88	54
Colby	1.26	43	75	84	0.61	51
Ackers and White (d_{50})	1.54	33	67	76	0.88	54
Ackers and White (d_{35})	2.27	13	35	46	1.86	46
Yang (d_{50})	0.95	39	70	89	0.57	54
Einstein	1.45	35	50	72	1.13	46
Toffaleti	1.57	24	50	76	1.27	46

TABLE 8. Comparison of Accuracy of Formulas According to Energy Slope, Using River Data

Author of formula (1)	DISCREPANCY RATIO, R_{23}: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) S = 0.00003–0.00170						
Laursen	1.64	35	57	68	1.95	211
Engelund and Hansen	1.85	26	47	62	1.43	293
Colby	1.52	36	60	74	1.79	229
Ackers and White (d_{50})	1.48	30	57	70	0.92	293
Ackers and White (d_{35})	2.18	17	33	49	1.92	211
Yang (d_{50})	1.18	36	59	78	0.80	293
Einstein	1.45	27	50	73	1.63	211
Toffaleti	1.41	33	58	78	1.45	211
(b) S = 0.001700–0.00250						
Laursen	0.88	4	8	54	1.25	26
Engelund and Hansen	1.23	19	50	81	1.18	26
Colby	1.52	40	40	80	3.53	5
Ackers and White (d_{50})	0.90	4	27	73	1.19	26
Ackers and White (d_{35})	1.42	15	38	69	2.08	26
Yang (d_{50})	1.01	27	62	88	0.72	26
Einstein	0.80	19	54	81	0.73	26
Toffaleti	0.70	4	4	19	1.48	26

TABLE 9. Summary of Comparison of Accuracy of Formulas

Author of formula (1)	DISCREPANCY RATIO: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) Laboratory Data						
Laursen	1.30	46	67	83	1.21	1,118
Engelund and Hansen	1.13	33	69	88	1.01	1,118
Colby	0.64	22	54	86	0.51	857
Ackers and White (d_{50})	1.22	41	72	86	0.63	1,114
Ackers and White (d_{35})	1.44	37	65	78	0.86	1,118
Yang (d_{50})	1.05	53	83	94	0.52	1,118
Einstein	2.28	12	23	34	1.24	1,118
Toffaleti	0.40	7	18	32	0.83	938
(b) River Data						
Laursen	1.56	32	52	67	1.70	237
Engelund and Hansen	1.80	25	48	64	1.41	319
Colby	1.52	36	60	74	1.57	234
Ackers and White (d_{50})	1.43	28	55	70	0.92	319
Ackers and White (d_{35})	2.09	16	33	51	1.84	237
Yang (d_{50})	1.17	35	60	79	0.71	319
Einstein	1.38	26	51	74	1.30	237
Toffaleti	1.33	30	52	71	1.38	237

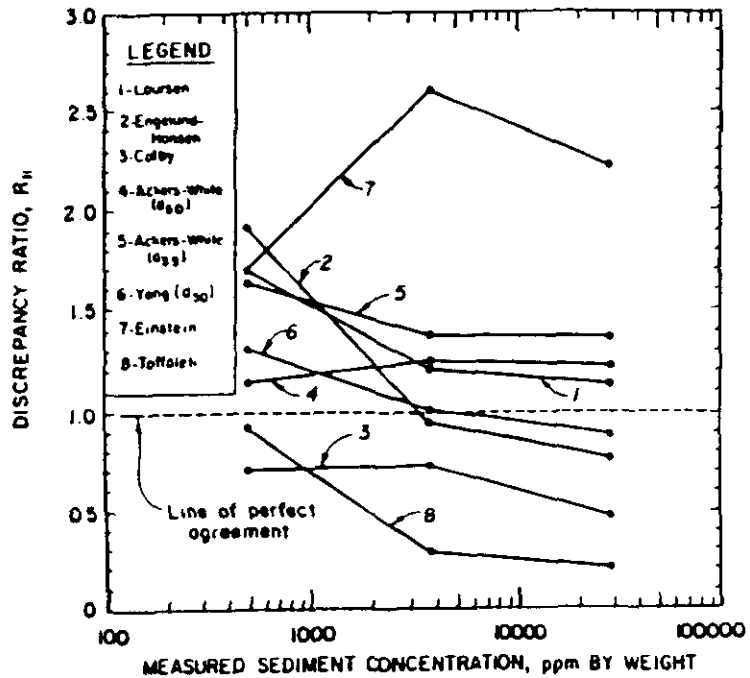

FIG. 1. Comparison of Discrepancy Ratio R_{11} Based on Measured Concentration from Laboratory Flumes

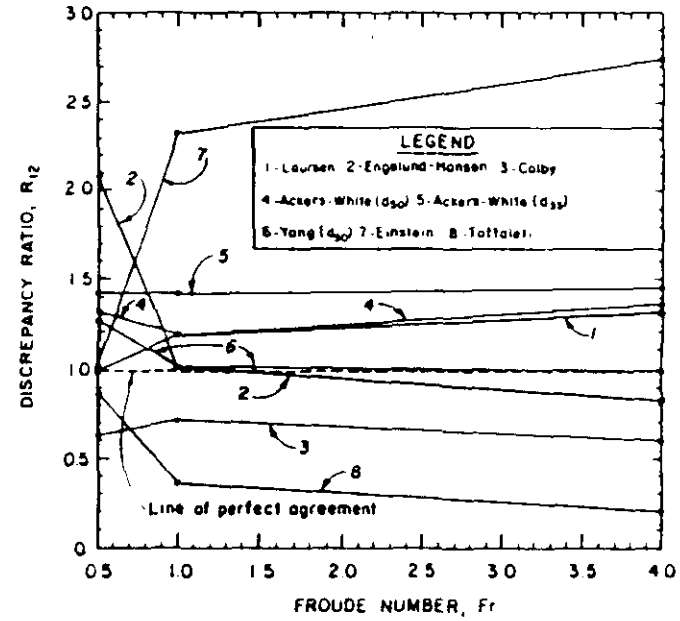

FIG. 2. Comparison of Discrepancy Ratio R_{12} Based on Measured Froude Number from Laboratory Flumes

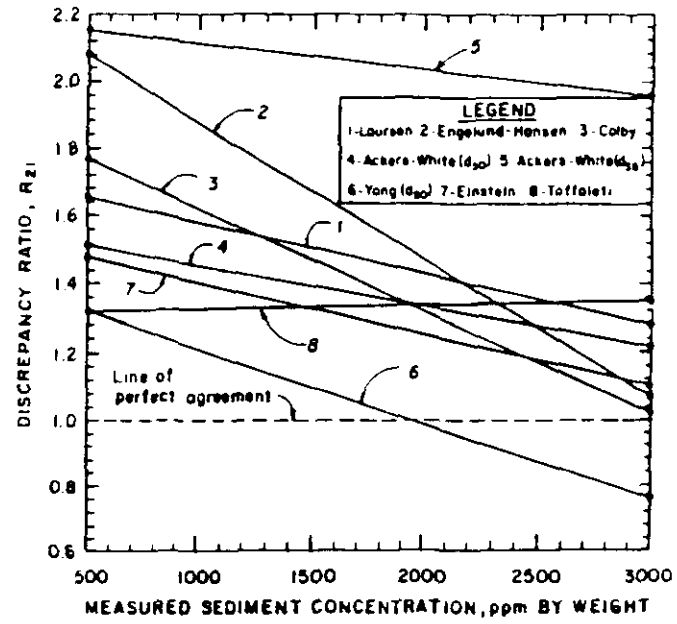

FIG. 3. Comparison of Discrepancy Ratio R_{21} Based on Measured Concentration from Rivers

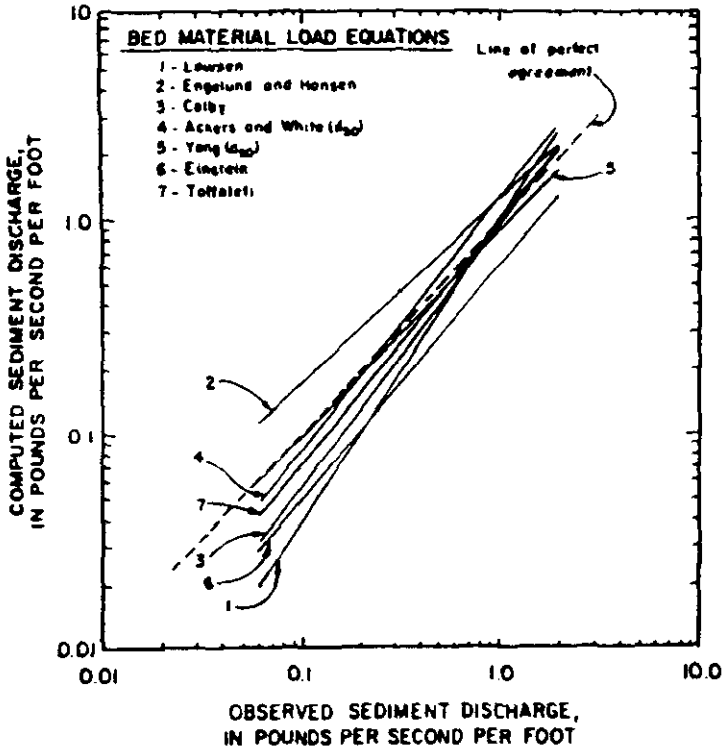

FIG. 4. Comparison of Computed Results by Seven Formulas and Measured Total Bed-Material Discharges from Niobrara River near Cody, Nebraska [from Stevens and Yang (1989)]

Ackers and White (d_{50}), Einstein, and Toffaleti formulas underpredict the total bed-material load in the Niobrara River.

Table 9 shows that different numbers of data sets were used in the comparison of accuracy of formulas. This is caused by the limitations of application of each formula suggested by the original author of the formula. Results in Tables 3–8 indicate that the accuracy of a formula may vary depending on the hydraulic and sediment conditions under which the formula is applied. Engineers may use the information in Tables 3–8 as a reference for selecting formulas to solve engineering problems under different hydraulic and sediment conditions.

Nonuniform Sediment Transport

Our knowledge of particle size distribution of bed materials in transportation is important to the study of reservoir sedimentation distribution and river engineering. Many practicing engineers assume that the particle size distribution of bed materials in transportation is the same as that on the alluvial bed. However, the fact that the average bed-material size decreases in the downstream direction suggests that the average size of bed materials in transportation should be finer than that on the bed. Four bed-material load

TABLE 10. Comparison between Computed and Measured Bed-Ma ›ze in Transportation by Guy et al. (1966)

Author of formula (1)	DISCREPANCY RATIO, γ_i					Number of data sets (7)
	Mean (2)	Percent of Data in Range 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	
(a) F_r = 0.2–0.30						
Laursen	0.86	79	100	100	0.15	19
Yang (fraction)	1.09	79	100	100	0.18	19
Einstein	2.64	0	0	0	0.84	19
Toffaleti	0.77	42	100	100	0.19	19
(b) F_r = 0.30–0.50						
Laursen	0.82	60	97	100	0.19	117
Yang (fraction)	1.03	85	93	100	0.21	117
Einstein	1.94	22	43	50	0.86	117
Toffaleti	0.61	32	59	85	0.28	117
(c) F_r = 0.50–1.00						
Laursen	0.78	60	88	95	0.23	86
Yang (fraction)	0.91	80	92	99	0.25	86
Einstein	1.41	55	77	84	0.64	86
Toffaleti	0.55	22	51	83	0.27	86
(d) F_r = 1.00–2.00						
Laursen	0.73	48	89	100	0.16	83
Yang (fraction)	0.85	66	99	100	0.18	83
Einstein	0.99	86	99	100	0.18	83
Toffaleti	0.53	22	47	94	0.23	83
(e) All Data						
Laursen	0.79	58	92	99	0.19	305
Yang (fraction)	0.95	78	95	100	0.21	305
Einstein	1.58	47	65	70	0.61	305
Toffaleti	0.58	27	65	87	0.26	305

formulas that can compute transport rate by size fraction are used in this paper to assess the impact of sorting on bed-material size distribution. They are the formulas by Laursen, Yang (fraction), Einstein, and Toffaleti. The Yang fraction formula is identical to his original formula except that the computation is made by size fraction, i.e.

$$C_c = \sum_{i=1}^{j} p_i C_i \quad \ldots \quad (4)$$

where C_i = computed sediment concentration in parts per million by weight in size fraction i; j = total number of size fraction used in the computation; and p_i = percentage of material in size i.

Let us define the discrepancy ratio γ_i as the ratio between median particle size d_c in transportation computed by a formula and actually measured me-

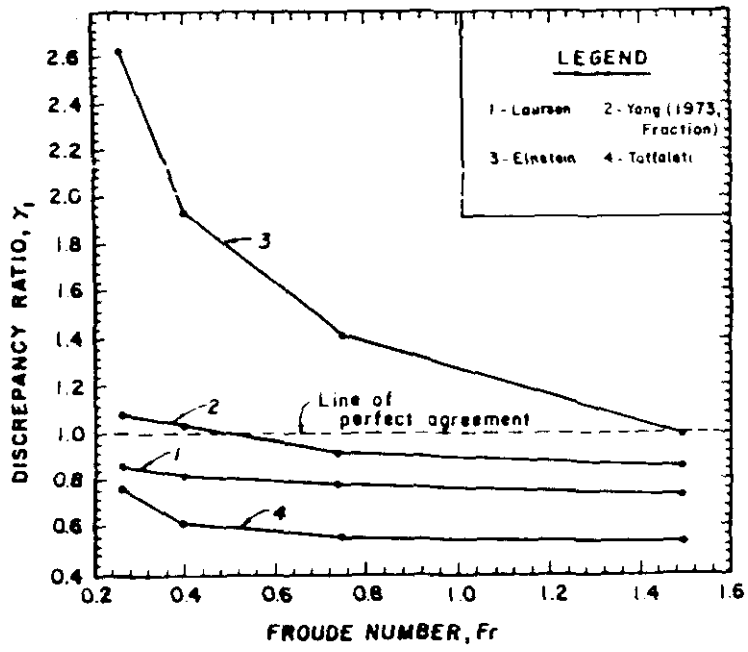

FIG. 5. Comparison between Computed and Measured Particle Size of Bed Material in Transportation

dian particle size d_m in transportation, i.e.

$$\gamma_1 = \frac{d_c}{d_m} \quad \ldots\ldots (5)$$

Let us also define the discrepancy ratio γ_2 as the ratio between the median particle size d_c in transportation computed by a formula and d_{50} of the original bed materials on the alluvial bed, i.e.

$$\gamma_2 = \frac{d_c}{d_{50}} \quad \ldots\ldots (6)$$

γ_1 should give us an indication of the average accuracy of a formula in predicting the size distribution of bed materials in transportation. γ_2 should give us an indication of the reasonableness of a formula in describing the sorting process or the reduction of average particle size in the transport process. The 305 sets of data published by Guy et al. (1966) include size distributions of bed materials on the bed and bed materials in transportation. The results shown in Table 10 indicate that Yang's 1973 fraction formula has the best overall discrepancy ratio of 0.95. The results shown in Table 10 and Fig. 5 also show that the γ_1 value of Yang's 1973 fraction formula is not very sensitive to the variation of Froude number. These results suggest that Yang's 1973 fraction equation can be used with accuracy to predict size distribution of bed materials in transportation. This study also indicates that

TABLE 11. Comparison between Computed Bed-Material Size in Transportation and Measured Original Bed-Material Size by Guy et al. (1966)

Author of formula (1)	DISCREPANCY RATIO, γ_1: Mean (2)	Percent of Data in Range: 0.75–1.25 (3)	0.5–1.5 (4)	0.25–1.75 (5)	Standard deviation (6)	Number of data sets (7)
(a) $F_* = 0.20$–0.30						
Laursen	0.66	26	84	100	0.14	19
Yang (fraction)	0.81	89	100	100	0.08	19
Einstein	1.98	0	26	37	0.54	19
Toffaleti	0.59	26	74	100	0.16	19
Measured value	0.77	58	95	100	0.10	19
(b) $F_* = 0.30$–0.50						
Laursen	0.61	17	87	91	0.16	117
Yang (fraction)	0.76	80	91	91	0.18	117
Einstein	1.34	51	70	87	0.39	117
Toffaleti	0.43	8	40	79	0.20	117
Measured value	0.77	56	91	96	0.17	117
(c) $F_* = 0.50$–1.00						
Laursen	0.63	37	79	91	0.19	86
Yang (fraction)	0.73	70	88	93	0.20	86
Einstein	1.06	90	97	100	0.17	86
Toffaleti	0.43	13	40	78	0.21	86
Measured value	0.77	79	91	99	0.17	86
(d) $F_* = 1.00$–2.00						
Laursen	0.65	17	93	100	0.10	83
Yang (fraction)	0.76	61	100	100	0.08	83
Einstein	0.90	80	100	100	0.14	83
Toffaleti	0.46	5	36	94	0.15	83
Measured value	0.77	70	98	100	0.17	83
(e) All Data						
Laursen	0.63	23	86	94	0.15	305
Yang (fraction)	0.75	73	93	95	0.15	305
Einstein	1.18	67	83	91	0.27	305
Toffaleti	0.45	10	41	84	0.19	305
Measured value	0.77	66	93	98	0.17	305

the median sizes of bed materials in transportation predicted by Laursen (1958) and Toffaleti (1968) are too small, while those predicted by Einstein (1950) are too large.

Table 11 and Fig. 6 show that, with the exception of the Einstein formula, bed materials in transportation computed by Laursen (1958), Yang (1973) (fraction), and Toffaleti (1968) are finer than the original bed materials on the bed, which is consistent with the sorting phenomena. This sorting process explains why bed-material size should decrease in the downstream direction. The measured γ_2 value of the data published by Guy et al. (1966)

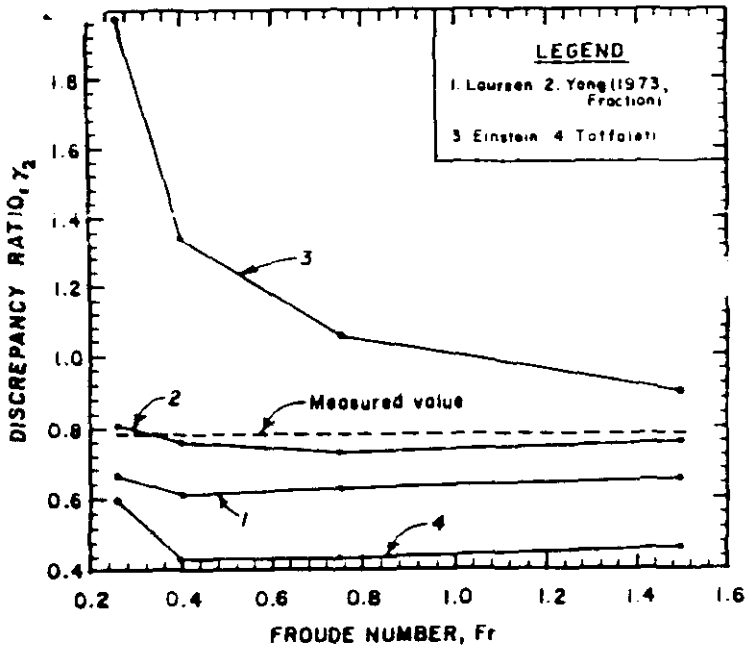

FIG. 6. Comparison between Computed Bed-Material Size in Transportation and Original Bed-Material Size

shows very little variation with changing F_r, and an average value of 0.77 is used in Table 11 for all data. This value is very close to the average value of 0.75 computed by Yang's 1973 fraction equation. Table 11 also shows that the γ_2 value for Yang's fraction equation is not sensitive to the variation of F_r, which is consistent with measurements made by Guy et al. (1966). The γ_2 values of the Einstein (1950) formula are greater than one for all flow conditions, which means the materials in transportation computed by the Einstein formula are coarser than the original bed materials, and the bed-material size would increase in the downstream direction. This unreasonable result may stem from the use of the hiding and lifting correction factors by Einstein.

The total bed-material load computed by the Einstein formula is directly related to bedload. In order to reflect the influence of nonuniform bed-material size distribution and lift force, Einstein introduced the hiding factor ξ and lifting factor Y. The values of ξ and Y vary from 1 to 100 and from 0.25 to 0.85, respectively. The combined effect of ξY on a finer particle could be as high as 340 times the effect on a larger particle when the finer particle is hiding behind the larger one. This effect is especially pronounced when the Froude number is small. This is why the values of γ_1 and γ_2 for the Einstein formula in Tables 10 and 11 decrease with increasing F_r values. *Our study suggests that Einstein's hiding and lifting factors overcorrected the effect of nonuniformity of bed-material size on the transport of graded bed materials.*

Summary and Conclusions

Laboratory and river data are used to compare the accuracy of total bed material load equations. These data are regrouped in accordance with the values of measured bed-material concentration, Froude number, and slope. The effect of nonuniformity of bed-material size on the materials being transported is also studied. These studies reached the following conclusions:

1. Based on 1,119 sets of laboratory data, the overall accuracy of bed material load formulas in descending order are those by Yang (d_{50}), Engelund and Hansen, Ackers and White (d_{50}), Laursen, Ackers and White (d_{35}), Colby, Einstein, and Toffaleti. Formulas developed by Colby, Einstein, and Toffaleti may not be suitable for laboratory flume and small river application. Based on the analyses of 319 sets of river data, the overall accuracy of formula in descending order are those by Yang (d_{50}), Toffaleti, Einstein, Ackers and White (d_{50}), Colby, Laursen, Engelund and Hansen, and Ackers and White (d_{35}).

2. Higher overall accuracy rating of a formula does not guarantee that the formula is superior to others under all flow and sediment conditions. The accuracy rating of a formula may vary depending on the measured values of concentration, Froude number, and slope. Engineers may use the information in Tables 3–8 as a reference for selecting formulas to solve engineering problems under different flow and sediment conditions.

3. Based on the data used in the analyses, Yang's sand transport equation by size fraction can accurately predict the size distribution of bed materials in transportation. The Einstein hiding and lifting correction factors overcorrected the effect of nonuniform size distribution of bed materials on total bed-material transport, especially for flows with low Froude number.

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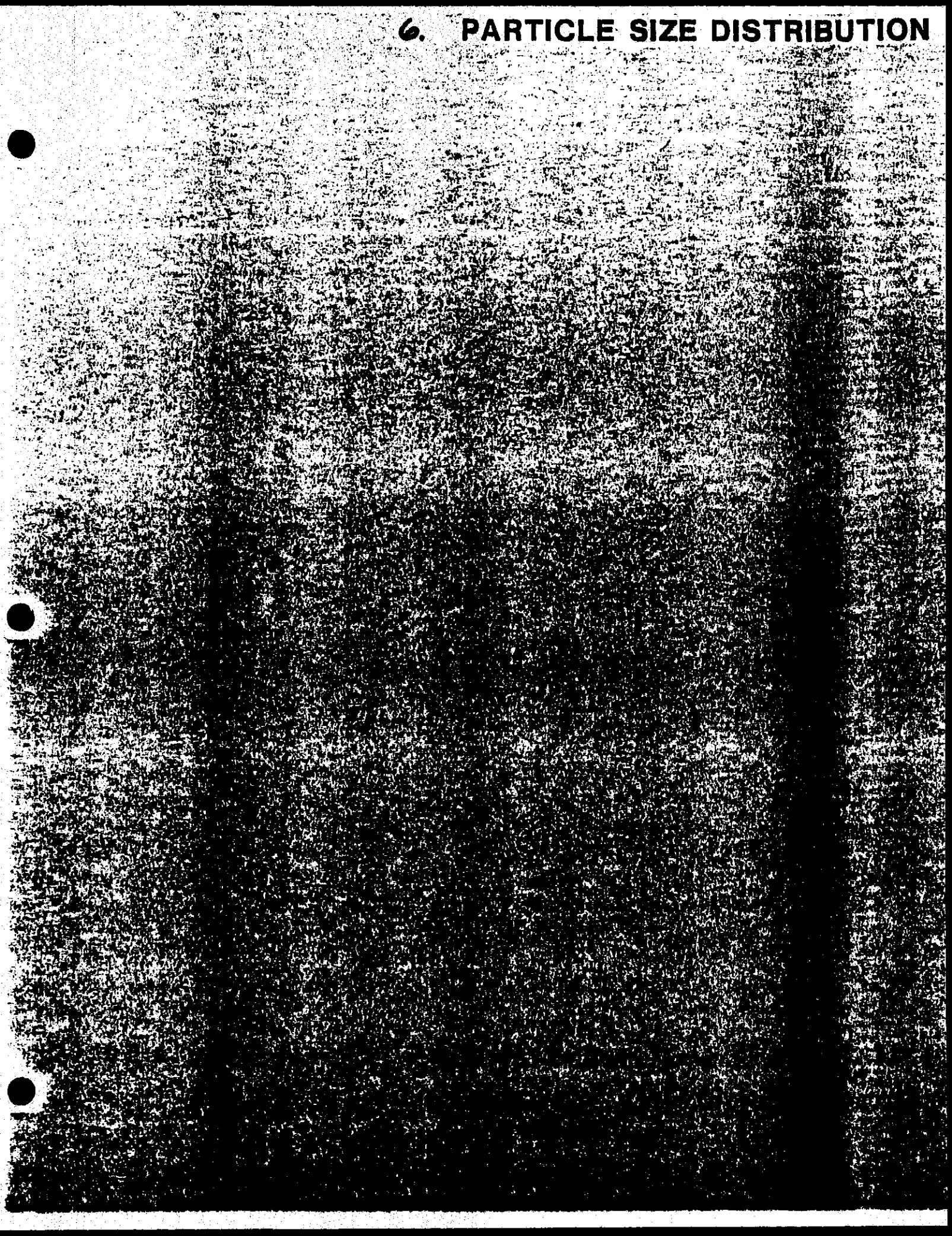
Appendix II. Notation

The following symbols are used in this paper:

C_t, C_m = computed and measured sediment concentration in parts per million by weight, respectively;
C_i = computed sediment cementation in parts per million by weight in size fraction i;
d_t, d_m = computed and measured median bed-material diameters in transportation, respectively;
d_{35}, d_{50} = sediment diameter of which 35% and 50% are finer, respectively;
F_r = Froude number;
p_i = percentage of bed material available in size fraction i;
R = discrepancy ratio between computed and measured values;
$\bar{R}$ = mean value of R;
S = energy or water-surface slope;
Y = Einstein's lifting correction factor;
γ_1, γ_2 = ratio of d_i/d_m and d_i/d_{50}, respectively;
ξ = Einstein's hiding correction factor; and
σ = standard deviation of R.

6. PARTICLE SIZE DISTRIBUTION



PARTICLE SIZE DISTRIBUTION

A key input required into any sediment transport analysis is particle size distribution of the sediment inflow and particle size distribution of the bed materials. In a riverine environment, the assumption is frequently made that the bed material particle size distribution represents the distribution of sediment in the streamflow. On an alluvial fan this assumption is not valid. The alluvial fan is formed because the materials developed at the source cannot be transported down the surface of the fan and therefore materials are deposited which create the characteristic cone appearance of an alluvial fan surface. For this reason, the particle size distribution of materials on the alluvial fan surface generally represent only the larger size fractions. Finer materials are transported down the surface of the fan and are eventually deposited at some downstream point or in a downstream receiving water. This is true on the Range Wash fan.

Several sediment samples were taken on the alluvial fan surface and along the proposed dike alignment. These are included for review. As can be seen from the summary of the samples presented, the particle sizes are heavily skewed toward the larger size fraction with less than 7 percent of the particles having a diameter less than .0625 millimeters. A review of the source materials in the Range Wash basin indicates that there is a significant source of finer size particles. The conclusion reached after reviewing these two conflicting pieces of information is that, as expected on an alluvial fan, the finer materials are being passed across the surface of the fan and are being deposited further downstream in the system.

To confirm that assumption, the SCS Soil Survey for the Las Vegas Valley was reviewed to determine the percentage of fines in the lower portion of the Las Vegas Valley. The attached maps show the downstream portions of the Range Wash basin near its confluence with Las Vegas Wash.

The predominant soils type at the confluence of Range Wash with Las Vegas Wash is Glencarb. The designation on the attached maps are map symbol 200, 206, and 222. As the engineering index properties table demonstrates, these materials have a percentage of 70 to 95 percent passing the number 200 sieve. This substantiates the assumption that a significant amount of fine materials are being introduced into the system and are being transported across the alluvial fan and deposited farther downstream.

The precise distribution of the fine and coarse particles cannot be determined directly from this information because the relative volume is unknown. Those samples taken on the fan are skewed toward the coarser particle sizes and those in the valley floor are skewed toward the finer particle sizes. The computation of equilibrium transport and the integration of the various event specific transports helps to define the particle size distribution. As will be discussed in slightly more detail later on, the transport capacity of the alluvial fan flows are sensitive to the relative distribution of fine and coarse particles. This was a significant calibration parameter in determining the event specific transport capacity necessary to match the average annual sediment yield identified in the PSI methodology. The range of values which might be reasonable for fine materials ranges from a minimum of 10 percent to a maximum of 90 percent of the total volume.

FAN MATERIAL SAMPLES

Summary of Samples on Fan and along Dike

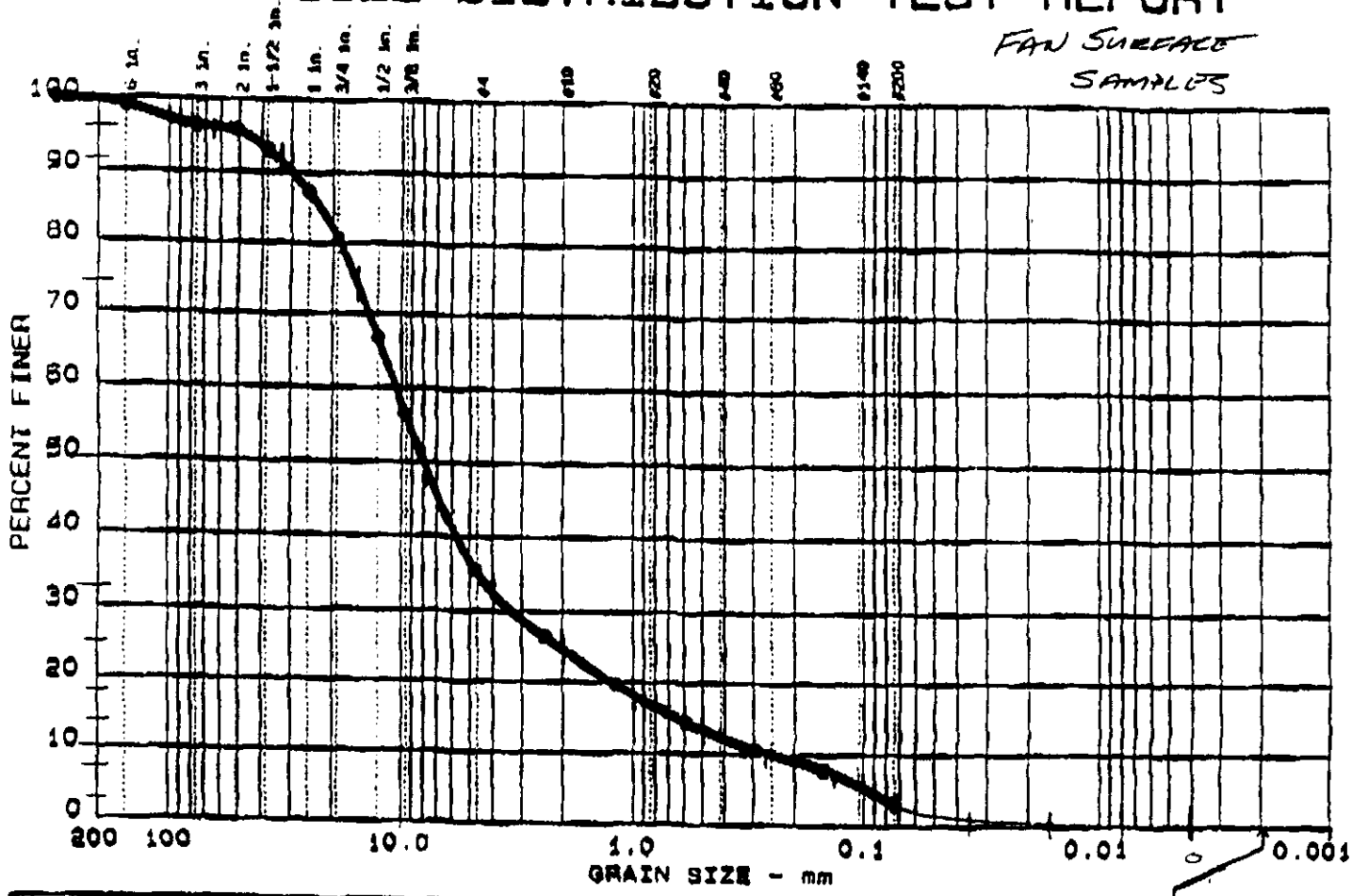
GRAIN SIZE DISTRIBUTIONS FOR BED MATERIAL

Grain Size (mm)	Percent Finer Alluvial Fan	Percent Finer Proposed Dike Alignment
.008	0.0	0.0
.016	0.0	3.0
.032	1.5	5.5
.0625	3.0	7.5
.125	4.5	10.0
.250	6.0	12.5
.500	7.5	15.5
1.00	10.0	19.5
2.00	14.0	25.0
4.00	21.0	33.0
8.00	35.0	47.0
16.00	59.0	66.0
32.00	82.0	83.5
64.00	97.0	97.0

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT

FAN SURFACE SAMPLES



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	20	3.7	60.7	32.5	3.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	22.59	10.57	8.01	3.300	0.8434	0.2532	4.07	41.7

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B5 - 1, depth: 0 - .5'

Date: 10-11-1991

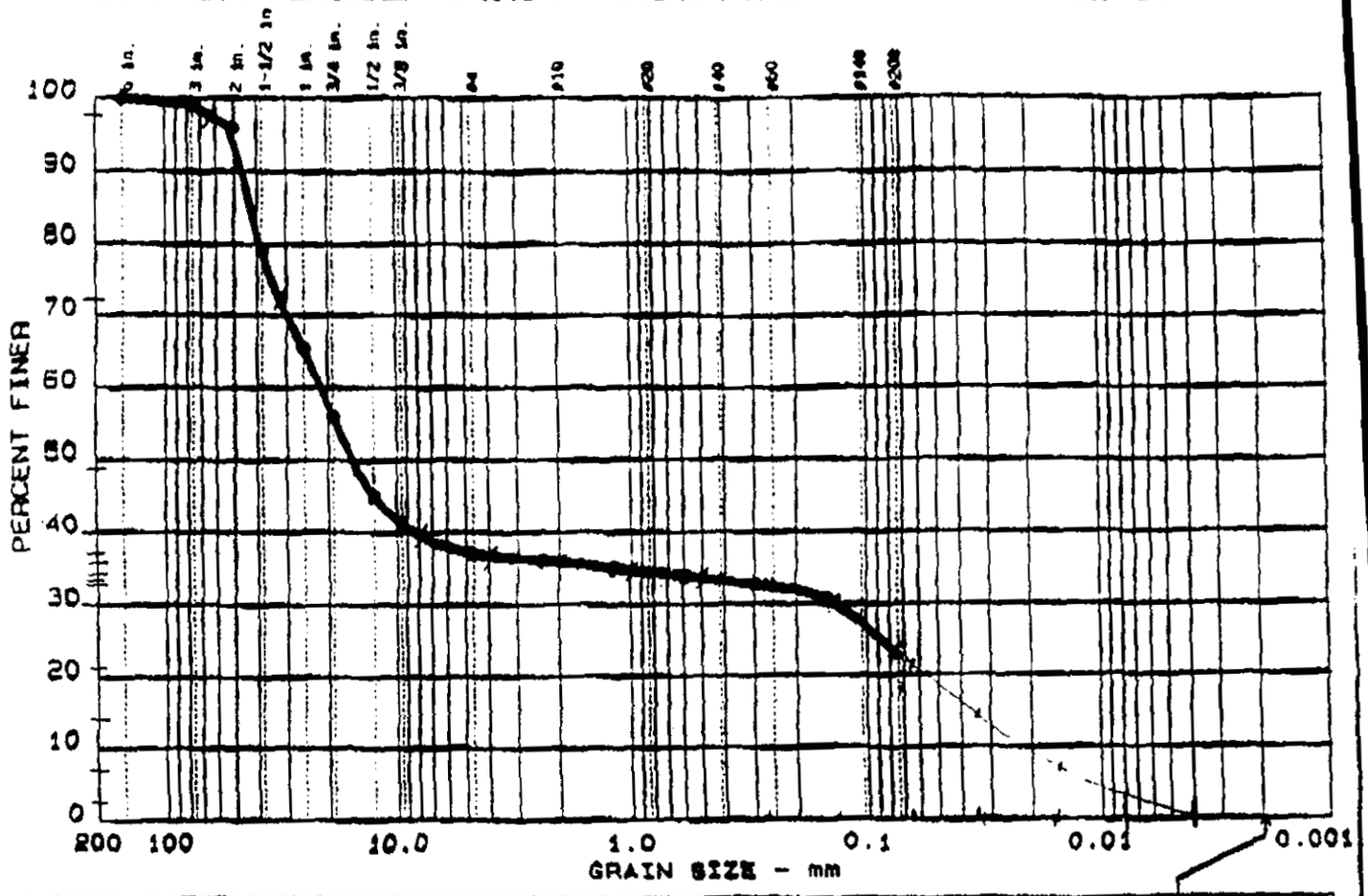
Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	1.0	61.9	14.0	23.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	42.81	21.38	15.67	0.138				

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY GRAVEL w/Sand DESERT PAVEMENT	GM	

Project No.: 91-33286-01
Project: Range Wash Dike
● Location: BS - 2, depth: 0 - .5'
Midway Between BS-1 & BS-3

Date: 10-11-1991

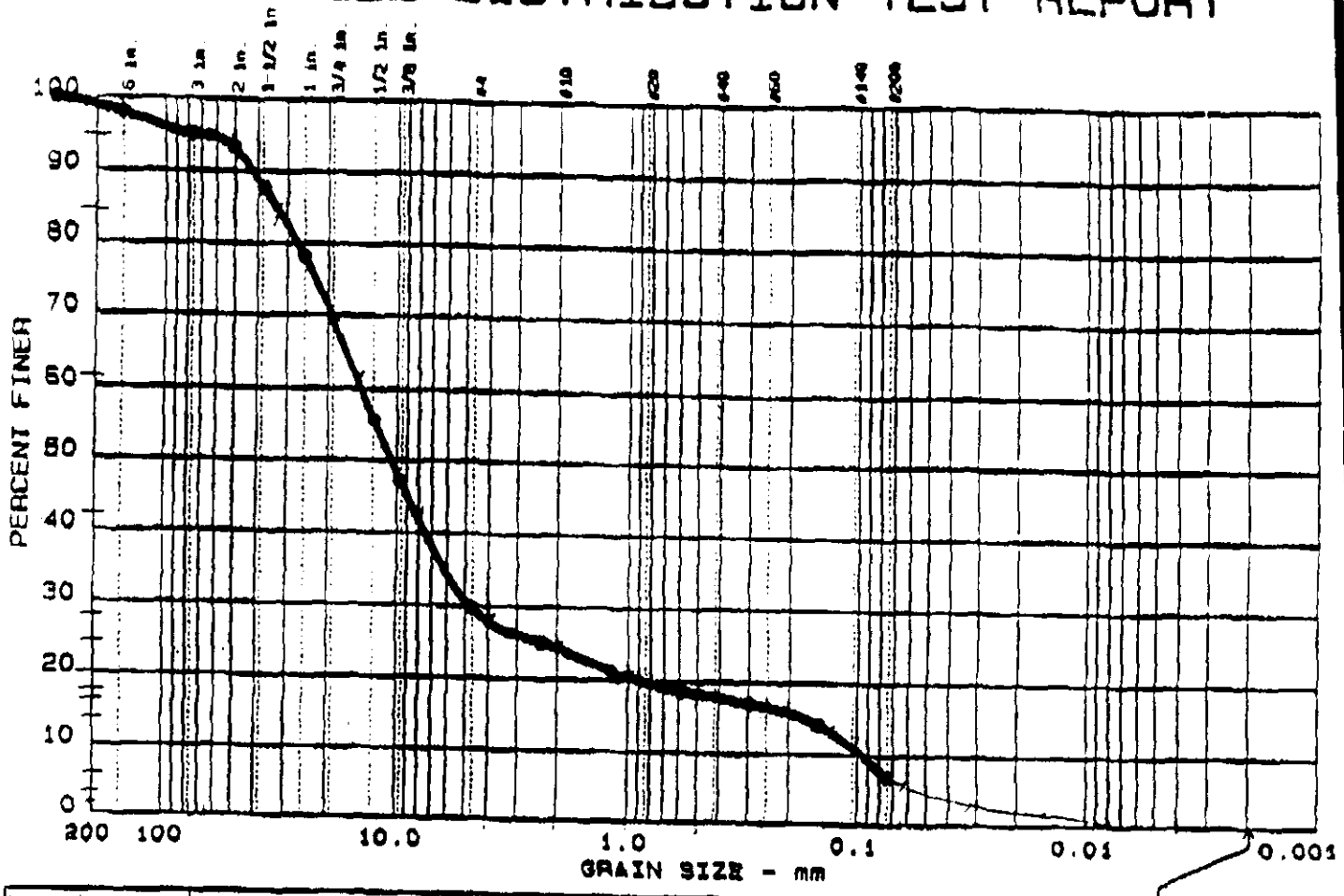
Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	S	5.0	65.2	22.8	7.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	33.50	14.29	10.53	4.814	0.1859	0.0950	17.08	150.5

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS -3, depth: 0 -.5'

Date: 10-11-1991

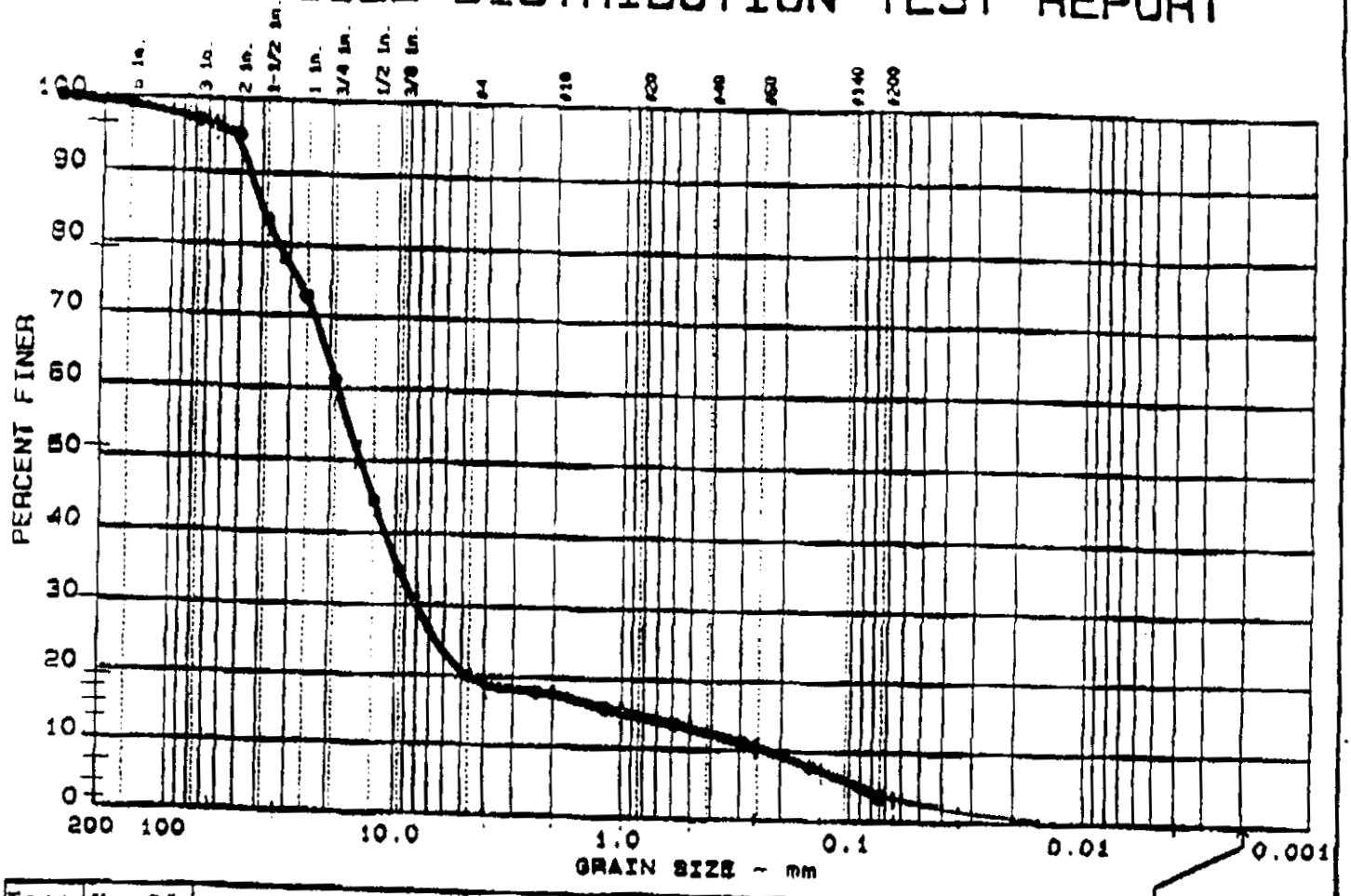
Remarks:
checked by AMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 3

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	3.0	76.8	16.8	3.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	39.81	18.51	14.54	8.082	0.9388	0.2304	15.31	80.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: SS - 4, depth: 0 - .5'

Date: 10-11-1991

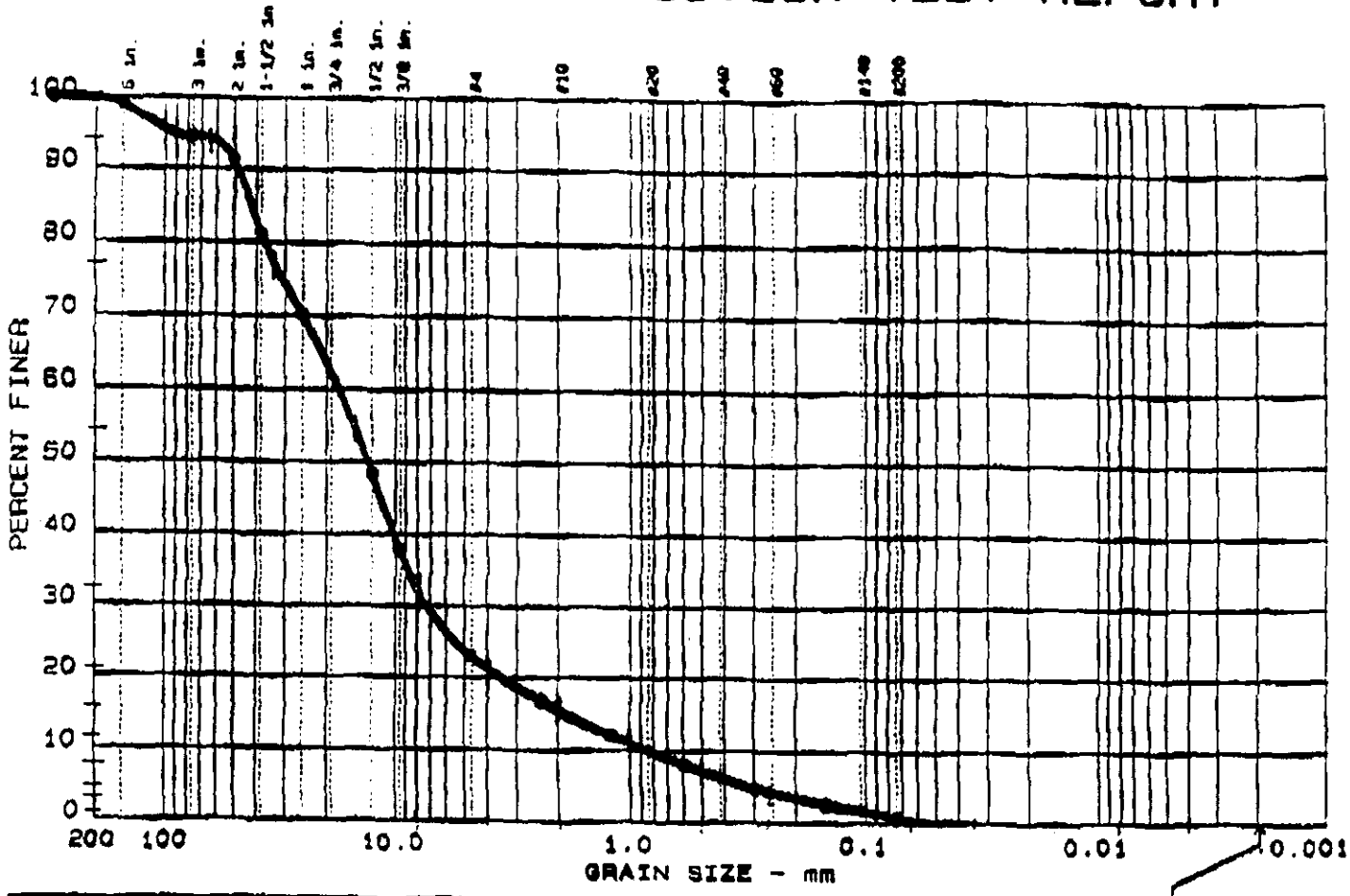
Remarks:
Checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 4

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	B	5.6	71.3	22.3	0.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_U
●	n/p	n/p	41.98	17.82	13.20	7.253	1.8642	0.8424	3.54	20.9

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BB - 5, depth: 0 - .5'

Date: 10-11-1991

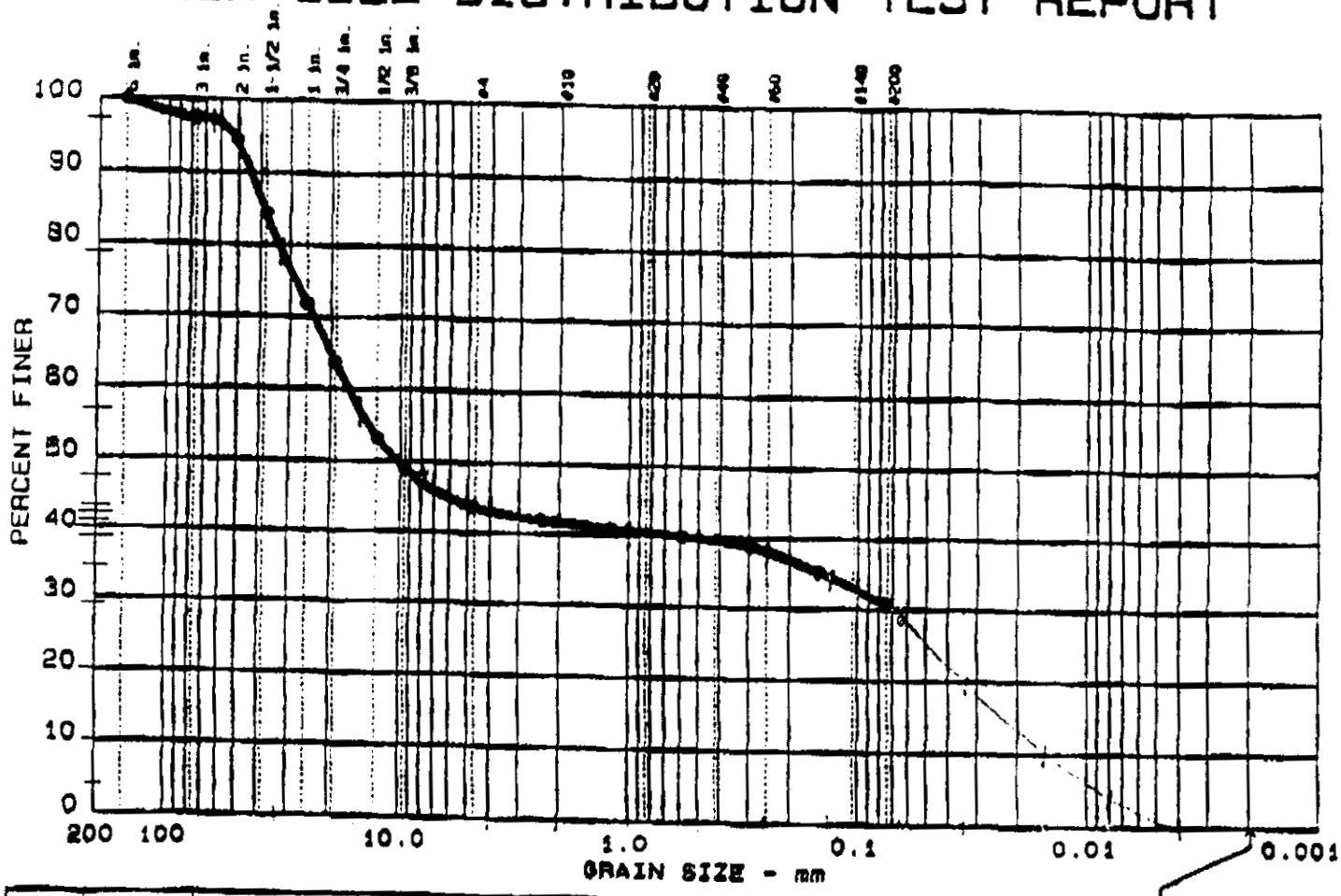
Remarks:
checked by AMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 5

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	2.7	53.6	13.2	30.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	38.77	15.54	10.32					

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY GRAVEL w/Sand	GM	
DESERT PAVEMENT		

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 6, depth: 0 - .5'
NEAR BS-5

Date: 10-11-1991

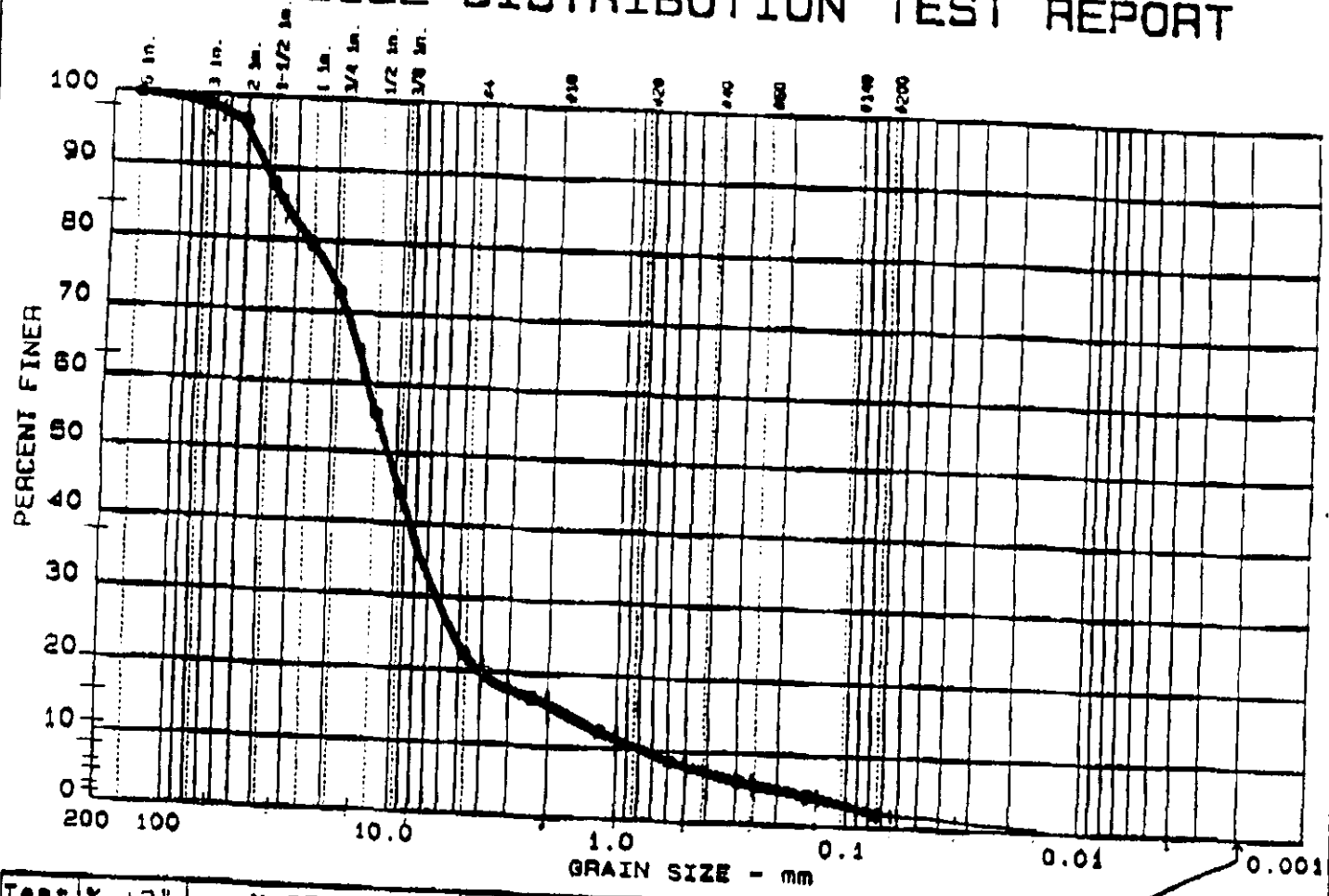
Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 6

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 10	1.2	78.5	20.4	1.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_U
●	n/p	n/p	33.88	13.92	11.05	6.427	1.7701	0.7907	3.75	17.6

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33288-01
Project: Range Wash Dike
● Location: BB - 7, depth: 0 - .5'

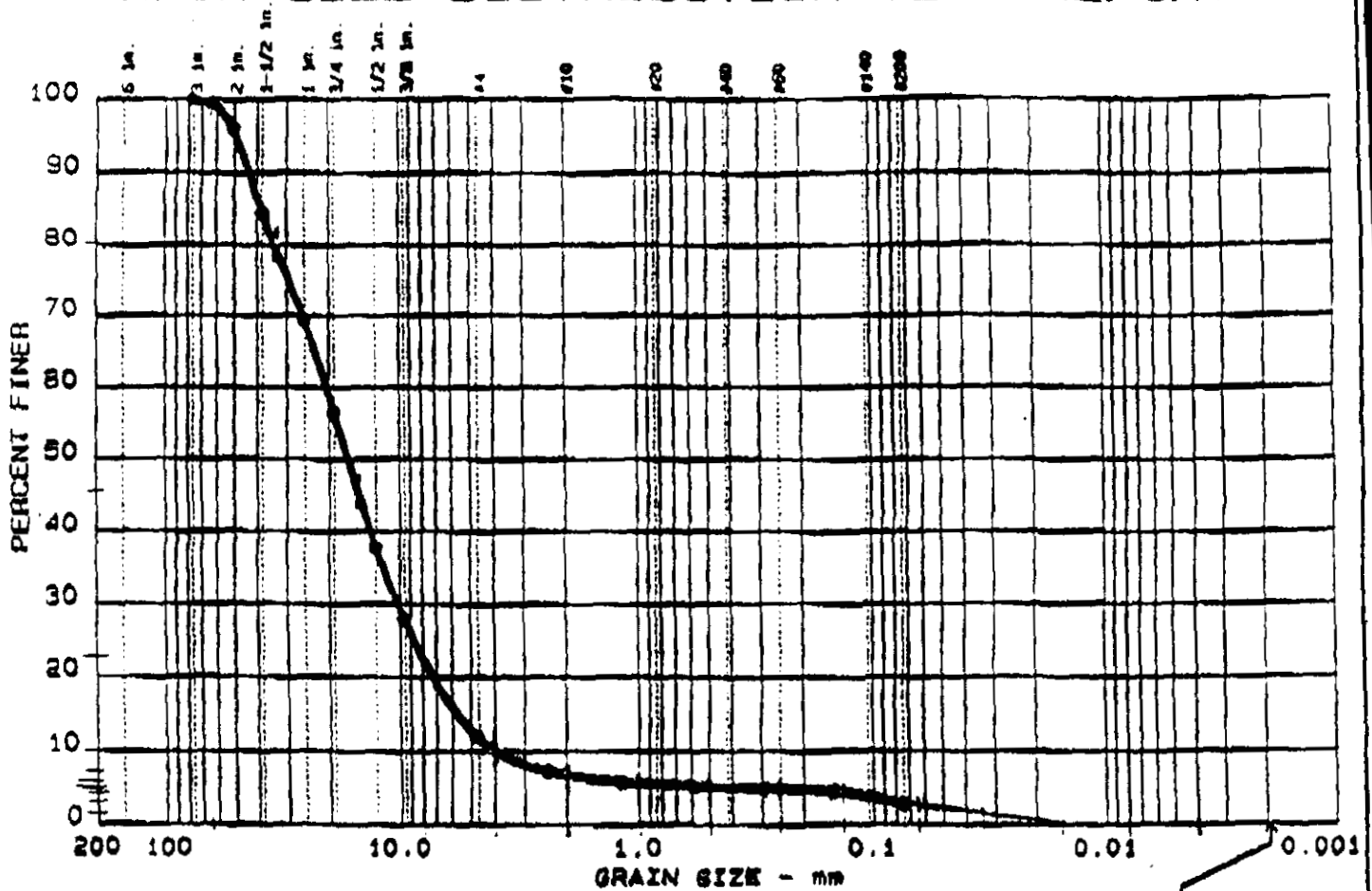
Date: 10-11-1991

Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 7

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	88.0	9.3	2.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	38.48	20.42	16.60	10.233	5.8886	3.9355	1.30	5.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Lt.brn. WELL GRADED GRAVEL	GW	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 8, depth: 0 - .5'
AT WASH CROSSING ROAD Just SE of BS-7
Date: 10-11-1991

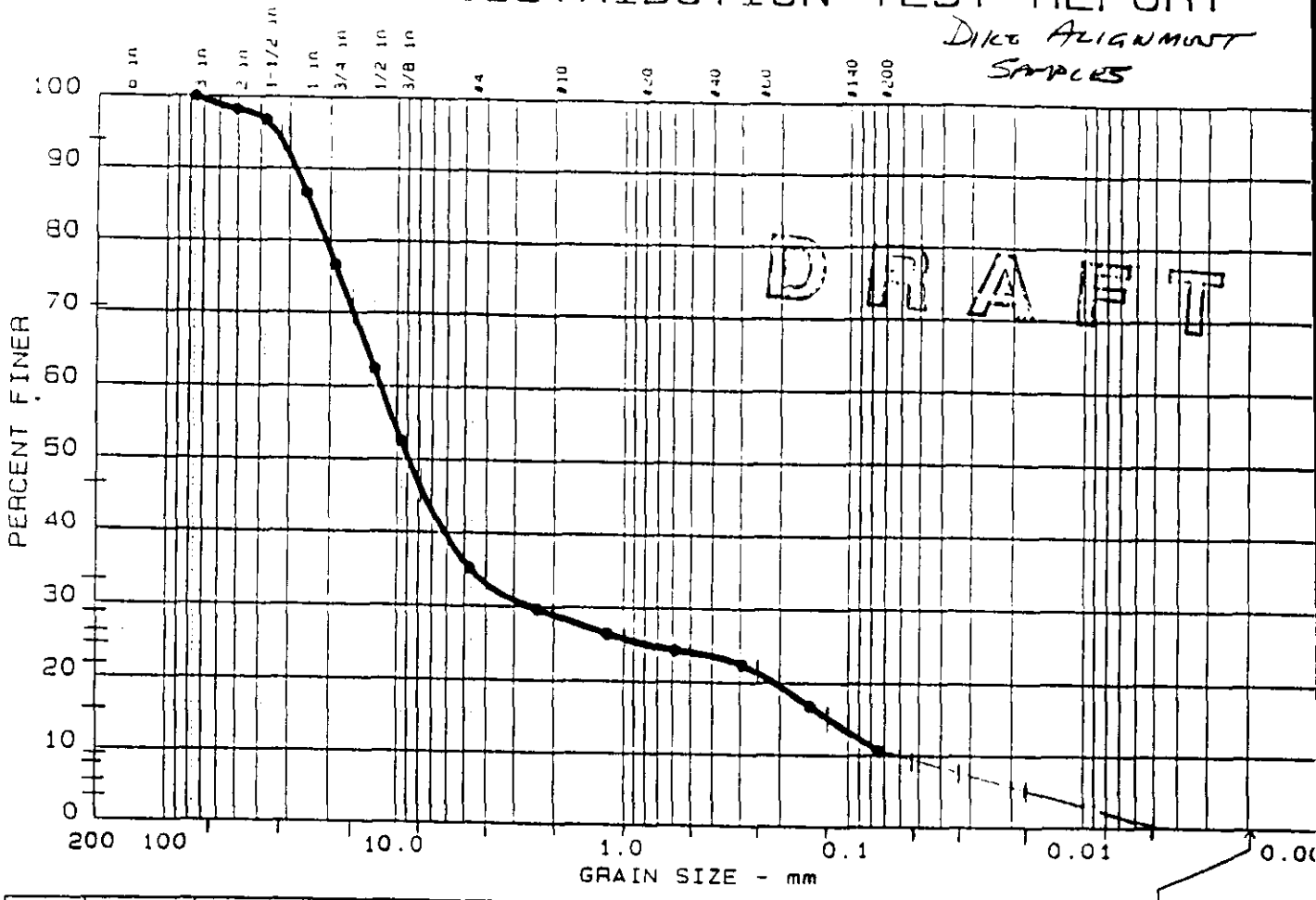
Remarks:
checked by AMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 8

GRAIN SIZE DISTRIBUTION TEST REPORT

Dike Alignment Samples



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	64.9	24.6	10.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	24.15	11.83	8.95	2.553	0.1222			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn.Sandy Gravel w Silt	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 1, sample BS - 1 depth 0 -14.5'

Date: September 6, 1991

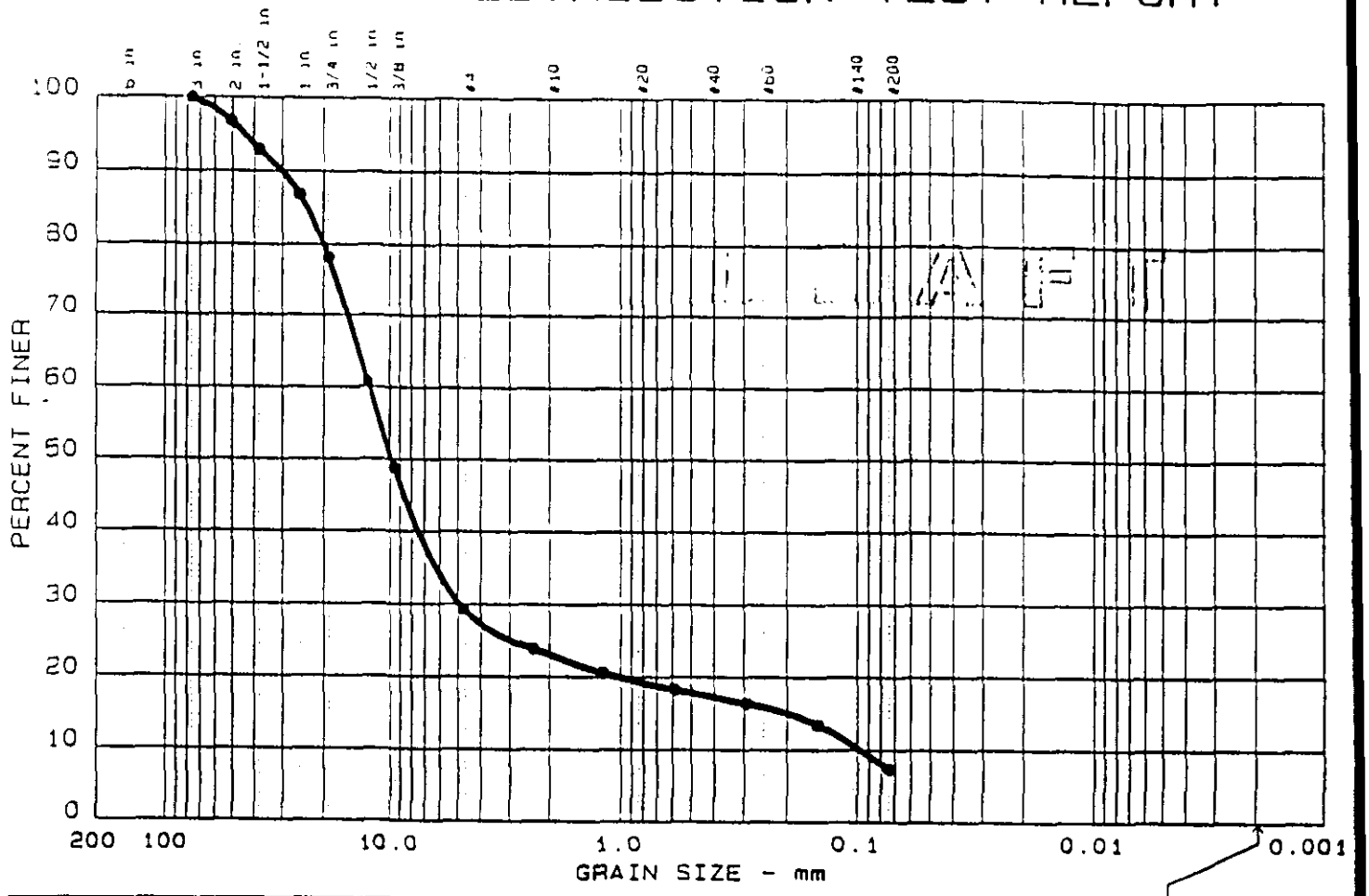
Remarks:
checked by RMJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	70.7	22.1	7.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	23.44	12.45	9.89	4.955	0.2018	0.0977	20.18	127.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Sandy Grave w/Silt	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B -2, sample BS - 1, depth: 0 -14.5'

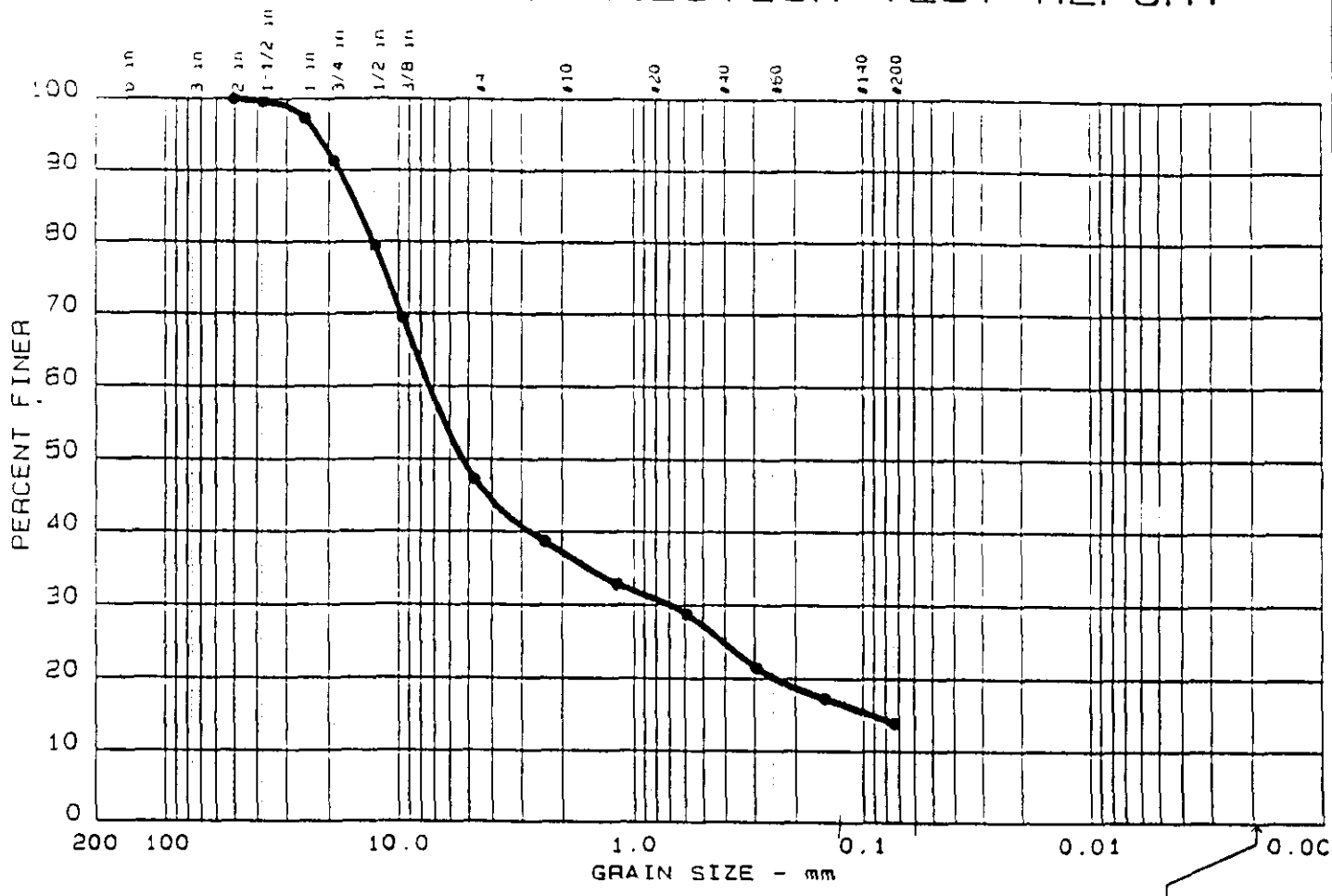
Date: September 6, 1991

Remarks:
checked by AMJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	B	0.0	52.7	33.4	13.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	15.14	7.41	5.31	0.700	0.0923			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 3, sample BS -1, depth: 0 -14.5'

Date: September 6, 1991

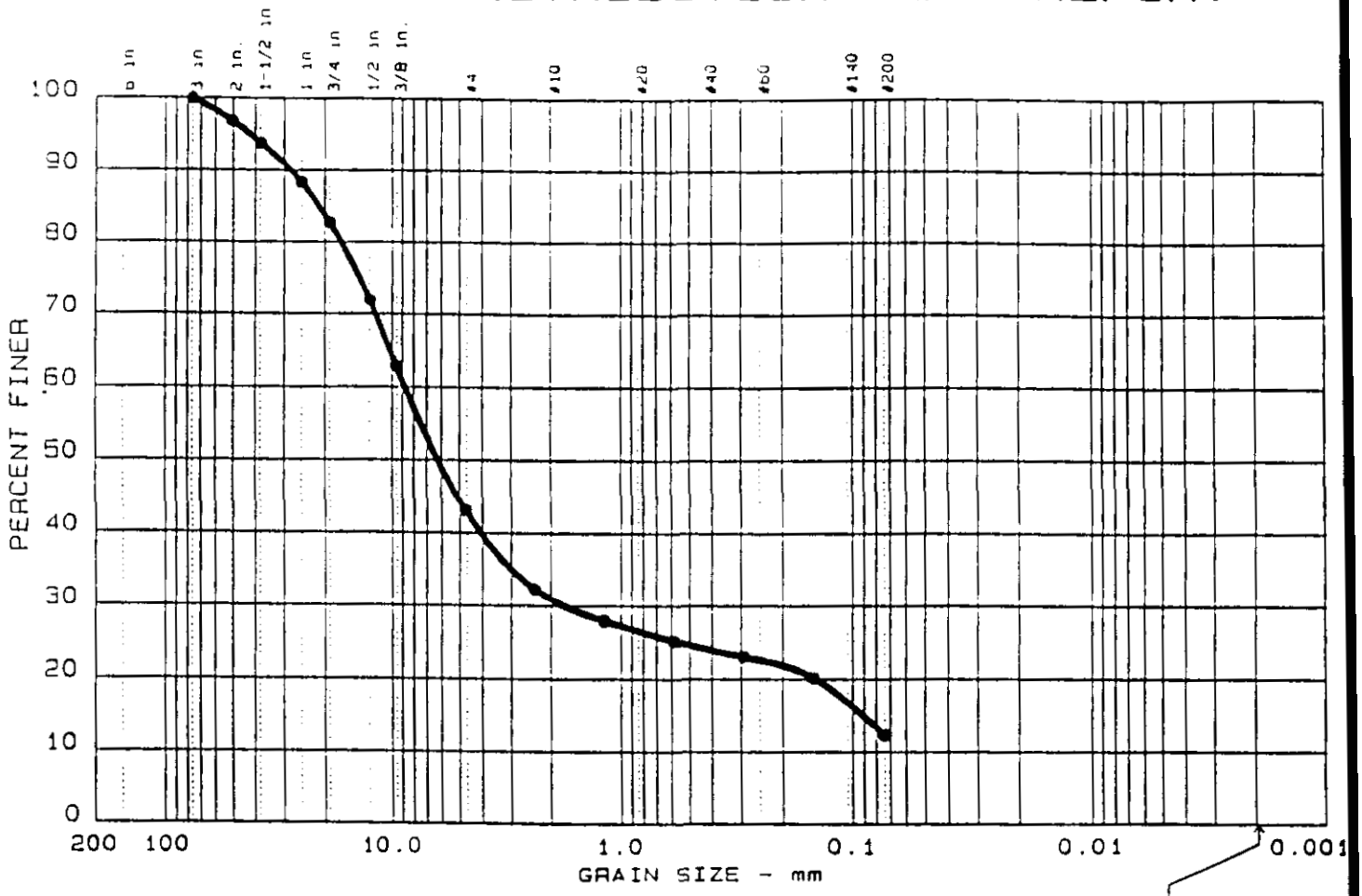
Remarks:
checked by AMJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 3

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	0.0	56.9	30.7	12.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	21.13	8.81	6.29	1.772	0.0898			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 8, BS - 1, depth: 0-14.5'

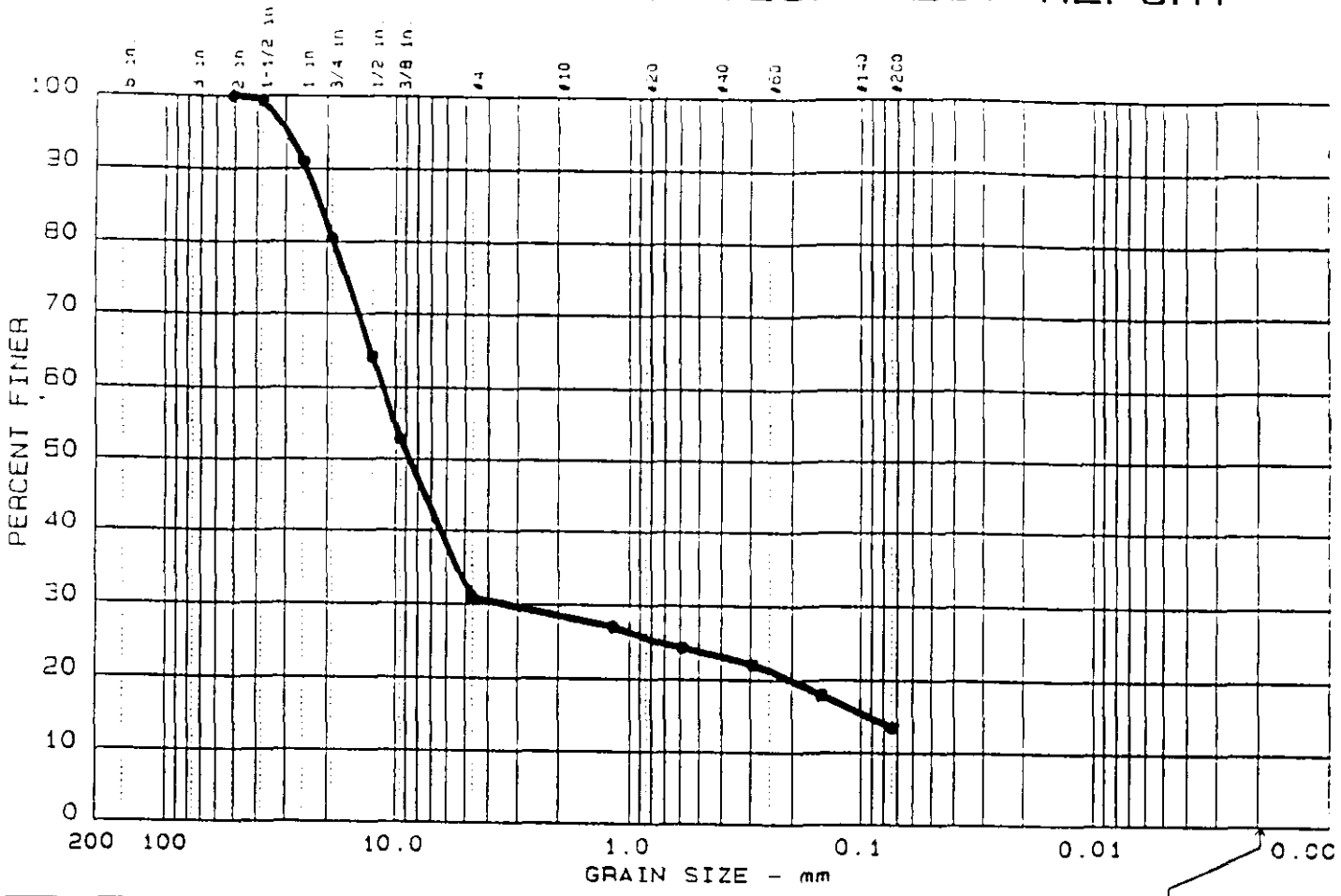
Date: September 9, 1991

Remarks:
checked by AMJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 4

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	69.1	17.4	13.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	21.38	11.44	8.78	3.338	0.0930			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn.Silty Gravel w/Sand	GM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: B - 7, BS - 1, depth: 0 -14.5'

Date: September 9, 1991

Remarks:

checked by RMJ

NP= Non-Plastic

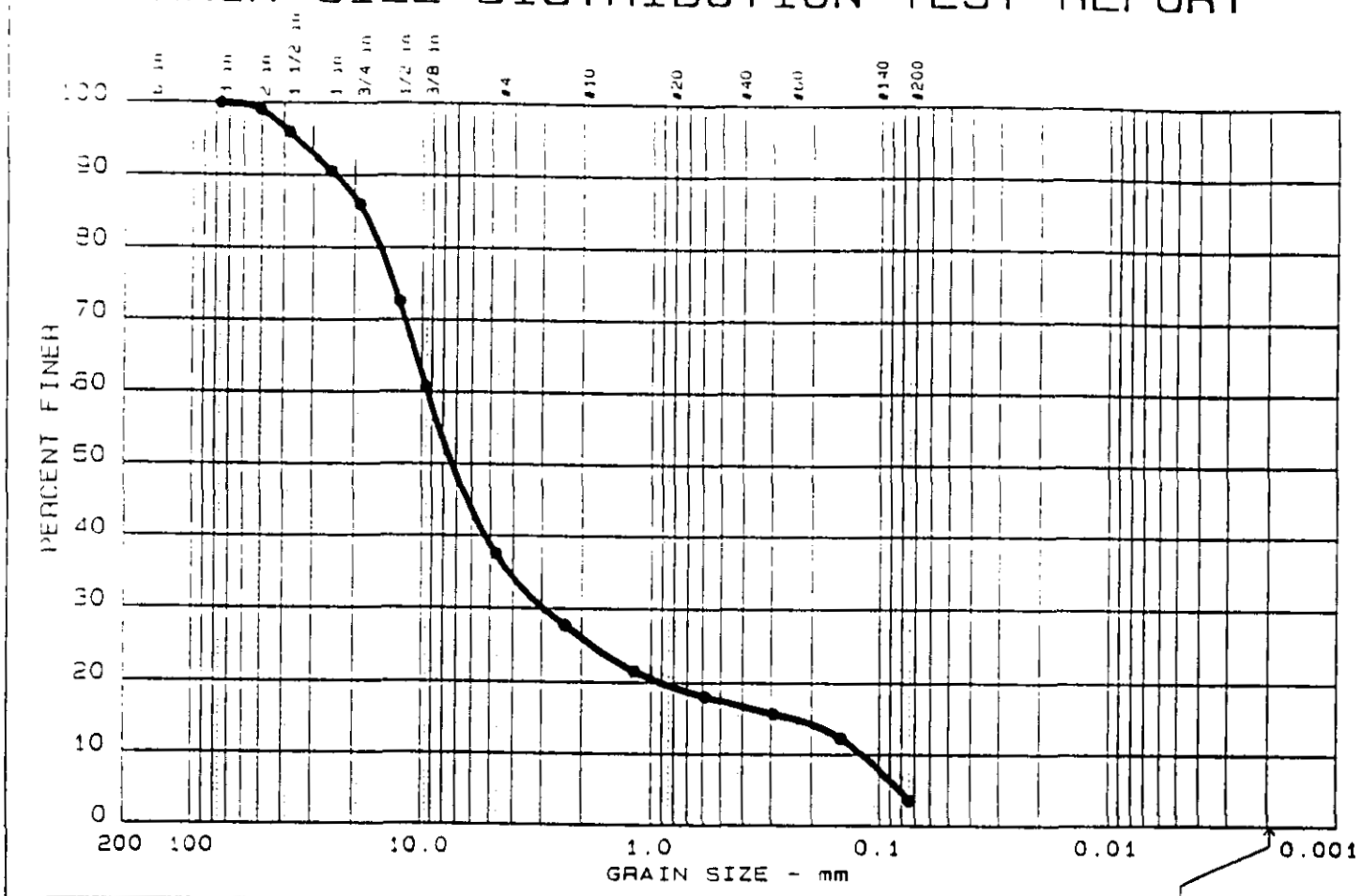
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 5

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% -3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	62.5	33.9	3.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	18.20	9.48	7.33	2.951	0.2344	0.1189	7.73	79.8

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt.brn. Sandy Gravel tr.Silt	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T-23, BS-1, depth: 0-8.5'

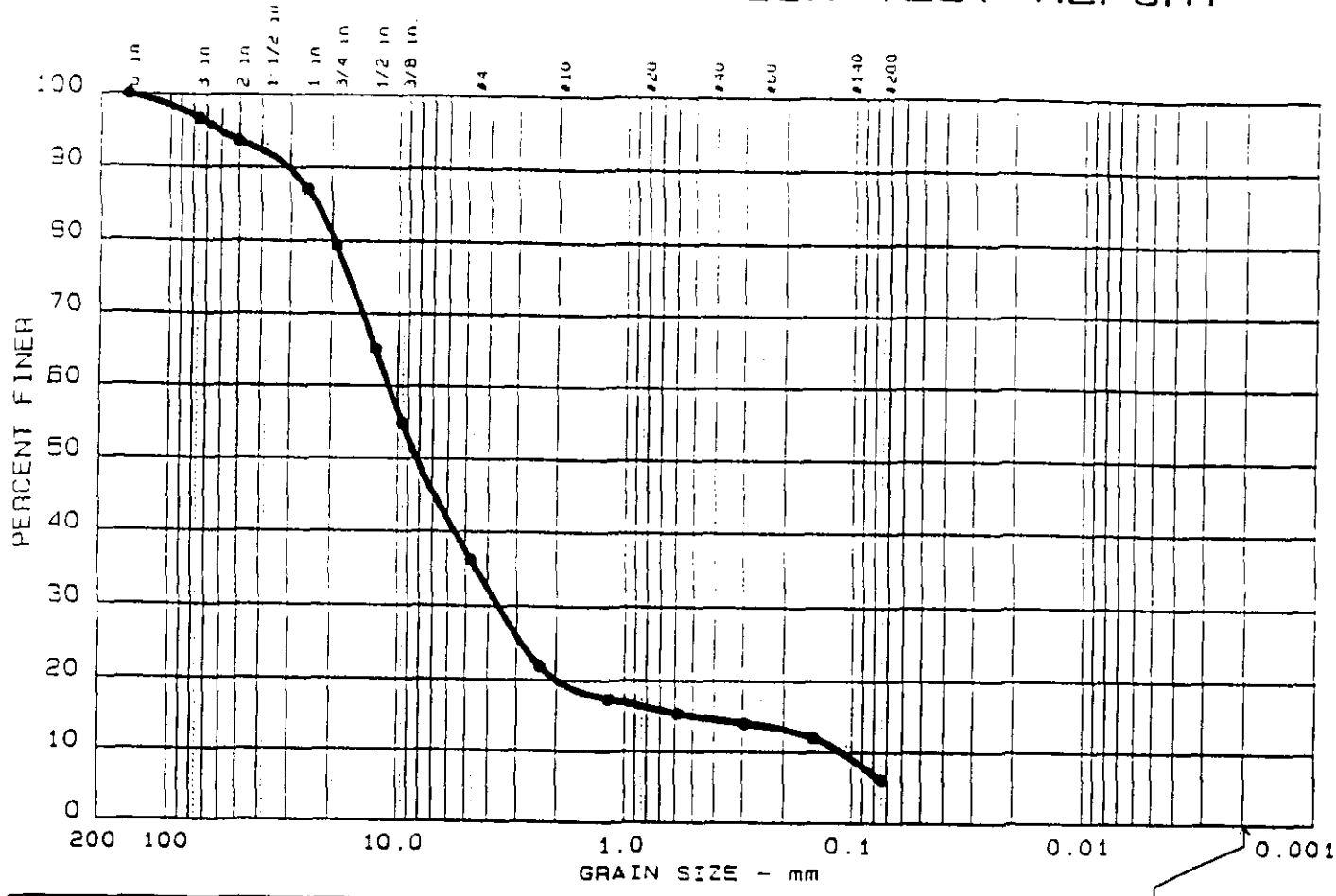
Date: September 16, 1991

Remarks:
checked by AJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	3.3	60.5	30.2	6.0	

	LL	PI	D_{95}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	23.17	11.09	8.29	3.618	0.5230	0.1118	10.56	99.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Lt. brn. Sandy Gravel w/Silt	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T-25, BR-1, depth: 0-10'

Date: September 16, 1991

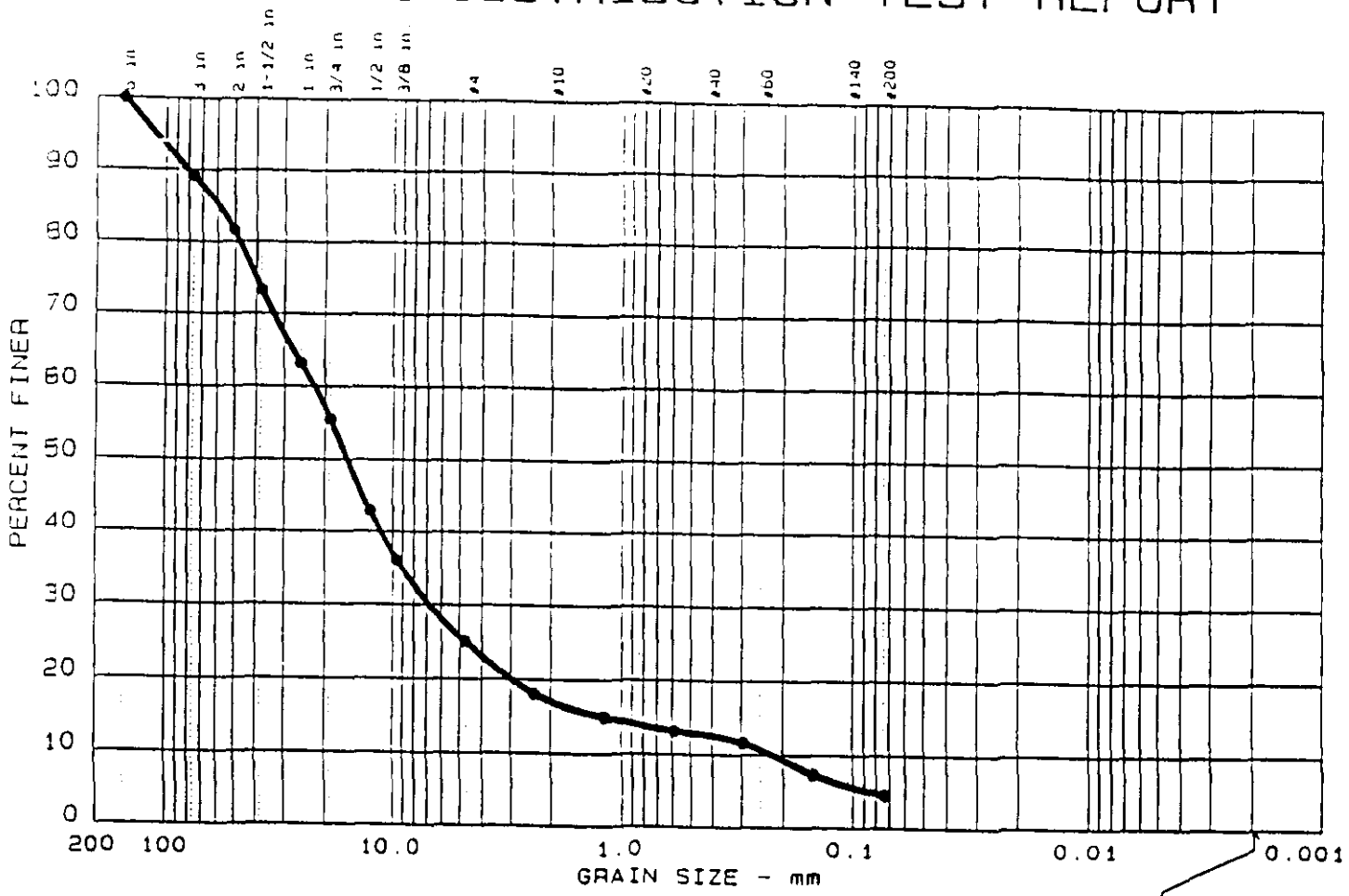
Remarks:
checked by RJ
NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	10.9	64.0	20.5	4.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	58.88	22.34	15.98	6.816	1.2120	0.2231	9.32	100.1

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Sandy Gravel tr. Silt	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T -27, BS-1, depth: 0 - 8'

Date: September 16, 1991

Remarks:
checked by RJ
NP= Non-Plastic

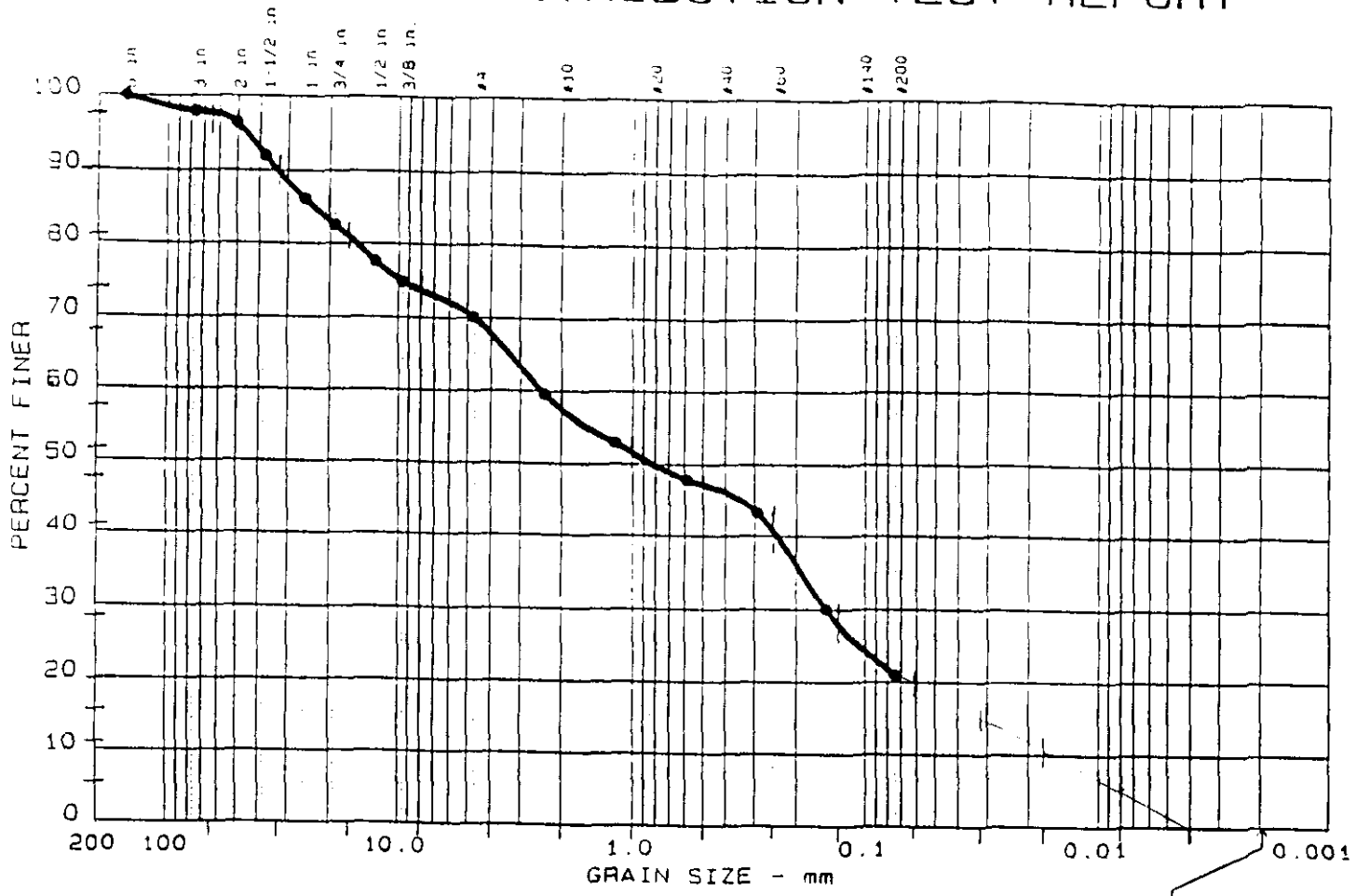
GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 3

PRELIM DATA PROVIDED BY CONVERSE 9/16/91

T-29

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	B	2.2	27.6	49.3	20.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	23.17	2.45	0.83	0.148				

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. orn. Silty Sand w/Gravel	SM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: T - 29, 8S - 1, depth: 0 -2.2'

Date: September 16, 1991

Remarks:

checked by RJ

NP= Non-Plastic

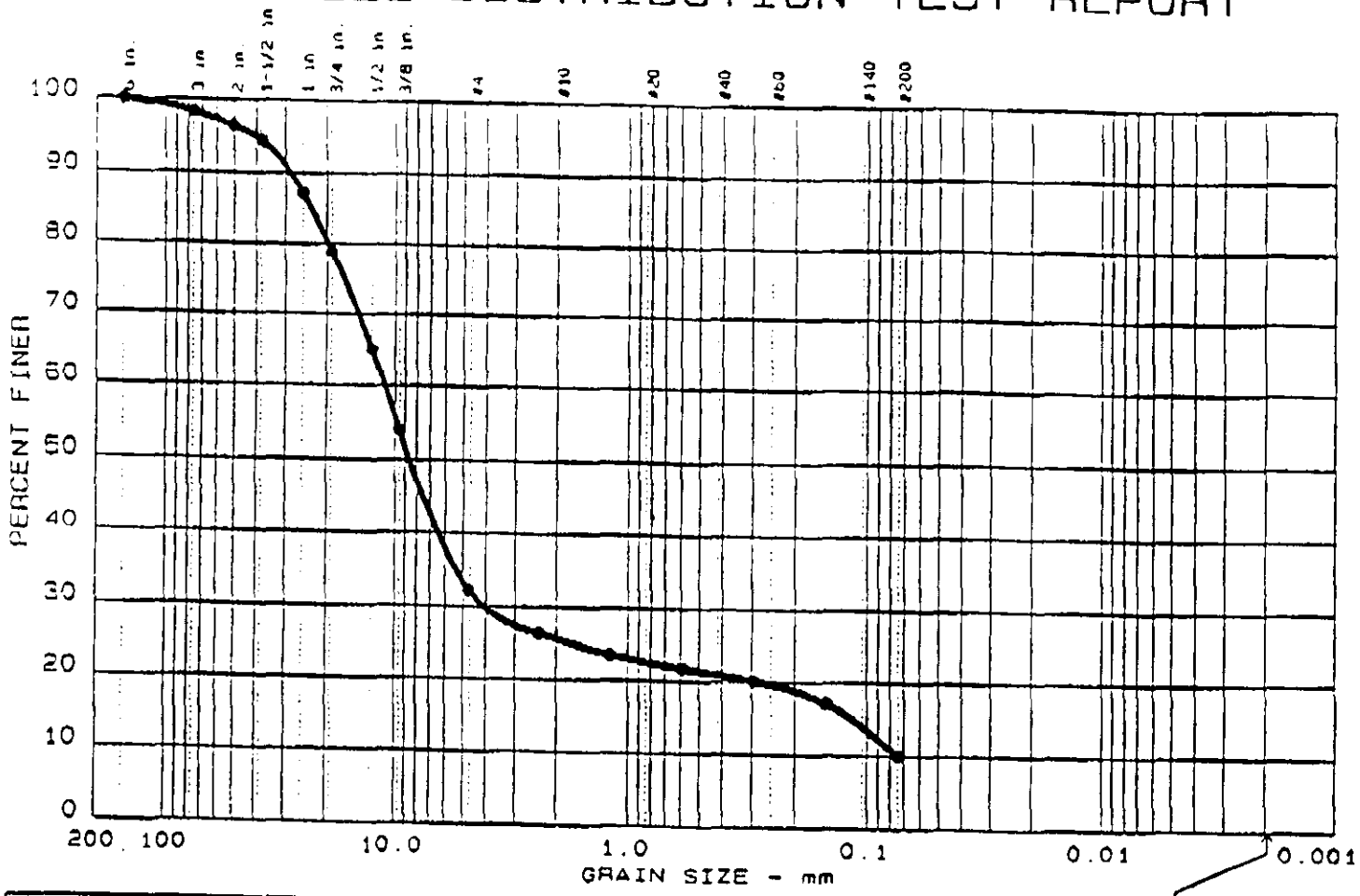
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 4

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	1.7	66.0	22.3	10.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	23.42	11.19	8.69	4.111	0.1172			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn.POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 30, depth: 0 - 5.5'
(T-21A)

Date: September 23, 1991

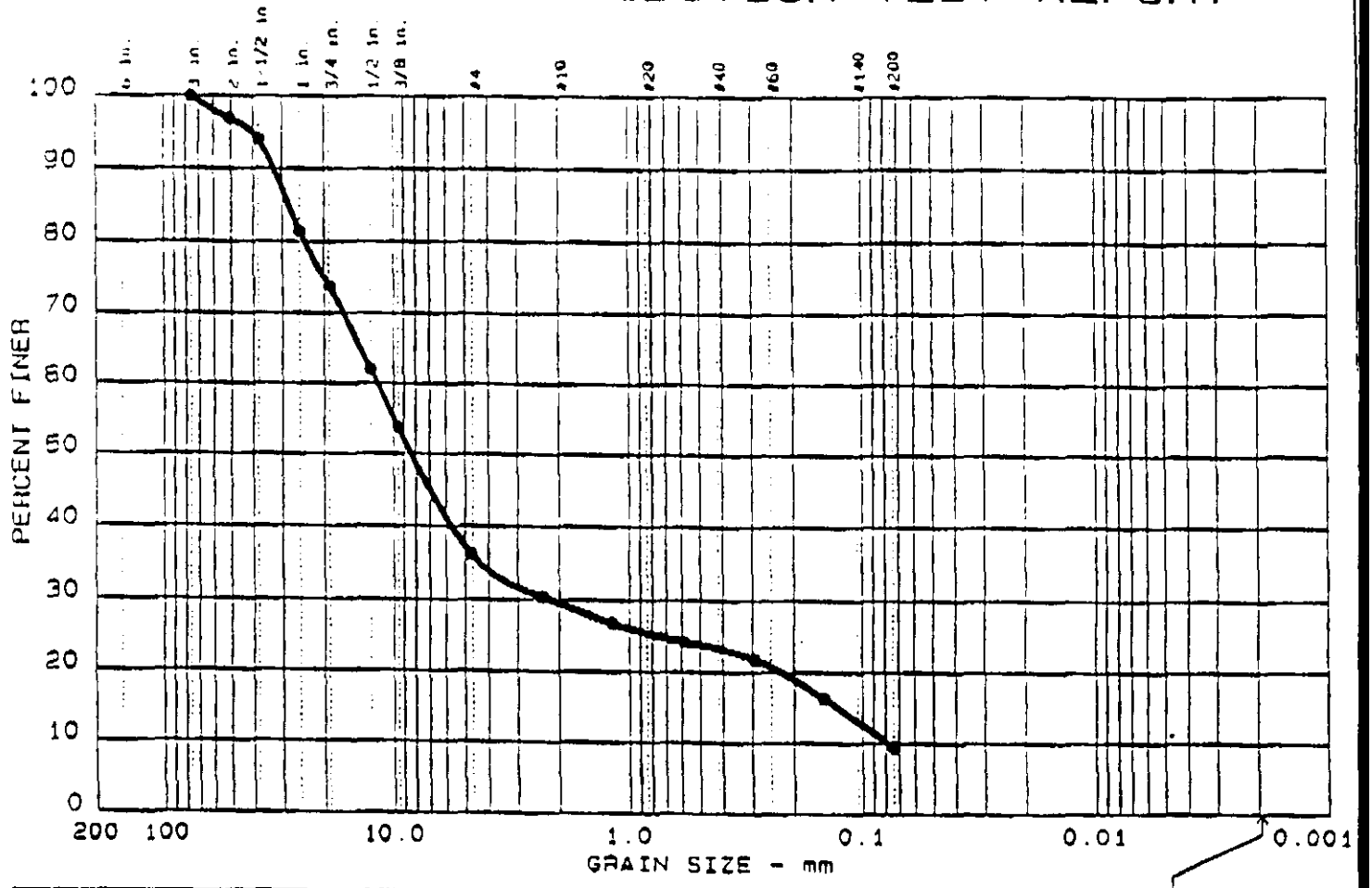
Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 5

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 1	0.0	63.8	26.8	9.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P		28.19	11.89	8.41	2.213	0.1318	0.0785	5.25	151.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33-298-01
Project: Range Wash Dike
● Location: T - 9, depth: 0 - 4'

Date: September 25, 1991

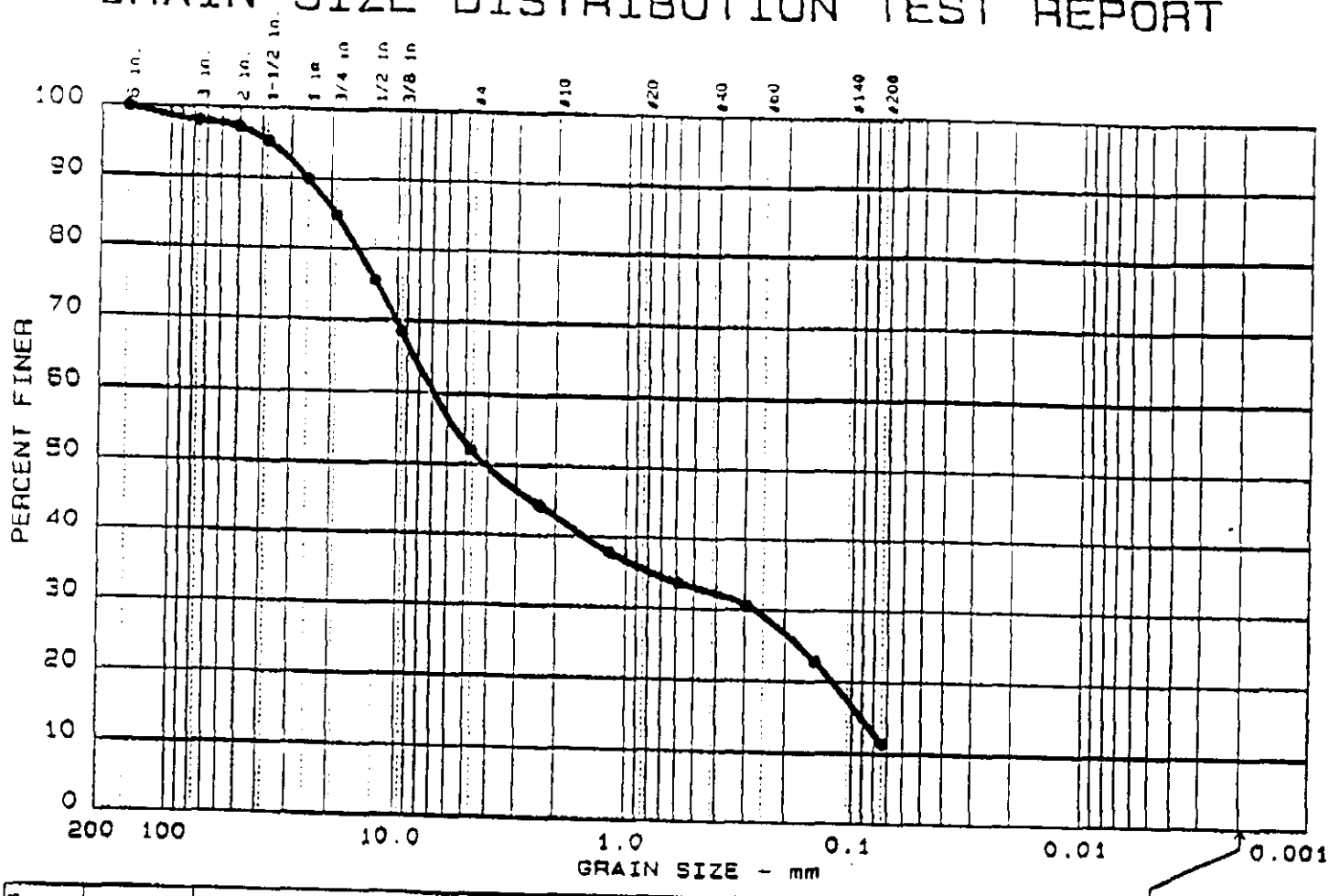
Remarks:
checked by AMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	2.0	45.9	40.7	11.4	

	LL	PI	D_{95}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	19.28	6.91	4.12	0.278	0.0911			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 20, depth: 0 - 6'

Date: September 25, 1991

Remarks:

checked by RMJ

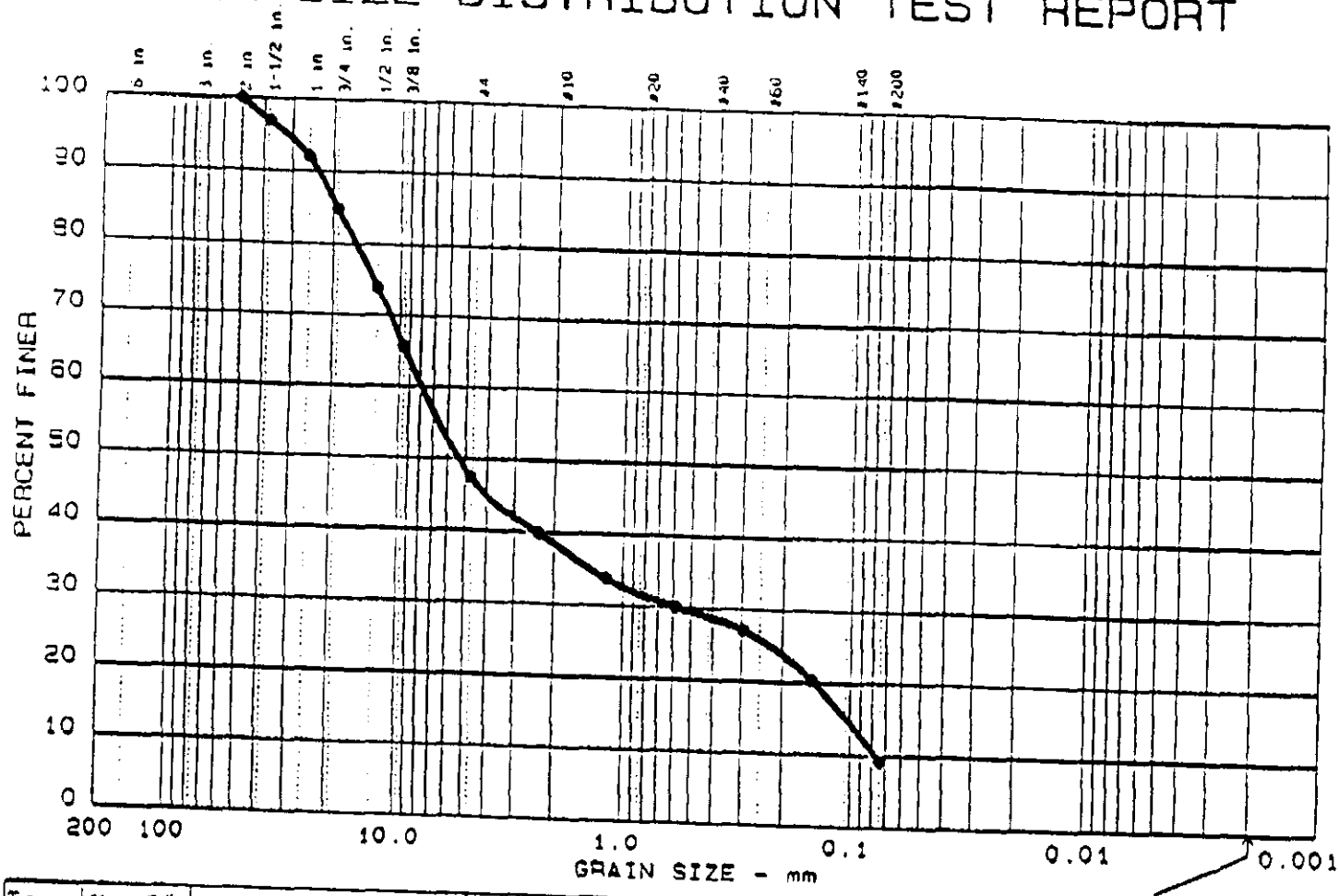
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% -3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	52.6	38.2	9.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	19.05	7.94	5.43	0.581	0.1046	0.0775	0.55	102.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 21, depth: 0-6'

Date: 9/27/91

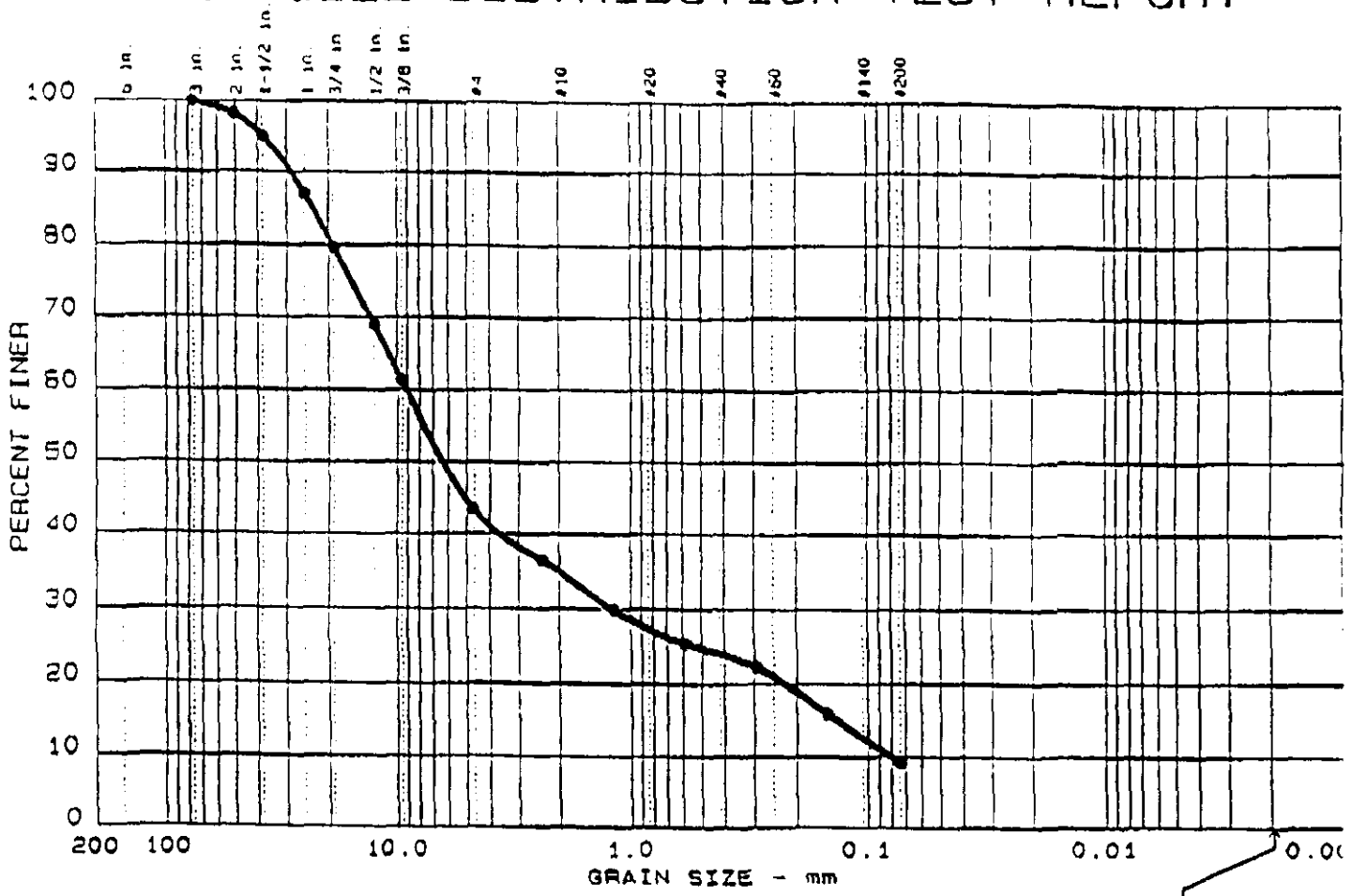
Remarks:
checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT
CONVERSE CONSULTANTS SOUTHWEST

Figure No. 3

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	S	0.0	56.6	34.3	9.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	23.44	9.19	6.42	1.209	0.1372	0.0808	1.97	113.8

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. WELL GRADED GRAVEL w/Silt and Sand	GW - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 22, depth: 0 -4.5'

Date: September 23, 1991

Remarks:

checked by RMJ

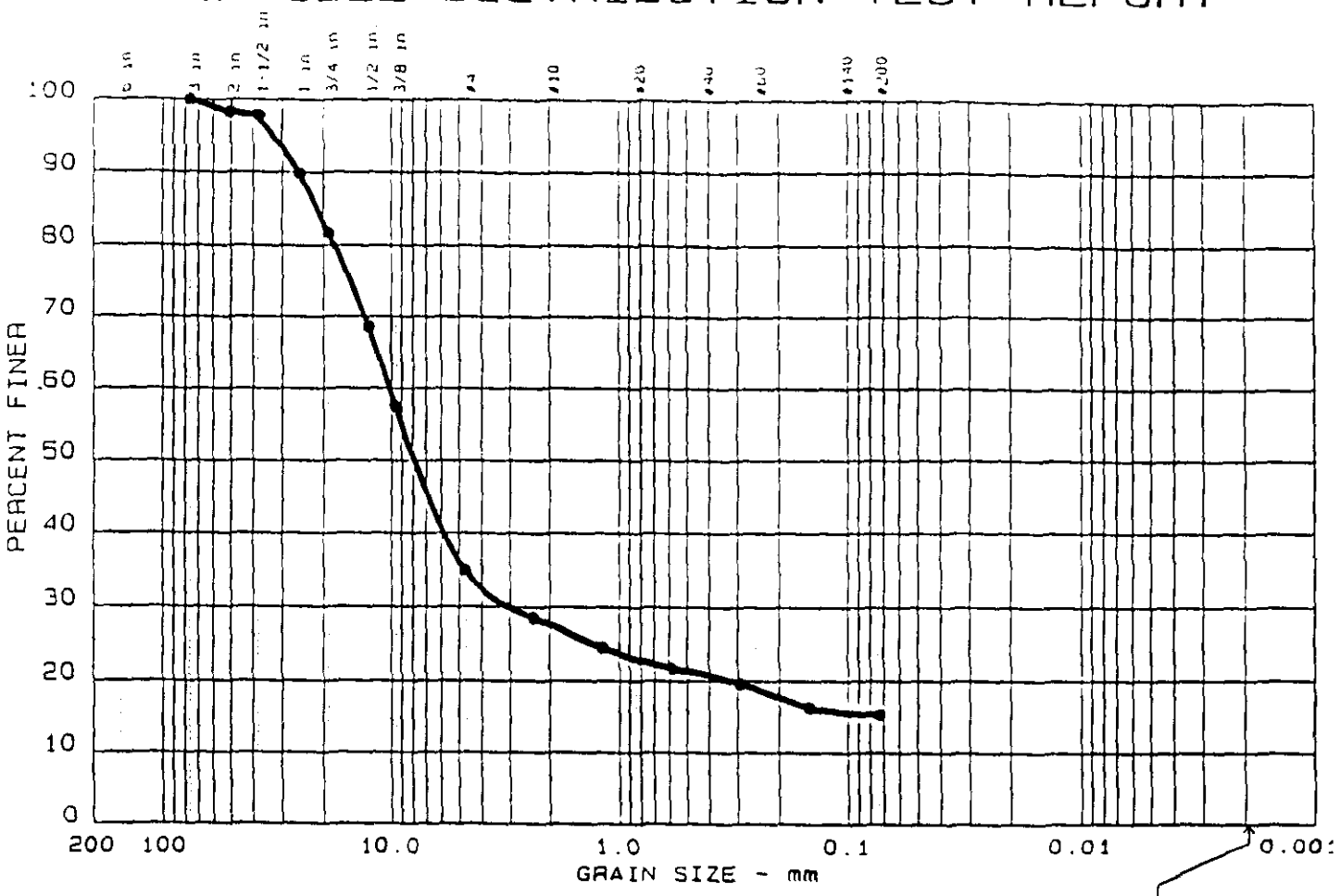
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 4

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	65.0	19.7	15.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	21.36	10.22	7.93	3.087				

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 17, BS - 1

Date: September 16, 1991

Remarks:

Checked by RJ

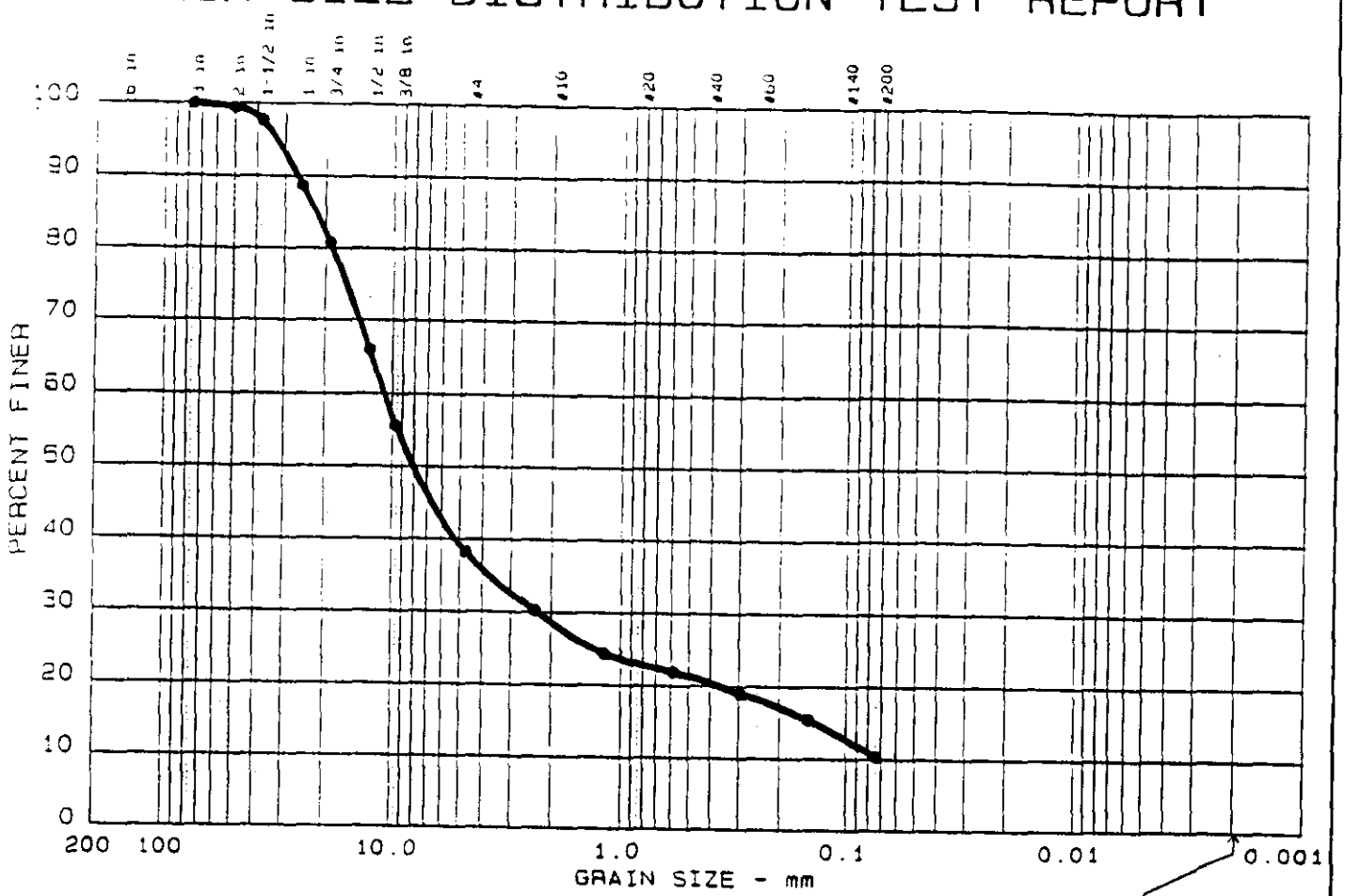
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

DRAFT

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 6	0.0	61.7	28.1	10.2	

	LL	PI	D_{95}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	n/p	n/p	22.05	10.88	8.06	2.299	0.1401			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. Silty Gravel w /SAND	GP - GM	

Project No.: 91-332980-01
Project: Range Wash Dike
● Location: B-18, BS-1, depth 0-14'

Date: September 17, 1991

Remarks:

checked by RMJ

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 313

DRAFT

9/25/91

Received from B. Olson
Converse

WGH

Percentage of Surficial Cobbles For Range Wash
CCSW Project No. 91-33298-01

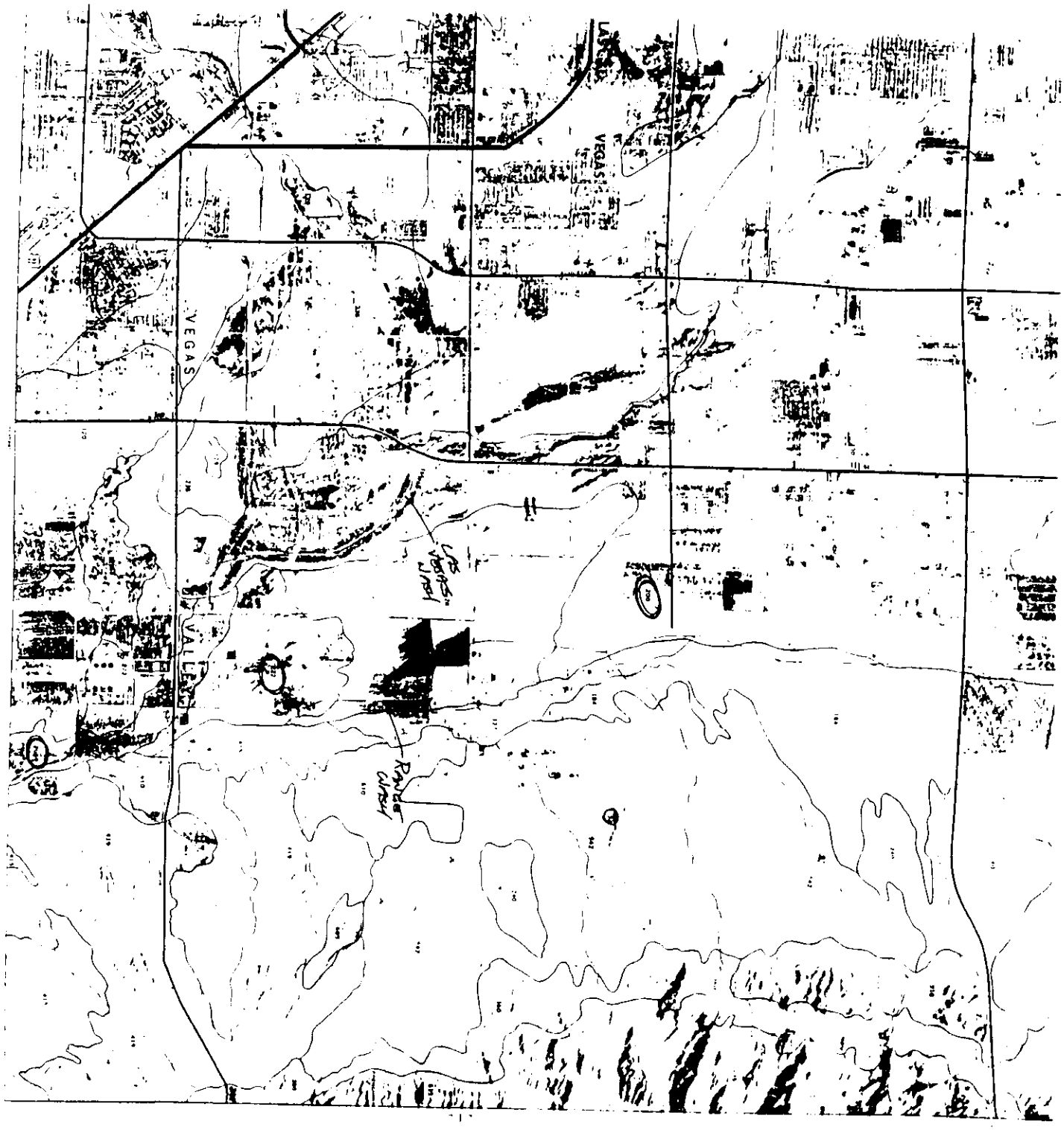
Location	Cobble Size (in)	Surficial Percentage
B-1	4-8	10-15
B-2	4-12	10-20
B-3	4-6	10-15
B-5	4-6	10-15
B-7	4-8	10-20
B-8	4-6	10-15
T-9	3-6	10
B-11	4-10	10-15
B-13	4-12	10-15
B-14	4-8	10-15
B-15	4-10	10-15
B-17	3-12	5-10
B-18	3-8	5-10
T-19	3-6	5-10
T-30	3-6	5-10

CLARK COUNTY SOIL SURVEY DATA

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

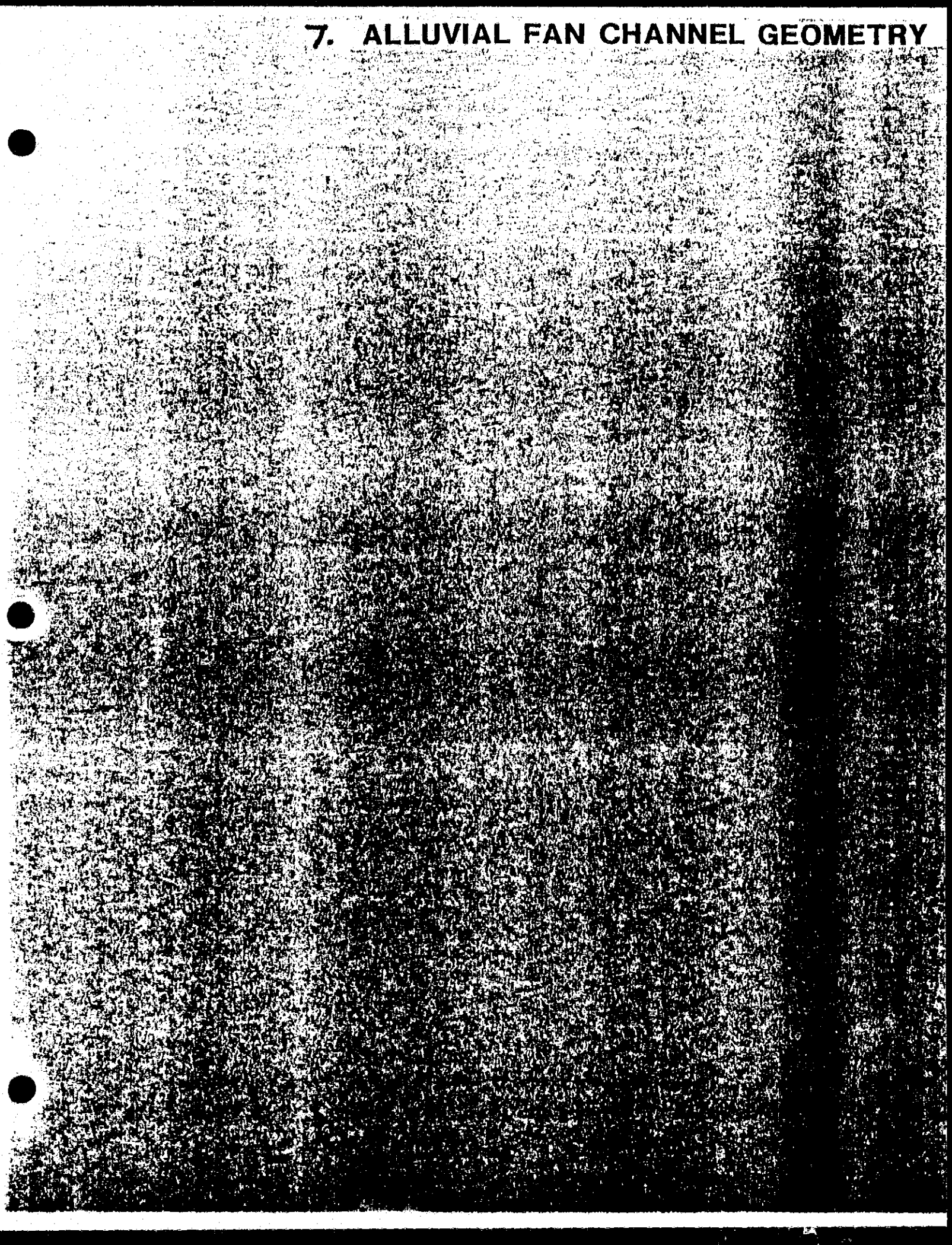
Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
190---------- Dalian	0-4	Very gravelly fine sandy loam.	GM	A-1	0	30-55	25-50	20-40	10-25	---	NP
	4-61	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM, GP-GM GP	A-1	5-10	20-60	10-50	5-40	0-25	---	NP
191---------- Dalian	0-5	Very cobbly fine sandy loam.	GM	A-1, A-2	35-50	55-65	50-60	40-55	20-30	---	NP
	5-60	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM, GP-GM	A-1	5-10	20-60	15-50	10-40	5-25	---	NP
192*: Dalian----------	0-5	Very gravelly fine sandy loam.	GM	A-1	0	30-55	25-50	20-40	10-25	---	NP
	5-60	Very gravelly sandy loam, extremely gravelly fine sandy loam.	GM,GP-GM	A-1	5-10	20-60	15-50	10-40	5-25	---	NP
McCullough------	0-5	Very gravelly very fine sandy loam.	GM	A-1	5-10	35-45	30-40	25-40	15-25	20-25	NP-5
	5-30	Stratified loam to sandy loam.	SM	A-4, A-2	0	95-100	90-100	55-65	30-40	15-25	NP-5
	30-40	Stratified coarse sand to loamy fine sand.	SM	A-1, A-2	0	80-100	75-95	40-60	10-30	---	NP
	40-60	Extremely gravelly loamy sand.	GP-GM	A-1	5-10	20-30	15-25	10-15	5-10	---	NP
200---------- Glencarb	0-6	Silt loam--------	ML, CL-ML	A-4	0	100	100	90-100	70-90	20-30	NP-10
	6-60	Stratified silty clay loam to very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	25-35	5-15
206---------- Glencarb	0-8	Silt loam--------	ML, CL-ML	A-4	0	100	100	95-100	75-90	20-30	NP-10
	8-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	5-20
222---------- Glencarb	0-6	Silty clay loam	CL	A-6	0	100	100	95-100	85-95	35-40	15-20
	6-60	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	95-100	80-95	30-45	5-20
236---------- Glencarb	0-6	Very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-95	55-65	20-30	NP-10
	6-60	Stratified clay loam to very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	95-100	75-85	20-30	5-15
237---------- Glencarb	0-6	Very fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-100	55-65	20-30	NP-10
	6-42	Stratified silty clay loam to silt loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	75-85	25-35	5-15
	42-60	Cemented---------	---	---	---	---	---	---	---	---	---

See footnote at end of table.


LAS VEGAS
VEGAS
VALLEY

RAMBO WASH
LAS VEGAS WASH
VEGAS
NORTH
VEGAS

7. ALLUVIAL FAN CHANNEL GEOMETRY



ALLUVIAL FAN CHANNEL GEOMETRY

The geometry of the channel as it flows down the alluvial fan is a key component in establishing transport capacity. The nature of alluvial fan flooding is indeterminate and makes the definition of channel geometry very difficult. We have used the Dawdy/FEMA equation to estimate the top width of an alluvial fan channel. The relationship identifies top width as a function solely of discharge. Dawdy and FEMA developed this relationship and have demonstrated its applicability to single channel reaches on alluvial fans.

We have evaluated the potential for reaching a multiple channel condition on the Range Wash alluvial fans. Based on the absence of physical evidence identifying a single channel and previously published FEMA references which relate length of the single channel and the ratio of canyon slope to fan slope, we have determined that multiple channels are likely down the alluvial fan. The hydraulic characteristics of FEMA multiple channels result in less sediment transport capacity; and therefore, from the viewpoint of sizing the dike, a less conservative condition than single channel flow. However, for the purposes of this analysis, we have assumed that flows are conveyed from the apex of the fans to the dike in a single FEMA channel. This results in the most conservative design condition; and therefore, provides the highest degree of confidence in the design of the dike.

BOYLE ENGINEERING CORPORATION

Project PANTEX WASH
Job No. [illegible]
By [illegible] Date 1/23/92

Description [illegible]

SHEET 1/1

DAWOY'S EQUATION

$T_s = 9.5 Q^{0.4}$ where T_s = Top width of single channel flow (feet)

Q = discharge (cfs)

$T_s = 9.5 (7030)^{0.4}$

$T_s \doteq 330$ feet (at Peak Discharge)

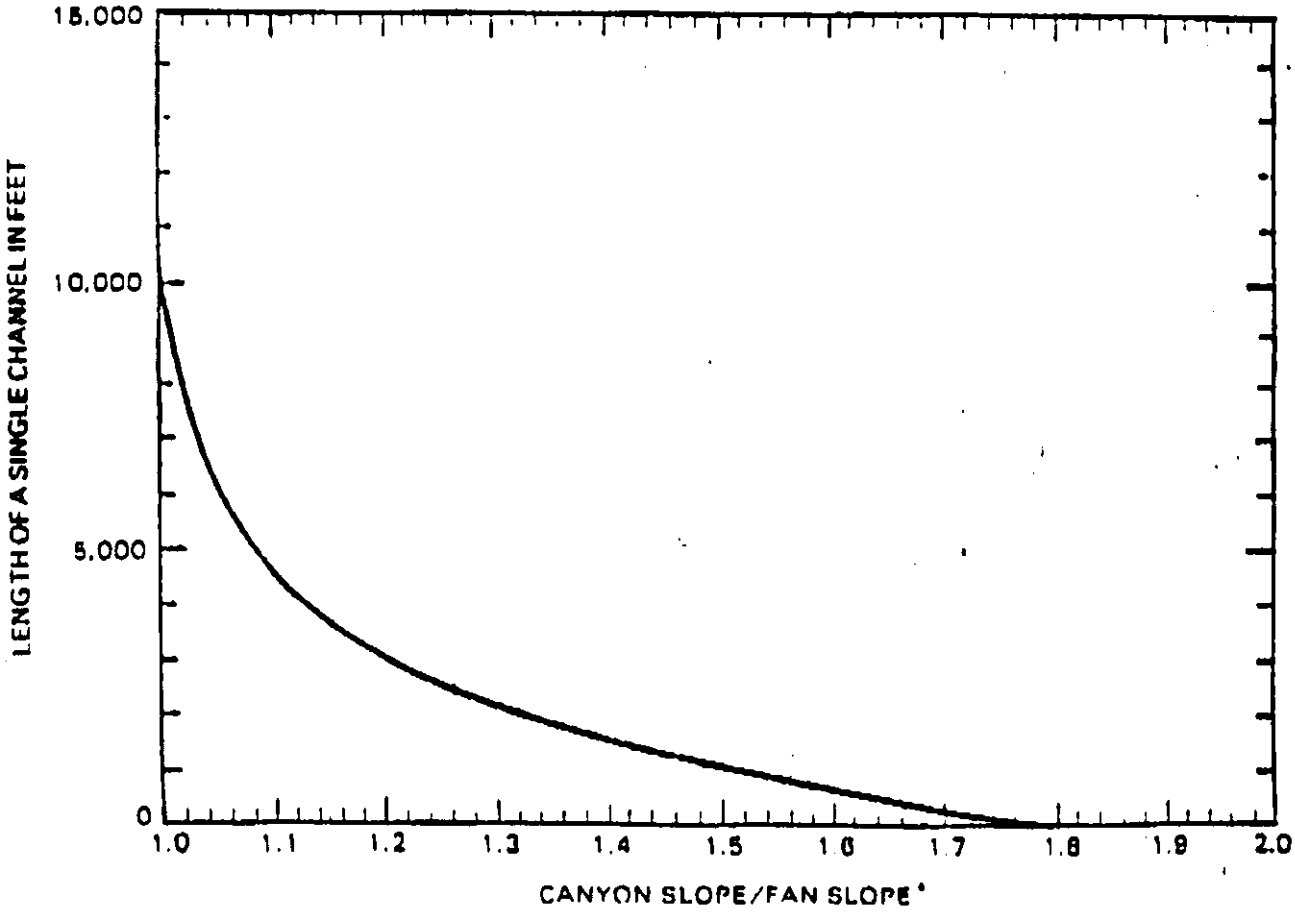
$T_m = 3.8\ T_s$ where T_m = Aggregate width of multiple channel flow (feet)

$T_m = 3.8 (330)$

$T_m = 1254$ feet

ACCORDING TO FIGURE A5-1, THE MAXIMUM LENGTH OF A SINGLE CHANNEL IS LESS THAN 15,000 FEET. THE APPROXIMATE DISTANCE FROM THE APEX OF THE FAN TO OUR DESIGN POINT IS APPROXIMATELY FOUR MILES. AS A CONSERVATIVE APPROACH, WE ARE USING THE SINGLE CHANNEL WIDTH.

FIGURE A5-1
RELATIONSHIP BETWEEN LENGTH OF A SINGLE CHANNEL
AND RATIO OF CANYON SLOPE TO FAN SLOPE



* Canyon slope should normally be computed along the stream bed of the lower canyon to a point upstream of the canyon mouth where there is a notable change to a steeper gradient. Fan slope should normally be computed for the upper portion of the fan to a point downstream of the fan apex where there is a notable change to a flatter gradient.

8. FAN EQUILIBRIUM

FAN EQUILIBRIUM

The sizing of the diversion dike is very sensitive to the inflow sediment volume during the 100-year event. As discussed in previous sections, no data exists to directly estimate the 100-year sediment inflow volume (or particle size distribution). Consequently, Boyle chose to estimate the equilibrium sediment transport down the fluvial fan for several events and integrate these values to compute an average annual sediment yield. Estimates of average annual yield have been made for the Las Vegas Valley by the Corps and have been previously developed for Range Wash by Boyle based on the Corps estimates and PSI.

The foundation for the analysis is to establish an event specific equilibrium transport down the alluvial fan which yields an average annual sediment yield as determined from the previous PSI analysis. Then sediment and flood discharges from the 100-year event are routed down the alluvial fan and along the dike to establish differences in sediment transport capacity and, thus, compute the required dike height.

Because of a lack of actual data defining the inflow sediment, various assumptions were made regarding sediment flows down the fan. These assumptions included:

- Inflow particle size distribution
- Roughness coefficient
- Temperature
- Sediment rating curve
- Total inflow sediment volume.

The assumed inflow particle size distribution has been discussed previously. The specific relationship of fine materials to coarse materials was difficult to ascertain from sediment records taken on the fan or those taken on the valley floor. The assumption was made that, at equilibrium, variations in the initial particle size distribution would be insignificant. This was confirmed through calibration and sensitivity runs which adjusted the coarse material size distribution without significant changes in equilibrium sediment transport.

The amount of fine particles in the inflow did have a significant influence on the total equilibrium sediment volume. Because fine materials are not subject to the mathematical relationships established for coarse particles, HEC-6 assumes that these are transported through the system without deposition. Given the velocity and character of flows down the fan this is a reasonable assumption. The concentration of fine particles does affect the viscosity of the water and therefore affects transport capacity. This was determined to be a significant calibration variable. The relationship of fine particles to coarse particles was adjusted until the integration of the event specific yields matched the average annual yield. A final particle distribution of 30 percent fine particles (materials less than .0624 millimeters) and 70 percent of coarse materials resulted in an acceptable correlation. This value is also within the bounds of reasonable estimates established by a review of fan surface particle sizes and valley floor soil surveys.

The roughness coefficient used in the sediment transport analysis is a function of bed material particle size and bed form. According to Design Guidelines and Criteria for Channels and Hydraulic Structures on Sandy Soils, a 1981 Simons and Li publication, bed form comprises the most significant component of roughness and is the determining factor for an "n" value in a sediment transport analysis. To establish an "n" value, the bed form must be determined. Stream power is a determining factor to establish bed forms. Based on a stream power equation which combines sheer stress and velocity, a stream power of 10.5 was identified. This stream power indicates that the bed form is in the antidune or plane bed range with an "n" value

of between .02 and .025. For this analysis an "n" value of .022 was assumed. Computations supporting this estimate are included in the "Roughness" section.

Temperature also plays a role in sediment transport capacity. The dynamics of rainfall and runoff in the Las Vegas Valley indicate that storm water is generally going to be of relatively high temperature. Most rainfall events occur as thunderstorms during relatively warm spring and summer days. Ground temperatures may be 100 degrees or more. The diversion dike is located relatively far downstream in the watershed and intercepts water after it has had a chance to pass over large expanses of land surface. Gages measuring temperature are limited. One gage station, Las Vegas Wash near Henderson, has recorded temperature. A review of this gage indicates that water temperatures approaching 80 degrees Fahrenheit are possible. Because this gage is located slightly lower in the watershed than the dike, a water temperature of 70 degrees was assumed. The referenced gage information is presented in the "Temperature" section.

A rating curve of sediment inflow versus discharge is required as part of the HEC-6 input. This curve requires an estimate of the total inflow volume and an estimate of the particle size distribution of the inflowing sediments. As previously discussed, a distribution of 30/70 for fines/coarse materials was determined. This was an iterative approach and is described in more detail in the average annual yield calibration discussion. To establish an estimate of total sediment inflow volume a review of similar studies was performed. Boyle collected several studies and evaluated the relationship between average annual yield and event specific yield. As previously mentioned, it was not felt that these were sufficiently compelling to use as the basis for the relationship between average annual yield and event specific yield. However, it was felt that this would provide a sufficient basis for the initial estimate. A ratio of seven between the 100-year event and the average annual event was used as a inflow sediment

estimate. A summary of the findings of the literature review, as well as pertinent sections of the literature are included in the "Inflow Volume" section.

The actual equilibrium transport capacity down the fan is a function of geometry and hydraulic characteristics rather than the inflow characteristics. Those materials which cannot be transported will be deposited and those material size fractions having a greater transport capacity will be scoured from the bed. The model runs indicate that equilibrium is achieved very soon after flows reach the alluvial fan and that the relative size and total volume of materials transported is relatively constant down the fan.

To establish the sediment rating curve as a function of discharge, literature was reviewed and a power function was identified. The exponent for this relationship varied from 1.07 to 1.84. A value of 1.5 was used as representing the overall average. References are included in the "Q vs Sed" section.. The relationship

$$q_{sed} = k*Q^{1.5}$$

where:

q_{sed} = sediment load in cubic feet per second

k = conversion constant and

Q = Discharge in cubic feet per second

The k coefficient was determined by integrating all discharges to the 1.5 power and dividing that value into the total sediment volume of seven times the average annual sediment volume. A rating curve was then established which related sediment load to clear water discharge.

This information established the foundation for the HEC-6 analysis. While this analysis is founded on several assumptions regarding the inflow sediment characteristics the application is relatively straightforward and lends itself to analysis using HEC-6. The analysis performed is

essentially a one-dimensional sediment transport analysis. The input information developed above resulted in a final run which was used for all subsequent analyses.

As previously described, the determination of the characteristics of alluvial fan flows, water and sediment, at equilibrium was critical to all subsequent analyses.

Sensitivity runs were made to test the effects of various temperature, roughness, inflow volumes and particle size distributions. Representative outputs are included in this notebook under the "Sensitivity Analyses" section. These demonstrate the relative insensitivity of temperature, roughness and inflow volume on the equilibrium transport.

The particle size distribution proved to be a very sensitive input parameter. This variable was used as the primary calibration tool to assure that the integrated event specific yields equalled the average annual yield predicted by PSIA. This process involved assuming a distribution of the fines relative to coarse particles and running the simulation model. If the integration did not result in an acceptable agreement with PSIA the distribution was changed. The final distribution of 30/70 was arrived at in this method and was verified using the previously discussed soil surveys.

Subsequent steps used in the analysis begin to diverge from the intended application of HEC-6. Several additional assumptions were required to simulate alluvial fan processes using HEC-6. HEC-6 is essentially a one-dimensional steady state sediment transport model. That is, it is intended to simulate riverine sediment transport through a fixed channel section with a movable bottom. The alluvial fan discharges are generally characterized by a very steep hydrograph with significant changes in discharge versus time. The width of the channel is also variable as a function of discharge, as determined by Dawdy/FEMA's approach. These two limitations

required a slight adaptation to the application of HEC-6 which will be described in subsequent sections.

Another limitation of HEC-6 is that changes in channel invert elevation and slope due to scour result in an instantaneous change in the sediment transport carrying capacity. While the instantaneous change in sediment carrying capacity is indeed consistent with the physical phenomenon being simulated, the impacts of that change are felt over a longer channel reach than the model predicts. This resulted in an overestimation of the impact at a particular cross section, but the results were indicative of total deposition or total scour through the system. Subsequent sections will address how those anomalies were addressed in our analysis.

ROUGHNESS

BOYLE ENGINEERING CORPORATION

Project: SALINE WASH
Job No.: QN 100 300 10
By: TSC Date: 10/28/91
Description: ESTIMATE ROUGHNESS
SHEET 1/1

FROM "DRAINAGE AND FLOOD CONTROL DESIGN GUIDELINES AND CRITERIA" SIMONS, LI, AND ASSOCIATES (1981)

IN ORDER TO ESTIMATE A MANNING'S "n" VALUE FOR THE ALLUVIAL STREAM, IT IS NECESSARY TO TAKE THE BED FORM ROUGHNESS INTO CONSIDERATION. THE TYPE OF BED ROUGHNESS IS RELATED TO STREAM POWER, ACCORDING TO FIGURE 2-8.

$$\text{STREAM POWER} = \tau_0 V \quad \left(\frac{\text{ft-lb}}{\text{ft}^2\,\text{sec}}\right)$$

AND, $\tau_0 = \frac{1}{8} \rho f_0 V^2$

where: $\rho = 1.94 \frac{\text{lb-sec}^2}{\text{ft}^4}$

$f_0 = 0.066$ (SIMONS, ET AL)

V = velocity of flow (ft/s) (assume velocity @ critical depth for 100 YR FLOW)

$\tau_0 = \frac{1}{8} (1.94)(0.066)(8.7)^2$

$\tau_0 = 1.21$

SO, STREAM POWER = $(1.21)(8.7) \doteq \underline{10.5}$

FROM FIGURE 2-8, THE BED FORM IS ANTIDUNES OR FLAT BED

FROM TABLE 2-2, $n = .025$ FOR ANTIDUNES
$n = .020$ FOR PLANE BED

∴ WE WILL ASSUME $\underline{n = .022}$

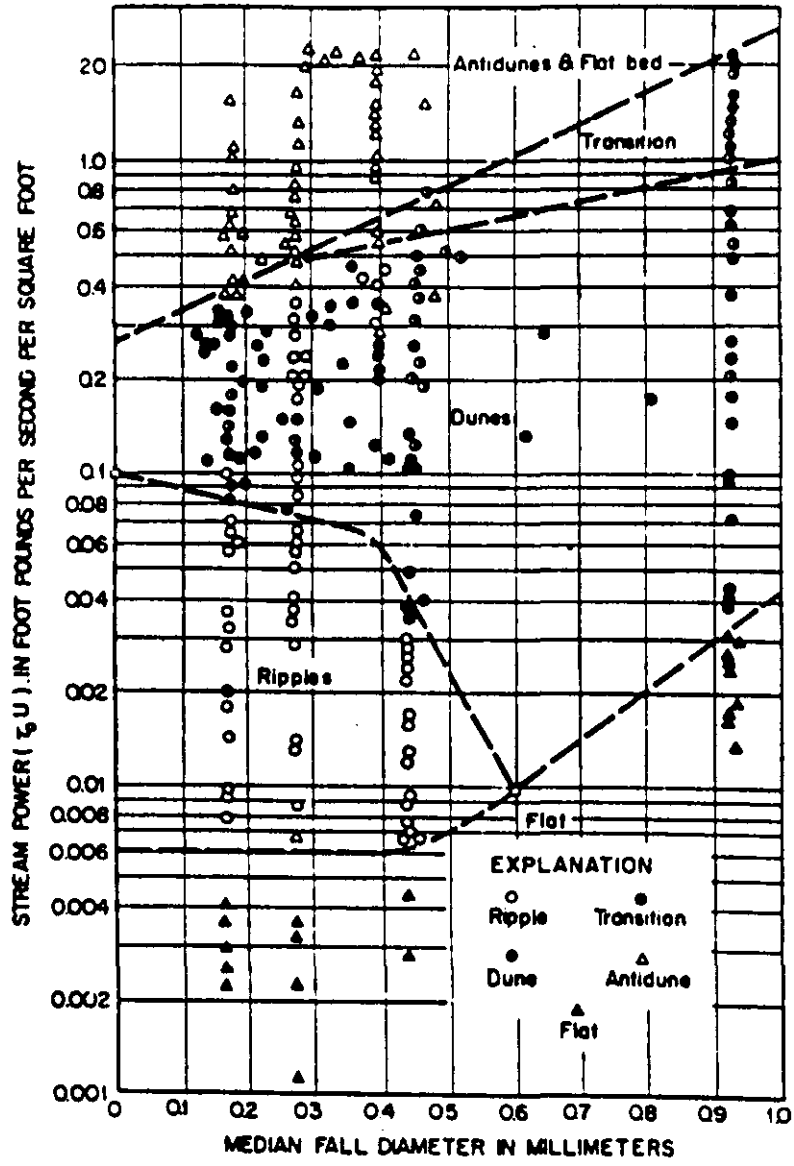


Figure 2-8. Relation of bed forms to stream power and median fall diameter of bed sediment (after Simons and Richardson, 1966).

TEMPERATURE

Station	LAS VEGAS WASH NEAR HENDERSON			Id	09419700
Parameter	Temperature, Water (Deg.C)			Statistic	Mean
Year	1986-1987	Drainage Area	2125	Hydrolog Unit	15010015
Site Code	Stream	Contribute Area	1518	Geologic Unit	
State	NV	Gage Datum	1540.00	Aquifer Type	?????
County	003	Well Depth	No value	Agency	USGS
Latitude	36:05:20	Sample XSection	No value	Agency Office	AZ
Longitude	114:59:05	Sample Depth	No value	Sequence#	00

2	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Year
D Cnt	31	53	62	54	56	62	33	30	43	62	62	53	601
D Avg	21.2	17.2	15.3	14.6	15.8	17.0	19.3	21.5	24.3	25.2	26.2	23.6	20.0
D Max	23.0	20.0	17.0	16.0	18.5	20.5	21.0	24.0	26.0	26.5	27.5	25.5	27.5
D Min	20.5	14.0	13.0	12.5	12.5	14.0	16.0	19.0	23.0	24.0	24.5	21.0	12.5
M Cnt	1	1	2	1	2	2	1	1	0	2	2	1	0
M Std	---	---	1.1	---	0.1	1.2	---	---	---	0.3	0.2	---	---
M Skw	---	---	---	---	---	---	---	---	---	---	---	---	---
M Max	21.2	18.0	16.0	14.7	15.9	17.8	19.5	21.5	---	25.4	26.4	23.0	---
M Min	21.2	18.0	14.5	14.7	15.7	16.2	19.5	21.5	---	24.9	26.1	23.0	---

$T_{ave} \doteq 77°F$

Coverage : 0500006000070000800009000010000200003000040000500006000070000800009
0

Basis for temperature of 70°F

INFLOW VOLUME

BOYLE ENGINEERING CORPORATION

Project RANGE NASH
Job No. 2N 1107 300 .0
By TBF Date 1/28/92

Description SEDIMENT VOLUME for Range Wash Diversion Dike

SHEET 1/1

FOR THE 100 YR STORM, THE SEDIMENT VOLUME WAS TAKEN AS 7 TIMES THE AVERAGE ANNUAL SEDIMENT YIELD. IN OUR CASE,

100 YR YIELD = 7 (16 AF) = 112 AF

THE COMPARISON OF RATIOS OF 100 YR TO AVERAGE ANNUAL SEDIMENT YIELD FOR SEVERAL OTHER STUDIES IS INCLUDED IN THIS SECTION.

THE FACTOR OF 7 IS THE HIGH END OF THE RANGE AS SHOWN IN THE COMPUTATIONS. WE ARE USING 7 AS A CONSERVATIVE ESTIMATE

BOYLE ENGINEERING CORPORATION

Project Drake Wash
Job No. W1127 300 22
Init Date 2/23/90

Description Memo Record to Document Sediment for Facility Planning Study

SHEET 1/2

Basis for inflow sediment volume estimate to fan system

From Arroyo Pasajero Report BEC 10/89
Central Valley, CA

	Ave Annual	100-year	100/Ave Annual
Sol Basin	437 AF/yr	2426 AF	5.6
Wartha	88	496	5.6
Jacobs	27	148	5.5

From Upper Newport Bay BEC 7/82
Southern Coastal, CA

Existing Cond	86 TONS/yr	443 TONS	5.2
Ultimate Cond.	64	269	4.2

From Ballhead City, Riviera Community Study Anderson-Nichols 4/85
Mohave Co., Az

General Reference	—	—	7.0

From Unnamed Wash Drainage Improvements SLA 9/89
Clark Co., NV

Sed Trans Capacity	4.2 AF/yr	21 AF	5.0
Muscle	7.8 AF/yr	31 AF	4.0

BOYLE ENGINEERING CORPORATION

Project _____ Description _____

Job No. _____ SHEET 1/1

/ Date _____

Estimates of Average Annual Sediment delivery to the 100 yr storm range from

1:4 to 1:7

With the exception of the general reference cited in the Bullhead City study all are in the 1:4 - 5.6 range.

The average of these remaining values is 1:5

For the purpose of the Range Wash Study a slightly higher value may be appropriate and the overall average of 5.3 will be used.

Basis for
inflow sediment
estimates

FLOOD CONTROL STUDY
OF
BULLHEAD CITY, RIVIERA COMMUNITIES, MOHAVE COUNTY, ARIZONA

SUBMITTED TO

ARIZONA DEPARTMENT OF WATER RESOURCES

APRIL, 1985

PREPARED BY

ANDERSON-NICHOLS & CO., INC.
CONSULTING ENGINEERS
PHOENIX, ARIZONA

3. In an ASCE technical paper (Reference 15) by Mr. Kenneth Renard, Southwest Rangeland Watershed Research Center, Tucson, Arizona, a comparison was made of several sediment yield equations or techniques. The methods were applied to the Walnut Gulch Experimental Watershed, a 58-square mile drainage area in southeastern Arizona operated by the Science and Education Administration of the United States Department of Agriculture. The watershed subareas varied in size from 0.136 square miles to 1.32 square miles and the record length averaged 14 years. The average annual measured sediment accumulation varied from 0.09 to 0.51 acre-feet/square mile/year for nine subareas within the study area. The PSIAC equation applied to these same watersheds resulted in average annual sediment yields ranging from 0.16 to 0.38 acre-feet/square mile/year.

The above comparisons on sediment yield methods and production rates would indicate that the PSIAC equation used for the Bullhead City study would generate reasonable values of average annual sediment yield for a reconnaissance level study.

In order to size the proposed desilting basins for a recurrence interval lower than the annual storm event (≃ 2.2 years), it was necessary to find a procedure to provide sediment yield for an individual storm event. In "Erosion and Sediment Yield" (Reference 14), it was stated that sediment yield was proportioned to runoff. The report presented a summary of sediment yield for the 2-, 10-, 50-, and 100-year recurrence interval storms. A relationship of sediment yields to recurrence interval was noted from the summary. The 100-, 50-, 25-, and 10-year storm sediment yields had approximately a 7:1, 6:1, 4:1, and 3:1 relation to the 2-year sediment yield, respectively.

The above relationship of sediment yield to 2-year storm or the average annual storm (2.2 year ±) was found in Reference 16, where sediment yield was computed for several storm events. The above relationship was also noted when the Modified Universal Soil Loss Equation (MUSLE) was applied to watersheds in the Bullhead City study area.

In conclusion, the above relationships were considered a reasonable relationship of individual storm yields to the average annual sediment yield. Therefore, the approximate sediment yields from the 100-, 50-, 25-, and 10-year storm events for this study were obtained by multiplying the annual sediment yield from the PSIAC equation by 7, 6, 4, or 3, respectively.

100yr/Ave Ann = 7.0

CONCEPT REPORT
FOR
UNNAMED WASH DRAINAGE IMPROVEMENTS
LAUGHLIN, NEVADA

Submitted to

The Walter Development Corporation
4100 W. Flamingo, Suite 2350
Las Vegas, Nevada

Prepared by

Simons, Li and Associates, Inc.
3901 Westerly Place, Suite 101
Newport Beach, California

September 25, 1989

SLA Project Number NV-SE-02

able 5.2. Probability-Weighting Procedure for Average Annual Sediment Production Based on Supply Channel Sediment Transport Capacity.

A	B	C	D	E	F
RETURN PERIOD (years)	PROBABILITY	SEDIMENT INFLOW (acre-feet)	PROBABILITY INTERVAL	AVERAGE INFLOW (acre-feet)	D * E (acre-feet)
0	1	0			
			0.90	3.51	3.16
10	0.10	7.02			
			0.08	11.31	0.90
50	0.02	15.60			
			0.01	18.09	0.18
100	0.01	20.57			
				TOTAL	4.24

Note: Volumes given in this table are not bulked for porosity. Multiply the volumes by 1.67 to obtain the actual volume that the sediment would occupy.

$100\,yr/Ave\ Ann = 21/4.2 = 5.0$

Table 5.3. Probability-Weighting Procedure for Average Annual Sediment Production Based on the MUSLE Equation.

A	B	C	D	E	F
RETURN PERIOD (years)	PROBABILITY	SEDIMENT YIELD (acre-feet)	PROBABILITY INTERVAL	AVERAGE YIELD (acre-feet)	D * E (acre-feet)
0	1	0			
			0.90	6.60	5.94
10	0.10	13.20			
			0.08	19.15	1.53
50	0.02	25.10			
			0.01	28.25	0.28
100	0.01	31.40			
				TOTAL	7.75

Note: Volumes given in this table are not bulked for porosity. Multiply the volumes by 1.67 to obtain the actual volume that the sediment would occupy.

$$100\,yr/Ave\ Ann = 31/7.8 = 4.0$$

Q vs. SED

DRAFT

SEDIMENT INFLOW REPORT

FOR

CAVE CREEK AND CUDIA CITY WASH AT

THE ARIZONA CANAL DIVERSION CHANNEL

MAY 1982

Boyle Engineering Corporation
consulting engineers / architects

Water Resources Division
7333 Ronson Road
San Diego, California 92111

714/268-4411

6.0 Sediment Yield Estimation

The detailed results of the sediment transport analyses of Cave Creek and Cudia City Wash are presented in this section.

6.1 Cave Creek

Design Storm. The sediment transport model HEC-6 as developed and calibrated in the previous section was applied to estimate sediment yield for the design storm (100-year). The HEC-6 results were then combined with the wash load estimates for upland areas to estimate the total sediment yield. Table 6-1 presents sediment yield, for each particle size, as a result of the design storm.

Average Annual. In section 5.2, sediment yield from 1970 to 1980 was estimated for comparison with sediment removal data. The average annual sediment production during this period was 95,000 tons, or 57 acre-feet. However, gaging station records available for Cave Creek since 1958 indicate that this 11-year period was considerably wetter than the previous 12 years (1958-1969). Average annual runoff volumes were 4,270 acre-feet for 1970 to 1980 and 3,120 acre-feet for 1958 to 1980.

In the inflow report by SLA (1982), a nearly linear correlation between annual water yield and sediment yield was shown with an exponent of 1.07. This relationship was applied to estimate the long-term annual sediment yield based on the period 1958 to 1980, as follows:

$$Qs_{58-80} = \left(\frac{Q_{58-80}}{Q_{70-80}}\right)^{1.07} Qs_{70-80}$$

FINAL REPORT
STREAM CHANNEL EROSION STUDY
ARROYO PASAJERO

Submitted To

State of California
Department of Water Resources
Division of Operations and Maintenance
P.O. Box 388
Sacramento, California 95802

By

Simons, Li & Associates, Inc.
4030 Birch Street
Suite 103
Newport Beach, California 92660

SLA Project Number CA-DWR-01
R578/RDF225

March 20, 1985

$$Q_s = 6.96 \times 10^{-5} H_y^{0.261} V^{4.085} TW \quad \text{(Zapato-Chino Creek)} \quad (6d)$$

where

Q_s is the sediment transport capacity (cfs)
V is the average flow velocity (ft/sec)
H_y is the hydraulic depth (ft)
T_W is the top width

The average annual bed-material transport capacity for Los Gatos Creek near the SPRR is determined by using Equation 6a in combination with the average hydraulics of Los Gatos Creek summarized in Table 3.1. The sediment transport capacity for various flood peaks is computed and a regression between the water discharge and bed-material discharge results in the following sediment rating curve

$$Q_s = 1.48 \times 10^{-5} Q^{1.84} \quad (7)$$

where

Q_s is the bed-material transport capacity (cfs)
Q is the water discharge (cfs)

Equation 7 is then used with the daily flow records of Los Gatos Creek at Nunez, which are modified by a weighting factor K (see Equation 2), to determine the bed-material transport rate from 1968 to 1980 of Los Gatos near the SPRR. The resultant average annual bed-material yield between 1968 and 1980 is 207.8 acre-feet.

The bed-material sediment rating curves for Warthan, Jacalitos and Zapato-Chino Creeks were developed in a similar fashion to those for Los Gatos Creek. The resulting sediment rating curves for the three creeks are:

$$Q_s = 7.58 \times 10^{-6} Q^{1.67} \quad \text{(Warthan Creek)} \quad (8a)$$

$$Q_s = 2.01 \times 10^{-5} Q^{1.74} \quad \text{(Jacalitos Creek)} \quad (8b)$$

$$Q_s = 9.94 \times 10^{-5} Q^{1.66} \quad \text{(Zapato-Chino Creek)} \quad (8c)$$

Arroyo Pasajero

DRAINAGE

AND

SEDIMENT CONTROL PLAN

FINAL REPORT

prepared for
U.S. BUREAU OF RECLAMATION
MID-PACIFIC REGION

prepared by
BOYLE ENGINEERING CORPORATION

DN-U10-100-15

July 1990

Boyle Engineering Corporation
consulting engineers
Suite 200
165 South Union
Lakewood, Colorado 80228
303 / 987-3443
FAX 303 / 987-3908

estimated for each basin the Arroyo Pasajero watershed range from .7 percent to 45 percent. The slope length-gradient factor (LS) is determined using the following equation:

$$LS = (\lambda / 72.6)^m (0.065 + 4.56s + 65.41 s^2) \quad (2)$$

Where:

LS = slope length-gradient factor;

m = coefficient related to watershed slope;

λ = slope-length factor;

s = slope-gradient factor equal to the sin of the slope angle in degrees.

The cover index factor (C) represents the relative soil loss reduction due to the influence of ground cover by vegetation, mulch or crop residual, and canopy cover by tall trees or brush. The value of C is unity for clean-tilled, continuous fallow cropland and unprotected construction areas. The average values within the Arroyo Pasajero watershed are estimated to range from about .042 to .649. The values vary considerably depending on vegetation types, cover and land use.

The practice factor (P) describes the reduction in runoff intensity caused by introducing erosion reduction practices on agricultural lands within the watershed. For natural conditions and up-and-down-slope cultivated agricultural areas, P is unity. The rainfall energy factor (R) quantifies the raindrop impact effect and a relative rate of runoff.

Equation (1) estimates average annual erosion rates. It does not estimate sediment delivered to the stream system. Eroded soil materials often move only short distances before a decrease in runoff velocities causes their deposition. They may remain in the fields where they originated or may be deposited on less steep slopes that are remote from the stream system. A conventional method to determine sediment yield (sediment actually reaching the stream system) is to use the concept of sediment delivery ratio. The sediment delivery ratio is the ratio of the actual amount of sediment delivered at a given location to the gross erosion from the drainage area above that location. A modified version of the USLE, which was used in this study, eliminates the need for a sediment delivery ratio by using a runoff factor in lieu of the rainfall energy factor in the USLE. This modification enables prediction of sediment yield resulting from individual storms which can then be used to establish a long-term average value.

The modified universal soil loss equation (MUSLE) begins with the basic assumption that sediment discharge can be related to water discharge by an equation in the form of:

$$q_s = a\, q^b \quad (3)$$

Where:

q_s = instantaneous sediment discharge in tons/day;

q = instantaneous water discharge in cfs;

a = constant

b = constant

The total sediment discharge for a given hydrograph can then be estimated by integrating the above equation over the entire hydrograph as follows:

$$Q_s = \int_0^T a\, q^b\, dt \qquad (4)$$

Where:

Q_s = the total sediment load during the hydrograph in tons;

T = the base of the hydrograph in days;

a and b = the same coefficients as defined in Equation (3).

The above equation may be approximated by:

$$Q_s = \frac{a}{2}\,\frac{2}{b+1}^{n}\, Q\, q_p^{b-1} \qquad (5)$$

Where:

Q = runoff volume in acre-feet;

q_p = peak discharge in cfs;

a and b = the same coefficients as defined in Equation (3).

Equation (5) may be rewritten as

$$Q_s = C\, Q\, q_p^{\beta} \qquad (6)$$

Where:

$C = \frac{a}{2}\,\frac{2}{b+1}^{n}$;

$\beta = b - 1$.

In general, the β term does not appreciably change within the watershed. On the other hand, the coefficient C varies appreciably, depending upon the watershed conditions. The coefficient C, instead of relating to the undefined coefficients a, b and n, may be related to the parameters involved in the USLE as follows:

$$C = KLSCP \tag{7}$$

$$Q_s = \alpha (Q q_p^{\beta}) KLSCP \tag{8}$$

This modified version of the USLE (MUSLE) is used to estimate sediment delivered to the stream. The above form of the equation is one of the two forms proposed by Williams and is considered to be appropriate for the study area.

Determination of the coefficients, α and β, in Equation (8) is based on calibration against total sediment deposits measured within the impoundment basin. They were determined to be 2.74 and 1.5, respectively.

The other parameters were evaluated for each land use within each drainage basin as described in the next section.

6.3.3 Estimation of Watershed USLE Parameters

As previously discussed, the sediment yield from a watershed is based on physical characteristics of the watershed as well as the total volume and peak flow of runoff. The MUSLE approach, adopted for this study, requires the determination of USLE parameters to develop the sediment yield of the watershed. These values were determined using available topographic information, previously published reports, and findings of the watershed mapping program.

The soil erodibility factor (K), the cover index factor (C), and the practice factor (P) were all developed as part of the watershed mapping program for each of the identified mapping units. These units were delineated based on different criteria than the sub-basin units used for this portion of the study and therefore did not correspond directly to the sub-basins in the sediment yield model. Composite K, C, and P factors were developed for each sub-basin based on an weighted average of the values for each mapping unit within each sub-basin.

The slope length-gradient factor (LS) was estimated from Equation (2) using USGS 7.5' topographic quadrangle maps to determine the slope-steepness (S) and slope-length factor (λ). These factors were estimated using the techniques developed by Williams and Berndt. The slope-steepness factor is estimated using the contour-length method for computing average watershed slope by weighting the slope between contours according to the area between contours. The slope-length factor is estimated using the contour-extreme point method for computing average watershed slope length.

DISTRIBUTION FINES/COARSE

Final Distribution, temp & n

ALLUVIAL FAN
100-YR PEAK
DAWDY/FEMA WIDTH

n = .022
T = 70°F
30/70

```
*************************************************      ***********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *      *  U.S. ARMY CORPS OF ENGINEERS   *
*       Version: 4.0.6  -  June 1991              *      *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  FAN7050.DAT                       *      *  609 SECOND STREET              *
*  OUTPUT FILE: FAN7050.OUT                       *      *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 04JUN92       RUN TIME: 11:10:56     *      *  (916) 756-1104                 *
*************************************************      ***********************************

                X     X  XXXXXXX   XXXXX          XXXXX
                X     X  X        X     X        X     X
                X     X  X        X              X
                XXXXXXX  XXXX     X        XXXXX  XXXXXX
                X     X  X        X              X     X
                X     X  X        X     X        X     X
                X     X  XXXXXXX   XXXXX          XXXXX

      ***************************************************************************
      *  MAXIMUM LIMITS FOR THIS VERSION ARE:                                   *
      *       10  Stream Segments (Main Stem + Tributaries)                     *
      *      150  Cross Sections                                                *
      *      100  Elevation/Station Points per Cross Section                    *
      *       15  Grain Sizes                                                   *
      *       10  Control Points                                                *
      ***************************************************************************

T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION     DN N07 300 10
T3      11/14/91      7050 CFS SINGLE FAN FLOW N = .022, T=70

NC  .0220    .0220    .0220    .1000    .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
  Add     40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 8 RIVER MILE= 41000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 9 RIVER MILE= 42000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

```
SECTION NO. 28 RIVER MILE=  61000.000
...Add    40.00 (ft) to each Elevation(Y)

    OF CROSS SECTIONS IN STREAM SEGMENT= 28
    OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

================================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91      7050 CFS SINGLE FAN FLOW N = .022, T=70

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ      SPGF       ACGR      NFALL     IBSHER
I1     10.        3       1     1.000     32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

    IS PRESENT

       MTCL    IASL    LASL     SGSL     PUSDLB     UWSDLB     CCSDLB
I3        1       1       4    2.650     82.000     65.000      5.700

  DEPOSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
              LAYER      STRESS
               NO.      lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 ND AND/OR GRAVEL ARE PRESENT

       MTC     IASA     LASA      SPGS       GSF       BSAE       PSI     UWDLB
I4       4        1       10     2.650      .667       .500    30.000    93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG
```

FOLLOWING GRAIN SIZES UTILIZED (MM)

SILT:	.0056	.0110	.0220	.0440	
D:	.0880	.1770	.3540	.7070	1.4140
	2.8280	5.6570	11.3140	22.6270	45.2550

- - - -

	1000.00						
46000.000		330.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
00.000		330.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
000.000		330.00	1061.63	1061.63	1061.63	14000.00	2.65
	1000.00						
49000.000		330.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
50000.000		330.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
51000.000		330.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		330.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		330.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		330.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		330.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		330.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		330.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		330.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		330.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
00.000		330.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		330.00	1581.63	1581.63	1581.63	27000.00	5.11

BED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070

.140 .240 .230 .150

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
SEDIMENT CONTROL VOLUMES

SECTION NUMBER	LENGTH (ft)	MAX. WIDTH (ft)	DEPTH (ft)	VOLUME (cu.ft)	VOLUME (cu.yd)
34000.000	500.00	330.00	10.00	.165000E+07	61111.0
35000.000	1000.00	330.00	10.00	.329999E+07	122222.
36000.000	1000.00	330.00	10.00	.329999E+07	122222.
37000.000	1000.00	330.00	10.00	.329999E+07	122222.
38000.000	1000.00	330.00	10.00	.329999E+07	122222.
39000.000	1000.00	330.00	10.00	.329999E+07	122222.
40000.000	1000.00	330.00	10.00	.329999E+07	122222.
41000.000	1000.00	330.00	10.00	.329999E+07	122222.
42000.000	1000.00	330.00	10.00	.329999E+07	122222.
43000.000	1000.00	330.00	10.00	.329999E+07	122222.
44000.000	1000.00	330.00	10.00	.329999E+07	122222.
45000.000	1000.00	330.00	10.00	.329999E+07	122222.
46000.000	1000.00	330.00	10.00	.329999E+07	122222.
47000.000	1000.00	330.00	10.00	.329999E+07	122222.
48000.000	1000.00	330.00	10.00	.329999E+07	122222.
49000.000	1000.00	330.00	10.00	.329999E+07	122222.
50000.000	1000.00	330.00	10.00	.329999E+07	122222.
51000.000	1000.00	330.00	10.00	.329999E+07	122222.
52000.000	1000.00	330.00	10.00	.329999E+07	122222.
53000.000	1000.00	330.00	10.00	.329999E+07	122222.
54000.000	1000.00	330.00	10.00	.329999E+07	122222.
900.000	1000.00	330.00	10.00	.329999E+07	122222.
000.000	1000.00	330.00	10.00	.329999E+07	122222.
57000.000	1000.00	330.00	10.00	.329999E+07	122222.
58000.000	1000.00	330.00	10.00	.329999E+07	122222.
59000.000	1000.00	330.00	10.00	.329999E+07	122222.
60000.000	1000.00	330.00	10.00	.329999E+07	122222.
61000.000	500.00	330.00	10.00	.165000E+07	61111.0

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

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BEGIN COMPUTATIONS.
$HYD

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• FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 112 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
` OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.02	61000.000	23.23			37.88		
TOTAL=	34000.000	23.23	11.61	.50	37.88	3.38	.91

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

	TOTAL	VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1581034.35	.00	.00	79051.72	1501982.63	
SANDS & GRAVELS	3689080.15	110672.40	110672.40	110672.40	184454.01	184454.01
		221344.81	442689.62	885379.24	811597.63	627143.63
TOTAL LOAD	5270114.50					
MENT OUTFLOW						
SILT	1581034.35	.00	.00	79051.72	1501982.63	
SANDS & GRAVELS	657368.46	186248.98	155133.24	106925.15	57988.32	44977.85
		2206.18	7873.31	23495.69	37995.12	34524.62
TOTAL LOAD	2238402.81					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	3.51	1584.09	1585.14	7050.	1581034.	1100835.
60000.000	-.02	1544.11	1541.61	7050.	1581034.	1131400.
59000.000	-.02	1504.10	1501.61	7050.	1581034.	1161883.
58000.000	-.02	1464.11	1461.61	7050.	1581034.	1186200.
57000.000	-.01	1424.09	1421.62	7050.	1581034.	1205323.
56000.000	-.01	1384.11	1381.62	7050.	1581034.	1221743.
55000.000	-.01	1344.09	1341.62	7050.	1581034.	1235305.
54000.000	-.01	1304.11	1301.62	7050.	1581034.	1248422.
53000.000	-.01	1264.10	1261.62	7050.	1581034.	1259929.
52000.000	-.01	1224.11	1221.62	7050.	1581034.	1271226.
51000.000	-.01	1184.09	1181.62	7050.	1581034.	1281103.
50000.000	-.01	1144.11	1141.62	7050.	1581034.	1290852.
49000.000	-.01	1104.09	1101.62	7050.	1581034.	1299271.
48000.000	-.01	1064.11	1061.62	7050.	1581034.	1307712.
47000.000	.00	1024.10	1021.63	7050.	1581034.	1315003.
46000.000	-.01	984.11	981.62	7050.	1581034.	1322448.
45000.000	.00	944.09	941.63	7050.	1581034.	1328788.
44000.000	.00	904.11	901.63	7050.	1581034.	1335277.
43000.000	.00	864.09	861.63	7050.	1581034.	1340685.

42000.000	.00	824.11	821.63	7050.	1581034.	1346340.
41000.000	.00	784.10	781.63	7050.	1581034.	1351198.
40000.000	.00	744.10	741.63	7050.	1581034.	1356209.
39000.000	.00	704.08	701.63	7050.	1581034.	1360174.
38000.000	.00	664.11	661.63	7050.	1581034.	1364480.
37000.000	.00	624.10	621.63	7050.	1581034.	1369488.
36000.000	.00	584.01	581.63	7050.	1581034.	1371431.
35000.000	-.01	544.10	541.62	7050.	1581034.	1389653.
34000.000	.99	504.04	502.62	7050.	1581034.	657368.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	109618.	76733.	32886.	0.	98594.				
61000.000	27891.	11449.	16443.	0.	70737.	70737.	51999.	18738.	0.
60000.000	28209.	11767.	16443.	0.	-253.	70484.	-253.	0.	0.
59000.000	28526.	12084.	16443.	0.	-253.	70231.	-253.	0.	0.
58000.000	28779.	12336.	16443.	0.	-201.	70030.	-201.	0.	0.
57000.000	28978.	12535.	16443.	0.	-158.	69871.	-158.	0.	0.
56000.000	29149.	12706.	16443.	0.	-136.	69735.	-136.	0.	0.
55000.000	29290.	12847.	16443.	0.	-112.	69623.	-112.	0.	0.
54000.000	29426.	12984.	16443.	0.	-109.	69514.	-109.	0.	0.
53000.000	29546.	13103.	16443.	0.	-95.	69419.	-95.	0.	0.
000.000	29664.	13221.	16443.	0.	-94.	69325.	-94.	0.	0.
000.000	29766.	13323.	16443.	0.	-82.	69243.	-82.	0.	0.
50000.000	29868.	13425.	16443.	0.	-81.	69163.	-81.	0.	0.
49000.000	29955.	13512.	16443.	0.	-70.	69093.	-70.	0.	0.
48000.000	30043.	13600.	16443.	0.	-70.	69023.	-70.	0.	0.
47000.000	30119.	13676.	16443.	0.	-60.	68963.	-60.	0.	0.
46000.000	30196.	13753.	16443.	0.	-62.	68901.	-62.	0.	0.
45000.000	30262.	13819.	16443.	0.	-53.	68848.	-53.	0.	0.
44000.000	30330.	13887.	16443.	0.	-54.	68795.	-54.	0.	0.
43000.000	30386.	13943.	16443.	0.	-45.	68750.	-45.	0.	0.
42000.000	30445.	14002.	16443.	0.	-47.	68703.	-47.	0.	0.
41000.000	30495.	14052.	16443.	0.	-40.	68663.	-40.	0.	0.
40000.000	30547.	14105.	16443.	0.	-42.	68621.	-42.	0.	0.
39000.000	30589.	14146.	16443.	0.	-33.	68588.	-33.	0.	0.
38000.000	30633.	14191.	16443.	0.	-36.	68553.	-36.	0.	0.
37000.000	30685.	14243.	16443.	0.	-41.	68511.	-41.	0.	0.
36000.000	30706.	14263.	16443.	0.	-16.	68495.	-16.	0.	0.
35000.000	30895.	14452.	16443.	0.	-151.	68344.	-151.	0.	0.
34000.000	23279.	6837.	16443.	0.	6066.	74410.	6066.	0.	0.

JOB COMPLETED
RUN TIME = 0 HOURS, 0 MINUTES & 2.09 SECONDS

SENSITIVITY ANALYSES

Sensitivity

n = 0.022

T = 80° F

40/60

(35,505 tons)

(Δ 2 %)

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**************************************************     ************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS    *
*       Version: 4.0.6  -  June 1991              *     *  HYDROLOGIC ENGINEERING CENTER   *
*  INPUT FILE:  FAN6600T.DAT                      *     *  609 SECOND STREET               *
*  UTPUT FILE: FAN6600T.OUT                       *     *  DAVIS, CALIFORNIA 95616-4687    *
*  RUN DATE: 23JAN92       RUN TIME: 15:47:19     *     *  (916) 756-1104                  *
**************************************************     ************************************

          X     X  XXXXXXX   XXXXX           XXXXX
          X     X  X        X     X         X     X
          X     X  X        X               X
          XXXXXXX  XXXX     X        XXXXX  XXXXXX
          X     X  X        X               X     X
          X     X  X        X     X         X     X
          X     X  XXXXXXX  XXXXX           XXXXX

        ************************************************************************
        *  MAXIMUM LIMITS FOR THIS VERSION ARE:                                *
        *       10  Stream Segments (Main Stem + Tributaries)                  *
        *      150  Cross Sections                                             *
        *      100  Elevation/Station Points per Cross Section                 *
        *       15  Grain Sizes                                                *
        *       10  Control Points                                             *
        ************************************************************************


T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 30D 10
        01/23/92     6600 CFS SINGLE FAN FLOW N = .022, T=80

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

TION NO.  8 RIVER MILE=  41000.000
dd    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
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SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

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TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
01/23/92     6600 CFS SINGLE FAN FLOW N = .022, T=80

SEDIMENT PROPERITES AND PARAMETERS

       SPI     IBG    MNQ      SPGF      ACGR      NFALL    IBSHER
I1     10.       3      1     1.000    32.174          2         1

SILT IS PRESENT

       MTCL    IASL    LASL     SGSL     PUSDLB     UWSDLB     CCSDLB
I3        1       1       4    2.650     82.000     65.000      5.700

POSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
               LAYER     STRESS
                NO.     lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4       4         1       10     2.650      .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

   OWING GRAIN SIZES UTILIZED (MM)
SILT:      .0056      .0110      .0220      .0440
SAND:      .0880      .1770      .3540      .7070     1.4140
          2.8280     5.6570    11.3140    22.6270    45.2550
```

SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
LOAD BY GRAIN SIZE CLASS (tons/day)

	100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	6600.00
L	VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L	FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L	MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	71600.5
L	CS	108.570	1593.13	6297.06	38322.5	199129.	867136.	.183775E+07
L	FVSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	FSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	MSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	CSA	8.46000	124.140	490.680	2986.17	15516.5	56307.5	143201.
L	VCS	8.46000	124.140	490.680	2986.17	15516.5	56307.5	143201.
L	VFG	10.1520	148.968	588.816	3583.40	18619.8	81082.8	171841.
L	FG	20.3040	297.936	1177.63	7166.81	37239.7	162166.	343683.
L	MG	40.6080	595.872	2355.26	14333.6	74479.4	324331.	687365.
L	CG	37.2240	546.216	2158.99	13139.1	68272.8	297304.	630085.
L	VCG	28.7640	422.076	1668.31	10153.0	52756.2	229735.	486884.
	TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.222978E+07	.477337E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		320.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		320.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		320.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		320.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		320.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		320.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		320.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		320.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		320.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		320.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		320.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		320.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
0.000		320.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		320.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		320.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		320.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]000.000		320.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
[illegible]000.000		320.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		320.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		320.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		320.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		320.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		320.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		320.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		320.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		320.00	1501.63	1501.63	1501.63	25000.00	4
60000.000		320.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		320.00	1581.63	1581.63	1581.63	27000.00	5.11

1000.00

BED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
[illegible]******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
[illegible]*******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	

N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION NUMBER	LENGTH (ft)	MAX. WIDTH (ft)	DEPTH (ft)	VOLUME (cu.ft)	VOLUME (cu.yd)

34000.000	500.00	320.00	10.00	.160000E+07	59259.2
35000.000	1000.00	320.00	10.00	.319999E+07	118518.
37000.000	1000.00	320.00	10.00	.319999E+07	118518.
38000.000	1000.00	320.00	10.00	.319999E+07	118518.
39000.000	1000.00	320.00	10.00	.319999E+07	118518.
40000.000	1000.00	320.00	10.00	.319999E+07	118518.
41000.000	1000.00	320.00	10.00	.319999E+07	118518.
42000.000	1000.00	320.00	10.00	.319999E+07	118518.
43000.000	1000.00	320.00	10.00	.319999E+07	118518.
44000.000	1000.00	320.00	10.00	.319999E+07	118518.
45000.000	1000.00	320.00	10.00	.319999E+07	118518.
46000.000	1000.00	320.00	10.00	.319999E+07	118518.
47000.000	1000.00	320.00	10.00	.319999E+07	118518.
48000.000	1000.00	320.00	10.00	.319999E+07	118518.
49000.000	1000.00	320.00	10.00	.319999E+07	118518.
50000.000	1000.00	320.00	10.00	.319999E+07	118518.
51000.000	1000.00	320.00	10.00	.319999E+07	118518.
52000.000	1000.00	320.00	10.00	.319999E+07	118518.
53000.000	1000.00	320.00	10.00	.319999E+07	118518.
54000.000	1000.00	320.00	10.00	.319999E+07	118518.
55000.000	1000.00	320.00	10.00	.319999E+07	118518.
56000.000	1000.00	320.00	10.00	.319999E+07	118518.
57000.000	1000.00	320.00	10.00	.319999E+07	118518.
58000.000	1000.00	320.00	10.00	.319999E+07	118518.
59000.000	1000.00	320.00	10.00	.319999E+07	118518.
60000.000	1000.00	320.00	10.00	.319999E+07	118518.
61000.000	500.00	320.00	10.00	.160000E+07	59259.2

. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 112 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

TOTAL NO. OF TIME STEPS READ = 1
L NO. OF WS PROFILES = 1
.ATIONS IN EXNER EQ = 280.
END OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.02	61000.000	28.05			29.41		
TOTAL=	34000.000	28.05	14.03	.50	29.41	3.46	.88

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1909347.60	.00	.00	71600.53	1837747.07	
SANDS & GRAVELS	2864021.40	85920.64	85920.64	85920.64	143201.07	143201.07
		171841.28	343682.57	687365.14	630084.71	486883.64
TOTAL LOAD	4773369.00					
SEDIMENT OUTFLOW						
SILT	1909347.60	.00	.00	71600.53	1837747.07	
SANDS & GRAVELS	674511.37	166947.90	141571.20	101113.86	72533.39	59219.50
		2674.95	9686.46	29475.81	48311.53	42976.78
TOTAL LOAD	2583858.97					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	2.34	1584.04	1583.97	6600.	1909348.	1190762.
60000.000	-.03	1544.06	1541.60	6600.	1909348.	1233709.
59000.000	-.03	1504.04	1501.60	6600.	1909348.	1273453.
58000.000	-.02	1464.06	1461.61	6600.	1909348.	1303317.
57000.000	-.02	1424.04	1421.61	6600.	1909348.	1326028.
56000.000	-.01	1384.06	1381.62	6600.	1909348.	1345146.
55000.000	-.01	1344.04	1341.62	6600.	1909348.	1361091.
54000.000	-.01	1304.06	1301.62	6600.	1909348.	1376234.
53000.000	-.01	1264.04	1261.62	6600.	1909348.	1389258.
52000.000	-.01	1224.06	1221.62	6600.	1909348.	1401900.
51000.000	-.01	1184.04	1181.62	6600.	1909348.	1412774.
50000.000	-.01	1144.06	1141.62	6600.	1909348.	1423454.
49000.000	-.01	1104.04	1101.62	6600.	1909348.	1432488.
48000.000	-.01	1064.06	1061.62	6600.	1909348.	1441474.
47000.000	-.01	1024.04	1021.62	6600.	1909348.	1449019.
46000.000	-.01	984.06	981.62	6600.	1909348.	1456738.
45000.000	.00	944.04	941.63	6600.	1909348.	1463168.
44000.000	.00	904.06	901.63	6600.	1909348.	1469824.
43000.000	.00	864.04	861.63	6600.	1909348.	1475201.
42000.000	.00	824.06	821.63	6600.	1909348.	1480858.
'000.000	.00	784.04	781.63	6600.	1909348.	1485365.
,000.000	.00	744.06	741.63	6600.	1909348.	1490308.
39000.000	.00	704.04	701.63	6600.	1909348.	1494197.
38000.000	.00	664.06	661.63	6600.	1909348.	1498520.
37000.000	.00	624.04	621.63	6600.	1909348.	1503339.
36000.000	.00	583.96	581.63	6600.	1909348.	1504597.

35000.000	-.02	544.05	541.61	6600.	1909348.	1526127.
34000.000	1.19	504.00	502.82	6600.	1909348.	674511.

HM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	99286.	59572.	39714.	0.	92707.				
61000.000	32241.	12384.	19857.	0.	60214.	60214.	37585.	22629.	0.
60000.000	32688.	12831.	19857.	0.	-356.	59858.	-356.	0.	0.
59000.000	33101.	13244.	19857.	0.	-329.	59529.	-329.	0.	0.
58000.000	33412.	13554.	19857.	0.	-247.	59282.	-247.	0.	0.
57000.000	33648.	13791.	19857.	0.	-188.	59094.	-188.	0.	0.
56000.000	33847.	13990.	19857.	0.	-158.	58935.	-158.	0.	0.
55000.000	34013.	14155.	19857.	0.	-132.	58803.	-132.	0.	0.
54000.000	34170.	14313.	19857.	0.	-125.	58678.	-125.	0.	0.
53000.000	34305.	14448.	19857.	0.	-108.	58570.	-108.	0.	0.
52000.000	34437.	14580.	19857.	0.	-105.	58465.	-105.	0.	0.
51000.000	34550.	14693.	19857.	0.	-90.	58375.	-90.	0.	0.
50000.000	34661.	14804.	19857.	0.	-88.	58287.	-88.	0.	0.
49000.000	34755.	14898.	19857.	0.	-75.	58212.	-75.	0.	0.
48000.000	34849.	14991.	19857.	0.	-74.	58137.	-74.	0.	0.
47000.000	34927.	15070.	19857.	0.	-63.	58075.	-63.	0.	0.
46000.000	35007.	15150.	19857.	0.	-64.	58011.	-64.	0.	0.
00.000	35074.	15217.	19857.	0.	-53.	57958.	-53.	0.	0.
.000.000	35143.	15286.	19857.	0.	-55.	57902.	-55.	0.	0.
43000.000	35199.	15342.	19857.	0.	-45.	57858.	-45.	0.	0.
42000.000	35258.	15401.	19857.	0.	-47.	57811.	-47.	0.	0.
41000.000	35305.	15448.	19857.	0.	-37.	57774.	-37.	0.	0.
40000.000	35356.	15499.	19857.	0.	-41.	57733.	-41.	0.	0.
39000.000	35397.	15540.	19857.	0.	-32.	57701.	-32.	0.	0.
38000.000	35442.	15585.	19857.	0.	-36.	57665.	-36.	0.	0.
37000.000	35492.	15635.	19857.	0.	-40.	57625.	-40.	0.	0.
36000.000	35505.	15648.	19857.	0.	-10.	57614.	-10.	0.	0.
35000.000	35729.	15872.	19857.	0.	-178.	57436.	-178.	0.	0.
34000.000	26872.	7015.	19857.	0.	7054.	64490.	7054.	0.	0.

JOB COMPLETED
RUN TIME = 0 HOURS, 0 MINUTES & 17.90 SECONDS

```
*************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
*  INPUT FILE:  FAN6600N.DAT                      *
   JTPUT FILE: FAN6600N.OUT                       *
   RUN DATE: 23JAN92      RUN TIME: 15:25:43      *
*************************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

Sensitivity
n = 0.028
T = 70°F
~~40/60~~
(Δ 10%)

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX  XXXXX          XXXXX
```

```
*********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                             *
*       10  Stream Segments (Main Stem + Tributaries)               *
*      150  Cross Sections                                          *
*      100  Elevation/Station Points per Cross Section              *
*       15  Grain Sizes                                             *
*       10  Control Points                                          *
*********************************************************************
```

```
T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
        01/23/92     6600 CFS SINGLE FAN FLOW N = .028, T=70

NC  .0280   .0280   .0280   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

TION NO.  8 RIVER MILE=  41000.000
  Id    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

ION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

TION NO. 28 RIVER MILE= 61000.000
d 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK = 28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK= 1
END OF GEOMETRIC DATA

==========

T4
T5 RANGE WASH DIVERSION DIKE LAS VEGAS, NEVADA
T6 BOYLE ENGINEERING CORPORATION ON N07 300 10
T7
T8 SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION ON N07 300 10
01/23/92 6600 CFS SINGLE FAN FLOW N = .028, T=70

- - - -

SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1
) BY GRAIN SIZE CLASS (tons/day)

	100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	6600.00
L	VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L	FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L	MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	71600.5
L	CS	108.570	1593.13	6297.06	38322.5	199129.	867136.	.183775E+07
L	FVSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	FSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	MSA	5.07600	74.4840	294.408	1791.70	9309.92	40541.4	85920.6
L	CSA	8.46000	124.140	490.680	2986.17	15516.5	56307.5	143201.
L	VCS	8.46000	124.140	490.680	2986.17	15516.5	56307.5	143201.
L	VFG	10.1520	148.968	588.816	3583.40	18619.8	81082.8	171841.
L	FG	20.3040	297.936	1177.63	7166.81	37239.7	162166.	343683.
L	MG	40.6080	595.872	2355.26	14333.6	74479.4	324331.	687365.
L	CG	37.2240	546.216	2158.99	13139.1	68272.8	297304.	630085.
L	VCG	28.7640	422.076	1668.31	10153.0	52756.2	229735.	486884.
	TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.222978E+07	.477337E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION . NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		320.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		320.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		320.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		320.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		320.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		320.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		320.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		320.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		320.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		320.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		320.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		320.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
1.000		320.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		320.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		320.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		320.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]0.000		320.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
[illegible]000.000		320.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		320.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		320.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		320.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		320.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		320.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		320.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		320.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		320.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		320.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		320.00	1581.63	1581.63	1581.63	27000.00	5.11

[illegible]ED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	320.00	10.00	.160000E+07	59259.2
35000.000	1000.00	320.00	10.00	.319999E+07	118518.
000.000	1000.00	320.00	10.00	.319999E+07	118518.
37000.000	1000.00	320.00	10.00	.319999E+07	118518.
38000.000	1000.00	320.00	10.00	.319999E+07	118518.
39000.000	1000.00	320.00	10.00	.319999E+07	118518.
40000.000	1000.00	320.00	10.00	.319999E+07	118518.
41000.000	1000.00	320.00	10.00	.319999E+07	118518.
42000.000	1000.00	320.00	10.00	.319999E+07	118518.
43000.000	1000.00	320.00	10.00	.319999E+07	118518.
44000.000	1000.00	320.00	10.00	.319999E+07	118518.
45000.000	1000.00	320.00	10.00	.319999E+07	118518.
46000.000	1000.00	320.00	10.00	.319999E+07	118518.
47000.000	1000.00	320.00	10.00	.319999E+07	118518.
48000.000	1000.00	320.00	10.00	.319999E+07	118518.
49000.000	1000.00	320.00	10.00	.319999E+07	118518.
50000.000	1000.00	320.00	10.00	.319999E+07	118518.
51000.000	1000.00	320.00	10.00	.319999E+07	118518.
52000.000	1000.00	320.00	10.00	.319999E+07	118518.
53000.000	1000.00	320.00	10.00	.319999E+07	118518.
54000.000	1000.00	320.00	10.00	.319999E+07	118518.
55000.000	1000.00	320.00	10.00	.319999E+07	118518.
56000.000	1000.00	320.00	10.00	.319999E+07	118518.
57000.000	1000.00	320.00	10.00	.319999E+07	118518.
58000.000	1000.00	320.00	10.00	.319999E+07	118518.
59000.000	1000.00	320.00	10.00	.319999E+07	118518.
60000.000	1000.00	320.00	10.00	.319999E+07	118518.
000.000	500.00	320.00	10.00	.160000E+07	59259.2

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

....

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 112 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

TL NO. OF TIME STEPS READ = 1
NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
END OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.02	61000.000	28.05			29.41		
TOTAL=	34000.000	28.05	14.03	.50	29.41	3.96	.87

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1909347.60	.00	.00	71600.53	1837747.07	
SANDS & GRAVELS	2864021.40	85920.64	85920.64	85920.64	143201.07	143201.07
		171841.28	343682.57	687365.14	630084.71	486883.64
TOTAL LOAD	4773369.00					
SEDIMENT OUTFLOW						
SILT	1909347.60	.00	.00	71600.53	1837747.07	
SANDS & GRAVELS	772151.97	171385.27	165158.60	139265.66	105298.03	84909.05
		2634.67	8982.43	25395.46	38249.88	30872.92
TOTAL LOAD	2681499.57					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	2.76	1584.06	1584.39	6600.	1909348.	891852.
60000.000	-.03	1544.06	1541.60	6600.	1909348.	935039.
59000.000	-.03	1504.05	1501.60	6600.	1909348.	975466.
58000.000	-.02	1464.05	1461.61	6600.	1909348.	1006271.
57000.000	-.02	1424.05	1421.61	6600.	1909348.	1030378.
56000.000	-.01	1384.06	1381.62	6600.	1909348.	1049924.
55000.000	-.01	1344.06	1341.62	6600.	1909348.	1066762.
54000.000	-.01	1304.06	1301.62	6600.	1909348.	1082027.
53000.000	-.01	1264.05	1261.62	6600.	1909348.	1095838.
52000.000	-.01	1224.05	1221.62	6600.	1909348.	1108386.
51000.000	-.01	1184.05	1181.62	6600.	1909348.	1119848.
50000.000	-.01	1144.06	1141.62	6600.	1909348.	1130377.
49000.000	-.01	1104.06	1101.62	6600.	1909348.	1140071.
48000.000	-.01	1064.06	1061.62	6600.	1909348.	1148976.
47000.000	-.01	1024.05	1021.62	6600.	1909348.	1157130.
46000.000	-.01	984.05	981.62	6600.	1909348.	1164603.
45000.000	.00	944.05	941.63	6600.	1909348.	1171494.
44000.000	.00	904.06	901.63	6600.	1909348.	1177891.
43000.000	.00	864.06	861.63	6600.	1909348.	1183839.
[illegible]000.000	.00	824.06	821.63	6600.	1909348.	1189336.
00.000	.00	784.05	781.63	6600.	1909348.	1194382.
40000.000	.00	744.05	741.63	6600.	1909348.	1199012.
39000.000	.00	704.05	701.63	6600.	1909348.	1203300.
38000.000	.00	664.06	661.63	6600.	1909348.	1207312.
37000.000	.00	624.06	621.63	6600.	1909348.	1212100.

36000.000	.00	583.96	581.63	6600.	1909348.	1214180.
35000.000	-.01	544.05	541.62	6600.	1909348.	1227248.
34000.000	.64	504.00	502.27	6600.	1909348.	772152.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	99286.	59572.	39714.	0.	92707.				
61000.000	29132.	9275.	19857.	0.	62690.	62690.	40061.	22629.	0.
60000.000	29582.	9724.	19857.	0.	-358.	62332.	-358.	0.	0.
59000.000	30002.	10145.	19857.	0.	-335.	61998.	-335.	0.	0.
58000.000	30322.	10465.	19857.	0.	-255.	61742.	-255.	0.	0.
57000.000	30573.	10716.	19857.	0.	-200.	61543.	-200.	0.	0.
56000.000	30776.	10919.	19857.	0.	-162.	61381.	-162.	0.	0.
55000.000	30952.	11094.	19857.	0.	-139.	61241.	-139.	0.	0.
54000.000	31110.	11253.	19857.	0.	-126.	61115.	-126.	0.	0.
53000.000	31254.	11397.	19857.	0.	-114.	61000.	-114.	0.	0.
52000.000	31384.	11527.	19857.	0.	-104.	60896.	-104.	0.	0.
51000.000	31504.	11646.	19857.	0.	-95.	60802.	-95.	0.	0.
50000.000	31613.	11756.	19857.	0.	-87.	60714.	-87.	0.	0.
49000.000	31714.	11857.	19857.	0.	-80.	60634.	-80.	0.	0.
48000.000	31807.	11949.	19857.	0.	-74.	60560.	-74.	0.	0.
47000.000	31891.	12034.	19857.	0.	-68.	60493.	-68.	0.	0.
0.000	31969.	12112.	19857.	0.	-62.	60431.	-62.	0.	0.
00.000	32041.	12184.	19857.	0.	-57.	60374.	-57.	0.	0.
44000.000	32107.	12250.	19857.	0.	-53.	60321.	-53.	0.	0.
43000.000	32169.	12312.	19857.	0.	-49.	60271.	-49.	0.	0.
42000.000	32226.	12369.	19857.	0.	-46.	60226.	-46.	0.	0.
41000.000	32279.	12422.	19857.	0.	-42.	60184.	-42.	0.	0.
40000.000	32327.	12470.	19857.	0.	-38.	60146.	-38.	0.	0.
39000.000	32372.	12514.	19857.	0.	-36.	60110.	-36.	0.	0.
38000.000	32413.	12556.	19857.	0.	-33.	60077.	-33.	0.	0.
37000.000	32463.	12606.	19857.	0.	-40.	60037.	-40.	0.	0.
36000.000	32485.	12627.	19857.	0.	-17.	60020.	-17.	0.	0.
35000.000	32621.	12763.	19857.	0.	-108.	59912.	-108.	0.	0.
34000.000	27888.	8030.	19857.	0.	3770.	63682.	3770.	0.	0.

JOB COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 18.46 SECONDS

Sensitivity

$n = 0.022$

$T = 70°F$

20/80

~~bef~~ doubled inflow (i.e. fine volume constant)

36,285 tons

$\Delta < 1\%$

```
*********************************************     **********************************
:OUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS  *
    Version: 4.0.6  -  June 1991              *     *  HYDROLOGIC ENGINEERING CENTER  *
IPUT FILE:  FAN6600P.DAT                      *     *  609 SECOND STREET             *
)TPUT FILE: FAN6600P.OUT                      *     *  DAVIS, CALIFORNIA 95616-4687  *
)N DATE: 28JAN92      RUN TIME: 17:29:22      *     *  (916) 756-1104                *
*********************************************     **********************************

          X     X  XXXXXXX   XXXXX          XXXXX
          X     X  X        X     X        X     X
          X     X  X        X              X
          XXXXXXX  XXXX     X        XXXXX  XXXXXX
          X     X  X        X              X     X
          X     X  X        X     X        X     X
          X     X  XXXXXXX   XXXXX          XXXXX

    **************************************************************************
    *  MAXIMUM LIMITS FOR THIS VERSION ARE:                                  *
    *       10  Stream Segments (Main Stem + Tributaries)                    *
    *      150  Cross Sections                                               *
    *      100  Elevation/Station Points per Cross Section                   *
    *       15  Grain Sizes                                                  *
    *       10  Control Points                                               *
    **************************************************************************

    RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
    BOYLE ENGINEERING CORPORATION      DN N07 300 10, DOUBLED
    01/28/92      6600 CFS SINGLE FAN FLOW N = .022, T=70

 .0220    .0220    .0220    .1000    .3000


 OF CROSS SECTIONS IN STREAM SEGMENT= 28
 OF INPUT DATA MESSAGES =   0

AL NO. OF CROSS SECTIONS IN THE NETWORK =  28
'AL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
 OF GEOMETRIC DATA

================================================================================


 RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
 BOYLE ENGINEERING CORPORATION    DN N07 300 10

 S   T TRANSPORT BY STREAM POWER
.GE    ST DIVERSION DIKE     LAS VEGAS,NV
YLE L  EERING CORPORATION    DN N07 300 10, DOUBLED COARSE PART.
/28/92      6600 CFS SINGLE FAN FLOW N = .022, T=70

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

SENSITIVITY RUN

FAN FLOW Q = 6600 CFS

INFLOWING SEDIMENT

FINES = 40%

COARSE MAT. = 2(60%) DOUBLED

EXIT PARTICLE SIZE ASSUMED OUT AND EQUIL TRANSPORT IS ESSENTIALLY THE SAME

48000.000	.00	1064.06	1061.63	6600.	1909348.	1543118.
47000.000	.00	1024.04	1021.63	6600.	1909348.	1547284.
46000.000	.00	984.06	981.63	6600.	1909348.	1551943.
5000.000	.00	944.04	941.63	6600.	1909348.	1555517.
000.000	.00	904.06	901.63	6600.	1909348.	1559591.
43000.000	.00	864.04	861.63	6600.	1909348.	1562540.
42000.000	.00	824.06	821.63	6600.	1909348.	1566000.
41000.000	.00	784.04	781.63	6600.	1909348.	1568436.
40000.000	.00	744.06	741.63	6600.	1909348.	1571516.
39000.000	.00	704.04	701.63	6600.	1909348.	1573642.
38000.000	.00	664.06	661.63	6600.	1909348.	1576384.
37000.000	.00	624.04	621.63	6600.	1909348.	1579811.
36000.000	.00	583.96	581.63	6600.	1909348.	1579562.
35000.000	-.02	544.05	541.61	6600.	1909348.	1601167.
34000.000	1.27	504.00	502.90	6600.	1909348.	695715.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

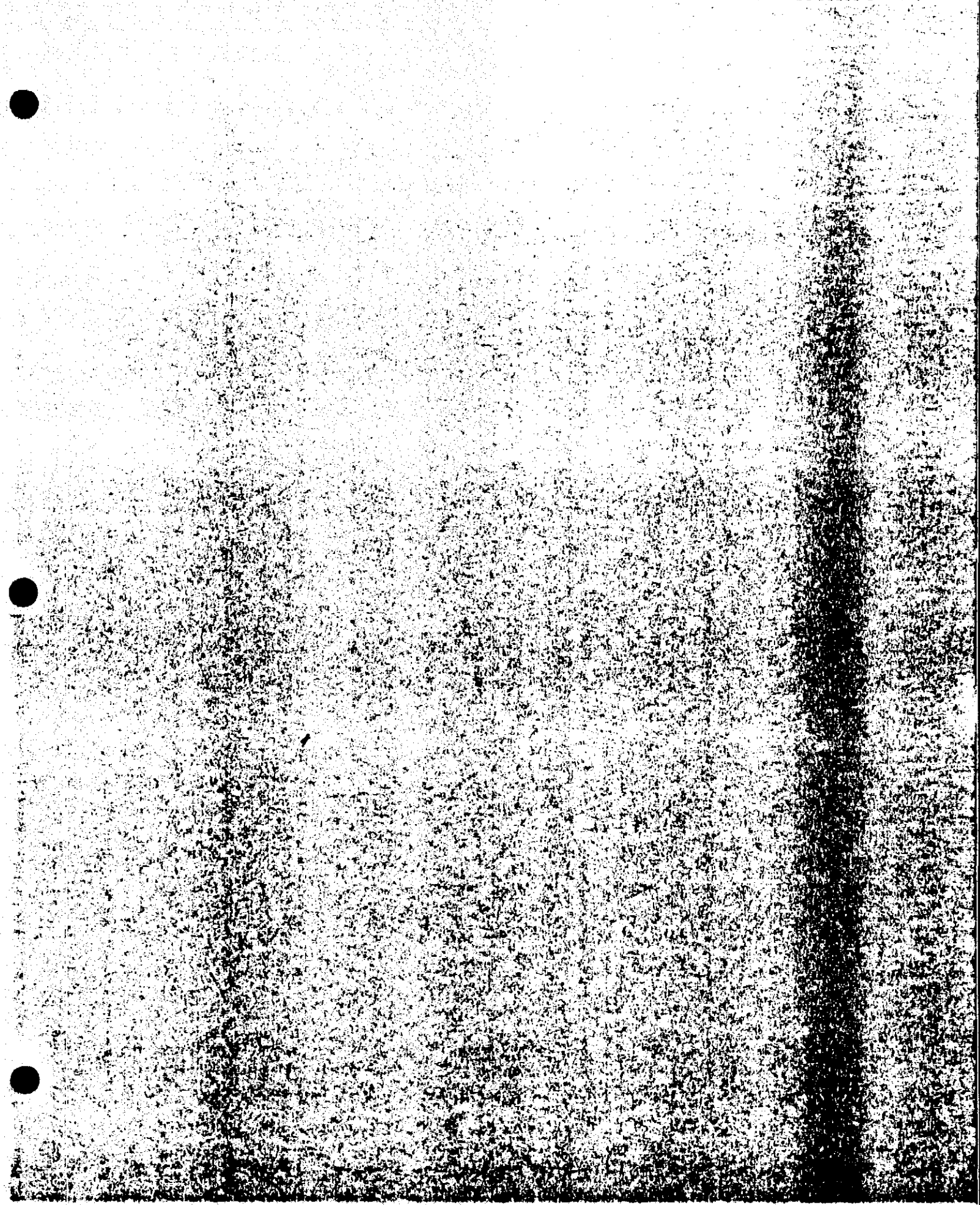
SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	158858.	119143.	39714.	0.	140156.				
61000.000	34900.	15043.	19857.	0.	105545.	105545.	82915.	22629.	0.
60000.000	34843.	14986.	19857.	0.	45.	105590.	45.	0.	0.
59000.000	34972.	15115.	19857.	0.	-102.	105488.	-102.	0.	0.
00.000	35104.	15247.	19857.	0.	-106.	105382.	-106.	0.	0.
00.000	35218.	15361.	19857.	0.	-91.	105291.	-91.	0.	0.
56000.000	35330.	15473.	19857.	0.	-89.	105203.	-89.	0.	0.
55000.000	35423.	15565.	19857.	0.	-74.	105129.	-74.	0.	0.
54000.000	35515.	15657.	19857.	0.	-73.	105055.	-73.	0.	0.
53000.000	35590.	15733.	19857.	0.	-60.	104995.	-60.	0.	0.
52000.000	35668.	15811.	19857.	0.	-62.	104933.	-62.	0.	0.
51000.000	35731.	15874.	19857.	0.	-51.	104883.	-51.	0.	0.
50000.000	35798.	15940.	19857.	0.	-53.	104830.	-53.	0.	0.
49000.000	35850.	15993.	19857.	0.	-42.	104788.	-42.	0.	0.
48000.000	35906.	16048.	19857.	0.	-44.	104744.	-44.	0.	0.
47000.000	35949.	16092.	19857.	0.	-35.	104709.	-35.	0.	0.
46000.000	35997.	16140.	19857.	0.	-39.	104671.	-39.	0.	0.
45000.000	36035.	16177.	19857.	0.	-30.	104641.	-30.	0.	0.
44000.000	36077.	16220.	19857.	0.	-34.	104607.	-34.	0.	0.
43000.000	36108.	16250.	19857.	0.	-24.	104583.	-24.	0.	0.
42000.000	36144.	16286.	19857.	0.	-29.	104554.	-29.	0.	0.
41000.000	36169.	16312.	19857.	0.	-20.	104534.	-20.	0.	0.
40000.000	36201.	16344.	19857.	0.	-26.	104509.	-26.	0.	0.
39000.000	36223.	16366.	19857.	0.	-18.	104491.	-18.	0.	0.
38000.000	36252.	16394.	19857.	0.	-23.	104468.	-23.	0.	0.
37000.000	36287.	16430.	19857.	0.	-28.	104440.	-28.	0.	0.
36000.000	36285.	16427.	19857.	0.	2.	104442.	2.	0.	0.
35000.000	36509.	16652.	19857.	0.	-179.	104263.	-179.	0.	0.
34000.000	27093.	7235.	19857.	0.	7500.	111763.	7500.	0.	0.

COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 18.94 SECONDS

9. MODEL CONFIRMATION



MODEL CONFIRMATION

HEC-6 is a complex and comprehensive tool to model sediment transport. Its complexity results from the requirement that several assumptions be made. To verify that the results of HEC-6 were in fact consistent with the physical conditions being modeled, a simplified confirmation process was undertaken. This process uses a program developed by Dr. Richard French, a renowned expert in the field of alluvial fans and alluvial fan hydraulics.

Dr. French simulated three conditions which were compared with the results of HEC-6. Two conditions using very simplified input parameters were simulated using French's formulation of Yang's equation and HEC-6. The results of these two tests were very similar and confirmed that the algorithms used in HEC-6 are being properly applied.

A third case was simulated using French's formulation of Yang's equation and resulted in wide disparity with the results of HEC-6. Further evaluation identified that French's formulation applied the transport equations developed by Yang outside of the range to which they were originally intended. As a result, French's formulation predicted that significantly greater quantities of fine materials were being transported than were available from upstream sources. The mountainous (limestone) headwaters and the bed materials on the alluvial fan limit the amount of fine materials available for transport. Once again, this supported the use of HEC-6 as it appeared to more reasonably reflect the actual conditions found in the Range Wash basin.

R. H. French, Ph.D., P.E.
Hydraulic/Hydrologic Consulting Engineer
3716 GREENCREST DRIVE
LAS VEGAS, NEVADA 89121
(702) 433-1702 office/fax

MEMORANDUM

January 6, 1992

TO: Mark Glidden

FROM: R.H. French RHF

SUBJECT: Las Vegas Range Wash - Test of HEC-6

VIA FAX: (303)-987-3908

Per our telephone conversation of this afternoon, I am writing to provice you three examples to check the HEC-6 implementation of the Yang equations. The intention is to make the HEC-6 data files trivial and to test the code.

TEST 1: Rectangular channel with

Q = 2228 ft^3/s
y = 1.5 ft (depth of flow)
B = 210 ft (bottom width)
u = 7 ft/s
S = 0.02 ft/ft
nu = 0.0000106 ft^2/s (kinematic viscosity)
Sediment Size = 1.41 mm

My hand calculations for the above data suggest that the equilibrium load is (4205 tons/hr) assuming a specific gravity of 2.65. Within reason, if this load is input into the above defined channel, there should be neither deposition nor erosion. This will test the sand size equation.

TEST 2: Rectangular channel with the above channel geometry but the sediment size is 7.8 mm. For these data, my hand calculations estimate the equilibrium load as 157 tons/hr assuming a specific gravity of 2.65. This will test the gravel size equation. I would note here that one of my concerns is that in earlier USACE programs such as (722-F3-R0-09G) the Yang gravel transport formulation was not implemented; and further, no error message was implemented when sand sizes were specified. This program is still being provided users through vendors.

TEST 3: The size distribution forwarded me by Tom or

Fraction Dia. mm	Geometric Mean mm	Fraction by Weight	Equilibrium Load (T/hr)
0.008-0.016	0.0113	0.030	93442370.
0.016-0.032	0.0226	0.025	2528306.
0.032-0.0625	0.0447	0.020	113806.
0.0625-0.125	0.0884	0.025	13556.
0.125-0.250	0.177	0.025	2423.
0.250-0.500	0.354	0.030	1062.
0.5-1.0	0.707	0.040	796.
1.0-2.0	1.41	0.055	758.
2.0-4.0	2.83	0.080	33.
4.0-8.0	5.66	0.140	93.
8.0-16.	11.3	0.190	209.
16.-32.	22.6	0.175	327.
32.-64.	45.3	0.135	432.

The channel geometry and hydraulic data are as follows:

$Q = 6584\ ft^3/s$
$y = 2.85\ ft$
$u = 14.3\ ft/s$
$S = 0.010\ ft/ft$
$nu = 0.00001059\ ft^2/s$
Trapezoidal channel with b = 150 ft; z = 4

and a specific gravity of 2.65 is assumed.

My computer estimation is that the equilibrium sediment transport is 96,104,180 tons/hr. 2,306,500,320 ton/day I would note that of this load 93,442,370 tons/hour derives from the smallest size fraction. This last test should confirm the performance outside the original sizes for which the Yang equations were developed. This is not to say that the answers are correct only that we are obtaining the same answers.

I would expect that some differences in the load will be noted. This could be due to the implementation within HEC-6 of a code for the fall velocity. However, let us see what happens. I hope that I have provided you and Tom sufficient data to implement these tests. Given my experience with USACE programs these tests are very important.

I'll call you on Wednesday and hopefully see you on Friday.

BOYLE ENGINEERING CORPORATION

Project _____ Description _____

Job No. _____ SHEET 1/2

By _____ Date _____

CASE 1

RECTANGULAR CHANNEL: Q = 2228 cfs

Y = 1.5 ft

B = 210 ft

V = 7 ft/s

S = .02 ft/ft

n = .035

500 um dia = 1.41 mm

SG = 2.65

EQUILIBRIUM LOAD

FRENCH	100,920	tons/day
(CASE1.DAT) HEC-6	90,020	tons/day

CASE 2

SAME AS ABOVE WITH SEDIMENT SIZE = 7.8 mm

EQUILIBRIUM LOAD

FRENCH	3768	tons/day
(CASE2.DAT) HEC-6	4402	tons/day

CASE 3

TRAPEZOIDAL CHANNEL: Q = 6500 cfs

Y = 2.85 ft

V = 10.3 ft/s

S = .01 ft/ft

n = .035

B = 150'

Z = 4

S.G. = 2.65

sediment size dia = [illegible] mm

EQUILIBRIUM LOAD

FRENCH	2,306,500,320	tons/day	
HEC-6	2,644,005	tons/day	(RCH150.DAT) } 150' @ .1%
HEC-6	2,536,026	tons/day	(RCH100.DAT) } 100' @ .5%

BOYLE ENGINEERING CORPORATION

Project [illegible] Description CONT

Job No. [illegible] HFC-6

By TJC Date [illegible]

SHEET 2/2

PARTICLE SIZE (mm)	SZ MATER. FRACTION	FRENCH EQUILIBRIUM LOAD (TON/DAY)	HFC-6 EQUILIBRIUM LOAD (TON/DAY)	SED LOAD FRAC-N FRENCH	SED LOAD FRAC-N HFC-6
.008 - .016	.030	2,242,616,880	—	.972	0
.016 - .032	.025	60,679,344	71,340	.026	.027
.032 - .0625	.020	2,731,344	1,831,069	.001	.672
.0625 - .125	.025	325,344	93,321	.0001	.035
.125 - .250	.025	58,152	87,012		.033
.250 - .500	.030	25,488	156,957		.059
.5 — 1.0	.040	19,104	102,608		.039
1.0 - 2.0	.055	18,192	95,817		.036
2.0 - 4.0	.080	792	6,273		.002
4.0 - 8.0	.140	2232	18,422		.007
8.0 - 16	.190	5016	41,360		.016
16 - 32	.175	7848	63,112		.024
32 - 64	.135	10,368	76,712	0	.029

French
Test Case 1

```
*************************************************      ***********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS   *
*       Version: 4.0.6  -  June 1991              *     *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  CASE1.DAT                         *     *  609 SECOND STREET              *
*  OUTPUT FILE: CASE1.OUT                         *     *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 24JAN92       RUN TIME: 11:05:33     *     *  (916) 756-1104                 *
*************************************************      ***********************************

                    X     X  XXXXXXX   XXXXX           XXXXX
                    X     X  X        X     X         X     X
                    X     X  X        X               X
                    XXXXXXX  XXXX     X        XXXXX  XXXXXX
                    X     X  X        X               X     X
                    X     X  X        X     X         X     X
                    X     X  XXXXXXX . XXXXX           XXXXX

          ***************************************************************************
          *  MAXIMUM LIMITS FOR THIS VERSION ARE:                                   *
          *       10  Stream Segments (Main Stem + Tributaries)                     *
          *      150  Cross Sections                                                *
          *      100  Elevation/Station Points per Cross Section                    *
          *       15  Grain Sizes                                                   *
          *       10  Control Points                                                *
          ***************************************************************************


T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION     ON N07 300 10
T3       1/07/92  CASE 1 TEST RUN, SINGLE FLOW, CASE1.DAT

NC  .0390   .0390   .0390   .1000   .3000

SECTION NO.  1 RIVER MILE=   7000.000

SECTION NO.  2 RIVER MILE=   7500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=   8000.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=   8500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=   9000.000
...Add    10.00 (ft) to each Elevation(Y)

 TION NO.  6 RIVER MILE=   9500.000
   dd     10.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  10000.000
...Add    10.00 (ft) to each Elevation(Y)
```

SECTION NO. 8 RIVER MILE= 10500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 9 RIVER MILE= 11000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 10 RIVER MILE= 11500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 12000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 12500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 13000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 13500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 14000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 14500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 15000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 15500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 16000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 16500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 17000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 17500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 18000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 18500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 19000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 19500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 20000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 20500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 29 RIVER MILE= 21000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 30 RIVER MILE= 21500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 31 RIVER MILE= 22000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 32 RIVER MILE= 22500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 33 RIVER MILE= 23000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 34 RIVER MILE= 23500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 35 RIVER MILE= 24000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 36 RIVER MILE= 24500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 37 RIVER MILE= 25000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 38 RIVER MILE= 25500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 39 RIVER MILE= 26000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 40 RIVER MILE= 26500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 41 RIVER MILE= 27000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 42 RIVER MILE= 27500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 43 RIVER MILE= 28000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 44 RIVER MILE= 28500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 45 RIVER MILE= 29000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 46 RIVER MILE= 29500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 47 RIVER MILE= 30000.000
...Add 10.00 (ft) to each Elevation(Y)

```
SECTION NO. 48 RIVER MILE=  30500.000
...Add    10.00 (ft) to each Elevation(Y)

 CTION NO. 49 RIVER MILE=  31000.000
   dd    10.00 (ft) to each Elevation(Y)

SECTION NO. 50 RIVER MILE=  31500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 51 RIVER MILE=  32000.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 52 RIVER MILE=  32500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 53 RIVER MILE=  33000.000
...Add    10.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 53
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  53
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

================================================================================

T4
T5  RANGE WASH DIVERSION DIKE       LAS VEGAS, NEVADA
    BOYLE ENGINEERING CORPORATION   DN N07 300 10

T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION     DN N07 300 10
 1/07/92  CASE 1 TEST RUN, SINGLE FLOW, CASE1.DAT

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

      SPI     IBG    MNQ      SPGF      ACGR     NFALL    IBSNER
I1    10.       3      1     1.000    32.174         2         1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

      MTC     IASA    LASA      SPGS       GSF      BSAE       PSI     UWDLB
I4      4        5       5     2.650      .667      .500    30.000    93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

FOLLOWING GRAIN SIZES UTILIZED (MM)
SAND:    1.4140

   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   1
 LOAD BY GRAIN SIZE CLASS (tons/day)
```

```
L   TEST | 2228.00    |
L     CS | 150000.    |
         ------------
    OTAL | 150000.    |
```

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION ID. NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
7000.000		210.00	244.91	234.91	244.91	.00	.00
	500.00						
7500.000		210.00	254.91	244.91	254.91	500.00	.09
	500.00						
8000.000		210.00	264.91	254.91	264.91	1000.00	.19
	500.00						
8500.000		210.00	274.91	264.91	274.91	1500.00	.28
	500.00						
9000.000		210.00	284.91	274.91	284.91	2000.00	.38
	500.00						
9500.000		210.00	294.91	284.91	294.91	2500.00	.47
	500.00						
10000.000		210.00	304.91	294.91	304.91	3000.00	.57
	500.00						
10500.000		210.00	314.91	304.91	314.91	3500.00	.66
	500.00						
'0.000		210.00	324.91	314.91	324.91	4000.00	.76
	500.00						
11500.000		210.00	334.91	324.91	334.91	4500.00	.85
	500.00						
12000.000		210.00	344.91	334.91	344.91	5000.00	.95
	500.00						
12500.000		210.00	354.91	344.91	354.91	5500.00	1.04
	500.00						
13000.000		210.00	364.91	354.91	364.91	6000.00	1.14
	500.00						
13500.000		210.00	374.91	364.91	374.91	6500.00	1.23
	500.00						
14000.000		210.00	384.91	374.91	384.91	7000.00	1.33
	500.00						
14500.000		210.00	394.91	384.91	394.91	7500.00	1.42
	500.00						
15000.000		210.00	404.91	394.91	404.91	8000.00	1.52
	500.00						
15500.000		210.00	414.91	404.91	414.91	8500.00	1.61
	500.00						
16000.000		210.00	424.91	414.91	424.91	9000.00	1.70
	500.00						
16500.000		210.00	434.91	424.91	434.91	9500.00	1.80
	500.00						
17000.000		210.00	444.91	434.91	444.91	10000.00	1.89
	500.00						
0.000		210.00	454.91	444.91	454.91	10500.00	1.99
	500.00						
18000.000		210.00	464.91	454.91	464.91	11000.00	2.08
	500.00						
18500.000		210.00	474.91	464.91	474.91	11500.00	2.18

	500.00					
19000.000		210.00	484.91	474.91	484.91	12000.00	2.27
	500.00					
[illegible]500.000		210.00	494.91	484.91	494.91	12500.00	2.37
	500.00					
[illegible]000.000		210.00	504.91	494.91	504.91	13000.00	2.46
	500.00					
20500.000		210.00	514.91	504.91	514.91	13500.00	2.56
	500.00					
21000.000		210.00	524.91	514.91	524.91	14000.00	2.65
	500.00					
21500.000		210.00	534.91	524.91	534.91	14500.00	2.75
	500.00					
22000.000		210.00	544.91	534.91	544.91	15000.00	2.84
	500.00					
22500.000		210.00	554.91	544.91	554.91	15500.00	2.94
	500.00					
23000.000		210.00	564.91	554.91	564.91	16000.00	3.03
	500.00					
23500.000		210.00	574.91	564.91	574.91	16500.00	3.13
	500.00					
24000.000		210.00	584.91	574.91	584.91	17000.00	3.22
	500.00					
24500.000		210.00	594.91	584.91	594.91	17500.00	3.31
	500.00					
25000.000		210.00	604.91	594.91	604.91	18000.00	3.41
	500.00					
25500.000		210.00	614.91	604.91	614.91	18500.00	3.50
	500.00					
[illegible]0.000		210.00	624.91	614.91	624.91	19000.00	3.60
	500.00					
26500.000		210.00	634.91	624.91	634.91	19500.00	3.69
	500.00					
27000.000		210.00	644.91	634.91	644.91	20000.00	3.79
	500.00					
27500.000		210.00	654.91	644.91	654.91	20500.00	3.88
	500.00					
28000.000		210.00	664.91	654.91	664.91	21000.00	3.98
	500.00					
28500.000		210.00	674.91	664.91	674.91	21500.00	4.07
	500.00					
29000.000		210.00	684.91	674.91	684.91	22000.00	4.17
	500.00					
29500.000		210.00	694.91	684.91	694.91	22500.00	4.26
	500.00					
30000.000		210.00	704.91	694.91	704.91	23000.00	4.36
	500.00					
30500.000		210.00	714.91	704.91	714.91	23500.00	4.45
	500.00					
31000.000		210.00	724.91	714.91	724.91	24000.00	4.55
	500.00					
31500.000		210.00	734.91	724.91	734.91	24500.00	4.64
	500.00					
32000.000		210.00	744.91	734.91	744.91	25000.00	4.73
	500.00					
[illegible].000		210.00	754.91	744.91	754.91	25500.00	4.83
	500.00					
33000.000		210.00	764.91	754.91	764.91	26000.00	4.92

BED MATERIAL GRADATION (as computed from PF-records)

	SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.
N	7000.000	1.000	.005	.005	1.000	1.000	1.000
N	00.000	1.000	.005	.005	1.000	1.000	1.000
N	8000.000	1.000	.005	.005	1.000	1.000	1.000
N	8500.000	1.000	.005	.005	1.000	1.000	1.000
N	9000.000	1.000	.005	.005	1.000	1.000	1.000
N	9500.000	1.000	.005	.005	1.000	1.000	1.000
N	********

SECTION NUMBER	LENGTH (ft)	MAX. WIDTH (ft)	DEPTH (ft)	VOLUME (cu.ft)	VOLUME (cu.yd)
7000.000	250.00	210.00	10.00	525000.	19444.4
500.000	500.00	210.00	10.00	.105000E+07	38888.9
8000.000	500.00	210.00	10.00	.105000E+07	38888.9
8500.000	500.00	210.00	10.00	.105000E+07	38888.9
9000.000	500.00	210.00	10.00	.105000E+07	38888.9
9500.000	500.00	210.00	10.00	.105000E+07	38888.9
10000.000	500.00	210.00	10.00	.105000E+07	38888.9
10500.000	500.00	210.00	10.00	.105000E+07	38888.9
11000.000	500.00	210.00	10.00	.105000E+07	38888.9
11500.000	500.00	210.00	10.00	.105000E+07	38888.9
12000.000	500.00	210.00	10.00	.105000E+07	38888.9
12500.000	500.00	210.00	10.00	.105000E+07	38888.9
13000.000	500.00	210.00	10.00	.105000E+07	38888.9
13500.000	500.00	210.00	10.00	.105000E+07	38888.9
14000.000	500.00	210.00	10.00	.105000E+07	38888.9
14500.000	500.00	210.00	10.00	.105000E+07	38888.9
15000.000	500.00	210.00	10.00	.105000E+07	38888.9
15500.000	500.00	210.00	10.00	.105000E+07	38888.9
16000.000	500.00	210.00	10.00	.105000E+07	38888.9
16500.000	500.00	210.00	10.00	.105000E+07	38888.9
17000.000	500.00	210.00	10.00	.105000E+07	38888.9
17500.000	500.00	210.00	10.00	.105000E+07	38888.9
18000.000	500.00	210.00	10.00	.105000E+07	38888.9
18500.000	500.00	210.00	10.00	.105000E+07	38888.9
19000.000	500.00	210.00	10.00	.105000E+07	38888.9
19500.000	500.00	210.00	10.00	.105000E+07	38888.9
000.000	500.00	210.00	10.00	.105000E+07	38888.9
500.000	500.00	210.00	10.00	.105000E+07	38888.9
21000.000	500.00	210.00	10.00	.105000E+07	38888.9
21500.000	500.00	210.00	10.00	.105000E+07	38888.9
22000.000	500.00	210.00	10.00	.105000E+07	38888.9
22500.000	500.00	210.00	10.00	.105000E+07	38888.9
23000.000	500.00	210.00	10.00	.105000E+07	38888.9
23500.000	500.00	210.00	10.00	.105000E+07	38888.9
24000.000	500.00	210.00	10.00	.105000E+07	38888.9
24500.000	500.00	210.00	10.00	.105000E+07	38888.9
25000.000	500.00	210.00	10.00	.105000E+07	38888.9
25500.000	500.00	210.00	10.00	.105000E+07	38888.9
26000.000	500.00	210.00	10.00	.105000E+07	38888.9
26500.000	500.00	210.00	10.00	.105000E+07	38888.9
27000.000	500.00	210.00	10.00	.105000E+07	38888.9
27500.000	500.00	210.00	10.00	.105000E+07	38888.9
28000.000	500.00	210.00	10.00	.105000E+07	38888.9
28500.000	500.00	210.00	10.00	.105000E+07	38888.9
29000.000	500.00	210.00	10.00	.105000E+07	38888.9
29500.000	500.00	210.00	10.00	.105000E+07	38888.9
30000.000	500.00	210.00	10.00	.105000E+07	38888.9
30500.000	500.00	210.00	10.00	.105000E+07	38888.9
31000.000	500.00	210.00	10.00	.105000E+07	38888.9
31500.000	500.00	210.00	10.00	.105000E+07	38888.9
32000.000	500.00	210.00	10.00	.105000E+07	38888.9
32500.000	500.00	210.00	10.00	.105000E+07	38888.9
33000.000	250.00	210.00	10.00	525000.	19444.4

NO. OF INPUT DATA MESSAGES= 0

END OF SEDIMENT DATA

```
================================================================================

BEGIN COMPUTATIONS.
 'YD

--------------------------------------------------------------------------------

$PRT
...PRINT AT SELECTED CROSS SECTIONS ONLY
CP              1
PN              5
END

================================================================================

*       FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

*       FLOW 2
*       FLOW 3
*       FLOW 4
*       FLOW 5
*       FLOW 6
*       FLOW 7
*       FLOW 8

================================================================================

*    8  FLOW 9

  .DARY CONDITION DATA, CONTROL POINT NO.  1
  TIME STEP NO.      9
WATER    DISCHARGE=    2228.00
         ELEVATION=    236.400
       TEMPERATURE=     70.000
FLOW DURATION(DAYS)  .1040E-01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**********************************************************
                    *                                    *
    TIME       ENTRY *             SAND                   *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF      *
                    *                                    *
     .09   33000.000 *      7.70                          *   O
   TOTAL=   7000.000 *      7.70      4.18       .46      *
                    *                                    *
**********************************************************

TABLE SB-1.            TOTAL              LOAD BY GRAIN SIZE (TONS/DAY)
                                    VF          F          M          C          VC
SEDIMENT INFLOW
 SANDS & GRAVELS    150000.00   150000.00
 'MENT OUTFLOW
  )S & GRAVELS      90206.02    90206.02


  SECTION   BED CHANGE   WS ELEV   THALWEG       Q        SEDIMENT LOAD (TONS/DAY)
   ID NO       FEET       FEET    EL FEET       CFS       SAND
```

33000.000	2.00	758.30	756.91	2228.	104615.
32500.000	.09	746.47	745.00	2228.	97615.
32000.000	.06	736.50	734.97	2228.	90450.
31500.000	.00	726.50	724.91	2228.	90638.
31000.000	-.01	716.37	714.90	2228.	91516.
30500.000	.01	706.41	704.92	2228.	88612.
30000.000	.00	696.41	694.91	2228.	91036.
29500.000	.00	686.49	684.91	2228.	90417.
29000.000	-.01	676.45	674.90	2228.	89983.
28500.000	.01	666.49	664.92	2228.	90004.
28000.000	.01	656.48	654.92	2228.	90136.
27500.000	-.01	646.47	644.90	2228.	90059.
27000.000	-.01	636.48	634.90	2228.	89898.
26500.000	.01	626.50	624.92	2228.	90064.
26000.000	.00	616.47	614.91	2228.	89961.
25500.000	.00	606.50	604.91	2228.	90386.
25000.000	.01	596.46	594.92	2228.	87035.
24500.000	-.01	586.36	584.90	2228.	93184.
24000.000	.01	576.48	574.92	2228.	90284.
23500.000	-.01	566.47	564.90	2228.	90392.
23000.000	.01	556.47	554.92	2228.	87055.
22500.000	.00	546.44	544.91	2228.	92687.
22000.000	-.01	536.44	534.90	2228.	90277.
21500.000	.00	526.49	524.91	2228.	90012.
21000.000	.00	516.47	514.91	2228.	90397.
20500.000	.01	506.44	504.92	2228.	88997.
20000.000	-.01	496.42	494.90	2228.	91092.
19500.000	.00	486.42	484.91	2228.	89327.
19000.000	.01	476.37	474.92	2228.	91084.
18500.000	-.01	466.40	464.90	2228.	88969.
18000.000	.00	456.41	454.91	2228.	90733.
17500.000	.01	446.45	444.92	2228.	87850.
17000.000	-.01	436.38	434.90	2228.	92312.
16500.000	.01	426.46	424.92	2228.	90232.
16000.000	-.01	416.48	414.90	2228.	89888.
15500.000	.00	406.50	404.91	2228.	89826.
15000.000	.01	396.51	394.92	2228.	89949.
14500.000	-.01	386.49	384.90	2228.	89915.
14000.000	.00	376.49	374.91	2228.	90413.
13500.000	.00	366.46	364.91	2228.	87547.
13000.000	-.01	356.33	354.90	2228.	93017.
12500.000	.00	346.47	344.91	2228.	89937.
12000.000	.01	336.51	334.92	2228.	89968.
11500.000	.00	326.48	324.91	2228.	90179.
11000.000	-.01	316.46	314.90	2228.	89904.
10500.000	.02	306.50	304.93	2228.	90162.
10000.000	-.01	296.45	294.90	2228.	90491.
9500.000	.00	286.43	284.91	2228.	88754.
9000.000	.01	276.42	274.92	2228.	91152.
8500.000	-.02	266.48	264.89	2228.	90104.
8000.000	.00	256.50	254.91	2228.	90290.
7500.000	.01	246.42	244.92	2228.	90200.
7000.000	-.02	236.40	234.89	2228.	90206.

==========

* C FLOW 10

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 10

WATER DISCHARGE= 2228.00
ELEVATION= 236.400
TEMPERATURE= 70.000
FLOW DURATION(DAYS) .1040E-01

- - - -

French
Test Case 2

```
**************************************************      ************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *      *  U.S. ARMY CORPS OF ENGINEERS    *
*       Version: 4.0.6  -  June 1991              *      *  HYDROLOGIC ENGINEERING CENTER   *
*  INPUT FILE:  CASE2.DAT                         *      *  609 SECOND STREET               *
   JTPUT FILE: CASE2.OUT                          *      *  DAVIS, CALIFORNIA 95616-4687    *
   RUN DATE: 24JAN92      RUN TIME: 11:11:55      *      *  (916) 756-1104                  *
**************************************************      ************************************

                    X     X  XXXXXXX   XXXXX           XXXXX
                    X     X  X        X     X         X     X
                    X     X  X        X               X
                    XXXXXXX  XXXX     X        XXXXX  XXXXXX
                    X     X  X        X               X     X
                    X     X  X        X     X         X     X
                    X     X  XXXXXXX   XXXXX           XXXXX

        **********************************************************************
        *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
        *       10  Stream Segments (Main Stem + Tributaries)                *
        *      150  Cross Sections                                           *
        *      100  Elevation/Station Points per Cross Section               *
        *       15  Grain Sizes                                              *
        *       10  Control Points                                           *
        **********************************************************************


T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
         1/07/92  CASE 1 TEST RUN, SINGLE FLOW, CASE1.DAT

NC  .0390   .0390   .0390   .1000   .3000

SECTION NO.  1 RIVER MILE=   7000.000

SECTION NO.  2 RIVER MILE=   7500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=   8000.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=   8500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=   9000.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=   9500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  10000.000
...Add    10.00 (ft) to each Elevation(Y)

 TION NO.  8 RIVER MILE=  10500.000
  dd    10.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  11000.000
...Add    10.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 11500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 12000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 12500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 13000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 13500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 14000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 14500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 15000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 15500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 16000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 16500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 17000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 17500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 18000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 18500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 19000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 19500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 20000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 20500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 29 RIVER MILE= 21000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 30 RIVER MILE= 21500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 31 RIVER MILE= 22000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 32 RIVER MILE= 22500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 33 RIVER MILE= 23000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 34 RIVER MILE= 23500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 35 RIVER MILE= 24000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 36 RIVER MILE= 24500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 37 RIVER MILE= 25000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 38 RIVER MILE= 25500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 39 RIVER MILE= 26000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 40 RIVER MILE= 26500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 41 RIVER MILE= 27000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 42 RIVER MILE= 27500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 43 RIVER MILE= 28000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 44 RIVER MILE= 28500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 45 RIVER MILE= 29000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 46 RIVER MILE= 29500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 47 RIVER MILE= 30000.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 48 RIVER MILE= 30500.000
...Add 10.00 (ft) to each Elevation(Y)

SECTION NO. 49 RIVER MILE= 31000.000
...Add 10.00 (ft) to each Elevation(Y)

```
SECTION NO. 50 RIVER MILE=  31500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 51 RIVER MILE=  32000.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 52 RIVER MILE=  32500.000
...Add    10.00 (ft) to each Elevation(Y)

SECTION NO. 53 RIVER MILE=  33000.000
...Add    10.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 53
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  53
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

================================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    ON N07 30O 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      ON N07 30O 10
 1/07/92  CASE 1 TEST RUN, SINGLE FLOW, CASE1.DAT

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ       SPGF       ACGR      NFALL     IBSHER
I1     10.        3       1      1.000     32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS        GSF       BSAE        PSI      UWDLB
I4       4         7        8     2.650       .667       .500     30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

FOLLOWING GRAIN SIZES UTILIZED (MM)
SAND:    5.6570   11.3140

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


SEDIMENT LOAD TABLE FOR STREAM SEGMENT #   1
 LOAD BY GRAIN SIZE CLASS (tons/day)
    -------------------------------
     EST | 2228.00     |
L     FG | 97500.0     |
L     MG | 52500.0     |
         ------------
   TOTAL | 150000.     |
```

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION ID. NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
7000.000		210.00	244.91	234.91	244.91	.00	.00
	500.00						
7500.000		210.00	254.91	244.91	254.91	500.00	.09
	500.00						
8000.000		210.00	264.91	254.91	264.91	1000.00	.19
	500.00						
8500.000		210.00	274.91	264.91	274.91	1500.00	.28
	500.00						
9000.000		210.00	284.91	274.91	284.91	2000.00	.38
	500.00						
9500.000		210.00	294.91	284.91	294.91	2500.00	.47
	500.00						
10000.000		210.00	304.91	294.91	304.91	3000.00	.57
	500.00						
10500.000		210.00	314.91	304.91	314.91	3500.00	.66
	500.00						
11000.000		210.00	324.91	314.91	324.91	4000.00	.76
	500.00						
11500.000		210.00	334.91	324.91	334.91	4500.00	.85
	500.00						
12000.000		210.00	344.91	334.91	344.91	5000.00	.95
	500.00						
12500.000		210.00	354.91	344.91	354.91	5500.00	1.04
	500.00						
13000.000		210.00	364.91	354.91	364.91	6000.00	1.14
	500.00						
13500.000		210.00	374.91	364.91	374.91	6500.00	1.23
	500.00						
14000.000		210.00	384.91	374.91	384.91	7000.00	1.33
	500.00						
14500.000		210.00	394.91	384.91	394.91	7500.00	1.42
	500.00						
15000.000		210.00	404.91	394.91	404.91	8000.00	1.52
	500.00						
15500.000		210.00	414.91	404.91	414.91	8500.00	1.61
	500.00						
16000.000		210.00	424.91	414.91	424.91	9000.00	1.70
	500.00						
16500.000		210.00	434.91	424.91	434.91	9500.00	1.80
	500.00						
17000.000		210.00	444.91	434.91	444.91	10000.00	1.89
	500.00						
17500.000		210.00	454.91	444.91	454.91	10500.00	1.99
	500.00						
18000.000		210.00	464.91	454.91	464.91	11000.00	2.08
	500.00						
18500.000		210.00	474.91	464.91	474.91	11500.00	2.18
	500.00						
19000.000		210.00	484.91	474.91	484.91	12000.00	2.27
	500.00						
19500.000		210.00	494.91	484.91	494.91	12500.00	2.37
	500.00						

20000.000	500.00	210.00	504.91	494.91	504.91	13000.00	2.46
20500.000	500.00	210.00	514.91	504.91	514.91	13500.00	2.56
0.000	500.00	210.00	524.91	514.91	524.91	14000.00	2.65
21500.000	500.00	210.00	534.91	524.91	534.91	14500.00	2.75
22000.000	500.00	210.00	544.91	534.91	544.91	15000.00	2.84
22500.000	500.00	210.00	554.91	544.91	554.91	15500.00	2.94
23000.000	500.00	210.00	564.91	554.91	564.91	16000.00	3.03
23500.000	500.00	210.00	574.91	564.91	574.91	16500.00	3.13
24000.000	500.00	210.00	584.91	574.91	584.91	17000.00	3.22
24500.000	500.00	210.00	594.91	584.91	594.91	17500.00	3.31
25000.000	500.00	210.00	604.91	594.91	604.91	18000.00	3.41
25500.000	500.00	210.00	614.91	604.91	614.91	18500.00	3.50
26000.000	500.00	210.00	624.91	614.91	624.91	19000.00	3.60
26500.000	500.00	210.00	634.91	624.91	634.91	19500.00	3.69
27000.000	500.00	210.00	644.91	634.91	644.91	20000.00	3.79
0.000	500.00	210.00	654.91	644.91	654.91	20500.00	3.88
28000.000	500.00	210.00	664.91	654.91	664.91	21000.00	3.98
28500.000	500.00	210.00	674.91	664.91	674.91	21500.00	4.07
29000.000	500.00	210.00	684.91	674.91	684.91	22000.00	4.17
29500.000	500.00	210.00	694.91	684.91	694.91	22500.00	4.26
30000.000	500.00	210.00	704.91	694.91	704.91	23000.00	4.36
30500.000	500.00	210.00	714.91	704.91	714.91	23500.00	4.45
31000.000	500.00	210.00	724.91	714.91	724.91	24000.00	4.55
31500.000	500.00	210.00	734.91	724.91	734.91	24500.00	4.64
32000.000	500.00	210.00	744.91	734.91	744.91	25000.00	4.73
32500.000	500.00	210.00	754.91	744.91	754.91	25500.00	4.83
33000.000		210.00	764.91	754.91	764.91	26000.00	4.92

ATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.	
N 7000.000	1.000	.026	.026	1.000	1.000	1.000	.000
N 7500.000	1.000	.026	.026	1.000	1.000	1.000	.000

N	8000.000	1.000	.026	.026	1.000	1.000	1.000	.000
N	8500.000	1.000	.026	.026	1.000	1.000	1.000	.000
N	9000.000	1.000	.026	.026	1.000	1.000	1.000	.000
N	9500.000	1.000	.026	.026	1.000	1.000	1.000	.000
	******	1.000	.026	.026	1.000	1.000	1.000	.000
	*******	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000
N	********	1.000	.026	.026	1.000	1.000	1.000	.000

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SEDIMENT CONTROL VOLUMES

SECTION NUMBER	LENGTH (ft)	MAX. WIDTH (ft)	DEPTH (ft)	VOLUME (cu.ft)	VOLUME (cu.yd)
7000.000	250.00	210.00	10.00	525000.	19444.4
7500.000	500.00	210.00	10.00	.105000E+07	38888.9

8000.000	500.00	210.00	10.00	.105000E+07	38888.9
8500.000	500.00	210.00	10.00	.105000E+07	38888.9
9000.000	500.00	210.00	10.00	.105000E+07	38888.9
9500.000	500.00	210.00	10.00	.105000E+07	38888.9
)00.000	500.00	210.00	10.00	.105000E+07	38888.9
.0500.000	500.00	210.00	10.00	.105000E+07	38888.9
11000.000	500.00	210.00	10.00	.105000E+07	38888.9
11500.000	500.00	210.00	10.00	.105000E+07	38888.9
12000.000	500.00	210.00	10.00	.105000E+07	38888.9
12500.000	500.00	210.00	10.00	.105000E+07	38888.9
13000.000	500.00	210.00	10.00	.105000E+07	38888.9
13500.000	500.00	210.00	10.00	.105000E+07	38888.9
14000.000	500.00	210.00	10.00	.105000E+07	38888.9
14500.000	500.00	210.00	10.00	.105000E+07	38888.9
15000.000	500.00	210.00	10.00	.105000E+07	38888.9
15500.000	500.00	210.00	10.00	.105000E+07	38888.9
16000.000	500.00	210.00	10.00	.105000E+07	38888.9
16500.000	500.00	210.00	10.00	.105000E+07	38888.9
17000.000	500.00	210.00	10.00	.105000E+07	38888.9
17500.000	500.00	210.00	10.00	.105000E+07	38888.9
18000.000	500.00	210.00	10.00	.105000E+07	38888.9
18500.000	500.00	210.00	10.00	.105000E+07	38888.9
19000.000	500.00	210.00	10.00	.105000E+07	38888.9
19500.000	500.00	210.00	10.00	.105000E+07	38888.9
20000.000	500.00	210.00	10.00	.105000E+07	38888.9
20500.000	500.00	210.00	10.00	.105000E+07	38888.9
21000.000	500.00	210.00	10.00	.105000E+07	38888.9
21500.000	500.00	210.00	10.00	.105000E+07	38888.9
22000.000	500.00	210.00	10.00	.105000E+07	38888.9
500.000	500.00	210.00	10.00	.105000E+07	38888.9
000.000	500.00	210.00	10.00	.105000E+07	38888.9
23500.000	500.00	210.00	10.00	.105000E+07	38888.9
24000.000	500.00	210.00	10.00	.105000E+07	38888.9
24500.000	500.00	210.00	10.00	.105000E+07	38888.9
25000.000	500.00	210.00	10.00	.105000E+07	38888.9
25500.000	500.00	210.00	10.00	.105000E+07	38888.9
26000.000	500.00	210.00	10.00	.105000E+07	38888.9
26500.000	500.00	210.00	10.00	.105000E+07	38888.9
27000.000	500.00	210.00	10.00	.105000E+07	38888.9
27500.000	500.00	210.00	10.00	.105000E+07	38888.9
28000.000	500.00	210.00	10.00	.105000E+07	38888.9
28500.000	500.00	210.00	10.00	.105000E+07	38888.9
29000.000	500.00	210.00	10.00	.105000E+07	38888.9
29500.000	500.00	210.00	10.00	.105000E+07	38888.9
30000.000	500.00	210.00	10.00	.105000E+07	38888.9
30500.000	500.00	210.00	10.00	.105000E+07	38888.9
31000.000	500.00	210.00	10.00	.105000E+07	38888.9
31500.000	500.00	210.00	10.00	.105000E+07	38888.9
32000.000	500.00	210.00	10.00	.105000E+07	38888.9
32500.000	500.00	210.00	10.00	.105000E+07	38888.9
33000.000	250.00	210.00	10.00	525000.	19444.4

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

:==========

BEGIN COMPUTATIONS.
$HYD

```
$PRT
   PRINT AT SELECTED CROSS SECTIONS ONLY
                1
                5
END
```

```
*       FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

*       FLOW 2
*       FLOW 3
*       FLOW 4
*       FLOW 5
*       FLOW 6
*       FLOW 7
*       FLOW 8
```

```
*    B  FLOW 9

BOUNDARY CONDITION DATA, CONTROL POINT NO.  1
  TIME STEP NO.      9
WATER    DISCHARGE=    2228.00
         ELEVATION=    236.400
      TEMPERATURE=     70.000
    DURATION(DAYS)  .1040E-01
```

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.09	33000.000	7.70		
TOTAL=	7000.000	7.70	.22	.97

TABLE S8-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

		VF	F	M	C	VC
SEDIMENT INFLOW						
SANDS & GRAVELS	150000.00	97500.00	52500.00			
SEDIMENT OUTFLOW						
SANDS & GRAVELS	4725.89	4725.89	.00			

SECTION 'D NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SAND
)00.000	5.50	761.38	760.41	2228.	7762.
32500.000	.04	746.53	744.95	2228.	4615.
32000.000	.00	736.41	734.91	2228.	4342.
31500.000	-.01	726.39	724.90	2228.	5019.
31000.000	.01	716.47	714.92	2228.	4728.

30500.000	.00	706.49	704.91	2228.	4723.
30000.000	.00	696.49	694.91	2228.	4732.
29500.000	.00	686.48	684.91	2228.	4728.
29000.000	.01	676.48	674.92	2228.	4747.
00.000	-.01	666.46	664.90	2228.	4712.
000.000	.00	656.50	654.91	2228.	4729.
27500.000	.00	646.49	644.91	2228.	4724.
27000.000	.00	636.50	634.91	2228.	4729.
26500.000	.00	626.49	624.91	2228.	4715.
26000.000	.00	616.50	614.91	2228.	4735.
25500.000	.00	606.48	604.91	2228.	4728.
25000.000	.00	596.48	594.91	2228.	4733.
24500.000	.00	586.48	584.91	2228.	4732.
24000.000	.00	576.48	574.91	2228.	4729.
23500.000	.00	566.48	564.91	2228.	4741.
23000.000	.00	556.46	554.91	2228.	4715.
22500.000	.00	546.50	544.91	2228.	4727.
22000.000	.00	536.49	534.91	2228.	4731.
21500.000	.00	526.47	524.91	2228.	4776.
21000.000	.00	516.46	514.91	2228.	3944.
20500.000	.00	506.32	504.91	2228.	5496.
20000.000	.00	496.48	494.91	2228.	4737.
19500.000	.00	486.46	484.91	2228.	4733.
19000.000	.00	476.47	474.91	2228.	4746.
18500.000	-.01	466.46	464.90	2228.	4713.
18000.000	.00	456.50	454.91	2228.	4745.
17500.000	.00	446.47	444.91	2228.	4713.
17000.000	.00	436.50	434.91	2228.	4780.
16500.000	.00	426.46	424.91	2228.	3998.
000.000	.00	416.42	414.91	2228.	5292.
00.000	.00	406.46	404.91	2228.	4722.
15000.000	.00	396.47	394.91	2228.	4718.
14500.000	.00	386.50	384.91	2228.	4778.
14000.000	.00	376.46	374.91	2228.	3901.
13500.000	.00	366.34	364.91	2228.	5521.
13000.000	.00	356.48	354.91	2228.	4720.
12500.000	.00	346.49	344.91	2228.	4777.
12000.000	.00	336.46	334.91	2228.	3957.
11500.000	.00	326.33	324.91	2228.	5460.
11000.000	.00	316.47	314.91	2228.	4767.
10500.000	.00	306.47	304.91	2228.	3921.
10000.000	.00	296.40	294.91	2228.	5427.
9500.000	.00	286.47	284.91	2228.	4729.
9000.000	.00	276.46	274.91	2228.	4734.
8500.000	.00	266.47	264.91	2228.	4729.
8000.000	.00	256.48	254.91	2228.	4765.
7500.000	.01	246.43	244.92	2228.	4511.
7000.000	-.01	236.40	234.90	2228.	4726.

==========

* C FLOW 10

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1

'ME STEP NO. 10

DISCHARGE= 2228.00

ELEVATION= 236.400

TEMPERATURE= 70.000

FLOW DURATION(DAYS) .1040E-01

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
FLOW # (N) = 1
FLOW...Q(N)= 2228.0
STEP DURATION (DAYS)= .0104
CUMULATED TIME (YRS)= .0003
WATER TEMPERATURE (DEG F)= 70.0000
********** FALL VELOCITY BY METHOD 2**********

DIAMETER	VELOCITY	REY. NO.	CD
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SANDS & GRAVELS	150000.00	97500.00	52500.00			

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
6.955	.020002	1.53	209.82	.0390	1.90709	.99123	.992

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	104949.50	104949.50	.00

CUMULATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	1.000000	.000000
BED MATERIAL BY PERCENT FINER/100	1.000000	1.000000

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT= .05885
MIN.GRAIN DIAM = .025485
BED SURFACE EXPOSED = 1.00000

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.000000	.00	.000000	.00
SAND	1.000000	9.93	1.000000	.08
TOTAL	1.000000	9.93	1.000000	.08

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046500	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 362.3
DEPTH OF NEW ACTIVE LAYER (ft) DSE= 1.4239
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL= 6948.8
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 366.4
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 48439.2

BED MATERIAL BY GRAIN SIZE FRACTION	1.000000	.000000
BED MATERIAL BY PERCENT FINER/100	1.000000	1.000000

** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION 1.000000 .000000
BED MATERIAL BY PERCENT FINER/100 1.000000 1.000000

NES, COEF(CFFML), MX POTENTIAL= .000000E+00 .100000E+01 .481248E+07

POTENTIAL TRANSPORT BY SIZE CLASS= .440239E+04 .596750E+04

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SANDS & GRAVELS	4402.39	4402.39	.00			

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.10	33000.000	8.47		
TOTAL=	7000.000	8.47	.25	.97

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SANDS & GRAVELS	150000.00	97500.00	52500.00			
MENT OUTFLOW						
DS & GRAVELS	4716.44	4716.44	.00			

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SAND
33000.000	6.11	761.99	761.02	2228.	8022.
32500.000	.04	746.50	744.95	2228.	4537.
32000.000	.00	736.46	734.91	2228.	4837.
31500.000	-.01	726.49	724.90	2228.	4739.
31000.000	.01	716.51	714.92	2228.	4736.
30500.000	.00	706.49	704.91	2228.	4738.
30000.000	.00	696.47	694.91	2228.	4720.
29500.000	.00	686.50	684.91	2228.	4719.
29000.000	.01	676.50	674.92	2228.	4750.
28500.000	-.01	666.46	664.90	2228.	4717.
28000.000	.00	656.49	654.91	2228.	4728.
27500.000	.00	646.49	644.91	2228.	4742.
27000.000	.00	636.46	634.91	2228.	4731.
26500.000	.00	626.48	624.91	2228.	4723.
26000.000	.00	616.49	614.91	2228.	4746.
25500.000	.00	606.46	604.91	2228.	4730.
25000.000	.00	596.47	594.91	2228.	4730.
24500.000	.00	586.48	584.91	2228.	4723.
24000.000	.00	576.49	574.91	2228.	4726.
23500.000	.00	566.49	564.91	2228.	4772.
23000.000	.00	556.46	554.91	2228.	4086.
22500.000	.00	546.38	544.91	2228.	5246.
22000.000	.00	536.46	534.91	2228.	4761.
21500.000	.00	526.44	524.91	2228.	4364.
21000.000	.00	516.40	514.91	2228.	4906.

20500.000	.00	506.47	504.91	2228.	4725.
20000.000	.00	496.48	494.91	2228.	4722.
19500.000	.00	486.49	484.91	2228.	4769.
19000.000	.01	476.47	474.92	2228.	4044.
18500.000	-.01	466.40	464.90	2228.	5284.
18000.000	.00	456.47	454.91	2228.	4764.
17500.000	.00	446.43	444.91	2228.	4414.
17000.000	.00	436.37	434.91	2228.	4890.
16500.000	.00	426.43	424.91	2228.	4352.
16000.000	.00	416.40	414.91	2228.	4917.
15500.000	.00	406.46	404.91	2228.	4712.
15000.000	.00	396.50	394.91	2228.	4771.
14500.000	.00	386.46	384.91	2228.	4144.
14000.000	-.01	376.38	374.90	2228.	5189.
13500.000	.00	366.46	364.91	2228.	4710.
13000.000	.00	356.50	354.91	2228.	4771.
12500.000	.00	346.46	344.91	2228.	4096.
12000.000	.00	336.40	334.91	2228.	4906.
11500.000	.00	326.49	324.91	2228.	4715.
11000.000	.00	316.49	314.91	2228.	4770.
10500.000	.01	306.47	304.92	2228.	3926.
10000.000	-.01	296.33	294.90	2228.	5519.
9500.000	.00	286.48	284.91	2228.	4763.
9000.000	.00	276.44	274.91	2228.	4402.
8500.000	.00	266.42	264.91	2228.	4610.
8000.000	.00	256.39	254.91	2228.	4689.
7500.000	.01	246.43	244.92	2228.	4529.
7000.000	-.01	236.40	234.90	2228.	4716.

ULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
231.7120				

.....

$SEND

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 10
TOTAL NO. OF WS PROFILES = 10
ITERATIONS IN EXNER EQ = 5300.
END OF JOB

JOB COMPLETED
RUN TIME = 0 HOURS, 2 MINUTES & 14.07 SECONDS

```
     WEIGHT IN OLD ACTIVE LAYER(tons)   WAL=          99.1
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=       48756.2
BED MATERIAL BY GRAIN SIZE FRACTION     1.000000
BED MATERIAL BY PERCENT FINER/100       1.000000
   CTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION     1.000000
BED MATERIAL BY PERCENT FINER/100       1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .000000E+00 .100000E+01 .481248E+07

POTENTIAL TRANSPORT BY SIZE CLASS=  .900198E+05
                        TOTAL              LOAD BY GRAIN SIZE (TONS/DAY)
                                       VF          F          M          C          VC
CALCULATED SEDIMENT LOAD, TONS/DAY
 SANDS & GRAVELS      90019.80    90019.80

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT #  1
            RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
            ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT
**************************************************
                    *                              *
    TIME       ENTRY *             SAND             *
    DAYS       POINT *    INFLOW   OUTFLOW  TRAP EFF *
                    *                              *
     .10   33000.000 *      8.47                    *
   TOTAL=   7000.000 *      8.47      4.64       .45 *
                    *                              *
**************************************************

   E SB-1.              TOTAL              LOAD BY GRAIN SIZE (TONS/DAY)
                                       VF          F          M          C          VC
SEDIMENT INFLOW
 SANDS & GRAVELS     150000.00   150000.00
SEDIMENT OUTFLOW
 SANDS & GRAVELS      90201.18    90201.18


  SECTION   BED CHANGE   WS ELEV   THALWEG        Q        SEDIMENT LOAD (TONS/DAY)
   ID NO        FEET       FEET   EL FEET       CFS        SAND
  33000.000      2.19     758.50    757.10      2228.     105589.
  32500.000       .11     746.57    745.02      2228.      95528.
  32000.000       .07     736.52    734.98      2228.      90374.
  31500.000       .00     726.50    724.91      2228.      90335.
  31000.000      -.01     716.45    714.90      2228.      90394.
  30500.000       .01     706.47    704.92      2228.      87520.
  30000.000      -.01     696.38    694.90      2228.      92709.
  29500.000       .00     686.46    684.91      2228.      90371.
  29000.000      -.01     676.45    674.90      2228.      90085.
  28500.000       .01     666.47    664.92      2228.      90421.
  28000.000       .01     656.46    654.92      2228.      87943.
  27500.000      -.01     646.43    644.90      2228.      92094.
  27000.000       .00     636.39    634.91      2228.      88787.
  26500.000       .00     626.37    624.91      2228.      91250.
  26000.000       .01     616.44    614.92      2228.      88556.
   500.000      -.01     606.40    604.90      2228.      91423.
   000.000       .01     596.41    594.92      2228.      91171.
  24500.000      -.01     586.49    584.90      2228.      90007.
  24000.000       .01     576.51    574.92      2228.      90146.
  23500.000      -.01     566.45    564.90      2228.      90118.
  23000.000       .01     556.48    554.92      2228.      90027.
```

22500.000	.00	546.49	544.91	2228.	90515.
22000.000	-.01	536.45	534.90	2228.	86920.
21500.000	-.01	526.38	524.90	2228.	93137.
21000.000	.00	516.47	514.91	2228.	90560.
500.000	.01	506.44	504.92	2228.	89426.
20000.000	-.01	496.36	494.90	2228.	91116.
19500.000	.00	486.44	484.91	2228.	88632.
19000.000	.00	476.41	474.91	2228.	91279.
18500.000	-.01	466.46	464.90	2228.	90324.
18000.000	.00	456.46	454.91	2228.	90153.
17500.000	.01	446.47	444.92	2228.	90160.
17000.000	-.01	436.47	434.90	2228.	90079.
16500.000	.01	426.47	424.92	2228.	90098.
16000.000	-.01	416.48	414.90	2228.	89982.
15500.000	.00	406.49	404.91	2228.	89885.
15000.000	.01	396.50	394.92	2228.	90024.
14500.000	-.01	386.48	384.90	2228.	90355.
14000.000	.01	376.47	374.92	2228.	87477.
13500.000	-.01	366.40	364.90	2228.	91180.
13000.000	-.01	356.47	354.90	2228.	90252.
12500.000	.00	346.47	344.91	2228.	90016.
12000.000	.01	336.49	334.92	2228.	90020.
11500.000	.00	326.49	324.91	2228.	90173.
11000.000	-.01	316.46	314.90	2228.	90066.
10500.000	.02	306.48	304.93	2228.	90142.
10000.000	-.01	296.47	294.90	2228.	90111.
9500.000	.00	286.47	284.91	2228.	89879.
9000.000	.01	276.51	274.92	2228.	90020.
8500.000	-.01	266.48	264.90	2228.	89895.
000.000	.00	256.49	254.91	2228.	90298.
/500.000	.01	246.42	244.92	2228.	90201.
7000.000	-.02	236.40	234.89	2228.	90201.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
231.7120				

.....

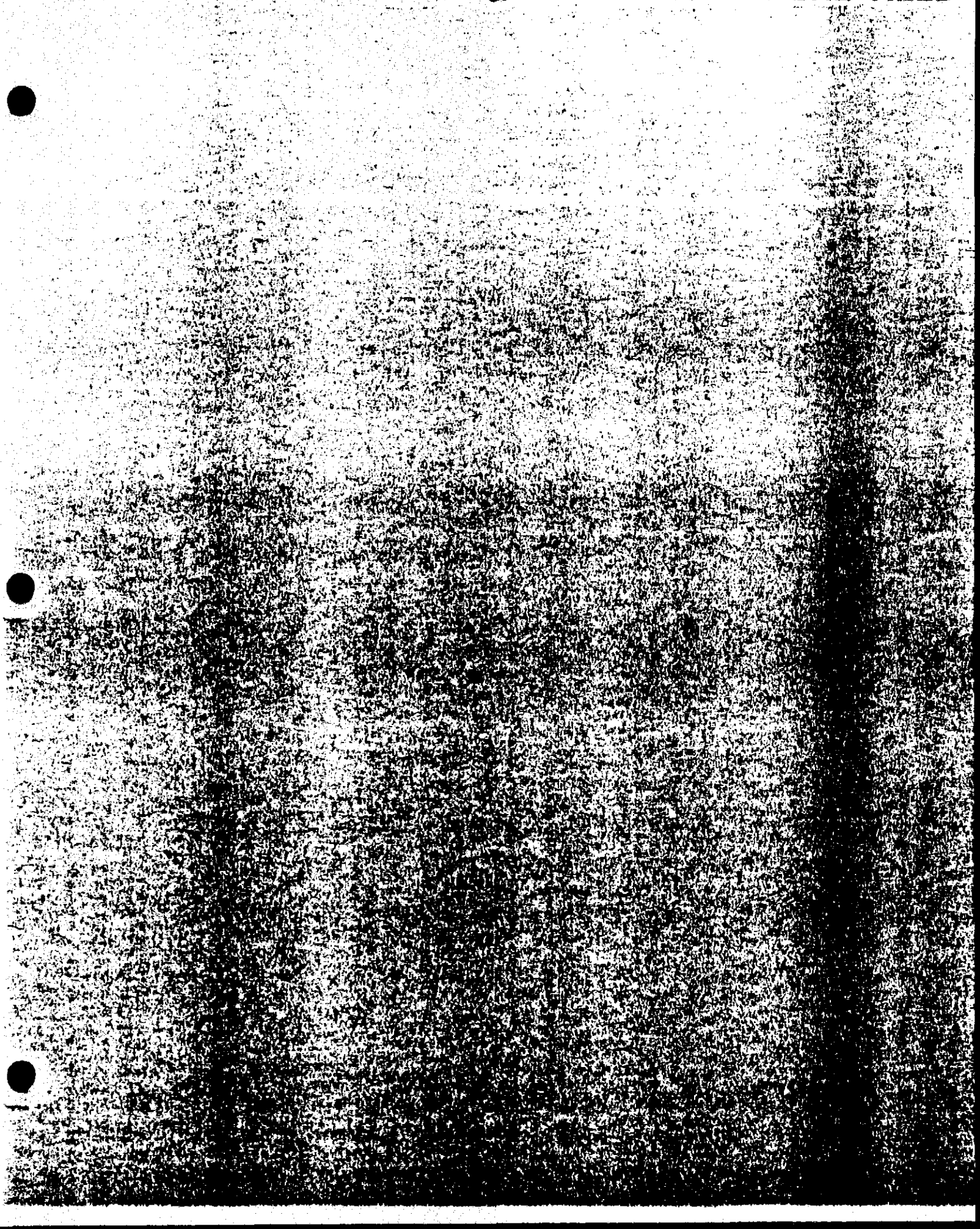
$$END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 10
TOTAL NO. OF WS PROFILES = 10
ITERATIONS IN EXNER EQ = 5300.
END OF JOB

JOB COMPLETED
RUN TIME = 0 HOURS, 2 MINUTES & 7.38 SECONDS

10. AVERAGE ANNUAL YIELD



AVERAGE ANNUAL SEDIMENT YIELD CALIBRATION

The determination of event specific yield was an interactive process as depicted on the attached flow chart. The first step was to estimate the various input parameters into HEC-6 and establish the equilibrium sediment transport at the location of the dike. These values were then integrated and compared to the average annual yield determined previously. If these values were within five percent this was assumed to be correct and was used for subsequent determinations.

The process of integrating event specific yields and determining an average annual yield has been documented for sediment transport studies as well as economic analyses and other applications. When used in a sediment transport analysis, discharges not related to a specific event must be considered. Commonly, an integration constant reflecting the relationship between the mathematical average of annual total runoff volume at the gage and the average annual runoff volume estimated using the integration process is computed. Two gages in the Las Vegas Valley were evaluated to determine the constant to be used in this analysis. A gage on the Las Vegas Wash at North Las Vegas resulted in a relationship of 1.2 while an analysis of the Flamingo Wash near Charleston Park resulted in a relationship of 1.3. Because the Flamingo Wash watershed was more similar to Range Wash in size, and integration constant of 1.3 was adopted for this analysis. The computations and gage analysis are attached in the "Integration Constant" section.

As previously discussed, the application of HEC-6 to an alluvial system cannot be accomplished without some manipulation to the methodology. The sharp rise and fall of the

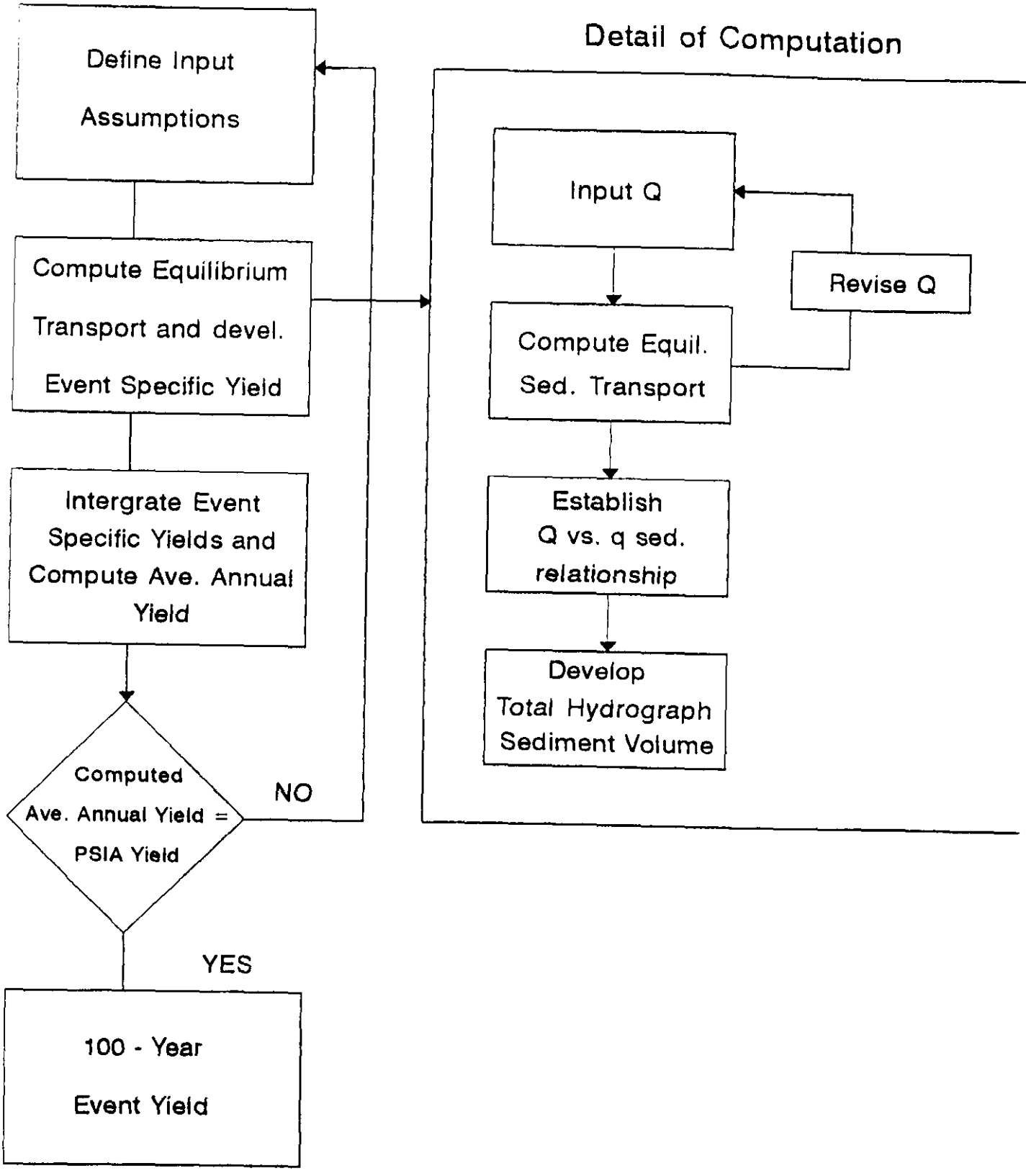
unit hydrograph and the variation in channel cross section make it very difficult to appropriately simulate the alluvial fan transport characteristics. To better establish equilibrium transport for each event, an equilibrium sediment transport relationship was developed for each discharge and these were combined to estimate total discharge for the total hydrograph. This process is depicted in the detail on the flow chart.

The system was modeled using a fixed discharge and a fixed channel cross section related to that discharge based on Dawdy/FEMA. The equilibrium sediment transport for that discharge was then computed using HEC-6. This process was performed for several discharges. The results of these simulations is included in the "Equilibrium Constant" section. A rating curve was then developed which was a power curve function of the form $Q_{sed} = AQuarter^{B}$. The rating curve computations are attached in the "Computation of Annual Yield" section. Using this relationship, the hydrograph of the flood event was discretized and a specific sediment discharge computed for each time step in the hydrograph. This is presented in the same section. It was then possible to sum the sediment volume for each time step over the entire storm and develop a total transport volume which represents an event specific sediment yield. These individual event values were then integrated and the integration factor applied to develop an average annual yield. These were compared to the PSIA estimate of average annual sediment and input parameters adjusted until an appropriate match was achieved. The integration is summarized and show on the final pages of this section.

The results of the calibration and integration process resulted in the following conclusions:

- o A roughness coefficient of .022 is appropriate
- o Water temperature of 70^{O} F is appropriate
- o A particle size distribution of 30/70 (fines/coarse) results in a appropriate estimation of average annual yield
- o The integration constant of 1.3 is supportable from gage records
- o The integrated volume sediment yield is 15.2 AF (within five percent of target 16 AF)
- o The 100-year event yield of 147 af is approximately 9.5 times the average annual yield (reasonably close to the assumed 7)

The runs attached at the end of this section provide several useful pieces of information. First and foremost, the runs indicate that the integration process has defined inflow characteristics at the apex of the fan which result in an average annual yield consistent with estimates. They also provide the basis for the inflow sediment rating curves used in the subsequent analyses. Because alluvial fan flows have reached equilibrium when they reach the dike, these models can be used to simulate the transition from fan to dike. They also establish the particle size distribution of inflows into the system.


Define Input
Assumptions
Compute Equilibrium
Transport and devel.
Event Specific Yield
Intergrate Event
Specific Yields and
Compute Ave. Annual
Yield
Computed
Ave. Annual Yield =
PSIA Yield
NO
YES
100 - Year
Event Yield
Detail of Computation
Input Q
Revise Q
Compute Equil.
Sed. Transport
Establish
Q vs. q sed.
relationship
Develop
Total Hydrograph
Sediment Volume

INTEGRATION CONSTANT

Integration Constant Determination

BOYLE ENGINEERING CORPORATION

Project [illegible] WASH

Job No. [illegible]

By [illegible] Date 1/21/92

Description [illegible]

SHEET 1/2

N. LAS VEGAS WASH

@ N. LAS VEGAS, NV

WTR YR	PEAK (CFS)	PEAK VOL AC-FT	VOL AC-FT
63	91	181	197
64	0	0	0
65	13	25	41
66	17	34	34
67	146	290	709
68	100	199	300
69	8	15	24
70	4	7	14
71	24	44	101
72	20	40	91
73	127	250	582
74	16	32	74
75	1400	2080	3309
76	274	544	949
77	333	660	1153
78	13	26	157

$\bar{V}$ = 482 AF

FLAMINGO WASH NEAR CHARLESTON PARK, NV

WTR YR	PEAK CFS	PEAK VOL AC-FT	VOL AC-FT
70	62	124	269
71	10	19	23
72	3	5	8
73	8	16	43
74	11	22	42
75	349	698	853
76	168	336	612
77	105	210	395
78	41	82	326

$\bar{V}$ = 286 AF

HECWRC ANALYSIS

RETURN PERIOD		VOL (AF)	
100	.01	7560	.01
50	.02	4051	.01
20	.05	1654	.03
10	.100	774	.05
5	.200	323	.10
2	.500	68	.30
		0	.20

INTEGRATION → 419 AF

$\frac{482}{419} = 1.2$

HECWRC ANALYSIS

RETURN PERIOD		VOL (AF)	
100	1.011	2850	.01
50	.02	1830	.01
20	.05	936	.03
10	.100	516	.05
5	.200	252	.10
2	.500	64.	.30
		0	.20

INTEGRATION → 229 AF

$\frac{286}{229} = 1.3$

```
TT LAS VEGAS WASH- FLOOD FLOW FREQUENCY ANALYSIS
TT ANNUAL MAXIMUM MEAN DAILY FLOWS (CFS) FOR WATER YEARS 1963-1978
TT FN: LVW.IN        DATE: 6/20/91  BY: T.A.BOWEN
ID 06889500 LAS VEGAS WASH AT N LAS VEGAS, NV DA=1300 SQ MI
CS  0688              .00
    58806011929      181
    .8809161930        0
..  J68810161930       25
QR  068811171931       34
QR  068802241936      290
QR  068802081937      199
QR  068805191938       15
QR  068804151939        7
QR  068805211940       44
QR  068806091941       20
QR  068810101941      250
QR  068806161943       32
QR  068804231944     2780
QR  068804161945      544
QR  068806191946      660
QR  068806231947       26
ED
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1
**********************************        **************************************
*            HECWRC              *        *                                    *
*    OOD FLOW FREQUENCY ANALYSIS *        *   U.S. ARMY CORPS OF ENGINEERS     *
*    OGRAM DATE:    1 APRIL 1978 *        * THE HYDROLOGIC ENGINEERING CENTER *
*  ERSION DATE:    1 APRIL 1987 *        *         609 SECOND STREET          *
* RUN  OATE     AND     TIME:   *        *      DAVIS, CALIFORNIA 95616       *
*     1/27/92         11:49:25  *        * (916) 551-1748 OR (FTS) 460-1748  *
**********************************        **************************************

 INPUT FILE NAME: LVW.IN
OUTPUT FILE NAME: LVW.OU

**TITLE CARD(S)**
TT   LAS VEGAS WASH- FLOOD FLOW FREQUENCY ANALYSIS
TT   ANNUAL MAXIMUM MEAN DAILY FLOWS (CFS) FOR WATER YEARS 1963-1978
TT   FN: LVW.IN       DATE: 6/20/91  BY: T.A.BOWEN

**STATION IDENTIFICATION**
ID   06889500 LAS VEGAS WASH AT N LAS VEGAS, NV DA=1300 SQ MI

**GENERALIZED SKEW**
     ISTN   GGMSE    SKEW
GS   0688    .000     .00

**SYSTEMATIC EVENTS**
     16 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

NOTE - ADOPTED SKEW EQUALS COMPUTED SKEW AND PRELIMINARY
       FREQUENCY STATISTICS ARE FOR THE CONDITIONAL
       FREQUENCY CURVE BECAUSE OF ZERO OR MISSING EVENTS.

 PRELIMINARY RESULTS
-FREQUENCY CURVE- 06889500 LAS VEGAS WASH AT N LAS VEGAS, NV DA
*************************************************************************
*.....FLOW,CFS.....*              *...CONFIDENCE LIMITS...*
*          EXPECTED   * EXCEEDANCE *                       *
*  COMPUTED PROBABILITY * PROBABILITY *  .05 LIMIT  .95 LIMIT *
*----------------------*------------*-----------------------*
*    28462.   136000.   *    .002    *   388000.     6560.   *
*    13618.    41000.   *    .005    *   138000.     3650.   *
*     7560.    17100.   *    .010    *    60500.     2280.   *
*     4051.     7240.   *    .020    *    25400.     1380.   *
*     1654.     2300.   *    .050    *     7420.      659.   *
*      774.      939.   *    .100    *     2670.      345.   *
*      323.      352.   *    .200    *      854.      157.   *
*       68.       68.   *    .500    *      138.       32.   *
*       16.       14.   *    .800    *       33.        5.   *
*        6.        5.   *    .900    *       15.        1.   *
*        0.        0.   *    .950    *        0.        0.   *
*        0.        0.   *    .990    *        0.        0.   *
*************************************************************************
*   FREQUENCY CURVE STATISTICS    *     STATISTICS BASED ON      *
*---------------------------------*------------------------------*
*  MEAN LOGARITHM          1.9488 *  HISTORIC EVENTS          0  *
*  STANDARD DEVIATION       .7360 *  HIGH OUTLIERS        0     *
*  COMPUTED SKEW            .4557 *  LOW OUTLIERS         0     *
*  GENERALIZED SKEW         .0000 *  ZERO OR MISSING      1     *
*  ADOPTED SKEW             .4557 *  SYSTEMATIC EVENTS       16 *
   *********************************************************

 FINAL RESULTS
-PLOTTING POSITIONS- 06889500 LAS VEGAS WASH AT N LAS VEGAS, NV DA
```

.....EVENTS ANALYZED.....				..... ORDERED EVENTS			
MON	DAY	YEAR	FLOW,CFS	RANK	WATER YEAR	FLOW,CFS	WEIBULL PLOT POS
	1	1929	181.	1	1944	2780.	.0588
	16	1930	0.	2	1946	660.	.1176
10	16	1930	25.	3	1945	544.	.1765
11	17	1931	34.	4	1936	290.	.2353
2	24	1936	290.	5	1942	250.	.2941
2	8	1937	199.	6	1937	199.	.3529
5	19	1938	15.	7	1929	181.	.4118
4	15	1939	7.	8	1940	44.	.4706
5	21	1940	44.	9	1932	34.	.5294
6	9	1941	20.	10	1943	32.	.5882
10	10	1941	250.	11	1947	26.	.6471
6	16	1943	32.	12	1931	25.	.7059
4	23	1944	2780.	13	1941	20.	.7647
4	16	1945	544.	14	1938	15.	.8235
6	19	1946	660.	15	1939	7.	.8824
6	23	1947	26.	16	1930	0.	.9412

-OUTLIER TESTS -

LOW OUTLIER TEST

BASED ON 15 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.247

0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF 2.0
BASED ON THE STATISTICS AFTER 1 ZERO OR MISSING EVENTS DELETED

STATISTICS AND FREQUENCY CURVE ADJUSTED FOR 0 LOW OUTLIER(S)
AND/OR 1 ZERO OR MISSING EVENT(S)

OUTLIER TEST

BASED ON 15 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 2.247

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 4005.

-SKEW WEIGHTING -

BASED ON 16 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .342
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS
-FREQUENCY CURVE- 06889500 LAS VEGAS WASH AT N LAS VEGAS, NV DA

.....FLOW,CFS.....			...CONFIDENCE LIMITS...	
COMPUTED	EXPECTED PROBABILITY	EXCEEDANCE PROBABILITY	.05 LIMIT	.95 LIMIT
17700.	66600.	.002	213000.	4340.
9500.	24800.	.005	88800.	2640.
5720.	11800.	.010	43800.	1760.
3320.	5620.	.020	20600.	1130.
1490.	2040.	.050	6850.	582.
743.	900.	.100	2690.	322.
327.	360.	.200	920.	155.
73.	73.	.500	153.	34.
18.	16.	.800	37.	6.
9.	7.	.900	20.	2.
5.	4.	.950	12.	1.
2.	1.	.990	5.	0.

FREQUENCY CURVE STATISTICS	STATISTICS BASED ON

* MEAN LOGARITHM	1.8862	*	HISTORIC EVENTS	0 *
* STANDARD DEVIATION	.7569	*	HIGH OUTLIERS	0 *
* COMPUTED SKEW	.4238	*	LOW OUTLIERS	0 *
* GENERALIZED SKEW	.0000	*	ZERO OR MISSING	1 *
* ADOPTED SKEW	.2000	*	SYSTEMATIC EVENTS	16 *

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++++++++++++++++++++++++++
+ END OF RUN   +
+ NORMAL STOP IN HECWRC +
++++++++++++++++++++++++++

```
TT FLAMINGO  WASH- FLOOD FLOW FREQUENCY ANALYSIS
TT ANNUAL MAXIMUM MEAN DAILY FLOWS (CFS) FOR WATER YEARS 1970-1978
TT FN: FLAM.IN      DATE:11/20/91  BY: MG/TBr
ID 06889500 FLAMINGO WASH NEAR CHARLESTON PARK, NV DA=9.20 Mi2
   0688              .00
   8806011929        124
   8809161930         19
QR 068810161930        5
QR 068811171931       16
QR 068802241936       22
QR 068802081937      698
QR 068805191938      336
QR 068804151939      210
QR 068805211940       82
ED
```

```
*********************************          **************************************
*            HECWRC             *          *                                    *
*    OOD FLOW FREQUENCY ANALYSIS *          *   U.S. ARMY CORPS OF ENGINEERS     *
*    OGRAM DATE:    1 APRIL 1978 *          * THE HYDROLOGIC ENGINEERING CENTER *
*   ERSION DATE:    1 APRIL 1987 *          *        609 SECOND STREET           *
* RUN  DATE     AND     TIME:    *          *      DAVIS, CALIFORNIA 95616       *
*     1/27/92         11:49:15   *          * (916) 551-1748 OR (FTS) 460-1748   *
*********************************          **************************************


 INPUT FILE NAME: FLAM.IN
OUTPUT FILE NAME: FLAM.OU



**TITLE CARD(S)**
TT   FLAMINGO  WASH- FLOOD FLOW FREQUENCY ANALYSIS
TT   ANNUAL MAXIMUM MEAN DAILY FLOWS (CFS) FOR WATER YEARS 1970-1978
TT   FN: FLAM.IN      DATE:11/20/91  BY: MG/TBr

**STATION IDENTIFICATION**
ID   06889500 FLAMINGO WASH NEAR CHARLESTON PARK, NV DA=9.20 Mi2

**GENERALIZED SKEW**
     ISTN   GGMSE     SKEW
GS   0688    .000      .00

**SYSTEMATIC EVENTS**
      9 EVENTS TO BE ANALYZED

**END OF INPUT DATA**
ED ************************************************************
***************************************************************
    * * WARNING - LESS THAN TEN EVENTS FOR ANALYSIS,
          BULLETIN 17-B PROCEDURES NOT APPLICABLE.


 FINAL RESULTS
-PLOTTING POSITIONS- 06889500 FLAMINGO WASH NEAR CHARLESTON PARK,
*****************************************************************
*.....EVENTS ANALYZED.....*.........ORDERED EVENTS.........*
*                         *          WATER                 WEIBULL  *
* MON DAY  YEAR  FLOW,CFS *   RANK  YEAR    FLOW,CFS  PLOT POS *
*-------------------------*-----------------------------------*
*   6   1  1929     124.  *     1   1937      698.     .1000  *
*   9  16  1930      19.  *     2   1938      336.     .2000  *
*  10  16  1930       5.  *     3   1939      210.     .3000  *
*  11  17  1931      16.  *     4   1929      124.     .4000  *
*   2  24  1936      22.  *     5   1940       82.     .5000  *
*   2   8  1937     698.  *     6   1936       22.     .6000  *
*   5  19  1938     336.  *     7   1930       19.     .7000  *
*   4  15  1939     210.  *     8   1932       16.     .8000  *
*   5  21  1940      82.  *     9   1931        5.     .9000  *
*****************************************************************


-OUTLIER TESTS  -
---------------------------------------------------------------
LOW OUTLIER TEST
----------------

BASED ON   9 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 1.977

      0 LOW OUTLIER(S) IDENTIFIED BELOW TEST VALUE OF      2.5


    ------------
HIGH OUTLIER TEST
-----------------

BASED ON   9 EVENTS, 10 PERCENT OUTLIER TEST VALUE K(N) = 1.977
```

0 HIGH OUTLIER(S) IDENTIFIED ABOVE TEST VALUE OF 1611.

W WEIGHTING -

BASED ON 9 EVENTS, MEAN-SQUARE ERROR OF STATION SKEW = .521
DEFAULT OR INPUT MEAN-SQUARE ERROR OF GENERALIZED SKEW = .302

FINAL RESULTS
-FREQUENCY CURVE- 06889500 FLAMINGO WASH NEAR CHARLESTON PARK,

FLOW,CFS EXPECTED COMPUTED	PROBABILITY	EXCEEDANCE PROBABILITY	CONFIDENCE LIMITS .05 LIMIT	.95 LIMIT
7040.	61800.	.002	230000.	1460.
4290.	20700.	.005	101000.	1010.
2850.	9370.	.010	51800.	739.
1830.	4330.	.020	25000.	524.
936.	1570.	.050	8470.	309.
516.	706.	.100	3310.	189.
252.	294.	.200	1100.	101.
64.	64.	.500	170.	24.
16.	14.	.800	40.	4.
8.	6.	.900	21.	1.
4.	3.	.950	13.	0.
1.	0.	.990	5.	7.

FREQUENCY CURVE STATISTICS		STATISTICS BASED ON	
MEAN LOGARITHM	1.8027	HISTORIC EVENTS	0
STANDARD DEVIATION	.7104	HIGH OUTLIERS	0
COMPUTED SKEW	-.0566	LOW OUTLIERS	0
GENERALIZED SKEW	.0000	ZERO OR MISSING	0
ADOPTED SKEW	.0000	SYSTEMATIC EVENTS	9

++++++++++++++++++++++++++
+ END OF RUN +
+ NORMAL STOP IN HECWRC +
++++++++++++++++++++++++++

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1961 TO SEP 1962
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
2	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
3	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
4	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
5	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
6	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
7	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
8	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
9	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
10	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
11	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
12	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
13	---	---	---	---	---	---	---	---	0.00	0.00	0.20	0.00
14	---	---	---	---	---	---	---	---	0.00	0.00	0.50	0.00
15	---	---	---	---	---	---	---	---	0.00	0.00	0.20	0.00
16	---	---	---	---	---	---	---	---	0.00	0.00	0.40	0.00
17	---	---	---	---	---	---	---	---	0.00	0.00	0.30	0.00
18	---	---	---	---	---	---	---	---	0.00	0.00	0.50	0.00
19	---	---	---	---	---	---	---	---	0.00	0.00	0.50	0.00
20	---	---	---	---	---	---	---	---	0.00	0.00	0.60	0.00
21	---	---	---	---	---	---	---	---	0.00	0.00	0.60	0.00
22	---	---	---	---	---	---	---	---	0.00	0.00	0.40	0.00
23	---	---	---	---	---	---	---	---	0.00	0.00	0.20	0.00
24	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
25	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
26	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
27	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
28	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
29	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
30	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
31	---	---	---	---	---	---	---	---	---	0.00	0.00	---
Total	---	---	---	---	---	---	---	---	0.00	0.00	4.4	0.00
Mean	---	---	---	---	---	---	---	---	0.00	0.00	0.14	0.00
Max	---	---	---	---	---	---	---	---	0.00	0.00	0.60	0.00
Min	---	---	---	---	---	---	---	---	0.00	0.00	0.00	0.00
Ac-Ft	---	---	---	---	---	---	---	---	0.00	0.00	8.7	0.00

WTR YR 1962 TOTAL --- MEAN --- MAX --- MIN --- AC-FT ---

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1962 TO SEP 1963
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.5	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	91
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.70	6.9	0.00	0.00	91
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.23	0.00	0.00	3.0
Max	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.50	6.5	0.00	0.00	91
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	0.00	0.00	0.00	1.2	1.4	14	0.00	0.00	181

WTR YR 1963 TOTAL 99 MEAN 0.27 MAX 91 MIN 0.00 AC-FT 197

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1963 TO SEP 1964
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WTR YR 1964 TOTAL 0.00 MEAN 0.00 MAX 0.00 MIN 0.00 AC-FT 0.00

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1964 TO SEP 1965
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	13	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	7.5	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	0.00	0.00	21	0.00	0.00	0.00	0.00	0.00
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.00
Max	0.00	0.00	0.00	0.00	0.00	0.00	13	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	0.00	0.00	0.00	41	0.00	0.00	0.00	0.00	0.00

WTR YR 1965 TOTAL 21 MEAN 0.06 MAX 13 MIN 0.00 AC-FT 41

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1965 TO SEP 1966
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.00	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-ft	0.00	34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WTR YR 1966 TOTAL 17 MEAN 0.05 MAX 17 MIN 0.00 AC-FT 34

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1966 TO SEP 1967
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	146	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.8	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	83	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.6
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	97
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.0
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	146	0.00	0.00	0.00	0.00	0.00	106	0.00	1.8	104
Mean	0.00	0.00	4.7	0.00	0.00	0.00	0.00	0.00	3.5	0.00	0.06	3.5
Max	0.00	0.00	146	0.00	0.00	0.00	0.00	0.00	83	0.00	1.8	97
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	290	0.00	0.00	0.00	0.00	0.00	210	0.00	3.6	205

WTR YR 1967 TOTAL 357 MEAN 0.98 MAX 146 MIN 0.00 AC-FT 709

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1967 TO SEP 1968
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	151	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.00	5.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	0.00	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WTR YR 1968 TOTAL 151 MEAN 0.41 MAX 100 MIN 0.00 AC-FT 300

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1968 TO SEP 1969
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
10	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	2.2	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	7.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	8.7	0.00	0.40	0.00	0.60	0.00	0.00	2.4	0.00
Mean	0.00	0.00	0.00	0.28	0.00	0.01	0.00	0.02	0.00	0.00	0.08	0.00
Max	0.00	0.00	0.00	7.7	0.00	0.20	0.00	0.60	0.00	0.00	2.2	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	17	0.00	0.79	0.00	1.2	0.00	0.00	4.8	0.00

WTR YR 1969 TOTAL 12 MEAN 0.03 MAX 7.7 MIN 0.00 AC-FT 24

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1969 TO SEP 1970

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.6	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*	*0.00*
9	*0.00*	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.00*	*0.00*	*0.00*
21	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.0	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00
28	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	1.1	0.00	0.00	0.00	0.00	0.00	5.7	0.00
Mean	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.19	0.00
Max	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	3.6	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	0.00	2.2	0.00	0.00	0.00	0.00	0.00	11	0.00

WTR YR 1970 TOTAL 6.8 MEAN 0.02 MAX 3.6 MIN 0.00 AC-FT 14

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1970 TO SEP 1971
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	22	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.3	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	1.2	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	1.2	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	49	0.00
Mean	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	1.6	0.00
Max	0.00	1.2	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	24	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	2.4	0.00	0.00	0.00	0.00	0.00	1.2	0.00	0.00	98	0.00

WTR YR 1971 TOTAL 51 MEAN 0.14 MAX 24 MIN 0.00 AC-FT 101

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1971 TO SEP 1972
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.02	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.33	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35	0.10
Mean	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.1	0.00
Max	0.31	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20	0.10
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.65	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	70	0.20

WTR YR 1972 TOTAL 36 MEAN 0.10 MAX 20 MIN 0.00 AC-FT 71

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1972 TO SEP 1973
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.7	1.2	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00
5	40	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00
6	0.00	0.00	0.00	0.00	2.9	5.0	0.00	0.12	0.00	0.00	0.40	0.31
7	0.28	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.18
8	0.00	0.00	0.00	0.00	0.00	1.7	0.00	0.00	0.00	0.00	0.00	0.00
9	36	0.00	0.00	0.09	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00
10	0.40	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.29	1.5	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.33	9.3	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.22	0.16	0.00	0.00	0.00	0.00	0.00	0.00
14	0.36	0.00	0.00	0.00	4.7	0.00	0.00	0.06	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.07	0.00	0.00	0.00
16	0.00	2.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	8.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16	0.00
21	0.00	0.00	0.00	0.00	1.5	0.00	0.00	0.00	0.00	0.00	2.3	0.00
22	0.00	0.00	0.00	0.00	2.9	1.5	0.00	0.00	0.00	0.00	0.56	0.00
23	0.00	0.00	0.00	0.00	0.43	0.01	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.13	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	1.0	0.00	0.19	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.10	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	16	0.00	0.00	0.00	0.00	0.05
31	0.00	---	0.00	0.00	---	0.00	---	127	---	0.00	0.00	---
Total	77	11	0.19	0.09	14	23	16	129	1.3	0.00	20	0.54
Mean	2.5	0.38	0.01	0.00	0.49	0.76	0.53	4.2	0.04	0.00	0.66	0.02
Max	40	8.8	0.19	0.09	4.7	9.3	16	127	1.2	0.00	16	0.31
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	153	22	0.38	0.18	27	47	32	256	2.5	0.00	40	1.1

WTR YR 1973 TOTAL 293 MEAN 0.80 MAX 127 MIN 0.00 AC-FT 582

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1973 TO SEP 1974
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.81	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.10	0.08	0.04	0.00	0.00	0.02	0.00	0.00	0.00	0.00
4	0.00	0.00	0.05	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.75	0.00
6	0.10	0.00	0.00	16	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.45	0.00	0.69	6.1	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
8	0.30	0.00	0.06	1.4	0.00	2.2	0.00	0.00	0.00	0.00	0.00	0.00
9	0.57	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00
10	0.54	0.00	0.00	0.00	0.00	0.29	0.44	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.08
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.22	0.00	0.00	0.00	0.10	0.00	0.00	0.01	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.07	0.00	0.17	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.41
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	1.2
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.04	0.00	0.40
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.29	0.00	---
Total	2.0	0.00	1.1	24	0.99	3.7	0.66	0.09	0.00	0.80	0.75	2.9
Mean	0.06	0.00	0.04	0.79	0.04	0.12	0.02	0.00	0.00	0.03	0.02	0.10
Max	0.57	0.00	0.69	16	0.37	2.2	0.44	0.07	0.00	0.29	0.75	1.2
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-ft	3.9	0.00	2.2	48	2.0	7.4	1.3	0.18	0.00	1.6	1.5	5.7

WTR YR 1974 TOTAL 37 MEAN 0.10 MAX 16 MIN 0.00 AC-FT 74

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1974 TO SEP 1975
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.54	0.64	0.00	0.18	0.00	13	0.00	0.00	0.00	0.00	0.00
2	0.08	1.3	0.55	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	3.9	0.80	1.4	0.11	0.05	0.00	0.00	0.00	0.00	1400	0.00	0.00
4	0.30	0.23	5.6	0.00	0.39	0.00	0.00	0.00	0.00	131	0.00	0.00
5	1.2	0.12	0.26	0.16	0.61	0.00	0.00	0.00	0.00	40	0.00	0.00
6	0.92	0.11	0.60	0.14	0.06	0.07	0.00	0.00	0.00	13	0.00	0.00
7	0.99	0.00	0.28	0.23	0.03	0.04	0.00	0.00	0.00	6.4	0.00	0.00
8	0.40	0.00	0.33	0.00	0.10	0.06	0.00	0.00	0.00	2.8	0.00	0.00
9	0.24	0.00	0.24	0.05	0.07	0.09	0.00	0.00	0.00	1.8	0.00	0.00
10	0.33	0.00	0.78	0.07	0.00	0.00	0.00	0.00	0.00	2.5	0.00	0.00
11	0.14	0.01	0.56	0.10	0.07	2.5	0.00	0.00	0.00	0.80	0.00	0.00
12	0.16	0.05	1.1	0.16	0.12	0.23	0.00	0.00	0.00	0.00	0.00	0.00
13	0.19	0.00	1.1	0.05	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00
14	0.11	0.00	0.66	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.18	0.14	0.57	0.39	0.32	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.46	0.07	0.46	1.3	0.10	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.02	0.06	0.34	0.46	0.09	0.00	0.00	0.00	0.00	0.00	0.00
18	0.26	0.08	0.00	0.15	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.35	0.24	0.00	0.18	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.06	0.29	0.00	0.10	0.29	0.00	0.00	0.00	0.00	0.00	5.4	0.00
21	0.00	0.21	0.03	0.10	0.36	0.00	0.00	0.00	0.00	0.00	0.35	0.00
22	0.00	0.10	0.17	0.12	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.12	0.12	0.17	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.14	0.08	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.68	0.00	0.09	0.18	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
27	0.21	0.08	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	1.0	0.13	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	1.1	0.17	0.20	0.06	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.69	0.70	0.08	0.13	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.63	---	0.05	0.08	---	1.4	---	0.00	---	0.00	0.00	---
Total	14	5.9	15	4.2	6.3	5.0	13	0.00	0.00	1598	5.8	0.00
Mean	0.45	0.20	0.49	0.13	0.22	0.16	0.43	0.00	0.00	52	0.19	0.00
Max	3.9	1.3	5.6	0.57	1.3	2.5	13	0.00	0.00	1400	5.4	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	28	12	30	8.3	12	10.0	26	0.00	0.00	3170	11	0.00

WTR YR 1975 TOTAL 1668 MEAN 4.6 MAX 1400 MIN 0.00 AC-FT 3308

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1975 TO SEP 1976
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.16	0.09	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	6.2	0.00	0.00	3.7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	2.2	0.00	0.00	0.70	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	274	0.00	0.00	0.19	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	7.8	0.00	0.00	0.12	0.00	0.00	0.00	24
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	5.0
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
13	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.52	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.38	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.47	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.3	0.00	46
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59	0.00	28
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.12	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.07	---	0.00	0.00	---
Total	0.00	0.00	2.8	0.00	304	0.16	0.44	5.3	0.02	62	0.00	103
Mean	0.00	0.00	0.09	0.00	10	0.01	0.01	0.17	0.00	2.0	0.00	3.4
Max	0.00	0.00	0.52	0.00	274	0.09	0.32	3.7	0.02	59	0.00	46
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	5.5	0.00	604	0.32	0.87	10	0.04	124	0.00	204

WTR YR 1976 TOTAL 478 MEAN 1.3 MAX 274 MIN 0.00 AC-FT 949

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1976 TO SEP 1977
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	333	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.94	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.1	4.4	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.8	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	203	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.9	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.03	0.00	0.00	0.00	1.1	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.03	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	362	0.00	0.00	0.73	0.00	0.32	0.00	8.8	4.4	0.00	205	0.00
Mean	12	0.00	0.00	0.02	0.00	0.01	0.00	0.28	0.15	0.00	6.6	0.00
Max	333	0.00	0.00	0.50	0.00	0.27	0.00	3.1	4.4	0.00	203	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	718	0.00	0.00	1.4	0.00	0.63	0.00	17	8.7	0.00	406	0.00

WTR YR 1977 TOTAL 581 MEAN 1.6 MAX 333 MIN 0.00 AC-FT 1153

09419650 LAS VEGAS WASH AT N LAS VEGAS, NV

LOCATION.--Lat 36:12:40, Long 115:06:20, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 1300.00 mi2 (3367.00 km2).

PERIOD OF RECORD.-- 1962-1978

GAGE.-- Altitude of gage is 1850.00 ft(564 m).

STREAMFLOW (CFS), WATER YEAR OCT 1977 TO SEP 1978
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	1.4	0.00	7.9	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	1.0	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	2.2	0.00	4.5	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	2.5	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	1.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	3.4	0.00	0.08	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	2.0	0.56	3.5	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.08	0.00	4.4	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	6.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	2.0	0.37	0.00	0.00	0.00	0.00	0.00	0.00	7.0
15	0.00	0.00	0.00	2.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	13	0.00	1.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.40	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	13	14	12	25	0.08	7.9	0.00	0.00	0.00	7.0
Mean	0.00	0.00	0.42	0.44	0.44	0.82	0.00	0.25	0.00	0.00	0.00	0.23
Max	0.00	0.00	13	2.6	6.6	9.0	0.08	7.9	0.00	0.00	0.00	7.0
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	26	27	24	50	0.16	16	0.00	0.00	0.00	14

WTR YR 1978 TOTAL 79 MEAN 0.22 MAX 13 MIN 0.00 AC-FT 157

09419677 FLAMINGO WASH AT MRLND PARKWAY, AT LAS VEGAS, NV

LOCATION.--Lat 36:08:35, Long 115:04:12, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 106.00 mi2 (274.54 km2).

PERIOD OF RECORD.-- 1970-1989

GAGE.-- Altitude of gage is 1976.60 ft(602 m).

STREAMFLOW (CFS), WATER YEAR OCT 1969 TO SEP 1970
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.2	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.5	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.3	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	62	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.4	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.2	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.4	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29	106	0.00
Mean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	3.4	0.00
Max	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24	62	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-ft	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58	211	0.00

WTR YR 1970 TOTAL 136 MEAN 0.37 MAX 62 MIN 0.00 AC-FT 269

09419677 FLAMINGO WASH AT MRLND PARKWAY, AT LAS VEGAS, NV

LOCATION.--Lat 36:08:35, Long 115:04:12, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 106.00 mi2 (274.54 km2).

PERIOD OF RECORD.-- 1970-1989

GAGE.-- Altitude of gage is 1976.60 ft(602 m).

STREAMFLOW (CFS), WATER YEAR OCT 1975 TO SEP 1976
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	6.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.2	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	168	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	8.7	0.00	0.00	0.00	0.00	0.00	0.00	55
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.5
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.6
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.4
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36	0.00	2.4
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.6	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	0.00	0.00	0.00	0.00	183	0.00	0.00	5.2	0.00	40	0.00	81
Mean	0.00	0.00	0.00	0.00	6.3	0.00	0.00	0.17	0.00	1.3	0.00	2.7
Max	0.00	0.00	0.00	0.00	168	0.00	0.00	5.2	0.00	36	0.00	55
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	0.00	0.00	0.00	0.00	363	0.00	0.00	10	0.00	79	0.00	160

WTR YR 1976 TOTAL 309 MEAN 0.84 MAX 168 MIN 0.00 AC-FT 612

09419677 FLAMINGO WASH AT MRLND PARKWAY, AT LAS VEGAS, NV

LOCATION.--Lat 36:08:35, Long 115:04:12, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 106.00 mi2 (274.54 km2).

PERIOD OF RECORD.-- 1970-1989

GAGE.-- Altitude of gage is 1976.60 ft(602 m).

STREAMFLOW (CFS), WATER YEAR OCT 1976 TO SEP 1977
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	86	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	105	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	7.9	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	86	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	113	0.20
Mean	2.8	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	3.6	0.01
Max	86	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	105	0.07
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-ft	171	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	224	0.40

WTR YR 1977 TOTAL 199 MEAN 0.55 MAX 105 MIN 0.00 AC-FT 395

09419677 FLAMINGO WASH AT MRLND PARKWAY, AT LAS VEGAS, NV

LOCATION.--Lat 36:08:35, Long 115:04:12, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 106.00 mi2 (274.54 km2).

PERIOD OF RECORD.-- 1970-1989

GAGE.-- Altitude of gage is 1976.60 ft(602 m).

STREAMFLOW (CFS), WATER YEAR OCT 1987 TO SEP 1988
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	2.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	---	26	0.00	0.00	8.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	---	2.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	---	1.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	---	26	8.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	13	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	2.5	0.00	0.00	0.00	0.00	0.00	11	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.6	0.00
30	0.00	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	0.00	0.73	0.00
31	18	---	0.00	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Total	---	58	32	19	11	0.00	0.00	0.00	0.00	0.00	15	0.00
Mean	---	1.9	1.0	0.61	0.37	0.00	0.00	0.00	0.00	0.00	0.49	0.00
Max	18	26	13	19	8.3	0.00	0.00	0.00	0.00	0.00	11	0.00
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ac-Ft	---	115	62	38	21	0.00	0.00	0.00	0.00	0.00	30	0.00

WTR YR 1988 TOTAL --- MEAN --- MAX --- MIN --- AC-FT ---

09419677 FLAMINGO WASH AT MRLND PARKWAY, AT LAS VEGAS, NV

LOCATION.--Lat 36:08:35, Long 115:04:12, Hydrologic Unit 15010015.

DRAINAGE AREA.-- 106.00 mi2 (274.54 km2).

PERIOD OF RECORD.-- 1970-1989

GAGE.-- Altitude of gage is 1976.60 ft(602 m).

STREAMFLOW (CFS), WATER YEAR OCT 1988 TO SEP 1989
MEAN

DAY	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	---	---	---	---	0.00	0.00	0.00	---	---	---	---	---
2	---	---	---	---	0.00	0.00	0.00	---	---	---	---	---
3	---	---	---	---	0.00	0.00	---	---	---	---	---	---
4	---	---	---	---	0.00	0.00	---	---	---	---	---	---
5	---	---	---	---	0.00	0.00	---	---	---	---	---	---
6	---	---	---	---	0.00	0.00	---	---	---	---	---	---
7	---	---	---	---	0.00	0.00	---	---	---	---	---	---
8	---	---	---	---	0.00	0.00	---	---	---	---	---	---
9	---	---	---	---	0.00	0.00	---	---	---	---	---	---
10	---	---	---	---	0.00	0.00	---	---	---	---	---	---
11	---	---	---	---	0.00	0.00	---	---	---	---	---	---
12	---	---	---	---	0.00	0.00	---	---	---	---	---	---
13	---	---	---	---	0.00	0.00	---	---	---	---	---	---
14	---	---	---	---	0.00	0.00	---	---	---	---	---	---
15	---	---	---	---	0.00	0.00	---	---	---	---	---	---
16	---	---	---	---	0.00	0.00	---	---	---	---	---	---
17	---	---	---	---	0.00	0.00	---	---	---	---	---	---
18	---	---	---	---	0.00	0.00	---	---	---	---	---	---
19	---	---	---	---	0.00	0.00	---	---	---	---	---	---
20	---	---	---	---	0.00	0.00	---	---	---	---	---	---
21	---	---	---	---	0.00	0.00	---	---	---	---	---	---
22	---	---	---	---	0.00	0.00	---	---	---	---	---	---
23	---	---	---	---	0.00	0.00	---	---	---	---	---	---
24	---	---	---	---	0.00	0.00	---	---	---	---	---	---
25	---	---	---	---	0.00	0.00	---	---	---	---	---	---
26	---	---	---	---	0.00	0.00	---	---	---	---	---	---
27	---	---	---	---	0.00	0.00	---	---	---	---	---	---
28	---	---	---	---	0.00	0.00	---	---	---	---	---	---
29	---	---	---	---	---	0.00	---	---	---	---	---	---
30	---	---	---	---	---	0.00	---	---	---	---	---	---
31	---	---	---	0.00	---	0.00	---	---	---	---	---	---
Total	---	---	---	---	0.00	0.00	---	---	---	---	---	---
Mean	---	---	---	---	0.00	0.00	---	---	---	---	---	---
Max	---	---	---	0.00	0.00	0.00	0.00	---	---	---	---	---
Min	---	---	---	0.00	0.00	0.00	0.00	---	---	---	---	---
Ac-Ft	---	---	---	---	0.00	0.00	---	---	---	---	---	---

WTR YR 1989 TOTAL --- MEAN --- MAX --- MIN --- AC-FT ---

EQUILIBRIUM MODELS

```
**************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
   'NPUT FILE:  FAN7050.DAT                       *
    JTPUT FILE: FAN7050.OUT                       *
*  RUN DATE: 04JUN92       RUN TIME: 11:10:56     *
**************************************************

**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************

X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX  XXXXX          XXXXX

**********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
*       10  Stream Segments (Main Stem + Tributaries)                *
*      150  Cross Sections                                           *
*      100  Elevation/Station Points per Cross Section               *
*       15  Grain Sizes                                              *
*       10  Control Points                                           *
**********************************************************************

-1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
        11/14/91     7050 CFS SINGLE FAN FLOW N = .022, T=70

NC  .0220    .0220    .0220    .1000    .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

 'ION NO.  8 RIVER MILE=  41000.000
 .d    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 7050 CFS

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

C  ============================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91      7050 CFS SINGLE FAN FLOW N = .022, T=70

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ       SPGF       ACGR      NFALL     IBSHER
I1     10.        3       1      1.000     32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SILT IS PRESENT

       MTCL     IASL     LASL     SGSL     PUSDLB     UWSDLB     CCSDLB
I3        1        1        4    2.650     82.000     65.000      5.700

C   OSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
               LAYER     STRESS
                NO.     lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4        4        1       10     2.650      .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

C   ING GRAIN SIZES UTILIZED (MM)
SILT:      .0056     .0110     .0220     .0440
SAND:      .0880     .1770     .3540     .7070    1.4140
          2.8280    5.6570   11.3140   22.6270   45.2550
```

'ENT LOAD TABLE FOR STREAM SEGMENT # 1
BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		330.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		330.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		330.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		330.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		330.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		330.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		330.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		330.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		330.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		330.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		330.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		330.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
.000		330.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		330.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		330.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		330.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]000.000		330.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
[illegible]000.000		330.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		330.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		330.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		330.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		330.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		330.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		330.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		330.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		330.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		330.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		330.00	1581.63	1581.63	1581.63	27000.00	5.11

[illegible]ED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	330.00	10.00	.165000E+07	61111.0
5000.000	1000.00	330.00	10.00	.329999E+07	122222.
000.000	1000.00	330.00	10.00	.329999E+07	122222.
37000.000	1000.00	330.00	10.00	.329999E+07	122222.
38000.000	1000.00	330.00	10.00	.329999E+07	122222.
39000.000	1000.00	330.00	10.00	.329999E+07	122222.
40000.000	1000.00	330.00	10.00	.329999E+07	122222.
41000.000	1000.00	330.00	10.00	.329999E+07	122222.
42000.000	1000.00	330.00	10.00	.329999E+07	122222.
43000.000	1000.00	330.00	10.00	.329999E+07	122222.
44000.000	1000.00	330.00	10.00	.329999E+07	122222.
45000.000	1000.00	330.00	10.00	.329999E+07	122222.
46000.000	1000.00	330.00	10.00	.329999E+07	122222.
47000.000	1000.00	330.00	10.00	.329999E+07	122222.
48000.000	1000.00	330.00	10.00	.329999E+07	122222.
49000.000	1000.00	330.00	10.00	.329999E+07	122222.
50000.000	1000.00	330.00	10.00	.329999E+07	122222.
51000.000	1000.00	330.00	10.00	.329999E+07	122222.
52000.000	1000.00	330.00	10.00	.329999E+07	122222.
53000.000	1000.00	330.00	10.00	.329999E+07	122222.
54000.000	1000.00	330.00	10.00	.329999E+07	122222.
55000.000	1000.00	330.00	10.00	.329999E+07	122222.
56000.000	1000.00	330.00	10.00	.329999E+07	122222.
57000.000	1000.00	330.00	10.00	.329999E+07	122222.
58000.000	1000.00	330.00	10.00	.329999E+07	122222.
59000.000	1000.00	330.00	10.00	.329999E+07	122222.
60000.000	1000.00	330.00	10.00	.329999E+07	122222.
000.000	500.00	330.00	10.00	.165000E+07	61111.0

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 112 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

'L NO. OF TIME STEPS READ = 1
.L NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
END OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.02	61000.000	23.23			37.88		
TOTAL=	34000.000	23.23	11.61	.50	37.88	3.38	.91

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

	TOTAL	VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1581034.35	.00	.00	79051.72	1501982.63	
SANDS & GRAVELS	3689080.15	110672.40	110672.40	110672.40	184454.01	184454.01
		221344.81	442689.62	885379.24	811597.63	627143.63
TOTAL LOAD	5270114.50					
SEDIMENT OUTFLOW						
SILT	1581034.35	.00	.00	79051.72	1501982.63	
SANDS & GRAVELS	657368.46	186248.98	155133.24	106925.15	57988.32	44977.85
		2206.18	7873.31	23495.69	37995.12	34524.62
TOTAL LOAD	2238402.81					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	3.51	1584.09	1585.14	7050.	1581034.	1100835.
60000.000	-.02	1544.11	1541.61	7050.	1581034.	1131400.
59000.000	-.02	1504.10	1501.61	7050.	1581034.	1161883.
58000.000	-.02	1464.11	1461.61	7050.	1581034.	1186200.
57000.000	-.01	1424.09	1421.62	7050.	1581034.	1205323.
56000.000	-.01	1384.11	1381.62	7050.	1581034.	1221743.
55000.000	-.01	1344.09	1341.62	7050.	1581034.	1235305.
54000.000	-.01	1304.11	1301.62	7050.	1581034.	1248422.
53000.000	-.01	1264.10	1261.62	7050.	1581034.	1259929.
52000.000	-.01	1224.11	1221.62	7050.	1581034.	1271226.
51000.000	-.01	1184.09	1181.62	7050.	1581034.	1281103.
50000.000	-.01	1144.11	1141.62	7050.	1581034.	1290852.
49000.000	-.01	1104.09	1101.62	7050.	1581034.	1299271.
48000.000	-.01	1064.11	1061.62	7050.	1581034.	1307712.
47000.000	.00	1024.10	1021.63	7050.	1581034.	1315003.
46000.000	-.01	984.11	981.62	7050.	1581034.	1322448.
45000.000	.00	944.09	941.63	7050.	1581034.	1328788.
44000.000	.00	904.11	901.63	7050.	1581034.	1335277.
43000.000	.00	864.09	861.63	7050.	1581034.	1340685.
700.000	.00	824.11	821.63	7050.	1581034.	1346340.
00.000	.00	784.10	781.63	7050.	1581034.	1351198.
40000.000	.00	744.10	741.63	7050.	1581034.	1356209.
39000.000	.00	704.08	701.63	7050.	1581034.	1360174.
38000.000	.00	664.11	661.63	7050.	1581034.	1364480.
37000.000	.00	624.10	621.63	7050.	1581034.	1369488.

36000.000	.00	584.01	581.63	7050.	1581034.	1371431.
35000.000	.01	544.10	541.62	7050.	1581034.	1389653.
34000.000	.99	504.04	502.62	7050.	1581034.	657368.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	109618.	76733.	32886.	0.	98594.				
61000.000	27891.	11449.	16443.	0.	70737.	70737.	51999.	18738.	0.
60000.000	28209.	11767.	16443.	0.	-253.	70484.	-253.	0.	0.
59000.000	28526.	12084.	16443.	0.	-253.	70231.	-253.	0.	0.
58000.000	28779.	12336.	16443.	0.	-201.	70030.	-201.	0.	0.
57000.000	28978.	12535.	16443.	0.	-158.	69871.	-158.	0.	0.
56000.000	29149.	12706.	16443.	0.	-136.	69735.	-136.	0.	0.
55000.000	29290.	12847.	16443.	0.	-112.	69623.	-112.	0.	0.
54000.000	29426.	12984.	16443.	0.	-109.	69514.	-109.	0.	0.
53000.000	29546.	13103.	16443.	0.	-95.	69419.	-95.	0.	0.
52000.000	29664.	13221.	16443.	0.	-94.	69325.	-94.	0.	0.
51000.000	29766.	13323.	16443.	0.	-82.	69243.	-82.	0.	0.
50000.000	29868.	13425.	16443.	0.	-81.	69163.	-81.	0.	0.
49000.000	29955.	13512.	16443.	0.	-70.	69093.	-70.	0.	0.
48000.000	30043.	13600.	16443.	0.	-70.	69023.	-70.	0.	0.
47000.000	30119.	13676.	16443.	0.	-60.	68963.	-60.	0.	0.
0.000	30196.	13753.	16443.	0.	-62.	68901.	-62.	0.	0.
0.000	30262.	13819.	16443.	0.	-53.	68848.	-53.	0.	0.
44000.000	30330.	13887.	16443.	0.	-54.	68795.	-54.	0.	0.
43000.000	30386.	13943.	16443.	0.	-45.	68750.	-45.	0.	0.
42000.000	30445.	14002.	16443.	0.	-47.	68703.	-47.	0.	0.
41000.000	30495.	14052.	16443.	0.	-40.	68663.	-40.	0.	0.
40000.000	30547.	14105.	16443.	0.	-42.	68621.	-42.	0.	0.
39000.000	30589.	14146.	16443.	0.	-33.	68588.	-33.	0.	0.
38000.000	30633.	14191.	16443.	0.	-36.	68553.	-36.	0.	0.
37000.000	30685.	14243.	16443.	0.	-41.	68511.	-41.	0.	0.
36000.000	30706.	14263.	16443.	0.	-16.	68495.	-16.	0.	0.
35000.000	30895.	14452.	16443.	0.	-151.	68344.	-151.	0.	0.
34000.000	23279.	6837.	16443.	0.	6066.	74410.	6066.	0.	0.

JOB COMPLETED
RUN TIME = 0 HOURS, 0 MINUTES & 2.09 SECONDS

```
**************************************************      **********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *      *  U.S. ARMY CORPS OF ENGINEERS  *
*       Version: 4.0.6  -  June 1991              *      *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  FAN4000.DAT                       *      *  609 SECOND STREET              *
*  OUTPUT FILE: FAN4000.OUT                       *      *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 04JUN92      RUN TIME: 11:09:34      *      *  (916) 756-1104                 *
**************************************************      **********************************

          X     X  XXXXXXX   XXXXX          XXXXX
          X     X  X        X     X        X     X
          X     X  X        X              X
          XXXXXXX  XXXX     X        XXXXX  XXXXX
          X     X  X        X              X     X
          X     X  X        X     X        X     X
          X     X  XXXXXXX  XXXXX          XXXXX

          **********************************************************************
          *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
          *       10  Stream Segments (Main Stem + Tributaries)                *
          *      150  Cross Sections                                           *
          *      100  Elevation/Station Points per Cross Section               *
          *       15  Grain Sizes                                              *
          *       10  Control Points                                           *
          **********************************************************************

T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
        11/14/91    4000 CFS SINGLE FAN FLOW  N = .022

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

TION NO.  8 RIVER MILE=  41000.000
 d    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 4000 CFS

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

==========================================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91     4000 CFS SINGLE FAN FLOW  N = .022

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ       SPGF      ACGR      NFALL     IBSHER
I1     10.        3       1      1.000    32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SILT IS PRESENT

       MTCL    IASL    LASL     SGSL     PUSDLB     UWSDLB     CCSDLB
I3      1       1       4      2.650     82.000     65.000      5.700

 'POSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
              LAYER      STRESS
               NO.       lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4      4         1       10      2.650       .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

   .OWING GRAIN SIZES UTILIZED (MM)
SILT:      .0056      .0110      .0220      .0440
SAND:      .0880      .1770      .3540      .7070     1.4140
          2.8280     5.6570    11.3140    22.6270    45.2550
```

MENT LOAD TABLE FOR STREAM SEGMENT # 1
BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		262.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		262.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		262.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		262.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		262.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		262.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		262.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		262.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		262.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		262.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		262.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		262.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
3.000		262.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		262.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		262.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		262.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
50000.000		262.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
51000.000		262.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		262.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		262.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		262.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		262.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		262.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		262.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		262.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		262.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		262.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		262.00	1581.63	1581.63	1581.63	27000.00	5.11

MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	262.00	10.00	.131000E+07	48518.4
[illegible]000.000	1000.00	262.00	10.00	.261999E+07	97036.9
[illegible]00.000	1000.00	262.00	10.00	.261999E+07	97036.9
[illegible]7000.000	1000.00	262.00	10.00	.261999E+07	97036.9
38000.000	1000.00	262.00	10.00	.261999E+07	97036.9
39000.000	1000.00	262.00	10.00	.261999E+07	97036.9
40000.000	1000.00	262.00	10.00	.261999E+07	97036.9
41000.000	1000.00	262.00	10.00	.261999E+07	97036.9
42000.000	1000.00	262.00	10.00	.261999E+07	97036.9
43000.000	1000.00	262.00	10.00	.261999E+07	97036.9
44000.000	1000.00	262.00	10.00	.261999E+07	97036.9
45000.000	1000.00	262.00	10.00	.261999E+07	97036.9
46000.000	1000.00	262.00	10.00	.261999E+07	97036.9
47000.000	1000.00	262.00	10.00	.261999E+07	97036.9
48000.000	1000.00	262.00	10.00	.261999E+07	97036.9
49000.000	1000.00	262.00	10.00	.261999E+07	97036.9
50000.000	1000.00	262.00	10.00	.261999E+07	97036.9
51000.000	1000.00	262.00	10.00	.261999E+07	97036.9
52000.000	1000.00	262.00	10.00	.261999E+07	97036.9
53000.000	1000.00	262.00	10.00	.261999E+07	97036.9
54000.000	1000.00	262.00	10.00	.261999E+07	97036.9
55000.000	1000.00	262.00	10.00	.261999E+07	97036.9
56000.000	1000.00	262.00	10.00	.261999E+07	97036.9
57000.000	1000.00	262.00	10.00	.261999E+07	97036.9
58000.000	1000.00	262.00	10.00	.261999E+07	97036.9
59000.000	1000.00	262.00	10.00	.261999E+07	97036.9
[illegible]0000.000	1000.00	262.00	10.00	.261999E+07	97036.9
[illegible]00.000	500.00	262.00	10.00	.131000E+07	48518.4

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 112 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

NO. OF TIME STEPS READ = 1
NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
END OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.02	61000.000	9.93			16.19		
TOTAL=	34000.000	9.93	4.96	.50	16.19	1.47	.91

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	675690.30	.00	.00	33784.52	641905.79	
SANDS & GRAVELS	1576610.70	47298.32	47298.32	47298.32	78830.53	78830.53
		94596.64	189193.28	378386.57	346854.35	268023.82
TOTAL LOAD	2252301.00					
SEDIMENT OUTFLOW						
SILT	675690.30	.00	.00	33784.52	641905.79	
SANDS & GRAVELS	286810.37	111043.62	76697.39	31655.76	15227.25	12613.54
		1067.79	3662.21	10279.23	14802.88	9760.71
TOTAL LOAD	962500.67					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	1.83	1583.62	1583.46	4000.	675690.	506816.
60000.000	-.02	1543.60	1541.61	4000.	675690.	524762.
59000.000	-.02	1503.62	1501.61	4000.	675690.	542570.
58000.000	-.01	1463.60	1461.62	4000.	675690.	556831.
57000.000	-.01	1423.62	1421.62	4000.	675690.	568731.
56000.000	-.01	1383.60	1381.62	4000.	675690.	579062.
55000.000	-.01	1343.62	1341.62	4000.	675690.	588672.
54000.000	-.01	1303.60	1301.62	4000.	675690.	597024.
53000.000	-.01	1263.62	1261.62	4000.	675690.	604862.
52000.000	-.01	1223.60	1221.62	4000.	675690.	611600.
51000.000	-.01	1183.62	1181.62	4000.	675690.	617993.
50000.000	.00	1143.60	1141.63	4000.	675690.	623473.
49000.000	.00	1103.62	1101.63	4000.	675690.	628774.
48000.000	.00	1063.60	1061.63	4000.	675690.	633270.
47000.000	.00	1023.62	1021.63	4000.	675690.	637644.
46000.000	.00	983.60	981.63	4000.	675690.	641264.
45000.000	.00	943.62	941.63	4000.	675690.	644847.
44000.000	.00	903.60	901.63	4000.	675690.	647792.
43000.000	.00	863.62	861.63	4000.	675690.	650805.
42000.000	.00	823.60	821.63	4000.	675690.	653234.
41000.000	.00	783.62	781.63	4000.	675690.	655740.
40000.000	.00	743.60	741.63	4000.	675690.	657670.
39000.000	.00	703.62	701.63	4000.	675690.	659725.
38000.000	.00	663.60	661.63	4000.	675690.	661287.
37000.000	.00	623.62	621.63	4000.	675690.	663050.

36000.000	.00	583.60	581.63	4000.	675690.	664430.
35000.000	-.01	543.60	541.62	4000.	675690.	672101.
34000.000	.66	503.59	502.29	4000.	675690.	286810.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	46848.	32794.	14054.	0.	42136.				
61000.000	12298.	5271.	7027.	0.	29930.	29930.	21922.	8008.	0.
60000.000	12485.	5458.	7027.	0.	-149.	29781.	-149.	0.	0.
59000.000	12670.	5643.	7027.	0.	-148.	29634.	-148.	0.	0.
58000.000	12818.	5791.	7027.	0.	-118.	29516.	-118.	0.	0.
57000.000	12942.	5915.	7027.	0.	-99.	29417.	-99.	0.	0.
56000.000	13049.	6022.	7027.	0.	-86.	29331.	-86.	0.	0.
55000.000	13149.	6122.	7027.	0.	-80.	29252.	-80.	0.	0.
54000.000	13236.	6209.	7027.	0.	-69.	29183.	-69.	0.	0.
53000.000	13318.	6291.	7027.	0.	-65.	29118.	-65.	0.	0.
52000.000	13388.	6361.	7027.	0.	-56.	29062.	-56.	0.	0.
51000.000	13454.	6427.	7027.	0.	-53.	29009.	-53.	0.	0.
50000.000	13511.	6484.	7027.	0.	-45.	28963.	-45.	0.	0.
49000.000	13566.	6539.	7027.	0.	-44.	28920.	-44.	0.	0.
48000.000	13613.	6586.	7027.	0.	-37.	28882.	-37.	0.	0.
47000.000	13659.	6631.	7027.	0.	-36.	28846.	-36.	0.	0.
46000.000	13696.	6669.	7027.	0.	-30.	28816.	-30.	0.	0.
45000.000	13734.	6706.	7027.	0.	-30.	28786.	-30.	0.	0.
44000.000	13764.	6737.	7027.	0.	-24.	28762.	-24.	0.	0.
43000.000	13796.	6768.	7027.	0.	-25.	28737.	-25.	0.	0.
42000.000	13821.	6794.	7027.	0.	-20.	28717.	-20.	0.	0.
41000.000	13847.	6820.	7027.	0.	-21.	28696.	-21.	0.	0.
40000.000	13867.	6840.	7027.	0.	-16.	28680.	-16.	0.	0.
39000.000	13888.	6861.	7027.	0.	-17.	28663.	-17.	0.	0.
38000.000	13905.	6877.	7027.	0.	-13.	28650.	-13.	0.	0.
37000.000	13923.	6896.	7027.	0.	-15.	28636.	-15.	0.	0.
36000.000	13937.	6910.	7027.	0.	-11.	28624.	-11.	0.	0.
35000.000	14017.	6990.	7027.	0.	-64.	28561.	-64.	0.	0.
34000.000	10010.	2983.	7027.	0.	3192.	31752.	3192.	0.	0.

JOB COMPLETED
RUN TIME = 0 HOURS, 0 MINUTES & 1.82 SECONDS

```
**************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
   INPUT FILE:  FAN1500.DAT                       *
    JTPUT FILE: FAN1500.OUT                       *
   RUN DATE: 04JUN92       RUN TIME: 11:09:30     *
**************************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX  XXXXX          XXXXX
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 1500 CFS

```
**********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
*       10  Stream Segments (Main Stem + Tributaries)                *
*      150  Cross Sections                                           *
*      100  Elevation/Station Points per Cross Section               *
*       15  Grain Sizes                                              *
*       10  Control Points                                           *
**********************************************************************
```

```
T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
        11/14/91    1500 CFS SINGLE FAN FLOW N = .022

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

TION NO.  8 RIVER MILE=  41000.000
dd    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA
```

```
T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91     1500 CFS SINGLE FAN FLOW N = .022

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ       SPGF       ACGR      NFALL     IBSHER
I1     10.        3       1      1.000     32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SILT IS PRESENT

       MTCL     IASL     LASL      SGSL     PUSDLB     UWSDLB     CCSDLB
I3        1        1        4     2.650     82.000     65.000      5.700
```

```
OSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
              LAYER      STRESS
               NO.      lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4        4        1       10     2.650      .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG
```

```
 ING GRAIN SIZES UTILIZED (MM)
SILT:      .0056      .0110      .0220      .0440
SAND:      .0880      .1770      .3540      .7070     1.4140
          2.8280     5.6570    11.3140    22.6270    45.2550
```

'MENT LOAD TABLE FOR STREAM SEGMENT # 1
BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		177.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		177.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		177.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		177.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		177.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		177.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		177.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		177.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		177.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		177.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		177.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		177.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
.000		177.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		177.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		177.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		177.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]00.000		177.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
51000.000		177.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		177.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		177.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		177.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		177.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		177.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		177.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		177.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		177.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		177.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		177.00	1581.63	1581.63	1581.63	27000.00	5.11

BED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXP1 (ft)	XP1	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
						.140	.240	.230	.150		

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	177.00	10.00	884997.	32777.7
[illegible]000.000	1000.00	177.00	10.00	.176999E+07	65555.4
00.000	1000.00	177.00	10.00	.176999E+07	65555.4
37000.000	1000.00	177.00	10.00	.176999E+07	65555.4
38000.000	1000.00	177.00	10.00	.176999E+07	65555.4
39000.000	1000.00	177.00	10.00	.176999E+07	65555.4
40000.000	1000.00	177.00	10.00	.176999E+07	65555.4
41000.000	1000.00	177.00	10.00	.176999E+07	65555.4
42000.000	1000.00	177.00	10.00	.176999E+07	65555.4
43000.000	1000.00	177.00	10.00	.176999E+07	65555.4
44000.000	1000.00	177.00	10.00	.176999E+07	65555.4
45000.000	1000.00	177.00	10.00	.176999E+07	65555.4
46000.000	1000.00	177.00	10.00	.176999E+07	65555.4
47000.000	1000.00	177.00	10.00	.176999E+07	65555.4
48000.000	1000.00	177.00	10.00	.176999E+07	65555.4
49000.000	1000.00	177.00	10.00	.176999E+07	65555.4
50000.000	1000.00	177.00	10.00	.176999E+07	65555.4
51000.000	1000.00	177.00	10.00	.176999E+07	65555.4
52000.000	1000.00	177.00	10.00	.176999E+07	65555.4
53000.000	1000.00	177.00	10.00	.176999E+07	65555.4
54000.000	1000.00	177.00	10.00	.176999E+07	65555.4
55000.000	1000.00	177.00	10.00	.176999E+07	65555.4
56000.000	1000.00	177.00	10.00	.176999E+07	65555.4
57000.000	1000.00	177.00	10.00	.176999E+07	65555.4
58000.000	1000.00	177.00	10.00	.176999E+07	65555.4
59000.000	1000.00	177.00	10.00	.176999E+07	65555.4
60000.000	1000.00	177.00	10.00	.176999E+07	65555.4
00.000	500.00	177.00	10.00	884997.	32777.7

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

....

$$END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
[illegible]F JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

IME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.02	61000.000	2.28			3.72		
TOTAL=	34000.000	2.28	1.14	.50	3.72	.44	.88

TABLE S8-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

	TOTAL	VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	155165.40	.00	.00	7758.27	147407.13	
SANDS & GRAVELS	362052.60	10861.58	10861.58	10861.58	18102.63	18102.63
		21723.16	43446.31	86892.62	79651.57	61548.94
TOTAL LOAD	517218.00					
SEDIMENT OUTFLOW						
SILT	155165.40	.00	.00	7758.27	147407.13	
SANDS & GRAVELS	85055.26	42479.14	21891.87	4996.87	2705.57	2523.07
		454.69	1448.10	3613.89	4065.81	876.25
TOTAL LOAD	240220.66					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	.54	1582.98	1582.17	1500.	155165.	149020.
60000.000	-.01	1543.00	1541.62	1500.	155165.	157833.
59000.000	-.01	1503.00	1501.62	1500.	155165.	166338.
58000.000	-.01	1462.98	1461.62	1500.	155165.	174166.
57000.000	-.01	1423.01	1421.62	1500.	155165.	181484.
56000.000	-.01	1383.00	1381.62	1500.	155165.	187502.
55000.000	-.01	1342.98	1341.62	1500.	155165.	192408.
54000.000	-.01	1303.00	1301.62	1500.	155165.	196591.
53000.000	.00	1263.00	1261.63	1500.	155165.	200163.
52000.000	.00	1222.98	1221.63	1500.	155165.	203059.
51000.000	.00	1183.01	1181.63	1500.	155165.	205584.
50000.000	.00	1143.00	1141.63	1500.	155165.	207776.
49000.000	.00	1102.98	1101.63	1500.	155165.	209506.
48000.000	.00	1063.00	1061.63	1500.	155165.	211033.
47000.000	.00	1023.00	1021.63	1500.	155165.	212377.
46000.000	.00	982.98	981.63	1500.	155165.	213398.
45000.000	.00	943.01	941.63	1500.	155165.	214341.
44000.000	.00	903.00	901.63	1500.	155165.	215198.
43000.000	.00	862.98	861.63	1500.	155165.	215797.
42000.000	.00	823.00	821.63	1500.	155165.	216368.
41000.000	.00	783.00	781.63	1500.	155165.	216902.
40000.000	.00	742.98	741.63	1500.	155165.	217235.
39000.000	.00	703.01	701.63	1500.	155165.	217597.
38000.000	.00	663.00	661.63	1500.	155165.	217960.
37000.000	.00	622.98	621.63	1500.	155165.	218422.
36000.000	.00	582.90	581.63	1500.	155165.	218319.
35000.000	.00	543.00	541.63	1500.	155165.	220158.
34000.000	.34	502.94	501.97	1500.	155165.	85055.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	10758.	7531.	3227.	0.	9676.				
61000.000	3164.	1550.	1614.	0.	6603.	6603.	4764.	1839.	0.
60000.000	3255.	1641.	1614.	0.	-73.	6530.	-73.	0.	0.
59000.000	3344.	1730.	1614.	0.	-70.	6459.	-70.	0.	0.
58000.000	3425.	1811.	1614.	0.	-65.	6394.	-65.	0.	0.
57000.000	3501.	1887.	1614.	0.	-61.	6334.	-61.	0.	0.
56000.000	3564.	1950.	1614.	0.	-50.	6284.	-50.	0.	0.
55000.000	3615.	2001.	1614.	0.	-41.	6243.	-41.	0.	0.
54000.000	3658.	2045.	1614.	0.	-35.	6209.	-35.	0.	0.
53000.000	3695.	2082.	1614.	0.	-30.	6179.	-30.	0.	0.
52000.000	3726.	2112.	1614.	0.	-24.	6155.	-24.	0.	0.
51000.000	3752.	2138.	1614.	0.	-21.	6134.	-21.	0.	0.
50000.000	3775.	2161.	1614.	0.	-18.	6116.	-18.	0.	0.
49000.000	3793.	2179.	1614.	0.	-14.	6102.	-14.	0.	0.
48000.000	3808.	2195.	1614.	0.	-13.	6089.	-13.	0.	0.
47000.000	3822.	2209.	1614.	0.	-11.	6078.	-11.	0.	0.
46000.000	3833.	2219.	1614.	0.	-8.	6069.	-8.	0.	0.
45000.000	3843.	2229.	1614.	0.	-8.	6062.	-8.	0.	0.
[illegible]000.000	3852.	2238.	1614.	0.	-7.	6055.	-7.	0.	0.
[illegible].000	3858.	2244.	1614.	0.	-5.	6050.	-5.	0.	0.
[illegible]0.000	3864.	2250.	1614.	0.	-5.	6045.	-5.	0.	0.
41000.000	3869.	2256.	1614.	0.	-4.	6040.	-4.	0.	0.
40000.000	3873.	2259.	1614.	0.	-3.	6038.	-3.	0.	0.
39000.000	3877.	2263.	1614.	0.	-3.	6035.	-3.	0.	0.
38000.000	3881.	2267.	1614.	0.	-3.	6032.	-3.	0.	0.
37000.000	3885.	2272.	1614.	0.	-4.	6028.	-4.	0.	0.
36000.000	3884.	2271.	1614.	0.	1.	6029.	1.	0.	0.
35000.000	3903.	2290.	1614.	0.	-15.	6013.	-15.	0.	0.
34000.000	2498.	885.	1614.	0.	1119.	7133.	1119.	0.	0.

JOB COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 1.82 SECONDS

```
**************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
   INPUT FILE:  FAN500.DAT                        *
    UTPUT FILE: FAN500.OUT                        *
*  RUN DATE: 04JUN92       RUN TIME: 11:09:27     *
**************************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX  XXXXX          XXXXX
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 500 CFS

```
**********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
*       10  Stream Segments (Main Stem + Tributaries)                *
*      150  Cross Sections                                           *
*      100  Elevation/Station Points per Cross Section               *
*       15  Grain Sizes                                              *
*       10  Control Points                                           *
**********************************************************************
```

```
T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
        BOYLE ENGINEERING CORPORATION     DN N07 300 10
        11/14/91     500 CFS SINGLE FAN FLOW N = .022

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

ION NO.  8 RIVER MILE=  41000.000
dd    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA
```

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T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91      500 CFS SINGLE FAN FLOW N = .022
```

- - - -

IMENT LOAD TABLE FOR STREAM SEGMENT # 1
BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		114.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		114.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		114.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		114.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		114.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		114.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		114.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		114.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		114.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		114.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		114.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		114.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
3.000		114.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		114.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		114.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		114.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]0.000		114.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
5[illegible].000		114.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		114.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		114.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		114.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		114.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		114.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		114.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		114.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		114.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		114.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		114.00	1581.63	1581.63	1581.63	27000.00	5.11

BED MATERIAL GRADATION (as computed from PF-records)

[illegible]ECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
[illegible] ****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150		
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	******	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	114.00	10.00	569997.	21111.0
[illegible]000.000	1000.00	114.00	10.00	.113999E+07	42222.0
[illegible]00.000	1000.00	114.00	10.00	.113999E+07	42222.0
[illegible]000.000	1000.00	114.00	10.00	.113999E+07	42222.0
38000.000	1000.00	114.00	10.00	.113999E+07	42222.0
39000.000	1000.00	114.00	10.00	.113999E+07	42222.0
40000.000	1000.00	114.00	10.00	.113999E+07	42222.0
41000.000	1000.00	114.00	10.00	.113999E+07	42222.0
42000.000	1000.00	114.00	10.00	.113999E+07	42222.0
43000.000	1000.00	114.00	10.00	.113999E+07	42222.0
44000.000	1000.00	114.00	10.00	.113999E+07	42222.0
45000.000	1000.00	114.00	10.00	.113999E+07	42222.0
46000.000	1000.00	114.00	10.00	.113999E+07	42222.0
47000.000	1000.00	114.00	10.00	.113999E+07	42222.0
48000.000	1000.00	114.00	10.00	.113999E+07	42222.0
49000.000	1000.00	114.00	10.00	.113999E+07	42222.0
50000.000	1000.00	114.00	10.00	.113999E+07	42222.0
51000.000	1000.00	114.00	10.00	.113999E+07	42222.0
52000.000	1000.00	114.00	10.00	.113999E+07	42222.0
53000.000	1000.00	114.00	10.00	.113999E+07	42222.0
54000.000	1000.00	114.00	10.00	.113999E+07	42222.0
55000.000	1000.00	114.00	10.00	.113999E+07	42222.0
56000.000	1000.00	114.00	10.00	.113999E+07	42222.0
57000.000	1000.00	114.00	10.00	.113999E+07	42222.0
58000.000	1000.00	114.00	10.00	.113999E+07	42222.0
59000.000	1000.00	114.00	10.00	.113999E+07	42222.0
60000.000	1000.00	114.00	10.00	.113999E+07	42222.0
[illegible]00.000	500.00	114.00	10.00	569997.	21111.0

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
[illegible]F JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

IME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.02	61000.000	.44			.72		
TOTAL=	34000.000	.44	.22	.50	.72	.11	.84

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	29861.70	.00	.00	1493.09	28368.62	
SANDS & GRAVELS	69677.30	2090.32	2090.32	2090.32	3483.86	3483.86
		4180.64	8361.28	16722.55	15329.01	11845.14
TOTAL LOAD	99539.00					
SEDIMENT OUTFLOW						
SILT	29861.70	.00	.00	1493.09	28368.62	
SANDS & GRAVELS	22166.40	13090.62	4401.46	877.91	567.43	580.25
		193.50	558.40	1156.55	740.28	.00
TOTAL LOAD	52028.10					

_CTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	.11	1582.50	1581.74	500.	29862.	40962.
60000.000	-.01	1542.51	1541.62	500.	29862.	46183.
59000.000	-.01	1502.52	1501.62	500.	29862.	50941.
58000.000	-.01	1462.52	1461.62	500.	29862.	55271.
57000.000	-.01	1422.51	1421.62	500.	29862.	58289.
56000.000	.00	1382.50	1381.63	500.	29862.	60407.
55000.000	.00	1342.50	1341.63	500.	29862.	61893.
54000.000	.00	1302.51	1301.63	500.	29862.	62940.
53000.000	.00	1262.52	1261.63	500.	29862.	63683.
52000.000	.00	1222.52	1221.63	500.	29862.	64213.
51000.000	.00	1182.51	1181.63	500.	29862.	64590.
50000.000	.00	1142.50	1141.63	500.	29862.	64851.
49000.000	.00	1102.50	1101.63	500.	29862.	65029.
48000.000	.00	1062.51	1061.63	500.	29862.	65153.
47000.000	.00	1022.52	1021.63	500.	29862.	65245.
46000.000	.00	982.52	981.63	500.	29862.	65316.
45000.000	.00	942.51	941.63	500.	29862.	65368.
44000.000	.00	902.50	901.63	500.	29862.	65401.
43000.000	.00	862.50	861.63	500.	29862.	65418.
42000.000	.00	822.51	821.63	500.	29862.	65427.
41000.000	.00	782.52	781.63	500.	29862.	65439.
40000.000	.00	742.52	741.63	500.	29862.	65453.
100.000	.00	702.51	701.63	500.	29862.	65466.
00.000	.00	662.50	661.63	500.	29862.	65470.
37000.000	.00	622.50	621.63	500.	29862.	65579.
36000.000	.00	582.41	581.63	500.	29862.	65436.
35000.000	.00	542.54	541.63	500.	29862.	65849.
34000.000	.17	502.49	501.80	500.	29862.	22166.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	2070.	1449.	621.	0.	1862.				
61000.000	737.	426.	311.	0.	1169.	1169.	815.	354.	0.
60000.000	791.	480.	311.	0.	-43.	1126.	-43.	0.	0.
59000.000	840.	530.	311.	0.	-39.	1086.	-39.	0.	0.
58000.000	885.	575.	311.	0.	-36.	1050.	-36.	0.	0.
57000.000	917.	606.	311.	0.	-25.	1025.	-25.	0.	0.
56000.000	939.	628.	311.	0.	-18.	1008.	-18.	0.	0.
55000.000	954.	644.	311.	0.	-12.	996.	-12.	0.	0.
54000.000	965.	655.	311.	0.	-9.	987.	-9.	0.	0.
53000.000	973.	662.	311.	0.	-6.	981.	-6.	0.	0.
52000.000	978.	668.	311.	0.	-4.	976.	-4.	0.	0.
51000.000	982.	672.	311.	0.	-3.	973.	-3.	0.	0.
50000.000	985.	674.	311.	0.	-2.	971.	-2.	0.	0.
49000.000	987.	676.	311.	0.	-1.	970.	-1.	0.	0.
48000.000	988.	678.	311.	0.	-1.	969.	-1.	0.	0.
47000.000	989.	679.	311.	0.	-1.	968.	-1.	0.	0.
46000.000	990.	679.	311.	0.	-1.	967.	-1.	0.	0.
45000.000	990.	680.	311.	0.	0.	967.	0.	0.	0.
'000.000	991.	680.	311.	0.	0.	967.	0.	0.	0.
1.000	991.	680.	311.	0.	0.	966.	0.	0.	0.
40.000	991.	680.	311.	0.	0.	966.	0.	0.	0.
41000.000	991.	681.	311.	0.	0.	966.	0.	0.	0.
40000.000	991.	681.	311.	0.	0.	966.	0.	0.	0.
39000.000	991.	681.	311.	0.	0.	966.	0.	0.	0.
38000.000	991.	681.	311.	0.	0.	966.	0.	0.	0.
37000.000	993.	682.	311.	0.	-1.	965.	-1.	0.	0.
36000.000	991.	681.	311.	0.	1.	966.	1.	0.	0.
35000.000	995.	685.	311.	0.	-3.	963.	-3.	0.	0.
34000.000	541.	231.	311.	0.	362.	1325.	362.	0.	0.

JOB COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 1.81 SECONDS

```
*************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*        Version: 4.0.6  -  June 1991             *
   INPUT FILE:  FAN150.DAT                        *
    JTPUT FILE: FAN150.OUT                        *
   RUN DATE: 04JUN92       RUN TIME: 11:09:24     *
*************************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX   XXXXX          XXXXX
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 150 CFS

```
**********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
*       10  Stream Segments (Main Stem + Tributaries)                *
*      150  Cross Sections                                           *
*      100  Elevation/Station Points per Cross Section               *
*       15  Grain Sizes                                              *
*       10  Control Points                                           *
**********************************************************************
```

```
T1
       BOYLE ENGINEERING CORPORATION     DN NO7 300 10
       11/14/91     150 CFS SINGLE FAN FLOW  N = .022

NC  .0220    .0220    .0220    .1000    .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

 TION NO.  8 RIVER MILE=  41000.000
  d    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 28 RIVER MILE= 61000.000
...Add 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA
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T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER

BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91      150 CFS SINGLE FAN FLOW  N = .022
```

- -

SEDIMENT PROPERITES AND PARAMETERS

	SPI	IBG	MNQ	SPGF	ACGR	NFALL	IBSHER
I1	10.	3	1	1.000	32.174	2	1

- -

SILT IS PRESENT

	MTCL	IASL	LASL	SGSL	PUSDLB	UWSDLB	CCSDLB
I3	1	1	4	2.650	82.000	65.000	5.700

'OSITION COEFFICIENTS BY LAYER

LAYER NO.	DEPOSITION THRESHOLD SHEAR STRESS lb/sq.ft
ACTIVE LAYER 1	.0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)

34000.000	1	35000.000	1	36000.000	1	37000.000	1	38000.000	1
39000.000	1	40000.000	1	41000.000	1	42000.000	1	43000.000	1
44000.000	1	45000.000	1	46000.000	1	47000.000	1	48000.000	1
49000.000	1	50000.000	1	51000.000	1	52000.000	1	53000.000	1
54000.000	1	55000.000	1	56000.000	1	57000.000	1	58000.000	1
59000.000	1	60000.000	1	61000.000	1				

- -

SAND AND/OR GRAVEL ARE PRESENT

	MTC	IASA	LASA	SPGS	GSF	BSAE	PSI	UWDLB
I4	4	1	10	2.650	.667	.500	30.000	93.000

USING TRANSPORT CAPACITY RELATIONSHIP # 4, YANG

'ING GRAIN SIZES UTILIZED (MM)

SILT:	.0056	.0110	.0220	.0440	
SAND:	.0880	.1770	.3540	.7070	1.4140
	2.8280	5.6570	11.3140	22.6270	45.2550

'MENT LOAD TABLE FOR STREAM SEGMENT # 1
BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		70.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		70.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		70.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		70.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		70.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		70.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		70.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		70.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		70.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		70.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		70.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
[illegible]000.000		70.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
.000		70.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		70.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		70.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		70.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
[illegible]000.000		70.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
[illegible]000.000		70.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		70.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		70.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		70.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		70.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		70.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		70.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		70.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		70.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		70.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		70.00	1581.63	1581.63	1581.63	27000.00	5.11

MATERIAL GRADATION (as computed from PF-records)

SECID	SAE	DMAX	DXPI	XPI	TOTAL	BED MATERIAL FRACTIONS				
	(%)	(ft)	(ft)		BED	per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1:

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	70.00	10.00	349997.	12962.9
5000.000	1000.00	70.00	10.00	699995.	25925.7
00.000	1000.00	70.00	10.00	699995.	25925.7
37000.000	1000.00	70.00	10.00	699995.	25925.7
38000.000	1000.00	70.00	10.00	699995.	25925.7
39000.000	1000.00	70.00	10.00	699995.	25925.7
40000.000	1000.00	70.00	10.00	699995.	25925.7
41000.000	1000.00	70.00	10.00	699995.	25925.7
42000.000	1000.00	70.00	10.00	699995.	25925.7
43000.000	1000.00	70.00	10.00	699995.	25925.7
44000.000	1000.00	70.00	10.00	699995.	25925.7
45000.000	1000.00	70.00	10.00	699995.	25925.7
46000.000	1000.00	70.00	10.00	699995.	25925.7
47000.000	1000.00	70.00	10.00	699995.	25925.7
48000.000	1000.00	70.00	10.00	699995.	25925.7
49000.000	1000.00	70.00	10.00	699995.	25925.7
50000.000	1000.00	70.00	10.00	699995.	25925.7
51000.000	1000.00	70.00	10.00	699995.	25925.7
52000.000	1000.00	70.00	10.00	699995.	25925.7
53000.000	1000.00	70.00	10.00	699995.	25925.7
54000.000	1000.00	70.00	10.00	699995.	25925.7
55000.000	1000.00	70.00	10.00	699995.	25925.7
56000.000	1000.00	70.00	10.00	699995.	25925.7
57000.000	1000.00	70.00	10.00	699995.	25925.7
58000.000	1000.00	70.00	10.00	699995.	25925.7
59000.000	1000.00	70.00	10.00	699995.	25925.7
60000.000	1000.00	70.00	10.00	699995.	25925.7
00.000	500.00	70.00	10.00	349997.	12962.9

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

BEGIN COMPUTATIONS.
$HYD

---

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

$$END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1

ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

IME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.02	61000.000	.07			.12		
TOTAL=	34000.000	.07	.04	.50	.12	.03	.74

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

	TOTAL	VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	4906.80	.00	.00	245.34	4661.46	
SANDS & GRAVELS	11449.20	343.48	343.48	343.48	572.46	572.46
		686.95	1373.90	2747.81	2518.82	1946.36
TOTAL LOAD	16356.00					
SEDIMENT OUTFLOW						
SILT	4906.80	.00	.00	245.34	4661.46	
SANDS & GRAVELS	6041.77	3892.96	847.39	216.24	156.44	161.99
		94.49	238.90	378.84	54.52	.00
TOTAL LOAD	10948.57					

.TION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	.01	1582.20	1581.64	150.	4907.	9230.
60000.000	-.01	1542.22	1541.62	150.	4907.	11913.
59000.000	-.01	1502.20	1501.62	150.	4907.	13528.
58000.000	.00	1462.21	1461.63	150.	4907.	14283.
57000.000	.00	1422.19	1421.63	150.	4907.	14637.
56000.000	.00	1382.21	1381.63	150.	4907.	14818.
55000.000	.00	1342.20	1341.63	150.	4907.	14899.
54000.000	.00	1302.22	1301.63	150.	4907.	14948.
53000.000	.00	1262.20	1261.63	150.	4907.	14965.
52000.000	.00	1222.21	1221.63	150.	4907.	14982.
51000.000	.00	1182.19	1181.63	150.	4907.	14982.
50000.000	.00	1142.21	1141.63	150.	4907.	14989.
49000.000	.00	1102.20	1101.63	150.	4907.	14985.
48000.000	.00	1062.22	1061.63	150.	4907.	14992.
47000.000	.00	1022.20	1021.63	150.	4907.	14987.
46000.000	.00	982.21	981.63	150.	4907.	14993.
45000.000	.00	942.19	941.63	150.	4907.	14987.
44000.000	.00	902.21	901.63	150.	4907.	14992.
43000.000	.00	862.20	861.63	150.	4907.	14987.
42000.000	.00	822.22	821.63	150.	4907.	14992.
41000.000	.00	782.20	781.63	150.	4907.	14988.
40000.000	.00	742.21	741.63	150.	4907.	14993.
00.000	.00	702.19	701.63	150.	4907.	14995.
00.000	.00	662.19	661.63	150.	4907.	14991.
37000.000	.00	622.20	621.63	150.	4907.	15016.
36000.000	.00	582.12	581.63	150.	4907.	14991.
35000.000	.00	542.21	541.63	150.	4907.	15053.
34000.000	.06	502.14	501.69	150.	4907.	6042.

STREAM SEGMENT # 1:

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	340.	238.	102.	0.	306.				
61000.000	147.	96.	51.	0.	171.	171.	113.	58.	0.
60000.000	175.	124.	51.	0.	-22.	149.	-22.	0.	0.
59000.000	192.	141.	51.	0.	-13.	136.	-13.	0.	0.
58000.000	200.	149.	51.	0.	-6.	130.	-6.	0.	0.
57000.000	203.	152.	51.	0.	-3.	127.	-3.	0.	0.
56000.000	205.	154.	51.	0.	-1.	125.	-1.	0.	0.
55000.000	206.	155.	51.	0.	-1.	124.	-1.	0.	0.
54000.000	206.	155.	51.	0.	0.	124.	0.	0.	0.
53000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
52000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
51000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
50000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
49000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
48000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
47000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
46000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
45000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
44000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
43000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
42000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
41000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
40000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
39000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
38000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
37000.000	207.	156.	51.	0.	0.	123.	0.	0.	0.
36000.000	207.	156.	51.	0.	0.	124.	0.	0.	0.
35000.000	208.	157.	51.	0.	-1.	123.	-1.	0.	0.
34000.000	114.	63.	51.	0.	75.	198.	75.	0.	0.

JOB COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 1.81 SECONDS

```
**************************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
*  INPUT FILE:  FAN60.DAT                         *
*  OUTPUT FILE: FAN60.OUT                         *
*  RUN DATE: 04JUN92       RUN TIME: 11:09:21     *
**************************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

HEC - 6

FAN EQUILIBRIUM MODEL

SINGLE Q = 60 CFS

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX  XXXXX          XXXXX
```

```
**********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
*       10  Stream Segments (Main Stem + Tributaries)                *
*      150  Cross Sections                                           *
*      100  Elevation/Station Points per Cross Section               *
*       15  Grain Sizes                                              *
*       10  Control Points                                           *
**********************************************************************
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```
      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
      BOYLE ENGINEERING CORPORATION     ON NO7 300 10
      11/14/91      60 CFS SINGLE FAN FLOW N = .022

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)

TION NO.  8 RIVER MILE=  41000.000
dd    40.00 (ft) to each Elevation(Y)

SECTION NO.  9 RIVER MILE=  42000.000
...Add    40.00 (ft) to each Elevation(Y)
```

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

ION NO. 11 RIVER MILE= 44000.000
id 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
Add 40.00 (ft) to each Elevation(Y)

ION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

ION NO. 28 RIVER MILE= 61000.000
id 40.00 (ft) to each Elevation(Y)

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 28
NO. OF INPUT DATA MESSAGES = 0

```
TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

================================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91       60 CFS SINGLE FAN FLOW N = .022

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ       SPGF       ACGR      NFALL     IBSHER
I1     10.        3       1      1.000     32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SILT IS PRESENT

       MTCL    IASL    LASL     SGSL     PUSDLB     UWSDLB     CCSDLB
I3        1       1       4    2.650     82.000     65.000      5.700

   OSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
               LAYER    STRESS
                NO.    lb/sq.ft

  ACTIVE LAYER  1       .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 SAND AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4       4         1       10     2.650      .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG

   WING GRAIN SIZES UTILIZED (MM)
SILT:      .0056     .0110     .0220     .0440
SAND:      .0880     .1770     .3540     .7070    1.4140
          2.8280    5.6570   11.3140   22.6270   45.2550
```

MENT LOAD TABLE FOR STREAM SEGMENT # 1
) BY GRAIN SIZE CLASS (tons/day)

100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		49.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		49.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		49.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		49.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		49.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		49.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		49.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		49.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		49.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
43000.000		49.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		49.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		49.00	941.63	941.63	941.63	11000.00	2.08
	1000.00						
J.000		49.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		49.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		49.00	1061.63	1061.63	1061.63	14000.00	2.65

	1000.00						
49000.000		49.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
50000.000		49.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
51000.000		49.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		49.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		49.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		49.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		49.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		49.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		49.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		49.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		49.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
60000.000		49.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		49.00	1581.63	1581.63	1581.63	27000.00	5.11

MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

BED SEDIMENT CONTROL VOLUMES

SECTION	LENGTH	MAX. WIDTH	DEPTH	VOLUME

NUMBER	(ft)	(ft)	(ft)	(cu.ft)	(cu.yd)
34000.000	500.00	49.00	10.00	244997.	9073.98
5000.000	1000.00	49.00	10.00	489995.	18148.0
00.000	1000.00	49.00	10.00	489995.	18148.0
,000.000	1000.00	49.00	10.00	489995.	18148.0
38000.000	1000.00	49.00	10.00	489995.	18148.0
39000.000	1000.00	49.00	10.00	489995.	18148.0
40000.000	1000.00	49.00	10.00	489995.	18148.0
41000.000	1000.00	49.00	10.00	489995.	18148.0
42000.000	1000.00	49.00	10.00	489995.	18148.0
43000.000	1000.00	49.00	10.00	489995.	18148.0
44000.000	1000.00	49.00	10.00	489995.	18148.0
45000.000	1000.00	49.00	10.00	489995.	18148.0
46000.000	1000.00	49.00	10.00	489995.	18148.0
47000.000	1000.00	49.00	10.00	489995.	18148.0
48000.000	1000.00	49.00	10.00	489995.	18148.0
49000.000	1000.00	49.00	10.00	489995.	18148.0
50000.000	1000.00	49.00	10.00	489995.	18148.0
51000.000	1000.00	49.00	10.00	489995.	18148.0
52000.000	1000.00	49.00	10.00	489995.	18148.0
53000.000	1000.00	49.00	10.00	489995.	18148.0
54000.000	1000.00	49.00	10.00	489995.	18148.0
55000.000	1000.00	49.00	10.00	489995.	18148.0
56000.000	1000.00	49.00	10.00	489995.	18148.0
57000.000	1000.00	49.00	10.00	489995.	18148.0
58000.000	1000.00	49.00	10.00	489995.	18148.0
59000.000	1000.00	49.00	10.00	489995.	18148.0
60000.000	1000.00	49.00	10.00	489995.	18148.0
00.000	500.00	49.00	10.00	244997.	9073.98

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

* FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

.....

$$END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.
OF JOB

END OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.02	61000.000	.02			.03		
TOTAL=	34000.000	.02	.01	.50	.03	.00	.84

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

	TOTAL	VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1241.40	.00	.00	62.07	1179.33	
SANDS & GRAVELS	2896.60	86.90	86.90	86.90	144.83	144.83
		173.80	347.59	695.18	637.25	492.42
TOTAL LOAD	4138.00					
SEDIMENT OUTFLOW						
SILT	1241.40	.00	.00	62.07	1179.33	
SANDS & GRAVELS	909.72	654.05	103.37	31.99	25.68	27.93
		19.87	35.88	10.96	.00	.00
TOTAL LOAD	2151.12					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	.00	1582.06	1581.63	60.	1241.	3134.
60000.000	-.01	1542.04	1541.62	60.	1241.	4258.
59000.000	.00	1502.04	1501.63	60.	1241.	4603.
58000.000	.00	1462.06	1461.63	60.	1241.	4721.
57000.000	.00	1422.03	1421.63	60.	1241.	4758.
56000.000	.00	1382.06	1381.63	60.	1241.	4773.
55000.000	.00	1342.04	1341.63	60.	1241.	4778.
54000.000	.00	1302.04	1301.63	60.	1241.	4777.
53000.000	.00	1262.06	1261.63	60.	1241.	4780.
52000.000	.00	1222.03	1221.63	60.	1241.	4779.
51000.000	.00	1182.06	1181.63	60.	1241.	4780.
50000.000	.00	1142.04	1141.63	60.	1241.	4780.
49000.000	.00	1102.04	1101.63	60.	1241.	4778.
48000.000	.00	1062.06	1061.63	60.	1241.	4780.
47000.000	.00	1022.04	1021.63	60.	1241.	4778.
46000.000	.00	982.06	981.63	60.	1241.	4780.
45000.000	.00	942.04	941.63	60.	1241.	4778.
44000.000	.00	902.06	901.63	60.	1241.	4780.
43000.000	.00	862.04	861.63	60.	1241.	4781.
42000.000	.00	822.04	821.63	60.	1241.	4779.
41000.000	.00	782.05	781.63	60.	1241.	4781.
40000.000	.00	742.03	741.63	60.	1241.	4778.
39000.000	.00	702.06	701.63	60.	1241.	4780.
38000.000	.00	662.04	661.63	60.	1241.	4780.
37000.000	.00	622.04	621.63	60.	1241.	4788.
36000.000	.00	581.96	581.63	60.	1241.	4779.
35000.000	.00	542.05	541.63	60.	1241.	4797.
34000.000	.04	502.00	501.67	60.	1241.	910.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	86.	60.	26.	0.	77.				
61000.000	46.	33.	13.	0.	37.	37.	22.	15.	0.
60000.000	57.	44.	13.	0.	-9.	27.	-9.	0.	0.
59000.000	61.	48.	13.	0.	-3.	25.	-3.	0.	0.
58000.000	62.	49.	13.	0.	-1.	24.	-1.	0.	0.
57000.000	62.	49.	13.	0.	0.	23.	0.	0.	0.
56000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
55000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
54000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
53000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
52000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
51000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
50000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
49000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
48000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
47000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
46000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
45000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
44000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
0.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
00.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
41000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
40000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
39000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
38000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
37000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
36000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
35000.000	63.	50.	13.	0.	0.	23.	0.	0.	0.
34000.000	22.	9.	13.	0.	32.	55.	32.	0.	0.

JOB COMPLETED

RUN TIME = 0 HOURS, 0 MINUTES & 1.70 SECONDS

```
**************************************************     **********************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *     *  U.S. ARMY CORPS OF ENGINEERS  *
*       Version: 4.0.6  -  June 1991              *     *  HYDROLOGIC ENGINEERING CENTER  *
*  INPUT FILE:  FAN10.DAT                         *     *  609 SECOND STREET              *
*  OUTPUT FILE: FAN10.OUT                         *     *  DAVIS, CALIFORNIA 95616-4687   *
*  RUN DATE: 04JUN92      RUN TIME: 11:09:17      *     *  (916) 756-1104                 *
**************************************************     **********************************

                    X     X  XXXXXXX   XXXXX          XXXXX
                    X     X  X        X     X        X     X
                    X     X  X        X              X
                    XXXXXXX  XXXX     X        XXXXX  XXXXXX
                    X     X  X        X              X     X
                    X     X  X        X     X        X     X
                    X     X  XXXXXXX   XXXXX          XXXXX

        **********************************************************************
        *  MAXIMUM LIMITS FOR THIS VERSION ARE:                              *
        *       10  Stream Segments (Main Stem + Tributaries)                *
        *      150  Cross Sections                                           *
        *      100  Elevation/Station Points per Cross Section               *
        *       15  Grain Sizes                                              *
        *       10  Control Points                                           *
        **********************************************************************


T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION     DN N07 300 10
T3      11/14/91      10 CFS SINGLE FAN FLOW  N =  .022

NC  .0220   .0220   .0220   .1000   .3000

SECTION NO.  1 RIVER MILE=  34000.000

SECTION NO.  2 RIVER MILE=  35000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  3 RIVER MILE=  36000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  4 RIVER MILE=  37000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  5 RIVER MILE=  38000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  6 RIVER MILE=  39000.000
...Add    40.00 (ft) to each Elevation(Y)

SECTION NO.  7 RIVER MILE=  40000.000
...Add    40.00 (ft) to each Elevation(Y)
```

HEC-6

FAN EQUILIBRIUM MODEL

SINGLE Q = 10 CFS

SECTION NO. 8 RIVER MILE= 41000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 9 RIVER MILE= 42000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 10 RIVER MILE= 43000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 11 RIVER MILE= 44000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 12 RIVER MILE= 45000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 13 RIVER MILE= 46000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 14 RIVER MILE= 47000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 15 RIVER MILE= 48000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 16 RIVER MILE= 49000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 17 RIVER MILE= 50000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 18 RIVER MILE= 51000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 19 RIVER MILE= 52000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 20 RIVER MILE= 53000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 21 RIVER MILE= 54000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 22 RIVER MILE= 55000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 23 RIVER MILE= 56000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 24 RIVER MILE= 57000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 25 RIVER MILE= 58000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 26 RIVER MILE= 59000.000
...Add 40.00 (ft) to each Elevation(Y)

SECTION NO. 27 RIVER MILE= 60000.000
...Add 40.00 (ft) to each Elevation(Y)

```
SECTION NO. 28 RIVER MILE=  61000.000
...Add    40.00 (ft) to each Elevation(Y)

    OF CROSS SECTIONS IN STREAM SEGMENT= 28
     F INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  28
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

*****************************************************************************

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10
11/14/91       10 CFS SINGLE FAN FLOW  N =  .022

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS

       SPI      IBG     MNQ      SPGF      ACGR      NFALL     IBSHER
I1     10.        3       1     1.000    32.174          2          1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

.    IS PRESENT

       MTCL    IASL    LASL     SGSL     PUSDLB    UWSDLB     CCSDLB
I3        1       1       4    2.650     82.000    65.000      5.700

  DEPOSITION COEFFICIENTS BY LAYER
                      DEPOSITION
                      THRESHOLD
                        SHEAR
              LAYER      STRESS
               NO.      lb/sq.ft

  ACTIVE LAYER  1        .0000

FINE-GRAIN SEDIMENT TYPES BY CROSS SECTION (XSEC,TYPE)
 34000.000   1  35000.000   1  36000.000   1  37000.000   1  38000.000   1
 39000.000   1  40000.000   1  41000.000   1  42000.000   1  43000.000   1
 44000.000   1  45000.000   1  46000.000   1  47000.000   1  48000.000   1
 49000.000   1  50000.000   1  51000.000   1  52000.000   1  53000.000   1
 54000.000   1  55000.000   1  56000.000   1  57000.000   1  58000.000   1
 59000.000   1  60000.000   1  61000.000   1

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

 ` AND/OR GRAVEL ARE PRESENT

       MTC      IASA     LASA      SPGS       GSF       BSAE       PSI      UWDLB
I4       4         1       10     2.650      .667       .500    30.000     93.000

USING TRANSPORT CAPACITY RELATIONSHIP #  4, YANG
```

FOLLOWING GRAIN SIZES UTILIZED (MM)

SILT:	.0056	.0110	.0220	.0440	
?:	.0880	.1770	.3540	.7070	1.4140
	2.8280	5.6570	11.3140	22.6270	45.2550

SEDIMENT LOAD TABLE FOR STREAM SEGMENT # 1

LOAD BY GRAIN SIZE CLASS (tons/day)

L 100YR	10.0000	60.0000	150.000	500.000	1500.00	4000.00	7700.00
L VFS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L FS	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19	.100000E-19
L MS	4.23000	62.0700	245.340	1493.09	7758.27	33784.5	90232.6
L CS	80.3700	1179.33	4661.46	28368.6	147407.	641906.	.171442E+07
L FVSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
L FSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
L MSA	5.92200	86.8980	343.476	2090.32	10861.6	47298.3	126326.
L CSA	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
L VCS	9.87000	144.830	572.460	3483.86	18102.6	78830.5	210543.
L VFG	11.8440	173.796	686.952	4180.64	21723.2	94596.6	252651.
L FG	23.6880	347.592	1373.90	8361.28	43446.3	189193.	505303.
L MG	47.3760	695.184	2747.81	16722.6	86892.6	378387.	.101061E+07
L CG	43.4280	637.252	2518.82	15329.0	79651.6	346854.	926389.
L VCG	33.5580	492.422	1946.36	11845.1	61548.9	268024.	715846.
TOTAL	282.000	4138.00	16356.0	99539.0	517218.	.225230E+07	.601551E+07

REACH GEOMETRY FOR STREAM SEGMENT 1

CROSS SECTION ID. NO.	REACH LENGTH (ft)	MOVABLE BED WIDTH	INITIAL BED-ELEVATIONS LEFT SIDE (ft)	THALWEG (ft)	RIGHT SIDE (ft)	ACCUMULATED CHANNEL DISTANCE FROM DOWNSTREAM (ft)	(miles)
	.00						
34000.000		24.00	501.63	501.63	501.63	.00	.00
	1000.00						
35000.000		24.00	541.63	541.63	541.63	1000.00	.19
	1000.00						
36000.000		24.00	581.63	581.63	581.63	2000.00	.38
	1000.00						
37000.000		24.00	621.63	621.63	621.63	3000.00	.57
	1000.00						
38000.000		24.00	661.63	661.63	661.63	4000.00	.76
	1000.00						
39000.000		24.00	701.63	701.63	701.63	5000.00	.95
	1000.00						
40000.000		24.00	741.63	741.63	741.63	6000.00	1.14
	1000.00						
41000.000		24.00	781.63	781.63	781.63	7000.00	1.33
	1000.00						
42000.000		24.00	821.63	821.63	821.63	8000.00	1.52
	1000.00						
.000		24.00	861.63	861.63	861.63	9000.00	1.70
	1000.00						
44000.000		24.00	901.63	901.63	901.63	10000.00	1.89
	1000.00						
45000.000		24.00	941.63	941.63	941.63	11000.00	2.08

	1000.00						
46000.000		24.00	981.63	981.63	981.63	12000.00	2.27
	1000.00						
47000.000		24.00	1021.63	1021.63	1021.63	13000.00	2.46
	1000.00						
48000.000		24.00	1061.63	1061.63	1061.63	14000.00	2.65
	1000.00						
49000.000		24.00	1101.63	1101.63	1101.63	15000.00	2.84
	1000.00						
50000.000		24.00	1141.63	1141.63	1141.63	16000.00	3.03
	1000.00						
51000.000		24.00	1181.63	1181.63	1181.63	17000.00	3.22
	1000.00						
52000.000		24.00	1221.63	1221.63	1221.63	18000.00	3.41
	1000.00						
53000.000		24.00	1261.63	1261.63	1261.63	19000.00	3.60
	1000.00						
54000.000		24.00	1301.63	1301.63	1301.63	20000.00	3.79
	1000.00						
55000.000		24.00	1341.63	1341.63	1341.63	21000.00	3.98
	1000.00						
56000.000		24.00	1381.63	1381.63	1381.63	22000.00	4.17
	1000.00						
57000.000		24.00	1421.63	1421.63	1421.63	23000.00	4.36
	1000.00						
58000.000		24.00	1461.63	1461.63	1461.63	24000.00	4.55
	1000.00						
59000.000		24.00	1501.63	1501.63	1501.63	25000.00	4.73
	1000.00						
1.000		24.00	1541.63	1541.63	1541.63	26000.00	4.92
	1000.00						
61000.000		24.00	1581.63	1581.63	1581.63	27000.00	5.11

BED MATERIAL GRADATION (as computed from PF-records)

SECID	SAE (%)	DMAX (ft)	DXPI (ft)	XPI	TOTAL BED	BED MATERIAL FRACTIONS per grain size, fine - coarse.				
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070
						.140	.240	.230	.150	
N ********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
						.015	.015	.025	.040	.070

						.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
	*****	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070
							.140	.240	.230	.150	
N	********	1.000	.984	.210	.970	.970	.000	.000	.015	.015	.015
							.015	.015	.025	.040	.070

.140 .240 .230 .150

FAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
SEDIMENT CONTROL VOLUMES

SECTION NUMBER	LENGTH (ft)	MAX. WIDTH (ft)	DEPTH (ft)	VOLUME (cu.ft)	VOLUME (cu.yd)
34000.000	500.00	24.00	10.00	119997.	4444.35
35000.000	1000.00	24.00	10.00	239995.	8888.70
36000.000	1000.00	24.00	10.00	239995.	8888.70
37000.000	1000.00	24.00	10.00	239995.	8888.70
38000.000	1000.00	24.00	10.00	239995.	8888.70
39000.000	1000.00	24.00	10.00	239995.	8888.70
40000.000	1000.00	24.00	10.00	239995.	8888.70
41000.000	1000.00	24.00	10.00	239995.	8888.70
42000.000	1000.00	24.00	10.00	239995.	8888.70
43000.000	1000.00	24.00	10.00	239995.	8888.70
44000.000	1000.00	24.00	10.00	239995.	8888.70
45000.000	1000.00	24.00	10.00	239995.	8888.70
46000.000	1000.00	24.00	10.00	239995.	8888.70
47000.000	1000.00	24.00	10.00	239995.	8888.70
48000.000	1000.00	24.00	10.00	239995.	8888.70
49000.000	1000.00	24.00	10.00	239995.	8888.70
50000.000	1000.00	24.00	10.00	239995.	8888.70
51000.000	1000.00	24.00	10.00	239995.	8888.70
52000.000	1000.00	24.00	10.00	239995.	8888.70
53000.000	1000.00	24.00	10.00	239995.	8888.70
54000.000	1000.00	24.00	10.00	239995.	8888.70
00.000	1000.00	24.00	10.00	239995.	8888.70
00.000	1000.00	24.00	10.00	239995.	8888.70
57000.000	1000.00	24.00	10.00	239995.	8888.70
58000.000	1000.00	24.00	10.00	239995.	8888.70
59000.000	1000.00	24.00	10.00	239995.	8888.70
60000.000	1000.00	24.00	10.00	239995.	8888.70
61000.000	500.00	24.00	10.00	119997.	4444.35

NO. OF INPUT DATA MESSAGES= 0
END OF SEDIMENT DATA

==========

BEGIN COMPUTATIONS.
$HYD

==========

• FLOW 1
BED GRADATION WAS CALCULATED FROM INFLOWING SEDIMENT LOAD

.....

END

0 DATA ERRORS DETECTED.

TOTAL NO. OF TIME STEPS READ = 1
TOTAL NO. OF WS PROFILES = 1
ITERATIONS IN EXNER EQ = 280.

END OF JOB

OF JOB ($$END) ENCOUNTERED AND NO PRINTOUT WAS REQUESTED, TIME = .01

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.02	61000.000	.00			.00		
TOTAL=	34000.000	.00	.00	.50	.00	.00	.62

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	84.60	.00	.00	4.23	80.37	
SANDS & GRAVELS	197.40	5.92	5.92	5.92	9.87	9.87
		11.84	23.69	47.38	43.43	33.56
TOTAL LOAD	282.00					
SEDIMENT OUTFLOW						
SILT	84.60	.00	.00	4.23	80.37	
S & GRAVELS	149.80	109.74	17.75	5.94	4.59	4.62
		4.78	2.38	.00	.00	.00
TOTAL LOAD	234.40					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	-.01	1581.87	1581.62	10.	85.	485.
60000.000	.00	1541.76	1541.63	10.	85.	567.
59000.000	.00	1501.87	1501.63	10.	85.	578.
58000.000	.00	1461.76	1461.63	10.	85.	579.
57000.000	.00	1421.87	1421.63	10.	85.	580.
56000.000	.00	1381.76	1381.63	10.	85.	579.
55000.000	.00	1341.87	1341.63	10.	85.	580.
54000.000	.00	1301.76	1301.63	10.	85.	579.
53000.000	.00	1261.87	1261.63	10.	85.	580.
52000.000	.00	1221.76	1221.63	10.	85.	579.
51000.000	.00	1181.87	1181.63	10.	85.	580.
50000.000	.00	1141.76	1141.63	10.	85.	579.
49000.000	.00	1101.87	1101.63	10.	85.	580.
48000.000	.00	1061.76	1061.63	10.	85.	579.
47000.000	.00	1021.87	1021.63	10.	85.	580.
46000.000	.00	981.76	981.63	10.	85.	579.
45000.000	.00	941.87	941.63	10.	85.	580.
44000.000	.00	901.76	901.63	10.	85.	579.
43000.000	.00	861.87	861.63	10.	85.	580.
42000.000	.00	821.76	821.63	10.	85.	579.
41000.000	.00	781.87	781.63	10.	85.	580.
40000.000	.00	741.76	741.63	10.	85.	579.

39000.000	.00	701.87	701.63	10.	85.	580.
38000.000	.00	661.76	661.63	10.	85.	579.
37000.000	.00	621.87	621.63	10.	85.	580.
'000.000	.00	581.76	581.63	10.	85.	579.
000.000	.00	541.86	541.63	10.	85.	580.
34000.000	.01	501.80	501.64	10.	85.	150.

STREAM SEGMENT # 1: RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

SUMMARY TABLE: MASS AND VOLUME OF SEDIMENT

SECTION	SEDIMENT PASSING SECTION (tons)				SEDIMENT DEPOSITED IN REACH in cu. yds				
	TOTAL	SAND	SILT	CLAY	TOTAL	ACCUMULATED	SAND	SILT	CLAY
INFLOW	6.	4.	2.	0.	5.				
61000.000	6.	5.	1.	0.	0.	0.	-1.	1.	0.
60000.000	7.	6.	1.	0.	-1.	0.	-1.	0.	0.
59000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
58000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
57000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
56000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
55000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
54000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
53000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
52000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
51000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
50000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
00.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
47000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
46000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
45000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
44000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
43000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
42000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
41000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
40000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
39000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
38000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
37000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
36000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
35000.000	7.	6.	1.	0.	0.	-1.	0.	0.	0.
34000.000	2.	2.	1.	0.	4.	3.	4.	0.	0.

JOB COMPLETED
RUN TIME = 0 HOURS, 0 MINUTES & 2.09 SECONDS

COMPUTATION OF ANNUAL YIELD

BOYLE ENGINEERING CORPORATION

Project MIKE WASH
Job No. [illegible]
By [illegible] Date 1/3/92

Description SEDIMENT RATING FIELD
[illegible] T = 50°F
[illegible] DIST.

SHEET 1/1

(TONS/DAY)

Q (CFS)	SEDIMENT OUTFLOW	CURVE FIT	FLOW WIDTH (FT) *
10	665	635	24
60	6029	6296	49
150	19,923	20,342	70
500	95,491	94,992	114
1500	373,587	387,616	177
4000	1,328,740	1,360,321	262
7050	2,950,522	2,809,870	330

$$g_{sed} = a\,Q_{Water}^{\,b} \qquad a = 33.3 \qquad b = 1.280$$

* COMPUTED BY DAWDY'S EQUATION, $T_w = 9.5\,Q^{0.4}$

BOYLE ENGINEERING CORPORATION

Project DANKE WASH

Job No. [illegible]

By [illegible] Date [illegible]

Description [illegible]

SHEET 1/2

FROM ANNIED4.CAL

PROBABILITY	EVENT	TOTAL YIELD (AF)	PROB. INTERVAL * AVE YIELD
.7		0	
.5	2	1.9	.19
.2	5	12	2.09
.1	10	28	2.00
.04	25	59	2.76
.02	50	110	1.74
.01	100	154	1.27
0		231	1.93

VOL = 12.0 AF

$\gamma_{silt} = 65$ lb/ft^3

$\gamma_{sand} = 93$ lb/ft^3

VOL * INTERPOLATION FACTOR

12.0 * 1.3 = 15.6 AF

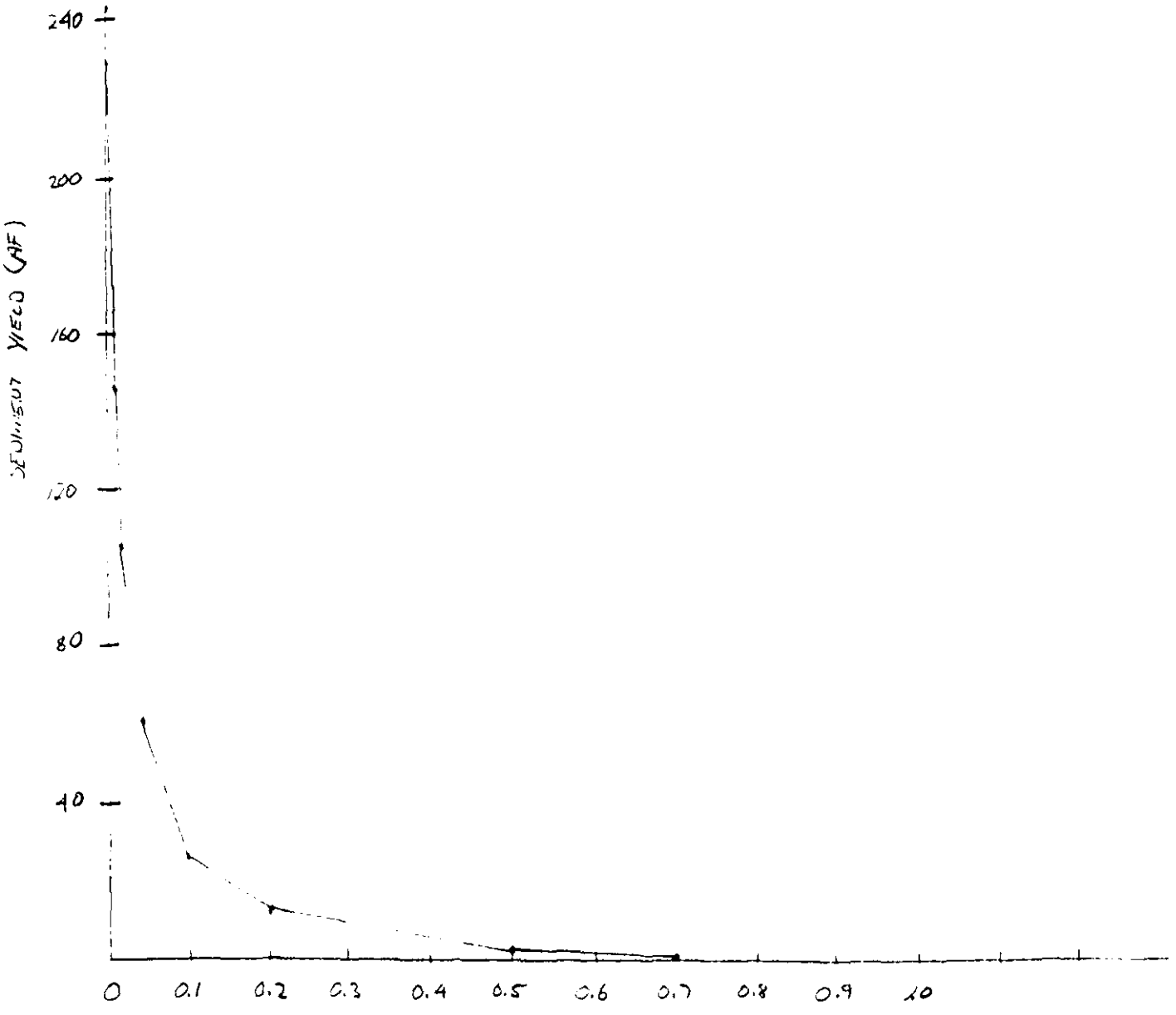
BOYLE ENGINEERING CORPORATION

Project _____ Description _____

Job No. _____ SHEET 2/2

By _____ Date _____

SEDIMENT YIELD VS RECURRENCE INTERVAL
FROM ARVIEDA, CAL



RECURRENCE INTERVAL

RANGE WASH HYDROLOGY/SEDIMENT TRANSPORT

FN: ANNSED4.CAL *HYDROGRAPH*

DATE: 06/01/92 BY: TBR FLOW VALUES IN CFS SEDIMENT LOAD IN TONS/DAY

2 YR DIKE	SED LOAD	5 YR DIKE	SED LOAD	10 YR DIKE	SED LOAD	25 YR DIKE	SED LOAD	50 YR DIKE	SED LOAD	100 YR DIKE	82 PCF SED LOAD
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.00	0
.00	0	.00	0	.00	0	.00	0	.00	0	.02	6.17e-5
.00	0	.00	0	.00	0	.00	0	.00	0	.05	1.99e-4
.00	0	.00	0	.00	0	.00	0	.00	0	.12	6.12e-4
.00	0	.00	0	.00	0	.00	0	.01	2.54e-5	.28	1.81e-3
.00	0	.00	0	.00	0	.00	0	.02	6.17e-5	.59	4.70e-3
.00	0	.00	0	.00	0	.00	0	.07	3.07e-4	1.13	1.08e-2
.00	0	.00	0	.00	0	.00	0	.19	1.10e-3	2.04	2.30e-2
.00	0	.00	0	.00	0	.00	0	.44	3.23e-3	3.47	4.54e-2
.00	0	.00	0	.00	0	.01	2.54e-5	.93	8.41e-3	5.60	8.37e-2
.00	0	.00	0	.00	0	.04	1.50e-4	1.78	1.93e-2	8.62	1.45e-1
.00	0	.00	0	.00	0	.10	4.84e-4	3.16	4.02e-2	12.74	2.40e-1
.00	0	.00	0	.00	0	.26	1.65e-3	5.28	7.76e-2	18.17	3.78e-1
.00	0	.00	0	.00	0	.56	4.39e-3	8.31	1.39e-1	25.08	5.70e-1
.00	0	.00	0	.00	0	1.10	1.04e-2	12.44	2.33e-1	33.63	8.30e-1

.00		.00	0	.00	0	1.97	2.	17.77	3.67e-1	43.91	1.168e0
.00	0	.00	0	.00	0	3.26	4.19e-2	24.35	5.49e-1	55.95	1.593e0
.00	0	.00	0	.01	2.54e-5	5.05	7.33e-2	32.13	7.83e-1	69.72	2.112e0
.00	0	.00	0	.03	1.04e-4	7.39	1.19e-1	40.98	1.070e0	85.11	2.726e0
.00	0	.00	0	.06	2.52e-4	10.29	1.82e-1	50.68	1.404e0	101.96	3.435e0
.00	0	.00	0	.13	6.78e-4	13.69	2.63e-1	61.00	1.780e0	120.05	4.233e0
.00	0	.00	0	.25	1.56e-3	17.55	3.61e-1	71.73	2.190e0	139.21	5.117e0
.00	0	.00	0	.48	3.61e-3	21.82	4.77e-1	82.78	2.631e0	159.36	6.084e0
.00	0	.00	0	.88	7.84e-3	26.51	6.12e-1	94.35	3.110e0	180.77	7.149e0
.00	0	.02	6.17e-5	1.57	1.64e-2	31.79	7.73e-1	106.83	3.646e0	203.85	8.337e0
.00	0	.08	3.64e-4	2.73	3.34e-2	38.06	9.73e-1	121.21	4.286e0	229.85	9.722e0
.00	0	.27	1.73e-3	4.68	6.65e-2	46.13	1.245e0	139.05	5.109e0	260.74	1.142e1
.01	2.54e-5	.73	6.17e-3	7.96	1.31e-1	57.27	1.642e0	162.77	6.251e0	299.61	1.365e1
.04	1.50e-4	1.75	1.89e-2	13.21	2.51e-1	72.90	2.236e0	194.86	7.870e0	349.65	1.663e1
.16	8.84e-4	3.81	5.11e-2	21.51	4.69e-1	95.46	3.157e0	239.47	1.025e1	416.21	2.079e1
.47	3.51e-3	7.62	1.24e-1	34.16	8.47e-1	127.70	4.582e0	300.94	1.373e1	504.85	2.662e1
1.16	1.12e-2	14.06	2.72e-1	52.89	1.483e0	173.41	6.778e0	385.20	1.883e1	623.11	3.485e1
2.45	2.91e-2	24.13	5.43e-1	79.60	2.502e0	236.55	1.009e1	498.10	2.616e1	778.36	4.633e1
4.60	6.51e-2	38.92	1.001e0	116.36	4.068e0	321.38	1.493e1	645.73	3.647e1	978.14	6.206e1
7.93	1.31e-1	59.48	1.723e0	165.19	6.370e0	431.59	2.178e1	832.97	5.053e1	1228.25	8.306e1
12.70	2.39e-1	86.67	2.790e0	227.75	9.608e0	569.93	3.109e1	1063.09	6.904e1	1532.33	1.102e2
19.11	4.03e-1	120.98	4.275e0	304.86	1.396e1	737.15	4.321e1	1336.15	9.251e1	1889.80	1.442e2
27.19	6.33e-1	162.38	6.231e0	396.24	1.952e1	931.52	5.830e1	1648.38	1.210e2	2295.77	1.850e2
36.81	9.32e-1	210.35	8.679e0	500.30	2.631e1	1148.71	7.624e1	1992.01	1.542e2	2741.64	2.321e2
47.68	1.298e0	263.74	1.159e1	614.24	3.421e1	1382.11	9.661e1	2356.10	1.912e2	3219.17	2.851e2
59.38	1.719e0	320.87	1.490e1	733.99	4.297e1	1622.87	1.187e2	2726.42	2.305e2	3741.64	3.456e2
71.36	2.175e0	379.57	1.848e1	854.61	5.221e1	1860.82	1.414e2	3088.83	2.704e2	4315.06	4.149e2
83.07	2.642e0	437.56	2.216e1	970.99	6.148e1	2085.64	1.636e2	3440.52	3.104e2	4916.51	4.903e2
94.06	3.098e0	492.73	2.580e1	1078.57	7.033e1	2288.50	1.842e2	3808.13	3.535e2	5491.25	5.648e2
104.02	3.524e0	543.45	2.925e1	1173.76	7.837e1	2462.71	2.024e2	4212.92	4.023e2	5983.71	6.304e2
112.90	3.913e0	588.79	3.241e1	1254.69	8.536e1	2608.59	2.178e2	4607.24	4.511e2	6369.63	6.829e2
120.93	4.273e0	628.64	3.524e1	1320.98	9.117e1	2746.66	2.327e2	4914.60	4.900e2	6653.68	7.221e2
128.58	4.622e0	663.65	3.777e1	1373.90	9.587e1	2925.00	2.522e2	5121.73	5.166e2	6847.06	7.491e2
136.47	4.988e0	695.00	4.007e1	1415.77	9.963e1	3135.50	2.757e2	5249.84	5.332e2	6962.69	7.654e2
145.24	5.402e0	724.21	4.224e1	1449.95	1.027e2	3295.07	2.937e2	5325.97	5.431e2	7019.44	7.733e2
155.48	5.895e0	752.81	4.439e1	1480.42	1.055e2	3385.52	3.041e2	5365.36	5.483e2	7028.39	7.746e2
167.53	6.486e0	781.97	4.660e1	1513.43	1.085e2	3442.01	3.106e2	5382.39	5.505e2	7008.97	7.719e2
181.45	7.183e0	812.32	4.893e1	1574.13	1.141e2	3482.19	3.153e2	5382.58	5.505e2	6973.97	7.669e2
196.90	7.975e0	843.67	5.136e1	1679.74	1.240e2	3514.48	3.190e2	5376.54	5.497e2	6932.63	7.611e2
213.21	8.830e0	875.04	5.382e1	1787.25	1.342e2	3541.84	3.222e2	5367.56	5.486e2	6889.00	7.550e2
229.40	9.698e0	904.72	5.616e1	1863.50	1.416e2	3562.82	3.246e2	5354.51	5.469e2	6841.71	7.484e2
244.37	1.052e1	930.56	5.822e1	1911.11	1.463e2	3575.70	3.261e2	5333.07	5.441e2	6786.31	7.406e2
256.98	1.121e1	950.24	5.980e1	1940.47	1.492e2	3576.16	3.262e2	5297.46	5.394e2	6715.31	7.307e2
266.27	1.174e1	961.73	6.073e1	1955.15	1.506e2	3559.75	3.243e2	5240.65	5.320e2	6620.75	7.176e2
271.58	1.204e1	964.57	6.096e1	1954.86	1.506e2	3522.46	3.199e2	5156.90	5.212e2	6495.33	7.002e2

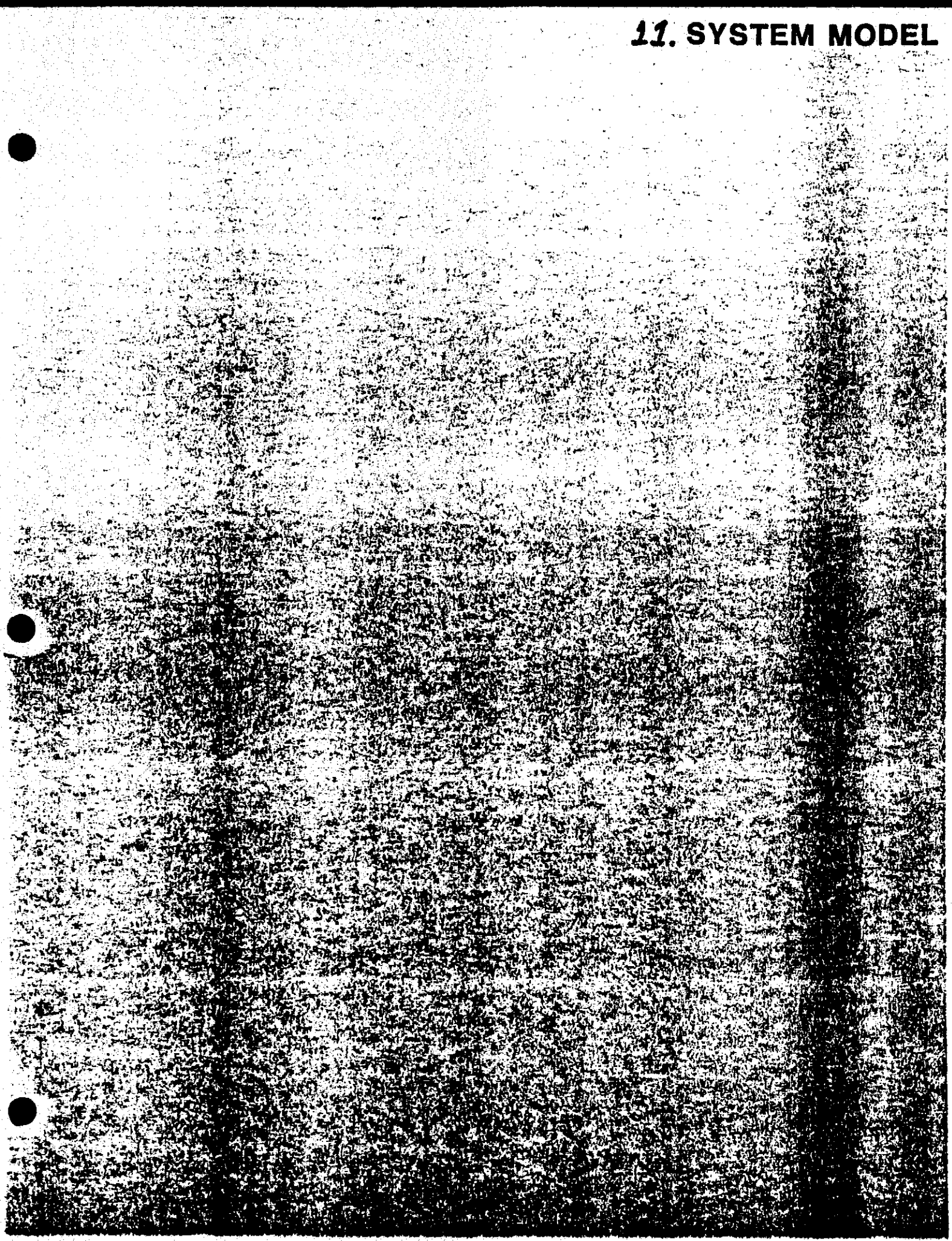
272.62 1.2[illegible]	966.37 6.111e1	1938.60 1.490e2	3461.24 3.[illegible]e2	5041.72 5.063e2	6333.76 6.780e2
269.47 1.192e1	981.33 6.232e1	1906.26 1.458e2	3375.05 3.029e2	4894.07 4.874e2	6134.58 6.508e2
262.53 1.153e1	998.90 6.375e1	1858.32 1.411e2	3264.95 2.903e2	4714.79 4.647e2	5897.96 6.189e2
252.40 1.096e1	995.07 6.344e1	1795.02 1.350e2	3133.07 2.754e2	4506.80 4.386e2	5626.44 5.826e2
239.77 1.026e1	969.39 6.135e1	1719.10 1.277e2	2981.99 2.585e2	4273.39 4.097e2	5326.15 5.431e2
225.35 9.479e0	931.39 5.829e1	1632.99 1.196e2	2815.91 2.402e2	4020.76 3.790e2	5004.81 5.016e2
209.78 8.649e0	887.09 5.477e1	1539.06 1.109e2	2638.90 2.211e2	3755.60 3.473e2	4668.75 4.589e2
193.61 7.805e0	837.10 5.085e1	1439.78 1.018e2	2455.38 2.016e2	3483.55 3.154e2	4325.48 4.161e2
177.30 6.974e0	783.67 4.673e1	1337.52 9.263e1	2269.36 1.822e2	3210.14 2.841e2	3981.70 3.743e2
161.19 6.173e0	728.69 4.258e1	1233.25 8.349e1	2084.48 1.635e2	2940.39 2.539e2	3643.20 3.340e2
145.55 5.417e0	673.33 3.848e1	1130.90 7.473e1	1903.75 1.455e2	2678.28 2.253e2	3314.57 2.960e2
130.57 4.714e0	618.71 3.453e1	1031.64 6.644e1	1729.77 1.287e2	2427.13 1.986e2	3000.13 2.605e2
116.40 4.069e0	565.13 3.075e1	936.73 5.872e1	1564.57 1.132e2	2189.68 1.741e2	2703.66 2.280e2
103.14 3.486e0	513.89 2.723e1	847.15 5.163e1	1409.64 9.908e1	1967.85 1.519e2	2427.33 1.986e2
90.87 2.964e0	465.66 2.400e1	763.46 4.519e1	1265.76 8.632e1	1762.46 1.319e2	2171.81 1.723e2
79.63 2.503e0	420.64 2.107e1	686.04 3.941e1	1133.32 7.493e1	1573.92 1.141e2	1937.45 1.489e2
69.41 2.100e0	379.00 1.844e1	614.94 3.426e1	1012.30 6.485e1	1402.62 9.844e1	1723.88 1.282e2
60.22 1.751e0	340.77 1.609e1	550.19 2.971e1	902.37 5.598e1	1247.63 8.474e1	1532.24 1.102e2
52.00 1.451e0	305.92 1.402e1	491.51 2.572e1	803.06 4.822e1	1108.03 7.280e1	1359.59 9.460e1
69.15 2.089e0	274.31 1.219e1	438.57 2.223e1	714.18 4.149e1	982.78 6.244e1	1204.49 8.101e1
69.43 2.100e0	245.79 1.059e1	390.99 1.919e1	634.82 3.569e1	871.19 5.351e1	1066.96 6.936e1
64.33 1.905e0	220.18 9.202e0	348.50 1.656e1	564.04 3.068e1	772.38 4.587e1	944.66 5.936e1
59.47 1.723e0	197.30 7.996e0	310.81 1.431e1	500.94 2.635e1	684.38 3.929e1	835.26 5.070e1
54.91 1.555e0	176.90 6.953e0	277.21 1.236e1	445.28 2.267e1	606.24 3.364e1	740.04 4.343e1
50.71 1.405e0	158.74 6.053e0	247.31 1.068e1	396.13 1.951e1	538.06 2.888e1	655.04 3.715e1
46.60 1.261e0	142.61 5.277e0	221.18 9.255e0	352.52 1.681e1	477.53 2.479e1	581.08 3.187e1
42.89 1.134e0	128.33 4.611e0	197.93 8.029e0	314.17 1.450e1	424.13 2.130e1	515.65 2.735e1
39.58 1.023e0	115.73 4.039e0	177.33 6.975e0	280.55 1.255e1	377.66 1.836e1	458.10 2.350e1
36.56 9.24e-1	104.55 3.547e0	159.37 6.084e0	250.66 1.086e1	336.28 1.582e1	407.57 2.024e1
33.82 8.36e-1	94.59 3.120e0	143.31 5.311e0	224.76 9.447e0	300.59 1.371e1	363.41 1.747e1
31.34 7.59e-1	85.84 2.756e0	129.27 4.654e0	201.66 8.223e0	269.21 1.190e1	324.40 1.511e1
29.08 6.89e-1	78.05 2.440e0	116.78 4.086e0	181.59 7.190e0	241.13 1.034e1	290.86 1.314e1
27.03 6.28e-1	71.07 2.164e0	105.73 3.598e0	163.68 6.295e0	216.78 9.020e0	261.97 1.149e1
25.17 5.73e-1	64.95 1.928e0	95.99 3.179e0	147.94 5.531e0	195.03 7.878e0	235.87 1.005e1
23.48 5.24e-1	59.45 1.722e0	87.25 2.814e0	133.85 4.866e0	176.10 6.913e0	212.39 8.787e0
21.96 4.81e-1	54.50 1.541e0	79.59 2.502e0	121.55 4.301e0	159.07 6.069e0	190.88 7.664e0
20.57 4.43e-1	50.15 1.385e0	72.65 2.226e0	110.44 3.805e0	144.35 5.360e0	172.93 6.754e0
19.29 4.08e-1	46.16 1.246e0	66.55 1.989e0	100.72 3.381e0	130.84 4.726e0	156.25 5.932e0
18.13 3.77e-1	42.64 1.125e0	61.00 1.780e0	91.89 3.007e0	119.64 4.215e0	141.80 5.239e0
17.05 3.48e-1	39.41 1.017e0	56.06 1.597e0	84.10 2.684e0	109.21 3.750e0	129.09 4.646e0
16.07 3.23e-1	36.52 9.23e-1	51.63 1.438e0	77.11 2.402e0	100.04 3.352e0	117.20 4.105e0
15.16 3.00e-1	33.90 8.39e-1	47.58 1.295e0	70.81 2.154e0	91.56 2.993e0	107.41 3.672e0
14.32 2.78e-1	31.51 7.64e-1	44.06 1.174e0	65.40 1.946e0	83.90 2.676e0	98.34 3.279e0
13.54 2.59e-1	29.36 6.98e-1	40.71 1.061e0	60.30 1.754e0	77.25 2.408e0	89.91 2.924e0
12.82 2.42e-1	27.40 6.39e-1	37.90 9.68e-1	55.96 1.594e0	70.98 2.161e0	83.06 2.642e0

12.16 2..	25.64 5.87e-1	35.24 8.82e-1	51.85 1 .:0	65.64 1.955e0	76.57 2.381e0
11.54 2.11e-1	24.02 5.40e-1	32.84 8.06e-1	48.14 1.314e0	60.77 1.771e0	70.42 2.139e0
10.96 1.98e-1	22.54 4.98e-1	30.72 7.40e-1	44.85 1.201e0	56.14 1.600e0	65.51 1.950e0
10.43 1.86e-1	21.20 4.60e-1	28.69 6.78e-1	41.69 1.093e0	52.35 1.463e0	60.83 1.773e0
9.92 1.74e-1	19.95 4.26e-1	26.93 6.25e-1	38.98 1.003e0	48.73 1.335e0	56.32 1.607e0
9.45 1.64e-1	18.83 3.95e-1	25.30 5.77e-1	36.45 9.21e-1	45.24 1.214e0	52.47 1.468e0
9.02 1.54e-1	17.74 3.66e-1	23.70 5.31e-1	33.99 8.42e-1	42.39 1.117e0	49.02 1.345e0
8.60 1.45e-1	16.80 3.42e-1	22.35 4.92e-1	31.96 7.78e-1	39.65 1.025e0	45.67 1.229e0
8.21 1.37e-1	15.89 3.18e-1	21.13 4.58e-1	30.00 7.18e-1	36.98 9.38e-1	42.42 1.118e0
7.84 1.29e-1	15.05 2.97e-1	19.94 4.25e-1	28.07 6.59e-1	34.70 8.64e-1	39.86 1.032e0
7.49 1.21e-1	14.28 2.77e-1	18.77 3.94e-1	26.48 6.12e-1	32.61 7.98e-1	37.36 9.50e-1
7.17 1.15e-1	13.52 2.59e-1	17.78 3.67e-1	24.94 5.66e-1	30.55 7.34e-1	34.92 8.71e-1
6.86 1.09e-1	12.87 2.43e-1	16.83 3.42e-1	23.43 5.23e-1	28.61 6.75e-1	32.56 7.97e-1
6.57 1.03e-1	12.22 2.27e-1	15.90 3.18e-1	22.11 4.85e-1	26.98 6.26e-1	30.70 7.39e-1
6.29 9.71e-2	11.62 2.13e-1	15.07 2.97e-1	20.90 4.52e-1	25.49 5.82e-1	28.88 6.83e-1
6.03 9.20e-2	11.07 2.00e-1	14.31 2.78e-1	19.70 4.19e-1	24.01 5.40e-1	27.09 6.30e-1
5.78 8.72e-2	10.53 1.88e-1	13.56 2.60e-1	18.56 3.88e-1	22.57 4.98e-1	25.34 5.78e-1
5.54 8.26e-2	10.03 1.77e-1	12.83 2.42e-1	17.62 3.63e-1	21.27 4.62e-1	23.93 5.37e-1
5.32 7.84e-2	9.58 1.66e-1	12.23 2.28e-1	16.68 3.38e-1	20.14 4.31e-1	22.62 5.00e-1
5.11 7.45e-2	9.15 1.57e-1	11.62 2.13e-1	15.75 3.15e-1	19.03 4.01e-1	21.33 4.64e-1
4.91 7.07e-2	8.71 1.47e-1	11.03 1.99e-1	14.91 2.93e-1	17.94 3.72e-1	20.06 4.29e-1
4.71 6.71e-2	8.32 1.39e-1	10.47 1.86e-1	14.17 2.75e-1	16.91 3.44e-1	18.80 3.94e-1
4.53 6.38e-2	7.95 1.31e-1	10.00 1.76e-1	13.44 2.57e-1	16.07 3.23e-1	17.85 3.69e-1
4.36 6.08e-2	7.59 1.24e-1	9.52 1.65e-1	12.72 2.39e-1	15.23 3.01e-1	16.91 3.44e-1
4.19 5.77e-2	7.25 1.17e-1	9.05 1.55e-1	12.06 2.23e-1	14.39 2.80e-1	15.98 3.20e-1
4.03 5.49e-2	6.94 1.10e-1	8.61 1.45e-1	11.49 2.10e-1	13.56 2.60e-1	15.05 2.97e-1
3.88 5.23e-2	6.64 1.04e-1	8.23 1.37e-1	10.92 1.97e-1	12.87 2.43e-1	14.14 2.74e-1
3.74 4.99e-2	6.34 9.81e-2	7.85 1.29e-1	10.35 1.84e-1	12.23 2.28e-1	13.39 2.55e-1
3.60 4.76e-2	6.08 9.30e-2	7.48 1.21e-1	9.80 1.71e-1	11.60 2.13e-1	12.71 2.39e-1
3.47 4.54e-2	5.82 8.79e-2	7.11 1.14e-1	9.35 1.61e-1	10.97 1.98e-1	12.04 2.23e-1
3.35 4.34e-2	5.57 8.31e-2	6.82 1.08e-1	8.92 1.52e-1	10.36 1.84e-1	11.39 2.08e-1
3.23 4.14e-2	5.34 7.88e-2	6.53 1.02e-1	8.50 1.43e-1	9.88 1.73e-1	10.75 1.93e-1
3.12 3.96e-2	5.13 7.48e-2	6.25 9.63e-2	8.08 1.34e-1	9.43 1.63e-1	10.14 1.79e-1
3.01 3.78e-2	4.93 7.11e-2	5.97 9.09e-2	7.71 1.26e-1	9.01 1.54e-1	9.70 1.69e-1
2.90 3.61e-2	4.72 6.73e-2	5.72 8.60e-2	7.40 1.20e-1	8.58 1.45e-1	9.27 1.60e-1
2.80 3.45e-2	4.55 6.42e-2	5.50 8.18e-2	7.09 1.13e-1	8.16 1.36e-1	8.85 1.50e-1
2.71 3.31e-2	4.38 6.11e-2	5.29 7.78e-2	6.78 1.07e-1	7.79 1.28e-1	8.43 1.41e-1
2.62 3.17e-2	4.21 5.81e-2	5.07 7.37e-2	6.47 1.01e-1	7.47 1.21e-1	8.02 1.33e-1
2.53 3.03e-2	4.04 5.51e-2	4.86 6.98e-2	6.18 9.50e-2	7.16 1.15e-1	7.60 1.24e-1
2.45 2.91e-2	3.90 5.27e-2	4.66 6.62e-2	5.95 9.05e-2	6.85 1.08e-1	7.25 1.17e-1
2.37 2.78e-2	3.76 5.03e-2	4.50 6.33e-2	5.71 8.58e-2	6.54 1.02e-1	6.96 1.11e-1
2.29 2.67e-2	3.62 4.79e-2	4.33 6.02e-2	5.48 8.14e-2	6.23 9.60e-2	6.68 1.05e-1
2.22 2.56e-2	3.48 4.55e-2	4.17 5.74e-2	5.25 7.71e-2	5.97 9.09e-2	6.40 9.93e-2
2.15 2.46e-2	3.36 4.35e-2	4.00 5.44e-2	5.02 7.28e-2	5.74 8.64e-2	6.12 9.38e-2
2.08 2.36e-2	3.25 4.17e-2	3.84 5.16e-2	4.83 6.93e-2	5.52 8.22e-2	5.84 8.83e-2

2.02 2.27e-2	3.14 3.99e-2	3.71 4.94e-2	4.66 6.22e-2	5.29 7.78e-2	5.56 8.29e-2
1.95 2.17e-2	3.02 3.80e-2	3.59 4.74e-2	4.48 6.29e-2	5.07 7.37e-2	5.30 7.80e-2
1.89 2.08e-2	2.92 3.64e-2	3.46 4.52e-2	4.31 5.99e-2	4.85 6.96e-2	5.11 7.45e-2
1.84 2.01e-2	2.82 3.48e-2	3.33 4.30e-2	4.14 5.69e-2	4.63 6.56e-2	4.92 7.09e-2
1.78 1.93e-2	2.73 3.34e-2	3.21 4.11e-2	3.96 5.37e-2	4.46 6.26e-2	4.73 6.74e-2
1.73 1.86e-2	2.64 3.20e-2	3.09 3.91e-2	3.82 5.13e-2	4.31 5.99e-2	4.54 6.40e-2
1.68 1.79e-2	2.55 3.06e-2	2.99 3.75e-2	3.69 4.91e-2	4.15 5.70e-2	4.35 6.06e-2
1.63 1.72e-2	2.47 2.94e-2	2.90 3.61e-2	3.56 4.69e-2	4.00 5.44e-2	4.17 5.74e-2
1.58 1.66e-2	2.39 2.81e-2	2.80 3.45e-2	3.43 4.47e-2	3.85 5.18e-2	3.98 5.41e-2
1.54 1.60e-2	2.32 2.71e-2	2.70 3.29e-2	3.30 4.25e-2	3.70 4.92e-2	3.79 5.08e-2
1.49 1.54e-2	2.24 2.59e-2	2.61 3.15e-2	3.17 4.04e-2	3.54 4.65e-2	3.66 4.86e-2
1.45 1.48e-2	2.16 2.47e-2	2.51 3.00e-2	3.05 3.85e-2	3.39 4.40e-2	3.54 4.65e-2
1.41 1.43e-2	2.10 2.39e-2	2.43 2.88e-2	2.95 3.69e-2	3.27 4.20e-2	3.42 4.45e-2
1.37 1.38e-2	2.04 2.30e-2	2.36 2.77e-2	2.86 3.54e-2	3.16 4.02e-2	3.29 4.24e-2
1.33 1.33e-2	1.98 2.21e-2	2.29 2.67e-2	2.76 3.38e-2	3.05 3.85e-2	3.17 4.04e-2
1.29 1.28e-2	1.92 2.13e-2	2.21 2.55e-2	2.67 3.24e-2	2.95 3.69e-2	3.05 3.85e-2
1.26 1.24e-2	1.85 2.03e-2	2.14 2.44e-2	2.57 3.09e-2	2.84 3.51e-2	2.92 3.64e-2
1.23 1.20e-2	1.80 1.96e-2	2.07 2.34e-2	2.48 2.95e-2	2.73 3.34e-2	2.80 3.45e-2
1.19 1.15e-2	1.75 1.89e-2	2.00 2.24e-2	2.38 2.80e-2	2.63 3.18e-2	2.68 3.26e-2
1.16 1.12e-2	1.70 1.82e-2	1.94 2.16e-2	2.31 2.69e-2	2.52 3.01e-2	2.58 3.10e-2
1.13 1.08e-2	1.65 1.75e-2	1.88 2.07e-2	2.24 2.59e-2	2.43 2.88e-2	2.51 3.00e-2
1.10 1.04e-2	1.60 1.68e-2	1.83 2.00e-2	2.17 2.49e-2	2.36 2.77e-2	2.43 2.88e-2
1.07 1.01e-2	1.56 1.63e-2	1.77 1.92e-2	2.10 2.39e-2	2.28 2.65e-2	2.35 2.75e-2
1.04 9.70e-3	1.51 1.56e-2	1.72 1.85e-2	2.03 2.28e-2	2.21 2.55e-2	2.28 2.65e-2
1.02 9.46e-3	1.47 1.51e-2	1.66 1.77e-2	1.96 2.18e-2	2.14 2.44e-2	2.20 2.53e-2
.99 9.11e-3	1.43 1.46e-2	1.61 1.70e-2	1.89 2.08e-2	2.07 2.34e-2	2.12 2.41e-2
.97 8.88e-3	1.39 1.41e-2	1.56 1.63e-2	1.82 1.99e-2	1.99 2.23e-2	2.04 2.30e-2
.94 8.53e-3	1.35 1.35e-2	1.52 1.58e-2	1.77 1.92e-2	1.92 2.13e-2	1.97 2.20e-2
.92 8.29e-3	1.31 1.30e-2	1.48 1.52e-2	1.72 1.85e-2	1.85 2.03e-2	1.89 2.08e-2
.90 8.06e-3	1.28 1.27e-2	1.44 1.47e-2	1.67 1.78e-2	1.78 1.93e-2	1.81 1.97e-2
.87 7.72e-3	1.24 1.22e-2	1.40 1.42e-2	1.62 1.71e-2	1.73 1.86e-2	1.76 1.90e-2
.85 7.49e-3	1.21 1.18e-2	1.35 1.35e-2	1.57 1.64e-2	1.69 1.81e-2	1.72 1.85e-2
.83 7.27e-3	1.18 1.14e-2	1.31 1.30e-2	1.52 1.58e-2	1.64 1.74e-2	1.67 1.78e-2
.81 7.05e-3	1.15 1.10e-2	1.27 1.25e-2	1.47 1.51e-2	1.59 1.67e-2	1.62 1.71e-2
.79 6.82e-3	1.12 1.07e-2	1.24 1.22e-2	1.42 1.45e-2	1.54 1.60e-2	1.58 1.66e-2
2.827e2 ①	1.770e3	4.035e3	9.235e3	1.596e4	2.232e4
1.947e0 ②	1.219e1	2.779e1	6.360e1	1.099e2	1.537e2

UNITS OF: ① TONS
② AF

11. SYSTEM MODEL



SYSTEM MODEL

To simulate the system of alluvial fan and dike flows, an extension of the alluvial fan surface model was developed. This model represents the transition from flow down the fan to flow along the diversion dike. To identify the worst case scenario several specific alternatives were investigated:

- o Fan surface to dike at a 1.0% slope
- o Fan surface to dike at a 0.5% slope

As is expected, the most critical case is the alluvial fan flows transitioning to flow along the dike at a 0.5% slope. Two key assumptions were made in the modeling of this system to reflect actual physical conditions:

- o The portion of the model representing fan flows assumed that flow for the entire hydrograph was in a channel with a width equal to Dawdy's 100-year channel width of 330 feet. Sensitivity runs were executed and it was determined that this was not a sensitive parameter. The total transport of sediment was less than 10 percent different when using a channel width of 100 feet versus the 100-year width of 330 feet. The wider channel width resulted in slightly more conservative results and was used in the analysis.

- To minimize the mathematical instability of the transition from fan to dike, a transition length of 1,000 feet was assumed. As previously mentioned, the HEC-6 model does not simulate abrupt changes in geometry without some mathematical instabilities. The critical information to be determined from the analysis is the absolute difference in the sediment carrying capacity between the fan and the dike at equilibrium, therefore, the length of the transition is not critical. It does, however, dampen some of the mathematical instability. The results of this analysis are attached hereto. A total volume of sediment deposited in the transition from alluvial fan to dike was computed. This was used in subsequent steps to determine the dike height. The computed total deposition was 65,000 tons.

```
**********************************************
*  SCOUR AND DEPOSITION IN RIVERS AND RESERVOIRS  *
*       Version: 4.0.6  -  June 1991              *
*  INPUT FILE:  RCH120B.DAT                       *
*  OUTPUT FILE: RCH120B.OUT                       *
*  RUN DATE: 30JUN92       RUN TIME: 15:49:11     *
**********************************************
```

```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS  *
*  HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET             *
*  DAVIS, CALIFORNIA 95616-4687  *
*  (916) 756-1104                *
**********************************
```

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  XXXXXX
X     X  X        X              X     X
X     X  X        X     X        X     X
X     X  XXXXXXX   XXXXX          XXXXX
```

```
*********************************************************************
*  MAXIMUM LIMITS FOR THIS VERSION ARE:                             *
*       10  Stream Segments (Main Stem + Tributaries)               *
*      150  Cross Sections                                          *
*      100  Elevation/Station Points per Cross Section              *
*       15  Grain Sizes                                             *
*       10  Control Points                                          *
*********************************************************************
```

```
T1      RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION      DN N07 300 10 , NEW JMM HYDROLOGY
T3      06/03/92 100 YR HYDROGRAPH, RCH120B.DAT, 120' @ 0.51%, 30/70 INFLW

NC  .0220   .0220   .0220   .1000   .3000

NO. OF CROSS SECTIONS IN STREAM SEGMENT= 90
NO. OF INPUT DATA MESSAGES =   0

TOTAL NO. OF CROSS SECTIONS IN THE NETWORK =  90
TOTAL NO. OF STREAM SEGMENTS IN THE NETWORK=   1
END OF GEOMETRIC DATA

================================================================================

T4
T5  RANGE WASH DIVERSION DIKE        LAS VEGAS, NEVADA
T6  BOYLE ENGINEERING CORPORATION    DN N07 300 10
T7
T8  SEDIMENT TRANSPORT BY STREAM POWER
RANGE WASH WEST DIVERSION DIKE     LAS VEGAS,NV
BOYLE ENGINEERING CORPORATION      DN N07 300 10 , NEW JMM HYDROLOGY
 '/92 100 YR HYDROGRAPH, RCH120B.DAT, 120' @ 0.51%, 30/70 INFLW

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

SEDIMENT PROPERITES AND PARAMETERS
```

SYSTEM ANALYSIS

TOTAL HYDROGRAPH (100-YR)

n = .022

T = 70° F

30/70 DIST.

FAN 256,780 TONS

DIKE 191,760 TONS

DEPOSITION 64,990 TONS

	SPI	IBG	MNQ	SPGF	ACGR	NFALL	IBSHER
I1	10.	3	1	1.000	32.174	2	1

- - - -

```
*    C  FLOW 3

   'DARY CONDITION DATA, CONTROL POINT NO.  1
     E STEP NO.      3
WATER    DISCHARGE=      261.00
         ELEVATION=     235.600
       TEMPERATURE=      70.000
FLOW DURATION(DAYS)  .1040E-01

- - - -
```

```
                                    .350000     .590000     .820000     .970000

SILT TRANSPORT CAPACITY:
*** SHEAR STRESS,lb/sq.ft =     .4546
      GRAIN SEDIMENT TYPE =         1
                LAYER TYPE =         1         2
DEPOSITION THRESHOLD #/sf =     .0000     .0000
EROSION THRESHOLD,#/sq.ft =     .0000     .0000

SIZE              EROSION RATE (tons/day)
CLASS          ACTIVE            INACTIVE
               LAYER               LAYER

    1             .00               .00
    2             .00               .00
    3             .00               .00
    4             .00               .00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=       .77147
MIN.GRAIN DIAM       =      .020144
BED SURFACE EXPOSED  =     1.00000

          INACTIVE LAYER            ACTIVE LAYER
          %          DEPTH          %          DEPTH
 CLAY     .000000      .00          .000000      .00
 SILT     .030862      .34          .000000      .00
 SAND     .969138     9.38         1.000000      .28
         1.000000     9.72         1.000000      .28

       AVG. UNIT                 AVG. UNIT
         WEIGHT                    WEIGHT

         .046308                   .046500

     COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=        .046500
     WEIGHT IN SURFACE LAYER (tons)    WTSL=       4540.9
     DEPTH OF NEW ACTIVE LAYER (ft)     DSE=        .1406
     WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=       2166.1
     WEIGHT IN OLD ACTIVE LAYER(tons)   WAL=       4268.8
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=     148542.6
BED MATERIAL BY GRAIN SIZE FRACTION    .000000     .000000     .015431     .015431     .014972
                                       .014972     .014972     .024954     .039927     .069872
                                       .139743     .239560     .229578     .149725
BED MATERIAL BY PERCENT FINER/100      .000000     .000000     .015431     .030862     .045835
                                       .060807     .075780     .100734     .140660     .210532
                                       .350275     .589835     .819413     .969138
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION    .000000     .000000     .000000     .000000     .015958
                                       .015954     .015957     .026596     .042554     .074466
                                       .148932     .255315     .244688     .159579
BED MATERIAL BY PERCENT FINER/100      .000000     .000000     .000000     .000000     .015958
                                       .031912     .047869     .074465     .117019     .191485
                                       .340417     .595732     .840421    1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .159815E+05 .123644E+01 .552498E+06

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .563108E+03 .106990E+05 .552498E+06
                                    .239589E+06 .724389E+05 .298709E+05 .171735E+05 .125418E+05
```

.137274E+05 .102577E+05 .140179E+03 .123644E-06

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
ACCULATED SEDIMENT LOAD, TONS/DAY						
SILT	11262.15	.00	.00	563.11	10699.04	
SANDS & GRAVELS	20614.14	8673.86	3761.73	1137.27	781.60	718.97
		918.86	2011.45	2576.67	33.74	.00

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
3.354	.005117	.63	122.94	.0220	.20225	.32280	.743

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	77500.00	77500.00	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030002	.025002	.020002	.024967
	.024993	.029998	.040000	.055001	.079998
	.139997	.190013	.175013	.135010	
BED MATERIAL BY PERCENT FINER/100	.000000	.030002	.055004	.075006	.099972
	.124966	.154964	.194965	.249966	.329964
	.469961	.659974	.834987	.969998	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	.2022	
GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

SAND

** ARMOR LAYER **

STABILITY COEFFICIENT=	.89258
MIN.GRAIN DIAM =	.042125
BED SURFACE EXPOSED =	.00000

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.26
TOTAL	1.000000	9.74	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

```
     COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=        .046500
     WEIGHT IN SURFACE LAYER (tons)    WTSL=       1060.0
     DEPTH OF NEW ACTIVE LAYER (ft)    DSE=         .0000
     WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=          9.7
     WEIGHT IN OLD ACTIVE LAYER(tons)  WAL=        946.3
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=     34729.5
BED MATERIAL BY GRAIN SIZE FRACTION     .000000   .030820   .025683   .020547   .024920
                                        .024920   .029904   .039872   .054824   .079744
                                        .139551   .189391   .174439   .134567
BED MATERIAL BY PERCENT FINER/100       .000000   .030820   .056503   .077049   .101969
                                        .126889   .156793   .196665   .251488   .331232
                                        .470783   .660174   .834613   .969180
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION     .000000   .000000   .000000   .000000   .026690
                                        .027692   .033469   .044719   .061518   .089342
                                        .156357   .212854   .196090   .151270
BED MATERIAL BY PERCENT FINER/100       .000000   .000000   .000000   .000000   .026690
                                        .054382   .087851   .132570   .194087   .283430
                                        .439787   .652640   .848730  1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .159815E+05 .133843E+01 .552498E+06

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .563108E+03 .106990E+05 .647792E+05
                                    .140163E+05 .572476E+04 .317442E+04 .238211E+04 .574946E+03
                                    .556754E+03 .122598E+03 .133843E-06 .133843E-06
```

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	11262.15	.00	.00	563.11	10699.04	
S & GRAVELS	2717.67	1725.44	374.42	183.83	135.99	140.33
		49.24	83.45	24.97	.00	.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.03	61000.000	.18			.30		
TOTAL=	7000.000	.18	.16	.14	.30	.04	.86

TABLE SB-1.	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	11262.15	.00	.00	563.11	10699.04	
SANDS & GRAVELS	26278.35	788.35	788.35	788.35	1313.92	1313.92
		1576.70	3153.40	6306.80	5781.24	4467.32
TOTAL LOAD	37540.50					
ENT OUTFLOW						
SILT	11262.15	.00	.00	563.11	10699.04	
SANDS & GRAVELS	939.09	582.72	94.34	71.00	62.73	71.53
		24.63	32.14	.00	.00	.00

TOTAL LOAD '2201.24

ION NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	.04	1472.85	1472.55	261.	11262.	10924.
60000.000	-.01	1432.73	1432.50	261.	11262.	14343.
59000.000	.00	1392.84	1392.51	261.	11262.	18636.
58000.000	.00	1352.74	1352.51	261.	11262.	20024.
57000.000	.00	1312.83	1312.51	261.	11262.	20489.
56000.000	.00	1272.74	1272.51	261.	11262.	20569.
55000.000	.00	1232.85	1232.51	261.	11262.	20644.
54000.000	.00	1192.74	1192.51	261.	11262.	20614.
53000.000	.00	1152.84	1152.51	261.	11262.	20656.
52000.000	.00	1112.74	1112.51	261.	11262.	20622.
51000.000	.00	1072.83	1072.51	261.	11262.	20657.
50000.000	.00	1032.74	1032.51	261.	11262.	20614.
49000.000	.00	992.85	992.51	261.	11262.	20656.
48000.000	.00	952.74	952.51	261.	11262.	20617.
47000.000	.00	912.84	912.51	261.	11262.	20656.
46000.000	.00	872.74	872.51	261.	11262.	20623.
45000.000	.00	832.83	832.51	261.	11262.	20657.
44000.000	.00	792.74	792.51	261.	11262.	20614.
43000.000	.00	752.85	752.51	261.	11262.	20656.
42000.000	.00	712.74	712.51	261.	11262.	20617.
41000.000	.00	672.84	672.51	261.	11262.	20656.
40000.000	.00	632.74	632.51	261.	11262.	20623.
39000.000	.00	592.83	592.51	261.	11262.	20657.
00.000	.00	552.74	552.51	261.	11262.	20614.
00.000	.00	512.85	512.51	261.	11262.	20656.
36000.000	.00	472.74	472.51	261.	11262.	20616.
35000.000	.00	432.84	432.51	261.	11262.	20658.
34000.000	.00	392.74	392.51	261.	11262.	19620.
33900.000	.01	388.99	388.67	261.	11262.	19317.
33800.000	.01	385.38	385.12	261.	11262.	18480.
33700.000	.01	382.23	381.87	261.	11262.	18211.
33600.000	.01	379.19	378.92	261.	11262.	17283.
33500.000	.01	376.66	376.27	261.	11262.	16966.
33400.000	.01	374.24	373.92	261.	11262.	16401.
33300.000	.02	372.20	371.88	261.	11262.	15562.
33200.000	.02	370.60	370.13	261.	11262.	14628.
33100.000	.04	369.19	368.70	261.	11262.	14404.
33000.000	.06	368.21	367.57	261.	11262.	9918.
32500.000	.02	365.57	364.98	261.	11262.	4826.
32000.000	.01	363.04	362.42	261.	11262.	3167.
31500.000	.00	360.46	359.86	261.	11262.	3062.
31000.000	.00	357.91	357.31	261.	11262.	2996.
30500.000	.00	355.40	354.76	261.	11262.	2775.
30000.000	.00	352.78	352.21	261.	11262.	3078.
29500.000	.00	350.29	349.66	261.	11262.	2677.
29000.000	.00	347.70	347.11	261.	11262.	3136.
28500.000	.00	345.17	344.56	261.	11262.	2920.
28000.000	.00	342.63	342.01	261.	11262.	2864.
27500.000	.00	340.04	339.46	261.	11262.	3010.
00.000	.00	337.51	336.91	261.	11262.	2773.
26500.000	.00	334.95	334.36	261.	11262.	2983.
26000.000	.00	332.44	331.81	261.	11262.	2748.
25500.000	.00	329.85	329.26	261.	11262.	3046.
25000.000	.00	327.34	326.71	261.	11262.	2685.

24500.000	.00	324.77	324.16	261.	11262.	3114.
24000.000	.00	322.24	321.61	261.	11262.	2685.
23500.000	.00	319.64	319.06	261.	11262.	3201.
23000.000	.00	317.12	316.51	261.	11262.	2609.
22500.000	.00	314.56	313.96	261.	11262.	3119.
22000.000	.00	312.05	311.41	261.	11262.	2685.
21500.000	.00	309.47	308.86	261.	11262.	2935.
21000.000	.00	306.92	306.31	261.	11262.	2862.
20500.000	.00	304.35	303.76	261.	11262.	2955.
20000.000	.00	301.85	301.21	261.	11262.	2687.
19500.000	.00	299.32	298.66	261.	11262.	3017.
19000.000	.00	296.70	296.11	261.	11262.	2917.
18500.000	.00	294.17	293.56	261.	11262.	2854.
18000.000	.00	291.66	291.01	261.	11262.	2818.
17500.000	.00	289.06	288.46	261.	11262.	3053.
17000.000	.00	286.55	285.91	261.	11262.	2658.
16500.000	.00	283.99	283.36	261.	11262.	3136.
16000.000	.00	281.41	280.81	261.	11262.	2708.
15500.000	.00	278.87	278.26	261.	11262.	3047.
15000.000	.00	276.32	275.71	261.	11262.	2782.
14500.000	.00	273.75	273.16	261.	11262.	3022.
14000.000	.00	271.23	270.61	261.	11262.	2704.
13500.000	.00	268.67	268.06	261.	11262.	3068.
13000.000	.00	266.14	265.51	261.	11262.	2708.
12500.000	.00	263.54	262.96	261.	11262.	3125.
12000.000	.00	261.02	260.41	261.	11262.	2661.
11500.000	.00	258.48	257.86	261.	11262.	3077.
11000.000	.00	255.92	255.31	261.	11262.	2733.
10500.000	.00	253.37	252.76	261.	11262.	3044.
10000.000	.00	250.83	250.21	261.	11262.	2744.
9500.000	.00	248.24	247.66	261.	11262.	3057.
9000.000	.00	245.74	245.11	261.	11262.	2718.
8500.000	.00	243.12	242.56	261.	11262.	3277.
8000.000	-.01	240.64	240.00	261.	11262.	2316.
7500.000	.01	238.06	237.47	261.	11262.	3486.
7000.000	-.02	235.60	234.89	261.	11262.	939.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
5.8448				

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* FLOW 4
* FLOW 5
* FLOW 6

==========

• C FLOW 7

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 7
WATER DISCHARGE= 2742.00
ELEVATION= 238.700
TEMPERATURE= 70.000
DURATION(DAYS) .104DE-01

. . . . . .

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

FLOW # (N) = 1
FLOW...Q(N)= 2742.0
TIME STEP DURATION (DAYS)= .0104
ACCUMULATED TIME (YRS)= .0002
TEMPERATURE (DEG F)= 70.0000

********** FALL VELOCITY BY METHOD 2**********

DIAMETER	VELOCITY	REY. NO.	CD
.000018	.8972544E-04	.1524015E-03	158259.2
.000036	.3567692E-03	.1211968E-02	20019.61
.000072	.1408035E-02	.9566370E-02	2570.593
.000144	.5451017E-02	.7406981E-01	343.0324
.000288	.2021579E-01	.5493945	49.88144
.000580	.6151953E-01	3.366993	10.84750
.001160	.1398207	15.30491	4.199934
.002319	.2877815	62.97450	1.981996
.004639	.4850357	212.3241	1.395741
.009279	.7215017	631.7419	1.261694
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086
.074216	2.082692	14585.58	1.211086
.148596	2.946998	41322.65	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SILT	383494.37	.00	.00	19174.72	364319.65	
SANDS & GRAVELS	894820.19	26844.61	26844.61	26844.61	44741.01	44741.01
		53689.21	107378.42	214756.85	196860.44	152119.43

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 38000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
11.075	.039474	.75	329.93	.0220	1.84987	.97624	2.254

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	329949.50	329949.50	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015000	.015000	.014991
	.014998	.015000	.025000	.040001	.070001
	.140002	.240003	.230002	.150000	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015000	.030001	.044992
	.059989	.074989	.099990	.139990	.209992
	.349994	.589997	.819999	.969999	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	1.8499	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
...ON THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day)	
	ACTIVE LAYER	INACTIVE LAYER

1	.00	.00
2	.00	.00
3	.00	.00
	.00	.00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT= .41085
MIN.GRAIN DIAM = .052514
BED SURFACE EXPOSED = 1.00000

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.030862	.34	.000000	.00
SAND	.969138	9.38	1.000000	.28
TOTAL	1.000000	9.72	1.000000	.28

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046308	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 4540.9
DEPTH OF NEW ACTIVE LAYER (ft) DSE= 1.0310
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL= 15770.2
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 4265.0
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 148542.6

MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015431	.015431	.014972
	.014972	.014972	.024954	.039927	.069872
	.139743	.239560	.229578	.149725	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015431	.030862	.045835
	.060807	.075780	.100734	.140660	.210532
	.350275	.589835	.819413	.969138	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.015633
	.015873	.015956	.026609	.042584	.074522
	.149031	.255450	.244753	.159588	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.015633
	.031506	.047463	.074072	.116655	.191177
	.340208	.595659	.840412	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .517998E+05 .203183E+01 .553923E+07

POTENTIAL TRANSPORT BY SIZE CLASS= .100000E-19 .100000E-19 .191747E+05 .364320E+06 .553923E+07
.553923E+07 .248514E+07 .992713E+06 .553775E+06 .838440E+05
.121477E+06 .171924E+06 .238881E+06 .299926E+06

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	383494.37	.00	.00	19174.72	364319.65	
SANDS & GRAVELS	413767.46	73302.84	79431.23	39267.57	26093.34	23279.09
		6165.65	17867.05	43352.15	57730.77	47277.77

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
8.761	.005150	2.38	131.34	.0220	.76642	.62838	1.001

SEDIMENT RESERVOIR COMPUTATIONS:

SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	77500.00	77500.00	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.029999	.024999	.019999	.024975
	.024978	.029997	.040003	.055005	.080019
	.140053	.190082	.174966	.134926	
BED MATERIAL BY PERCENT FINER/100	.000000	.029999	.054997	.074996	.099971
	.124950	.154946	.194949	.249954	.329974
	.470026	.660109	.835075	.970001	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	.7664	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

SAND

** ARMOR LAYER **

STABILITY COEFFICIENT=	.66041
MIN.GRAIN DIAM =	.233264
BED SURFACE EXPOSED =	.00000

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.26
TOTAL	1.000000	9.74	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=		.046500
WEIGHT IN SURFACE LAYER (tons)	WTSL=	1060.0
DEPTH OF NEW ACTIVE LAYER (ft)	DSE=	.0001
WEIGHT IN NEW ACTIVE LAYER(tons)	WTMXAL=	9.9
WEIGHT IN OLD ACTIVE LAYER(tons)	WAL=	950.8
USEABLE WEIGHT, OLD INACTIVE LAYER,	WIL=	34729.5

ATERIAL BY GRAIN SIZE FRACTION	.000000	.030820	.025683	.020547	.024920
	.024920	.029904	.039872	.054824	.079744
	.139551	.189391	.174439	.134567	
BED MATERIAL BY PERCENT FINER/100	.000000	.030820	.056503	.077049	.101969
	.126889	.156793	.196665	.251488	.331232

	.470783	.660174	.334613	.969180	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.026980
	.027119	.033394	.044790	.061637	.090097
	.158368	.215338	.194229	.148047	
MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.026980
	.054099	.087493	.132283	.193920	.284017
	.442385	.657724	.851953	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .517998E+05 .236535E+01 .553923E+07

POTENTIAL TRANSPORT BY SIZE CLASS= .100000E-19 .100000E-19 .191747E+05 .364320E+06 .369461E+07
.770283E+06 .302050E+06 .162184E+06 .120641E+06 .872288E+04
.147360E+05 .237407E+05 .354028E+05 .396535E+05

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	383494.37	.00	.00	19174.72	364319.65	
SANDS & GRAVELS	161296.98	98009.51	19677.12	9498.96	6913.00	7120.72
		761.23	2246.39	4885.70	6585.86	5598.49

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.07	61000.000	4.77			7.78		
TAL=	7000.000	4.77	4.74	.01	7.78	.80	.90

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	383494.37	.00	.00	19174.72	364319.65	
SANDS & GRAVELS	894820.19	26844.61	26844.61	26844.61	44741.01	44741.01
		53689.21	107378.42	214756.85	196860.44	152119.43
TOTAL LOAD	1278314.55					
SEDIMENT OUTFLOW						
SILT	383494.37	.00	.00	19174.72	364319.65	
SANDS & GRAVELS	109008.93	88497.43	11528.85	3121.19	1915.63	2032.79
		109.87	349.21	753.58	700.39	.00
TOTAL LOAD	492503.29					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	1.28	1474.09	1473.79	2742.	383494.	306511.
100.000	-.01	1433.77	1432.50	2742.	383494.	302379.
,000.000	-.01	1393.86	1392.50	2742.	383494.	304855.
58000.000	-.01	1353.77	1352.50	2742.	383494.	306913.
57000.000	-.01	1313.83	1312.50	2742.	383494.	309693.
56000.000	-.01	1273.77	1272.50	2742.	383494.	311007.

55000.000	-.01	1233.86	1232.50	2742.	383494.	313011.
54000.000	-.01	1193.77	1192.50	2742.	383494.	313881.
53000.000	-.01	1153.86	1152.50	2742.	383494.	317142.
52000.000	-.01	1113.77	1112.50	2742.	383494.	320293.
00.000	-.01	1073.83	1072.50	2742.	383494.	325311.
000.000	-.01	1033.73	1032.50	2742.	383494.	330791.
49000.000	-.01	993.85	992.50	2742.	383494.	339557.
48000.000	-.01	953.73	952.50	2742.	383494.	347780.
47000.000	-.01	913.85	912.50	2742.	383494.	357608.
46000.000	-.01	873.74	872.50	2742.	383494.	365937.
45000.000	-.01	833.84	832.50	2742.	383494.	375631.
44000.000	-.01	793.74	792.50	2742.	383494.	382873.
43000.000	-.01	753.85	752.50	2742.	383494.	390737.
42000.000	.00	713.74	712.51	2742.	383494.	396137.
41000.000	.00	673.85	672.51	2742.	383494.	402299.
40000.000	.00	633.74	632.51	2742.	383494.	406225.
39000.000	.00	593.84	592.51	2742.	383494.	410990.
38000.000	.00	553.74	552.51	2742.	383494.	413767.
37000.000	.00	513.83	512.51	2742.	383494.	417442.
36000.000	.00	473.74	472.51	2742.	383494.	419329.
35000.000	.00	433.83	432.51	2742.	383494.	422266.
34000.000	.08	393.77	392.59	2742.	383494.	382359.
33900.000	.15	390.12	388.81	2742.	383494.	379859.
33800.000	.24	386.53	385.35	2742.	383494.	361626.
33700.000	.31	383.37	382.17	2742.	383494.	340464.
33600.000	.27	380.62	379.18	2742.	383494.	328859.
33500.000	.31	378.04	376.57	2742.	383494.	312764.
33400.000	.36	375.80	374.27	2742.	383494.	294290.
33300.000	.36	373.91	372.22	2742.	383494.	281981.
200.000	.44	372.31	370.55	2742.	383494.	264056.
00.000	.33	371.06	368.99	2742.	383494.	253866.
33000.000	.40	370.21	367.91	2742.	383494.	213298.
32500.000	.10	367.60	365.06	2742.	383494.	218680.
32000.000	.08	364.95	362.49	2742.	383494.	205811.
31500.000	.06	362.38	359.92	2742.	383494.	198832.
31000.000	.03	359.82	357.34	2742.	383494.	190668.
30500.000	.03	357.33	354.79	2742.	383494.	191202.
30000.000	.04	354.85	352.25	2742.	383494.	176462.
29500.000	-.01	352.12	349.65	2742.	383494.	188251.
29000.000	.04	349.73	347.15	2742.	383494.	174708.
28500.000	-.01	347.05	344.55	2742.	383494.	185163.
28000.000	.02	344.54	342.03	2742.	383494.	176693.
27500.000	.01	342.00	339.47	2742.	383494.	179889.
27000.000	.00	339.45	336.91	2742.	383494.	178502.
26500.000	.00	336.85	334.36	2742.	383494.	179632.
26000.000	.00	334.36	331.81	2742.	383494.	181338.
25500.000	.03	331.89	329.29	2742.	383494.	171136.
25000.000	-.02	329.18	326.69	2742.	383494.	182163.
24500.000	.02	326.67	324.18	2742.	383494.	173278.
24000.000	.01	324.17	321.62	2742.	383494.	175224.
23500.000	-.01	321.52	319.05	2742.	383494.	176640.
23000.000	.03	319.10	316.54	2742.	383494.	170357.
22500.000	-.03	316.39	313.93	2742.	383494.	177072.
22000.000	.03	313.97	311.44	2742.	383494.	167956.
21500.000	-.02	311.36	308.84	2742.	383494.	173360.
000.000	.01	308.81	306.32	2742.	383494.	169570.
0500.000	-.01	306.26	303.75	2742.	383494.	172580.
20000.000	.02	303.80	301.23	2742.	383494.	164109.
19500.000	-.02	301.10	298.64	2742.	383494.	172724.
19000.000	.02	298.71	296.13	2742.	383494.	162267.

18500.000	-.02	295.98	293.54	2742.	383494.	172021.
18000.000	.03	293.63	291.04	2742.	383494.	159287.
17500.000	-.02	290.90	288.44	2742.	383494.	170967.
17000.000	.03	288.52	285.94	2742.	383494.	158778.
16500.000	-.02	285.78	283.34	2742.	383494.	169727.
16000.000	.02	283.35	280.83	2742.	383494.	158589.
15500.000	-.01	280.78	278.25	2742.	383494.	164052.
15000.000	-.01	278.22	275.70	2742.	383494.	165247.
14500.000	.02	275.70	273.18	2742.	383494.	158868.
14000.000	-.02	273.06	270.59	2742.	383494.	163437.
13500.000	.02	270.65	268.08	2742.	383494.	156748.
13000.000	-.02	267.97	265.49	2742.	383494.	163671.
12500.000	.03	265.56	262.99	2742.	383494.	155375.
12000.000	-.03	262.88	260.38	2742.	383494.	162987.
11500.000	.03	260.46	257.89	2742.	383494.	154657.
11000.000	-.03	257.77	255.28	2742.	383494.	162102.
10500.000	.03	255.36	252.79	2742.	383494.	153913.
10000.000	-.03	252.67	250.18	2742.	383494.	161604.
9500.000	.03	250.25	247.69	2742.	383494.	153215.
9000.000	-.02	247.56	245.09	2742.	383494.	161297.
8500.000	.02	245.08	242.58	2742.	383494.	154118.
8000.000	.00	242.53	240.01	2742.	383494.	157403.
7500.000	.00	239.96	237.46	2742.	383494.	154964.
7000.000	.51	238.70	235.42	2742.	383494.	109009.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
62.7120				

==========

* FLOW 8
* FLOW 9
* FLOW 10

==========

* C FLOW 11

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 11
WATER DISCHARGE= 7028.00
ELEVATION= 237.500
TEMPERATURE= 70.000
FLOW DURATION(DAYS) .1040E-01

- -

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
FLOW # (N) = 1
FLOW...Q(N)= 7028.0
TIME STEP DURATION (DAYS)= .0104
ACCUMULATED TIME (YRS)= .0003
WATER TEMPERATURE (DEG F)= 70.0000
********** FALL VELOCITY BY METHOD 2**********

DIAMETER	VELOCITY	REY. NO.	CD
.000018	.8972544E-04	.1524015E-03	158259.2
.000036	.3567692E-03	.1211968E-02	20019.61
.000072	.1408035E-02	.9566370E-02	2570.593

.000144	.5451017E-02	.7406981E-01	343.0324
.000288	.2021579E-01	.5493945	49.88144
.000580	.6151953E-01	3.366993	10.84750
.001160	.1398207	15.30491	4.199934
.002319	.2877815	62.97450	1.981996
.004639	.4850357	212.3241	1.395741
.009279	.7215017	631.7419	1.261694
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086
.074216	2.082692	14585.58	1.211086
.148596	2.946998	41322.65	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SILT	1573639.39	.00	.00	78681.97	1494957.42	
SANDS & GRAVELS	3671825.25	110154.76	110154.76	110154.76	183591.26	183591.26
		220309.52	440619.03	881238.06	807801.56	624210.29

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 38000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
16.070	.038915	1.33	329.97	.0220	3.22104	1.28821	2.461

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	329949.50	329949.50	.00

ATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015021	.015021	.014574
	.014574	.014574	.025037	.040056	.070095
	.140190	.240322	.230302	.150192	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015021	.030041	.044615
	.059190	.073764	.098801	.138858	.208953
	.349143	.589464	.819767	.969959	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	3.2210	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

RMOR LAYER **

STABILITY COEFFICIENT=	.21513
MIN.GRAIN DIAM =	.094801
BED SURFACE EXPOSED =	1.00000

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
CLAY	.000000	.00	.000000	.00
T	.030862	.34	.000000	.00
	.969138	9.38	1.000000	.26
TOTAL	1.000000	9.72	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046308	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 4540.9
DEPTH OF NEW ACTIVE LAYER (ft) DSE= 2.3503
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL= 35927.4
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 4059.1
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 148542.6

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015431	.015431	.014972
	.014972	.014972	.024954	.039927	.069872
	.139743	.239560	.229578	.149725	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015431	.030862	.045835
	.060807	.075780	.100734	.140660	.210532
	.350275	.589835	.819413	.969138	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.000000	.000000	.028081	.044808	.078288
	.156529	.268201	.256810	.167282	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.000000	.000000	.028081	.072890	.151178
	.307707	.575907	.832718	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .829296E+05 .367692E+01 .136068E+08

POTENTIAL TRANSPORT BY SIZE CLASS=	.100000E-19	.100000E-19	.786820E+05	.149496E+07	.136068E+08
	.136068E+08	.136068E+08	.552265E+07	.300802E+07	.221875E+06
	.327932E+06	.482482E+06	.726047E+06	.108707E+07	

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	1573639.39	.00	.00	78681.97	1494957.42	
SANDS & GRAVELS	1095432.59	96164.38	93502.73	93533.77	146322.98	127727.05
		16476.37	48704.11	122840.79	177154.34	173006.07

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THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
11.640	.004624	4.27	141.40	.0220	1.23319	.79708	.993

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	77500.00	77500.00	.00

TION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030111	.025092	.020074	.024347
	.024972	.029907	.039894	.054884	.080228
	.140318	.190264	.175012	.134785	
BED MATERIAL BY PERCENT FINER/100	.000000	.030111	.055203	.075277	.099623

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                                    .124596     .154503     .194398     .249282     .329509
                                    .469827     .660092     .835104     .969889

 - * TRANSPORT CAPACITY:
    (EAR STRESS,lb/sq.ft =   1.2332
 FINE GRAIN SEDIMENT TYPE =        1
              LAYER TYPE =        1           2
DEPOSITION THRESHOLD #/sf =    .0000       .0000
EROSION THRESHOLD,#/sq.ft =    .0000       .0000

SIZE              EROSION RATE (tons/day)
CLASS          ACTIVE              INACTIVE
               LAYER                 LAYER

    1             .00                 .00
    2             .00                 .00
    3             .00                 .00
    4             .00                 .00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=       .62287
MIN.GRAIN DIAM       =      .534997
BED SURFACE EXPOSED  =       .07173

          INACTIVE LAYER              ACTIVE LAYER
          %          DEPTH            %          DEPTH
 CLAY    .000000       .00          .000000       .00
 SILT    .077049       .84          .000000       .00
         .922951      8.89         1.000000       .23
        1.000000      9.74         1.000000       .23

       AVG. UNIT                   AVG. UNIT
         WEIGHT                      WEIGHT

         .046024                     .046500

     COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=          .046500
     WEIGHT IN SURFACE LAYER (tons)    WTSL=         1060.0
     DEPTH OF NEW ACTIVE LAYER (ft)     DSE=         1.8015
     WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=         6434.0
     WEIGHT IN OLD ACTIVE LAYER(tons)   WAL=          817.8
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=        34729.5
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .030820     .025683     .020547     .024920
                                        .024920     .029904     .039872     .054824     .079744
                                        .139551     .189391     .174439     .134567
BED MATERIAL BY PERCENT FINER/100       .000000     .030820     .056503     .077049     .101969
                                        .126889     .156793     .196665     .251488     .331232
                                        .470783     .660174     .834613     .969180
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .000000     .000000     .000000     .000000
                                        .027206     .030057     .040858     .057450     .100786
                                        .172882     .227359     .199353     .144049
BED MATERIAL BY PERCENT FINER/100       .000000     .000000     .000000     .000000     .000000
                                        .027206     .057262     .098120     .155570     .256356
                                        .429238     .656597     .855951    1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .829296E+05 .521667E+01 .136068E+08

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .786820E+05 .149496E+07 .136068E+08
```

.493632E+07 .194128E+07 .104728E+07 .779796E+06 .263427E+05
.464235E+05 .801290E+05 .136595E+06 .214085E+06

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
ATED SEDIMENT LOAD, TONS/DAY						
SILT	1573639.39	.00	.00	78681.97	1494957.42	
SANDS & GRAVELS	466065.31	99226.53	137097.84	61586.90	43702.31	44447.78
		2193.67	6763.50	15845.21	24916.60	30284.96

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.11	61000.000	42.09			68.64		
TOTAL=	7000.000	42.09	42.06	.00	68.64	9.71	.86

TABLE SB-1.

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1573639.39	.00	.00	78681.97	1494957.42	
SANDS & GRAVELS	3671825.25	110154.76	110154.76	110154.76	183591.26	183591.26
		220309.52	440619.03	881238.06	807801.56	624210.29
TOTAL LOAD	5245464.64					
SEDIMENT OUTFLOW						
SILT	1573639.39	.00	.00	78681.97	1494957.42	
SANDS & GRAVELS	462018.88	99226.53	134883.63	60845.25	43840.65	44844.36
		2024.63	6365.38	15212.87	24415.17	30360.40
TOTAL LOAD	2035658.27					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	14.14	1480.32	1481.02	7028.	1573639.	1121642.
60000.000	.08	1434.91	1432.59	7028.	1573639.	1044589.
59000.000	-.04	1394.95	1392.47	7028.	1573639.	1065910.
58000.000	-.02	1354.87	1352.49	7028.	1573639.	1067690.
57000.000	-.02	1314.96	1312.49	7028.	1573639.	1072005.
56000.000	-.02	1274.87	1272.49	7028.	1573639.	1072699.
55000.000	-.02	1234.98	1232.49	7028.	1573639.	1077608.
54000.000	-.02	1194.88	1192.49	7028.	1573639.	1078962.
53000.000	-.02	1154.95	1152.49	7028.	1573639.	1083323.
52000.000	-.02	1114.88	1112.49	7028.	1573639.	1084072.
51000.000	-.02	1074.97	1072.49	7028.	1573639.	1088145.
50000.000	-.01	1034.88	1032.50	7028.	1573639.	1087982.
9000.000	-.01	994.98	992.50	7028.	1573639.	1091501.
00.000	-.01	954.88	952.50	7028.	1573639.	1090878.
47000.000	-.01	914.97	912.50	7028.	1573639.	1093744.
46000.000	-.01	874.88	872.50	7028.	1573639.	1092708.
45000.000	-.01	834.97	832.50	7028.	1573639.	1095167.
44000.000	-.01	794.88	792.50	7028.	1573639.	1093653.

43000.000	-.01	754.98	752.50	7028.	1573639.	1096045.
42000.000	-.01	714.88	712.50	7028.	1573639.	1094434.
41000.000	-.01	674.97	672.50	7028.	1573639.	1096564.
40000.000	-.01	634.88	632.50	7028.	1573639.	1094922.
39000.000	-.01	594.97	592.50	7028.	1573639.	1096859.
38000.000	-.01	554.88	552.50	7028.	1573639.	1095433.
37000.000	-.01	514.95	512.50	7028.	1573639.	1097033.
36000.000	-.01	474.88	472.50	7028.	1573639.	1096606.
35000.000	-.01	434.88	432.50	7028.	1573639.	1094162.
34000.000	.68	395.22	393.19	7028.	1573639.	937364.
33900.000	-.17	391.55	388.49	7028.	1573639.	1049749.
33800.000	4.07	388.08	389.18	7028.	1573639.	598836.
33700.000	-3.82	385.94	378.04	7028.	1573639.	1376839.
33600.000	5.85	383.72	384.76	7028.	1573639.	442430.
33500.000	4.62	382.32	380.88	7028.	1573639.	557137.
33400.000	-2.93	380.72	370.98	7028.	1573639.	418659.
33300.000	5.91	378.94	377.77	7028.	1573639.	509904.
33200.000	-2.58	378.92	367.53	7028.	1573639.	394983.
33100.000	6.66	376.85	375.32	7028.	1573639.	467161.
33000.000	.21	372.74	367.72	7028.	1573639.	564408.
32500.000	.36	369.87	365.32	7028.	1573639.	560257.
32000.000	.27	367.17	362.68	7028.	1573639.	529113.
31500.000	.18	364.58	360.04	7028.	1573639.	518469.
31000.000	.12	361.95	357.43	7028.	1573639.	499122.
30500.000	.10	359.43	354.86	7028.	1573639.	493089.
30000.000	.05	356.81	352.26	7028.	1573639.	488679.
29500.000	.05	354.27	349.71	7028.	1573639.	484800.
29000.000	.03	351.70	347.14	7028.	1573639.	484507.
28500.000	.03	349.15	344.59	7028.	1573639.	485696.
28000.000	.01	346.58	342.02	7028.	1573639.	487717.
27500.000	.03	344.06	339.49	7028.	1573639.	487095.
27000.000	.01	341.52	336.92	7028.	1573639.	489550.
26500.000	.00	338.95	334.36	7028.	1573639.	495005.
26000.000	.01	336.38	331.82	7028.	1573639.	492300.
25500.000	.01	333.86	329.27	7028.	1573639.	496404.
25000.000	.00	331.29	326.71	7028.	1573639.	499072.
24500.000	.02	328.75	324.18	7028.	1573639.	497599.
24000.000	.00	326.21	321.61	7028.	1573639.	501932.
23500.000	.01	323.66	319.07	7028.	1573639.	497718.
23000.000	.00	321.09	316.51	7028.	1573639.	505836.
22500.000	.01	318.53	313.97	7028.	1573639.	497628.
22000.000	.02	316.01	311.43	7028.	1573639.	505719.
21500.000	.01	313.44	308.87	7028.	1573639.	503802.
21000.000	.00	310.90	306.31	7028.	1573639.	499440.
20500.000	.01	308.34	303.77	7028.	1573639.	502340.
20000.000	.01	305.80	301.22	7028.	1573639.	497200.
19500.000	.00	303.25	298.66	7028.	1573639.	498979.
19000.000	.01	300.69	296.12	7028.	1573639.	492898.
18500.000	.01	298.17	293.57	7028.	1573639.	495230.
18000.000	.01	295.59	291.02	7028.	1573639.	498011.
17500.000	.01	293.04	288.47	7028.	1573639.	491731.
17000.000	-.01	290.49	285.90	7028.	1573639.	493416.
16500.000	.00	287.90	283.36	7028.	1573639.	489744.
16000.000	.01	285.39	280.82	7028.	1573639.	487677.
15500.000	.00	282.85	278.26	7028.	1573639.	488552.
15000.000	.00	280.28	275.71	7028.	1573639.	485250.
14500.000	.00	277.74	273.16	7028.	1573639.	483723.
14000.000	.00	275.19	270.61	7028.	1573639.	482607.
13500.000	.00	272.64	268.06	7028.	1573639.	483308.
13000.000	-.01	270.09	265.50	7028.	1573639.	480207.

12500.000	.00	267.54	262.96	7028.	1573639.	481760.
12000.000	.00	264.99	260.41	7028.	1573639.	477703.
11500.000	-.01	262.43	257.85	7028.	1573639.	482253.
11000.000	.01	259.89	255.32	7028.	1573639.	473894.
10500.000	-.03	257.34	252.73	7028.	1573639.	485312.
10000.000	.02	254.75	250.23	7028.	1573639.	470018.
9500.000	-.04	252.25	247.62	7028.	1573639.	489915.
9000.000	.03	249.64	245.14	7028.	1573639.	466065.
8500.000	-.04	247.16	242.52	7028.	1573639.	494248.
8000.000	.02	244.53	240.03	7028.	1573639.	462113.
7500.000	.04	242.12	237.50	7028.	1573639.	482620.
7000.000	.28	239.60	235.19	7028.	1573639.	462019.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
314.1112				

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* FLOW 12
* FLOW 13
* FLOW 14

==========

* C FLOW 15

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 15
DISCHARGE= 5897.00
ELEVATION= 236.200
TEMPERATURE= 70.000
FLOW DURATION(DAYS) .1040E-01

- -

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
FLOW # (N) = 1
FLOW...Q(N)= 5897.0
TIME STEP DURATION (DAYS)= .0104
ACCUMULATED TIME (YRS)= .0004
WATER TEMPERATURE (DEG F)= 70.0000
**************************** FALL VELOCITY BY METHOD 2****************************

DIAMETER	VELOCITY	REY. NO.	CD
.000018	.8972544E-04	.1524015E-03	158259.2
.000036	.3567692E-03	.1211968E-02	20019.61
.000072	.1408035E-02	.9566370E-02	2570.593
.000144	.5451017E-02	.7406981E-01	343.0324
.000288	.2021579E-01	.5493945	49.88144
.000580	.6151953E-01	3.366993	10.84750
.001160	.1398207	15.30491	4.199934
.002319	.2877815	62.97450	1.981996
.004639	.4850357	212.3241	1.395741
.009279	.7215017	631.7419	1.261694
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086
.074216	2.082692	14585.58	1.211086
.148596	2.946998	41322.65	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SILT	1209495.66	.00	.00	60474.78	1149020.88	
S & GRAVELS	2822156.54	84664.70	84664.70	84664.70	141107.83	141107.83
		169329.39	338658.79	677317.57	620874.44	479766.61

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 38000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
14.993	.039038	1.19	329.96	.0220	2.90614	1.22362	2.421

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	329949.50	329949.50	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015023	.015023	.014576
	.014576	.014576	.024932	.040012	.070105
	.140209	.240358	.230343	.150223	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015023	.030045	.044621
	.059197	.073773	.098705	.138717	.208822
	.349031	.589389	.819731	.969955	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	2.9061	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
SITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

SAND

** ARMOR LAYER **

STABILITY COEFFICIENT=	.24042
MIN.GRAIN DIAM =	.093736
BED SURFACE EXPOSED =	1.00000

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.030862	.34	.000000	.00
SAND	.969138	9.38	1.000000	.26
TOTAL	1.000000	9.72	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046308	.046500

```
     COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=        .046500
     WEIGHT IN SURFACE LAYER (tons)    WTSL=       4540.9
     DEPTH OF NEW ACTIVE LAYER (ft)    DSE=        2.0058
     WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=      30664.4
     WEIGHT IN OLD ACTIVE LAYER(tons)  WAL=       4040.0
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=     148542.6
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .000000     .015431     .015431     .014972
                                        .014972     .014972     .024954     .039927     .069872
                                        .139743     .239560     .229578     .149725
BED MATERIAL BY PERCENT FINER/100       .000000     .000000     .015431     .030862     .045835
                                        .060807     .075780     .100734     .140660     .210532
                                        .350275     .589835     .819413     .969138
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .000000     .000000     .000000     .000000
                                        .000000     .000000     .024103     .043161     .078685
                                        .157346     .269697     .258451     .168558
BED MATERIAL BY PERCENT FINER/100       .000000     .000000     .000000     .000000     .000000
                                        .000000     .000000     .024103     .067264     .145949
                                        .303295     .572992     .831442    1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .759643E+05 .325283E+01 .115280E+08

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .604748E+05 .114902E+07 .115280E+08
                                    .115280E+08 .101084E+08 .397428E+07 .217482E+07 .183682E+06
                                    .270878E+06 .396640E+06 .590911E+06 .866396E+06
                      TOTAL              LOAD BY GRAIN SIZE (TONS/DAY)
                                    VF          F           M           C          VC
CALCULATED SEDIMENT LOAD, TONS/DAY
          SILT   1209495.66         .00         .00    60474.78  1149020.88
    DS & GRAVELS   849715.77    74760.76    73351.30    73356.14    98620.83    90468.34
                                13700.16    40411.56   101460.38   144916.46   138669.84

*******************************************************************************************
        THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION   9000.000
        ----------------------------------------------------------


HYDRAULIC PARAMETERS:
     VEL       SLO       EFD       EFW     N-VALUE      TAU      USTARM    FROUDE NO.
   10.739   .005137      3.95    139.12      .0220   1.26611     .80765       .953
BED SEDIMENT RESERVOIR COMPUTATIONS:
NEW SURFACE AREA (SQ FT):     TOTAL        K-PORTION      S-PORTION
                            77500.00       77500.00            .00
GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .030087     .025073     .020058     .024328
                                        .025625     .029665     .039762     .054820     .080170
                                        .140234     .190202     .175041     .134850
BED MATERIAL BY PERCENT FINER/100       .000000     .030087     .055160     .075218     .099546
                                        .125171     .154836     .194597     .249417     .329587
                                        .469821     .660022     .835063     .969913

SILT TRANSPORT CAPACITY:
BED SHEAR STRESS,lb/sq.ft =   1.2661
 FINE GRAIN SEDIMENT TYPE =        1
              LAYER TYPE =        1         2
   SITION THRESHOLD #/sf =    .0000     .0000
EROSION THRESHOLD,#/sq.ft =   .0000     .0000

SIZE              EROSION RATE (tons/day)
CLASS         ACTIVE            INACTIVE
```

	LAYER	LAYER
1	.00	.00
2	.00	.00
	.00	.00
4	.00	.00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT= .61479
MIN.GRAIN DIAM = .110705
BED SURFACE EXPOSED = 1.00000

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.23
TOTAL	1.000000	9.74	1.000000	.23

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 1060.0
DEPTH OF NEW ACTIVE LAYER (ft) DSE= 2.5044
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL= 8941.4
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 845.5
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 34729.5

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030820	.025683	.020547	.024920
	.024920	.029904	.039872	.054824	.079744
	.139551	.189391	.174439	.134567	
BED MATERIAL BY PERCENT FINER/100	.000000	.030820	.056503	.077049	.101969
	.126889	.156793	.196665	.251488	.331232
	.470783	.660174	.834613	.969180	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.054593	.019841	.035244	.054652	.097682
	.168269	.223510	.199763	.146448	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.054593	.074434	.109678	.164330	.262011
	.430280	.653790	.853552	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .759643E+05 .448116E+01 .115280E+08

POTENTIAL TRANSPORT BY SIZE CLASS=	.100000E-19	.100000E-19	.604748E+05	.114902E+07	.115280E+08
	.364175E+07	.142726E+07	.766703E+06	.568304E+06	.183241E+05
	.318843E+05	.540282E+05	.892676E+05	.131011E+06	

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY) VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	1209495.66	.00	.00	60474.78	1149020.88	
DS & GRAVELS	344784.11	76711.60	108610.83	44284.36	31530.79	32081.11
		1513.11	4612.13	10631.06	16257.76	18551.36

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME	ENTRY	SILT			SAND		
DAYS	POINT	INFLOW	OUTFLOW	TRAP EFF	INFLOW	OUTFLOW	TRAP EFF
.16	61000.000	83.54			136.23		
TOTAL=	7000.000	83.54	83.51	.00	136.23	18.40	.86

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)

		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	1209495.66	.00	.00	60474.78	1149020.88	
SANDS & GRAVELS	2822156.54	84664.70	84664.70	84664.70	141107.83	141107.83
		169329.39	338658.79	677317.57	620874.44	479766.61
TOTAL LOAD	4031652.20					
SEDIMENT OUTFLOW						
SILT	1209495.66	.00	.00	60474.78	1149020.88	
SANDS & GRAVELS	350512.78	76711.60	106677.44	43479.89	31581.60	32153.22
		1609.46	5035.68	11940.19	18867.67	22456.05
TOTAL LOAD	1560008.44					

SECTION	BED CHANGE	WS ELEV	THALWEG	Q	SEDIMENT LOAD (TONS/DAY)	
NO	FEET	FEET	EL FEET	CFS	SILT	SAND
000.000	29.34	1487.30	1491.82	5897.	1209496.	917023.
60000.000	.33	1434.76	1432.84	5897.	1209496.	817972.
59000.000	-.10	1394.66	1392.41	5897.	1209496.	841899.
58000.000	-.02	1354.59	1352.49	5897.	1209496.	842106.
57000.000	-.02	1314.71	1312.49	5897.	1209496.	843263.
56000.000	-.02	1274.59	1272.49	5897.	1209496.	841064.
55000.000	-.02	1234.68	1232.49	5897.	1209496.	841694.
54000.000	-.02	1194.59	1192.49	5897.	1209496.	839227.
53000.000	-.02	1154.70	1152.49	5897.	1209496.	840166.
52000.000	-.02	1114.59	1112.49	5897.	1209496.	838094.
51000.000	-.02	1074.69	1072.49	5897.	1209496.	839417.
50000.000	-.02	1034.59	1032.49	5897.	1209496.	838120.
49000.000	-.02	994.68	992.49	5897.	1209496.	839986.
48000.000	-.02	954.59	952.49	5897.	1209496.	839186.
47000.000	-.02	914.70	912.49	5897.	1209496.	841784.
46000.000	-.02	874.60	872.49	5897.	1209496.	841274.
45000.000	-.02	834.69	832.49	5897.	1209496.	844029.
44000.000	-.02	794.60	792.49	5897.	1209496.	843704.
43000.000	-.02	754.69	752.49	5897.	1209496.	846413.
42000.000	-.02	714.60	712.49	5897.	1209496.	845761.
41000.000	-.02	674.72	672.49	5897.	1209496.	848687.
40000.000	-.01	634.60	632.50	5897.	1209496.	848117.
39000.000	-.02	594.69	592.49	5897.	1209496.	850613.
38000.000	-.01	554.60	552.50	5897.	1209496.	849716.
7000.000	-.02	514.71	512.49	5897.	1209496.	852337.
00.000	-.01	474.60	472.50	5897.	1209496.	851451.
5000.000	-.01	434.70	432.50	5897.	1209496.	852692.
34000.000	1.18	395.10	393.69	5897.	1209496.	539101.
33900.000	2.58	392.67	391.24	5897.	1209496.	678156.
33800.000	1.25	389.44	386.36	5897.	1209496.	1011544.

33700.000	5.83	385.30	387.69	5897.	1209496.	355173.
33600.000	4.43	384.60	383.34	5897.	1209496.	488780.
33500.000	.55	380.97	376.81	5897.	1209496.	828812.
00.000	5.36	379.49	379.27	5897.	1209496.	314615.
0.000	4.82	377.96	376.68	5897.	1209496.	411108.
3200.000	.18	377.40	370.29	5897.	1209496.	301998.
33100.000	4.89	375.63	373.55	5897.	1209496.	393645.
33000.000	.88	372.69	368.39	5897.	1209496.	438690.
32500.000	.62	369.54	365.58	5897.	1209496.	396982.
32000.000	.27	366.74	362.68	5897.	1209496.	380452.
31500.000	.28	364.27	360.14	5897.	1209496.	387182.
31000.000	.25	361.66	357.56	5897.	1209496.	385229.
30500.000	.21	359.06	354.97	5897.	1209496.	377038.
30000.000	.16	356.48	352.37	5897.	1209496.	372986.
29500.000	.13	353.87	349.79	5897.	1209496.	367783.
29000.000	.11	351.29	347.22	5897.	1209496.	362812.
28500.000	.09	348.73	344.65	5897.	1209496.	359881.
28000.000	.08	346.16	342.09	5897.	1209496.	354955.
27500.000	.06	343.62	339.52	5897.	1209496.	352500.
27000.000	.05	341.03	336.96	5897.	1209496.	349686.
26500.000	.04	338.49	334.40	5897.	1209496.	343964.
26000.000	.03	335.94	331.84	5897.	1209496.	342255.
25500.000	.03	333.37	329.29	5897.	1209496.	339747.
25000.000	.01	330.82	326.72	5897.	1209496.	336781.
24500.000	.02	328.26	324.18	5897.	1209496.	333878.
24000.000	.01	325.72	321.62	5897.	1209496.	332052.
23500.000	.01	323.15	319.07	5897.	1209496.	330774.
23000.000	.00	320.61	316.51	5897.	1209496.	327727.
22500.000	-.01	318.06	313.95	5897.	1209496.	327029.
10.000	.00	315.50	311.41	5897.	1209496.	325496.
00.000	-.01	312.96	308.85	5897.	1209496.	325476.
21000.000	-.01	310.39	306.30	5897.	1209496.	323585.
20500.000	-.02	307.86	303.74	5897.	1209496.	323894.
20000.000	-.01	305.29	301.20	5897.	1209496.	323012.
19500.000	-.01	302.76	298.65	5897.	1209496.	321297.
19000.000	-.01	300.21	296.10	5897.	1209496.	323957.
18500.000	-.01	297.66	293.55	5897.	1209496.	325448.
18000.000	-.01	295.11	291.00	5897.	1209496.	327951.
17500.000	-.01	292.55	288.45	5897.	1209496.	330672.
17000.000	-.02	290.01	285.89	5897.	1209496.	334851.
16500.000	-.01	287.46	283.35	5897.	1209496.	338544.
16000.000	-.01	284.92	280.80	5897.	1209496.	340574.
15500.000	-.02	282.35	278.24	5897.	1209496.	348129.
15000.000	.02	279.82	275.73	5897.	1209496.	338102.
14500.000	-.05	277.28	273.11	5897.	1209496.	361461.
14000.000	.05	274.67	270.66	5897.	1209496.	338049.
13500.000	-.07	272.21	267.99	5897.	1209496.	375007.
13000.000	.04	269.53	265.55	5897.	1209496.	342266.
12500.000	-.03	267.11	262.93	5897.	1209496.	377075.
12000.000	.03	264.44	260.44	5897.	1209496.	337154.
11500.000	-.05	262.00	257.81	5897.	1209496.	377302.
11000.000	.05	259.36	255.36	5897.	1209496.	337866.
10500.000	-.06	256.92	252.70	5897.	1209496.	374107.
10000.000	.05	254.26	250.26	5897.	1209496.	340153.
500.000	-.06	251.82	247.60	5897.	1209496.	377069.
00.000	.06	249.17	245.17	5897.	1209496.	344784.
8500.000	-.08	246.69	242.48	5897.	1209496.	377160.
8000.000	.05	243.97	240.06	5897.	1209496.	345401.
7500.000	.14	241.77	237.60	5897.	1209496.	366791.
7000.000	.33	239.20	235.24	5897.	1209496.	350513.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
585.6656				

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* FLOW 16
* FLOW 17
* FLOW 18

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* C FLOW 19

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 19
WATER DISCHARGE= 2172.00
ELEVATION= 235.400
TEMPERATURE= 70.000
FLOW DURATION(DAYS) .1040E-01

. . . . . .

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
FLOW # (N) = 1
FLOW...Q(N)= 2172.0
TIME STEP DURATION (DAYS)= .0104
ACCUMULATED TIME (YRS)= .0005
WATER TEMPERATURE (DEG F)= 70.0000

********** FALL VELOCITY BY METHOD 2**********

DIAMETER	VELOCITY	REY. NO.	CD
.000018	.8972544E-04	.1524015E-03	158259.2
.000036	.3567692E-03	.1211968E-02	20019.61
.000072	.1408035E-02	.9566370E-02	2570.593
.000144	.5451017E-02	.7406981E-01	343.0324
.000288	.2021579E-01	.5493945	49.88144
.000580	.6151953E-01	3.366993	10.84750
.001160	.1398207	15.30491	4.199934
.002319	.2877815	62.97450	1.981996
.004639	.4850357	212.3241	1.395741
.009279	.7215017	631.7419	1.261694
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086
.074216	2.082692	14585.58	1.211086
.148596	2.946998	41322.65	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SILT	270363.22	.00	.00	13518.16	256845.06	
SANDS & GRAVELS	630847.52	18925.43	18925.43	18925.43	31542.38	31542.38
		37850.85	75701.70	151403.40	138786.45	107244.08

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 38000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
10.104	.039612	.65	329.93	.0220	1.61181	.91126	2.207

SEDIMENT RESERVOIR COMPUTATIONS:

SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	329949.50	329949.50	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015024	.015024	.014578
	.014578	.014578	.024872	.039868	.070116
	.140234	.240407	.230400	.150271	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015024	.030049	.044627
	.059204	.073783	.098655	.138523	.208639
	.348873	.589280	.819680	.969951	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	1.6118	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

** ARMOR LAYER **

STABILITY COEFFICIENT=	.49141	
MIN.GRAIN DIAM =	.074234	
BED SURFACE EXPOSED =	1.00000	

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.030862	.34	.000000	.00
SAND	.969138	9.38	1.000000	.26
TOTAL	1.000000	9.72	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046308	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=	.046500				
WEIGHT IN SURFACE LAYER (tons) WTSL=	4540.9				
DEPTH OF NEW ACTIVE LAYER (ft) DSE=	.8528				
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=	13047.0				
WEIGHT IN OLD ACTIVE LAYER(tons) WAL=	4021.2				
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=	148542.6				
MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015431	.015431	.014972
	.014972	.014972	.024954	.039927	.069872
	.139743	.239560	.229578	.149725	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015431	.030862	.045835
	.060807	.075780	.100734	.140660	.210532
	.350275	.589835	.819413	.969138	

** ACTIVE LAYER **

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.000000	.000018	.021850	.037699	.079146
	.158362	.271698	.260767	.170460	
ATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.000000	.000018	.021868	.059567	.138713
	.297075	.568773	.829540	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .461025E+05 .187485E+01 .442116E+07

POTENTIAL TRANSPORT BY SIZE CLASS=	.100000E-19	.100000E-19	.135182E+05	.256845E+06	.442116E+07
	.442116E+07	.172048E+07	.690184E+06	.387007E+06	.697907E+05
	.100229E+06	.139569E+06	.187509E+06	.216699E+06	

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	270363.22	.00	.00	13518.16	256845.06	
SANDS & GRAVELS	222136.29	19059.92	19214.48	13901.95	16477.38	15235.16
		5266.99	15132.08	36138.86	46567.63	35141.85

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
7.822	.005070	2.13	130.12	.0220	.67561	.58998	.944

BED SEDIMENT RESERVOIR COMPUTATIONS:

SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	77500.00	77500.00	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.029985	.024988	.019990	.024245
	.025322	.029815	.039947	.055010	.079994
	.140039	.190160	.175268	.135253	
BED MATERIAL BY PERCENT FINER/100	.000000	.029985	.054973	.074963	.099207
	.124529	.154344	.194290	.249300	.329294
	.469334	.659494	.834762	.970015	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	.6756	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

** ARMOR LAYER **

STABILITY COEFFICIENT=	.67422	
MIN.GRAIN DIAM =	.092926	
BED SURFACE EXPOSED =	1.00000	

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
'Y	.000000	.00	.000000	.00
	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.27
TOTAL	1.000000	9.74	1.000000	.27

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 1060.0
DEPTH OF NEW ACTIVE LAYER (ft) DSE= .9436
WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL= 3375.6
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 966.8
USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 34729.5

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030820	.025683	.020547	.024920
	.024920	.029904	.039872	.054824	.079744
	.139551	.189391	.174439	.134567	
BED MATERIAL BY PERCENT FINER/100	.000000	.030820	.056503	.077049	.101969
	.126889	.156793	.196665	.251488	.331232
	.470783	.660174	.834613	.969180	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.039761	.026611	.042634	.061702	.088985
	.157578	.217799	.205062	.159869	
'ATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.039761	.066372	.109005	.170708	.259693
	.417270	.635069	.840131	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .461025E+05 .215579E+01 .442116E+07

POTENTIAL TRANSPORT BY SIZE CLASS= .100000E-19 .100000E-19 .135182E+05 .256845E+06 .229074E+07
.482747E+06 .191376E+06 .103775E+06 .779263E+05 .617498E+04
.102630E+05 .159949E+05 .220314E+05 .186528E+05

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	270363.22	.00	.00	13518.16	256845.06	
SANDS & GRAVELS	59095.27	18584.84	13838.31	5515.92	4318.87	4570.33
		526.83	1538.79	3275.37	4185.01	2741.02

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.20	61000.000	100.62			164.10		
TOTAL=	7000.000	100.62	100.60	.00	164.10	21.59	.87

TABLE SB-1. TOTAL LOAD BY GRAIN SIZE (TONS/DAY)
VF F M C VC

SEDIMENT INFLOW

SILT	270363.22	.00	.00	13518.16	256845.06	
SANDS & GRAVELS	630847.52	18925.43	18925.43	18925.43	31542.38	31542.38
		37850.85	75701.70	151403.40	138786.45	107244.08
TOTAL LOAD	901210.74					

SEDIMENT OUTFLOW

SILT	270363.22	.00	.00	13518.16	256845.06	
SANDS & GRAVELS	68817.27	18584.84	17327.92	6982.56	5159.47	5355.40
		608.25	1802.55	3901.96	5171.94	3922.38
TOTAL LOAD	339180.49					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	34.82	1490.70	1491.44	2172.	270363.	282283.
60000.000	.60	1433.84	1433.11	2172.	270363.	217109.
59000.000	-.13	1393.62	1392.38	2172.	270363.	224482.
58000.000	-.03	1353.57	1352.48	2172.	270363.	224427.
57000.000	-.02	1313.65	1312.49	2172.	270363.	224127.
56000.000	-.01	1273.54	1272.50	2172.	270363.	222890.
55000.000	-.02	1233.66	1232.49	2172.	270363.	223136.
54000.000	-.02	1193.54	1192.49	2172.	270363.	222171.
53000.000	-.02	1153.65	1152.49	2172.	270363.	222523.
52000.000	-.02	1113.54	1112.49	2172.	270363.	221626.
51000.000	-.02	1073.64	1072.49	2172.	270363.	221943.
'00.000	-.02	1033.54	1032.49	2172.	270363.	221151.
,00.000	-.02	993.64	992.49	2172.	270363.	221509.
48000.000	-.02	953.54	952.49	2172.	270363.	220648.
47000.000	-.02	913.68	912.49	2172.	270363.	221133.
46000.000	-.02	873.58	872.49	2172.	270363.	220666.
45000.000	-.02	833.66	832.49	2172.	270363.	221323.
44000.000	-.02	793.54	792.49	2172.	270363.	220715.
43000.000	-.02	753.66	752.49	2172.	270363.	221499.
42000.000	-.02	713.54	712.49	2172.	270363.	220971.
41000.000	-.02	673.66	672.49	2172.	270363.	221764.
40000.000	-.02	633.54	632.49	2172.	270363.	221271.
39000.000	-.02	593.66	592.49	2172.	270363.	222081.
38000.000	-.02	553.54	552.49	2172.	270363.	222136.
37000.000	-.02	513.54	512.49	2172.	270363.	221785.
36000.000	-.02	473.65	472.49	2172.	270363.	222494.
35000.000	.00	433.56	432.51	2172.	270363.	219243.
34000.000	1.41	394.36	393.92	2172.	270363.	232828.
33900.000	3.17	390.44	388.54	2172.	270363.	123943.
33800.000	2.91	388.15	388.02	2172.	270363.	131825.
33700.000	2.92	385.62	380.36	2172.	270363.	289560.
33600.000	6.72	381.08	380.35	2172.	270363.	79562.
33500.000	2.96	379.74	379.22	2172.	270363.	118980.
33400.000	2.92	377.59	376.83	2172.	270363.	218139.
33300.000	5.86	374.36	372.28	2172.	270363.	114880.
33200.000	5.45	373.44	369.55	2172.	270363.	80137.
'3100.000	3.27	372.73	371.93	2172.	270363.	117956.
00.000	1.90	371.48	369.41	2172.	270363.	99653.
32500.000	.60	367.65	365.56	2172.	270363.	79034.
32000.000	.34	364.93	362.75	2172.	270363.	80049.
31500.000	.28	362.33	360.14	2172.	270363.	84290.
31000.000	.28	359.76	357.59	2172.	270363.	82517.

30500.000	.26	357.19	355.02	2172.	270363.	80457.
30000.000	.19	354.54	352.40	2172.	270363.	78598.
29500.000	.20	352.01	349.86	2172.	270363.	74501.
00.000	.11	349.37	347.22	2172.	270363.	74292.
30.000	.12	346.90	344.68	2172.	270363.	68977.
8000.000	.10	344.23	342.11	2172.	270363.	72012.
27500.000	.07	341.76	339.53	2172.	270363.	66731.
27000.000	.07	339.17	336.98	2172.	270363.	69593.
26500.000	.04	336.54	334.40	2172.	270363.	68229.
26000.000	.06	334.08	331.87	2172.	270363.	65237.
25500.000	.03	331.43	329.29	2172.	270363.	68135.
25000.000	.04	328.92	326.75	2172.	270363.	63860.
24500.000	.04	326.37	324.20	2172.	270363.	64296.
24000.000	.03	323.82	321.64	2172.	270363.	62434.
23500.000	.02	321.23	319.08	2172.	270363.	62159.
23000.000	.02	318.73	316.53	2172.	270363.	59496.
22500.000	.00	316.12	313.96	2172.	270363.	60592.
22000.000	.02	313.62	311.43	2172.	270363.	57266.
21500.000	.02	311.06	308.88	2172.	270363.	60196.
21000.000	-.02	308.50	306.29	2172.	270363.	54499.
20500.000	.01	305.95	303.77	2172.	270363.	58807.
20000.000	-.01	303.43	301.20	2172.	270363.	52975.
19500.000	.00	300.79	298.66	2172.	270363.	57680.
19000.000	-.02	298.29	296.09	2172.	270363.	53183.
18500.000	.00	295.72	293.56	2172.	270363.	56033.
18000.000	-.01	293.20	291.00	2172.	270363.	53325.
17500.000	-.01	290.68	288.45	2172.	270363.	54220.
17000.000	-.03	288.04	285.88	2172.	270363.	55055.
16500.000	.01	285.66	283.37	2172.	270363.	48959.
00.000	-.04	282.91	280.77	2172.	270363.	58440.
00.000	.02	280.56	278.28	2172.	270363.	48584.
15000.000	-.05	277.78	275.66	2172.	270363.	58579.
14500.000	.01	275.46	273.17	2172.	270363.	47420.
14000.000	-.02	272.72	270.59	2172.	270363.	57353.
13500.000	-.02	270.28	268.04	2172.	270363.	48190.
13000.000	-.01	267.62	265.50	2172.	270363.	55069.
12500.000	-.02	265.16	262.94	2172.	270363.	49563.
12000.000	-.02	262.53	260.39	2172.	270363.	55093.
11500.000	-.02	260.05	257.84	2172.	270363.	51028.
11000.000	-.02	257.44	255.29	2172.	270363.	56469.
10500.000	-.01	254.95	252.75	2172.	270363.	53699.
10000.000	-.03	252.35	250.18	2172.	270363.	57929.
9500.000	-.01	249.83	247.65	2172.	270363.	56186.
9000.000	.00	247.29	245.11	2172.	270363.	59095.
8500.000	-.03	244.74	242.53	2172.	270363.	58809.
8000.000	.01	242.21	240.02	2172.	270363.	60572.
7500.000	.22	239.97	237.68	2172.	270363.	58303.
7000.000	.10	237.18	235.01	2172.	270363.	68817.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
732.9088				

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FLOW 20
FLOW 21
* FLOW 22

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*    C  FLOW 23

-   'DARY CONDITION DATA, CONTROL POINT NO.  1
     E STEP NO.     23
 ATER    DISCHARGE=     516.00
         ELEVATION=    236.600
       TEMPERATURE=     70.000
FLOW DURATION(DAYS)  .1040E-01

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
FLOW # (N) =    1
FLOW...Q(N)=     516.0
TIME STEP DURATION (DAYS)=     .0104
ACCUMULATED TIME    (YRS)=     .0007
WATER TEMPERATURE (DEG F)=   70.0000
**************************** FALL VELOCITY BY METHOD 2****************************

                    DIAMETER      VELOCITY      REY. NO.          CD

                     .000018  .8972544E-04  .1524015E-03  158259.2
                     .000036  .3567692E-03  .1211968E-02  20019.61
                     .000072  .1408035E-02  .9566370E-02  2570.593
                     .000144  .5451017E-02  .7406981E-01  343.0324
                     .000288  .2021579E-01  .5493945      49.88144
                     .000580  .6151953E-01  3.366993      10.84750
                     .001160  .1398207      15.30491      4.199934
                     .002319  .2877815      62.97450      1.981996
                     .004639  .4850357      212.3241      1.395741
                     .009279  .7215017      631.7419      1.261694
                     .018560  1.041282      1823.675      1.211627
                     .037120  1.472924      5159.284      1.211086
                     .074216  2.082692      14585.58      1.211086
                     .148596  2.946998      41322.65      1.211086

SEDIMENT INFLOW (TONS/DAY)
                      TOTAL              LOAD BY GRAIN SIZE (TONS/DAY)
                                   VF          F          M          C          VC
           SILT     31306.46       .00        .00     1565.32   29741.14
 SANDS & GRAVELS    73048.42   2191.45    2191.45    2191.45    3652.42    3652.42
                               4382.91    8765.81   17531.62   16070.65   12418.23

*********************************************************************************************
        THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION  38000.000
        ------------------------------------------------------------


HYDRAULIC PARAMETERS:
     VEL       SLO       EFD       EFW     N-VALUE      TAU      USTARM    FROUDE NO.
    5.698   .039843       .27    329.91      .0220    .68293    .59316     1.918
BED SEDIMENT RESERVOIR COMPUTATIONS:
NEW SURFACE AREA (SQ FT):     TOTAL        K-PORTION      S-PORTION
                           329949.50      329949.50            .00
   'ATION OF ACTIVE PLUS INACTIVE DEPOSITS
    ATERIAL BY GRAIN SIZE FRACTION      .000000    .000000    .015024    .015024    .014578
                                        .014578    .014579    .024872    .039829    .070117
                                        .140238    .240417    .230413    .150282
BED MATERIAL BY PERCENT FINER/100       .000000    .000000    .015024    .030049    .044626
                                        .059204    .073783    .098655    .138484    .208602
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                                  .348839     .589256     .819670     .969951

SILT TRANSPORT CAPACITY:
    SHEAR STRESS,lb/sq.ft =    .6829
      GRAIN SEDIMENT TYPE =       1
                LAYER TYPE =       1        2
DEPOSITION THRESHOLD #/sf =    .0000    .0000
EROSION THRESHOLD,#/sq.ft =    .0000    .0000

SIZE              EROSION RATE (tons/day)
CLASS          ACTIVE            INACTIVE
               LAYER               LAYER

    1             .00               .00
    2             .00               .00
    3             .00               .00
    4             .00               .00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT=      .64927
MIN.GRAIN DIAM       =     .041999
BED SURFACE EXPOSED  =    1.00000

          INACTIVE LAYER          ACTIVE LAYER
          %          DEPTH        %          DEPTH
 CLAY    .000000       .00       .000000       .00
 SILT    .030862       .34       .000000       .00
 SAND    .969138      9.38      1.000000       .26
        1.000000      9.72      1.000000       .26

       AVG. UNIT               AVG. UNIT
         WEIGHT                  WEIGHT

         .046308                 .046500

     COMPOSITE UNIT WT OF ACTIVE LAYER t/cf=        .046500
     WEIGHT IN SURFACE LAYER (tons)    WTSL=       4540.9
     DEPTH OF NEW ACTIVE LAYER (ft)     DSE=        .2449
     WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=       3758.8
     WEIGHT IN OLD ACTIVE LAYER(tons)   WAL=       4021.7
     USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=     148542.6
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .000000     .015431     .015431     .014972
                                        .014972     .014972     .024954     .039927     .069872
                                        .139743     .239560     .229578     .149725
BED MATERIAL BY PERCENT FINER/100       .000000     .000000     .015431     .030862     .045835
                                        .060807     .075780     .100734     .140660     .210532
                                        .350275     .589835     .819413     .969138
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION     .000000     .000000     .000000     .000000     .000000
                                        .000000     .000049     .021833     .036234     .079191
                                        .158506     .272069     .261268     .170850
BED MATERIAL BY PERCENT FINER/100       .000000     .000000     .000000     .000000     .000000
                                        .000000     .000049     .021882     .058115     .137307
                                        .295813     .567882     .829150    1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .224709E+05 .139578E+01 .108325E+07

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .156532E+04 .297411E+05 .108325E+07
                                    .678456E+06 .203184E+06 .832988E+05 .478441E+05 .234793E+05
```

.298286E+05 .325437E+05 .225792E+05 .139578E-06

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
ULATED SEDIMENT LOAD, TONS/DAY						
SILT	31306.46	.00	.00	1565.32	29741.14	
SANDS & GRAVELS	30744.19	2466.68	2466.66	1644.83	1989.20	1856.88
		1772.37	4504.99	8431.02	5611.56	.00

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
3.928	.005155	1.05	124.90	.0220	.33860	.41767	.675

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	77500.00	77500.00	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030048	.025040	.020032	.024296
	.024657	.029745	.039898	.055006	.080129
	.140234	.190329	.175299	.135237	
BED MATERIAL BY PERCENT FINER/100	.000000	.030048	.055089	.075121	.099417
	.124074	.153819	.193717	.248723	.328853
	.469087	.659416	.834714	.969952	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	.3386	
GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
4	.00	.00

SAND

** ARMOR LAYER **

STABILITY COEFFICIENT=	.84059	
MIN.GRAIN DIAM =	.051435	
BED SURFACE EXPOSED =	1.00000	

	INACTIVE LAYER		ACTIVE LAYER	
	%	DEPTH	%	DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.25
TAL	1.000000	9.74	1.000000	.25

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

```
      COMPOSITE UNIT WT OF ACTIVE LAYER t/ct=          .046500
      WEIGHT IN SURFACE LAYER (tons)    WTSL=         1060.0
      DEPTH OF NEW ACTIVE LAYER (ft)    DSE=           .1424
      WEIGHT IN NEW ACTIVE LAYER(tons)WTMXAL=          517.1
      WEIGHT IN OLD ACTIVE LAYER(tons)  WAL=           891.6
      USEABLE WEIGHT, OLD INACTIVE LAYER,WIL=        34729.5
BED MATERIAL BY GRAIN SIZE FRACTION      .000000     .030820     .025683     .020547     .024920
                                         .024920     .029904     .039872     .054824     .079744
                                         .139551     .189391     .174439     .134567
BED MATERIAL BY PERCENT FINER/100        .000000     .030820     .056503     .077049     .101969
                                         .126889     .156793     .196665     .251488     .331232
                                         .470783     .660174     .834613     .969180
** ACTIVE LAYER **
BED MATERIAL BY GRAIN SIZE FRACTION      .000000     .000000     .000000     .000000     .000000
                                         .014432     .023559     .040912     .062106     .095162
                                         .166837     .226862     .208784     .161347
BED MATERIAL BY PERCENT FINER/100        .000000     .000000     .000000     .000000     .000000
                                         .014432     .037991     .078902     .141008     .236170
                                         .403008     .629870     .838653    1.000000

C FINES, COEF(CFFML), MX POTENTIAL= .224709E+05 .157602E+01 .108325E+07

POTENTIAL TRANSPORT BY SIZE CLASS=  .100000E-19 .100000E-19 .156532E+04 .297411E+05 .173918E+06
                                    .383555E+05 .158870E+05 .890519E+04 .682241E+04 .766920E+03
                                    .929464E+03 .627656E+03 .157602E-06 .157602E-06
```

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	31306.46	.00	.00	1565.32	29741.14	
DS & GRAVELS	4516.71	2174.07	790.66	439.32	365.71	403.28
		67.67	143.87	132.13	.00	.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.24	61000.000	103.11			168.15		
TOTAL=	7000.000	103.11	103.08	.00	168.15	22.00	.87

TABLE SB-1.	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	31306.46	.00	.00	1565.32	29741.14	
SANDS & GRAVELS	73048.42	2191.45	2191.45	2191.45	3652.42	3652.42
		4382.91	8765.81	17531.62	16070.65	12418.23
TOTAL LOAD	104354.88					
IENT OUTFLOW						
SILT	31306.46	.00	.00	1565.32	29741.14	
SANDS & GRAVELS	180.81	99.57	25.73	12.64	14.78	22.62
		3.86	1.61	.00	.00	.00

TOTAL LOAD 31487.27

TION .D NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
61000.000	35.37	1490.51	1489.42	516.	31306.	52016.
60000.000	.70	1433.24	1433.21	516.	31306.	29838.
59000.000	-.14	1392.90	1392.37	516.	31306.	30735.
58000.000	-.03	1352.86	1352.48	516.	31306.	30976.
57000.000	-.01	1312.99	1312.50	516.	31306.	31055.
56000.000	-.01	1272.88	1272.50	516.	31306.	30858.
55000.000	-.02	1232.98	1232.49	516.	31306.	30865.
54000.000	-.02	1192.88	1192.49	516.	31306.	30680.
53000.000	-.02	1152.97	1152.49	516.	31306.	30719.
52000.000	-.02	1112.87	1112.49	516.	31306.	30556.
51000.000	-.02	1072.99	1072.49	516.	31306.	30654.
50000.000	-.02	1032.87	1032.49	516.	31306.	30538.
49000.000	-.02	992.97	992.49	516.	31306.	30634.
48000.000	-.02	952.87	952.49	516.	31306.	30535.
47000.000	-.02	912.97	912.49	516.	31306.	30636.
46000.000	-.02	872.87	872.49	516.	31306.	30520.
45000.000	-.02	832.99	832.49	516.	31306.	30645.
44000.000	-.02	792.87	792.49	516.	31306.	30533.
43000.000	-.02	752.99	752.49	516.	31306.	30663.
42000.000	-.02	712.87	712.49	516.	31306.	30668.
41000.000	-.02	672.87	672.49	516.	31306.	30581.
40000.000	-.02	632.98	632.49	516.	31306.	30708.
39000.000	-.02	592.87	592.49	516.	31306.	30605.
00.000	-.02	552.99	552.49	516.	31306.	30744.
00.000	-.02	512.87	512.49	516.	31306.	30673.
36000.000	-.02	472.96	472.49	516.	31306.	30659.
35000.000	.00	433.00	432.51	516.	31306.	30285.
34000.000	1.46	393.51	392.50	516.	31306.	31168.
33900.000	2.91	389.94	388.29	516.	31306.	33672.
33800.000	2.84	386.38	385.03	516.	31306.	27210.
33700.000	4.32	383.60	381.76	516.	31306.	27146.
33600.000	5.36	380.97	378.99	516.	31306.	24731.
33500.000	3.57	378.42	376.87	516.	31306.	25188.
33400.000	4.80	375.95	373.96	516.	31306.	20797.
33300.000	5.25	374.06	371.67	516.	31306.	24438.
33200.000	6.01	372.35	370.11	516.	31306.	12679.
33100.000	4.78	371.36	369.19	516.	31306.	10529.
33000.000	1.94	370.31	369.45	516.	31306.	10130.
32500.000	.63	366.46	365.59	516.	31306.	9247.
32000.000	.35	363.68	362.76	516.	31306.	8950.
31500.000	.26	361.04	360.12	516.	31306.	8729.
31000.000	.30	358.51	357.61	516.	31306.	9349.
30500.000	.24	355.95	355.00	516.	31306.	8551.
30000.000	.22	353.34	352.43	516.	31306.	8864.
29500.000	.19	350.74	349.85	516.	31306.	8032.
29000.000	.13	348.16	347.24	516.	31306.	7982.
28500.000	.13	345.58	344.69	516.	31306.	7545.
28000.000	.11	343.03	342.12	516.	31306.	7380.
27500.000	.07	340.46	339.53	516.	31306.	7201.
00.000	.08	337.93	336.99	516.	31306.	6897.
26500.000	.04	335.31	334.40	516.	31306.	7423.
26000.000	.05	332.81	331.86	516.	31306.	6748.
25500.000	.04	330.17	329.30	516.	31306.	7080.
25000.000	.04	327.70	326.75	516.	31306.	6521.

24500.000	.05	325.11	324.21	516.	31306.	7062.
24000.000	.03	322.59	321.64	516.	31306.	6175.
23500.000	.03	319.98	319.09	516.	31306.	6895.
23000.000	.02	317.49	316.53	516.	31306.	5910.
22500.000	.00	314.89	313.96	516.	31306.	6668.
22000.000	.03	312.41	311.44	516.	31306.	5671.
21500.000	.01	309.75	308.87	516.	31306.	6604.
21000.000	-.01	307.24	306.30	516.	31306.	5421.
20500.000	.00	304.65	303.76	516.	31306.	6207.
20000.000	.01	302.15	301.22	516.	31306.	5397.
19500.000	-.02	299.54	298.64	516.	31306.	5870.
19000.000	.00	297.04	296.11	516.	31306.	5197.
18500.000	-.01	294.44	293.55	516.	31306.	5826.
18000.000	.01	291.97	291.02	516.	31306.	5021.
17500.000	-.03	289.31	288.43	516.	31306.	5962.
17000.000	.00	286.89	285.91	516.	31306.	4772.
16500.000	-.01	284.26	283.35	516.	31306.	6048.
16000.000	-.02	281.75	280.79	516.	31306.	4837.
15500.000	.00	279.13	278.26	516.	31306.	5856.
15000.000	-.04	276.62	275.67	516.	31306.	4855.
14500.000	.00	274.05	273.16	516.	31306.	5614.
14000.000	-.02	271.54	270.59	516.	31306.	4837.
13500.000	-.02	268.93	268.04	516.	31306.	5616.
13000.000	-.01	266.44	265.50	516.	31306.	4834.
12500.000	-.02	263.83	262.94	516.	31306.	5682.
12000.000	-.02	261.31	260.39	516.	31306.	4860.
11500.000	-.02	258.74	257.84	516.	31306.	5509.
11000.000	-.02	256.24	255.29	516.	31306.	4851.
10500.000	-.01	253.62	252.75	516.	31306.	5555.
10000.000	-.03	251.16	250.18	516.	31306.	4767.
9500.000	-.02	248.53	247.64	516.	31306.	5930.
9000.000	-.01	246.11	245.10	516.	31306.	4517.
8500.000	-.03	243.28	242.53	516.	31306.	8440.
8000.000	.01	241.09	240.02	516.	31306.	4277.
7500.000	.22	238.47	237.68	516.	31306.	8947.
7000.000	.03	236.60	234.94	516.	31306.	181.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
773.0008				

==========

* FLOW 24
* FLOW 25
* FLOW 26

==========

* C FLOW 27

BOUNDARY CONDITION DATA, CONTROL POINT NO. 1
TIME STEP NO. 27
WATER DISCHARGE= 142.00
ELEVATION= 235.100
TEMPERATURE= 70.000
DURATION(DAYS) .1040E-01

- -

RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV

FLOW # (N) = 1
FLOW...Q(N)= 142.0
TIME STEP DURATION (DAYS)= .0104
ACCUMULATED TIME (YRS)= .0008
TEMPERATURE (DEG F)= 70.0000

********** FALL VELOCITY BY METHOD 2**********

DIAMETER	VELOCITY	REY. NO.	CD
.000018	.8972544E-04	.1524015E-03	158259.2
.000036	.3567692E-03	.1211968E-02	20019.61
.000072	.1408035E-02	.9566370E-02	2570.593
.000144	.5451017E-02	.7406981E-01	343.0324
.000288	.2021579E-01	.5493945	49.88144
.000580	.6151953E-01	3.366993	10.84750
.001160	.1398207	15.30491	4.199934
.002319	.2877815	62.97450	1.981996
.004639	.4850357	212.3241	1.395741
.009279	.7215017	631.7419	1.261694
.018560	1.041282	1823.675	1.211627
.037120	1.472924	5159.284	1.211086
.074216	2.082692	14585.58	1.211086
.148596	2.946998	41322.65	1.211086

SEDIMENT INFLOW (TONS/DAY)

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SILT	4519.55	.00	.00	225.98	4293.57	
SANDS & GRAVELS	10545.62	316.37	316.37	316.37	527.28	527.28
		632.74	1265.47	2530.95	2320.04	1792.76

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 38000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
3.584	.040016	.12	329.90	.0220	.30010	.39320	1.823

BED SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT):	TOTAL	K-PORTION	S-PORTION
	329949.50	329949.50	.00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015024	.015024	.014578
	.014578	.014579	.024872	.039825	.070118
	.140238	.240418	.230414	.150283	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015024	.030049	.044627
	.059205	.073784	.098656	.138481	.208598
	.348837	.589254	.819668	.969951	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft =	.3001	
FINE GRAIN SEDIMENT TYPE =	1	
LAYER TYPE =	1	2
DEPOSITION THRESHOLD #/sf =	.0000	.0000
EROSION THRESHOLD,#/sq.ft =	.0000	.0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER

1	.00	.00
2	.00	.00
3	.00	.00
	.00	.00

SAND
** ARMOR LAYER **
STABILITY COEFFICIENT= .83437
MIN.GRAIN DIAM = .020799
BED SURFACE EXPOSED = 1.00000

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.030862	.34	.000000	.00
SAND	.969138	9.38	1.000000	.26
TOTAL	1.000000	9.72	1.000000	.26

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046308	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500
WEIGHT IN SURFACE LAYER (tons) WTSL= 4540.9
DEPTH OF NEW ACTIVE LAYER (ft) DSE= .0908
WEIGHT IN NEW ACTIVE LAYER(tons) WTMXAL= 1403.9
WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 4020.4
USEABLE WEIGHT, OLD INACTIVE LAYER, WIL= 148542.6

ATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.015431	.015431	.014972
	.014972	.014972	.024954	.039927	.069872
	.139743	.239560	.229578	.149725	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.015431	.030862	.045835
	.060807	.075780	.100734	.140660	.210532
	.350275	.589835	.819413	.969138	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.000000	.000046	.021842	.036054	.079209
	.158536	.272111	.261297	.170905	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.000000	.000046	.021888	.057942	.137151
	.295687	.567798	.829095	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .117881E+05 .114389E+01 .302200E+06

POTENTIAL TRANSPORT BY SIZE CLASS=	.100000E-19	.100000E-19	.225978E+03	.429357E+04	.302200E+06
	.104843E+06	.315617E+05	.129469E+05	.734707E+04	.892406E+04
	.798275E+04	.278995E+04	.114389E-06	.114389E-06	

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY) VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	4519.55	.00	.00	225.98	4293.57	
SANDS & GRAVELS	4228.08	426.21	353.27	254.07	309.23	284.70
		673.22	1204.75	722.62	.00	.00

****

THE FOLLOWING TABLE IS PRINTOUT FOR CROSS SECTION 9000.000

HYDRAULIC PARAMETERS:

VEL	SLO	EFD	EFW	N-VALUE	TAU	USTARM	FROUDE NO.
3.080	.005117	.38	121.75	.0220	.12102	.24970	.882

SEDIMENT RESERVOIR COMPUTATIONS:

NEW SURFACE AREA (SQ FT): TOTAL K-PORTION S-PORTION

77500.00 77500.00 .00

GRADATION OF ACTIVE PLUS INACTIVE DEPOSITS

BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.030031	.025026	.020021	.024282
	.024640	.029775	.039903	.055003	.080137
	.140293	.190451	.175246	.135160	
BED MATERIAL BY PERCENT FINER/100	.000000	.030031	.055057	.075078	.099360
	.124000	.153775	.193678	.248681	.328818
	.469112	.659562	.834809	.969969	

SILT TRANSPORT CAPACITY:

BED SHEAR STRESS,lb/sq.ft = .1210

FINE GRAIN SEDIMENT TYPE = 1

LAYER TYPE = 1 2

DEPOSITION THRESHOLD #/sf = .0000 .0000

EROSION THRESHOLD,#/sq.ft = .0000 .0000

SIZE CLASS	EROSION RATE (tons/day) ACTIVE LAYER	INACTIVE LAYER
1	.00	.00
2	.00	.00
3	.00	.00
	.00	.00

SAND

** ARMOR LAYER **

STABILITY COEFFICIENT= .92176

MIN.GRAIN DIAM = .024530

BED SURFACE EXPOSED = 1.00000

	INACTIVE LAYER %	INACTIVE LAYER DEPTH	ACTIVE LAYER %	ACTIVE LAYER DEPTH
CLAY	.000000	.00	.000000	.00
SILT	.077049	.84	.000000	.00
SAND	.922951	8.89	1.000000	.25
TOTAL	1.000000	9.74	1.000000	.25

AVG. UNIT WEIGHT	AVG. UNIT WEIGHT
.046024	.046500

COMPOSITE UNIT WT OF ACTIVE LAYER t/cf= .046500

WEIGHT IN SURFACE LAYER (tons) WTSL= 1060.0

DEPTH OF NEW ACTIVE LAYER (ft) DSE= .1141

WEIGHT IN NEW ACTIVE LAYER(tons)WTHXAL= 416.2

WEIGHT IN OLD ACTIVE LAYER(tons) WAL= 911.9

USEABLE WEIGHT, OLD INACTIVE LAYER,WIL= 34729.5

\TERIAL BY GRAIN SIZE FRACTION	.000000	.030820	.025683	.020547	.024920
	.024920	.029904	.039872	.054824	.079744
	.139551	.189391	.174439	.134567	
BED MATERIAL BY PERCENT FINER/100	.000000	.030820	.056503	.077049	.101969
	.126889	.156793	.196665	.251488	.331232

	.470783	.660174	.834613	.969180	
** ACTIVE LAYER **					
BED MATERIAL BY GRAIN SIZE FRACTION	.000000	.000000	.000000	.000000	.000000
	.013991	.024858	.041088	.061833	.095137
	.168555	.230804	.205990	.157745	
BED MATERIAL BY PERCENT FINER/100	.000000	.000000	.000000	.000000	.000000
	.013991	.038848	.079936	.141769	.236906
	.405461	.636265	.842255	1.000000	

C FINES, COEF(CFFML), MX POTENTIAL= .117881E+05 .117459E+01 .302200E+06

POTENTIAL TRANSPORT BY SIZE CLASS= .100000E-19 .100000E-19 .225978E+03 .429357E+04 .300167E+05
.629467E+04 .250863E+04 .135225E+04 .100069E+04 .595508E+03
.472099E+03 .657745E+01 .117459E-06 .117459E-06

	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
CALCULATED SEDIMENT LOAD, TONS/DAY						
SILT	4519.55	.00	.00	225.98	4293.57	
SANDS & GRAVELS	680.91	242.26	126.40	70.25	55.58	59.07
		52.57	73.39	1.40	.00	.00

TABLE SA-1. TRAP EFFICIENCY ON STREAM SEGMENT # 1
RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV
ACCUMULATED AC-FT ENTERING AND LEAVING THIS STREAM SEGMENT

TIME DAYS	ENTRY POINT	SILT INFLOW	SILT OUTFLOW	SILT TRAP EFF	SAND INFLOW	SAND OUTFLOW	SAND TRAP EFF
.28	61000.000	103.41			168.65		
TAL=	7000.000	103.41	103.39	.00	168.65	22.05	.87

TABLE SB-1.	TOTAL	LOAD BY GRAIN SIZE (TONS/DAY)				
		VF	F	M	C	VC
SEDIMENT INFLOW						
SILT	4519.55	.00	.00	225.98	4293.57	
SANDS & GRAVELS	10545.62	316.37	316.37	316.37	527.28	527.28
		632.74	1265.47	2530.95	2320.04	1792.76
TOTAL LOAD	15065.17					
SEDIMENT OUTFLOW						
SILT	4519.55	.00	.00	225.98	4293.57	
SANDS & GRAVELS	1925.57	176.81	686.35	229.46	161.75	161.05
		129.22	235.54	145.39	.00	.00
TOTAL LOAD	6445.13					

SECTION ID NO	BED CHANGE FEET	WS ELEV FEET	THALWEG EL FEET	Q CFS	SEDIMENT LOAD (TONS/DAY) SILT	SAND
1000.000	35.42	1490.16	1489.47	142.	4520.	8685.
00.000	.73	1432.97	1432.52	142.	4520.	4250.
59000.000	-.14	1392.65	1392.37	142.	4520.	3240.
58000.000	-.03	1352.65	1352.48	142.	4520.	3284.
57000.000	-.01	1312.68	1312.50	142.	4520.	1438.
56000.000	-.02	1272.62	1272.49	142.	4520.	4095.

55000.000	-.01	1232.68	1232.50	142.	4520.	1403.
54000.000	-.02	1192.62	1192.49	142.	4520.	4175.
53000.000	-.01	1152.73	1152.50	142.	4520.	3241.
[illegible]000.000	-.02	1112.62	1112.49	142.	4520.	4263.
[illegible]00.000	-.01	1072.66	1072.50	142.	4520.	1530.
[illegible]000.000	-.02	1032.62	1032.49	142.	4520.	4330.
49000.000	-.02	992.66	992.49	142.	4520.	1513.
48000.000	-.02	952.62	952.49	142.	4520.	4292.
47000.000	-.02	912.71	912.49	142.	4520.	3184.
46000.000	-.02	872.71	872.49	142.	4520.	3200.
45000.000	-.02	832.62	832.49	142.	4520.	4358.
44000.000	-.02	792.74	792.49	142.	4520.	3209.
43000.000	-.02	752.62	752.49	142.	4520.	4346.
42000.000	-.02	712.73	712.49	142.	4520.	3213.
41000.000	-.02	672.62	672.49	142.	4520.	4324.
40000.000	-.02	632.72	632.49	142.	4520.	3206.
39000.000	-.02	592.74	592.49	142.	4520.	3222.
38000.000	-.02	552.62	552.49	142.	4520.	4228.
37000.000	-.02	512.74	512.49	142.	4520.	3230.
36000.000	-.02	472.62	472.49	142.	4520.	4225.
35000.000	.01	432.73	432.52	142.	4520.	3174.
34000.000	1.44	393.19	392.49	142.	4520.	5037.
33900.000	2.92	389.18	388.30	142.	4520.	5287.
33800.000	2.90	386.02	385.09	142.	4520.	4886.
33700.000	4.36	382.85	381.81	142.	4520.	4397.
33600.000	5.41	380.27	379.04	142.	4520.	4067.
33500.000	3.61	377.74	376.91	142.	4520.	3973.
33400.000	4.83	375.24	373.99	142.	4520.	3611.
33300.000	5.42	373.23	371.84	142.	4520.	3036.
[illegible]00.000	6.14	371.73	370.23	142.	4520.	2362.
[illegible]00.000	4.91	370.62	369.33	142.	4520.	1820.
33000.000	1.94	369.87	369.45	142.	4520.	1267.
32500.000	.65	366.06	365.61	142.	4520.	986.
32000.000	.35	363.16	362.76	142.	4520.	1042.
31500.000	.26	360.55	360.12	142.	4520.	953.
31000.000	.30	358.02	357.61	142.	4520.	1017.
30500.000	.25	355.48	355.01	142.	4520.	929.
30000.000	.22	352.80	352.43	142.	4520.	1011.
29500.000	.20	350.31	349.86	142.	4520.	791.
29000.000	.13	347.63	347.24	142.	4520.	868.
28500.000	.13	345.11	344.69	142.	4520.	779.
28000.000	.10	342.48	342.11	142.	4520.	825.
27500.000	.08	339.97	339.54	142.	4520.	715.
27000.000	.07	337.39	336.98	142.	4520.	803.
26500.000	.05	334.84	334.41	142.	4520.	702.
26000.000	.05	332.25	331.86	142.	4520.	784.
25500.000	.04	329.74	329.30	142.	4520.	677.
25000.000	.04	327.15	326.75	142.	4520.	782.
24500.000	.05	324.62	324.21	142.	4520.	726.
24000.000	.03	322.03	321.64	142.	4520.	678.
23500.000	.03	319.53	319.09	142.	4520.	666.
23000.000	.02	316.97	316.53	142.	4520.	622.
22500.000	.01	314.36	313.97	142.	4520.	699.
22000.000	.03	311.87	311.44	142.	4520.	577.
[illegible]1500.000	.01	309.32	308.87	142.	4520.	672.
[illegible]0.000	.00	306.74	306.31	142.	4520.	578.
[illegible]0500.000	.00	304.17	303.76	142.	4520.	633.
20000.000	.01	301.60	301.22	142.	4520.	604.
19500.000	-.02	299.07	298.64	142.	4520.	552.
19000.000	.00	296.53	296.11	142.	4520.	583.

18500.000	-.01	293.94	293.55	142.	4520.	548.
18000.000	.01	291.49	291.02	142.	4520.	544.
17500.000	-.03	288.80	288.43	142.	4520.	578.
17000.000	.00	286.41	285.91	142.	4520.	493.
00.000	-.01	283.75	283.35	142.	4520.	616.
16000.000	-.02	281.23	280.79	142.	4520.	488.
15500.000	.00	278.65	278.26	142.	4520.	602.
15000.000	-.04	276.08	275.67	142.	4520.	530.
14500.000	.00	273.60	273.16	142.	4520.	512.
14000.000	-.02	271.01	270.59	142.	4520.	536.
13500.000	-.02	268.53	268.04	142.	4520.	442.
13000.000	-.01	265.86	265.50	142.	4520.	771.
12500.000	-.02	263.40	262.94	142.	4520.	475.
12000.000	-.01	260.76	260.40	142.	4520.	614.
11500.000	-.02	258.32	257.84	142.	4520.	459.
11000.000	-.02	255.66	255.29	142.	4520.	642.
10500.000	-.01	253.24	252.75	142.	4520.	441.
10000.000	-.03	250.56	250.18	142.	4520.	613.
9500.000	-.02	248.11	247.64	142.	4520.	465.
9000.000	-.01	245.47	245.10	142.	4520.	681.
8500.000	-.03	243.00	242.53	142.	4520.	479.
8000.000	.01	240.40	240.02	142.	4520.	724.
7500.000	.22	238.23	237.68	142.	4520.	429.
7000.000	.02	235.30	234.93	142.	4520.	1926.

ACCUMULATED WATER DISCHARGE FROM DAY ZERO(SFD)

MAIN	TRIB #1	TRIB #2	TRIB #3	....ETC
782.9640				

.....

$$END

0 DATA ERRORS DETECTED.

WARNING: SILT+CLAY CONCENTRATIONS IN EXCESS OF 50000. PPM WERE DETECTED 1080 TIMES.
MUDFLOW CONCENTRATIONS (SILT+CLAY IN EXCESS OF 800000. PPM) WERE DETECTED 0 TIMES.

TOTAL NO. OF TIME STEPS READ = 27
TOTAL NO. OF WS PROFILES = 27
ITERATIONS IN EXNER EQ = 24300.
END OF JOB

JOB COMPLETED
RUN TIME = 0 HOURS, 1 MINUTES & 21.72 SECONDS

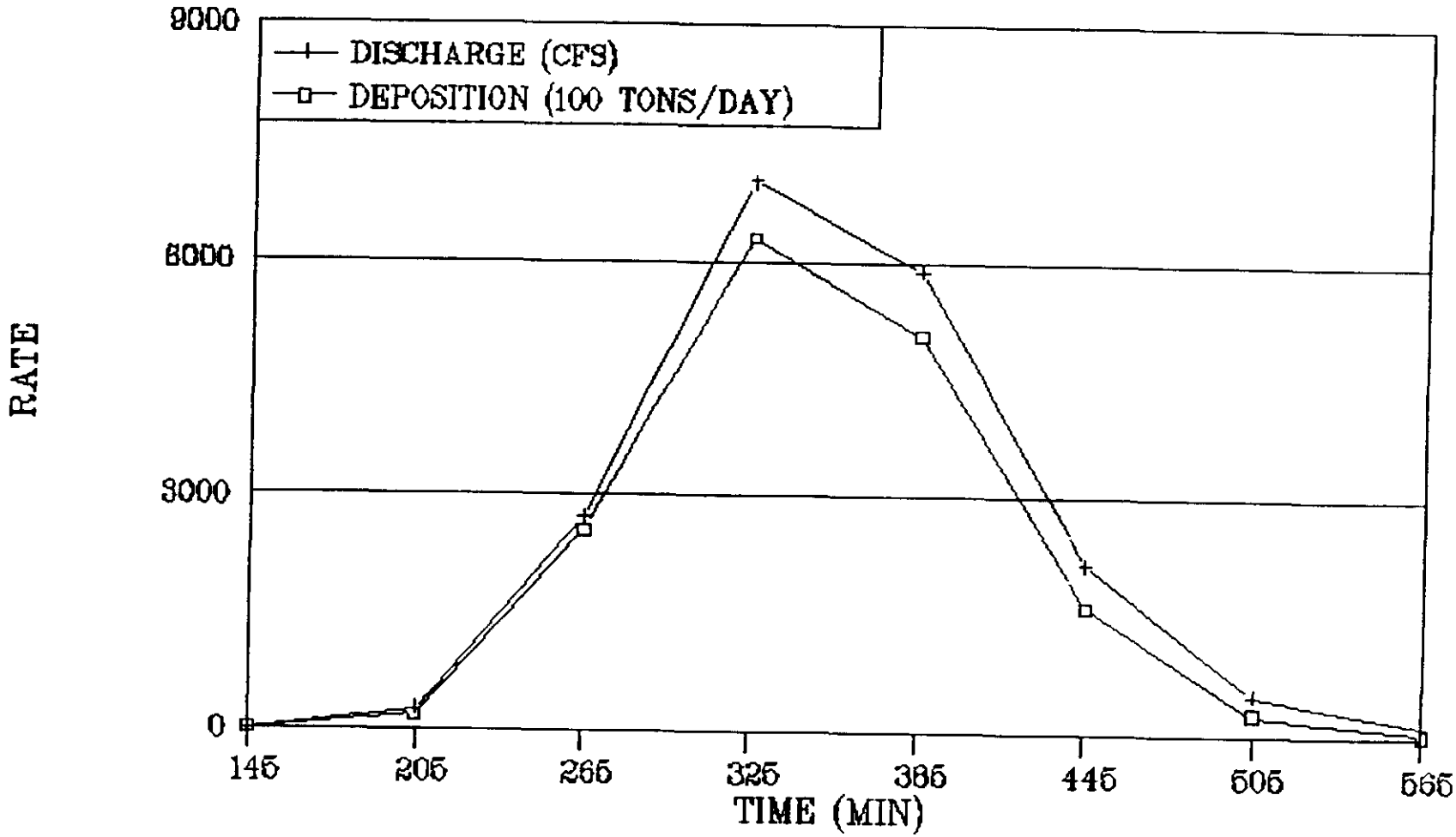
12. DEPOSITION PERCENTAGE

DEPOSITION PERCENTAGE

During the course of the analysis, certain mathematical instabilities were identified within HEC-6. The computed instantaneous transport capacity at a particular section would oscillate above and below the final equilibrium capacity. At the end of the hydrograph and also farther downstream, these oscillations had been dampered sufficiently to have reach stability. As such, the results from HEC-6 could not be used directly to determine the channel invert elevation or the amount of instantaneous deposition at the time of the 100-year peak discharge. Therefore, an intermediate series of computation had to be performed.

A form of the integration approach was utilized to estimate total deposition at the time of the 100-year peak. The difference in equilibrium transport capacity of flows on the fan and those along the dike was determined several times throughout the hydrograph. These points were plotted and a deposition rate versus time curve was developed. The area beneath the curve represents the total deposition and that portion of the curve which lies before the peak discharge represents deposition at the time of the 100-year peak. A tabulation of the results was prepared. Using this analysis it was determined that 37 percent of the total deposition had occurred at the time of the peak discharge. This value represents the amount of sediment which is distributed through the transition reach when peak channel flows occur.

RANGE WASH
100 YR HYDROGRAPH AND RATE OF DEPOSITION



FILENAME: MASS3.CAL
DATE: 07/01/92
: SEDIMENT MASS CURVE FOR INFLOW - OUTLFOW
FROM HEC6 RUN

TEMPORAL DISTRIBUTION OF SEDIMENT DEPOSITION

TIME (MIN)	DIKE 100 YR (CFS)	XSEC 37000 INFLOW TONS/ DAY	XSEC 9000 OUTFLOW (TONS/ DAY)	RATE OF DEPOS. (100'S TONS/ DAY)	DELTA DEPOS. (TONS)	ACCUM DEPOS. (TONS)	FRACT TOTAL
145	0	0	0	0	0	0	.000
205	261	3.192e4	1.398e4	1.794e2	374	374	.006
265	2742	8.009e5	5.448e5	2.561e3	5710	6084	.091
325	7028	2.671e6	2.040e6	6.310e3	18482	24565	.368
385	5897	2.062e6	1.554e6	5.076e3	23719	48284	.723
445	2172	4.921e5	3.295e5	1.627e3	13963	62248	.932
505	516	6.198e4	3.582e4	2.616e2	3934	66182	.991
565	142	7.75e3	5.201e3	2.549e1	598	66780	1.000

TRANSITION MODEL

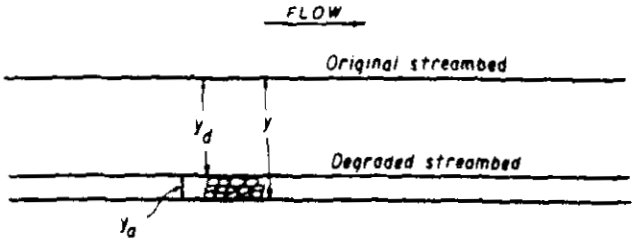
The computation of sediment transport through the transition from alluvial fan flow to dike flow presents considerable difficulties using HEC-6. As previously mentioned, HEC-6 has computational difficulties modeling sediment transport through changes in channel geometry and flow rate. The mathematical instabilities make it difficult to compute the actual amount of deposition occurring at a specific time and at a specific location. That is compounded by the difficulty in predicting the horizontal changes in channel alignment occurring coincident with the deposition. The unique conditions make the application of HEC-6 very difficult.

As a result of the aforementioned conditions, an alternative approach to model the changes in sediment transport and the resulting deposition along the transition from fan flows to flows along the dike was adopted. This methodology relies on work done by the Bureau of Reclamation on general scour below dam outlet structures. The geometry of channel scour is similar to the geometry of deposition. A copy of the Bureau of Reclamation channel degradation analysis copied from Design of Small Dams is attached hereto. The assumptions used in adapting this methodology to the case of transition deposition is also included.

The geometry of the deposition is a function of total deposition volume and of the width of the channel. Since peak discharges are of interest, the volume of deposition which has occurred at the time of the peak is used in these computations. This volume will be superimposed on the channel invert and an appropriate dike height for the 100-year discharge will be computed. An average of the alluvial fan channel and the diversion dike channel was used in the computations. Using this information, a maximum depth of deposition of 5.64 feet is computed

and a horizontal distance of 1,050 feet is computed. The deposition was determined to fit a vertical parabolic curve as described by the Bureau of Reclamation.

Appendix H
B. Downstream Channel Effects
H-4 Channel Degradation



y_d = Depth of degradation

y_a = Armoring layer

Figure H–15. Armoring definition sketch. 288–D–2856.

The size analysis of streambed material shown in figure H–16 is also available. Computed armoring sizes, D_a, are:

(1) $V_b = 0.7(3.4) = 2.4$
From figure H-13 $D_a = 22$ mm.

(2) $T.F. = 62.4(4.0)(0.0021) = 0.52$ lb./ft.^{2}
From figure H-14 $D_a = 31$ mm.

(3) $D_a = \dfrac{5.26(0.0021)(4.0)}{(0.03/(34)^{1/6})^{3/2}} = 20$ mm.

(4) $D_a = \dfrac{4762(0.0021)^{4/3}.500}{60} = 11$ mm.

A mean of the above armoring sizes is 21 mm., which was adopted as a representative armoring size. By use of equation 21 and figure H–16, the depth of degradation is:

$$y_a = 3\ D_a = 3(21) = 63 \text{ mm. or } 0.206 \text{ ft.}$$

$$y_d = 0.206\left(\frac{1}{0.19} - 1\right) = 0.9 \text{ ft.}$$

(d) *Degradation Limited by a Stable Slope.*—This method is based on the limiting or stable slope which will result in no transport of the material forming the bed of the stream channel, and is used where there is not enough coarse material available to form an armor on the channel bed. The stable slope can be computed for a river reach using equations 13 and 14.

In addition to the limiting or stable slope of the degraded channel, it is also necessary to determine the volume of material that can be expected to be removed from the channel. If there are no downstream channel controls that could limit degradation, it is sometimes assumed that the river will pick up a load of coarse sediment (>0.0625 mm.) equal to that portion of the historic load in the same size range. This necessarily assumes little depletion in quantity of streamflow and minor regulation by the upstream reservoir. If the streamflow is significantly depleted or regulated, the sediment load to be picked up will be less than the historic load and appropriate adjustments in the load to be picked up will have to be made.

Having determined the stable slope and the volume of material that can be expected to be removed, the depth of degradation at the dam and the degraded channel profile can be estimated if the following assumptions can be reasonably well satisfied:

(1) The degradation reach is sufficiently uniform to permit the use of average cross sections and slope throughout the reach.
(2) The bed and bank material throughout the reach is similar enough that an average composition can be used and that there are no existing nonerodible barriers in the bed or banks to prevent the stream from attaining the average stable section at the stable slope.
(3) The degradation will be such that the vertical component will predominate and horizontal movement will be limited to bank sloughing resulting from the vertical degradation.

Experience has shown that a degraded stream profile can be represented by a typical three-slope arrangement, as shown in figure H–17 [23]. The derivation of the formulae for the longitudinal area, A_T, and the degradation reach length, L, are included in the figure. The previously determined volume may be expresed by:

$$V = \frac{A_T B}{43{,}560} \qquad (22)$$

where

V=volume of material to be degraded in acre-feet

A_T=longitudinal area of degradation in square feet

B=degraded channel width in feet.

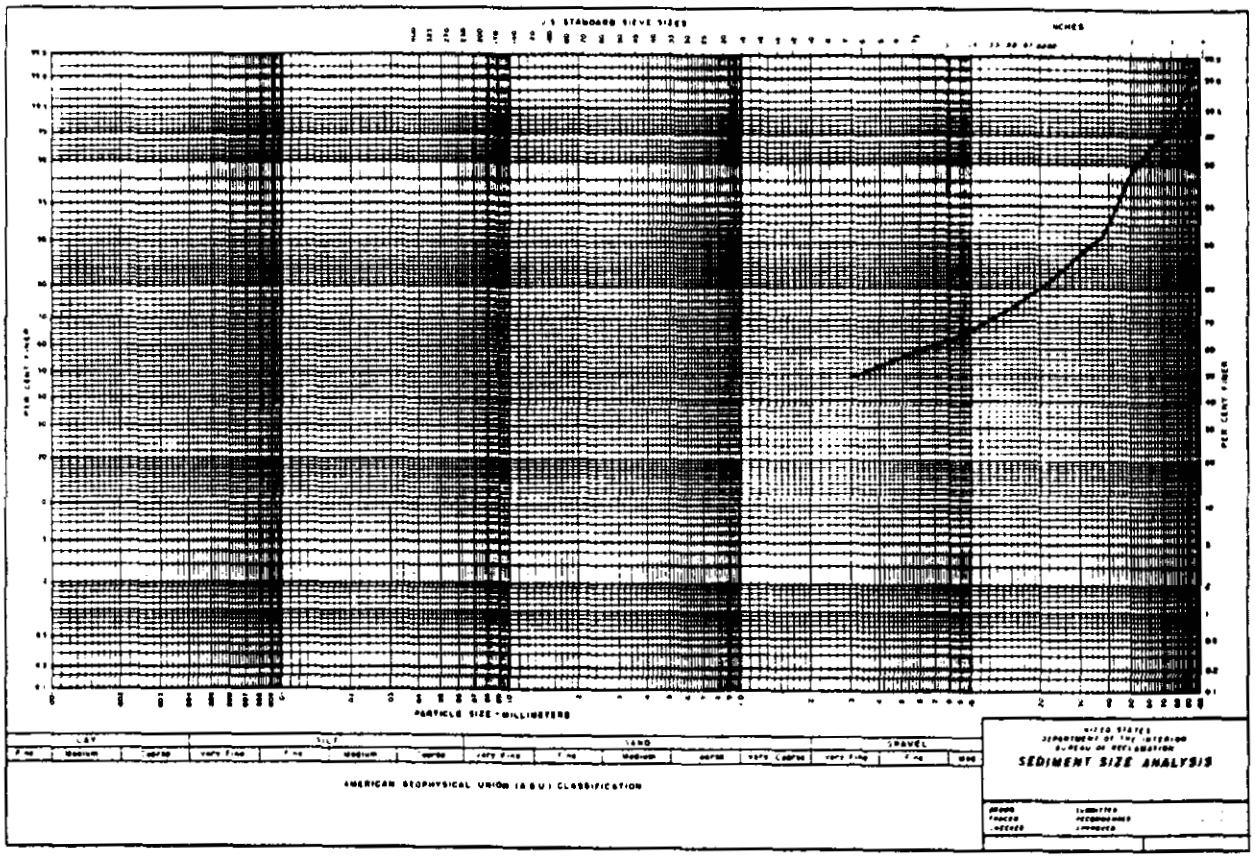


Figure H–16. Bed material size analysis. 288–D–2857.

By rearranging equation 22 the longitudinal area may be found:

$$A_T = \frac{43{,}560\ V}{B} \tag{23}$$

Once a value has been found for A_T, the depth of degradation may be computed using the following equation:

$$D = \left(\frac{64\ A_T \Delta S}{39}\right)^{1/2} \tag{24}$$

where ΔS=the difference between the existing slope and the stable slope and the length of the degraded reach can be computed by:

$$L = \frac{13\ D}{S \Delta S} \tag{25}$$

If it is anticipated that lateral degradation will be a significant factor, additional study will be necessary to determine the degraded channel width. Because part of the material will be coming from the stream banks, the extent of vertical degradation will ordinarily not be as great. Lateral movement should always be suspect when the banks are composed of the same material as the bed and there is not a great deal of vegetation to hold them. References [25] and [26] are recommended as guides when these conditions prevail.

If a permanent control exists at some point within the degradation reach, equation 25 may be used to solve for the depth of degradation directly.

As an example of degradation computations when the stable slope controls, the following

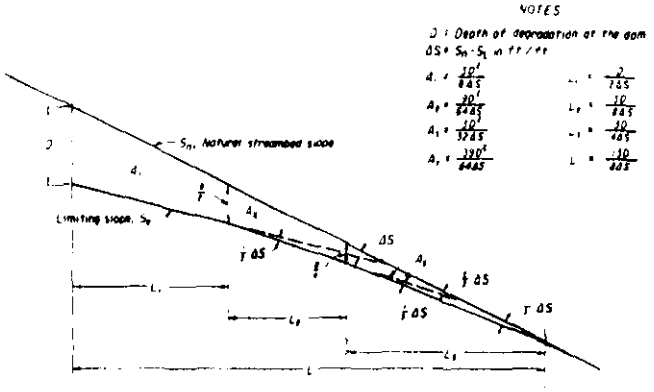


Figure H-17 Degraded channel by the three-slope method. 288-D-2858.

data are known about a river channel below a diversion dam:

Dominant discharge	$=Q=780$ c.f.s.
Channel width	$=B=350$ ft.
Mean channel depth	$=d=1.05$ ft.
Existing stream gradient	$=S_n=0.0014$
Bed material—$D_m=D_{50}$	$=0.3$ mm.
D_{90}	$=0.96$ mm.
Manning's n value	$=0.027$.

It was computed that 2,160 acre-feet of sand would deposit behind the diversion dam during the 100-year economic life of the structure, and that an equal volume of sand would be eroded from the downstream channel.

The stable slope computations are:

$$S_1=\left(\frac{0.00021\,(0.3)\,(350)}{780}\right)^{1.4}=0.000387$$

and

$$S_1=\frac{0.19[0.027/(0.96)^{1/6}]^{3/2}\,0.3}{1.05}=0.000244$$

(Q/Q_n is assumed equal to unity)

A mean of the two computed slopes is 0.000315 and it is assumed to be the stable slope. The difference between the existing and degraded slope, ΔS, is 0.001085.

The longitudinal degradation area is:

$$A_T=\frac{43{,}560\,(2{,}160)}{350}=268{,}830\text{ ft.}^2,$$

the depth of degradation at the dam is:

$$D=\left(\frac{64\,(268{,}830)\,(0.001085)}{39}\right)^{1/2}=21.9\text{ ft.},$$

and the length of the degradation reach is:

$$L=\frac{13\,(21.9)}{8\,(0.001085)}=32{,}800\text{ ft.}$$

C. BIBLIOGRAPHY

H-5. *Bibliography.*

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BOYLE ENGINEERING CORPORATION

Project Range Wash
Job No. 1A1107 302 CO
By MWG Date 1/11/92
Description Fan deposition length and maximum deposition simulation on fan & dike
SHEET 1/4

From DSD methodology (Appendix H)

eq 1 $V = \frac{A_T B}{43560}$ where V = volume of deposition, AF
A_T = longitudinal area of depos. ft²
B = channel width ft

eq 2 $D = \left(\frac{64 A_T \Delta S}{39}\right)^{1/2}$ D = depth of deposition ft
ΔS = change in slope ft/ft

eq 3 $L = \frac{13D}{B\Delta S}$ L = length of deposition ft

This method must be modified to fit our condition

DSD definition sketch

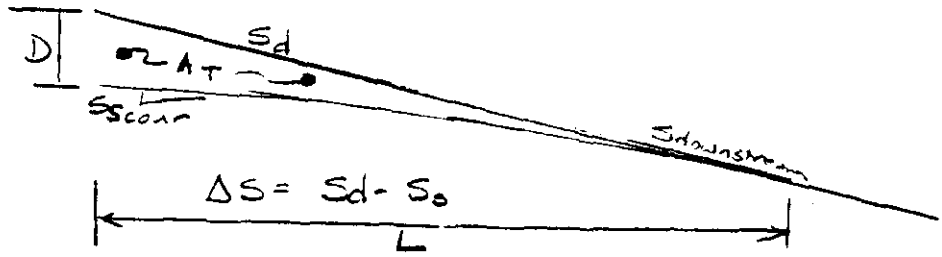


Fig 1

Modification to fit our condition
S_o = slope at point of maximum deposition
deposition geometry symmetric about intersection

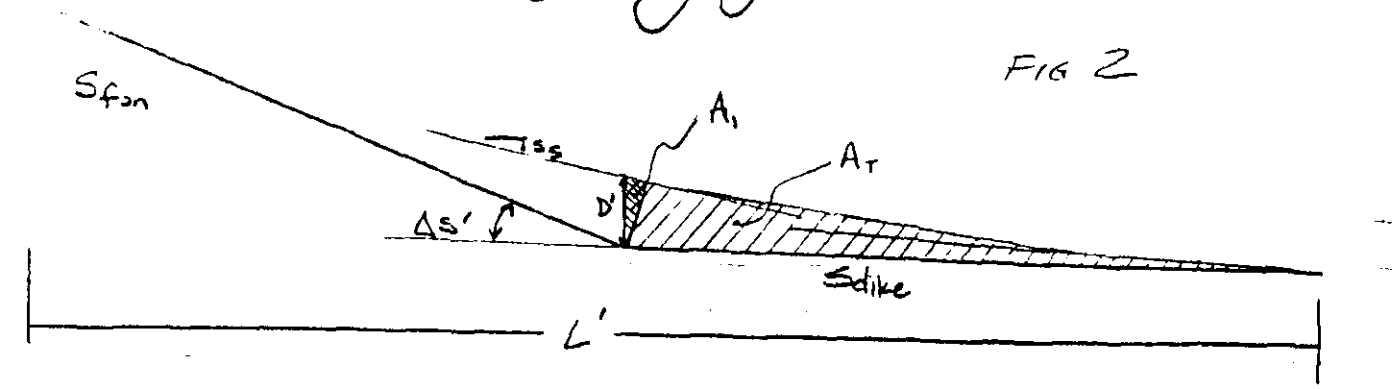


FIG 2

for worst case

FAN to Dike @ 0.5%

$S_{fan} = S_f = 0.04$

$S_{dike} = S_d = 0.005$

From HEC-6 file RC11208.DAT (see System Model section)

Total deposition = 64989 tons (all deposits sand)

@ 93 #/ft³ = 1.4×10^6 ft³

= 32.1 AF

Volume of peak flow

36.8% of total (see Deposition % section)

$V_{PEAK} = .368 \times 32.1 = 11.8$ AF

$A_{PEAK} = 2(A_T - A_1)$

Eq 1 $V_{PEAK} = \frac{2(A_T - A_1)B}{43560} = 2(V_T - V_1)$

$V_T = V_{PEAK}/2 + V_1$ (ignore V_1 and verify later)

$V_T = V_{PEAK}/2$

$V_T = 11.8/2 = 5.9$ AF

$B = 232'$ see transition geometry and width explanation attached

$\Delta S = S_d - S_s$

$\Delta S' = S_{rm} - S_{dike}$

$\Delta S' = S_{rm} - S_s + S_s - S_{dike}$

Therefore $\Delta S' = 2\Delta S$

$\Delta S = \Delta S'/2$

$\Delta S = \frac{1}{2}(.04 - 0.005) = 0.0175$

$V_{PEAK} = \frac{A_T B}{43560}$ eq 1

$5.9 = \frac{A_T (232)}{43560}$

$A_T = 1108$ ft^2

$D = \left(\frac{64 A_T \Delta S}{39}\right)^{1/2}$ Eq 2

$= \left[\frac{64(1108)}{39} 0.0175\right]^{1/2}$

$D = 5.64$ feet

$D' = D/\cos \frac{1}{2}\Delta S' = 5.64/0.9975$

$D' = 5.64$ feet

$$L = \frac{13D}{5\Delta s} \qquad \text{Eq } 3$$

$$= \frac{13(5.04)}{3(.0175)}$$

$L = 324$ feet

$L' = 2L = 1048'$

$L' = 1050'$

Check V_1 Assumption

$A_1 = D(\tan \frac{1}{2}\Delta s' D)/2$

$A_1 = 5.64(0.0175 \times 5.64)/2$

$= 0.28$ ft²

$A_1/A_T = 0.28/1108 \Rightarrow 0.03\%$ error

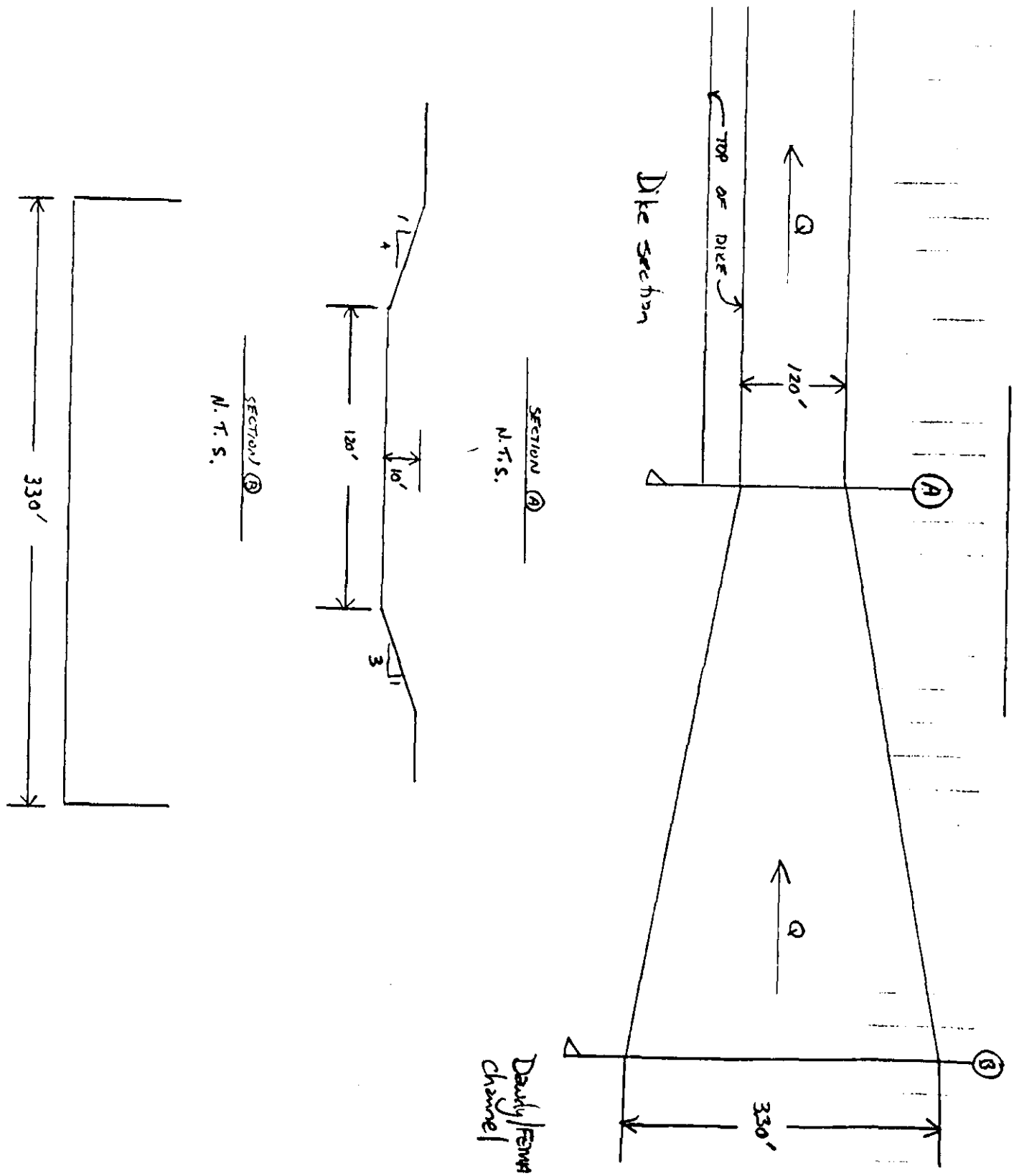
Ignore V_1 is reasonable

BOYLE ENGINEERING CORPORATION

Project RANGE WASH
Job No. ON NM7 300 10
By TBC Date 2/7/92

Description TRANSITION GEOMETRY

SHEET 1/2



BOYLE ENGINEERING CORPORATION

Project RANGE MASH
Job No. [illegible]
By [illegible] Date 7/1/92

Description TRANSITION WIDTH

SHEET 2/2

THE AVERAGE TRANSITION WIDTH FROM THE FAN TO THE DIKE WAS USED FOR MODELING THE MAXIMUM DEPOSITION. THE AVERAGE WIDTH WAS CALCULATED AS FOLLOWS:

FAN CHANNEL WIDTH = 330 feet

DIKE BOTTOM WIDTH = 120 feet
DIKE SIDE SLOPES = 3.5:1 (AVE)
WATER DEPTH = 4 feet

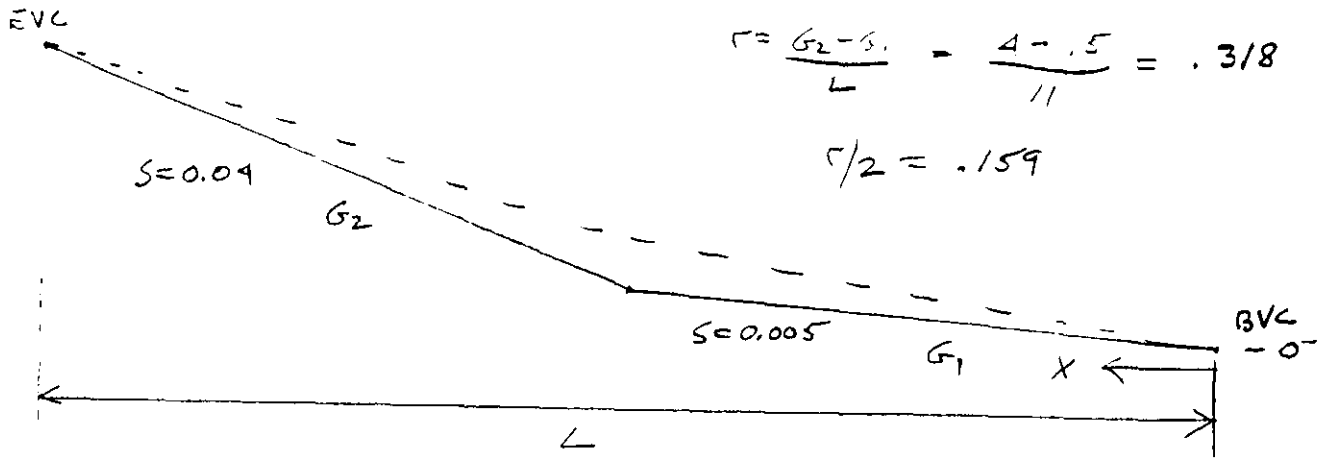
AVERAGE DIKE WIDTH = $\frac{120 + (120 + (4 \times 3.5 \times 2))}{2} = 134'$

AVERAGE TRANSITION WIDTH = $\frac{330' + 134'}{2} = 232'$

BOYLE ENGINEERING CORPORATION

Project SNAKE WASH
Job No. 2N NOM 300 J
By TRS Date 6 82

Description TRANSITION BY PARABOLIC VERTICAL CURVE FROM -5% TO -1% SHEET 1



$r = \frac{G_2 - G_1}{L} = \frac{4 - .5}{11} = .318$

$r/2 = .159$

$L = 1040' \approx 1000'$

STATION	X	$(r/2)X^2$	G_1X	(curve elev) $(r/2)X^2 + G_1X$	model elev	width
330+00	0	0	0	0	364.91	120
331	1	.159	.5	.659	365.57	138
332	2	.636	1.0	1.636	366.55	158
333	3	1.431	1.5	2.931	367.89	175
334	4	2.544	2.0	4.544	369.45	193
335	5	3.975	2.5	6.475	371.39	211
336	6	5.724	3.0	8.724	373.62	229
337	7	7.791	3.5	11.291	376.20	249
338	8	10.176	4.0	14.176	379.09	265
339	9	12.879	4.5	17.379	382.29	289
340	10	15.900	5.0	20.900	385.81	307
341+00	11	19.239	5.5	24.739	389.65	320

WATER SURFACE PROFILE DETERMINATION

Using the deposition depth, the computed geometry and the peak discharge, a HEC-2 water surface profile computation was performed. This analysis was performed for both the subcritical and supercritical condition. It was determined that the critical location was in the subcritical run at a section along the dike at which the depth of flow was 4.4 feet and the velocity head was 2.3 feet. This value was very similar to the subcritical profile at which the depth of flow was 4.6 feet and the velocity head of 2.1 feet. In both cases, the total energy head was 6.7 feet which was the basis for the dike height computation.

SUPER-CRITICAL PROFILE

```
T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION     ON NO7 300 10
T3      06/02/92 100 YR PEAK, FAN TO 120' @ 0.5%, RNGSC.DAT, SUPERCRITICAL
      0       2       0       1     .04       0       0       0 1468.00
      1       0      -1
    150
NC  .022    .022    .022      .1      .3
QT    1    7028
X1 61000       2       0     320    1000    1000    1000
GR1465.6       0  1465.6     320
X1 60000       0       0       0    1000    1000    1000       0  -40.00
X1 59000       0       0       0    1000    1000    1000       0  -40.00
X1 58000       0       0       0    1000    1000    1000       0  -40.00
X1 57000       0       0       0    1000    1000    1000       0  -40.00
X1 56000       0       0       0    1000    1000    1000       0  -40.00
X1 55000       0       0       0    1000    1000    1000       0  -40.00
X1 54000       0       0       0    1000    1000    1000       0  -40.00
X1 53000       0       0       0    1000    1000    1000       0  -40.00
X1 52000       0       0       0    1000    1000    1000       0  -40.00
X1 51000       0       0       0    1000    1000    1000       0  -40.00
X1 50000       0       0       0    1000    1000    1000       0  -40.00
X1 49000       0       0       0    1000    1000    1000       0  -40.00
X1 48000       0       0       0    1000    1000    1000       0  -40.00
X1 47000       0       0       0    1000    1000    1000       0  -40.00
X1 46000       0       0       0    1000    1000    1000       0  -40.00
X1 45000       0       0       0    1000    1000    1000       0  -40.00
X1 44000       0       0       0    1000    1000    1000       0  -40.00
X1 43000       0       0       0    1000    1000    1000       0  -40.00
X1 42000       0       0       0    1000    1000    1000       0  -40.00
    1000       0       0       0    1000    1000    1000       0  -40.00
     100       0       0       0    1000    1000    1000       0  -40.00
  39000       0       0       0    1000    1000    1000       0  -40.00
X1 38000       0       0       0    1000    1000    1000       0  -40.00
X1 37000       0       0       0    1000    1000    1000       0  -40.00
X1 36000       0       0       0    1000    1000    1000       0  -40.00
X1 35000       0       0       0     500     500     500       0  -40.00
X1 34500       0       0       0     100     100     100       0  -20.00
X1 34400       0       0       0     100     100     100       0   -4.00
X1 34300       0       0       0     100     100     100       0   -4.00
X1 34200       0       0       0     100     100     100       0   -4.00
X1 34100       4       0   320.0     100     100     100       0
GR395.91       0  389.65     0.1  389.65     320  395.91   320.1
X1 34000       4       0   302.0     100     100     100       0
GR392.91       0  385.81     0.1  385.81     302  392.91   302.1
X1 33900       4       0   284.0     100     100     100       0
GR389.06       0  382.29     0.1  382.29     284  389.06   284.1
X1 33800       4       0   265.0     100     100     100       0
GR386.51       0  379.09     0.1  379.09     265  386.51   265.1
X1 33700       4       0   247.0     100     100     100       0
GR384.26       0  376.20     0.1  376.20     247  384.26   247.1
X1 33600       4       0   229.0     100     100     100       0
GR382.31       0  373.63     0.1  373.63     229  382.31   229.1
X1 33500       4       0   211.0     100     100     100       0
GR380.66       0  371.39     0.1  371.39     211  380.66   211.1
 33400       4       0   193.0     100     100     100       0
    31       0  369.45     0.1  369.45     193  378.31   193.1
   .00       4       0   175.0     100     100     100       0
GR377.26       0  367.84     0.1  367.84     175  377.26   175.1
X1 33200       4       0   156.0     100     100     100       0
GR376.51       0  366.55     0.1  366.55     156  376.51   156.1
```

HEC-2

FAN TO DIKE

SUPERCRITICAL PROFILE

@ Transition

$y = 1.99$

$h_v = 3.90$

$E = 5.89'$

@ Dike channel

$y = 4.38$

$h_v = 2.26$

$E = 6.64'$

```
X1 33100      4       0   138.0     100     100     100       0
GR375.06      0  365.57     0.1  365.57     138  375.06   138.1
X1 33000      7       0     220     500     500     500
 *74.91       0  374.91      40  364.91    69.9  364.91      70  364.91      190
    .91     220  374.91   220.1
   2500       0       0       0     500     500     500       0   -2.55
X1 32000      0       0       0     500     500     500       0   -2.55
X1 31500      0       0       0     500     500     500       0   -2.55
X1 31000      0       0       0     500     500     500       0   -2.55
X1 30500      0       0       0     500     500     500       0   -2.55
X1 30000      0       0       0     500     500     500       0   -2.55
X1 29500      0       0       0     500     500     500       0   -2.55
X1 29000      0       0       0     500     500     500       0   -2.55
X1 28500      0       0       0     500     500     500       0   -2.55
X1 28000      0       0       0     500     500     500       0   -2.55
X1 27500      0       0       0     500     500     500       0   -2.55
X1 27000      0       0       0     500     500     500       0   -2.55
X1 26500      0       0       0     500     500     500       0   -2.55
X1 26000      0       0       0     500     500     500       0   -2.55
X1 25500      0       0       0     500     500     500       0   -2.55
X1 25000      0       0       0     500     500     500       0   -2.55
EJ
ER
```

```
**********************************************
*  HEC-2 WATER SURFACE PROFILES              *
*                                            *
*  Version  4.6.0;  February 1991            *
*                                            *
*  RUN DATE    04JUN92    TIME   16:02:49    *
**********************************************
```


```
**********************************
*  U.S. ARMY CORPS OF ENGINEERS
*  HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616-4687
*        (916) 756-1104
**********************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                  X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX  XXXXX              XXXXXXX
```

1

THIS RUN EXECUTED 04JUN92 16:02:49

```
**********************************
  C-2 WATER SURFACE PROFILES

  Version  4.6.0;  February 1991
**********************************
```

T1 *RANGE WASH WEST DIVERSION DIKE LAS VEGAS,NV*
T2 BOYLE ENGINEERING CORPORATION ON N07 300 10
T3 06/02/92 100 YR PEAK, FAN TO 120' @ 0.5%, *RNGSC.DAT, SUPERCRITICAL*

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	1	.04	0	0	0	1468.00	

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0	-1							

J3 *VARIABLE CODES FOR SUMMARY PRINTOUT*

150

NC	.022	.022	.022	.1	.3				
QT	1	7028							
**	61000	2	0	320	1000	1000	1000		
	1465.6	0	1465.6	320					
X1	60000	0	0	0	1000	1000	1000	0	-40.00
X1	59000	0	0	0	1000	1000	1000	0	-40.00

X1	58000	0	0	0	1000	1000	1000	0	-40.00
X1	57000	0	0	0	1000	1000	1000	0	-40.00
	56000	0	0	0	1000	1000	1000	0	-40.00
X1	55000	0	0	0	1000	1000	1000	0	-40.00
X1	54000	0	0	0	1000	1000	1000	0	-40.00
X1	53000	0	0	0	1000	1000	1000	0	-40.00
X1	52000	0	0	0	1000	1000	1000	0	-40.00
X1	51000	0	0	0	1000	1000	1000	0	-40.00

X1	50000	0	0	0	1000	1000	1000	0	-40.00
X1	49000	0	0	0	1000	1000	1000	0	-40.00
X1	48000	0	0	0	1000	1000	1000	0	-40.00
X1	47000	0	0	0	1000	1000	1000	0	-40.00
	46000	0	0	0	1000	1000	1000	0	-40.00
...	45000	0	0	0	1000	1000	1000	0	-40.00
X1	44000	0	0	0	1000	1000	1000	0	-40.00
X1	43000	0	0	0	1000	1000	1000	0	-40.00
X1	42000	0	0	0	1000	1000	1000	0	-40.00
X1	41000	0	0	0	1000	1000	1000	0	-40.00
X1	40000	0	0	0	1000	1000	1000	0	-40.00
X1	39000	0	0	0	1000	1000	1000	0	-40.00
X1	38000	0	0	0	1000	1000	1000	0	-40.00
X1	37000	0	0	0	1000	1000	1000	0	-40.00
X1	36000	0	0	0	1000	1000	1000	0	-40.00
X1	35000	0	0	0	500	500	500	0	-40.00
X1	34500	0	0	0	100	100	100	0	-20.00
	34400	0	0	0	100	100	100	0	-4.00
X1	34300	0	0	0	100	100	100	0	-4.00
X1	34200	0	0	0	100	100	100	0	-4.00

X1	34100	4	0	320.0	100	100	100	0		
GR	395.91	0	389.65	0.1	389.65	320	395.91	320.1		
	34000	4	0	302.0	100	100	100	0		
	392.91	0	385.81	0.1	385.81	302	392.91	302.1		
X1	33900	4	0	284.0	100	100	100	0		
GR	389.06	0	382.29	0.1	382.29	284	389.06	284.1		

1

X1	33800	4	0	265.0	100	100	100	0		
GR	386.51	0	379.09	0.1	379.09	265	386.51	265.1		
X1	33700	4	0	247.0	100	100	100	0		
GR	384.26	0	376.20	0.1	376.20	247	384.26	247.1		
X1	33600	4	0	229.0	100	100	100	0		
GR	382.31	0	373.63	0.1	373.63	229	382.31	229.1		
X1	33500	4	0	211.0	100	100	100	0		
GR	380.66	0	371.39	0.1	371.39	211	380.66	211.1		
X1	33400	4	0	193.0	100	100	100	0		
GR	378.31	0	369.45	0.1	369.45	193	378.31	193.1		
	33300	4	0	175.0	100	100	100	0		
	377.26	0	367.84	0.1	367.84	175	377.26	175.1		
X1	33200	4	0	156.0	100	100	100	0		
GR	376.51	0	366.55	0.1	366.55	156	376.51	156.1		
X1	33100	4	0	138.0	100	100	100	0		
GR	375.06	0	365.57	0.1	365.57	138	375.06	138.1		
X1	33000	7	0	220	500	500	500			
GR	374.91	0	374.91	40	364.91	69.9	364.91	70	364.91	190
GR	374.91	220	374.91	220.1						
X1	32500	0	0	0	500	500	500	0	-2.55	
X1	32000	0	0	0	500	500	500	0	-2.55	
X1	31500	0	0	0	500	500	500	0	-2.55	
X1	31000	0	0	0	500	500	500	0	-2.55	
X1	30500	0	0	0	500	500	500	0	-2.55	
X1	30000	0	0	0	500	500	500	0	-2.55	
	29500	0	0	0	500	500	500	0	-2.55	
	29000	0	0	0	500	500	500	0	-2.55	
X1	28500	0	0	0	500	500	500	0	-2.55	

```
 X1    28000        0         0         0        500       500       500         0       -2.55
1
    04JUN92      16:02:49                                                                  PAGE    4

 X1    27500        0         0         0        500       500       500         0       -2.55

 X1    27000        0         0         0        500       500       500         0       -2.55

 X1    26500        0         0         0        500       500       500         0       -2.55

 X1    26000        0         0         0        500       500       500         0       -2.55

 X1    25500        0         0         0        500       500       500         0       -2.55

 X1    25000        0         0         0        500       500       500         0       -2.55
1
    04JUN92      16:02:49                                                                  PAGE    5

     SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        QLOSS     L-BANK ELEV
     Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
     TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
     SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*PROF 1

   V=     .100 CEHV=     .300
    NO 61000.000
   0 CROSS SECTION  61000.00 EXTENDED      1.34 FEET

 61000.000      1.34   1466.94   1468.06   1468.00   1471.13      4.19       .00       .00   1465.60
    7028.0        .0    7028.0        .0        .0     427.8        .0        .0        .0   1465.60
       .00       .00     16.43       .00      .000      .022      .000      .000   1465.60       .00
   .040610        0.        0.        0.         0         8         5       .00    320.00    320.00


*SECNO 60000.000
3840 SECTION NOT HIGH ENOUGH  1507.543  1475.600  1425.600  1475.600  1467.039         2
 60000.000      1.35   1426.95   1428.06       .00   1431.07      4.12     40.04       .02   1425.60
    7028.0        .0    7028.0        .0        .0     431.5        .0       9.9       7.3   1425.60
       .02       .00     16.29       .00      .000      .022      .000      .000   1425.60       .00
   .039473     1000.     1000.     1000.         6        14         0       .00    320.00    320.00


*SECNO 59000.000
3840 SECTION NOT HIGH ENOUGH  1466.989  1435.600  1385.600  1435.600  1426.947         2
 59000.000      1.34   1386.94   1388.06       .00   1391.12      4.18     39.95       .01   1385.60
    7028.0        .0    7028.0        .0        .0     428.4        .0      19.7      14.7   1385.60
       .03       .00     16.41       .00      .000      .022      .000      .000   1385.60       .00
   .040426     1000.     1000.     1000.         6        14         0       .00    320.00    320.00


   0 58000.000
     SECTION NOT HIGH ENOUGH  1426.886  1395.600  1345.600  1395.600  1386.937         2
 58000.000      1.35   1346.95   1348.06       .00   1351.[illegible]      4.13     40.02       .01   1345.60
    7028.0        .0    7028.0        .0        .0     431.0        .0      29.6      22.0   1345.60
       .05       .00     16.31       .00      .000      .022      .000      .000   1345.60       .00
```

.039628	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 57000.000

SECTION NOT HIGH ENOUGH	1386.974	1355.600	1305.600	1355.600	1346.945		2		
00.000	1.34	1306.94	1308.06	.00	1311.11	4.17	39.96	.00	1305.60
7028.0	.0	7028.0	.0	.0	428.8	.0	39.5	29.4	1305.60
.07	.00	16.39	.00	.000	.022	.000	.000	1305.60	.00
.040304	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

1

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 56000.000

3840 SECTION NOT HIGH ENOUGH	1346.902	1315.600	1265.600	1315.600	1306.938		2		
56000.000	1.35	1266.95	1268.06	.00	1271.08	4.14	40.02	.01	1265.60
7028.0	.0	7028.0	.0	.0	430.6	.0	49.3	36.7	1265.60
.08	.00	16.32	.00	.000	.022	.000	.000	1265.60	.00
.039736	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

CNO 55000.000

SECTION NOT HIGH ENOUGH	1306.963	1275.600	1225.600	1275.600	1266.944		2		
000.000	1.34	1226.94	1228.06	.00	1231.11	4.17	39.97	.00	1225.60
7028.0	.0	7028.0	.0	.0	429.1	.0	59.2	44.1	1225.60
.10	.00	16.38	.00	.000	.022	.000	.000	1225.60	.00
.040206	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 54000.000

3840 SECTION NOT HIGH ENOUGH	1266.911	1235.600	1185.600	1235.600	1226.939		2		
54000.000	1.34	1186.94	1188.06	.00	1191.08	4.14	40.02	.01	1185.60
7028.0	.0	7028.0	.0	.0	430.3	.0	69.1	51.4	1185.60
.12	.00	16.33	.00	.000	.022	.000	.000	1185.60	.00
.039832	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 53000.000

3840 SECTION NOT HIGH ENOUGH	1226.957	1195.600	1145.600	1195.600	1186.943		2		
53000.000	1.35	1146.95	1148.06	.00	1151.11	4.16	39.98	.00	1145.60
7028.0	.0	7028.0	.0	.0	429.4	.0	78.9	58.8	1145.60
.14	.00	16.37	.00	.000	.022	.000	.000	1145.60	.00
.040121	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 52000.000

3840 SECTION NOT HIGH ENOUGH	1186.919	1155.600	1105.600	1155.600	1146.940		2		
00.000	1.34	1106.94	1108.06	.00	1111.09	4.15	40.01	.00	1105.60
028.0	.0	7028.0	.0	.0	430.1	.0	88.8	66.1	1105.60
.15	.00	16.34	.00	.000	.022	.000	.000	1105.60	.00
.039904	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 51000.000

3840 SECTION NOT HIGH ENOUGH 1146.952 1115.600 1065.600 1115.600 1106.943 2

51000.000	1.34	1066.94	1068.06	.00	1071.10	4.16	39.99	.00	1065.60
7028.0	.0	7028.0	.0	.0	429.5	.0	98.7	73.5	1065.60
.17	.00	16.36	.00	.000	.022	.000	.000	1065.60	.00
.040073	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 50000.000

3840 SECTION NOT HIGH ENOUGH 1106.928 1075.600 1025.600 1075.600 1066.941 2

50000.000	1.34	1026.94	1028.06	.00	1031.09	4.15	40.01	.00	1025.60
7028.0	.0	7028.0	.0	.0	430.0	.0	108.5	80.8	1025.60
.19	.00	16.35	.00	.000	.022	.000	.000	1025.60	.00
.039940	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 49000.000

3840 SECTION NOT HIGH ENOUGH 1066.945 1035.600 985.600 1035.600 1026.942 2

000.000	1.35	986.95	988.06	.00	991.10	4.15	39.99	.00	985.60
7028.0	.0	7028.0	.0	.0	429.6	.0	118.4	88.2	985.60
.20	.00	16.36	.00	.000	.022	.000	.000	985.60	.00
.040037	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 48000.000

3840 SECTION NOT HIGH ENOUGH 1026.932 995.600 945.600 995.600 986.941 2

48000.000	1.35	946.95	948.06	.00	951.10	4.15	40.00	.00	945.60
7028.0	.0	7028.0	.0	.0	429.9	.0	128.3	95.5	945.60
.22	.00	16.35	.00	.000	.022	.000	.000	945.60	.00
.039970	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 47000.000

3840 SECTION NOT HIGH ENOUGH 986.947 955.600 905.600 955.600 946.942 2

47000.000	1.35	906.95	908.06	.00	911.10	4.15	40.00	.00	905.60
7028.0	.0	7028.0	.0	.0	429.7	.0	138.1	102.8	905.60
.24	.00	16.36	.00	.000	.022	.000	.000	905.60	.00
.040025	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 46000.000

3840 SECTION NOT HIGH ENOUGH 946.940 915.600 865.600 915.600 906.941 2

46000.000	1.35	866.95	868.06	.00	871.10	4.15	40.00	.00	865.60
7028.0	.0	7028.0	.0	.0	429.8	.0	148.0	110.2	865.60
.25	.00	16.35	.00	.000	.022	.000	.000	865.60	.00
039976	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 45000.000

3840 SECTION NOT HIGH ENOUGH	906.944	875.600	825.600	875.600	866.942	2			
45000.000	1.35	826.95	828.06	.00	831.10	4.15	40.00	.00	825.60
7028.0	.0	7028.0	.0	.0	429.7	.0	157.9	117.5	825.60
.27	.00	16.36	.00	.000	.022	.000	.000	825.60	.00
040018	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 44000.000

3840 SECTION NOT HIGH ENOUGH	866.941	835.600	785.600	835.600	826.941	2			
44000.000	1.35	786.95	788.06	.00	791.10	4.15	40.00	.00	785.60
7028.0	.0	7028.0	.0	.0	429.8	.0	167.7	124.9	785.60
.29	.00	16.35	.00	.000	.022	.000	.000	785.60	.00
.039988	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 43000.000

3840 SECTION NOT HIGH ENOUGH	826.945	795.600	745.600	795.600	786.942	2			
43000.000	1.35	746.95	748.06	.00	751.10	4.15	40.00	.00	745.60
7028.0	.0	7028.0	.0	.0	429.7	.0	177.6	132.2	745.60
.31	.00	16.35	.00	.000	.022	.000	.000	745.60	.00
040006	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 42000.000

3840 SECTION NOT HIGH ENOUGH	786.940	755.600	705.600	755.600	746.941	2			
42000.000	1.35	706.95	708.06	.00	711.10	4.15	40.00	.00	705.60
7028.0	.0	7028.0	.0	.0	429.8	.0	187.5	139.6	705.60
.32	.00	16.35	.00	.000	.022	.000	.000	705.60	.00
.039994	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 41000.000

3840 SECTION NOT HIGH ENOUGH	746.944	715.600	665.600	715.600	706.942	2			
41000.000	1.35	666.95	668.06	.00	671.10	4.15	40.00	.00	665.60
7028.0	.0	7028.0	.0	.0	429.7	.0	197.3	146.9	665.60
.34	.00	16.35	.00	.000	.022	.000	.000	665.60	.00
.040006	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 40000.000

3840 SECTION NOT HIGH ENOUGH	706.942	675.600	625.600	675.600	666.941	2			
40000.000	1.35	626.95	628.06	.00	631.10	4.15	40.00	.00	625.60
7028.0	.0	7028.0	.0	.0	429.8	.0	207.2	154.3	625.60
.36	.00	16.35	.00	.000	.022	.000	.000	625.60	.00
.039994	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 39000.000

3840 SECTION NOT HIGH ENOUGH	666.943	635.600	585.600	635.600	626.942	2			
39000.000	1.35	586.95	588.06	.00	591.10	4.15	40.00	.00	585.60

7028.0	.0	7028.0	.0	.0	429.8	.0	217.1	161.6	585.60
.37	.00	16.35	.00	.000	.022	.000	.000	585.60	.00
.040000	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 38000.000

3840 SECTION NOT HIGH ENOUGH		626.942	595.600	545.600	595.600	586.941	2		
38000.000	1.35	546.95	548.06	.00	551.10	4.15	40.00	.00	545.60
7028.0	.0	7028.0	.0	.0	429.8	.0	226.9	169.0	545.60
.39	.00	16.35	.00	.000	.022	.000	.000	545.60	.00
.040000	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 37000.000

3840 SECTION NOT HIGH ENOUGH		586.944	555.600	505.600	555.600	546.941	2		
37000.000	1.35	506.95	508.06	.00	511.10	4.15	40.00	.00	505.60
7028.0	.0	7028.0	.0	.0	429.8	.0	236.8	176.3	505.60
.41	.00	16.35	.00	.000	.022	.000	.000	505.60	.00
.040000	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 36000.000

3840 SECTION NOT HIGH ENOUGH		546.944	515.600	465.600	515.600	506.941	2		
36000.000	1.35	466.95	468.06	.00	471.10	4.15	40.00	.00	465.60
7028.0	.0	7028.0	.0	.0	429.8	.0	246.7	183.7	465.60
.42	.00	16.35	.00	.000	.022	.000	.000	465.60	.00
.040000	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 35000.000

3840 SECTION NOT HIGH ENOUGH		506.944	475.600	425.600	475.600	466.941	2		
35000.000	1.35	426.95	428.06	.00	431.10	4.15	40.00	.00	425.60
7028.0	.0	7028.0	.0	.0	429.8	.0	256.5	191.0	425.60
.44	.00	16.35	.00	.000	.022	.000	.000	425.60	.00
.040000	1000.	1000.	1000.	6	14	0	.00	320.00	320.00

*SECNO 34500.000

3280 CROSS SECTION 34500.00 EXTENDED 1.34 FEET

34500.000	1.35	406.95	408.06	.00	411.10	4.15	20.00	.00	405.60
7028.0	.0	7028.0	.0	.0	429.8	.0	261.5	194.7	405.60
.45	.00	16.35	.00	.000	.022	.000	.000	405.60	.00
.039985	500.	500.	500.	6	14	0	.00	320.00	320.00

*SECNO 34400.000

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST

3280 CROSS SECTION 34400.00 EXTENDED 1.34 FEET

34400.000	1.35	402.95	404.06	.00	407.10	4.15	4.00	.00	401.60
7028.0	.0	7028.0	.0	.0	429.8	.0	262.4	195.4	401.60
.45	.00	16.35	.00	.000	.022	.000	.000	401.60	.00
.040003	100.	100.	100.	7	14	0	.00	320.00	320.00

*SECNO 34300.000
3280 CROSS SECTION 34300.00 EXTENDED 1.34 FEET

34300.000	1.35	398.95	400.06	.00	403.10	4.15	4.00	.00	397.60
7028.0	.0	7028.0	.0	.0	429.8	.0	263.4	196.1	397.60
.45	.00	16.35	.00	.000	.022	.000	.000	397.60	.00
.039994	100.	100.	100.	7	14	0	.00	320.00	320.00

*SECNO 34200.000
3280 CROSS SECTION 34200.00 EXTENDED 1.34 FEET

34200.000	1.35	394.95	396.06	.00	399.10	4.15	4.00	.00	393.60
7028.0	.0	7028.0	.0	.0	429.8	.0	264.4	196.9	393.60
.46	.00	16.35	.00	.000	.022	.000	.000	393.60	.00
040000	100.	100.	100.	7	14	0	.00	320.00	320.00

*SECNO 34100.000

34100.000	1.35	391.00	392.11	.00	395.13	4.13	3.97	.01	395.91
7028.0	.0	7028.0	.0	.0	431.2	.0	265.4	197.6	389.65
.46	.00	16.30	.13	.000	.022	.022	.000	389.65	.08
.039336	100.	100.	100.	7	14	0	.00	319.94	320.02

*SECNO 34000.000

34000.000	1.43	387.24	388.37	.00	391.35	4.11	3.77	.00	392.91
7028.0	.0	7028.0	.0	.0	431.9	.0	266.4	198.3	385.81
.46	.00	16.27	.13	.000	.022	.022	.000	385.81	.08
.036219	100.	100.	100.	8	14	0	.00	301.94	302.02

*SECNO 33900.000

33900.000	1.53	383.82	384.95	.00	387.89	4.07	3.45	.01	389.06
7028.0	.0	7028.0	.0	.0	434.0	.0	267.4	199.0	382.29
.46	.00	16.20	.12	.000	.022	.022	.000	382.29	.08
.032882	100.	100.	100.	8	14	0	.00	283.95	284.02

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV

TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
NO 33800.000									
00.000	1.65	380.74	381.88	.00	384.77	4.03	3.11	.01	386.51
7028.0	.0	7028.0	.0	.0	436.2	.0	268.4	199.6	379.09
.46	.00	16.11	.12	.000	.022	.022	.000	379.09	.08
.029493	100.	100.	100.	8	14	0	.00	264.94	265.02
*SECNO 33700.000									
33700.000	1.78	377.98	379.12	.00	381.96	3.99	2.79	.01	384.26
7028.0	.0	7028.0	.0	.0	438.5	.0	269.4	200.2	376.20
.46	.00	16.03	.11	.000	.022	.022	.000	376.20	.08
.026427	100.	100.	100.	8	14	0	.00	246.94	247.02
*SECNO 33600.000									
33600.000	1.94	375.57	376.70	.00	379.47	3.91	2.47	.02	382.31
7028.0	.0	7028.0	.0	.0	443.2	.0	270.4	200.8	373.63
.47	.00	15.86	.10	.000	.022	.022	.000	373.63	.08
.023102	100.	100.	100.	8	14	0	.00	228.94	229.02
*SECNO 33500.000									
33500.000	2.14	373.53	374.63	.00	377.31	3.78	2.13	.04	380.66
7028.0	.0	7028.0	.0	.0	450.5	.0	271.4	201.3	371.39
.47	.00	15.60	.09	.000	.022	.022	.000	371.39	.08
.019659	100.	100.	100.	7	14	0	.00	210.95	211.02
*SECNO 33400.000									
33400.000	2.38	371.83	372.89	.00	375.47	3.64	1.79	.04	378.31
7028.0	.0	7028.0	.0	.0	459.2	.0	272.5	201.7	369.45
.47	.00	15.31	.09	.000	.022	.022	.000	369.45	.07
.016423	100.	100.	100.	6	14	0	.00	192.95	193.03
*SECNO 33300.000									
33300.000	2.72	370.56	371.51	.00	373.95	3.39	1.45	.08	377.26
7028.0	.0	7028.0	.0	.0	475.8	.0	273.5	202.2	367.84
.47	.00	14.77	.08	.000	.022	.022	.000	367.84	.07
.012853	100.	100.	100.	5	14	0	.00	174.96	175.03

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
O 33200.000									
33200.000	3.27	369.82	370.53	.00	372.76	2.94	1.05	.13	376.51
7028.0	.0	7028.0	.0	.0	510.9	.1	274.7	202.5	366.55
.47	.00	13.76	.06	.000	.022	.022	.000	366.55	.07

.008760	100.	100.	100.	7	11	0	.00	155.97	156.03

*SECNO 33100.000

, HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33100.000	4.31	369.88	369.88	.00	372.05	2.17	.62	.27	375.06
7028.0	.0	7028.0	.0	.0	593.9	.1	275.9	202.9	365.57
.48	.00	11.83	.05	.000	.022	.022	.000	365.57	.05
.004564	100.	100.	100.	20	11	0	.00	137.99	138.05

*SECNO 33000.000

33000.000	4.33	369.24	369.45	.00	371.55	2.31	.49	.01	374.91
7028.0	.0	7028.0	.0	.0	576.3	.0	277.3	203.2	374.91
.48	.00	12.20	.00	.000	.022	.000	.000	364.91	56.95
.005294	100.	100.	100.	4	8	0	.00	146.04	202.99

*SECNO 32500.000

32500.000	4.46	366.82	366.90	.00	368.98	2.17	2.52	.04	372.36
7028.0	.0	7028.0	.0	.0	594.7	.0	284.0	204.9	372.36
.49	.00	11.82	.00	.000	.022	.000	.000	362.36	56.58
.004802	500.	500.	500.	2	8	0	.00	146.79	203.37

NO 32000.000

_000.000	4.33	364.14	364.37	.00	366.45	2.31	2.52	.01	369.81
7028.0	.0	7028.0	.0	.0	576.3	.0	290.7	206.6	369.81
.50	.00	12.19	.00	.000	.022	.000	.000	359.81	56.95
.005294	500.	500.	500.	4	5	0	.00	146.04	202.99

*SECNO 31500.000

31500.000	4.45	361.71	361.80	.00	363.88	2.18	2.53	.04	367.26
7028.0	.0	7028.0	.0	.0	593.7	.0	297.4	208.2	367.26
.51	.00	11.84	.00	.000	.022	.000	.000	357.26	56.60
.004827	500.	500.	500.	2	8	0	.00	146.75	203.35

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SECNO 31000.000

0.000	4.34	359.05	359.27	.00	361.35	2.30	2.52	.01	364.71
028.0	.0	7028.0	.0	.0	577.0	.0	304.2	209.9	364.71
.52	.00	12.18	.00	.000	.022	.000	.000	354.71	56.94
.005275	500.	500.	500.	4	5	0	.00	146.07	203.01

*SECNO 30500.000

30500.000	4.44	356.60	356.70	.00	358.78	2.18	2.53	.04	362.16
7028.0	.0	7028.0	.0	.0	592.6	.0	310.9	211.6	362.16
.54	.00	11.86	.00	.000	.022	.000	.000	352.16	56.62
.004855	500.	500.	500.	2	8	0	.00	146.71	203.33

*SECNO 30000.000

30000.000	4.35	353.96	354.15	.00	356.25	2.29	2.52	.01	359.61
7028.0	.0	7028.0	.0	.0	578.4	.0	317.6	213.3	359.61
.55	.00	12.15	.00	.000	.022	.000	.000	349.61	56.91
.005233	500.	500.	500.	3	8	0	.00	146.13	203.04

*SECNO 29500.000

29500.000	4.41	351.47	351.60	.00	353.69	2.21	2.55	.02	357.06
7028.0	.0	7028.0	.0	.0	588.7	.0	324.3	215.0	357.06
.56	.00	11.94	.00	.000	.022	.000	.000	347.06	56.70
.004956	500.	500.	500.	2	8	0	.00	146.55	203.25

*SECNO 29000.000

29000.000	4.37	348.88	349.05	.00	351.15	2.27	2.53	.01	354.51
7028.0	.0	7028.0	.0	.0	581.3	.0	331.0	216.6	354.51
.57	.00	12.09	.00	.000	.022	.000	.000	344.51	56.85
.005153	500.	500.	500.	3	8	0	.00	146.25	203.10

*SECNO 28500.000

28500.000	4.37	346.33	346.50	.00	348.58	2.26	2.56	.00	351.96
7028.0	.0	7028.0	.0	.0	583.2	.0	337.7	218.3	351.96
.58	.00	12.05	.00	.000	.022	.000	.000	341.96	56.81
.005103	500.	500.	500.	2	8	0	.00	146.32	203.13

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 28000.000

28000.000	4.37	343.78	343.95	.00	346.04	2.25	2.55	.00	349.41
7028.0	.0	7028.0	.0	.0	583.5	.0	344.4	220.0	349.41
.59	.00	12.04	.00	.000	.022	.000	.000	339.41	56.80
.005093	500.	500.	500.	2	8	0	.00	146.34	203.14

*SECNO 27500.000

27500.000	4.39	341.25	341.40	.00	343.49	2.24	2.54	.00	346.86
7028.0	.0	7028.0	.0	.0	584.9	.0	351.1	221.7	346.86
.60	.00	12.02	.00	.000	.022	.000	.000	336.86	56.77
.005056	500.	500.	500.	3	8	0	.00	146.39	203.17

*SECNO 27000.000

27000.000	4.38	338.69	338.85	.00	340.95	2.26	2.54	.00	344.31
7028.0	.0	7028.0	.0	.0	582.8	.0	357.8	223.4	344.31
.62	.00	12.06	.00	.000	.022	.000	.000	334.31	56.82
105111	500.	500.	500.	3	8	0	.00	146.31	203.13

*SECNO 26500.000

26500.000	4.39	336.15	336.30	.00	338.40	2.25	2.55	.00	341.76
7028.0	.0	7028.0	.0	.0	584.0	.0	364.5	225.0	341.76
.63	.00	12.03	.00	.000	.022	.000	.000	331.76	56.79
.005081	500.	500.	500.	3	8	0	.00	146.36	203.15

*SECNO 26000.000

26000.000	4.38	333.59	333.75	.00	335.85	2.26	2.55	.00	339.21
7028.0	.0	7028.0	.0	.0	582.8	.0	371.2	226.7	339.21
.64	.00	12.06	.00	.000	.022	.000	.000	329.21	56.82
.005114	500.	500.	500.	3	8	0	.00	146.31	203.13

*SECNO 25500.000

25500.000	4.39	331.05	331.20	.00	333.30	2.25	2.55	.00	336.66
7028.0	.0	7028.0	.0	.0	584.0	.0	377.9	228.4	336.66
.65	.00	12.03	.00	.000	.022	.000	.000	326.66	56.79
.005081	500.	500.	500.	3	8	0	.00	146.36	203.15

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST

*SECNO 25000.000

25000.000	4.38	328.49	328.65	.00	330.75	2.26	2.55	.00	334.11
7028.0	.0	7028.0	.0	.0	582.9	.0	384.6	230.1	334.11
.66	.00	12.06	.00	.000	.022	.000	.000	324.11	56.82
.005111	500.	500.	500.	3	8	0	.00	146.31	203.13

THIS RUN EXECUTED 04JUN92 16:02:52

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HEC-2 WATER SURFACE PROFILES

ion 4.6.0; February 1991

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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

'RY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
61000.000	.00	.00	.00	1465.60	7028.00	1466.94	1468.06	1471.13	406.10	16.43	427.81	348.7
60000.000	1000.00	.00	.00	1425.60	7028.00	1426.95	1428.06	1431.07	394.73	16.29	431.48	353.7
59000.000	1000.00	.00	.00	1385.60	7028.00	1386.94	1388.06	1391.12	404.26	16.41	428.40	349.5
58000.000	1000.00	.00	.00	1345.60	7028.00	1346.95	1348.06	1351.08	396.28	16.31	430.98	353.0
57000.000	1000.00	.00	.00	1305.60	7028.00	1306.94	1308.06	1311.11	403.04	16.39	428.79	350.0
56000.000	1000.00	.00	.00	1265.60	7028.00	1266.95	1268.06	1271.08	397.36	16.32	430.63	352.5
55000.000	1000.00	.00	.00	1225.60	7028.00	1226.94	1228.06	1231.11	402.06	16.38	429.10	350.5
54000.000	1000.00	.00	.00	1185.60	7028.00	1186.94	1188.06	1191.08	398.32	16.33	430.31	352.1
53000.000	1000.00	.00	.00	1145.60	7028.00	1146.95	1148.06	1151.11	401.21	16.37	429.38	350.8
52000.000	1000.00	.00	.00	1105.60	7028.00	1106.94	1108.06	1111.09	399.04	16.34	430.08	351.8
51000.000	1000.00	.00	.00	1065.60	7028.00	1066.94	1068.06	1071.10	400.73	16.36	429.53	351.0
50000.000	1000.00	.00	.00	1025.60	7028.00	1026.94	1028.06	1031.09	399.40	16.35	429.96	351.6
49000.000	1000.00	.00	.00	985.60	7028.00	986.95	988.06	991.10	400.37	16.36	429.65	351.2
48000.000	1000.00	.00	.00	945.60	7028.00	946.95	948.06	951.10	399.70	16.35	429.86	351.5
47000.000	1000.00	.00	.00	905.60	7028.00	906.95	908.06	911.10	400.25	16.36	429.69	351.2
46000.000	1000.00	.00	.00	865.60	7028.00	866.95	868.06	871.10	399.76	16.35	429.84	351.5
45000.000	1000.00	.00	.00	825.60	7028.00	826.95	828.06	831.10	400.18	16.36	429.71	351.3

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SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
44000.000	1000.00	.00	.00	785.60	7028.00	786.95	788.06	791.10	399.88	16.35	429.80	351.4
43000.000	1000.00	.00	.00	745.60	7028.00	746.95	748.06	751.10	400.06	16.35	429.75	351.3
42000.000	1000.00	.00	.00	705.60	7028.00	706.95	708.06	711.10	399.94	16.35	429.79	351.4
41000.000	1000.00	.00	.00	665.60	7028.00	666.95	668.06	671.10	400.06	16.35	429.75	351.3
40000.000	1000.00	.00	.00	625.60	7028.00	626.95	628.06	631.10	399.94	16.35	429.79	351.4
39000.000	1000.00	.00	.00	585.60	7028.00	586.95	588.06	591.10	400.00	16.35	429.77	351.4

38000.000	1000.00	.00	.00	545.60	7028.00	546.95	548.06	551.10	400.00	16.35	429.77	351.4
37000.000	1000.00	.00	.00	505.60	7028.00	506.95	508.06	511.10	400.00	16.35	429.77	351.4
36000.000	1000.00	.00	.00	465.60	7028.00	466.95	468.06	471.10	400.00	16.35	429.77	351.4
35000.000	1000.00	.00	.00	425.60	7028.00	426.95	428.06	431.10	400.00	16.35	429.77	351.4
34500.000	500.00	.00	.00	405.60	7028.00	406.95	408.06	411.10	399.85	16.35	429.81	351.4
34400.000	100.00	.00	.00	401.60	7028.00	402.95	404.06	407.10	400.03	16.35	429.76	351.3
34300.000	100.00	.00	.00	397.60	7028.00	398.95	400.06	403.10	399.94	16.35	429.79	351.4
34200.000	100.00	.00	.00	393.60	7028.00	394.95	396.06	399.10	400.00	16.35	429.77	351.4
34100.000	100.00	.00	.00	389.65	7028.00	391.00	392.11	395.13	393.36	16.30	431.17	354.3
34000.000	100.00	.00	.00	385.81	7028.00	387.24	388.37	391.35	362.19	16.27	431.96	369.2
33900.000	100.00	.00	.00	382.29	7028.00	383.82	384.95	387.89	328.82	16.20	433.98	387.5
33800.000	100.00	.00	.00	379.09	7028.00	380.74	381.88	384.77	294.93	16.11	436.26	409.2
33700.000	100.00	.00	.00	376.20	7028.00	377.98	379.12	381.96	264.27	16.03	438.53	432.3
33600.000	100.00	.00	.00	373.63	7028.00	375.57	376.70	379.47	231.02	15.86	443.18	462.3
33500.000	100.00	.00	.00	371.39	7028.00	373.53	374.63	377.31	196.59	15.60	450.48	501.2
33400.000	100.00	.00	.00	369.45	7028.00	371.83	372.89	375.47	164.23	15.31	459.19	548.4
33300.000	100.00	.00	.00	367.84	7028.00	370.56	371.51	373.95	128.53	14.77	475.84	619.9
33200.000	100.00	.00	.00	366.55	7028.00	369.82	370.53	372.76	87.60	13.76	510.95	750.9
33100.000	100.00	.00	.00	365.57	7028.00	369.88	369.88	372.05	45.64	11.83	593.98	1040.3
33000.000	100.00	.00	.00	364.91	7028.00	369.24	369.45	371.55	52.94	12.20	576.29	965.8

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SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
32500.000	500.00	.00	.00	362.36	7028.00	366.82	366.90	368.98	48.02	11.82	594.69	1014.1
32000.000	500.00	.00	.00	359.81	7028.00	364.14	364.37	366.45	52.94	12.19	576.30	965.9
31500.000	500.00	.00	.00	357.26	7028.00	361.71	361.80	363.88	48.27	11.84	593.71	1011.6
31000.000	500.00	.00	.00	354.71	7028.00	359.05	359.27	361.35	52.75	12.18	576.96	967.6
30500.000	500.00	.00	.00	352.16	7028.00	356.60	356.70	358.78	48.55	11.86	592.61	1008.6
30000.000	500.00	.00	.00	349.61	7028.00	353.96	354.15	356.25	52.33	12.15	578.45	971.5
29500.000	500.00	.00	.00	347.06	7028.00	351.47	351.60	353.69	49.56	11.94	588.68	998.3

29000.000	500.00	.00	.00	344.51	7028.00	348.88	349.05	351.15	51.53	12.09	581.34	979.0
28500.000	500.00	.00	.00	341.96	7028.00	346.33	346.50	348.58	51.03	12.05	583.17	983.8
28000.000	500.00	.00	.00	339.41	7028.00	343.78	343.95	346.04	50.93	12.04	583.51	984.7
27500.000	500.00	.00	.00	336.86	7028.00	341.25	341.40	343.49	50.56	12.02	584.92	988.4
27000.000	500.00	.00	.00	334.31	7028.00	338.69	338.85	340.95	51.11	12.06	582.85	983.0
26500.000	500.00	.00	.00	331.76	7028.00	336.15	336.30	338.40	50.81	12.03	583.98	985.9
26000.000	500.00	.00	.00	329.21	7028.00	333.59	333.75	335.85	51.14	12.06	582.76	982.7
25500.000	500.00	.00	.00	326.66	7028.00	331.05	331.20	333.30	50.81	12.03	583.98	985.9
25000.000	500.00	.00	.00	324.11	7028.00	328.49	328.65	330.75	51.11	12.06	582.85	983.0

06/02/92 100 YR PEAK, FA

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
1000.000	7028.00	1466.94	.00	.00	-1.06	320.00	.00
60000.000	7028.00	1426.95	.00	-39.99	.00	320.00	1000.00
59000.000	7028.00	1386.94	.00	-40.01	.00	320.00	1000.00
58000.000	7028.00	1346.95	.00	-39.99	.00	320.00	1000.00
57000.000	7028.00	1306.94	.00	-40.01	.00	320.00	1000.00
56000.000	7028.00	1266.95	.00	-39.99	.00	320.00	1000.00
55000.000	7028.00	1226.94	.00	-40.00	.00	320.00	1000.00
54000.000	7028.00	1186.94	.00	-40.00	.00	320.00	1000.00
53000.000	7028.00	1146.95	.00	-40.00	.00	320.00	1000.00
52000.000	7028.00	1106.94	.00	-40.00	.00	320.00	1000.00
51000.000	7028.00	1066.94	.00	-40.00	.00	320.00	1000.00
50000.000	7028.00	1026.94	.00	-40.00	.00	320.00	1000.00
49000.000	7028.00	986.95	.00	-39.99	.00	320.00	1000.00
.000.000	7028.00	946.95	.00	-40.00	.00	320.00	1000.00
47000.000	7028.00	906.95	.00	-40.00	.00	320.00	1000.00

46000.000	7028.00	866.95	.00	-40.00	.00	320.00	1000.00
45000.000	7028.00	826.95	.00	-40.00	.00	320.00	1000.00
44000.000	7028.00	786.95	.00	-40.00	.00	320.00	1000.00
43000.000	7028.00	746.95	.00	-40.00	.00	320.00	1000.00
42000.000	7028.00	706.95	.00	-40.00	.00	320.00	1000.00
41000.000	7028.00	666.95	.00	-40.00	.00	320.00	1000.00
40000.000	7028.00	626.95	.00	-40.00	.00	320.00	1000.00
39000.000	7028.00	586.95	.00	-40.00	.00	320.00	1000.00
38000.000	7028.00	546.95	.00	-40.00	.00	320.00	1000.00

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SECNO	Q	CWSEL	DIFWSP	DIFWSK	DIFKWS	TOPWID	XLCH
37000.000	7028.00	506.95	.00	-40.00	.00	320.00	1000.00
36000.000	7028.00	466.95	.00	-40.00	.00	320.00	1000.00
35000.000	7028.00	426.95	.00	-40.00	.00	320.00	1000.00
34500.000	7028.00	406.95	.00	-20.00	.00	320.00	500.00
34400.000	7028.00	402.95	.00	-4.00	.00	320.00	100.00
34300.000	7028.00	398.95	.00	-4.00	.00	320.00	100.00
34200.000	7028.00	394.95	.00	-4.00	.00	320.00	100.00
34100.000	7028.00	391.00	.00	-3.95	.00	319.94	100.00
34000.000	7028.00	387.24	.00	-3.76	.00	301.94	100.00
33900.000	7028.00	383.82	.00	-3.42	.00	283.95	100.00
33800.000	7028.00	380.74	.00	-3.08	.00	264.94	100.00
33700.000	7028.00	377.98	.00	-2.76	.00	246.94	100.00
33600.000	7028.00	375.57	.00	-2.41	.00	228.94	100.00
33500.000	7028.00	373.53	.00	-2.04	.00	210.95	100.00
33400.000	7028.00	371.83	.00	-1.69	.00	192.95	100.00
33300.000	7028.00	370.56	.00	-1.27	.00	174.96	100.00
33200.000	7028.00	369.82	.00	-.74	.00	155.97	100.00
* 33100.000	7028.00	369.88	.00	.05	.00	137.99	100.00

33000.000	7028.00	369.24	.00	-.64	.00	146.04	100.00
32500.000	7028.00	366.82	.00	-2.42	.00	146.79	500.00
:000.000	7028.00	364.14	.00	-2.67	.00	146.04	500.00
31500.000	7028.00	361.71	.00	-2.43	.00	146.75	500.00
31000.000	7028.00	359.05	.00	-2.66	.00	146.07	500.00
30500.000	7028.00	356.60	.00	-2.45	.00	146.71	500.00
30000.000	7028.00	353.96	.00	-2.64	.00	146.13	500.00
29500.000	7028.00	351.47	.00	-2.49	.00	146.55	500.00

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SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
29000.000	7028.00	348.88	.00	-2.59	.00	146.25	500.00
28500.000	7028.00	346.33	.00	-2.55	.00	146.32	500.00
28000.000	7028.00	343.78	.00	-2.55	.00	146.34	500.00
27500.000	7028.00	341.25	.00	-2.53	.00	146.39	500.00
/000.000	7028.00	338.69	.00	-2.56	.00	146.31	500.00
26500.000	7028.00	336.15	.00	-2.54	.00	146.36	500.00
26000.000	7028.00	333.59	.00	-2.56	.00	146.31	500.00
25500.000	7028.00	331.05	.00	-2.54	.00	146.36	500.00
25000.000	7028.00	328.49	.00	-2.56	.00	146.31	500.00

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SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 33100.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 33100.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 33100.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

SUB-CRITICAL PROFILE

*	24500.000	7050.00	326.96	.00	2.50	.00	147.36	500.00
*	25000.000	7050.00	329.46	.00	2.50	.00	147.36	500.00
	500.000	7050.00	331.96	.00	2.50	.00	147.36	500.00
	26000.000	7050.00	334.46	.00	2.50	.00	147.36	500.00
*	26500.000	7050.00	336.96	.00	2.50	.00	147.36	500.00
*	27000.000	7050.00	339.46	.00	2.50	.00	147.36	500.00
*	27500.000	7050.00	341.96	.00	2.50	.00	147.36	500.00
*	28000.000	7050.00	344.46	.00	2.50	.00	147.36	500.00
*	28500.000	7050.00	346.96	.00	2.50	.00	147.36	500.00
*	29000.000	7050.00	349.46	.00	2.50	.00	147.36	500.00
*	29500.000	7050.00	351.96	.00	2.50	.00	147.36	500.00
*	30000.000	7050.00	354.46	.00	2.50	.00	147.36	500.00
*	30500.000	7050.00	356.96	.00	2.50	.00	147.36	500.00
*	31000.000	7050.00	359.46	.00	2.50	.00	147.36	500.00
*	31500.000	7050.00	361.96	.00	2.50	.00	147.36	500.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	32000.000	7050.00	364.46	.00	2.50	.00	147.36	500.00
*	32500.000	7050.00	366.96	.00	2.50	.00	147.36	500.00
*	33000.000	7050.00	369.46	.00	2.50	.00	147.36	500.00
*	33100.000	7050.00	369.90	.00	.44	.00	137.99	100.00
	33200.000	7050.00	370.53	.00	.63	.00	155.98	100.00
*	33300.000	7050.00	371.52	.00	.99	.00	174.98	100.00
*	33400.000	7050.00	372.90	.00	1.38	.00	192.98	100.00
*	33500.000	7050.00	374.65	.00	1.75	.00	210.97	100.00
*	33600.000	7050.00	376.72	.00	2.07	.00	228.97	100.00
*	33700.000	7050.00	379.14	.00	2.42	.00	246.97	100.00
	300.000	7050.00	381.89	.00	2.76	.00	264.98	100.00
*	33900.000	7050.00	384.96	.00	3.07	.00	283.98	100.00

*	34000.000	7050.00	388.38	.00	3.41	.00	301.97	100.00
*	34100.000	7050.00	392.12	.00	3.74	.00	320.05	100.00
	000.000	7050.00	428.11	.00	35.99	.00	320.05	900.00
*	36000.000	7050.00	468.11	.00	40.00	.00	320.05	1000.00
*	37000.000	7050.00	508.11	.00	40.00	.00	320.05	1000.00
*	38000.000	7050.00	548.11	.00	40.00	.00	320.05	1000.00
*	39000.000	7050.00	588.11	.00	40.00	.00	320.05	1000.00
*	40000.000	7050.00	628.11	.00	40.00	.00	320.05	1000.00
*	41000.000	7050.00	668.11	.00	40.00	.00	320.05	1000.00
*	42000.000	7050.00	708.11	.00	40.00	.00	320.05	1000.00
*	43000.000	7050.00	748.11	.00	40.00	.00	320.05	1000.00
*	44000.000	7050.00	788.11	.00	40.00	.00	320.05	1000.00
*	45000.000	7050.00	828.11	.00	40.00	.00	320.05	1000.00
*	46000.000	7050.00	868.11	.00	40.00	.00	320.05	1000.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	47000.000	7050.00	908.11	.00	40.00	.00	320.05	1000.00
*	48000.000	7050.00	948.11	.00	40.00	.00	320.05	1000.00
*	49000.000	7050.00	988.11	.00	40.00	.00	320.05	1000.00
*	50000.000	7050.00	1028.12	.00	40.00	.00	320.05	1000.00
*	51000.000	7050.00	1068.11	.00	40.00	.00	320.05	1000.00
*	52000.000	7050.00	1108.11	.00	40.00	.00	320.05	1000.00
*	53000.000	7050.00	1148.11	.00	40.00	.00	320.05	1000.00
*	54000.000	7050.00	1188.11	.00	40.00	.00	320.05	1000.00
*	55000.000	7050.00	1228.11	.00	40.00	.00	320.05	1000.00
*	56000.000	7050.00	1268.11	.00	40.00	.00	320.05	1000.00
*	57000.000	7050.00	1308.11	.00	40.00	.00	320.05	1000.00
	000.000	7050.00	1348.11	.00	40.00	.00	320.05	1000.00
*	59000.000	7050.00	1388.11	.00	40.00	.00	320.05	1000.00

*	60000.000	7050.00	1428.11	.00	40.00	.00	320.05	1000.00
*	61000.000	7050.00	1468.11	.00	40.00	.00	320.05	1000.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 7000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 7500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 8000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 8500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 9000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 9000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 9500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 9500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

ION SECNO= 10000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
ION SECNO= 10000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 10500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 11000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 11000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 11500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 11500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 12000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 12000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 12500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 12500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 13000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 13000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 13500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 13500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 14000.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
ON SECNO= 14000.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

ION SECNO= 14500.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 14500.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

```
T1       RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2       BOYLE ENGINEERING CORPORATION     DN N07 300 10
T3       01/28/92 100 YR PEAK, FAN TO 120' @ 0.5%, RNGB120.DAT
         0       2       0       0    .005       0       0       0  238.00
         1       0      -1
       150
NC    .022    .022    .022      .1      .3
QT       1    7050
X1    7300       7       0     220       0       0       0       0       0
GR244.91       0  244.91      40  234.91    69.9  234.91      70  234.91     190
GR244.91     220  244.91   220.1
X1    7500       0       0       0     500     500     500       0    2.50
X1    8000       0       0       0     500     500     500       0    2.50
X1    8500       0       0       0     500     500     500       0    2.50
X1    9000       0       0       0     500     500     500       0    2.50
X1    9500       0       0       0     500     500     500       0    2.50
X1   10000       0       0       0     500     500     500       0    2.50
X1   10500       0       0       0     500     500     500       0    2.50
X1   11000       0       0       0     500     500     500       0    2.50
X1   11500       0       0       0     500     500     500       0    2.50
X1   12000       0       0       0     500     500     500       0    2.50
X1   12500       0       0       0     500     500     500       0    2.50
X1   13000       0       0       0     500     500     500       0    2.50
X1   13500       0       0       0     500     500     500       0    2.50
X1   14000       0       0       0     500     500     500       0    2.50
X1   14500       0       0       0     500     500     500       0    2.50
X1   15000       0       0       0     500     500     500       0    2.50
X1   15500       0       0       0     500     500     500       0    2.50
X1   16000       0       0       0     500     500     500       0    2.50
     16500       0       0       0     500     500     500       0    2.50
     17000       0       0       0     500     500     500       0    2.50
     17500       0       0       0     500     500     500       0    2.50
X1   18000       0       0       0     500     500     500       0    2.50
X1   18500       0       0       0     500     500     500       0    2.50
X1   19000       0       0       0     500     500     500       0    2.50
X1   19500       0       0       0     500     500     500       0    2.50
X1   20000       0       0       0     500     500     500       0    2.50
X1   20500       0       0       0     500     500     500       0    2.50
X1   21000       0       0       0     500     500     500       0    2.50
X1   21500       0       0       0     500     500     500       0    2.50
X1   22000       0       0       0     500     500     500       0    2.50
X1   22500       0       0       0     500     500     500       0    2.50
X1   23000       0       0       0     500     500     500       0    2.50
X1   23500       0       0       0     500     500     500       0    2.50
X1   24000       0       0       0     500     500     500       0    2.50
X1   24500       0       0       0     500     500     500       0    2.50
X1   25000       0       0       0     500     500     500       0    2.50
X1   25500       0       0       0     500     500     500       0    2.50
X1   26000       0       0       0     500     500     500       0    2.50
X1   26500       0       0       0     500     500     500       0    2.50
X1   27000       0       0       0     500     500     500       0    2.50
X1   27500       0       0       0     500     500     500       0    2.50
X1   28000       0       0       0     500     500     500       0    2.50
X1   28500       0       0       0     500     500     500       0    2.50
X1   29000       0       0       0     500     500     500       0    2.50
     29500       0       0       0     500     500     500       0    2.50
     30000       0       0       0     500     500     500       0    2.50
X1   30500       0       0       0     500     500     500       0    2.50
X1   31000       0       0       0     500     500     500       0    2.50
X1   31500       0       0       0     500     500     500       0    2.50
```

HEC-2

FAN D DIKE

SUBCRITICAL PROFILE

@ Transition

$y = 3.09$

$h_v = 1.54$

$E = 4.63'$

@ Dike channel

$y = 4.55$

$h_v = 2.08$

$E = 6.63'$

X1 32000	0	0	0	500	500	500	0	2.50
X1 32500	0	0	0	500	500	500	0	2.50
X1 33000	0	0	0	500	500	500	0	2.50
[illegible]100	4	0	138.0	100	100	100	0	
[illegible]06	0	365.57	0.1	365.57	138	375.06	138.1	
[illegible]3200	4	0	156.0	100	100	100	0	
GR376.51	0	366.55	0.1	366.55	156	376.51	156.1	
X1 33300	4	0	175.0	100	100	100	0	
GR377.26	0	367.84	0.1	367.84	175	377.26	175.1	
X1 33400	4	0	193.0	100	100	100	0	
GR378.31	0	369.45	0.1	369.45	193	378.31	193.1	
X1 33500	4	0	211.0	100	100	100	0	
GR380.66	0	371.39	0.1	371.39	211	380.66	211.1	
X1 33600	4	0	229.0	100	100	100	0	
GR382.31	0	373.63	0.1	373.63	229	382.31	229.1	
X1 33700	4	0	247.0	100	100	100	0	
GR384.26	0	376.20	0.1	376.20	247	384.26	247.1	
X1 33800	4	0	265.0	100	100	100	0	
GR386.51	0	379.09	0.1	379.09	265	386.51	265.1	
X1 33900	4	0	284.0	100	100	100	0	
GR389.06	0	382.29	0.1	382.29	284	389.06	284.1	
X1 34000	4	0	302.0	100	100	100	0	
GR392.91	0	385.81	0.1	385.81	302	392.91	302.1	
X1 34100	4	0	320.0	100	100	100	0	
GR392.91	0	389.65	0.1	389.65	320	392.91	320.1	
X1 35000	0	0	0	900	900	900	0	36.00
X1 36000	0	0	0	1000	1000	1000	0	40.00
X1 37000	0	0	0	1000	1000	1000	0	40.00
X1 38000	0	0	0	1000	1000	1000	0	40.00
[illegible]00	0	0	0	1000	1000	1000	0	40.00
[illegible]00	0	0	0	1000	1000	1000	0	40.00
[illegible]1000	0	0	0	1000	1000	1000	0	40.00
X1 42000	0	0	0	1000	1000	1000	0	40.00
X1 43000	0	0	0	1000	1000	1000	0	40.00
X1 44000	0	0	0	1000	1000	1000	0	40.00
X1 45000	0	0	0	1000	1000	1000	0	40.00
X1 46000	0	0	0	1000	1000	1000	0	40.00
X1 47000	0	0	0	1000	1000	1000	0	40.00
X1 48000	0	0	0	1000	1000	1000	0	40.00
X1 49000	0	0	0	1000	1000	1000	0	40.00
X1 50000	0	0	0	1000	1000	1000	0	40.00
X1 51000	0	0	0	1000	1000	1000	0	40.00
X1 52000	0	0	0	1000	1000	1000	0	40.00
X1 53000	0	0	0	1000	1000	1000	0	40.00
X1 54000	0	0	0	1000	1000	1000	0	40.00
X1 55000	0	0	0	1000	1000	1000	0	40.00
X1 56000	0	0	0	1000	1000	1000	0	40.00
X1 57000	0	0	0	1000	1000	1000	0	40.00
X1 58000	0	0	0	1000	1000	1000	0	40.00
X1 59000	0	0	0	1000	1000	1000	0	40.00
X1 60000	0	0	0	1000	1000	1000	0	40.00
X1 61000	0	0	0	1000	1000	1000	0	40.00
EJ								
ER								

```
**********************************************
*  HEC-2 WATER SURFACE PROFILES              *
*                                            *
   Version   4.6.0;  February 1991           *
                                             *
   RUN DATE    04JUN92    TIME   16:05:55    *
**********************************************
```

```
**************************************
*  U.S. ARMY CORPS OF ENGINEERS
*  HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616-4687
*         (916) 756-1104
**************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX  XXXXX              XXXXXXX
```

1

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   04JUN92      16:05:55                                                    PAGE    1
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                                                    THIS RUN EXECUTED 04JUN92    16:05:55
**************************************
   -2 WATER SURFACE PROFILES

  rsion   4.6.0;  February 1991
**************************************
```

```
T1      RANGE WASH WEST DIVERSION DIKE    LAS VEGAS,NV
T2      BOYLE ENGINEERING CORPORATION     DN N07 300 10
T3      01/28/92 100 YR PEAK, FAN TO 120' @ 0.5%, RNGB120.DAT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

        0         2         0         0      .005         0         0         0    238.00

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

        1         0        -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    150

NC      .022      .022      .022        .1        .3
QT         1      7050
**      7000         7         0       220         0         0         0         0         0
      244.91         0    244.91        40    234.91      69.9    234.91        70    234.91       190
      244.91       220    244.91     220.1

X1      7500         0         0         0       500       500       500         0      2.50
```

X1	8000	0	0	0	500	500	500	0	2.50
X1	8500	0	0	0	500	500	500	0	2.50
	9000	0	0	0	500	500	500	0	2.50
X1	9500	0	0	0	500	500	500	0	2.50
X1	10000	0	0	0	500	500	500	0	2.50
X1	10500	0	0	0	500	500	500	0	2.50
X1	11000	0	0	0	500	500	500	0	2.50
X1	11500	0	0	0	500	500	500	0	2.50
X1	12000	0	0	0	500	500	500	0	2.50

X1	12500	0	0	0	500	500	500	0	2.50
X1	13000	0	0	0	500	500	500	0	2.50
X1	13500	0	0	0	500	500	500	0	2.50
X1	14000	0	0	0	500	500	500	0	2.50
	14500	0	0	0	500	500	500	0	2.50
X1	15000	0	0	0	500	500	500	0	2.50
X1	15500	0	0	0	500	500	500	0	2.50
X1	16000	0	0	0	500	500	500	0	2.50
X1	16500	0	0	0	500	500	500	0	2.50
X1	17000	0	0	0	500	500	500	0	2.50
X1	17500	0	0	0	500	500	500	0	2.50
X1	18000	0	0	0	500	500	500	0	2.50
X1	18500	0	0	0	500	500	500	0	2.50
X1	19000	0	0	0	500	500	500	0	2.50
X1	19500	0	0	0	500	500	500	0	2.50
X1	20000	0	0	0	500	500	500	0	2.50
X1	20500	0	0	0	500	500	500	0	2.50
	21000	0	0	0	500	500	500	0	2.50
X1	21500	0	0	0	500	500	500	0	2.50

X1	22000	0	0	0	500	500	500	0	2.50
X1	22500	0	0	0	500	500	500	0	2.50
	23000	0	0	0	500	500	500	0	2.50
X1	23500	0	0	0	500	500	500	0	2.50
X1	24000	0	0	0	500	500	500	0	2.50

1

X1	24500	0	0	0	500	500	500	0	2.50
X1	25000	0	0	0	500	500	500	0	2.50
X1	25500	0	0	0	500	500	500	0	2.50
X1	26000	0	0	0	500	500	500	0	2.50
X1	26500	0	0	0	500	500	500	0	2.50
X1	27000	0	0	0	500	500	500	0	2.50
X1	27500	0	0	0	500	500	500	0	2.50
X1	28000	0	0	0	500	500	500	0	2.50
	28500	0	0	0	500	500	500	0	2.50
X1	29000	0	0	0	500	500	500	0	2.50
X1	29500	0	0	0	500	500	500	0	2.50
X1	30000	0	0	0	500	500	500	0	2.50
X1	30500	0	0	0	500	500	500	0	2.50
X1	31000	0	0	0	500	500	500	0	2.50
X1	31500	0	0	0	500	500	500	0	2.50
X1	32000	0	0	0	500	500	500	0	2.50
X1	32500	0	0	0	500	500	500	0	2.50
X1	33000	0	0	0	500	500	500	0	2.50
X1	33100	4	0	138.0	100	100	100	0	
GR	375.06	0	365.57	0.1	365.57	138	375.06	138.1	
X1	33200	4	0	156.0	100	100	100	0	
[illegible]	376.51	0	366.55	0.1	366.55	156	376.51	156.1	
	33300	4	0	175.0	100	100	100	0	
GR	377.26	0	367.84	0.1	367.84	175	377.26	175.1	
X1	33400	4	0	193.0	100	100	100	0	

GR	378.31	0	369.45	0.1	369.45	193	378.31	193.1	

1

X1	33500	4	0	211.0	100	100	100	0	
GR	380.66	0	371.39	0.1	371.39	211	380.66	211.1	
X1	33600	4	0	229.0	100	100	100	0	
GR	382.31	0	373.63	0.1	373.63	229	382.31	229.1	
X1	33700	4	0	247.0	100	100	100	0	
GR	384.26	0	376.20	0.1	376.20	247	384.26	247.1	
X1	33800	4	0	265.0	100	100	100	0	
GR	386.51	0	379.09	0.1	379.09	265	386.51	265.1	
X1	33900	4	0	284.0	100	100	100	0	
GR	389.06	0	382.29	0.1	382.29	284	389.06	284.1	
X1	34000	4	0	302.0	100	100	100	0	
GR	392.91	0	385.81	0.1	385.81	302	392.91	302.1	
X1	34100	4	0	320.0	100	100	100	0	
GR	392.91	0	389.65	0.1	389.65	320	392.91	320.1	
X1	35000	0	0	0	900	900	900	0	36.00
	36000	0	0	0	1000	1000	1000	0	40.00
...	37000	0	0	0	1000	1000	1000	0	40.00
X1	38000	0	0	0	1000	1000	1000	0	40.00
X1	39000	0	0	0	1000	1000	1000	0	40.00
X1	40000	0	0	0	1000	1000	1000	0	40.00
X1	41000	0	0	0	1000	1000	1000	0	40.00
X1	42000	0	0	0	1000	1000	1000	0	40.00
X1	43000	0	0	0	1000	1000	1000	0	40.00
X1	44000	0	0	0	1000	1000	1000	0	40.00
X1	45000	0	0	0	1000	1000	1000	0	40.00
X1	46000	0	0	0	1000	1000	1000	0	40.00
X1	47000	0	0	0	1000	1000	1000	0	40.00
X1	48000	0	0	0	1000	1000	1000	0	40.00

X1	49000	0	0	0	1000	1000	1000	0	40.00

X1	50000	0	0	0	1000	1000	1000	0	40.00
	51000	0	0	0	1000	1000	1000	0	40.00
	52000	0	0	0	1000	1000	1000	0	40.00
X1	53000	0	0	0	1000	1000	1000	0	40.00
X1	54000	0	0	0	1000	1000	1000	0	40.00
X1	55000	0	0	0	1000	1000	1000	0	40.00
X1	56000	0	0	0	1000	1000	1000	0	40.00
X1	57000	0	0	0	1000	1000	1000	0	40.00
X1	58000	0	0	0	1000	1000	1000	0	40.00
X1	59000	0	0	0	1000	1000	1000	0	40.00
X1	60000	0	0	0	1000	1000	1000	0	40.00
X1	61000	0	0	0	1000	1000	1000	0	40.00

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300

*SECNO 7000.000

3720 CRITICAL DEPTH ASSUMED

7000.000	4.56	239.47	239.47	238.00	241.54	2.07	.00	.00	244.91
7050.0	.0	7050.0	.0	.0	610.2	.0	.0	.0	244.91
.00	.00	11.55	.00	.000	.022	.000	.000	234.91	56.26
.004462	0.	0.	0.	0	11	0	.00	147.42	203.68

*SECNO 7500.000

7185 MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

7500.000	4.55	241.96	241.96	.00	244.04	2.09	2.24	.00	247.41
7050.0	.0	7050.0	.0	.0	608.3	.0	7.0	1.7	247.41
.01	.00	11.59	.00	.000	.022	.000	.000	237.41	56.30
.004505	500.	500.	500.	2	5	0	.00	147.35	203.65

*SECNO 8000.000

MINIMUM SPECIFIC ENERGY

CRITICAL DEPTH ASSUMED

8000.000	4.55	244.46	244.46	.00	246.54	2.08	2.25	.00	249.91
7050.0	.0	7050.0	.0	.0	608.7	.0	14.0	3.4	249.91
.02	.00	11.58	.00	.000	.022	.000	.000	239.91	56.29

.004495	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 8500.000
MINIMUM SPECIFIC ENERGY
CRITICAL DEPTH ASSUMED

8500.000	4.55	246.96	246.96	.00	249.04	2.08	2.25	.00	252.41
7050.0	.0	7050.0	.0	.0	608.6	.0	21.0	5.1	252.41
.04	.00	11.58	.00	.000	.022	.000	.000	242.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 9000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9000.000	4.55	249.46	249.46	.00	251.54	2.08	2.25	.00	254.91
7050.0	.0	7050.0	.0	.0	608.6	.0	27.9	6.8	254.91
.05	.00	11.58	.00	.000	.022	.000	.000	244.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 9500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9500.000	4.55	251.96	251.96	.00	254.04	2.08	2.25	.00	257.41
7050.0	.0	7050.0	.0	.0	608.6	.0	34.9	8.5	257.41
.06	.00	11.58	.00	.000	.022	.000	.000	247.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 10000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10000.000	4.55	254.46	254.46	.00	256.54	2.08	2.25	.00	259.91
7050.0	.0	7050.0	.0	.0	608.6	.0	41.9	10.1	259.91
.07	.00	11.58	.00	.000	.022	.000	.000	249.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 10500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10500.000	4.55	256.96	256.96	.00	259.04	2.08	2.25	.00	262.41
7050.0	.0	7050.0	.0	.0	608.6	.0	48.9	11.8	262.41
.08	.00	11.58	.00	.000	.022	.000	.000	252.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 11000.000
7185 MINIMUM SPECIFIC ENERGY

3720 CRITICAL DEPTH ASSUMED

11000.000	4.55	259.46	259.46	.00	261.54	2.08	2.25	.00	264.91
7050.0	.0	7050.0	.0	.0	608.6	.0	55.9	13.5	264.91
.10	.00	11.58	.00	.000	.022	.000	.000	254.91	56.29
004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 11500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11500.000	4.55	261.96	261.96	.00	264.04	2.08	2.25	.00	267.41
7050.0	.0	7050.0	.0	.0	608.6	.0	62.9	15.2	267.41
.11	.00	11.58	.00	.000	.022	.000	.000	257.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

00.000	4.55	264.46	264.46	.00	266.54	2.08	2.25	.00	269.91
7050.0	.0	7050.0	.0	.0	608.6	.0	69.9	16.9	269.91
.12	.00	11.58	.00	.000	.022	.000	.000	259.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 12500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12500.000	4.55	266.96	266.96	.00	269.04	2.08	2.25	.00	272.41
7050.0	.0	7050.0	.0	.0	608.6	.0	76.9	18.6	272.41
.13	.00	11.58	.00	.000	.022	.000	.000	262.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 13000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13000.000	4.55	269.46	269.46	.00	271.54	2.08	2.25	.00	274.91
7050.0	.0	7050.0	.0	.0	608.6	.0	83.8	20.3	274.91
.14	.00	11.58	.00	.000	.022	.000	.000	264.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 13500.000
7185 MINIMUM SPECIFIC ENERGY
CRITICAL DEPTH ASSUMED

00.000	4.55	271.96	271.96	.00	274.04	2.08	2.25	.00	277.41
7050.0	.0	7050.0	.0	.0	608.6	.0	90.8	22.0	277.41
.16	.00	11.58	.00	.000	.022	.000	.000	267.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 14000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14000.000	4.55	274.46	274.46	.00	276.54	2.08	2.25	.00	279.91
7050.0	.0	7050.0	.0	.0	608.6	.0	97.8	23.7	279.91
.17	.00	11.58	.00	.000	.022	.000	.000	269.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 14500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14500.000	4.55	276.96	276.96	.00	279.04	2.08	2.25	.00	282.41
7050.0	.0	7050.0	.0	.0	608.6	.0	104.8	25.4	282.41
.18	.00	11.58	.00	.000	.022	.000	.000	272.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

NO 15000.000
85 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15000.000	4.55	279.46	279.46	.00	281.54	2.08	2.25	.00	284.91
7050.0	.0	7050.0	.0	.0	608.6	.0	111.8	27.1	284.91
.19	.00	11.58	.00	.000	.022	.000	.000	274.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 15500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15500.000	4.55	281.96	281.96	.00	284.04	2.08	2.25	.00	287.41
7050.0	.0	7050.0	.0	.0	608.6	.0	118.8	28.8	287.41
.20	.00	11.58	.00	.000	.022	.000	.000	277.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 16000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16000.000	4.55	284.46	284.46	.00	286.54	2.08	2.25	.00	289.91
7050.0	.0	7050.0	.0	.0	608.6	.0	125.8	30.4	289.91
.22	.00	11.58	.00	.000	.022	.000	.000	279.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 16500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16500.000	4.55	286.96	286.96	.00	289.04	2.08	2.25	.00	292.41
7050.0	.0	7050.0	.0	.0	608.6	.0	132.7	32.1	292.41
.23	.00	11.58	.00	.000	.022	.000	.000	282.41	56.29
004497	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 17000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

17000.000	4.55	289.46	289.46	.00	291.54	2.08	2.25	.00	294.91
7050.0	.0	7050.0	.0	.0	608.6	.0	139.7	33.8	294.91
.24	.00	11.58	.00	.000	.022	.000	.000	284.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 17500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

17500.000	4.55	291.96	291.96	.00	294.04	2.08	2.25	.00	297.41
7050.0	.0	7050.0	.0	.0	608.6	.0	146.7	35.5	297.41
.25	.00	11.58	.00	.000	.022	.000	.000	287.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 18000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

18000.000	4.55	294.46	294.46	.00	296.54	2.08	2.25	.00	299.91
7050.0	.0	7050.0	.0	.0	608.6	.0	153.7	37.2	299.91
.26	.00	11.58	.00	.000	.022	.000	.000	289.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 18500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

18500.000	4.55	296.96	296.96	.00	299.04	2.08	2.25	.00	302.41
7050.0	.0	7050.0	.0	.0	608.6	.0	160.7	38.9	302.41
.28	.00	11.58	.00	.000	.022	.000	.000	292.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 19000.000
7185 MINIMUM SPECIFIC ENERGY
[illegible]0 CRITICAL DEPTH ASSUMED

[illegible]0.000	4.55	299.46	299.46	.00	301.54	2.08	2.25	.00	304.91
[illegible]050.0	.0	7050.0	.0	.0	608.6	.0	167.7	40.6	304.91
.29	.00	11.58	.00	.000	.022	.000	.000	294.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 19500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

19500.000	4.55	301.96	301.96	.00	304.04	2.08	2.25	.00	307.41
7050.0	.0	7050.0	.0	.0	608.6	.0	174.7	42.3	307.41
.30	.00	11.58	.00	.000	.022	.000	.000	297.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 20000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

20000.000	4.55	304.46	304.46	.00	306.54	2.08	2.25	.00	309.91
7050.0	.0	7050.0	.0	.0	608.6	.0	181.6	44.0	309.91
.31	.00	11.58	.00	.000	.022	.000	.000	299.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 20500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

20500.000	4.55	306.96	306.96	.00	309.04	2.08	2.25	.00	312.41
7050.0	.0	7050.0	.0	.0	608.6	.0	188.6	45.7	312.41
.32	.00	11.58	.00	.000	.022	.000	.000	302.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 21000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

21000.000	4.55	309.46	309.46	.00	311.54	2.08	2.25	.00	314.91
7050.0	.0	7050.0	.0	.0	608.6	.0	195.6	47.4	314.91
.34	.00	11.58	.00	.000	.022	.000	.000	304.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 21500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

21500.000	4.55	311.96	311.96	.00	314.04	2.08	2.25	.00	317.41
7050.0	.0	7050.0	.0	.0	608.6	.0	202.6	49.1	317.41
.35	.00	11.58	.00	.000	.022	.000	.000	307.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 22000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

22000.000	4.55	314.46	314.46	.00	316.54	2.08	2.25	.00	319.91
7050.0	.0	7050.0	.0	.0	608.6	.0	209.6	50.7	319.91
.36	.00	11.58	.00	.000	.022	.000	.000	309.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 22500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

22500.000	4.55	316.96	316.96	.00	319.04	2.08	2.25	.00	322.41
7050.0	.0	7050.0	.0	.0	608.6	.0	216.6	52.4	322.41
.37	.00	11.58	.00	.000	.022	.000	.000	312.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 23000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

23000.000	4.55	319.46	319.46	.00	321.54	2.08	2.25	.00	324.91
7050.0	.0	7050.0	.0	.0	608.6	.0	223.6	54.1	324.91
.38	.00	11.58	.00	.000	.022	.000	.000	314.91	56.29
004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 23500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

23500.000	4.55	321.96	321.96	.00	324.04	2.08	2.25	.00	327.41
7050.0	.0	7050.0	.0	.0	608.6	.0	230.5	55.8	327.41
.40	.00	11.58	.00	.000	.022	.000	.000	317.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 24000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

24000.000	4.55	324.46	324.46	.00	326.54	2.08	2.25	.00	329.91
7050.0	.0	7050.0	.0	.0	608.6	.0	237.5	57.5	329.91
.41	.00	11.58	.00	.000	.022	.000	.000	319.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 24500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

0.000	4.55	326.96	326.96	.00	329.04	2.08	2.25	.00	332.41
7050.0	.0	7050.0	.0	.0	608.6	.0	244.5	59.2	332.41
.42	.00	11.58	.00	.000	.022	.000	.000	322.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 25000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

25000.000	4.55	329.46	329.46	.00	331.54	2.08	2.25	.00	334.91
7050.0	.0	7050.0	.0	.0	608.6	.0	251.5	60.9	334.91
.43	.00	11.58	.00	.000	.022	.000	.000	324.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 25500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

25500.000	4.55	331.96	331.96	.00	334.04	2.08	2.25	.00	337.41
7050.0	.0	7050.0	.0	.0	608.6	.0	258.5	62.6	337.41
.44	.00	11.58	.00	.000	.022	.000	.000	327.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 26000.000
MINIMUM SPECIFIC ENERGY
CRITICAL DEPTH ASSUMED

26000.000	4.55	334.46	334.46	.00	336.54	2.08	2.25	.00	339.91
7050.0	.0	7050.0	.0	.0	608.6	.0	265.5	64.3	339.91
.46	.00	11.58	.00	.000	.022	.000	.000	329.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 26500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

26500.000	4.55	336.96	336.96	.00	339.04	2.08	2.25	.00	342.41
7050.0	.0	7050.0	.0	.0	608.6	.0	272.5	66.0	342.41
.47	.00	11.58	.00	.000	.022	.000	.000	332.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 27000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

27000.000	4.55	339.46	339.46	.00	341.54	2.08	2.25	.00	344.91

7050.0	.0	7050.0	.0	.0	608.6	.0	279.4	67.7	344.91
.48	.00	11.58	.00	.000	.022	.000	.000	334.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

SECNO 27500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

27500.000	4.55	341.96	341.96	.00	344.04	2.08	2.25	.00	347.41
7050.0	.0	7050.0	.0	.0	608.6	.0	286.4	69.4	347.41
.49	.00	11.58	.00	.000	.022	.000	.000	337.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 28000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

28000.000	4.55	344.46	344.46	.00	346.54	2.08	2.25	.00	349.91
7050.0	.0	7050.0	.0	.0	608.6	.0	293.4	71.0	349.91
.50	.00	11.58	.00	.000	.022	.000	.000	339.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 28500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

28500.000	4.55	346.96	346.96	.00	349.04	2.08	2.25	.00	352.41
7050.0	.0	7050.0	.0	.0	608.6	.0	300.4	72.7	352.41
.52	.00	11.58	.00	.000	.022	.000	.000	342.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 29000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

29000.000	4.55	349.46	349.46	.00	351.54	2.08	2.25	.00	354.91
7050.0	.0	7050.0	.0	.0	608.6	.0	307.4	74.4	354.91
.53	.00	11.58	.00	.000	.022	.000	.000	344.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 29500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

29500.000	4.55	351.96	351.96	.00	354.04	2.08	2.25	.00	357.41
7050.0	.0	7050.0	.0	.0	608.6	.0	314.4	76.1	357.41
.54	.00	11.58	.00	.000	.022	.000	.000	347.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 30000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

30000.000	4.55	354.46	354.46	.00	356.54	2.08	2.25	.00	359.91
7050.0	.0	7050.0	.0	.0	608.6	.0	321.4	77.8	359.91
.55	.00	11.58	.00	.000	.022	.000	.000	349.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 30500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

30500.000	4.55	356.96	356.96	.00	359.04	2.08	2.25	.00	362.41
7050.0	.0	7050.0	.0	.0	608.6	.0	328.3	79.5	362.41
.56	.00	11.58	.00	.000	.022	.000	.000	352.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 31000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

31000.000	4.55	359.46	359.46	.00	361.54	2.08	2.25	.00	364.91
7050.0	.0	7050.0	.0	.0	608.6	.0	335.3	81.2	364.91
.58	.00	11.58	.00	.000	.022	.000	.000	354.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 31500.000
7185 MINIMUM SPECIFIC ENERGY
CRITICAL DEPTH ASSUMED

31500.000	4.55	361.96	361.96	.00	364.04	2.08	2.25	.00	367.41
7050.0	.0	7050.0	.0	.0	608.6	.0	342.3	82.9	367.41
.59	.00	11.58	.00	.000	.022	.000	.000	357.41	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 32000.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

32000.000	4.55	364.46	364.46	.00	366.54	2.08	2.25	.00	369.91
7050.0	.0	7050.0	.0	.0	608.6	.0	349.3	84.6	369.91
.60	.00	11.58	.00	.000	.022	.000	.000	359.91	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

IO 32500.000
MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

32500.000	4.55	366.96	366.96	.00	369.04	2.08	2.25	.00	372.41
7050.0	.0	7050.0	.0	.0	608.6	.0	356.3	86.3	372.41

.61	.00	11.58	.00	.000	.022	.000	.000	362.41	56.29
.004498	500.	500.	500.	2	5	0	.00	147.36	203.65

CNO 33000.000
.185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33000.000	4.55	369.46	369.46	.00	371.54	2.08	2.25	.00	374.91
7050.0	.0	7050.0	.0	.0	608.6	.0	363.3	88.0	374.91
.62	.00	11.58	.00	.000	.022	.000	.000	364.91	56.29
.004497	500.	500.	500.	2	5	0	.00	147.36	203.65

*SECNO 33100.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33100.000	4.33	369.90	369.90	.00	372.06	2.16	.45	.02	375.06
7050.0	.0	7050.0	.0	.0	597.2	.1	364.7	88.3	365.57
.63	.00	11.81	.05	.000	.022	.022	.000	365.57	.05
.004509	100.	100.	100.	2	8	0	.00	137.99	138.05

*SECNO 33200.000

33200.000	3.98	370.53	370.52	.00	372.54	2.01	.46	.02	376.51
7050.0	.0	7050.0	.0	.0	620.4	.1	366.1	88.6	366.55
.63	.00	11.36	.05	.000	.022	.022	.000	366.55	.06
.004641	100.	100.	100.	2	11	0	.00	155.98	156.04

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 33300.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33300.000	3.68	371.52	371.52	.00	373.38	1.86	.47	.01	377.26
7050.0	.0	7050.0	.0	.0	643.9	.1	367.5	89.0	367.84
.63	.00	10.95	.05	.000	.022	.022	.000	367.84	.06
.004751	100.	100.	100.	20	11	0	.00	174.98	175.04

*SECNO 33400.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33400.000	3.45	372.90	372.90	.00	374.64	1.74	.48	.01	378.31
7050.0	.0	7050.0	.0	.0	665.4	.1	369.0	89.4	369.45
.63	.00	10.59	.05	.000	.022	.022	.000	369.45	.06
J04832	100.	100.	100.	20	11	0	.00	192.98	193.04

*SECNO 33500.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

***500.000	3.26	374.65	374.65	.00	376.28	1.63	.48	.01	380.66
050.0	.0	7050.0	.0	.0	688.3	.1	370.6	89.9	371.39
.64	.00	10.24	.05	.000	.022	.022	.000	371.39	.06
.004849	100.	100.	100.	20	8	0	.00	210.97	211.04

*SECNO 33600.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33600.000	3.09	376.72	376.72	.00	378.26	1.54	.49	.01	382.31
7050.0	.0	7050.0	.0	.0	707.2	.1	372.2	90.4	373.63
.64	.00	9.97	.05	.000	.022	.022	.000	373.63	.06
.004928	100.	100.	100.	20	8	0	.00	228.97	229.04

*SECNO 33700.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
`LOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3720 CRITICAL DEPTH ASSUMED

33700.000	2.94	379.14	379.14	.00	380.60	1.47	.50	.01	384.26
7050.0	.0	7050.0	.0	.0	725.1	.1	373.8	90.9	376.20
.64	.00	9.72	.05	.000	.022	.022	.000	376.20	.06
.005005	100.	100.	100.	20	8	0	.00	246.97	247.04

*SECNO 33800.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33800.000	2.80	381.89	381.89	.00	383.29	1.40	.50	.01	386.51
7050.0	.0	7050.0	.0	.0	742.2	.1	375.5	91.5	379.09
.64	.00	9.50	.05	.000	.022	.022	.000	379.09	.06
.005076	100.	100.	100.	20	8	0	.00	264.98	265.04

*SECNO 33900.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

33900.000	2.67	384.96	384.96	.00	386.30	1.34	.51	.01	389.06
7050.0	.0	7050.0	.0	.0	759.5	.1	377.2	92.2	382.29
.65	.00	9.28	.05	.000	.022	.022	.000	382.29	.06
J05150	100.	100.	100.	20	8	0	.00	283.98	284.04

*SECNO 34000.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7[illegible]000.000	2.57	388.38	388.38	.00	389.66	1.29	.52	.01	392.91
'050.0	.0	7050.0	.0	.0	774.9	.0	379.0	92.8	385.81
.65	.00	9.10	.05	.000	.022	.022	.000	385.81	.06
.005221	100.	100.	100.	20	8	0	.00	301.97	302.04

*SECNO 34100.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

34100.000	2.47	392.12	392.12	.00	393.36	1.24	.53	.00	392.91
7050.0	.0	7050.0	.0	.0	790.0	.1	380.8	93.5	389.65
.65	.00	8.92	.05	.000	.022	.022	.000	389.65	.02
.005283	100.	100.	100.	20	8	0	.00	320.05	320.08

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

'NO 35000.000
20 TRIALS ATTEMPTED WSEL,CWSEL
[illegible]3 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

35000.000	2.46	428.11	428.11	.00	429.36	1.24	4.78	.00	428.91
7050.0	.0	7050.0	.0	.0	787.9	.1	397.1	100.2	425.65
.68	.00	8.95	.05	.000	.022	.022	.000	425.65	.02
.005330	900.	900.	900.	20	5	0	.00	320.05	320.08

*SECNO 36000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

36000.000	2.46	468.11	468.11	.00	469.36	1.24	5.32	.00	468.91
7050.0	.0	7050.0	.0	.0	788.5	.1	415.2	107.5	465.65
.71	.00	8.94	.05	.000	.022	.022	.000	465.65	.02
.005316	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 37000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37000.000	2.46	508.11	508.11	.00	509.36	1.24	5.32	.00	508.91
7050.0	.0	7050.0	.0	.0	788.2	.1	433.3	114.9	505.65
.74	.00	8.94	.05	.000	.022	.022	.000	505.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 38000.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

38000.000	2.46	548.11	548.11	.00	549.36	1.24	5.32	.00	548.91
7050.0	.0	7050.0	.0	.0	788.2	.1	451.4	122.2	545.65
.77	.00	8.94	.05	.000	.022	.022	.000	545.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 39000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3720 CRITICAL DEPTH ASSUMED

39000.000	2.46	588.11	588.11	.00	589.36	1.24	5.32	.00	588.91
7050.0	.0	7050.0	.0	.0	788.2	.1	469.5	129.5	585.65
.81	.00	8.94	.05	.000	.022	.022	.000	585.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 40000.000
20 TRIALS ATTEMPTED WSEL,CWSEL
3 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

40000.000	2.46	628.11	628.11	.00	629.36	1.24	5.32	.00	628.91
7050.0	.0	7050.0	.0	.0	788.2	.1	487.6	136.9	625.65
.84	.00	8.94	.05	.000	.022	.022	.000	625.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 41000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

41000.000	2.46	668.11	668.11	.00	669.36	1.24	5.32	.00	668.91
7050.0	.0	7050.0	.0	.0	788.2	.1	505.7	144.2	665.65
.87	.00	8.94	.05	.000	.022	.022	.000	665.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 42000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

42000.000	2.46	708.11	708.11	.00	709.36	1.24	5.32	.00	708.91
7050.0	.0	7050.0	.0	.0	788.2	.1	523.8	151.6	705.65
.90	.00	8.94	.05	.000	.022	.022	.000	705.65	.02
.05323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 43000.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

43000.000	2.46	748.11	748.11	.00	749.36	1.24	5.32	.00	748.91
7050.0	.0	7050.0	.0	.0	788.2	.1	541.9	158.9	745.65
.93	.00	8.94	.05	.000	.022	.022	.000	745.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 44000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

44000.000	2.46	788.11	788.11	.00	789.36	1.24	5.32	.00	788.91
7050.0	.0	7050.0	.0	.0	788.2	.1	560.0	166.3	785.65
.96	.00	8.94	.05	.000	.022	.022	.000	785.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 45000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

45000.000	2.46	828.11	828.11	.00	829.36	1.24	5.32	.00	828.91
7050.0	.0	7050.0	.0	.0	788.2	.1	578.1	173.6	825.65
.99	.00	8.94	.05	.000	.022	.022	.000	825.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 46000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

46000.000	2.46	868.11	868.11	.00	869.36	1.24	5.32	.00	868.91
7050.0	.0	7050.0	.0	.0	788.2	.1	596.1	181.0	865.65
1.02	.00	8.94	.05	.000	.022	.022	.000	865.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 47000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

47000.000	2.46	908.11	908.11	.00	909.36	1.24	5.32	.00	908.91
7050.0	.0	7050.0	.0	.0	788.2	.1	614.2	188.3	905.65
1.05	.00	8.94	.05	.000	.022	.022	.000	905.65	.02
005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 48000.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3720 CRITICAL DEPTH ASSUMED

48000.000	2.46	948.11	948.11	.00	949.36	1.24	5.32	.00	948.91
7050.0	.0	7050.0	.0	.0	788.2	.1	632.3	195.7	945.65
1.09	.00	8.94	.05	.000	.022	.022	.000	945.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 49000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

49000.000	2.46	988.11	988.11	.00	989.36	1.24	5.32	.00	988.91
7050.0	.0	7050.0	.0	.0	788.2	.1	650.4	203.0	985.65
1.12	.00	8.94	.05	.000	.022	.022	.000	985.65	.02
.005323	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

NO 50000.000
20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

50000.000	2.47	1028.12	1028.12	.00	1029.36	1.24	5.32	.00	1028.91
7050.0	.0	7050.0	.0	.0	788.7	.1	668.5	210.4	1025.65
1.15	.00	8.94	.05	.000	.022	.022	.000	1025.65	.02
.005312	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 51000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

51000.000	2.46	1068.11	1068.11	.00	1069.36	1.24	5.32	.00	1068.91
7050.0	.0	7050.0	.0	.0	788.1	.1	686.6	217.7	1065.65
1.18	.00	8.95	.05	.000	.022	.022	.000	1065.65	.02
.005326	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 52000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

52000.000	2.46	1108.11	1108.11	.00	1109.36	1.24	5.32	.00	1108.91
7050.0	.0	7050.0	.0	.0	788.4	.1	704.7	225.1	1105.65
1.21	.00	8.94	.05	.000	.022	.022	.000	1105.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 53000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

53000.000	2.46	1148.11	1148.11	.00	1149.36	1.24	5.32	.00	1148.91
7050.0	.0	7050.0	.0	.0	788.4	.1	722.8	232.4	1145.65
1.24	.00	8.94	.05	.000	.022	.022	.000	1145.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 54000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

54000.000	2.46	1188.11	1188.11	.00	1189.36	1.24	5.32	.00	1188.91
7050.0	.0	7050.0	.0	.0	788.4	.1	740.9	239.8	1185.65
1.27	.00	8.94	.05	.000	.022	.022	.000	1185.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

NO 55000.000
20 TRIALS ATTEMPTED WSEL,CWSEL
PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

55000.000	2.46	1228.11	1228.11	.00	1229.36	1.24	5.32	.00	1228.91
7050.0	.0	7050.0	.0	.0	788.4	.1	759.0	247.1	1225.65
1.30	.00	8.94	.05	.000	.022	.022	.000	1225.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 56000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

56000.000	2.46	1268.11	1268.11	.00	1269.36	1.24	5.32	.00	1268.91
7050.0	.0	7050.0	.0	.0	788.4	.1	777.1	254.5	1265.65
1.33	.00	8.94	.05	.000	.022	.022	.000	1265.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 57000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY

ECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3720 CRITICAL DEPTH ASSUMED

57000.000	2.46	1308.11	1308.11	.00	1309.36	1.24	5.32	.00	1308.91
7050.0	.0	7050.0	.0	.0	788.4	.1	795.2	261.8	1305.65
1.37	.00	8.94	.05	.000	.022	.022	.000	1305.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 58000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

58000.000	2.46	1348.11	1348.11	.00	1349.36	1.24	5.32	.00	1348.91
7050.0	.0	7050.0	.0	.0	788.4	.1	813.4	269.1	1345.65
1.40	.00	8.94	.05	.000	.022	.022	.000	1345.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 59000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

59000.000	2.46	1388.11	1388.11	.00	1389.36	1.24	5.32	.00	1388.91
7050.0	.0	7050.0	.0	.0	788.4	.1	831.5	276.5	1385.65
1.43	.00	8.94	.05	.000	.022	.022	.000	1385.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*NO 60000.000
20 TRIALS ATTEMPTED WSEL,CWSEL
PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

60000.000	2.46	1428.11	1428.11	.00	1429.36	1.24	5.32	.00	1428.91
7050.0	.0	7050.0	.0	.0	788.4	.1	849.6	283.8	1425.65
1.46	.00	8.94	.05	.000	.022	.022	.000	1425.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

*SECNO 61000.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

61000.000	2.46	1468.11	1468.11	.00	1469.36	1.24	5.32	.00	1468.91
7050.0	.0	7050.0	.0	.0	788.4	.1	867.7	291.2	1465.65
1.49	.00	8.94	.05	.000	.022	.022	.000	1465.65	.02
.005319	1000.	1000.	1000.	20	5	0	.00	320.05	320.08

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THIS RUN EXECUTED 04JUN92 16:05:58

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..-2 WATER SURFACE PROFILES

Version 4.6.0; February 1991

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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

01/28/92 100 YR PEAK, FA

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
•	7000.000	.00	.00	.00	234.91	7050.00	239.47	239.47	241.54	44.62	11.55	610.16	1055.4
*	7500.000	500.00	.00	.00	237.41	7050.00	241.96	241.96	244.04	45.05	11.59	608.28	1050.3
•	8000.000	500.00	.00	.00	239.91	7050.00	244.46	244.46	246.54	44.95	11.58	608.70	1051.4
*	8500.000	500.00	.00	.00	242.41	7050.00	246.96	246.96	249.04	44.98	11.58	608.61	1051.2
*	9000.000	500.00	.00	.00	244.91	7050.00	249.46	249.46	251.54	44.97	11.58	608.64	1051.3
•	9500.000	500.00	.00	.00	247.41	7050.00	251.96	251.96	254.04	44.97	11.58	608.64	1051.3
•	10000.000	500.00	.00	.00	249.91	7050.00	254.46	254.46	256.54	44.98	11.58	608.57	1051.1
•	10500.000	500.00	.00	.00	252.41	7050.00	256.96	256.96	259.04	44.97	11.58	608.64	1051.3
	1000.000	500.00	.00	.00	254.91	7050.00	259.46	259.46	261.54	44.98	11.58	608.58	1051.1
	.1500.000	500.00	.00	.00	257.41	7050.00	261.96	261.96	264.04	44.98	11.58	608.60	1051.2
•	12000.000	500.00	.00	.00	259.91	7050.00	264.46	264.46	266.54	44.97	11.58	608.64	1051.3
*	12500.000	500.00	.00	.00	262.41	7050.00	266.96	266.96	269.04	44.98	11.58	608.58	1051.1
*	13000.000	500.00	.00	.00	264.91	7050.00	269.46	269.46	271.54	44.98	11.58	608.60	1051.2
•	13500.000	500.00	.00	.00	267.41	7050.00	271.96	271.96	274.04	44.97	11.58	608.64	1051.3
•	14000.000	500.00	.00	.00	269.91	7050.00	274.46	274.46	276.54	44.98	11.58	608.58	1051.1
•	14500.000	500.00	.00	.00	272.41	7050.00	276.96	276.96	279.04	44.98	11.58	608.60	1051.2
•	15000.000	500.00	.00	.00	274.91	7050.00	279.46	279.46	281.54	44.97	11.58	608.64	1051.3

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
•	15500.000	500.00	.00	.00	277.41	7050.00	281.96	281.96	284.04	44.98	11.58	608.58	1051.1
	000.000	500.00	.00	.00	279.91	7050.00	284.46	284.46	286.54	44.98	11.58	608.60	1051.2
	16500.000	500.00	.00	.00	282.41	7050.00	286.96	286.96	289.04	44.97	11.58	608.64	1051.3
•	17000.000	500.00	.00	.00	284.91	7050.00	289.46	289.46	291.54	44.98	11.58	608.58	1051.1

17500.000	500.00	.00	.00	287.41	7050.00	291.96	291.96	294.04	44.98	11.58	608.60	1051.2
18000.000	500.00	.00	.00	289.91	7050.00	294.46	294.46	296.54	44.97	11.58	608.64	1051.3
18500.000	500.00	.00	.00	292.41	7050.00	296.96	296.96	299.04	44.98	11.58	608.58	1051.1
19000.000	500.00	.00	.00	294.91	7050.00	299.46	299.46	301.54	44.98	11.58	608.60	1051.2
19500.000	500.00	.00	.00	297.41	7050.00	301.96	301.96	304.04	44.97	11.58	608.64	1051.3
20000.000	500.00	.00	.00	299.91	7050.00	304.46	304.46	306.54	44.98	11.58	608.58	1051.1
20500.000	500.00	.00	.00	302.41	7050.00	306.96	306.96	309.04	44.98	11.58	608.60	1051.2
21000.000	500.00	.00	.00	304.91	7050.00	309.46	309.46	311.54	44.97	11.58	608.64	1051.3
21500.000	500.00	.00	.00	307.41	7050.00	311.96	311.96	314.04	44.98	11.58	608.58	1051.1
22000.000	500.00	.00	.00	309.91	7050.00	314.46	314.46	316.54	44.98	11.58	608.60	1051.2
22500.000	500.00	.00	.00	312.41	7050.00	316.96	316.96	319.04	44.97	11.58	608.64	1051.3
23000.000	500.00	.00	.00	314.91	7050.00	319.46	319.46	321.54	44.98	11.58	608.58	1051.1
23500.000	500.00	.00	.00	317.41	7050.00	321.96	321.96	324.04	44.98	11.58	608.60	1051.2
24000.000	500.00	.00	.00	319.91	7050.00	324.46	324.46	326.54	44.97	11.58	608.64	1051.3
24500.000	500.00	.00	.00	322.41	7050.00	326.96	326.96	329.04	44.98	11.58	608.58	1051.1
25000.000	500.00	.00	.00	324.91	7050.00	329.46	329.46	331.54	44.98	11.58	608.60	1051.2
25500.000	500.00	.00	.00	327.41	7050.00	331.96	331.96	334.04	44.97	11.58	608.64	1051.3
26000.000	500.00	.00	.00	329.91	7050.00	334.46	334.46	336.54	44.98	11.58	608.58	1051.1
26500.000	500.00	.00	.00	332.41	7050.00	336.96	336.96	339.04	44.98	11.58	608.60	1051.2
27000.000	500.00	.00	.00	334.91	7050.00	339.46	339.46	341.54	44.97	11.58	608.64	1051.3
27500.000	500.00	.00	.00	337.41	7050.00	341.96	341.96	344.04	44.98	11.58	608.58	1051.1
28000.000	500.00	.00	.00	339.91	7050.00	344.46	344.46	346.54	44.98	11.58	608.60	1051.2

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
28500.000	500.00	.00	.00	342.41	7050.00	346.96	346.96	349.04	44.97	11.58	608.64	1051.3
29000.000	500.00	.00	.00	344.91	7050.00	349.46	349.46	351.54	44.98	11.58	608.58	1051.1
29500.000	500.00	.00	.00	347.41	7050.00	351.96	351.96	354.04	44.98	11.58	608.60	1051.2
30000.000	500.00	.00	.00	349.91	7050.00	354.46	354.46	356.54	44.97	11.58	608.64	1051.3
30500.000	500.00	.00	.00	352.41	7050.00	356.96	356.96	359.04	44.98	11.58	608.58	1051.1

* 31000.000	500.00	.00	.00	354.91	7050.00	359.46	359.46	361.54	44.98	11.58	608.60	1051.2
* 31500.000	500.00	.00	.00	357.41	7050.00	361.96	361.96	364.04	44.97	11.58	608.64	1051.3
32000.000	500.00	.00	.00	359.91	7050.00	364.46	364.46	366.54	44.98	11.58	608.58	1051.1
* 32500.000	500.00	.00	.00	362.41	7050.00	366.96	366.96	369.04	44.98	11.58	608.60	1051.2
* 33000.000	500.00	.00	.00	364.91	7050.00	369.46	369.46	371.54	44.97	11.58	608.64	1051.3
* 33100.000	100.00	.00	.00	365.57	7050.00	369.90	369.90	372.06	45.09	11.81	597.30	1049.9
33200.000	100.00	.00	.00	366.55	7050.00	370.53	370.52	372.54	46.41	11.36	620.48	1034.8
* 33300.000	100.00	.00	.00	367.84	7050.00	371.52	371.52	373.38	47.51	10.95	644.01	1022.8
* 33400.000	100.00	.00	.00	369.45	7050.00	372.90	372.90	374.64	48.32	10.59	665.51	1014.1
* 33500.000	100.00	.00	.00	371.39	7050.00	374.65	374.65	376.28	48.49	10.24	688.33	1012.4
* 33600.000	100.00	.00	.00	373.63	7050.00	376.72	376.72	378.26	49.28	9.97	707.24	1004.2
* 33700.000	100.00	.00	.00	376.20	7050.00	379.14	379.14	380.60	50.05	9.72	725.14	996.5
* 33800.000	100.00	.00	.00	379.09	7050.00	381.89	381.89	383.29	50.76	9.50	742.29	989.5
* 33900.000	100.00	.00	.00	382.29	7050.00	384.96	384.96	386.30	51.50	9.28	759.52	982.4
34000.000	100.00	.00	.00	385.81	7050.00	388.38	388.38	389.66	52.21	9.10	774.95	975.7
34100.000	100.00	.00	.00	389.65	7050.00	392.12	392.12	393.36	52.83	8.92	790.10	969.9
* 35000.000	900.00	.00	.00	425.65	7050.00	428.11	428.11	429.36	53.30	8.95	787.97	965.6
* 36000.000	1000.00	.00	.00	465.65	7050.00	468.11	468.11	469.36	53.16	8.94	788.63	966.9
* 37000.000	1000.00	.00	.00	505.65	7050.00	508.11	508.11	509.36	53.23	8.94	788.32	966.3
* 38000.000	1000.00	.00	.00	545.65	7050.00	548.11	548.11	549.36	53.23	8.94	788.32	966.3
* 39000.000	1000.00	.00	.00	585.65	7050.00	588.11	588.11	589.36	53.23	8.94	788.32	966.3

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SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
* 40000.000	1000.00	.00	.00	625.65	7050.00	628.11	628.11	629.36	53.23	8.94	788.32	966.3
* 41000.000	1000.00	.00	.00	665.65	7050.00	668.11	668.11	669.36	53.23	8.94	788.32	966.3
* 42000.000	1000.00	.00	.00	705.65	7050.00	708.11	708.11	709.36	53.23	8.94	788.32	966.3
43000.000	1000.00	.00	.00	745.65	7050.00	748.11	748.11	749.36	53.23	8.94	788.32	966.3
* 44000.000	1000.00	.00	.00	785.65	7050.00	788.11	788.11	789.36	53.23	8.94	788.32	966.3
* 45000.000	1000.00	.00	.00	825.65	7050.00	828.11	828.11	829.36	53.23	8.94	788.32	966.3

* 46000.000	1000.00	.00	.00	865.65	7050.00	868.11	868.11	869.36	53.23	8.94	788.32	966.3
* 47000.000	1000.00	.00	.00	905.65	7050.00	908.11	908.11	909.36	53.23	8.94	788.32	966.3
48000.000	1000.00	.00	.00	945.65	7050.00	948.11	948.11	949.36	53.23	8.94	788.32	966.3
* 49000.000	1000.00	.00	.00	985.65	7050.00	988.11	988.11	989.36	53.23	8.94	788.32	966.3
* 50000.000	1000.00	.00	.00	1025.65	7050.00	1028.12	1028.12	1029.36	53.12	8.94	788.81	967.3
* 51000.000	1000.00	.00	.00	1065.65	7050.00	1068.11	1068.11	1069.36	53.26	8.95	788.18	966.0
* 52000.000	1000.00	.00	.00	1105.65	7050.00	1108.11	1108.11	1109.36	53.19	8.94	788.49	966.6
* 53000.000	1000.00	.00	.00	1145.65	7050.00	1148.11	1148.11	1149.36	53.19	8.94	788.49	966.6
* 54000.000	1000.00	.00	.00	1185.65	7050.00	1188.11	1188.11	1189.36	53.19	8.94	788.49	966.6
* 55000.000	1000.00	.00	.00	1225.65	7050.00	1228.11	1228.11	1229.36	53.19	8.94	788.49	966.6
* 56000.000	1000.00	.00	.00	1265.65	7050.00	1268.11	1268.11	1269.36	53.19	8.94	788.49	966.6
* 57000.000	1000.00	.00	.00	1305.65	7050.00	1308.11	1308.11	1309.36	53.19	8.94	788.49	966.6
* 58000.000	1000.00	.00	.00	1345.65	7050.00	1348.11	1348.11	1349.36	53.19	8.94	788.49	966.6
* 59000.000	1000.00	.00	.00	1385.65	7050.00	1388.11	1388.11	1389.36	53.19	8.94	788.49	966.6
60000.000	1000.00	.00	.00	1425.65	7050.00	1428.11	1428.11	1429.36	53.19	8.94	788.49	966.6
61000.000	1000.00	.00	.00	1465.65	7050.00	1468.11	1468.11	1469.36	53.19	8.94	788.49	966.6

01/28/92 100 YR PEAK, FA

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	7000.000	7050.00	239.47	.00	.00	1.47	147.42	.00
*	7500.000	7050.00	241.96	.00	2.49	.00	147.35	500.00
*	8000.000	7050.00	244.46	.00	2.50	.00	147.36	500.00
*	8500.000	7050.00	246.96	.00	2.50	.00	147.36	500.00
*	9000.000	7050.00	249.46	.00	2.50	.00	147.36	500.00
*	9500.000	7050.00	251.96	.00	2.50	.00	147.36	500.00
	000.000	7050.00	254.46	.00	2.50	.00	147.36	500.00
*	10500.000	7050.00	256.96	.00	2.50	.00	147.36	500.00

*	11000.000	7050.00	259.46	.00	2.50	.00	147.36	500.00
*	11500.000	7050.00	261.96	.00	2.50	.00	147.36	500.00
	2000.000	7050.00	264.46	.00	2.50	.00	147.36	500.00
*	12500.000	7050.00	266.96	.00	2.50	.00	147.36	500.00
*	13000.000	7050.00	269.46	.00	2.50	.00	147.36	500.00
*	13500.000	7050.00	271.96	.00	2.50	.00	147.36	500.00
*	14000.000	7050.00	274.46	.00	2.50	.00	147.36	500.00
*	14500.000	7050.00	276.96	.00	2.50	.00	147.36	500.00
*	15000.000	7050.00	279.46	.00	2.50	.00	147.36	500.00
*	15500.000	7050.00	281.96	.00	2.50	.00	147.36	500.00
*	16000.000	7050.00	284.46	.00	2.50	.00	147.36	500.00
*	16500.000	7050.00	286.96	.00	2.50	.00	147.36	500.00
*	17000.000	7050.00	289.46	.00	2.50	.00	147.36	500.00
*	17500.000	7050.00	291.96	.00	2.50	.00	147.36	500.00
*	18000.000	7050.00	294.46	.00	2.50	.00	147.36	500.00
	8500.000	7050.00	296.96	.00	2.50	.00	147.36	500.00

1

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	19000.000	7050.00	299.46	.00	2.50	.00	147.36	500.00
*	19500.000	7050.00	301.96	.00	2.50	.00	147.36	500.00
*	20000.000	7050.00	304.46	.00	2.50	.00	147.36	500.00
*	20500.000	7050.00	306.96	.00	2.50	.00	147.36	500.00
*	21000.000	7050.00	309.46	.00	2.50	.00	147.36	500.00
*	21500.000	7050.00	311.96	.00	2.50	.00	147.36	500.00
*	22000.000	7050.00	314.46	.00	2.50	.00	147.36	500.00
*	22500.000	7050.00	316.96	.00	2.50	.00	147.36	500.00
*	23000.000	7050.00	319.46	.00	2.50	.00	147.36	500.00
	3500.000	7050.00	321.96	.00	2.50	.00	147.36	500.00
*	24000.000	7050.00	324.46	.00	2.50	.00	147.36	500.00

DIKE HEIGHT COMPUTATION

The height of the dike was determined by the sum of the following components:

o	Deposition	=	5.6 feet
o	Depth of flow	=	4.4 feet
o	Velocity head	=	2.3 feet
o	Freeboard	=	3 feet
	Total Dike Height	=	15.3 feet

This represents the most conservative combination of all of the factors together. It presumes that the entire deposition has occurred along the toe of the dike. Because of the horizontal transition, it is likely that this deposition will occur at some distance remote from the dike and at the dike the deposition is likely to be substantially less. Once again, limitations of the HEC-6 model render it unable to determine the form of the horizontal transition. Therefore, for the purpose of computation, we have assumed that the actual flow is in a straight alignment and that all deposition would occur at the toe of the dike. This is a conservative assumption.

We have evaluated the impact of alluvial fan flows striking the dike at a 90^{o} angle. The effect of fan flows impacting the dike perpendicular to its alignment is not the most critical assumption. As identified in the HEC-2 computation, the total energy head of fan flows is approximately 5.8 feet. The total energy head of flows along the dike is 6.6 feet. This indicates that more energy is required to force flows in a longitudinal direction along the dike than to drive flows down the fan. The total energy head of 6.6 feet used in the dike height determination allows for the water

to develop sufficient head to drive it in the downstream direction. Once again, this is an extremely conservative assumption in that the channel width and required energy head is likely to be less at the location of maximum deposition.

In addition to the degree of conservatism associated with the deposition computation and the total energy head computation, a three-foot freeboard is superimposed on those values to reflect FEMA freeboard for levee systems. The combination of this freeboard with the conservative estimates of energy head and deposition result in a dike of sufficient height to meet FEMA requirements.

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

ADDENDUM NO. 2
ADDITIONAL SLOPE STABILITY ANALYSIS
RANGE WASH FLOOD CONTROL PROJECT
NORTH LAS VEGAS, NEVADA

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33298-02

June 22, 1992

Converse Consultants Southwest, Inc.
4870 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

June 22, 1992 91-33298-02

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Addendum No. 2
Additional Slope Stability Analysis
Range Wash Flood Control Project
North Las Vegas, Nevada

Gentlemen:

INTRODUCTION

This report presents the results of our slope stability analysis conducted for the new profile of the Range Wash Flood Control Project located near Range Road in North Las Vegas, Nevada. This study was performed in general accordance with our signed confirmation letter dated February 3, 1992. Geotechnical recommendations relative to this project were provided in our Geotechnical Investigation report, dated January 8, 1992 (CCSW Project No. 91-33298-01). The findings and conclusions of this study supplement those provided in the previous report.

We understand that the dike will be 15.2 feet in height above the earthern channel bottom, and that the soil-cement facing on the upstream face of the dike may not be used. A 3:1 (horizontal to vertical) slope is planned for the downstream slope, and a 4:1 (horizontal to vertical) for the upstream face of the dike. We also understand that the crest width of the dike is 12 feet, and the water depth within the channel is on the order of 10 feet.

SLOPE STABILITY ANALYSIS

The stability analyses were conducted in general accordance with the Nevada State Statutes, the Clark County Regional Flood Control District "Hydrologic Criteria and Drainage Design Manual." The anticipated maximum dike slope sections were analyzed for four separate cases; (1) end of construction, (2) sudden drawdown, (3) steady state seepage, and (4) seismic analysis under steady state seepage. The dike was analyzed for a height of 15.2 feet with 10 feet of impounded water. The computer program SB-Slope, Version 3.0, developed by von Gunten Engineering Software, Inc. was used to calculate the minimum factor of safety by Bishop's simplified method of slices for circular failure surfaces. Based on

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previously performed laboratory tests, an average saturated angle of internal friction of 38 degrees, and a cohesion intercept of zero, were used, for both the foundation soil and the compacted embankment. A summary of the minimum acceptable factors of safety, and calculated factors of safety is presented in the following table. The results of the slope stability analyses are presented in Appendix A.

Calculated and Required Factors of Safety for Slope Stability

Loading Condition	Case	Required[1] F.S.	Calculated F.S.
End of Construction	1	1.3	2.5
Sudden Drawdown	2	1.2	1.8
Static-Steady State Seepage	3	1.5	1.7
Seismic-Steady[2] State Seepage	4	1.0	1.4

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers (1973).
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.05.

It has been our pleasure to be of continued service to you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Hector E. Marin, E.I.T.
Staff Engineer

Reviewed by:

Al Stilley, P.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
ALAN N. STILLEY
Civil
No. 7031
6-23-92

HEM:ANS:sc
46/43S

Encl: Appendix A

Dist: 10/Addressee

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used*:

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

APPENDIX A

RESULTS OF SLOPE STABILITY ANALYSIS

File: RANG3 - end of construction
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 43.7, Y= 73.4
FS= 2.547 at R= 64.1

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project ccsw no. 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG3 Description: end of construction

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	10.0	1	1	2	1
2	40.0	10.0	2	2	3	3
3	85.6	25.2	3	3	4	3
4	97.6	25.2	4	4	5	3
5	158.4	10.0	5	5	6	1
6	198.0	10.0	6	2	5	1
7	0.0	0.0				
8	0.0	0.0				
9	0.0	0.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.0
2	135.0	0	38.0
3	135.0	0	38.0
4	140.0	0	38.0

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project ccsw no. 91-33298-02

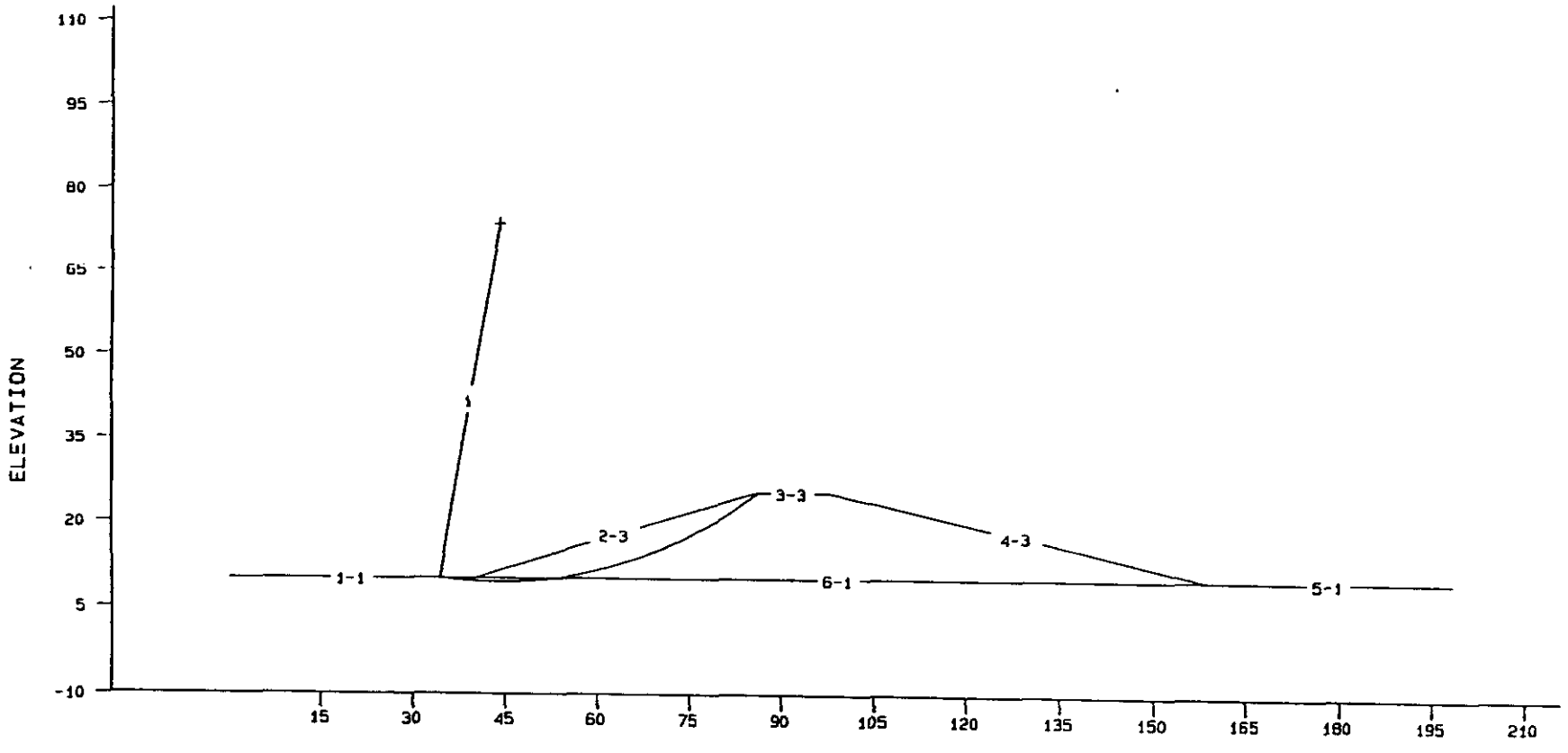
LOCATION: North Las Vegas, Nevada

FILE: RANG3

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	43.7	73.4	64.1	2.55

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG2 - rapid draw-down
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 148.7, Y= 61.9
FS= 1.833 at R= 53.6

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG2 Description: rapid draw-down

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	40.0	10.0	2	2	3	4	Y
3	55.0	15.0	3	3	4	3	N
4	85.6	25.2	4	4	5	3	N
5	97.6	25.2	5	5	6	3	N
6	118.4	20.0	6	6	7	4	Y
7	158.4	10.0	7	7	8	2	Y
8	198.0	10.0	8	3	6	4	Y
9	198.0	20.0	9	2	7	2	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.
2	135.0	0	38.
3	135.0	0	38.
4	140.0	0	38.

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project 91-33298-02

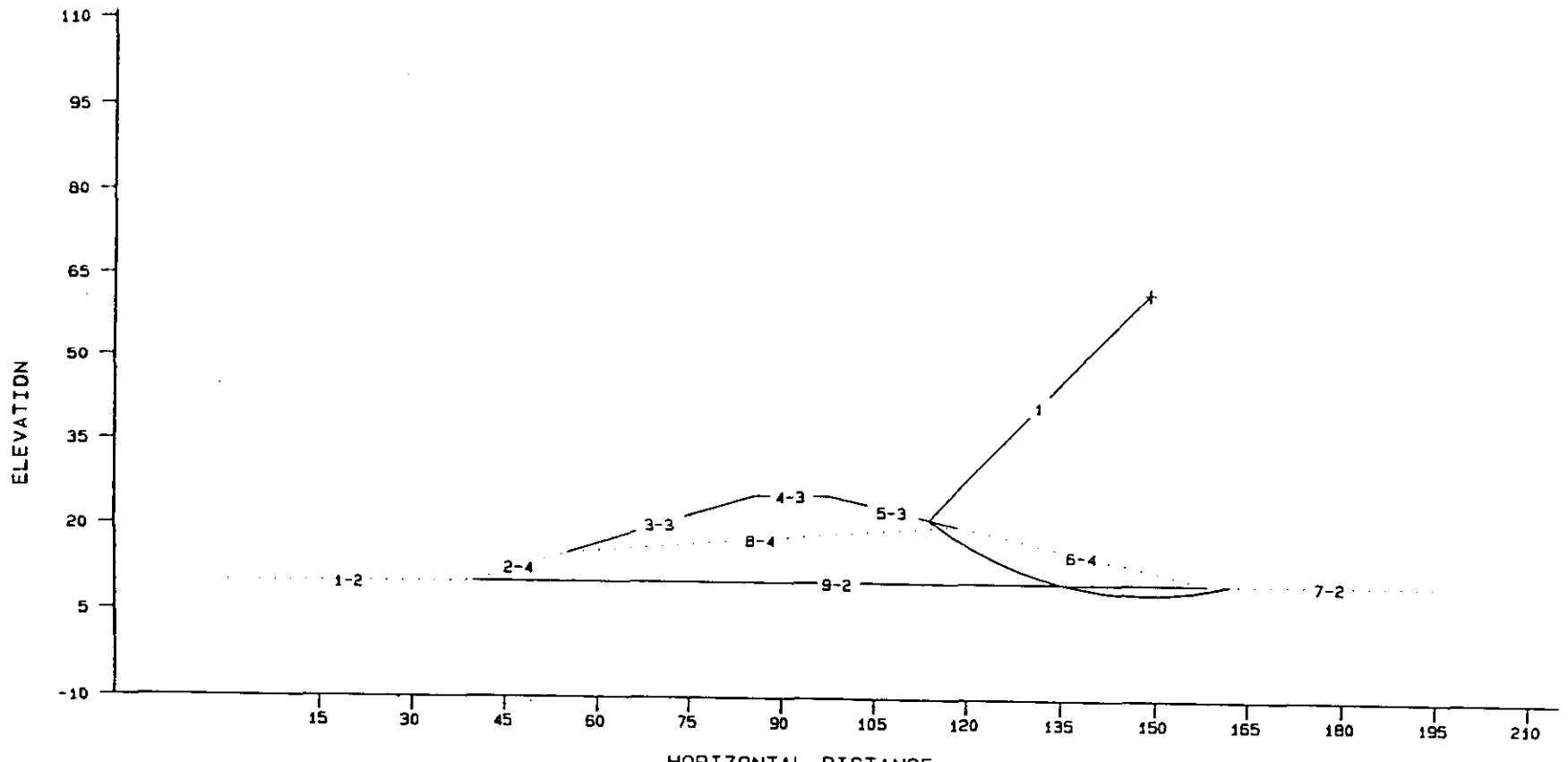
LOCATION: North Las Vegas, Nevada

FILE: RANG2

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	148.7	61.9	53.6	1.83

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG1 - steady state
SINGLE CENTER ANALYSIS
\pproximately 30 slices selected
Circle center at X= 45.7, Y= 38.7
FS= 1.693 at R= 30.6

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project ccsw no. 91-33298 02
Location: North Las Vegas, Nevada
Filename: RANG1 Description: steady state

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	40.0	10.0	2	2	3	4	Y
3	55.0	15.0	3	3	4	3	N
4	85.6	25.2	4	4	5	3	N
5	97.6	25.2	5	5	6	3	N
6	118.4	20.0	6	6	7	4	N
7	158.4	10.0	7	7	8	2	N
8	198.0	10.0	8	3	6	4	Y
9	198.0	20.0	9	2	7	2	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.0
2	135.0	0	38.0
3	135.0	0	38.0
4	140.0	0	38.0

Free water surface, left point = 6
right point = 9

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project ccsw no. 91-33298 02

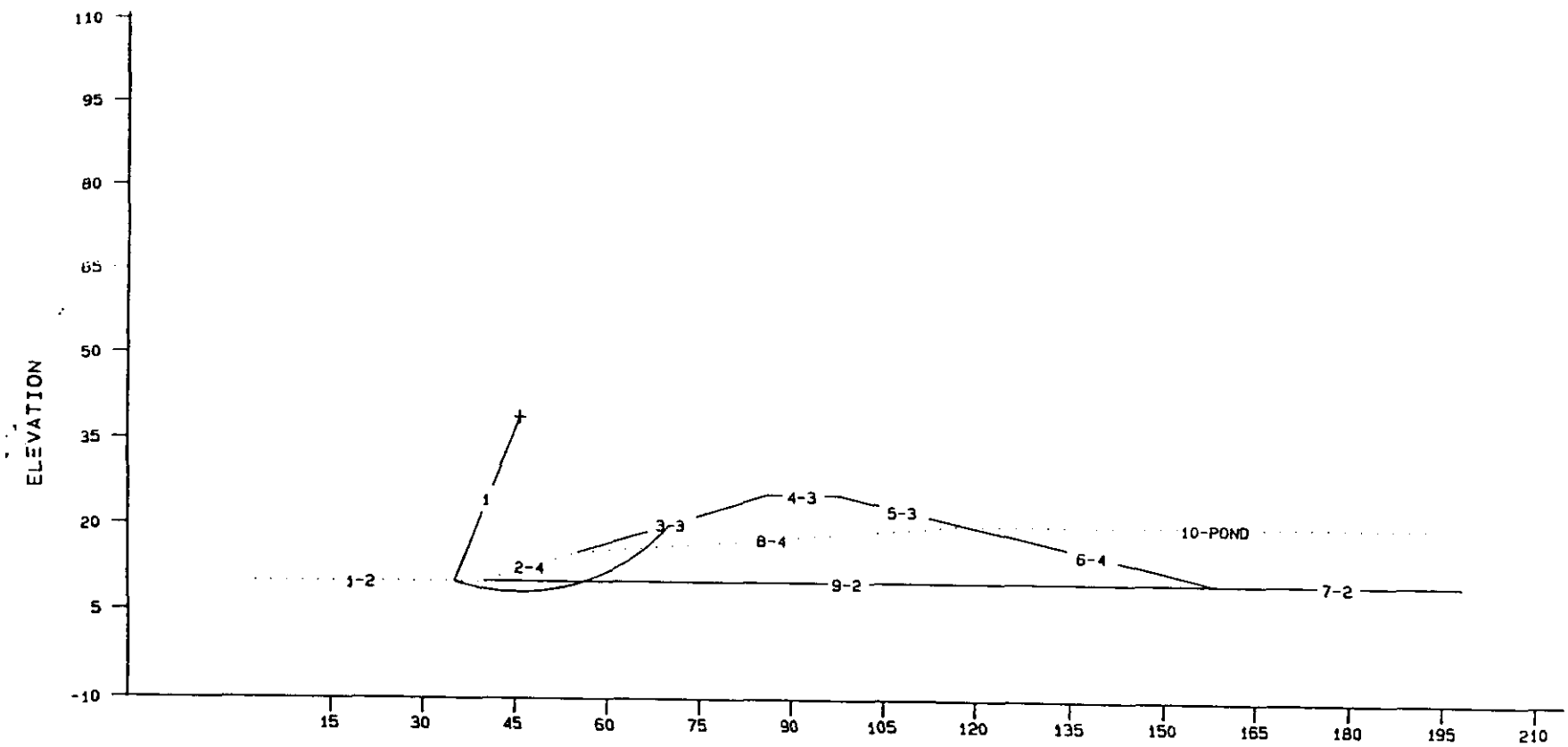
LOCATION: North Las Vegas, Nevada

FILE: RANG1

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	45.7	38.7	30.6	1.69

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG1S - steady state with seismic coeffs
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 45.6, Y= 35.4
FS= 1.432 at R= 27.5

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash control project ccsw no. 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG1S Description: steady state with seismic coeffs

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	40.0	10.0	2	2	3	4	Y
3	55.0	15.0	3	3	4	3	N
4	85.6	25.2	4	4	5	3	N
5	97.6	25.2	5	5	6	3	N
6	118.4	20.0	6	6	7	4	N
7	158.4	10.0	7	7	8	2	N
8	198.0	10.0	8	3	6	4	Y
9	198.0	20.0	9	2	7	2	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.0
2	135.0	0	38.0
3	135.0	0	38.0
4	140.0	0	38.0

Free water surface, left point = 6
right point = 9

Seismic coefficient, horizontal = 0.050
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash control project ccsw no. 91-33298-02

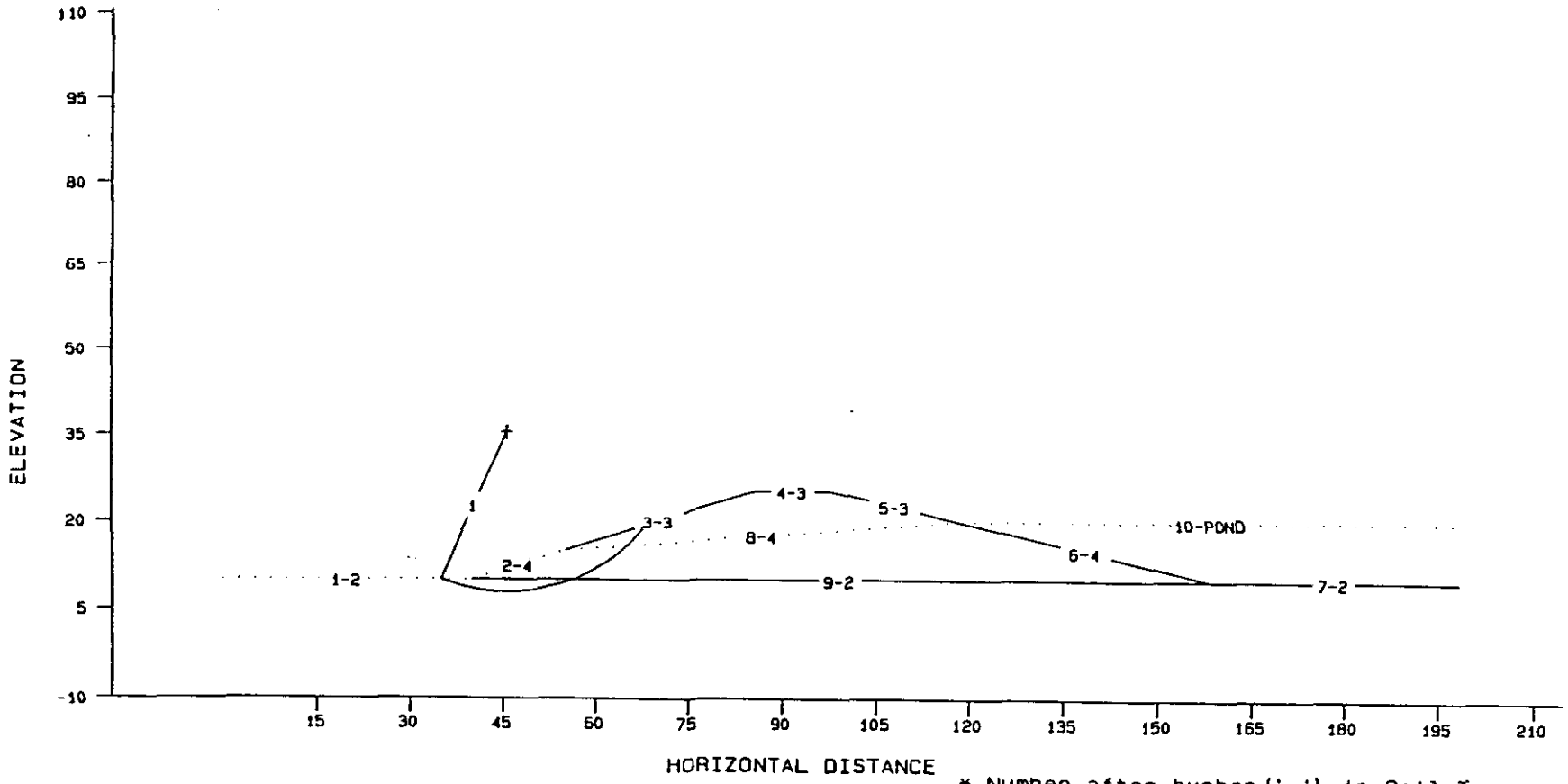
LOCATION: North Las Vegas, Nevada

FILE: RANG1S

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	45.6	35.4	27.5	1.43

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

OTHER TOPICS

Slug Flow

The Clark County Regional Flood Control District Design Manual requires that slug flow conditions be considered in open channels flowing at high velocity. Slug flow was reviewed for flow along the dike and was determined not to be a problem. Slug flow exists if Froude numbers exceed 2. Flows in the Range Wash fan/dike system result in Froude numbers less than 1.4 and therefore indicate slug flow is not a critical design consideration.

Superelevation

Superelevation in horizontal curves has been evaluated as part of the sizing of the dike. It was determined that the maximum superelevation likely is .64 feet. This was assumed to occur along curves in the dike alignment where maximum deposition would not occur. Maximum deposition occurs at the transition from fan to dike. Superelevation in this region is not expected. The channel has been sized with a provision for freeboard which includes consideration of the energy head depth of flow and deposition since superelevation is not likely to occur coincident with maximum deposition, superelevation has not been included as a freeboard component.

BOYLE ENGINEERING CORPORATION

Project MIKE WASH — Description DIKE CHANNEL
Job No. [illegible] 200 2 — DESIGN CONCEPTS
By [illegible] Date 1/7/92 — SHEET 1/1

SLUG FLOW

FROM — CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, DESIGN MANUAL (10/90)

SLUG FLOW ≡ series of shallow water shock waves which occur in steep supercritical channels.

The concern is for the overtopping of freeboard, and therefore all channels should be designed to avoid slug flow.

WHEN $F > 2.0$, $S < 12/Re$ where: F = Froude #
S = slope (ft/ft)
$Re = VR/\nu$

IF $F < 2.0$, SLUG FLOW SHOULD NOT OCCUR

where: V = Design velocity (ft/s)
R = Hydraulic radius (ft)
ν = Kinematic viscosity (ft^2/s)

$$F = \frac{V}{\sqrt{gL}}$$

CASE 1: $Q = 6584$ cfs
$S = 0.5\%$
$B = 120$ ft
$V = 11.37$ ft/s
$D = 4.34$ ft

$$F = \frac{11.37}{\sqrt{32.2(4.34)}} \cong .96 \quad \text{(clearwater)}$$

CASE 2: $Q = 6589$ cfs
$S = 1.0\%$
$B = 120$ ft
$V = 14.61$ ft/s
$D = 3.45$ ft

$$F = \frac{14.61}{\sqrt{32.2(3.45)}} \cong 1.39 \quad \text{(clearwater)}$$

∴ SLUG FLOW SHOULD NOT OCCUR

BOYLE ENGINEERING CORPORATION

Project _____ Description Slug Flow using Small Canal Structures

Job No. _____ SHEET /

By MWG Date 7/20/92

① $S = 0.005$ ft/ft = ERL slope $\theta = 0.29°$

② $Q = 7050$ cfs $Q_{.2} = 1410$ cfs

$Q_{.5} = 3520$ cfs

$n = 0.010$ not appropriate for earthen channel

use $n = 0.022$

③ $SL = 0.005 \times 1000 = 5$

assume S = channel slope

$L = 1000'$ arbitrary length

④ a) $\underline{V} = \frac{2}{3} \frac{b}{wp} \times \frac{V}{\sqrt{gd\cos\theta}}$

where $b = 120'$

$d = \text{Area}/TW = 580/145 = 4.0$ depth = 4.4'

from supercritical run

$g = 32.2$ ft/sec^2

$wp = 120 + 4.4 \times \sqrt{3.5^2+1} \times 2 = 152'$

$\theta = 0.29°$

$V = 12$ fps

$$\underline{V} = \frac{2}{3} \times \frac{120}{152} \times \frac{12}{\sqrt{32.2(4)(\cos .29)}} = 0.56$$

$$\underline{M^2} = \frac{V^2}{g\,SL\cos\alpha}$$

$$= \frac{12^2}{32.2\ 5\ \cos .29} = 0.89$$

⑤ Plot of point is well below slug flow zone

No slug flow

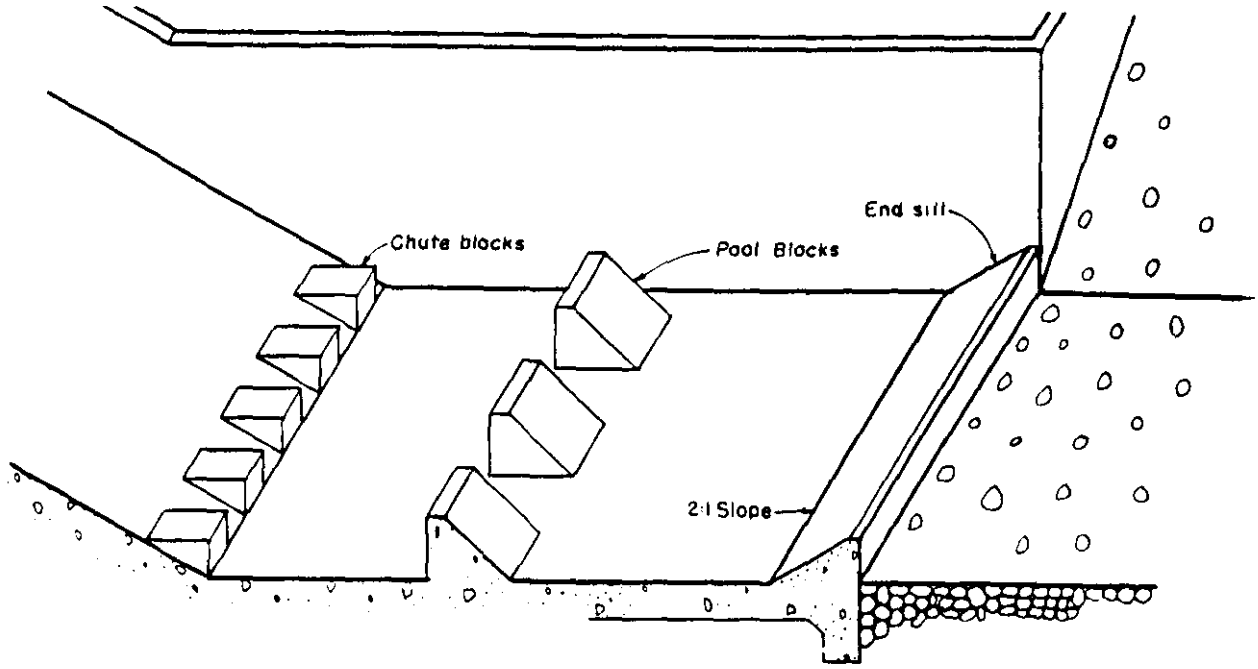


Figure 2-40. **Stilling pool with end sill. 103-D-1277**

Figures 2-45 and 2-46 have been developed to predict the possibility of slug flow occurring in a chute. The use of the figures requires the following operations:

(1) Divide the chute into a number of reaches as shown on figure 2-47. Point 1 should be at the beginning of the chute section.

(2) Using equation (6) or (7), with Q equal to 0.2, 0.5, and 1.0 times design Q, compute the water depth and energy levels at the points along the chute section that are to be checked for slugging. Use Manning's n = 0.010.

Figure 2-41. **Surging in a stilling pool caused by unstable flow in a chute structure. P222-117-36223**

(3) Determine sL for the point to be checked (fig. 2-47).

(4) At the points to be considered:

a. Compute the Vedernikov number ($\underline{V}$) [10].

$$\underline{V} = \frac{2}{3} \times \frac{b}{wp} \times \frac{V}{\sqrt{gd \cos\theta}} \qquad (10)$$

b. Compute the square of the Montuori number ($\underline{M}$) [11].

$$\underline{M}^2 = \frac{V^2}{g\, sL \cos\theta} \qquad (11)$$

In equations (10) and (11)

b = bottom width of the chute section

d = average water depth in the chute section:

$$d = \frac{\text{Area of the water prism}}{\text{Top width of the water prism,}}$$

Figure 2-42. **Pulsating flow in steep chute. Flow is 57 cfs. P222-117-36208D**

Figure 2-43. **Unstable flow at shallow depth. H-686-55D**

g = acceleration of gravity,
L = length of reach under consideration,
s = average slope of the energy gradient.

$$s = \tan \theta .$$

V = velocity,
wp = wetted perimeter of the section, and
θ = angle of inclination of the energy gradient.

(5) Plot the computed values on figure 2-45. If the plotted points fall within the slug flow zone, intermediate points may be checked to determine the point at which the waves begin to form.

(6) Compute the shape factor for the chute section.

$$\frac{d}{wp}$$

(7) Plot the computed value of $\frac{d}{wp}$ against the slope of the energy gradient, s, on figure 2-46.

Waves are not likely to be generated in the structure, unless the plotted data falls within the slugging zone on both figures 2-45 and 2-46.

If the charts indicate that slug flow will occur, the design may be modified to reduce the probability of waves being generated or the structure may be adapted to accommodate the

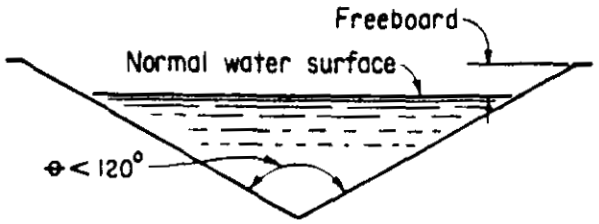


Figure 2-44. **Theoretical waveless chute section. Triangular shape prevents both cross waves and slug flow. 103-D-1278**

surging flow that does occur. Possible design changes include:

(1) Divide the flow in the chute section with a wall down the center of the chute.

(2) Change the shape of the section. The theoretical waveless shapes could be considered.

(3) Reduce the length of the chute. A series of shorter chutes or drops could be considered.

(4) Steepen the chute.

(5) Replace the open channel chute section with pipe.

If these design changes are impractical, the chute section might be adapted to accommodate surging flow by:

(1) Increasing the freeboard of the chute walls.

(2) Providing a cover for the chute section to contain the waves, or

(3) Protecting the backfill around the chute section with riprap or paving.

Adaptations to the stilling pool could include:

(1) Designing the pool to provide for the momentary surge discharge. This would

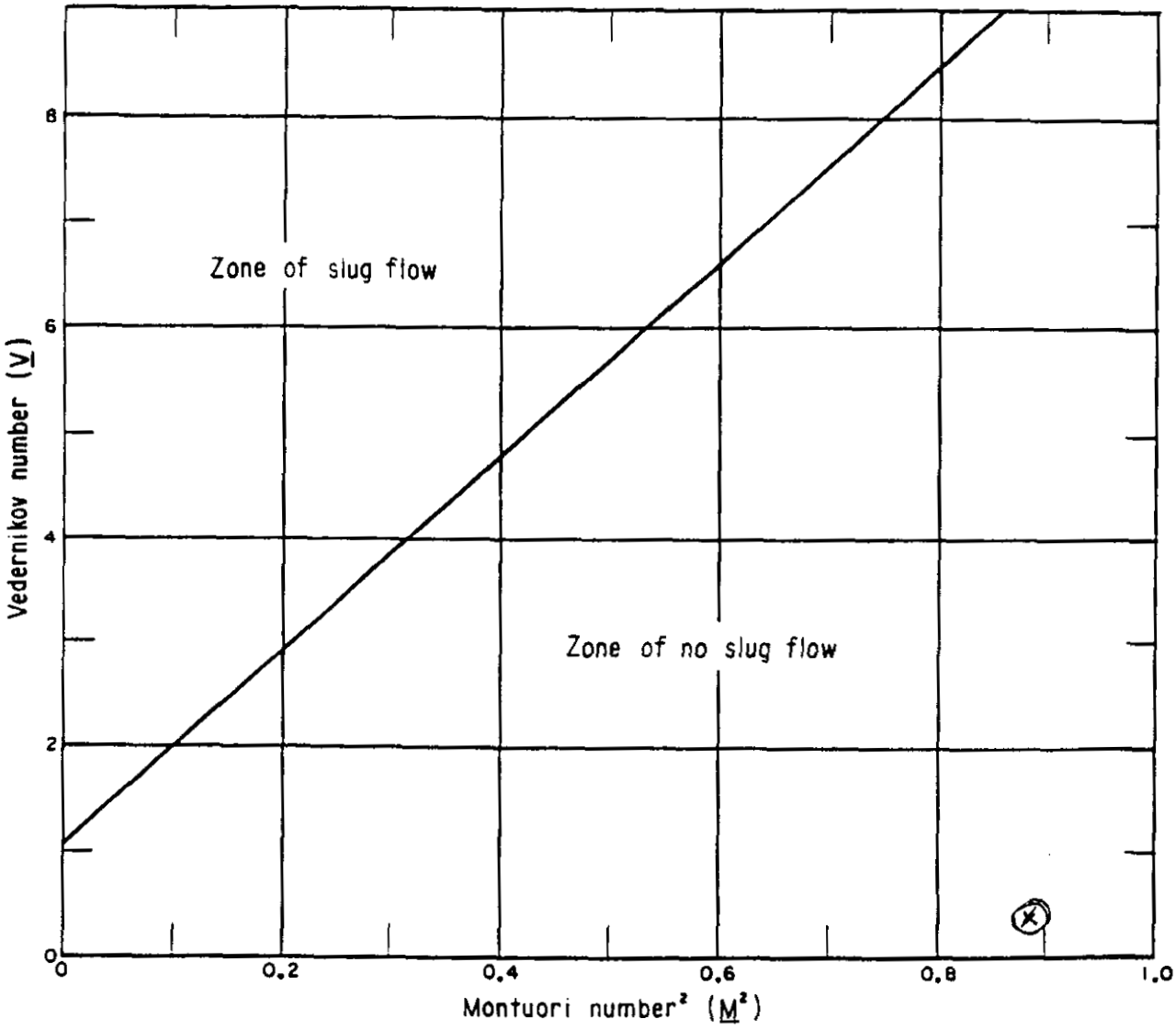


Figure 2-45. Criteria for slug flow. 103-D-1279

provide a longer pool and higher pool walls to contain the surge.

(2) Provide additional riprap to protect the channel downstream and the backfill around the pool.

(3) Provide a surge suppressing device in the stilling pool. A baffle or weir wall in the pool could prevent flow from sweeping through the pool and outlet transition (fig. 2-48). Weir walls could also provide tailwater to submerge the surges. Rafts or other floating wave dampeners could be used.

(4) An energy dissipator less sensitive to surging could be used.

The study of wave action in chute structures is based largely on empirical data. If a serious wave problem in a structure is indicated, further studies should be undertaken to verify the extent of the problem and the effectiveness of the proposed solutions.

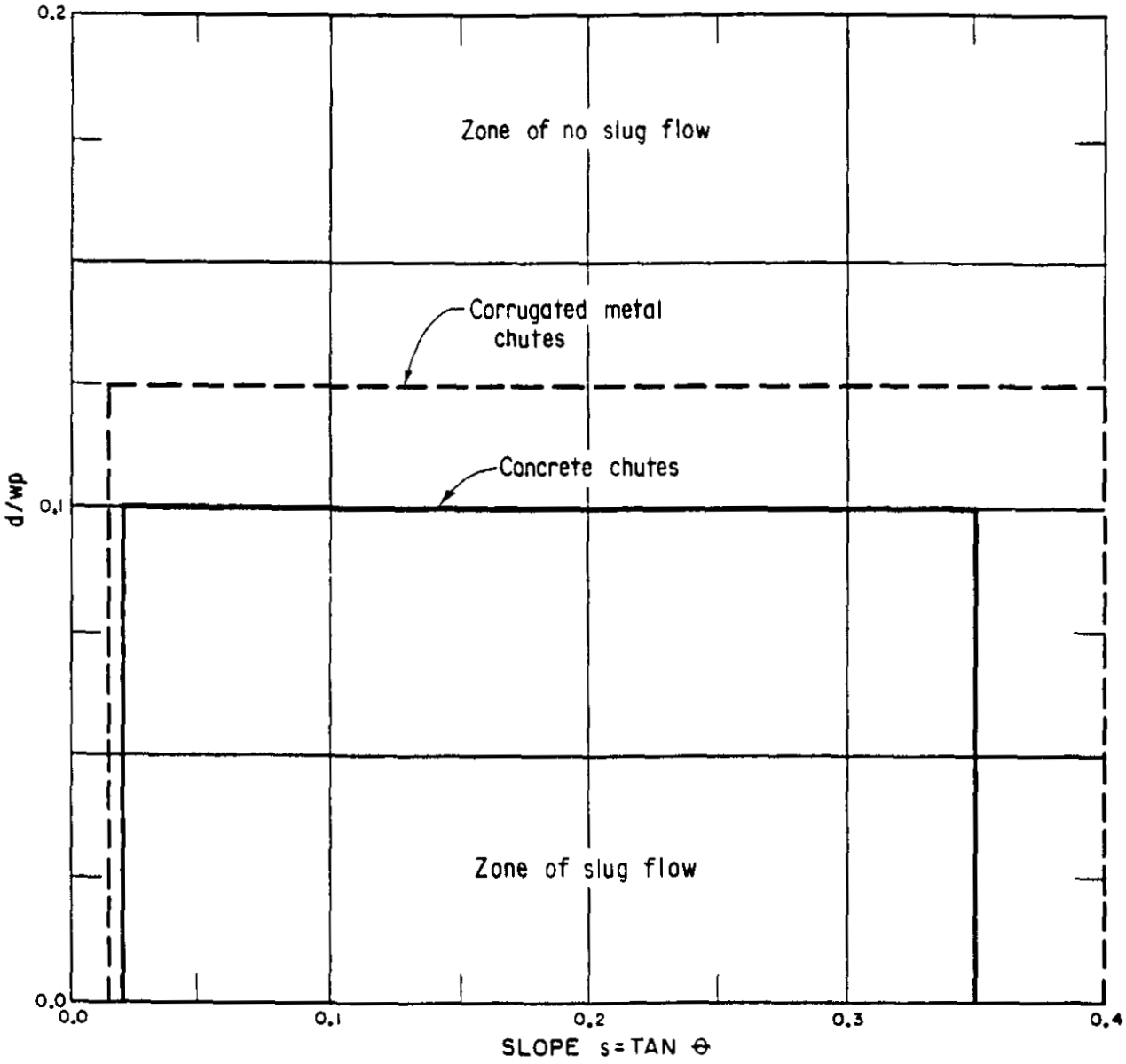


Figure 2-46. **Shape and slope criteria for slug flow. 103-D-1280**

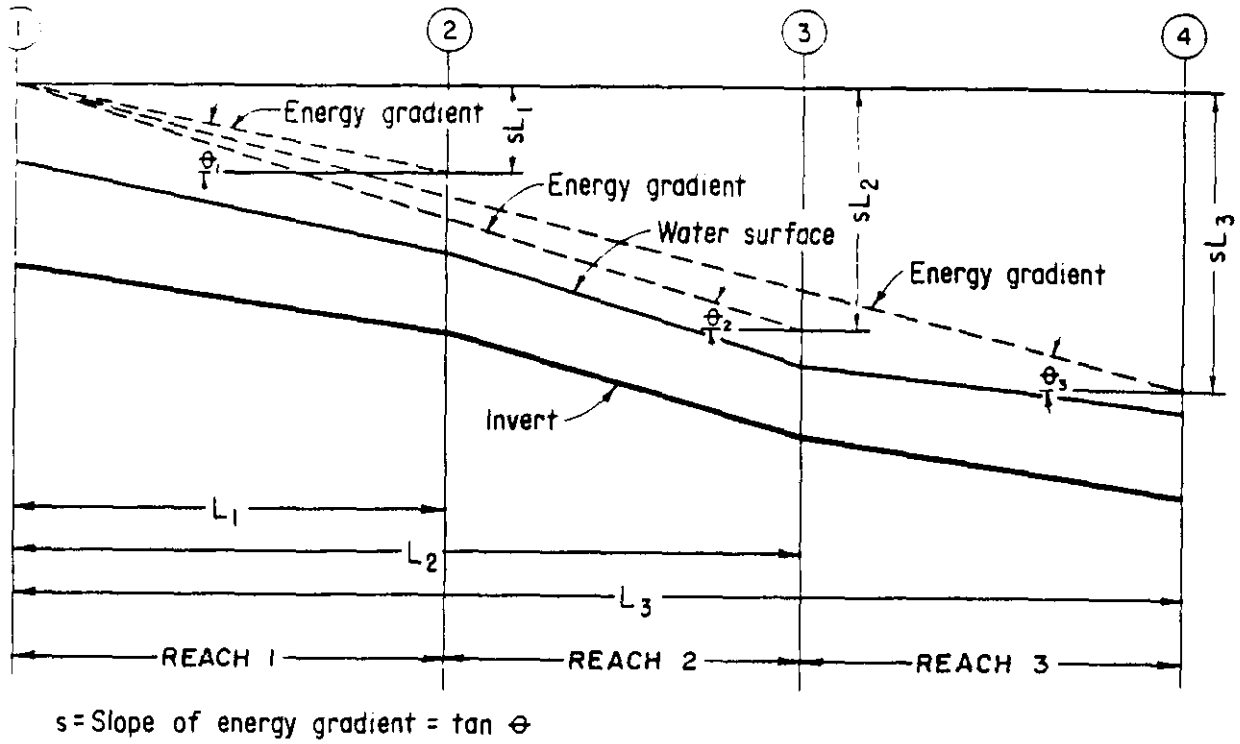


Figure 2-47. **Invert, water surface, and energy profiles of a chute structure. 103-D-1281**

2-35. *Design Procedure.*–

(1) Select and design the type of inlet to be used.

(2) Determine the energy gradient at the beginning of the chute section.

Figure 2-48. **Wave sweeping through the outlet transition of a stilling pool. Flow is 140 cfs. P222-117-36227**

(3) Compute the variables of flow down the chute section.

(4) Design the trajectory and the steep portion of the chute section.

(5) Assume an elevation for the floor of the stilling pool and compute the characteristics of flow upstream of the hydraulic jump.

Determine d_2 and the energy gradient after the hydraulic jump.

(6) Determine the energy gradient in the channel downstream and compare to the energy gradient after the jump.

(7) It may be necessary to assume a new pool invert elevation and to recompute the above values several times before a check in energy gradients is obtained.

(8) Review for proper operation at partial capacity.

(9) Determine the length of the pool and the height of the pool walls.

(10) Design the chute and floor blocks and the end sill or outlet transition as required.

(11) Check the possibility of waves developing on the structure.

BOYLE ENGINEERING CORPORATION

Project SNAKE WASH
Job No. [illegible]
By TJF Date 1/27/92

Description SUPER ELEVATION
SHEET 1

Super elevation

FROM OPEN-CHANNEL HYDRAULICS, CHOW, 1959

EQUATION (16-11) pg 448

For Superelevation, $\Delta h = \frac{V_2^2 b}{g r_c}$

where: Δh = superelevation, ft
b = width of channel, ft
r_c = radius of curvature, ft
V_2 = mean velocity, ft/s

$V_2 = 11.35$ ft/s
$b = 120 + 5(4)(2) = 160$
$g = 32.2$ ft/s^2
$r_c = 1000'$

$$\Delta h = \frac{11.35^2 (160)}{(32.2)(1000)} = .64 \text{ feet}$$

Superelevation will occur in bends where deposition is << 5.9' therefore not an issue

CCNV INCORPORATED AREAS VOLUME III

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

VOLUME 3

SECTION 5 REFERENCE MATERIALS
Range Wash Dike Documentation
Continued

Submitted by:	**Clark County Regional Flood Control District**
Study Contractor:	**Post, Buckley, Schuh & Jernigan, Inc.**
Date Submitted:	**February 27, 1996**

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5.3.7	Clark County Regional Flood Control District Maintenance Work Program

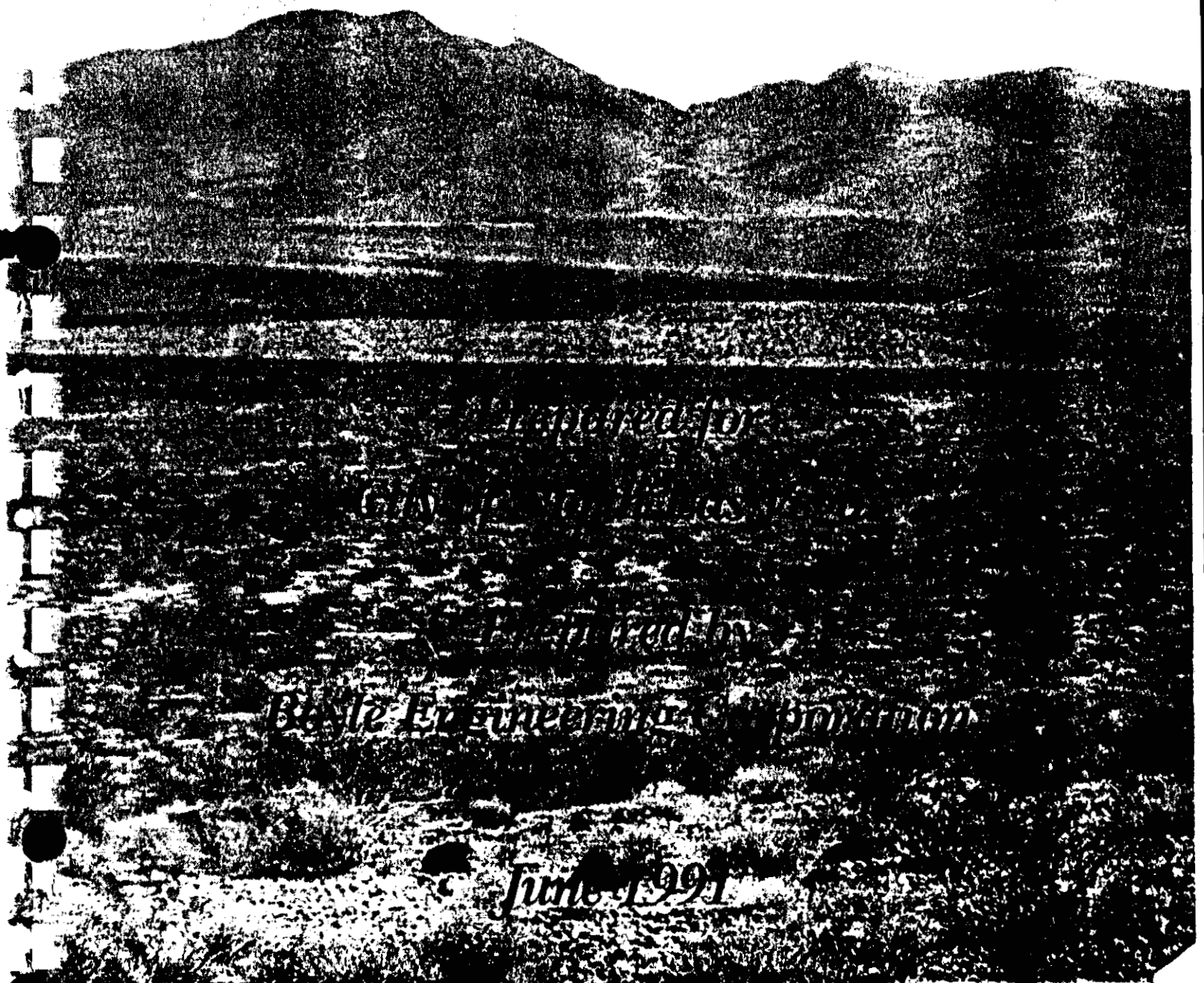
5.3.1 Western and Eastern Tributaries of Range Wash

Flood Control Facility Plan

RETURN TO KELLY CHUMA CNLV

Western and Eastern Tributaries of Range Wash

Flood Control Facility Plan



Jun. 1991

WESTERN AND EASTERN TRIBUTARIES OF RANGE WASH

FLOOD CONTROL FACILITY PLAN

Prepared for

CITY OF NORTH LAS VEGAS

Prepared By

BOYLE ENGINEERING CORPORATION

JUNE 1991

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EXECUTIVE SUMMARY

INTRODUCTION

Boyle Engineering Corporation was authorized to evaluate and develop preliminary designs of drainage facilities within the Eastern and Western Tributaries of Range Wash by an agreement between Boyle Engineering Corporation and the City of North Las Vegas dated January 18, 1989.

STUDY AREA DESCRIPTION

The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley. It is bounded on the north and east by the Las Vegas Mountain Range and on the west by the Las Vegas Wash basin. The Range Wash basin outfalls into Las Vegas Wash adjacent to the Sunrise Station Power Plant. The mainstem of Range Wash extends north along Sloan Channel to the southern limit of Nellis Air Force Base at the confluence of the Western and Eastern Tributaries. The western tributary extends to the northwest into the Las Vegas Mountain Range. The eastern tributary extends northeasterly into the Las Vegas Dunes Recreation Lands.

The basin is characterized by three distinct land types; mountainous; alluvial fan, and; urban developed. The mountainous regions are steep with limited vegetation and high runoff potential. The alluvial fan has relatively low runoff potential, however the existence of numerous incised channels makes hydrologic response difficult to predict. The area downstream of I-15 is generally highly developed with quick, high intensity runoff due to the large amount of impervious surface.

HYDROLOGIC EVALUATION

A hydrologic evaluation of the Range Wash basin was performed as part of this study. The U.S. Army Corps of Engineers' HEC-1 computed probability simulation was the basis for this study. Clark County Regional Flood Control District rainfall amounts and distributions were used to determine design storms, SCS curve numbers simulated rainfall abstractions, and runoff was generated using the SCS dimensionless unit hydrograph or the Kinematic wave overland flow

plane methodology of HEC-1. Channel routing was accomplished through the use of Kinematic Wave or Muskingum routing. Once developed, the model was calibrated to match the regionally calibrated Corps of Engineers computed probability discharge estimates. The results of the hydrologic analysis are summarized in the following table.

HYDROLOGIC SUMMARY
FUTURE BASIN DEVELOPMENT

Location	100-Year Event Peak Flow (cfs)	100-Year Event Runoff Volume (acre-ft)
Western Tributary at Confluence	7260	2180
Eastern Tributary at Confluence	3370	1040
Range Wash at Las Vegas Wash	8870	3300

Subsequent to the completion of the hydrologic modelling, CCRFCD adopted new hydrologic criteria. Since this model was calibrated to computed probability discharges, a change in methodology should not result in significantly different discharges. CCRFCD also initiated a concurrent Master Plan Update. That study also resulted in discharges similar to those presented in this study.

CONCEPTUAL ALTERNATIVE DEVELOPMENT

Four alternatives were identified which reduced flood hazard to existing structures, which minimized exposure of possible future developments to flooding and which satisfied FEMA requirements. The four alternatives were:

I) The Master Plan alternative. This is the alternative proposed in the existing Master Plan with some minor adjustment of facility locations to reflect projected development.

II) The Beltway diversion alternative. This involves an alluvial fan apex detention facility, diversion of fan flows via the projected beltway alignment, a detention basin at the I-15

crossing of the West Tributary and detention at the confluence of the East and West Tributaries of Range Wash. Detention facilities will be sized to limit flows to existing channel capacities, if possible.

III) The Master Plan with confluence detention alternative. This includes the Master Plan alternative with additional detention at the confluence to minimize or eliminate the necessity of improvements to the Sloan Channel.

IV) The North Las Vegas Detention Basin Diversion alternative. This is generally alternative III with Western Tributary storage eliminated and replaced with a diversion to the North Las Vegas Detention Basin.

Conceptual costs of each alternative were estimated and are summarized in the following table.

SUMMARY OF CONCEPTUAL FACILITY COSTS
(Millions of Dollars)

Alternative		East Tributary	West Tributary	Sloan Channel	Total
I	Facility	$ 12.0	$ 29.0	$ 9.3	
	Land	2.2	2.3	0.0	
	Contingency	2.8	6.2	1.9	
	Total	$ 17.0	$ 38.0	$ 11.0	$ 66.0
II	Facility	$ 30.0	$ 10.0	$ 6.9	
	Land	1.5	1.1	1.0	
	Contingency	6.3	2.3	1.6	
	Total	$ 38.0	$ 13.0	$ 9.5	$ 61.0
III	Facility	$ 12.0	$ 29.0	$ 6.9	
	Land	2.2	2.3	0.8	
	Contingency	2.8	6.2	1.5	
	Total	$ 17.0	$ 38.0	$ 9.2	$ 64.0
IV	Facility	$ 12.0	$ 17.0	$ 6.9	
	Land	2.2	0.9	0.8	
	Contingency	2.8	3.6	1.5	
	Total	$ 17.0	$ 22.0	$ 9.2	$ 48.0

All evaluated alternatives reduce the hazard of flooding as a result of detention and improved conveyance. Alternative I is the most costly due to the expense of improving Sloan Channel to convey design discharges. Alternative III is essentially the same as Alternative I, except that it substitutes the confluence detention basin for improvements along Sloan Channel. Alternative II relies on the proposed Beltway and provides minimal protection to facilities on the fan to the north. Alternative IV is significantly less expensive than the other alternatives, however it relies on an interbasin diversion, which may increase hazard or the perceived hazard in the receiving watershed.

Subsequent to review, Alternatives III and IV were selected for further evaluation and preliminary design. The selection of the alternatives was based largely on estimated construction cost and as a result of the uncertainty of the alignment of the proposed beltway.

PRELIMINARY DESIGN

The purpose of the preliminary design is to identify general components of the selected alternatives such as types and sizes of facilities and their approximate location. The sizing of facilities is based on a refinement of the hydrologic model and hydraulic analysis. Design of detention facilities includes estimates of required storage volume, embankment height and spillway geometry. Channel and floodway design includes slope, geometry and lining type. Street crossings include identification of required culvert sizes or bridge spans. Preliminary horizontal alignments of channel and crossing facilities are identified schematically on the drawings developed. Vertical elevations are identified using the available topographic information. Utilizing the alignments and grades established by this design, utility conflicts are identified and reconciled to the extent possible. Right-of-way acquisition limits are estimated and included. The previously prepared cost estimates are refined to reflect the preliminary design effort.

The preliminary designs for Alternative III and Alternative IV are depicted on the drawings presented as Appendix A of the report. This preliminary design is conceptual in nature and lacks significant detail because no detailed topography was developed for this study. Utility owners were notified and utility maps made available were consolidated during the study. The utilities identified on the plans are those reported by the various utility owners. This information was used during the conceptual evaluation and the preliminary design to reconcile potential utility conflicts. The horizontal alignments depicted on the plans are related to physical features identified through field observation and from the available mapping. The alignments are

generally identified by their relation to existing facilities such as road crossings or channels or by their proximity to existing rights-of-way. Vertical alignments are based on the 20-foot contour interval presented on the USGS quadrangle maps.

Opinions of probable cost were estimated for each alternative and are summarized in the following table. The cost estimates prepared during this study reflect the preliminary nature of the project. No detailed structural analysis or design was performed for the facilities nor was a detailed estimate of earthwork prepared. The costs represent estimates consistent with the level of detail of the study and the topographic mapping available. Appropriate contingencies have been included in the cost estimates to reflect the lack of detail of the available information.

SUMMARY OF PRELIMINARY FACILITY COSTS
(Millions of Dollars)

Alternative		East Tributary	West Tributary	Sloan Channel	Total
III	Facility	$ 11.6	$ 24.8	$ 8.6	
	Land	1.2	3.2	1.9	
	Contingency	2.6	5.6	2.1	
	Total	$ 15.4	$ 33.6	$ 12.6	$ 61.6
IV	Facility	$ 11.6	$ 10.6	$ 8.6	
	Land	1.2	1.2	1.9	
	Contingency	2.6	2.4	2.1	
	Total	$ 15.4	$ 14.2	$ 12.6	$ 42.2

RECOMMENDED PLAN

The City of North Las Vegas and the Clark County Regional Flood Control District have selected Alternative IV as their preferred alternative. This alternative features the diversion of western tributary flows to the existing North Las Vegas detention basin. It also includes conveyance downstream of Interstate 15 on the western tributary and detention and conveyance along the eastern tributary from the fan downstream to the confluence with the western tributary. Detention is proposed at the confluence and limited channel improvements are required downstream before discharging into the Las Vegas Wash.

This plan utilizes existing facilities to the greatest extent practicable by limiting flow rates to existing capacities or adding facilities to inadequate existing structures. New facilities are proposed where no existing facilities are in place or where existing facilities are not compatible with proposed ones. By adopting this approach, the desired flood protection is provided at lower cost.

Because sufficient funds are not available to construct all the facilities identified in this plan, an implementation plan has been formulated. The plan weighs the need for the improvements along with the cost and relative benefit to develop a priority list. Using the criteria, two facilities are of highest priority; the Western tributary diversion dike and the confluence detention basin.

The importance of the western tributary dike and the resulting flow reduction has long been recognized. The existing Master Plan identifies a detention basin which achieves the same objective as does dike construction. This facility was funded in the District's 10-year program. Since the dike serves the same function, at lower cost, its priority is clear. The timeliness of this is even more evident given the ongoing development pressures which exist on this portion of the fan.

Past flooding, and the highest degree of residential development, have occurred along the Sloan Channel. To most cost effectively reduce the flooding and subsequent damage, the confluence detention basin should be constructed. To collect and convey Western Tributary flows, the golf course channel must be constructed concurrently.

The following table presents a recommended priority listing of the facilities identified in this plan.

IMPLEMENTATION PRIORITY

Priority	Facility Description	Facility Designation
1A	Western Tributary Diversion Dike	Dike W-1
1B	Confluence Detention Basin and Golf Course Channel	Basin R-M and Channel W-9D
2	Property Acquisition for East Tributary Detention Basin	Basin E-J1 land
3	Sloan Channel Improvements	Channels R-1 to R-7
4	West Tributary Channel from from UPRR to Golf Course Channel	Channels W-6 to W-9
5	East Tributary Detention Basin and Channel to Forrestal	Basin E-J1 and Channels B-4 and E-5
6	East Tributary Channel and dikes upstream of Detention Basin	Dike E-1A and Floodway E-2A
7	East Tributary Channel Forrestal to Confluence Detention Basin	Channels E-6 and E-7

I - INTRODUCTION

GENERAL INTRODUCTION

The evaluation and preliminary design of drainage facilities within the Eastern and Western Tributaries of Range Wash upstream of the Sloan Channel, in the Las Vegas Valley area of Nevada, was performed under the terms of an agreement executed on January 18, 1989 between the City of North Las Vegas, Nevada and Boyle Engineering Corporation.

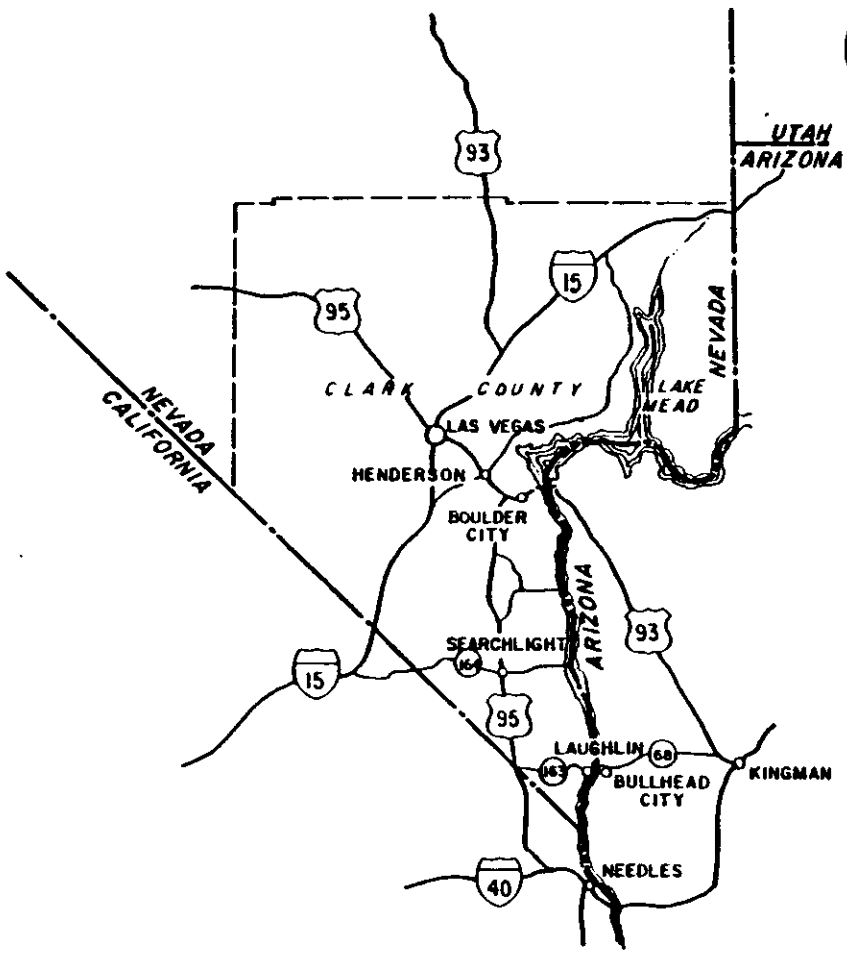
The purpose of the project is to evaluate and develop preliminary designs for drainage facilities within the Eastern and Western Tributaries of Range Wash. The effort includes a review of previously developed studies, updating and refining existing hydrologic models, development and evaluation of alternative flood control facilities, conceptual design of selected flood control facilities within the Western and Eastern Tributaries of Range Wash, and the preparation of a report summarizing the effort.

PROJECT LOCATION

The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley (Figure I-1). The study area boundary is bounded on the north and east by the Las Vegas Mountain Range and extends into the Desert National Wildlife Range.

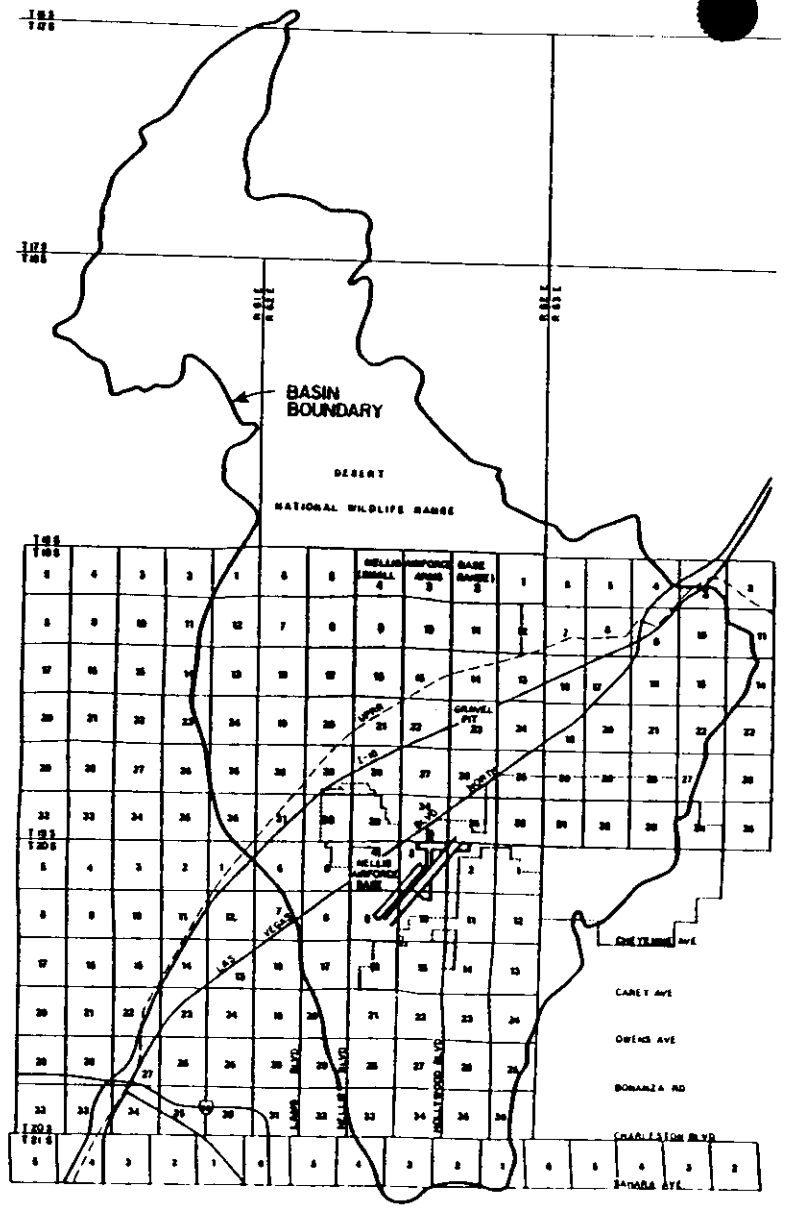
The basin lies entirely within Clark County, Nevada and includes portions of the City of North Las Vegas, Nellis Air Force Base, and portions of unincorporated Clark County. The entire drainage area is contained within the boundaries of the Clark County Regional Flood Control District.

The Range Wash Drainage Basin is a tributary to Las Vegas Wash. Flows from Range Wash enter Las Vegas Wash adjacent to the Sunrise Station Power Plant near the intersection of Vegas Valley Drive and Hollywood Boulevard. The mainstem of Range Wash extends north from this location approximately five miles along the Sloan Channel to the southern limit of Nellis Air Force Base, at the confluence of the Western Tributary of Range Wash with the Eastern Tributary of Range Wash.



LOCATION MAP

NOT TO SCALE



VICINITY MAP

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FIGURE I-1

From the confluence the Western Tributary of Range Wash extends along the western boundary of Nellis Air Force Base, then northwesterly to I-15, crossing Las Vegas Boulevard North, Lamb Boulevard, and Craig Road. Upstream of I-15 and the Union Pacific Railroad, the channel is poorly defined with numerous minor channels distributed across the alluvial fan. Upstream of the alluvial fan area, in the Las Vegas Mountain Range, channels are well defined.

The Eastern Tributary of Range Wash extends from the confluence around the eastern boundary of Nellis Air Force to a point near the intersection of O'Bannon Road and Forrestal Boulevard. Here, two fairly distinct branches join. The easterly branch extends northeasterly into the Las Vegas Dunes Recreation Lands area. The westerly branch collects flows from an area to the north and east of the Western Tributary alluvial fan.

The basin can be characterized by three distinct land types: mountainous; alluvial fan, and; urban developed. The mountainous regions of the watershed are steep, rocky areas with limited vegetation and high runoff potential. Areas on the alluvial fan are characterized by alluvial deposits and numerous incised channels of limited capacity. Runoff from this area is relatively low and hydraulic conditions are such that the route of flood flows is difficult to predict. The highly developed area, downstream of I-15, is generally characterized by existing residential and commercial developments and Nellis Air Force Base, with rapid development and construction of additional commercial and residential developments. Runoff from this area is rapid and high due to the large amount of impervious surface found in the area.

PROJECT SCOPE

The purpose for the drainage planning study for the Western and Eastern Tributaries of Range Wash is to develop a planning document to direct the design and construction of drainage improvements within the watershed. Using this document, priorities and budgets for improvements can be established, possible future problems can be averted and land development can proceed with a better understanding of the flood hazards and the required mitigation measures.

The drainage planning study for the Western and Eastern Tributaries of Range Wash involves the preparation of conceptual designs for drainage improvements along the two tributaries of Range Wash. The defined scope of work includes the five following principal components:

- o Data Collection and Project Coordination;
- o Hydrologic Analysis;
- o Alternative Development and Evaluation;
- o Conceptual Design of Drainage Improvements, and;
- o Report Preparation

Data collection and project coordination were among the first tasks performed for the project and continued throughout the duration of the project. This effort involved obtaining and reviewing past hydrologic studies of the watershed, alternative flood control measures previously proposed within the watershed, and record drawings of existing storm drainage facilities. The effort also included the collection and review of utility plans, land-use plans and the identification of regulatory requirements imposed on potential improvements within the watershed. An initial meeting and on-going project coordination meetings were held to facilitate the collection of data, to review project progress, and to discuss project results. These meetings included representatives from the City of North Las Vegas, the Clark County Regional Flood Control District, Clark County Public Works Department, Nellis Air Force Base, and the Cities of Henderson and Las Vegas. In addition to those in attendance at the meetings, coordination and communication with other agencies such as the Federal Emergency Management Agency and the U.S. Army Corps of Engineers was also established and maintained throughout the project duration.

A hydrologic analysis was performed for the Range Wash watershed. This analysis included an evaluation of the hydrologic response of the Western and Eastern Tributaries of Range Wash for both the existing and future drainage basin conditions. A hydrologic computer model was utilized to simulate the response of the watershed to design rain storms. The model was calibrated to the computed probability results presented by the U.S. Army Corps of Engineers in their Feasibility Study. A sediment yield analysis was also performed to estimate probable sediment volumes reaching the proposed facilities.

The results of the hydrologic analysis were used to identify problem areas and establish design discharges for proposed facilities within the watershed. The model was also used to refine the sizing of selected facilities, to evaluate the impacts of selected facilities on downstream facilities and to estimate design flow rates for the selected facilities.

The development and evaluation of alternative flood control facilities which address the identified problems within the watershed was a two step process. The first step was the development and evaluation of conceptual alternatives at a level of detail sufficient to establish general facility type and size. The second step was a conceptual analysis and provided additional information regarding facility alignment, size and type.

Four conceptual alternative facilities were identified for the control of flooding within the Range Wash watershed. These facilities were developed in coordination with the City of North Las Vegas, the Clark County Regional Flood Control District, and the other agencies identified and involved in the project. These alternatives were selected to reconcile the identified technical, economic, political and aesthetic considerations within the watershed.

The evaluation of the four conceptual alternatives included locating, sizing and cost estimating the various component facilities. Because of the conceptual nature of this analysis simplifying assumptions were made to identify the most attractive alternatives for further study. These assumptions include the use of simplified hydrologic techniques, consistent with the conceptual level of analysis, to size facilities and evaluate their impacts. Normal flow assumptions are used for the sizing of channels, pipes and culverts and alignments in general corridors, rather in specific locations, are considered. The conceptual evaluation established relative facility locations, sizes and costs and, in conjunction with other nontechnical considerations, allowed for the selection of certain alternatives for further evaluation.

Two of the four conceptual alternatives were selected for further refinement. This refinement effort included a more detailed hydrologic impact assessment, more site-specific facility sizing, more extensive hydraulic analysis, more detailed cost estimate preparation and the preparation of conceptual designs. The conceptual design included sizing of hydraulic structures including bridge and street crossings, a determination of the hydraulic grade line through the proposed facilities, and a determination of a conceptual vertical alignment of the proposed facilities. Facilities sized and located in this conceptual design process were included in the detailed hydrologic model to assess their impacts on the overall system. Modifications and refinements to facilities were made as a result of the detailed modelling.

In addition to the conceptual design of the facilities, estimates of probable right-of-way requirements for the alternatives were included. This information, along with the general details of the conceptual design, are presented on plan and profile sheets.

This report summarizes the analysis and evaluations performed for the project. A discussion of the approach, results and conclusions is included along with a brief discussion of the alternatives, and a presentation of the conceptual design plan and profile drawings. Included in the report is a phasing plan to facilitate the implementation of the Plan.

EXISTING DATA

Data from several sources was collected which might effect the feasibility and economics of the various alternative facilities. Sources for the data included governmental agencies such as the City of North Las Vegas, Clark County Public Works Department, Clark County Regional Flood Control District, and Clark County Comprehensive Planning. Other governmental agencies were contacted to identify and collect additional information. These agencies included Nellis Air Force Base, the Federal Emergency Management Agency, and the U.S. Army Corps of Engineers. Utility information was also collected from the various utility companies within the watershed including the Clark County Sanitation District, Nevada Power Company, Southwest Gas Corporation, and telephone and cable TV companies. The information obtained from the various sources was important in identifying the extent of existing facilities within the watershed. Existing drainage improvements were also identified. These included existing channels, street crossings and existing detention facilities which might be utilized for alternative plans.

Land uses within the watershed were perhaps the most important constraint to proposed facilities. Land-use information identified both the character and type of existing development, as well as proposed development locations and extent. Existing land uses within the watershed were identified using combinations of available mapping, area photographs, and field reconnaissance. This information was supplemented by existing hydrologic and planning studies available for the basin. Future land-use information was obtained from the City of North Las Vegas Land-Use Plan, Clark County Comprehensive Planning, and the previous studies. This information was compiled and presented to the City of North Las Vegas and the other interested agencies for review and comment. Subsequent to the initial collection effort, the City of North Las Vegas provided amended land-use plans which resulted in a slight modification of development limits and facility sites. This information was utilized to identify feasible alignments and facility sites.

EXISTING BASIN DESCRIPTION

The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley. The watershed drains a western tributary and an eastern tributary. The Range Wash basin is tributary to Las Vegas Wash with its outfall near the Sunrise Station Power Plant. Flow in the basin is generally from north to south. The Western Tributary watershed headwaters are in the uplands of the Las Vegas Mountain Range. Runoff leaving the Las Vegas Mountain Range flows across an alluvial fan in a southerly direction and is intercepted by a Union Pacific Railroad line and Interstate 15. After crossing these roads, flow is in a general southeasterly direction to the southern portion of Nellis Air Force Base where it joins flows from the Eastern Tributary. Eastern tributary flows begin in the lower portions of the Las Vegas Mountain Range in the Las Vegas Dunes Recreational Lands area just to the northeast of the intersection of Interstate 15 with Las Vegas Boulevard north. Flow from this area is generally to the south or southwest and passes along the eastern border of the Nellis Air Force Base main base area. Here flows combine and flow in a southwesterly direction to the southern portion of Nellis Air Force Base where they join with Western Tributary flows. Combined flows then proceed southward along the Sloan Channel to the ultimate outfall into Las Vegas Wash.

The watershed consists of three distinct regions: the northern and eastern mountainous areas; the central alluvial fan, and; the downstream developed basin. The mountainous areas are rugged and steep with nominal vegetation and high runoff potential. The alluvial fan area is characterized by numerous small incised channels across the steep alluvial fan areas. The downstream developed areas of the watershed are combinations of residential and commercial developments.

At the transition from the alluvial fan areas to the downstream developed areas lies Nellis Air Force Base. This property is affected by flows from both the Western Tributary and the Eastern Tributary of Range Wash. Nellis is somewhat protected by the presence of Interstate 15, the Union Pacific Railroad, and Las Vegas Boulevard North. Crossings of these streets or railroads concentrate flows and subject the Air Force Base to concentrated flows.

Existing drainage facilities within the Range Wash basin are relatively limited. Sloan Channel improvements are designed and partially constructed. This affords some limited protection to downstream properties. The Vandenberg Channel, immediately downstream of I-15, is another improved section of the channel. Nellis Air Force Base has completed improvements to several segments of the channel in and around the Air Force Base for the protection of Air Force property. Beyond these channel structures, the improvements are generally limited to street

and railroad crossing structures which are frequently inadequate to convey the full 100-year flows. The Clark County Regional Flood Control District Master Plan has identified several facilities to control runoff from the Western and Eastern tributaries of Range Wash. These facilities are incorporated into the alternatives evaluated. The facilities proposed in the Regional Flood Control District Master Plan have not been designed or constructed.

Chapter 1

Hydrol...

II - HYDROLOGY

INTRODUCTION

Hydrologic analyses were performed for the Western and Eastern Tributaries of Range Wash upstream of Las Vegas Wash. The purpose of these analyses was to update past hydrologic studies and to develop detailed hydrology for the evaluation and of sizing facilities in the Range Wash watershed.

The Clark County Regional Flood Control District Master Plan developed hydrology for the entire Clark County area including Range Wash. This effort, while comprehensive in scope, was predicated on a number of generalized regional assumptions. These assumptions render the flows developed for individual watersheds inadequate when evaluating site specific facilities.

The U.S. Army Corps of Engineers developed a computer model for the Las Vegas Valley which was based on the Master Plan model. This model refined some of the regional assumptions used in the Master Plan and is more useful in evaluating site specific facilities. The Corp of Engineers model did not provide a sufficient level of discretization, nor did it utilize sufficient detail in representing rainfall losses, to be used without modification in this study.

The following sections present Boyle's approach in the development of a hydrologic model for the Western and Eastern Tributaries of Range Wash including methodologies, assumptions and results of the analyses. The adopted methodologies are based on the Hydrologic Memorandum submitted on March 27, 1989.

MODELING APPROACH

The hydrologic model utilized was the Flood Hydrograph Package (HEC-1) developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center. HEC-1 is a rainfall-runoff event simulation model which uses an interconnected system of hydrologic and hydraulic components to simulate the surface runoff response of a drainage area to precipitation. This package has been used in many previous studies in the Las Vegas Valley, including the Master Plan and the Corps of Engineers Feasibility Study.

The Clark County Regional Flood Control District (CCRFCD) procedure for determining rainfall amounts and distributions was used to develop estimates for the 10-, 25-, 50- and 100-year storms. Hydrometerological Report No. 49 (HMR-49) was used to develop the estimated rainfall for the probable maximum precipitation (PMP) event.

The USDA Soil Conservation Service (SCS) curve number methodology was used to estimate loss rates because it provides a deterministic method based on soil type and cover. The SCS dimensionless unit hydrograph methodology was used to develop runoff hydrographs for predominantly undeveloped subbasins north of Interstate 15 and east of the developed metropolitan area. The kinematic wave overland flow plane methodology was used to generate hydrographs for developed subbasins.

Kinematic wave flood routing was used to route flow along channel segments having well defined channels. The Muskingum method was used for routing flows across alluvial fans and in subbasins with poorly defined or undersized channels. Little attenuation is expected when using the kinematic wave method which is consistent with flow through well defined, adequately sized channels. In other channel reaches, overbank storage effects are considerable and can best be accounted for through use of the Muskingum method.

The model was then calibrated by adjusting the curve numbers through modification of the Antecedent Moisture Condition assumptions until the regionally-calibrated Corps of Engineers computed probability discharge estimates were achieved.

Subsequent to the completion of the hydrologic modelling, CCRFCD adopted new criteria which revised some of the basic information used as input into hydrologic models. The most significant revision affecting this study was the adoption of a revised areal reduction relationship. Because the results of the hydrologic modelling effort under taken for this project are calibrated to the Corps of Engineers' computed discharges, and because future modelling efforts will generally be required to yield similar results, no attempt was made to revise the model.

A concurrent project for the CCRFCD to update the Las Vegas Valley Master Plan also included a hydrologic modelling effort. As expected, that study yielded results similar to those presented in this report. Some differences in basin routing were identified in that study, however no changes in the identified facilities or facility sizes result from those differences.

BASIN CHARACTERISTICS

Subbasin Delineation

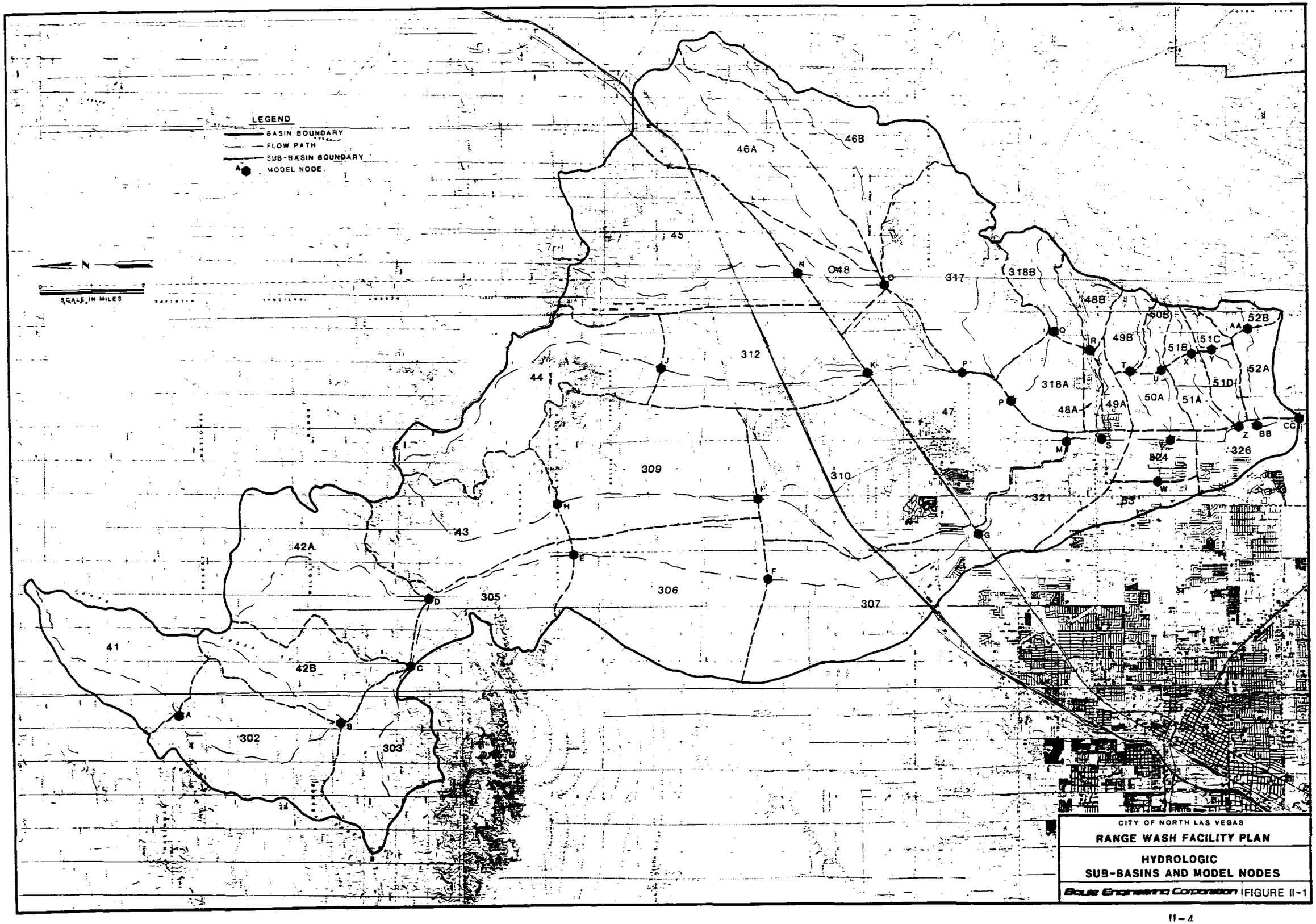
The watershed was delineated and subdivided into 38 separate subbasins ranging in area from approximately one-half to ten square miles. The subbasin locations are presented in Figure II-1. Individual subbasin areas, in addition to other information, have been tabulated in Table II-3. Subbasin boundaries and their designation are generally based upon delineations and names used by the Corps of Engineers (COE) Feasibility Study and the CCRFCD Master Plan. Boundaries were adjusted and new subbasins added to provide a more detailed simulation of watershed response.

Hydrologic points of interest (nodes) such as confluences, possible structure locations and outfall points were identified. A schematic diagram of the subbasins, nodes and routing links is presented in Figure II-2.

Precipitation

Point precipitation values were obtained for the 10-, 25-, 50-, and 100-year recurrence interval storms using the NOAA Atlas 2, "Precipitation - Frequency Atlas of the Western United States, Volume VII - Nevada", (NOAA Atlas) as presented in the Draft Rainfall for the Clark County Regional Flood Control District Area manual (Draft CCRFCD manual). Table II-1 lists the NOAA point precipitation values for each recurrence interval storm by subbasin.

In accordance with procedures outlined in the Draft CCRFCD Manual, point precipitation values were modified to account for rainfall records not available at the time of NOAA Atlas publication. The COE, Los Angeles District (LACOE) developed ratio adjustments for various recurrence intervals which were used to modify the NOAA values to arrive at the point rainfall values used as the basis for model simulation precipitation. The ratios are listed in Table II-2.

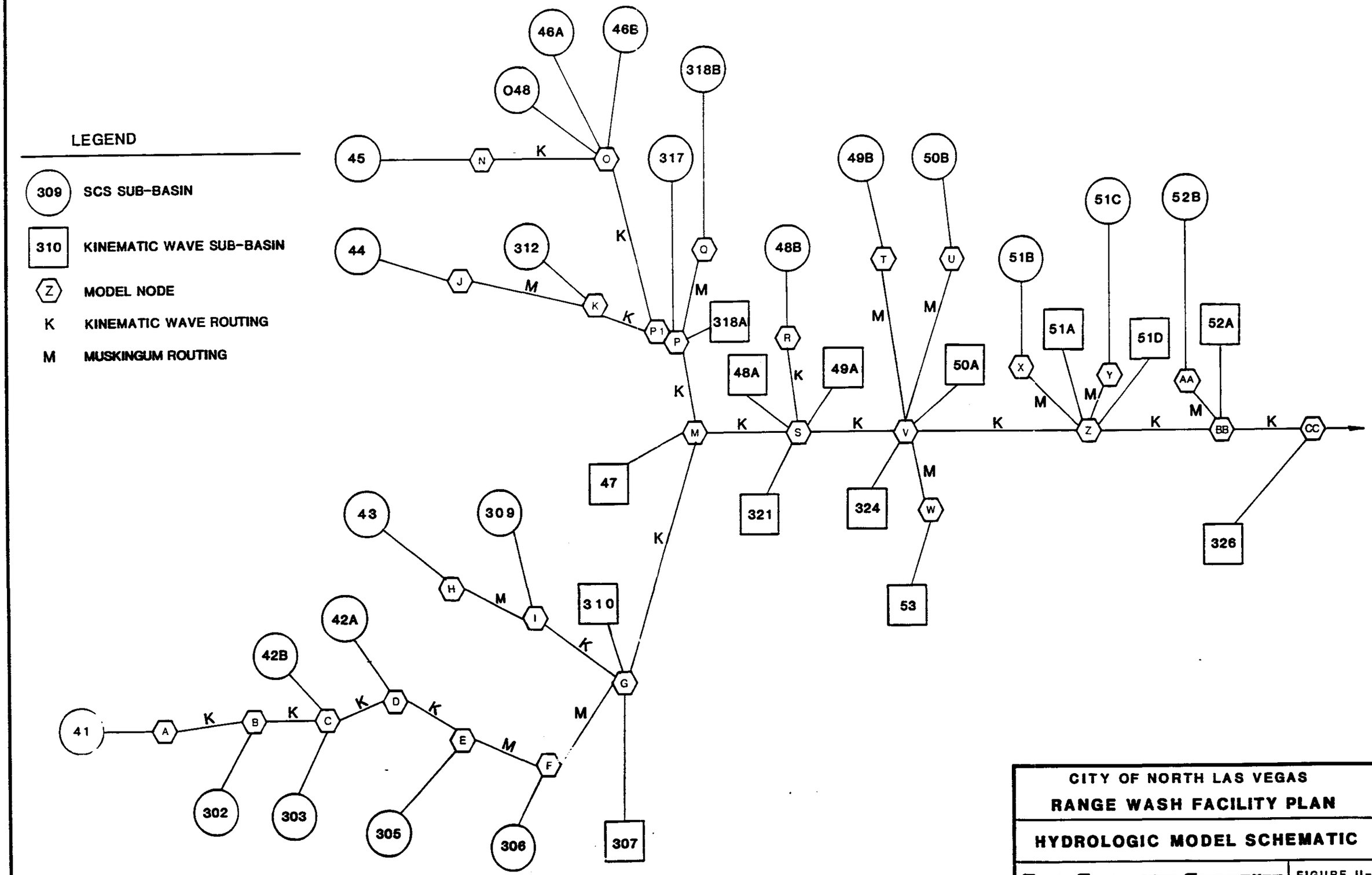


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

HYDROLOGIC SUB-BASINS AND MODEL NODES

Boyle Engineering Corporation | FIGURE II-1



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

HYDROLOGIC MODEL SCHEMATIC

Boyle Engineering Corporation | FIGURE II-2

TABLE II-1

NOAA ATLAS POINT PRECIPITATION BY SUBBASIN
(Inches)

Subbasin ID	Recurrence Interval 10-YR	25-YR	50-YR	100-YR
41	1.65	1.95	2.20	2.40
302	1.60	1.85	2.10	2.30
42A	1.50	1.75	2.00	2.20
42B	1.50	1.80	2.00	2.20
303	1.45	1.70	2.00	2.15
305	1.35	1.60	1.80	2.00
43	1.40	1.60	1.80	2.00
44	1.40	1.60	1.80	2.00
306	1.30	1.60	1.80	2.00
309	1.30	1.60	1.80	2.00
312	1.35	1.60	1.80	2.00
451	1.40	1.70	1.90	2.00
46A	1.45	1.75	1.90	2.10
46B	1.45	1.75	1.90	2.10
O48	1.40	1.70	1.80	2.00
307	1.30	1.60	1.80	2.00
310	1.30	1.60	1.80	2.00
47	1.40	1.70	1.80	2.00
317	1.50	1.80	2.00	2.20
321	1.30	1.60	1.80	2.00
53	1.50	1.60	1.80	2.00
318	1.45	1.75	1.95	2.05
318B	1.50	1.85	2.00	2.20
48A	1.40	1.75	1.90	2.05
48B	1.50	1.80	2.00	2.10
49A	1.40	1.70	1.90	2.00
49B	1.40	1.80	1.95	2.05
324	1.35	1.65	1.85	2.00
50A	1.40	1.70	1.90	2.00
50B	1.40	1.80	2.00	2.10
51A	1.40	1.70	2.00	2.05
51B	1.40	1.75	1.90	2.00
51C	1.40	1.75	2.00	2.05
51D	1.40	1.65	1.90	2.00
52A	1.40	1.65	1.90	2.00
52B	1.40	1.70	1.95	2.00
326	1.35	1.60	1.80	2.00

TABLE II-2

PRECIPITATION-FREQUENCY ADJUSTMENT RATIOS

Recurrence Frequency	Ratio to NOAA Atlas
2-year	1.000
5-year	1.161
10-year	1.241
25-year	1.328
50-year	1.387
100-year	1.430

Temporal and Areal Rainfall Distribution

The 6-hour design storm duration was chosen for modeling purposes. This storm duration represents the local storm generally accepted for detention facility sizing and, because of the rainfall distribution, also results in acceptable peak flow estimates.

Five different storm distributions, each assigned a Storm Distribution Number (SDN), have been developed by the LACOE. The appropriate SDN was utilized based on the size of the contributing drainage area and storm recurrence interval. SDN 5, the least intense distribution, was used for all analyses since even the partial basin simulations included a drainage area consistent with the SDN 5 distribution assumption.

The rainfall depths listed in Table II-1 represent NOAA point rainfall values. The NOAA point rainfall values were increased to reflect the Table II-2 ratios and further adjusted to areal rainfall values using Depth Area Reduction Factors (DARF) from the CCRFCD manual for each specific storm areal extent and location.

Several rainstorms were evaluated to estimate peak flows from storms of different areal extent located over different portions of the basin. The DARF was adjusted to reflect tributary subbasins and only appropriate sub-basins were modeled in each storm simulation. To represent a rainstorm over the entire basin, "Total Basin Storm", a DARF equal to 0.62 was used

to reduce the point precipitation values over all subbasins. This storm also was used to simulate peak flows at the confluence of the Eastern and Western tributaries.

The "Upland Storm" simulation represents a rainstorm over the upland part of the basin which is tributary to the proposed detention facility sites identified in the Master Plan for each tributary. This consists of the currently undeveloped portion of the basin. This area is also above the probable development limits and is expected to remain largely undeveloped due to the mountainous terrain. A DARF of 0.72 was used in the simulation to adjust rainfall in each tributary above the identified detention basin sites.

The "Tributary Basin Storm" represents a storm located over each tributary. A DARF of 0.68 was used for this simulation and represents rainfall over each tributary basin individually. This storm is intended to represent the maximum flows in each tributary and can be used to determine the temporal distribution of runoff from each tributary.

The final storm "Lower Basin Storm" represents a rainstorm over the lower portion of the basin. This area is subject to intense development and potentially high unit runoff. For this simulation, it was assumed that no rainfall occurs in the upper portion of the basin and that the lower watershed is the only contributor of runoff. A DARF of 0.69 was used to simulate this storm.

Figure II-3 presents the coverage of the various storms in a schematic manner.

Probable Maximum Precipitation

The probable maximum precipitation estimate was determined using HMR-49, titled "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages", prepared by the U.S. Department of Commerce and the U.S. Department of Army, reprinted in 1984. The local storm procedure was used to develop the amounts and distribution for the 6-hour probable maximum precipitation (PMP) for both 40 square-mile basins above the two identified detention facility sites. The 6-hour precipitation of 10.35 inches was applied to each subbasin in the probable maximum flood (PMF) analysis.

SUBBASIN INPUT PARAMETERS

Curve Numbers and Loss Rates

Vegetative interception, depression storage, and infiltration are collectively referred to in the HEC-1 model as precipitation losses. The SCS curve number method was selected for use in

RANGE WASH
STORM SCHEMATIC

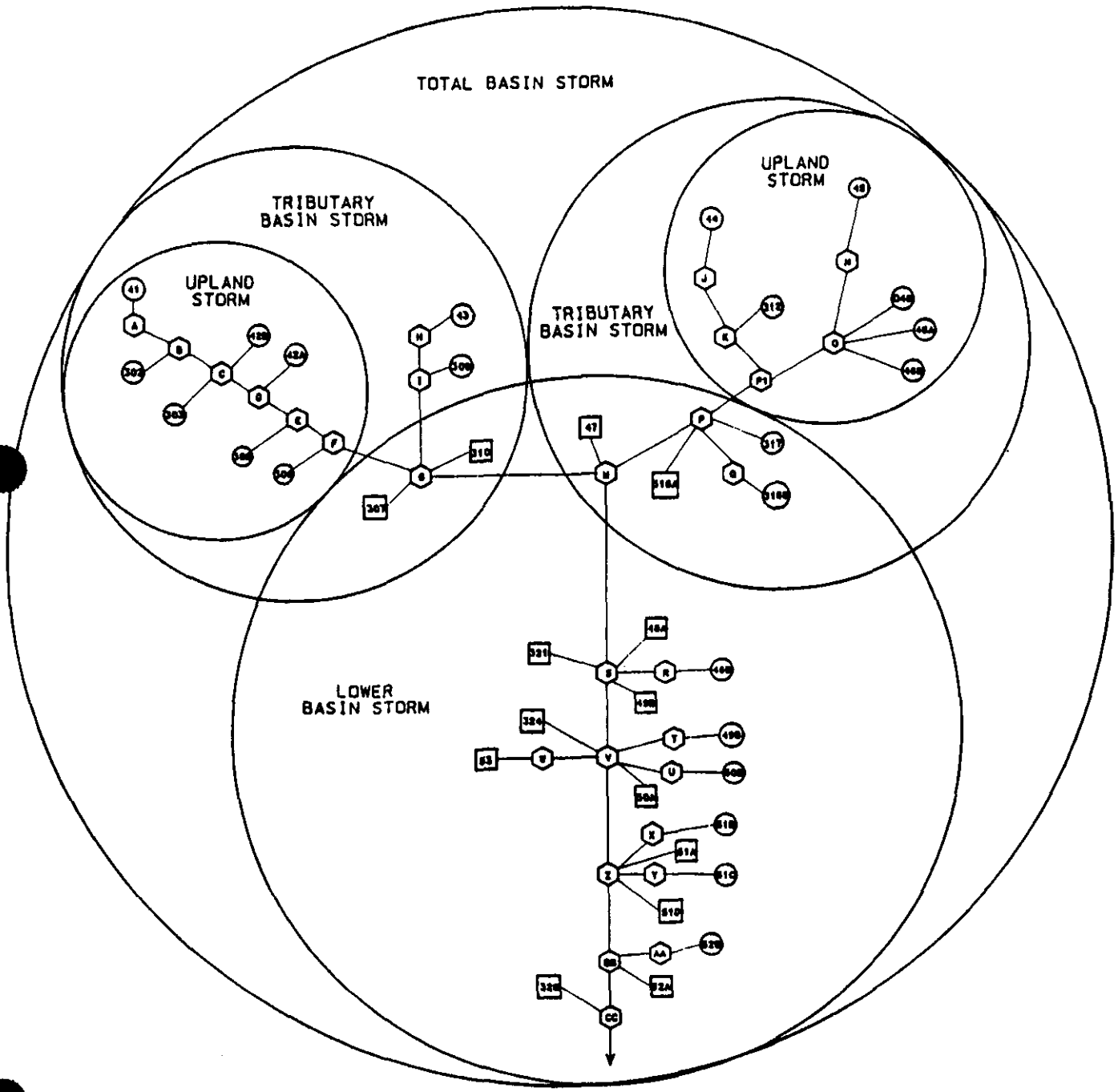


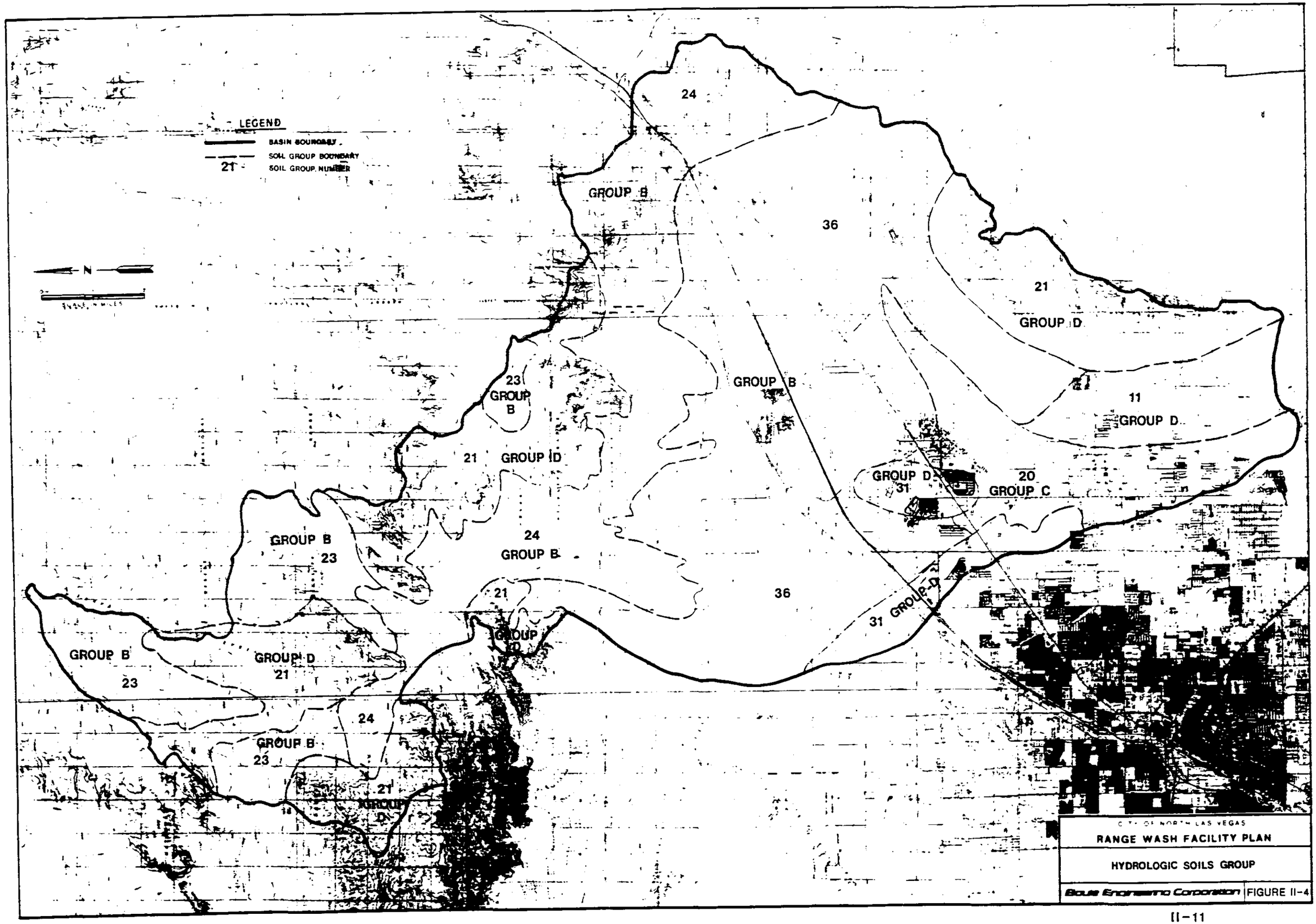
FIGURE II-3

estimating those losses. In this method, losses are related to the drainage characteristics of the soil and the land cover using the curve number, and are a function of the rainfall depth at each time step. Curve numbers were assigned to each subbasin based upon their predominant soil type, land use, type and quality of vegetation, and degree of development. The hydrologic soils group for the soils within the watershed are depicted on Figure II-4. These curve numbers represent runoff conditions assuming antecedent moisture condition (AMC) 2, the average condition. AMC 2 curve numbers for each subbasin are presented, along with other parameters, in Table II-3.

For subbasins modeled using the SCS Unit Hydrograph procedure, AMC 2 curve numbers were assigned using hydrologic soil group and cover information provided by Clark County SCS personnel. Composite subbasin curve numbers were developed using a weighted average of individual curve numbers representing different soil types and covers. It was assumed that vegetative cover was "open brush" in fair to poor condition for all undeveloped subbasins which were modeled using this procedure. The resulting curve numbers are consistent with other common cover types such as desert shrub.

Curve numbers (AMC 2) for developed areas were assigned using guidelines in "Urban Hydrology for Small Watersheds" (TR-55) by the Soil Conservation Service. Curve number for the kinematic wave basins were assigned using a procedure similar to that used in the SCS subbasins. For pervious areas, a composite curve number was developed using a weighted average of individual curve numbers for different soil types and, vegetation types and, densities.

The impervious percentage of each subbasin was estimated based on the degree and type of development. For SCS Unit Hydrograph subbasins, the impervious area was used in the development of the composite subbasin curve number. This method was chosen over entering the percent impervious in the model since the SCS Unit Hydrograph methodology assumes impervious areas are directly connected to the outfall and produce instantaneous runoff. In the watershed, the impervious areas are distributed and frequently flow across pervious lands. Modifying the curve number more uniformly distributes the impervious areas over the entire subbasin. For kinematic wave subbasins the actual impervious area percentage is used as an input parameter. An AMC 2 curve number of 98 was used for impervious areas.


LEGEND
BASIN BOUNDARY
SOIL GROUP BOUNDARY
21 SOIL GROUP NUMBER
N
24
GROUP B
36
21
GROUP D
23
GROUP B
GROUP B
11
GROUP D
21 GROUP D
GROUP D
31
20
GROUP C
GROUP B
23
24
GROUP B
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GROUP D
36
31 GROUP D
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GROUP D
21
24
GROUP B
23
21
GROUP D
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
HYDROLOGIC SOILS GROUP
Boyle Engineering Corporation
FIGURE II-4

TABLE II-3

SUBBASIN HYDROGRAPH PARAMETERS

Subbasin Number	Area (Sq.Mi.)	Runoff Method	PRESENT CONDITIONS Imperv. (%)	PRESENT CONDITIONS AMC 2 Curve Number	PRESENT CONDITIONS LAG (hr)	FUTURE CONDITIONS Imperv. (%)	FUTURE CONDITIONS AMC 2 Curve Number	FUTURE CONDITIONS LAG (hr)
41	4.73	SCS	0	79	.66	0	79	.66
302	6.14	SCS	0	79	.82	0	79	.82
42 A	8.23	SCS	0	79	.81	0	79	.81
42 B	4.08	SCS	0	79	.65	0	79	.65
303	4.49	SCS	0	85	.54	0	85	.54
305	3.99	SCS	0	85	.76	0	85	.76
43	6.40	SCS	0	79	.88	0	79	.88
44	7.23	SCS	0	79	1.22	0	79	1.22
306	9.04	SCS	0	76	2.00	0	83	1.61
309	9.24	SCS	0	79	1.51	0	79	1.51
312	6.77	SCS	0	77	2.83	0	77	2.83
45	10.73	SCS	0	76	1.31	0	76	1.31
46 A	7.35	SCS	0	77	1.60	0	77	1.60
46 B	6.02	SCS	0	77	1.71	0	77	1.71
048	2.07	SCS	0	76	1.97	0	76	1.97
307	8.07	Kin	11	78	--	49	77	--
310	9.14	Kin	11	78	--	32	77	--
47	7.40	Kin	26	78	--	31	77	--
317	7.66	SCS	0	80	.97	0	80	.97
321	3.42	Kin	22	78	--	46	76	--
53	1.44	Kin	30	77	--	44	77	--
318 A	2.19	Kin	11	78	--	26	77	--
318 B	1.86	SCS	0	87	.37	2	87	.37
48 A	.49	Kin	23	78	--	27	77	--
48 B	.99	SCS	0	87	.24	2	87	.24
49 A	.60	Kin	20	78	--	27	77	--
49 B	1.04	SCS	0	87	.25	9	88	.24

TABLE II-3 (continued)

SUBBASIN HYDROGRAPH PARAMETERS

Subbasin Number	Area (Sq.Mi.)	Runoff Method	PRESENT CONDITIONS Imperv. (%)	PRESENT CONDITIONS AMC 2 Curve Number	PRESENT CONDITIONS LAG (hr)	FUTURE CONDITIONS Imperv. (%)	FUTURE CONDITIONS AMC 2 Curve Number	FUTURE CONDITIONS LAG (hr)
324	1.40	Kin	26	77	--	44	77	--
50 A	1.78	Kin	11	78	--	27	77	--
50 B	.55	SCS	0	87	.17	11	88	.16
51 A	.99	Kin	14	78	--	27	77	--
51 B	.47	SCS	0	87	.13	8	88	.12
51 C	.43	SCS	0	87	.19	3	87	.19
51 D	.83	Kin	12	78	--	23	77	--
52 A	1.18	Kin	7	78	--	9	78	--
52 B	.70	SCS	0	87	.11	0	87	.11
326	1.71	Kin	20	78	--	27	77	--

Unit Hydrograph Parameters

The SCS Unit Hydrograph runoff option in HEC-1 requires input of the SCS lag, which is equal to the time in hours between the center of mass of rainfall excess and the peak of the unit hydrograph.

The SCS curve number method, as presented in the SCS National Engineering Handbook, Section 4 - Hydrology, was used for calculating lag time. In this method, lag time is a function of the hydraulic length, the slope of the watershed, and the subbasin curve number. The following equation was used to calculate subbasin lag times:

$$L = \frac{l^{0.8}\,(s + 1)^{0.7}}{1900\,Y^{0.5}}$$

Where:
- L = lag in hours
- l = hydraulic length of watershed in feet
- s = $\frac{1000}{CN} - 10$ where CN is the subbasin curve number
- Y = average watershed land slope in percent.

This equation was used to represent basin lag rather than other equations (e.g.. the COE lag equation) because of its application to generally undeveloped subbasins. The COE method, provided comparable lag times in the upper watersheds but resulted in significantly shorter lag times in the flat undeveloped subbasins on the fan. The SCS equation, having been developed for flatter agricultural and range lands, was more representative for use in this study. Developed subbasins for which the SCS equation may not be as applicable are modeled using the kinematic wave overland flow methodology which does not require the input of lag times.

Values for l and Y were determined from USGS 7.5 minute quadrangle maps. Table II-3 presents the calculated lag time.

Kinematic Wave Parameters

For determination of subbasin runoff using the kinematic wave option in HEC-1, information is required about overland flow planes, collector channels and a main channel. Both pervious

and impervious overland flow elements are provided to represent runoff from the subbasin area. Sub-collectors, collectors, and the main channel represent the drainage network in the subbasin. For subbasin runoff generation, basin area, percentage of the area that is impervious, and the length, slope and roughness of pervious and impervious overland flow planes are required input. Percent impervious for each subbasin is presented in Table II-3. Runoff from these flow planes is routed through the drainage network. Parameters used for routing are channel length, slope, roughness, cross-sectional geometry and the contributing area to a typical sub-collector or collector. The kinematic wave parameters were estimated from the USGS 7.5 minute quadrangle maps.

In general, the impervious areas were modeled as having an overland flow length of approximately 50 feet for residential development, to reflect flow length from roof to street flow-line, and 300 feet in commercial and industrial developments, which represents significant parking lot overland flow. A roughness coefficient of 0.1 was used to represent shallow overland flow across impervious areas.

Pervious surface overland flow lengths range between 600 and 800 feet and reflect lawn flow in developed areas or overland flow prior to gully formation in undeveloped areas. A roughness coefficient of 0.2 was used for undeveloped areas and 0.3 for developed lawn areas.

Collector systems in undeveloped areas consisted of small washes. These were modeled in a manner consistent with COE's model using small trapezoidal sections. Developed area collector systems included street sections or improved channels and were modeled to represent actual physical geometry.

FLOOD ROUTING

The kinematic wave flood routing option was used for routing links having well defined, adequate channels. This assumes that there is little floodplain or channel storage and that slopes are steep resulting in the energy grade line slope equalling the ground slope. In areas where this assumption is not appropriate, particularly across the alluvial fan and in developed areas where the drainage system is undersized, the Muskingum storage routing method is used. This method assigns a storage factor to account for the expected attenuation of flows. This study uses the COE values as initial estimates with modification to reflect changes in subbasin delineation and character. Values range from 0.15 for channel reaches across the fan which have some storage in the overbank but few obstructions, to 0.10 for inadequate channels

in developed basins where overbank flows would encounter numerous obstructions and consequently be significantly attenuated.

Kinematic Wave Flood Routing

The kinematic wave approach to channel routing requires the estimation of channel lengths, slopes, average bottom widths, side slopes, and Manning's "n" values. Channel lengths and slopes were estimated from the USGS 7.5 minute quadrangle maps. Average bottom widths, side slopes and "n" values were estimated from mapping, construction drawings, former studies and observations. Length and slope for each routing link, including Muskingum reaches, are presented in Table II-4.

Muskingum Flood Routing

The Muskingum approach to flood routing requires estimation of coefficients that reflect flood wave travel time and channel storage. The "K" factor which approximates flood wave travel time was estimated by the COE in their Feasibility Study. This value is dependent upon length, computational interval and estimated velocity. The "X" values were assigned based on the relative importance of channel storage, with 0.10 for significant storage and 0.15 for lesser degrees of storage. X values for each routing link are presented in Table II-4.

TABLE II-4

ROUTING PARAMETERS

ROUTING LINK	ROUTING METHOD	DISTANCE (feet)	SLOPE (feet/feet)	MUSKINGUM "X"
A-B	Kin	19100	.0455	--
B-C	Kin	9910	.0504	--
C-D	Kin	7000	.0571	--
D-E	Kin	16200	.0414	--
E-F	Musk	20100	.0398	.10
F-G	Musk	32550	.0106	.10
H-I	Musk	20700	.0360	.10
J-K	Musk	21200	.0244	.15
I-G	Kin	24000	.0118	.15
G-M	Kin	15800	.0035	--
N-O	Kin	9550	.0157	--
K-P	Kin	17400	.0052	--
O-P	Kin	18600	.0051	--
Q-P	Musk	8100	.0290	.15
P-M	Kin	7400	.0034	--
R-S	Kin	9100	.0316	--
M-S	Kin	4600	.0028	--
T-V	Musk	8600	.0214	.10
U-V	Musk	7200	.0269	.10
W-V	Musk	6000	.0010	.10
S-V	Kin	6800	.0038	--
X-Z	Musk	8900	.0299	.10
Y-Z	Musk	9000	.0229	.10
V-Z	Kin	7780	.0041	--
AA-BB	Musk	10300	.0206	.10
Z-BB	Kin	2680	.0045	--
BB-CC	Kin	4000	.0055	--

BASIN DEVELOPMENT

General

The hydrologic analysis was performed for both existing basin development and future basin development. Existing conditions reflect present land use and development currently underway. This level of development is generally unchanged from that presented in the Master Plan.

Future conditions refers to the projected extent of development within the Study Area by the year 2055. It represents ultimate development as foreseen today. The boundary of future development was determined using projections from several sources. The boundary used by the COE in their Feasibility Study was adjusted using information from the City of North Las Vegas's Land Use Plan and the Economic Development Department regarding areas of future development in and around the City. COE development limits and those used in this study are shown on Figure II-5. Zoning information from the Clark County Comprehensive Planning Department was used to identify the type and extent of future development.

Future Basin Model

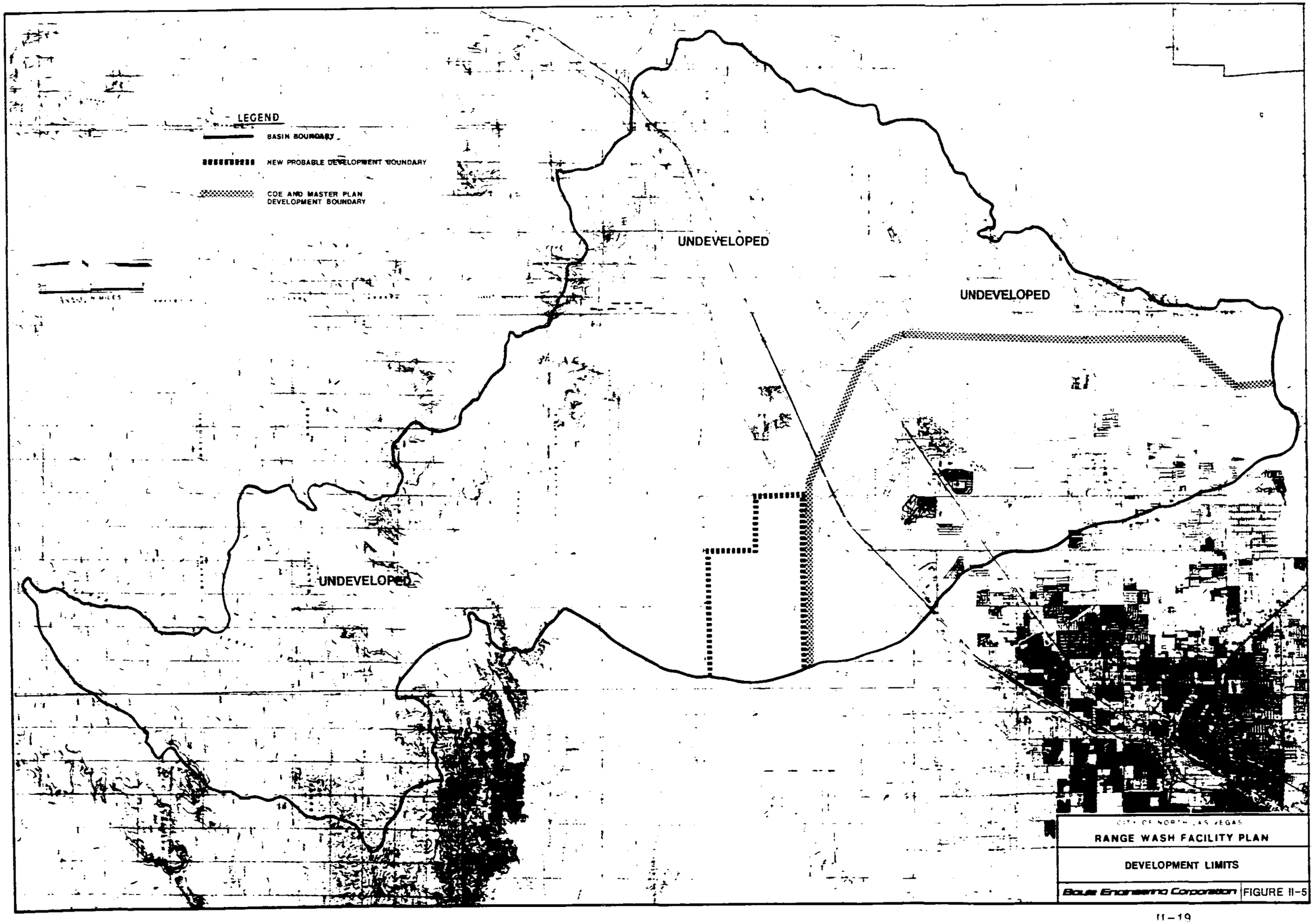
Using the information regarding future land use type and extent, estimates were made of the future amounts of impervious surface, future curve numbers, and changes to the kinematic wave runoff parameters. Future development will increase the amount of impervious surface within a subbasin. The SCS unit hydrograph methodology was selected for basins that would remain generally unchanged after development and therefore model changes were generally nominal and resulted in minor, or no, changes in the curve number. For subbasin 306, the future development scenario calls for virtually full development of a currently undeveloped basin. Runoff characteristics of this basin changed considerably reflecting the significant change between the present and future condition.

In kinematic wave subbasins, increased development resulted in an increase in the percentage of the basin modeled as impervious. In some cases, when the dominant type of development charged, the overland flow characteristics were also changed to reflect altered flow lengths and flow characteristics. Where there was a significant degree of development proposed in a watershed, the pervious area curve number was adjusted downward to reflect a better vegetative cover which would result from improved watering and maintenance. Table II-3 presents the future percent imperviousness and curve numbers.

CALIBRATION

Comparison with Past Studies

Prior to calibration, simulation was performed for the 100-year storm using the parameters as discussed above for the present and future development conditions. The resultant peak flows at the Range Wash Outfall to Las Vegas Wash were 10,880 cfs and 11,380 cfs for the present and future conditions respectively. Table II-5 presents a comparison of Boyle's initial peak



CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
DEVELOPMENT LIMITS
Boyle Engineering Corporation | FIGURE II-5

flows at the Range Wash Outfall with those simulated by the COE in both their Computed and Expected Probability analyses, and with those from the CCRFCD Master Plan.

TABLE II-5

COMPARISON OF INITIAL SIMULATION RESULTS
RANGE WASH OUTFALL

Drainage Study and Point of Comparison	Drainage Area (sq. mi.)	Estimated Peak Flow (cfs)	Calculated Unit Peak Flow (cfs/sq. mi.)	Regional Curve Unit Peak Flow (cfs/sq. mi.)
Initial Boyle Node CC - present	150.8	10880	72	70
Initial Boyle Node CC - future		11380	75	70
COE-C CP1 - present	156.3	8000	51	70
COE-C CP1 - future		8350	53	70
COE-E CP1 - present	156.3	12000	77	70
COE-E CP1 - future		12500	80	70
M.P. RW-326	156.3	16410	105	70

"Initial Boyle" refers to this study before calibration.

"COE-E" refers to Corps of Engineers Feasibility Study, Expected probability flows.

"COE-C" refers to Corps of Engineers, Special Flood Hazard Study, Computed probability flows.

"M.P." refers to CCRFCD Master Plan, Ultimate Development Flows.

The Eastern and Western Tributaries of Range Wash and Range Wash itself are ungaged streams. There is little historical data available for use in calibrating peak flows in a computer model. There are however, several earlier hydrologic studies which attempted to utilize regional calibrated flood events. The most extensive historical and regional analysis was done by the COE as part of their Feasibility Study. The COE conducted an analysis of 36 stations in the California-Nevada desert area with record lengths of greater than 10 years. Using a flood-flow frequency analysis on this data, they developed a regional 100-year peak flow versus drainage area relationship for the Las Vegas Valley. The result of this analysis is a curve which provides a generally accepted range of flow for larger areas. While this curve lumps several hydrologically different watersheds together, the curve does represent an estimate against

which to check the reasonableness of values determined via modeling. Values from this curve are presented in Table II-5 as the Regional Curve Unit Peak Flow.

The COE used the earlier Master Plan model framework as the basis for their computer modeling of the Las Vegas Valley. They developed both Expected and Computed Probability discharge estimates, each based on separate and different statistical assumptions about the data and their reliability. Local governments in the Las Vegas Valley have adopted the Computed Probability estimated flows for regulation purposes within their jurisdictions.

As Table II-5 demonstrates, Boyle's initial peak flow estimates fall between the COE's Expected and Computed Probability estimates and correlate well with the COE regional curves.

In evaluating the differences between the study results presented in Table II-5, several factors appear to be relevant. First, the input parameters for the COE study and Boyle's study are based on many of the same physical assumptions. Routing parameters, subbasins, and routing structure are very similar. The approaches used to model loss rates, however, are different. The COE feasibility study used a constant loss rate whereas Boyle used the SCS curve number method. This has the effect of moderating Boyle's subbasin peak flows since peak losses occur at the time of peak rainfall rather than being constant. Boyle's model also provides a more site specific representation of factors affecting runoff peaks than does the COE model.

Another significant difference in the simulation efforts is the rainfall used in the models. The COE and Boyle used different depth area reduction factors to modify the point precipitation. COE used a DARF developed by their meteorologists which results in a divergence of rainfall amounts for areas over 100 square miles. This DARF curve is inconsistent with the curve presented in HYDRO-40 which is the generally accepted methodology within the Las Vegas Valley. For comparative purposes, Boyle used the COE DARF in the initial model developed for this study and achieved results comparable to the COE computed probability values. As previously identified, the CCRFCD has adopted the COE DARF, however, the final discharges will remain unchanged since the computed probability values are the calibration target.

Calibration Results

The COE calibrated their expected and computed probability model to the peak flow estimates developed from a statistical evaluation of regional gages. This approach forced COE to utilize the same constant loss rate throughout the Valley regardless of soil type or cover.

Calibration of Boyle's model to the COE computed probability peak flows was accomplished in a manner comparable to that used by COE. The Antecedent Moisture Condition (AMC) reflected in the curve numbers was adjusted, thereby effectively changing the losses throughout the watershed. This results in a match of the target computed probability value while maintaining the models ability to reflect varying basin soil and cover characteristics. Curve numbers used in the calibrated present development condition model represent an AMC of 1.8. Calibrated curve numbers are presented in Table II-6. A curve number of 97 was used for impervious areas rather than the 98 used in the initial model.

The projected limits of future development differ between the COE model and Boyle's model. In order to calibrate the Boyle future development model, the future development limit used in the COE model was modeled in Boyle's model. The curve numbers were adjusted by AMC revision until the peak flow at the outfall matched the COE Computed Probability estimate. Calibration of the future condition model resulted in the use of curve numbers representing an AMC of 1.8. The expanded development limits were then introduced into Boyle's model to reflect the information received from the City of North Las Vegas.

SIMULATION RESULTS

Simulations were performed for the 10-, 25-, 50- and 100-year rainfall events for both present and future levels of development. These simulations were run for the temporal and areal rainfall distributions discussed earlier: 1) DARF of 0.62 for the "Total Basin Storm"; 2) DARF of 0.72 for the "Upland Storm" used to model the tributaries to the Master Plan detention ponds; 3) DARF of 0.68 for the "Tributary Basin Storm" above the confluence of the Eastern and Western tributaries; 4) DARF of 0.69 for the "Lower Basin Storm", and; 5) the PMP. Table II-7 presents the resulting peak discharges and volumes for the identified points of interest on East Range Wash, West Range Wash, their confluence and the Range Wash Outfall. The simulated 100-year peak discharges at the Range Wash Outfall for the present and future development conditions, respectively, are 8,040 and 8,870 cfs. Figures II-6 through II-9 present graphical representation of the 100-year present and future development hydrographs.

TABLE II-6

CALIBRATED CURVE NUMBERS

Subbasin Number	AMC 2		Calibrated	
	Present	Future	Present	Future
41	79	79	76	76
302	79	79	76	76
42 A	79	79	76	76
42 B	79	79	76	76
303	85	85	82	81
305	85	85	82	81
43	79	79	76	76
44	79	79	76	76
306	76	76	72	80
309	79	79	75	75
312	77	77	73	73
45	76	76	72	72
46 A	77	77	73	73
46 B	77	77	73	73
048	76	76	72	72
307	78	77	74	73
310	78	77	74	73
47	78	77	74	73
317	80	80	76	76
321	78	76	74	72
53	77	77	73	73
318 A	78	77	74	73
318 B	87	87	84	84
48 A	78	77	74	72
48 B	87	87	84	84
49 A	78	77	74	72
49 B	87	88	84	85
324	77	77	73	73
50 A	78	77	74	72
50 B	87	88	84	85
51 A	78	77	72	73
51 B	87	88	84	85
51 C	87	87	84	85
51 D	78	77	72	72
52 A	78	78	74	74
52 B	87	87	84	85
326	78	77	74	72

TABLE II - 7

PEAK FLOW AND TOTAL VOLUME FOR PRESENT AND FUTURE DEVELOPMENT

POINT OF INTEREST	DRAINAGE AREA (sq. mi.)	10-YR PEAK (cfs)	10-YR VOL. (af)	25-YR PEAK (cfs)	25-YR VOL. (af)	50-YR PEAK (cfs)	50-YR VOL. (af)	100-YR PEAK (cfs)	100-YR VOL. (af)
UPLAND STORM DARF = 0.72									
West Range Wash Ponding Area (Node F)	40.7								
Present		1500	300	2800	590	4160	920	5600	1250
Future		1690	340	3140	660	4600	1020	6160	1360
East Range Wash Ponding Area (Node P1)	40.2								
Present		560	140	1370	360	2170	570	3000	790
Future		560	140	1370	360	2170	570	3000	790
TRIBUTARY BASIN STORM DARF = 0.68									
West Range Wash Tributary (G-M)	73.6								
Present								6400	1730
Future								7260	2180
East Range Wash Tributary (P-M)	51.9								
Present								3350	1010
Future								3370	1040

TABLE II - 7 (continued)

PEAK FLOW AND TOTAL VOLUME FOR PRESENT AND FUTURE DEVELOPMENT

POINT OF INTEREST	DRAINAGE AREA (sq. mi.)	10-YR PEAK (cfs)	10-YR VOL. (af)	25-YR PEAK (cfs)	25-YR VOL. (af)	50-YR PEAK (cfs)	50-YR VOL. (af)	100-YR PEAK (cfs)	100-YR VOL. (af)
ENTIRE BASIN STORM DARF = 0.62									
Confluence of East and West Range Wash (Node M)	132.9								
Present		1310	490	3200	1100	5380	1720	7700	2390
Future		1940	820	3700	1410	5950	2080	8350	2790
Range Wash Outfall (Node CC)	150.9								
Present		1350	600	3360	1320	5610	2040	8040	2780
Future		2300	1010	3950	1720	6340	2500	8870	3300
LOWER BASIN STORM DARF = 0.69									
Range Wash Outfall (Node CC)	54.4								
Present								4340	1480
Future								6330	1950

PROBABLE MAX PRECIPITATION		PEAK (cfs)	Vol. (af)
West Range Wash	40.7	105000	17000
East Range Wash	40.2	67900	16000

EAST RANGE WASH
UPSTREAM OF SLOAN CHANNEL
100-YR HYDROGRAPH (DARF=.68)

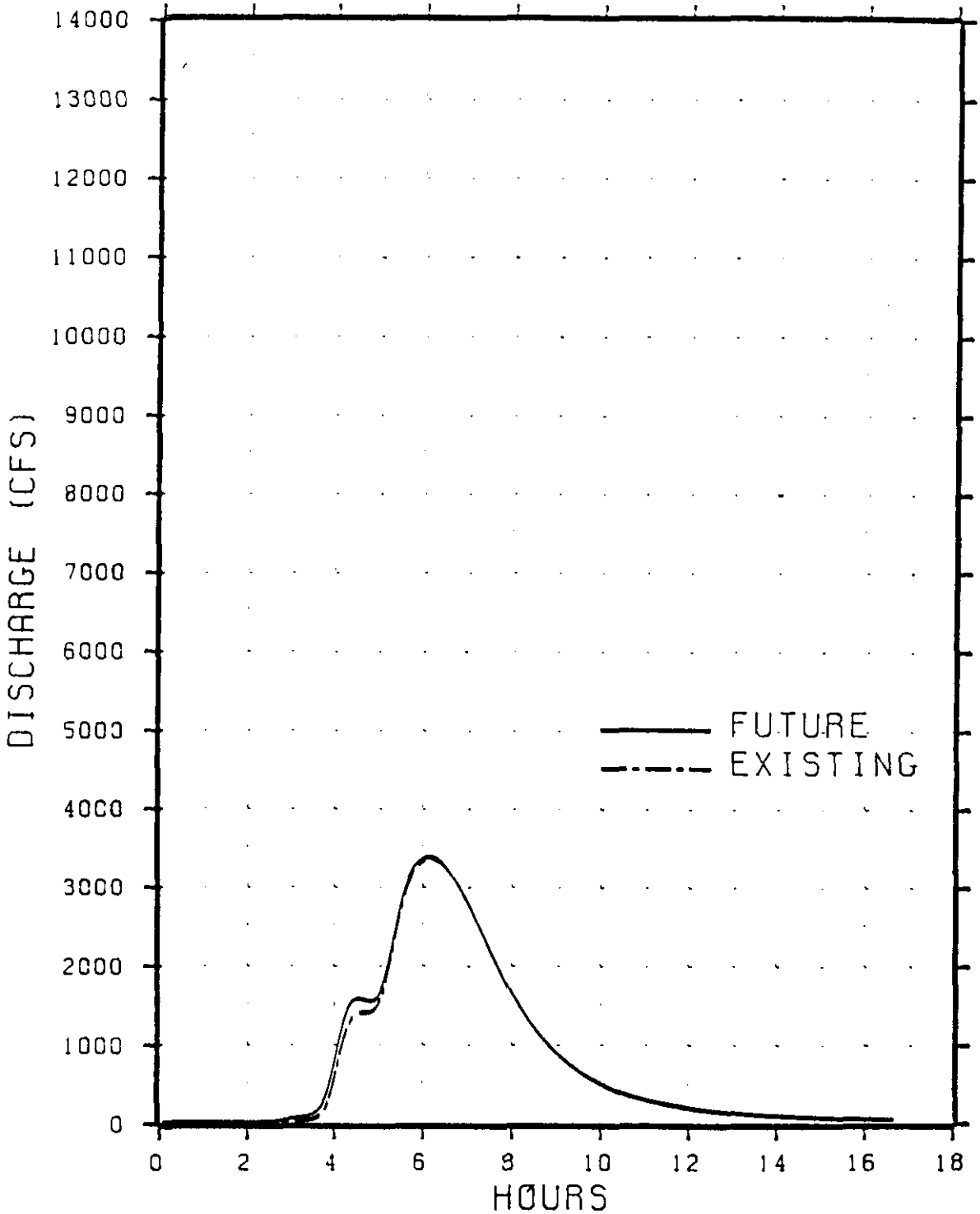


FIGURE II-6

Boyle Engineering Corporation

WEST RANGE WASH
UPSTREAM OF SLOAN CHANNEL
100-YR HYDROGRAPH (DARF=.68)

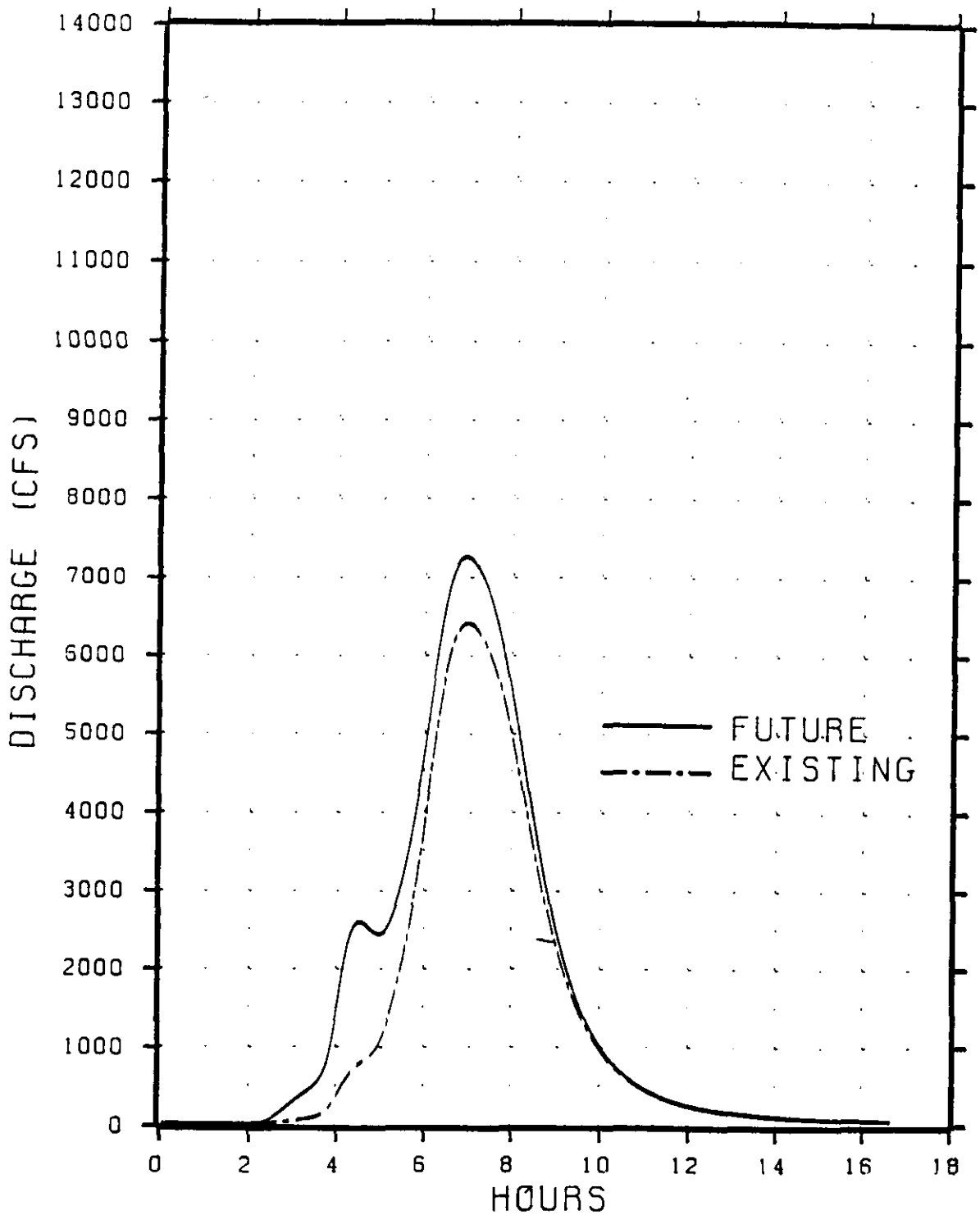


FIGURE II-7

Boyle Engineering Corporation

RANGE WASH OUTFALL
ENTIRE BASIN STORM
100-YR HYDROGRAPH (DARF=.62)

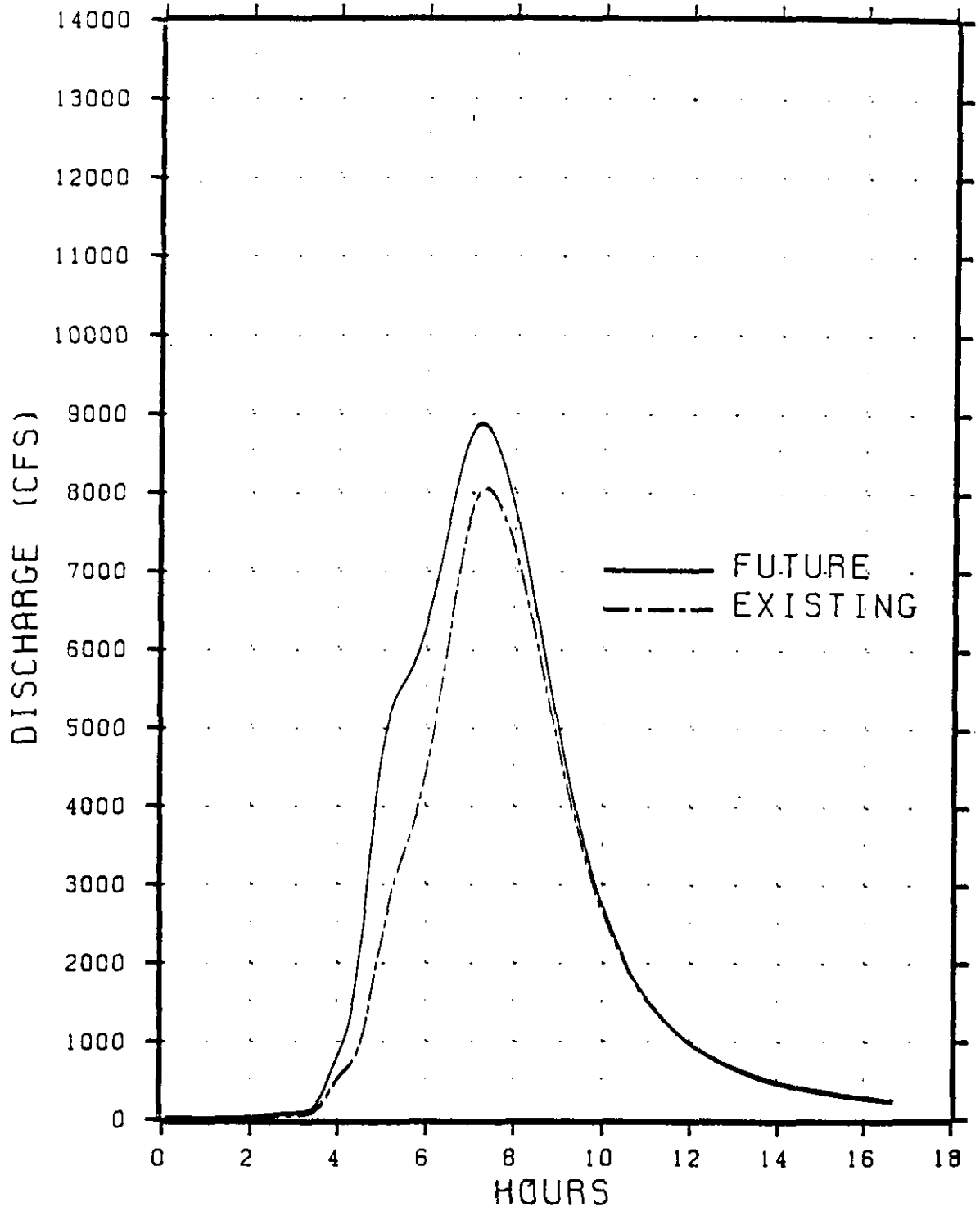


FIGURE II-8

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RANGE WASH OUTFALL
LOWER BASIN STORM
100-YR HYDROGRAPH (DARF=.69)

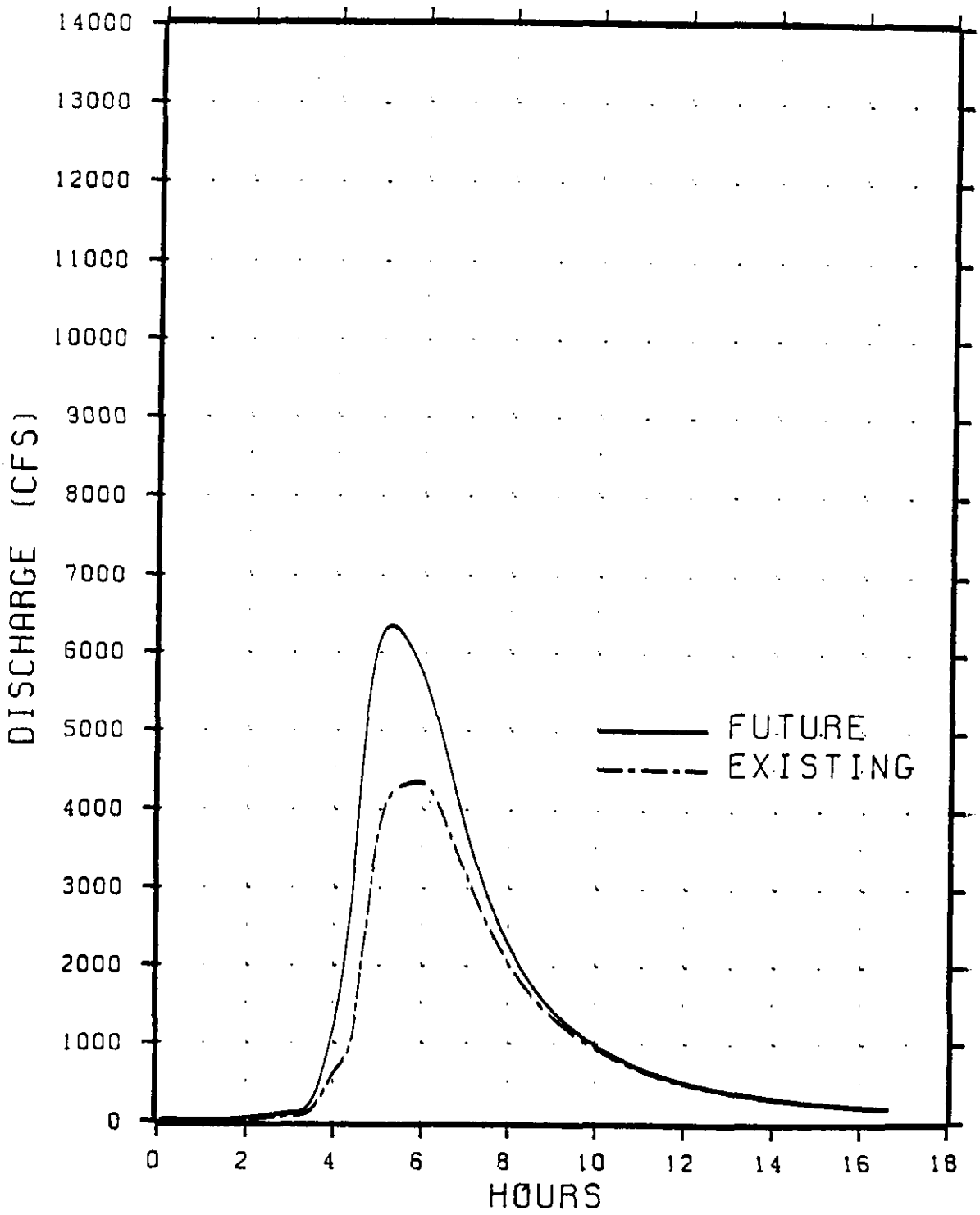

FIGURE II-9

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SEDIMENT YIELD ANALYSIS

Methodology

The sediment yield analysis of the Range Wash Study Area was performed using the Pacific Southwest Interagency (PSIA) methodology. This methodology is intended for broad planning purposes rather than specific project planning. The PSIA methodology considers climate and physical factors of the area, as well as evidence of past erosion, to determine a sediment yield classification for the area in question. The factors consideration: geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport. The factors are each assigned a numeric value based on information obtained from a rating which is used to estimate unit sediment yield.

Basin Discretization

Three watershed subdivisions were selected for analysis using the PSIA methodology: Western Range Wash tributary to the detention facility identified in the master plan (Node F of the Hydrologic analysis); Eastern Range Wash tributary to the detention facility identified in the master plan (Node P1 of the Hydrologic analysis), and; both Washes above their confluence (Node M of the Hydrologic analysis).

Factors Affecting Sediment Yield

The sediment yield analysis factors are summarized below:

Surface Geology: The exposed rock of the study area is predominantly limestone and dolomite, somewhat fractured and weathered. Rock is only exposed in the steep upland areas.

Soils: Soils of the area are generally very gravely with a distinct erosion pavement. Soil material is fine sandy loam with occasional caliche layers and high percentage of rock fragments. A larger extent of caliche was found near the surface in the Eastern Range Wash area than in the western area.

Climate: The Las Vegas Valley has an arid climate with infrequent convective storms and little freeze-thaw occurrence.

Runoff: The Range Wash watersheds produce moderate runoff peak flows and volumes.

Topography: The steep upland slopes have high relief with extensive alluvial fan development at their base. A larger percentage of the western tributary has steep slopes than of the eastern tributary.

Ground Cover: Vegetative ground cover is less than 20 percent. An extensive erosion pavement of rock fragments covers most of the study area.

Land Uses: The majority of the study area is virtually undisturbed except for occasional roads, and mining exploration.

Upland Erosion: The erosion pavement is evidence of upland erosion as are the numerous rills and gullies on the alluvial fans.

Channel Erosion and Sediment Transport: Eroding channel backs are evident where flow is collected either naturally or by man caused means (e.g., roads). Flow is intermittent and of short duration. The eastern tributary is channelized to a slightly higher degree than the western tributary area. The fan above the western ponding area has no well defined channel.

Results

The factors described above were assigned a numeric value representing their relative contribution to the sediment yield of the part of the basin in question. These numeric values were summed and a rating was established. Using curves provided by the PSIA methodology, a unit sediment yield was estimated.

Table II-8 presents a summary of the numeric values assigned to each analysis factor and an estimate of the total average annual sediment production which can be expected at each point of interest.

TABLE II-8

SEDIMENT YIELD ANALYSIS SUMMARY

	Western Tributary	Eastern Tributary	Confluence
PSIA Factor Ratings			
Geology	2	2	2
Soils	7	5	6
Climate	2	2	2
Runoff	5	5	5
Topography	11	8	6
Ground Cover	3	3	3
Land Use	-10	-10	-10
Upland Erosion	12	10	10
Channel Condition	10	18	15
Summary Ratings	42	43	38
Unit Sediment Yield (af/sq mi/yr)	.40	.42	.37
Drainage Area (sq mi)	41	40	133
Sediment Yield			
Estimated Average Annual Sediment Yield (af/yr)	16	17	49

Comparisons with Past Studies

The average annual sediment yield for the three watershed subdivisions is estimated to range from 0.37 af/sq.mi./yr to 0.42 af/sq.mi./yr. The COE feasibility study developed, and presented, a curve of estimated average annual sediment delivery rates to detention basins within the Las Vegas Valley. These curves present sediment delivery per year per square mile versus basin area for areas similar to those found in Range Wash. The COE Feasibility Study estimates were 0.35 af/sq.mi./yr to 0.40 af/sq.mi./yr. This is very close to the values determined in this effort. Differences may be attributed to slightly higher rainfall in the Range Wash watershed than in the Valley as a whole.

Design Storm Sediment Volume

The estimated average annual sediment yield for the Range Wash basin must be converted to a design storm value to be used for channel and other conveyance facility sizing purposes. A review of several studies performed on similar basins in Clark County, Nevada, Mohave County, Arizona and in Southern California indicated that the 100-year sediment volume is generally between four and seven times the average annual volume.

These values were developed primarily using two methods. One method was to develop a Modified Universal Soil loss estimate of sediment delivery for each recurrence interval storm and then integrate over all storm frequencies to establish an average annual sediment delivery volume. The other methodology was to develop an estimate of the sediment yield and sediment transport capacity for each recurrence interval storm and then integrate over all storms to develop an average annual sediment delivery volume.

The ratio of 7 is from a general reference and does not reflect the same level of analysis as the other references. The range of ratios presented in the other reports is between 4 and 5.6 for the 100-year to the average annual. A composite average of 5.26 has been adopted for this study.

Using the adopted 5.26 relationship between the 100-year storm volume and the average annual volume as presented in Table II-8, a 100-year storm sediment volume is computed. Table II-9 presents the estimated 100-year sediment volume.

TABLE II-9

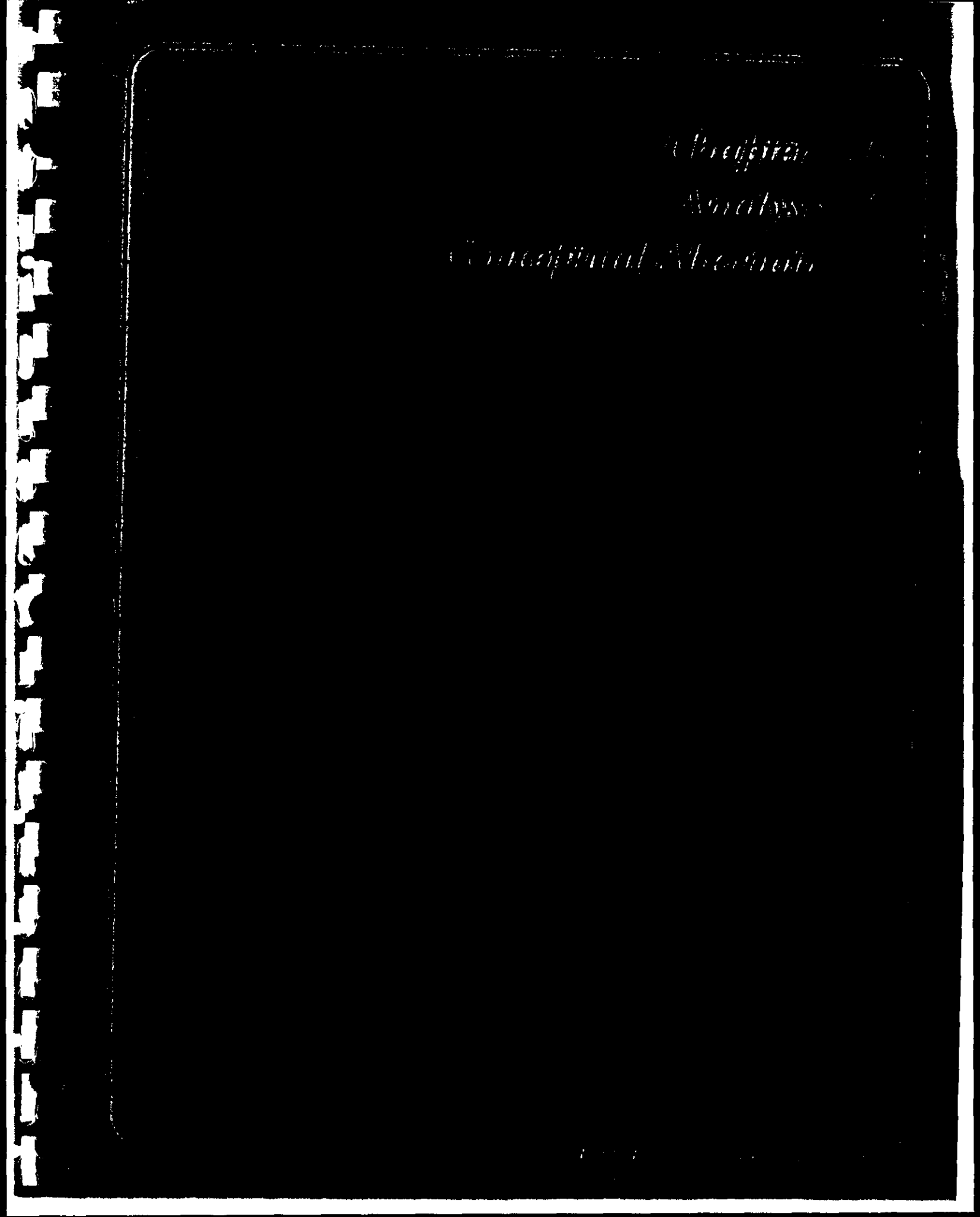
100-YEAR SEDIMENT DELIVERY

	Western Tributary	Eastern Tributary	Confluence
Unit Sediment Yield (AF/MI^2)	2.1	2.2	1.9
100-Year Sediment Yield (AF)	86	88	260

The distribution of this sediment during the hydrograph duration is based on a linear relationship to the discharge rate. Studies have indicated that the relationship of sediment flow to discharge may also follow a power function, however, without calibration, there is no

evidence that a power function provides a better representation and is therefore not used in this study. This distribution can be interpreted as a bulking factor by which clear water discharges can be adjusted to reflect sediment volume.

Using the runoff volumes presented in Table II-7 for the 100-year storm under present basin conditions for each tributary and for the entire basin, the sediment volume constitutes an increase of between 7 and 11%. For this study, a bulking factor of 11% will be utilized for the design of hydraulic facilities subject to sediment laden flows. Facilities below debris basins or other sediment control facilities will use clearwater discharge assumptions.



III - CONCEPTUAL ANALYSIS

INTRODUCTION

The Clark County Regional Flood Control District Master Plan identified a plan for flood control facilities along the Eastern and Western Tributaries of Range Wash. This plan included a series of collector dikes on the alluvial fans of both the Eastern and Western Tributaries of Range Wash. The flow collected along these dikes is conveyed via a stabilized floodway to stormwater detention facilities located on the fan. The stormwater detention basins reduce flows and the subsequent flood hazard downstream. These detention basins are generally located above I-15 and the Union Pacific Railroad tracks, approximately halfway down the alluvial fan. From the outfall of these detention basins, improved channels were proposed. These channels extend to the confluence of the Eastern and Western Tributaries just south of Nellis Air Force Base, and along the existing Sloan Channel alignment to their ultimate outfall in Las Vegas Wash. In addition to the facilities identified along the two major tributaries of Range Wash, smaller debris basins are located on tributaries to the Sloan Channel.

Subsequent to the development and adoption of the Master Plan in 1985, several improvements to the methodologies utilized in the development and evaluation of the plan, and extensive land development within the watershed have made it necessary to update the plan. Utilizing information from subsequent studies, it has been determined that the flow rates presented in the original Master Plan may no longer represent actual flow rates expected during flooding events. The differences in flow rates can be attributed to many factors, including adopted changes in total rainfall depth and areal distribution of rainfall.

The Master Plan, because of its regional scope, used large storms to identify and evaluate regional facilities. Because this study is intended to focus on Range Wash and will ultimately proceed to final design, a more comprehensive evaluation of rainfall and runoff for site specific storm events was required. The resulting revised design discharges at specific locations within the watershed, many of which differ from the Master Plan, are necessary to proceed with final design of proposed facilities. Because the flow rates differ from those in the Master Plan, many of the facility sizes will differ but are necessary accomplish the same flood protection objectives.

Development which has occurred since the adoption of the existing Master Plan has resulted in some of the facilities no longer being feasible in their proposed location or configuration. Many

of the existing improvements constructed along various reaches of Range Wash are not consistent with the intentions of the Master Plan or do not reflect the improved hydrologic techniques. These facilities will be integrated to the extent possible with facilities recommended as part of this basin-wide plan. The limits of ultimate development have also been revised during the intervening years and will have an impact on some of the facilities originally proposed in the Master Plan.

CONCEPTUAL ALTERNATIVE ANALYSIS

Introduction

The development of conceptual alternatives was performed in a manner which utilized, to the extent possible, the information presented in the existing Master Plan. Utilizing this information, plans were developed which satisfied the general objectives of this study. These general objectives are: reduce the flood hazard to existing structures; reduce flood exposure to undeveloped property to allow for greater future development; and, satisfy FEMA requirements for the removal of property from designated floodplains.

Plan Objectives

To reduce flood hazard to existing structures requires that flow be controlled. Controlling flows on the alluvial fan is a difficult task and must be accomplished to direct flows to locations of future downstream facilities. Flood hazard can also be reduced by reducing peak flood discharges. By reducing discharges, residual flood depths and velocities are reduced. The reduction of peak discharges also reduces the size of required downstream facilities necessary to convey the flood flows and minimizes the necessary modifications to existing facilities.

The protection of property designated for future development requires that improvements be made to reduce flood hazard to existing undeveloped properties. This provides greater flexibility for the construction of future developments in areas outside of high flood hazard. These facilities can generally be constructed at relatively low cost because right-of-way, utility and development constraints have not yet been introduced.

To facilitate future development and to reduce the burden of flood insurance premiums on existing properties, the acceptance of any proposed improvements by FEMA is important. FEMA encourages a general fan approach to accomplish this objective. The general fan approach recognizes that there is a statistical likelihood that floods can occur anywhere across

the fan and that protection can most reliably be provided by collecting and controlling flows, and conveying them safely down the fan. FEMA also required that consideration be given to the aggradation and degradation characteristics of the flow and that these considerations be incorporated into the design of facilities.

Alternative Development

Detention is an important element in any plan which addresses the flood hazards on the Range Wash Basin. The Master Plan identifies the benefits of stormwater detention facilities located on the alluvial fan. Detention controls flow by collecting and defining a single point of discharge. In addition, detention reduces the peak flow through storage. This reduces the size of required downstream facilities. An additional benefit to the Range Wash basin is that detention has sediment trapping capabilities. By collecting and detaining floodwaters, water-borne sediments settle out thereby reducing the sediment available for deposition in downstream channel sections.

A review of the results of the hydrologic analysis performed during this study indicates that detention at the confluence of the Western and Eastern Tributaries of Range Wash has a considerable flood reduction benefit. A thunderstorm centered over the lower portion of the basin, below any Master Plan detention basins on the alluvial fan, can result in peak discharges in excess of releases from the detention basins and can exceed the capacity of the Sloan Channel. Detention at the confluence can reduce flows to less than the capacity of the existing Sloan Channel. The detention at the confluence can be constructed before any additional upstream improvements since the confluence is a natural collection point. An immediate benefit will be realized without an extensive upstream collection and conveyance system.

An acceptable level of flow control within the upper reaches of the Range Wash Basin can only be provided through a system of dikes or levees across the alluvial fan. The statistical likelihood of floods on the fan impacting any point is equal, therefore facilities which protect only a portion of the fan provide little protection to areas beyond their physical limits. By constructing dikes, flow can be collected and directed to other facilities for conveyance through the watershed. These dikes can also be constructed in a manner which protects existing developments from flooding. By constructing these facilities immediately upstream of the existing or anticipated future development, that development is protected from fan floods and is only subjected to flooding only from locally-generated runoff. Locally generated flows can be controlled with on-site drainage facilities and will not be addressed in this study.

The construction of improved conveyance systems, either channels, floodways, or pipelines, is another important element in any alternative selected to reduce flooding in the Range Wash Basin. Stabilized conveyance systems can control flows and reduce damage associated with flooding. Existing developed facilities can be protected by confining flows within established rights-of-way. It also enhances future development potential by reducing or eliminating the floodplain associated with natural, uncontrolled flows.

Other Considerations

Several existing flood control facilities exist within the Range Wash Basin which should be integrated into the modified plan. These existing facilities include the Sloan Channel and the Vandenburg Channel. These channels have a capacity less than the 100-year peak discharges. In the case of these and other partially constructed facilities, their alignment is established and therefore limits the potential for changes to channel alignment in their vicinity.

Existing channel crossings also should be incorporated where possible. For example, crossings on the Sloan Channel, at I-15, and at the Union Pacific Railroad all have a fixed capacity and may be inadequate for the conveyance of the existing 100-year peak flows. They also establish horizontal locations and elevations which, if the structures are to be retained, must be incorporated into this plan.

In some cases, existing utilities limit the flexibility of proposed alternatives. Of greatest concern are gravity sanitary sewer lines, which are not easily relocated or adjusted. Other utilities such as water lines, gas lines, and telephone, electric, or TV cables require consideration, but do not present the same constraints as gravity sanitary sewer lines.

Land uses also limit the feasibility of certain alternatives. The proposed Wilderness Study Areas identified on the alluvial fan impose the most restrictions on potential alternatives. The designation may prohibit development or any human impacts in the future. Drainage facilities are inconsistent with Wilderness Study Area designation. Anticipation of future development may also impose similar restrictions on land. The presence of drainage facilities may diminish the flexibility of future development and may offset any potential flood control benefits.

Alternative Description

Based on the foregoing objectives, potential facilities and constraints for alternative plans were identified. The four alternatives are: Master Plan Alternative; Beltway Alignment Alternative;

Master Plan with Confluence Detention Alternative; and Diversion to North Las Vegas Detention Basin Alternative.

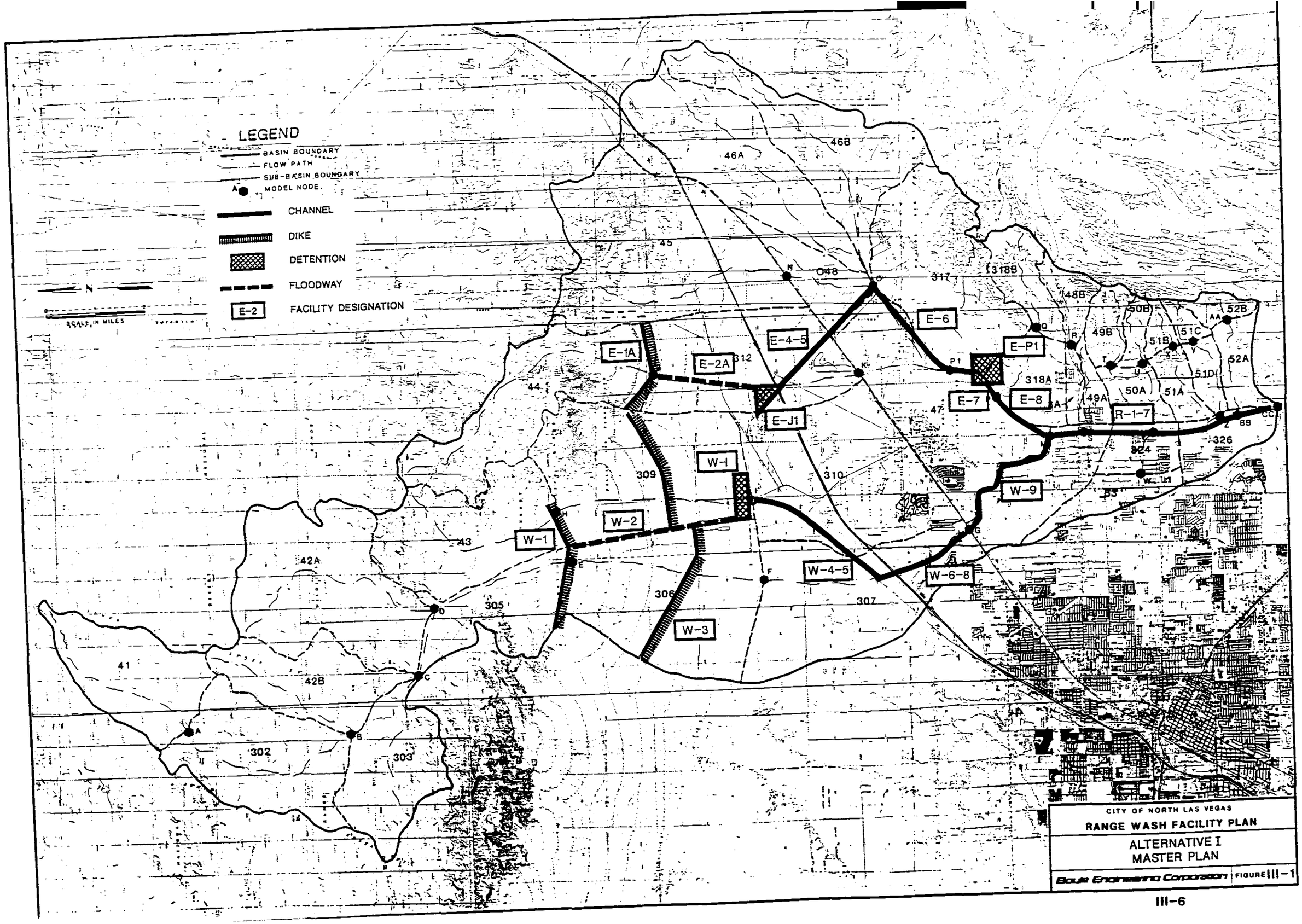
Master Plan Alternative

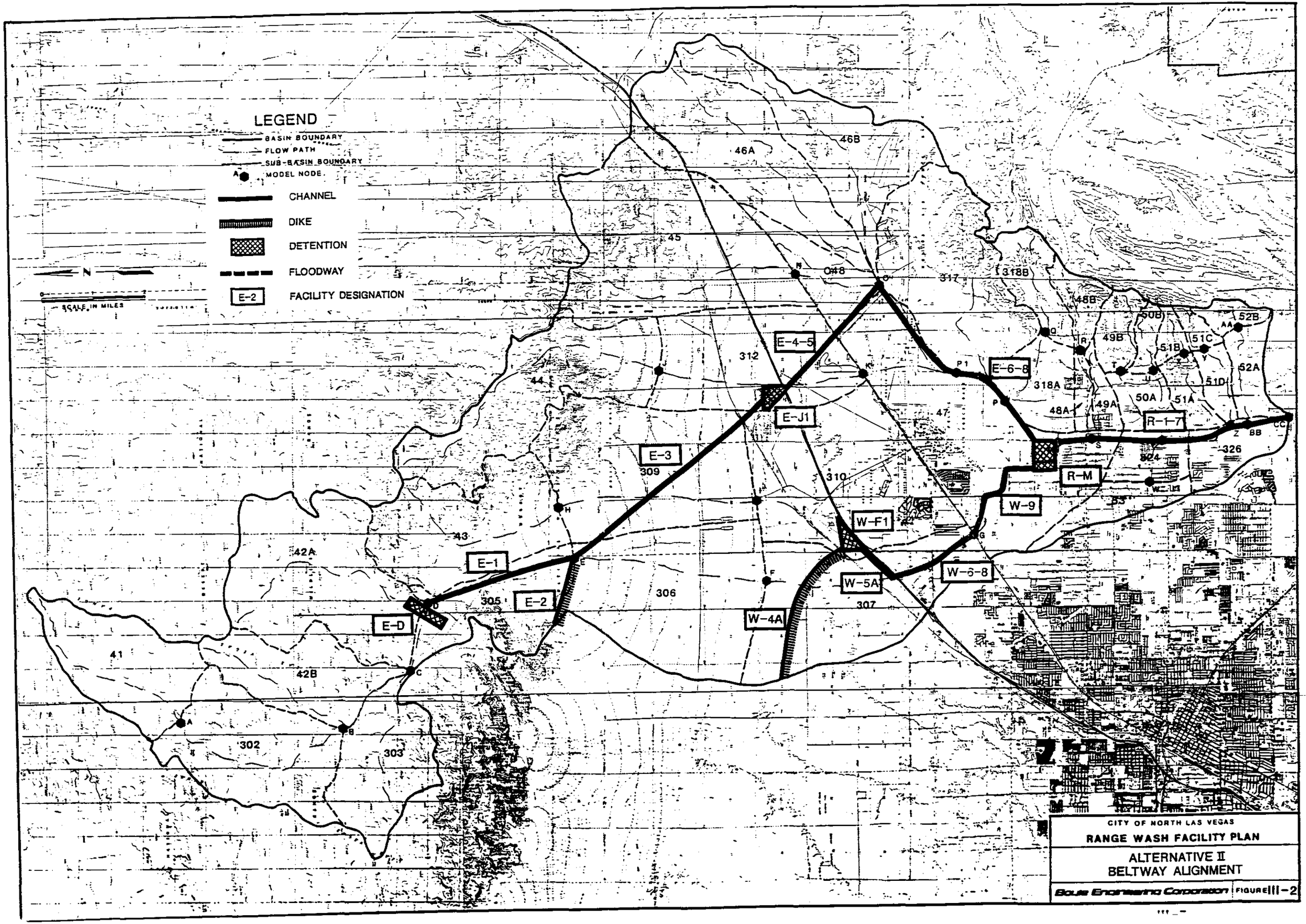
The Master Plan Alternative (Alternative I) represents the alternative proposed in the Clark County Regional Flood Control District Master Plan with minor adjustments to facility location to reflect revised projected development limits. It does not include storm drains and debris basins proposed east of the Sloan Channel. The plan also differs from that presented in the Flood Control District's Master Plan in the sizes of channel and detention facilities. Channels in the current plan are sized to convey local events, therefore the required storage capacity upstream can be reduced to fully utilize the available channel capacity. Revised FEMA requirements for drainage facilities on alluvial fans require more substantial dike structures than those proposed in the current Master Plan. A floodway is also included to convey flows down the Western Tributary alluvial fan to the lower dike location.

The Master Plan Alternative (Figure III-1) includes collection dikes on the Western Tributary alluvial fan with a floodway to convey flows to a detention basin located on the fan, north of the Union Pacific Railroad. A stabilized channel is proposed downstream to the confluence with the Eastern Tributary. A series of diversion dikes is proposed on the Eastern Tributary of Range Wash with a floodway conveying flows to a detention basin located north of I-15. Flows are conveyed in a stabilized channel to the southeast to the confluence with drainage from Area 2 of Nellis Air Force Base. The combined flow is conveyed downstream to the confluence with the Western Tributary after passing through a stormwater detention facility located south and east of Nellis Air Force Base. From the confluence, flows follow the existing Sloan Channel to the ultimate outfall at Las Vegas Wash.

Beltway Alignment Alternative

The Beltway Alignment Alternative (Alternative II shown in Figure III-2) includes a detention facility located on the Western Tributary alluvial fan apex and a diversion dike routing these flows east to a detention facility located on the Eastern Tributary of Range Wash just north of I-15. A stabilized channel extends to the southeast to the confluence with the Nellis Area 2 runoff, and then downstream to the confluence with the Western Tributary of Range Wash. Western Tributary flows are concentrated along the proposed beltway alignment to a detention facility north of I-15 and then in a stabilized channel to the confluence with the Eastern Tributary. A detention basin located at the confluence of the Western and Eastern Tributaries is


LEGEND
BASIN BOUNDARY
FLOW PATH
SUB-BASIN BOUNDARY
MODEL NODE
CHANNEL
DIKE
DETENTION
FLOODWAY
E-2
FACILITY DESIGNATION
SCALE IN MILES
E-1A
E-2A
E-4-5
E-6
E-P1
E-7
E-8
E-J1
W-1
W-2
W-3
W-4-5
W-6-8
W-9
R-1-7
41
42A
42B
43
44
45
46A
46B
47
48A
48B
49A
49B
50A
50B
51A
51B
51C
51D
52A
52B
301
302
303
304
305
306
307
308
309
310
311
312
313
317
318A
318B
324
326
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
P1
Q
R
S
T
U
V
W
X
Y
Z
AA
BB
CC
DD
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
ALTERNATIVE I
MASTER PLAN
Boyle Engineering Corporation
FIGURE III-1



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

ALTERNATIVE II
BELTWAY ALIGNMENT

Boyle Engineering Corporation FIGURE III-2

included with an outfall to the existing, unimproved Sloan Channel. This alternative minimizes dikes and other alluvial fan facilities which are subject to rigorous scrutiny by FEMA.

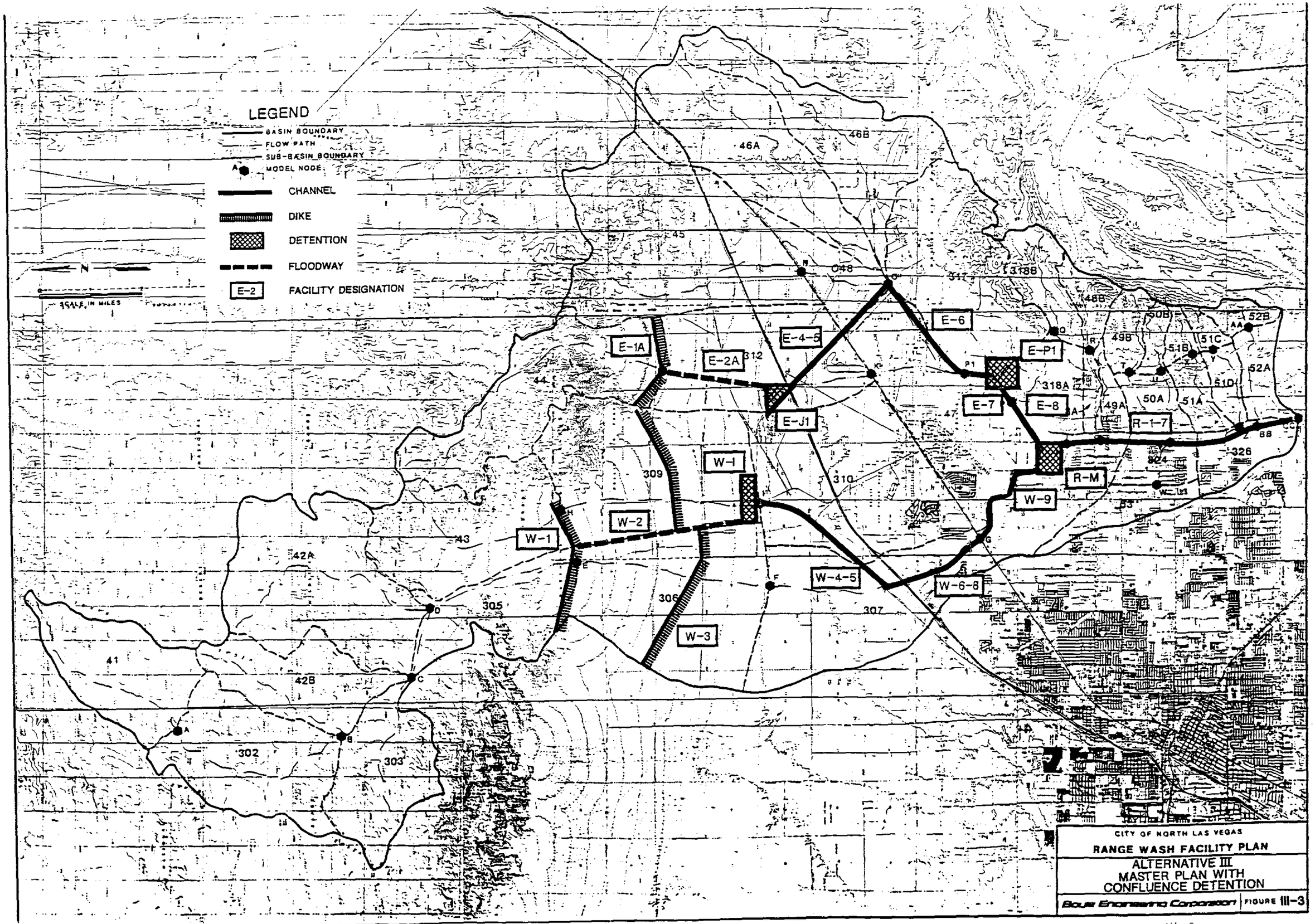
Master Plan with Confluence Detention

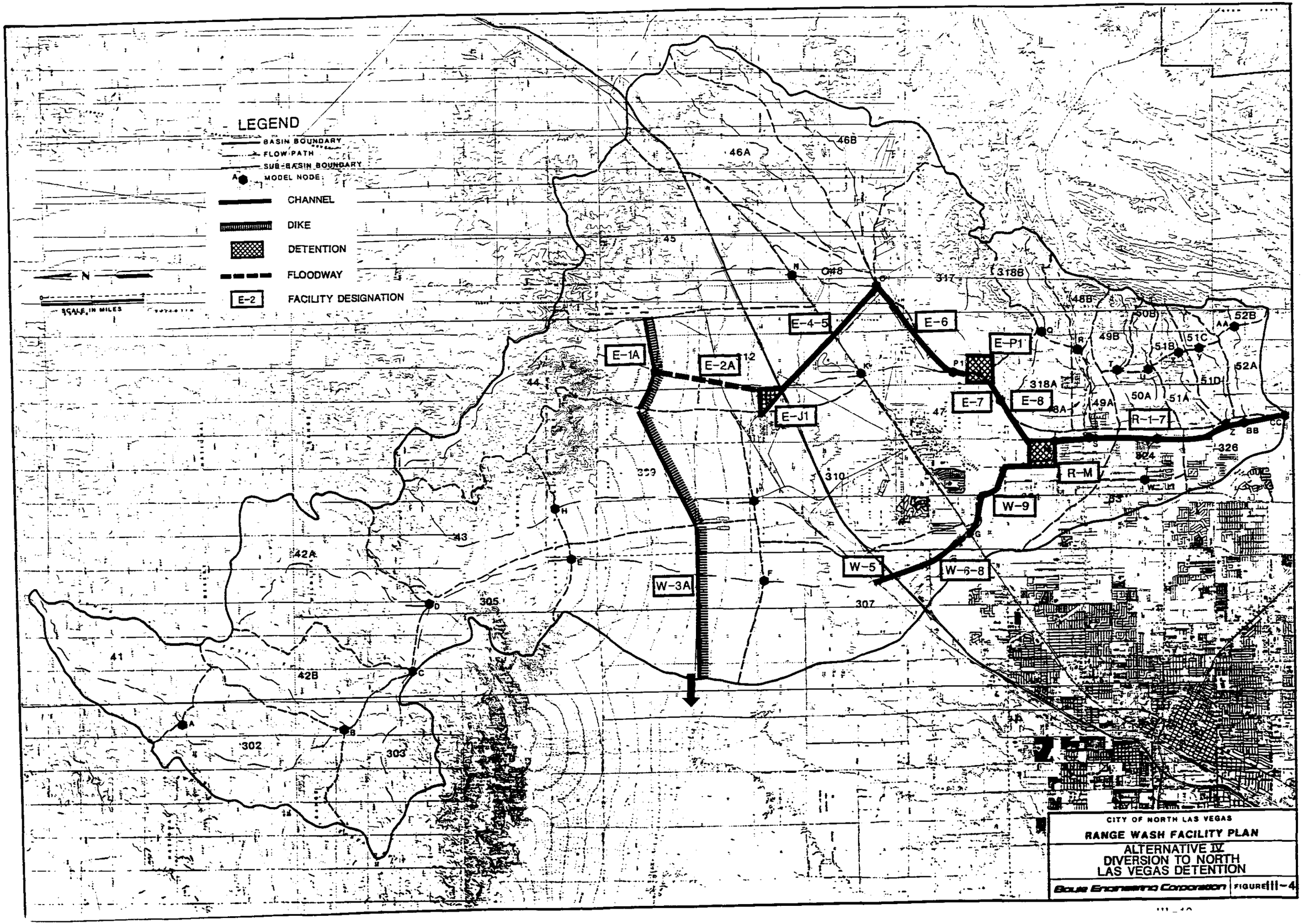
Alternative III is the Master Plan with Confluence Detention Alternative. This alternative is shown in Figure III-3. This alternative includes the facilities of the Master Plan Alternative (Alternative I) along with detention at the confluence of the Eastern and Western Tributaries to Range Wash. A stormwater detention facility located at this site reduces the required downstream improvements along Sloan Channel.

Diversion to North Las Vegas Wash Detention Basin Alternative

The Diversion to North Las Vegas Wash Detention Basin Alternative (Alternative IV shown in Figure III-4) includes all of the Master Plan with Confluence Detention Alternative facilities along the Eastern Tributary and along the Sloan Channel, however it includes modifications to the Western Tributary facilities. A diversion dike is proposed along the Western Tributary at the approximate location of the Western Tributary Detention Basin proposed in Alternatives I and III. This dike concentrates and conveys alluvial fan flows to the existing North Las Vegas detention basin site. Facilities above the Union Pacific Railroad tracks on the Western Tributary are eliminated. An improved channel is provided from the railroad tracks downstream to the confluence detention facility.

Many of the facilities proposed in these alternatives are common to all the alternatives. To simplify a comparison between the various alternatives, Table III-1, Alternative Facility Matrix has been prepared. This table identifies the various facilities and the alternatives for which these facilities are included.


LEGEND
BASIN BOUNDARY
FLOW PATH
SUB-BASIN BOUNDARY
MODEL NODE
CHANNEL
DIKE
DETENTION
FLOODWAY
E-2
FACILITY DESIGNATION
SCALE IN MILES
E-1A
E-2A
E-4-5
E-6
E-P1
E-7
E-8
E-J1
W-1
W-2
W-3
W-4-5
W-6-8
W-9
R-1-7
R-M
46A
46B
45
44
43
42A
42B
41
48A
48B
49A
49B
50A
50B
51A
51B
51C
51D
52A
52B
318A
318B
312
317
309
310
306
307
305
304
326
302
303
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
ALTERNATIVE III
MASTER PLAN WITH
CONFLUENCE DETENTION
Boyle Engineering Corporation
FIGURE III-3

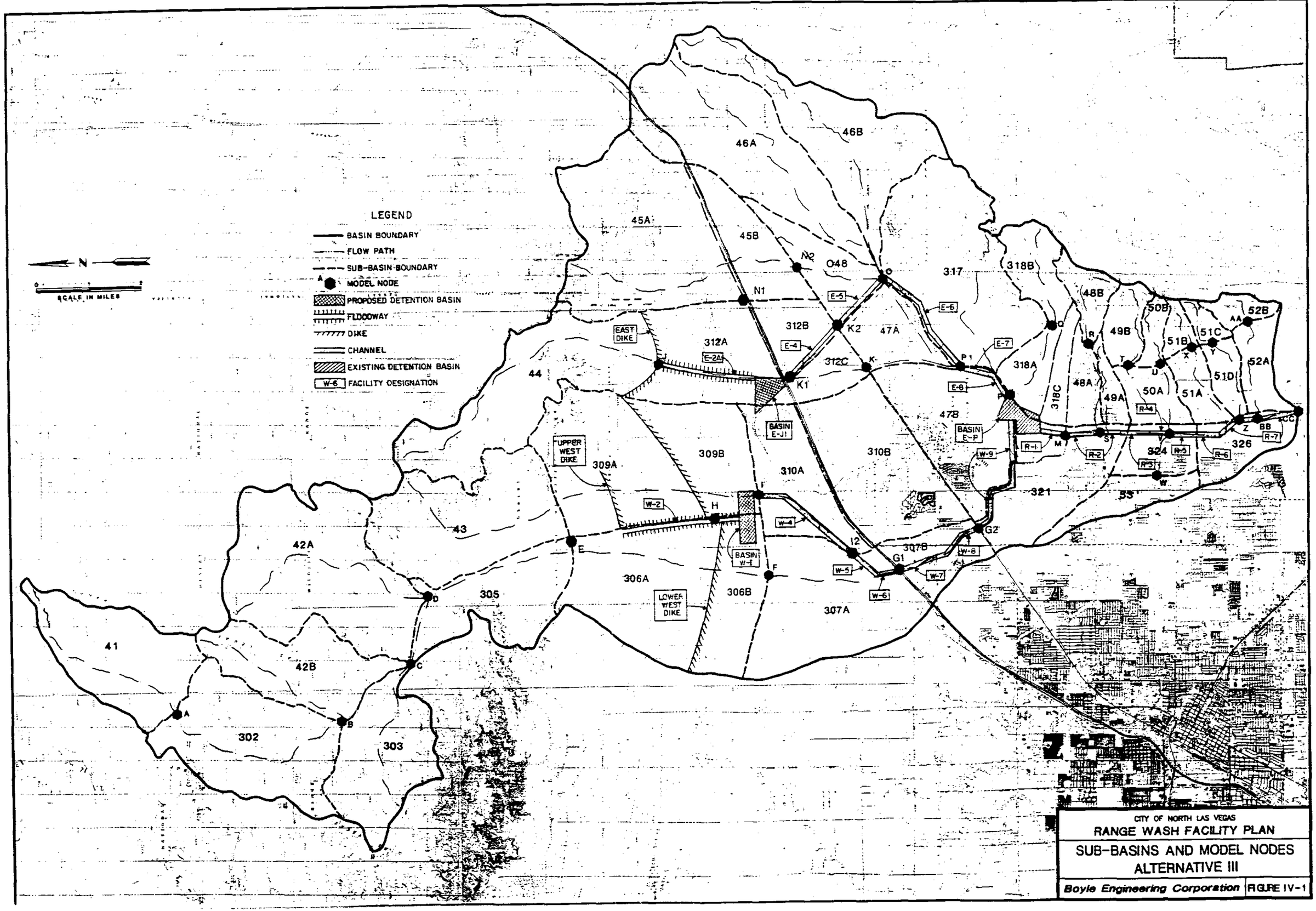


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

ALTERNATIVE IV
DIVERSION TO NORTH
LAS VEGAS DETENTION

Boyle Engineering Corporation | FIGURE III-4



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

SUB-BASINS AND MODEL NODES ALTERNATIVE III

Boyle Engineering Corporation | FIGURE IV-1

LEGEND

- BASIN BOUNDARY
- FLOW PATH
- SUB-BASIN BOUNDARY
- A — MODEL NODE
- PROPOSED DETENTION BASIN
- FLOODWAY
- DIKE
- CHANNEL
- EXISTING DETENTION BASIN
- W-6 FACILITY DESIGNATION

N

SCALE IN MILES

41 42A 42B 43 44 45A 45B 46A 46B 47A 47B 48A 48B 49A 49B 50A 50B 51A 51B 51C 51D 52A 52B 302 303 305 306A 306B 307A 307B 309A 309B 310A 310B 312A 312B 312C 317 318A 318B 318C 321 324 326 33

A B C D E F1 F2 G1 G2 H I1 I2 I3 K K1 K2 N1 N2 O48 O P P1 Q R S T U W X Y Z AA BB CC

EAST DIKE WEST DIKE

E-4 E-5 E-6 E-7 E-8 E2-A

BASIN E-J1 BASIN E-P

W-6 W-7 W-9 R-1 R-2 R-3 R-4 R-5 R-6 R-7

EXISTING NORTH LAS VEGAS DETENTION BASIN

CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
SUB-BASINS AND MODEL NODES
ALTERNATIVE IV
Boyle Engineering Corporation | FIGURE IV-2

HYDROLOGIC EVALUATION OF CONCEPTUAL ALTERNATIVES

Introduction

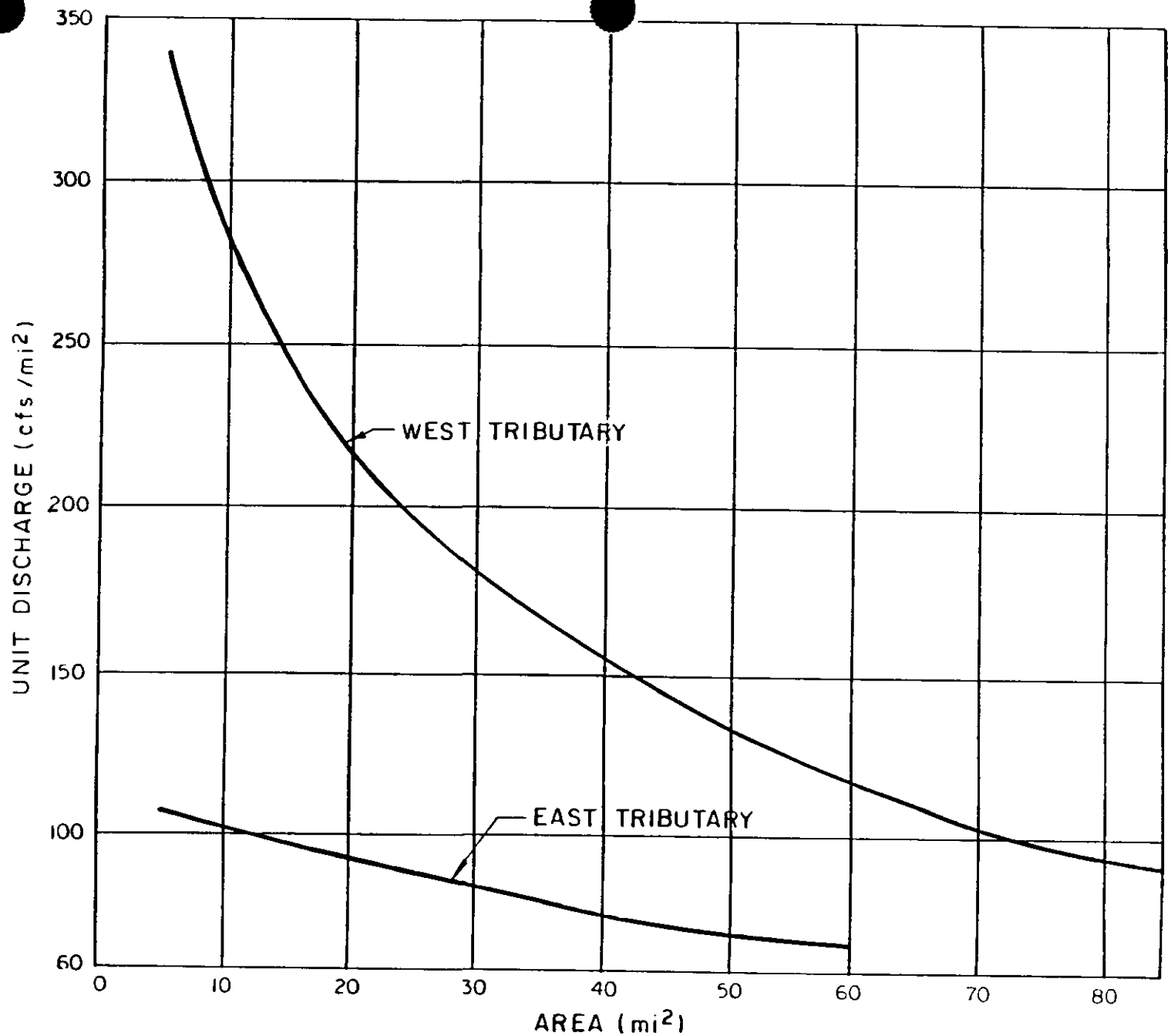
Appropriate methodologies consistent with the purpose and objective of the conceptual analysis were established to perform hydrologic evaluations of the alternatives. Use of these methodologies is predicated on the conceptual nature of the proposed alternatives and a need to evaluate not only basin wide hydrologic events, but to determine spatial distribution of hydrologic events resulting in critical peak discharges and volumes. Methodologies used were: 1) Use of weighted average SCS curve numbers with areally adjusted gross precipitation to estimate inflow volumes to proposed detention basins and 2) Development of unit discharge curves (areal peak discharge versus drainage area) to estimate peak discharges at selected watershed points.

Estimation of Storm Runoff Volumes

Storm runoff volumes were estimated at points of interest within the watershed by determining excess precipitation using the SCS curve number methodology described in Chapter II. Weighted average curve numbers were developed using calibrated curve numbers in Table II-6. Runoff volumes were estimated based on areally adjusted point precipitation values using depth area reduction factors described in Chapter II for the basin area directly tributary to the point of interest.

Unit Discharge Curves

Using the hydrologic model developed in Chapter II for future conditions with existing facilities, unit discharge curves were developed by analyzing storms of different areal extent. For each analysis, precipitation values were adjusted using the appropriate depth area reduction factor for the basin size being analyzed. To account for variation between the hydrologic response of different portions of the watershed, unit discharge curves were developed for both the Western and Eastern Tributaries of Range Wash (Figure III - 5). The unit discharge curves developed illustrate the greater hydrologic response, as measured by peak discharge, of the Western Tributary over that of the Eastern Tributary. This greater response is indicative of differing hydrologic parameters, such as development limits, average land slope and hydrologic soil groups. The Western Tributary has a greater potential for development, a greater average land slope and a greater percentage of soil in SCS hydrologic soil group D. Although use of these unit discharge curves outside the scope of this planning study may be of benefit in estimating



UNIT DISCHARGE CURVES
FIGURE III-5

Boyle Engineering Corporation

order-of-magnitude peak discharges, their use is not considered a substitute for detailed hydrologic investigation and analysis for design of facilities. They are only used for this conceptual analysis and will not be used for preliminary design.

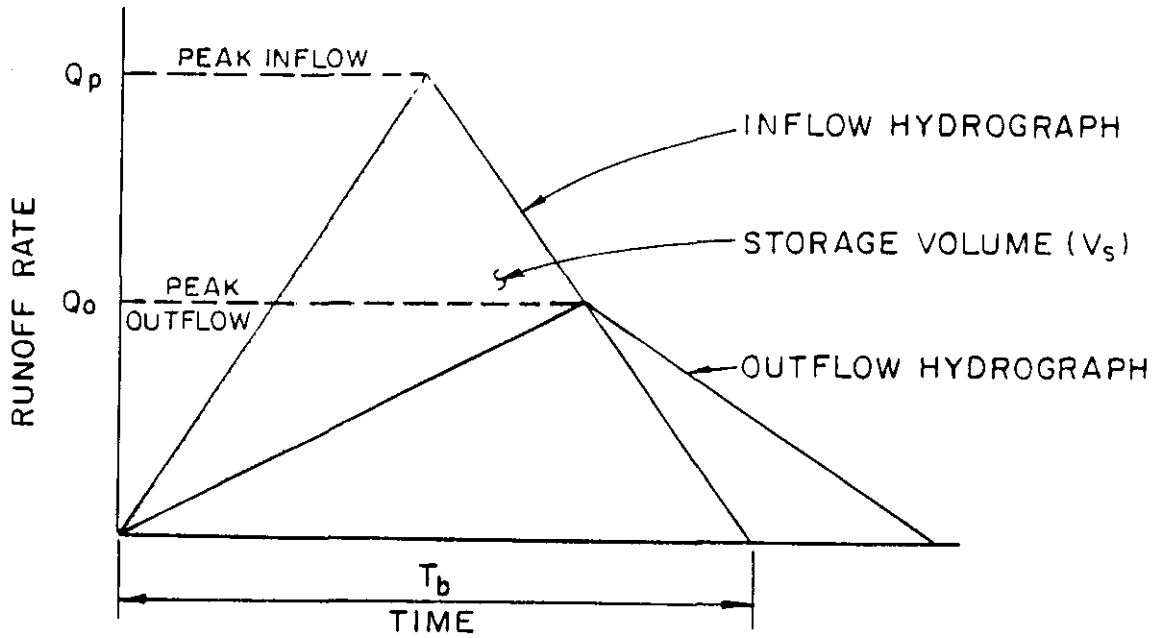
CONCEPTUAL FACILITY SIZING

Approach

The proposed facilities for all alternatives consist of combinations of detention basins, channels and alluvial fan improvements. The approach adopted to size the proposed facilities was to minimize the total cost of all facilities for each alternative. This was accomplished by establishing detention basin volumes by considering the total cost of each detention basin and its associated outlet channel for various detention basin volumes and corresponding outlet channel discharges. Typically an evaluation of this type yields one of three results: 1) Total cost is least with no detention (all conveyance system); 2) Total cost is least with maximum detention (retention system) or; 3) Total cost is least for a detention volume between none and the maximum. This type of analysis is also typically performed for a storm distributed over the area upstream of a proposed detention basin, which ignores the potentially higher unit runoff from a storm distributed over the area downstream of a proposed detention basin. If the results of the analysis indicated maximum detention, then detention basin volumes were reduced such that the peak runoff released to lower outlet channel reaches equalled the flowrate for an intense storm centered downstream of the detention basins. The design peak discharge is the minimum for which the channel can be sized and is independent of basin discharge.

Detention Basins

Detention facility sizing is dependent on runoff volume and its relationship to peak runoff rate, whereas the sizing of the other proposed facilities is predominantly dependent on peak runoff only. Inclusion of upstream detention, which lowers downstream peak runoff rate, generally reduces the size of downstream facilities in a combined system. Methods described in "Urban Stormwater Management," Special Report No. 49, American Public Works Association were used to prepare preliminary storage capacity estimates of proposed detention basins based on estimates of target detention basin outflows. The method uses triangular shapes for both inflow and outflow hydrographs, which provides an expedient means to estimate detention basin volumes for preselected basin outflows. The computational methods are illustrated in Figure III - 6.



$$\text{STORM VOLUME} = V = \frac{T_b Q_p}{2}$$

$$\text{STORAGE VOLUME} = V_s = \frac{T_b}{2}(Q_p - Q_o)$$

$$= V\left(1 - \frac{Q_o}{Q_p}\right)$$

ESTIMATING DETENTION BASIN STORAGE VOLUMES USING TRIANGULAR HYDROGRAPHS

FIGURE III-6

While this method provides reasonable estimates of detention basin storage requirements it does not provide a means of estimating the hydrograph resulting from combining the detention basin outflow hydrograph with downstream inflow hydrographs, unless a relationship regarding the time to peak is known, estimated or assumed. For this analysis it was assumed that 37.5% (3/8) of the runoff volume occurred prior to the peak, which is consistent with the SCS Unit Hydrograph. Therefore, the time to peak of the triangular inflow hydrograph is 37.5% of the hydrograph time base. With the known Q_o the time of the peak outflow can be determined and the shape and time base of the detention basin release hydrograph can be estimated. Combination of runoff hydrographs is important when considering multiple detention basin systems, where design of downstream detention basins is dependent on the ability of upstream detention basins to "delay" the release of storm runoff volume, as well as reduce peak inflow rate.

Channels and Roadway Crossings

Channels were sized based on a height of lining equal to normal depth as given by Manning's equation plus a freeboard allowance of 1.5 feet. Channels downstream of detention basins were assumed to be concrete lined to provide protection from clear water scour. Assumed side slopes for concrete lined channels were 2 horizontal to 1 vertical and bottom widths were based on a channel section producing a maximum flow velocity of 25 feet per second. Where possible, channel velocities were limited to less than 15 feet per second. Manning's n value for concrete lined channels was assumed to be 0.015.

Existing culvert roadway crossings were evaluated on their capability to adequately pass estimated discharge using Bureau of Public Roads "Hydraulic Engineering Circular No. 5" and "Hydraulic Engineering Circular No. 10" based on an allowable headwater one and one-half feet below the roadway overtopping elevation. Record drawings of existing crossings were utilized to obtain geometric data. Existing bridge crossings were evaluated based on open channel hydraulics using the net waterway area and a wetted perimeter which included pier effects. Proposed improvements to roadway crossings without sufficient hydraulic capacity consist of the addition of culvert cells or a replacement structure, depending on the geometry of the crossing. Proposed facilities were sized using the same criteria and methodology used to analyze existing facilities.

Alluvial Fan Improvements

Proposed alluvial fan improvements consist of earthen embankments, which act to concentrate and direct alluvial runoff to selected points; and bank stabilized floodways, which convey runoff to detention basins. Conceptual sizing of these facilities was based on establishing an order-of-magnitude facility size which was consistent with evolving FEMA criteria. New FEMA rule changes have clarified FEMA's position regarding alluvial fan improvements, but do not provide details of acceptable methodologies. In general terms "FEMA will consider for map revision purposes major flood control measures whose design and construction are supported by sound engineering analyses which demonstrate that the measures will effectively eliminate all alluvial fan flood hazard from the area protected by such measures." The engineering analyses referred too must include the following:

1. Quantification of design discharge and volumes of water flow, debris flow and sediment movement associated with the flood that has a one-percent probability of being equaled or exceeded in any year at the apex of the fan under current watershed conditions and under potential adverse conditions (watershed deforestation).

2. Analyses showing that project elements will accommodate the above quantities, and their associated hydrodynamic and hydrostatic forces.

3. Analyses showing design of project elements against erosion and scour.

4. Analyses showing that project elements provide protection from lateral migration and sudden relocation of flows from other parts of the fan.

5. Analysis that assesses method of disposal of concentrated flood water and associated sediment load on adjacent properties.

6. Analysis demonstrating that flooding from local runoff, or sources other than the fan apex, is insignificant, or otherwise has been accommodated.

For this planning study, it is assumed, that the runoff and sediment volume estimates presented in Chapter II meet requirement 1 above. Also, since these runoff estimates include direct rainfall on the fan, below the apex, it is assumed that requirement 6 is met. Requirement 5 is assumed met by discharge of alluvial runoff to detention basins.

Dikes

Element one of the proposed alluvial fan facilities are earthen embankments. To address lateral migration and flow relocation (requirement 4) this study assumed the same design discharge and sediment load at any point along the dike. It was assumed that apex flows reaching the dike would be confined to a single channel with top width equal to that given by Dawdy's equation.

$$T = 9.5Q^{0.4}$$

where

T = Top width of flow (feet)

Q = Discharge (cfs)

This equation also relies on the assumption that the flow forms the channel and the flow regime is critical, i.e. depth of flow is at critical depth. Since the dike is a transverse obstruction to this channel, the hydrodynamic force (requirement 2) of the incoming flow was assumed to be represented by hydrostatic force equal to the depth of flow and velocity head, which conservatively implies that flow is completely stopped before being directed along the toe of the dike. The conveyance area and slope along the dike was determined based on maintaining the flow velocity of the incoming runoff. It was assumed that since the incoming flow represented a state of equilibrium on the fan, then flow along the dike should be similar. It was assumed that a similar velocity distribution would produce a similar state of equilibrium along the dike. To account for sediment deposition (requirement 2) along the dike, especially at the point of impact, a sediment depth was assumed equal to the flow depth along the dike times the percentage of the flow composed of bulked sediment. Prior to performing the sediment yield analysis presented in Chapter II, this percentage was estimated to be 20% based on a 100-year sediment volume equal to ten times the average annual sediment yield. To provide protection against erosion and scour (requirement 3), the upstream dike face was assumed to be soil cemented lined with a lean concrete toe-in equal to the greater of the sediment depth (assumes amount scoured equals potential amount deposited), or a minimum of five feet.

Summarizing, the total design dike height above existing ground elevation is composed of the following four components:

Y_n = normal depth along dike at design discharge, assuming velocity along dike equals fan channel velocity.

Y_v = impact depth, equal to velocity head of fan channel.

Y_s = sediment depth, equal to normal depth times bulking percentage.

Y_f = FEMA minimum freeboard requirement for dikes and levees, equal to three feet.

During the conceptual evaluation it was assumed dikes would be constructed directly on the fan slope using material excavated from floodways, without formation of a channel along the upstream face.

Floodways

Floodways on the fan serve to convey flows concentrated by dikes to existing or proposed alluvial fan detention basins. Conceptual sizing of floodways assumed a top width equal to that given by Dawdy's equation and a total depth equal to critical depth plus three feet of freeboard. Use of Dawdy's regime equation to size floodways is assumed to represent a conservative approach to provide a stable alluvial channel which meets FEMA's requirements 2 and 3. To prevent lateral migration and flow relocation (requirement 4) banks of floodways were assumed to be stabilized by gabions with a toe-in equal to floodway depth. Excavated materials from floodway areas were assumed to be used for dike embankment construction.

CONCEPTUAL FACILITIES

Facilities sized during the conceptual evaluation are presented in tabular form in Appendix B. These tables provide geometric and hydraulic information for each facility of each alternative. Table III-2 compares the peak flow estimated for future development/existing facilities with each alternative at key points within the watershed.

Alternatives I, III and IV have the same percentage peak flow reduction for the Western and Eastern Tributaries at the confluence with Range Wash. However, because Alternatives III and IV include a confluence detention basin, they have a 50 percent greater reduction in peak flow along Range Wash (Sloan Channel), above that for Alternative I. From this comparison, it can

be concluded that inclusion of a confluence detention basin greatly enhances peak flow reduction for Sloan Channel, and diversion of Western Tributary alluvial fan flows has the same effect as a Western Tributary alluvial fan detention basin.

Alternative II provides similar reduction of Sloan Channel peak flows, but further reduces Western Tributary flows at the confluence by a combination of detention and intra-basin diversion to the Eastern Tributary. Whereas Western Tributary peak flows are reduced, no substantial reduction in Eastern Tributary peak flows is obtained.

TABLE III-2

COMPARISON OF 100-YEAR PEAK FLOW (CFS)

Location	Future Development Existing Facilities	Alternative I	II	III	IV
Western Tributary at Confluence	7260	4470	2950	4470	4500
Eastern Tributary at Confluence	3370	860	3100	860	860
Range Wash at Las Vegas Wash	8870	5340	2570	2600	2600

CONCEPTUAL FACILITY COST ESTIMATES

General

Opinions of probable costs for right-of-way and facility construction were prepared for comparing alternatives, and are summarized in Tables III-3, III-4, III-5 and III-6 for alternatives I, II, III and IV, respectively. A contingency of 20 percent of the sum of right-of-way and facility construction cost is included because of the conceptual nature of the facilities. As such, the estimates are opinions of probable cost, subject to changing economic conditions and were developed to allow equal basis comparison of alternatives.

Right-Of-Way Costs

Right-of-way costs are a function of numerous variables, which are not easily defined into monetary values; are best determined on a case-by-case basis with individual property owners;

TABLE III - 3

CONCEPTUAL FACILITY COSTS
ALTERNATIVE I - MASTER PLAN

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1	$ 330,000	$ 4,300,000	$ 930,000	$ 5,600,000
W - 2	400,000	1,300,000	340,000	2,000,000
W - 3	690,000	9,000,000	1,900,000	12,000,000
W - I	320,000	3,600,000	780,000	4,700,000
W - 4	75,000	2,000,000	420,000	2,500,000
W - 5	40,000	580,000	120,000	740,000
W - 6	170,000	1,600,000	350,000	2,100,000
W - 7	63,000	1,100,000	230,000	1,400,000
W - 8	200,000	1,100,000	260,000	1,600,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	31,000	270,000	60,000	360,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - 1	$ 0	$ 870,000	$ 170,000	$ 1,000,000
R - 2	0	1,100,000	220,000	1,300,000
R - 3	0	1,400,000	280,000	1,700,000
R - 4	0	1,100,000	220,000	1,300,000
R - 5	0	1,400,000	280,000	1,700,000
R - 6	0	1,300,000	260,000	1,600,000
R - 7	0	2,100,000	420,000	2,500,000
SUMMARY				
WESTERN TRIBUTARY	$ 2,300,000	$ 29,000,000	$ 6,200,000	$ 38,000,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	0	9,300,000	1,900,000	11,000,000
TOTAL	$ 5,000,000	$ 50,000,000	$ 11,000,000	$ 66,000,000

[1] See Figure III-1

TABLE III - 4

CONCEPTUAL FACILITY COSTS
ALTERNATIVE II - BELTWAY ALIGNMENT

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - F1	$ 530,000	$ 2,400,000	$ 590,000	$ 3,500,000
W - 4A	220,000	4,800,000	1,000,000	6,000,000
W - 5A	19,000	240,000	52,000	310,000
W - 6	160,000	1,100,000	250,000	1,500,000
W - 7	44,000	580,000	120,000	740,000
W - 8	60,000	810,000	170,000	1,000,000
W - 9	50,000	400,000	90,000	540,000
EASTERN TRIBUTARY				
E - 0	$ 100,000	$ 3,000,000	$ 620,000	$ 3,700,000
E - 1	130,000	4,700,000	970,000	5,800,000
E - 2	110,000	140,000	50,000	300,000
E - 3	230,000	8,500,000	1,700,000	10,000,000
E - J1	380,000	3,600,000	790,000	4,800,000
E - 4	69,000	600,000	130,000	800,000
E - 5	65,000	620,000	140,000	830,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - 7	62,000	3,200,000	650,000	3,900,000
E - 8	200,000	3,400,000	720,000	4,300,000
SLOAN CHANNEL				
R - M	$ 960,000	$ 3,200,000	$ 830,000	$ 5,000,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	560,000	110,000	670,000
R - 4	0	490,000	98,000	590,000
R - 5	0	530,000	110,000	640,000
R - 6	0	640,000	130,000	770,000
- 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 1,100,000	$ 10,000,000	$ 2,300,000	$ 13,000,000
EASTERN TRIBUTARY	1,500,000	30,000,000	6,300,000	38,000,000
SLOAN CHANNEL	960,000	6,900,000	1,600,000	9,500,000
TOTAL	$ 4,000,000	$ 47,000,000	$ 10,000,000	$ 61,000,000

[1] See Figure III-2

TABLE III - 5

CONCEPTUAL FACILITY COSTS
ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1	$ 330,000	$ 4,300,000	$ 930,000	$ 5,600,000
W - 2	400,000	1,300,000	340,000	2,000,000
W - 3	690,000	9,000,000	1,900,000	12,000,000
W - 1	320,000	3,600,000	780,000	4,700,000
W - 4	75,000	2,000,000	420,000	2,500,000
W - 5	40,000	580,000	120,000	740,000
W - 6	170,000	1,600,000	350,000	2,100,000
W - 7	63,000	1,100,000	230,000	1,400,000
W - 8	200,000	1,100,000	260,000	1,400,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	31,000	270,000	60,000	360,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - M	$ 800,000	$ 3,209,000	$ 800,000	$ 4,800,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	520,000	100,000	620,000
R - 4	0	470,000	94,000	560,000
R - 5	0	530,000	110,000	640,000
R - 6	0	650,000	130,000	780,000
R - 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 2,300,000	$29,000,000	$ 6,200,000	$38,00,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	800,000	6,900,000	1,500,000	9,200,000
TOTAL	$ 5,300,000	$48,000,000	$11,000,000	$64,000,000

[1] See Figure III-3

TABLE III - 6

CONCEPTUAL FACILITY COSTS
ALTERNATIVE IV - DIVERSION TO NORTH LAS VEGAS DETENTION BASIN

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 3A	$ 690,000	$ 9,000,000	$ 1,900,000	$12,000,000
W - 5	40,000	380,000	84,000	500,000
W - 6	57,000	1,400,000	290,000	1,700,000
W - 7	37,000	850,000	180,000	1,100,000
W - 8	58,000	960,000	200,000	1,200,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	20,000	220,000	50,000	290,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - M	$ 800,000	$ 3,200,000	$ 800,000	$ 4,800,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	520,000	100,000	620,000
R - 4	0	470,000	94,000	560,000
R - 5	0	530,000	110,000	640,000
R - 6	0	650,000	130,000	780,000
R - 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 940,000	$17,000,000	$ 3,600,000	$22,000,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	800,000	6,900,000	1,500,000	9,200,000
TOTAL	$ 3,900,000	$36,000,000	$ 7,900,000	$48,000,000

[1] See Figure III-4

and vary both in location and time. The facilities proposed for the various alternatives tend to be located in the following general areas:

1. Historical washes and improved drainage channels with existing right-of-way, such as Sloan Channel, from Las Vegas Boulevard North downstream to Las Vegas Wash and the Vandenberg Channel, from Lone Mountain Road to Craig Road.

2. Various United States public and military reservation lands, such as the proposed alluvial fan improvements and the confluence detention basin.

3. Privately held lands within historical drainage paths located adjacent to military reservations, such as the lower Eastern Tributary Detention Basin and the lower reaches of the Eastern Tributary channel improvements near Nellis Air Force Base.

4. Privately held lands within historical drainage paths and developing urban areas, such as the Western Tributary from Craig Road downstream to Las Vegas Boulevard North.

During the conceptual evaluation, officials at Nellis Air Force Base were contacted regarding recent land acquisitions. The privately held lands being acquired by the Air Force were located within the historical drainage path of the Eastern Tributary of Range Wash. Acquisition costs were between $7,000 and $8,000 per acre. On this basis, $8,000 per acre was assumed appropriate for right-of-way costs for privately held lands. For land within the public domain, or on military reservations, costs were assumed at one-half that for private property, or $4,000 per acre.

Right-of-way widths for lined channels and floodways were calculated as the sum of the channel top width and a minimum allowance of 12 feet for maintenance access, rounded up to the next five feet. Right-of-way areas for detention basins were based on an area necessary to contain the basin with a minimum of 12 feet of access around basin limits.

Facility Construction Costs

General

Opinions of probable construction cost were estimated based on generalized unit costs for the major work quantities which could readily be estimated for the type of facility and its geometry relative to the topographic base mapping used. Identification of all components of work was

not possible, but use of slightly higher unit costs for the major components is considered reasonable to include minor work components.

Detention Basins

Using the detention basin volumes estimated during the conceptual hydrologic evaluation, major cost component quantities, such as excavation and embankment were estimated. Each detention basin site was evaluated and a configuration developed based on balanced earthwork quantities. Detention basins were assumed to consist of an earthen embankment with 3:1 side slopes and a minimum top width of 15 feet. Embankments were assumed to be constructed from materials excavated on-site. No specific embankment or foundation treatments for seepage control were considered because of the relative short duration during which flood waters would be detained. Emergency spillways were assumed to be constructed from built-up soil cement core and were sized for the probable maximum flood (PMF) estimated in Chapter II, with a head not greater than six feet. Because of the steep alluvial fan slopes, "in-ground" detention basins, with excavation volumes exceeding storage volume, were not considered cost-effective. In general, for the configurations and sites evaluated, 25 percent to 40 percent of the storage volume was obtained from required excavations.

Channels and Roadway Crossings

Channels were assumed lined with reinforced concrete 6-inches thick and underlain with an 8-inch granular bedding. Quantities of excavation were estimated assuming excavation of the entire channel section (waterway area, structural section and bedding), except along existing channels, such as Sloan Channel. Roadway culvert crossings and modifications to existing crossings were estimated based qualitative lump sum costs provided from local contractors.

Alluvial Fan Dikes and Floodways

Dikes were assumed to be constructed from material excavated for floodways. Dike side slopes were assumed to be 3 horizontal to 1 vertical with the upstream face lined with an 18-inch thick soil cement blanket placed directly on the slope. A five foot lean concrete cutoff along the upstream toe provides erosion and scour protection. The major work items for floodways consist of bulk excavation and construction of gabions for bank stability. Gabions are constructed with a toe-in equal to floodway depth, based on a three foot gabion basket configuration.

Unit Costs

Table III-7 summarizes the unit costs for major work items used in the development of the conceptual facility cost estimates.

TABLE III-7

UNIT COSTS
MAJOR WORK ITEMS

Description	Unit	Unit Cost
Earthwork	Cubic Yard	$ 3.50
Soil Cement	Cubic Yard	$ 50.00
Gabions	Cubic Yard	$ 100.00
Reinforced Concrete		
Slip-form Channel Lining	Cubic Yard	$ 175.00
Structural Formed	Cubic Yard	$ 400.00
Drain Rock	Ton	$ 14.00

CONCEPTUAL ANALYSIS RESULTS

Introduction

The four conceptual alternatives were analyzed to assess their ability to satisfy identified general objectives and relative construction cost. Results of the qualitative analysis and conceptual cost estimates are used to identify two alternatives which are selected for further consideration.

Qualitative Analysis

As a result of detention and conveyance, all alternatives reduce the hazard of flooding on the Western and Eastern Tributaries and below the confluence. Detention facilities located on the alluvial fan, at the apex of the fan, or above areas of significant development all result in decreased discharges and increased control of flood flows. Dikes also reduce flood hazard by controlling flows.

Alternative I has a lesser degree of flow reduction along the Sloan Channel than the other Alternatives because it does not include the confluence detention basin. The higher residual flows are controlled by proposed improvements to the Sloan Channel and downstream crossings. Alternative II includes an intra-basin diversion of flood waters and relies on

establishment of a Beltway alignment and its relationship to proposed improvements. While the Eastern Tributary facilities are sized to handle flows from the Western Tributary, any intra-basin diversion results in the perception of increased hazard due to the increased frequency of flows reaching that portion of the basin.

Alternative IV also increases the perceived hazard to the adjacent drainage basin. The collection and conveyance of water along the dike from the Western Tributary of Range Wash to the North Las Vegas detention basin, located within the Las Vegas Wash drainage basin, is an inter-basin transfer of water. This transfer increases the frequency and duration of flows in the Las Vegas Wash downstream of the detention basin. The basin is sized to mitigate the flooding impacts downstream, however, the prolonged discharge of water from the detention basin introduces additional problems. Increasing the frequency and duration of flooding in the Las Vegas Wash drainage basin, as a result of flows from the Range Wash basin, is a perceived increase in hazard and may result in increased exposure to liability.

The dikes and channel improvements protect property. The dikes confine and control flows resulting in the downstream area being protected from flood hazard. Channel improvements also control and convey flows thereby protecting adjacent properties from flooding.

The Alternative II beltway diversion provides protection downstream of the proposed beltway. The area upstream of the beltway, below the apex dike and diversion channel, is subject to potential flooding from flows generated on the alluvial fan. The flood peaks are not as high as those flows emanating from the canyon above the apex of the fan, however they are large and generally unconfined, consisting of gully flow, overland flow and flow in small channels. These flows are difficult to control without extensive facilities within a development.

All four alternatives address FEMA requirements as they are currently defined, however FEMA requirements for facilities and improvements on alluvial fans are evolving. The overall fan approach is the standard to which FEMA is measuring alternatives. Because of the evolution of alluvial fan technology, there are no guarantees that this approach will be accepted in the future. Under the current FEMA requirements, facilities which are designed to control alluvial fan flows, which consider sedimentation and the associated aggradation and degradation potential, and those which are appropriately maintained, will be processed and appropriate Letters of Map Revision (LOMR) will be issued. FEMA does reserve the right to change criteria and superimpose revised criteria on existing facilities and existing floodplains. Therefore, while we believe the facilities identified in these alternatives meet the current FEMA criteria, no assurances can be given that a LOMR can be obtained at the time of design or construction.

Cost Comparisons

Costs estimates for the facilities identified in each of the alternatives reflect the conceptual level analysis based on preliminary facility sizes. The cost estimates for each alternative are compared and summarized in Table III-8, Summary of Facility Costs. Estimates include the estimated facility construction cost, the estimated right-of-way cost and the total facility cost, for each alternative.

TABLE III-8

SUMMARY OF FACILITY COSTS
(Millions of Dollars)

Alternative		East Tributary	West Tributary	Sloan Channel	Total
I	Facility	$ 12.0	$ 29.0	$ 9.3	
	Land	2.2	2.3	0.0	
	Contingency	2.8	6.3	1.9	
	Total	$ 17.0	$ 38.0	$ 11.0	$ 66.0
II	Facility	$ 30.0	$ 10.0	$ 6.9	
	Land	1.5	1.1	1.0	
	Contingency	6.3	2.2	1.6	
	Total	$ 38.0	$ 13.0	$ 9.5	$ 61.0
III	Facility	$ 12.0	$ 29.0	$ 6.9	
	Land	2.2	2.3	0.8	
	Contingency	2.8	6.3	1.5	
	Total	$ 17.0	$ 38.0	$ 9.2	$ 64.0
IV	Facility	$ 12.0	$ 17.0	$ 6.9	
	Land	2.2	0.9	0.8	
	Contingency	2.8	3.6	1.5	
	Total	$ 17.0	$ 22.0	$ 9.2	$ 48.0

The estimated conceptual level construction costs for Alternatives I, II and III range from $61 to $66 million. Alternative IV has a substantially lower estimated conceptual level construction cost of $48 million. This reduction in estimated cost stems from the diversion of flows from

Range Wash to the North Las Vegas detention basin. The estimate does not include any modifications to the detention basin nor does it include any channel improvement costs downstream of the basin outlet.

Selected Alternatives

Subsequent to a review of the findings of the conceptual evaluation with the Project Sponsors, Alternatives III and IV were selected for further evaluation and preliminary design. These alternatives feature many common elements including, confluence detention, limited improvements to Sloan Channel, improvements along the Eastern Tributary of Range Wash from the alluvial fan downstream to the confluence, and improvements from the Union Pacific Railroad tracks to the confluence along the Western Tributary. The alternatives differ in their handling of Western Tributary alluvial fan flows. Alternative III provides dikes and a floodway conveying flows to a detention basin located on the alluvial fan and a channelized outflow downstream. Alternative IV consists of the diversion of Western Tributary flows across the alluvial fan to the existing North Las Vegas detention basin.

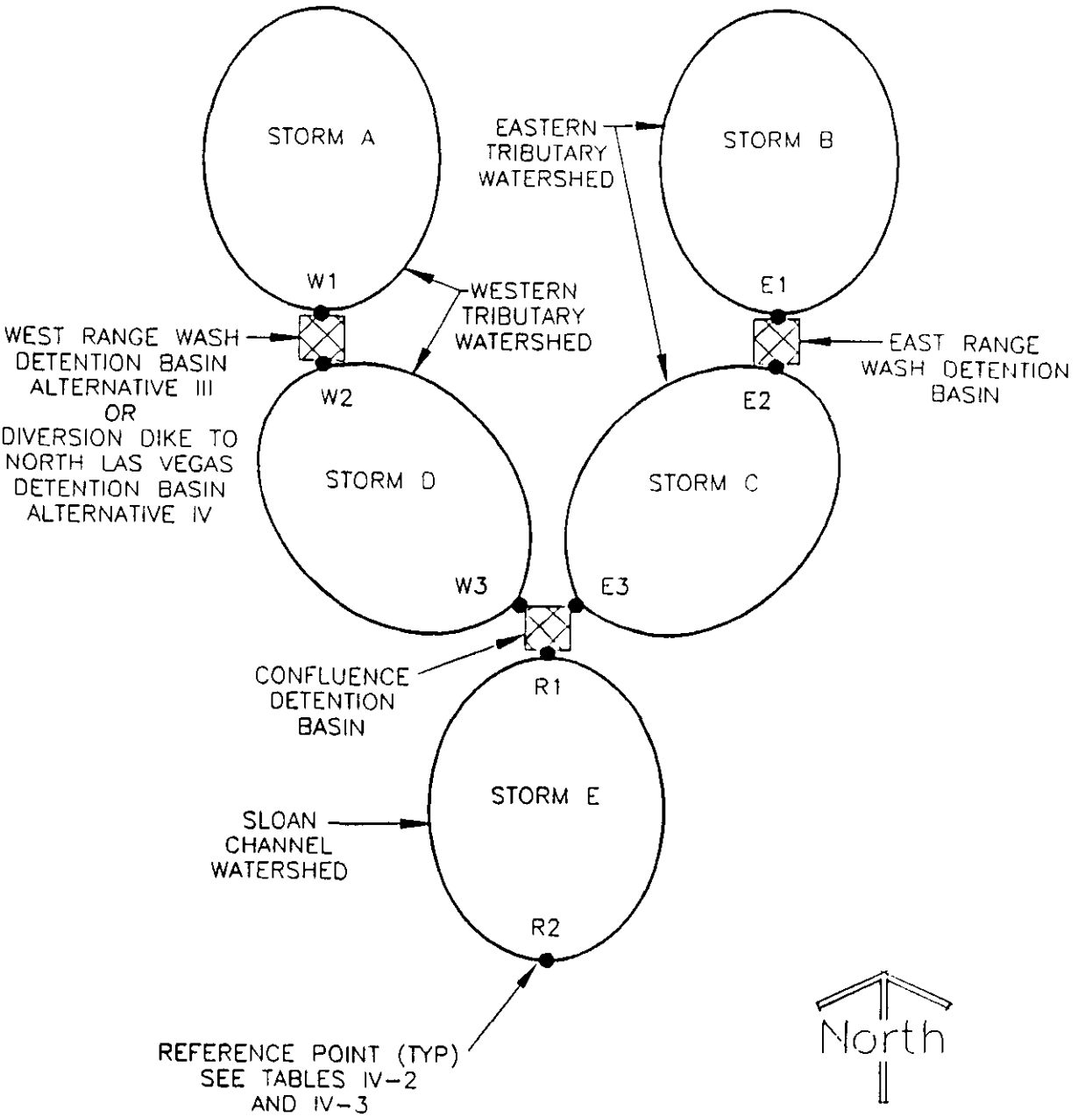
During the review process, the importance of a confluence detention basin to the facility plan became evident. Also, since the lower Eastern Tributary Detention Basin (facility E-P1) is in close proximity to the confluence detention basin and only reduces peak flows for a short reach downstream to the confluence detention basin, project sponsors suggested that only a single confluence detention basin be considered for preliminary design investigations. It was concluded, after further evaluation, that such a plan was feasible and advantageous because of the economics of scale related to cost of a single, large detention basin as opposed to cost of two, moderate sized detention basins.

Subsequent to the identification of these two alternatives, Nellis Air Force Base identified that the confluence detention basin site is an abandoned landfill which may contain hazardous materials. The Air Force is currently evaluating this as a potential Superfund cleanup site. It was determined that an alternative detention basin site would be preferable, if the flood control requirements could be satisfied. After consultation, review and evaluation, an alternative site was identified to the east of Nellis Air Force Base, adjacent to the existing golf course. This site is located on the Eastern Tributary of Range Wash. Moving the detention basin to this location requires a channel across the Nellis Air Force Base golf course to convey Western Tributary flows to the proposed detention basin site. This golf course channel requires integration into the existing golf course and will be earth or grass lined. The alternative detention basin site further justifies the elimination of detention basin E-P1. This is accomplished by enlarging the

size of the previously proposed confluence detention to utilize the additional storage volume available at the newly identified site. This change is include in the evaluation and preliminary design of the two selected alternatives.

The selection of Alternatives III and IV is based largely on the estimated construction cost savings resulting from detention basin construction at the confluence versus the construction of the necessary channel improvements along the Sloan Channel. The difference in cost between these two approaches has been estimated at approximately $2 million. The detention basin also provides an additional benefit in that the construction of the basin along with the golf course channel alone immediate benefits to downstream properties. Because the these facilities are located at the natural low point, extensive upstream facilities are not required to collect the flow and downstream improvements are minimized because of flow reduction.

Alternative II, the Beltway Alignment Alternative, was not selected because of the uncertainty regarding the final beltway alignment and the relationship of the beltway with any proposed drainage improvements. The construction of the beltway diversion dike is a considerable expenditure. The reconstruction of this dike to accommodate an altered beltway alignment would require considerable capital expenditures and was deemed ill-advised at this time.



STORM SCHEMATIC

FIGURE IV-3

Simulation results at key locations within the watershed are summarized in Tables IV - 2 and IV - 3 for Alternative III and Alternative IV, respectively.

Discussion

Comparison of Tables IV-2 and IV-3 indicates that each alternative generally provides the same level of flood control protection. The only significant difference is the Western Tributary below the proposed Western Tributary detention basin for Alternative III. Alternative IV diverts all tributary runoff to the North Las Vegas Detention Basin, thereby reducing the Western Tributary watershed by approximately forty-eight square miles. Therefore, a new watershed beginning point has been established by inclusion of the diversion dike.

Alternative III, with its Western Tributary detention basin, still retains all of the tributary watershed and discharges reduced flows to the lower reaches of the Western Tributary. These clear water outflows are conveyed to the Western Tributary at the Union Pacific Railroad in a stabilized, below grade channel. Critical design discharges (1200 cfs) in the upper reaches of this channel result from a storm centered on the area directly tributary to the detention basin (Western Tributary Upland Storm), whereas the critical design discharge (3400 cfs) for lower reaches results from a storm centered over the upstream and downstream tributary areas (Western Tributary storm).

It is interesting to note that for a storm centered over only the downstream watershed (Western Tributary Lower Basin storm), the estimated peak flow is only 3% less (3300 cfs) than that for the Western Tributary storm (3400 cfs). This is because the Western Tributary alluvial fan detention basin was sized such that lower channel reaches were subject to the same peak flow regardless of whether a storm covered the entire tributary watershed, or the portion downstream of the detention basin. The same observation holds true for the Eastern Tributary detention basin and the confluence detention basin, although to a lesser degree.

FACILITY SIZING

General

Facility sizing criteria used for preliminary design of detention basins, channels and roadway crossings did not differ from that used for the conceptual analysis. This resulted from the lack of site specific mapping of sufficient detail to establish horizontal and vertical alignments beyond a planning level investigation. Where possible, recent drawings of existing channel and

TABLE IV-2
HYDROLOGIC EVALUATION RESULTS AT KEY LOCATIONS
FACILITIES ALTERNATIVE III

LOCATION	Peak Discharge (cfs) Storm Areal Distribution									TOTAL BASIN	CRITICAL
	A	B	C	D	AD	BC	CD	ABCD	E		
W1	**6500**	0	0	0	6000	0	0	5200	0	5000	**6500**
W2	**1200**	0	0	0	1100	0	0	1000	0	1000	**1200**
W3	1200	0	0	3300	**3400**	0	2800	3000	0	2910	**3400**
E1	0	**1800**	0	0	0	1400	0	1000	0	980	**1800**
E2	0	**910**	0	0	0	770	0	640	0	610	**910**
E3	0	900	**3100**	0	0	2900	2700	2100	0	2000	**3100**
R1	710	450	780	870	960	820	1100	**1100**	0	1100	**1100**
R2	700	450	780	870	960	820	1100	1100	**3100**	2500	**3100**

TABLE IV-3
HYDROLOGIC EVALUATION RESULTS AT KEY LOCATIONS
FACILITIES ALTERNATIVE IV

	Peak Discharge (cfs) Storm Areal Distribution										
LOCATION	A	B	C	D	BC	CD	BCD	E	BCDE	TOTAL BASIN	CRITICAL
W1	**6400**	0	0	0	0	0	0	0	0	4800	**6400**
W2	0	0	0	0	0	0	0	0	0	0	**0**
W3	0	0	0	**3400**	0	2900	2800	0	2600	2400	**3400**
E1	0	**1800**	0	0	1400	0	1200	0	1100	980	**1800**
E2	0	**910**	0	0	780	0	730	0	700	610	**910**
E3	0	900	**3100**	0	2900	2600	2500	0	2300	2000	**3100**
R1	0	450	780	880	820	1100	**1100**	0	1100	1000	**1191**
R2	0	450	780	880	820	1100	1100	**3100**	2400	2500	**3100**

roadway crossing facilities were used to establish channel stationing and grades. Also, where possible, County 1" = 200' topographic mapping was used to obtain more site specific information regarding proposed detention basins, especially the confluence detention basin. Additionally, mapping provided by Nellis Air Force Base was used for the golf course channel.

Alluvial Fan Improvements

Upon completion of the conceptual analysis, the sizing of alluvial fan dikes was revised to include an unlined upstream conveyance section. Previously, no conveyance section was included, and the dike was assumed to be constructed from floodway borrow material. To allow independent construction of floodways and dikes, the conveyance section was added. This revision allows the dike to be constructed from material excavated for the conveyance section and also reduces the total dike height by reducing the depth of flow. All other aspects of dike sizing remain the same.

Subsequent to these changes, representatives from Boyle Engineering Corporation and the City of North Las Vegas met informally with Alan Johnson of FEMA to discuss the proposed approach to handling alluvial fan flows. A brief presentation was made regarding the total fan approach for each alternative and specific mention was made regarding the conceptual facilities, especially proposed dikes. While this was an unofficial meeting, Mr. Johnson appeared receptive to the total fan approach, expressed a desire to work with Project Sponsors regarding the improvements, and seemed to exhibit a positive attitude regarding the proposed facilities. Alluvial fan dikes were discussed and the conceptual dike design approach, including an upstream conveyance section, was positively received. Although this unofficial, informal meeting was positive, Mr. Johnson was not in a position to comment on acceptability until final design and construction of each facility, pursuant to FEMA regulations. However, the positive tone of the meeting indicates the beginning of a cooperative relationship which should be continued during final design.

FACILITY COST ESTIMATES

Opinions of probable cost were estimated for each facility of each alternative and are summarized in Tables IV-4 and IV-5 for Alternatives III and IV, respectively. The same estimating basis was used as that for the conceptual analysis, but reflects a better estimation of quantities obtained from preparation of the drawings presented in Appendix A.

TABLE IV - 4

FACILITY COSTS

ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION BASIN

Facility Designation (Sheet Numbers)[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1 (11)	$ 353,000	$ 1,457,000	$ 362,000	$ 2,170,000
W - 3 (12,13)	872,000	3,892,000	952,000	5,720,000
W - 2 (10)	864,000	2,542,000	681,000	4,090,000
W - I (9,10)	680,000	7,898,000	1,716,000	10,290,000
W - 4 (8,9)	160,000	1,609,000	354,000	2,120,000
W - 5 (8)	36,000	476,000	102,000	610,000
W - 6 (7,8)	40,000	740,000	156,000	940,000
W - 7 (7)	37,000	1,076,000	223,000	1,340,000
W - 8 (7)	50,000	776,000	165,000	990,000
W - 9A (6)	20,000	300,000	64,000	380,000
W - 9B (6)	0	440,000	88,000	530,000
W - 9C (6)	0	2,560,000	512,000	3,070,000
W - 9D (5)	106,000	1,040,000	229,000	1,380,000
EASTERN TRIBUTARY				
E - 1A (18)	$ 350,000	$ 1,860,000	$ 442,000	$ 2,650,000
E - 2A (17)	240,000	960,000	240,000	1,440,000
E - 3 (17)	34,000	900,000	187,000	1,120,000
E - J1 (17)	160,000	1,200,000	272,000	1,630,000
E - 4 (16)	83,000	1,000,000	217,000	1,300,000
E - 5 (15,16)	66,000	1,060,000	225,000	1,350,000
E - 6 (15)	73,000	1,270,000	269,000	1,610,000
E - 7 (15)	80,000	1,240,000	264,000	1,580,000
E - 8A (14,15)	44,000	750,000	159,000	950,000
E - 8B (14)	76,000	1,330,000	281,000	1,690,000
SLOAN CHANNEL				
R - M (19)	$ 1,880,000	$ 4,550,000	$ 1,286,000	$ 7,720,000
R - 1 (4)	50,000	540,000	118,000	710,000
R - 2A (4)	0	0	0	0
R - 2B (4)	0	0	0	0
R - 3 (4)	0	450,000	90,000	540,000
R - 4 (3,4)	0	460,000	92,000	550,000
R - 5 (3)	0	470,000	94,000	560,000
R - 6 (3)	0	560,000	112,000	670,000
R - 7 (3)	0	1,600,000	320,000	1,920,000
SUMMARY				
WESTERN TRIBUTARY	$ 3,218,000	$ 24,806,000	$ 5,604,000	$ 33,630,000
EASTERN TRIBUTARY	1,206,000	11,570,000	2,556,000	15,330,000
SLOAN CHANNEL	1,930,000	8,630,000	2,112,000	12,670,000
TOTAL	$ 6,350,000	$ 45,010,000	$ 10,270,000	$ 61,630,000

1 See Appendix A Drawings

TABLE IV - 5

FACILITY COSTS
ALTERNATIVE IV - DIVERSION TO NORTH LAS VEGAS DETENTION BASIN

Facility Designation (Sheet Numbers)[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1 (20,21,22)	$ 910,000	$ 3,700,000	$ 922,000	$ 5,530,000
W - 6 (7,8)	40,000	740,000	156,000	940,000
W - 7 (7)	37,000	1,076,000	223,000	1,340,000
W - 8 (7)	50,000	776,000	165,000	990,000
W - 9A (6)	20,000	300,000	64,000	380,000
W - 9B (6)	0	440,000	88,000	530,000
W - 9C (6)	0	2,560,000	512,000	3,070,000
W - 9D (5)	106,000	1,040,000	229,000	1,380,000
EASTERN TRIBUTARY				
E - 1A (18)	$ 350,000	$ 1,860,000	$ 442,000	$ 2,650,000
E - 2A (17)	240,000	960,000	240,000	1,440,000
E - 3 (17)	34,000	900,000	187,000	1,120,000
E - J1 (17)	160,000	1,200,000	272,000	1,630,000
E - 4 (16)	83,000	1,000,000	217,000	1,300,000
E - 5 (15,16)	66,000	1,060,000	225,000	1,350,000
E - 6 (15)	73,000	1,270,000	269,000	1,610,000
E - 7 (15)	80,000	1,240,000	264,000	1,580,000
E - 8A (14,15)	44,000	750,000	159,000	950,000
E - 8B (14)	76,000	1,330,000	281,000	1,690,000
SLOAN CHANNEL				
R - M (19)	$ 1,880,000	$ 4,550,000	$ 1,286,000	$ 7,720,000
R - 1 (4)	50,000	540,000	118,000	710,000
R - 2A (4)	0	0	0	0
R - 2B (4)	0	0	0	0
R - 3 (4)	0	450,000	90,000	540,000
R - 4 (3,4)	0	460,000	92,000	550,000
R - 5 (3)	0	470,000	94,000	560,000
R - 6 (3)	0	560,000	112,000	670,000
R - 7 (3)	0	1,600,000	320,000	1,920,000
SUMMARY				
WESTERN TRIBUTARY	$ 1,163,000	$ 10,632,000	$ 2,359,000	$ 14,150,000
EASTERN TRIBUTARY	1,206,000	11,570,000	2,556,000	15,330,000
SLOAN CHANNEL	1,930,000	8,630,000	2,112,000	12,670,000
TOTAL	$ 4,300,000	$ 30,830,000	$ 7,030,000	$ 42,160,000

1 See Appendix A Drawings

Table IV-5 summarizes and compares opinions of probable cost for the two alternatives.

TABLE IV - 6

SUMMARY OF PRELIMINARY FACILITY COSTS
(Millions of Dollars)

Alternative		East Tributary	West Tributary	Sloan Channel	Total
III	Facility	$ 11.6	$ 24.8	$ 8.6	
	Land	1.2	3.2	1.9	
	Contingency	2.6	5.6	2.1	
	Total	$ 15.4	$ 33.6	$ 12.6	$ 61.6
IV	Facility	$ 11.6	$ 10.6	$ 8.6	
	Land	1.2	1.2	1.9	
	Contingency	2.6	2.4	2.1	
	Total	$ 15.4	$ 14.2	$ 12.6	$ 42.2

Comparing estimated costs, Alternative IV is the least costly. This results from differing means of handling Western Tributary alluvial fan flows. Alternative IV diverts flows to the existing North Las Vegas Detention Basin, an existing facility, wheras Alternative III requires construction of an alluvial fan detention basin, as well as the collector dikes and floodway required to direct runoff to the basin. However, the estimated cost of Alternative IV does not include costs for modification to the existing detention basin. A concurrent analysis performed by others for the City of North Las Vegas indicates that excess capacity exists within the exiting detention basin, which can be utilized by modification to the exiting outlet works. Costs for this modification are not included in the costs presented in this report.

V - IMPLEMENTATION PLAN

SELECTED ALTERNATIVE

The City of North Las Vegas and the Clark County Regional Flood Control District have selected Alternative IV as their preferred alternative. This alternative features the diversion of Western Tributary flows to the existing North Las Vegas detention basin. It also includes conveyance downstream of Interstate 15 on the Western Tributary and detention and conveyance along the Eastern Tributary from the fan downstream to the confluence with the Western Tributary. Detention is proposed at the confluence and limited channel improvements are required downstream before discharging into the Las Vegas Wash.

This plan utilizes existing facilities to the greatest extent practicable by limiting flow rates to existing capacities or adding limited facilities to inadequate existing structures. New facilities are proposed where no existing facilities are in place or where existing facilities are not compatible with proposed ones. By adopting this approach, the desired flood protection is provided at lower cost.

COORDINATION WITH MASTER PLAN UPDATE

Subsequent to the initiation of this study, the Clark County Regional Flood Control District authorized a project to update the existing Clark County Master Plan. Boyle worked closely with the District's consultant, James M. Montgomery, to incorporate the findings of the facility planning study into the Master Plan Update.

The Master Plan Update hydrology is based on the hydrologic model developed by Boyle. Some modifications were made to incorporate recently adopted hydrologic criteria. The discharges developed during the Master Plan Update are consistent with those of this study and therefore do not require any modification of the recommended plan. For regulatory purposes, the Master Plan Update has adopted the discharges which reflect the diversion dike (Facility W-1) superimposed on the existing watershed. This reflects the assumption that the construction of this facility will occur in the near future.

The facilities recommended in this Facility Plan have been incorporated into the Master Plan Update with nominal modification. Some additional facilities are proposed between the

diversion dike (W-1) and Interstate 15 to collect and convey flows expected during future development. These facilities were not included in this study because it was believed that needlessly encumbered development of this area and would be more appropriately planned, designed and constructed by the developer at the time of development. The master plan update also includes runoff control of the east side drainages which are directly tributary to Sloan Channel. These facilities were included at the request of Clark County in response to historic debris and sedimentation problems experienced along the roadways. They were not included in the facility plan because they did not affect the sizing of facilities along Sloan Channel and because any flood flows would flow down existing streets or drainages and ultimately reach Sloan Channel regardless of the extent of improvements.

The Master Plan Update summarizes and incorporates the findings of this study. While only a Facility Plan, this study contains a more detailed presentation of the Alternative plan than does the Master Plan Update. Plan and Profile drawings with preliminary alignments and grades are provided as part of this study. This Facility Plan is intended to provide the foundation for final design by identifying significant constraints and identifying a geometry and alignment which best reconciles the identified constraints. At the time of final design, more detailed mapping will be required to provide enough information to confirm the preliminary alignment and geometry and allow reconciliation of remaining problem areas.

IMPLEMENTATION PLAN

Because sufficient funds are not available to construct all the facilities identified in this plan, an implementation plan has been formulated. The plan weighs the need for the improvements along with the cost and relative benefit to develop a priority list. Using the criteria, two facilities are of highest priority; the Western Tributary diversion dike and the confluence detention basin.

The importance of the Western Tributary dike and the resulting flow reduction has long been recognized. The existing Master Plan identifies a detention basin which achieves the same objective as does dike construction. This facility was funded in the District's 10-year program. Since the dike serves the same function, at lower cost, its priority is clear. The timeliness of this is even more evident given the ongoing development pressures which exist on this portion of the fan.

Past flooding, and the highest degree of residential development, have occurred along the Sloan Channel. To most cost effectively reduce the flooding and subsequent damage, the confluence detention basin should be constructed. To collect western tributary flows, the golf

course channel must be constructed concurrently. The existing master plan did not include the facility, therefore, it is not included in any identified funding program. It has been included in the Master Plan Update and will be eligible for future inclusion.

The remaining facilities are all important parts of this plan and are vital to provide the required level of flood protection. The following table presents a recommended priority listing of the facilities identified in this plan.

TABLE V - 1

IMPLEMENTATION PRIORITY

Priority	Facility Description	Facility Designation
1A	Western Tributary Diversion Dike	Dike W-1
1B	Confluence Detention Basin and Golf Course Channel	Basin R-M and Channel W-9D
2	Property Acquisition for East Tributary Detention Basin	Basin E-J1 land
3	Sloan Channel Improvements	Channels R-1 to R-7
4	West Tributary Channel from from UPRR to Golf Course Channel	Channels W-6 to W-9
5	East Tributary Detention Basin and Channel to Forrestal	Basin E-J1 and Channels E-4 and E-5
6	East Tributary Floodway and dikes upstream of Detention Basin	Dike E-1A and Floodway E-2A
7	East Tributary Channel Forrestal to Confluence Detention Basin	Channels E-6 and E-7

These priorities represent conditions which exist within the basin at the present time. It is advisable to review these priorities periodically and reassess their applicability to current needs.

If opportunities for the construction of lower rated improvements become available, they should be encouraged, particularly if private funds are suggested for the construction.

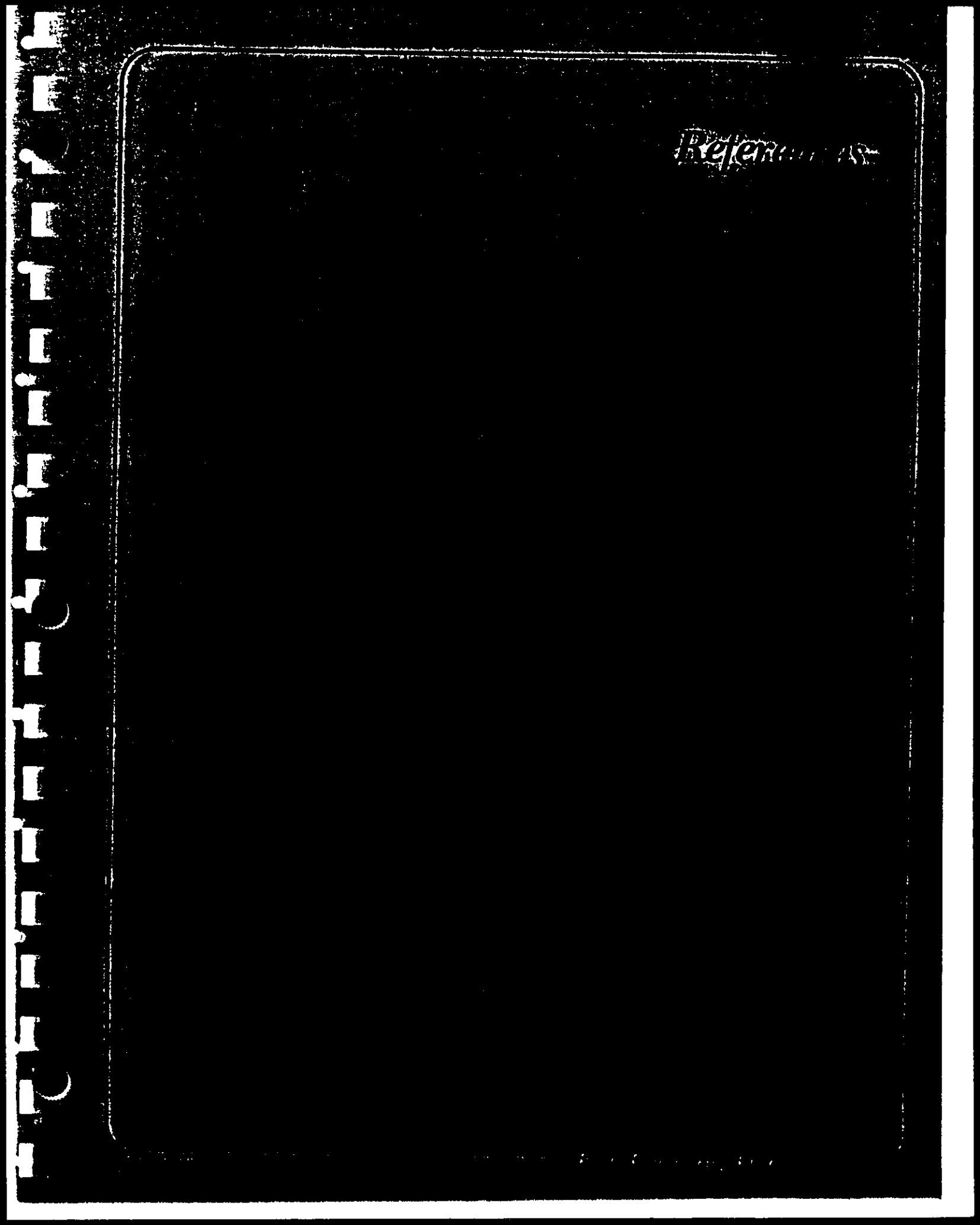

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TABLE III-1

ALTERNATIVE FACILITY MATRIX

Facility Designation	Description	Alternative I	II	III	IV
Eastern Tributary					
E-D	Detention		X		
E-1	Channel		X		
E-2	Dike		X		
E-3	Channel		X		
E-1A	Dike	X		X	X
E-2A	Floodway	X		X	X
E-J1	Detention	X	X	X	X
E-4-5	Channel	X	X	X	X
E-6	Channel	X	X	X	X
E-P1	Detention	X		X	X
E-7	Channel	X	X	X	X
E-8	Channel	X	X	X	X
Western Tributary					
W-1	Dike	X		X	
W-2	Floodway	X		X	
W-3	Dike	X		X	
W-3A	Diversion Dike				X
W-I	Detention	X		X	
W-4A	Dike		X		
W-F1	Detention		X		
W-4	Channel	X		X	
W-5	Channel	X		X	X
W-5A	Channel		X		
W-6-8	Channel	X	X	X	X
W-9	Channel	X	X	X	X
Combined Range Wash					
R-M	Detention		X	X	X
R-1-7	Channel	X	X	X	X

HYDROLOGIC EVALUATION OF CONCEPTUAL ALTERNATIVES

Introduction

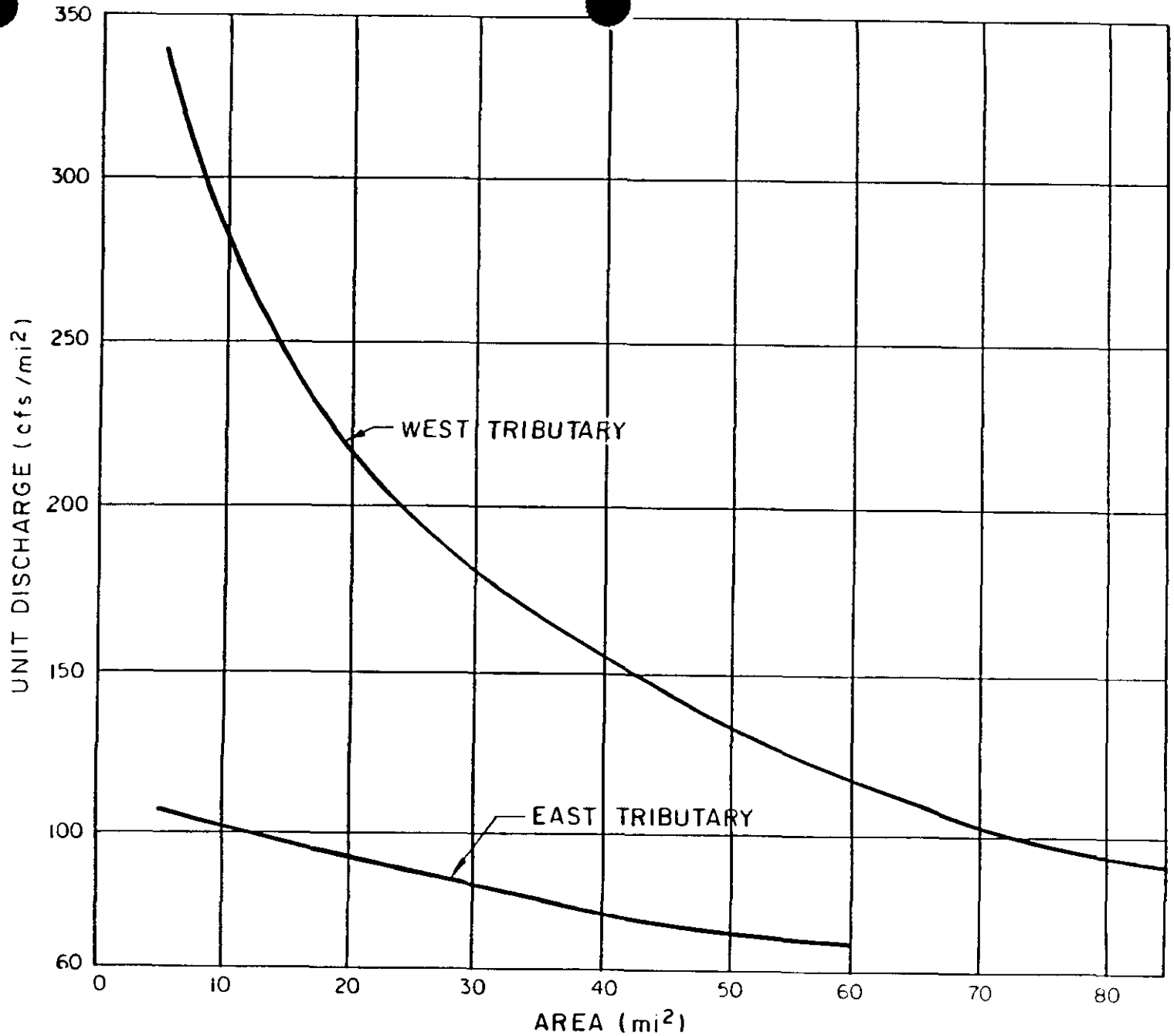
Appropriate methodologies consistent with the purpose and objective of the conceptual analysis were established to perform hydrologic evaluations of the alternatives. Use of these methodologies is predicated on the conceptual nature of the proposed alternatives and a need to evaluate not only basin wide hydrologic events, but to determine spatial distribution of hydrologic events resulting in critical peak discharges and volumes. Methodologies used were: 1) Use of weighted average SCS curve numbers with areally adjusted gross precipitation to estimate inflow volumes to proposed detention basins and 2) Development of unit discharge curves (areal peak discharge versus drainage area) to estimate peak discharges at selected watershed points.

Estimation of Storm Runoff Volumes

Storm runoff volumes were estimated at points of interest within the watershed by determining excess precipitation using the SCS curve number methodology described in Chapter II. Weighted average curve numbers were developed using calibrated curve numbers in Table II-6. Runoff volumes were estimated based on areally adjusted point precipitation values using depth area reduction factors described in Chapter II for the basin area directly tributary to the point of interest.

Unit Discharge Curves

Using the hydrologic model developed in Chapter II for future conditions with existing facilities, unit discharge curves were developed by analyzing storms of different areal extent. For each analysis, precipitation values were adjusted using the appropriate depth area reduction factor for the basin size being analyzed. To account for variation between the hydrologic response of different portions of the watershed, unit discharge curves were developed for both the Western and Eastern Tributaries of Range Wash (Figure III - 5). The unit discharge curves developed illustrate the greater hydrologic response, as measured by peak discharge, of the Western Tributary over that of the Eastern Tributary. This greater response is indicative of differing hydrologic parameters, such as development limits, average land slope and hydrologic soil groups. The Western Tributary has a greater potential for development, a greater average land slope and a greater percentage of soil in SCS hydrologic soil group D. Although use of these unit discharge curves outside the scope of this planning study may be of benefit in estimating



UNIT DISCHARGE CURVES
FIGURE III-5

Boyle Engineering Corporation

order-of-magnitude peak discharges, their use is not considered a substitute for detailed hydrologic investigation and analysis for design of facilities. They are only used for this conceptual analysis and will not be used for preliminary design.

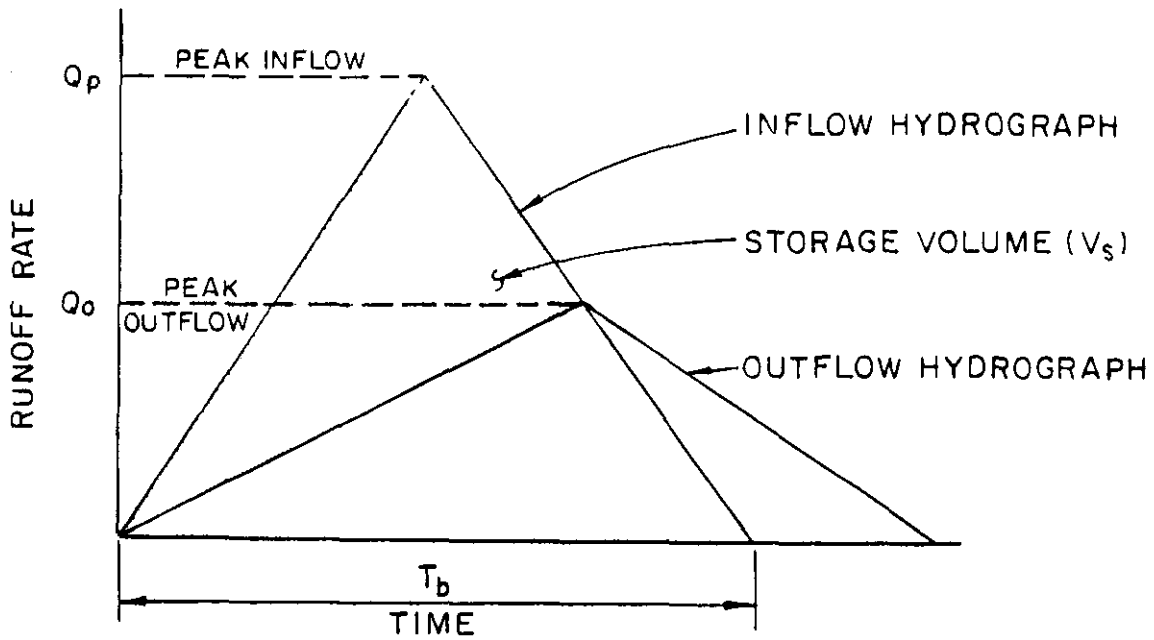
CONCEPTUAL FACILITY SIZING

Approach

The proposed facilities for all alternatives consist of combinations of detention basins, channels and alluvial fan improvements. The approach adopted to size the proposed facilities was to minimize the total cost of all facilities for each alternative. This was accomplished by establishing detention basin volumes by considering the total cost of each detention basin and its associated outlet channel for various detention basin volumes and corresponding outlet channel discharges. Typically an evaluation of this type yields one of three results: 1) Total cost is least with no detention (all conveyance system); 2) Total cost is least with maximum detention (retention system) or; 3) Total cost is least for a detention volume between none and the maximum. This type of analysis is also typically performed for a storm distributed over the area upstream of a proposed detention basin, which ignores the potentially higher unit runoff from a storm distributed over the area downstream of a proposed detention basin. If the results of the analysis indicated maximum detention, then detention basin volumes were reduced such that the peak runoff released to lower outlet channel reaches equalled the flowrate for an intense storm centered downstream of the detention basins. The design peak discharge is the minimum for which the channel can be sized and is independent of basin discharge.

Detention Basins

Detention facility sizing is dependent on runoff volume and its relationship to peak runoff rate, whereas the sizing of the other proposed facilities is predominantly dependent on peak runoff only. Inclusion of upstream detention, which lowers downstream peak runoff rate, generally reduces the size of downstream facilities in a combined system. Methods described in "Urban Stormwater Management," Special Report No. 49, American Public Works Association were used to prepare preliminary storage capacity estimates of proposed detention basins based on estimates of target detention basin outflows. The method uses triangular shapes for both inflow and outflow hydrographs, which provides an expedient means to estimate detention basin volumes for preselected basin outflows. The computational methods are illustrated in Figure III - 6.



$$\text{STORM VOLUME} = V = \frac{T_b Q_p}{2}$$

$$\text{STORAGE VOLUME} = V_s = \frac{T_b}{2}(Q_p - Q_o)$$

$$= V\left(1 - \frac{Q_o}{Q_p}\right)$$

ESTIMATING DETENTION BASIN STORAGE VOLUMES USING TRIANGULAR HYDROGRAPHS

FIGURE III-6

While this method provides reasonable estimates of detention basin storage requirements it does not provide a means of estimating the hydrograph resulting from combining the detention basin outflow hydrograph with downstream inflow hydrographs, unless a relationship regarding the time to peak is known, estimated or assumed. For this analysis it was assumed that 37.5% (3/8) of the runoff volume occurred prior to the peak, which is consistent with the SCS Unit Hydrograph. Therefore, the time to peak of the triangular inflow hydrograph is 37.5% of the hydrograph time base. With the known Q_o the time of the peak outflow can be determined and the shape and time base of the detention basin release hydrograph can be estimated. Combination of runoff hydrographs is important when considering multiple detention basin systems, where design of downstream detention basins is dependent on the ability of upstream detention basins to "delay" the release of storm runoff volume, as well as reduce peak inflow rate.

Channels and Roadway Crossings

Channels were sized based on a height of lining equal to normal depth as given by Manning's equation plus a freeboard allowance of 1.5 feet. Channels downstream of detention basins were assumed to be concrete lined to provide protection from clear water scour. Assumed side slopes for concrete lined channels were 2 horizontal to 1 vertical and bottom widths were based on a channel section producing a maximum flow velocity of 25 feet per second. Where possible, channel velocities were limited to less than 15 feet per second. Manning's n value for concrete lined channels was assumed to be 0.015.

Existing culvert roadway crossings were evaluated on their capability to adequately pass estimated discharge using Bureau of Public Roads "Hydraulic Engineering Circular No. 5" and "Hydraulic Engineering Circular No. 10" based on an allowable headwater one and one-half feet below the roadway overtopping elevation. Record drawings of existing crossings were utilized to obtain geometric data. Existing bridge crossings were evaluated based on open channel hydraulics using the net waterway area and a wetted perimeter which included pier effects. Proposed improvements to roadway crossings without sufficient hydraulic capacity consist of the addition of culvert cells or a replacement structure, depending on the geometry of the crossing. Proposed facilities were sized using the same criteria and methodology used to analyze existing facilities.

Alluvial Fan Improvements

Proposed alluvial fan improvements consist of earthen embankments, which act to concentrate and direct alluvial runoff to selected points; and bank stabilized floodways, which convey runoff to detention basins. Conceptual sizing of these facilities was based on establishing an order-of-magnitude facility size which was consistent with evolving FEMA criteria. New FEMA rule changes have clarified FEMA's position regarding alluvial fan improvements, but do not provide details of acceptable methodologies. In general terms "FEMA will consider for map revision purposes major flood control measures whose design and construction are supported by sound engineering analyses which demonstrate that the measures will effectively eliminate all alluvial fan flood hazard from the area protected by such measures." The engineering analyses referred too must include the following:

1. Quantification of design discharge and volumes of water flow, debris flow and sediment movement associated with the flood that has a one-percent probability of being equaled or exceeded in any year at the apex of the fan under current watershed conditions and under potential adverse conditions (watershed deforestation).

2. Analyses showing that project elements will accommodate the above quantities, and their associated hydrodynamic and hydrostatic forces.

3. Analyses showing design of project elements against erosion and scour.

4. Analyses showing that project elements provide protection from lateral migration and sudden relocation of flows from other parts of the fan.

5. Analysis that assesses method of disposal of concentrated flood water and associated sediment load on adjacent properties.

6. Analysis demonstrating that flooding from local runoff, or sources other than the fan apex, is insignificant, or otherwise has been accommodated.

For this planning study, it is assumed, that the runoff and sediment volume estimates presented in Chapter II meet requirement 1 above. Also, since these runoff estimates include direct rainfall on the fan, below the apex, it is assumed that requirement 6 is met. Requirement 5 is assumed met by discharge of alluvial runoff to detention basins.

Dikes

Element one of the proposed alluvial fan facilities are earthen embankments. To address lateral migration and flow relocation (requirement 4) this study assumed the same design discharge and sediment load at any point along the dike. It was assumed that apex flows reaching the dike would be confined to a single channel with top width equal to that given by Dawdy's equation.

$$T = 9.5Q^{0.4}$$

where

T = Top width of flow (feet)

Q = Discharge (cfs)

This equation also relies on the assumption that the flow forms the channel and the flow regime is critical, i.e. depth of flow is at critical depth. Since the dike is a transverse obstruction to this channel, the hydrodynamic force (requirement 2) of the incoming flow was assumed to be represented by hydrostatic force equal to the depth of flow and velocity head, which conservatively implies that flow is completely stopped before being directed along the toe of the dike. The conveyance area and slope along the dike was determined based on maintaining the flow velocity of the incoming runoff. It was assumed that since the incoming flow represented a state of equilibrium on the fan, then flow along the dike should be similar. It was assumed that a similar velocity distribution would produce a similar state of equilibrium along the dike. To account for sediment deposition (requirement 2) along the dike, especially at the point of impact, a sediment depth was assumed equal to the flow depth along the dike times the percentage of the flow composed of bulked sediment. Prior to performing the sediment yield analysis presented in Chapter II, this percentage was estimated to be 20% based on a 100-year sediment volume equal to ten times the average annual sediment yield. To provide protection against erosion and scour (requirement 3), the upstream dike face was assumed to be soil cemented lined with a lean concrete toe-in equal to the greater of the sediment depth (assumes amount scoured equals potential amount deposited), or a minimum of five feet.

Summarizing, the total design dike height above existing ground elevation is composed of the following four components:

Y_n = normal depth along dike at design discharge, assuming velocity along dike equals fan channel velocity.

Y_v = impact depth, equal to velocity head of fan channel.

Y_s = sediment depth, equal to normal depth times bulking percentage.

Y_f = FEMA minimum freeboard requirement for dikes and levees, equal to three feet.

During the conceptual evaluation it was assumed dikes would be constructed directly on the fan slope using material excavated from floodways, without formation of a channel along the upstream face.

Floodways

Floodways on the fan serve to convey flows concentrated by dikes to existing or proposed alluvial fan detention basins. Conceptual sizing of floodways assumed a top width equal to that given by Dawdy's equation and a total depth equal to critical depth plus three feet of freeboard. Use of Dawdy's regime equation to size floodways is assumed to represent a conservative approach to provide a stable alluvial channel which meets FEMA's requirements 2 and 3. To prevent lateral migration and flow relocation (requirement 4) banks of floodways were assumed to be stabilized by gabions with a toe-in equal to floodway depth. Excavated materials from floodway areas were assumed to be used for dike embankment construction.

CONCEPTUAL FACILITIES

Facilities sized during the conceptual evaluation are presented in tabular form in Appendix B. These tables provide geometric and hydraulic information for each facility of each alternative. Table III-2 compares the peak flow estimated for future development/existing facilities with each alternative at key points within the watershed.

Alternatives I, III and IV have the same percentage peak flow reduction for the Western and Eastern Tributaries at the confluence with Range Wash. However, because Alternatives III and IV include a confluence detention basin, they have a 50 percent greater reduction in peak flow along Range Wash (Sloan Channel), above that for Alternative I. From this comparison, it can

be concluded that inclusion of a confluence detention basin greatly enhances peak flow reduction for Sloan Channel, and diversion of Western Tributary alluvial fan flows has the same effect as a Western Tributary alluvial fan detention basin.

Alternative II provides similar reduction of Sloan Channel peak flows, but further reduces Western Tributary flows at the confluence by a combination of detention and intra-basin diversion to the Eastern Tributary. Whereas Western Tributary peak flows are reduced, no substantial reduction in Eastern Tributary peak flows is obtained.

TABLE III-2

COMPARISON OF 100-YEAR PEAK FLOW (CFS)

Location	Future Development Existing Facilities	Alternative I	II	III	IV
Western Tributary at Confluence	7260	4470	2950	4470	4500
Eastern Tributary at Confluence	3370	860	3100	860	860
Range Wash at Las Vegas Wash	8870	5340	2570	2600	2600

CONCEPTUAL FACILITY COST ESTIMATES

General

Opinions of probable costs for right-of-way and facility construction were prepared for comparing alternatives, and are summarized in Tables III-3, III-4, III-5 and III-6 for alternatives I, II, III and IV, respectively. A contingency of 20 percent of the sum of right-of-way and facility construction cost is included because of the conceptual nature of the facilities. As such, the estimates are opinions of probable cost, subject to changing economic conditions and were developed to allow equal basis comparison of alternatives.

Right-Of-Way Costs

Right-of-way costs are a function of numerous variables, which are not easily defined into monetary values; are best determined on a case-by-case basis with individual property owners;

TABLE III - 3

CONCEPTUAL FACILITY COSTS
ALTERNATIVE I - MASTER PLAN

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1	$ 330,000	$ 4,300,000	$ 930,000	$ 5,600,000
W - 2	400,000	1,300,000	340,000	2,000,000
W - 3	690,000	9,000,000	1,900,000	12,000,000
W - I	320,000	3,600,000	780,000	4,700,000
W - 4	75,000	2,000,000	420,000	2,500,000
W - 5	40,000	580,000	120,000	740,000
W - 6	170,000	1,600,000	350,000	2,100,000
W - 7	63,000	1,100,000	230,000	1,400,000
W - 8	200,000	1,100,000	260,000	1,600,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	31,000	270,000	60,000	360,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - 1	$ 0	$ 870,000	$ 170,000	$ 1,000,000
R - 2	0	1,100,000	220,000	1,300,000
R - 3	0	1,400,000	280,000	1,700,000
R - 4	0	1,100,000	220,000	1,300,000
R - 5	0	1,400,000	280,000	1,700,000
R - 6	0	1,300,000	260,000	1,600,000
R - 7	0	2,100,000	420,000	2,500,000
SUMMARY				
WESTERN TRIBUTARY	$ 2,300,000	$ 29,000,000	$ 6,200,000	$ 38,000,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	0	9,300,000	1,900,000	11,000,000
TOTAL	$ 5,000,000	$ 50,000,000	$ 11,000,000	$ 66,000,000

[1] See Figure III-1

TABLE III - 4

CONCEPTUAL FACILITY COSTS
ALTERNATIVE II - BELTWAY ALIGNMENT

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - F1	$ 530,000	$ 2,400,000	$ 590,000	$ 3,500,000
W - 4A	220,000	4,800,000	1,000,000	6,000,000
W - 5A	19,000	240,000	52,000	310,000
W - 6	160,000	1,100,000	250,000	1,500,000
W - 7	44,000	580,000	120,000	740,000
W - 8	60,000	810,000	170,000	1,000,000
W - 9	50,000	400,000	90,000	540,000
EASTERN TRIBUTARY				
E - D	$ 100,000	$ 3,000,000	$ 620,000	$ 3,700,000
E - 1	130,000	4,700,000	970,000	5,800,000
E - 2	110,000	140,000	50,000	300,000
E - 3	230,000	8,500,000	1,700,000	10,000,000
E - J1	380,000	3,600,000	790,000	4,800,000
E - 4	69,000	600,000	130,000	800,000
E - 5	65,000	620,000	140,000	830,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - 7	62,000	3,200,000	650,000	3,900,000
E - 8	200,000	3,400,000	720,000	4,300,000
SLOAN CHANNEL				
R - M	$ 960,000	$ 3,200,000	$ 830,000	$ 5,000,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	560,000	110,000	670,000
R - 4	0	490,000	98,000	590,000
R - 5	0	530,000	110,000	640,000
R - 6	0	640,000	130,000	770,000
- 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 1,100,000	$ 10,000,000	$ 2,300,000	$ 13,000,000
EASTERN TRIBUTARY	1,500,000	30,000,000	6,300,000	38,000,000
SLOAN CHANNEL	960,000	6,900,000	1,600,000	9,500,000
TOTAL	$ 4,000,000	$ 47,000,000	$ 10,000,000	$ 61,000,000

[1] See Figure III-2

TABLE III - 5

CONCEPTUAL FACILITY COSTS
ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 1	$ 330,000	$ 4,300,000	$ 930,000	$ 5,600,000
W - 2	400,000	1,300,000	340,000	2,000,000
W - 3	690,000	9,000,000	1,900,000	12,000,000
W - 1	320,000	3,600,000	780,000	4,700,000
W - 4	75,000	2,000,000	420,000	2,500,000
W - 5	40,000	580,000	120,000	740,000
W - 6	170,000	1,600,000	350,000	2,100,000
W - 7	63,000	1,100,000	230,000	1,400,000
W - 8	200,000	1,100,000	260,000	1,400,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	31,000	270,000	60,000	360,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - M	$ 800,000	$ 3,209,000	$ 800,000	$ 4,800,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	520,000	100,000	620,000
R - 4	0	470,000	94,000	560,000
R - 5	0	530,000	110,000	640,000
R - 6	0	650,000	130,000	780,000
R - 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 2,300,000	$29,000,000	$ 6,200,000	$38,00,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	800,000	6,900,000	1,500,000	9,200,000
TOTAL	$ 5,300,000	$48,000,000	$11,000,000	$64,000,000

[1] See Figure III-3

TABLE III - 6

CONCEPTUAL FACILITY COSTS
ALTERNATIVE IV - DIVERSION TO NORTH LAS VEGAS DETENTION BASIN

Facility Designation[1]	Right-of-Way Cost	Construction Cost	Contingency	Total Facility Cost
WESTERN TRIBUTARY				
W - 3A	$ 690,000	$ 9,000,000	$ 1,900,000	$12,000,000
W - 5	40,000	380,000	84,000	500,000
W - 6	57,000	1,400,000	290,000	1,700,000
W - 7	37,000	850,000	180,000	1,100,000
W - 8	58,000	960,000	200,000	1,200,000
W - 9	57,000	4,500,000	910,000	5,500,000
EASTERN TRIBUTARY				
E - 1A	$ 190,000	$ 2,200,000	$ 480,000	$ 2,900,000
E - 2A	240,000	960,000	240,000	1,400,000
E - J1	240,000	630,000	170,000	1,000,000
E - 4	74,000	830,000	180,000	1,100,000
E - 5	84,000	1,100,000	240,000	1,400,000
E - 6	160,000	2,300,000	490,000	3,000,000
E - P1	1,100,000	1,900,000	600,000	3,600,000
E - 7	20,000	220,000	50,000	290,000
E - 8	130,000	1,400,000	310,000	1,800,000
SLOAN CHANNEL				
R - M	$ 800,000	$ 3,200,000	$ 800,000	$ 4,800,000
R - 1	0	0	0	0
R - 2	0	0	0	0
R - 3	0	520,000	100,000	620,000
R - 4	0	470,000	94,000	560,000
R - 5	0	530,000	110,000	640,000
R - 6	0	650,000	130,000	780,000
R - 7	0	1,500,000	300,000	1,800,000
SUMMARY				
WESTERN TRIBUTARY	$ 940,000	$17,000,000	$ 3,600,000	$22,000,000
EASTERN TRIBUTARY	2,200,000	12,000,000	2,800,000	17,000,000
SLOAN CHANNEL	800,000	6,900,000	1,500,000	9,200,000
TOTAL	$ 3,900,000	$36,000,000	$ 7,900,000	$48,000,000

[1] See Figure III-4

and vary both in location and time. The facilities proposed for the various alternatives tend to be located in the following general areas:

1. Historical washes and improved drainage channels with existing right-of-way, such as Sloan Channel, from Las Vegas Boulevard North downstream to Las Vegas Wash and the Vandenberg Channel, from Lone Mountain Road to Craig Road.

2. Various United States public and military reservation lands, such as the proposed alluvial fan improvements and the confluence detention basin.

3. Privately held lands within historical drainage paths located adjacent to military reservations, such as the lower Eastern Tributary Detention Basin and the lower reaches of the Eastern Tributary channel improvements near Nellis Air Force Base.

4. Privately held lands within historical drainage paths and developing urban areas, such as the Western Tributary from Craig Road downstream to Las Vegas Boulevard North.

During the conceptual evaluation, officials at Nellis Air Force Base were contacted regarding recent land acquisitions. The privately held lands being acquired by the Air Force were located within the historical drainage path of the Eastern Tributary of Range Wash. Acquisition costs were between $7,000 and $8,000 per acre. On this basis, $8,000 per acre was assumed appropriate for right-of-way costs for privately held lands. For land within the public domain, or on military reservations, costs were assumed at one-half that for private property, or $4,000 per acre.

Right-of-way widths for lined channels and floodways were calculated as the sum of the channel top width and a minimum allowance of 12 feet for maintenance access, rounded up to the next five feet. Right-of-way areas for detention basins were based on an area necessary to contain the basin with a minimum of 12 feet of access around basin limits.

Facility Construction Costs

General

Opinions of probable construction cost were estimated based on generalized unit costs for the major work quantities which could readily be estimated for the type of facility and its geometry relative to the topographic base mapping used. Identification of all components of work was

not possible, but use of slightly higher unit costs for the major components is considered reasonable to include minor work components.

Detention Basins

Using the detention basin volumes estimated during the conceptual hydrologic evaluation, major cost component quantities, such as excavation and embankment were estimated. Each detention basin site was evaluated and a configuration developed based on balanced earthwork quantities. Detention basins were assumed to consist of an earthen embankment with 3:1 side slopes and a minimum top width of 15 feet. Embankments were assumed to be constructed from materials excavated on-site. No specific embankment or foundation treatments for seepage control were considered because of the relative short duration during which flood waters would be detained. Emergency spillways were assumed to be constructed from built-up soil cement core and were sized for the probable maximum flood (PMF) estimated in Chapter II, with a head not greater than six feet. Because of the steep alluvial fan slopes, "in-ground" detention basins, with excavation volumes exceeding storage volume, were not considered cost-effective. In general, for the configurations and sites evaluated, 25 percent to 40 percent of the storage volume was obtained from required excavations.

Channels and Roadway Crossings

Channels were assumed lined with reinforced concrete 6-inches thick and underlain with an 8-inch granular bedding. Quantities of excavation were estimated assuming excavation of the entire channel section (waterway area, structural section and bedding), except along existing channels, such as Sloan Channel. Roadway culvert crossings and modifications to existing crossings were estimated based qualitative lump sum costs provided from local contractors.

Alluvial Fan Dikes and Floodways

Dikes were assumed to be constructed from material excavated for floodways. Dike side slopes were assumed to be 3 horizontal to 1 vertical with the upstream face lined with an 18-inch thick soil cement blanket placed directly on the slope. A five foot lean concrete cutoff along the upstream toe provides erosion and scour protection. The major work items for floodways consist of bulk excavation and construction of gabions for bank stability. Gabions are constructed with a toe-in equal to floodway depth, based on a three foot gabion basket configuration.

Unit Costs

Table III-7 summarizes the unit costs for major work items used in the development of the conceptual facility cost estimates.

TABLE III-7

UNIT COSTS
MAJOR WORK ITEMS

Description	Unit	Unit Cost
Earthwork	Cubic Yard	$ 3.50
Soil Cement	Cubic Yard	$ 50.00
Gabions	Cubic Yard	$ 100.00
Reinforced Concrete		
Slip-form Channel Lining	Cubic Yard	$ 175.00
Structural Formed	Cubic Yard	$ 400.00
Drain Rock	Ton	$ 14.00

CONCEPTUAL ANALYSIS RESULTS

Introduction

The four conceptual alternatives were analyzed to assess their ability to satisfy identified general objectives and relative construction cost. Results of the qualitative analysis and conceptual cost estimates are used to identify two alternatives which are selected for further consideration.

Qualitative Analysis

As a result of detention and conveyance, all alternatives reduce the hazard of flooding on the Western and Eastern Tributaries and below the confluence. Detention facilities located on the alluvial fan, at the apex of the fan, or above areas of significant development all result in decreased discharges and increased control of flood flows. Dikes also reduce flood hazard by controlling flows.

Alternative I has a lesser degree of flow reduction along the Sloan Channel than the other Alternatives because it does not include the confluence detention basin. The higher residual flows are controlled by proposed improvements to the Sloan Channel and downstream crossings. Alternative II includes an intra-basin diversion of flood waters and relies on

establishment of a Beltway alignment and its relationship to proposed improvements. While the Eastern Tributary facilities are sized to handle flows from the Western Tributary, any intra-basin diversion results in the perception of increased hazard due to the increased frequency of flows reaching that portion of the basin.

Alternative IV also increases the perceived hazard to the adjacent drainage basin. The collection and conveyance of water along the dike from the Western Tributary of Range Wash to the North Las Vegas detention basin, located within the Las Vegas Wash drainage basin, is an inter-basin transfer of water. This transfer increases the frequency and duration of flows in the Las Vegas Wash downstream of the detention basin. The basin is sized to mitigate the flooding impacts downstream, however, the prolonged discharge of water from the detention basin introduces additional problems. Increasing the frequency and duration of flooding in the Las Vegas Wash drainage basin, as a result of flows from the Range Wash basin, is a perceived increase in hazard and may result in increased exposure to liability.

The dikes and channel improvements protect property. The dikes confine and control flows resulting in the downstream area being protected from flood hazard. Channel improvements also control and convey flows thereby protecting adjacent properties from flooding.

The Alternative II beltway diversion provides protection downstream of the proposed beltway. The area upstream of the beltway, below the apex dike and diversion channel, is subject to potential flooding from flows generated on the alluvial fan. The flood peaks are not as high as those flows emanating from the canyon above the apex of the fan, however they are large and generally unconfined, consisting of gully flow, overland flow and flow in small channels. These flows are difficult to control without extensive facilities within a development.

All four alternatives address FEMA requirements as they are currently defined, however FEMA requirements for facilities and improvements on alluvial fans are evolving. The overall fan approach is the standard to which FEMA is measuring alternatives. Because of the evolution of alluvial fan technology, there are no guarantees that this approach will be accepted in the future. Under the current FEMA requirements, facilities which are designed to control alluvial fan flows, which consider sedimentation and the associated aggradation and degradation potential, and those which are appropriately maintained, will be processed and appropriate Letters of Map Revision (LOMR) will be issued. FEMA does reserve the right to change criteria and superimpose revised criteria on existing facilities and existing floodplains. Therefore, while we believe the facilities identified in these alternatives meet the current FEMA criteria, no assurances can be given that a LOMR can be obtained at the time of design or construction.

Cost Comparisons

Costs estimates for the facilities identified in each of the alternatives reflect the conceptual level analysis based on preliminary facility sizes. The cost estimates for each alternative are compared and summarized in Table III-8, Summary of Facility Costs. Estimates include the estimated facility construction cost, the estimated right-of-way cost and the total facility cost, for each alternative.

TABLE III-8

SUMMARY OF FACILITY COSTS
(Millions of Dollars)

Alternative		East Tributary	West Tributary	Sloan Channel	Total
I	Facility	$ 12.0	$ 29.0	$ 9.3	
	Land	2.2	2.3	0.0	
	Contingency	2.8	6.3	1.9	
	Total	$ 17.0	$ 38.0	$ 11.0	$ 66.0
II	Facility	$ 30.0	$ 10.0	$ 6.9	
	Land	1.5	1.1	1.0	
	Contingency	6.3	2.2	1.6	
	Total	$ 38.0	$ 13.0	$ 9.5	$ 61.0
III	Facility	$ 12.0	$ 29.0	$ 6.9	
	Land	2.2	2.3	0.8	
	Contingency	2.8	6.3	1.5	
	Total	$ 17.0	$ 38.0	$ 9.2	$ 64.0
IV	Facility	$ 12.0	$ 17.0	$ 6.9	
	Land	2.2	0.9	0.8	
	Contingency	2.8	3.6	1.5	
	Total	$ 17.0	$ 22.0	$ 9.2	$ 48.0

The estimated conceptual level construction costs for Alternatives I, II and III range from $61 to $66 million. Alternative IV has a substantially lower estimated conceptual level construction cost of $48 million. This reduction in estimated cost stems from the diversion of flows from

Range Wash to the North Las Vegas detention basin. The estimate does not include any modifications to the detention basin nor does it include any channel improvement costs downstream of the basin outlet.

Selected Alternatives

Subsequent to a review of the findings of the conceptual evaluation with the Project Sponsors, Alternatives III and IV were selected for further evaluation and preliminary design. These alternatives feature many common elements including, confluence detention, limited improvements to Sloan Channel, improvements along the Eastern Tributary of Range Wash from the alluvial fan downstream to the confluence, and improvements from the Union Pacific Railroad tracks to the confluence along the Western Tributary. The alternatives differ in their handling of Western Tributary alluvial fan flows. Alternative III provides dikes and a floodway conveying flows to a detention basin located on the alluvial fan and a channelized outflow downstream. Alternative IV consists of the diversion of Western Tributary flows across the alluvial fan to the existing North Las Vegas detention basin.

During the review process, the importance of a confluence detention basin to the facility plan became evident. Also, since the lower Eastern Tributary Detention Basin (facility E-P1) is in close proximity to the confluence detention basin and only reduces peak flows for a short reach downstream to the confluence detention basin, project sponsors suggested that only a single confluence detention basin be considered for preliminary design investigations. It was concluded, after further evaluation, that such a plan was feasible and advantageous because of the economics of scale related to cost of a single, large detention basin as opposed to cost of two, moderate sized detention basins.

Subsequent to the identification of these two alternatives, Nellis Air Force Base identified that the confluence detention basin site is an abandoned landfill which may contain hazardous materials. The Air Force is currently evaluating this as a potential Superfund cleanup site. It was determined that an alternative detention basin site would be preferable, if the flood control requirements could be satisfied. After consultation, review and evaluation, an alternative site was identified to the east of Nellis Air Force Base, adjacent to the existing golf course. This site is located on the Eastern Tributary of Range Wash. Moving the detention basin to this location requires a channel across the Nellis Air Force Base golf course to convey Western Tributary flows to the proposed detention basin site. This golf course channel requires integration into the existing golf course and will be earth or grass lined. The alternative detention basin site further justifies the elimination of detention basin E-P1. This is accomplished by enlarging the

size of the previously proposed confluence detention to utilize the additional storage volume available at the newly identified site. This change is include in the evaluation and preliminary design of the two selected alternatives.

The selection of Alternatives III and IV is based largely on the estimated construction cost savings resulting from detention basin construction at the confluence versus the construction of the necessary channel improvements along the Sloan Channel. The difference in cost between these two approaches has been estimated at approximately $2 million. The detention basin also provides an additional benefit in that the construction of the basin along with the golf course channel alone immediate benefits to downstream properties. Because the these facilities are located at the natural low point, extensive upstream facilities are not required to collect the flow and downstream improvements are minimized because of flow reduction.

Alternative II, the Beltway Alignment Alternative, was not selected because of the uncertainty regarding the final beltway alignment and the relationship of the beltway with any proposed drainage improvements. The construction of the beltway diversion dike is a considerable expenditure. The reconstruction of this dike to accommodate an altered beltway alignment would require considerable capital expenditures and was deemed ill-advised at this time.

IV - PRELIMINARY DESIGN

INTRODUCTION

Two of the alternatives evaluated during the conceptual analysis phase of this study were selected for preliminary design. The selection for preliminary design was based on estimated construction cost and non-quantifiable considerations such as flood hazard reduction, ease of implementation, and compatibility with future development plans within the community. The two selected alternatives are Alternative III - the Master Plan with Confluence Detention Alternative, and Alternative IV - the Diversion to North Las Vegas Detention Basin Alternative.

The purpose of the preliminary design is to identify general components of the selected alternatives such as types and sizes of facilities and their approximate location. The sizing of facilities is based on a refinement of the hydrologic model and hydraulic analysis. Design of detention facilities includes estimates of required storage volume, embankment height and spillway geometry. Channel and floodway preliminary design includes slope, geometry and lining type. Street crossings include identification of required culvert sizes or bridge spans. Preliminary horizontal alignments of channel and crossing facilities are identified schematically on the drawings developed. Vertical elevations are identified using the available topographic information. Utilizing the alignments and grades established by this design, utility conflicts are identified and reconciled to the extent possible. Right-of-way acquisition limits are estimated and included. The previously prepared cost estimates are refined to reflect the preliminary design effort.

The preliminary designs for Alternative III and Alternative IV are depicted on the drawings presented as Appendix A of the report. This preliminary design is conceptual in nature and lacks significant detail because no detailed topography was developed for this study. USGS 7-1/2 minute quadrangle maps, enlarged to a scale of 1" = 500', were used as base mapping. The 20-foot contour interval is the basis for most vertical information presented on the plans. This information is supplemented with record drawings of specific improvements, where available. Using the preliminary designs and alignments established during this study, more site specific surveying can be obtained for final design of facilities along the selected alignment.

No extensive utility location, surveying, or potholing program was performed. Utility owners were notified and utility maps made available were consolidated during the study. The utilities

identified on the plans are those reported by the various utility owners. This information was used during the conceptual evaluation and the preliminary design to reconcile potential utility conflicts. Subsequent field surveys for design should include more site specific utility location to allow for the detailed reconciliation of possible conflicts.

The identification of precise horizontal and vertical alignments for these improvements is not possible since no site specific mapping was performed for this project. The horizontal alignments depicted on the plans are related to physical features identified through field observation and from the available mapping. Alignments are generally identified by their relation to existing facilities such as road crossings or channels or by their proximity to existing rights-of-way. Horizontal information provided on the plans is provided to identify hydraulic constraints (for example, curve radius data). Specific horizontal alignments will be established during final design.

Vertical alignments are based on the 20-foot contour interval presented on the USGS quadrangle maps. In some cases, the existing crossings were identified on record drawings with elevations called out using the USGS datum. In these cases, the record elevations are used. All other elevations and grades identified on the plans are approximate and reflect the accuracy of the available topographic mapping.

The cost estimates prepared during this study reflect the preliminary nature of the project. No detailed structural analysis or design was performed for the facilities nor was a detailed estimate of earthwork prepared. The costs represent estimates consistent with the level of detail of the study and the topographic mapping available. Appropriate contingencies have been included in the cost estimates to reflect the lack of detail of the available information.

ALTERNATIVE DESCRIPTION

The two alternatives selected for preliminary design are Alternative III, The Master Plan with Confluence Detention Alternative, and Alternative IV, The Diversion to the North Las Vegas Detention Basin Alternative. Both alternatives were selected because of their relative low cost and because they satisfy the primary objectives of flood hazard reduction and development potential enhancement. The major elements of Alternative III include control of flows on the alluvial fan using a system of dikes and floodways and the incorporation of detention at the confluence of the Eastern and Western Tributaries of Range Wash. The principal element of

Alternative IV is the diversion of alluvial fan flows from the Western Tributary to the existing North Las Vegas Detention Basin.

Alternative III

Alternative III facilities are depicted on Sheets 3 thru 19 of the drawings included as Appendix A. The facilities consist of collector dikes on the Western Tributary of Range Wash with a floodway conveying flows south to a detention basin located above proposed development areas on the alluvial fan. From the detention basin, an outlet channel conveys flows downstream to the Union Pacific Railroad tracks, then along the tracks to a crossing near the interchange of Lamb Boulevard and Interstate 15. The channel then turns to the south, crossing the Interstate and continues southeast to a crossing of Las Vegas Boulevard North near Marion Drive. From the Las Vegas Boulevard North crossing, the channel flows southeasterly, eventually traversing the Nellis Air Force Base golf course and discharging into the confluence detention basin.

Flows from the East Range Wash drainage basin are collected by dikes on the alluvial fan and conveyed in a stabilized floodway south to a crossing of the Union Pacific Railroad tracks and then in a stabilized channel to a detention basin near I-15. Flow is then conveyed in a lined channel extending south along an existing railroad spur, beneath Interstate 15 to Las Vegas Boulevard North, and along the northeast boundary of Nellis Air Force Base to Nellis Air Force Base Area 2. The channel turns to the southwest and extends along the southeastern boundary of Nellis Air Force Base into the confluence detention basin.

The confluence detention basin is located east of the Nellis Air Force Base golf course and stores flow from the Eastern Tributary of Range Wash as well as those from the Western Tributary which have been conveyed across the golf course. The detention basin discharges flows into a stabilized channel located along the eastern boundary of the Nellis Air Force Base landfill and ultimately into Sloan Channel. Sloan Channel conveys flows south to their ultimate outfall in Las Vegas Wash. Portions of the Sloan Channel are adequate for the conveyance of the 100-year flood and are not identified for improvement. Unlined portions of Sloan Channel are identified for improvement to convey clear water discharges from the Confluence Detention Basin.

Alternative IV

Alternative IV, the Diversion to the North Las Vegas Detention Basin Alternative, is depicted on Sheets 3 through 7, 14 through 18, and 20 through 22 of the drawings included as Appendix A. This alternative consists of many elements already identified as part of Alternative III.

Specifically, facilities downstream of Interstate 15 on the Western Tributary of Range Wash, all of the Eastern Tributary of Range Wash and the entire Sloan Channel improvements are the same for both Alternatives III and IV.

The differences between Alternatives III and IV are limited to the means of handling alluvial fan flows on the Western Tributary. Alternative IV proposes to divert alluvial fan flows (at a location near the Alternative III detention basin) to the west to the existing North Las Vegas detention basin. Because of this diversion, no additional facilities are required on the fan north of the Union Pacific Railroad tracks. The proposed Alternative IV facilities are shown on the drawing included as Appendix A. For simplicity, the components which are common to both Alternatives III and IV are not repeated, rather, references are made to the appropriate drawings depicting Alternative III improvements.

Golf Course Channel Evaluation

The location of the proposed confluence detention basin (Basin R-M) at the eastern edge of the Nellis Air Force Base golf course requires the construction of a conveyance system to direct Western Tributary flows across the golf course. Both Alternatives III and IV include this channel. The City of North Las Vegas and the Clark County Regional Flood Control District recognized the significance of this conveyance and its possible impact on the operation of the golf course. As a result, they requested that a more detailed evaluation be performed to minimize disruption to the golf course and ot properly integrate the channel into the course.

Three alternatives were evaluated and discussed with the Nellis Air Force Base leadership. Their comments were received and incorporated into Alternatives III and IV.

The first alternative evaluated requires the shifting of one hole to allow the channel to follow the northern perimeter road. It also includes box culvert crossings of two fairways as well as two culvert crossings at the perimeter road.

Alternative two does not require the relocation of any golf holes, however, the channel crosses two fairways as an open ditch. One crossing is a trapezoidal section with 3:1 side slopes and the other is a trapezoidal section with very flat, 8:1 to 12:1, side slopes. Once again, crossings of the perimeter road are required in two locations.

The third alternative requires the relocation of two golf holes but only one crossing of a fairway. The channel passes between the relocated holes and crosses the single fairway using the flat side slope trapezoidal channel section. Two crossings of the perimeter road are required.

An evaluation of these three alternatives was performed. Of greatest concern to the City and CCRFCD were the flood carrying capacity, the cost and the maintenance issues associated with the proposed facilities. The Air Force Base was primarily concerned with the impacts on their property and with the potential for disruption to golf course use. To address these concerns, Boyle evaluated the hydraulics and was able to size facilities such that flood control objectives were not compromised. A cost estimate was prepared which identified the cost of the three alternatives. Maintenance access was provided to all facilities and slopes were proposed to minimize access problems and expedite cleaning, mowing and repair. To alleviate the concerns regarding disruption to use of the golf course, a detailed construction schedule was provided for each alternative. This resulted in the identification of construction timetables which minimized the duration of disruptive activities.

After considerable discussion and modification, agreement with the Air Force was reached on a revised version of Alternative 2. This alternative has been included in the facility plan and is shown on Sheet 19 of the included drawings. Changes to the original Alternative 2 include the modification of the channel alignment entering the golf course. This modification requires an additional road crossing but provides a hydraulically efficient alignment. Architectural stone bridges have been requested to minimize the visual impact of required pedestrian and maintenance crossings of the channels where they cross fairways. The Air Force Base also requested that the flat sloped channel crossing of the fairway be modified to the steeper geometry to minimize disruption to the golf hole.

Specific details of the various amenities associated with improvements to the golf course will be identified at the time of final design of the improvements. The Air Force Base has requested other elements such as continued access to their well and assurances that their existing utility systems will not be disrupted. These requests will be addressed during final design but are beyond the level of detail required for this facility planning study. When final design is initiated, these facilities will be formally incorporated.

HYDROLOGIC EVALUATION

Hydrologic Models

The proposed facilities for each alterative selected were superimposed on the watershed and the subbasin delineation utilized for the existing conditions model was adjusted to reflect the proposed facilities. Basin and routing parameters were also adjusted to reflect addition of the

proposed facilities. Subbasin and model nodes are depicted in Figures IV-1 and IV-2, for Alternatives III and IV, respectively.

Based on the conceptual hydrologic analysis results, stage-storage-discharge relationships were developed for each detention basin and included in the models. Initial simulation runs were made and adjustments made in detention basin volumes and discharge relationships. This was done to size detention basins such that peak discharges in outlet channel reaches were approximately the same for an intense storm below the detention basin as for the basin discharge, and to "fine tune" the conceptual hydrologic analysis.

Results

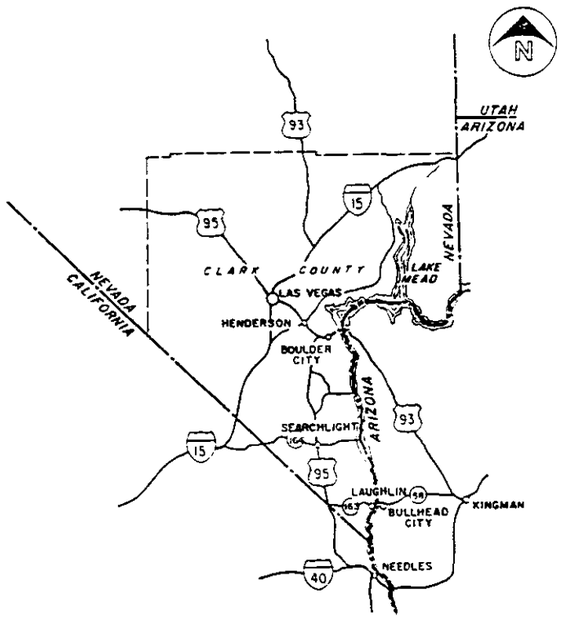
Once the base models were prepared, analyses were made simulating precipitation over portions of the watershed to estimate critical discharges for facility design. Storm descriptions and designations simulated for each alternative are summarized in Table IV-1 and schematically depicted in Figure IV-3.

TABLE IV - 1

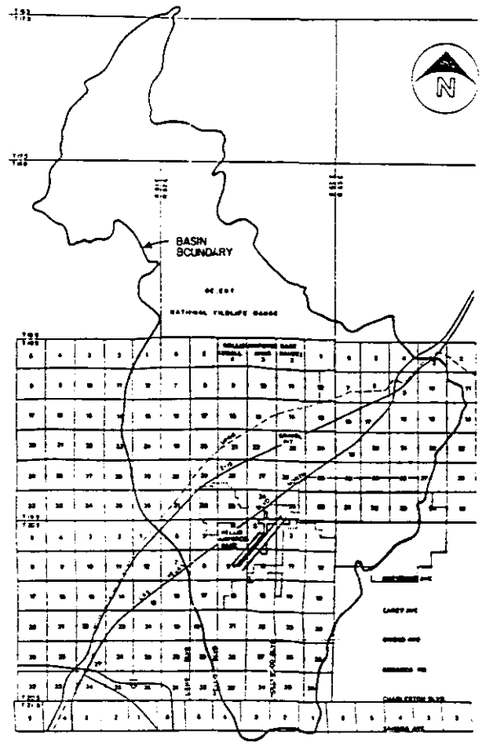
HYDROLOGIC STORM CENTERINGS

Description	Storm Designation	Alternative III	Alternative IV
Western Tributary Upland Storm	A	X	X
Eastern Tributary Upland Storm	B	X	X
Eastern Tributary Lower Basin Storm	C	X	X
Western Tributary Lower Basin Storm	D	X	X
Western Tributary Storm	AD	X	
Eastern Tributary Storm	BC	X	X
Central Basin Storm	CD	X	X
Central and Eastern Tributary Upland Storm	BCD		X
Upper Basin Storm	ABCD	X	
Range Wash Storm	E	X	X
Downstream of Diversion Dike Storm	BCDE		X
Total Basin Storm	ABCDE	X	X

CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN



LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

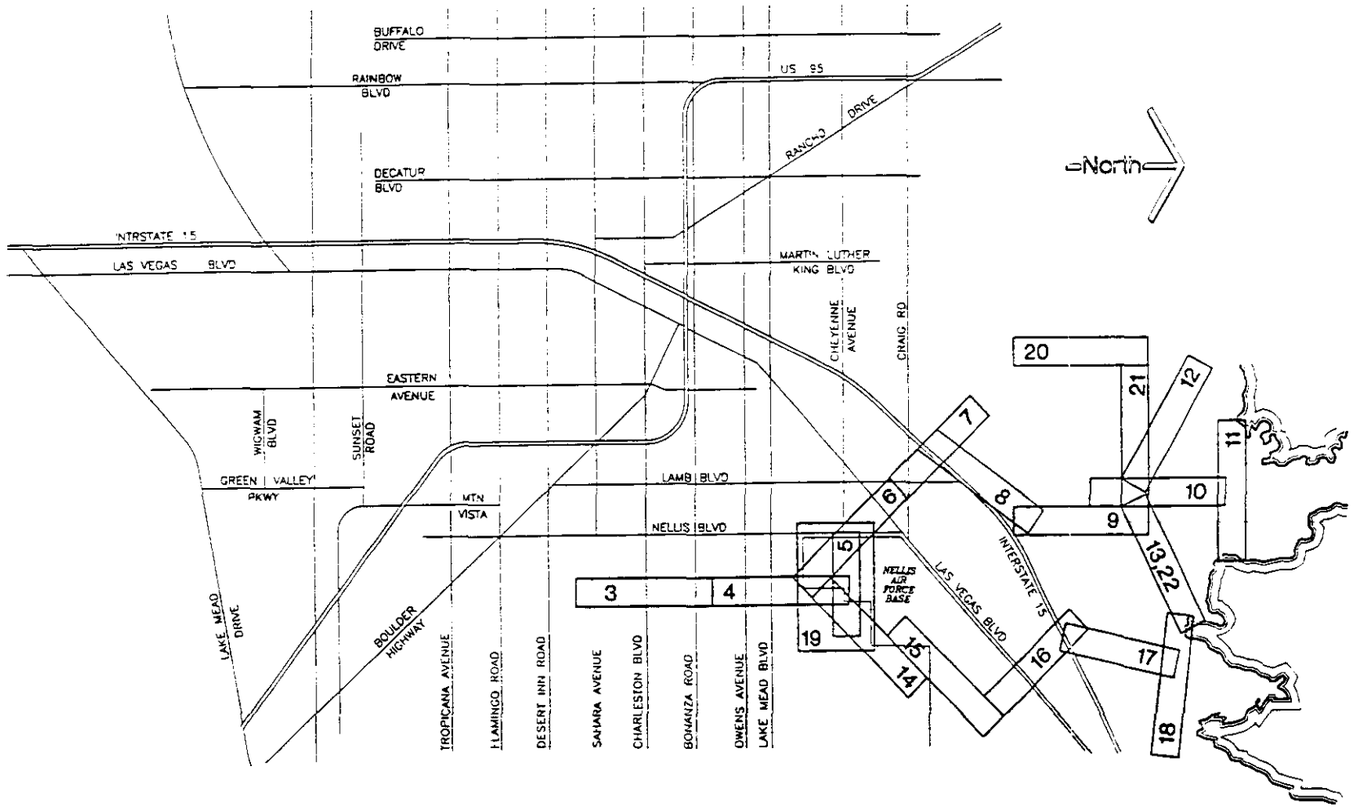
SHEET INDEX

SHEET NO	TITLE
1.	COVER SHEET
2.	KEY MAP, LEGEND, ABBREVIATIONS AND GENERAL NOTES
	ALTERNATIVE III AND IV FACILITIES
3.	CHANNEL R-4 THRU R-7 (SLOAN CHANNEL) STA 100+00 TO STA 235+00
4.	CHANNEL R-1 THRU R-4 (SLOAN CHANNEL) STA 235+00 TO STA 357+50
5.	CHANNEL W-9 STA 394+10 TO STA 444+00
6.	CHANNEL W-9 STA 444+00 TO STA 548+75
7.	CHANNEL W-6 THRU W-8 STA 548+75 TO STA 630+00
	ALTERNATIVE III FACILITIES
8.	CHANNEL W-4 THRU W-5 STA 630+00 TO STA 747+20
9.	CHANNEL W-4 STA 747+20 TO STA 831+10 AND DETENTION BASIN W-I
10.	FLOODWAY W-2 STA 840+50 TO STA 974+80
11.	DIKE W-1 STA 6000+00 TO STA 6136+00
12.	DIKE W-3 (WEST HALF) STA 3000+00 TO STA 3150+50
13.	DIKE W-3 (EAST HALF) STA 2559+30 TO STA 2664+80
	ALTERNATIVE III AND IV FACILITIES
14.	DETENTION BASIN R-M / CHANNEL E-8 STA 1004+00 TO STA 1068+50
15.	CHANNEL E-6 AND E-7 STA 1068+50 TO STA 1207+80
16.	CHANNEL E-4 AND E-5 STA 1207+80 TO STA 1330+80
17.	DETENTION BASIN E-J1 / FLOODWAY E-2A STA 1345+30 TO STA 1462+15
18.	DIKE E-1A STA 2000+00 TO STA 2150+80
19.	DETENTION BASIN R-M
	ALTERNATIVE IV FACILITIES
20.	FLOODWAY W-2 STA 4000+00 TO STA 4047+80
21.	DIKE W-1 STA 4047+80 TO STA 4182+90
22.	DIKE W-1 STA 4182+90 TO STA 4310+20
23.	TYPICAL SECTIONS

CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN

COVER SHEET
SHEET INDEX, LOCATION MAP AND VICINITY MAP

Boyle Engineering Corporation | SHEET 1



KEY MAP

NOT TO SCALE

GENERAL NOTES

1. BASE MAPPING IS COMPOSED FROM PHOTOGRAPHIC ENLARGEMENTS OF THE FOLLOWING USGS 7.5 MINUTE QUADRANGLES:
   LAS VEGAS NE (1967) (PHOTO REVISED 1984)
   FRENCHMAN MTN (1970) (PHOTO REVISED 1983)
   VALLEY (1974)
   APEX
2. FACILITIES ARE DEPICTED FOR PLANNING PURPOSES ONLY, NOT FOR CONSTRUCTION. FINAL ALIGNMENT AND DIMENSIONS ARE CONTINGENT ON FINAL DESIGN.
3. SLOPES ARE NOTED IN FT/FT.
4. IDENTIFIED RIGHT-OF-WAY REQUIREMENTS ARE BASED ON CLARK COUNTY ASSESSORS MAPS OBTAINED IN APRIL 1989.
5. EXISTING UTILITIES AND DRAINAGE FACILITIES ARE BASED ON INFORMATION OBTAINED FROM PROJECT SPONSORS AND DO NOT REFLECT ACTUAL FIELD SURVEYS.
6. *FOR CLARITY, CHANNEL TRANSITIONS ARE NOT SHOWN.* DESIGN OF TRANSITIONS WILL BE BASED ON DETAILED HYDRAULIC EVALUATIONS PERFORMED DURING FINAL DESIGN.

ABBREVIATIONS

EL	ELEVATION
GB	GRADE BREAK
APPROX	APPROXIMATE
EXIST	EXISTING
SHT	SHEET
BLVD	BOULEVARD
RD	ROAD
DR	DRIVE
B	BOTTOM WIDTH
Z	SIDE SLOPE
Q_{100}	100 YEAR DISCHARGE
R	RADIUS
CFS	CUBIC FEET PER SECOND
W/	WITH
STA	STATION
RCB	REINFORCED CONCRETE BOX
AVE	AVENUE
PI	POINT OF INTERSECTION
S	SLOPE
UPRR	UNION PACIFIC RAILROAD
BM	BENCH MARK

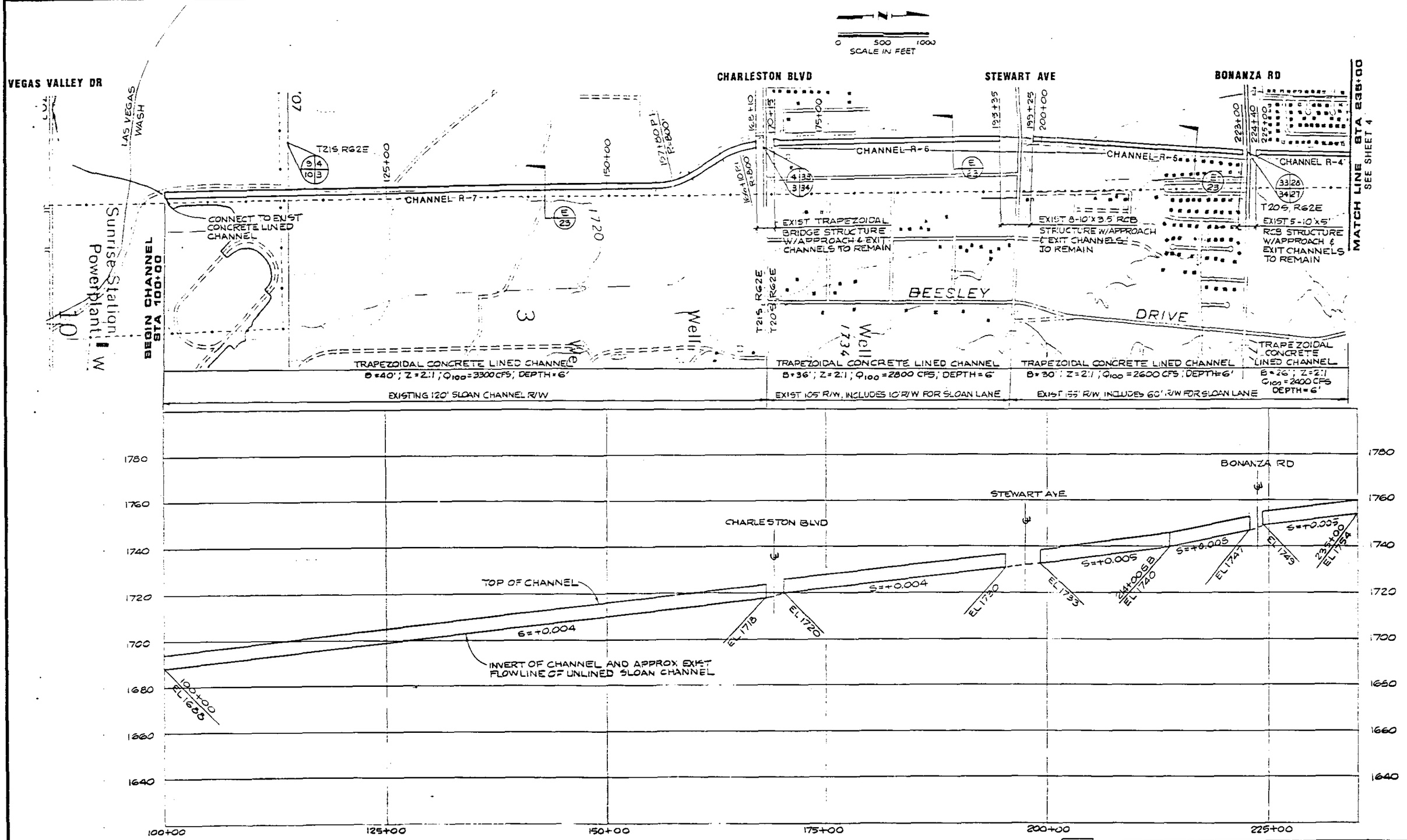
LEGEND

℄	CENTERLINE
	PROPOSED STRUCTURE
	UNIMPROVED ROADWAY
	RAILROAD
	IMPROVED ROADWAY
	PROPOSED CHANNEL
	PROPOSED FLOODWAY
	CUT OR FILL
1 6 / 2 7	SECTION CORNER
T20S R62E	TOWNSHIP AND RANGE

CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN

KEY MAP, LEGEND, ABBREVIATIONS AND GENERAL NOTES

Boyle Engineering Corporation | SHEET 2



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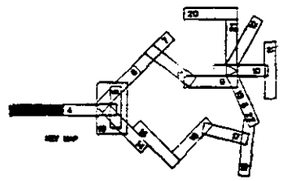


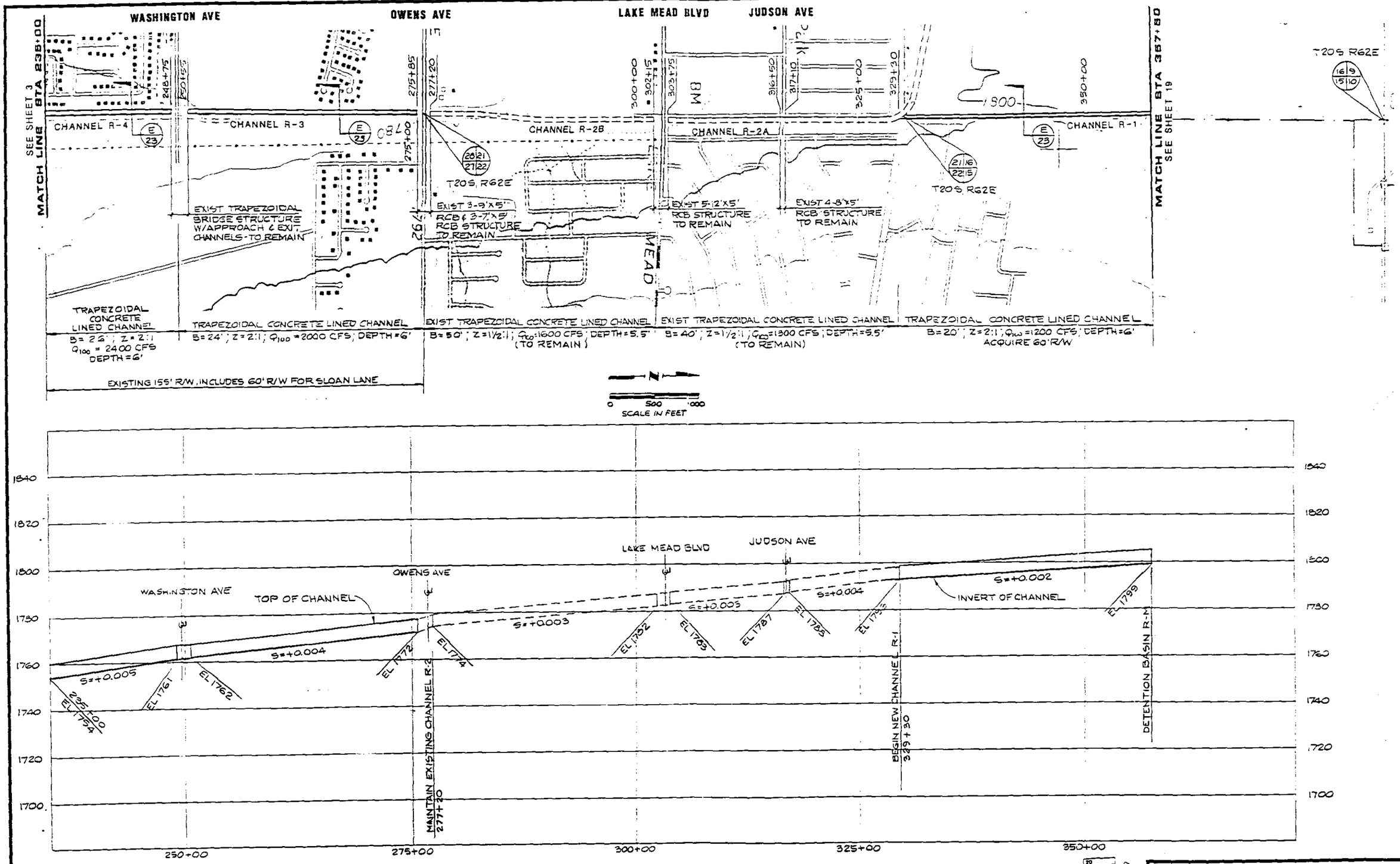
CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

CHANNEL R-4 THRU R-7 (SLOAN CHANNEL)

STA 100+00 TO STA 235+00
RANGE WASH

Boyle Engineering Corporation | SHEET 3



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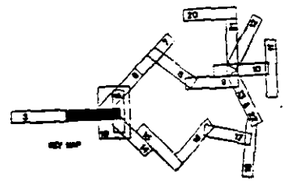


CITY OF NORTH LAS VEGAS

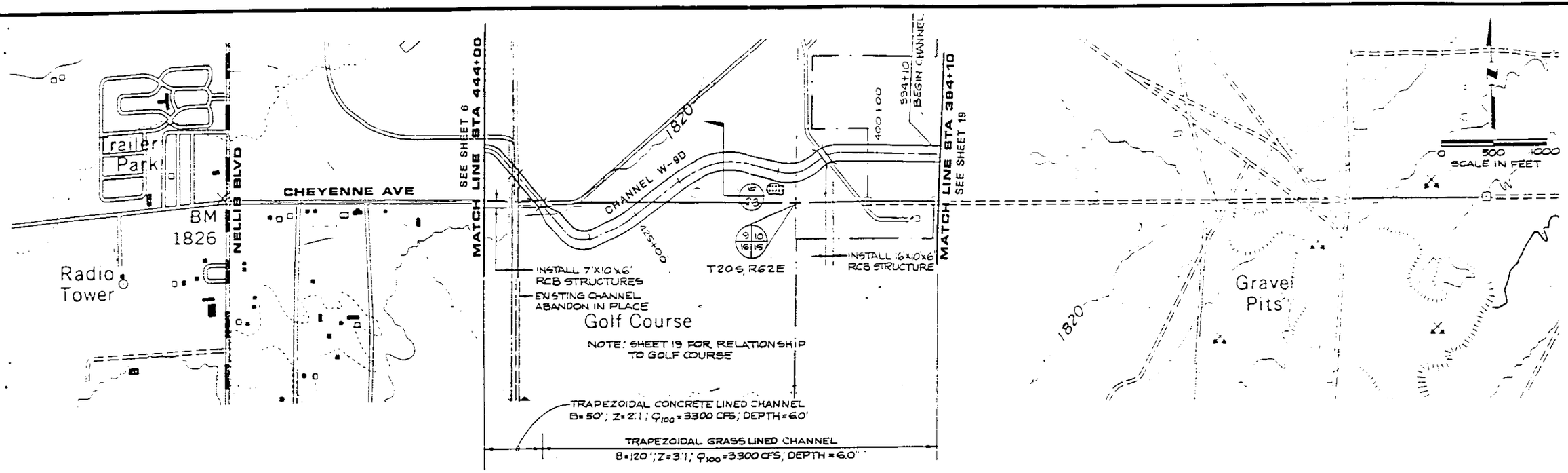
RANGE WASH FACILITY PLAN

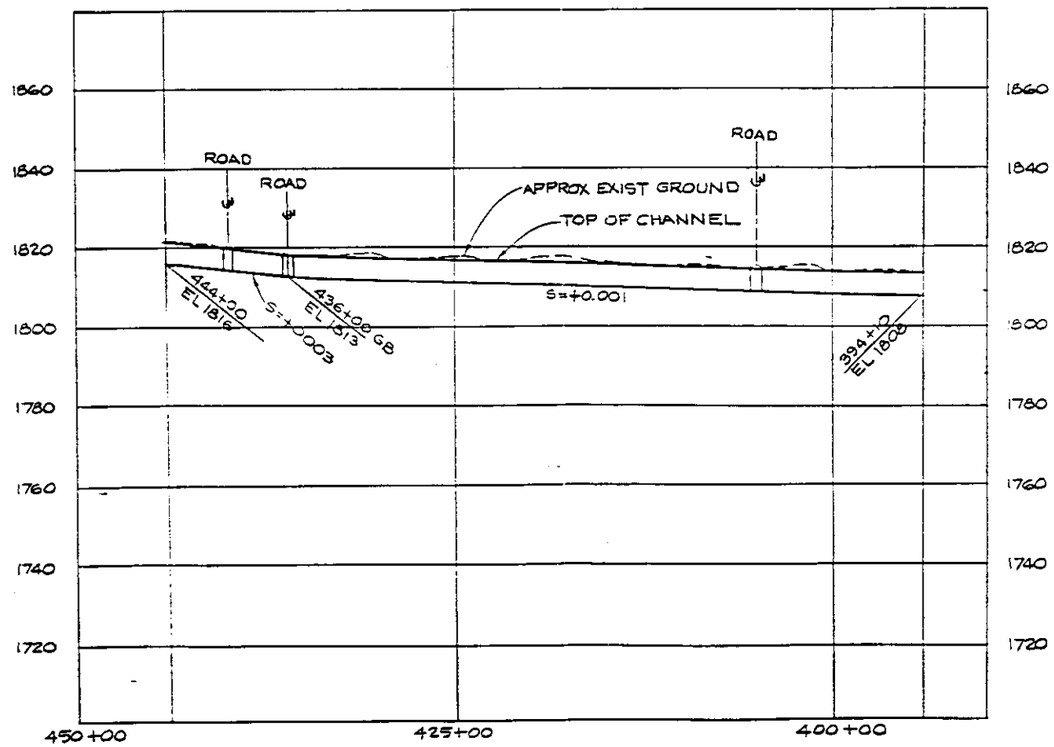
CHANNEL R-1 THRU R-4 (SLOAN CHANNEL)

STA 235+00 TO STA 357+50

RANGE WASH

Boyle Engineering Corporation | SHEET 4





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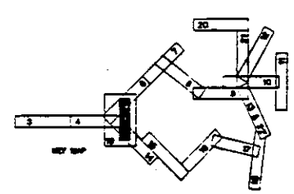


CITY OF NORTH LAS VEGAS

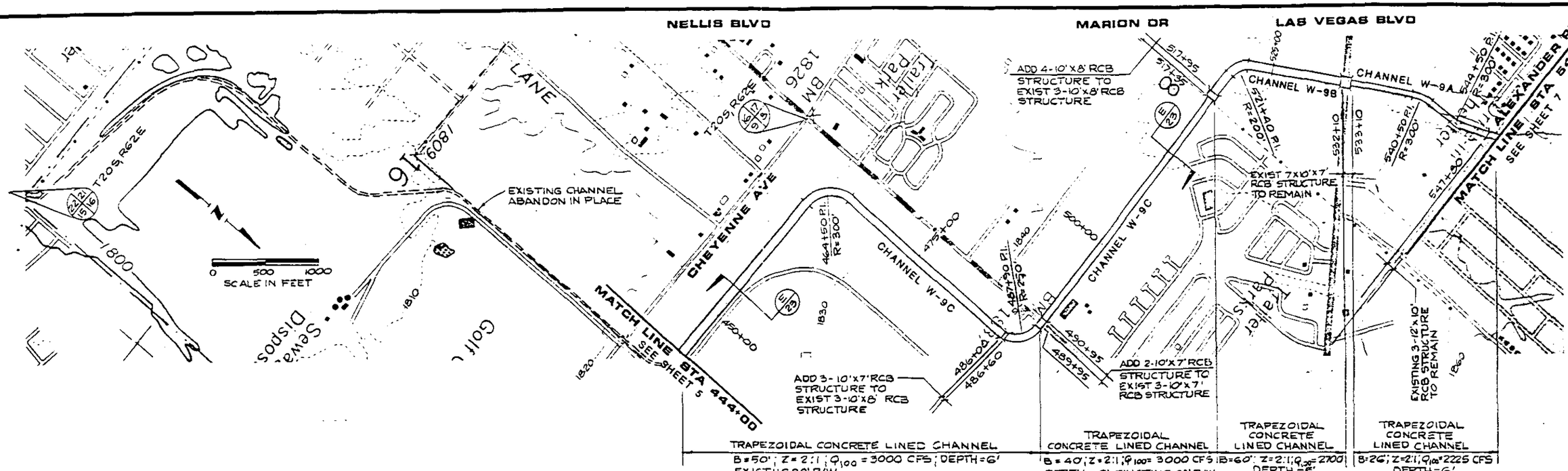
RANGE WASH FACILITY PLAN

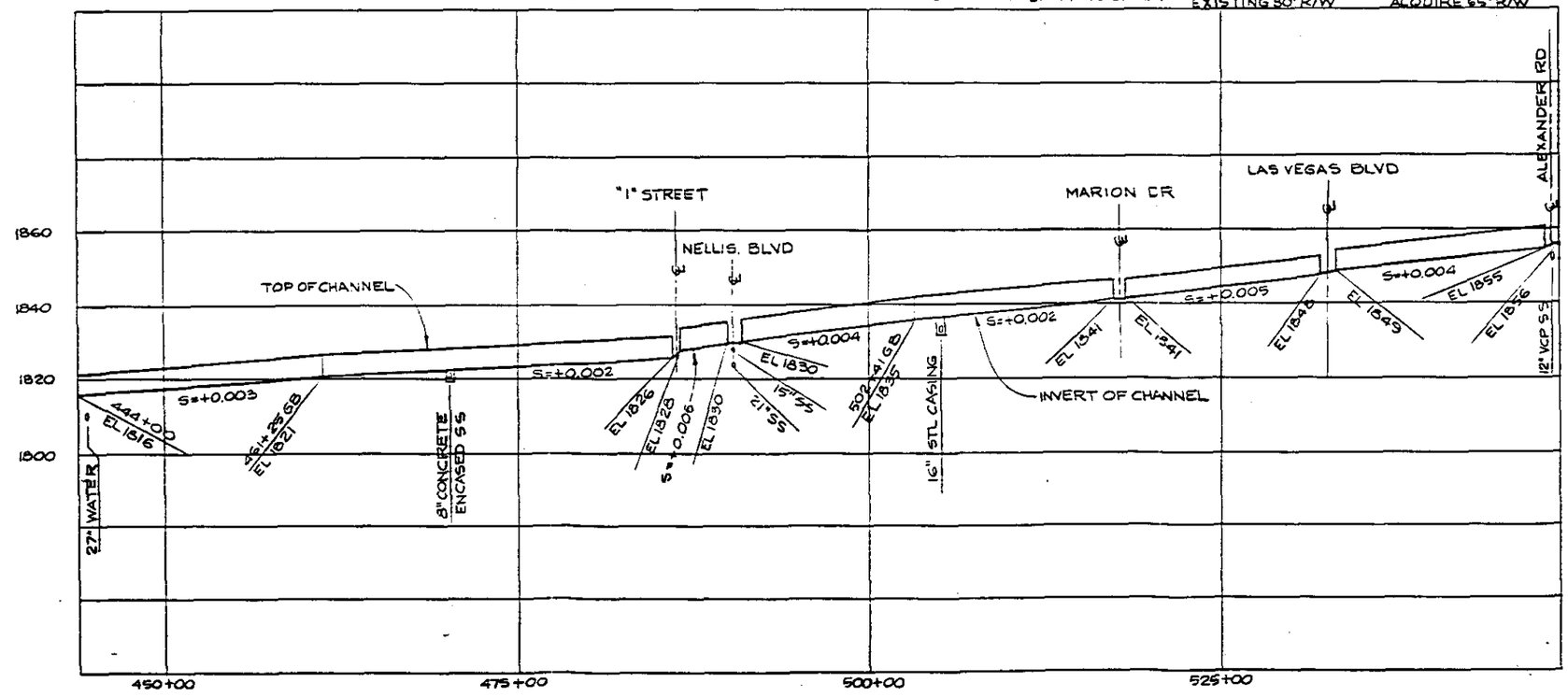
CHANNEL W-9

STA 394+10 TO STA 444+00

WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 5





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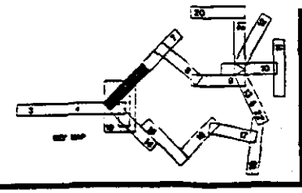


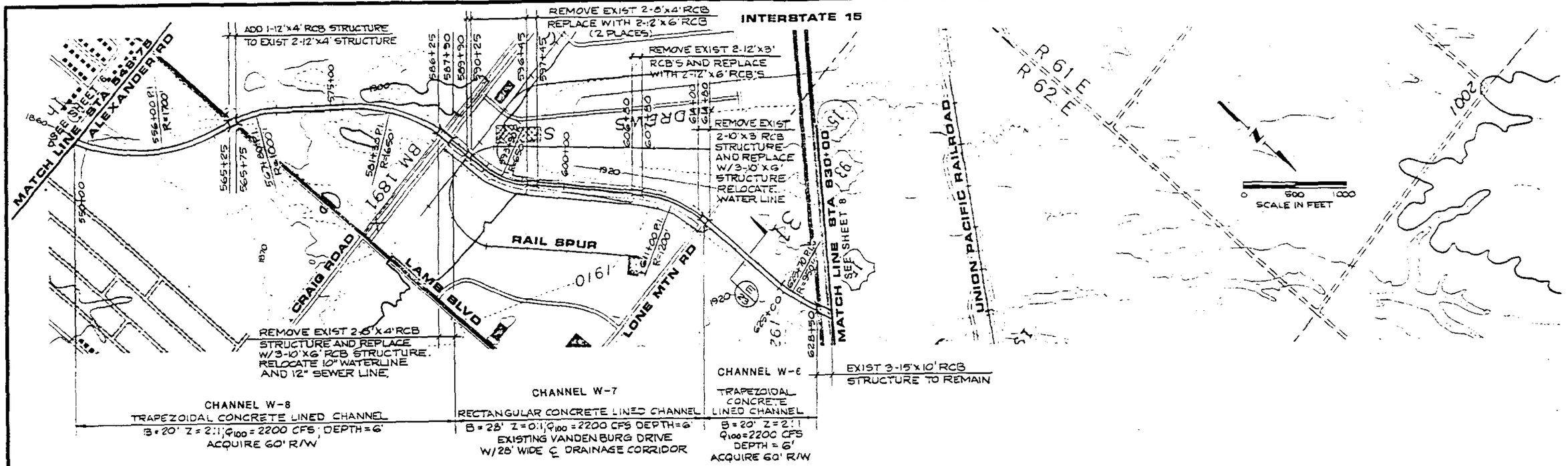
CITY OF NORTH LAS VEGAS

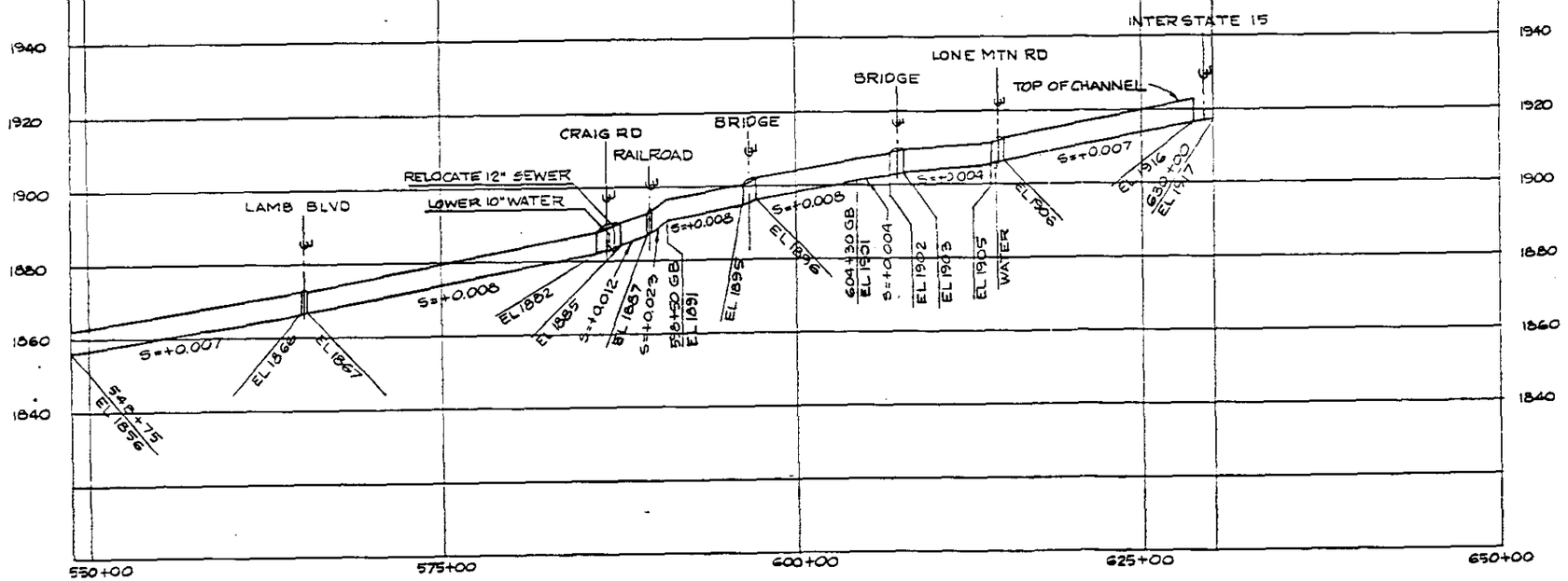
RANGE WASH FACILITY PLAN

CHANNEL W-9

STA 444+00 TO STA 548+75
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 6





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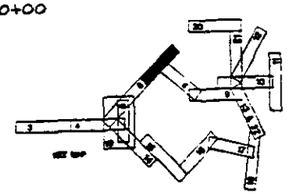


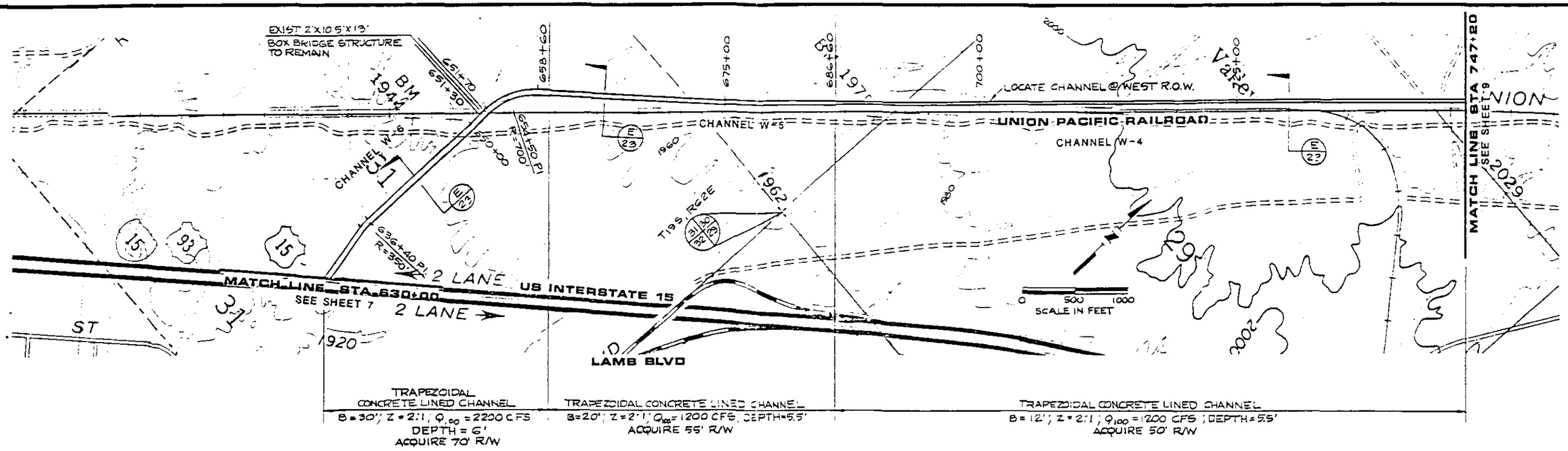
CITY OF NORTH LAS VEGAS

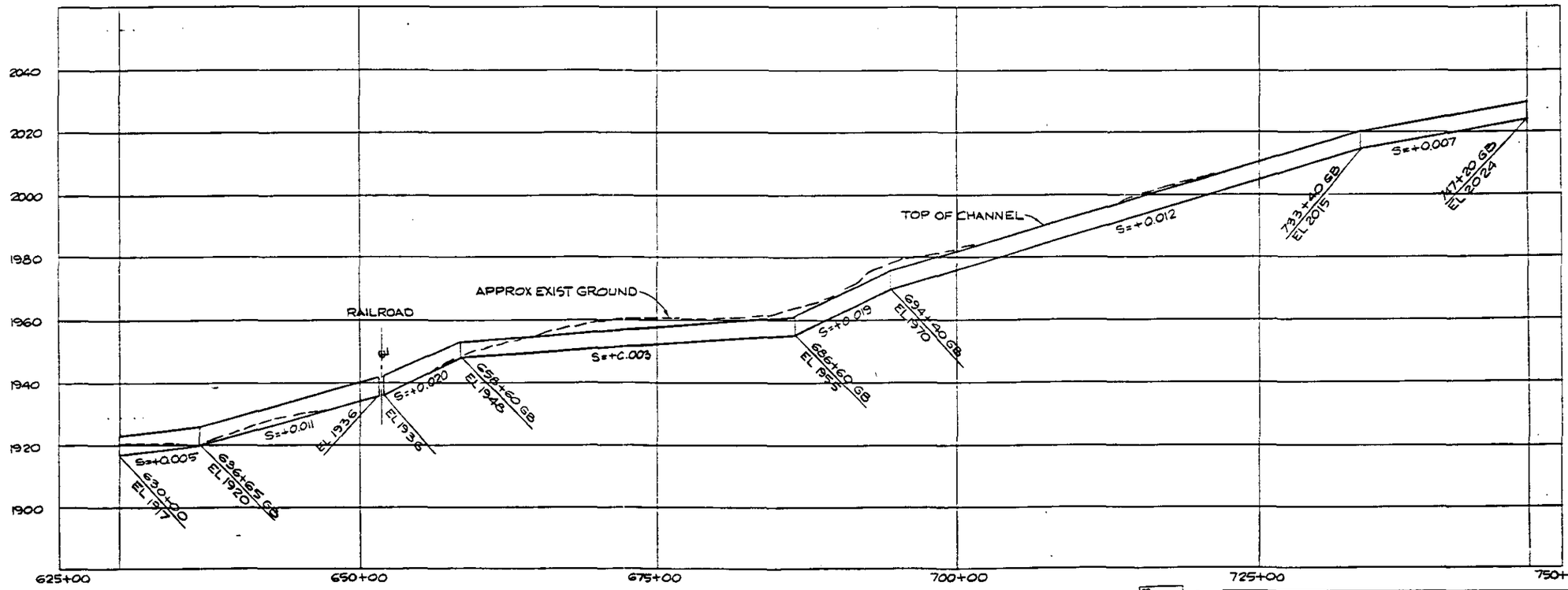
RANGE WASH FACILITY PLAN

CHANNEL W-6 THRU W-8

STA 548+75 TO STA 630+00
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 7





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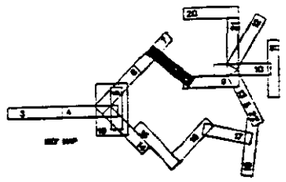


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

CHANNEL W-4 THRU W-5

STA 630+00 TO STA 747+20
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 8

SEE SHEET 10
MATCH LINE

SEE SHEET 8
MATCH LINE STA 747+20

UNION PACIFIC RAILROAD

EMERGENCY SPILLWAY

SCALE IN FEET
0 500 1000

CHANNEL W-4

DETENTION BASIN DATA

EMBANKMENT CREST ELEVATION	2218	MSL
EMBANKMENT HEIGHT	0 TO 18	FT
EMERGENCY SPILLWAY CREST ELEVATION	2213	MSL
DISCHARGE AT SPILLWAY CREST	1200	CFS
EMERGENCY SPILLWAY LENGTH	3500	FT
BANK FULL STORAGE VOLUME	2000	AC-FT
STORAGE VOLUME AT SPILLWAY CREST	1290	AC-FT
SEDIMENT STORAGE VOLUME	200	AC-FT

DETENTION BASIN W-I

EARTHEN DIKE CONTINUOUS WITH BASIN EMBANKMENT

831+10 END CHANNEL

MATCH LINE
SEE SHEET 13

T19S, R62E

T19S, R62S

UPPER RANGE ROAD

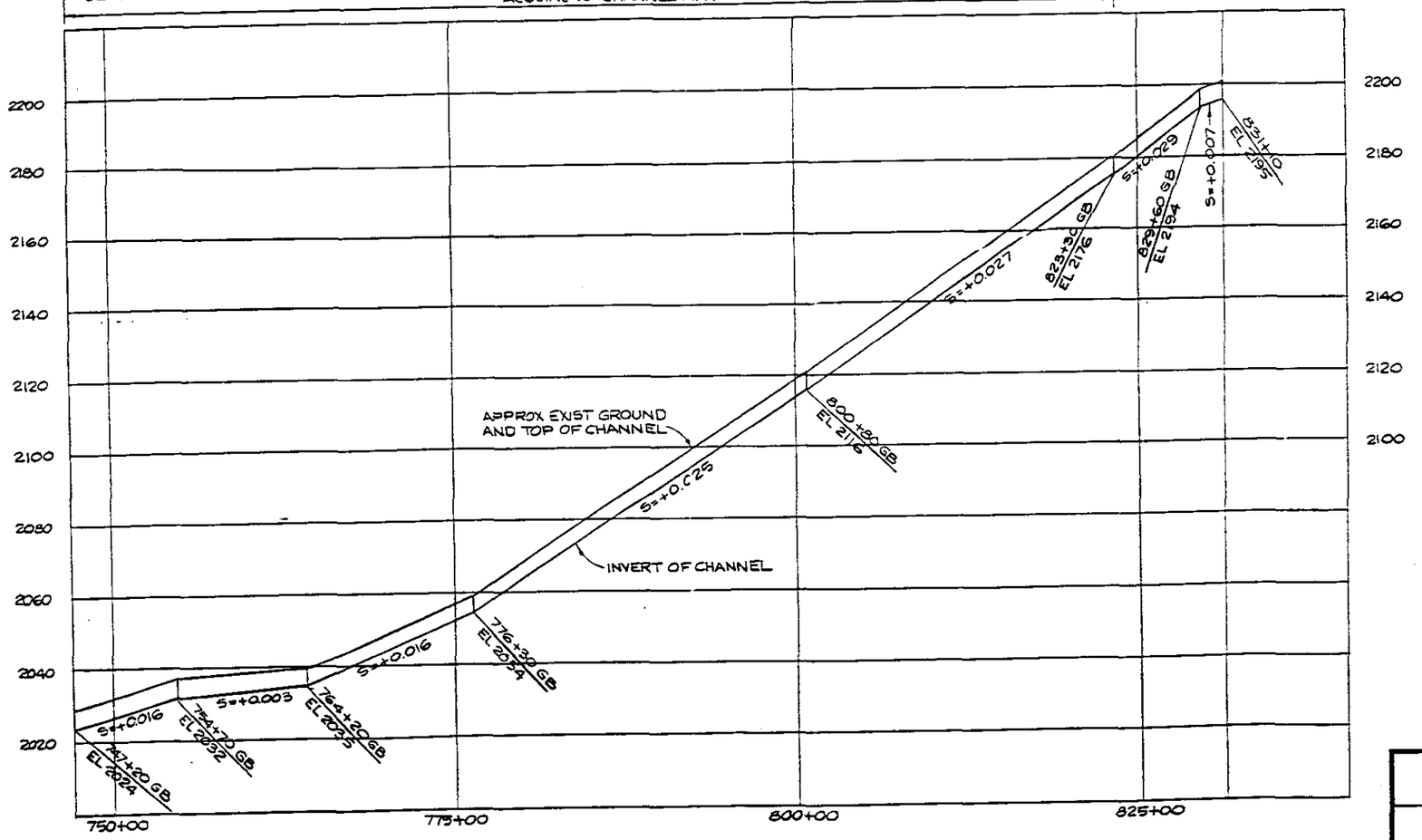
TRAPEZOIDAL CONCRETE LINED CHANNEL
B=12' Z=2:1
Q_{100}=1200 CFS;
DEPTH=5.5'

TRAPEZOIDAL GABION LINED CHANNEL
B=16' ; Z=2:1 ; Q_{100}=1200 CFS ; DEPTH=5'

ACQUIRE 50' CHANNEL R/W

EARTHEN DIKE WITH SOIL CEMENT LINING ON UPSTREAM FACE
H=6'(ABOVE EXIST GROUND) ; Q_{100}=700 CFS

SIM



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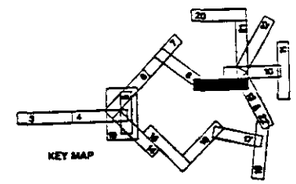


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

CHANNEL W-4/DETENTION BASIN W-I

STA 747+20 TO STA 831+10
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 9

SEE SHEET 12
MATCH LINE STA 3000+00

T19S, R62E

FLOODWAY W-2

3000+00
DIKE

840+50
FLOODWAY

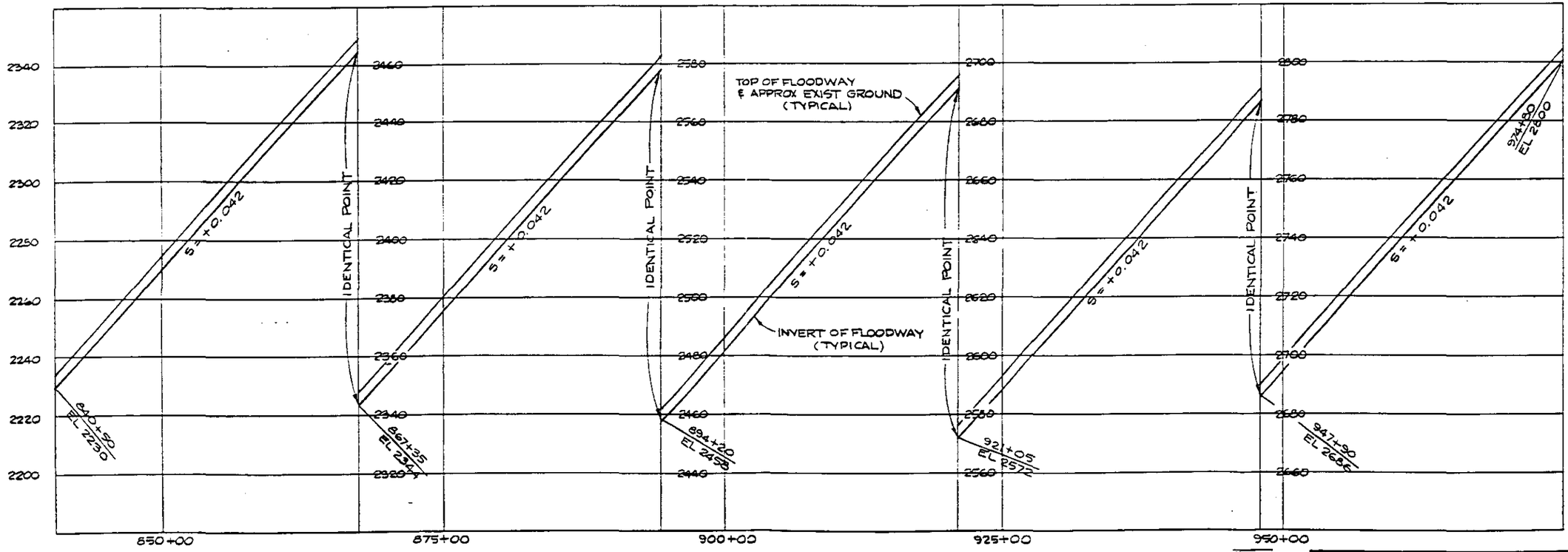
DETENTION BASIN W-I
SEE SHEET 9

MATCH LINE
SEE SHEET 9

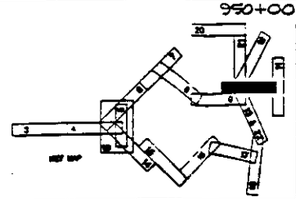
MATCH LINE STA 874+80
SEE SHEET 11

0 500 1000
SCALE IN FEET

EARTHEN BOTTOM FLOODWAY WITH GABION SIDES
B=320' ; Q_{100}=6400 CFS ; DEPTH=4'
ACQUIRE 345' R/W

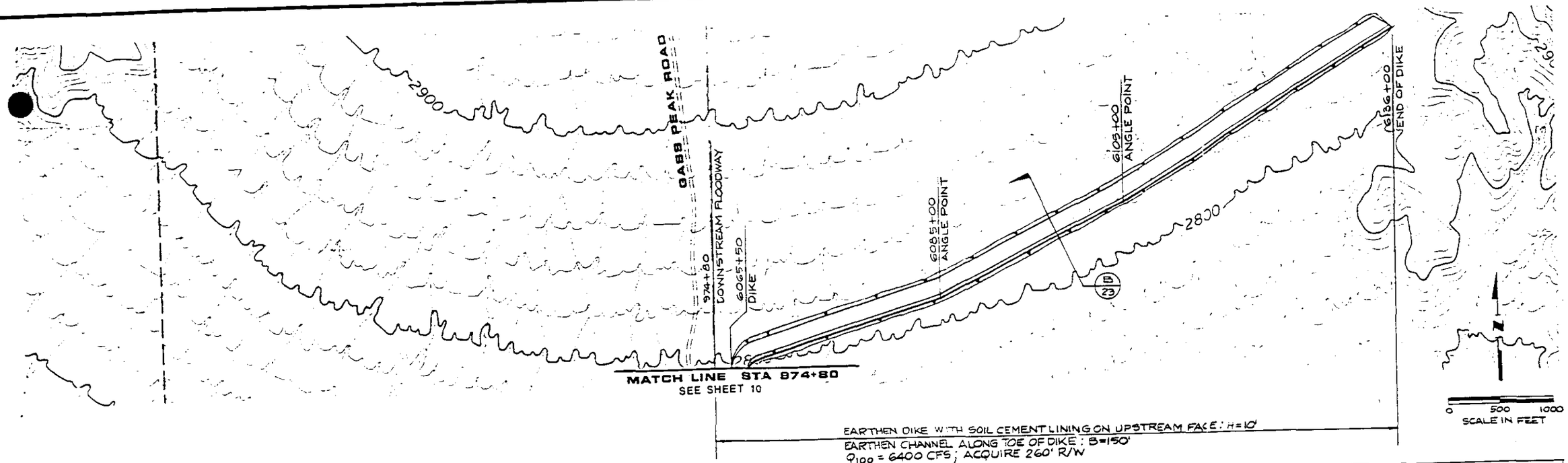


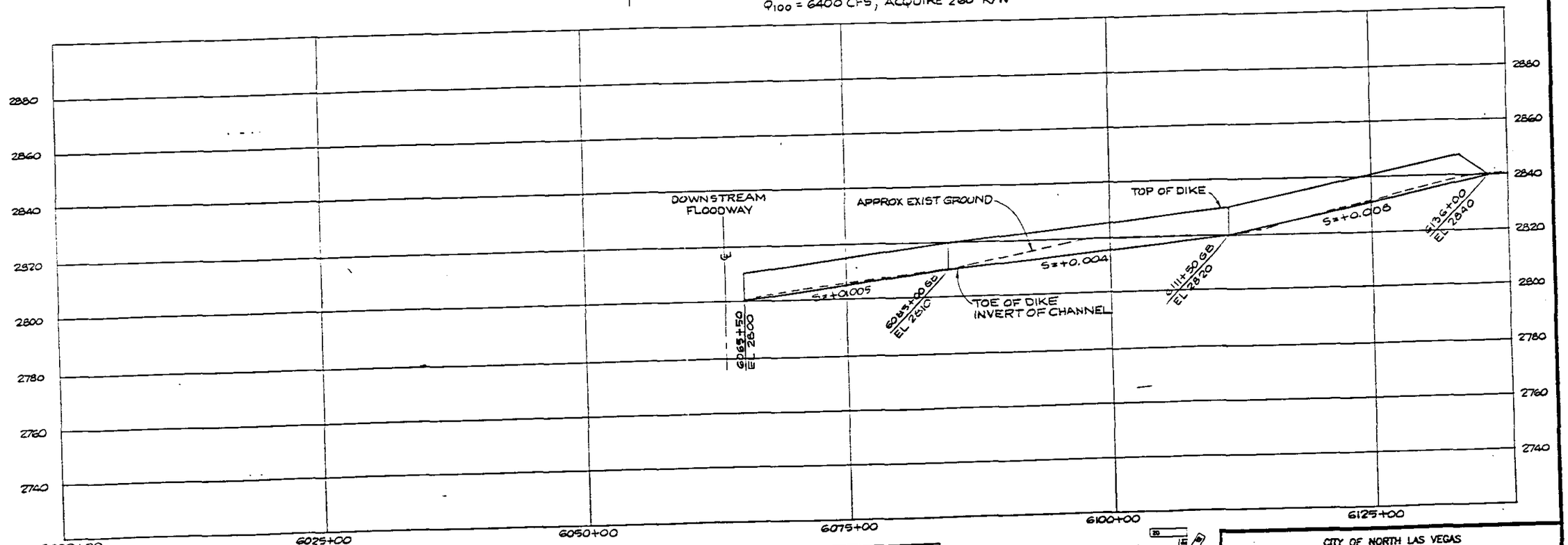
THE FIGURES SHOWN ON THIS DRAWING HAVE BEEN IDENTIFIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



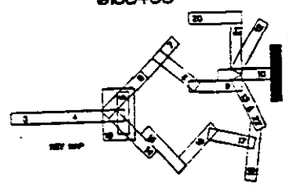
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
DETENTION BASIN W-I/FLOODWAY W-2
STA 840+50 TO STA 974+80
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 10





THE FIGURES SHOWN ON THIS SHEET HAVE BEEN DETERMINED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY DIFFERENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



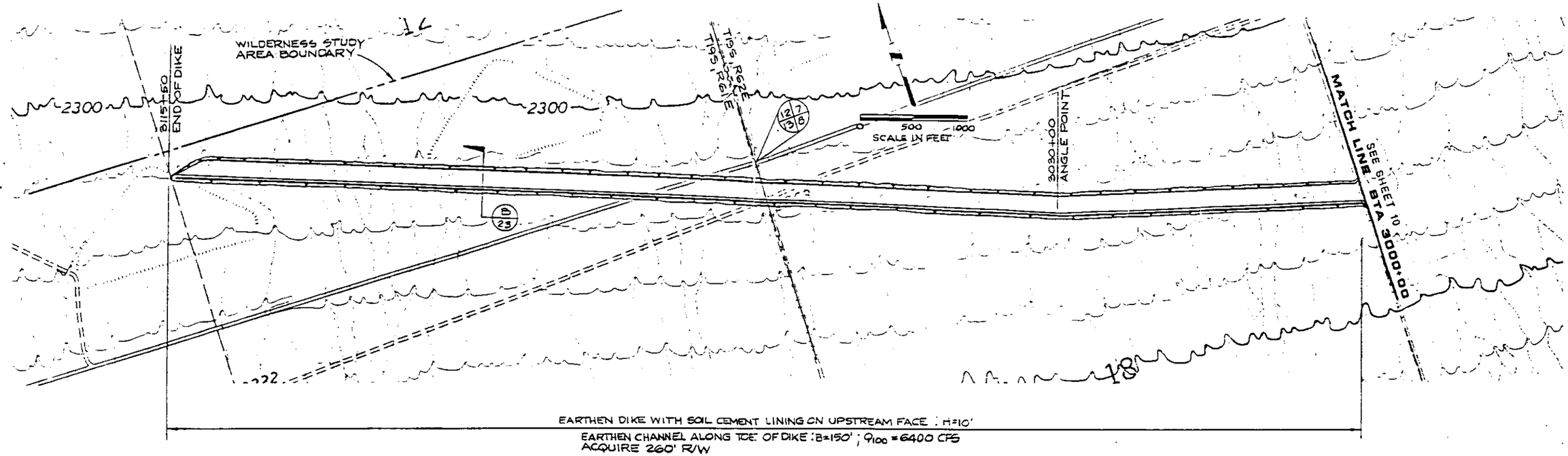
CITY OF NORTH LAS VEGAS

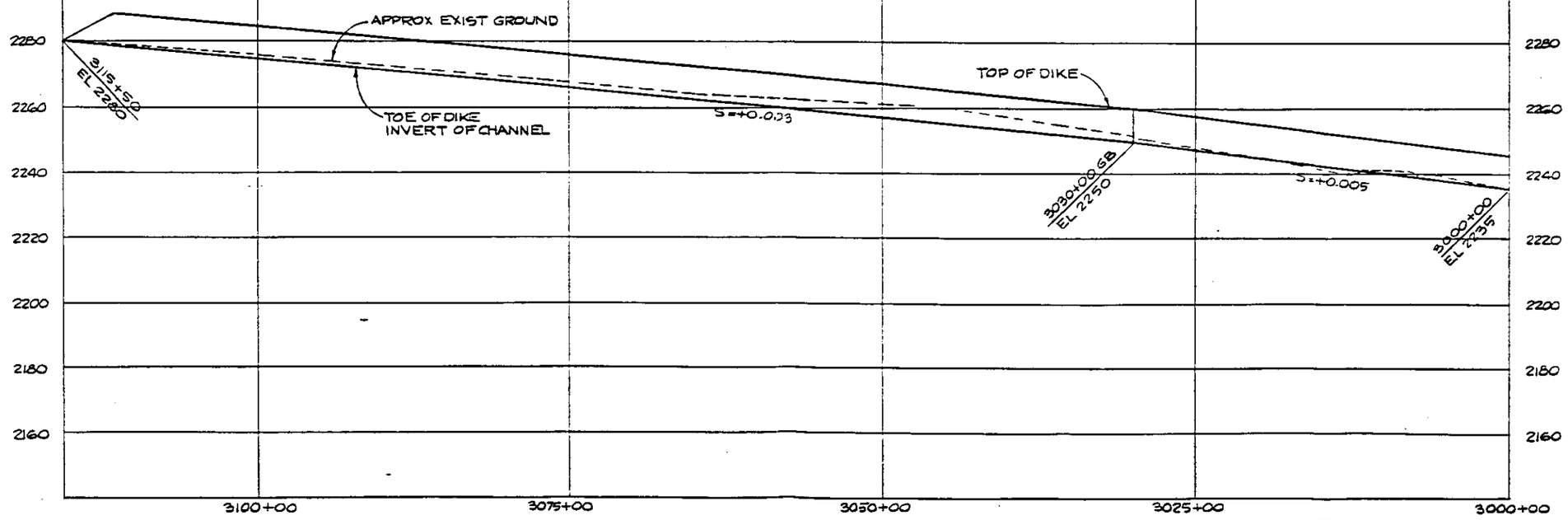
RANGE WASH FACILITY PLAN

DIKE W-1

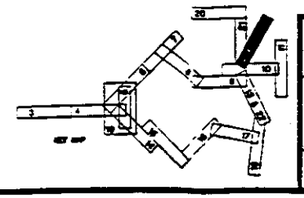
STA 6065+50 TO STA 6136+00
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 11





THE FACILITIES SHOWN ON THIS DRAWING HAVE BEEN IDENTIFIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



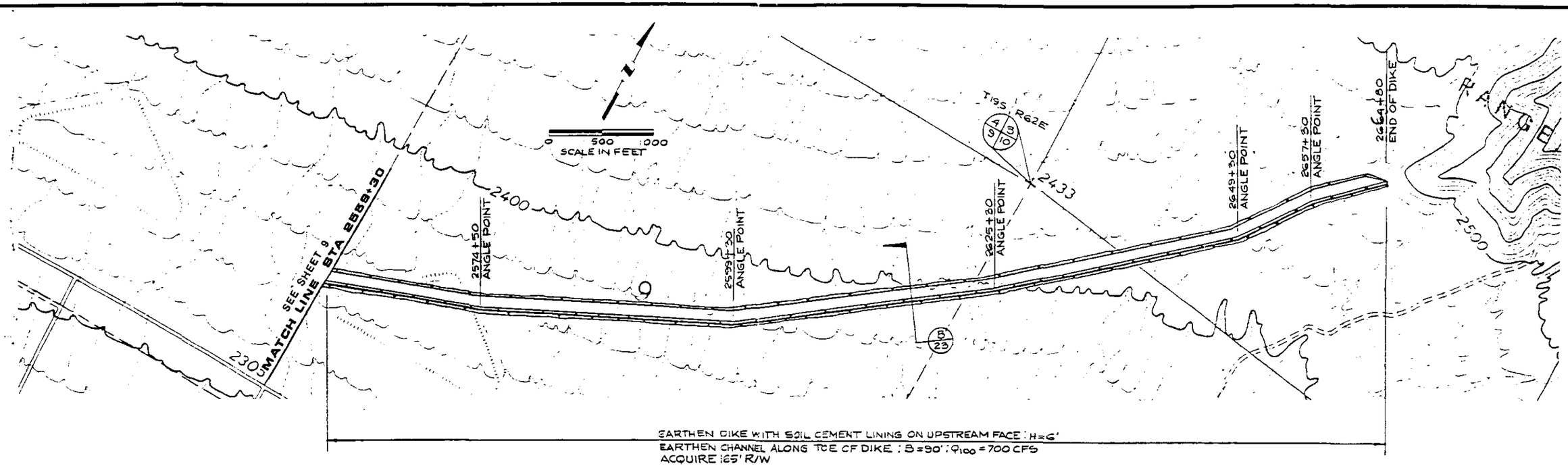
CITY OF NORTH LAS VEGAS

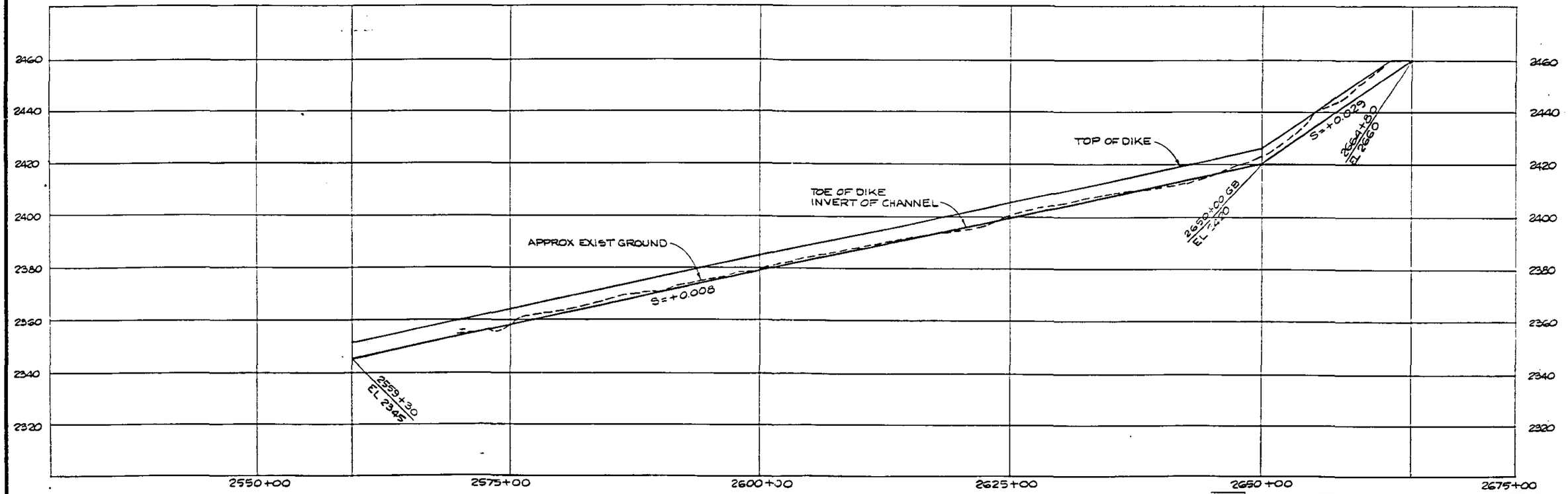
RANGE WASH FACILITY PLAN

DIKE W-3 (WEST HALF)

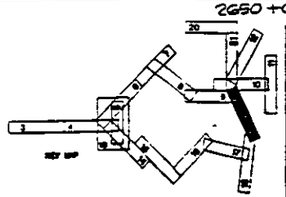
STA 3000+00 TO STA 3115+50
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 12





THE FACILITIES SHOWN ON THIS DRAWING HAVE BEEN IDENTIFIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



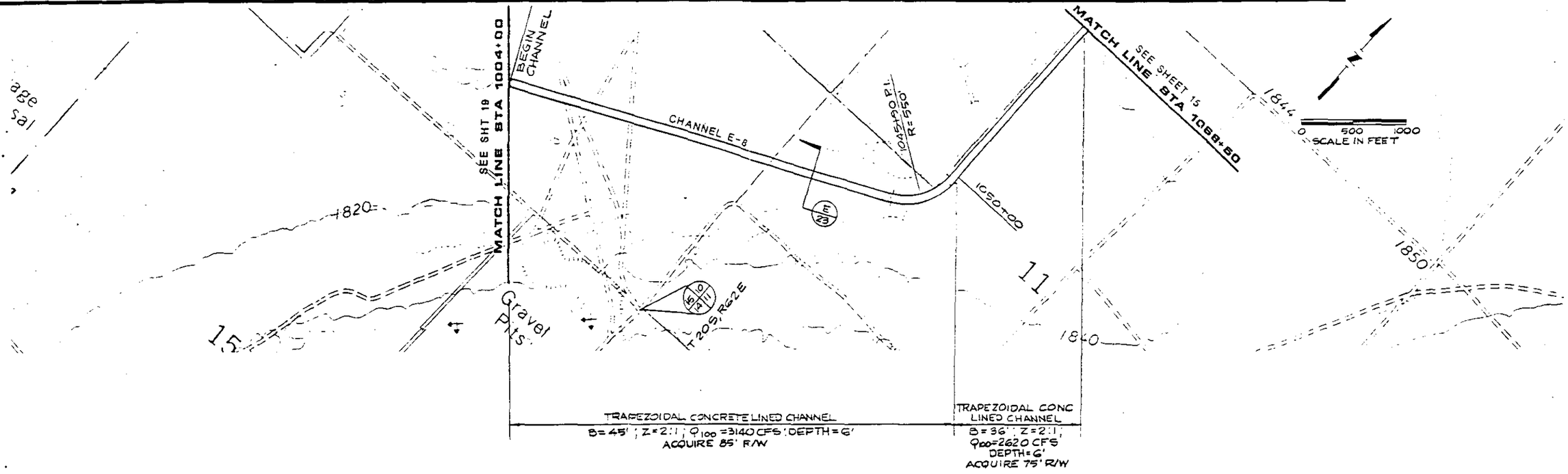
CITY OF NORTH LAS VEGAS

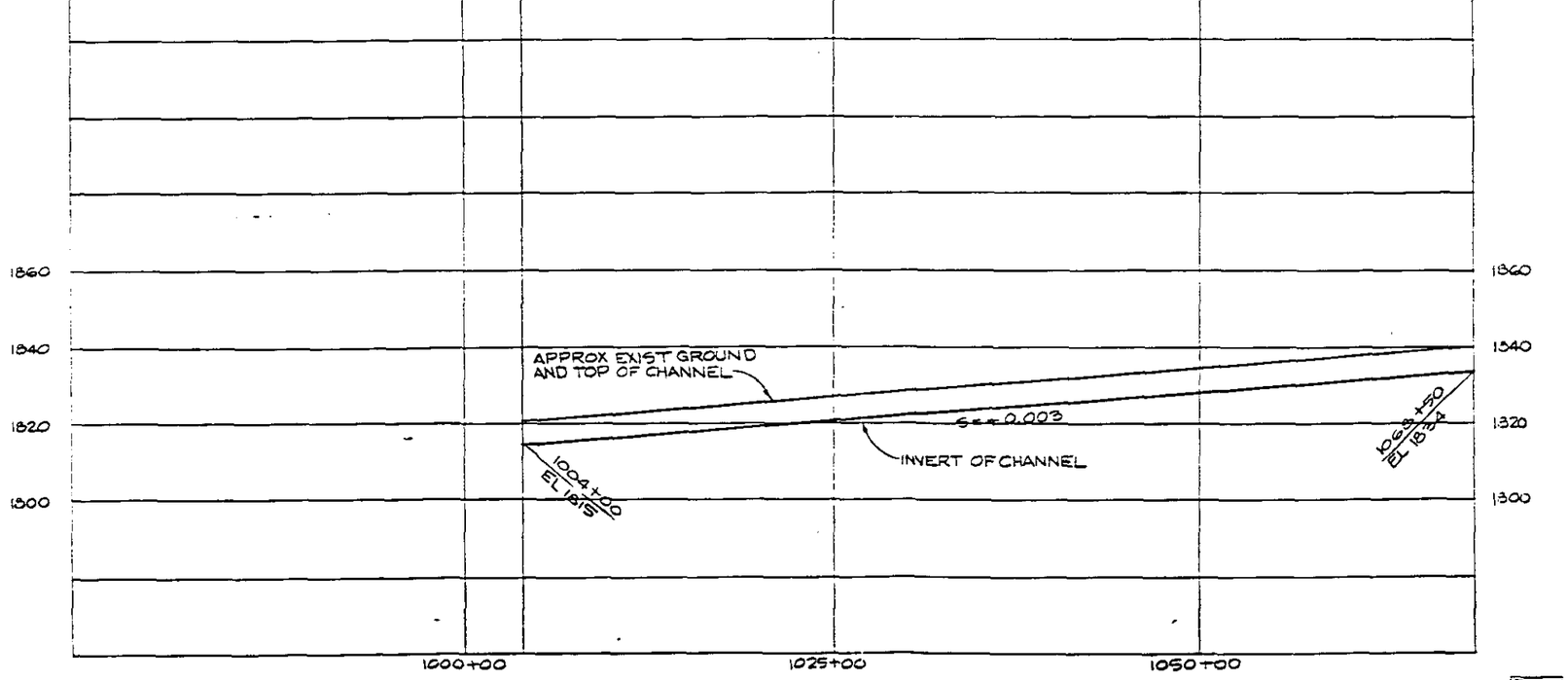
RANGE WASH FACILITY PLAN

DIKE W-3 (EAST HALF)

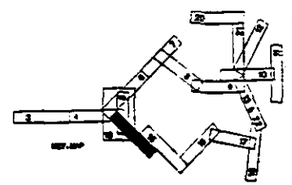
STA 2559+30 TO STA 2664+80
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 13





THE FACILITIES SHOWN ON THIS DRAWING HAVE BEEN MODIFIED DURING THIS STUDY. THEY ARE SHOWN TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DRAWINGS.



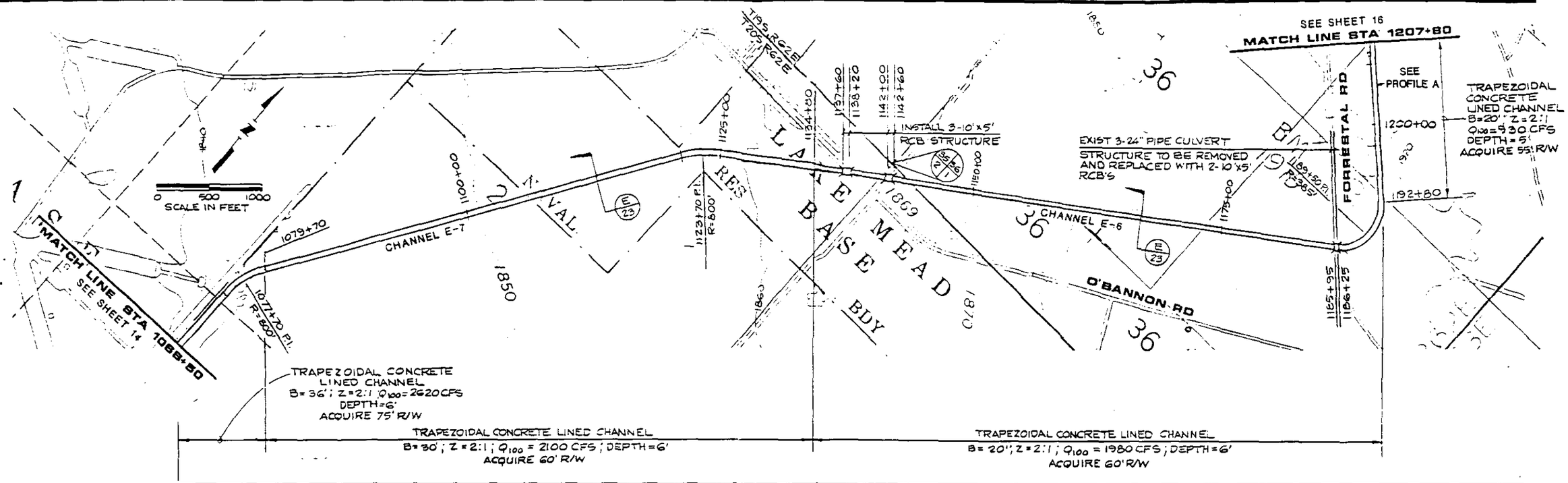
CITY OF NORTH LAS VEGAS

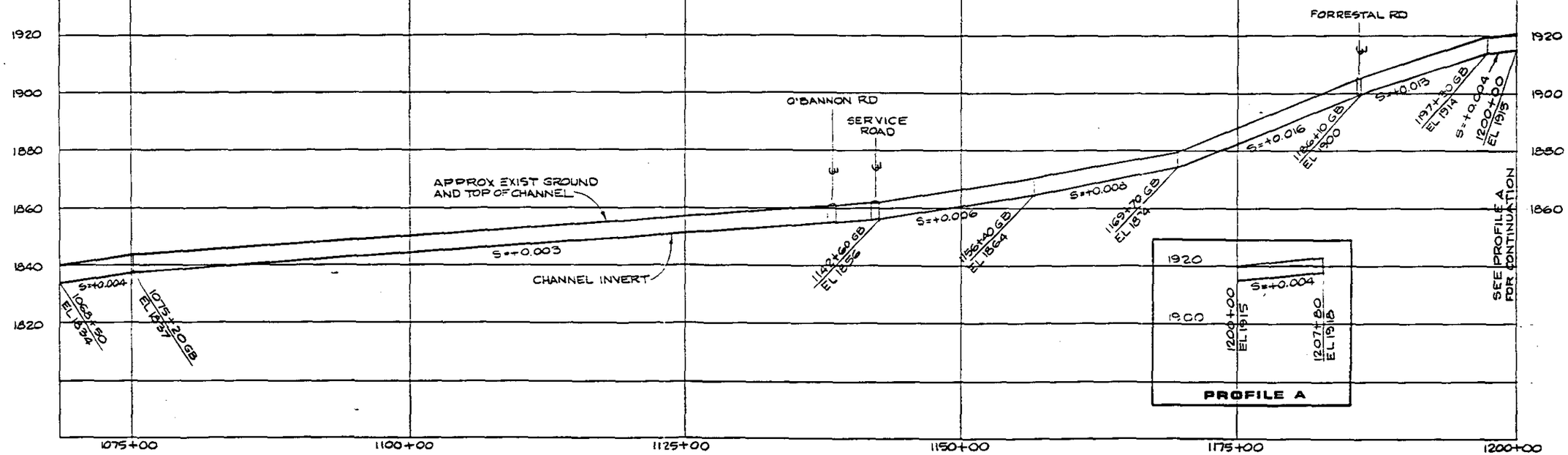
RANGE WASH FACILITY PLAN

CHANNEL E-8

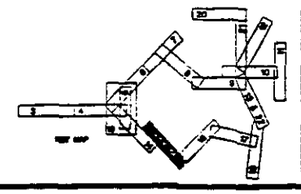
STA 1004+00 TO STA 1068+50
EASTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 14





THE FACILITIES SHOWN ON THIS DRAWING HAVE BEEN REVIEWED DURING THIS STUDY. THEY ARE INTENDED TO PROVIDE SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

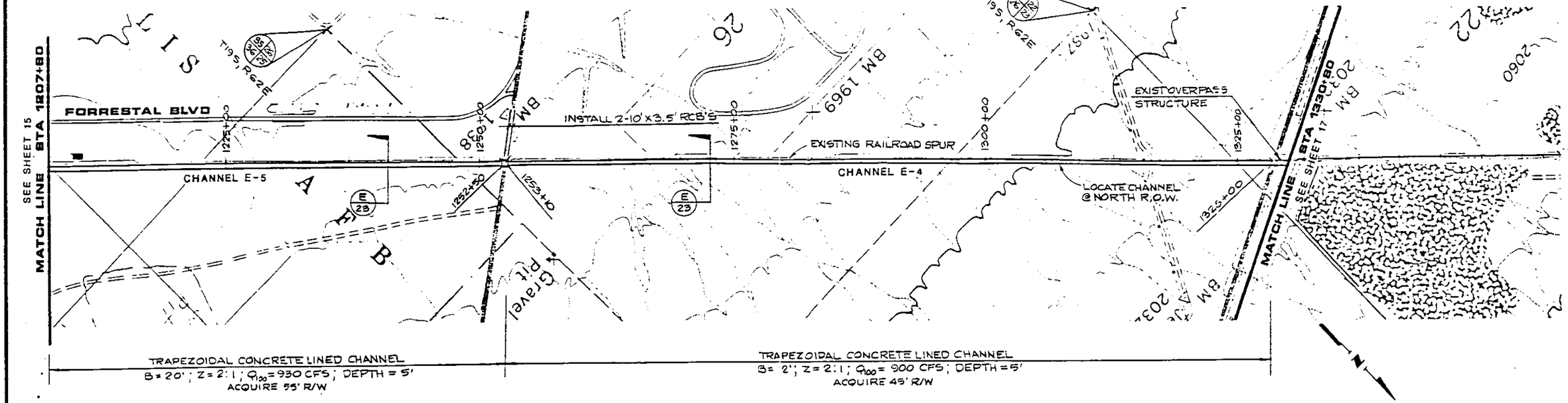
CHANNEL E-6 AND E-7

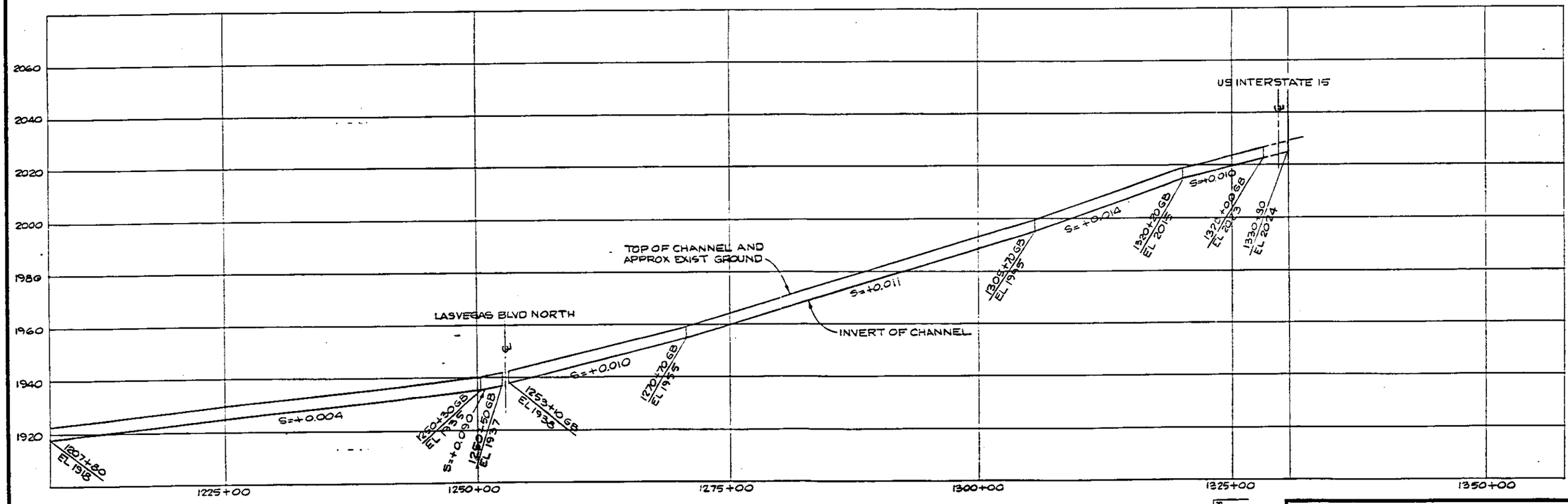
STA 1068+50 TO STA 1207+80
EASTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 15

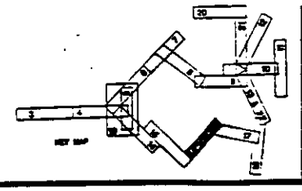
LAS VEGAS BLVD. NORTH

U.S. INTERSTATE 15





THE FIGURES SHOWN ON THIS DRAWING HAVE BEEN SIGNIFIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

CHANNEL E-4 AND E-5

STA 1207+80 TO STA 1330+80
EASTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 18

EMERGENCY SPILLWAY

LOW-FLOW CHANNEL

DETENTION BASIN E-J1

MATCH LINE STA 1330+80 SEE SHEET 16

UB INTERSTATE 15

BM X

BM

DETENTION BASIN DATA

EMBANKMENT CREST ELEVATION	2068	MSL
EMBANKMENT HEIGHT	0 TO 18	FT
EMERGENCY SPILLWAY CREST ELEVATION	2063	MSL
DISCHARGE AT SPILLWAY CREST	900	CFS
EMERGENCY SPILLWAY LENGTH	1200	FT
BANK FULL STORAGE VOLUME	450	AC-FT
STORAGE VOLUME AT SPILLWAY CREST	286	AC-FT
SEDIMENT STORAGE VOLUME	70	AC-FT

1375+00

1360+80 R=1200'

1394+80

1395+30

1400+00

UNION PACIFIC RAILROAD

T19S R62E

1405+10 P.I. R=1150'

INSTALL 4-10'x6' RCB STRUCTURE

1425+00

1450+00

FLOODWAY E2-A

MATCH LINE STA 1462+15 SEE SHEET 18

0 500 1000 SCALE IN FEET

TRAPEZOIDAL GABION LINED CHANNEL
B=20'; Z=2:1; Q_{100}=1100 CFS; DEPTH=5'
ACQUIRE 60' R/W

EARTHEN FLOODWAY WITH GABION SIDES
B=150'; Z=0:1; Q_{100}=1100 CFS; DEPTH=3.5'
ACQUIRE 175' R/W

2140
2120
2100
2080
2060
2040
2020
2000

S=+0.024

1360+80 GB EL 2085

1345+30 EL 2059

S=+0.017

IDENTICAL POINT

TOP OF CHANNEL AND EXIST GROUND (TYPICAL)

S=+0.056

RAILROAD

INVERT OF CHANNEL (TYPICAL)

1395+30 GB EL 2171

1394+80 GB EL 2165

S=+0.040

1385+80 GB EL 2155

1385+00 EL 2143

S=+0.024

IDENTICAL POINT

S=+0.036

1443+50 GB EL 2337

S=+0.054

1462+15 EL 2420

1425+00 EL 2270

1350+00
1375+00
1400+00
1425+00
1450+00

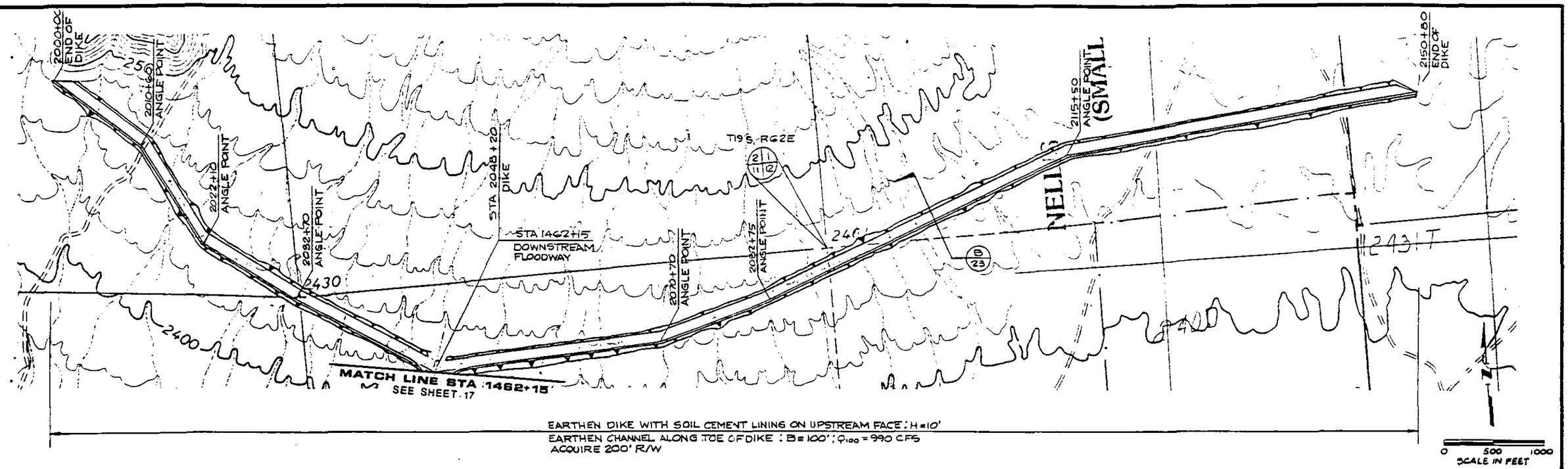
THE FACILITIES SHOWN ON THIS DRAWING HAVE BEEN IDENTIFIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.

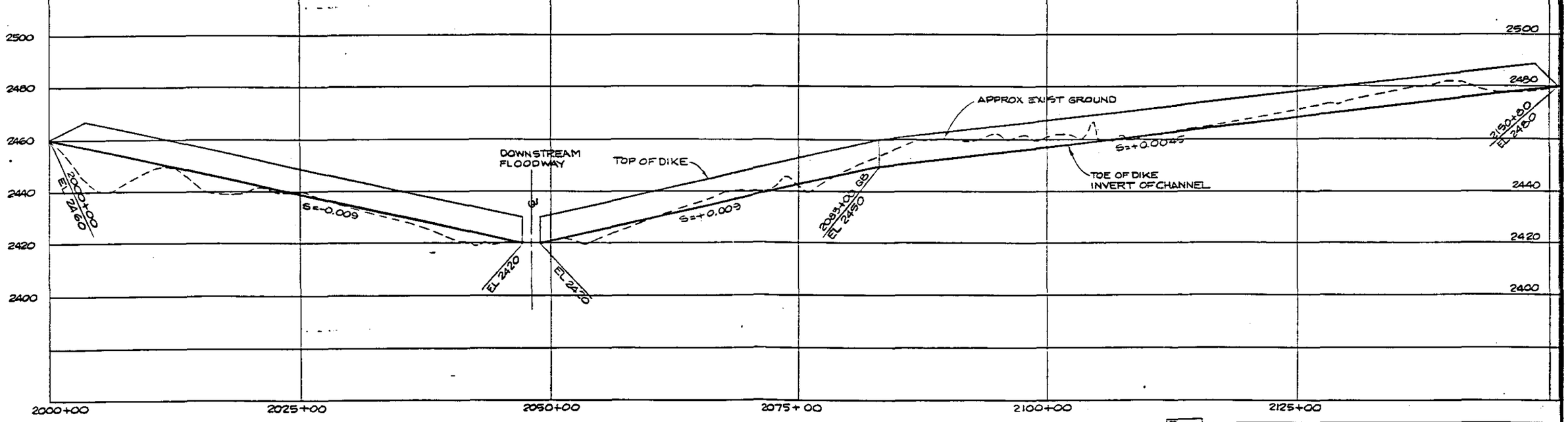
CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

DETENTION BASIN E-J1/FLOODWAY E-2A
STA 1345+30 TO STA 1462+15
EASTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 17





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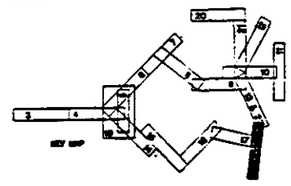


CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

DIKE E-1A

STA 2000+00 TO STA 2150+80

EASTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 18

0 500 1000 1500
SCALE IN FEET

LEGEND

- NELLIS AFB BOUNDARY
- LIMITS OF FEDERAL LAND HOLDINGS
- EXISTING CHANNEL
- PROPERTY LINE
- GREEN
- TEE BOX
- FAIRWAY

NOTES

1. LOCATION OF NELLIS GOLF COURSE FAIRWAYS AND GREENS BASED ON COOPER AERIAL 1"=400' AERIAL PHOTO NOS. 11-9 AND 11-10 DATED NOVEMBER, 1968
2. ALL LANDS PRIVATE, UNLESS OTHERWISE NOTED (DEDICATED PUBLIC RIGHTS-OF WAY NOT INDICATED FOR CLARITY)

NELLIS AIR FORCE BASE
USA
CHANNEL W-9
SEE SHEETS 5 & 6
CHEYENNE RD
T20S, R62E
BM 1826
NELLIS BLVD
Golf Course
Sewage
Gravel Pit
EXISTING SLOAN CHANNEL
CHANNEL R-1
SEE SHEET 4
MATCH LINE STA 357+50
SEE SHEET 4
MATCH LINE STA 384+19
SEE SHEET 5
MATCH LINE STA 1004+00
SEE SHEET 14
CHANNEL E-8
SEE SHEET 14
LIMITS OF DETENTION BASIN R-M
DETENTION BASIN R-M
LOW FLOW CHANNEL
EMERGENCY SPILLWAY
CLARK COUNTY
Gravel Pits
Trailer Park
Substation
CAREY AVE
BM 1797
1809
1814
1820
1830
1800
1860

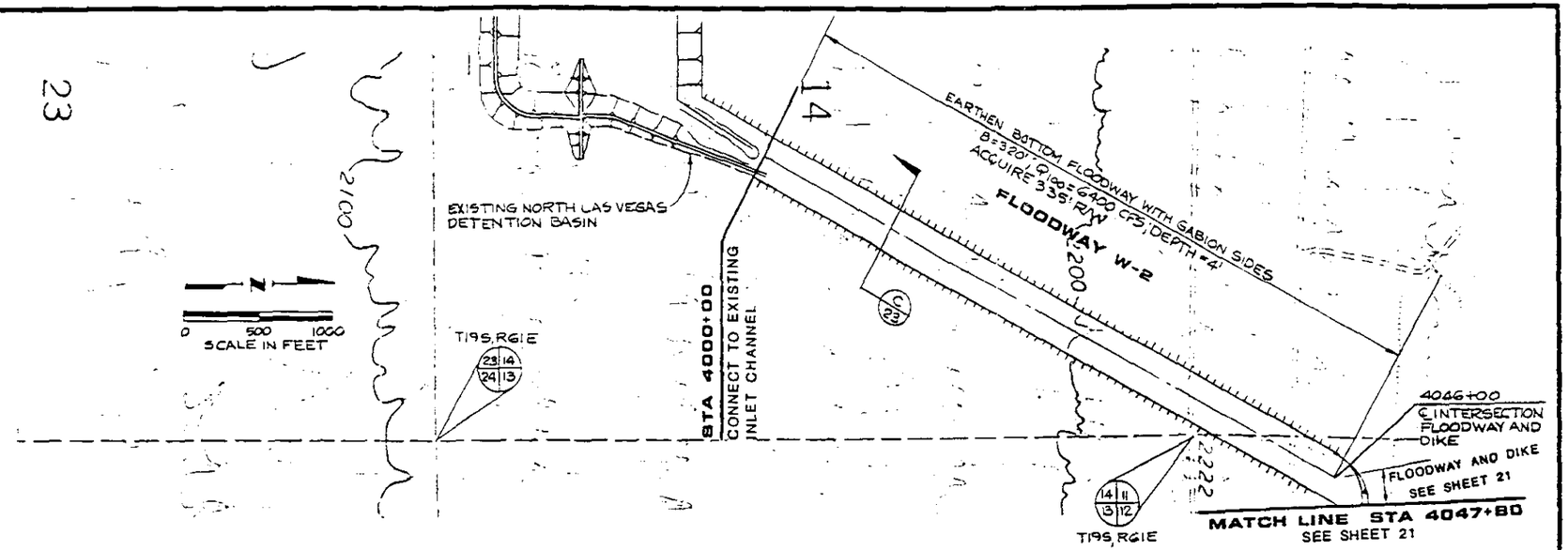
DETENTION BASIN DATA

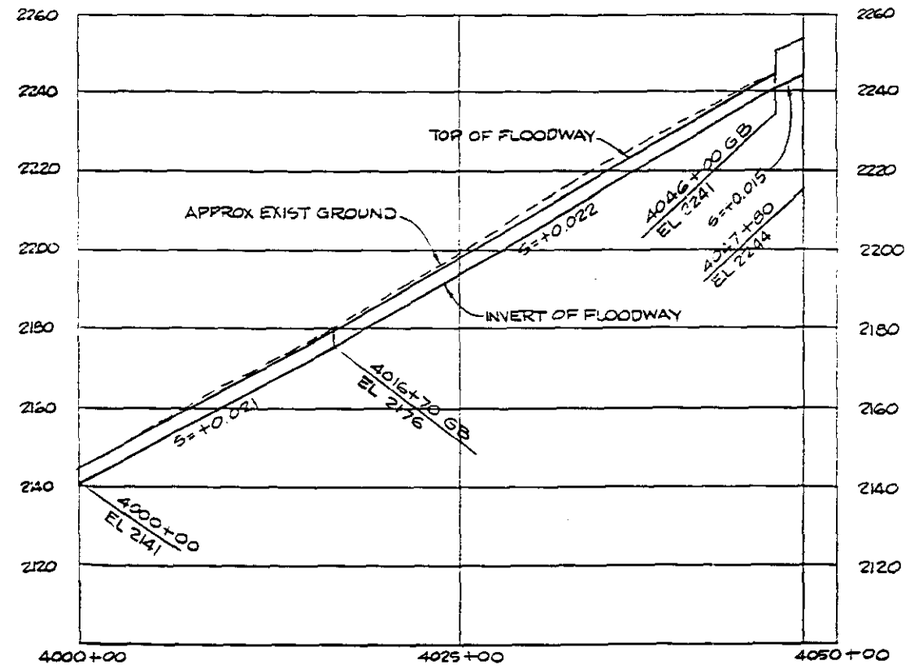
EMBANKMENT CREST ELEVATION	1821	MSL
EMBANKMENT HEIGHT	0 TO 22	FT
EMERGENCY SPILLWAY CREST ELEVATION	1815	MSL
DISCHARGE AT SPILLWAY CREST	1200	CFS
EMERGENCY SPILLWAY LENGTH	1600	FT
BANK FULL STORAGE VOLUME	2450	AC-FT
STORAGE VOLUME AT SPILLWAY CREST	1300	AC-FT

THE FIGURES SHOWN ON THIS DRAWING HAVE BEEN SUPPLIED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.

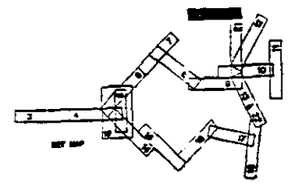
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
DETENTION BASIN R-M
CONFLUENCE OF EAST AND WEST RANGE WASHES

Boyle Engineering Corporation | SHEET 19





THE FACILITIES SHOWN ON THIS DRAWING MAY OCCUR SEVERAL TIMES DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY DIFFERENT ALIGNMENTS AND GEOMETRY TO REFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



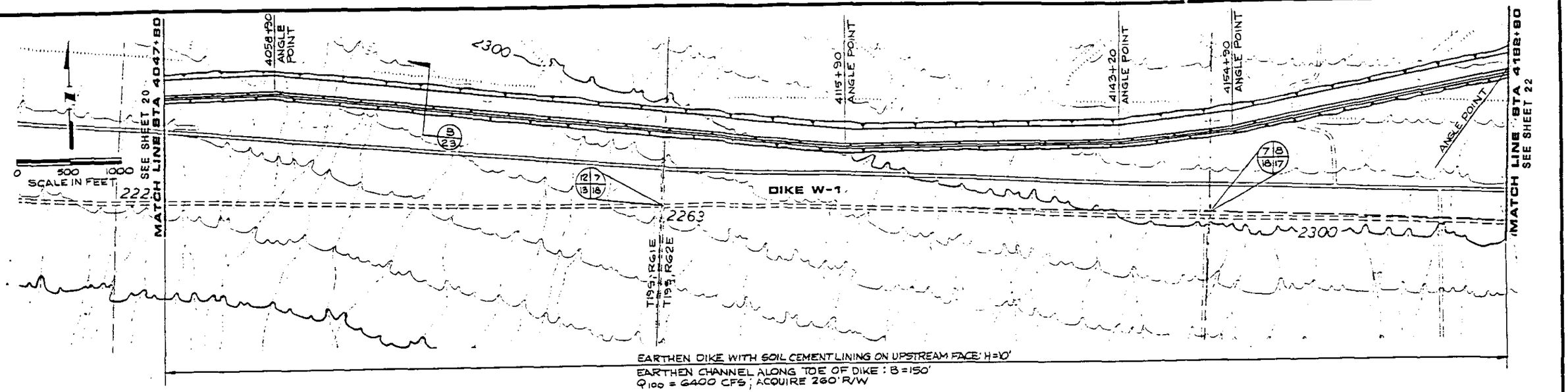
CITY OF NORTH LAS VEGAS

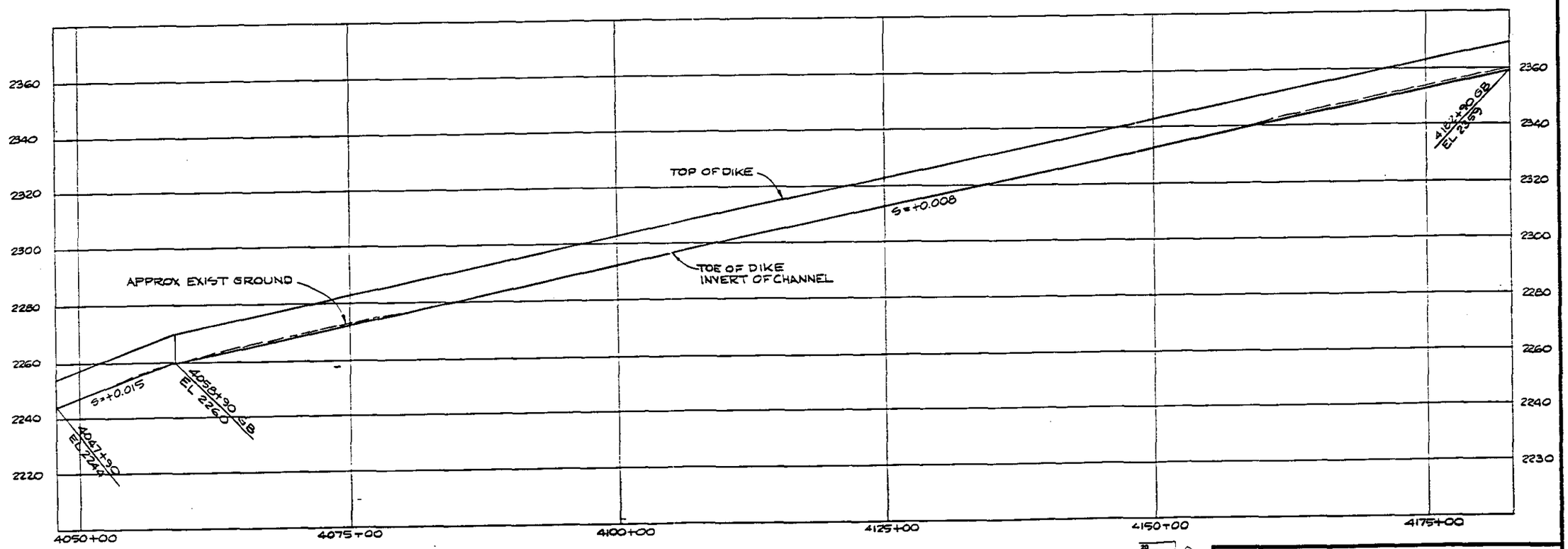
RANGE WASH FACILITY PLAN

DIKE W-2

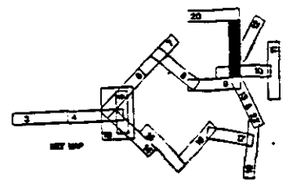
STA 4000+00 TO STA 4047+80
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 20





THE FIGURES SHOWN ON THIS DRAWING HAVE BEEN DEVELOPED DURING THIS STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. SURVEYED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL COMPUTATIONS ARE ASSUMED TO PRECEDE CONSTRUCTION DOCUMENTS.



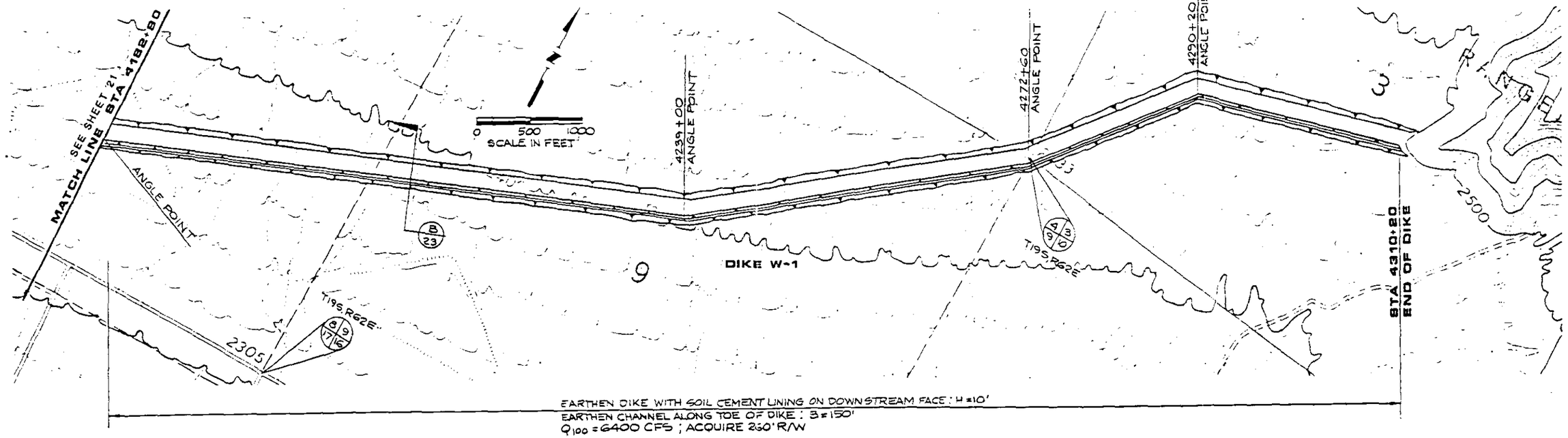
CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

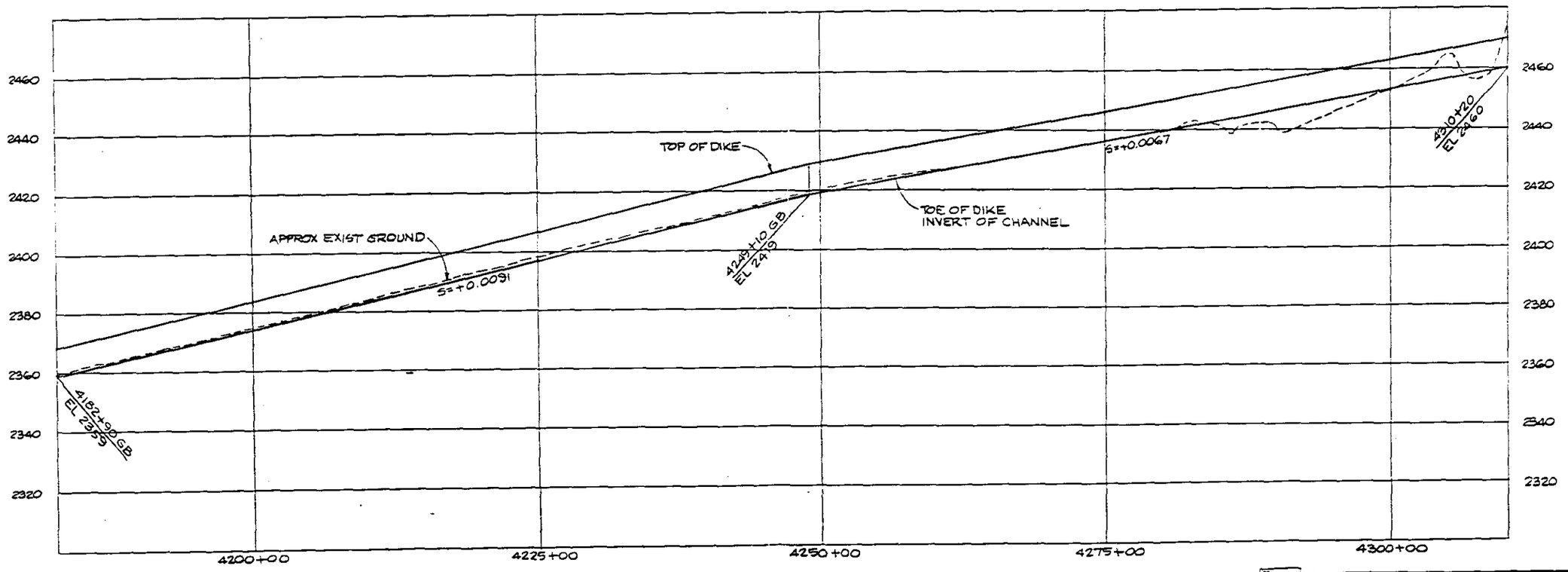
DIKE W-1

STA 4047+80 TO STA 4182+90
WESTERN TRIBUTARY OF RANGE WASH

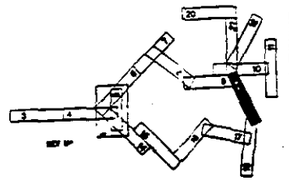
Boyle Engineering Corporation | SHEET 21



EARTHEN DIKE WITH SOIL CEMENT LINING ON DOWNSTREAM FACE : H =10'
EARTHEN CHANNEL ALONG TOE OF DIKE : B=150'
Q_{100} = 6400 CFS ; ACQUIRE 260' R/W



THE FACILITIES SHOWN ON THIS DRAWING WERE GIVEN PRELIMINARY SIZING FOR STUDY. THEY ARE INTENDED TO PORTRAY SUFFICIENT ALIGNMENTS AND GEOMETRY TO DEFINE PROJECT COMPONENTS. DETAILED SURVEYS, UTILITY AND GEOTECHNICAL INVESTIGATIONS, AND HYDRAULIC AND STRUCTURAL CONFIRMATIONS ARE REQUIRED TO PREPARE CONSTRUCTION DOCUMENTS.



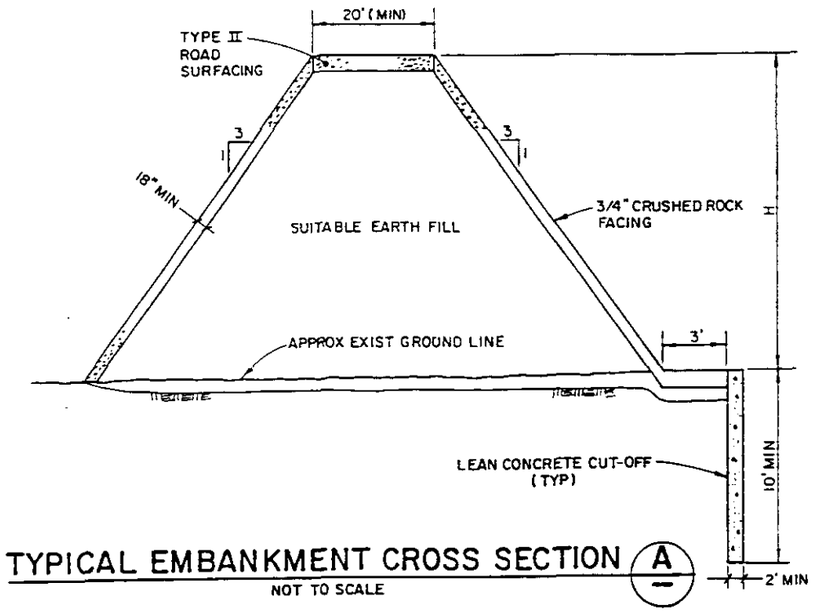
CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

DIKE W-1

STA 4182+90 TO STA 4310+20
WESTERN TRIBUTARY OF RANGE WASH

Boyle Engineering Corporation | SHEET 22

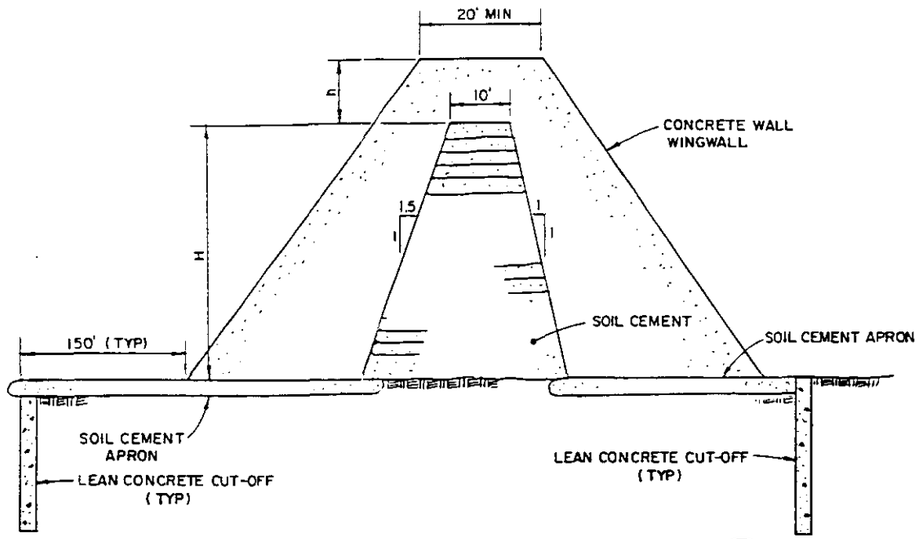


TYPICAL EMBANKMENT CROSS SECTION A

NOT TO SCALE

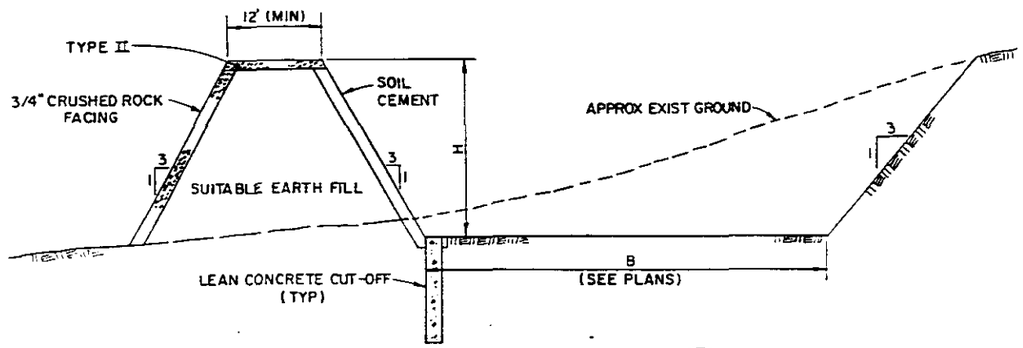
DETENTION BASIN DATA

BASIN	EMBANKMENT		SPILLWAY			
	HEIGHT (H)	ELEVATION	HEIGHT (H)	MAX HEAD (h)	LENGTH	ELEVATION
W-I	0-18'	2218	13'	5'	3500'	2213
E-J1	0-18'	2058	13'	5'	1200'	2253
R-M	0-22'	1821	16'	6'	1600'	1815



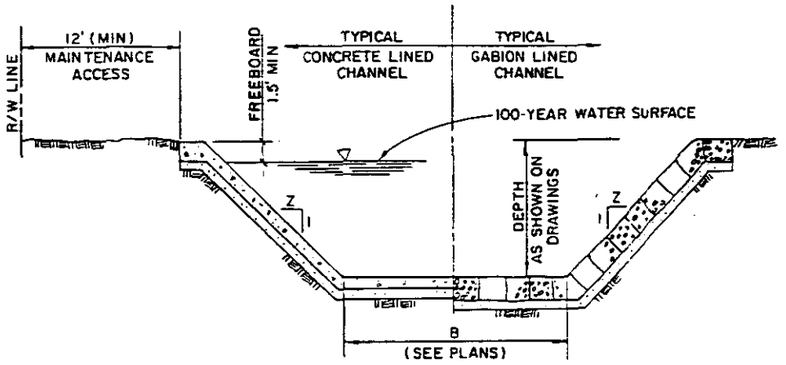
TYPICAL SPILLWAY CROSS SECTION D

NOT TO SCALE



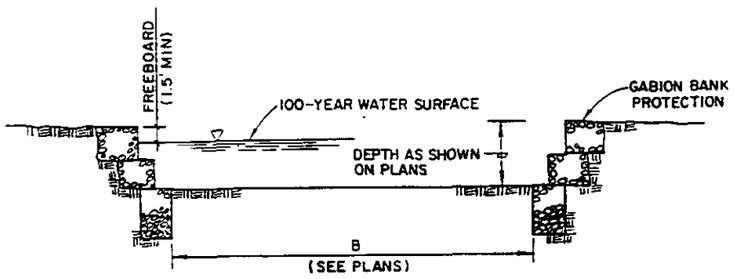
TYPICAL DIKE CROSS SECTION B

NOT TO SCALE



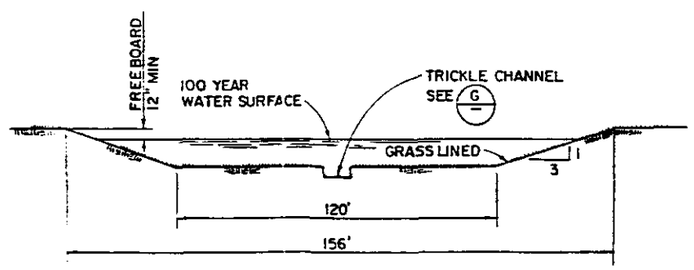
TYPICAL CHANNEL CROSS SECTION E

NOT TO SCALE



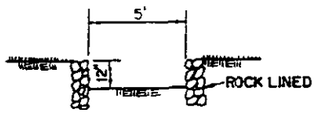
TYPICAL FLOODWAY CROSS SECTION C

NOT TO SCALE



GOLF COURSE CHANNEL SECTION F

NOT TO SCALE



TRICKLE CHANNEL G

NOT TO SCALE

CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

TYPICAL SECTIONS

Boyle Engineering Corporation

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Appendix B

(Conceptual Plan) ... 25

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(Continued)

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Sloan Channel B-12

TABLE B - 1

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE I - MASTER PLAN
WESTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
W - 1	DIKE	UPPER WEST FAN	H=	13.5	Q=	5600
W - 2	FLOODWAY	WEST FAN	W=	300	Q=	5600
			D=	5	V=	7
			S=	4	Y=	2.2
					F=	1
W - 3	DIKE	LOWER WEST FAN	H=	13.5	Q=	5600
W - 1	BASIN	SECTIONS 16 AND 1	H=	21	Qin=	7000
			A=	79	Qout=	2180
					Vol=	750
W - 4	CHANNEL	OUTFALL TO UPRR	D=	5	Q=	2180
			B=	30	V=	18
			Z=	2	Y=	3.3
			S=	.9	F=	1.9
W - 5	CHANNEL	UPRR TO I-15	D=	5	Q=	3680
			B=	50	V=	19
			Z=	2	Y=	3.4
			S=	.9	F=	2
W - 6	CHANNEL	I-15 TO CRAIG ROAD	D=	5	Q=	3880
			B=	60	V=	17-19
			Z=	0	Y=	3.8-3.3
			S=	.6-.9	F=	1.6-1.9
W - 7	CHANNEL	CRAIG ROAD TO LAMB BLVD	D=	5	Q=	3880
			B=	60	V=	17
			Z=	2	Y=	3.3
			S=	.73	F=	1.8
W - 8	CHANNEL	LAMB BLVD TO LV BLVD NORTH	D=	5	Q=	3880
			B=	60	V=	16
			Z=	2	Y=	3.6
			S=	.55	F=	1.6
W - 9	CHANNEL	LV BLVD NORTH TO CONFLUENCE	D=	6	Q=	4470
			B=	60	V=	15
			Z=	2	Y=	4.4
			S=	.39	F=	1.3

[1] SEE FIGURE III - 1

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 2

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE 1 - MASTER PLAN
EASTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
E - 1A	DIKE	UPPER EAST FAN	H=	10	Q=	2200
E - 2A	FLOODWAY	EAST FAN	W=	200	Q=	2200
			D=	5	V=	9
			S=	3.6	Y=	1.6
					F=	1
E - J1	BASIN	SECTION 22	H=	27	Qin=	4500
			A=	30	Qout=	1480
					Vol=	360
E - 4	CHANNEL	I-15 TO	D=	5	Q=	1480
		LV BLVD	B=	14	V=	20
		NORTH	Z=	2	Y=	3.5
			S=	1.2	F=	2.2
E - 5	CHANNEL	LV BLVD	D=	6	Q=	1890
		NORTH TO	B=	24	V=	15
		NELLIS	Z=	2	Y=	4
		AREA 2	S=	.5	F=	1.5
E - 6	CHANNEL	NELLIS	D=	6	Q=	2660
		AREA 2 TO	B=	24-40	V=	20-14
		SECTION 2	Z=	2	Y=	4
			S=	1-.4	F=	2-1.3
E - P1	BASIN	SECTION 11	H=	18	Qin=	2660
			A=	130	Qout=	320
					Vol=	700
E - 7	CHANNEL	SECTION 2 TO	D=	5	Q=	320
		SECTION 11	B=	10	V=	8
			Z=	2	Y=	2.6
			S=	.3	F=	1
E - 8	CHANNEL	SECTION 11 TO	D=	6	Q=	880
		SLOAN	B=	24-40	V=	7-14
		CHANNEL	Z=	2	Y=	4
			S=	.1-.6	F=	.4-1.5

[1] SEE FIGURE III - 1

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 3

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE I - MASTER PLAN
SLOAN CHANNEL

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
R - 1	CHANNEL	CAREY TO LAKE MEAD	D=	6	Q=	4900
			B=	60	V=	16
			Z=	2	Y=	4.4
			S=	.46	F=	1.5
R - 2	CHANNEL	LAKE MEAD TO OWENS	D=	6	Q=	4900
			B=	60	V=	16
			Z=	2	Y=	4.4
			S=	.46	F=	1.5
R - 3	CHANNEL	OWENS TO WASHINGTON	D=	6	Q=	5000
			B=	60	V=	16
			Z=	2	Y=	4.4
			S=	.46	F=	1.5
R - 4	CHANNEL	WASHINGTON TO BONANZA	D=	6	Q=	5000
			B=	60	V=	16
			Z=	2	Y=	4.4
			S=	.46	F=	1.5
R - 5	CHANNEL	BONANZA TO STEWART	D=	6	Q=	5100
			B=	60	V=	16
			Z=	2	Y=	4.5
			S=	.46	F=	1.5
R - 6	CHANNEL	STEWART TO CHARLESTON	D=	6	Q=	5200
			B=	60	V=	16
			Z=	2	Y=	4.5
			S=	.46	F=	1.5
R - 7	CHANNEL	CHARLESTON TO LV WASH	D=	6	Q=	5340
			B=	60	V=	17
			Z=	2	Y=	4.6
			S=	.46	F=	1.5

[1] SEE FIGURE III - 1

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 4

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE II - BELTWAY ALIGNMENT
WESTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
W - F1	BASIN	LAMB AND BELTWAY	H=	22	Qin=	4000
			A=	66	Qout=	1500
					Vol=	440
W - 4A	DIKE	BELTWAY DIKE	H=	10	Q=	6500
W - 5A	CHANNEL	BELTWAY TO I-15	D=	5.5	Q=	1560
			B=	20	V=	16
			Z=	2	Y=	3.6
			S=	.67	F=	1.7
W - 6	CHANNEL	I-15 TO CRAIG ROAD	D=	5	Q=	1650
			B=	30	V=	14-17
			Z=	2	Y=	3.1-2.8
			S=	.6-.93	F=	1.8-1.9
W - 7	CHANNEL	CRAIG ROAD TO LAMB BLVD	D=	5	Q=	1830
			B=	30	V=	16
			Z=	2	Y=	3.1
			S=	.73	F=	1.7
W - 8	CHANNEL	LAMB BLVD TO LV BLVD NORTH	D=	5-6	Q=	2000
			B=	50	V=	10-15
			Z=	2	Y=	3.5-2.4
			S=	.23-.86	F=	1-1.8
W - 9	CHANNEL	LV BLVD NORTH TO CONFLUENCE	D=	5	Q=	2950
			B=	60	V=	13
			Z=	2	Y=	3.4
			S=	.4	F=	1.3

[1] SEE FIGURE III - 2

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 5

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE II - BELTWAY ALIGNMENT
EASTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
E - D	BASIN	FAN APEX	H=	21	Qin =	5200
			A=	25	Qout =	3340
					Vol =	350
E - 1	CHANNEL	FAN APEX TO COLLECTOR DIKE	D=	3	Q=	3340
			B=	100	V=	25
			Z=	2	Y=	1.3
			S=	5	F=	4
E - 2	DIKE	COLLECTOR DIKE	H=	9	Q=	1400
E - 3	CHANNEL	COLLECTOR DIKE TO SECTION 23	D=	3-4	Q=	3800
			B=	80-60	V=	27-24
			Z=	2	Y=	1.7-2.4
			S=	4-2	F=	3.8
E - J1	BASIN	SECTION 23	H=	35	Qin =	5900
			A=	45	Qout =	1000
					Vol =	720
E - 4	CHANNEL	I-15 TO LV BLVD NORTH	D=	5	Q=	720
			B=	10	V=	17
			Z=	2	Y=	2.8
			S=	1.2	F=	2
E - 5	CHANNEL	LV BLVD NORTH TO NELLIS AREA 2	D=	6	Q=	900
			B=	10	V=	13
			Z=	2	Y=	4
			S=	.5	F=	1.4
E - 6	CHANNEL	NELLIS AREA 2 TO SECTION 11	D=	5	Q=	2100
			B=	40	V=	17-13
			Z=	2	Y=	2.7-3.5
			S=	1-.4	F=	2-1.3
E - 7	CHANNEL	SECTION 11 TO HOLLYWOOD	D=	6	Q=	2600
			B=	50	V=	12
			Z=	2	Y=	3.8
			S=	.3	F=	1.2
E - 8	CHANNEL	HOLLYWOOD TO CONFLUENCE	D=	5.5-7	Q=	3100
			B=	80-40	V=	8-17
			Z=	2	Y=	4.5-3.9
			S=	.1-.6	F=	.7-1.6

[1] SEE FIGURE III - 2

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 6

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE II - BELTWAY ALIGNMENT
SLOAN CHANNEL

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
R - M	BASIN	CONFLUENCE	H=	16	Qin=	3800
			A=	120	Qout=	1490
					Vol=	900
R - 1	CHANNEL	CAREY TO LAKE MEAD	D=	N/A	Q=	1490
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.4	F=	N/A
R - 2	CHANNEL	LAKE MEAD TO OWENS	D=	N/A	Q=	1750
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.3	F=	N/A
R - 3	CHANNEL	OWENS TO WASHINGTON	D=	5	Q=	1920
			B=	40	V=	12
			Z=	2	Y=	3.3
			S=	.4	F=	1.3
R - 4	CHANNEL	WASHINGTON TO BONANZA	D=	5	Q=	2080
			B=	40	V=	14
			Z=	2	Y=	3.2
			S=	.54	F=	1.5
R - 5	CHANNEL	BONANZA TO STEWART	D=	5	Q=	2170
			B=	40	V=	15
			Z=	2	Y=	3.2
			S=	.56	F=	1.5
R - 6	CHANNEL	STEWART TO CHARLESTON	D=	5	Q=	2260
			B=	40	V=	15
			Z=	2	Y=	3.3
			S=	.58	F=	1.6
R - 7	CHANNEL	CHARLESTON TO LV WASH	D=	6	Q=	2570
			B=	40	V=	14
			Z=	2	Y=	3.8
			S=	.46	F=	1.4

[1] SEE FIGURE III - 2

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 7

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION
WESTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
W - 1	DIKE	UPPER WEST FAN	H=	13.5	Q=	5600
W - 2	FLOODWAY	WEST FAN	W=	300	Q=	5600
			D=	5	V=	7
			S=	4	Y=	2.2
					F=	1
W - 3	DIKE	LOWER WEST FAN	H=	13.5	Q=	5600
W - 1	BASIN	SECTIONS 16 AND 17	H=	21	Qin=	7000
			A=	79	Qout=	2180
					Vol=	750
W - 4	CHANNEL	OUTFALL TO UPRR	D=	5	Q=	2180
			B=	30	V=	18
			Z=	2	Y=	3.3
			S=	.9	F=	1.9
W - 5	CHANNEL	UPRR TO I-15	D=	5	Q=	3680
			B=	50	V=	19
			Z=	2	Y=	3.4
			S=	.9	F=	2
W - 6	CHANNEL	I-15 TO CRAIG ROAD	D=	5	Q=	3880
			B=	60	V=	17-19
			Z=	0	Y=	3.8-3.3
			S=	.6-.9	F=	1.6-1.9
W - 7	CHANNEL	CRAIG ROAD TO LAMB BLVD	D=	5	Q=	3880
			B=	60	V=	17
			Z=	2	Y=	3.3
			S=	.73	F=	1.8
W - 8	CHANNEL	LAMB BLVD TO LV BLVD NORTH	D=	5	Q=	3880
			B=	60	V=	16
			Z=	2	Y=	3.6
			S=	.55	F=	1.6
W - 9	CHANNEL	LV BLVD NORTH TO CONFLUENCE	D=	6	Q=	4470
			B=	60	V=	15
			Z=	2	Y=	4.4
			S=	.39	F=	1.3

[1] SEE FIGURE III - 3

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 8

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION
EASTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
E - 1A	DIKE	UPPER EAST FAN	H=	10	Q=	2200
E - 2A	FLOODWAY	EAST FAN	W=	200	Q=	2200
			D=	5	V=	9
			S=	3.6	Y=	1.6
					F=	1
E - J1	BASIN	SECTION 22	H=	27	Qin=	4500
			A=	30	Qout=	1480
					Vol=	360
E - 4	CHANNEL	I-15 TO LV BLVD NORTH	D=	5	Q=	1480
			B=	14	V=	20
			Z=	2	Y=	3.5
			S=	1.2	F=	2.2
E - 5	CHANNEL	LV BLVD NORTH TO NELLIS AREA 2	D=	6	Q=	1890
			B=	24	V=	15
			Z=	2	Y=	4
			S=	.5	F=	1.5
E - 6	CHANNEL	NELLIS AREA 2 TO SECTION 2	D=	6	Q=	2660
			B=	24-40	V=	20-14
			Z=	2	Y=	4
			S=	1-.4	F=	2-1.3
E - P1	BASIN	SECTION 11	H=	18	Qin=	2660
			A=	130	Qout=	320
					Vol=	700
E - 7	CHANNEL	SECTION 2 TO SECTION 11	D=	5	Q=	320
			B=	10	V=	8
			Z=	2	Y=	2.6
			S=	.3	F=	1
E - 8	CHANNEL	SECTION 11 TO SLOAN CHANNEL	D=	6	Q=	860
			B=	24-40	V=	7-14
			Z=	2	Y=	4
			S=	.1-.6	F=	.4-1.5

[1] SEE FIGURE III - 3

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 9

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE III - MASTER PLAN WITH CONFLUENCE DETENTION
SLOAN CHANNEL

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
R - M	BASIN	AT CONFLUENCE	H=	13	Qin=	3100
			A=	100	Qout=	870
					Vol=	800
R - 1	CHANNEL	CAREY TO LAKE MEAD	D=	N/A	Q=	1400
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.4	F=	N/A
R - 2	CHANNEL	LAKE MEAD TO OWENS	D=	N/A	Q=	1600
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.3	F=	N/A
R - 3	CHANNEL	OWENS TO WASHINGTON	D=	5	Q=	1800
			B=	40	V=	12
			Z=	2	Y=	3.2
			S=	.4	F=	1.3
R - 4	CHANNEL	WASHINGTON TO BONANZA	D=	5	Q=	2000
			B=	40	V=	14
			Z=	2	Y=	3.2
			S=	.54	F=	1.5
R - 5	CHANNEL	BONANZA TO STEWART	D=	5	Q=	2200
			B=	40	V=	15
			Z=	2	Y=	3.2
			S=	.56	F=	1.5
R - 6	CHANNEL	STEWART TO CHARLESTON	D=	5	Q=	2300
			B=	40	V=	15
			Z=	2	Y=	3.3
			S=	.58	F=	1.6
R - 7	CHANNEL	CHARLESTON TO LV WASH	D=	6	Q=	2600
			B=	60	V=	13
			Z=	2	Y=	3.1
			S=	.46	F=	1.4

[1] SEE FIGURE III - 3

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 10

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE IV - NORTH LAS VEGAS DETENTION BASIN DIVERSION
WESTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
W - 3 A	DIKE	DIVERSION DIKE	H =	13.5	Q =	6720
W - 5	CHANNEL	UPRR TO I-15	D =	5	Q =	2520
			B =	40	V =	17
			Z =	2	Y =	3
			S =	.9	F =	1.7
W - 6	CHANNEL	I-15 TO CRAIG ROAD	D =	5	Q =	3000
			B =	60	V =	16-18
			Z =	0	Y =	3.2-2.8
			S =	.6-.9	F =	1.9
W - 7	CHANNEL	CRAIG ROAD TO LAMB BLVD	D =	5	Q =	3000
			B =	50	V =	17
			Z =	2	Y =	3.2
			S =	.73	F =	1.8
W - 8	CHANNEL	LAMB BLVD TO LV BLVD NORTH	D =	5	Q =	3000
			B =	50	V =	15
			Z =	2	Y =	3.5
			S =	.55	F =	1.5
W - 9	CHANNEL	LV BLVD NORTH TO CONFLUENCE	D =	6	Q =	4500
			B =	60	V =	15
			Z =	2	Y =	4.4
			S =	.39	F =	1.3

[1] SEE FIGURE III - 4

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 11

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE IV - NORTH LAS VEGAS DETENTION BASIN DIVERSION
EASTERN TRIBUTARY

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
E - 1A	DIKE	UPPER EAST FAN	H=	10	Q=	2200
E - 2A	FLOODWAY	EAST FAN	W=	200	Q=	2200
			D=	5	V=	9
			S=	3.6	Y=	1.6
					F=	1
E - J1	BASIN	SECTION 22	H=	27	Qin=	4500
			A=	30	Qout=	1480
					Vol=	360
E - 4	CHANNEL	I-15 TO LV BLVD NORTH	D=	5	Q=	1480
			B=	14	V=	20
			Z=	2	Y=	3.5
			S=	1.2	F=	2.2
E - 5	CHANNEL	LV BLVD NORTH TO NELLIS AREA 2	D=	6	Q=	1890
			B=	24	V=	15
			Z=	2	Y=	4
			S=	.5	F=	1.5
E - 6	CHANNEL	NELLIS AREA 2 TO SECTION 2	D=	6	Q=	2660
			B=	24-40	V=	20-14
			Z=	2	Y=	4
			S=	1-.4	F=	2-1.3
E - P1	BASIN	SECTION 11	H=	18	Qin=	2660
			A=	130	Qout=	320
					Vol=	700
E - 7	CHANNEL	SECTION 2 TO SECTION 11	D=	5	Q=	320
			B=	10	V=	8
			Z=	2	Y=	2.6
			S=	.3	F=	1
E - 8	CHANNEL	SECTION 11 TO SLOAN CHANNEL	D=	6	Q=	860
			B=	24-40	V=	7-14
			Z=	2	Y=	4
			S=	.1-.6	F=	.4-1.5

[1] SEE FIGURE III - 4

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

TABLE B - 12

SUMMARY OF CONCEPTUAL FACILITIES
ALTERNATIVE IV - NORTH LAS VEGAS DETENTION BASIN DIVERSION
SLOAN CHANNEL FACILITIES

FACILITY DESIGNATION[1]	FACILITY TYPE	LOCATION	GEOMETRY[2]		HYDRAULICS[2]	
R - M	BASIN	AT CONFLUENCE	H=	18	Qin=	3100
			A=	130	Qout=	870
					Vol=	800
R - 1	CHANNEL	CAREY TO LAKE MEAD	D=	N/A	Q=	1400
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.46	F=	N/A
R - 2	CHANNEL	LAKE MEAD TO OWENS	D=	N/A	Q=	1600
			B=	N/A	V=	N/A
			Z=	N/A	Y=	N/A
			S=	.3	F=	N/A
R - 3	CHANNEL	OWENS TO WASHINGTON	D=	5	Q=	1800
			B=	40	V=	12
			Z=	2	Y=	3.2
			S=	.4	F=	1.3
R - 4	CHANNEL	WASHINGTON TO BONANZA	D=	5	Q=	2000
			B=	40	V=	14
			Z=	2	Y=	3.2
			S=	.54	F=	1.5
R - 5	CHANNEL	BONANZA TO STEWART	D=	5	Q=	2200
			B=	40	V=	15
			Z=	2	Y=	3.2
			S=	.56	F=	1.5
R - 6	CHANNEL	STEWART TO CHARLESTON	D=	5	Q=	2300
			B=	40	V=	15
			Z=	2	Y=	3.3
			S=	.58	F=	1.6
R - 7	CHANNEL	CHARLESTON TO LV WASH	D=	6	Q=	2600
			B=	60	V=	13
			Z=	2	Y=	3.1
			S=	.46	F=	1.4

[1] SEE FIGURE III - 4

[2] WHERE

H = HEIGHT (FEET)
Q = DISCHARGE (CFS)
W = WIDTH (FT)
D = TOTAL DEPTH (FT)
S = SLOPE (PERCENT)
V = VELOCITY (FEET PER SECOND)
Y = NORMAL DEPTH (FT)
F = FROUDE NUMBER
A = SURFACE AREA (ACRES)
Qin = INFLOW (CFS)
Qout = OUTFLOW (CFS)
Vol = VOLUME (ACRE-FEET)
B = BOTTOM WIDTH (FEET)
Z = SIDE SLOPE

5.3.2 Western and Eastern Tributaries of Range Wash

Hydrologic Analysis

RETURN TO KELLY CHUMA UNLV
657-2295

HYDROLOGIC ANALYSIS

WESTERN AND EASTERN TRIBUTARIES OF RANGE WASH

CITY OF NORTH LAS VEGAS

April 1990

Boyle Engineering Corporation
Consulting engineers
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Las Vegas, Nevada 89104
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HYDROLOGIC ANALYSIS

WESTERN AND EASTERN TRIBUTARIES OF RANGE WASH

Prepared for

CITY OF NORTH LAS VEGAS

Prepared By

BOYLE ENGINEERING CORPORATION

April 1990

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CHAPTER I

INTRODUCTION

I - INTRODUCTION

GENERAL INTRODUCTION

The evaluation and preliminary design of drainage facilities within the Eastern and Western Tributaries of Range Wash upstream of the Sloan Channel, in the Las Vegas Valley area of Nevada, was performed under the terms of an agreement executed on January 18, 1989 between the City of North Las Vegas, Nevada and Boyle Engineering Corporation.

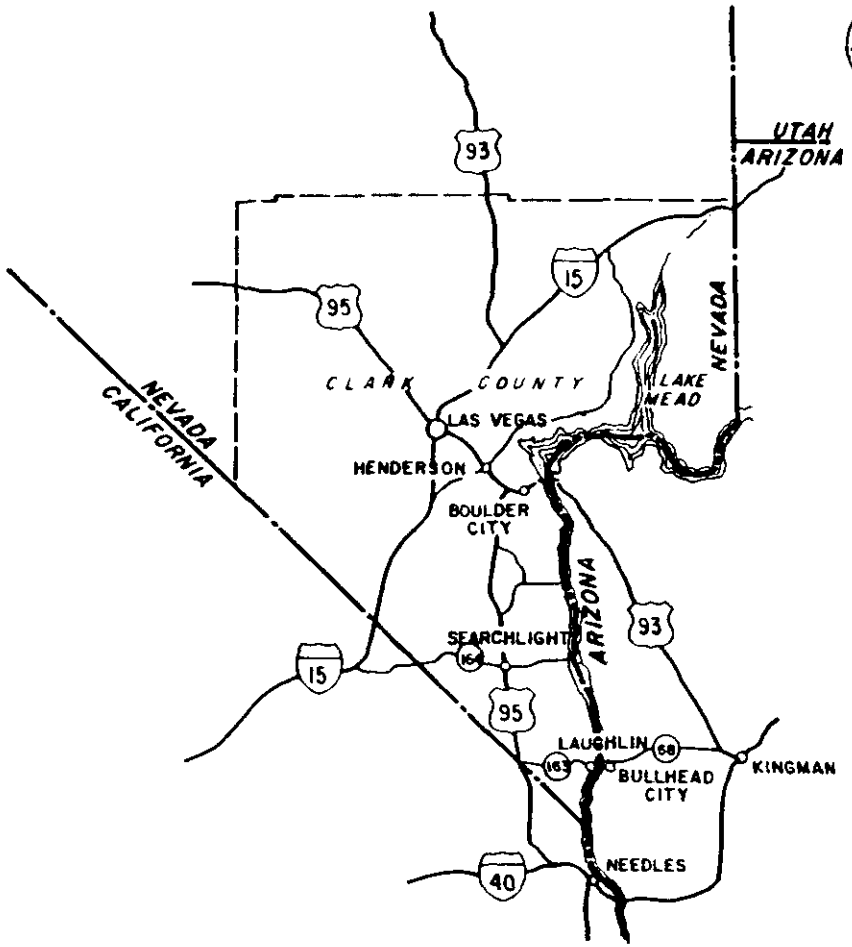
The purpose of the project is to evaluate and develop preliminary designs for drainage facilities within the Eastern and Western Tributaries of Range Wash. The effort includes a review of previously developed studies, updating and refining existing hydrologic models, development and evaluation of alternative flood control facilities, conceptual design of selected flood control facilities within the Western and Eastern Tributaries of Range Wash, and the preparation of a report summarizing the effort.

PROJECT LOCATION

The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley (Figure I-1). The study area boundary is bounded on the north and east by the Las Vegas Mountain Range and extends into the Desert National Wildlife Range.

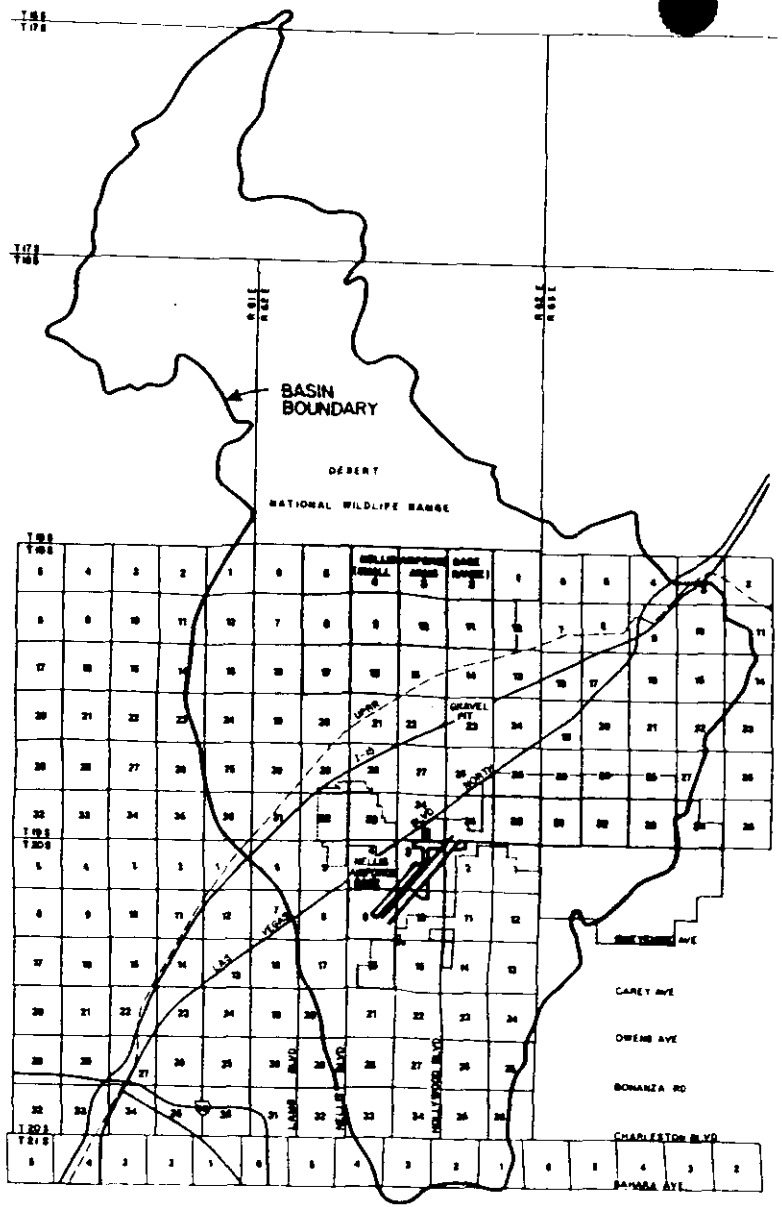
The basin lies entirely within Clark County, Nevada and includes portions of the City of North Las Vegas, Nellis Air Force Base, and portions of unincorporated Clark County. The entire drainage area is contained within the boundaries of the Clark County Regional Flood Control District.

The Range Wash Drainage Basin is a tributary to Las Vegas Wash. Flows from Range Wash enter Las Vegas Wash adjacent to the Sunrise Station Power Plant near the intersection of Vegas Valley Drive and Hollywood Boulevard. The mainstem of Range Wash extends north from this location approximately five miles along the Sloan Channel to the southern limit of Nellis Air Force Base at the confluence of the Western Tributary of Range Wash with the Eastern Tributary of Range Wash.



LOCATION MAP

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

FIGURE I-1

The Western Tributary of Range Wash extends along the western boundary of Nellis Air Force, then northwesterly crossing Las Vegas Boulevard North, Lamb Boulevard, and Craig Road, and through the Vandenberg Channel and a crossing of I-15. Upstream of I-15 and the parallel Union Pacific Railroad track, the channel is fairly poorly defined with numerous minor channels distributed across the alluvial fan. Upstream of the alluvial fan area, in the Las Vegas Mountain Range, channels are well defined.

The Eastern Tributary of Range Wash extends around the eastern boundary of Nellis Air Force to a point near the intersection of O'Dannon Road and Forrestal Boulevard between the main base area and Area 2. Here, two fairly distinct branches join. The easterly branch extends northeasterly into the Las Vegas Dunes Recreation Lands area. The westerly branch collects flows from an area to the north and east of the Western Tributary alluvial fan.

The basin can be characterized by three distinct land types: mountainous; alluvial fan, and; urban developed. The mountainous regions of the watershed are steep rocky areas with limited vegetation and high runoff potential. Areas on the alluvial fan are characterized by alluvial deposits and numerous incised channels of limited capacity. Runoff from this area is relatively low however, hydraulic conditions are such that the route of flood flows is difficult to predict. The highly developed area, downstream of I-15, is generally characterized by existing residential and commercial developments and Nellis Air Force Base, with rapid development and construction of additional commercial and residential developments. Runoff from this area is rapid and high due to the large amount of impervious surface found in the area.

PROJECT SCOPE

The drainage planning study for the Western and Eastern Tributaries of Range Wash involves the preparation of conceptual designs for drainage improvements along the two tributaries of Range Wash. The defined scope of work includes the five following principal components:

- Data Collection and Project Coordination;
- Hydrologic Analysis;
- Alternative Development and Evaluation;

- Conceptual Design of Drainage Improvements, and;

- Report Preparation

Data collection and project coordination were among the first tasks performed for the project and continued throughout the duration of the project. This effort involved obtaining and reviewing past hydrologic studies of the watershed, alternative flood control measures previously proposed within the watershed, and final design drawings of storm drainage facilities. The effort also included the collection and review of utility plans, land-use plans and the identification of regulatory requirements imposed on potential improvements within the watershed. An initial meeting and on-going project coordination meetings were held to facilitate the collection of data, to review project progress, and to discuss project results. These meetings included representatives from the City of North Las Vegas, the Clark County Regional Flood Control District, Clark County Public Works Department, Nellis Air Force Base, and the Cities of Henderson and Las Vegas. In addition to those in attendance at the meetings, coordination and communication with other agencies such as the Federal Emergency Management Agency and the U.S. Army Corps of Engineers was also established and maintained throughout the project duration.

A hydrologic analysis was performed for the Range Wash watershed. This analysis included an evaluation of the hydrologic response of the Western and Eastern Tributaries of Range Wash for both the existing and future drainage basin conditions. A hydrologic computer model was utilized to simulate the response of the watershed to design rain storms. The model was calibrated to the computed probability results presented by the U.S. Army Corps of Engineers in their Feasibility Study. A sediment yield analysis was also performed to estimate probable sediment volumes reaching the proposed facilities.

The results of the hydrologic analysis were used to establish design discharges for proposed facilities within the watershed. The model was also used to evaluate the impacts of proposed facilities on downstream flows and to provide additional information for the sizing of downstream facilities.

Four conceptual alternative facilities were identified for the control of flooding within the Range Wash watershed. These facilities were developed in conjunction with the City of North Las Vegas, the Clark County Regional Flood Control District, and the other agencies identified and

involved in the project. These alternatives were selected to reconcile the identified technical, economic, political and aesthetic considerations within the watershed.

The evaluation of the four conceptual alternatives included locating, sizing and cost estimating the various component facilities. Simplifying assumptions were made to identify the most attractive alternatives for further study.

Two of the four conceptual alternatives were selected for further refinement. This refinement effort included a more detailed hydrologic impact assessment, more site-specific facility sizing, more extensive hydraulic analysis, and more detailed cost estimate preparation. The conceptual design also included sizing of hydraulic structures including bridge and street crossings, a determination of the hydraulic grade line through the proposed facilities, and a determination of a conceptual vertical alignment of the proposed facilities.

In addition to the conceptual design of the facilities, estimates of probable right-of-way requirements for the alternatives were included. This information, along with the general details of the conceptual design, was presented on plan and profile sheets.

This report summarizes the project work. A discussion of the work performed is included along with a brief discussion of the advantages and/or disadvantages of the alternatives, and a presentation of the plan and profile drawings. Included in the report is a phasing plan to facilitate the implementation of the Plan.

EXISTING DATA

Data from several sources was collected which might effect the feasibility and economics of the various alternative facilities. Sources for the data included governmental agencies such as the City of North Las Vegas, Clark County Public Works Department, Clark County Regional Flood Control District, and Clark County Comprehensive Planning. Other governmental agencies were contacted to identify and collect additional information. These agencies included Nellis Air Force Base, the Federal Emergency Management Agency, and the U.S. Army Corps of Engineers. Utility information was also collected from the various utility companies within the watershed including the Clark County Sanitation District, Nevada Power Company, Southwest Gas Corporation, and telephone and cable TV companies. The information obtained from the various sources was important in identifying the extent of existing facilities within the watershed. Existing drainage improvements were also identified. These included existing channels, street crossings and existing detention facilities which might be utilized for alternative plans.

Land uses within the watershed were perhaps the most important constraint to proposed facilities. Land-use information identified both the character and type of existing development, as well as proposed development locations and extent. Existing land uses within the watershed were identified using combinations of available mapping, area photographs, and field reconnaissance. This information was supplemented by existing hydrologic and planning studies available for the basin. Future land-use information was obtained from the City of Las Vegas Land-Use Plan, Clark County Comprehensive Planning, and the previous studies. This information was compiled and presented to the City of North Las Vegas and the other interested agencies for review and comment. Subsequent to the initial collection effort, the City of North Las Vegas provided amended land-use plans which resulted in a slight modification of development limits and facility sites. This information was utilized to identify feasible alignments and facility sites.

EXISTING BASIN DESCRIPTION

The Range Wash drainage basin is located in the northeast portion of the Las Vegas Valley. The watershed drains a western tributary and an eastern tributary. The Range Wash basin is tributary to Las Vegas Wash with its outfall near the Sunrise Station Power Plant. Flow in the basin is generally from north to south. The Western Tributary watershed headwaters are in the uplands of the Las Vegas Mountain Range. Runoff leaving the Las Vegas Mountain Range flows across an alluvial fan in a southerly direction and is intercepted by a Union Pacific Railroad line and Interstate 15. After crossing these roads, flow is in a general southeasterly direction to the southern portion of Nellis Air Force Base where it joins flows from the Eastern Tributary. Eastern tributary flows begin in the lower portions of the Las Vegas Mountain Range in the Las Vegas Dunes Recreational Lands area just to the northeast of the intersection of Interstate 15 with Las Vegas Boulevard north. Flow from this area is generally to the south or southwest and passes along the eastern border of the Nellis Air Force Base main base area. Here flows combine and flow in a southwesterly direction to the southern portion of Nellis Air Force Base where they join with Western Tributary flows. Combined flows then proceed southward along the Sloan Channel to the ultimate outfall into Las Vegas Wash.

The watershed consists of three distinct regions: the northern and eastern mountainous areas; the central alluvial fan, and; the downstream developed basin. The mountainous areas are rugged and steep with nominal vegetation and high runoff potential. The alluvial fan area is characterized by numerous small incised channels across the steep alluvial fan areas. The

downstream developed areas of the watershed are combinations of residential and commercial developments.

At the transition from the alluvial fan areas to the downstream developed areas lies Nellis Air Force Base. This property is affected by flows from both the Western Tributary and the Eastern Tributary of Range Wash. Nellis is somewhat protected by the presence of Interstate 15, the Union Pacific Railroad, and Las Vegas Boulevard North. Crossings of these streets or railroads concentrate flows and subject the Air Force Base to concentrated flows.

Existing drainage facilities within the Range Wash basin are relatively limited. Sloan Channel improvements are designed and partially constructed. This affords some limited protection to downstream properties. The Vandenberg Channel, immediately downstream of I-15, is another improved section of the channel. Nellis Air Force Base has completed improvements to several segments of the channel in and around the Air Force Base for the protection of Air Force property. Beyond these channel structures, the improvements are generally limited to street and railroad crossing structures which are frequently inadequate to convey the full 100-year flows. The Clark County Regional Flood Control District Master Plan has identified several facilities to control runoff from the Western and Eastern tributaries of Range Wash. These facilities are incorporated into the alternatives evaluated. The facilities proposed in the Regional Flood Control District Master Plan have not been designed or constructed.

CHAPTER II

HYDROLOGY

II - HYDROLOGY

INTRODUCTION

Hydrologic analyses were performed for the Western and Eastern Tributaries of Range Wash upstream of Las Vegas Wash. The purpose of these analyses was to update past hydrologic studies and to develop detailed hydrology for the evaluation and of sizing facilities in the Range Wash watershed.

The Clark County Regional Flood Control District Master Plan developed hydrology for the entire Clark County area including Range Wash. This effort, while comprehensive in scope, was predicated on a number of generalized regional assumptions. These assumptions render the flows developed for individual watersheds inadequate when evaluating site specific facilities.

The U.S. Army Corps of Engineers developed a computer model for the Las Vegas Valley which was based on the Master Plan model. This model refined some of the regional assumptions used in the Master Plan and is more useful in evaluating site specific facilities. The Corp of Engineers model did not provide a sufficient level of discretization, nor did it utilize sufficient detail in representing rainfall losses, to be used without modification in this study.

The following sections present Boyle's approach in the development of a hydrologic model for the Western and Eastern Tributaries of Range Wash including methodologies, assumptions and results of the analyses. The adopted methodologies are based on the Hydrologic Memorandum submitted on March 27, 1989.

MODELING APPROACH

The hydrologic model utilized was the Flood Hydrograph Package (HEC-1) developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center. HEC-1 is a rainfall-runoff event simulation model which uses an interconnected system of hydrologic and hydraulic components to simulate the surface runoff response of a drainage area to precipitation. This package has been used in many previous studies in the Las Vegas Valley, including the Master Plan and the Corps of Engineers Feasibility Study.

The Clark County Regional Flood Control District (CCRFCD) procedure for determining rainfall amounts and distributions was used to develop estimates for the 10-, 25-, 50- and 100-year storms. Hydrometerological Report No. 49 (HMR-49) was used to develop the estimated rainfall for the probable maximum precipitation (PMP) event.

The USDA Soil Conservation Service (SCS) curve number methodology was used to estimate loss rates because it provides a deterministic method based on soil type and cover. The SCS dimensionless unit hydrograph methodology was used to develop runoff hydrographs for predominantly undeveloped subbasins north of Interstate 15 and east of the developed metropolitan area. The kinematic wave overland flow plane methodology was used to generate hydrographs for developed subbasins.

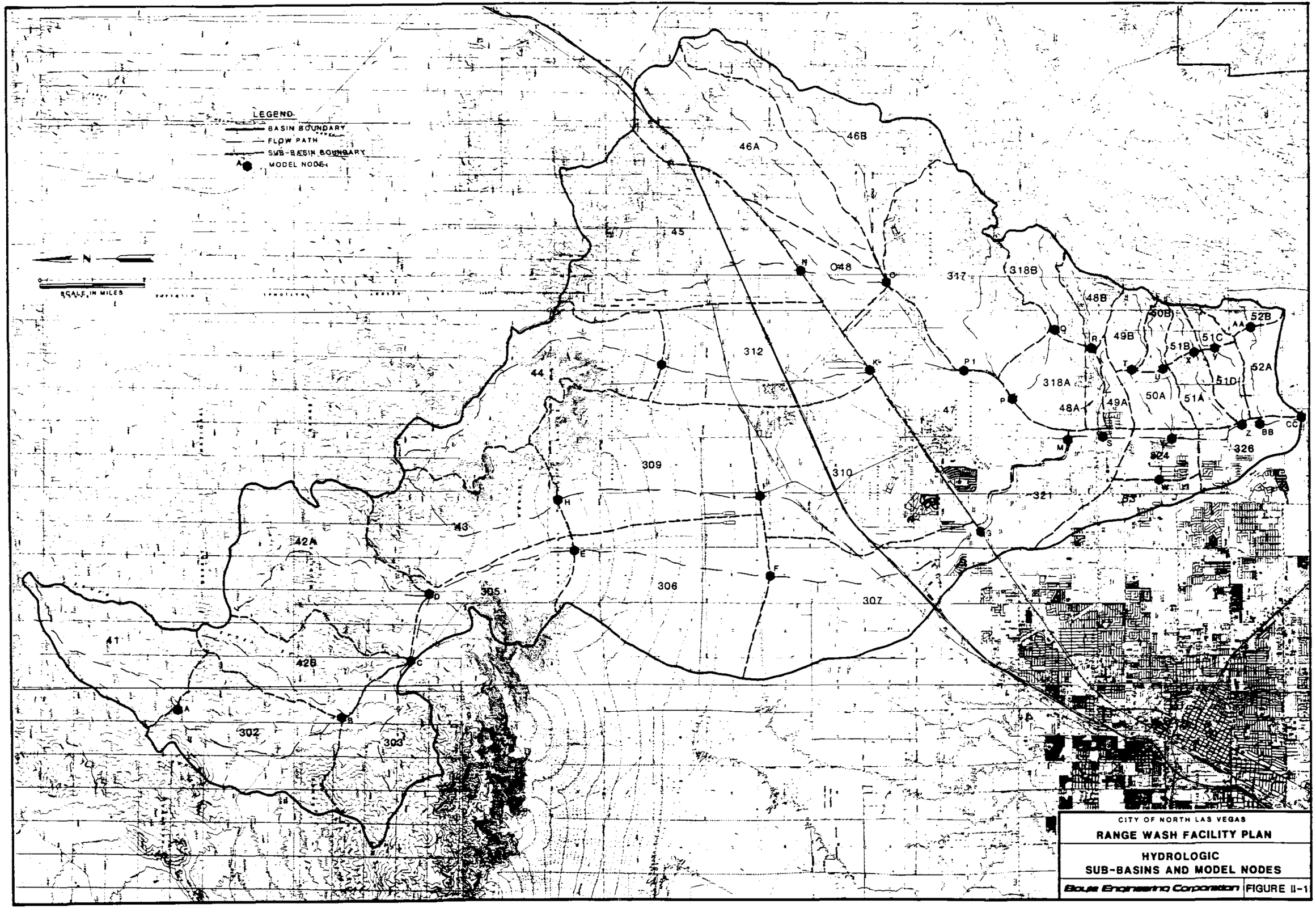
Kinematic wave flood routing was used to route flow along channel segments having well defined channels. The Muskingum method was used for routing flows across alluvial fans and in subbasins with poorly defined or undersized channels. Little attenuation is expected when using the kinematic wave method which is consistent with flow through well defined, adequately sized channels. In other channel reaches, overbank storage effects are considerable and can best be accounted for through use of the Muskingum method.

The model was then calibrated by adjusting the curve numbers through modification of the Antecedent Moisture Condition assumptions until the regionally-calibrated Corps of Engineers computed probability discharge estimates were achieved.

BASIN CHARACTERISTICS

Subbasin Delineation

The watershed was delineated and subdivided into 38 separate subbasins ranging in area from approximately one-half to ten square miles. The subbasin locations are presented in Figure II-1. Individual subbasin areas, in addition to other information, have been tabulated in Table II-3. Subbasin boundaries and their designation are generally based upon delineations and names used by the Corps of Engineers (COE) Feasibility Study and the CCRFCD Master Plan. Boundaries were adjusted and new subbasins added to provide a more detailed simulation of watershed response.


LEGEND
BASIN BOUNDARY
FLOW PATH
SUB-BASIN BOUNDARY
MODEL NODE
N
SCALE, IN MILES
41
42A
42B
43
44
45
46A
46B
47
48A
48B
49A
49B
50A
50B
51A
51B
51C
51D
52A
52B
302
303
305
306
307
309
310
312
317
318A
318B
321
324
326
A
B
C
D
E
F
G
H
K
M
O48
P
P1
Q
R
S
T
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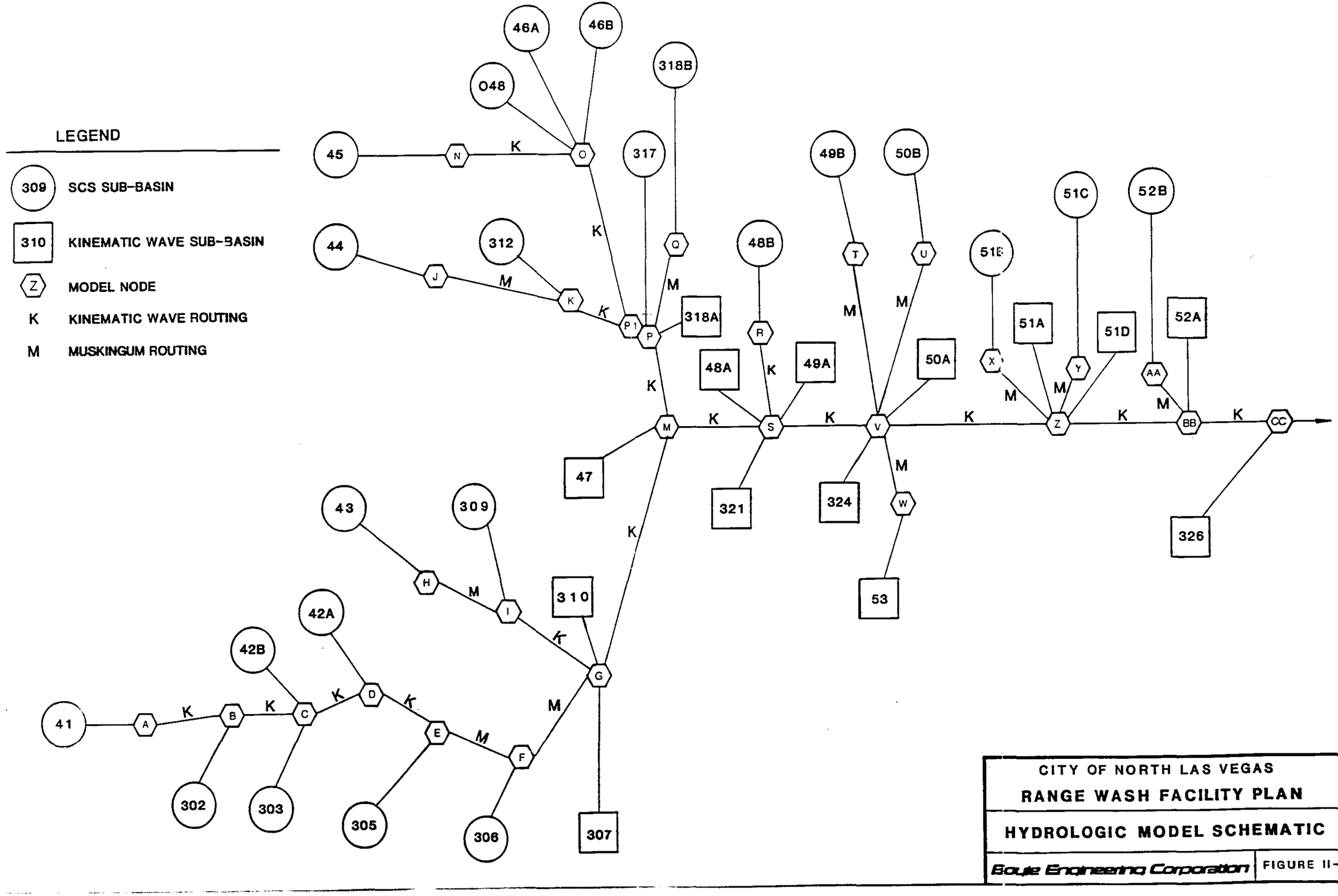
W
X
Y
Z
AA
BB
CC
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
HYDROLOGIC
SUB-BASINS AND MODEL NODES
Boyle Engineering Corporation
FIGURE II-1

Hydrologic points of interest (nodes) such as confluences, possible structure locations and outfall points were identified. A schematic diagram of the subbasins, nodes and routing links is presented in Figure II-2.

Precipitation

Point precipitation values were obtained for the 10-, 25-, 50-, and 100-year recurrence interval storms using the NOAA Atlas 2, "Precipitation - Frequency Atlas of the Western United States, Volume VII - Nevada", (NOAA Atlas) as presented in the Draft Rainfall for the Clark County Regional Flood Control District Area manual (Draft CCRFCD manual). Table II-1 lists the NOAA point precipitation values for each recurrence interval storm by subbasin.

In accordance with procedures outlined in the Draft CCRFCD Manual, point precipitation values were modified to account for rainfall records not available at the time of NOAA Atlas publication. The COE, Los Angeles District (LACOE) developed ratio adjustments for various recurrence intervals which were used to modify the NOAA values to arrive at the point rainfall values used as the basis for model simulation precipitation. The ratios are listed in Table II-2.



CITY OF NORTH LAS VEGAS

RANGE WASH FACILITY PLAN

HYDROLOGIC MODEL SCHEMATIC

Boyle Engineering Corporation | FIGURE II-2

TABLE II-1

NOAA ATLAS POINT PRECIPITATION BY SUBBASIN
(inches)

Subbasin ID	Recurrence Interval 10-YR	25-YR	50-YR	100-YR
41	1.65	1.95	2.20	2.40
302	1.60	1.85	2.10	2.30
42A	1.50	1.75	2.00	2.20
42B	1.50	1.80	2.00	2.20
303	1.45	1.70	2.00	2.15
305	1.35	1.60	1.80	2.00
43	1.40	1.60	1.80	2.00
44	1.40	1.60	1.80	2.00
306	1.30	1.60	1.80	2.00
309	1.30	1.60	1.80	2.00
312	1.35	1.60	1.80	2.00
451	1.40	1.70	1.90	2.00
46A	1.45	1.75	1.90	2.10
46B	1.45	1.75	1.90	2.10
O48	1.40	1.70	1.80	2.00
307	1.30	1.60	1.80	2.00
310	1.30	1.60	1.80	2.00
47	1.40	1.70	1.80	2.00
317	1.50	1.80	2.00	2.20
321	1.30	1.60	1.80	2.00
53	1.50	1.60	1.80	2.00
318	1.45	1.75	1.95	2.05
318B	1.50	1.85	2.00	2.20
48A	1.40	1.75	1.90	2.05
48B	1.50	1.80	2.00	2.10
49A	1.40	1.70	1.90	2.00
49B	1.40	1.80	1.95	2.05
324	1.35	1.65	1.85	2.00
50A	1.40	1.70	1.90	2.00
50B	1.40	1.80	2.00	2.10
51A	1.40	1.70	2.00	2.05
51B	1.40	1.75	1.90	2.00
51C	1.40	1.75	2.00	2.05
51D	1.40	1.65	1.90	2.00
52A	1.40	1.65	1.90	2.00
52B	1.40	1.70	1.95	2.00
326	1.35	1.60	1.80	2.00

TABLE II-2

PRECIPITATION-FREQUENCY ADJUSTMENT RATIOS

Recurrence Frequency	Ratio to NOAA Atlas
2-year	1.000
5-year	1.161
10-year	1.241
25-year	1.328
50-year	1.387
100-year	1.430

Temporal and Areal Rainfall Distribution

The 6-hour design storm duration was chosen for modeling purposes. This storm duration represents the local storm generally accepted for detention facility sizing and, because of the rainfall distribution, also results in acceptable peak flow estimates.

Five different storm distributions, each assigned a Storm Distribution Number (SDN), have been developed by the LACOE. The appropriate SDN was utilized based on the size of the contributing drainage area and storm recurrence interval. SDN 5, the least intense distribution, was used for all analyses since even the partial basin simulations included a drainage area consistent with the SDN 5 distribution assumption.

The rainfall depths listed in Table II-1 represent NOAA point rainfall values. The NOAA point rainfall values were increased to reflect the Table II-2 ratios and further adjusted to areal rainfall values using Depth Area Reduction Factors (DARF) from the CCRFCD manual for each specific storm areal extent and location.

Several rainstorms were evaluated to estimate peak flows from storms of different areal extent located over different portions of the basin. The DARF was adjusted to reflect tributary subbasins and only appropriate sub-basins were modeled in each storm simulation. To

represent a rainstorm over the entire basin, "Total Basin Storm", a DARF equal to 0.62 was used to reduce the point precipitation values over all subbasins. This storm also was used to simulate peak flows at the confluence of the Eastern and Western tributaries.

The "Upland Storm" simulation represents a rainstorm over the upland part of the basin which is tributary to the proposed detention facility sites identified in the Master Plan for each tributary. This consists of the currently undeveloped portion of the basin. This area is also above the probable development limits and is expected to remain largely undeveloped due to the mountainous terrain. A DARF of 0.72 was used in the simulation to adjust rainfall in each tributary above the identified detention basin sites.

The "Tributary Basin Storm" represents a storm located over each tributary. A DARF of 0.68 was used for this simulation and represents rainfall over each tributary basin individually. This storm is intended to represent the maximum flows in each tributary and can be used to determine the temporal distribution of runoff from each tributary.

The final storm "Lower Basin Storm" represents a rainstorm over the lower portion of the basin. This area is subject to intense development and potentially high unit runoff. For this simulation, it was assumed that no rainfall occurs in the upper portion of the basin and that the lower watershed is the only contributor of runoff. A DARF of 0.69 was used to simulate this storm.

Figure II-3 presents the coverage of the various storms in a schematic manner.

Probable Maximum Precipitation

The probable maximum precipitation estimate was determined using HMR-49, titled "Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages", prepared by the U.S. Department of Commerce and the U.S. Department of Army, reprinted in 1984. The local storm procedure was used to develop the amounts and distribution for the 6-hour probable maximum precipitation (PMP) for both 40 square-mile basins above the two identified detention facility sites. The 6-hour precipitation of 10.35 inches was applied to each subbasin in the probable maximum flood (PMF) analysis.

RANGE WASH
STORM SCHEMATIC

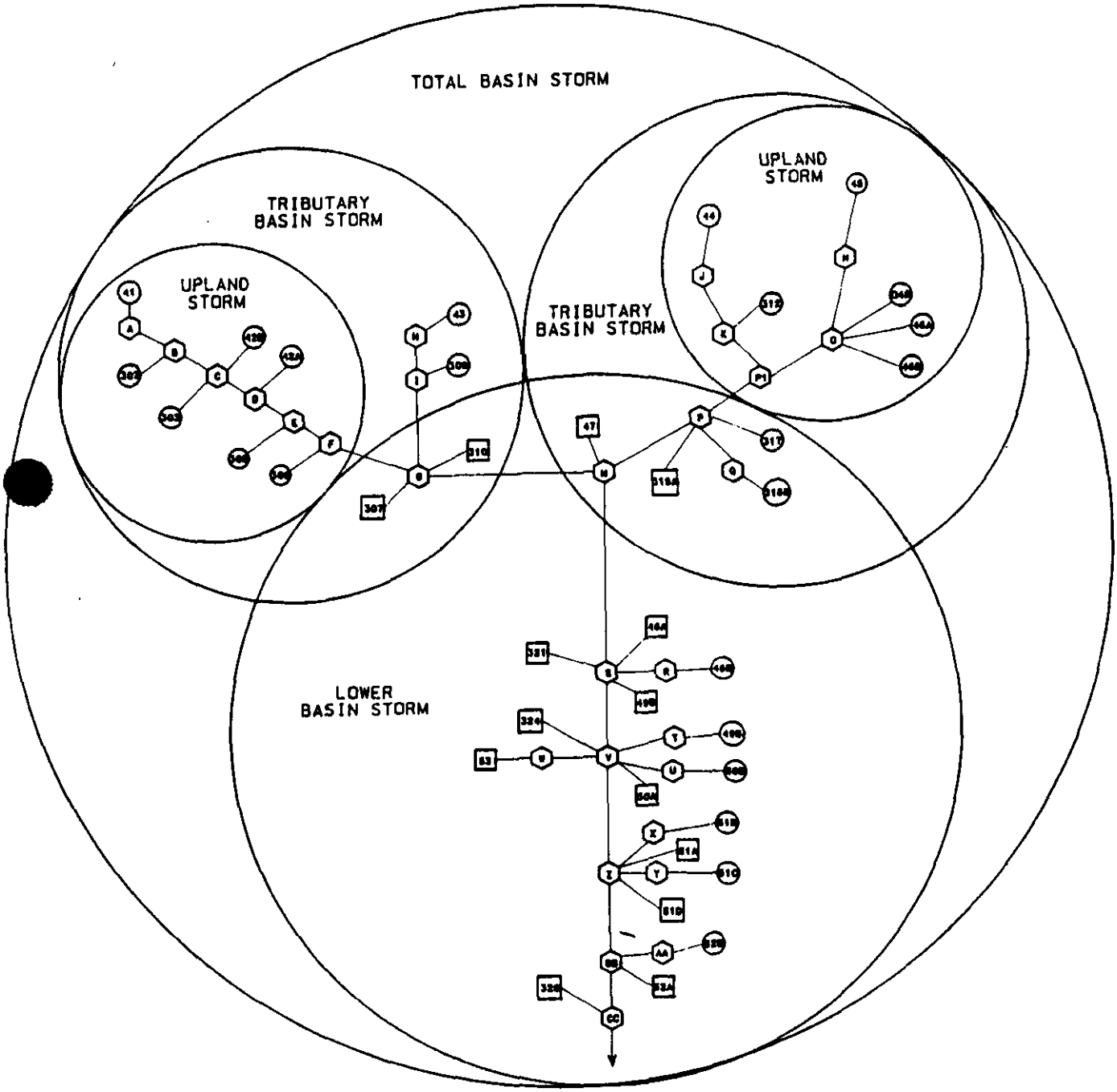


FIGURE II-3

SUBBASIN INPUT PARAMETERS

Curve Numbers and Loss Rates

Vegetative interception, depression storage, and infiltration are collectively referred to in the HEC-1 model as precipitation losses. The SCS curve number method was selected for use in estimating those losses. In this method, losses are related to the drainage characteristics of the soil and the land cover using the curve number, and are a function of the rainfall depth at each time step. Curve numbers were assigned to each subbasin based upon their predominant soil type, land use, type and quality of vegetation, and degree of development. The hydrologic soils group for the soils within the watershed are depicted on Figure II-4. These curve numbers represent runoff conditions assuming antecedent moisture condition (AMC) 2, the average condition. AMC 2 curve numbers for each subbasin are presented, along with other parameters, in Table II-3.

For subbasins modeled using the SCS Unit Hydrograph procedure, AMC 2 curve numbers were assigned using hydrologic soil group and cover information provided by Clark County SCS personnel. Composite subbasin curve numbers were developed using a weighted average of individual curve numbers representing different soil types and covers. It was assumed that vegetative cover was "open brush" in fair to poor condition for all undeveloped subbasins which were modeled using this procedure. The resulting curve numbers are consistent with other common cover types such as desert shrub.

Curve numbers (AMC 2) for developed areas were assigned using guidelines in "Urban Hydrology for Small Watersheds" (TR-55) by the Soil Conservation Service. Curve number for the kinematic wave basins were assigned using a procedure similar to that used in the SCS subbasins. For pervious areas, a composite curve number was developed using a weighted average of individual curve numbers for different soil types and, vegetation types and, densities.

The impervious percentage of each subbasin was estimated based on the degree and type of development. For SCS Unit Hydrograph subbasins, the impervious area was used in the development of the composite subbasin curve number. This method was chosen over entering the percent impervious in the model since the SCS Unit Hydrograph methodology assumes impervious areas are directly connected to the outfall and produce instantaneous runoff. In the watershed, the impervious areas are distributed and frequently flow across pervious lands. Modifying the curve number more uniformly distributes the impervious areas over the entire

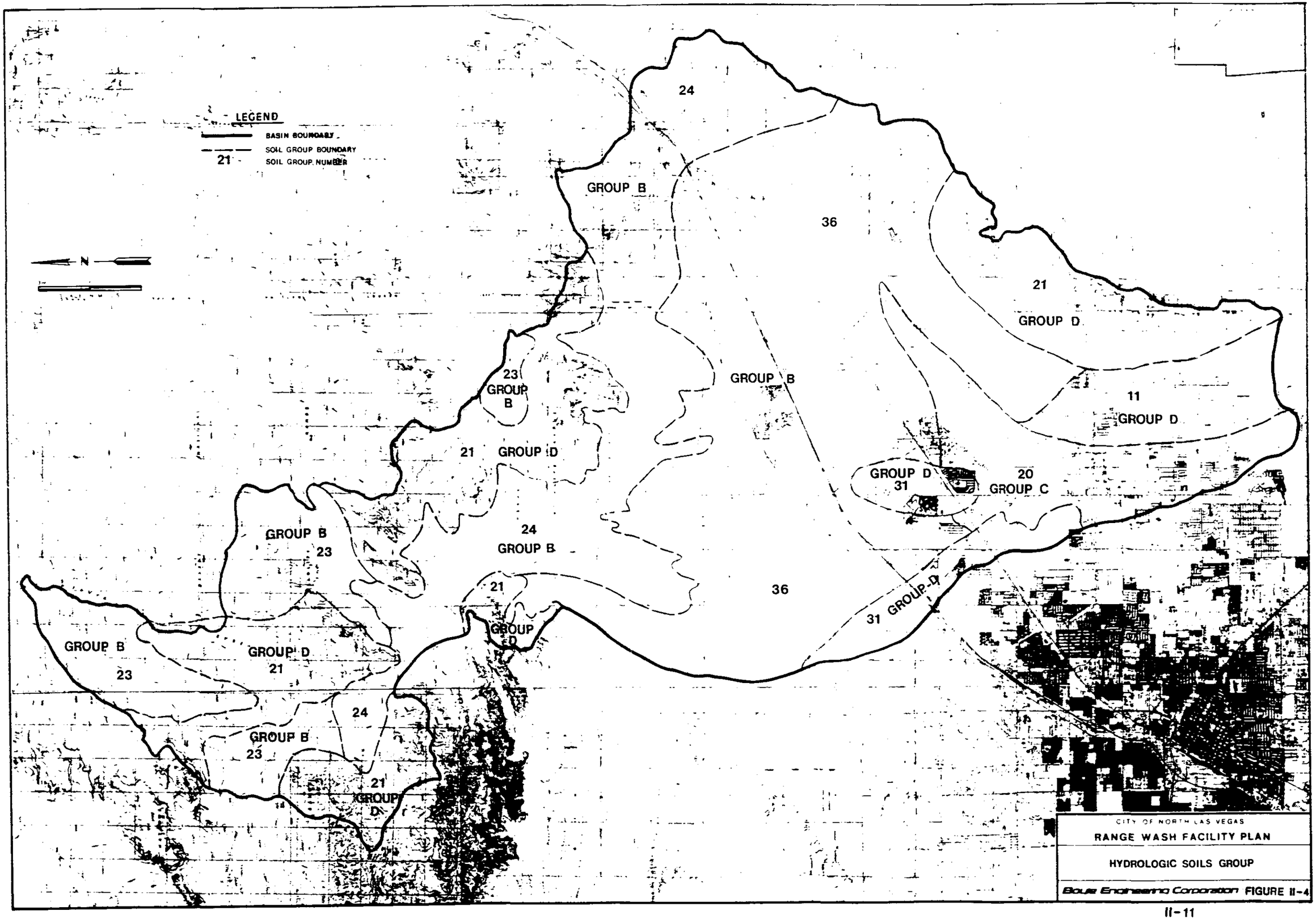

LEGEND
BASIN BOUNDARY
SOIL GROUP BOUNDARY
21 SOIL GROUP NUMBER
N
24
GROUP B
36
21
GROUP D
23
GROUP B
GROUP B
11
GROUP D
21 GROUP D
GROUP D
31
20
GROUP C
GROUP B
23
24
GROUP B
21
GROUP D
36
31 GROUP D
GROUP B
23
GROUP D
21
24
GROUP B
23
21
GROUP D
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
HYDROLOGIC SOILS GROUP
Boyle Engineering Corporation FIGURE II-4

TABLE II-3

SUBBASIN HYDROGRAPH PARAMETERS

Subbasin Number	Area (Sq.Mi.)	Runoff Method	PRESENT CONDITIONS Imperv. (%)	PRESENT CONDITIONS AMC 2 Curve Number	PRESENT CONDITIONS LAG (hr)	FUTURE CONDITIONS Imperv. (%)	FUTURE CONDITIONS AMC 2 Curve Number	FUTURE CONDITIONS LAG (hr)
41	4.73	SCS	0	79	.66	0	79	.66
302	6.14	SCS	0	79	.82	0	79	.82
42 A	8.23	SCS	0	79	.81	0	79	.81
42 B	4.08	SCS	0	79	.65	0	79	.65
303	4.49	SCS	0	85	.54	0	85	.54
305	3.99	SCS	0	85	.76	0	85	.76
43	6.40	SCS	0	79	.88	0	79	.88
44	7.23	SCS	0	79	1.22	0	79	1.22
306	9.04	SCS	0	76	2.00	0	83	1.61
309	9.24	SCS	0	79	1.51	0	79	1.51
312	6.77	SCS	0	77	2.83	0	77	2.83
45	10.73	SCS	0	76	1.31	0	76	1.31
46 A	7.35	SCS	0	77	1.60	0	77	1.60
46 B	6.02	SCS	0	77	1.71	0	77	1.71
048	2.07	SCS	0	76	1.97	0	76	1.97
307	8.07	Kin	11	78	--	49	77	--
310	9.14	Kin	11	78	--	32	77	--
47	7.40	Kin	26	78	--	31	77	--
317	7.66	SCS	0	80	.97	0	80	.97
321	3.42	Kin	22	78	--	46	76	--
53	1.44	Kin	30	77	--	44	77	--
318 A	2.19	Kin	11	78	--	26	77	--
318 B	1.86	SCS	0	87	.37	2	87	.37
48 A	.49	Kin	23	78	--	27	77	--
48 B	.99	SCS	0	87	.24	2	87	.24
49 A	.60	Kin	20	78	--	27	77	--
49 B	1.04	SCS	0	87	.25	9	88	.24

TABLE II-3 (continued)

SUBBASIN HYDROGRAPH PARAMETERS

Subbasin Number	Area (Sq.Mi.)	Runoff Method	PRESENT CONDITIONS Imperv. (%)	PRESENT CONDITIONS AMC 2 Curve Number	PRESENT CONDITIONS LAG (hr)	FUTURE CONDITIONS Imperv. (%)	FUTURE CONDITIONS AMC 2 Curve Number	FUTURE CONDITIONS LAG (hr)
324	1.40	Kin	26	77	--	44	77	--
50 A	1.78	Kin	11	78	--	27	77	--
50 B	.55	SCS	0	87	.17	11	88	.16
51 A	.99	Kin	14	78	--	27	77	--
51 B	.47	SCS	0	87	.13	8	88	.12
51 C	.43	SCS	0	87	.19	3	87	.19
51 D	.83	Kin	12	78	--	23	77	--
52 A	1.18	Kin	7	78	--	9	78	--
52 B	.70	SCS	0	87	.11	0	87	.11
326	1.71	Kin	20	78	--	27	77	--

subbasin. For kinematic wave subbasins the actual impervious area percentage is used as an input parameter. An AMC 2 curve number of 98 was used for impervious areas.

Unit Hydrograph Parameters

The SCS Unit Hydrograph runoff option in HEC-1 requires input of the SCS lag, which is equal to the time in hours between the center of mass of rainfall excess and the peak of the unit hydrograph.

The SCS curve number method, as presented in the SCS National Engineering Handbook, Section 4 - Hydrology, was used for calculating lag time. In this method, lag time is a function of the hydraulic length, the slope of the watershed, and the subbasin curve number. The following equation was used to calculate subbasin lag times:

$$L = \frac{l^{0.8}\,(s + 1)^{0.7}}{1900\,Y^{0.5}}$$

Where:

L	=	lag in hours	
l	=	hydraulic length of watershed in feet	
s	=	$\frac{1000}{CN} - 10$	where CN is the subbasin curve number
Y	=	*average watershed land slope in percent.*	

This equation was used to represent basin lag rather than other equations (e.g. the COE lag equation) because of its application to generally undeveloped subbasins. The COE method, provided comparable lag times in the upper watersheds but resulted in significantly shorter lag times in the flat undeveloped subbasins on the fan. The SCS equation, having been developed for flatter agricultural and range lands, was more representative for use in this study. Developed subbasins for which the SCS equation may not be as applicable are modeled using the kinematic wave overland flow methodology which does not require the input of lag times.

Values for l and Y were determined from USGS 7.5 minute quadrangle maps. Table II-3 presents the calculated lag time.

Kinematic Wave Parameters

For determination of subbasin runoff using the kinematic wave option in HEC-1, information is required about overland flow planes, collector channels and a main channel. Both pervious and impervious overland flow elements are provided to represent runoff from the subbasin area. Sub-collectors, collectors, and the main channel represent the drainage network in the subbasin. For subbasin runoff generation, basin area, percentage of the area that is impervious, and the length, slope and roughness of pervious and impervious overland flow planes are required input. Percent impervious for each subbasin is presented in Table II-3. Runoff from these flow planes is routed through the drainage network. Parameters used for routing are channel length, slope, roughness, cross-sectional geometry and the contributing area to a typical sub-collector or collector. The kinematic wave parameters were estimated from the USGS 7.5 minute quadrangle maps.

In general, the impervious areas were modeled as having an overland flow length of approximately 50 feet for residential development, to reflect flow length from roof to street flow-line, and 300 feet in commercial and industrial developments, which represents significant parking lot overland flow. A roughness coefficient of 0.1 was used to represent shallow overland flow across impervious areas.

Pervious surface overland flow lengths range between 600 and 800 feet and reflect lawn flow in developed areas or overland flow prior to gully formation in undeveloped areas. A roughness coefficient of 0.2 was used for undeveloped areas and 0.3 for developed lawn areas.

Collector systems in undeveloped areas consisted of small washes. These were modeled in a manner consistent with COE's model using small trapezoidal sections. Developed area collector systems included street sections or improved channels and were modeled to represent actual physical geometry.

FLOOD ROUTING

The kinematic wave flood routing option was used for routing links having well defined, adequate channels. This assumes that there is little floodplain or channel storage and that slopes are steep resulting in the energy grade line slope equalling the ground slope. In areas where this assumption is not appropriate, particularly across the alluvial fan and in developed areas where the drainage system is undersized, the Muskingum storage routing method is

used. This method assigns a storage factor to account for the expected attenuation of flows. This study uses the COE values as initial estimates with modification to reflect changes in subbasin delineation and character. Values range from 0.15 for channel reaches across the fan which have some storage in the overbank but few obstructions, to 0.10 for inadequate channels in developed basins where overbank flows would encounter numerous obstructions and consequently be significantly attenuated.

Kinematic Wave Flood Routing

The kinematic wave approach to channel routing requires the estimation of channel lengths, slopes, average bottom widths, side slopes, and Manning's "n" values. Channel lengths and slopes were estimated from the USGS 7.5 minute quadrangle maps. Average bottom widths, side slopes and "n" values were estimated from mapping, construction drawings, former studies and observations. Length and slope for each routing link, including Muskingum reaches, are presented in Table II-4.

Muskingum Flood Routing

The Muskingum approach to flood routing requires estimation of coefficients that reflect flood wave travel time and channel storage. The "K" factor which approximates flood wave travel time was estimated by the COE in their Feasibility Study. This value is dependent upon length, computational interval and estimated velocity. The "X" values were assigned based on the relative importance of channel storage, with 0.10 for significant storage and 0.15 for lesser degrees of storage. X values for each routing link are presented in Table II-4.

TABLE II-4

ROUTING PARAMETERS

ROUTING LINK	ROUTING METHOD	DISTANCE (feet)	SLOPE (feet/feet)	MUSKINGUM "X"
A-B	Kin	19100	.0455	--
B-C	Kin	9910	.0504	--
C-D	Kin	7000	.0571	--
D-E	Kin	16200	.0414	--
E-F	Musk	20100	.0398	.10
F-G	Musk	32550	.0106	.10
H-I	Musk	20700	.0360	.10
J-K	Musk	21200	.0244	.15
I-G	Kin	24000	.0118	.15
G-M	Kin	15800	.0035	--
N-O	Kin	9550	.0157	--
K-P	Kin	17400	.0052	--
O-P	Kin	18600	.0051	--
Q-P	Musk	8100	.0290	.15
P-M	Kin	7400	.0034	--
R-S	Kin	9100	.0316	--
M-S	Kin	4600	.0028	--
T-V	Musk	8600	.0214	.10
U-V	Musk	7200	.0269	.10
W-V	Musk	6000	.0010	.10
S-V	Kin	6800	.0038	--
X-Z	Musk	8900	.0299	.10
Y-Z	Musk	9000	.0229	.10
V-Z	Kin	7780	.0041	--
AA-BB	Musk	10300	.0206	.10
Z-BB	Kin	2680	.0045	--
BB-CC	Kin	4000	.0055	--

BASIN DEVELOPMENT

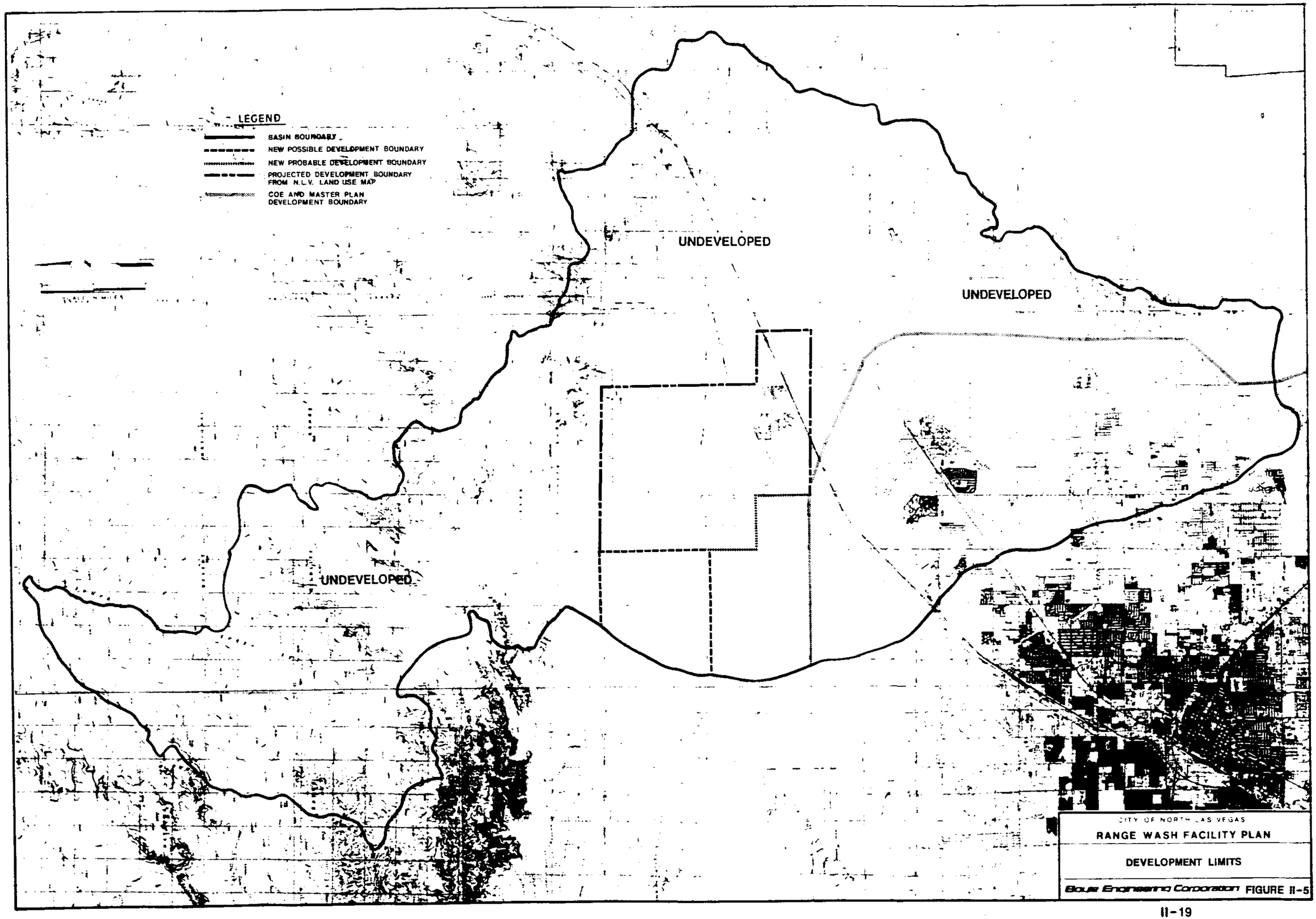
The hydrologic analysis was performed for both existing basin development and future basin development. Existing conditions reflect present land use and development currently underway. This level of development is generally unchanged from that presented in the Master Plan.

Future conditions refers to the projected extent of development within the Study Area by the year 2055. It represents ultimate development as foreseen today. The boundary of future development was determined using projections from several sources. The boundary used by the COE in their Feasibility Study was adjusted using information from the City of North Las Vegas's Land Use Plan and the Economic Development Department regarding areas of future development in and around the City. COE development limits and those used in this study are shown on Figure II-5. Zoning information from the Clark County Comprehensive Planning Department was used to identify the type and extent of future development.

Future Basin Model

Using the information regarding future land use type and extent, estimates were made of the future amounts of impervious surface, future curve numbers, and changes to the kinematic wave runoff parameters. Future development will increase the amount of impervious surface within a subbasin. The SCS unit hydrograph methodology was selected for basins that would remain generally unchanged after development and therefore model changes were generally nominal and resulted in minor, or no, changes in the curve number. For subbasin 306, the future development scenario calls for virtually full development of a currently undeveloped basin. Runoff characteristics of this basin changed considerably reflecting the significant change between the present and future condition.

In kinematic wave subbasins, increased development resulted in an increase in the percentage of the basin modeled as impervious. In some cases, when the dominant type of development charged, the overland flow characteristics were also changed to reflect altered flow lengths and flow characteristics. Where there was a significant degree of development proposed in a watershed, the pervious area curve number was adjusted downward to reflect a better vegetative cover which would result from improved watering and maintenance. Table II-3 presents the future percent imperviousness and curve numbers.


LEGEND
BASIN BOUNDARY
NEW POSSIBLE DEVELOPMENT BOUNDARY
NEW PROBABLE DEVELOPMENT BOUNDARY
PROJECTED DEVELOPMENT BOUNDARY FROM N.L.V. LAND USE MAP
COE AND MASTER PLAN DEVELOPMENT BOUNDARY
UNDEVELOPED
UNDEVELOPED
UNDEVELOPED
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
DEVELOPMENT LIMITS
Boyle Engineering Corporation
FIGURE II-5

CALIBRATION

Comparison with Past Studies

Prior to calibration, simulation was performed for the 100-year storm using the parameters as discussed above for the present and future development conditions. The resultant peak flows at the Range Wash Outfall to Las Vegas Wash were 10,880 cfs and 11,380 cfs for the present and future conditions respectively. Table II-5 presents a comparison of Boyle's initial peak flows at the Range Wash Outfall with those simulated by the COE in both their Computed and Expected Probability analyses, and with those from the CCRFCD Master Plan.

The Eastern and Western Tributaries of Range Wash and Range Wash itself are ungaged streams. There is little historical data available for use in calibrating peak flows in a computer model. There are however, several earlier hydrologic studies which attempted to utilize regional calibrated flood events. The most extensive historical and regional analysis was done by the COE as part of their Feasibility Study. The COE conducted an analysis of 36 stations in the California-Nevada desert area with record lengths of greater than 10 years. Using a flood-flow frequency analysis on this data, they developed a regional 100-year peak flow versus drainage area relationship for the Las Vegas Valley. The result of this analysis is a curve which provides a generally accepted range of flow for larger areas. While this curve lumps several hydrologically different watersheds together, the curve does represent an estimate against which to check the reasonableness of values determined via modeling. Values from this curve are presented in Table II-5 as the Regional Curve Unit Peak Flow.

The COE used the earlier Master Plan model framework as the basis for their computer modeling of the Las Vegas Valley. They developed both Expected and Computed Probability discharge estimates, each based on separate and different statistical assumptions about the data and their reliability. Local governments in the Las Vegas Valley have adopted the Computed Probability estimated flows for regulation purposes within their jurisdictions.

As Table II-5 demonstrates, Boyle's initial peak flow estimates fall between the COE's Expected and Computed Probability estimates and correlate well with the COE regional curves.

TABLE II-5

COMPARISON OF INITIAL SIMULATION RESULTS RANGE WASH OUTFALL

Drainage Study and Point of Comparison	Drainage Area (sq. mi.)	Estimated Peak Flow (cfs)	Calculated Unit Peak Flow (cfs/sq. mi.)	Regional Curve Unit Peak Flow (cfs/sq. mi.)
Initial Boyle Node CC - present	150.8	10880	72	70
Initial Boyle Node CC - future		11380	75	70
COE-C CP1 - present	156.3	8000	51	70
COE-C CP1 - future		8350	53	70
COE-E CP1 - present	156.3	12000	77	70
COE-E CP1 - future		12500	80	70
M.P. RW-326	156.3	16410	105	70

"Initial Boyle" refers to this study before calibration.

"COE-E" refers to Corps of Engineers Feasibility Study, Expected probability flows.

"COE-C" refers to Corps of Engineers, Special Flood Hazard Study, Computed probability flows.

"M.P." refers to CCRFCD Master Plan, Ultimate Development Flows.

In evaluating the differences between the study results presented in Table II-5, several factors appear to be relevant. First, the input parameters for the COE study and Boyle's study are based on many of the same physical assumptions. Routing parameters, subbasins, and routing structure are very similar. The approaches used to model loss rates, however, are different. The COE feasibility study used a constant loss rate whereas Boyle used the SCS curve number method. This has the effect of moderating Boyle's subbasin peak flows since peak losses occur at the time of peak rainfall rather than being constant. Boyle's model also provides a more site specific representation of factors affecting runoff peaks than does the COE model.

Another significant difference in the simulation efforts is the rainfall used in the models. The COE and Boyle used different depth area reduction factors to modify the point precipitation. COE used a DARF developed by their meteorologists which results in a divergence of rainfall

amounts for areas over 100 square miles. This DARF curve is inconsistent with the curve presented in HYDRO-40 which is the generally accepted methodology within the Las Vegas Valley. For comparative purposes, Boyle used the COE DARF in the initial model developed for this study and achieved results comparable to the COE computed probability values.

Calibration

The COE calibrated their expected and computed probability model to the peak flow estimates developed from a statistical evaluation of regional gages. This approach forced COE to utilize the same constant loss rate throughout the Valley regardless of soil type or cover.

Calibration of Boyle's model to the COE computed probability peak flows was accomplished in a manner comparable to that used by COE. The Antecedent Moisture Condition (AMC) reflected in the curve numbers was adjusted, thereby effectively changing the losses throughout the watershed. This results in a match of the target computed probability value while maintaining the models ability to reflect varying basin soil and cover characteristics. Curve numbers used in the calibrated present development condition model represent an AMC of 1.8. Calibrated curve numbers are presented in Table II-6. A curve number of 97 was used for impervious areas rather than the 98 used in the initial model.

The projected limits of future development differ between the COE model and Boyle's model. In order to calibrate the Boyle future development model, the future development limit used in the COE model was modeled in Boyle's model. The curve numbers were adjusted by AMC revision until the peak flow at the outfall matched the COE Computed Probability estimate. Calibration of the future condition model resulted in the use of curve numbers representing an AMC of 1.8. The expanded development limits were then introduced into Boyle's model to reflect the information received from the City of North Las Vegas.

SIMULATION RESULTS

Simulations were performed for the 10-, 25-, 50- and 100-year rainfall events for both present and future levels of development. These simulations were run for the temporal and areal rainfall distributions discussed earlier: 1) DARF of 0.62 for the "Total Basin Storm"; 2) DARF of 0.72 for the "Upland Storm" used to model the tributaries to the Master Plan detention ponds; 3) DARF of 0.68 for the "Tributary Basin Storm" above the confluence of the Eastern and Western tributaries; 4) DARF of 0.69 for the "Lower Basin Storm", and; 5) the PMP. Table II-7 presents

TABLE II-6

CALIBRATED CURVE NUMBERS

Subbasin Number	AMC 2		Calibrated	
	Present	Future	Present	Future
41	79	79	76	76
302	79	79	76	76
42 A	79	79	76	76
42 B	79	79	76	76
303	85	85	82	81
305	85	85	82	81
43	79	79	76	76
44	79	79	76	76
306	76	76	72	80
309	79	79	75	75
312	77	77	73	73
45	76	76	72	72
46 A	77	77	73	73
46 B	77	77	73	73
048	76	76	72	72
307	78	77	74	73
310	78	77	74	73
47	78	77	74	73
317	80	80	76	76
321	78	76	74	72
53	77	77	73	73
318 A	78	77	74	73
318 B	87	87	84	84
48 A	78	77	74	72
48 B	87	87	84	84
49 A	78	77	74	72
49 B	87	88	84	85
324	77	77	73	73
50 A	78	77	74	72
50 B	87	88	84	85
51 A	78	77	72	73
51 B	87	88	84	85
51 C	87	87	84	85
51 D	78	77	72	72
52 A	78	78	74	74
52 B	87	87	84	85
326	78	77	74	72

TABLE II-7

PEAK FLOW AND TOTAL VOLUME FOR PRESENT AND FUTURE DEVELOPMENT

POINT OF INTEREST	DRAINAGE AREA (sq. mi.)	10-YR PEAK (cfs)	10-YR VOL. (af)	25-YR PEAK (cfs)	25-YR VOL. (af)	50-YR PEAK (cfs)	50-YR VOL. (af)	100-YR PEAK (cfs)	100-YR VOL. (af)
UPLAND STORM DARF = 0.72									
West Range Wash Ponding Area (Node F)	40.7								
Present		1500	300	2800	590	4160	920	5600	1250
Future		1690	340	3140	660	4600	1020	6160	1360
East Range Wash Ponding Area (Node P1)	40.2								
Present		560	140	1370	360	2170	570	3000	790
Future		560	140	1370	360	2170	570	3000	790
TRIBUTARY BASIN STORM DARF = 0.68									
West Range Wash Tributary (G-M)	73.6								
Present								6400	1730
Future								7260	2180
East Range Wash Tributary (P-M)	51.9								
Present								3350	1010
Future								3370	1040

TABLE II-7 (continued)

PEAK FLOW AND TOTAL VOLUME FOR PRESENT AND FUTURE DEVELOPMENT

POINT OF INTEREST	DRAINAGE AREA (sq. mi.)	10-YR PEAK (cfs)	10-YR VOL. (af)	25-YR PEAK (cfs)	25-YR VOL. (af)	50-YR PEAK (cfs)	50-YR VOL. (af)	100-YR PEAK (cfs)	100-YR VOL. (af)
ENTIRE BASIN STORM									
DARF = 0.62									
Confluence of East and West Range Wash (Node M)	132.9								
Present		1310	490	3200	1100	5380	1720	7700	2390
Future		1940	820	3700	1410	5950	2080	8350	2790
Range Wash Outfall (Node CC)	150.9								
Present		1350	600	3360	1320	5610	2040	8040	2780
Future		2300	1010	3950	1720	6340	2500	8870	3300
LOWER BASIN STORM									
DARF = 0.69									
Range Wash Outfall (Node CC)	54.4								
Present								4340	1480
Future								6330	1950

PROBABLE MAXIMUM PRECIPITATION		PEAK (cfs)	Vol. (af)
West Range Wash	40.7	105000	17000
East Range Wash	40.2	67900	16000

the resulting peak discharges and volumes for the identified points of interest on East Range Wash, West Range Wash, their confluence and the Range Wash Outfall. The simulated 100-year peak discharges at the Range Wash Outfall for the present and future development conditions, respectively, are 8,040 and 8,870 cfs. Figures II-6 through II-9 present graphical representation of the 100-year present and future development hydrographs.

SEDIMENT YIELD ANALYSIS

Methodology

The sediment yield analysis of the Range Wash Study Area was performed using the Pacific Southwest Interagency (PSIA) methodology. This methodology is intended for broad planning purposes rather than specific project planning. The PSIA methodology considers climate and physical factors of the area, as well as evidence of past erosion, to determine a sediment yield classification for the area in question. The factors consideration: geology, soils, climate, runoff, topography, ground cover, land use, upland erosion, and channel erosion and sediment transport. The factors are each assigned a numeric value based on information obtained from a rating which is used to estimate unit sediment yield.

Basin Discretization

Three watershed subdivisions were selected for analysis using the PSIA methodology: Western Range Wash tributary to the detention facility identified in the master plan (Node F of the Hydrologic analysis); Eastern Range Wash tributary to the detention facility identified in the master plan (Node P1 of the Hydrologic analysis), and; both Washes above their confluence (Node M of the Hydrologic analysis).

Factors Affecting Sediment Yield

The sediment yield analysis factors are summarized below:

Surface Geology: The exposed rock of the study area is predominantly limestone and dolomite, somewhat fractured and weathered. Rock is only exposed in the steep upland areas.

Soils: Soils of the area are generally very gravely with a distinct erosion pavement. Soil material is fine sandy loam with occasional caliche layers and high percentage of rock

EAST RANGE WASH
UPSTREAM OF SLOAN CHANNEL
100-YR HYDROGRAPH (DARF=.68)

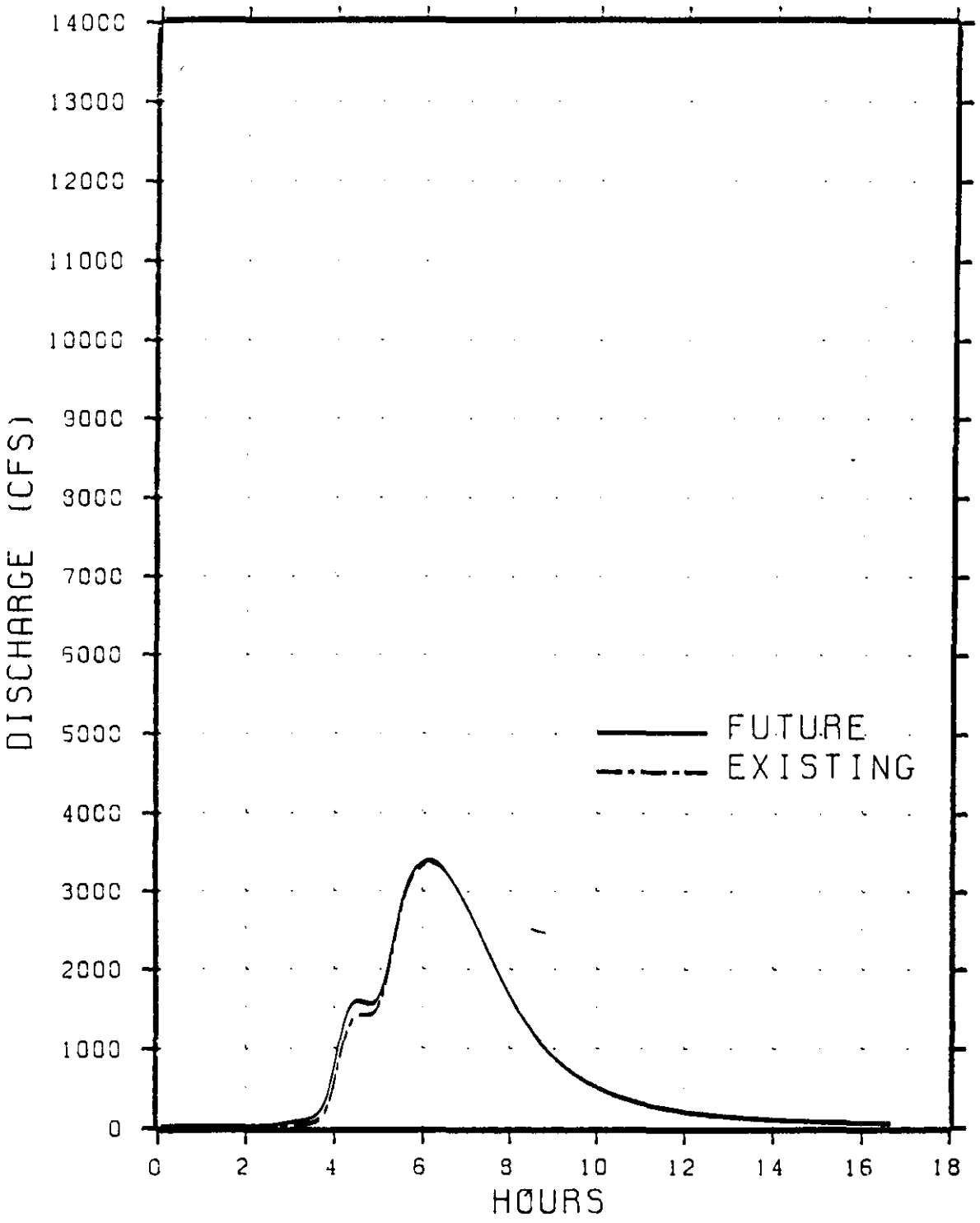


FIGURE II-6

Boyle Engineering Corporation

WEST RANGE WASH
UPSTREAM OF SLOAN CHANNEL
100-YR HYDROGRAPH (DARF=.68)

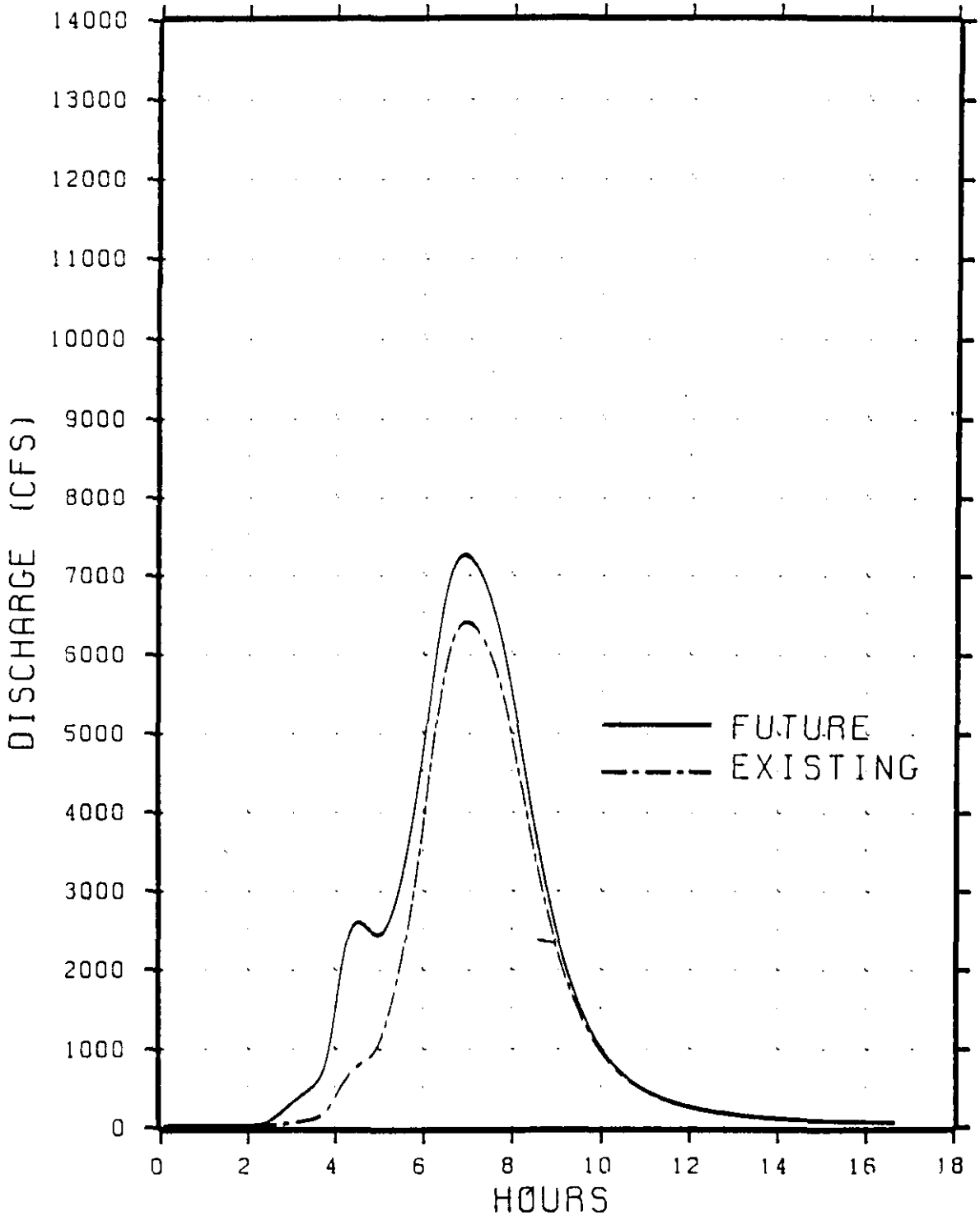


FIGURE II-7

Boyle Engineering Corporation

RANGE WASH OUTFALL
ENTIRE BASIN STORM
100-YR HYDROGRAPH (DARF=.62)

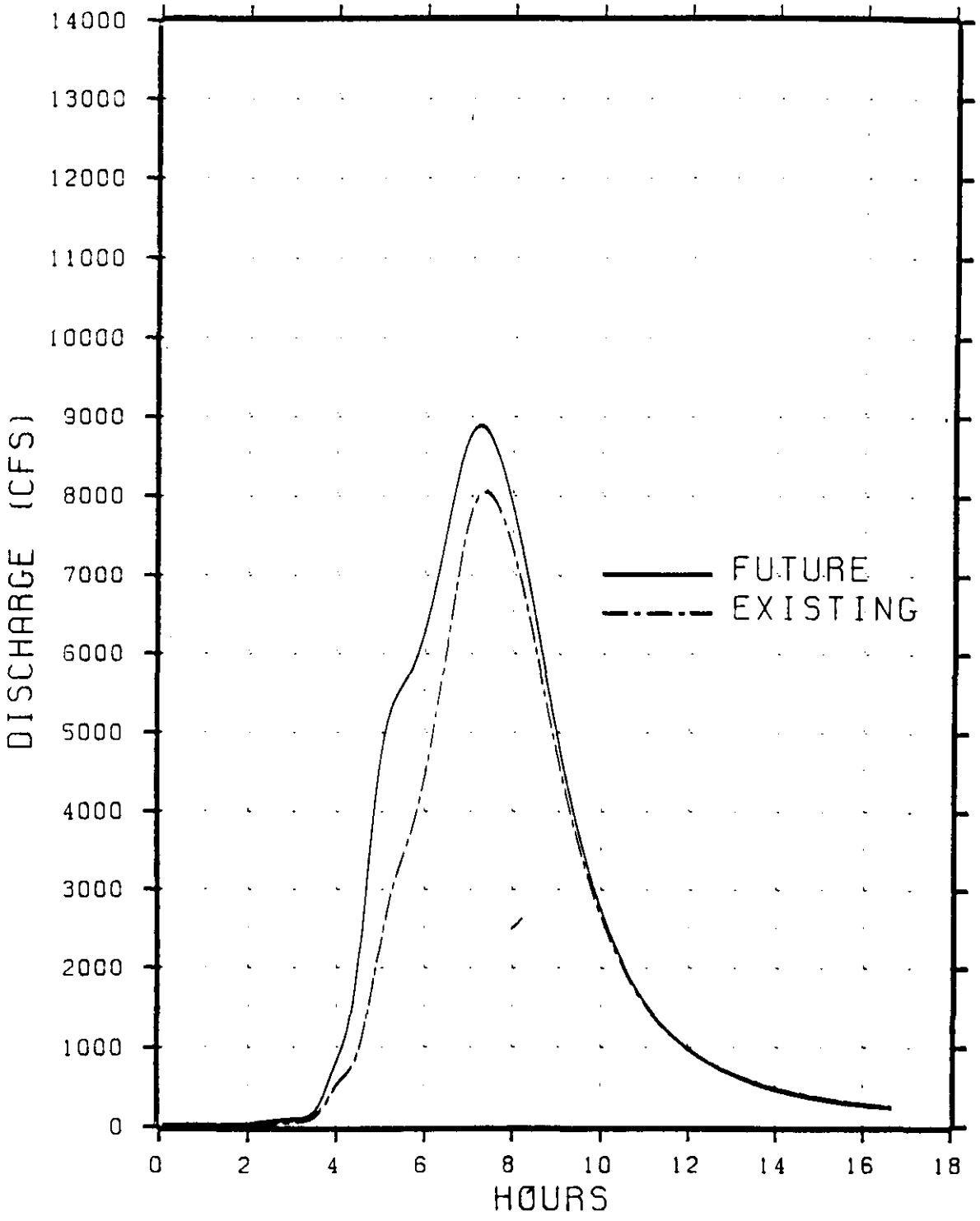


FIGURE II-8

Boyle Engineering Corporation

RANGE WASH OUTFALL
LOWER BASIN STORM
100-YR HYDROGRAPH (DARF=.69)

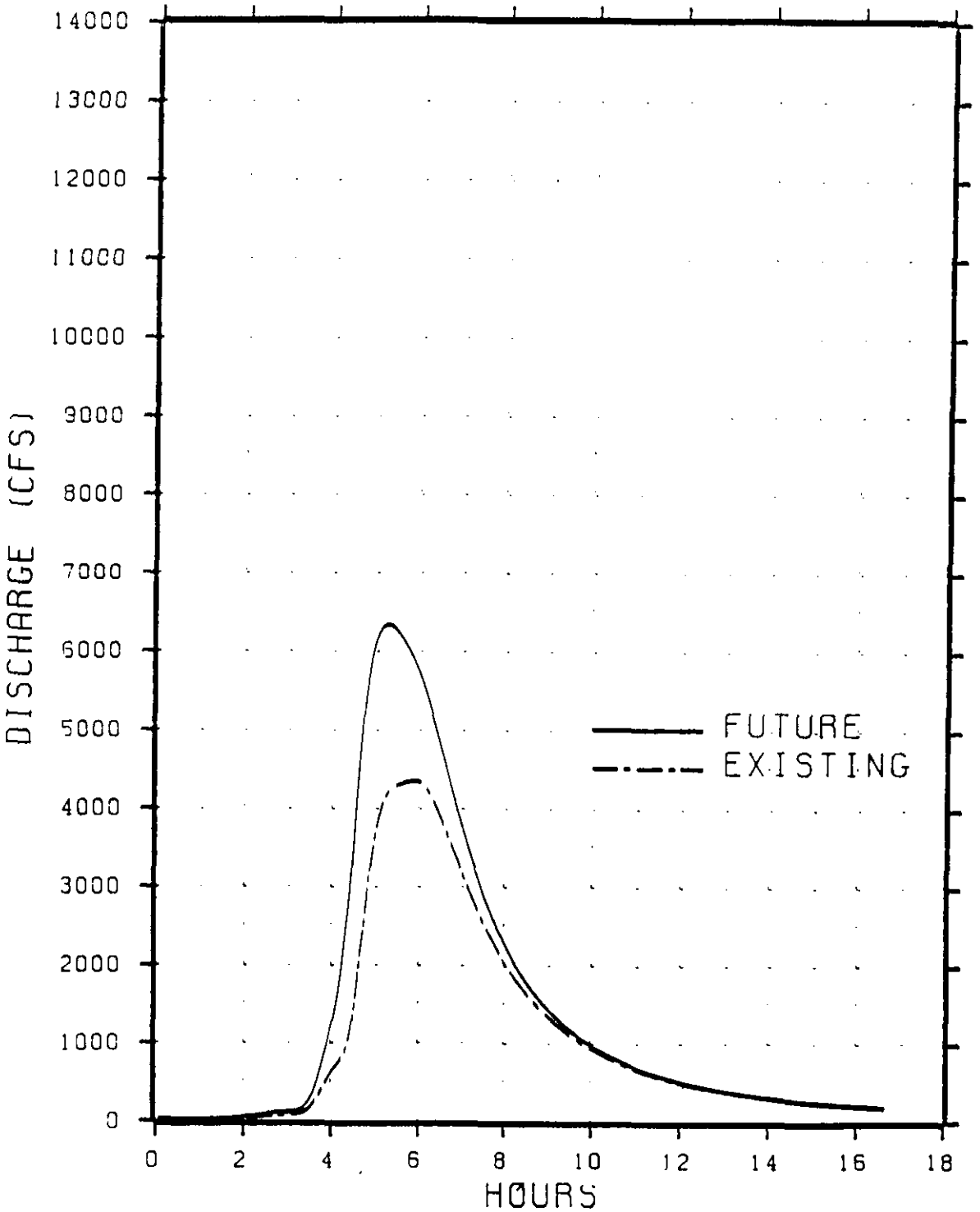


FIGURE II-9

Boyle Engineering Corporation

fragments. A larger extent of caliche was found near the surface in the Eastern Range Wash area than in the western area.

Climate: The Las Vegas Valley has an arid climate with infrequent convective storms and little freeze-thaw occurrence.

Runoff: The Range Wash watersheds produce moderate runoff peak flows and volumes.

Topography: The steep upland slopes have high relief with extensive alluvial fan development at their base. A larger percentage of the western tributary has steep slopes than of the eastern tributary.

Ground Cover: Vegetative ground cover is less than 20 percent. An extensive erosion pavement of rock fragments covers most of the study area.

Land Uses: The majority of the study area is virtually undisturbed except for occasional roads, and mining exploration.

Upland Erosion: The erosion pavement is evidence of upland erosion as are the numerous rills and gullies on the alluvial fans.

Channel Erosion and Sediment Transport: Eroding channel backs are evident where flow is collected either naturally or by man caused means (e.g., roads). Flow is intermittent and of short duration. The eastern tributary is channelized to a slightly higher degree than the western tributary area. The fan above the western ponding area has no well defined channel.

Results

The factors described above were assigned a numeric value representing their relative contribution to the sediment yield of the part of the basin in question. These numeric values were summed and a rating was established. Using curves provided by the PSIA methodology, a unit sediment yield was estimated.

Table II-8 presents a summary of the numeric values assigned to each analysis factor and an estimate of the total average annual sediment production which can be expected at each point of interest.

TABLE II-8

SEDIMENT YIELD ANALYSIS SUMMARY

	Western Tributary	Eastern Tributary	Confluence
PSIA Factor Ratings			
Geology	2	2	2
Soils	7	5	6
Climate	2	2	2
Runoff	5	5	5
Topography	11	8	6
Ground Cover	3	3	3
Land Use	-10	-10	-10
Upland Erosion	12	10	10
Channel Condition	10	18	15
Summary Ratings	42	43	38
Unit Sediment Yield (af/sq mi/yr)	.40	.42	.37
Drainage Area (sq mi)	41	40	133
Sediment Yield			
Estimated Average Annual Sediment Yield (af/yr)	16	17	49

Comparisons with Past Studies

The average annual sediment yield for the three watershed subdivisions is estimated to range from 0.37 af/sq.mi./yr to 0.42 af/sq.mi./yr. The COE feasibility study developed, and presented, a curve of estimated average annual sediment delivery rates to detention basins within the Las Vegas Valley. These curves present sediment delivery per year per square mile versus basin area for areas similar to those found in Range Wash. The COE Feasibility Study

estimates were 0.35 af/sq.mi./yr to 0.40 af/sq.mi./yr. This is very close to the values determined in this effort. Differences may be attributed to slightly higher rainfall in the Range Wash watershed than in the Valley as a whole.

Design Storm Sediment Volume

The estimated average annual sediment yield for the Range Wash basin must be converted to a design storm value to be used for channel and other conveyance facility sizing purposes. A review of several studies performed on similar basins in Clark County, Nevada, Mohave County, Arizona and in Southern California indicated that the 100-year sediment volume is generally between four and seven times the average annual volume.

These values were developed primarily using two methods. One method was to develop a *Modified Universal Soil loss estimate of sediment delivery for each recurrence interval storm* and then integrate over all storm frequencies to establish an average annual sediment delivery volume. The other methodology was to develop an estimate of the sediment yield and sediment transport capacity for each recurrence interval storm and then integrate over all storms to develop an average annual sediment delivery volume.

The ratio of 7 is from a general reference and does not reflect the same level of analysis as the other references. The range of ratios presented in the other reports is between 4 and 5.6 for the 100-year to the average annual. A composite average of 5.26 has been adopted for this study.

Using the adopted 5.26 relationship between the 100-year storm volume and the average annual volume as presented in Table II-8, a 100-year storm sediment volume is computed. Table II-9 presents the estimated 100-year sediment volume.

TABLE II-9

100-YEAR SEDIMENT DELIVERY

	Western Tributary	Eastern Tributary	Confluence
Unit Sediment Yield (AF/Mi^2)	2.1	2.2	1.9
100-Year Sediment Yield (AF)	86	88	260

The distribution of this sediment during the hydrograph duration is based on a linear relationship to the discharge rate. Studies have indicated that the relationship of sediment flow to discharge may also follow a power function, however, without calibration, there is no evidence that a power function provides a better representation and is therefore not used in this study. This distribution can be interpreted as a bulking factor by which clear water discharges can be adjusted to reflect sediment volume.

Using the runoff volumes presented in Table II-7 for the 100-year storm under present basin conditions for each tributary and for the entire basin, the sediment volume constitutes an increase of between 7 and 11%. For this study, a bulking factor of 11% will be utilized for the design of hydraulic facilities subject to sediment laden flows. Facilities below debris basins or other sediment control facilities will use clearwater discharge assumptions.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

HEC-1 ANALYSIS INPUT/OUTPUT

CONTENTS

Entire Basin Storm - Present Conditions/Existing Facilities
100-year/ARF = 0.62 ..... B - 1

Entire Basin Storm - Future Conditions/Existing Facilities
100-year/ARF = 0.62 ..... B - 15

Upland Storm - Present Conditions/Existing Facilities
100-year/ARF = 0.72 ..... B - 29

Upland Storm - Future Conditions/Existing Facilities
100-year/ARF = 0.72 ..... B - 37

Tributary Basin Storm - Present Conditions/Existing Facilities
100-year/ARF = 0.68 ..... B - 52

Tributary Basin Storm - Future Conditions/Existing Facilities
100-year/ARF = 0.68 ..... B - 61

Lower Basin Storm - Present Conditions/Existing Facilities
100-year/ARF = 0.69 ..... B - 70

Lower Basin Storm - Future Conditions/Existing Facilities
100-year/ARF = 0.69 ..... B - 79

ENTIRE BASIN STORM

PRESENT CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.62

1

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1

HEC-1 INPUT PAGE 1

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID                  100-YR, 6-HR STORM      ARF = 0.62
    2         ID               PRESENT CONDITIONS, EXISTING FACILITIES
    3         ID                          JULY 1989
    4         ID                   BOYLE ENGINEERING CORPORATION
    5         ID               AREA C -- 151 SQ MI -- ABOVE M AND TOTAL
    6         ID                          AMC 1.8
    7         ID                 (BASINS 309 AND 317 MODIFIED TO AMC 1.79)
    8         IT      05       0       0     200
    9         IO       5       0       0

   10         KK      41   SUB-BASIN 41 HYDROGRAPH
   11         KM           SCS RUNOFF COMPUTATION, SUB-41
   12         BA    4.73
   13         PB    2.13
   14         PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   15         PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   16         PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   17         PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   18         PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   19         PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   20         PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   21         PC   99.90  100.00
   22         LS       0      76
   23         UD     .66

   24         KK     A-B      ROUTE FLOW TO NODE B
   25         RK   19100   .0455    .040            TRAP      50       1

   26         KK     302   SUB-BASIN 302 HYDROGRAPH
   27         KM           SCS RUNOFF CALCULATIONS
   28         BA    6.14
   29         PB    2.04
   30         LS       0      76
   31         UD     .82

   32         KK  NODE B   COMBINE FLOW AT NODE B
   33         HC       2

   34         KK     B-C   ROUTE FLOW TO NODE C
   35         RK    9910   .0504    .040            TRAP      50       1

   36         KK     303   SUB-BASIN 303 HYDROGRAPH
   37         KM           SCS RUNOFF COMPUTATION
   38         BA    4.49
   39         PB    1.91
   40         LS       0      82
   41         UD     .65

   42         KK     428   SUB-BASIN 42B HYDROGRAPH
   43         KM           SCS RUNOFF COMPUTION
   44         BA    4.08
   45         PB    1.95
   46         LS       0      76
   47         UD     .65
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  48      KK  NODE C  COMBINE FLOW AT NODE C
  49      HC       3
  50      KK     C-D    ROUTE FLOW TO NODE D
  51      RK    7000   .0571    .035            TRAP      50       1
  52      KK     42A    SUB-BASIN 42A HYDROGRAPH
  53      KM            SCS RUNOFF COMPUTATION
  54      BA    8.23
  55      PB    1.95
  56      LS       0      76
  57      UD     .81
  58      KK  NODE D  COMBINE FLOW AT NODE D
  59      HC       2
  60      KK     D-E    ROUTE FLOW TO NODE E
  61      RK   16200   .0414     .03            TRAP      70       1
  62      KK     305    SUB-BASIN 305 HYDROGRAPH
  63      KM            SCS RUNOFF COMPUTATION
  64      BA    3.99
  65      PB    1.77
  66      LS       0      82
  67      UD     .76
  68      KK  NODE E COMBINE FLOWS AT NODE E
  69      HC       2
  70      KK     E-F    ROUTE FLOWS TO NODE F
  71      RM       5     .46     .10
  72      KK     306    SUB-BASIN 306 HYDROGRAPH
  73      KM            SCS RUNOFF COMPUTATION
  74      BA    9.04
  75      PB    1.77
  76      LS       0      72
  77      UD    2.00
  78      KK  NODE F  COMBINE FLOWS AT NODE F
  79      HC       2
  80      KK     F-G    ROUTE FLOWS TO NODE G
  81      RM      18    1.57     .10
  82      KK     307   SUB-BASIN 307 HYDROGRAPH
  83      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  84      BA    8.07
  85      PB    1.77
  86      LS       0      74       0       0      97
  87      UK     800   .0123     .20      89
  88      UK      60    .015     .10      11
  89      RK   10000     .01   .0375     .67              5       1
  90      RK    3200    .013   .0375     2.0              5       1
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  91      RK    9500    .008     .03            TRAP      40     1.5      NO

  92      KK      43    SUB-BASIN 43 HYDROGRAPH
  93      KM            SCS RUNOFF COMPUTATION
  94      BA    6.40
  95      PB    1.77
  96      LS       0      76
  97      UD     .88

  98      KK     H-I    ROUTE FLOWS TO NODE I
  99      RM       7     .72     .10

 100      KK     309     SUB-BASIN 309 HYDROGRAPH
 101      KM            SCS RUNOFF COMPUTATION
 102      BA    9.24
 103      PB    1.77
 104      LS       0      75
 105      UD    1.51

 106      KK  NODE I COMBINE FLOWS AT NODE I
 107      HC       2

 108      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 109      RM       8     .58     .15

 110      KK     310    SUB-BASIN 310 HYDROGRAPH
 111      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 112      BA    9.14
 113      PB    1.77
 114      LS       0      74       0       0      97
 115      UK     800    .015     .20      89
 116      UK      60    .020     .10      11
 117      RK    5500     .01   .0375    1.01
 118      RK    8500     .01   .0375    3.04    TRAP      50
 119      RK    9000.  .0036     .05            TRAP      60       1      NO

 120      KK  NODE G  COMBINE ALL FLOWS AT NODE G
 121      HC       4

 122      KK     G-M    ROUTE FLOWS TO NODE M
 123      RK   15800  0.0035    .023            TRAP      50       1

 124      KK      44    SUB-BASIN 44 HYDROGRAPH
 125      KM            SCS RUNOFF COMPUTATION
 126      BA    7.23
 127      PB    1.77
 128      LS       0      76
 129      UD    1.22

 130      KK     J-K    ROUTE FLOW TO NODE K
 131      RM       8     .58     .15
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  132     KK     312   SUB-BASIN 312 HYDROGRAPH
  133     KM           SCS RUNOFF COMPUTATION
  134     BA    6.77
  135     PB    1.77
  136     LS       0      73
  137     UD    2.83

  138     KK  NODE K  COMBINE FLOW AT NODE K
  139     HC       2

  140     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  141     RK   17400   .0052    .030            TRAP      70       1

  142     KK      45   SUB-BASIN 45 HYDROGRAPH
  143     KM           SCS RUNOFF COMPUTATION
  144     BA   10.73
  145     PB    1.77
  146     LS       0      72       0       0       0       0
  147     UD    1.31

  148     KK     N-O    ROUTE FLOW TO NODE O
  149     RK    9550   .0157    .035            TRAP      50       1

  150     KK     048    SUB-BASIN 048 HYDROGRAPH
  151     KM           SCS RUNOFF COMPUTATION
  152     BA    2.07
  153     PB    1.77
  154     LS       0      72
  155     UD    1.97

  156     KK     46A   SUB-BASIN 46A HYDROGRAPH
  157     KM           SCS RUNOFF COMPUTATION
  158     BA    7.35
  159     PB    1.86
  160     LS       0      73
  161     UD    1.60

  162     KK     46B   SUB-BASIN 46B HYDROGRAPH
  163     KM           SCS RUNOFF COMPUTATION
  164     BA    6.02
  165     PB    1.86
  166     LS       0      73
  167     UD    1.71

  168     KK  NODE O  COMBINE ALL FLOW AT NODE O
  169     HC       4

  170     KK     O-P    ROUTE FLOW TO NODE P
  171     RK   18600   .0051     .03            TRAP      70       1
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  172     KK    P*1     COMBINE FLOWS AT P
  173     HC      2
  174     KK     317    SUB-BASIN 317 HYDROGRAPH
  175     KM            SCS RUNOFF COMPUTATION
  176     BA    7.66
  177     PB    1.95
  178     LS       0      76
  179     UD     .97
  180     KK    3188    SUB-BASIN 318B HYDROGRAPH
  181     KM            SCS RUNOFF COMPUTATION
  182     BA    1.86
  183     PB    1.95
  184     LS       0      84
  185     UD     .37
  186     KK     Q-P    ROUTE FLOW TO NODE P
  187     RM       4     .26     .15
  188     KK    318A    SUB BASIN 318A HYDROGRAPH
  189     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  190     BA    2.19
  191     PB    1.82
  192     LS       0      74       0       0      97
  193     UK     700    .020     .30      89
  194     UK      50    .025     .10      11
  195     RK    2000    .035   .0375     .06              30      50
  196     RK    7000    .014     .05     .55              30      50
  197     RK    9200   .0043     .03             TRAP     30       1
  198     KK  NODE P  COMBINE FLOWS AT NODE P
  199     HC       4
  200     KK     P-M    ROUTE FLOWS TO NODE M
  201     RK    7400   .0034     .03             TRAP     80       1
  202     KK     047    SUB-BASIN 47 HYDROGRAPH
  203     KM            KINEMATIC RUNOFF COMPUTATION
  204     BA    7.40
  205     PB    1.77
  206     LS       0      74       0       0      97
  207     UK     800    .008     .20      74
  208     UK      80    .012     .10      26
  209     RK    7000    .007    .050    1.23              30      50
  210     RK   22000    .005     .03             TRAP     40       1
  211     KK  NODE M  COMBINE FLOW AT NODE M
  212     HC       3
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  213     KK     M-S    ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  214     RK    4600   .0028    .023            TRAP      80       1

  215     KK     48B    SUB-BASIN 48B HYDROGRAPH
  216     KM            SCS RUNOFF COMPUTATION
  217     BA     .99
  218     PB    1.86
  219     LS       0      84       0       0       0       0
  220     UD     .24

  221     KK     R-S    ROUTE FLOW TO NODE S
  222     RK    9100   .0316    .035            TRAP      80       1

  223     KK     48A    SUB-BASIN 48A HYDROGRAPH
  224     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  225     BA     .49
  226     PB    1.82
  227     LS       0      74       0       0      97
  228     UK     700    .025     .30      77
  229     UK      60     .03     .10      23
  230     RK     800     .02    .050     .12              30      50
  231     RK    9000    .033     .02            TRAP      20       1      NO

  232     KK     321    SUB-BASIN 321 HYDROGRAPH
  233     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  234     BA    3.42
  235     PB    1.77
  236     LS       0      74       0       0      97
  237     UK     800    .010     .30      78
  238     UK      50    .020     .10      22
  239     RK    3500    .006    .050     .14              30      50
  240     RK    7400   .0014    .050     .58              30      50
  241     RK   21200.  .0035    .035            TRAP     70.      1.     NO

  242     KK     49A    SUB-BASIN 49A HYDROGRAPH
  243     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  244     BA    0.60
  245     PB    1.77
  246     LS       0      74       0       0      97
  247     UK     700    .034     .30      80
  248     UK      60     .04     .10      20
  249     RK    1000    .003    .050     .12              30      50
  250     RK    9200    .034    .035            TRAP      20       1      NO

  251     KK   NODE S  COMBINE ALL FLOWS AT NODE S
  252     HC       5

  253     KK     S-V    ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)
  254     RK    6800   .0038    .023            TRAP      80       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

255       KK     324    SUB-BASIN 324 HYDROGRAPH
256       KM            KINEMATIC WAVE RUNOFF COMPUTATION
257       BA    1.40
258       PB    1.77
259       LS       0      73       0       0      97
260       UK     800     .01     .30      74
261       UK      60     .01     .10      26
262       RK    1300.    .004     .05     .07    TRAP      30      50
263       RK    2500    .0017     .05     .28               30      50
264       RK    7000.    .005    .035             TRAP      70       1      NO

265       KK     49B     SUB-BASIN 49B HYDROGRAPH
266       KM             SCS RUNOFF COMPUTATION
267       BA    1.04
268       PB    1.82
269       LS       0      84       0       0       0       0
270       UD     .25

271       KK     T-V    ROUTE FLOWS TO NODE V
272       RM       3     .52     .10

273       KK   NODE V   COMBINE ALL FLOWS AT NODE V
274       HC       3

275       KK     50B    SUB-BASIN 50B HYDROGRAPH
276       KM            SCS RUNOFF COMPUTATION
277       BA     .55
278       PB    1.86
279       LS       0      84       0       0       0       0
280       UD     .17

281       KK     U-V    ROUTE FLOWS TO NODE V
282       RM       3     .43     .10

283       KK     50A    SUB-BASIN 50A HYDROGRAPH
284       KM            KINEMATIC WAVE RUNOFF COMPUTATION
285       BA    1.78
286       PB    1.77
287       LS       0      74       0       0      97       0
288       UK     800    .025     .30      89
289       UK      60     .03     .10      11
290       RK    3000    .010    .050     .45               30      50
291       RK    7500    .029    .035             TRAP      40       1      NO

292       KK      53     SUB-BASIN 53 HYDROGRAPH
293       KM             KINEMATIC WAVE RUNOFF COMPUTATION
294       BA    1.44
295       PB    1.77
296       LS       0      73       0       0      97       0
297       UK     600    .010     .30      70
298       UK      50    .010     .10      30
299       RK    1300.   .0033    .050    .053    TRAP      30      50
300       RK    3100.   .0017    .050     .21    TRAP      30      50
301       RK   12300.   .0033     .02             TRAP      20       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  302     KK     W-V    ROUTE FLOWS TO NODE V
  303     RM       3     .36     .10

  304     KK  NODE V  COMBINE ALL FLOWS AT NODE V
  305     HC       4

  306     KK     V-Z   ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  307     RK    7780   .0041     .23            TRAP      80       1

  308     KK     51B    SUB-BASIN 51B HYDROGRAPH
  309     KM            SCS RUNOFF COMPUTATION
  310     BA    0.47
  311     PB    1.77
  312     LS       0      84       0       0       0       0
  313     UD     .13

  314     KK     X-Z    ROUTE FLOWS TO NODE Z
  315     RM       3     .54     .10

  316     KK     51A     SUB-BASIN 51A HYDROGRAPH
  317     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  318     BA     .99
  319     PB    1.82
  320     LS       0      72       0       0      97       0
  321     UK     600     .03     .30      86
  322     UK      60    .030     .10      14
  323     RK   2500.   .0075    .050    .100    TRAP      30      50
  324     RK   8000.   .0400    .025            TRAP      50       1      NO

  325     KK     51C    SUB-BASIN 51C HYDROGRAPH
  326     KM            SCS RUNOFF COMPUTATION
  327     BA     .43
  328     PB    1.82
  329     LS       0      84
  330     UD     .19

  331     KK     Y-Z    ROUTE FLOWS TO NODE Z
  332     RM       3     .54     .10

  333     KK     51D    SUB-BASIN 51D HYDROGRAPH
  334     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  335     BA     .83
  336     PB    1.77
  337     LS       0      72       0       0      97
  338     UK     600     .03     .30      88
  339     UK      60    .035     .10      12
  340     RK    2500   .0240    .050    .080              30      50
  341     RK    8000   .0300    .025            TRAP      50       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  342     KK  NODE Z    COMBINE ALL FLOWS AT NODE Z
  343     HC       5
  344     KK    Z-BB    ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  345     RK    2680   .0044    .023            TRAP      80       1
  346     KK     52B    SUB-BASIN 52B HYDROLOGY
  347     KM            SCS RUNOFF COMPUTATION
  348     BA     .70
  349     PB    1.77
  350     LS       0      84
  351     UD     .11
  352     KK   AA-BB    ROUTE FLOWS TO NODE BB
  353     RM        4     .62     .10
  354     KK  NODEBB    COMBINE ALL FLOWS AT NODE BB
  355     HC       2
  356     KK     52A    SUB-BASIN 52A HYDROGRAPH
  357     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  358     BA    1.18
  359     PB    1.77
  360     LS       0      74       0       0      97       0
  361     UK     600    .025     .30      93
  362     UK      60    .035     .10       7
  363     RK    2000    .025     .050     .24              30      50
  364     RK   11200.   .028     .035             TRAP      30       1      NO
  365     KK   NO.BB  COMBINE ALL FLOWS AT NODE BB
  366     HC       2
  367     KK   BB-CC    ROUTE FLOWS TO NODE CC
  368     RK    4000      55    .023            TRAP      80       1
  369     KK     326    SUB-BASIN 326 HYDROGRAPH
  370     KM            KINEMATIC WAVE COMPUTATION
  371     BA    1.71
  372     PB    1.77
  373     LS       0      74       0       0      97       0
  374     UK     700    .010     .30      80
  375     UK      60   .0100     .10      20
  376     RK    1800   .0035     .050     .11              30      50
  377     RK    4000   .0014     .050     .43              30      50
  378     RK   12500   .0038     .035             TRAP      80       1
  379     KK   NO.CC    COMBINE ALL FLOWS AT NODE CC
  380     HC       2
  381     ZZ
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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

100-YR, 6-HR STORM ARF = 0.62
PRESENT CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
AREA C -- 151 SQ MI -- ABOVE H AND TOTAL
AMC 1.8
(BASINS 309 AND 317 MODIFIED TO AMC 1.79)

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	41	698.	4.17	245.	89.	89.	4.73		
+	ROUTED TO	A-B	629.	4.50	242.	89.	89.	4.73		
+	HYDROGRAPH AT	302	714.	4.33	287.	104.	104.	6.14		
+	2 COMBINED AT	NODE B	1329.	4.42	528.	192.	192.	10.87		
+	ROUTED TO	B-C	1315.	4.58	526.	192.	192.	10.87		
+	HYDROGRAPH AT	303	839.	4.08	285.	103.	103.	4.49		
+	HYDROGRAPH AT	42B	480.	4.17	170.	62.	62.	4.08		
+	3 COMBINED AT	NODE C	2400.	4.42	976.	357.	357.	19.44		
+	ROUTED TO	C-D	2396.	4.42	975.	357.	357.	19.44		
+	HYDROGRAPH AT	42A	860.	5.33	344.	124.	124.	8.23		
+	2 COMBINED AT	NODE D	3242.	4.42	1319.	481.	481.	27.67		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	D-E	3194.	4.58	1314.	481.	481.	27.67		
HYDROGRAPH AT	305	580.	4.25	215.	78.	78.	3.99		
2 COMBINED AT	NODE E	3719.	4.50	1523.	559.	559.	31.66		
ROUTED TO	E-F	3583.	5.83	1523.	559.	559.	31.66		
HYDROGRAPH AT	306	363.	6.33	188.	71.	71.	9.04		
2 COMBINED AT	NODE F	3914.	5.83	1710.	630.	630.	40.70		
ROUTED TO	F-G	3775.	7.17	1705.	629.	629.	40.70		
HYDROGRAPH AT	307	384.	3.92	247.	108.	108.	8.07		
HYDROGRAPH AT	43	525.	5.42	208.	75.	75.	6.40		
ROUTED TO	H-I	502.	6.00	207.	75.	75.	6.40		
HYDROGRAPH AT	309	580.	5.75	269.	99.	99.	9.24		
2 COMBINED AT	NODE I	1070.	5.83	476.	174.	174.	15.64		
ROUTED TO	I-G	1060.	6.42	476.	174.	174.	15.64		
HYDROGRAPH AT	310	408.	5.50	271.	118.	118.	9.14		
4 COMBINED AT	NODE G	5226.	6.83	2626.	1029.	1029.	73.55		
ROUTED TO	G-M	5200.	7.00	2615.	1024.	1024.	73.55		
HYDROGRAPH AT	44	533.	5.50	233.	85.	85.	7.23		
ROUTED TO	J-K	527.	6.08	233.	85.	85.	7.23		
HYDROGRAPH AT	312	233.	7.08	146.	59.	59.	6.77		
2 COMBINED AT	NODE K	719.	6.25	376.	144.	144.	14.00		
ROUTED TO	K-P	685.	6.75	359.	142.	142.	14.00		
HYDROGRAPH AT									

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	45	542.	5.67	231.	84.	84.	10.73		
ROUTED TO	N-O	539.	5.83	229.	84.	84.	10.73		
HYDROGRAPH AT	048	84.	6.25	43.	16.	16.	2.07		
HYDROGRAPH AT	46A	429.	5.83	202.	74.	74.	7.35		
HYDROGRAPH AT	46B	340.	5.92	165.	61.	61.	6.02		
4 COMBINED AT	NODE O	1385.	5.92	638.	236.	236.	26.17		
ROUTED TO	O-P	1328.	6.33	617.	234.	234.	26.17		
2 COMBINED AT	P*1	1974.	6.50	973.	376.	376.	40.17		
HYDROGRAPH AT	317	759.	5.42	320.	116.	116.	7.66		
HYDROGRAPH AT	318B	555.	3.75	142.	51.	51.	1.86		
ROUTED TO	Q-P	520.	4.08	142.	51.	51.	1.86		
HYDROGRAPH AT	318A	98.	5.92	69.	30.	30.	2.19		
4 COMBINED AT	NODE P	2512.	6.08	1433.	574.	574.	51.88		
ROUTED TO	P-M	2504.	6.25	1425.	571.	571.	51.88		
HYDROGRAPH AT	047	571.	4.25	331.	146.	146.	7.40		
3 COMBINED AT	NODE M	7691.	6.83	4331.	1742.	1742.	132.83		
ROUTED TO	M-S	7685.	6.83	4329.	1739.	1739.	132.83		
HYDROGRAPH AT	48B	327.	3.67	69.	25.	25.	.99		
ROUTED TO	R-S	270.	3.83	68.	25.	25.	.99		
HYDROGRAPH AT	48A	85.	3.58	23.	10.	10.	.49		
HYDROGRAPH AT	321	159.	6.83	115.	57.	57.	3.42		
HYDROGRAPH AT	49A	64.	3.67	25.	11.	11.	.60		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

K	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
		6-HOUR	24-HOUR	72-HOUR			
[illegible]	6.83	4516.	1841.	1841.	138.33		
[illegible]	6.92	4512.	1836.	1836.	138.33		
[illegible]	4.33	58.	26.	26.	1.40		
[illegible]	3.67	69.	25.	25.	1.04		
[illegible]	4.17	69.	25.	25.	1.04		
[illegible]	6.92	4613.	1887.	1887.	140.77		
[illegible]	3.58	38.	14.	14.	.55		
[illegible]	4.00	38.	14.	14.	.55		
[illegible]	3.75	54.	24.	24.	1.78		
[illegible]	4.50	69.	30.	30.	1.44		
[illegible]	4.92	69.	30.	30.	1.44		
[illegible]	6.92	4752.	1955.	1955.	144.54		
[illegible]	7.25	4668.	1926.	1926.	144.54		
[illegible]	3.58	30.	11.	11.	.47		
[illegible]	4.00	30.	11.	11.	.47		
[illegible]	3.92	34.	14.	14.	.99		
[illegible]	3.58	29.	10.	10.	.43		
[illegible]	4.08	29.	10.	10.	.43		
[illegible]	3.83	24.	11.	11.	.83		
[illegible]	7.25	4732.	1972.	1972.	147.26		
[illegible]	7.25	4733.	1970.	1970.	147.26		
[illegible]	3.50	44.	16.	16.	.70		

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	ROUTED TO									
+		AA-BB	157.	4.08	44.	16.	16.	.70		
	2 COMBINED AT									
+		NODEBB	7945.	7.25	4751.	1986.	1986.	147.96		
	HYDROGRAPH AT									
+		52A	57.	5.58	33.	14.	14.	1.18		
	2 COMBINED AT									
+		NO.BB	7974.	7.25	4778.	2000.	2000.	149.14		
	ROUTED TO									
+		BB-CC	7973.	7.25	4778.	2000.	2000.	149.14		
	HYDROGRAPH AT									
+		326	88.	5.75	60.	28.	28.	1.71		
	2 COMBINED AT									
+		NO.CC	8039.	7.25	4836.	2028.	2028.	150.85		

*** NORMAL END OF HEC-1 ***

ENTIRE BASIN STORM

FUTURE CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.62

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

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THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1

HEC-1 INPUT


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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID                    EAST AND WEST RANGE WASHES
    2     ID                  100-YR, 6-HR STORM      ARF = 0.62
    3     ID                FUTURE  CONDITIONS, EXISTING FACILITIES
    4     ID                        JULY   1989
    5     ID                   BOYLE ENGINEERING CORPORATION
    6     ID                     SUB-AREA C -- TOTAL AREA
    7     ID                  AMC 1.8 (309, 317, 305, 303 AMC 1.77)
    8     ID                  NEW FUTURE DEVELOPMENT IN 306, 307, 310
    9     IT      05       0       0     200
   10     IO       5       0       0

   11     KK      41   SUB-BASIN 41 HYDROGRAPH
   12     KM           SCS RUNOFF COMPUTATION, SUB-41
   13     BA    4.73
   14     PB    2.13
   15     PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   16     PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   17     PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   18     PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   19     PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   20     PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   21     PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   22     PC   99.90  100.00
   23     LS       0      76
   24     UD     .66

   25     KK     A-B      ROUTE FLOW TO NODE B
   26     RK   19100   .0455    .040            TRAP      50       1

   27     KK     302   SUB-BASIN 302 HYDROGRAPH
   28     KM           SCS RUNOFF CALCULATIONS
   29     BA    6.14
   30     PB    2.04
   31     LS       0      76
   32     UD     .82

   33     KK  NODE B  COMBINE FLOW AT NODE B
   34     HC       2

   35     KK     B-C   ROUTE FLOW TO NODE C
   36     RK    9910   .0504    .040            TRAP      50       1

   37     KK     303   SUB-BASIN 303 HYDROGRAPH
   38     KM           SCS RUNOFF COMPUTATION
   39     BA    4.49
   40     PB    1.91
   41     LS       0      81
   42     UD     .65

   43     KK     42B   SUB-BASIN 42B HYDROGRAPH
   44     KM           SCS RUNOFF COMPUTION
   45     BA    4.08
   46     PB    1.95
   47     LS       0      76
   48     UD     .65
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK  NODE C  COMBINE FLOW AT NODE C
  50      HC       3
  51      KK     C-D    ROUTE FLOW TO NODE D
  52      RK    7000   .0571    .035            TRAP      50       1
  53      KK     42A    SUB-BASIN 42A HYDROGRAPH
  54      KM            SCS RUNOFF COMPUTATION
  55      BA    8.23
  56      PB    1.95
  57      LS       0      76
  58      UD     .81
  59      KK  NODE D  COMBINE FLOW AT NODE D
  60      HC       2
  61      KK     D-E    ROUTE FLOW TO NODE E
  62      RK   16200   .0414     .03            TRAP      70       1
  63      KK     305    SUB-BASIN 305 HYDROGRAPH
  64      KM            SCS RUNOFF COMPUTATION
  65      BA    3.99
  66      PB    1.77
  67      LS       0      81
  68      UD     .76
  69      KK  NODE E  COMBINE FLOWS AT NODE E
  70      HC       2
  71      KK     E-F    ROUTE FLOWS TO NODE F
  72      RM       5     .46     .10
  73      KK     306    SUB-BASIN 306 HYDROGRAPH
  74      KM            SCS RUNOFF COMPUTATION
  75      BA    9.04
  76      PB    1.77
  77      LS       0      80
  78      UD    1.61
  79      KK  NODE F  COMBINE FLOWS AT NODE F
  80      HC       2
  81      KK     F-G    ROUTE FLOWS TO NODE G
  82      RM      18    1.57     .10
  83      KK     307   SUB-BASIN 307 HYDROGRAPH
  84      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  85      BA    8.07
  86      PB    1.77
  87      LS       0      73       0       0      97
  88      UK     800   .0123     .20      51
  89      UK     300    .015     .10      49
  90      RK    5000     .01     .05     .25             30       50
  91      RK    3200    .013     .05    1.01             30       50
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  92      RK    9500    .008     .03            TRAP      40      1.5      NO

  93      KK      43    SUB-BASIN 43 HYDROGRAPH
  94      KM            SCS RUNOFF COMPUTATION
  95      BA    6.40
  96      PB    1.77
  97      LS       0      76
  98      UD     .88

  99      KK     H-I    ROUTE FLOWS TO NODE I
 100      RM       7     .72     .10

 101      KK     309     SUB-BASIN 309 HYDROGRAPH
 102      KM            SCS RUNOFF COMPUTATION
 103      BA    9.24
 104      PB    1.77
 105      LS       0      75
 106      UD    1.51

 107      KK   NODE I COMBINE FLOWS AT NODE I
 108      HC       2

 109      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 110      RM       8     .58     .15

 111      KK     310    SUB-BASIN 310 HYDROGRAPH
 112      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 113      BA    9.14
 114      PB    1.77
 115      LS       0      73       0       0      97
 116      UK     800    .015     .20      68
 117      UK     300    .020     .10      32
 118      RK    2750     .01     .05     .25              30      50
 119      RK    7300     .01     .05    1.01    TRAP      30      50
 120      RK   9000.   .0036     .05            TRAP      60       1      NO

 121      KK   NODE G  COMBINE ALL FLOWS AT NODE G
 122      HC       4

 123      KK     G-M    ROUTE FLOWS TO NODE M
 124      RK   15800  0.0035    .023            TRAP      50       1

 125      KK      44    SUB-BASIN 44 HYDROGRAPH
 126      KM            SCS RUNOFF COMPUTATION
 127      BA    7.23
 128      PB    1.77
 129      LS       0      76
 130      UD    1.22

 131      KK     J-K    ROUTE FLOW TO NODE K
 132      RM       8     .58     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  133     KK     312   SUB-BASIN 312 HYDROGRAPH
  134     KM           SCS RUNOFF COMPUTATION
  135     BA    6.77
  136     PB    1.77
  137     LS       0      73
  138     UD    2.83

  139     KK  NODE K  COMBINE FLOW AT NODE K
  140     HC       2

  141     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  142     RK   17400   .0052    .030            TRAP      70       1

  143     KK      45   SUB-BASIN 45 HYDROGRAPH
  144     KM           SCS RUNOFF COMPUTATION
  145     BA   10.73
  146     PB    1.77
  147     LS       0      72       0       0       0       0
  148     UD    1.31

  149     KK     N-O    ROUTE FLOW TO NODE O
  150     RK    9550   .0157    .035            TRAP      50       1

  151     KK     048    SUB-BASIN 048 HYDROGRAPH
  152     KM           SCS RUNOFF COMPUTATION
  153     BA    2.07
  154     PB    1.77
  155     LS       0      72
  156     UD    1.97

  157     KK     46A   SUB-BASIN 46A HYDROGRAPH
  158     KM           SCS RUNOFF COMPUTATION
  159     BA    7.35
  160     PB    1.86
  161     LS       0      73
  162     UD    1.60

  163     KK     468   SUB-BASIN 468 HYDROGRAPH
  164     KM           SCS RUNOFF COMPUTATION
  165     BA    6.02
  166     PB    1.86
  167     LS       0      73
  168     UD    1.71

  169     KK  NODE O  COMBINE ALL FLOW AT NODE O
  170     HC       4

  171     KK     O-P    ROUTE FLOW TO NODE P
  172     RK   18600   .0051     .03            TRAP      70       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 173      KK     P*1    COMBINE FLOWS AT P*1
 174      HC       2
 175      KK     317    SUB-BASIN 317 HYDROGRAPH
 176      KM            SCS RUNOFF COMPUTATION
 177      BA    7.66
 178      PB    1.95
 179      LS       0      76
 180      UD     .97
 181      KK    318B    SUB-BASIN 318B HYDROGRAPH
 182      KM            SCS RUNOFF COMPUTATION
 183      BA    1.89
 184      PB    1.95
 185      LS       0      84       0
 186      UD     .37
 187      KK     Q-P    ROUTE FLOW TO NODE P
 188      RM       4     .26     .15
 189      KK    318A    SUB BASIN 318A HYDROGRAPH
 190      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 191      BA    2.19
 192      PB    1.82
 193      LS       0      73       0       0      97
 194      UK     700    .020     .30      74
 195      UK      50    .025     .10      26
 196      RK    2000    .035     .05     .06              30      50
 197      RK    7000    .014     .05     .55              30      50
 198      RK    9200   .0043     .03            TRAP      30       1
 199      KK  NODE P  COMBINE FLOWS AT NODE P
 200      HC       4
 201      KK     P-M    ROUTE FLOWS TO NODE M
 202      RK    7400   .0034     .03            TRAP      80       1
 203      KK     047    SUB-BASIN 47 HYDROGRAPH
 204      KM            KINEMATIC RUNOFF COMPUTATION
 205      BA    7.40
 206      PB    1.77
 207      LS       0      73       0       0      97
 208      UK     800    .008     .20      69
 209      UK      80    .012     .10      31
 210      RK    2000    .003     .05     .25              30      50
 211      RK    7000    .007     .05    1.23              30      50
 212      RK   22000    .005     .03            TRAP      40       1
 213      KK  NODE M  COMBINE FLOW AT NODE M
 214      HC       3
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  215     KK     M-S    ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  216     RK    4600   .0028    .023            TRAP      80       1

  217     KK     48B    SUB-BASIN 48B HYDROGRAPH
  218     KM            SCS RUNOFF COMPUTATION
  219     BA     .99
  220     PB    1.86
  221     LS       0      84       0       0       0       0
  222     UD     .24

  223     KK     R-S     ROUTE FLOW TO NODE S
  224     RK    9100   .0316    .035            TRAP      80       1

  225     KK     48A     SUB-BASIN 48A HYDROGRAPH
  226     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  227     BA     .49
  228     PB    1.86
  229     LS       0      72       0       0      97
  230     UK     700    .025     .30      73
  231     UK      60     .03     .10      27
  232     RK    2000     .02    .050     .04              30      50
  233     RK     800     .02    .050     .12              30      50
  234     RK    9000    .033     .02            TRAP      20       1      NO

  235     KK     321    SUB-BASIN 321 HYDROGRAPH
  236     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  237     BA    3.42
  238     PB    1.77
  239     LS       0      72       0       0      97
  240     UK     800    .010     .30      54
  241     UK      50    .020     .10      46
  242     RK    3500    .006    .050     .14              30      50
  243     RK    7400   .0014    .050     .58              30      50
  244     RK  21200.   .0035    .035            TRAP     70.      1.      NO

  245     KK     49A    SUB-BASIN 49A HYDROGRAPH
  246     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  247     BA    0.60
  248     PB    1.77
  249     LS       0      72       0       0      97
  250     UK     700    .034     .30      73
  251     UK      60     .04     .10      27
  252     RK    2000     .03     .05     .04              30      50
  253     RK    1000    .003    .050     .12              30      50
  254     RK    9200    .034    .035            TRAP      20       1      NO

  255     KK  NODE S  COMBINE ALL FLOWS AT NODE S
  256     HC       5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  257     KK     S-V    ROUTE FLOWS TO NODE V   (SLOAN CHANNEL)
  258     RK    6800   .0038    .023            TRAP      80       1

  259     KK     324    SUB-BASIN 324 HYDROGRAPH
  260     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  261     BA    1.40
  262     PB    1.77
  263     LS       0      73       0       0      97
  264     UK     800     .01     .30      56
  265     UK      60     .01     .10      44
  266     RK   1300.    .004     .05     .07    TRAP      30       50
  267     RK    2500   .0017     .05     .28              30       50
  268     RK   7000.    .005    .035            TRAP      70       1       NO

  269     KK     49B    SUB-BASIN 49B HYDROGRAPH
  270     KM            SCS RUNOFF COMPUTATION
  271     BA    1.04
  272     PB    1.82
  273     LS       0      85       0       0       0       0
  274     UD     .25

  275     KK     T-V    ROUTE FLOWS TO NODE V
  276     RM       3     .52     .10

  277     KK   NODE V   COMBINE ALL FLOWS AT NODE V
  278     HC       3

  279     KK     50B    SUB-BASIN 50B HYDROGRAPH
  280     KM            SCS RUNOFF COMPUTATION
  281     BA     .55
  282     PB    1.86
  283     LS       0      85       0       0       0       0
  284     UD     .17

  285     KK     U-V    ROUTE FLOWS TO NODE V
  286     RM       3     .43     .10

  287     KK     50A    SUB-BASIN 50A HYDROGRAPH
  288     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  289     BA    1.78
  290     PB    1.77
  291     LS       0      72       0       0      97       0
  292     UK     800    .025     .30      73
  293     UK      60     .03     .10      27
  294     RK    1000    .030    .050     .12              30       50
  295     RK    3000    .010    .050     .45              30       50
  296     RK    7500    .029    .035            TRAP      40       1       NO

  297     KK      53    SUB-BASIN 53 HYDROGRAPH
  298     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  299     BA    1.44
  300     PB    1.77
  301     LS       0      73       0       0      97       0
  302     UK     600    .010     .30      56
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  303     UK      50    .010     .10      44
  304     RK    1300.   .0033    .050    .053    TRAP      30       50
  305     RK    3100.   .0017    .050     .21    TRAP      30       50
  306     RK   12300.   .0033     .02            TRAP      20        1      NO

  307     KK     W-V    ROUTE FLOWS TO NODE V
  308     RM       3     .36      .10

  309     KK   NODE V   COMBINE ALL FLOWS AT NODE V
  310     HC       4

  311     KK     V-Z    ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  312     RK    7780    .0041     .23            TRAP      80        1

  313     KK     51B     SUB-BASIN 51B HYDROGRAPH
  314     KM             SCS RUNOFF COMPUTATION
  315     BA    0.47
  316     PB    1.77
  317     LS       0       85       0       0       0       0
  318     UD     .13

  319     KK     X-Z     ROUTE FLOWS TO NODE Z
  320     RM       3      .54      .10

  321     KK     51A      SUB-BASIN 51A HYDROGRAPH
  322     KM              KINEMATIC WAVE RUNOFF COMPUTATION
  323     BA     .99
  324     PB    1.82
  325     LS       0       73       0       0      97       0
  326     UK     600      .03      .30      73
  327     UK      60     .030      .10      27
  328     RK    1000.     .03     .050     .05                30       50
  329     RK    2500.    .0075    .050    .100    TRAP       30       50
  330     RK    8000.    .0400    .025            TRAP       50        1      NO

  331     KK     51C     SUB-BASIN 51C HYDROGRAPH
  332     KM             SCS RUNOFF COMPUTATION
  333     BA     .43
  334     PB    1.82
  335     LS       0       85       0
  336     UD     .19

  337     KK     Y-Z     ROUTE FLOWS TO NODE Z
  338     RM       3      .54      .10

  339     KK     51D     SUB-BASIN 51D HYDROGRAPH
  340     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  341     BA     .83
  342     PB    1.77
  343     LS       0       72       0       0      97
  344     UK     600      .03      .30      77
  345     UK      60     .035      .10      23
  346     RK    1000      .03      .05     .02                30       50
  347     RK    2500     .0240     .050    .080               30       50
  348     RK    8000     .0300     .025            TRAP       50        1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  349     KK  NODE Z    COMBINE ALL FLOWS AT NODE Z
  350     HC       5
  351     KK    Z-BB    ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  352     RK    2680   .0044    .023            TRAP      80       1
  353     KK     52B    SUB-BASIN 52B HYDROLOGY
  354     KM            SCS RUNOFF COMPUTATION
  355     BA     .70
  356     PB    1.77
  357     LS       0      85
  358     UD     .11
  359     KK   AA-BB    ROUTE FLOWS TO NODE BB
  360     RM       4     .62     .10
  361     KK  NODEBB    COMBINE ALL FLOWS AT NODE BB
  362     HC       2
  363     KK     52A    SUB-BASIN 52A HYDROGRAPH
  364     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  365     BA    1.18
  366     PB    1.77
  367     LS       0      74       0       0      97       0
  368     UK     600    .025     .30      91
  369     UK      60    .035     .10       9
  370     RK    1000     .03    .050     .04              30      50
  371     RK    2000    .025    .050     .24              30      50
  372     RK   11200.   .028    .035             TRAP      30       1      NO
  373     KK   NO.BB  COMBINE ALL FLOWS AT NODE BB
  374     HC       2
  375     KK   BB-CC    ROUTE FLOWS TO NODE CC
  376     RK    4000      55    .023            TRAP      80       1
  377     KK     326    SUB-BASIN 326 HYDROGRAPH
  378     KM            KINEMATIC WAVE COMPUTATION
  379     BA    1.71
  380     PB    1.77
  381     LS       0      72       0       0      97       0
  382     UK     700    .010     .30      73
  383     UK      60   .0100     .10      27
  384     RK    1800   .0035    .050     .11              30      50
  385     RK    4000   .0014    .050     .43              30      50
  386     RK   12500   .0038    .035             TRAP      80       1
  387     KK   NO.CC    COMBINE ALL FLOWS AT NODE CC
  388     HC       2
  389     ZZ
```

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.62
FUTURE CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
SUB-AREA C -- TOTAL AREA
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

10 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	41	698.	4.17	245.	89.	89.	4.73		
ROUTED TO	A-B	629.	4.50	242.	89.	89.	4.73		
HYDROGRAPH AT	302	714.	4.33	287.	104.	104.	6.14		
2 COMBINED AT	NODE B	1329.	4.42	528.	192.	192.	10.87		
ROUTED TO	B-C	1315.	4.58	526.	192.	192.	10.87		
HYDROGRAPH AT	303	776.	4.08	265.	96.	96.	4.49		
HYDROGRAPH AT	42B	480.	4.17	170.	62.	62.	4.08		
3 COMBINED AT	NODE C	2353.	4.42	957.	350.	350.	19.44		
ROUTED TO	C-D	2346.	4.42	956.	350.	350.	19.44		
HYDROGRAPH AT	42A	860.	5.33	344.	124.	124.	8.23		

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
2 COMBINED AT	NODE D	3193.	4.42	1300.	474.	474.	27.67		
ROUTED TO	D-E	3156.	5.42	1294.	474.	474.	27.67		
HYDROGRAPH AT	305	532.	4.25	199.	72.	72.	3.99		
2 COMBINED AT	NODE E	3626.	4.50	1488.	546.	546.	31.66		
ROUTED TO	E-F	3526.	5.83	1487.	545.	545.	31.66		
HYDROGRAPH AT	306	830.	5.75	408.	151.	151.	9.04		
2 COMBINED AT	NODE F	4352.	5.83	1894.	696.	696.	40.70		
ROUTED TO	F-G	4216.	7.17	1889.	696.	696.	40.70		
HYDROGRAPH AT	307	1521.	4.00	584.	235.	235.	8.07		
HYDROGRAPH AT	43	525.	5.42	208.	75.	75.	6.40		
ROUTED TO	H-I	502.	6.00	207.	75.	75.	6.40		
HYDROGRAPH AT	309	580.	5.75	269.	99.	99.	9.24		
2 COMBINED AT	NODE I	1070.	5.83	476.	174.	174.	15.64		
ROUTED TO	I-G	1060.	6.42	476.	174.	174.	15.64		
HYDROGRAPH AT	310	919.	4.42	474.	198.	198.	9.14		
4 COMBINED AT	NODE G	5814.	6.83	3296.	1302.	1302.	73.55		
ROUTED TO	G-M	5791.	7.00	3280.	1297.	1297.	73.55		
HYDROGRAPH AT	44	533.	5.50	233.	85.	85.	7.23		
ROUTED TO	J-K	527.	6.08	233.	85.	85.	7.23		
HYDROGRAPH AT	312	233.	7.08	146.	59.	59.	6.77		
2 COMBINED AT	NODE K	719.	6.25	376.	144.	144.	14.00		
ROUTED TO	K-P	685.	6.75	359.	142.	142.	14.00		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	45	542.	5.67	231.	84.	84.	10.73		
ROUTED TO	N-O	539.	5.83	229.	84.	84.	10.73		
HYDROGRAPH AT	048	84.	6.25	43.	16.	16.	2.07		
HYDROGRAPH AT	46A	429.	5.83	202.	74.	74.	7.35		
HYDROGRAPH AT	468	340.	5.92	165.	61.	61.	6.02		
4 COMBINED AT	NODE O	1385.	5.92	638.	236.	236.	26.17		
ROUTED TO	O-P	1328.	6.33	617.	234.	234.	26.17		
2 COMBINED AT	P*1	1974.	6.50	973.	376.	376.	40.17		
HYDROGRAPH AT	317	759.	5.42	320.	116.	116.	7.66		
HYDROGRAPH AT	318B	564.	3.75	144.	52.	52.	1.89		
ROUTED TO	Q-P	528.	4.08	144.	52.	52.	1.89		
HYDROGRAPH AT	318A	195.	4.17	101.	44.	44.	2.19		
4 COMBINED AT	NODE P	2529.	6.08	1465.	588.	588.	51.91		
ROUTED TO	P-M	2520.	6.25	1457.	585.	585.	51.91		
HYDROGRAPH AT	047	644.	4.50	355.	155.	155.	7.40		
3 COMBINED AT	NODE M	8347.	6.75	5083.	2037.	2037.	132.86		
ROUTED TO	M-S	8342.	6.83	5081.	2034.	2034.	132.86		
HYDROGRAPH AT	488	327.	3.67	69.	25.	25.	.99		
ROUTED TO	R-S	270.	3.83	68.	25.	25.	.99		
HYDROGRAPH AT	48A	79.	3.67	24.	10.	10.	.49		
HYDROGRAPH AT	321	348.	5.92	208.	92.	92.	3.42		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	49A	77.	3.75	27.	11.	11.	.60		
5 COMBINED AT	NODE S	8675.	6.75	5379.	2172.	2172.	138.36		
ROUTED TO	S-V	8672.	6.83	5375.	2167.	2167.	138.36		
HYDROGRAPH AT	324	223.	4.08	89.	37.	37.	1.40		
HYDROGRAPH AT	49B	349.	3.67	74.	27.	27.	1.04		
ROUTED TO	T-V	249.	4.17	74.	27.	27.	1.04		
3 COMBINED AT	NODE	8728.	6.83	5510.	2231.	2231.	140.80		
HYDROGRAPH AT	50B	229.	3.58	41.	15.	15.	.55		
ROUTED TO	U-V	154.	3.92	41.	15.	15.	.55		
HYDROGRAPH AT	50A	267.	3.67	79.	34.	34.	1.78		
HYDROGRAPH AT	53	207.	4.33	94.	39.	39.	1.44		
ROUTED TO	W-V	198.	4.67	94.	39.	39.	1.44		
4 COMBINED AT	NODE V	8849.	6.83	5686.	2319.	2319.	144.57		
ROUTED TO	V-Z	8729.	7.17	5589.	2291.	2291.	144.57		
HYDROGRAPH AT	51B	188.	3.58	32.	12.	12.	.47		
ROUTED TO	X-Z	113.	4.00	32.	12.	12.	.47		
HYDROGRAPH AT	51A	135.	3.75	50.	21.	21.	.99		
HYDROGRAPH AT	51C	163.	3.58	31.	11.	11.	.43		
ROUTED TO	Y-Z	106.	4.08	31.	11.	11.	.43		
HYDROGRAPH AT	51D	91.	3.75	34.	14.	14.	.83		
5 COMBINED AT	NODE Z	8771.	7.17	5672.	2349.	2349.	147.29		
ROUTED TO	Z-BB	8770.	7.17	5672.	2347.	2347.	147.29		

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	52B	291.	3.50	48.	17.	17.	.70		
+	ROUTED TO	AA-BB	169.	4.08	48.	17.	17.	.70		
+	2 COMBINED AT	NODEBB	8771.	7.17	5696.	2364.	2364.	147.99		
+	HYDROGRAPH AT	52A	57.	5.42	34.	14.	14.	1.18		
+	2 COMBINED AT	NO.BB	8802.	7.17	5725.	2378.	2378.	149.17		
+	ROUTED TO	BB-CC	8801.	7.17	5725.	2378.	2378.	149.17		
+	HYDROGRAPH AT	326	117.	5.33	69.	31.	31.	1.71		
+	2 COMBINED AT	NO.CC	8869.	7.17	5792.	2409.	2409.	150.88		

*** NORMAL END OF HEC-1 ***

UPLAND STORM

PRESENT CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.72

1 ****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1 HEC-1 INPUT PAGE 1

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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID                    EAST AND WEST RANGE WASHES
  2           ID                 100-YR, 6-HR STORM      ARF = 0.72
  3           ID              PRESENT CONDITIONS, EXISTING FACILITIES
  4           ID                          JULY 1989
  5           ID                   BOYLE ENGINEERING CORPORATION
  6           ID                     SUB-AREA A -- 40.7 SQ MI
  7           ID      CALIB. TO COE, AMC 1.8 (309,317 AMC 1.79)
  8           IT      05       0       0     200
  9           IO       5       0       0

 10           KK      41   SUB-BASIN 41 HYDROGRAPH
 11           KM           SCS RUNOFF COMPUTATION, SUB-41
 12           BA    4.73
 13           PB    2.47
 14           PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
 15           PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
 16           PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
 17           PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
 18           PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
 19           PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
 20           PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
 21           PC   99.90  100.00
 22           LS       0      76
 23           UD     .66

 24           KK     A-B      ROUTE FLOW TO NODE B
 25           RK   19100   .0455    .040            TRAP      50       1

 26           KK     302   SUB-BASIN 302 HYDROGRAPH
 27           KM           SCS RUNOFF CALCULATIONS
 28           BA    6.14
 29           PB    2.47
 30           LS       0      76
 31           UD     .82

 32           KK  NODE B  COMBINE FLOW AT NODE B
 33           HC       2

 34           KK     B-C   ROUTE FLOW TO NODE C
 35           RK    9910   .0504    .040            TRAP      50       1

 36           KK     303   SUB-BASIN 303 HYDROGRAPH
 37           KM           SCS RUNOFF COMPUTATION
 38           BA    4.49
 39           PB    2.21
 40           LS       0      82
 41           UD     .65

 42           KK     428   SUB-BASIN 428 HYDROGRAPH
 43           KM           SCS RUNOFF COMPUTION
 44           BA    4.08
 45           PB    2.27
 46           LS       0      76
 47           UD     .65
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  48      KK  NODE C  COMBINE FLOW AT NODE C
  49      HC       3
  50      KK     C-D    ROUTE FLOW TO NODE D
  51      RK    7000   .0571    .035            TRAP      50       1
  52      KK     42A    SUB-BASIN 42A HYDROGRAPH
  53      KM            SCS RUNOFF COMPUTATION
  54      BA    8.23
  55      PB    2.27
  56      LS       0      76
  57      UD     .81
  58      KK  NODE D  COMBINE FLOW AT NODE D
  59      HC       2
  60      KK     D-E    ROUTE FLOW TO NODE E
  61      RK   16200   .0414     .03            TRAP      70       1
  62      KK     305    SUB-BASIN 305 HYDROGRAPH
  63      KM            SCS RUNOFF COMPUTATION
  64      BA    3.99
  65      PB    2.06
  66      LS       0      82
  67      UD     .76
  68      KK  NODE E COMBINE FLOWS AT NODE E
  69      HC       2
  70      KK     E-F    ROUTE FLOWS TO NODE F
  71      RM       5     .46     .10
  72      KK     306    SUB-BASIN 306 HYDROGRAPH
  73      KM            SCS RUNOFF COMPUTATION
  74      BA    9.04
  75      PB    2.06
  76      LS       0      72
  77      UD    2.00
  78      KK  NODE F  COMBINE FLOWS AT NODE F
  79      HC       2
  80      KK     F-G    ROUTE FLOWS TO NODE G
  81      RM      18    1.57     .10
  82      KK     307   SUB-BASIN 307 HYDROGRAPH
  83      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  84      BA    8.07
  85      PB    2.06
  86      LS       0      74       0       0      97
  87      UK     800   .0123     .20      89
  88      UK      60    .015     .10      11
  89      RK   10000     .01   .0375     .67              5       1
  90      RK    3200    .013   .0375     2.0              5       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  91      RK    9500    .008     .03            TRAP      40     1.5      NO

  92      KK      43    SUB-BASIN 43 HYDROGRAPH
  93      KM            SCS RUNOFF COMPUTATION
  94      BA    6.40
  95      PB    2.06
  96      LS       0      76
  97      UD     .88

  98      KK     H-I    ROUTE FLOWS TO NODE I
  99      RM       7     .72     .10

 100      KK     309     SUB-BASIN 309 HYDROGRAPH
 101      KM            SCS RUNOFF COMPUTATION
 102      BA    9.24
 103      PB    2.06
 104      LS       0      75
 105      UD    1.51

 106      KK  NODE I COMBINE FLOWS AT NODE I
 107      HC       2

 108      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 109      RM       8     .58     .15

 110      KK     310    SUB-BASIN 310 HYDROGRAPH
 111      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 112      BA    9.14
 113      PB    2.06
 114      LS       0      74       0       0      97
 115      UK     800    .015     .20      89
 116      UK      60    .020     .10      11
 117      RK    5500     .01   .0375    1.01
 118      RK    8500     .01   .0375    3.04    TRAP      50
 119      RK   9000.   .0036     .05            TRAP      60       1      NO

 120      KK  NODE G  COMBINE ALL FLOWS AT NODE G
 121      HC       4

 122      KK     G-M    ROUTE FLOWS TO NODE M
 123      RK   15800  0.0035    .023            TRAP      50       1

 124      KK      44    SUB-BASIN 44 HYDROGRAPH
 125      KM            SCS RUNOFF COMPUTATION
 126      BA    7.23
 127      PB    2.06
 128      LS       0      76
 129      UD    1.22

 130      KK     J-K    ROUTE FLOW TO NODE K
 131      RM       8     .58     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  132     KK     312   SUB-BASIN 312 HYDROGRAPH
  133     KM           SCS RUNOFF COMPUTATION
  134     BA    6.77
  135     PB    2.06
  136     LS       0      73
  137     UD    2.83

  138     KK  NODE K  COMBINE FLOW AT NODE K
  139     HC       2

  140     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  141     RK   17400   .0052    .030            TRAP      70       1

  142     KK      45   SUB-BASIN 45 HYDROGRAPH
  143     KM           SCS RUNOFF COMPUTATION
  144     BA   10.73
  145     PB    2.06
  146     LS       0      72       0       0       0       0
  147     UD    1.31

  148     KK     N-O    ROUTE FLOW TO NODE O
  149     RK    9550   .0157    .035            TRAP      50       1

  150     KK     048    SUB-BASIN 048 HYDROGRAPH
  151     KM           SCS RUNOFF COMPUTATION
  152     BA    2.07
  153     PB    2.06
  154     LS       0      72
  155     UD    1.97

  156     KK     46A   SUB-BASIN 46A HYDROGRAPH
  157     KM           SCS RUNOFF COMPUTATION
  158     BA    7.35
  159     PB    2.16
  160     LS       0      73
  161     UD    1.60

  162     KK     46B   SUB-BASIN 46B HYDROGRAPH
  163     KM           SCS RUNOFF COMPUTATION
  164     BA    6.02
  165     PB    2.16
  166     LS       0      73
  167     UD    1.71

  168     KK  NODE O  COMBINE ALL FLOW AT NODE O
  169     HC       4

  170     KK     O-P    ROUTE FLOW TO NODE P
  171     RK   18600   .0051     .03            TRAP      70       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  172     KK     P*1    COMBINE FLOWS AT P*1
  173     HC       2
  174     KK     317    SUB-BASIN 317 HYDROGRAPH
  175     KM            SCS RUNOFF COMPUTATION
  176     BA    7.66
  177     PB    2.27
  178     LS       0      76
  179     UD     .97
  180     KK    318B    SUB-BASIN 318B HYDROGRAPH
  181     KM            SCS RUNOFF COMPUTATION
  182     BA    1.89
  183     PB    2.27
  184     LS       0      84
  185     UD     .37
  186     KK     Q-P    ROUTE FLOW TO NODE P
  187     RM       4     .26     .15
  188     KK    318A    SUB BASIN 318A HYDROGRAPH
  189     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  190     BA    2.19
  191     PB    2.11
  192     LS       0      74       0       0      97
  193     UK     700    .020     .30      89
  194     UK      50    .025     .10      11
  195     RK    2000    .035   .0375     .06              30      50
  196     RK    7000    .014     .05     .55              30      50
  197     RK    9200   .0043     .03            TRAP      30       1
  198     KK  NODE P   COMBINE FLOWS AT NODE P
  199     HC       4
  200     KK     P-M    ROUTE FLOWS TO NODE M
  201     RK    7400   .0034     .03            TRAP      80       1
  202     KK     047    SUB-BASIN 47 HYDROGRAPH
  203     KM            KINEMATIC RUNOFF COMPUTATION
  204     BA    7.40
  205     PB    2.06
  206     LS       0      74       0       0      97
  207     UK     800    .008     .20      74
  208     UK      80    .012     .10      26
  209     RK    7000    .007    .050    1.23              30      50
  210     RK   22000    .005     .03            TRAP      40       1
  211     KK  NODE M   COMBINE FLOW AT NODE M
  212     HC       3
  213     ZZ
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1 ****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.72
PRESENT CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
SUB-AREA A -- 40.7 SQ MI
CALIB. TO COE, AMC 1.8 (309,317 AMC 1.79)

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	41	996.	4.17	344.	125.	125.	4.73		
+	ROUTED TO	A-B	904.	4.42	340.	124.	124.	4.73		
+	HYDROGRAPH AT	302	1146.	4.33	446.	162.	162.	6.14		
+	2 COMBINED AT	NODE B	2032.	4.42	784.	286.	286.	10.87		
+	ROUTED TO	B-C	2020.	4.50	783.	286.	286.	10.87		
+	HYDROGRAPH AT	303	1130.	4.08	381.	138.	138.	4.49		
+	HYDROGRAPH AT	42B	711.	4.17	246.	89.	89.	4.08		
+	3 COMBINED AT	NODE C	3615.	4.33	1401.	513.	513.	19.44		
+	ROUTED TO	C-D	3602.	4.33	1400.	513.	513.	19.44		
+	HYDROGRAPH AT	42A	1267.	4.33	495.	179.	179.	8.23		

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
2 COMBINED AT	NODE D	4870.	4.33	1895.	692.	692.	27.67		
ROUTED TO	D-E	4822.	4.42	1890.	691.	691.	27.67		
HYDROGRAPH AT	305	800.	4.25	295.	107.	107.	3.99		
2 COMBINED AT	NODE E	5576.	4.42	2178.	798.	798.	31.66		
ROUTED TO	E-F	5284.	4.92	2177.	798.	798.	31.66		
HYDROGRAPH AT	306	564.	6.25	296.	112.	112.	9.04		
2 COMBINED AT	NODE F	5591.	5.00	2471.	910.	910.	40.70		
ROUTED TO	F-G	5349.	7.00	2465.	910.	910.	40.70		
HYDROGRAPH AT	307	630.	5.25	354.	150.	150.	8.07		
HYDROGRAPH AT	43	733.	5.33	306.	111.	111.	6.40		
ROUTED TO	H-I	708.	6.00	306.	111.	111.	6.40		
HYDROGRAPH AT	309	850.	5.67	402.	148.	148.	9.24		
2 COMBINED AT	NODE I	1547.	5.75	708.	258.	258.	15.64		
ROUTED TO	I-G	1536.	6.33	708.	258.	258.	15.64		
HYDROGRAPH AT	310	722.	5.42	393.	165.	165.	9.14		
4 COMBINED AT	NODE G	7570.	6.67	3827.	1483.	1483.	73.55		
ROUTED TO	G-M	7538.	6.83	3814.	1478.	1478.	73.55		
HYDROGRAPH AT	44	762.	5.50	344.	125.	125.	7.23		
ROUTED TO	J-K	756.	6.00	344.	125.	125.	7.23		
HYDROGRAPH AT	312	358.	7.00	226.	91.	91.	6.77		
2 COMBINED AT	NODE K	1053.	6.25	565.	217.	217.	14.00		
ROUTED TO	K-P	1024.	6.58	545.	214.	214.	14.00		

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	45	824.	5.58	364.	133.	133.	10.73		
ROUTED TO	N-O	819.	5.75	361.	133.	133.	10.73		
HYDROGRAPH AT	048	131.	6.17	68.	26.	26.	2.07		
HYDROGRAPH AT	46A	637.	5.75	306.	113.	113.	7.35		
HYDROGRAPH AT	46B	505.	5.92	249.	92.	92.	6.02		
4 COMBINED AT	NODE O	2083.	5.83	983.	363.	363.	26.17		
ROUTED TO	O-P	2034.	6.17	958.	362.	362.	26.17		
2 COMBINED AT	P*1	3004.	6.33	1499.	576.	576.	40.17		
HYDROGRAPH AT	317	1060.	4.50	460.	167.	167.	7.66		
HYDROGRAPH AT	318B	748.	3.75	191.	69.	69.	1.89		
ROUTED TO	Q-P	700.	4.00	191.	69.	69.	1.89		
HYDROGRAPH AT	318A	167.	5.83	99.	42.	42.	2.19		
4 COMBINED AT	NODE P	3936.	5.92	2157.	854.	854.	51.91		
ROUTED TO	P-M	3929.	6.00	2149.	851.	851.	51.91		
HYDROGRAPH AT	047	719.	4.25	442.	192.	192.	7.40		
3 COMBINED AT	NODE M	11409.	6.58	6356.	2521.	2521.	132.86		

*** NORMAL END OF HEC-1 ***

UPLAND STORM

FUTURE CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.72

1

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1 HEC-1 INPUT PAGE 1

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1     ID                    EAST AND WEST RANGE WASHES
    2     ID                 100-YR, 6-HR STORM      ARF = 0.72
    3     ID              FUTURE  CONDITIONS, EXISTING FACILITIES
    4     ID                         JULY   1989
    5     ID                   BOYLE ENGINEERING CORPORATION
    6     ID                     SUB-AREA A -- 40.7 SQ MI
    7     ID                  AMC 1.8 (309, 317, 305, 303 AMC 1.77)
    8     ID                 NEW FUTURE DEVELOPMENT IN 306, 307, 310
    9     IT      05       0       0     200
   10     IO       5       0       0

   11     KK      41   SUB-BASIN 41 HYDROGRAPH
   12     KM           SCS RUNOFF COMPUTATION, SUB-41
   13     BA    4.73
   14     PB    2.47
   15     PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   16     PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   17     PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   18     PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   19     PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   20     PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   21     PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   22     PC   99.90  100.00
   23     LS       0      76
   24     UD     .66

   25     KK     A-B      ROUTE FLOW TO NODE B
   26     RK   19100   .0455    .040            TRAP      50       1

   27     KK     302   SUB-BASIN 302 HYDROGRAPH
   28     KM           SCS RUNOFF CALCULATIONS
   29     BA    6.14
   30     PB    2.47
   31     LS       0      76
   32     UD     .82

   33     KK  NODE B  COMBINE FLOW AT NODE B
   34     HC       2

   35     KK     B-C   ROUTE FLOW TO NODE C
   36     RK    9910   .0504    .040            TRAP      50       1

   37     KK     303   SUB-BASIN 303 HYDROGRAPH
   38     KM           SCS RUNOFF COMPUTATION
   39     BA    4.49
   40     PB    2.21
   41     LS       0      81
   42     UD     .65

   43     KK     428   SUB-BASIN 428 HYDROGRAPH
   44     KM           SCS RUNOFF COMPUTION
   45     BA    4.08
   46     PB    2.27
   47     LS       0      76
   48     UD     .65
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK  NODE C  COMBINE FLOW AT NODE C
  50      HC       3
  51      KK     C-D    ROUTE FLOW TO NODE D
  52      RK    7000   .0571    .035            TRAP      50       1
  53      KK     42A    SUB-BASIN 42A HYDROGRAPH
  54      KM            SCS RUNOFF COMPUTATION
  55      BA    8.23
  56      PB    2.27
  57      LS       0      76
  58      UD     .81
  59      KK  NODE D  COMBINE FLOW AT NODE D
  60      HC       2
  61      KK     D-E    ROUTE FLOW TO NODE E
  62      RK   16200   .0414     .03            TRAP      70       1
  63      KK     305    SUB-BASIN 305 HYDROGRAPH
  64      KM            SCS RUNOFF COMPUTATION
  65      BA    3.99
  66      PB    2.06
  67      LS       0      81
  68      UD     .76
  69      KK  NODE E  COMBINE FLOWS AT NODE E
  70      HC       2
  71      KK     E-F    ROUTE FLOWS TO NODE F
  72      RM       5     .46     .10
  73      KK     306    SUB-BASIN 306 HYDROGRAPH
  74      KM            SCS RUNOFF COMPUTATION
  75      BA    9.04
  76      PB    2.06
  77      LS       0      80
  78      UD    1.61
  79      KK  NODE F  COMBINE FLOWS AT NODE F
  80      KO       1
  81      HC       2
  82      KK     F-G    ROUTE FLOWS TO NODE G
  83      RM      18    1.57     .10
  84      KK     307   SUB-BASIN 307 HYDROGRAPH
  85      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  86      BA    8.07
  87      PB    2.06
  88      LS       0      73       0       0      97
  89      UK     800   .0123     .20      51
  90      UK     300    .015     .10      49
  91      RK    5000     .01     .05     .25             30       50
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  92      RK    3200    .013     .05    1.01              30      50
  93      RK    9500    .008     .03            TRAP      40     1.5      NO

  94      KK      43    SUB-BASIN 43 HYDROGRAPH
  95      KM            SCS RUNOFF COMPUTATION
  96      BA    6.40
  97      PB    2.06
  98      LS       0      76
  99      UD     .88

 100      KK     H-I    ROUTE FLOWS TO NODE I
 101      RM       7     .72     .10

 102      KK     309     SUB-BASIN 309 HYDROGRAPH
 103      KM            SCS RUNOFF COMPUTATION
 104      BA    9.24
 105      PB    2.06
 106      LS       0      75
 107      UD    1.51

 108      KK  NODE I COMBINE FLOWS AT NODE I
 109      HC       2

 110      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 111      RM       8     .58     .15

 112      KK     310    SUB-BASIN 310 HYDROGRAPH
 113      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 114      BA    9.14
 115      PB    2.06
 116      LS       0      73       0       0      97
 117      UK     800    .015     .20      68
 118      UK     300    .020     .10      32
 119      RK    2750     .01     .05     .25              30      50
 120      RK    7300     .01     .05    1.01    TRAP      30      50
 121      RK   9000.   .0036     .05            TRAP      60       1      NO

 122      KK  NODE G  COMBINE ALL FLOWS AT NODE G
 123      HC       4

 124      KK     G-M    ROUTE FLOWS TO NODE M
 125      RK   15800  0.0035    .023            TRAP      50       1

 126      KK      44    SUB-BASIN 44 HYDROGRAPH
 127      KM            SCS RUNOFF COMPUTATION
 128      BA    7.23
 129      PB    2.06
 130      LS       0      76
 131      UD    1.22
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  132     KK     J-K    ROUTE FLOW TO NODE K
  133     RM       8     .58     .15

  134     KK     312    SUB-BASIN 312 HYDROGRAPH
  135     KM            SCS RUNOFF COMPUTATION
  136     BA    6.77
  137     PB    2.06
  138     LS       0      73
  139     UD    2.83

  140     KK   NODE K   COMBINE FLOW AT NODE K
  141     HC       2

  142     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  143     RK   17400    .0052    .030            TRAP      70       1

  144     KK      45    SUB-BASIN 45 HYDROGRAPH
  145     KM            SCS RUNOFF COMPUTATION
  146     BA   10.73
  147     PB    2.06
  148     LS       0      72       0       0       0       0
  149     UD    1.31

  150     KK     N-O    ROUTE FLOW TO NODE O
  151     RK    9550    .0157    .035            TRAP      50       1

  152     KK     048    SUB-BASIN 048 HYDROGRAPH
  153     KM            SCS RUNOFF COMPUTATION
  154     BA    2.07
  155     PB    2.06
  156     LS       0      72
  157     UD    1.97

  158     KK     46A    SUB-BASIN 46A HYDROGRAPH
  159     KM            SCS RUNOFF COMPUTATION
  160     BA    7.35
  161     PB    2.16
  162     LS       0      73
  163     UD    1.60

  164     KK     46B    SUB-BASIN 46B HYDROGRAPH
  165     KM            SCS RUNOFF COMPUTATION
  166     BA    6.02
  167     PB    2.16
  168     LS       0      73
  169     UD    1.71

  170     KK   NODE O   COMBINE ALL FLOW AT NODE O
  171     HC       4
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  172     KK     O-P    ROUTE FLOW TO NODE P
  173     RK   18600   .0051     .03            TRAP      70       1

  174     KK     P*1    COMBINE FLOWS AT P*1
  175     KO       1
  176     HC       2

  177     KK     317    SUB-BASIN 317 HYDROGRAPH
  178     KM            SCS RUNOFF COMPUTATION
  179     BA    7.66
  180     PB    2.27
  181     LS       0      76
  182     UD     .97

  183     KK    3188    SUB-BASIN 318B HYDROGRAPH
  184     KM            SCS RUNOFF COMPUTATION
  185     BA    1.89
  186     PB    2.27
  187     LS       0      84       0
  188     UD     .37

  189     KK     Q-P    ROUTE FLOW TO NODE P
  190     RM       4     .26     .15

  191     KK    318A    SUB BASIN 318A HYDROGRAPH
  192     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  193     BA    2.19
  194     PB    2.11
  195     LS       0      73       0       0      97
  196     UK     700    .020     .30      74
  197     UK      50    .025     .10      26
  198     RK    2000    .035     .05     .06              30       50
  199     RK    7000    .014     .05     .55              30       50
  200     RK    9200   .0043     .03            TRAP      30        1

  201     KK  NODE P  COMBINE FLOWS AT NODE P
  202     HC       4

  203     KK     P-M    ROUTE FLOWS TO NODE M
  204     RK    7400   .0034     .03            TRAP      80        1

  205     KK     047    SUB-BASIN 47 HYDROGRAPH
  206     KM            KINEMATIC RUNOFF COMPUTATION
  207     BA    7.40
  208     PB    2.06
  209     LS       0      73       0       0      97
  210     UK     800    .008     .20      69
  211     UK      80    .012     .10      31
  212     RK    2000    .003     .05     .25              30       50
  213     RK    7000    .007     .05    1.23              30       50
  214     RK   22000    .005     .03            TRAP      40        1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 215      KK  NODE M  COMBINE FLOW AT NODE M
 216      HC       3
 217      KK     M-S   ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
 218      RK    4600  .0028    .023            TRAP      80       1
 219      KK     48B   SUB-BASIN 48B HYDROGRAPH
 220      KM           SCS RUNOFF COMPUTATION
 221      BA     .99
 222      PB    2.16
 223      LS       0      84       0       0       0       0
 224      UD     .24
 225      KK     R-S   ROUTE FLOW TO NODE S
 226      RK    9100  .0316    .035            TRAP      80       1
 227      KK     48A   SUB-BASIN 48A HYDROGRAPH
 228      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 229      BA     .49
 230      PB    2.11
 231      LS       0      72       0       0      97
 232      UK     700    .025     .30      73
 233      UK      60     .03     .10      27
 234      RK    2000     .02    .050     .04              30      50
 235      RK     800     .02    .050     .12              30      50
 236      RK    9000    .033     .02            TRAP      20       1      NO
 237      KK     321   SUB-BASIN 321 HYDROGRAPH
 238      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 239      BA    3.42
 240      PB    2.06
 241      LS       0      72       0       0      97
 242      UK     800    .010     .30      54
 243      UK      50    .020     .10      46
 244      RK    3500    .006    .050     .14              30      50
 245      RK    7400   .0014    .050     .58              30      50
 246      RK   21200.  .0035    .035            TRAP     70.      1.     NO
 247      KK     49A   SUB-BASIN 49A HYDROGRAPH
 248      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 249      BA    0.60
 250      PB    2.06
 251      LS       0      72       0       0      97
 252      UK     700    .034     .30      73
 253      UK      60     .04     .10      27
 254      RK    2000     .03     .05     .04              30      50
 255      RK    1000    .003    .050     .12              30      50
 256      RK    9200    .034    .035            TRAP      20       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  257     KK  NODE S  COMBINE ALL FLOWS AT NODE S
  258     HC       5

  259     KK     S-V   ROUTE FLOWS TO NODE V   (SLOAN CHANNEL)
  260     RK    6800  .0038    .023            TRAP      80       1

  261     KK     324   SUB-BASIN 324 HYDROGRAPH
  262     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  263     BA    1.40
  264     PB    2.06
  265     LS       0      73       0       0      97
  266     UK     800     .01     .30      56
  267     UK      60     .01     .10      44
  268     RK   1300.    .004     .05     .07    TRAP      30       50
  269     RK    2500   .0017     .05     .28              30       50
  270     RK   7000.    .005    .035            TRAP      70       1      NO

  271     KK     498    SUB-BASIN 498 HYDROGRAPH
  272     KM           SCS RUNOFF COMPUTATION
  273     BA    1.04
  274     PB    2.11
  275     LS       0      85       0       0       0       0
  276     UD     .25

  277     KK     T-V   ROUTE FLOWS TO NODE V
  278     RM       3    .52     .10

  279     KK  NODE V   COMBINE ALL FLOWS AT NODE V
  280     HC       3

  281     KK     50B   SUB-BASIN 50B HYDROGRAPH
  282     KM           SCS RUNOFF COMPUTATION
  283     BA     .55
  284     PB    2.16
  285     LS       0      85       0       0       0       0
  286     UD     .17

  287     KK     U-V   ROUTE FLOWS TO NODE V
  288     RM       3    .43     .10

  289     KK     50A   SUB-BASIN 50A HYDROGRAPH
  290     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  291     BA    1.78
  292     PB    2.06
  293     LS       0      72       0       0      97       0
  294     UK     800    .025     .30      73
  295     UK      60     .03     .10      27
  296     RK    1000    .030    .050     .12              30       50
  297     RK    3000    .010    .050     .45              30       50
  298     RK    7500    .029    .035            TRAP      40       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  299     KK      53     SUB-BASIN 53 HYDROGRAPH
  300     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  301     BA    1.44
  302     PB    2.06
  303     LS       0      73       0       0      97       0
  304     UK     600    .010     .30      56
  305     UK      50    .010     .10      44
  306     RK    1300.  .0033    .050    .053    TRAP      30      50
  307     RK    3100.  .0017    .050    .21     TRAP      30      50
  308     RK   12300.  .0033    .02             TRAP      20       1      NO

  309     KK     W-V    ROUTE FLOWS TO NODE V
  310     RM       3     .36     .10

  311     KK  NODE V  COMBINE ALL FLOWS AT NODE V
  312     HC       4

  313     KK     V-Z   ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  314     RK    7780  .0041     .23             TRAP      80       1

  315     KK     51B    SUB-BASIN 51B HYDROGRAPH
  316     KM            SCS RUNOFF COMPUTATION
  317     BA    0.47
  318     PB    2.06
  319     LS       0      85       0       0       0       0
  320     UD     .13

  321     KK     X-Z    ROUTE FLOWS TO NODE Z
  322     RM       3     .54     .10

  323     KK     51A     SUB-BASIN 51A HYDROGRAPH
  324     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  325     BA     .99
  326     PB    2.11
  327     LS       0      73       0       0      97       0
  328     UK     600     .03     .30      73
  329     UK      60    .030     .10      27
  330     RK    1000.    .03    .050     .05              30      50
  331     RK    2500.  .0075    .050    .100    TRAP      30      50
  332     RK    8000.  .0400    .025            TRAP      50       1      NO

  333     KK     51C     SUB-BASIN 51C HYDROGRAPH
  334     KM             SCS RUNOFF COMPUTATION
  335     BA     .43
  336     PB    2.11
  337     LS       0      85       0
  338     UD     .19

  339     KK     Y-Z    ROUTE FLOWS TO NODE Z
  340     RM       3     .54     .10
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  341     KK     510    SUB-BASIN 51D HYDROGRAPH
  342     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  343     BA    .83
  344     PB   2.06
  345     LS      0      72       0       0      97
  346     UK    600     .03     .30      77
  347     UK     60     .035    .10      23
  348     RK   1000     .03     .05     .02             30      50
  349     RK   2500    .0240    .050    .080            30      50
  350     RK   8000    .0300    .025            TRAP    50       1

  351     KK  NODE Z    COMBINE ALL FLOWS AT NODE Z
  352     HC      5

  353     KK    Z-BB    ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  354     RK    2680    .0044    .023           TRAP     80       1

  355     KK     52B    SUB-BASIN 52B HYDROLOGY
  356     KM            SCS RUNOFF COMPUTATION
  357     BA    .70
  358     PB   2.06
  359     LS      0      85
  360     UD    .11

  361     KK   AA-BB    ROUTE FLOWS TO NODE BB
  362     RM      4     .62     .10

  363     KK  NODEBB    COMBINE ALL FLOWS AT NODE BB
  364     HC      2

  365     KK     52A    SUB-BASIN 52A HYDROGRAPH
  366     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  367     BA    1.18
  368     PB   2.06
  369     LS      0      74       0       0      97       0
  370     UK    600     .025    .30      91
  371     UK     60     .035    .10       9
  372     RK   1000     .03     .050    .04             30      50
  373     RK   2000     .025    .050    .24             30      50
  374     RK  11200.    .028    .035            TRAP    30       1      NO

  375     KK   NO.BB  COMBINE ALL FLOWS AT NODE BB
  376     HC      2

  377     KK   BB-CC    ROUTE FLOWS TO NODE CC
  378     RK   4000      55    .023           TRAP     80       1

  379     KK     326    SUB-BASIN 326 HYDROGRAPH
  380     KM            KINEMATIC WAVE COMPUTATION
  381     BA    1.71
  382     PB   2.06
  383     LS      0      72       0       0      97       0
  384     UK    700     .010    .30      73
  385     UK     60    .0100    .10      27
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  386     RK    1800    .0035    .050     .11              30       50
  387     RK    4000    .0014    .050     .43              30       50
  388     RK   12500    .0038    .035             TRAP     80        1

  389     KK   NO.CC    COMBINE ALL FLOWS AT NODE CC
  390     HC       2
  391     ZZ
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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.72
FUTURE CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
SUB-AREA A -- 40.7 SQ MI
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

10 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	41	996.	4.17	344.	125.	125.	4.73		
+	ROUTED TO	A-B	904.	4.42	340.	124.	124.	4.73		
+	HYDROGRAPH AT	302	1146.	4.33	446.	162.	162.	6.14		
+	2 COMBINED AT	NODE B	2032.	4.42	784.	286.	286.	10.87		
•	ROUTED TO	B-C	2020.	4.50	783.	286.	286.	10.87		
+	HYDROGRAPH AT	303	1058.	4.08	358.	130.	130.	4.49		
+	HYDROGRAPH AT	42B	711.	4.17	246.	89.	89.	4.08		
+	3 COMBINED AT	NODE C	3557.	4.33	1379.	504.	504.	19.44		
+	ROUTED TO	C-D	3541.	4.33	1378.	504.	504.	19.44		
	HYDROGRAPH AT	42A	1267.	4.33	495.	179.	179.	8.23		
+	2 COMBINED AT	NODE D	4809.	4.33	1873.	683.	683.	27.67		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	D-E	4760.	4.42	1868.	683.	683.	27.67		
HYDROGRAPH AT	305	746.	4.25	275.	100.	100.	3.99		
2 COMBINED AT	NODE E	5465.	4.42	2137.	783.	783.	31.66		
ROUTED TO	E-F	5178.	4.92	2136.	783.	783.	31.66		
HYDROGRAPH AT	306	1145.	5.67	569.	211.	211.	9.04		
2 COMBINED AT	NODE F	6164.	5.00	2705.	993.	993.	40.70		
ROUTED TO	F-G	5922.	7.00	2699.	993.	993.	40.70		
HYDROGRAPH AT	307	1845.	4.00	728.	292.	292.	8.07		
HYDROGRAPH AT	43	733.	5.33	306.	111.	111.	6.40		
ROUTED TO	H-I	708.	6.00	306.	111.	111.	6.40		
HYDROGRAPH AT	309	850.	5.67	402.	148.	148.	9.24		
2 COMBINED AT	NODE I	1547.	5.75	708.	258.	258.	15.64		
ROUTED TO	I-G	1536.	6.33	708.	258.	258.	15.64		
HYDROGRAPH AT	310	1173.	4.33	618.	255.	255.	9.14		
4 COMBINED AT	NODE G	8332.	6.67	4587.	1798.	1798.	73.55		
ROUTED TO	G-M	8301.	6.75	4570.	1794.	1794.	73.55		
HYDROGRAPH AT	44	762.	5.50	344.	125.	125.	7.23		
ROUTED TO	J-K	756.	6.00	344.	125.	125.	7.23		
HYDROGRAPH AT	312	358.	7.00	226.	91.	91.	6.77		
2 COMBINED AT	NODE K	1053.	6.25	565.	217.	217.	14.00		
ROUTED TO	K-P	1024.	6.58	545.	214.	214.	14.00		
HYDROGRAPH AT	45	824.	5.58	364.	133.	133.	10.73		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	N-O	819.	5.75	361.	133.	133.	10.73		
HYDROGRAPH AT	048	131.	6.17	68.	26.	26.	2.07		
HYDROGRAPH AT	46A	637.	5.75	306.	113.	113.	7.35		
HYDROGRAPH AT	46B	505.	5.92	249.	92.	92.	6.02		
4 COMBINED AT	NODE O	2083.	5.83	983.	363.	363.	26.17		
ROUTED TO	O-P	2034.	6.17	958.	362.	362.	26.17		
2 COMBINED AT	P*1	3004.	6.33	1499.	576.	576.	40.17		
HYDROGRAPH AT	317	1060.	4.50	460.	167.	167.	7.66		
HYDROGRAPH AT	318B	748.	3.75	191.	69.	69.	1.89		
ROUTED TO	Q-P	700.	4.00	191.	69.	69.	1.89		
HYDROGRAPH AT	318A	246.	4.17	133.	57.	57.	2.19		
4 COMBINED AT	NODE P	3946.	5.83	2187.	869.	869.	51.91		
ROUTED TO	P-M	3940.	6.00	2179.	866.	866.	51.91		
HYDROGRAPH AT	047	804.	4.42	465.	201.	201.	7.40		
3 COMBINED AT	NODE M	12222.	6.58	7204.	2860.	2860.	132.86		
ROUTED TO	M-S	12215.	6.67	7202.	2857.	2857.	132.86		
HYDROGRAPH AT	48B	432.	3.67	91.	33.	33.	.99		
ROUTED TO	R-S	379.	3.83	90.	33.	33.	.99		
HYDROGRAPH AT	48A	94.	3.67	31.	13.	13.	.49		
HYDROGRAPH AT	321	425.	5.83	260.	115.	115.	3.42		
HYDROGRAPH AT	49A	98.	3.75	36.	15.	15.	.60		
5 COMBINED AT	NODE S	12640.	6.67	7583.	3033.	3033.	138.36		

TRIBUTARY BASIN STORM

PRESENT CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.68

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
ROUTED TO	S-V	12634.	6.67	7578.	3028.	3028.	138.36		
HYDROGRAPH AT	324	278.	4.08	111.	47.	47.	1.40		
HYDROGRAPH AT	498	456.	3.67	98.	35.	35.	1.04		
ROUTED TO	T-V	327.	4.17	98.	35.	35.	1.04		
3 COMBINED AT	NODE	12720.	6.67	7756.	3111.	3111.	140.80		
HYDROGRAPH AT	508	298.	3.58	54.	20.	20.	.55		
ROUTED TO	U-V	203.	3.92	54.	20.	20.	.55		
HYDROGRAPH AT	50A	330.	3.67	106.	45.	45.	1.78		
HYDROGRAPH AT	53	256.	4.25	118.	49.	49.	1.44		
ROUTED TO	W-V	243.	4.67	118.	49.	49.	1.44		
4 COMBINED AT	NODE V	12902.	6.67	7991.	3225.	3225.	144.57		
ROUTED TO	V-Z	12782.	6.92	7893.	3195.	3195.	144.57		
HYDROGRAPH AT	51B	247.	3.58	42.	15.	15.	.47		
ROUTED TO	X-Z	150.	4.00	42.	15.	15.	.47		
HYDROGRAPH AT	51A	165.	3.75	66.	27.	27.	.99		
HYDROGRAPH AT	51C	214.	3.58	41.	15.	15.	.43		
ROUTED TO	Y-Z	139.	4.08	41.	15.	15.	.43		
HYDROGRAPH AT	51D	115.	3.75	46.	19.	19.	.83		
5 COMBINED AT	NODE Z	12846.	6.92	8014.	3270.	3270.	147.29		
ROUTED TO	Z-BB	12839.	6.92	8012.	3268.	3268.	147.29		
HYDROGRAPH AT	52B	384.	3.50	63.	23.	23.	.70		
ROUTED TO	AA-BB	224.	4.08	63.	23.	23.	.70		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	2 COMBINED AT	NODEBB	12842.	6.92	8048.	3291.	3291.	147.99		
+	HYDROGRAPH AT	52A	103.	5.25	49.	20.	20.	1.18		
+	2 COMBINED AT	NO.BB	12886.	6.92	8091.	3312.	3312.	149.17		
+	ROUTED TO	BB-CC	12885.	6.92	8091.	3311.	3311.	149.17		
+	HYDROGRAPH AT	326	150.	5.25	93.	42.	42.	1.71		
+	2 COMBINED AT	NO.CC	12985.	6.92	8182.	3353.	3353.	150.88		

*** NORMAL END OF HEC-1 ***

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
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THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1 HEC-1 INPUT PAGE 1

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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID                  100-YR, 6-HR STORM      ARF = 0.68
    2         ID               PRESENT CONDITIONS, EXISTING FACILITIES
    3         ID                        JULYL 1989
    4         ID                    BOYLE ENGINEERING CORPORATION
    5         ID               AREA C -- 151 SQ MI -- ABOVE M
    6         ID                  AMC 1.8 (309,317 MODIFIED TO AMC 1.79)
    7         IT      05       0       0     200
    8         IO       5       0       0

    9         KK      41   SUB-BASIN 41 HYDROGRAPH
   10         KM           SCS RUNOFF COMPUTATION, SUB-41
   11         BA    4.73
   12         PB    2.13
   13         PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   14         PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   15         PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   16         PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   17         PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   18         PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   19         PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   20         PC   99.90  100.00
   21         LS       0      76
   22         UD     .66

   23         KK     A-B      ROUTE FLOW TO NODE B
   24         RK   19100   .0455    .040            TRAP      50       1

   25         KK     302   SUB-BASIN 302 HYDROGRAPH
   26         KM           SCS RUNOFF CALCULATIONS
   27         BA    6.14
   28         PB    2.23
   29         LS       0      76
   30         UD     .82

   31         KK  NODE B   COMBINE FLOW AT NODE B
   32         HC       2

   33         KK     B-C   ROUTE FLOW TO NODE C
   34         RK    9910   .0504    .040            TRAP      50       1

   35         KK     303   SUB-BASIN 303 HYDROGRAPH
   36         KM           SCS RUNOFF COMPUTATION
   37         BA    4.49
   38         PB    2.10
   39         LS       0      82
   40         UD     .65

   41         KK     42B   SUB-BASIN 42B HYDROGRAPH
   42         KM           SCS RUNOFF COMPUTION
   43         BA    4.08
   44         PB    2.14
   45         LS       0      76
   46         UD     .65
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  47      KK  NODE C  COMBINE FLOW AT NODE C
  48      HC       3
  49      KK     C-D    ROUTE FLOW TO NODE D
  50      RK    7000   .0571    .035            TRAP      50       1
  51      KK     42A    SUB-BASIN 42A HYDROGRAPH
  52      KM            SCS RUNOFF COMPUTATION
  53      BA    8.23
  54      PB    2.14
  55      LS       0      76
  56      UD     .81
  57      KK  NODE D  COMBINE FLOW AT NODE D
  58      HC       2
  59      KK     D-E    ROUTE FLOW TO NODE E
  60      RK   16200   .0414     .03            TRAP      70       1
  61      KK     305    SUB-BASIN 305 HYDROGRAPH
  62      KM            SCS RUNOFF COMPUTATION
  63      BA    3.99
  64      PB    1.95
  65      LS       0      82
  66      UD     .76
  67      KK  NODE E COMBINE FLOWS AT NODE E
  68      HC       2
  69      KK     E-F    ROUTE FLOWS TO NODE F
  70      RM       5     .46     .10
  71      KK     306    SUB-BASIN 306 HYDROGRAPH
  72      KM            SCS RUNOFF COMPUTATION
  73      BA    9.04
  74      PB    1.95
  75      LS       0      72
  76      UD    2.00
  77      KK  NODE F  COMBINE FLOWS AT NODE F
  78      HC       2
  79      KK     F-G    ROUTE FLOWS TO NODE G
  80      RM      1B    1.57     .10
  81      KK     307   SUB-BASIN 307 HYDROGRAPH
  82      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  83      BA    8.07
  84      PB    1.95
  85      LS       0      74       0       0      97
  86      UK     800   .0123     .20      89
  87      UK      60    .015     .10      11
  88      RK   10000     .01   .0375     .67              5       1
  89      RK    3200    .013   .0375     2.0              5       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  90      RK    9500    .008     .03            TRAP      40     1.5      NO

  91      KK      43    SUB-BASIN 43 HYDROGRAPH
  92      KM            SCS RUNOFF COMPUTATION
  93      BA    6.40
  94      PB    1.95
  95      LS       0      76
  96      UD     .88

  97      KK     H-I    ROUTE FLOWS TO NODE I
  98      RM       7     .72     .10

  99      KK     309     SUB-BASIN 309 HYDROGRAPH
 100      KM            SCS RUNOFF COMPUTATION
 101      BA    9.24
 102      PB    1.95
 103      LS       0      75
 104      UD    1.51

 105      KK  NODE I COMBINE FLOWS AT NODE I
 106      HC       2

 107      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 108      RM       8     .58     .15

 109      KK     310    SUB-BASIN 310 HYDROGRAPH
 110      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 111      BA    9.14
 112      PB    1.95
 113      LS       0      74       0       0      97
 114      UK     800    .015     .20      89
 115      UK      60    .020     .10      11
 116      RK    5500     .01   .0375    1.01
 117      RK    8500     .01   .0375    3.04    TRAP      50
 118      RK   9000.   .0036     .05            TRAP      60       1      NO

 119      KK  NODE G  COMBINE ALL FLOWS AT NODE G
 120      HC       4

 121      KK     G-M    ROUTE FLOWS TO NODE M
 122      RK   15800  0.0035    .023            TRAP      50       1

 123      KK      44    SUB-BASIN 44 HYDROGRAPH
 124      KM            SCS RUNOFF COMPUTATION
 125      BA    7.23
 126      PB    1.95
 127      LS       0      76
 128      UD    1.22

 129      KK     J-K    ROUTE FLOW TO NODE K
 130      RM       8     .58     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  131     KK     312   SUB-BASIN 312 HYDROGRAPH
  132     KM           SCS RUNOFF COMPUTATION
  133     BA    6.77
  134     PB    1.95
  135     LS       0      73
  136     UD    2.83

  137     KK  NODE K  COMBINE FLOW AT NODE K
  138     HC       2

  139     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  140     RK   17400   .0052    .030            TRAP      70       1

  141     KK      45   SUB-BASIN 45 HYDROGRAPH
  142     KM           SCS RUNOFF COMPUTATION
  143     BA   10.73
  144     PB    1.95
  145     LS       0      72       0       0       0       0
  146     UD    1.31

  147     KK     N-O    ROUTE FLOW TO NODE O
  148     RK    9550   .0157    .035            TRAP      50       1

  149     KK     048    SUB-BASIN 048 HYDROGRAPH
  150     KM           SCS RUNOFF COMPUTATION
  151     BA    2.07
  152     PB    1.95
  153     LS       0      72
  154     UD    1.97

  155     KK     46A   SUB-BASIN 46A HYDROGRAPH
  156     KM           SCS RUNOFF COMPUTATION
  157     BA    7.35
  158     PB    2.05
  159     LS       0      73
  160     UD    1.60

  161     KK     46B   SUB-BASIN 46B HYDROGRAPH
  162     KM           SCS RUNOFF COMPUTATION
  163     BA    6.02
  164     PB    2.05
  165     LS       0      73
  166     UD    1.71

  167     KK  NODE O  COMBINE ALL FLOW AT NODE O
  168     HC       4

  169     KK     O-P    ROUTE FLOW TO NODE P
  170     RK   18600   .0051     .03            TRAP      70       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  171     KK    P*1     COMBINE FLOWS AT P
  172     HC      2
  173     KK     317    SUB-BASIN 317 HYDROGRAPH
  174     KM            SCS RUNOFF COMPUTATION
  175     BA    7.66
  176     PB    2.14
  177     LS       0      76
  178     UD     .97
  179     KK    318B    SUB-BASIN 318B HYDROGRAPH
  180     KM            SCS RUNOFF COMPUTATION
  181     BA    2.05
  182     PB    1.95
  183     LS       0      84
  184     UD     .37
  185     KK     Q-P    ROUTE FLOW TO NODE P
  186     RM       4     .26     .15
  187     KK    318A    SUB BASIN 318A HYDROGRAPH
  188     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  189     BA    2.19
  190     PB    2.00
  191     LS       0      74       0       0      97
  192     UK     700    .020     .30      89
  193     UK      50    .025     .10      11
  194     RK    2000    .035   .0375     .06              30      50
  195     RK    7000    .014     .05     .55              30      50
  196     RK    9200   .0043     .03             TRAP     30       1
  197     KK  NODE P  COMBINE FLOWS AT NODE P
  198     HC       4
  199     KK     P-M    ROUTE FLOWS TO NODE M
  200     RK    7400   .0034     .03             TRAP     80       1
  201     KK     047    SUB-BASIN 47 HYDROGRAPH
  202     KM            KINEMATIC RUNOFF COMPUTATION
  203     BA    7.40
  204     PB    1.95
  205     LS       0      74       0       0      97
  206     UK     800    .008     .20      74
  207     UK      80    .012     .10      26
  208     RK    7000    .007    .050    1.23              30      50
  209     RK   22000    .005     .03             TRAP     40       1
  210     KK  NODE M  COMBINE FLOW AT NODE M
  211     HC       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 212      KK     M-S    ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
 213      RK    4600   .0028    .023            TRAP      80       1
 214      ZZ
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FLOOD HYDROGRAPH PACKAGE HEC-1 (18M XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

100-YR, 6-HR STORM ARF = 0.68
PRESENT CONDITIONS, EXISTING FACILITIES
JULYL 1989
BOYLE ENGINEERING CORPORATION
AREA C -- 151 SQ MI -- ABOVE M
AMC 1.8 (309,317 MODIFIED TO AMC 1.79)

8 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	41	698.	4.17	245.	89.	89.	4.73		
ROUTED TO	A-B	629.	4.50	242.	89.	89.	4.73		
HYDROGRAPH AT	302	899.	4.33	354.	128.	128.	6.14		
2 COMBINED AT	NODE B	1507.	4.42	595.	217.	217.	10.87		
ROUTED TO	B-C	1494.	4.50	594.	217.	217.	10.87		
HYDROGRAPH AT	303	1022.	4.08	345.	125.	125.	4.49		
HYDROGRAPH AT	42B	614.	4.17	214.	77.	77.	4.08		
3 COMBINED AT	NODE C	2869.	4.33	1145.	419.	419.	19.44		
ROUTED TO	C-D	2856.	4.42	1145.	419.	419.	19.44		
HYDROGRAPH AT	42A	1094.	4.33	431.	156.	156.	8.23		
2 COMBINED AT	NODE D	3941.	4.33	1576.	575.	575.	27.67		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	D-E	3908.	4.50	1571.	575.	575.	27.67		
HYDROGRAPH AT	305	715.	4.25	264.	96.	96.	3.99		
2 COMBINED AT	NODE E	4555.	4.42	1829.	670.	670.	31.66		
ROUTED TO	E-F	4340.	5.00	1828.	670.	670.	31.66		
HYDROGRAPH AT	306	484.	6.25	253.	96.	96.	9.04		
2 COMBINED AT	NODE F	4643.	5.83	2079.	766.	766.	40.70		
ROUTED TO	F-G	4517.	7.08	2074.	765.	765.	40.70		
HYDROGRAPH AT	307	515.	5.25	311.	133.	133.	8.07		
HYDROGRAPH AT	43	652.	5.33	267.	97.	97.	6.40		
ROUTED TO	H-I	628.	6.00	267.	97.	97.	6.40		
HYDROGRAPH AT	309	743.	5.67	349.	128.	128.	9.24		
2 COMBINED AT	NODE I	1359.	5.83	617.	225.	225.	15.64		
ROUTED TO	I-G	1348.	6.33	616.	225.	225.	15.64		
HYDROGRAPH AT	310	589.	5.50	345.	147.	147.	9.14		
4 COMBINED AT	NODE G	6424.	6.75	3262.	1270.	1270.	73.55		
ROUTED TO	G-M	6397.	6.92	3250.	1265.	1265.	73.55		
HYDROGRAPH AT	44	673.	5.50	300.	109.	109.	7.23		
ROUTED TO	J-K	665.	6.00	300.	109.	109.	7.23		
HYDROGRAPH AT	312	309.	7.00	194.	79.	79.	6.77		
2 COMBINED AT	NODE K	921.	6.25	490.	188.	188.	14.00		
ROUTED TO	K-P	891.	6.67	471.	185.	185.	14.00		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	45	712.	5.67	311.	113.	113.	10.73		
+	ROUTED TO	N-O	706.	5.83	308.	113.	113.	10.73		
+	HYDROGRAPH AT	048	112.	6.25	58.	22.	22.	2.07		
+	HYDROGRAPH AT	46A	558.	5.83	266.	98.	98.	7.35		
+	HYDROGRAPH AT	46B	442.	5.92	217.	80.	80.	6.02		
+	4 COMBINED AT	NODE O	1810.	5.83	848.	313.	313.	26.17		
+	ROUTED TO	O-P	1758.	6.25	824.	312.	312.	26.17		
+	2 COMBINED AT	P*1	2602.	6.33	1292.	497.	497.	40.17		
+	HYDROGRAPH AT	317	926.	5.42	401.	145.	145.	7.66		
	HYDROGRAPH AT	318B	612.	3.75	156.	57.	57.	2.05		
+	ROUTED TO	Q-P	573.	4.08	156.	57.	57.	2.05		
+	HYDROGRAPH AT	318A	138.	5.92	87.	38.	38.	2.19		
+	4 COMBINED AT	NODE P	3361.	6.00	1857.	737.	737.	52.07		
+	ROUTED TO	P-M	3353.	6.08	1849.	734.	734.	52.07		
+	HYDROGRAPH AT	047	656.	4.25	398.	174.	174.	7.40		
+	2 COMBINED AT	NODE M	3839.	6.00	2227.	908.	908.	59.47		
+	ROUTED TO	M-S	3837.	6.08	2225.	906.	906.	59.47		

*** NORMAL END OF HEC-1 ***

TRIBUTARY BASIN STORM

FUTURE CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.68

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1 HEC-1 INPUT PAGE 1

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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID                    EAST AND WEST RANGE WASHES
  2           ID                 100-YR, 6-HR STORM      ARF = 0.68
  3           ID              FUTURE  CONDITIONS, EXISTING FACILITIES
  4           ID                         JULY   1989
  5           ID                    BOYLE ENGINEERING CORPORATION
  6           ID                  SUB-AREA M--AREA ABOVE CONFLUENCE
  7           ID                 AMC 1.8 (309, 317, 305, 303 AMC 1.77)
  8           ID                 NEW FUTURE DEVELOPMENT IN 306, 307, 310
  9           IT      05       0       0     200
 10           IO       5       0       0

 11           KK      41   SUB-BASIN 41 HYDROGRAPH
 12           KM           SCS RUNOFF COMPUTATION, SUB-41
 13           BA    4.73
 14           PB    2.34
 15           PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
 16           PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
 17           PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
 18           PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
 19           PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
 20           PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
 21           PC   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
 22           PC   99.90  100.00
 23           LS       0      76
 24           UD     .66

 25           KK     A-B      ROUTE FLOW TO NODE B
 26           RK   19100   .0455    .040            TRAP      50       1

 27           KK     302   SUB-BASIN 302 HYDROGRAPH
 28           KM           SCS RUNOFF CALCULATIONS
 29           BA    6.14
 30           PB    2.24
 31           LS       0      76
 32           UD     .82

 33           KK  NODE B   COMBINE FLOW AT NODE B
 34           HC       2

 35           KK     B-C   ROUTE FLOW TO NODE C
 36           RK    9910   .0504    .040            TRAP      50       1

 37           KK     303   SUB-BASIN 303 HYDROGRAPH
 38           KM           SCS RUNOFF COMPUTATION
 39           BA    4.49
 40           PB    2.10
 41           LS       0      81
 42           UD     .65

 43           KK     42B   SUB-BASIN 42B HYDROGRAPH
 44           KM           SCS RUNOFF COMPUTION
 45           BA    4.08
 46           PB    2.14
 47           LS       0      76
 48           UD     .65
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK  NODE C  COMBINE FLOW AT NODE C
  50      HC       3
  51      KK     C-D    ROUTE FLOW TO NODE D
  52      RK    7000   .0571    .035            TRAP      50       1
  53      KK     42A    SUB-BASIN 42A HYDROGRAPH
  54      KM            SCS RUNOFF COMPUTATION
  55      BA    8.23
  56      PB    2.14
  57      LS       0      76
  58      UD     .81
  59      KK  NODE D  COMBINE FLOW AT NODE D
  60      HC       2
  61      KK     D-E    ROUTE FLOW TO NODE E
  62      RK   16200   .0414     .03            TRAP      70       1
  63      KK     305    SUB-BASIN 305 HYDROGRAPH
  64      KM            SCS RUNOFF COMPUTATION
  65      BA    3.99
  66      PB    1.95
  67      LS       0      81
  68      UD     .76
  69      KK  NODE E COMBINE FLOWS AT NODE E
  70      HC       2
  71      KK     E-F    ROUTE FLOWS TO NODE F
  72      RM       5     .46     .10
  73      KK     306    SUB-BASIN 306 HYDROGRAPH
  74      KM            SCS RUNOFF COMPUTATION
  75      BA    9.04
  76      PB    1.95
  77      LS       0      80
  78      UD    1.61
  79      KK  NODE F  COMBINE FLOWS AT NODE F
  80      HC       2
  81      KK     F-G    ROUTE FLOWS TO NODE G
  82      RM      18    1.57     .10
  83      KK     307   SUB-BASIN 307 HYDROGRAPH
  84      KM           KINEMATIC WAVE RUNOFF COMPUTATION
  85      BA    8.07
  86      PB    1.95
  87      LS       0      73       0       0      97
  88      UK     800   .0123     .20      51
  89      UK     300    .015     .10      49
  90      RK    5000     .01     .05     .25             30       50
  91      RK    3200    .013     .05    1.01             30       50
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  92      RK    9500    .008     .03            TRAP      40     1.5      NO

  93      KK      43    SUB-BASIN 43 HYDROGRAPH
  94      KM            SCS RUNOFF COMPUTATION
  95      BA    6.40
  96      PB    1.95
  97      LS       0      76
  98      UD     .88

  99      KK     H-I    ROUTE FLOWS TO NODE I
 100      RM       7     .72     .10

 101      KK     309     SUB-BASIN 309 HYDROGRAPH
 102      KM            SCS RUNOFF COMPUTATION
 103      BA    9.24
 104      PB    1.95
 105      LS       0      75
 106      UD    1.51

 107      KK  NODE I  COMBINE FLOWS AT NODE I
 108      HC       2

 109      KK     I-G    ROUTE FLOWS FROM NODE I TO NODE G
 110      RM       8     .58     .15

 111      KK     310    SUB-BASIN 310 HYDROGRAPH
 112      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 113      BA    9.14
 114      PB    1.95
 115      LS       0      73       0       0      97
 116      UK     800    .015     .20      68
 117      UK     300    .020     .10      32
 118      RK    2750     .01     .05     .25             30      50
 119      RK    7300     .01     .05    1.01    TRAP     30      50
 120      RK   9000.   .0036     .05            TRAP     60       1      NO

 121      KK  NODE G  COMBINE ALL FLOWS AT NODE G
 122      HC       4

 123      KK     G-M    ROUTE FLOWS TO NODE M
 124      RK   15800  0.0035    .023            TRAP     50       1

 125      KK      44    SUB-BASIN 44 HYDROGRAPH
 126      KM            SCS RUNOFF COMPUTATION
 127      BA    7.23
 128      PB    1.95
 129      LS       0      76
 130      UD    1.22

 131      KK     J-K    ROUTE FLOW TO NODE K
 132      RM       8     .58     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  133     KK     312   SUB-BASIN 312 HYDROGRAPH
  134     KM           SCS RUNOFF COMPUTATION
  135     BA    6.77
  136     PB    1.95
  137     LS       0      73
  138     UD    2.83

  139     KK  NODE K  COMBINE FLOW AT NODE K
  140     HC       2

  141     KK     K-P    ROUTE FLOW FROM NODE K TO NODE P
  142     RK   17400   .0052    .030            TRAP      70       1

  143     KK      45   SUB-BASIN 45 HYDROGRAPH
  144     KM           SCS RUNOFF COMPUTATION
  145     BA   10.73
  146     PB    1.95
  147     LS       0      72       0       0       0       0
  148     UD    1.31

  149     KK     N-O    ROUTE FLOW TO NODE O
  150     RK    9550   .0157    .035            TRAP      50       1

  151     KK     048    SUB-BASIN 048 HYDROGRAPH
  152     KM           SCS RUNOFF COMPUTATION
  153     BA    2.07
  154     PB    1.95
  155     LS       0      72
  156     UD    1.97

  157     KK     46A   SUB-BASIN 46A HYDROGRAPH
  158     KM           SCS RUNOFF COMPUTATION
  159     BA    7.35
  160     PB    2.05
  161     LS       0      73
  162     UD    1.60

  163     KK     46B   SUB-BASIN 46B HYDROGRAPH
  164     KM           SCS RUNOFF COMPUTATION
  165     BA    6.02
  166     PB    2.05
  167     LS       0      73
  168     UD    1.71

  169     KK  NODE O  COMBINE ALL FLOW AT NODE O
  170     HC       4

  171     KK     O-P    ROUTE FLOW TO NODE P
  172     RK   18600   .0051     .03            TRAP      70       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  173     KK     P*1    COMBINE FLOWS AT P*1
  174     HC       2

  175     KK     317    SUB-BASIN 317 HYDROGRAPH
  176     KM            SCS RUNOFF COMPUTATION
  177     BA    7.66
  178     PB    2.14
  179     LS       0      76
  180     UD     .97

  181     KK    318B    SUB-BASIN 318B HYDROGRAPH
  182     KM            SCS RUNOFF COMPUTATION
  183     BA    1.89
  184     PB    2.14
  185     LS       0      84       0
  186     UD     .37

  187     KK     Q-P    ROUTE FLOW TO NODE P
  188     RM       4     .26     .15

  189     KK    318A    SUB BASIN 318A HYDROGRAPH
  190     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  191     BA    2.19
  192     PB    2.00
  193     LS       0      73       0       0      98
  194     UK     700    .020     .30      74
  195     UK      50    .025     .10      26
  196     RK    2000    .035     .05     .06              30      50
  197     RK    7000    .014     .05     .55              30      50
  198     RK    9200   .0043     .03            TRAP      30       1

  199     KK  NODE P   COMBINE FLOWS AT NODE P
  200     HC       4

  201     KK     P-M    ROUTE FLOWS TO NODE M
  202     RK    7400   .0034     .03            TRAP      80       1

  203     KK     047    SUB-BASIN 47 HYDROGRAPH
  204     KM            KINEMATIC RUNOFF COMPUTATION
  205     BA    7.40
  206     PB    1.95
  207     LS       0      73       0       0      98
  208     UK     800    .008     .20      69
  209     UK      80    .012     .10      31
  210     RK    2000    .003     .05     .25              30      50
  211     RK    7000    .007     .05    1.23              30      50
  212     RK   22000    .005     .03            TRAP      40       1

  213     KK  NODE M   COMBINE FLOW AT NODE M
  214     HC       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  215     KK     M-S    ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  216     RK    4600   .0028    .023            TRAP      80       1
  217     ZZ
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FLOOD HYDROGRAPH PACKAGE (HEC-1) (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

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EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.68
FUTURE CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
SUB-AREA M--AREA ABOVE CONFLUENCE
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

10 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	41	879.	4.17	305.	110.	110.	4.73		
+	ROUTED TO	A-B	815.	4.42	302.	110.	110.	4.73		
+	HYDROGRAPH AT	302	909.	4.33	358.	130.	130.	6.14		
+	2 COMBINED AT	NODE B	1713.	4.42	659.	240.	240.	10.87		
+	ROUTED TO	B-C	1702.	4.50	657.	240.	240.	10.87		
+	HYDROGRAPH AT	303	953.	4.08	323.	117.	117.	4.49		
+	HYDROGRAPH AT	42B	614.	4.17	214.	77.	77.	4.08		
+	3 COMBINED AT	NODE C	3053.	4.33	1187.	434.	434.	19.44		
+	ROUTED TO	C-D	3034.	4.42	1187.	434.	434.	19.44		
+	HYDROGRAPH AT	42A	1094.	4.33	431.	156.	156.	8.23		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
2 COMBINED AT	NODE D	4124.	4.33	1618.	590.	590.	27.67		
ROUTED TO	D-E	4085.	4.50	1612.	590.	590.	27.67		
HYDROGRAPH AT	305	663.	4.25	246.	89.	89.	3.99		
2 COMBINED AT	NODE E	4687.	4.42	1852.	679.	679.	31.66		
ROUTED TO	E-F	4451.	5.00	1852.	678.	678.	31.66		
HYDROGRAPH AT	306	1023.	5.67	506.	187.	187.	9.04		
2 COMBINED AT	NODE F	5334.	5.00	2357.	866.	866.	40.70		
ROUTED TO	F-G	5189.	7.08	2352.	865.	865.	40.70		
HYDROGRAPH AT	307	1753.	4.00	673.	270.	270.	8.07		
HYDROGRAPH AT	43	652.	5.33	267.	97.	97.	6.40		
ROUTED TO	H-I	628.	6.00	267.	97.	97.	6.40		
HYDROGRAPH AT	309	743.	5.67	349.	128.	128.	9.24		
2 COMBINED AT	NODE I	1359.	5.83	617.	225.	225.	15.64		
ROUTED TO	I-G	1348.	6.33	616.	225.	225.	15.64		
HYDROGRAPH AT	310	1072.	4.33	562.	233.	233.	9.14		
4 COMBINED AT	NODE G	7286.	6.67	4052.	1593.	1593.	73.55		
ROUTED TO	G-M	7258.	6.83	4036.	1589.	1589.	73.55		
HYDROGRAPH AT	44	673.	5.50	300.	109.	109.	7.23		
ROUTED TO	J-K	665.	6.00	300.	109.	109.	7.23		
HYDROGRAPH AT	312	309.	7.00	194.	79.	79.	6.77		
2 COMBINED AT	NODE K	921.	6.25	490.	188.	188.	14.00		
ROUTED TO	K-P	891.	6.67	471.	185.	185.	14.00		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	45	712.	5.67	311.	113.	113.	10.73		
ROUTED TO	N-O	706.	5.83	308.	113.	113.	10.73		
HYDROGRAPH AT	048	112.	6.25	58.	22.	22.	2.07		
HYDROGRAPH AT	46A	558.	5.83	266.	98.	98.	7.35		
HYDROGRAPH AT	46B	442.	5.92	217.	80.	80.	6.02		
4 COMBINED AT	NODE O	1810.	5.83	848.	313.	313.	26.17		
ROUTED TO	O-P	1758.	6.25	824.	312.	312.	26.17		
2 COMBINED AT	P*1	2602.	6.33	1292.	497.	497.	40.17		
HYDROGRAPH AT	317	926.	5.42	401.	145.	145.	7.66		
HYDROGRAPH AT	318B	672.	3.75	172.	62.	62.	1.89		
ROUTED TO	Q-P	629.	4.00	172.	62.	62.	1.89		
HYDROGRAPH AT	318A	235.	4.17	124.	54.	54.	2.19		
4 COMBINED AT	NODE P	3379.	5.92	1900.	759.	759.	51.91		
ROUTED TO	P-M	3372.	6.08	1893.	756.	756.	51.91		
HYDROGRAPH AT	047	774.	4.42	436.	191.	191.	7.40		
2 COMBINED AT	NODE M	3928.	6.00	2316.	947.	947.	59.31		
ROUTED TO	M-S	3926.	6.00	2314.	945.	945.	59.31		

*** NORMAL END OF HEC-1 ***

LOWER BASIN STORM

PRESENT CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.69

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

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THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1

HEC-1 INPUT


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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID                    EAST AND WEST RANGE WASHES
  2           ID                 100-YR, 6-HR STORM      ARF = 0.69
  3           ID               PRESENT CONDITIONS, EXISTING FACILITIES
  4           ID                          JULY 1989
  5           ID                  BOYLE ENGINEERING CORPORATION
  6           ID                  LOWER PORTION OF THE BASIN ONLY
  7           ID                        AMC 1.8 (309,317 AT 1.79)
  8           IT     05       0       0     200
  9           IO      5       0       0

 10           KK    307    SUB-BASIN 307 HYDROGRAPH
 11           KM           KINEMATIC WAVE RUNOFF COMPUTATION
 12           BA   8.07
 13           PB   1.97
 14           PC    .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
 15           PC  18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
 16           PC  25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
 17           PC  32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
 18           PC  56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
 19           PC  81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
 20           PC  97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
 21           PC  99.90  100.00
 22           LS      0      74       0       0      97
 23           UK    800   .0123     .20      89
 24           UK     60    .015     .10      11
 25           RK  10000     .01   .0375     .67                5       1
 26           RK   3200     .013  .0375    2.0                 5       1
 27           RK   9500     .008   .03             TRAP       40     1.5      NO

 28           KK    310    SUB-BASIN 310 HYDROGRAPH
 29           KM           KINEMATIC WAVE RUNOFF COMPUTATION
 30           BA   9.14
 31           PB   1.97
 32           LS      0      74       0       0      97
 33           UK    800    .015     .20      89
 34           UK     60    .020     .10      11
 35           RK   5500     .01   .0375    1.01
 36           RK   8500     .01   .0375    3.04   TRAP       50
 37           RK   9000.  .0036     .05             TRAP       60       1      NO

 38           KK  NODE G  COMBINE ALL FLOWS AT NODE G
 39           HC      2

 40           KK    G-M    ROUTE FLOWS TO NODE M
 41           RK  15800  0.0035    .023             TRAP       50       1

 42           KK    317    SUB-BASIN 317 HYDROGRAPH
 43           KM           SCS RUNOFF COMPUTATION
 44           BA   7.66
 45           PB   2.17
 46           LS      0      76
 47           UD    .97
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  48      KK    3188    SUB-BASIN 3188 HYDROGRAPH
  49      KM            SCS RUNOFF COMPUTATION
  50      BA    1.89
  51      PB    2.17
  52      LS       0      84
  53      UD     .37

  54      KK     Q-P    ROUTE FLOW TO NODE P
  55      RM       4     .26     .15

  56      KK    318A    SUB BASIN 318A HYDROGRAPH
  57      KM            KINEMATIC WAVE RUNOFF COMPUTATION
  58      BA    2.19
  59      PB    2.02
  60      LS       0      74       0       0      97
  61      UK     700    .020     .30      89
  62      UK      50    .025     .10      11
  63      RK    2000    .035     .05     .06              30      50
  64      RK    7000    .014     .05     .55              30      50
  65      RK    9200   .0043     .03            TRAP      30       1

  66      KK  NODE P  COMBINE FLOWS AT NODE P
  67      HC       3

  68      KK     P-M    ROUTE FLOWS TO NODE M
  69      RK    7400   .0034     .03            TRAP      80       1

  70      KK     047    SUB-BASIN 47 HYDROGRAPH
  71      KM            KINEMATIC RUNOFF COMPUTATION
  72      BA    7.40
  73      PB    1.97
  74      LS       0      74       0       0      97
  75      UK     800    .008     .20      74
  76      UK      80    .012     .10      26
  77      RK    7000    .007    .050    1.23              30      50
  78      RK   22000    .005     .03            TRAP      40       1

  79      KK  NODE M  COMBINE FLOW AT NODE M
  80      HC       3

  81      KK     M-S    ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  82      RK    4600   .0028    .023            TRAP      80       1

  83      KK     488    SUB-BASIN 488 HYDROGRAPH
  84      KM            SCS RUNOFF COMPUTATION
  85      BA     .99
  86      PB    2.07
  87      LS       0      84       0       0       0       0
  88      UD     .24
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK     R-S     ROUTE FLOW TO NODE S
  90      RK    9100   .0316    .035            TRAP     100       1

  91      KK     48A     SUB-BASIN 48A HYDROGRAPH
  92      KM             KINEMATIC WAVE RUNOFF COMPUTATION
  93      BA     .49
  94      PB    2.02
  95      LS       0      74       0       0      97
  96      UK     700    .025     .30      77
  97      UK      60     .03     .10      23
  98      RK     800     .02    .050     .12              30      50
  99      RK    9000    .033     .02            TRAP      20       1      NO

 100      KK     321     SUB-BASIN 321 HYDROGRAPH
 101      KM             KINEMATIC WAVE RUNOFF COMPUTATION
 102      BA    3.42
 103      PB    1.97
 104      LS       0      74       0       0      97
 105      UK     800    .010     .30      78
 106      UK      50    .020     .10      22
 107      RK    3500    .006    .050     .14              30      50
 108      RK    7400   .0014    .050     .58              30      50
 109      RK   21200.  .0035    .035            TRAP     70.       1.     NO

 110      KK     49A     SUB-BASIN 49A HYDROGRAPH
 111      KM             KINEMATIC WAVE RUNOFF COMPUTATION
 112      BA    0.60
 113      PB    1.97
 114      LS       0      74       0       0      97
 115      UK     700    .034     .30      80
 116      UK      60     .04     .10      20
 117      RK    1000    .003    .050     .12              30      50
 118      RK    9200    .034    .035            TRAP      20       1      NO

 119      KK   NODE S  COMBINE ALL FLOWS AT NODE S
 120      HC       5

 121      KK     S-V     ROUTE FLOWS TO NODE V   (SLOAN CHANNEL)
 122      RK    6800   .0038    .023            TRAP      80       1

 123      KK     324     SUB-BASIN 324 HYDROGRAPH
 124      KM             KINEMATIC WAVE RUNOFF COMPUTATION
 125      BA    1.40
 126      PB    1.97
 127      LS       0      73       0       0      97
 128      UK     800     .01     .30      74
 129      UK      60     .01     .10      26
 130      RK    1300.    .004     .05     .07     TRAP      30      50
 131      RK    2500   .0017     .05     .28              30      50
 132      RK    7000.    .005    .035            TRAP      70       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  133     KK     49B     SUB-BASIN 49B HYDROGRAPH
  134     KM             SCS RUNOFF COMPUTATION
  135     BA    1.04
  136     PB    2.02
  137     LS       0      84       0       0       0       0
  138     UD     .25

  139     KK     T-V     ROUTE FLOWS TO NODE V
  140     RM       3      .52     .10

  141     KK   NODE V    COMBINE ALL FLOWS AT NODE V
  142     HC       3

  143     KK     50B     SUB-BASIN 50B HYDROGRAPH
  144     KM             SCS RUNOFF COMPUTATION
  145     BA     .55
  146     PB    2.07
  147     LS       0      84       0       0       0       0
  148     UD     .17

  149     KK     U-V     ROUTE FLOWS TO NODE V
  150     RM       3      .43     .10

  151     KK     50A     SUB-BASIN 50A HYDROGRAPH
  152     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  153     BA    1.78
  154     PB    1.97
  155     LS       0      74       0       0      97       0
  156     UK     800    .025     .30      89
  157     UK      60     .03     .10      11
  158     RK    3000    .010    .050     .45              30      50
  159     RK    7500    .029    .035             TRAP    40       1      NO

  160     KK      53     SUB-BASIN 53 HYDROGRAPH
  161     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  162     BA    1.44
  163     PB    1.97
  164     LS       0      73       0       0      97       0
  165     UK     600    .010     .30      70
  166     UK      50    .010     .10      30
  167     RK   1300.   .0033    .050    .053    TRAP    30      50
  168     RK   3100.   .0017    .050     .21    TRAP    30      50
  169     RK  12300.   .0033     .02             TRAP    20       1      NO

  170     KK     W-V     ROUTE FLOWS TO NODE V
  171     RM       3      .36     .10

  172     KK   NODE V    COMBINE ALL FLOWS AT NODE V
  173     HC       4
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```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  174     KK     V-Z   ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  175     RK    7780   .0041     .23            TRAP      80       1

  176     KK     51B    SUB-BASIN 51B HYDROGRAPH
  177     KM            SCS RUNOFF COMPUTATION
  178     BA    0.47
  179     PB    1.97
  180     LS       0     84       0       0       0       0
  181     UD     .13

  182     KK     X-Z   ROUTE FLOWS TO NODE Z
  183     RM       3    .54     .10

  184     KK     51A    SUB-BASIN 51A HYDROGRAPH
  185     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  186     BA     .99
  187     PB    2.02
  188     LS       0     72       0       0      97       0
  189     UK     600    .03     .30      86
  190     UK      60   .030     .10      14
  191     RK   2500.  .0075    .050    .100    TRAP      30      50
  192     RK   8000.  .0400    .025            TRAP      50       1      NO

  193     KK     51C    SUB-BASIN 51C HYDROGRAPH
  194     KM            SCS RUNOFF COMPUTATION
  195     BA     .43
  196     PB    2.02
  197     LS       0     84
  198     UD     .19

  199     KK     Y-Z   ROUTE FLOWS TO NODE Z
  200     RM       3    .54     .10

  201     KK     51D    SUB-BASIN 51D HYDROGRAPH
  202     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  203     BA     .83
  204     PB    1.97
  205     LS       0     72       0       0      97
  206     UK     600    .03     .30      88
  207     UK      60   .035     .10      12
  208     RK    2500  .0240    .050    .080            30      50
  209     RK    8000  .0300    .025            TRAP    50       1

  210     KK  NODE Z   COMBINE ALL FLOWS AT NODE Z
  211     HC       5

  212     KK    Z-BB   ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  213     RK    2680   .0044    .023            TRAP      80       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  214     KK     52B    SUB-BASIN 52B HYDROLOGY
  215     KM            SCS RUNOFF COMPUTATION
  216     BA      .70
  217     PB     1.97
  218     LS        0      84
  219     UD      .11

  220     KK   AA-BB    ROUTE FLOWS TO NODE BB
  221     RM        4     .62     .10

  222     KK  NODEBB    COMBINE ALL FLOWS AT NODE BB
  223     HC        2

  224     KK     52A    SUB-BASIN 52A HYDROGRAPH
  225     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  226     BA     1.18
  227     PB     1.97
  228     LS        0      74       0       0      97       0
  229     UK      600    .025     .30      93
  230     UK       60    .035     .10       7
  231     RK     2000    .025    .050     .24                30      50
  232     RK   11200.    .028    .035              TRAP      30       1      NO

  233     KK   NO.BB  COMBINE ALL FLOWS AT NODE BB
  234     HC        2

  235     KK   BB-CC    ROUTE FLOWS TO NODE CC
  236     RK     4000      55    .023              TRAP      80       1

  237     KK      326    SUB-BASIN 326 HYDROGRAPH
  238     KM            KINEMATIC WAVE COMPUTATION
  239     BA     1.71
  240     PB     1.97
  241     LS        0      74       0       0      97       0
  242     UK      700    .010     .30      80
  243     UK       60   .0100     .10      20
  244     RK     1800   .0035    .050     .11                30      50
  245     RK     4000   .0014    .050     .43                30      50
  246     RK    12500   .0038    .035              TRAP      80       1

  247     KK   NO.CC    COMBINE ALL FLOWS AT NODE CC
  248     HC        2
  249     ZZ
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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.69
PRESENT CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
LOWER PORTION OF THE BASIN ONLY
AMC 1.8 (309,317 AT 1.79)

9 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	307	534.	5.25	318.	136.	136.	8.07		
+	HYDROGRAPH AT	310	613.	5.50	354.	150.	150.	9.14		
+	2 COMBINED AT	NODE G	1141.	5.42	671.	286.	286.	17.21		
•	ROUTED TO	G-M	1115.	5.75	664.	282.	282.	17.21		
+	HYDROGRAPH AT	317	953.	5.42	414.	150.	150.	7.66		
+	HYDROGRAPH AT	318B	690.	3.75	176.	64.	64.	1.89		
+	ROUTED TO	Q-P	645.	4.00	176.	64.	64.	1.89		
+	HYDROGRAPH AT	318A	145.	5.92	90.	39.	39.	2.19		
+	3 COMBINED AT	NODE P	1513.	4.25	672.	253.	253.	11.74		
	ROUTED TO	P-M	1497.	4.42	670.	252.	252.	11.74		
+	HYDROGRAPH AT	047	667.	4.25	406.	177.	177.	7.40		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
3 COMBINED AT	NODE M	3139.	5.50	1733.	711.	711.	36.35		
ROUTED TO	M-S	3128.	5.58	1731.	709.	709.	36.35		
HYDROGRAPH AT	48B	400.	3.67	85.	31.	31.	.99		
ROUTED TO	R-S	333.	3.83	83.	31.	31.	.99		
HYDROGRAPH AT	48A	98.	3.50	29.	12.	12.	.49		
HYDROGRAPH AT	321	197.	6.83	145.	70.	70.	3.42		
HYDROGRAPH AT	49A	75.	3.67	31.	13.	13.	.60		
5 COMBINED AT	NODE S	3449.	5.50	1989.	835.	835.	41.85		
ROUTED TO	S-V	3441.	5.58	1986.	831.	831.	41.85		
HYDROGRAPH AT	324	138.	4.25	70.	32.	32.	1.40		
HYDROGRAPH AT	49B	397.	3.67	85.	31.	31.	1.04		
ROUTED TO	T-V	284.	4.17	85.	31.	31.	1.04		
3 COMBINED AT	NODE	3695.	5.58	2132.	893.	893.	44.29		
HYDROGRAPH AT	50B	261.	3.58	47.	17.	17.	.55		
ROUTED TO	U-V	177.	3.92	47.	17.	17.	.55		
HYDROGRAPH AT	50A	122.	5.17	71.	31.	31.	1.78		
HYDROGRAPH AT	53	153.	4.42	83.	36.	36.	1.44		
ROUTED TO	W-V	148.	4.83	83.	36.	36.	1.44		
4 COMBINED AT	NODE V	4011.	5.50	2326.	977.	977.	48.06		
ROUTED TO	V-Z	3932.	5.92	2269.	954.	954.	48.06		
HYDROGRAPH AT	51B	215.	3.58	37.	13.	13.	.47		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	ROUTED TO	X-Z	129.	4.00	37.	13.	13.	.47		
+	HYDROGRAPH AT	51A	78.	5.25	43.	18.	18.	.99		
+	HYDROGRAPH AT	51C	186.	3.58	35.	13.	13.	.43		
•	ROUTED TO	Y-Z	120.	4.08	35.	13.	13.	.43		
+	HYDROGRAPH AT	51D	58.	5.17	31.	13.	13.	.83		
+	5 COMBINED AT	NODE Z	4102.	5.83	2367.	1011.	1011.	50.78		
+	ROUTED TO	Z-BB	4097.	5.92	2367.	1009.	1009.	50.78		
+	HYDROGRAPH AT	52B	333.	3.50	54.	20.	20.	.70		
•	ROUTED TO	AA-BB	193.	4.08	54.	20.	20.	.70		
	2 COMBINED AT	NODEBB	4149.	5.83	2398.	1029.	1029.	51.48		
•	HYDROGRAPH AT	52A	88.	5.33	43.	18.	18.	1.18		
+	2 COMBINED AT	NO.BB	4226.	5.83	2437.	1047.	1047.	52.66		
•	ROUTED TO	BB-CC	4226.	5.83	2437.	1046.	1046.	52.66		
+	HYDROGRAPH AT	326	109.	5.75	76.	35.	35.	1.71		
•	2 COMBINED AT	NO.CC	4335.	5.83	2513.	1082.	1082.	54.37		

*** NORMAL END OF HEC-1 ***

LOWER BASIN STORM

FUTURE CONDITIONS/EXISTING FACILITIES

100-YEAR/ARF = 0.69

1

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

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THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

1

HEC-1 INPUT


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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   1          ID                    EAST AND WEST RANGE WASHES
   2          ID                 100-YR, 6-HR STORM      ARF = 0.69
   3          ID               FUTURE  CONDITIONS, EXISTING FACILITIES
   4          ID                          JULY  1989
   5          ID                      BOYLE ENGINEERING CORPORATION
   6          ID                   LOWER PORTION OF THE BASIN ONLY
   7          ID                 AMC 1.8 (309, 317, 305, 303 AMC 1.77)
   8          ID                NEW FUTURE DEVELOPMENT IN 306, 307, 310
   9          IT     05       0       0     200
  10          IO      5       0       0

  11          KK    307   SUB-BASIN 307 HYDROGRAPH
  12          KM          KINEMATIC WAVE RUNOFF COMPUTATION
  13          BA   8.07
  14          PB   1.97
  15          PC    .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
  16          PC  18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
  17          PC  25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
  18          PC  32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
  19          PC  56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
  20          PC  81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
  21          PC  97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
  22          PC  99.90  100.00
  23          LS      0      73       0       0      97
  24          UK    800   .0123     .20      51
  25          UK    300    .015     .10      49
  26          RK   5000     .01     .05     .25              30      50
  27          RK   3200    .013     .05    1.01              30      50
  28          RK   9500    .008     .03            TRAP      40     1.5      NO

  29          KK    310   SUB-BASIN 310 HYDROGRAPH
  30          KM          KINEMATIC WAVE RUNOFF COMPUTATION
  31          BA   9.14
  32          PB   1.97
  33          LS      0      73       0       0      97
  34          UK    800    .015     .20      68
  35          UK    300    .020     .10      32
  36          RK   2750     .01     .05     .25              30      50
  37          RK   7300     .01     .05    1.01    TRAP      30      50
  38          RK  9000.   .0036     .05            TRAP      60       1      NO

  39          KK  NODE G  COMBINE ALL FLOWS AT NODE G
  40          HC      2

  41          KK    G-M   ROUTE FLOWS TO NODE M
  42          RK  15800 0.0035    .023            TRAP      50       1

  43          KK    317   SUB-BASIN 317 HYDROGRAPH
  44          KM          SCS RUNOFF COMPUTATION
  45          BA   7.66
  46          PB   2.17
  47          LS      0      76
  48          UD    .97
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  49      KK    318B    SUB-BASIN 318B HYDROGRAPH
  50      KM            SCS RUNOFF COMPUTATION
  51      BA   1.89
  52      PB   2.17
  53      LS      0      84       0
  54      UD    .37

  55      KK    Q-P     ROUTE FLOW TO NODE P
  56      RM      4      .26     .15

  57      KK    318A    SUB BASIN 318A HYDROGRAPH
  58      KM            KINEMATIC WAVE RUNOFF COMPUTATION
  59      BA   2.19
  60      PB   2.02
  61      LS      0      73       0       0      97
  62      UK    700    .020     .30      74
  63      UK     50    .025     .10      26
  64      RK   2000    .035     .05     .06              30      50
  65      RK   7000    .014     .05     .55              30      50
  66      RK   9200   .0043     .03            TRAP      30       1

  67      KK  NODE P  COMBINE FLOWS AT NODE P
  68      HC      3

  69      KK    P-M     ROUTE FLOWS TO NODE M
  70      RK   7400   .0034     .03            TRAP      80       1

  71      KK    047     SUB-BASIN 47 HYDROGRAPH
  72      KM            KINEMATIC RUNOFF COMPUTATION
  73      BA   7.40
  74      PB   1.97
  75      LS      0      73       0       0      97
  76      UK    800    .008     .20      69
  77      UK     80    .012     .10      31
  78      RK   2000    .003     .05     .25              30      50
  79      RK   7000    .007     .05    1.23              30      50
  80      RK  22000    .005     .03            TRAP      40       1

  81      KK  NODE M  COMBINE FLOW AT NODE M
  82      HC      3

  83      KK    M-S     ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  84      RK   4600   .0028    .023            TRAP      80       1

  85      KK    488     SUB-BASIN 488 HYDROGRAPH
  86      KM            SCS RUNOFF COMPUTATION
  87      BA    .99
  88      PB   2.07
  89      LS      0      84       0       0       0       0
  90      UD    .24
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  91      KK     R-S     ROUTE FLOW TO NODE S
  92      RK    9100   .0316    .035            TRAP      80       1

  93      KK     48A     SUB-BASIN 48A HYDROGRAPH
  94      KM             KINEMATIC WAVE RUNOFF COMPUTATION
  95      BA    .49
  96      PB   2.02
  97      LS      0      72       0       0      97
  98      UK    700    .025     .30      73
  99      UK     60     .03     .10      27
 100      RK   2000     .02    .050     .04                30       50
 101      RK    800     .02    .050     .12                30       50
 102      RK   9000    .033     .02            TRAP      20        1      NO

 103      KK    321     SUB-BASIN 321 HYDROGRAPH
 104      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 105      BA   3.42
 106      PB   1.97
 107      LS      0      72       0       0      97
 108      UK    800    .010     .30      54
 109      UK     50    .020     .10      46
 110      RK   3500    .006    .050     .14                30       50
 111      RK   7400   .0014    .050     .58                30       50
 112      RK  21200.   .0035    .035            TRAP     70.       1.      NO

 113      KK    49A     SUB-BASIN 49A HYDROGRAPH
 114      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 115      BA   0.60
 116      PB   1.97
 117      LS      0      72       0       0      97
 118      UK    700    .034     .30      73
 119      UK     60     .04     .10      27
 120      RK   2000     .03     .05     .04                30       50
 121      RK   1000    .003    .050     .12                30       50
 122      RK   9200    .034    .035            TRAP      20        1      NO

 123      KK  NODE S  COMBINE ALL FLOWS AT NODE S
 124      HC      5

 125      KK    S-V     ROUTE FLOWS TO NODE V   (SLOAN CHANNEL)
 126      RK   6800   .0038    .023            TRAP      80        1

 127      KK    324     SUB-BASIN 324 HYDROGRAPH
 128      KM            KINEMATIC WAVE RUNOFF COMPUTATION
 129      BA   1.40
 130      PB   1.97
 131      LS      0      73       0       0      97
 132      UK    800     .01     .30      56
 133      UK     60     .01     .10      44
 134      RK  1300.    .004     .05     .07    TRAP      30       50
 135      RK   2500   .0017     .05     .28                30       50
 136      RK  7000.    .005    .035            TRAP      70        1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  137     KK     49B     SUB-BASIN 49B HYDROGRAPH
  138     KM             SCS RUNOFF COMPUTATION
  139     BA    1.04
  140     PB    2.02
  141     LS       0      85       0       0       0       0
  142     UD     .25

  143     KK     T-V     ROUTE FLOWS TO NODE V
  144     RM       3      .52     .10

  145     KK   NODE V    COMBINE ALL FLOWS AT NODE V
  146     HC       3

  147     KK     50B     SUB-BASIN 50B HYDROGRAPH
  148     KM             SCS RUNOFF COMPUTATION
  149     BA     .55
  150     PB    2.07
  151     LS       0      85       0       0       0       0
  152     UD     .17

  153     KK     U-V     ROUTE FLOWS TO NODE V
  154     RM       3      .43     .10

  155     KK     50A     SUB-BASIN 50A HYDROGRAPH
  156     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  157     BA    1.78
  158     PB    1.97
  159     LS       0      72       0       0      97       0
  160     UK     800    .025     .30      73
  161     UK      60     .03     .10      27
  162     RK    1000    .030    .050     .12                30      50
  163     RK    3000    .010    .050     .45                30      50
  164     RK    7500    .029    .035             TRAP       40       1      NO

  165     KK      53     SUB-BASIN 53 HYDROGRAPH
  166     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  167     BA    1.44
  168     PB    1.97
  169     LS       0      73       0       0      97       0
  170     UK     600    .010     .30      56
  171     UK      50    .010     .10      44
  172     RK   1300.   .0033    .050    .053    TRAP       30      50
  173     RK   3100.   .0017    .050     .21    TRAP       30      50
  174     RK  12300.   .0033     .02             TRAP       20       1      NO

  175     KK     W-V     ROUTE FLOWS TO NODE V
  176     RM       3      .36     .10

  177     KK   NODE V    COMBINE ALL FLOWS AT NODE V
  178     HC       4
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  179     KK     V-Z   ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  180     RK    7780   .0041     .23            TRAP      80       1

  181     KK     51B    SUB-BASIN 51B HYDROGRAPH
  182     KM            SCS RUNOFF COMPUTATION
  183     BA    0.47
  184     PB    1.97
  185     LS       0     85       0       0       0       0
  186     UD     .13

  187     KK     X-Z   ROUTE FLOWS TO NODE Z
  188     RM       3    .54     .10

  189     KK     51A    SUB-BASIN 51A HYDROGRAPH
  190     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  191     BA     .99
  192     PB    2.02
  193     LS       0     73       0       0      97       0
  194     UK     600    .03     .30      73
  195     UK      60   .030     .10      27
  196     RK   1000.    .03    .050     .05              30      50
  197     RK   2500.  .0075    .050    .100    TRAP      30      50
  198     RK   8000.  .0400    .025            TRAP      50       1      NO

  199     KK     51C    SUB-BASIN 51C HYDROGRAPH
  200     KM            SCS RUNOFF COMPUTATION
  201     BA     .43
  202     PB    2.02
  203     LS       0     85       0
  204     UD     .19

  205     KK     Y-Z   ROUTE FLOWS TO NODE Z
  206     RM       3    .54     .10

  207     KK     51D    SUB-BASIN 51D HYDROGRAPH
  208     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  209     BA     .83
  210     PB    1.97
  211     LS       0     72       0       0      97
  212     UK     600    .03     .30      77
  213     UK      60   .035     .10      23
  214     RK    1000    .03     .05     .02              30      50
  215     RK    2500   .0240    .050    .080              30      50
  216     RK    8000   .0300    .025            TRAP      50       1

  217     KK   NODE Z   COMBINE ALL FLOWS AT NODE Z
  218     HC       5

  219     KK    Z-BB   ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  220     RK    2680   .0044     .023           TRAP      80       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  221     KK     52B    SUB-BASIN 52B HYDROLOGY
  222     KM            SCS RUNOFF COMPUTATION
  223     BA      .70
  224     PB     1.97
  225     LS        0      85
  226     UD      .11

  227     KK   AA-BB    ROUTE FLOWS TO NODE BB
  228     RM        4     .62     .10

  229     KK  NODEBB    COMBINE ALL FLOWS AT NODE BB
  230     HC        2

  231     KK     52A    SUB-BASIN 52A HYDROGRAPH
  232     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  233     BA     1.18
  234     PB     1.97
  235     LS        0      74       0       0      97       0
  236     UK      600    .025     .30      91
  237     UK       60    .035     .10       9
  238     RK     1000     .03    .050     .04                30      50
  239     RK     2000    .025    .050     .24                30      50
  240     RK   11200.    .028    .035             TRAP       30       1      NO

  241     KK   NO.BB  COMBINE ALL FLOWS AT NODE BB.
  242     HC        2

  243     KK   BB-CC    ROUTE FLOWS TO NODE CC
  244     RK     4000      55    .023             TRAP       80       1

  245     KK      326    SUB-BASIN 326 HYDROGRAPH
  246     KM            KINEMATIC WAVE COMPUTATION
  247     BA     1.71
  248     PB     1.97
  249     LS        0      72       0       0      97       0
  250     UK      700    .010     .30      73
  251     UK       60   .0100     .10      27
  252     RK     1800   .0035    .050     .11                30      50
  253     RK     4000   .0014    .050     .43                30      50
  254     RK    12500   .0038    .035             TRAP       80       1

  255     KK   NO.CC    COMBINE ALL FLOWS AT NODE CC
  256     HC        2
  257     ZZ
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1

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM ARF = 0.62
FUTURE CONDITIONS, EXISTING FACILITIES
JULY 1989
BOYLE ENGINEERING CORPORATION
LOWER PORTION OF THE BASIN ONLY
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

10 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	307	1779.	4.00	684.	274.	274.	8.07		
HYDROGRAPH AT	310	1091.	4.33	572.	237.	237.	9.14		
2 COMBINED AT	NODE G	2711.	4.08	1246.	511.	511.	17.21		
ROUTED TO	G-M	2618.	4.33	1238.	507.	507.	17.21		
HYDROGRAPH AT	317	953.	5.42	414.	150.	150.	7.66		
HYDROGRAPH AT	318B	690.	3.75	176.	64.	64.	1.89		
ROUTED TO	Q-P	645.	4.00	176.	64.	64.	1.89		
HYDROGRAPH AT	318A	229.	4.17	123.	53.	53.	2.19		
3 COMBINED AT	NODE P	1652.	4.25	710.	267.	267.	11.74		
ROUTED TO	P-M	1638.	4.33	707.	266.	266.	11.74		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	047	750.	4.50	429.	186.	186.	7.40		
3 COMBINED AT	NODE M	4990.	4.33	2373.	959.	959.	36.35		
ROUTED TO	M-S	4977.	4.42	2372.	956.	956.	36.35		
HYDROGRAPH AT	488	400.	3.67	85.	31.	31.	.99		
ROUTED TO	R-S	347.	3.83	84.	31.	31.	.99		
HYDROGRAPH AT	48A	89.	3.67	29.	12.	12.	.49		
HYDROGRAPH AT	321	407.	5.83	245.	108.	108.	3.42		
HYDROGRAPH AT	49A	91.	3.75	33.	14.	14.	.60		
5 COMBINED AT	NODE S	5375.	4.42	2748.	1121.	1121.	41.85		
ROUTED TO	S-V	5348.	4.50	2746.	1117.	1117.	41.85		
HYDROGRAPH AT	324	256.	4.08	103.	44.	44.	1.40		
HYDROGRAPH AT	49B	423.	3.67	91.	33.	33.	1.04		
ROUTED TO	T-V	303.	4.17	91.	33.	33.	1.04		
3 COMBINED AT	NODE	5777.	4.42	2929.	1193.	1193.	44.29		
HYDROGRAPH AT	508	277.	3.58	50.	18.	18.	.55		
ROUTED TO	U-V	188.	3.92	50.	18.	18.	.55		
HYDROGRAPH AT	50A	310.	3.67	97.	41.	41.	1.78		
HYDROGRAPH AT	53	240.	4.25	110.	46.	46.	1.44		
ROUTED TO	W-V	228.	4.67	110.	46.	46.	1.44		
4 COMBINED AT	NODE V	6205.	4.42	3175.	1299.	1299.	48.06		
ROUTED TO	V-Z	5637.	5.08	3099.	1276.	1276.	48.06		
HYDROGRAPH AT	51B	228.	3.58	39.	14.	14.	.47		

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
ROUTED TO	X-Z	138.	4.00	39.	14.	14.	.47		
HYDROGRAPH AT	51A	154.	3.75	61.	25.	25.	.99		
HYDROGRAPH AT	51C	198.	3.58	37.	14.	14.	.43		
ROUTED TO	Y-Z	128.	4.08	37.	14.	14.	.43		
HYDROGRAPH AT	51D	107.	3.75	42.	17.	17.	.83		
5 COMBINED AT	NODE Z	5980.	5.08	3231.	1346.	1346.	50.78		
ROUTED TO	Z-BB	5979.	5.17	3232.	1344.	1344.	50.78		
HYDROGRAPH AT	52B	354.	3.50	58.	21.	21.	.70		
ROUTED TO	AA-BB	207.	4.08	58.	21.	21.	.70		
2 COMBINED AT	NODEBB	6106.	5.17	3278.	1365.	1365.	51.48		
HYDROGRAPH AT	52A	87.	5.33	44.	18.	18.	1.18		
2 COMBINED AT	NO.BB	6191.	5.17	3320.	1384.	1384.	52.66		
ROUTED TO	BB-CC	6190.	5.17	3320.	1384.	1384.	52.66		
HYDROGRAPH AT	326	138.	5.33	85.	38.	38.	1.71		
2 COMBINED AT	NO.CC	6327.	5.17	3405.	1422.	1422.	54.37		

*** NORMAL END OF HEC-1 ***

5.3.3 North Las Vegas Detention Basin Outlet Modification Report

RECEIVED
OCT 8 1993
REGIONAL FLOOD CONTROL DISTRICT

CITY OF NORTH LAS VEGAS, NEVADA

NORTH LAS VEGAS DETENTION BASIN OUTLET MODIFICATION REPORT

August 25, 1993
(Revised October 1, 1993)

BLACK & VEATCH
PROGRESS BY DESIGN

RECEIVED
OCT 21 1993
REGIONAL
FLOOD CONTROL DISTRICT

~~Kent~~ file

BLACK & VEATCH

1900 East Flamingo Road Suite 295 Las Vegas, Nevada 89119 (702) 732-0448 Fax (702) 732-7578

North Las Vegas, Nevada
North Las Vegas Detention Basin

B&V Project 23546.300
B&V File AC
October 5, 1993

Mr. Jason King, P.E.
Department of Conservation and Natural Resources
Division of Water Resources
Capital Complex
123 W. Nye Lane
Carson City, Nevada 89710

Subject: Permit J208

Dear Mr. King:

Attached is a copy of "North Las Vegas Detention Basin Outlet Modification Report." The purpose of the study is to investigate the feasibility of modifying the outlet structure at the North Las Vegas detention basin to reduce peak storm water discharges from the detention basin. The City of North Las Vegas contracted Black & Veatch to conduct the study to determine if the storage capacity of the existing basin could be more effectively utilized to further reduce 100-yr flows for numerous drainage and transportation facilities located downstream on the Las Vegas Wash. The existing facility is currently under utilized due to the recent construction of the Upper Las Vegas Wash Detention Basin, located upstream on the Las Vegas Wash, and the soon to be constructed West Range Wash Diversion Dike, located to the north east of the detention basin.

The report recommends closure of two of the five 72 inch outlet pipes. The impact of the outlet modifications on the detention basin is increased basin stage duration and drain time. However, the peak discharge and basin stage produced by the five design storms of 6 hour duration modeled in this study are less than those for the original design hydrology.

Attached to this letter are the following: 1) a copy of your letter, dated September 1, 1993, in which you state a detailed seepage analysis is not required, 2) a copy of the report with the submittal letter to Bob Murnane, the Development & Flood Control Coordinator for North Las Vegas, and 3) three copies of the construction drawings of the outlet modifications. Submittal of a completed application form and the $500 application fee were waived by J. Stephen Folk during our discussions in May 1993.

Mr. Jason King, P.E.

B&V Project 23546.300
October 5, 1993

If you have any questions regarding this report, please do not hesitate to call me.

Very truly yours,

BLACK & VEATCH

Stephen C. Roberts, P.E.

rmp
Attachment
DALE FRASER, LCRFCD

NL12/101903

RECEIVED
OCT 8 1993
REGIONAL
FLOOD CONTROL DISTRICT

BLACK & VEATCH
1900 East Flamingo Road Suite 295, Las Vegas, Nevada 89119 (702) 732-0448 Fax (702) 732-7578

City of North Las Vegas, Nevada
North Las Vegas Detention Basin

B&V Project 23546.300
B&V File AC
October 5, 1993

Mr. Robert A. Murnane, P.E.
Development & Flood Control Coordinator
City of North Las Vegas
2200 Civic Center Drive
North Las Vegas, Nevada 89030

Subject: Outlet Modification Project

Dear Mr. Murnane:

Subsequent to our meeting on August 25, 1993, we received a letter from the Nevada Department of Water Resources, indicating their acceptance of the project. A copy of the letter is attached for your file.

Also attached are six sets of construction drawings and one revised copy of the Outlet Modification Report. Revisions to the report are indicated by a vertical line along the right hand margin.

As always, it has been a pleasure to work with you on this project. If you have any questions regarding this project, please give me a call.

Very truly yours,

BLACK & VEATCH

Stephen C. Roberts, P.E.
Project Engineer

rmp
Enclosures

cc: Gale Fraser, CCRFCD, w/enclosure

NL12/100103

OVERVIEW

The North Las Vegas Wash detention basin was constructed in 1984, to collect and control stormwater runoff from the northern Las Vegas Wash watershed. In recent years, the Clark County Regional Flood Control District (CCRFCD), has developed a Master Plan for proposed construction of additional flood control facilities throughout the Las Vegas Valley. Included in CCRFCD's Master Plan are the Upper Las Vegas Wash detention basin and the Range Wash Diversion dike. Construction of the Upper Las Vegas Wash detention basin was completed in July, 1993. The forecasted completion date for construction of the Range Wash Diversion dike is January, 1994. The construction of these two facilities will result in "structural changes" to the northern Las Vegas Wash watershed that impact stormwater flows at the existing detention basin.

In addition, CCRFCD adopted standard hydrologic procedures and developed drainage and hydrologic policies for the design of Master Plan flood control facilities. These hydrologic procedures are different than those originally used for the design of the North Las Vegas Wash detention basin. As a result, the anticipated stormwater flows today are likely different than those at the time of design.

The purpose of this study is to investigate the feasibility of modifying the outlet structure at the North Las Vegas wash detention basin to reduce peak stormwater discharges from the detention basin. Decreased peak discharges will reduce the cost of channel improvements and bridge replacement along the Las Vegas Wash in North Las Vegas and Clark County.

This study consists of hydrologic modeling for six 100-year storm centerings located upstream of the North Las Vegas Wash detention basin. The areal extent of the storms range from 48 to 160 square miles. For each of the six storms, reservoir stage, storage and peak discharge were determined for existing and modified outlet conditions.

NORTH LAS VEGAS WASH DETENTION BASIN

The North Las Vegas detention basin is located in Section 14, Township 19 South, Range 61 East, of Clark County. The detention basin was designed by James M. Montgomery Engineers (JMM), for the City of North Las Vegas in 1983. The facility was constructed in 1984.

Photo 1 - Outlet Structure at North Las Vegas Wash Detention Basin.

The outlet works at the North Las Vegas detention basin includes both low flow and auxiliary discharge facilities. The low flow outlet consists of five 72 inch diameter concrete pipes as shown in Photo 1. The auxiliary outlet is an ogee spillway overflow section with a length of 100 ft and crest elevation of 2134.0. The storage capacity of the detention basin at the spillway crest elevation is 1,440 acre-ft. The stage-discharge and stage-storage information for the outlet facilities and detention basin were obtained from JMM record drawings for the project. The stage-discharge relationship for the low flow and auxiliary outlets and the stage-storage relationship for the detention basin are provided in Appendix A.

HYDROLOGIC ANALYSIS

Rainfall runoff response simulation and flood routing for the six storm centerings was modeled using the U. S. Army Corps of Engineers HEC-1 computer program, Version 4.0. Models for the SP and LC storm centerings are based on existing models developed by JMM for the *Las Vegas Valley Flood Insurance Study (FIS)*. The remaining models are based on work performed previously by Black & Veatch for the *Flood Control Facilities Plan for the*

Northern Las Vegas Wash, Transbasin Diversion Hydrologic Evaluation and the *Predesign report for the Upper Las Vegas Wash Detention Basin*. All models include minor revisions to incorporate the final design data for the Upper Las Vegas Wash detention basin. In addition, routing revisions were required in all but the *FIS* models due instabilities associated with the kinematic wave routing algorithm of HEC-1, Version 4.0. For each storm centering the North Las Vegas detention basin was modeled with the existing five pipe outlet, and modified 3 and 4 pipe outlets for comparison. A brief description of each model is listed below. Storm data, inflow, outflow and maximum basin stage for each storm centering are listed in Table 1. Hydrograph and basin stage vs. time plots for each storm are shown on Figures 1 through 6.

Spring Mountain Storm (SP) - Existing *FIS* model for 136.34 square mile storm centered over the Spring Mountain Range. All subbasin runoff routed through the Upper Las Vegas Wash detention basin.

Lower Central Valley Storm (LC) - Existing *FIS* model for 60.65 square mile storm centered between the Upper Las Vegas Wash detention basin and the North Las Vegas detention basin. Subbasin runoff from 20.52 square miles routed through the upper basin with the remaining 39.48 square miles directly tributary to North Las Vegas basin.

Transbasin B5 Storm (TB5) - Model from *Transbasin Diversion Hydrologic Evaluation*. A 99.62 square mile storm centered over the southern Sheep Mountains and abutting alluvial fans. Areal extent of storm is split between two watersheds with 51.45 square miles tributary to the Las Vegas Wash and 48.17 square miles tributary to the Range Wash. Subbasin runoff from 20.52 of the 51.45 square miles tributary to the Las Vegas Wash routed through the upper basin. Subbasin runoff from the western Range Wash diverted by the Range Wash diversion dike to the North Las Vegas detention basin.

Sheep Mountain Storm (TBS) - Model from *Transbasin Diversion Hydrologic Evaluation*. A 159.25 square mile storm centered over the central Sheep Mountains. All subbasin runoff routed through the Upper Las Vegas Wash detention basin.

Range Wash Storm (RW) - Portion of the TB5 model from *Transbasin Diversion Hydrologic Evaluation* used by Boyle Engineers Inc., for the design of Range Wash Diversion project. A 48.17 square mile storm over the western portion of the range wash watershed. All subbasin runoff is diverted by the Range Wash diversion dike to the North Las Vegas detention basin.

Interbasin Storm (F) - Model from *Predesign Report for the Upper Las Vegas Wash Detention Basin*. A 54.37 square mile storm centered between the Upper Las Vegas Wash detention basin and the North Las Vegas detention basin. All subbasin runoff directly tributary to the North Las Vegas basin.

TABLE 1

Storm	Storm Area (sq.mi.)	DARF	Peak Inflow (cfs)	Existing 5 Pipe Outlet		Modified 4 Pipe Outlet		Modified 3 Pipe Outlet	
				Peak Outflow (cfs)	Max[1] Basin Stage (ft)	Peak Outflow (cfs)	Max[1] Basin Stage (ft)	Peak Outflow (cfs)	Max[1] Basin Stage (ft)
SP	136.34	0.56	4,750	3,310	19.06	2,970	23.34	2,780	27.25[2]
LC	60.65	0.66	5,820	2,920	15.40	2,530	17.57	2,070	20.36
TB5	99.62	0.58	7,620	3,310	19.01	2,820	21.08	2,240	23.58
TBS	159.25	0.54	4,140	3,250	18.49	2,930	22.69	2,680	26.98[2]
RW	48.17	0.69	6,090	2,770	13.97	2,330	15.25	1,840	16.78
F	54.37	0.66	8,340	3,510	20.92	2,940	22.97	2,320	25.20

[1] Basin stage shown in absolute depth, basin stage of 0.0 ft = El. 2108.0.
[2] Indicates auxiliary spillway discharge.

DISCUSSION OF RESULTS

The original hydrologic design data for the North Las Vegas Wash Detention Basin is unavailable. However, review of the JMM record drawings indicates that the detention basin design storm was a 3 hour, 100-year event. The design storm produced a maximum basin stage of 28.0 ft (El. 2136.0), which resulted in a peak discharge of approximately 4,690 cfs. This design storm resulted in auxiliary spillway operation at a flow depth of two feet above the crest elevation. As shown in Table 1, the peak discharge and basin stage produced by the storms of 6 hour duration modeled in this study are less that those for the original design hydrology. This decrease in stage and discharge may be partially attributed to the more rapid runoff response associated with 3 hour storm events. In addition, the Upper Las Vegas Wash detention basin provides significant hydrograph peak attenuation for the SP, LC, TB5 and TBS storm events. Of the six storms modeled, the Spring Mountain storm (SP), produces the greatest peak discharge and maximum basin stage at the North Las Vegas detention basin.

Closure of one pipe, or the modified 4 pipe outlet reduces peak flows by an average of 420 cfs. The average reduction of peak flows for the 3 pipe outlet is 860 cfs. It is important to note that the SP and S storms both result in auxiliary spillway discharge for the 3 pipe outlet condition. However, the operating head on the spillway is less than that of the original design storm. Due to low head conditions the spillway operation is inefficient, and overall, total discharge from the detention basin is significantly reduced.

As previously mentioned, the SP and LC storm models are based upon CCRFCD's *FIS* models. A comparison of *FIS*, existing condition and modified outlet peak discharges for the North Las Vegas detention basin are listed in Table 2.

TABLE 2

Storm	*FIS* Discharge (cfs)	Existing 5 Pipe Outlet (cfs)	Modified 4 Pipe Outlet (cfs)	Modified 3 Pipe Outlet (cfs)
SP	3,050	3,310	2,970	2,780
LC	2,500	2,920	2,530	2,070

The *FIS* models prepared by JMM are based on the closure of one existing pipe at the North Las Vegas detention basin. As shown in Table 2, detention basin discharges reported by this study for the modified 4 pipe outlet condition are in close agreement with the *FIS* figures.

As a result of modifying the detention basin outlet by closing one or two of the existing pipes, basin stage duration and drain time for each of the 6 storm events will be increased. The drain time for the detention basin for each of the storms based on existing and modified outlet conditions is shown in Table 3.

TABLE 3

Storm	Existing 5 Pipe Outlet	Modified 4 Pipe Outlet	Modified 3 Pipe Outlet
SP	26.7 hrs	29.8 hrs	~34 hrs
LC	17.0 hrs	18.3 hrs	22.5 hrs
TB5	16.5 hrs	19.0 hrs	23.3 hrs
TB5	~30 hrs	~32 hrs	~36 hrs
RW	15.0 hrs	16.8 hrs	20.2 hrs
F	17.5 hrs	20.4 hrs	22.9 hrs

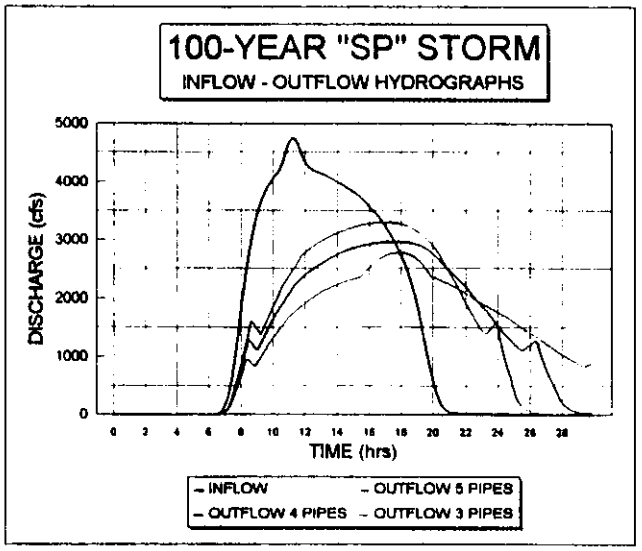
As shown in Table 3, the increase in detention basin drain time due to closure of one pipe ranges from approximately 1 to 3 hours. If two pipes are closed the drain time will be increased by approximately 5 to 7 hours for the various storms.

During the original design of the North Las Vegas detention basin, and embankment seepage analysis was performed by J. H. Kleinfelder & Associates. The Kleinfelder analysis was based on an assumed 24 hour detention time and an embankment permeability greater than $1x10^{-2}$ cm/sec. In their report, dated October 29, 1982, Kleinfelder states that seepage waters do not exit the downstream slope of the embankment and that seepage control measures such as toe and blanket drains are not necessary.

A detailed seepage analysis was not in the scope of this study, but our review of the original soil borings for the project indicates that actual embankment permeability values most likely range from $1x10^{-3}$ to $1x10^{-5}$ cm/sec. It is our opinion that the increased detention times due to closure of one or two of the existing outlet pipes will not result in significant changes, as compared to the original design, in the advancement of seepage or embankment stability factors of safety.

CONCLUSION

Closing one of the five existing 72 inch diameter outlet pipes will attenuate peak discharges from the North Las Vegas detention basin so that actual flows will agree with the modelled *FIS* flows developed for future Flood Insurance mapping. However, we recommend that discharges from the detention basin be reduced even more by closing two of the existing five outlet pipes. This modification will more effectively utilize the storage capacity of the existing detention basin and will further reduce 100-yr peak flows along the Las Vegas Wash for numerous downstream drainage and transportation facilities.



100-YEAR "SP" STORM
(SPRING MOUNTAIN STORM)

Storm Area:	136.34	sq. mi
D.A.R.F:	0.56	
Peak Inflow:	4,747	cfs
Time to Peak:	11.2	hrs
Total Volume:	2,063	acre-ft

Existing 5 Pipe Outlet

Peak Reservoir Stage:	19.06	ft
Peak Reservoir Storage	976	acre-ft
Peak Discharge:	3,312	cfs
Reservoir Drain Time	26.7	hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage:	23.34	ft
Peak Reservoir Storage	1,243	acre-ft
Peak Discharge:	2,968	cfs
Reservoir Drain Time	29.8	hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage:	27.25	ft
Peak Reservoir Storage	1,567	acre-ft
Peak Discharge:	2,779	cfs
Reservoir Drain Time	aprox. 34	hrs

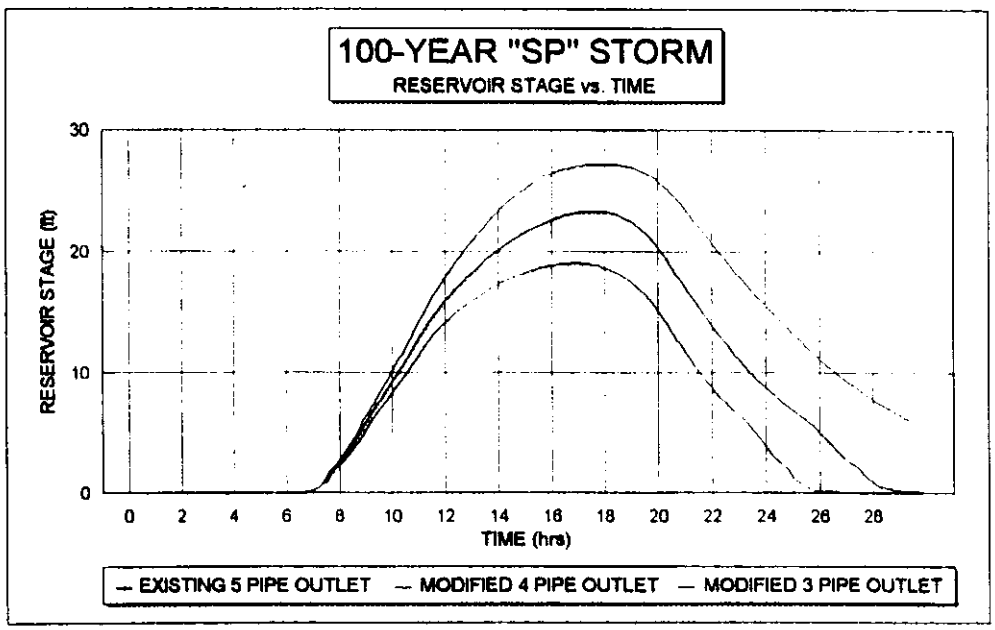
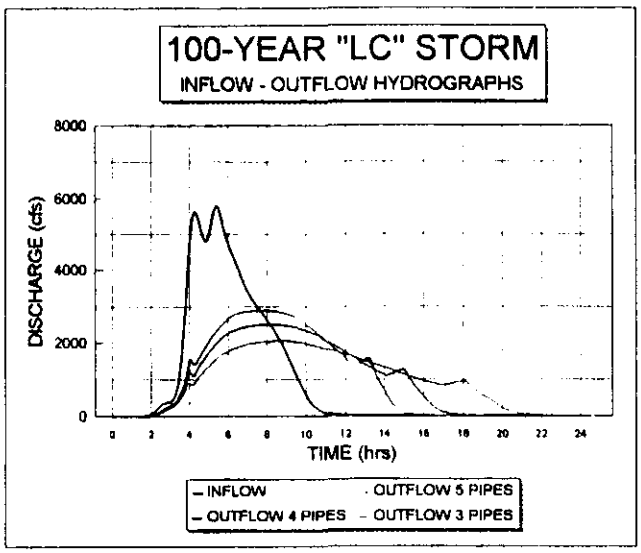


FIGURE 1



100-YEAR "LC" STORM
(LOWER CENTRAL VALLEY STORM)

Storm Area:	60.65	sq. mi.
D.A.R.F:	0.66	
Peak Inflow:	5,818	cfs
Time to Peak:	5.4	hrs
Total Volume:	1,821	acre-ft.

Existing 5 Pipe Outlet

Peak Reservoir Stage:	15 4	ft
Peak Reservoir Storage:	751	acre-ft
Peak Discharge:	2.920	cfs
Reservoir Drain Time	17	hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage:	17 57	ft
Peak Reservoir Storage	884	acre-ft
Peak Discharge:	2,526	cfs
Reservoir Drain Time	18 3	hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage:	20 36	ft
Peak Reservoir Storage	1,056	acre-ft
Peak Discharge:	2,069	cfs
Reservoir Drain Time	22 5	hrs

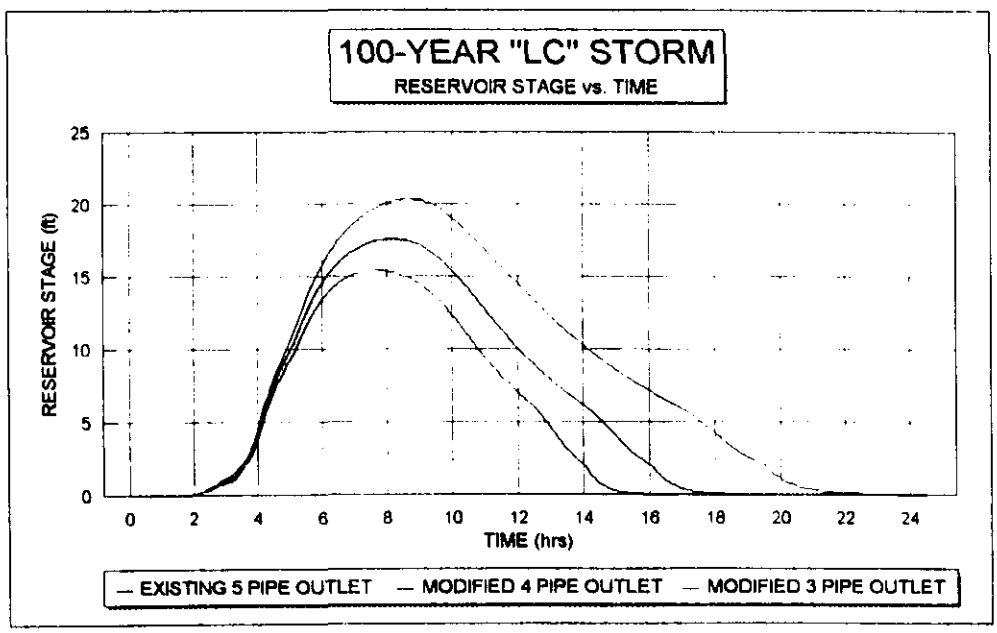
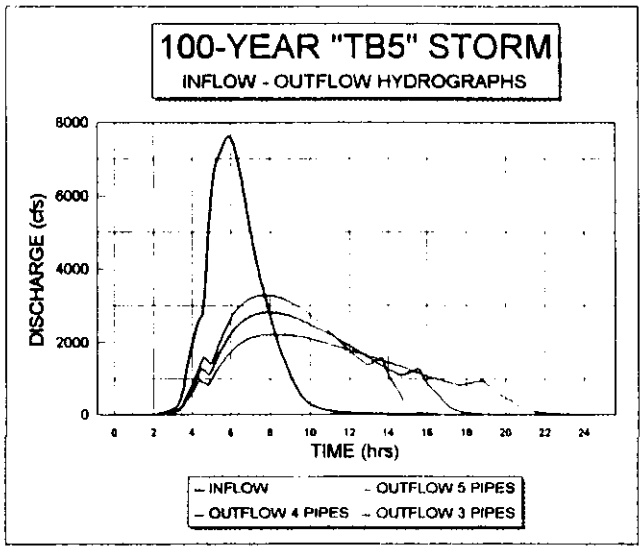


FIGURE 2



100-YEAR "TB5" STORM
(TRANSBASIN 5 STORM)

Storm Area:	99.62 sq. mi.
D.A.R.F.:	0.58
Peak Inflow:	7,616 cfs
Time to Peak:	5.9 hrs
Total Volume:	1,975 acre-ft.

Existing 5 Pipe Outlet

Peak Reservoir Stage:	19.01 ft.
Peak Reservoir Storage	973 acre-ft
Peak Discharge:	3,307 cfs
Reservoir Drain Time	16.5 hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage	21.08 ft
Peak Reservoir Storage	1,100 acre-ft
Peak Discharge:	2,825 cfs
Reservoir Drain Time	19 hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage	23.58 ft
Peak Reservoir Storage	1,258 acre-ft
Peak Discharge	2,239 cfs
Reservoir Drain Time	23.3 hrs

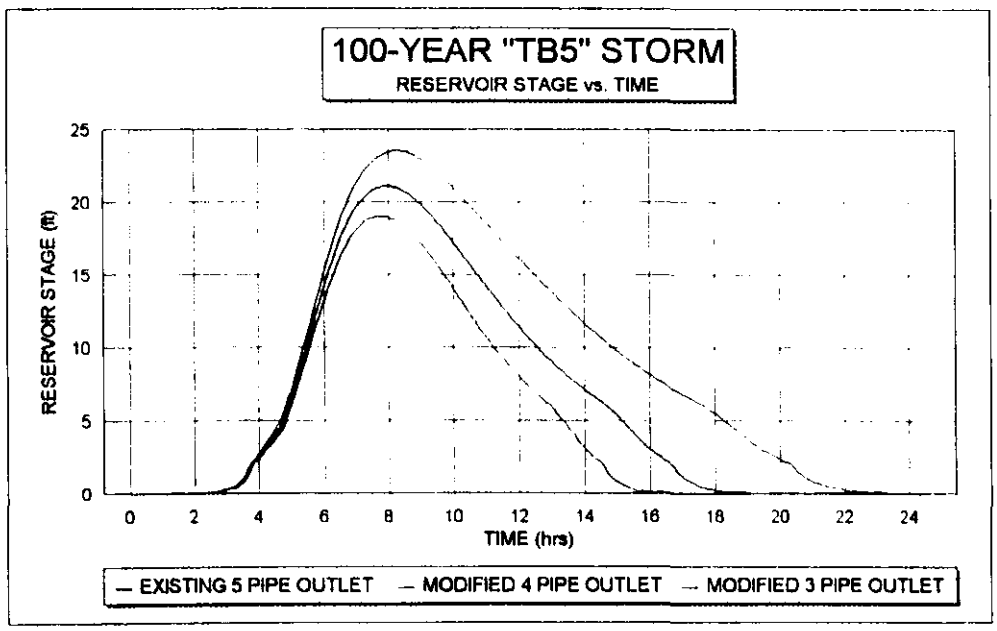
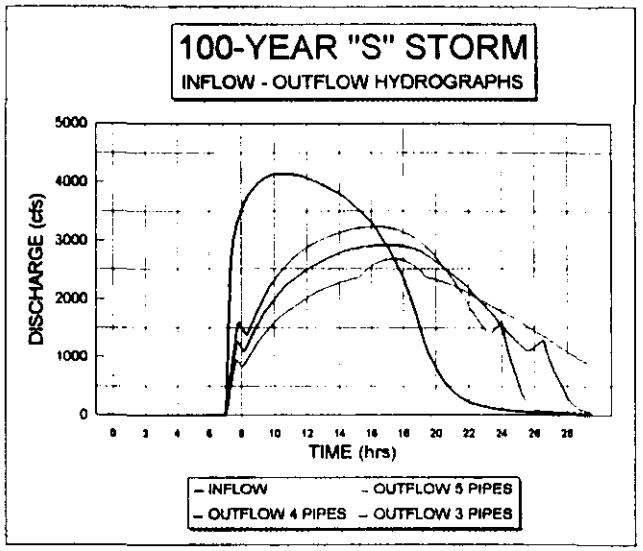


FIGURE 3



100-YEAR "S" STORM
(SHEEP MOUNTAIN STORM)

Storm Area:	159.25 sq. mi.
D.A.R.F:	0.54
Peak Inflow:	4,142 cfs
Time to Peak:	10.5 hrs
Total Volume:	1,986 acre-ft

Existing 5 Pipe Outlet

Peak Reservoir Stage:	18.49 ft
Peak Reservoir Storage:	941 acre-ft
Peak Discharge:	3,251 cfs
Reservoir Drain Time:	30 hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage:	22.69 ft
Peak Reservoir Storage:	1,202 acre-ft
Peak Discharge:	2,927 cfs
Reservoir Drain Time:	32 hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage:	26.98 ft
Peak Reservoir Storage:	1,538 acre-ft
Peak Discharge:	2,682 cfs
Reservoir Drain Time:	36 hrs

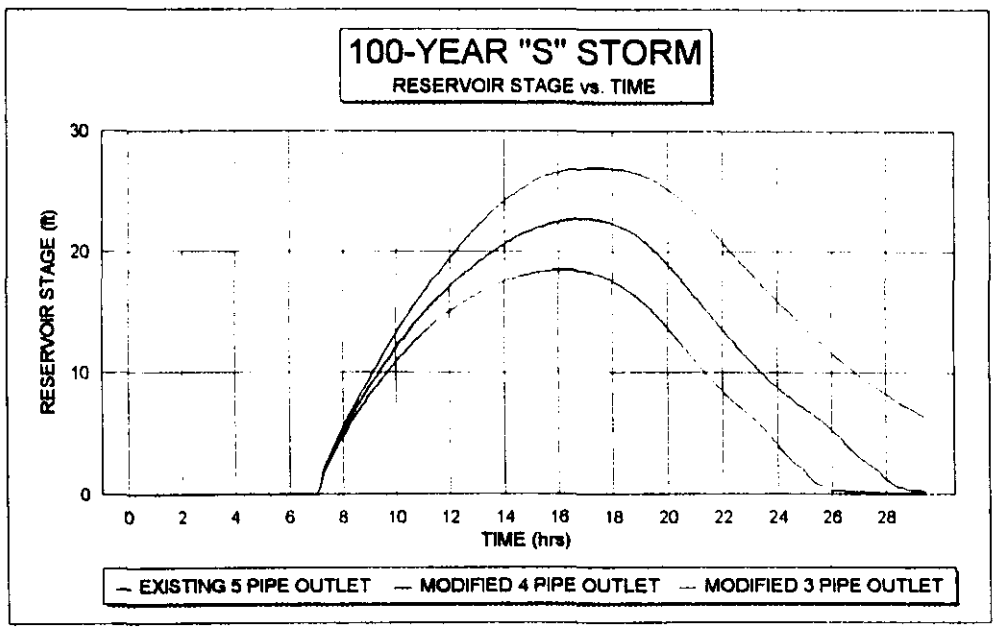
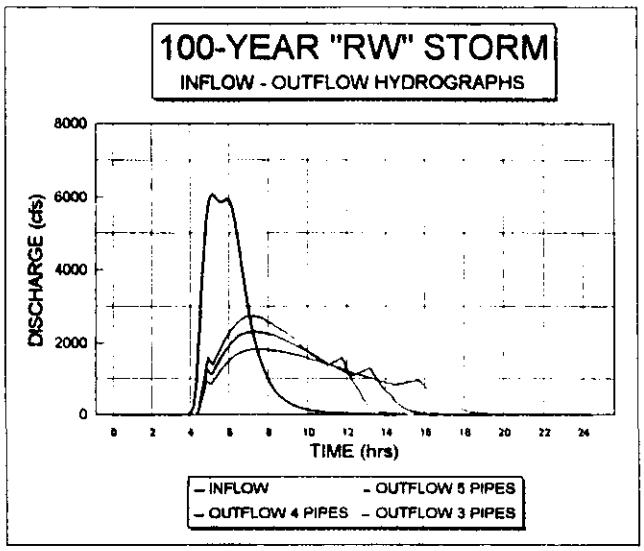


FIGURE 4



100-YEAR "RW" STORM
(RANGE WASH DESIGN STORM)

Storm Area:	48.17 sq. mi.
D.A.R.F:	0.69
Peak Inflow:	6,087 cfs
Time to Peak:	5.17 hrs
Total Volume:	1,320 acre-ft.

Existing 5 Pipe Outlet

Peak Reservoir Stage:	13.97 ft
Peak Reservoir Storage	663 acre-ft
Peak Discharge:	2,766 cfs
Reservoir Drain Time	15.0 hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage:	15.25 ft
Peak Reservoir Storage	742 acre-ft
Peak Discharge:	2,327 cfs
Reservoir Drain Time:	16.8 hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage:	16.78 ft
Peak Reservoir Storage	836 acre-ft
Peak Discharge:	1,839 cfs
Reservoir Drain Time	20.25 hrs

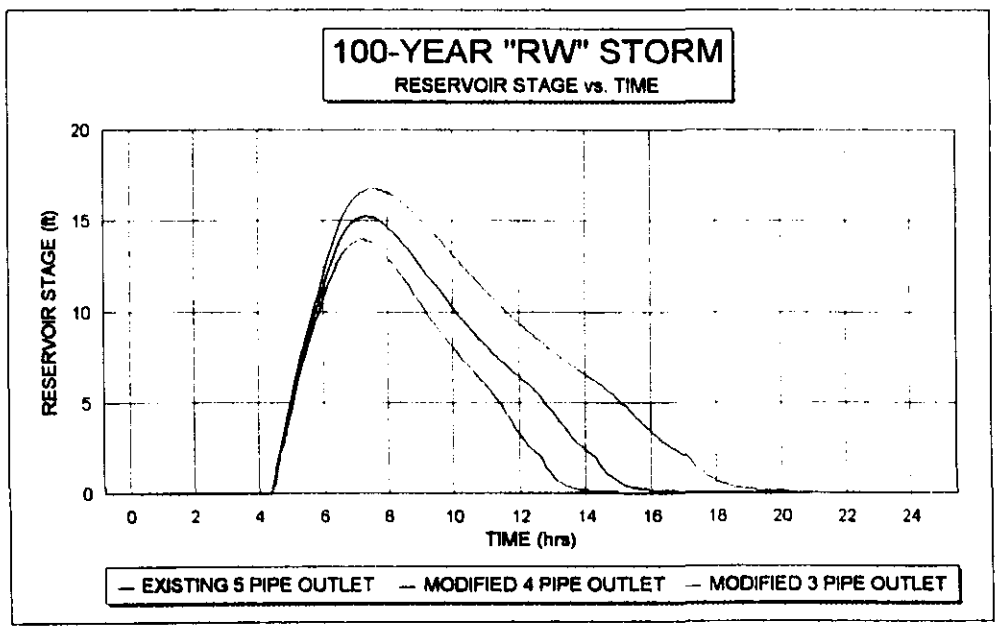
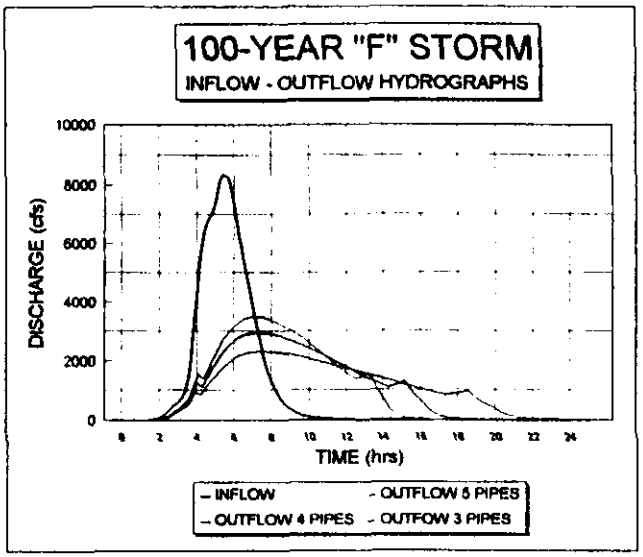


FIGURE 5



100-YEAR "F" STORM

Storm Area:	54.37	sq. mi.
D.A.R.F:	0.66	
Peak Inflow:	8,340	cfs
Time to Peak:	5.5	hrs
Total Volume:	2,062	acre-ft.

Existing 5 Pipe Outlet

Peak Reservoir Stage:	20.92	ft
Peak Reservoir Storage	1,090	acre-ft
Peak Discharge:	3,511	cfs
Reservoir Drain Time:	17.5	hrs

Modified 4 Pipe Outlet

Peak Reservoir Stage:	22.97	ft
Peak Reservoir Storage	1,220	acre-ft
Peak Discharge:	2,945	cfs
Reservoir Drain Time:	20.4	hrs

Modified 3 Pipe Outlet

Peak Reservoir Stage:	25.2	ft
Peak Reservoir Storage	1,375	acre-ft
Peak Discharge:	2,320	cfs
Reservoir Drain Time	22.9	hrs

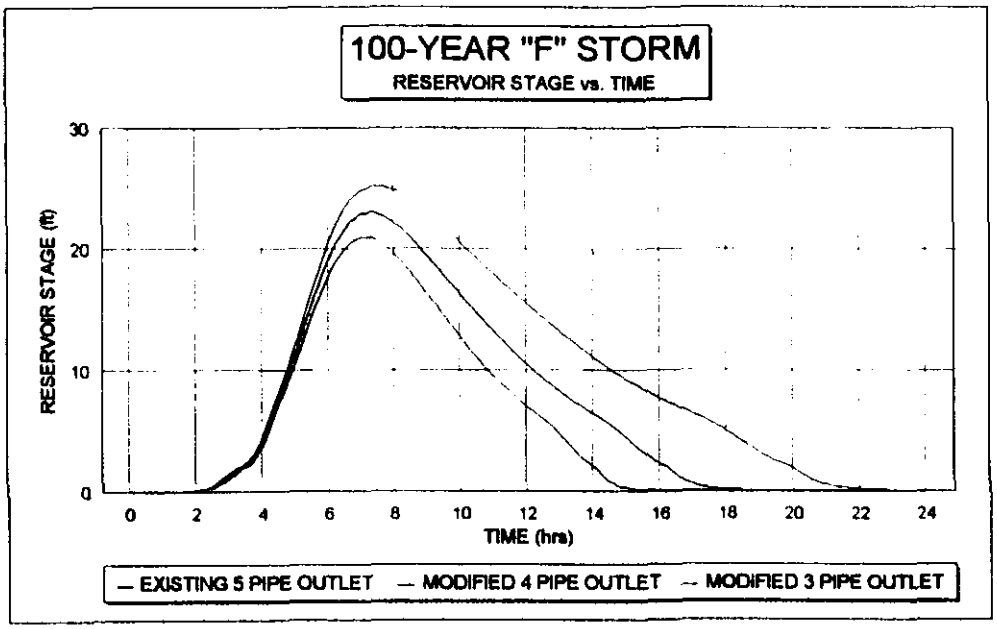


FIGURE 6

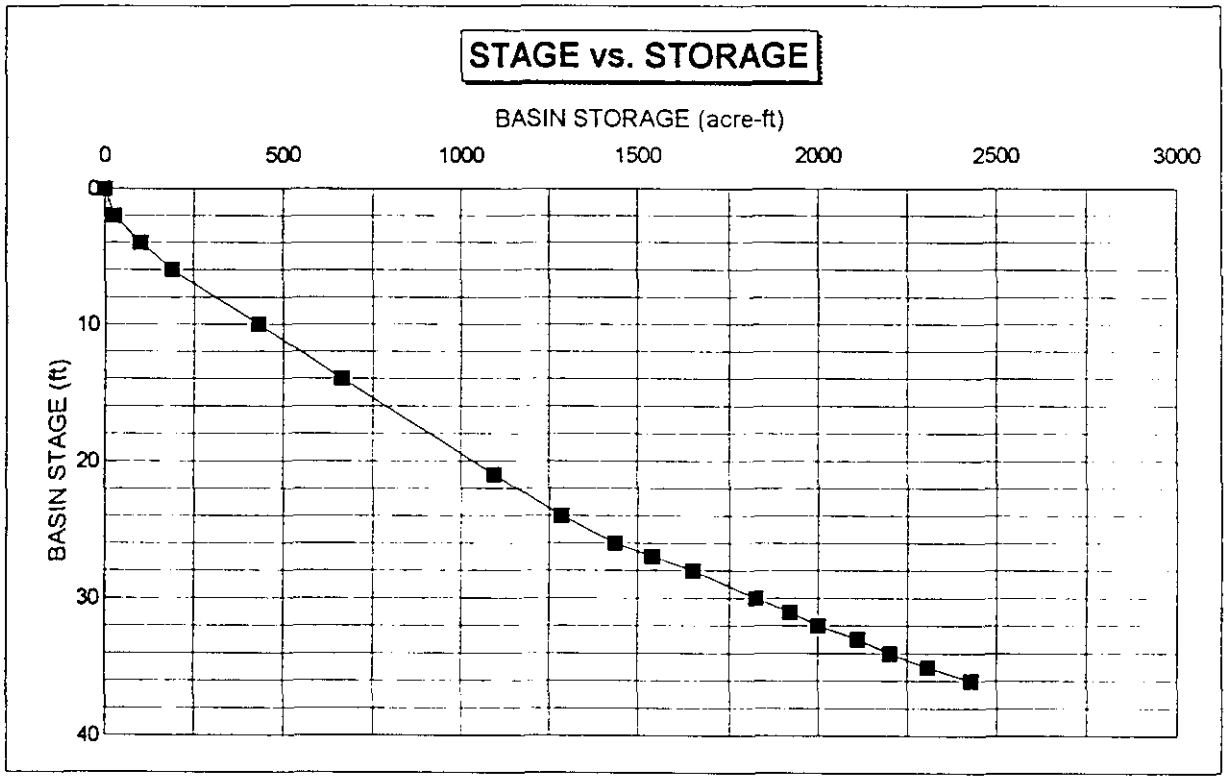
Appendix A

BLACK & VEATCH

City of North Las Vegas, Nevada
Existing North Las Vegas Detention Basin
Outlet Works Modifications
Stage-Storage Relationship

Project: 23546.300
Date: 6/15/93
By: SDC

STAGE (ft)	WS EL. (ft)	STORAGE (acre-ft)
0	2108	0
2	2110	25
4	2112	100
6	2114	190
10	2118	430
14	2122	665
21	2129	1095
24	2132	1285
26	2134	1435
27	2135	1540
28	2136	1650
30	2138	1825
31	2139	1920
32	2140	2000
33	2141	2110
34	2142	2200
35	2143	2310
36	2144	2430

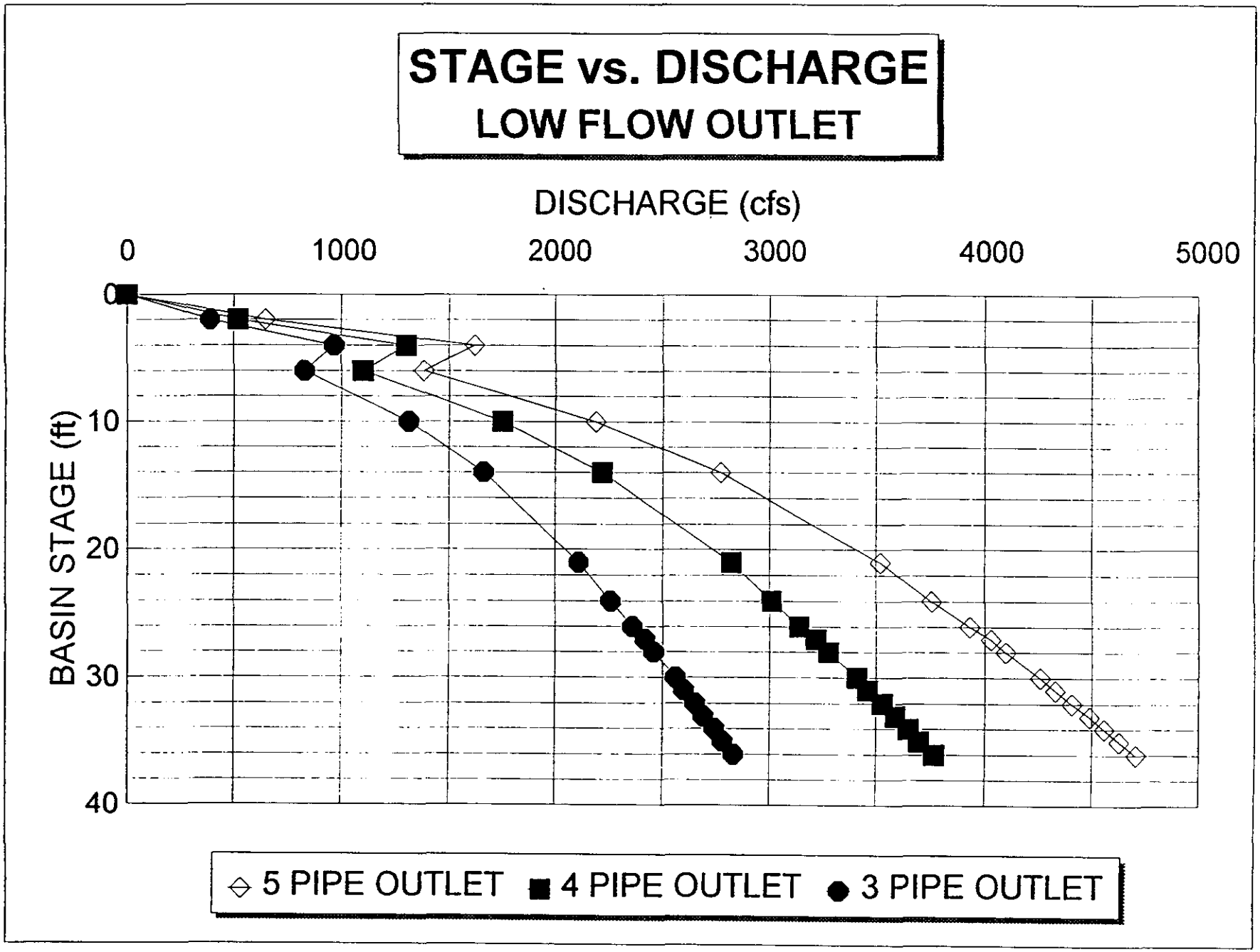


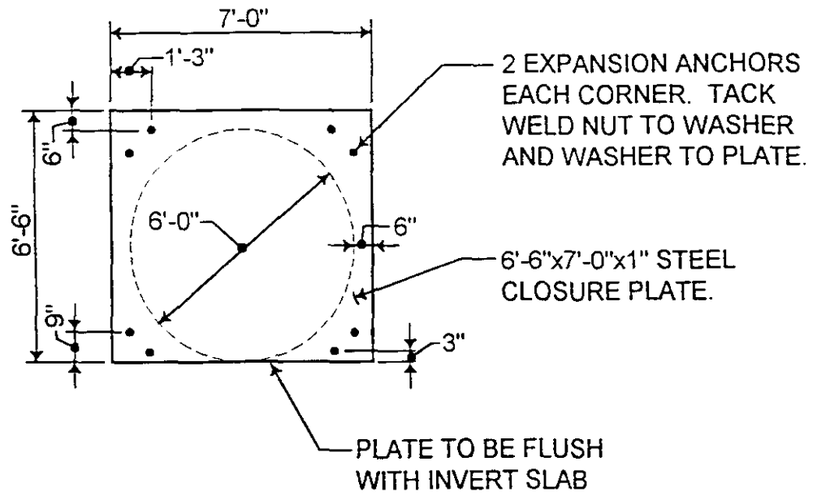
BLACK & VEATCH

City of North Las Vegas, Nevada
Existing North Las Vegas Detention Basin
Outlet Works Modifications
Stage-Discharge Relationship

Project: 23546.300
Date: 6/15/93
By: SDC

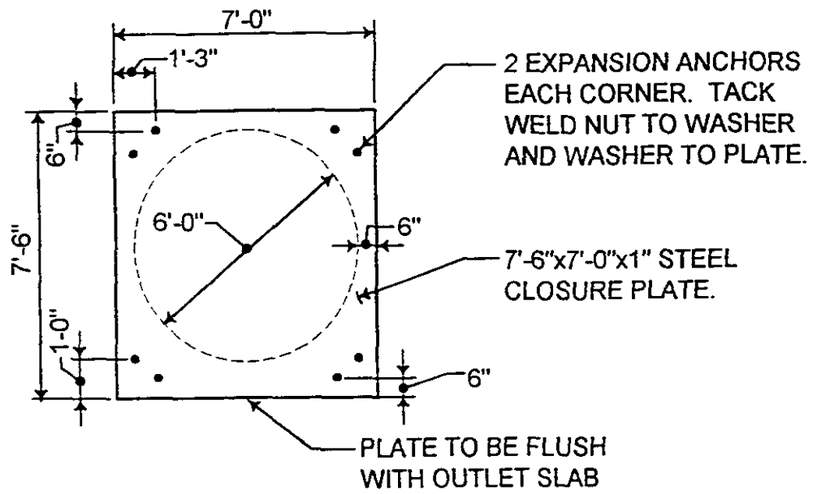
STAGE (ft)	WS EL. (ft)	SPILLWAY (cfs)	5 PIPES (cfs)	4 PIPES (cfs)	3 PIPES (cfs)	SPILLWAY & 5 PIPES (cfs)	SPILLWAY & 4 PIPES (cfs)	SPILLWAY & 3 PIPES (cfs)
0	2108	0	0	0	0	0	0	0
2	2110	0	650	520	390	650	520	390
4	2112	0	1620	1300	970	1620	1300	970
6	2114	0	1380	1100	830	1380	1100	830
10	2118	0	2190	1750	1310	2190	1750	1310
14	2122	0	2770	2220	1660	2770	2220	1660
21	2129	0	3520	2820	2110	3520	2820	2110
24	2132	0	3760	3010	2260	3760	3010	2260
26	2134	0	3930	3140	2360	3930	3140	2360
27	2135	270	4030	3220	2420	4300	3490	2690
28	2136	590	4100	3280	2460	4690	3870	3050
30	2138	2070	4260	3410	2560	6330	5480	4630
31	2139	3110	4330	3460	2600	7440	6570	5710
32	2140	4440	4410	3530	2650	8850	7970	7090
33	2141	5920	4490	3590	2690	10410	9510	8610
34	2142	7400	4560	3650	2740	11960	11050	10140
35	2143	8890	4630	3700	2780	13520	12590	11670
36	2144	10370	4710	3770	2830	15080	14140	13200


STAGE vs. DISCHARGE
LOW FLOW OUTLET
DISCHARGE (cfs)
0
1000
2000
3000
4000
5000
BASIN STAGE (ft)
0
10
20
30
40
5 PIPE OUTLET
4 PIPE OUTLET
3 PIPE OUTLET



DETAIL UPSTREAM PLATE

1/4" = 1'-0"



DETAIL DOWNSTREAM PLATE

1/4" = 1'-0"

CITY OF NORTH LAS VEGAS, NEVADA
NORTH LAS VEGAS DETENTION BASIN OUTLET MODIFICATIONS

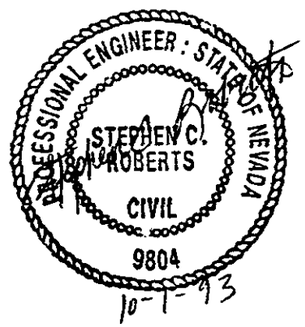
AUGUST 25, 1993

PROJECT LOCATION: NORTH LAS VEGAS DETENTION BASIN, CLARK COUNTY, NEVADA. TOWNSHIP 19 SOUTH, RANGE 61 EAST, SECTION 14.

PROJECT DESCRIPTION: INSTALLATION OF STEEL CLOSURE PLATES OVER 72" DIAMETER OUTLET PIPES.

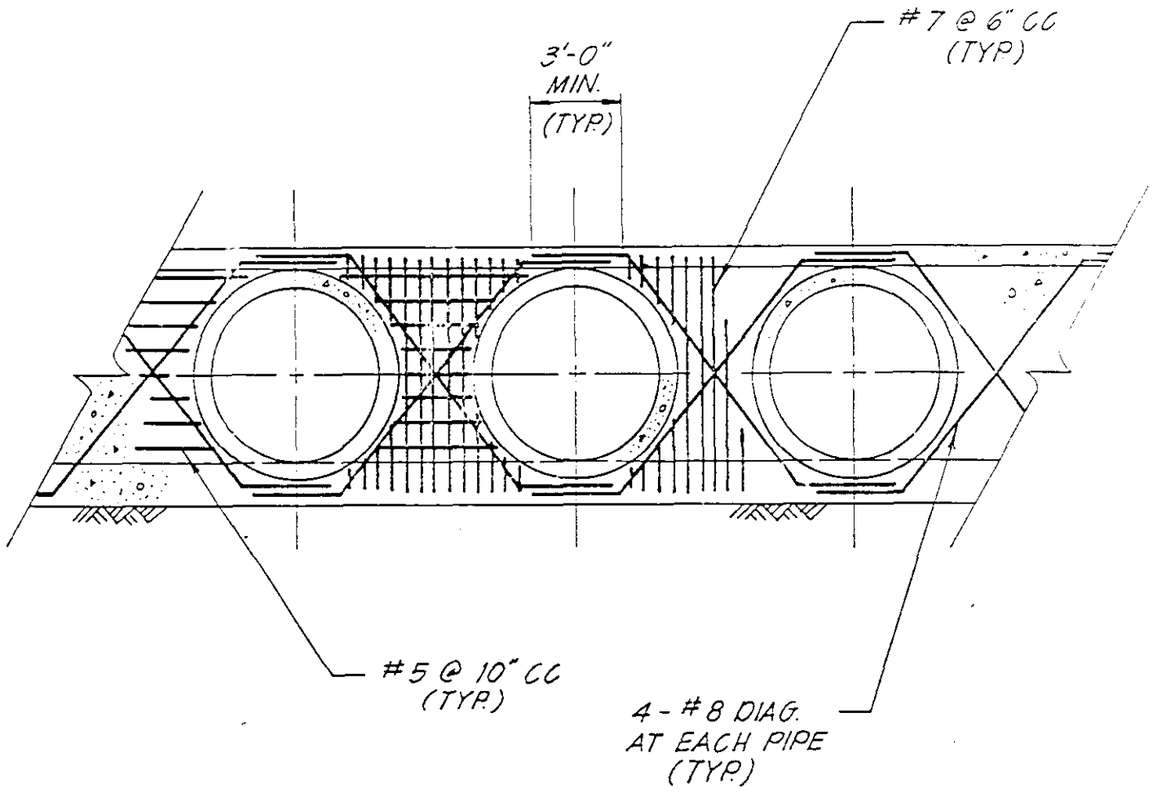
GENERAL NOTES:

1. CONTRACTOR IS ADVISED TO VISIT SITE PRIOR TO BEGINNING WORK.
2. CLOSURE PLATES SHALL BE INSTALLED ON THE UPSTREAM AND DOWNSTREAM END OF PIPE.
3. CONTRACTOR SHALL VERIFY FIELD DIMENSIONS AND LOCATE EXISTING HEADWALL REINFORCING STEEL AS REQUIRED FOR EXPANSION ANCHOR INSTALLATION.
4. CLOSURE PLATES SHALL BE ASTM A36 STEEL SHOP COATED WITH RED OXIDE PRIMER.
5. EXPANSION ANCHORS SHALL BE HILTI HVA ADHESIVE ANCHOR SYSTEM INSTALLED PER MANUFACTURERS DIRECTIONS. CONTRACTOR SHALL USE 3/4"x9-5/8" HILTI HAS ANCHOR RODS WITH 3/4" HILTI HFA INSERTS. USE ONE 3/4"x6-5/8" HILTI HVA ADHESIVE CAPSULE PER ANCHOR.
6. STEEL FABRICATOR MAY PROVIDE LONG SLOTTED HOLES IN CLOSURE PLATES TO ALLOW FOR FIELD ADJUSTMENT.



DESIGNED J.C. Roberts DETAILED L.J. Thomas APPROVED D.K. Reed DATE 10-1-93	Black & Veatch Engineers-Architects Las Vegas, Nevada Project # 23546.300	CITY OF NORTH LAS VEGAS NORTH LAS VEGAS DETENTION BASIN OUTLET MODIFICATIONS	SHEET 1 OF 3

511080



EXISTING REINFORCING AT PIPE INLET WALL

SCALE:3/16"=1'-0"

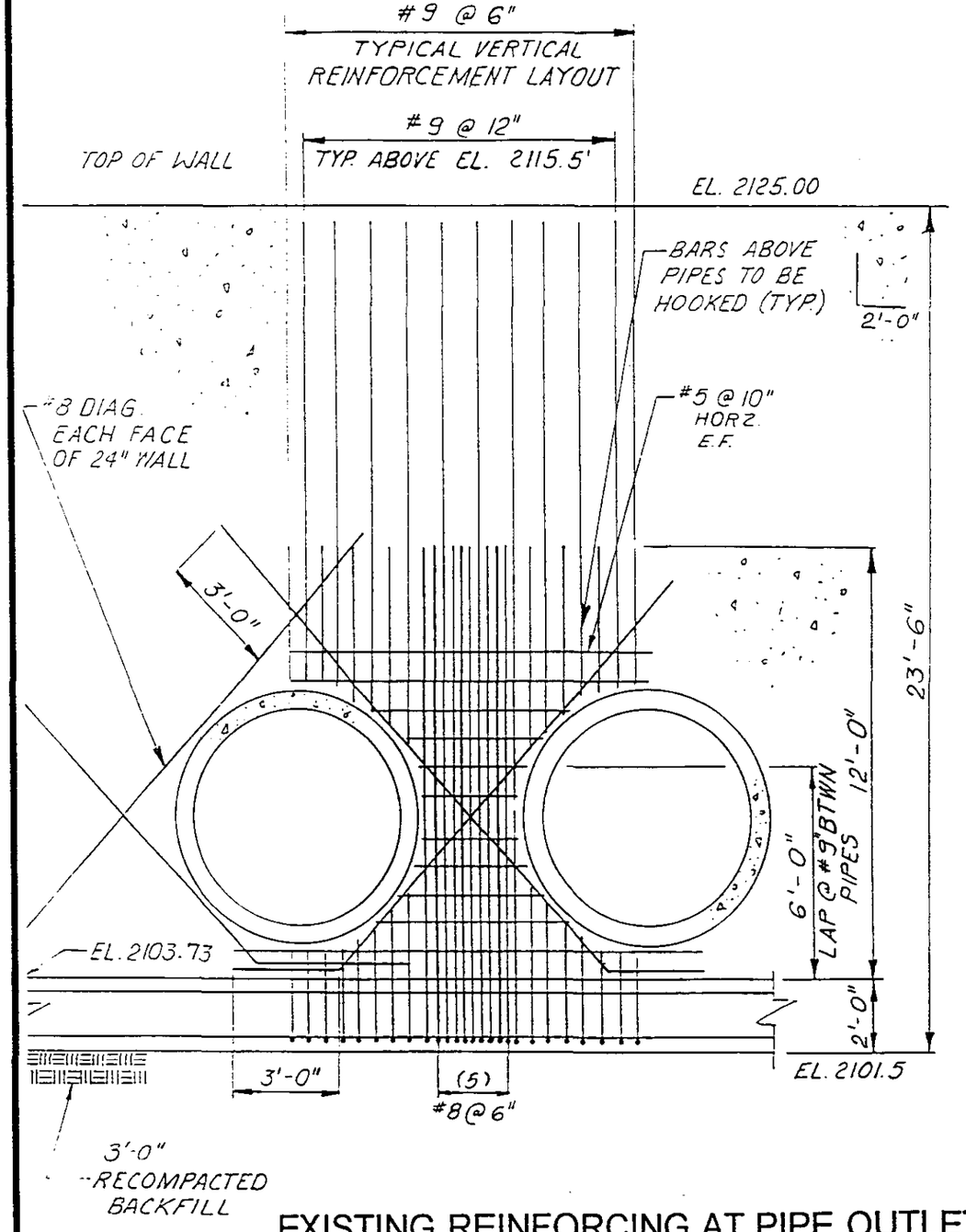
Photograph 2. Exisiting Inlet structure of North Las Vegas Detention Basin.

Photograph 2. Exisiting Inlet structure of North Las Vegas Detention Basin.

PROFESSIONAL ENGINEER : STATE OF NEVADA
STEPHEN C. ROBERTS
CIVIL
9804
10-1-93

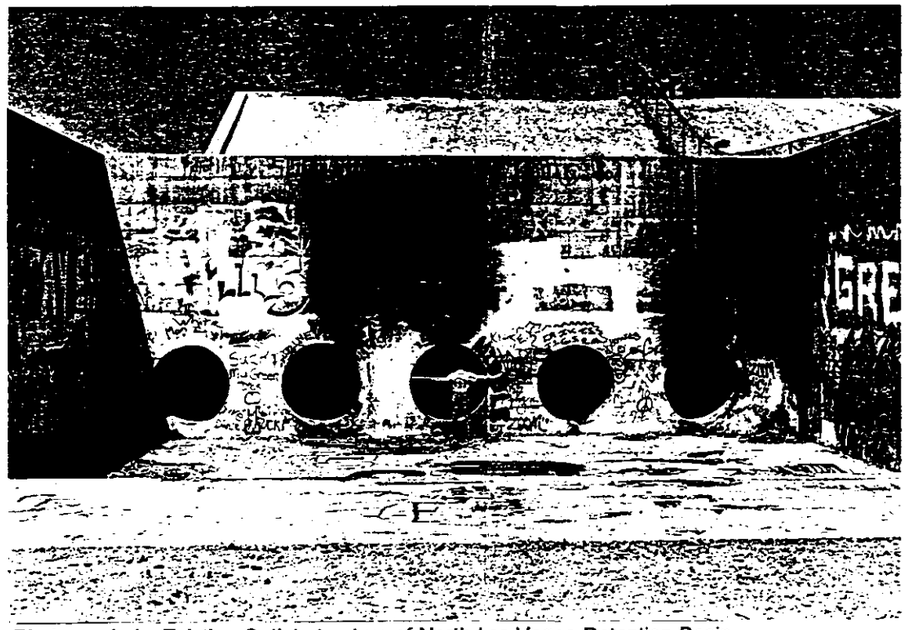
DESIGNED J.C. Roberts	Black & Veatch Engineers-Architects Las Vegas, Nevada	CITY OF NORTH LAS VEGAS	SHEET
DETAILED T. J. Hamilton	RV Project # 23546.300	NORTH LAS VEGAS DETENTION BASIN OUTLET MODIFICATIONS	2 OF 3
APPROVED D.V. Reed			
DATE 10-1-93			

511080

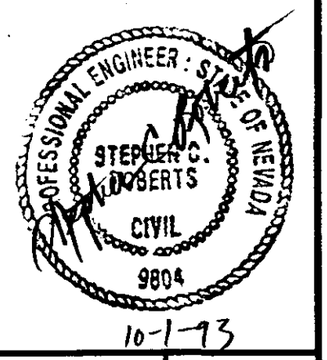


EXISTING REINFORCING AT PIPE OUTLET WALL

SCALE:1/4"=1'-0"



Photograph 1. Existing Outlet structure of North Las Vegas Detention Basin.



10-1-93

DESIGNED / DETAILED / APPROVED / DATE 10-1-93	Black & Veatch Engineers-Architects Las Vegas, Nevada — Project # 23546.300	CITY OF NORTH LAS VEGAS NORTH LAS VEGAS DETENTION BASIN OUTLET MODIFICATIONS	SHEET 3 OF 3

511060

5.3.4 Geotechnical Investigation
Range Wash Flood Control Project

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

GEOTECHNICAL INVESTIGATION
RANGE WASH FLOOD CONTROL PROJECT
NEAR RANGE ROAD
NORTH LAS VEGAS, NEVADA

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33298-01

January 8, 1992

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

January 8, 1992 91-33298-01

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Geotechnical Investigation
Range Wash Flood Control Project
Near Range Road
North Las Vegas, Nevada

Gentlemen:

We are pleased to submit the results of our geotechnical investigation conducted for the construction of the Range Wash Flood Control Project located near Range Road in North Las Vegas, Nevada. The study was performed in general accordance with our signed Standard Form of Agreement With Consultant for Professional Service dated July 29, 1991.

The dike should receive adequate support from undisturbed medium dense to dense granular soils or on moderately hard to hard cemented soils. The on-site soils are suitable for use as materials for soil-cement and dike embankment fill.

Groundwater was not encountered to the depths explored for this project. Hard caliche and/or moderately hard partially cemented soils were encountered at most of the boring and test pit locations at various depths. Rock excavation techniques may be required for excavation of the cemented soils.

If you have questions concerning information contained in this report, please contact us at your convenience.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Algirdas G. Leskys, P.E.
President

AGL:glt
83/27G

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities; and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used*:

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

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DRAWING NO. 1 - VICINITY MAP
DRAWING NO. 2 - LOCATION OF SUBSURFACE EXPLORATIONS

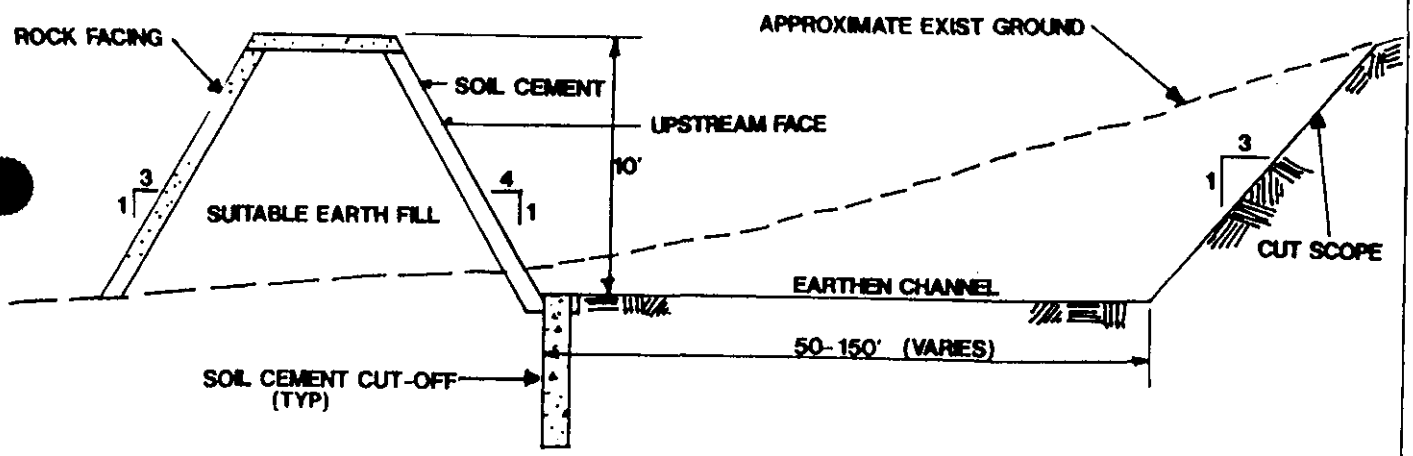
APPENDIX A - FIELD AND LABORATORY INVESTIGATIONS
APPENDIX B - SLOPE STABILITY ANALYSIS
APPENDIX C - SOIL CEMENT MIX DESIGNS

INTRODUCTION

This report presents the results of our geotechnical investigation performed for the construction of the Range Wash Flood Control Project near Range Road in North Las Vegas, Nevada. A vicinity map showing the location of the project within the Las Vegas area is provided on Drawing No. 1. The purposes of this investigation were to (1) provide geotechnical recommendations for the proposed dike, floodway and inlet structure; and (2) provide recommendations regarding construction requirements and mix designs for soil-cement. The geotechnical portion of our investigation is presented in this report while the soil-cement portion is presented in Appendix C.

We understand the project will consist of the construction of about 27,000 feet of diversion dike and earthen channel, and approximately 4,000 feet of trapezoidal floodway channel. A portion of the dike will be on Nellis Air Force Base property. The eastern 1/3 of the dike alignment crosses the Air Force Base small arms range. The dike will be about 10 feet in height above the earthen channel bottom with soil cement placed on the upstream face of the slopes. The downstream face of the dike will have 4 to 6 inches of local rock facing for erosion protection. Oversize gravels and cobbles from the channel excavation may be used for the rock facing. The earthen channel will vary between 50 and 150 feet in width and will run along the toe of the dike. A 3:1 (horizontal to vertical) cut slope is planned for the side of the earthen channel opposite the dike. Figure No. 1 presents the typical cross-section of the dike and earthen channel. The floodway channel will have a 300 foot wide earthen bottom while the slopes will be lined with soil cement. The floodway channel will be approximately 3 to 4 feet deep and will transition into a narrower inlet area to the existing North Las Vegas Detention Basin. Soil cement cutoff walls extending below the toe of the dike and floodway channel slopes are also planned. The bend where the floodway and dike meet has a radius of approximately 500 feet. The bend may require rip-rap, gabions, or soil cement reinforcement.

The anticipated maximum (100-year) depth of water against the dike is 5 feet. The flow within the floodway will generally meander through the 300 foot wide channel. The approximate alignment of the dike, earthen channel, and floodway, and location of the inlet area, bend and existing detention basin are presented on Drawing No. 2.



TYPICAL DIKE CROSS SECTION

RANGE WASH FLOOD CONTROL PROJECT
RANGE ROAD
NORTH LAS VEGAS, & CLARK COUNTY, NEVADA

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Sciences

Scale	NOT TO SCALE
Prepared by	TA
Checked by	BLO
Approved by	B20
Project No.	91-33298-01
Date	11/11/91
Figure No.	1

SCOPE OF SERVICES

The following tasks were included in our scope of services:

1. A field exploration program was conducted which consisted of drilling, excavating, logging, and sampling of sixteen (16) exploratory borings and fourteen (14) test pits to depths varying from 2½ to 15 feet. The approximate location of the explorations are shown on Drawing No. 2. A description of the equipment and procedures used during the exploration program is presented in Appendix A. Summaries of the boring and test pit logs are also presented in Appendix A. Samples of the subsurface soils were obtained from the borings and test pits and were taken to our laboratory for further evaluation and testing.
2. Eight (8) bulk samples of the surficial soils on the fan area, both in and out of the washes, were obtained for grain-size distribution tests for sediment transport analysis (by Boyle). The approximate location of the bulk samples are shown on Drawing No. 2. The results of the grain-size distribution tests are presented on Drawings Nos. A-53 through A-60 in Appendix A.
3. Laboratory tests were conducted on selected soil samples. Tests included moisture-density determinations, solubility, chemical analyses, sieve analyses, and direct shear tests. Descriptions and results of the laboratory tests are presented in Appendix A.
4. Laboratory tests were also conducted on selected soil samples for the two soil cement designs. Tests including sieve analyses, Atterberg Limits, and moisture/density relationships were performed on each sample to classify the soil and to establish a range of cement contents for the mix design. Other tests included freeze/thaw, wet/dry, and compressive strength. The freeze/thaw, wet/dry, and compressive strength graphs, gradations, and moisture/density curves for each mix design are enclosed in Appendix C.
5. Results of the field exploration and laboratory testing were evaluated and engineering analyses were performed to develop appropriate recommendations for the design and construction of the proposed project.
6. This geotechnical report and the soil cement mix design report were prepared to present the findings, conclusions and recommendations of this firm.

GEOLOGIC AND SEISMIC CONDITIONS

FAULTING AND SEISMICITY

No bedrock or tectonic faults are known to transect the alluvium deposits in the area of the proposed project. The nearest fault with evidence of possible geologically recent displacement is located at the foot of Frenchman Mountain, approximately 7 miles southeast of the project.

The west end of the project is located approximately 1½ miles east of a topographic lineation regarded as a compaction fault as mapped on the Fault Scarps and Fissures in Las Vegas Valley Map, published by the Nevada Bureau of Mines and Geology, Bulletin 95, John W. Bell, 1981. It is generally agreed that compaction faults are not bedrock faults, although their displacement may have been at least partly induced by a seismic event. The age of these escarpments have been dated by others at about 14,000 years old. No fissures were observed along the proposed alignment.

Las Vegas Valley is located in Seismic Zone 2B as categorized in the Uniform Building Code. Zone 2B represents a low to moderately active seismic area.

ESTIMATED GROUND ACCELERATIONS

A regional map published by Algermissen and Perkins (1976) presents the expected peak horizontal ground acceleration for the Las Vegas Valley as approximately 0.04 g. This value has a 10 percent chance of being exceeded in a 50-year period. Site specific seismicity model analyses have been performed by CCSW on other projects in the Las Vegas Valley. This analyses have typically found the maximum credible peak horizontal ground acceleration to range between 0.2g and 0.3g. For an event having a 10 percent chance of exceedance during a 100-year design life the peak horizontal ground acceleration has ranged between 0.1g and 0.2 g. The peak horizontal ground acceleration recommended for the design of the project is 0.15g.

EXISTING CONDITIONS

SURFACE

At the time of our field investigation, the proposed dike and floodway alignments were undeveloped desert. Some scattered trash, debris and fill piles existed on or near the western half of the dike alignment and some of the floodway alignment. The ground surface within or near the alignments were either disturbed or in a natural state. Several washes crossed the dike alignment. The dike alignment crosses several berms (undocumented fill) that are generally in the shape of a triangle (as seen from an aerial view) that are on the Nellis Air Force Base property.

SUBSURFACE

Based on results of our subsurface explorations, the subsoils generally consisted of 0 to 1 foot of loose granular soils overlying medium dense to dense granular soils and moderately hard to hard cemented soils (caliche). The depths to and thickness of the cemented soils are provided below in Table No. 1. Free groundwater was not encountered to the depths explored for this project.

Table No. 1: Depth to and Thickness of Cemented Soils

Boring Location	Depth to Cemented Soils (ft)	Thickness of Cemented Soils (ft)	Soil Description
B-4	3	>12	Mod. Hard
T-6	7	BR	Mod. Hard to Hard
T-9	2	2	Mod. Hard
T-9	4	BR	Mod. Hard to Hard
B-11	6	4	Mod. Hard
B-12	5	3	Mod. Hard
B-12	11	2	Mod. Hard
B-13	5	3	Mod. Hard
B-13	11	> 4	Mod. Hard

Table No. 1: Depth to and Thickness of Cemented Soils (Continued)

Boring Location	Depth to Cemented Soils (ft)	Thickness of Cemented Soils (ft)	Soil Description
B-14	5	3	Mod. Hard
B-15	3	3	Mod. Hard
B-15	10	3	Mod. Hard
B-16	4	>10	Mod. Hard
B-17	6	2	Mod. Hard
B-18	10	1	Mod. Hard
B-18	13	> 1	Mod. Hard
T-19	6	BR	Mod. Hard to Hard
T-20	7	BR	Mod. Hard to Hard
T-21	1½	6	Mod. Hard
T-21	6	BR	Mod. Hard to Hard
T-21A	5½	BR	Mod. Hard to Hard
T-22	2	2½	Mod. Hard
T-22	4½	BR	Mod. Hard to Hard
T-23	8½	BR	Mod. Hard to Hard
T-24	6½	BR	Mod. Hard to Hard
T-25	2	8	Mod. Hard
T-25	10	BR	Mod. Hard to Hard
T-26	10	1	Mod. Hard
T-26	11	BR	Mod. Hard to Hard
T-27	6	2	Mod. Hard
T-27	8	BR	Mod. Hard to Hard
T-28	2½	BR	Mod. Hard to Hard
T-29	2	½	Mod. Hard
T-29	2½	BR	Mod. Hard to Hard

BR = Backhoe Refusal

Laboratory test results indicate that the on-site soils have moderate dry densities, a moderate to high shear strength, and a low potential for gypsum solubility. The native soils should be considered corrosive to concrete, soil cement and metal.

Based on the results of our subsurface exploration and our experience, variations in the continuity and depth of subsoil deposits should be anticipated. Due to the nature and depositional characteristics of the natural soils along the dike and floodway alignment, care should be exercised in interpolating subsurface soil conditions beyond the exploratory borings and test pits.

GENERAL EVALUATION

Based on the results of the field and laboratory investigations, it is our opinion that the undocumented fills and the surficial loose native soils in their present condition are not considered suitable for the support of the dike. The native medium dense to dense granular soils and the moderately hard to hard cemented soils should provide adequate support after the surface vegetation and organics have been removed. Cemented soils will be difficult to excavate and will require heavy-duty excavation methods for removal.

The on-site soils are suitable for use as materials for soil-cement and dike embankment fill. Based on slope stability analyses, the planned 4:1 and 3:1 slopes for the dike and/or earthen channel cut slope are stable. Depending on the construction methods for the soil-cement, a flatter slope may be required for the upstream face of the dike. A 3:1 slope for the floodway channel should be used.

RECOMMENDATIONS

DIKE

It is our understanding that the proposed dike to be constructed will be about 10 feet in height above the earthen channel bottom.

The native granular soils should provide adequate support for the dike after the surface vegetation and organics have been removed and the foundation preparation has been conducted as presented in the following Earthwork section. The on-site soils are suitable for use as materials for dike embankment fill or other

structural fills. The requirements for structural fill, placement and compaction are presented in the following Earthwork section.

The stability analysis indicates that the dike embankment slopes on both the upstream and downstream faces should not be made steeper than 3:1 (horizontal to vertical). The dike was also analyzed for a minimum crest width of 10 feet. The recommended slopes assume that all of the exposed dike surfaces will be adequately protected from erosional forces. The planned rock facing for the downstream face and soil-cement for the upstream face are suitable for embankment protection. Embankment settlement due to consolidation of fill and foundation materials should be negligible.

The inclination of the dike or channel slopes will depend to a certain extent on the type of erosion protection and method of construction selected. If soil-cement is used on the outer face, it should be a minimum of 12 inches thick (perpendicular to the slope) from a construction standpoint. Soil-cement slope protection is normally placed by one of two methods. Lifts of the soil-cement can be placed parallel to the slope and compacted. This method usually requires a minimum soil-cement lift width equal to the width of the equipment (about 8 feet). The outer face of the slope is normally overbuilt with this method, and trimmed back to the final face. With this method, slopes as steep as 3:1 (horizontal to vertical) could be constructed.

Soil-cement can also be placed and compacted in lifts perpendicular to the slope. With this method, soil-cement thicknesses down to 12 inches could be constructed, but it is normally necessary to flatten slopes, so that placement and compaction equipment can operate up and down the slope. Our past experience has indicated that with conventional placement and compaction equipment, this usually requires slopes of 4:1 (horizontal to vertical) or flatter.

The final thickness of the soil-cement erosion protection layer, should be determined by a qualified hydraulic engineer, after water velocities, and the soil-cement strength and durability characteristics have been determined.

Slope stability analyses were performed on the dike in general accordance with the Nevada State Statutes, Corps of Engineers and the Clark County Regional Flood Control District "Hydrologic Criteria and Drainage Design Manual". The dike was analyzed with the computer program SB-Slope, Version 3.0. It was used to calculate the minimum factor of safety for four separate cases; (1) end of construction, (2) sudden drawdown, (3) steady state seepage, and (4) seismic steady

state seepage. Since the 3:1 cut slope is generally of the same materials as the dike, it was assumed that the factors of safety obtained for the dike were applicable to the 3:1 cut slope. The SB-Slope program utilizes the simplified Bishop Method of slope stability analysis for circular failure surfaces. A layer of soil cement and rock facing erosion protection materials were simulated in the stability analyses as uniform surcharge loads. Based on laboratory tests, an average saturated angle of internal friction of 38 degrees was used. The maximum failure surface was 10 feet below the dike. A summary of the minimum acceptable factors of safety, and calculated factors of safety is presented on the following table. The results of the slope stability analysis are presented and further explained in Appendix B.

Table No. 2: Calculated and Required Factors of Safety for Slope Stability

Loading Condition	Case	Required[1] F.S.	Calculated F.S.
End of Construction	1	1.3	2.4
Sudden Drawdown	2	1.2	2.0
Static-Steady State Seepage	3	1.5	2.3
Seismic-Steady[2] State Seepage	4	1.0	1.2

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers (1973).
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.15.

FLOODWAY CHANNEL

It is our understanding that for erosion protection the floodway channel slopes will be covered with either benched gabions, wire basket rip-rap or soil cement. Based on our slope stability analysis, it is recommended that the floodway channel slopes should not be made steeper than 3:1. If soil-cement is used for erosion protection, a flatter slope may be necessary for construction purposes. The floodway channel slopes were also analyzed with the computer program SB-Slope for the same cases as the embankment. The computed factors

of safety were higher than the required minimums. The sudden drawdown case, which was the worst case, is presented in Appendix B. A factor of safety of 1.2 was calculated.

Benched gabions or wire basket rip-rap should be placed on native medium dense to dense granular soils. Gabions should be designed within the guidelines and standards of the manufacturer.

EROSION PROTECTION

Based on the results of our field and laboratory investigations, it is our opinion that the on-site granular soils will be subject to erosion due to high water velocities. Therefore, erosion protection will be required for inlet and bend areas, dike slopes, and along the floodway channel. As previously mentioned, soil-cement will be used for the upstream slope of the dike and possibly the floodway channel side slopes. Soil-cement should be at least 12 inches thick. However, the soil-cement thickness should be designed based on water velocity, and strength and durability of soil-cement.

Erosion protection for the inlet area to the detention basin and for the transition from dike channel to floodway channel (1000 foot radius bend), may consist of dumped rip-rap, wire basket rip-rap or gabions. The rip-rap rock size and section thicknesses should be designed after flow velocities are determined by a hydraulic engineer. If rip-rap or gabions are used, a puncture-resistant synthetic filter cloth may be required to reduce the amount of scour and piping of natural soils during heavy flows. The type of filter cloth will depend on the type of erosion protection used. We are available to provide additional detailed recommendations for erosion protection after a particular method has been selected.

EARTHWORK

Site Preparation: Within the areas to be graded, we recommend that all vegetation, undocumented fill, rubble, trash, debris and any loose or disturbed native soils should be removed from within the proposed dike, floodway and inlet structure areas. Undocumented fill, loose, or disturbed native soils should be excavated, processed, and stockpiled for later use as engineered fill.

Following stripping and clearing in areas to receive structural fill, such as the dike area, we recommend that the exposed native soils be scarified to a depth of at least 9 inches, moisture-conditioned to within 2 percent of the optimum moisture content, and recompacted to a minimum relative compaction of 95 percent (ASTM D1557). Scarification may be terminated on moderately hard to hard cemented soils.

The on-site sands and gravels should be considered to be highly erodible. Care should be taken during construction to minimize potential storm water from eroding the unprotected side slopes of the proposed dike and floodway channel.

Excavation Considerations: The surficial non-cemented soils encountered during our field exploration should be readily excavatable with conventional earthwork equipment. Hard caliche and moderately hard cemented soils were encountered at varying depths below the existing ground surface. Excavation of these cemented materials will require the use of rock excavation techniques such as ripping with a heavy-duty dozer, heavy-duty backhoe, Ho-ram, blasting, headache ball or other methods. The Contractor should be aware of the potential for vibrational damage to adjacent or nearby structures when using heavy impact equipment or blasting during removal of moderately hard to hard cemented materials.

Excavations over 4 feet deep should be laid back to safe slopes. Cut excavation operations should be conducted in accordance with Section Nos. 1926.650 *through* .653 *of the State of* Nevada Occupational Safety and Health Standards for the Construction Industry as currently amended. Safety of construction personnel is the responsibility of the Contractor.

Dike Fill: Prior to the placement of compacted fill for the dike, the native soils should be scarified and recompacted as recommended in the prior subsection, Site Preparation. Fill materials may consist of approved imported granular soils or on-site sands and gravels that are cleaned of organics and cobbles larger than 6 inches. The on-site soils will be suitable for embankment construction. Unless additional stability analysis is conducted, imported fill materials should consist of well or poorly graded sand or gravel with the following characteristics:

a. be free of organics and inert materials larger than 6 inches,
b. have 80 to 100 percent passing the 3-inch sieve,
c. have 10 to 70 percent passing the No. 4 sieve,
d. have less than 25 percent passing the No. 200 sieve,
e. have a saturated and drained shear strength internal friction angle of 38 degrees or greater,
f. be non-expansive,
g. have a gypsum solubility of 1 percent or less, and
h. have water soluble sodium sulfate percentage less than 0.2.

All imported fill should be evaluated and/or tested by a representative of this office for conformance with these recommendations.

Structural fill should be placed in controlled layers compatible with the type of compaction equipment used but not exceed 12 inches loose. The fill should be moisture conditioned to obtain soil moisture within 2 percent of optimum. Each layer of fill should be compacted to at least 95 percent of the maximum laboratory dry density (as determined by ASTM D-1557). The compaction requirements for fill slopes should extend out to the slope face. The best method for compacting the slope face is to overfill and then cut back to the properly compacted material.

Where fill is placed on a natural slope steeper than 5:1 (horizontal to vertical), and a height greater than 5 feet, the fill should be benched into competent materials. The height of the benches should not exceed 3 feet.

Material Volume Changes: There will be shrinkage when excavating and compacting the on-site soils. An estimated shrinkage factor of 10 to 20 percent is applicable for non-cemented native soils. A subsidence factor of 0.1 feet should be used in all areas where the exposed native soils are compacted to a depth of 6 inches. An estimated swell factor of 0 to 10 percent is applicable for the natural cemented soils.

SOIL CORROSIVITY

The on-site soils should be considered corrosive to buried metal and have sulfate levels above that considered harmful to normal strength concrete and soil cement.

1. Consideration should be given to corrosion protection systems for buried metal such as cathodic protection or the use of PVC where permitted by local building codes.
2. All concrete and soil cement in contact with the on-site soils should contain Type V cement.
3. The concrete should be placed with a maximum 4-inch slump and good densification procedures should be used during placement to prevent honeycombing.

PROJECT REVIEW AND CONSTRUCTION OBSERVATION

This report has been prepared to aid in the evaluation of this alignment and to assist in the design of this project. This office should be provided the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented in this report are valid and have been implemented. Review of the final design drawings and specifications should be noted in writing and become a supplement to this report.

Variations in soil conditions may be encountered during construction of this project. In order to permit correlation between the field conditions encountered in this investigation and the actual conditions encountered during construction, and to confirm recommendations presented herein, this office should be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that the recommended foundation preparations are performed, that suitable dike fill soils are placed properly on prepared native soils, and that fills are properly placed and compacted.

CLOSURE

The recommendations given in this report are based on results of field and laboratory investigations, combined with interpolation of subsurface conditions between boring and trench locations. The nature and extent of variations between

the explorations may not become evident until construction. If variations are exposed during construction, this office should be notified so the variations can be reviewed and the recommendations of this report modified or verified in writing.

If changes in the nature, design, or location of the facility are planned, the recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report modified or verified in writing.

This report has been prepared only to aid in the evaluation of this site and to provide geotechnical recommendations for the design of this project. Any person using this report for bidding or construction purposes should be aware of the limitations of this report as mentioned above and should conduct an independent investigation as he deems necessary to satisfy himself as to the surface and subsurface conditions to be encountered, and the procedures to be used in the performance of work on this project.

It has been our pleasure to serve you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Brad L. Olsen

Brad L. Olsen, E.I.T.
Staff Engineer

Reviewed by:

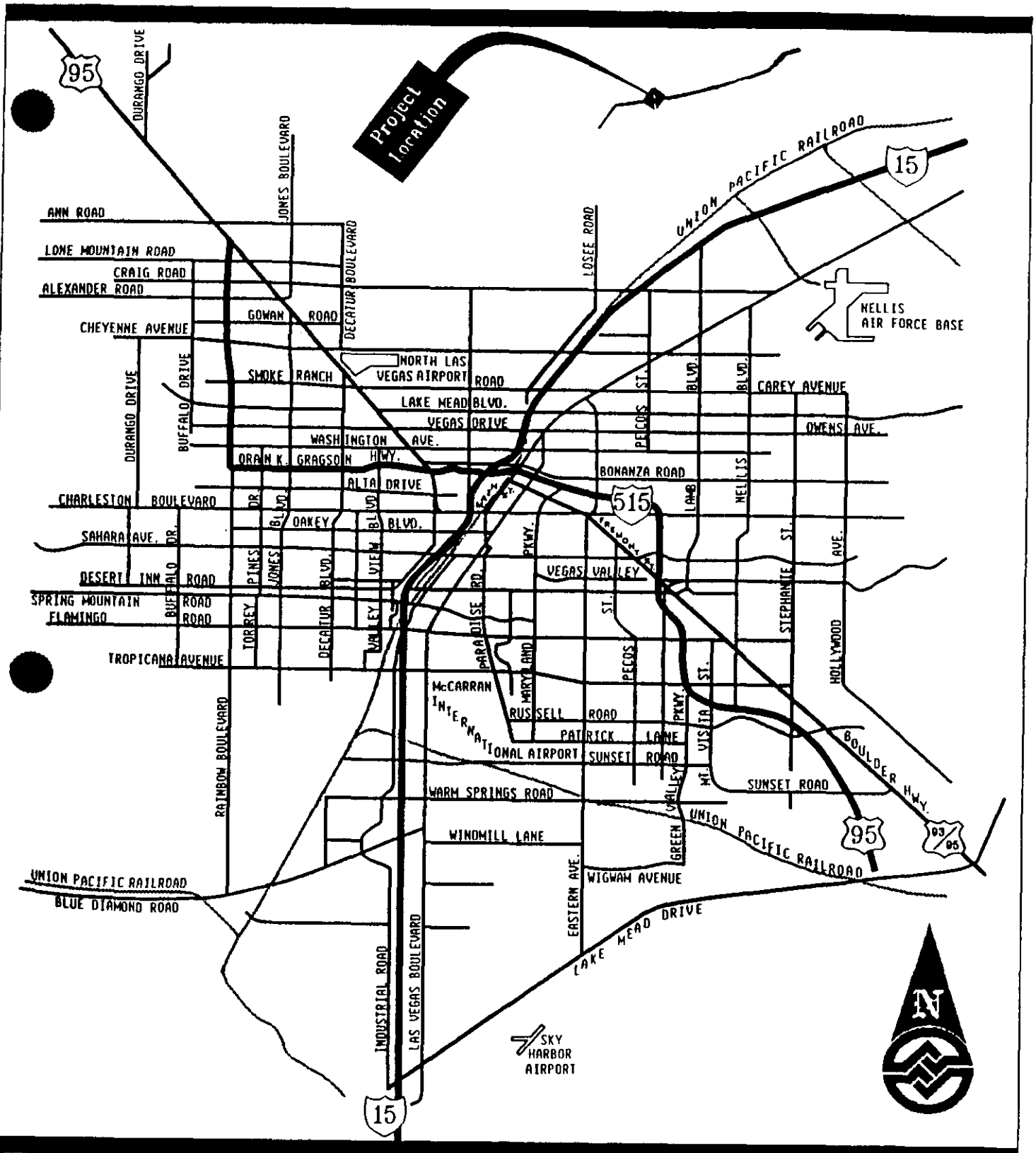
Al Stilley, P.E.
Principal Engineer

BLO:ANS:glt
63/27G

Encl: Drawing Nos. 1 and 2
Appendix A
Appendix B
Appendix C

Dist: 20/Addressee

1-8-92



LAS VEGAS VICINITY

RANGE WASH FLOOD CONTROL PROJECT
RANGE ROAD
NORTH LAS VEGAS & CLARK COUNTY , NEVADA

Converse Consultants Southwest, Inc.

PROJECT NO.	DRAWING NO.
91-33298-01	1

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

FIELD INVESTIGATION

The subsurface soil conditions were explored by drilling sixteen (16) borings and excavating fourteen (14) test pits to depths varying from 2½ to 15 feet. In addition, eight (8) bulk samples of the surficial soils in and out of the wash were obtained for laboratory testing. The approximate locations of the explorations are shown on Drawing No. 2. Continuous logs of the subsurface conditions as encountered in the explorations were recorded at the time of drilling or excavation by a field engineer. The subsurface conditions encountered were visually classified in accordance with ASTM D2487-85, which is based on the Unified Soil Classification System. Summaries of the subsurface conditions encountered are presented on the boring and trench summary sheets, Drawing Nos. A-1 through A-30. A key to soil symbols and terms is found on Drawing No. A-31. The soil classification system for engineering purposes is further explained on Drawing No. A-32.

Drilling was accomplished with a truck-mounted rotary air drill rig and a hollow stem auger rig equipped for soil sampling. Relatively undisturbed soil samples were obtained using a 2.5-inch inside diameter Converse sampler driven with a 340-pound or 140-pound hammer free-falling through a distance of 30 inches. Sampler driving resistance, expressed as blows per foot of penetration, is presented on the boring logs at the respective sampling depths. The test pits were excavated with a Case 580E rubber-tired backhoe.

LABORATORY INVESTIGATION

Laboratory tests were conducted on representative soil samples for the purpose of classification, and determination of their physical properties and engineering characteristics. The amount and selection of the types of testing for a given study are based on the geotechnical conditions of the project. A summary of the various laboratory tests conducted by our office for engineering purposes is presented below.

The soil samples presently stored in our laboratory will be discarded 30 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period.

MOISTURE CONTENT AND DRY DENSITY: Data obtained from these tests, performed on relatively undisturbed samples obtained from the field, were used in the classification and correlation of the soils and to provide qualitative information regarding soils strength and compressibility. Test results are presented on the summary boring logs, Drawing Nos. A-1 through A-30.

CHEMICAL ANALYSES: Chemical tests were performed on representative soil samples to investigate the potential for chemical heave and for soil corrosion of concrete. The chemical analyses for water soluble sulfates and sodium were performed by Atlas Chemical Testing Laboratories, Inc. in Las Vegas, Nevada. The results of the chemical tests are presented in the table below:

Exploration Location	Depth (feet)	Soil Description	Percent Sodium	Percent Sulfate	Total Available Water Soluble Sodium Sulfate%
B-2	0-14½	PRLY GRADED GRAVEL	<0.01	0.01	<0.01
T-9	0-4	PRLY GRADED GRAVEL	<0.01	<0.01	<0.01
B-13	0-15	PRLY GRADED GRAVEL	0.01	<0.01	<0.01
T-27	0-8	PRLY GRADED GRAVEL	0.08	0.55	0.24

DIRECT SHEAR STRENGTH: Progressive direct shear tests were performed on selected undisturbed and remolded samples using a constant strain rate direct shear machine. The remolded samples were compacted to 90 percent of the maximum dry density within 2 percent of optimum moisture content. The samples were placed in the shear machine, a specified normal load was applied, and the specimen was saturated then sheared until a maximum shear strength was developed. After the soil specimen had developed maximum shear resistance under the first normal load, the normal load was removed and the specimen was pushed back to its original undeformed configuration. Another normal load was then applied, and the specimen was sheared a second time. This process was repeated for several different normal loads. Results of the direct shear tests are presented in the following table:

Exploration Location	Depth (feet)	Soil Description	Angle of Internal Friction, (°)	Coulomb Cohesion (psf)
*B-1	3-4	POORLY GRADED GRAVEL	45	300
*B-1	13-14	POORLY GRADED GRAVEL	45	0
B-1	0-14½	POORLY GRADED GRAVEL	35	250
*B-2	8-9	POORLY GRADED GRAVEL	44	200
*B-3	3-4	POORLY GRADED GRAVEL	49	100
*B-3	8-9	SILTY GRAVEL	41	100
B-7	0-14½	SILTY GRAVEL	39	100
B-14	0-14½	POORLY GRADED GRAVEL	40	50
T-21A	0-5½	POORLY GRADED GRAVEL	36	100
T-23	0-8½	POORLY GRADED GRAVEL	42	0
T-27	0-8	POORLY GRADED GRAVEL	38	0

*Undisturbed sample

SOLUBILITY: *Solubility tests were performed to determine the amount of* water-soluble materials (principally gypsum) present in the soil. After drying the samples in a 60-degree centigrade oven, about 2.0 liters of tap water was passed through each sample. The samples were then oven-dried and the amount of soluble materials lost was calculated. The results of the solubility tests are presented in the following table:

Exploration Location	Sample Depth (feet)	Soil Description	Solubility, (percent by dry weight)
B-2	0-14½	POORLY GRADED GRAVEL	0.4
B-13	0-15	POORLY GRADED GRAVEL	1.1
T-25	0-10	POORLY GRADED GRAVEL	1.6

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 1

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
2	POORLY GRADED GRAVEL With Silt & Sand (GP-GM); loose, brown, dry						
4	---medium dense, slightly moist			85/8	3	113	
6	---occasional cobbles, dense						
8							
10				85/10"	1	129	
12							
14				83/10	2	116	

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-1

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 2

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		**POORLY GRADED GRAVEL With Silt & Sand (GP-GM)**; occasional cobbles, and small boulders, loose, brown, dry						
2		---medium dense						
4			■		33/11"	1		
6								
8			■		50/6"	2	104	
10								
12								
14			■		50/6"	3	82	

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.5 feet

APPROVED BY BJC ON 1-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-2

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 3

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
	SILTY GRAVEL With Sand (GM); loose, brown, dry						
	---medium dense, slightly moist						
2							
	---dense						
4		■		72/10"	2	118	
6							
8		■		50/3"	3	101	
10							
12							
14		■		65/6"	3		

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.5 feet

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North Las Vegas, & County Nevada

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Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-3

Date Drilled: 8/8/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 4

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
		POORLY GRADED GRAVEL With Silt & Sand (GP-GM); loose to medium dense, light brown, slightly moist						
2		---partially cemented, moderately hard, gray						
4								
6								
8								
10								
12								
14								

APPROVED BY BLG ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: lb/in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
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91-33298-01

Drawing No.
A-4

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Date Drilled: 9/4/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 5

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0		•					
		•		30/12"			
2							
		---dense					
				40/6"	2	132	
4							
6							
8							
10							
12							
14							

POORLY GRADED GRAVEL With Silt & Sand (GP-GM); occasional cobbles, loose to medium dense, brown, slightly moist

APPROVED BY BJO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
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Converse Consultants Southwest, Inc.
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Drawing No.
A-5

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T- 6

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
0		**POORLY GRADED GRAVEL With Silt & Sand (GP-GM)**; occasional cobbles, medium dense, brown, slightly moist					
2		---slightly cemented, dense					
4		----thin scattered sand layers					
6							
		BACKHOE REFUSAL DUE TO CEMENTATION					

Groundwater: None Observed

Bottom of Trench at 7.0 feet

APPROVED BY BJO ON 1-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-6

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 7

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
2	SILTY GRAVEL With Sand (GM); occasional cobbles, loose, brown, dense						
	---medium dense						
	---slightly moist						
4	---dense			80/10"	1		
6							
8				55/6"			
10							
12							
14				75/4"			

Groundwater: None Observed
Driving Weight and Drop: *140lb/30in*

End of Boring at 14.5 feet

APPROVED BY BZO ON 1-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-7

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B- 8

DEPTH (ft.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		**SILTY GRAVEL With Sand (GM)**; loose, brown, slightly moist						
2		---medium dense						
4		---dense			50/3"			
6								
8		**POORLY GRADED GRAVEL With Silt & Sand (GP-GM)**; dense, brown, slightly moist			95/8"	2	130	
10								
12								
14					65/3"			

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-8

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T- 9

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Silt & Sand (GP-GM); medium dense, brown, slightly moist					
2		---partially cemented, moderately hard					
4		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BLA ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 4.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-9

Date Drilled: 8/8/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-10

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		**POORLY GRADED GRAVEL With Sand (GP)**; loose to medium dense, light brown, slightly moist						
2								
4								
6								
8		---slightly cemented, very dense						
10		**POORLY GRADED SAND With Gravel (SP)**; dense, light brown, slightly moist						
12		**POORLY GRADED GRAVEL With Sand (GP)**; dense, light brown, slightly moist						
14								

APPROVED BY BLC ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: lb/in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-10

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-11

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and *should be read with the report. This summary applies only at the* location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0		-					
		-		25			
	POORLY GRADED GRAVEL With Silt & Sand (GP-GM); occasional cobbles, medium dense, brown, dry ---slightly moist						
2							
4							
6	---partially cemented, moderately hard, white						
8							
10	---no cementation, dense						
12							
14							

APPROVED BY BLC ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-11

Date Drilled: 9/4/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-12

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0		**POORLY GRADED GRAVEL With Sand (GP)**; loose to medium dense, brown, dry to slightly moist	•		20			
2								
4								
6		---partially cemented, moderately hard, white						
8		---no cementation, dense, brown						
10		---partially cemented, moderately hard, white						
12		---no cementation, dense, brown						
14								

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-12

Date Drilled: 9/4/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-13

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		**POORLY GRADED GRAVEL With Sand (GP);** occasional cobbles, medium dense, brown, dry	-	-	30			
		---slightly moist						
2								
4								
		---partially cemented, moderately hard, white, dry						
6								
8		---no cementation, medium dense, brown, slightly moist						
10		---partially cemented, moderately hard, white, dry						
12								
14								

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Drawing No.
A-13

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Date Drilled: 9/4/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No2

Log of Boring No. B-14

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
				25			
2							
4							
6							
8							
10							
12							
14							

POORLY GRADED GRAVEL With Sand (GP); medium dense, brown, slightly moist

---partially cemented, moderately hard, white, dry

---no cementation, medium dense, brown, slightly moist

APPROVED BY BLA ON 1-7-92

Groundwater: None Observed

End of Boring at 15.0 feet

Driving Weight and Drop: 340lb/30in

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-14

Date Drilled: 9/4/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-15

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
				25/3"			
2							
4							
6							
8							
10							
12							
14							

POORLY GRADED GRAVEL With Sand (GP); occasional cobbles, medium dense, brown, slightly moist

---partially cemented, moderately hard, white, dry

---no cementation, medium dense, brown, slightly moist

---partially cemented, moderately hard, white, dry

----no cementation, medium dense, brown, slightly moist

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed

End of Boring at 15.0 feet

Driving Weight and Drop: 340lb/30in

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

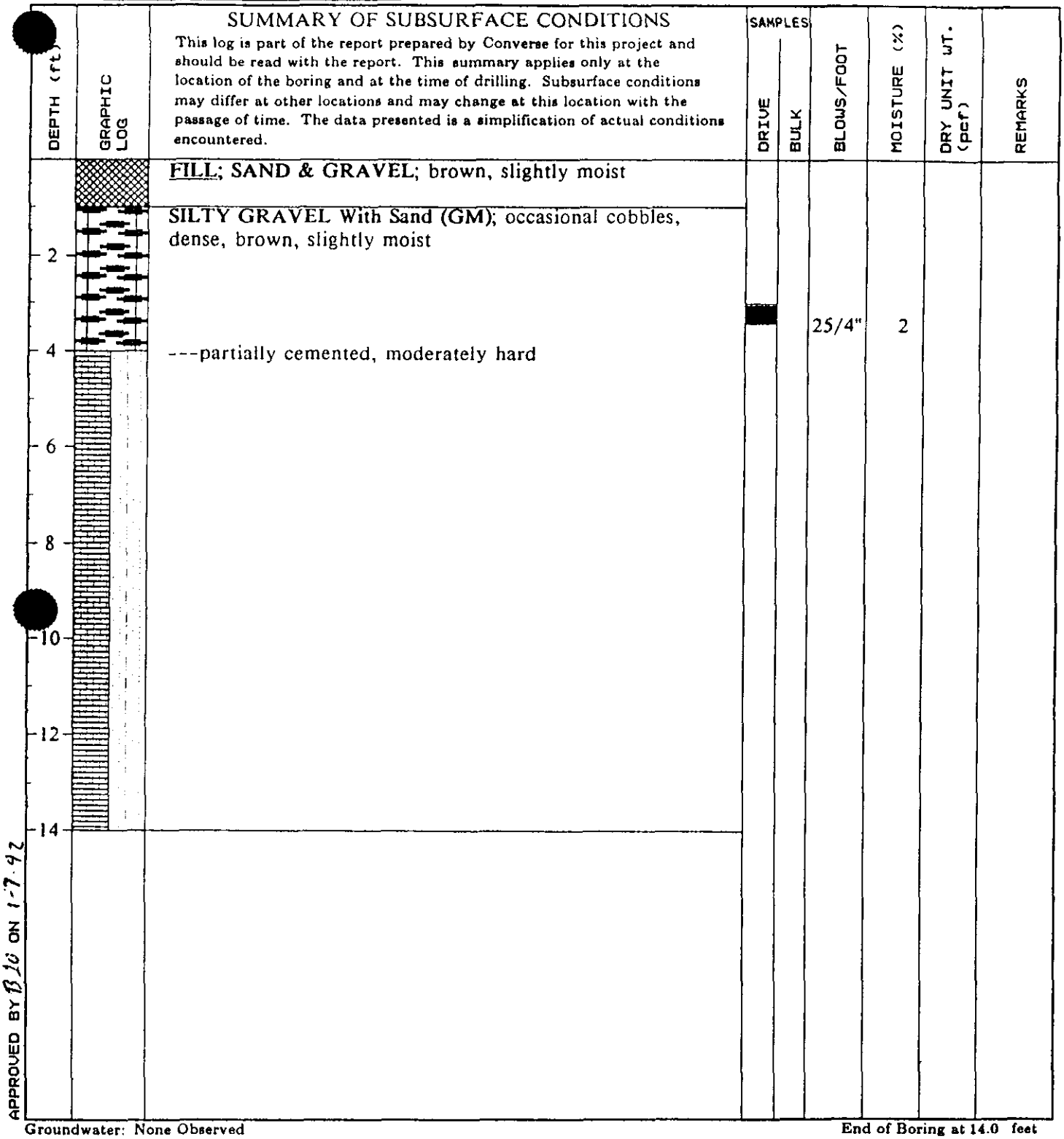
Project No.
91-33298-01

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-15

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-16



APPROVED BY BJC ON 1-7-92

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-16

Date Drilled: 9/10/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-17

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
	SILTY GRAVEL With Sand (GM); (disturbed to 1'), brown, slightly moist						
	---medium dense						
2							
	---dense						
4				100/7"			
6	---partially cemented, moderately hard						
8	---no cementation, very dense			100/4"			
10							
12							
				100/4"			
14							
16							
18				100/5"			

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 18.0 feet

APPROVED BY BZO ON 10-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-17

Date Drilled: 9/11/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Boring No. B-18

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							
2							
4		-		100/6"			
6							
8							
10				100/10"	3	105	
12							
14		-		100/3"			

POORLY GRADED GRAVEL With Sand (GP);
(disturbed to 6"), brown, dry
---medium dense, gray, slightly moist

---occasional cobbles, light brown

---partially cemented, moderately hard

---no cementation, dense

---partially cemented, moderately hard

APPROVED BY BXO ON 1-24-92

Groundwater: None Observed
Driving Weight and Drop: 140lb/30in

End of Boring at 14.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-18

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-19

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		POORLY GRADED GRAVEL With Silt & Sand (GP-GM); medium dense, brown, slightly moist		▨			
4		---slightly cementation, very dense		▨			
6				▨			

APPROVED BY BZD ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 6.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
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Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-19

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-20

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		POORLY GRADED GRAVEL With Sand (GP); dense, brown, slightly moist		▒			
4		---slightly cemented, very dense		▒			
6				▒			

APPROVED BY BJC ON 1-2-92

Groundwater: None Observed

Bottom of Trench at 7.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-20

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-21

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		**POORLY GRADED GRAVEL With Sand (GP)**; medium dense, brown, slightly moist					
4		---partially cemented, moderately hard					
6							

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 6.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-21

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-21A

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Sand (GP); occasional cobbles, medium dense, brown, slightly moist		▨			
2							
4							
		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BJO ON 7-7-92

Groundwater: None Observed

Bottom of Trench at 5.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-22

Date Drilled: 9/13/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-22

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Sand (GP); medium dense, brown, slightly moist					
2		---partially cemented, moderately hard					
4		BACKHOE REFUSAL DUE TO CEMENTATION					

Groundwater: None Observed

Bottom of Trench at 4.5 feet

APPROVED BY BJO ON 1-2-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-23

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-23

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		**POORLY GRADED GRAVEL With Sand (GP)**; occasional cobbles (3 to 6"), loose, brown, slightly moist ---medium dense					
4							
6							
8							
		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BJO ON 6-2-92

Groundwater: None Observed

Bottom of Trench at 8.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-24

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-24

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Sand (GP); occasional cobbles (3 to 12"), medium dense, brown, slightly moist					
2		---slight cementation					
4							
6		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BJG ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 6.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-25

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-25

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		POORLY GRADED GRAVEL With Silt & Sand (GP-GM); loose, brown, slightly moist ---medium dense ---slightly to partially cemented, very dense to moderately hard		▨			
4							
6							
8							
10		*BACKHOE REFUSAL DUE TO CEMENTATION*					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY BJC ON 1-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-26

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-26

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Sand (GP); occasional cobbles (4" to 12"), loose, brown, dry					
2		---medium dense ---slightly moist					
4		---dense					
6							
8							
10		---partially cemented, moderately hard					
		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BLO ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 11.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-27

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See Drawing No.2

Log of Trench No. T-27

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		POORLY GRADED GRAVEL With Sand (GP); occasional cobbles (3" to 12"), loose, brown, slightly moist					
2		---medium dense					
4							
6		---partially cemented, moderately hard					
8		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY BKC ON 1-7-92

Groundwater: None Observed

Bottom of Trench at 8.0 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-28

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: See drawing No.2

Log of Trench No. T-28

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
2		POORLY GRADED GRAVEL With Silt & Sand (GP-GM); occasional cobble, loose, light brown, slightly moist ---medium dense					
		BACKHOE REFUSAL DUE TO CEMENTATION					

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Groundwater: None Observed

Bottom of Trench at 2.5 feet

APPROVED BY BLG ON 1-7-92

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-29

Date Drilled: 9/3/91
Logged By: R.A.MATTUCCI
Ground Surface Elevation: Not Measured
Location: *See Drawing No.2*

Log of Trench No. T-29

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		SILTY SAND With Gravel (SM); loose, light brown, slightly moist					
		---medium dense					
2		---partially cemented, moderately hard					
		BACKHOE REFUSAL DUE TO CEMENTATION					

APPROVED BY RLG ON 10-7-91

Groundwater: None Observed

Bottom of Trench at 2.5 feet

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, & County Nevada

Project No.
91-33298-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-30

KEY TO SOILS SYMBOLS AND TERMS

TERMS USED IN THIS REPORT FOR DESCRIBING SOILS ACCORDING TO THEIR TEXTURE OR GRAIN SIZE DISTRIBUTIONS ARE GENERALLY IN ACCORDANCE WITH THE UNIFIED SOILS CLASSIFICATION SYSTEM.

TERMS DESCRIBING CONDITION, CONSISTENCY AND HARDNESS

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): includes (1) clean gravels, (2) silty or clayey gravels and (3) silty, clayey or gravelly sands. Consistency is rated according to relative density, as determined by laboratory tests.

Descriptive Term	Relative Density
Very loose	0 to 15%
Loose	15 to 40%
Medium Dense	40 to 70%
Dense	70 to 85%
Very Dense	85 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength as indicated by penetrometer readings or by direct shear tests.

Description Term	Shear Strength (ksf)
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

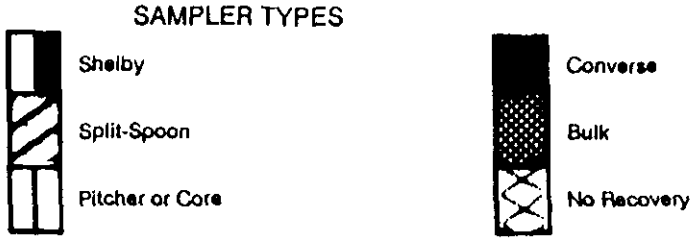
ROCK: Includes gravels, cobbles, rock, caliche and bedrock materials. Hardness is related to field identification procedures described below.

Descriptive Term	Field Identification Test
Soft	Can be dug by hand and crushed by fingers
Moderately hard	*Friable, can be gouged deeply with knife and will crumble readily under light hammer blows.*
Hard	Knife scratch leaves dust trace, will withstand a few hammer blows before breaking.
Very Hard	Scratched with knife with difficulty, difficult to break with hammer blows.

LEGEND OF LABORATORY TESTS

G-Grain	S-Swell	DS-Direct Shear
A-Liquid & Plastic Limits	Ch-Chemical	T-Triaxial
PP-Pocket Penetrometer	N-Chemical Heave	Sol-Solubility
U-Unconfined	C-Consolidation	P-Compaction

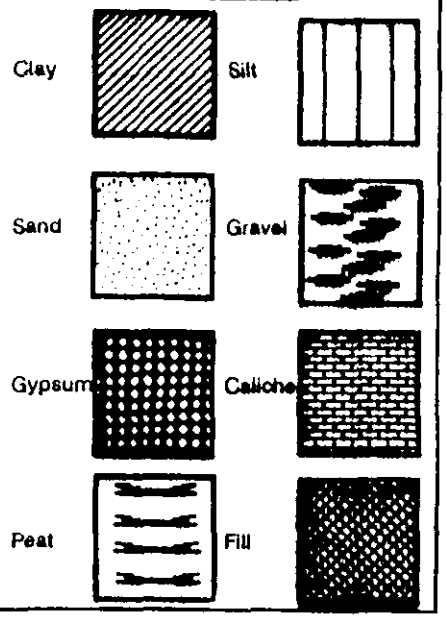
SAMPLER TYPES



SIZE PROPORTIONS

Designation	Percent by Weight
Trace	0 to 5
Few	5 to 10
Little	15 to 25
Some	30 to 45

SOIL TYPE KEY

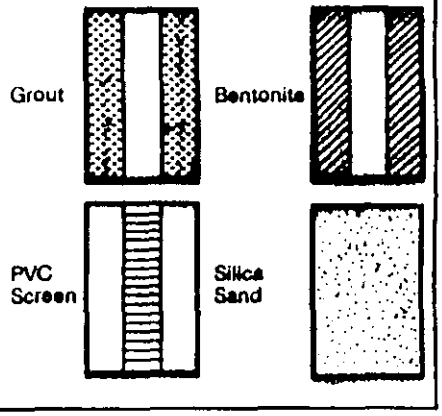


SOIL MOISTURE

From low to high the soil moisture is indicated by:

Dry
Slightly moist
Moist
Very moist
Wet

WELL DESIGN KEY



Converse Consultants Southwest, Inc. Drawing No. A-31

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

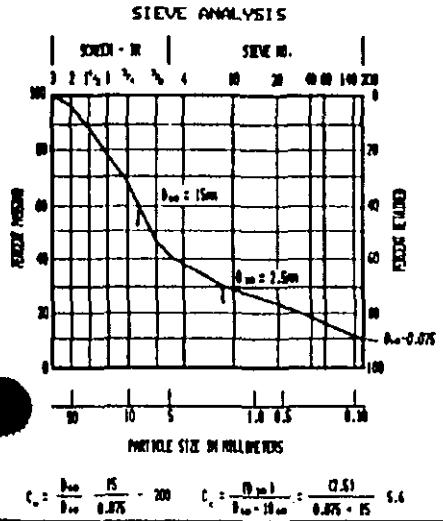
ASTM Designation: D 2487 - 85
(Based on Unified Soil Classification System)

Criteria for Assigned Group Symbols and Groups Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$C_u \geq 4$ and $1 \geq C_c \geq 3$[E]	GW	Well graded gravel[F]
			$C_u < 4$ and/or $1 > C_c > 3$[E]	GP	*Poorly graded gravel*[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F G H]
			Fines classify as CL or CH	GC	Clayey gravel[F G H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$C_u \geq 6$ and $1 \geq C_c \geq 3$[E]	SW	Well-graded sand[I]
			$C_u < 6$ and/or $1 > C_c > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML of MH	SM	Silty sand[G H I]
			Fines classify as CL of CH	SC	Clayey sand[G H I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limits less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	*Silt*[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OL	Organic clay[K L M N] Organic silt[K L M O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OH	*Organic clay*[K L M P] Organic silt[K L M O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

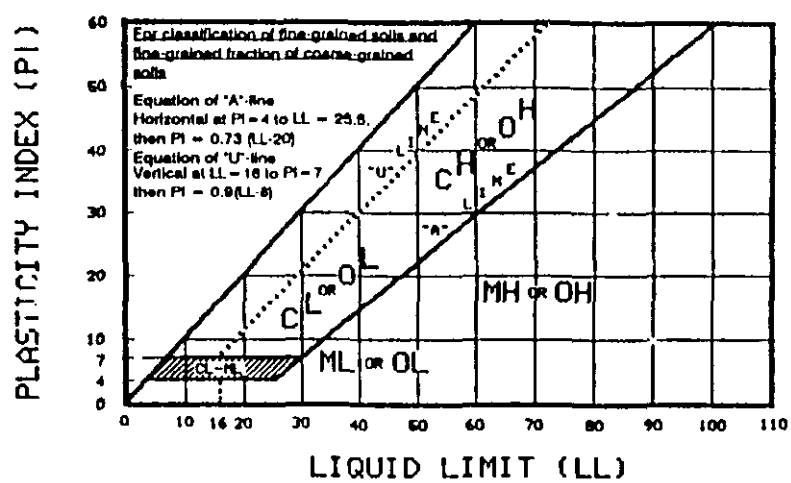
[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add 'with cobbles or boulders, or both' to group name.
Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

$$^{E}Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

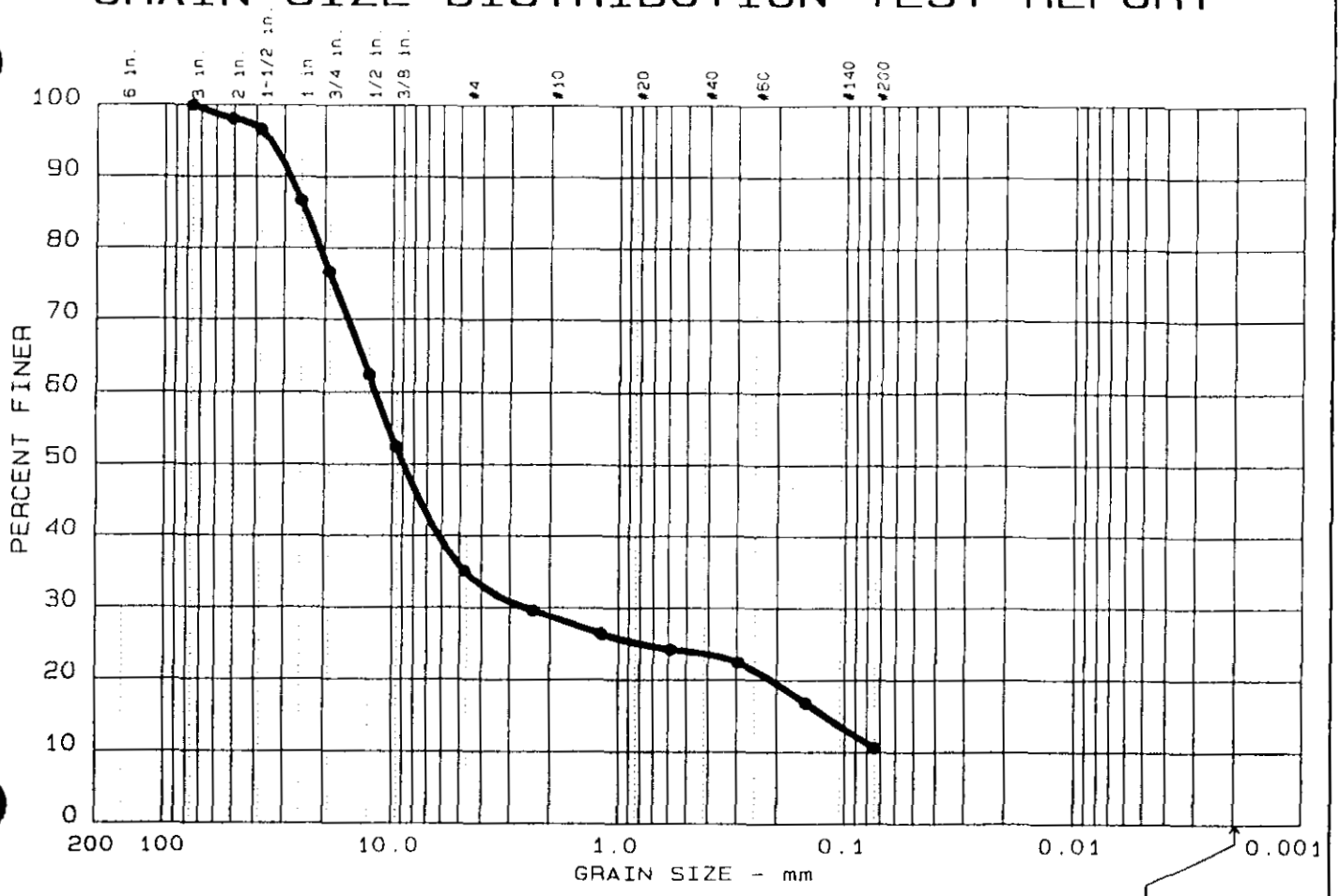
[C] If soil contains ≥ 15% sand, add 'with sand' to group names.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add 'with organic fines' to group name.
[I] If soil contains ≥ 15% gravel, add 'with gravel' to group name.
[J] If Atterberg limits plot in hatched area, soils is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No.200, add 'with sand' or 'with gravel', whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add 'sandy' to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add 'gravelly' to group name.
[N] PI ≥ 4 and plots on or above 'A' line.
[O] PI < 4 or plots below 'A' line.
[P] PI plots on or above 'A' line.
[Q] PI plots below 'A' line.



$$C_u = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}} = \frac{(0.5)^2}{0.075 \times 15} = 0.2$$



GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	64.9	24.6	10.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	24.15	11.83	8.95	2.553	0.1222			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. **POORLY GRADED GRAVEL W/Silt & Sand**	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 1, sample BS - 1 depth 0 -14.5'

Date: September 6, 1991

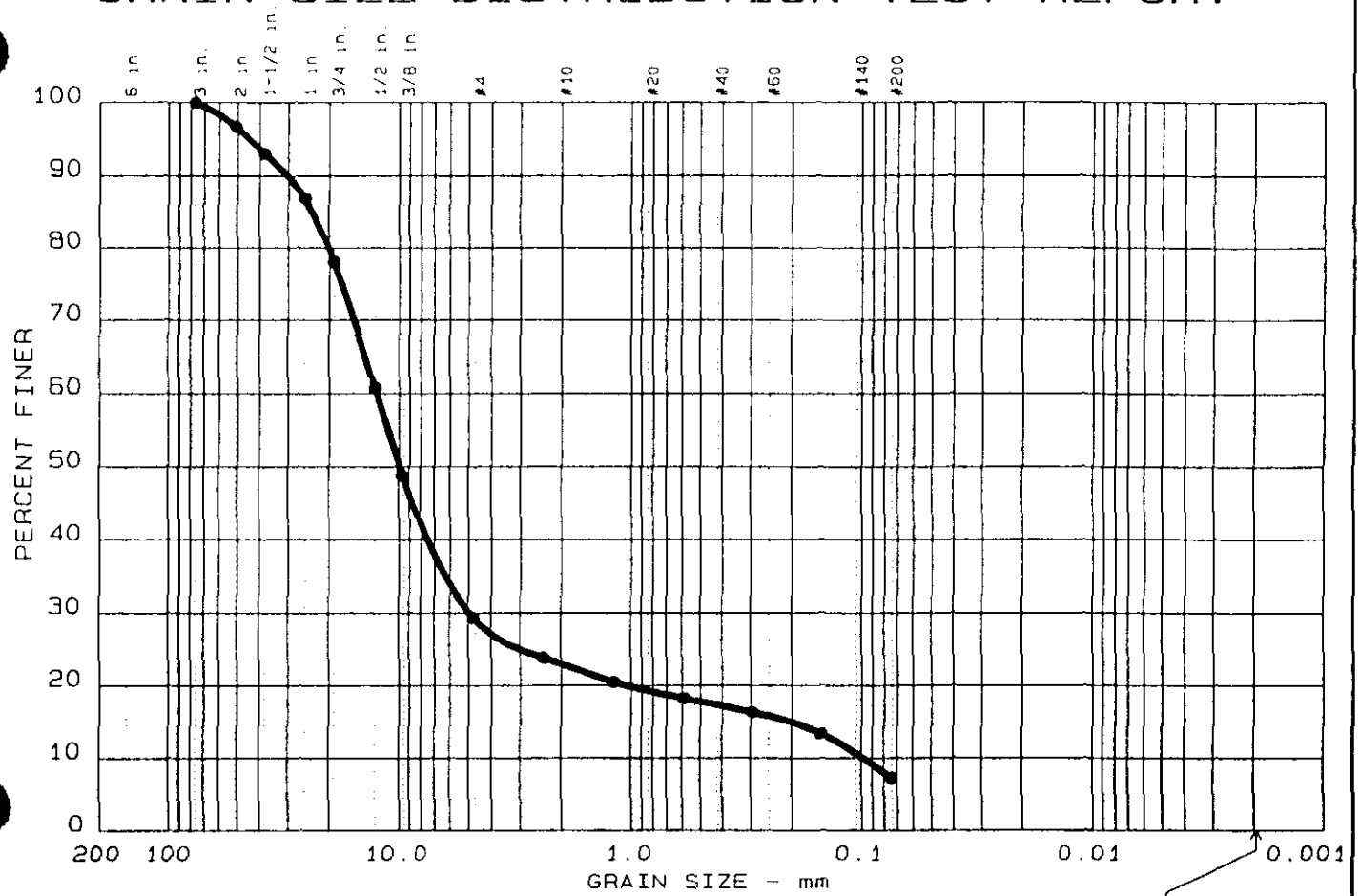
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-33

B40 1-7-92

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	70.7	22.1	7.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NP	NP	23.44	12.45	9.89	4.955	0.2018	0.0977	20.18	127.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. **POORLY GRADED GRAVEL With Silt & Sand**	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B -2, sample BS - 1, depth: 0 -14.5'

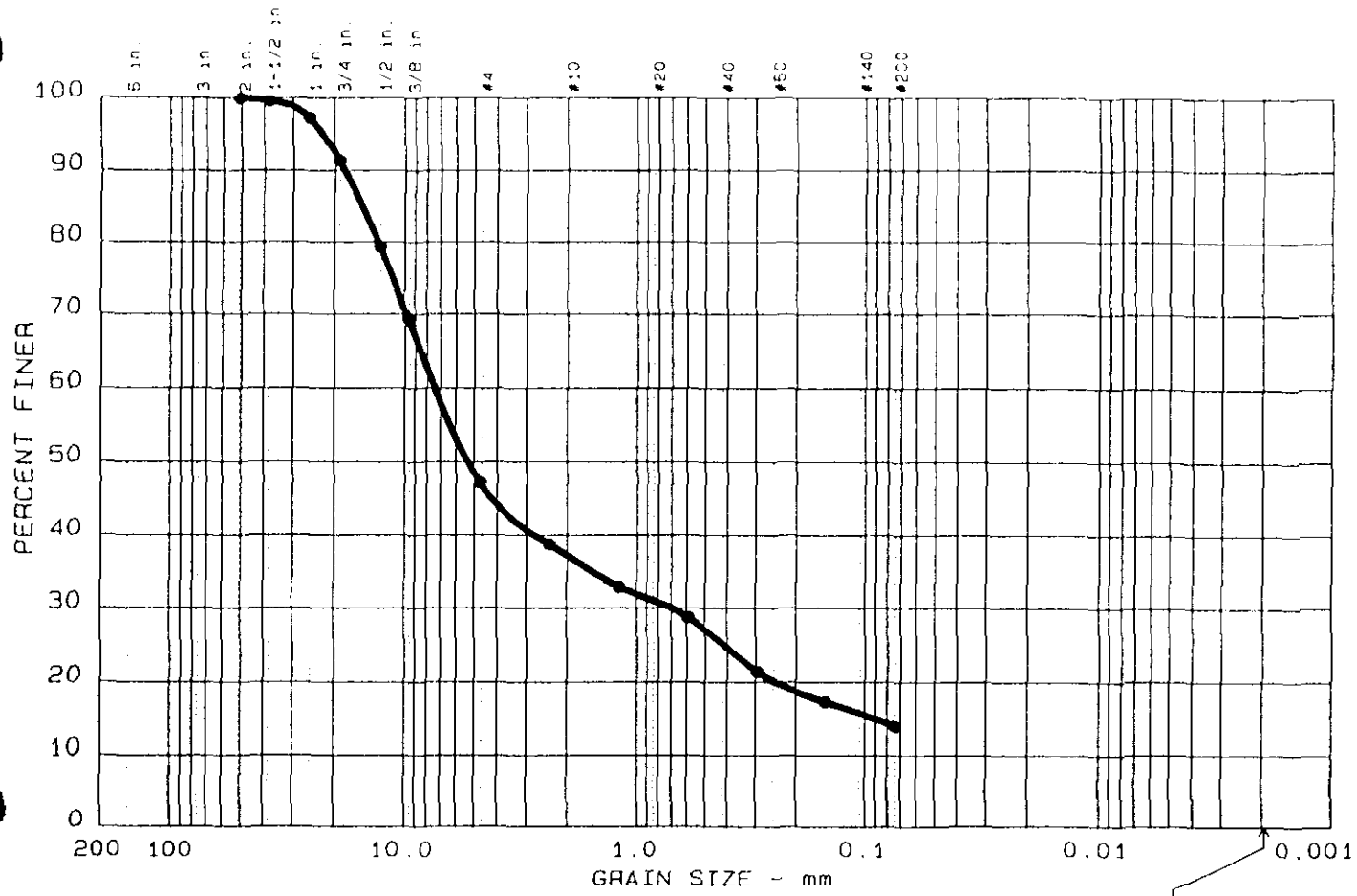
Date: September 6, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO A-34

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	B	0.0	52.7	33.4	13.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	15.14	7.41	5.31	0.700	0.0923			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: B - 3, sample BS -1, depth: 0 -14.5'

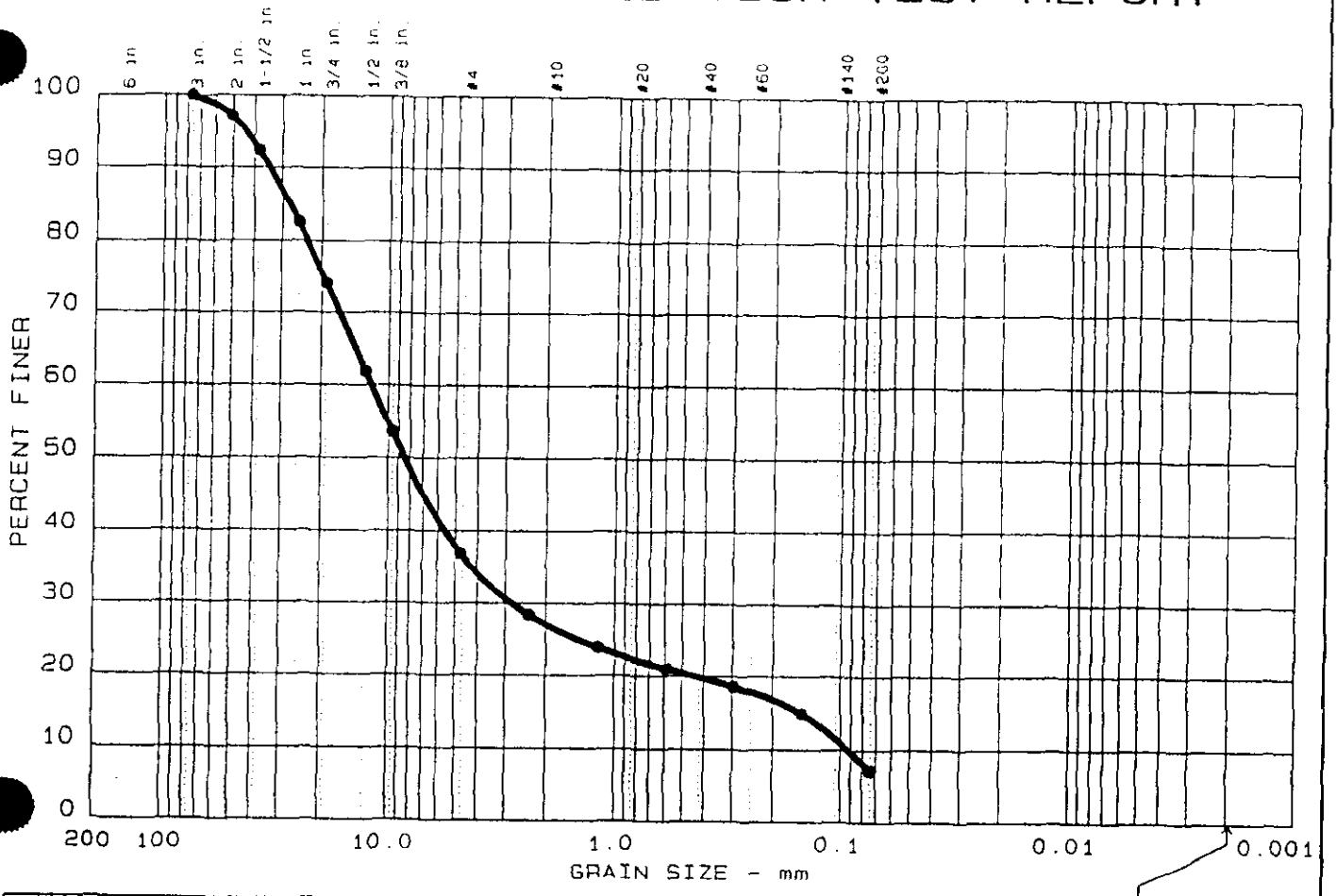
Date: September 6, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO.A-35

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	63.1	29.7	7.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NP	NP	27.77	11.93	8.44	2.796	0.1501	0.0926	7.08	128.8

MATERIAL DESCRIPTION	USCS	AASHTO
● Brn Poorly Graded Gravel With Silt & Sand	GP-GM	

Project No.: 91-33421-01
Project: Range Wash Soil Cement
● Location: T-6

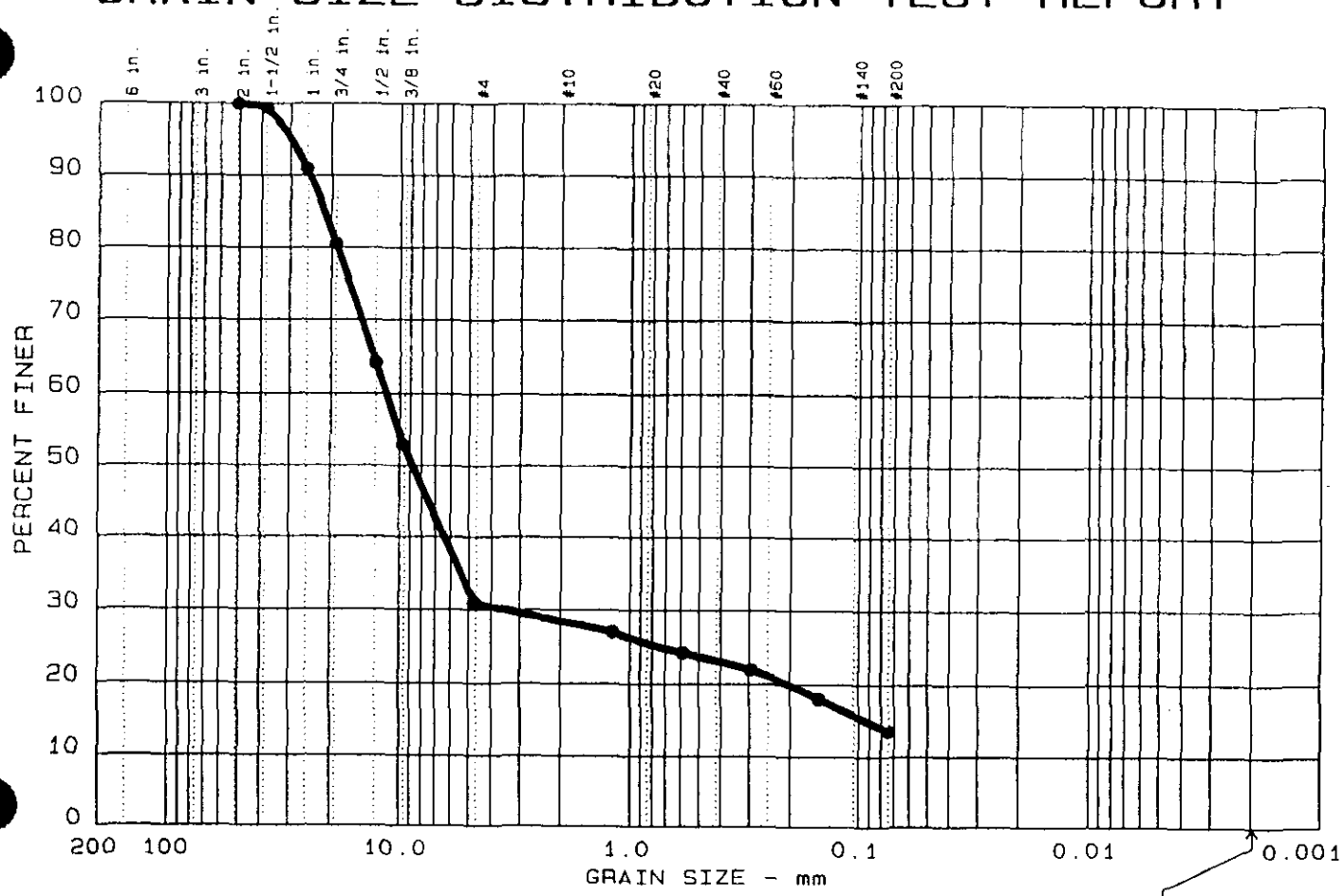
Date: 9/25/91

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-36

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	69.1	17.4	13.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	21.38	11.44	8.78	3.338	0.0930			

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt.brn.Silty Gravel w/Sand	GM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: B - 7, BS - 1, depth: 0 -14.5'

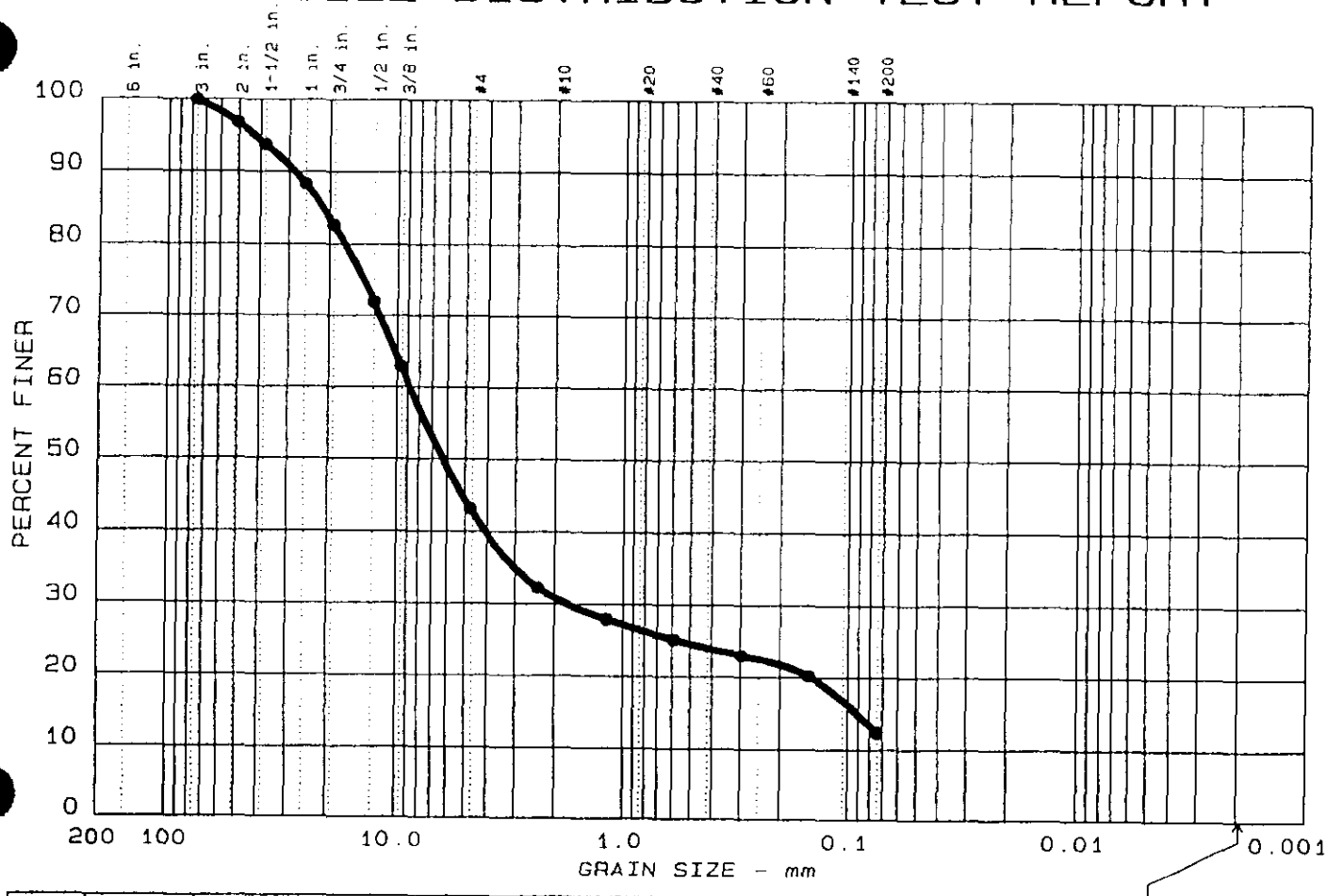
Date: September 9, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-37

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	0.0	56.9	30.7	12.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NP	NP	21.13	8.81	6.29	1.772	0.0898			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 8, BS - 1, depth: 0-14.5'

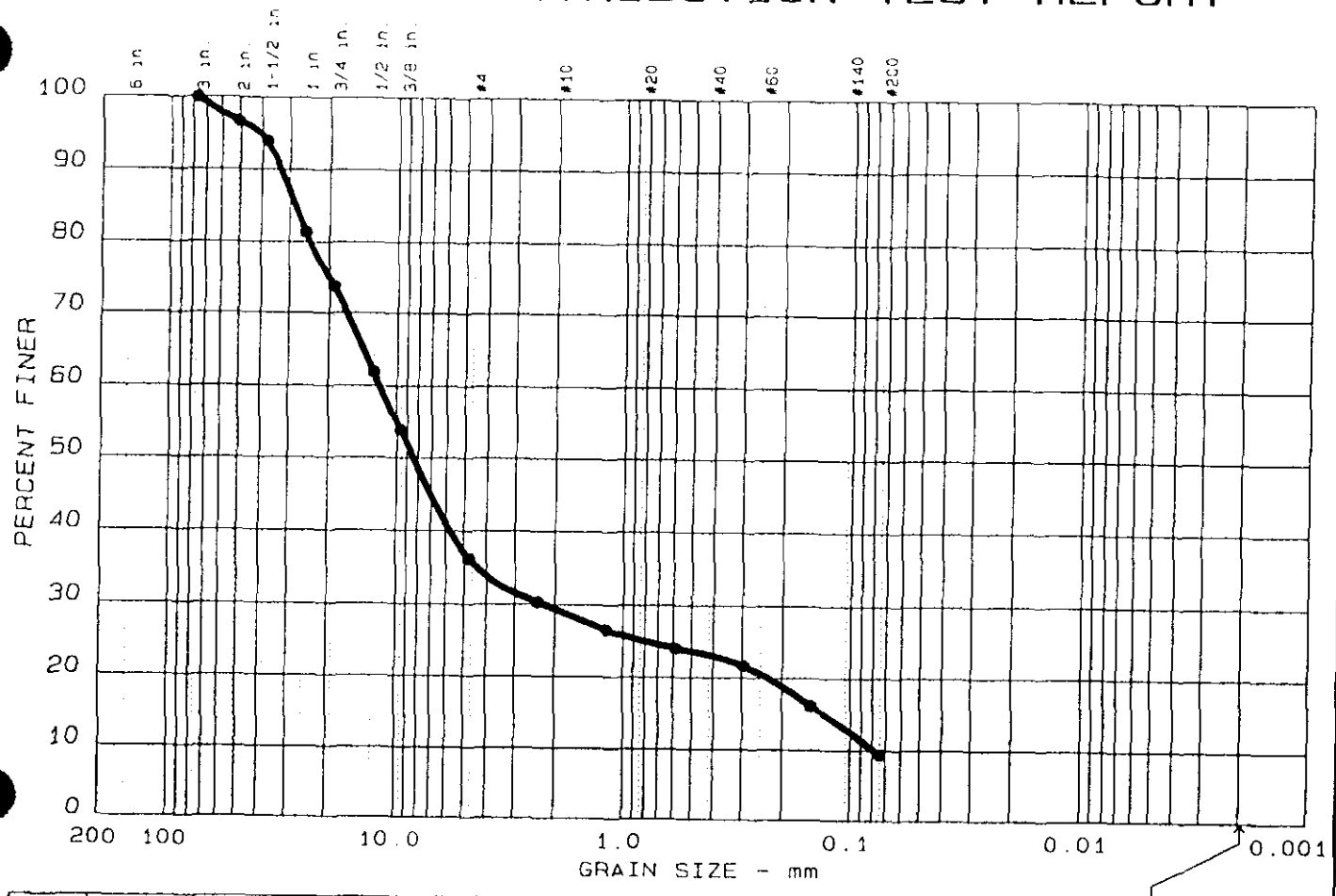
Date: September 9, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-38

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	63.8	26.8	9.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_u
●	N/P		28.18	11.89	8.41	2.213	0.1318	0.0785	5.25	151.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33-298-01
Project: Range Wash Dike
● Location: T - 9, depth: 0 - 4'

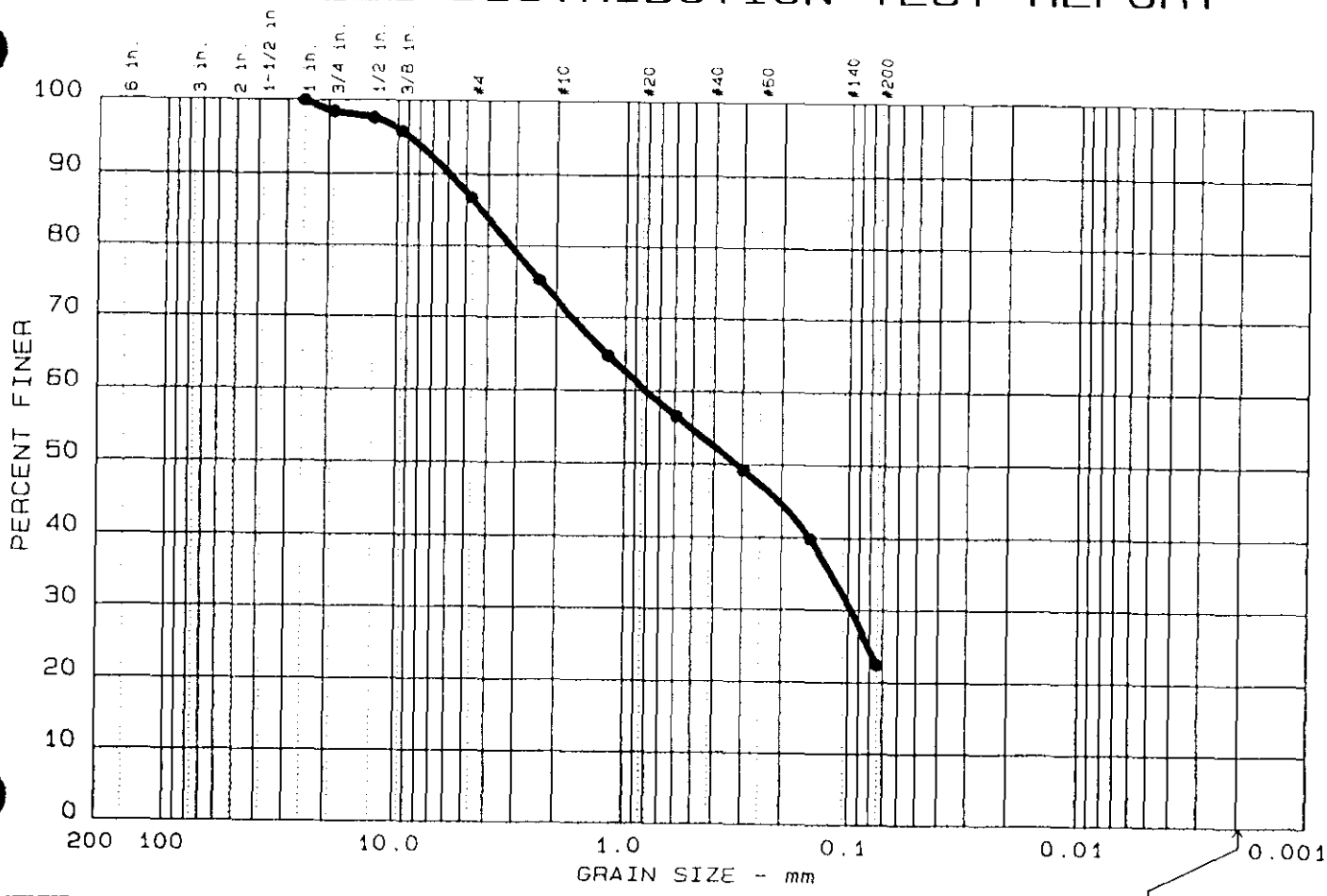
Date: September 25, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-39

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	13.3	64.2	22.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	N/P	N/P	4.27	0.80	0.32	0.097				

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. SILTY SAND	SM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: B - 12, BS -1, depth: 0 -15'

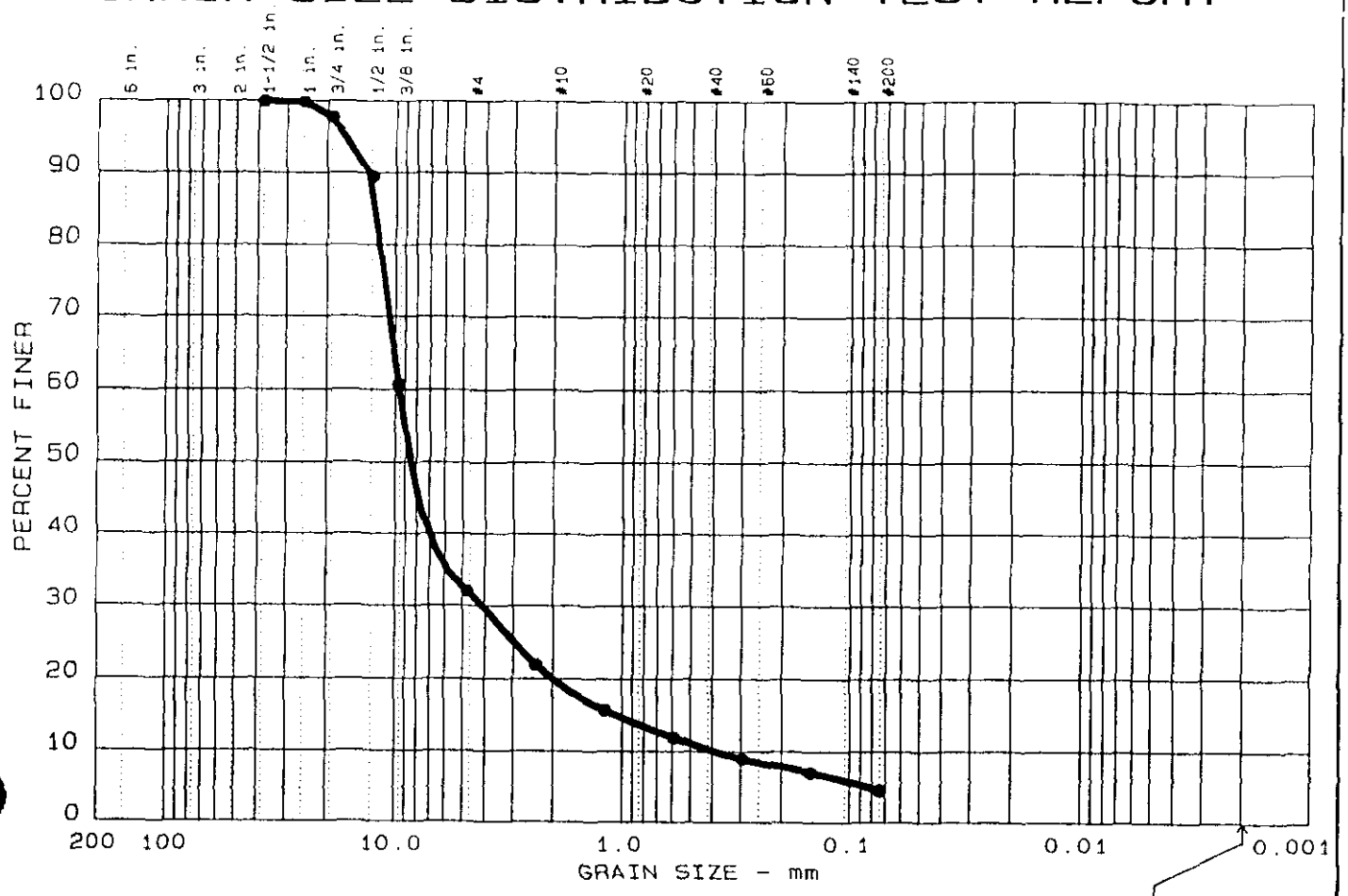
Date: September 27, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-40

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	0.0	67.9	27.6	4.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	12.22	9.57	8.50	4.069	1.0580	0.3931	4.40	24.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED **GRAVEL W/SAND**	GP	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: B - 13, BS - 1, depth: 0 -15'

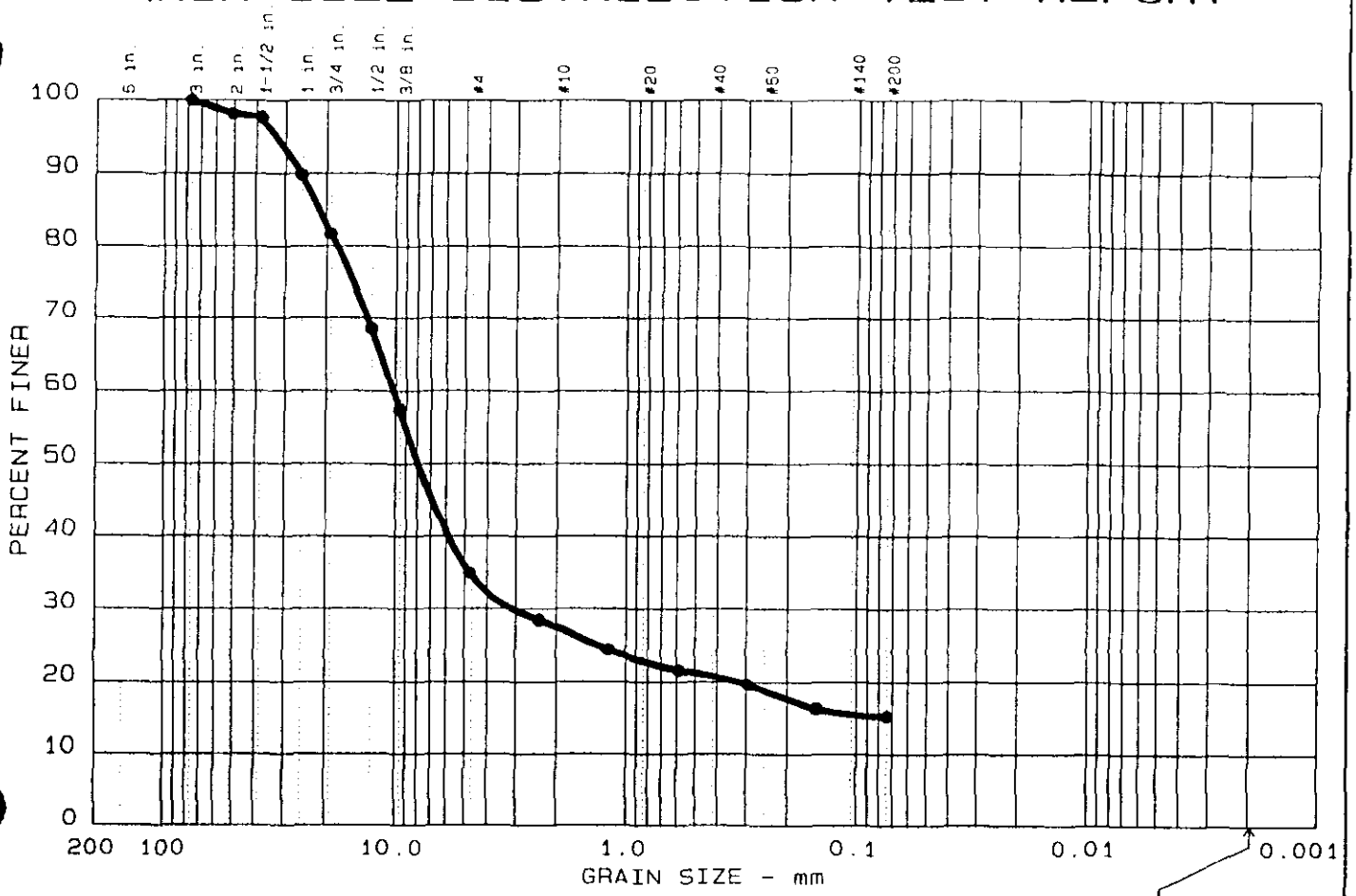
Date: September 27, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-41

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	65.0	19.7	15.3	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	21.36	10.22	7.93	3.087				

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. Silty Gravel w/Sand	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: B - 17, BS - 1

Date: September 16, 1991

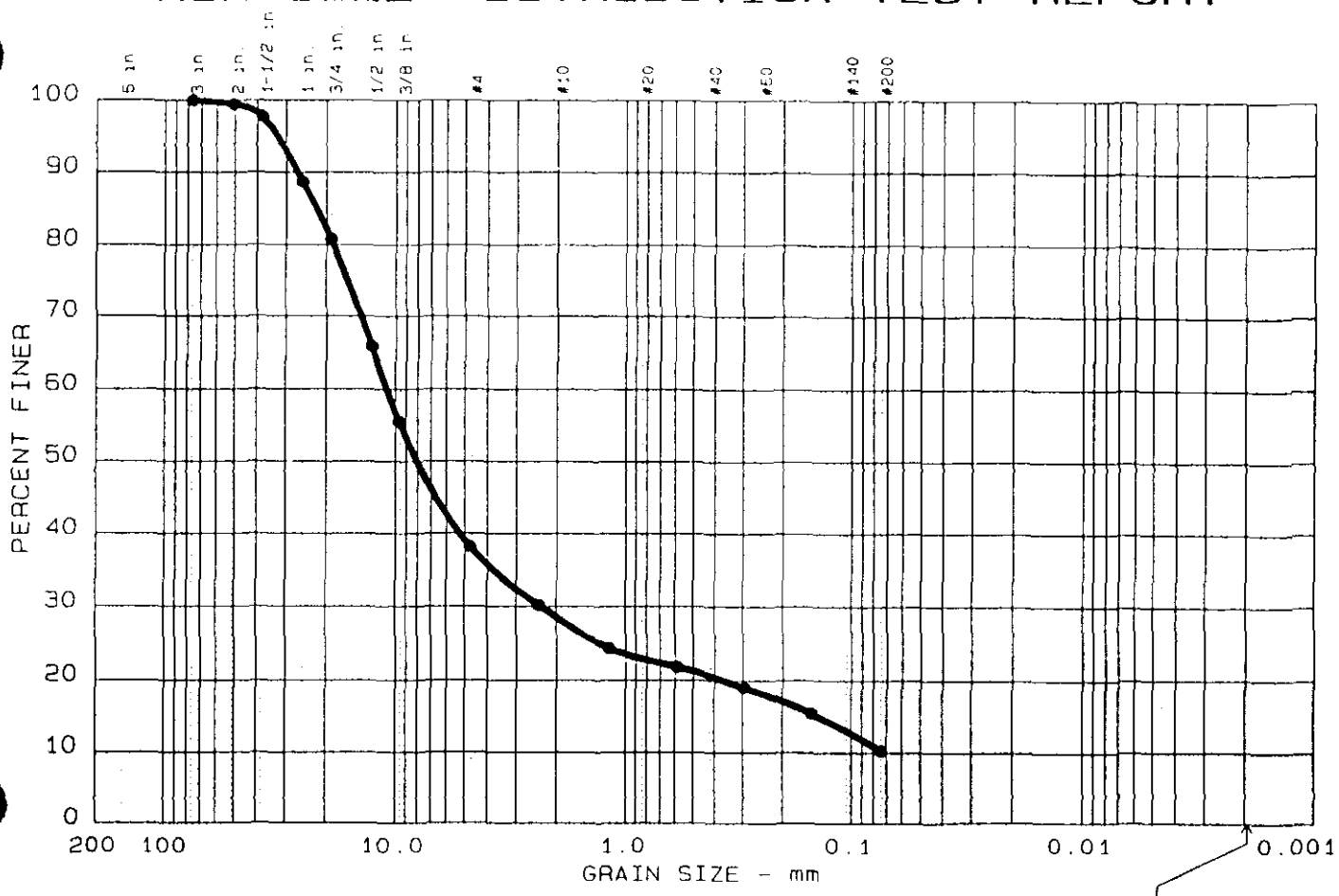
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-42

RLO 11-7-91

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	61.7	28.1	10.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	22.05	10.88	8.06	2.299	0.1401			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. **POORLY GRADED GRAVEL W/Silt & Sand**	GP - GM	

Project No.: 91-332980-01
Project: Range Wash Dike
● Location: B-18, BS-1, depth 0-14'

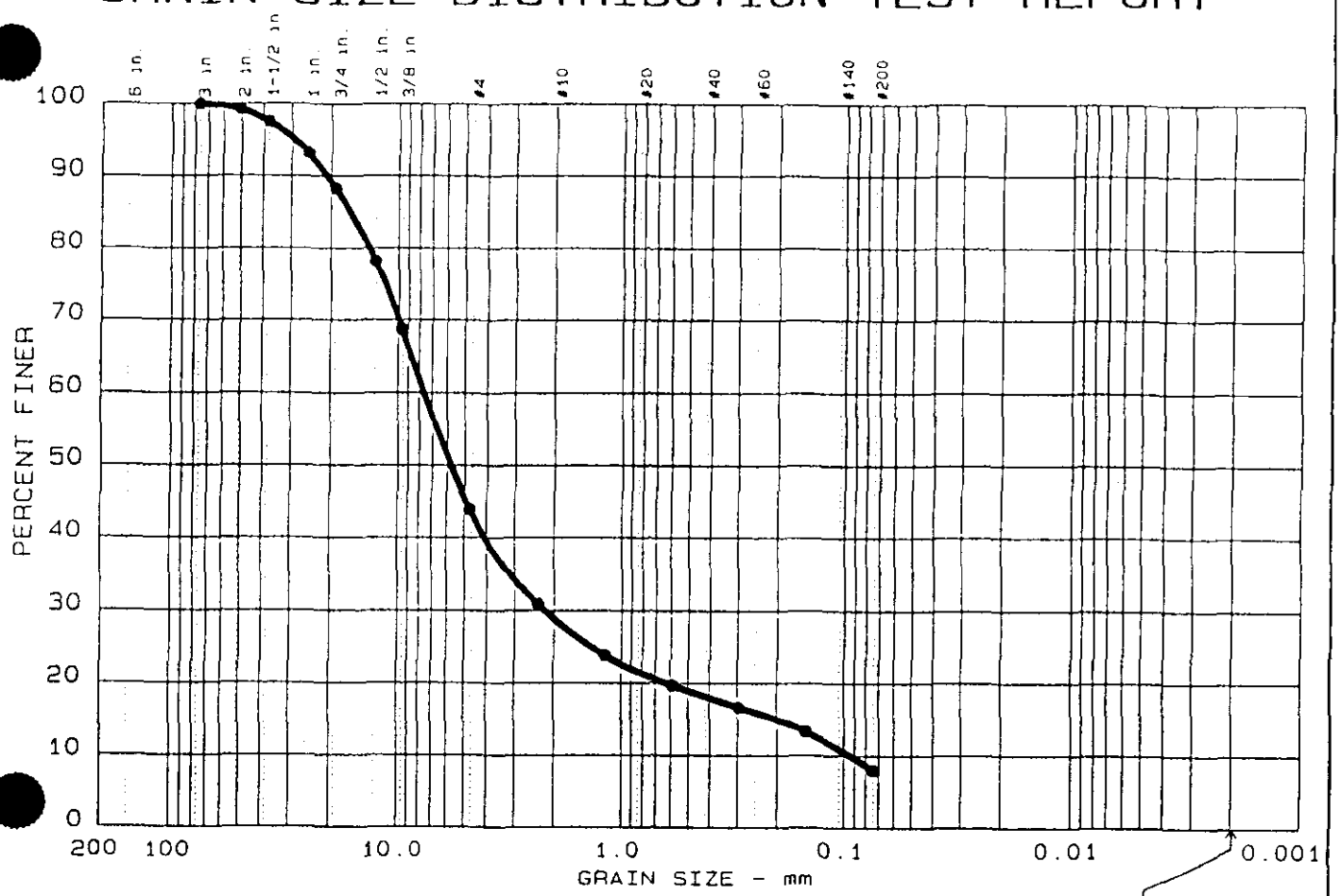
Date: September 17, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-43

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	16	0.0	56.1	35.9	8.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	16.37	7.64	5.79	2.200	0.2007	0.0939	6.75	81.4

MATERIAL DESCRIPTION	USCS	AASHTO
● Brn Poorly Graded **Gravel With Silt And Sand**	GP-GM	

Project No.: 91-33421-01
Project: Range Wash Soil Cement
● Location: T-19

Date: 9/25/91

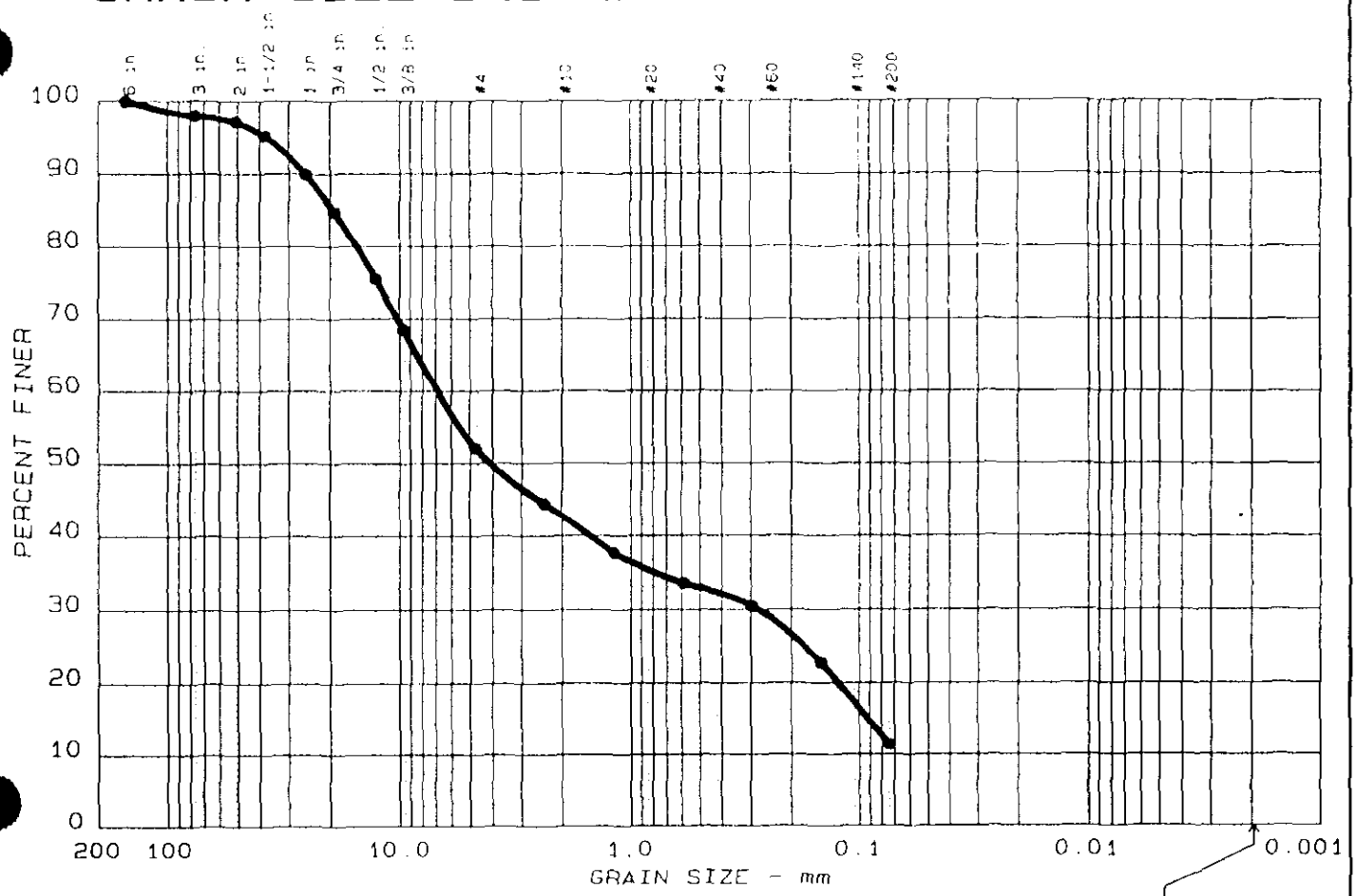
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO.-A-44

A320 (-) 92

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	2.0	45.9	40.7	11.4	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	19.28	6.91	4.12	0.278	0.0911			

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn.POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: T - 20, depth: 0 - 6'

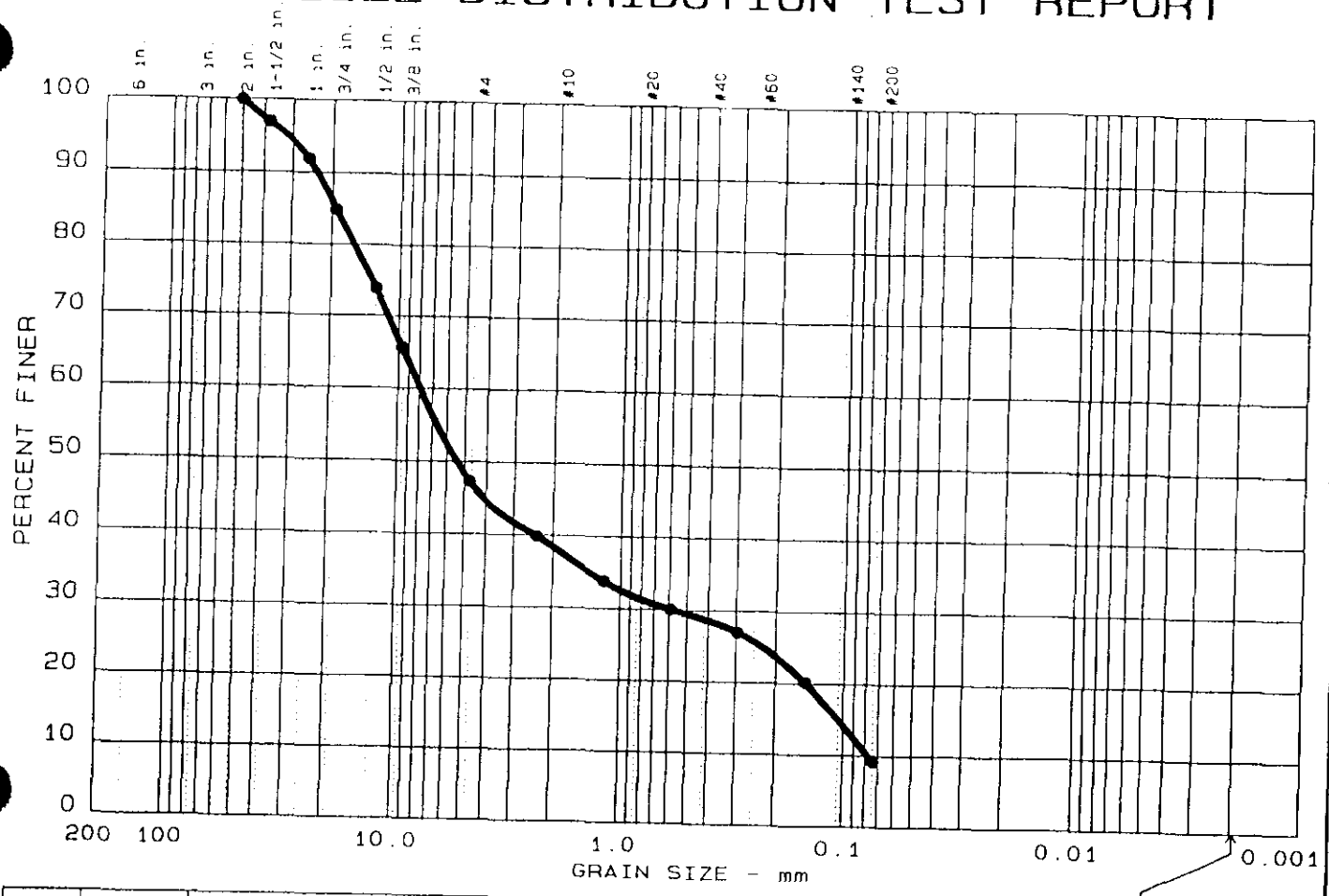
Date: September 25, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-45

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	52.6	38.2	9.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	19.05	7.94	5.43	0.581	0.1046	0.0775	0.55	102.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01

Project: Range Wash Dike

● Location: T - 21, depth: 0-6'

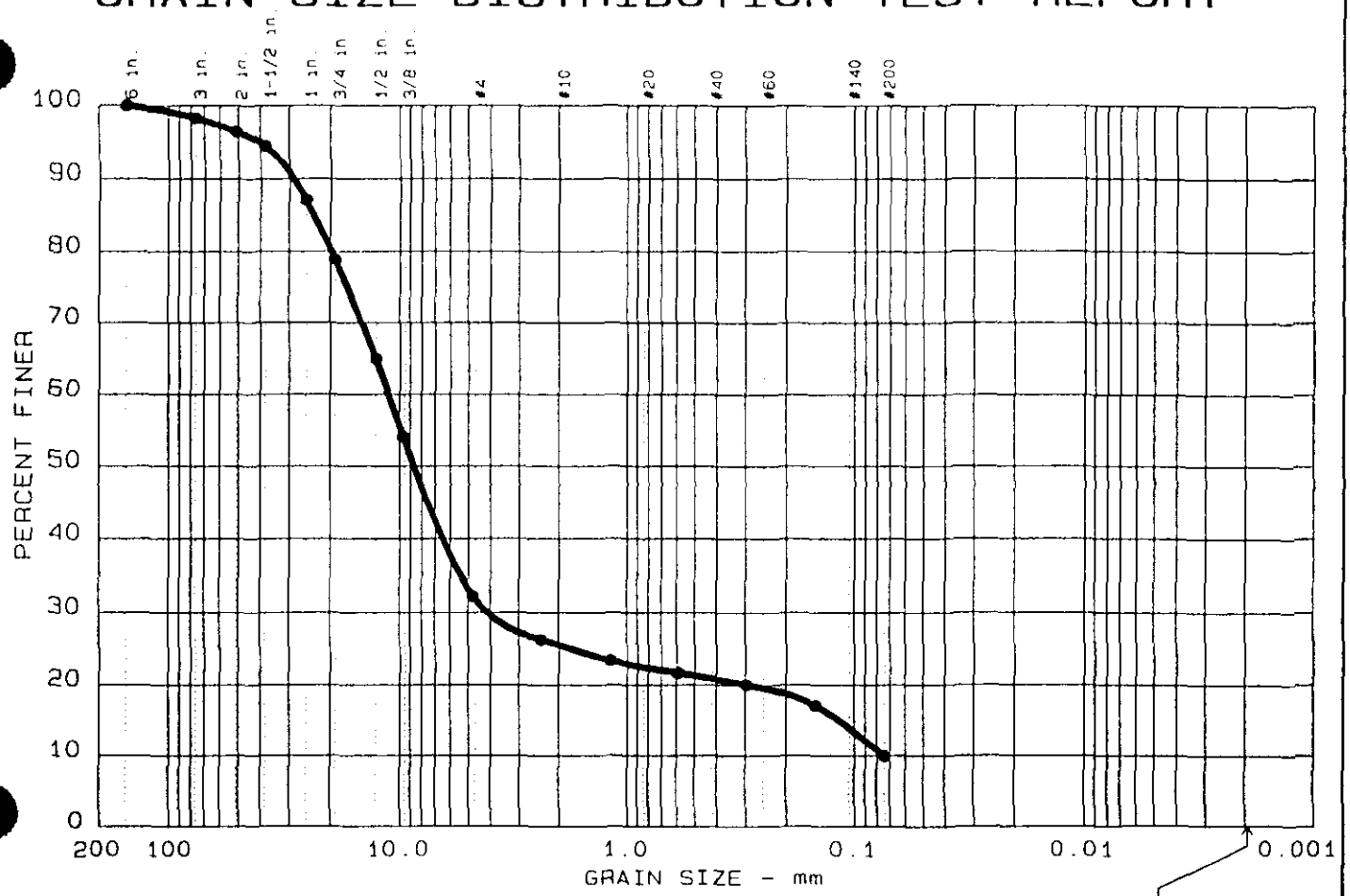
Date: 9/27/91

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-46

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	1.7	66.0	22.3	10.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	23.42	11.19	8.69	4.111	0.1172			

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt.brn.POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 21A depth: 0 - 5.5'

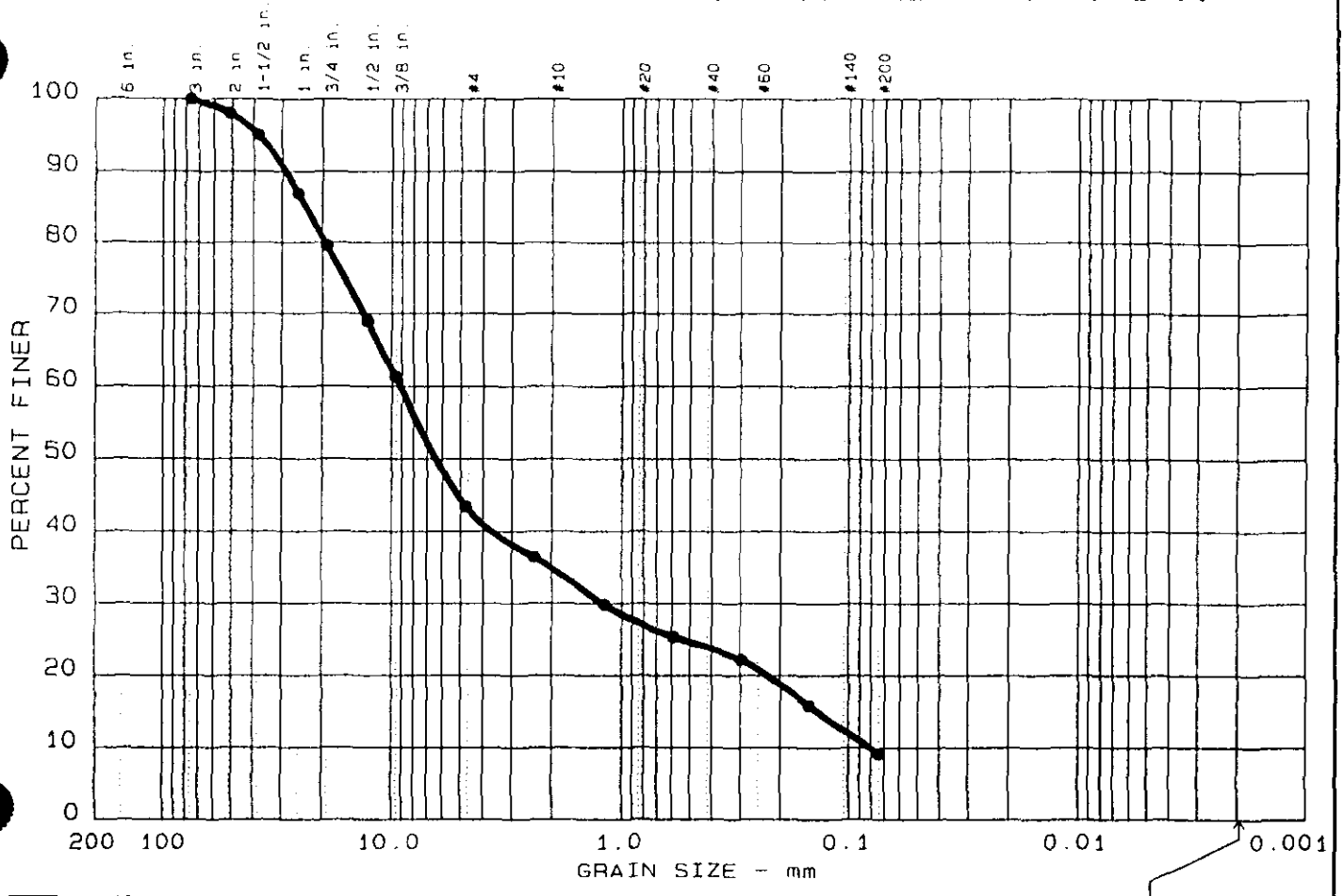
Date: September 23, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-47

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	56.6	34.3	9.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	N/P	N/P	23.44	9.19	6.42	1.209	0.1372	0.0808	1.97	113.8

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. WELL GRADED GRAVEL w/Silt and Sand	GW - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 22, depth: 0 -4.5'

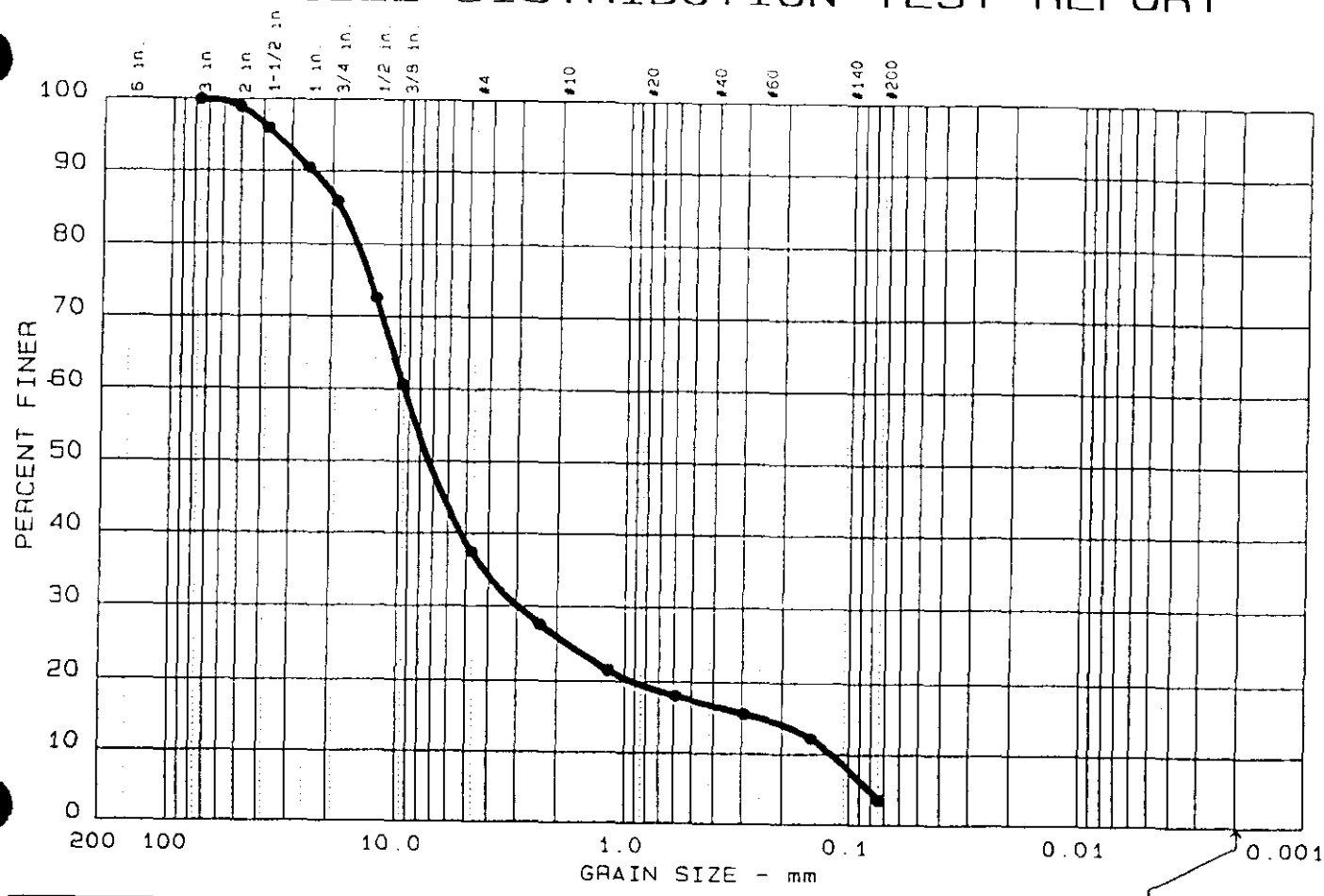
Date: September 23, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-48

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	62.5	33.9	3.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	18.20	9.48	7.33	2.951	0.2344	0.1189	7.73	79.8

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. **POORLY GRADED GRAVEL W/Sand**	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T-23, BS-1, depth: 0-8.5'

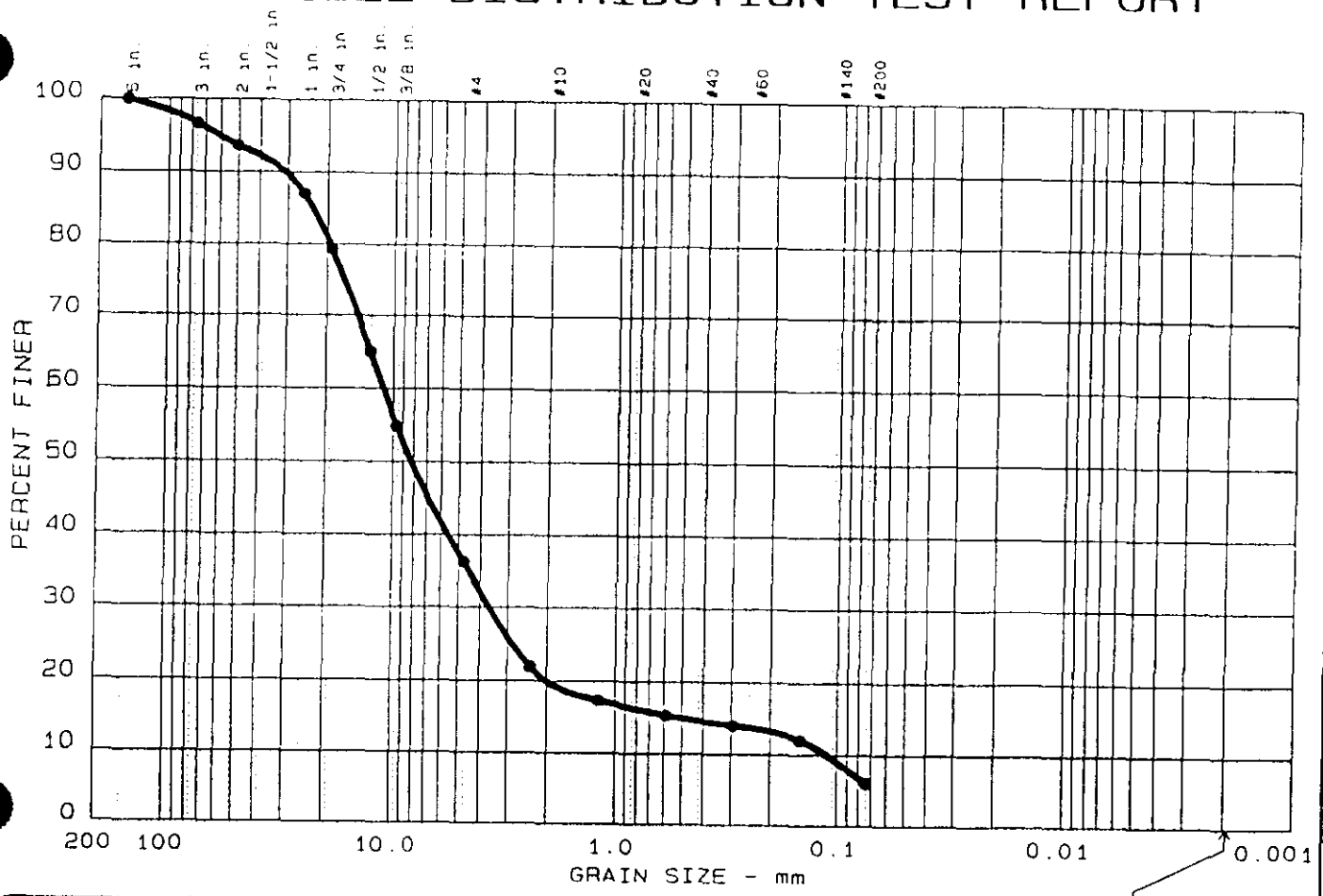
Date: September 16, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-49

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	3.3	60.5	30.2	6.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	NP	NP	23.17	11.09	8.29	3.618	0.5230	0.1118	10.56	99.2

MATERIAL DESCRIPTION	USCS	AASHTO
● POORLY GRADED GRAVEL W/Silt & Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T-25, BR-1, depth: 0-10'

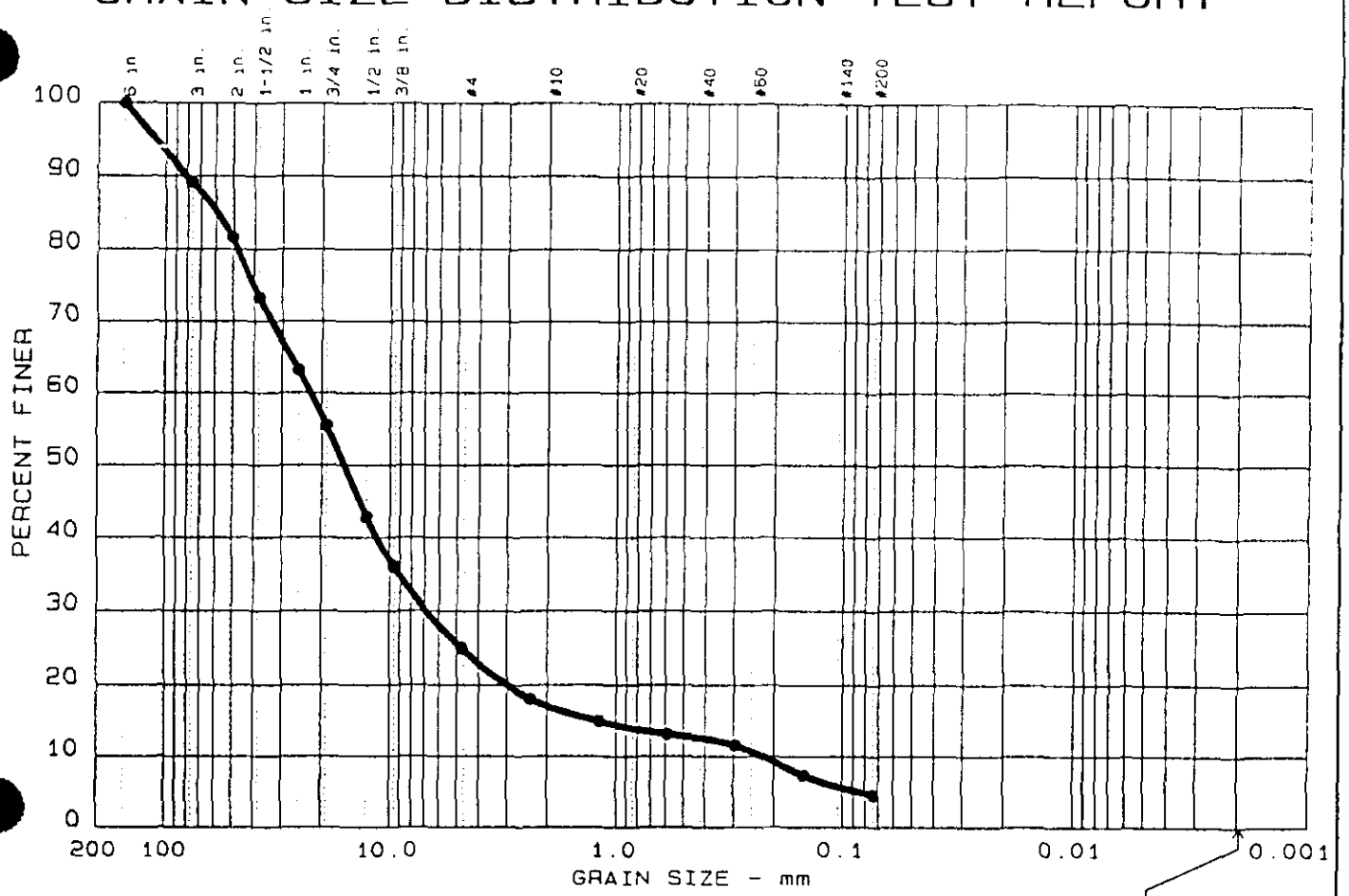
Date: September 16, 1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-50

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	10.9	64.0	20.5	4.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	58.88	22.34	15.98	6.816	1.2120	0.2231	9.32	100.1

MATERIAL DESCRIPTION	USCS	AASHTO
● lt.brn. **POORLY GRADED GRAVEL W/Sand**	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T -27, BS-1, depth: 0 - 8'

Date: September 16, 1991

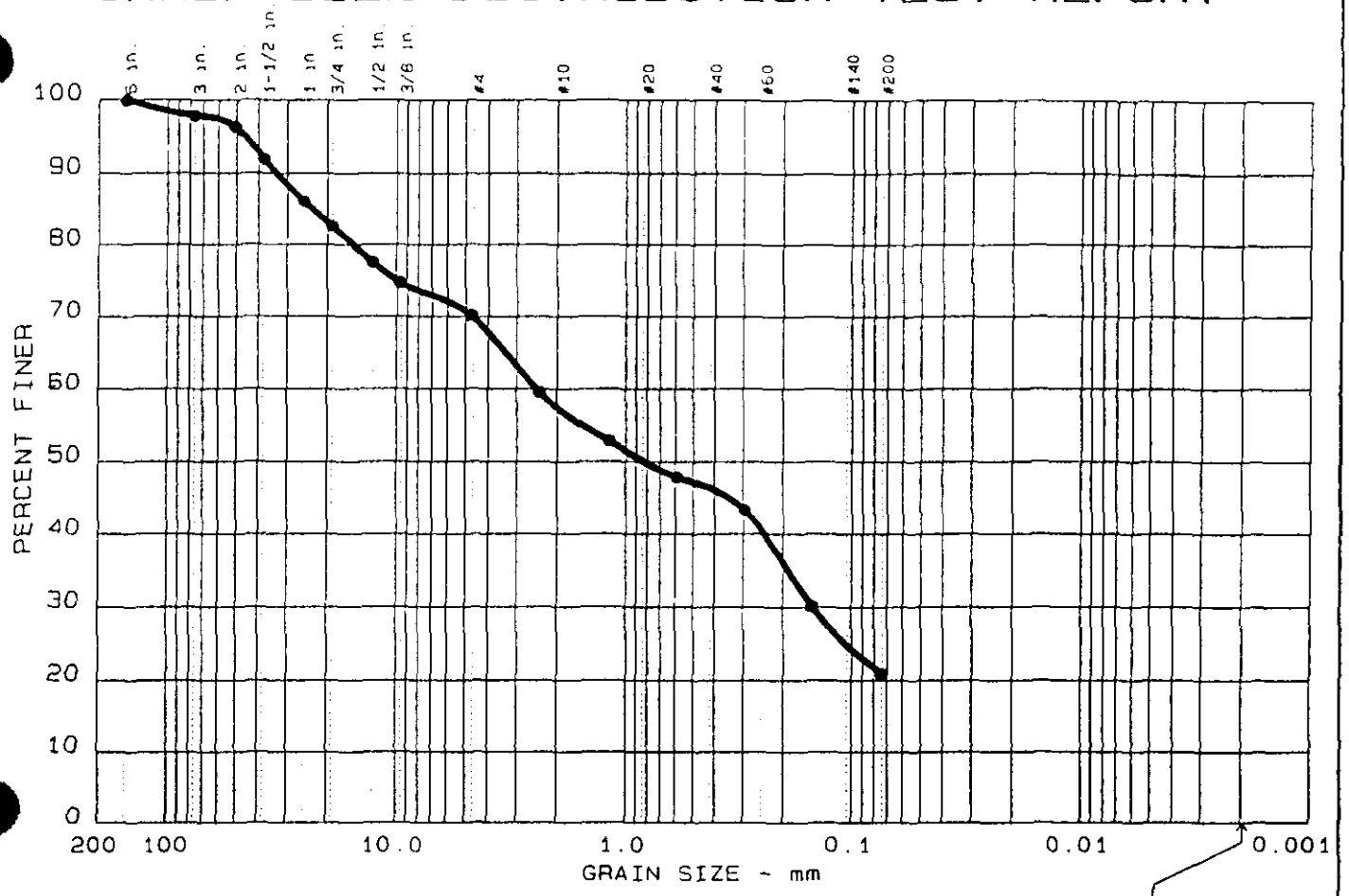
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO: A-51

B10 (-7-92

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	8	2.2	27.6	49.3	20.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	23.17	2.45	0.83	0.148				

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. Silty Sand w/Gravel	SM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: T - 29, BS - 1, depth: 0 -2.2'

Date: September 16, 1991

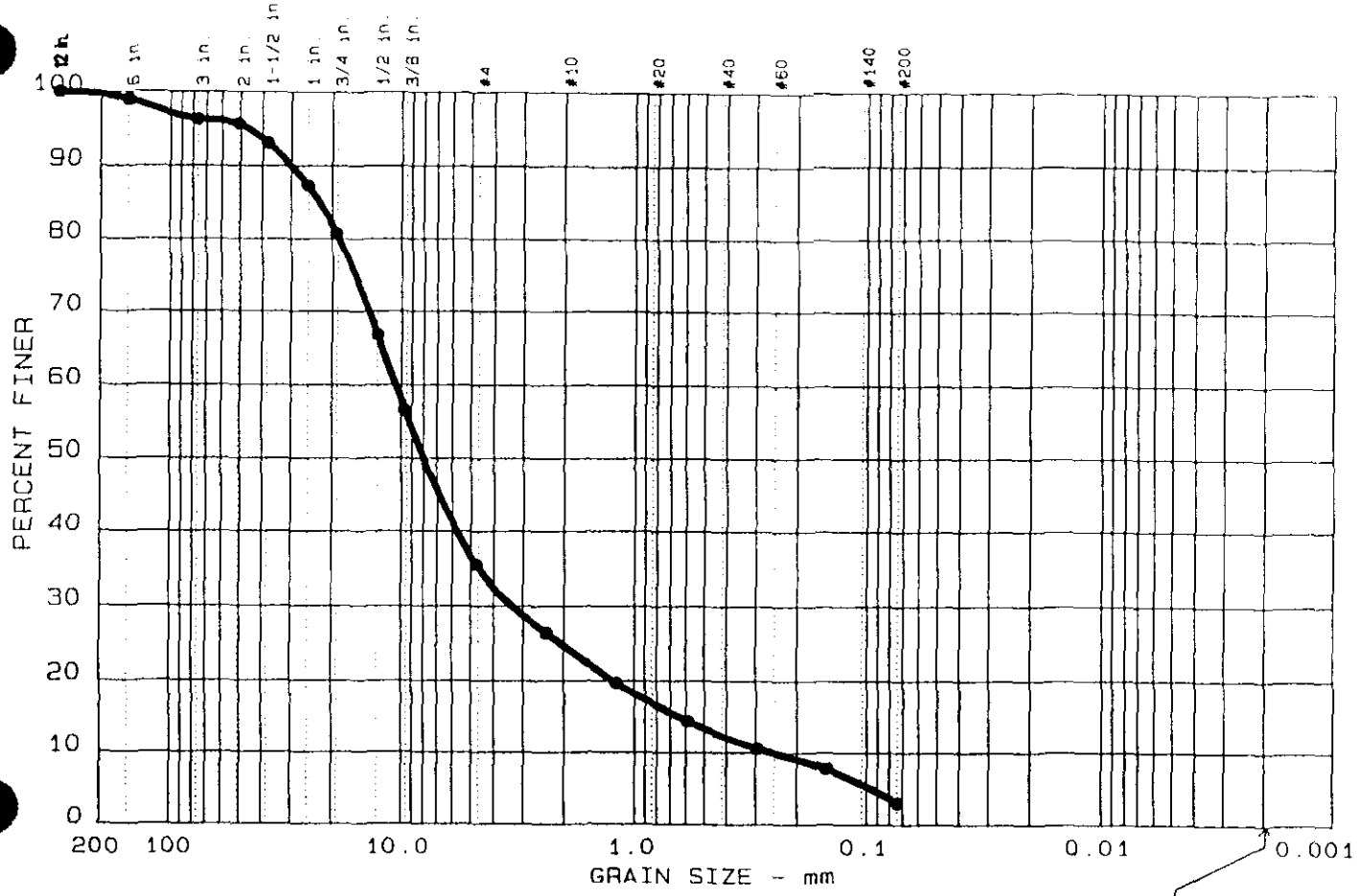
GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-52

11/0 (-7-92

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	20	3.7	60.7	32.5	3.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	n/p	n/p	22.59	10.57	8.01	3.300	0.6434	0.2532	4.07	41.7

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 1, depth: 0 - .5'

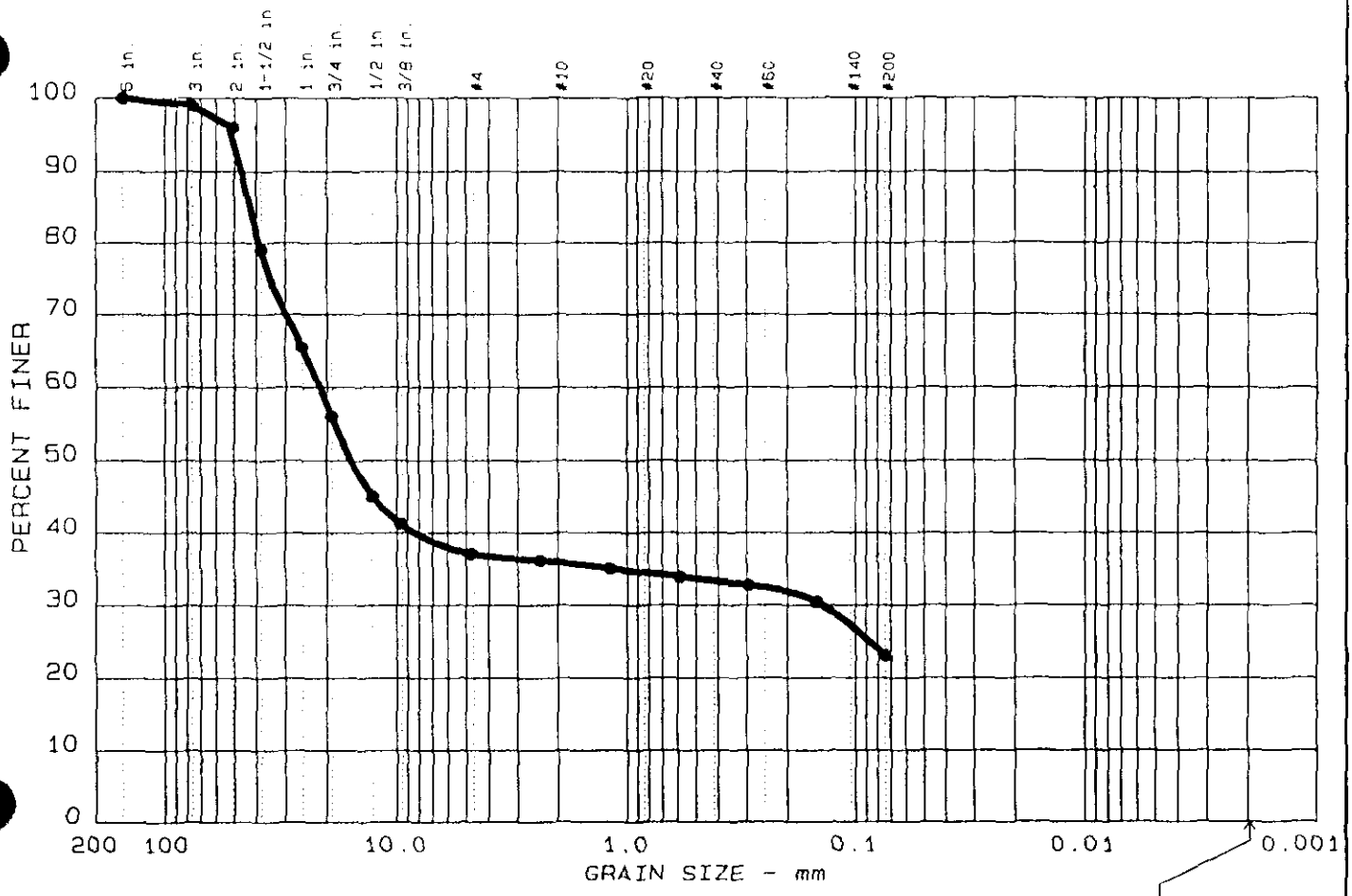
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-53

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	1.0	61.9	14.0	23.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	42.81	21.38	15.67	0.138				

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. SILTY GRAVEL w/Sand **(Desert Pavement)**	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 2, depth: 0 - .5'

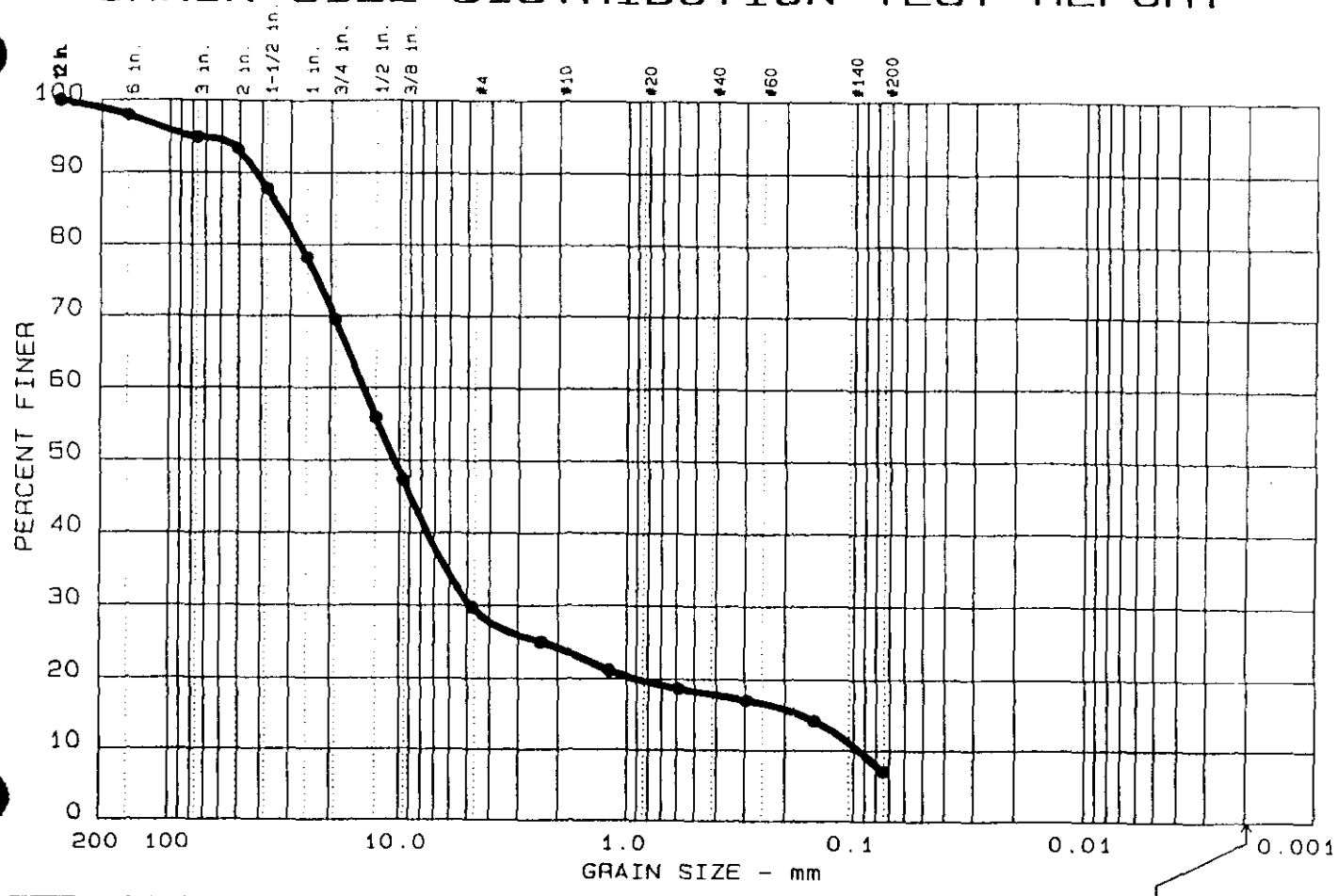
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-54

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	5.0	65.2	22.8	7.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	33.50	14.29	10.53	4.814	0.1669	0.0950	17.08	150.5

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Silt and Sand	GP - GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS -3, depth: 0 - 5'

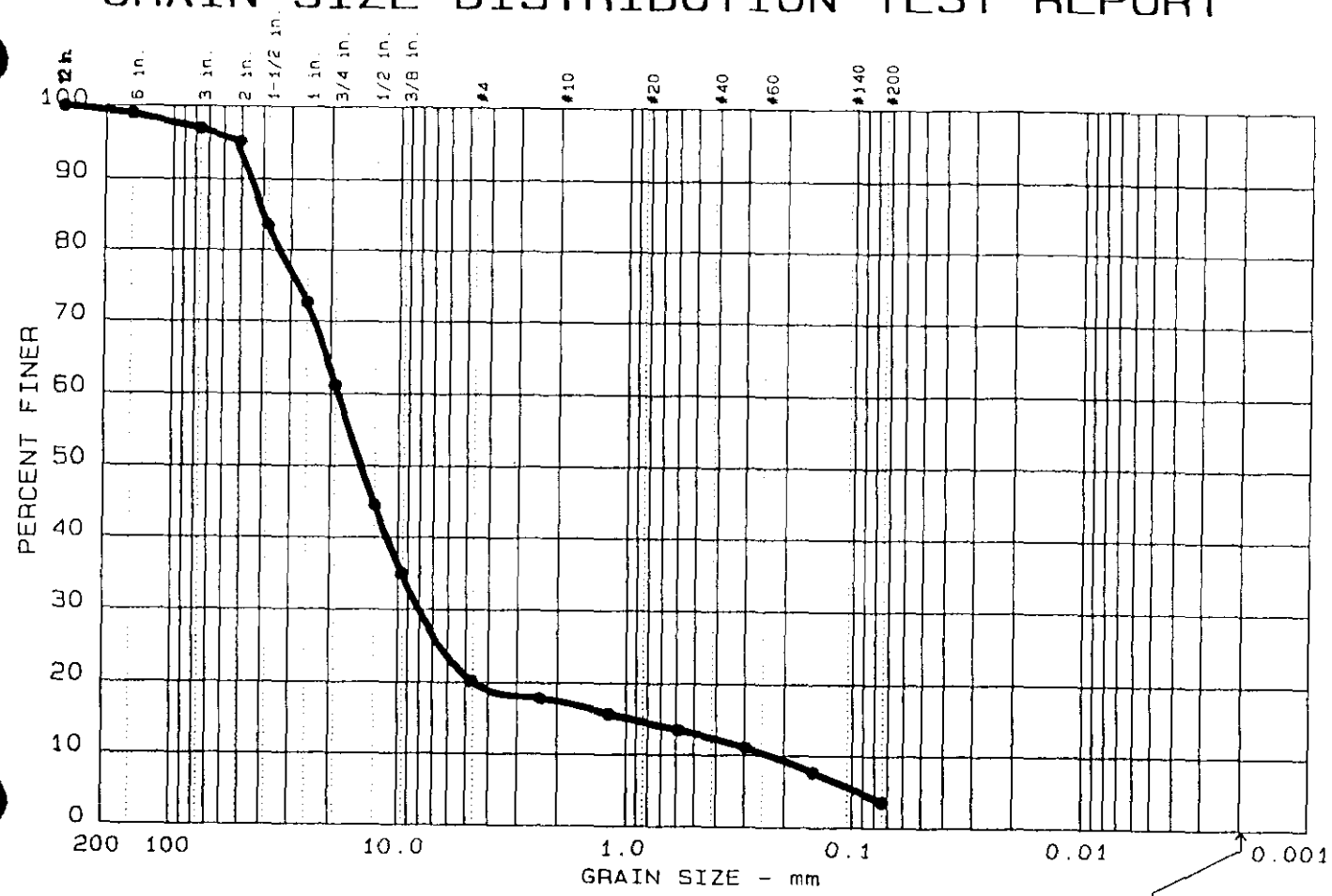
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-55

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	3.0	76.8	16.6	3.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	n/p	n/p	39.81	18.51	14.54	8.082	0.9386	0.2304	15.31	80.4

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 4, depth: 0 -.5'

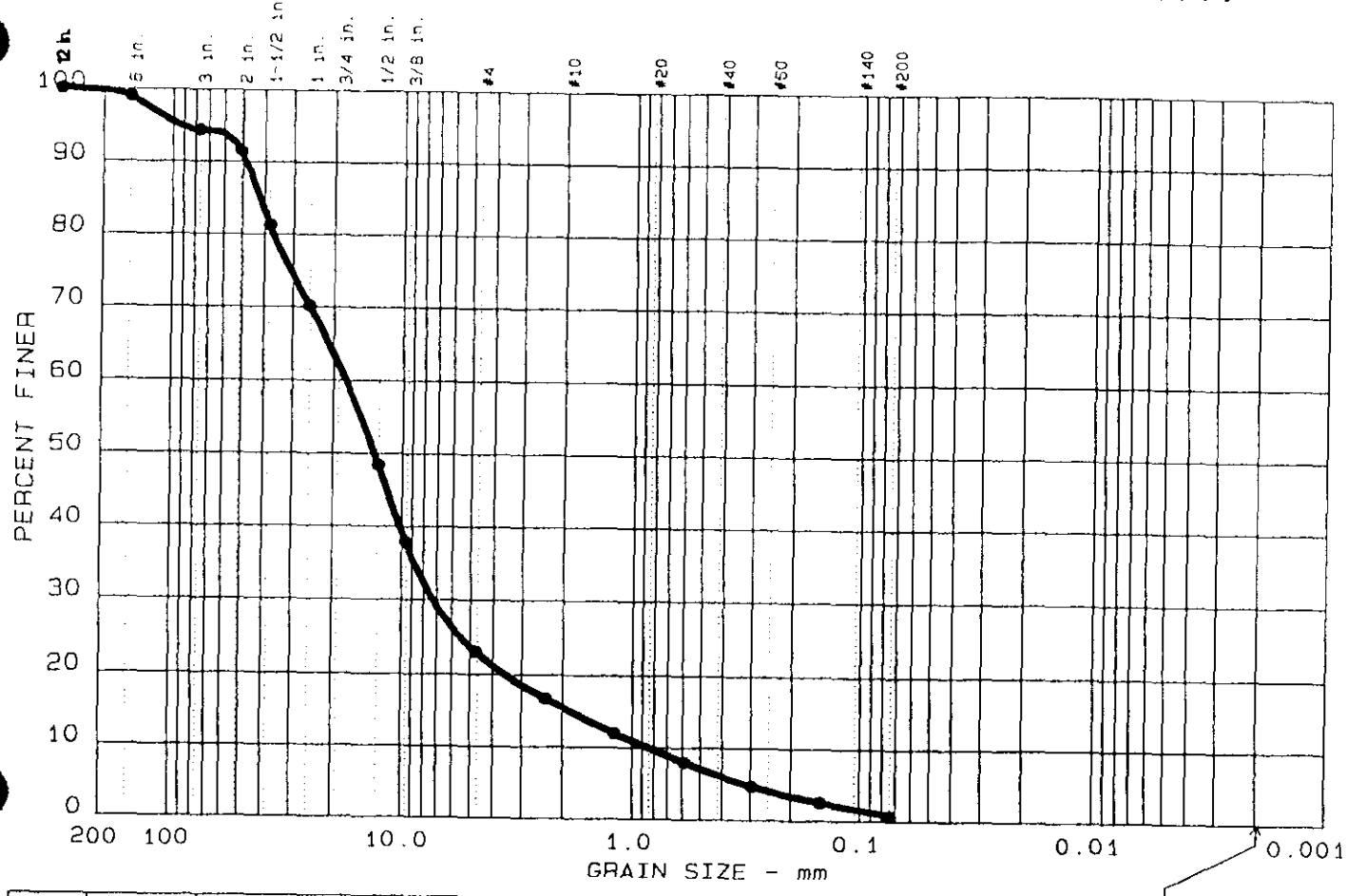
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-56

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 8	5.6	71.3	22.3	0.8	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	41.98	17.62	13.20	7.253	1.8642	0.8424	3.54	20.9

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 5, depth: 0 - .5'

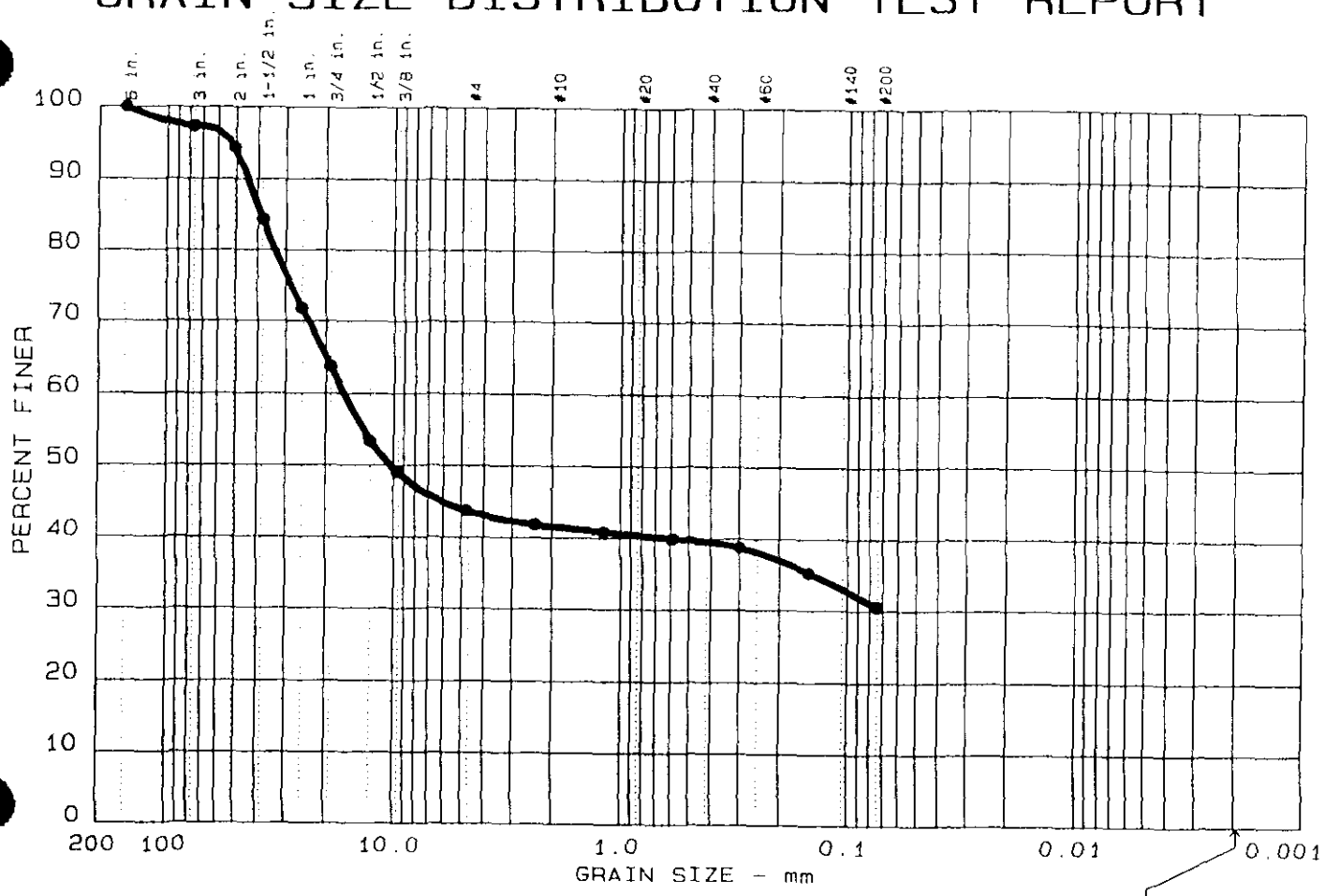
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO.: A-57

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	9	2.7	53.6	13.2	30.5	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	38.77	16.54	10.32					

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY GRAVEL w/Sand **(Desert Pavement)**	GM	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 6, depth: 0 - .5'

Date: 10-11-1991

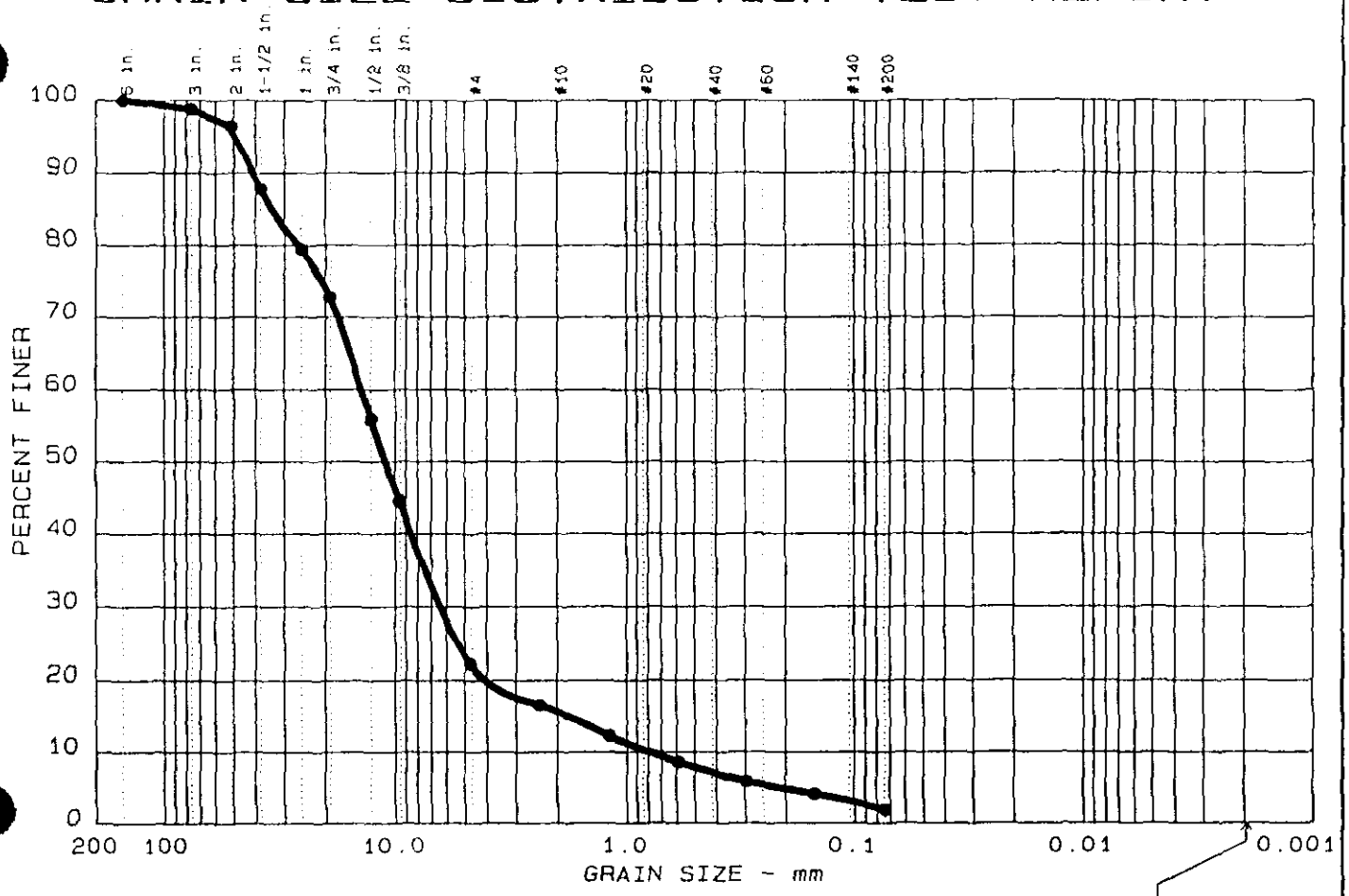
B/C 1-7-92

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING-NO. A-58

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	10	1.2	76.5	20.4	1.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	n/p	n/p	33.88	13.92	11.05	6.427	1.7701	0.7907	3.75	17.6

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. POORLY GRADED GRAVEL w/Sand	GP	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 7, depth: 0 ~ .5'

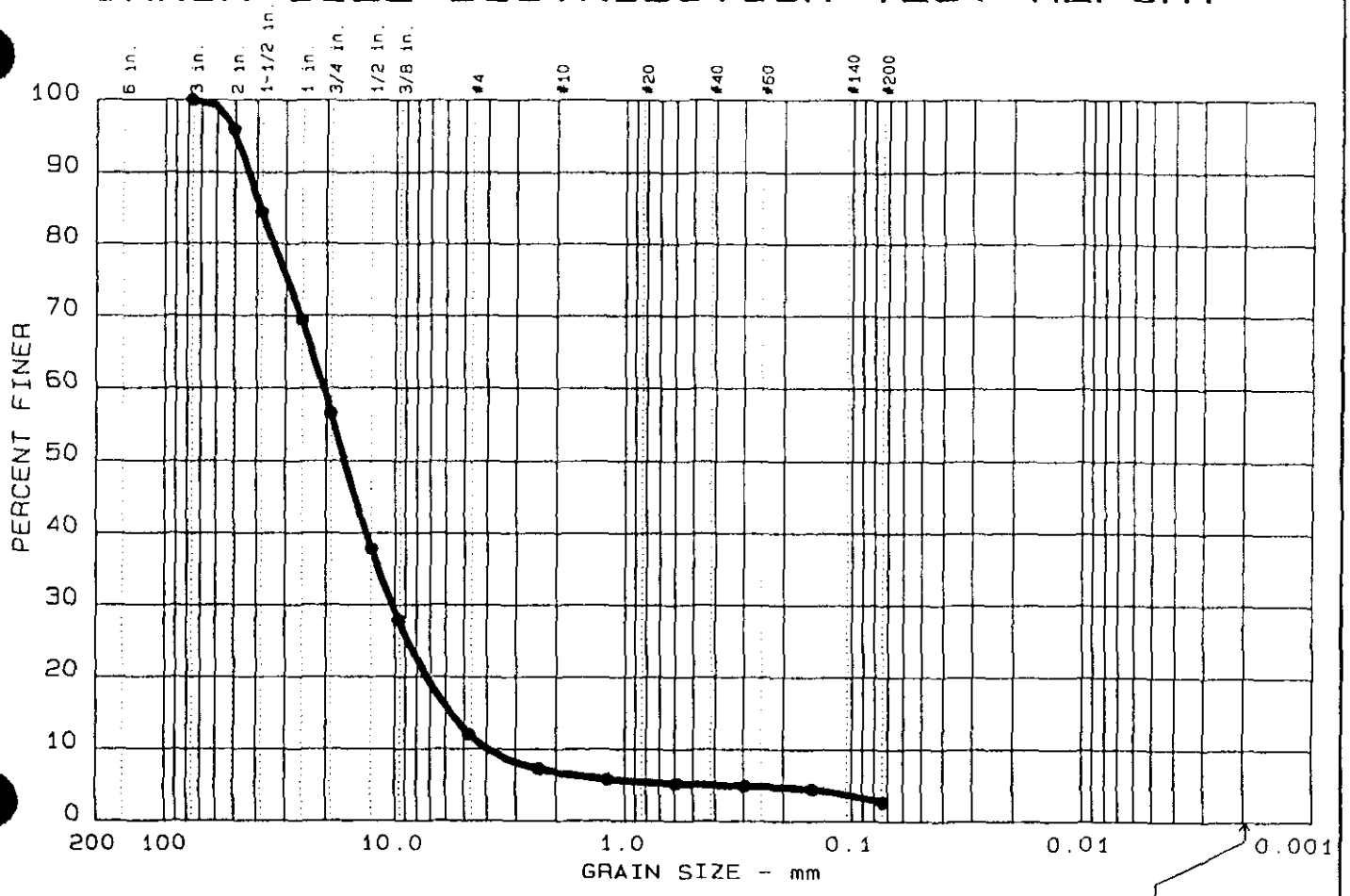
Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-59

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	88.0	9.3	2.7	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	n/p	n/p	38.46	20.42	16.60	10.233	5.6885	3.9355	1.30	5.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Lt.brn. WELL GRADED GRAVEL	GW	

Project No.: 91-33298-01
Project: Range Wash Dike
● Location: BS - 8, depth: 0 - .5'

Date: 10-11-1991

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-60

APPENDIX B

SLOPE STABILITY ANALYSIS

Based on the results of the geologic/seismic evaluation and the field and laboratory investigations, slope stability analyses of the proposed dike embankment were performed. The stability analyses were conducted in general accordance with the Nevada State Statutes, the Clark County Regional Flood Control District "Hydrologic Criteria and Drainage Design Manual". The anticipated maximum dike and floodway channel slope sections were analyzed for four separate cases; (1) end of construction, (2) sudden drawdown, (3) steady state seepage and (4) seismic. The dike was analyzed for a height of 10 to 11 feet with 5 feet of water. The floodway channel side slopes were analyzed for a height of 4 feet with 3 feet of water. The computer program SB-Slope, Version 3.0, developed by Von Gunten Engineering Software, Inc. was used to calculate the minimum factor of safety for each of the 4 cases for the dike. The factor of safety for sudden drawdown was calculated for the floodway channel side slopes (worst case) only. The SB-Slope program utilizes the simplified Bishop Method of slope stability analysis for circular failure surfaces. A 12-inch layer of soil cement and a 6-inch thick layer of rock material was simulated in the stability analyses as uniform surcharge loads of 145 and 65 pounds per square foot (psf) on the dike toe slope and back slope, respectively. The computer printouts showing the results of the stability analyses for the maximum anticipated embankment and floodway channel sections are also presented in this Appendix.

B10-1

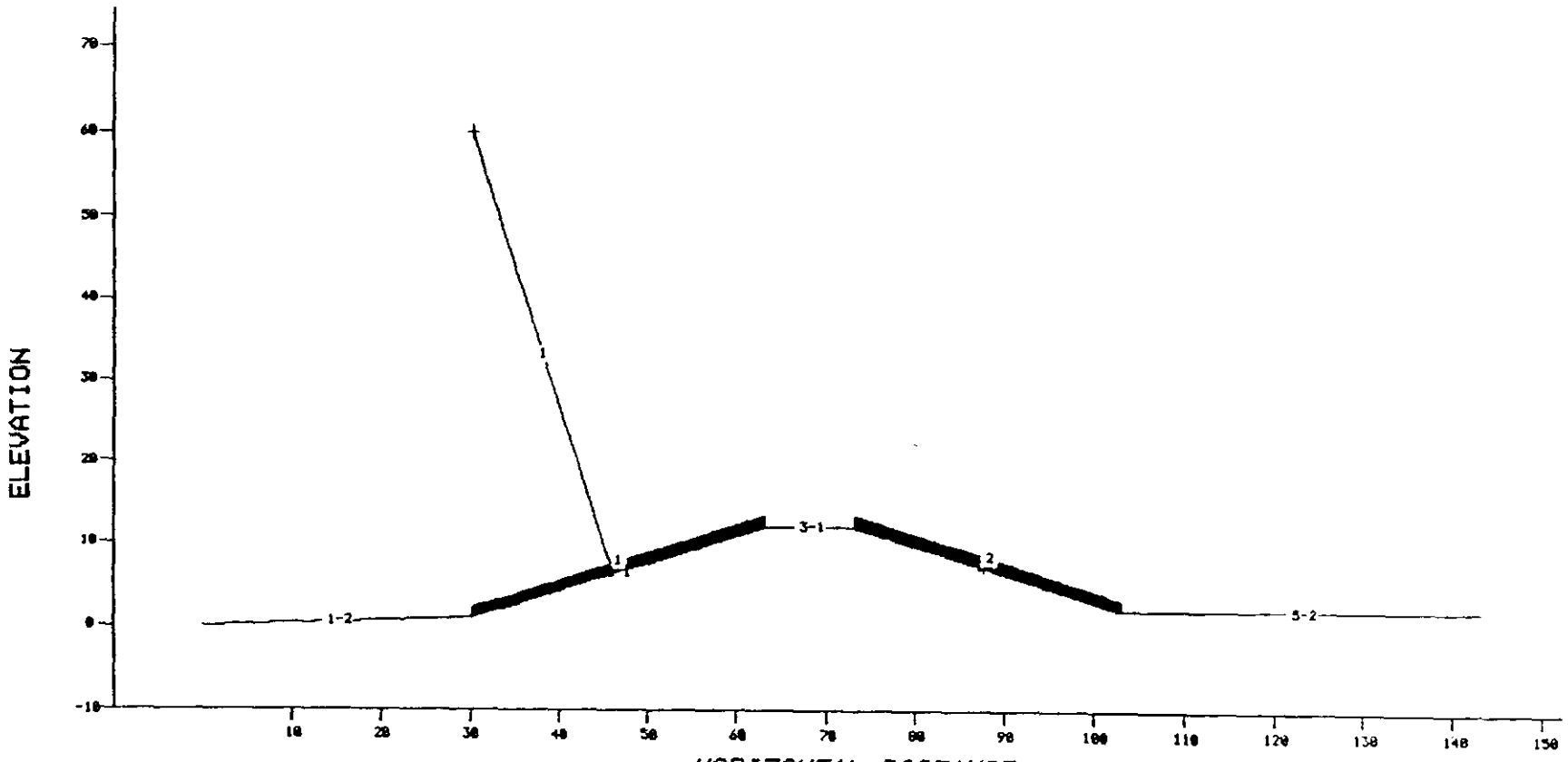
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33298-01-Range Wash Flood Control Project
LOCATION: North Las Vegas
FILE: RANGE1B
COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	30.0	60.0	56.0	2.35

SOIL*	DENSITY	COHESION	PHI
1	135.0	0.0	38.0
2	130.0	0.0	38.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0



* Number after hyphen('-') is Soil Type

B10

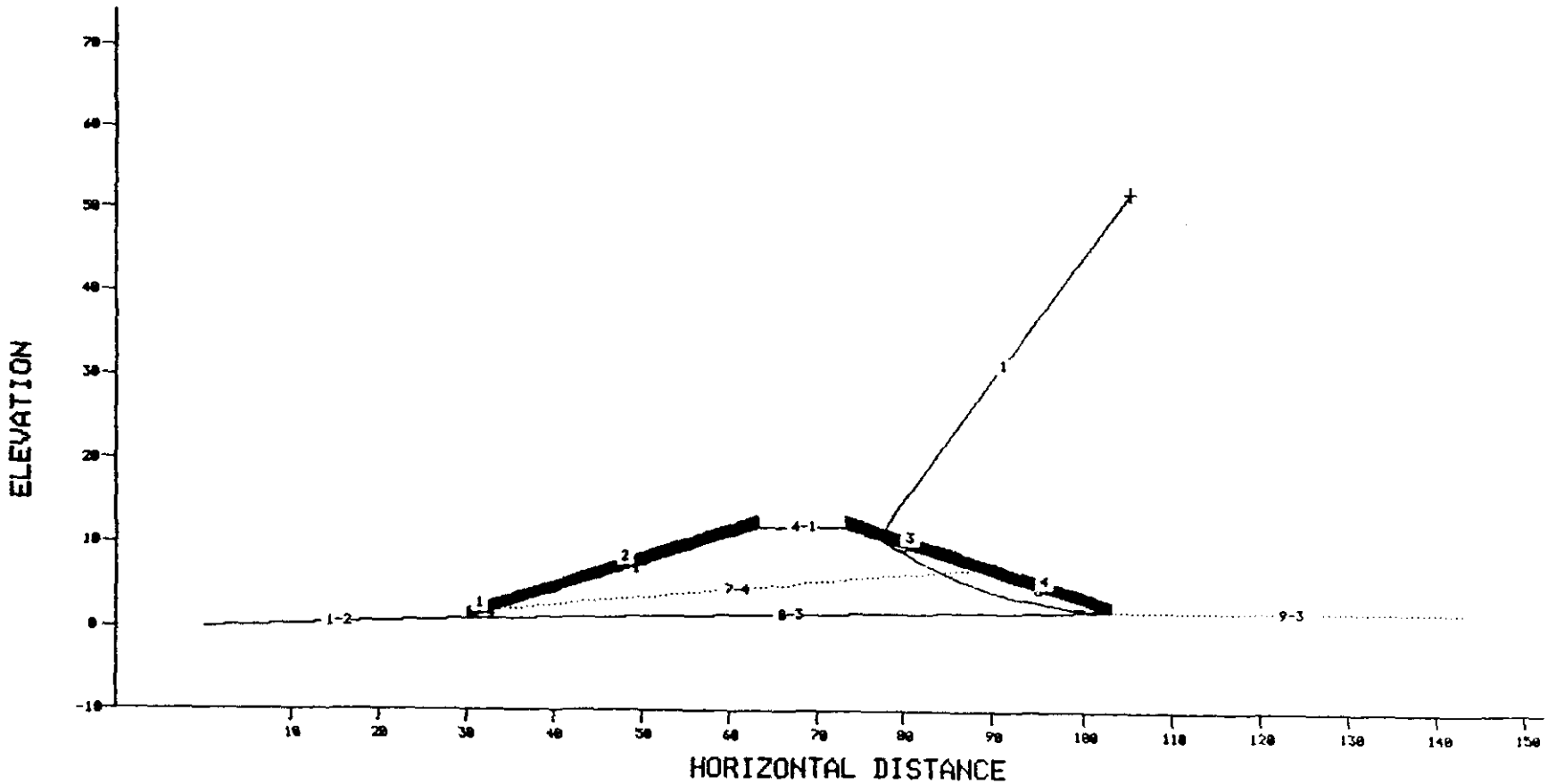
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33298-01-Range Wash Flood Control Project
LOCATION: North Las Vegas
FILE: RANGE6B
COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	105.0	52.0	50.0	1.97

SOIL*	DENSITY	COHESION	PHI
1	135.0	0.0	38.0
2	130.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen('-') is Soil Type

B20 -92

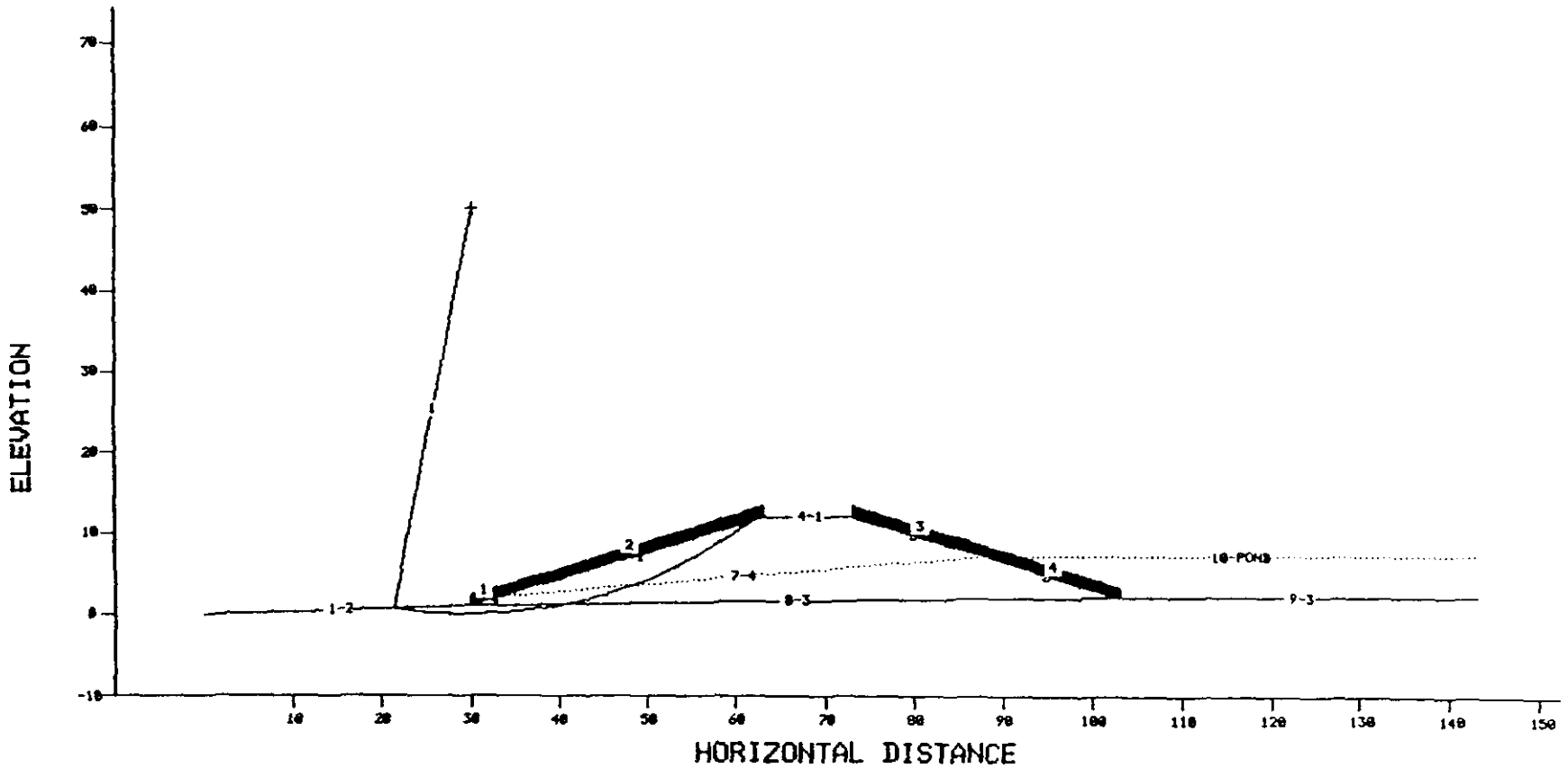
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33298-01-Range Wash Flood Control Project
LOCATION: North Las Vegas
FILE: RANGE2B
COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	30.0	50.0	50.0	2.30

SOIL*	DENSITY	COHESION	PHI
1	135.0	0.0	38.0
2	130.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen('-') is Soil Type

B201-

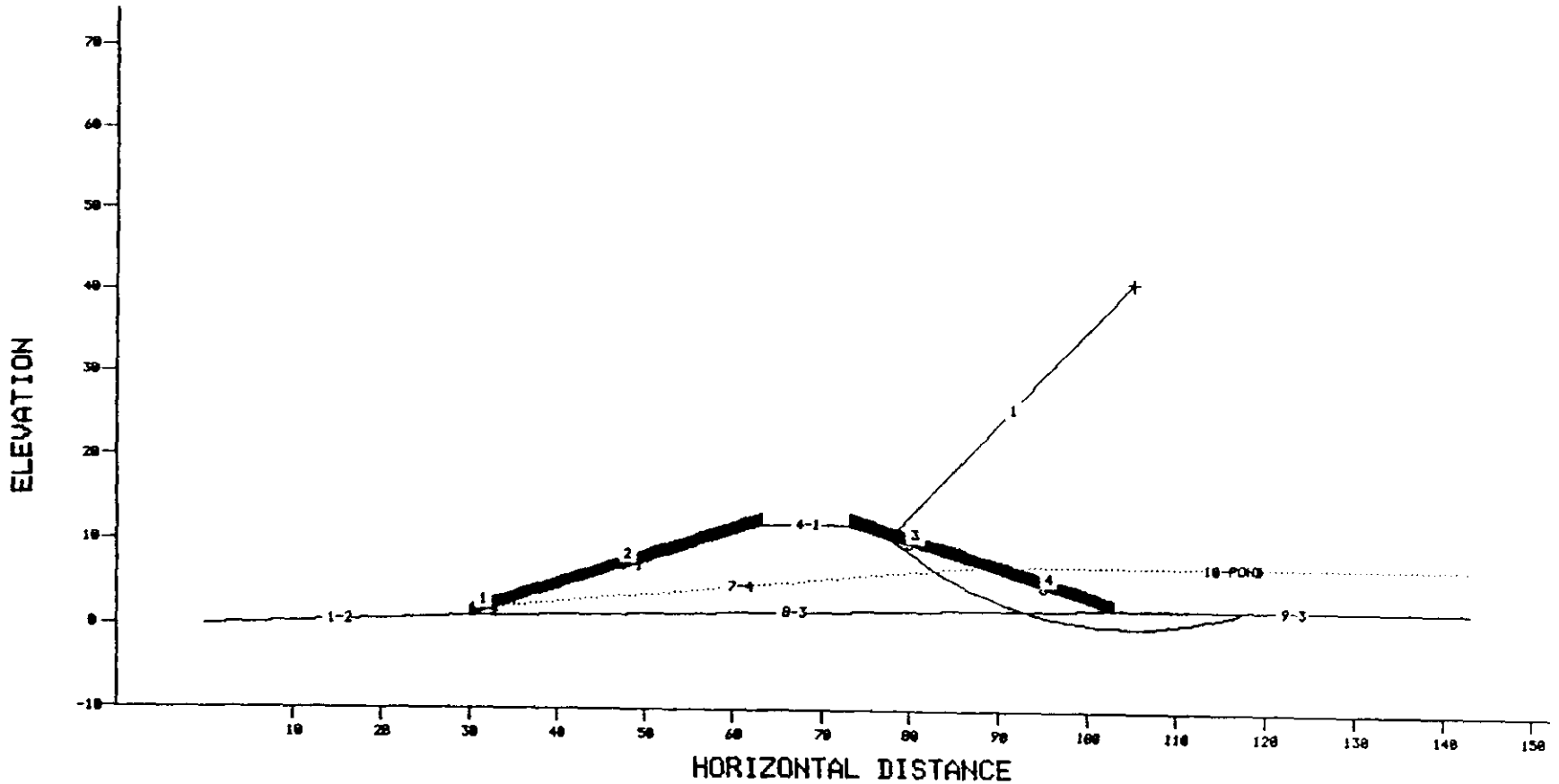
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33298-01-Range Wash Flood Control Project
LOCATION: North Las Vegas
FILE: RANGE4B
COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	105.0	41.0	41.0	1.21

SOIL*	DENSITY	COHESION	PHI
1	135.0	0.0	38.0
2	130.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen('-') is Soil Type

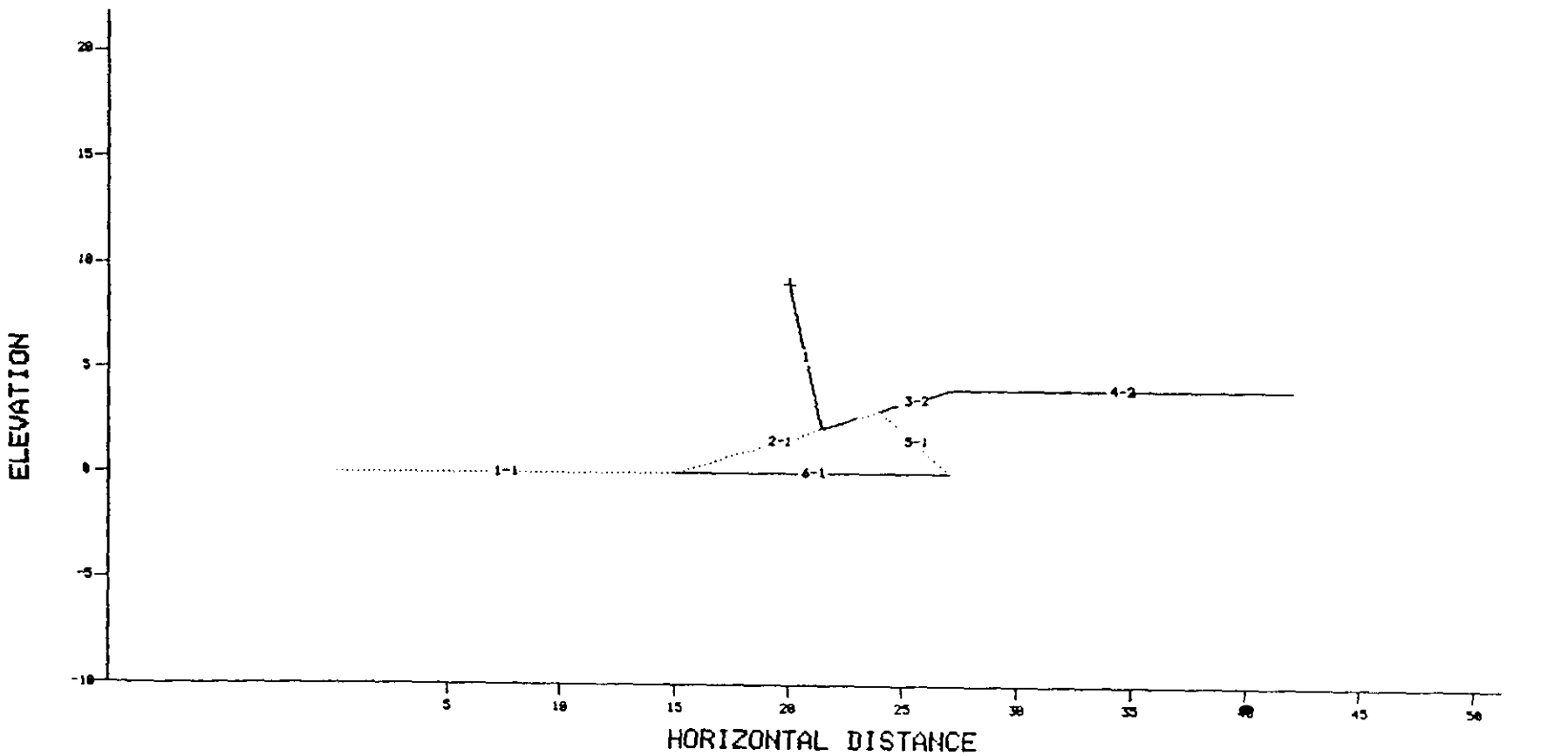
SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33298-01-Range Wash Flood Control Project
LOCATION: North Las Vegas, Nevada
FILE: RANGE7B
COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	20.0	9.0	7.0	1.15

SOIL*	DENSITY	COHESION	PHI
1	135.0	0.0	38.0
2	130.0	0.0	38.0



* Number after hyphen('-') is Soil Type

APPENDIX C

SOIL CEMENT MIX DESIGNS REPORT

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

January 7, 1992

91-33421-01

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Soil Cement Mix Designs
Range Wash Flood Control Project
Near Range Road
North Las Vegas, Nevada

Gentlemen:

We are pleased to submit the results of our Soil Cement Mix Designs conducted for the construction of the Range Wash Flood Control Project in North Las Vegas, Nevada. The mix designs were performed in accordance with our proposal of July 29, 1991.

FIELD INVESTIGATION

On September 13, 1991, a representative of Converse Consultants Southwest, Inc. (CCSW) sampled Trenches 6 and 19 at the locations shown on Drawing No. 2 in the body of this report. The samples were a composite of material from the surface down to 6 feet.

LABORATORY INVESTIGATION

Gradations, Atterberg Limits, and Moisture/Density Relationships were performed on each sample to classify the soil and to establish a range of cement contents for the mix design. Both samples were classified as poorly graded silty gravel with sand. The engineering properties of the samples were found to be similar, the difference being 7 percent more gravel in Trench 6 than in the sample from Trench 19. CCSW used the soil cement mix design procedures from the PCA Soil Cement Laboratory Handbook and the procedures for soil cement from ASTM D558, D559, and D560. The freeze/thaw, wet/dry, and compressive strength graphs, gradations, and moisture/density curves for each mix design are enclosed with this report.

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

ENGINEERING ANALYSIS

The PCA Soil Cement Manual recommends a maximum allowable volume loss of 14 percent on the wet/dry and freeze/thaw samples for this type of soil (AASHTO Classification A-1-a). This criteria was used to determine the percent of cement to be used for the soil cement.

CCSW has evaluated the test data for both test areas. Five percent cement content is the critical point of the wet/dry and freeze/thaw curves for both mix designs. The data indicates that a 5 percent cement content will provide a soil cement mixture with sufficient resistance to weathering as well as a factor of safety to guard against minor deviations during construction, mixing, and batching the soil cement. For construction control, the compressive strength for both mix designs should be a minimum of 550 psi at 7 days.

PCA procedures are for resistance to weathering of a base course material covered by a surfacing course. Some weathering of the top surface should be anticipated if the material is not covered by a surfacing course.

If design criteria other than weather resistance is to be considered, such as compressive strength, the enclosed compressive strength curves may be used. In selecting a cement content based upon compressive strength, we recommend a factor of safety of 0.5 percent cement be used.

SOIL CEMENT MIXTURE

Soil Cement shall be produced and constructed in accordance with the requirements listed below and Section 304 of the Uniform Standard Specifications for Public Works Construction Off-Site Improvements, Clark County Area, Nevada, 1986 Edition. The plant-mix method of batching and mixing shall be used.

Minimum Compaction: 95% of ASTM D 558 maximum density
Minimum 7 Day Compressive Strength: 550 psi
Soil Source: Screened Native Gravels, AASHTO Classification A-1-a
Cement Type: V
Cement Content: 5% by weight of dry soil
Soil Properties:
Plastic Index: 6 maximum
Gradation:

Screen or Sieve Size	Percent Passing
3"	100
2"	90-100
No. 4	35-65
No. 10	20-50
No. 40	10-30
No. 200	4-15

If you have any questions regarding these mix designs or if we may be of further assistance, please don't hesitate to call.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Robert Kukes

Robert Kukes, EIT
Staff Engineer

Reviewed and approved:

William W. Taylor

William W. Taylor, P.E.
Principal Engineer

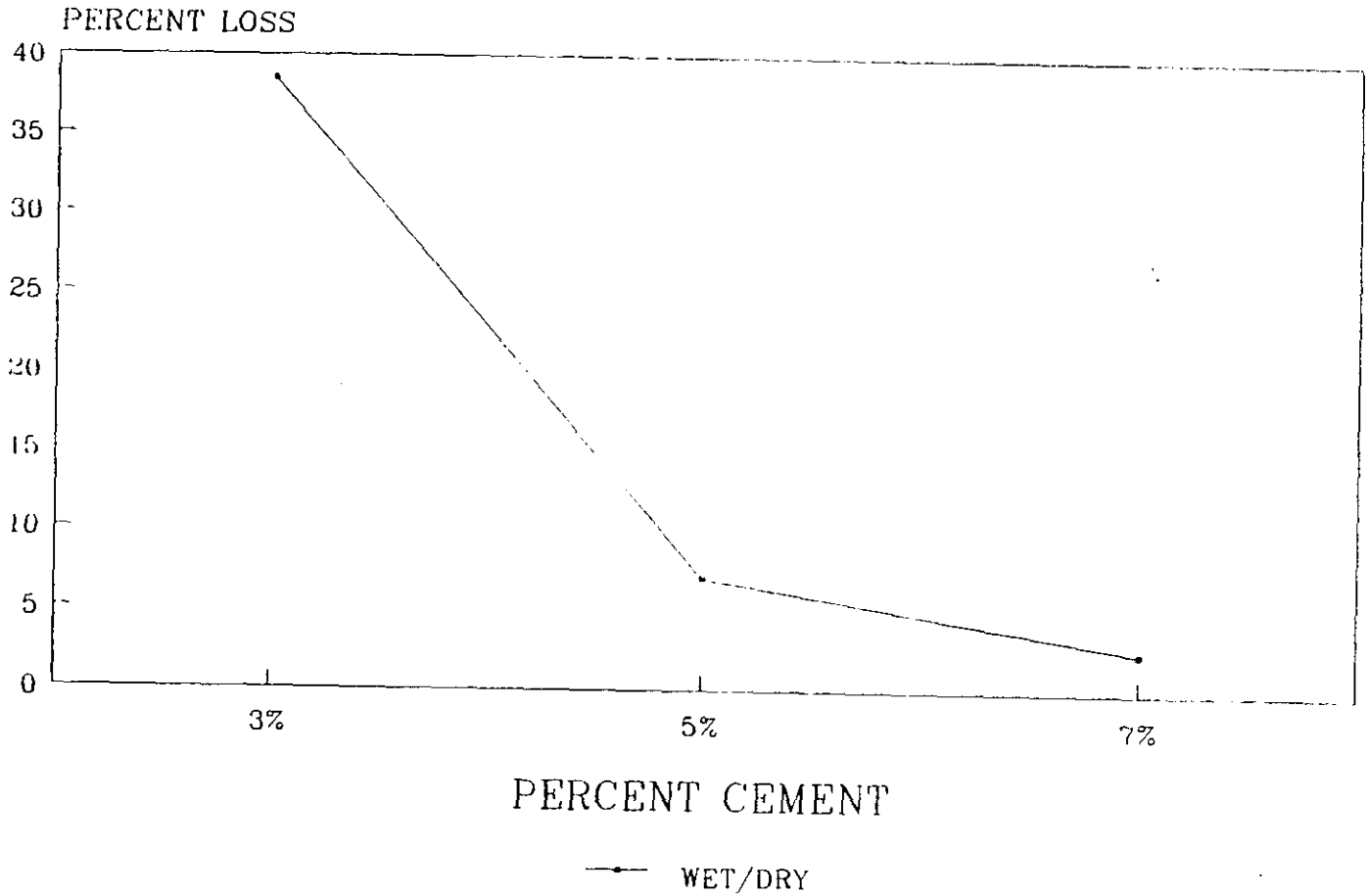
REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
WILLIAM W. TAYLOR
CIVIL
NO. 8773
1/7/92

WWT:RWK:sc
29/32S

Encl: Mix Design Graphs
Gradation and M/D Curves

Dist: 20/Addressee

SOIL CEMENT
WET/DRY TRENCH 19

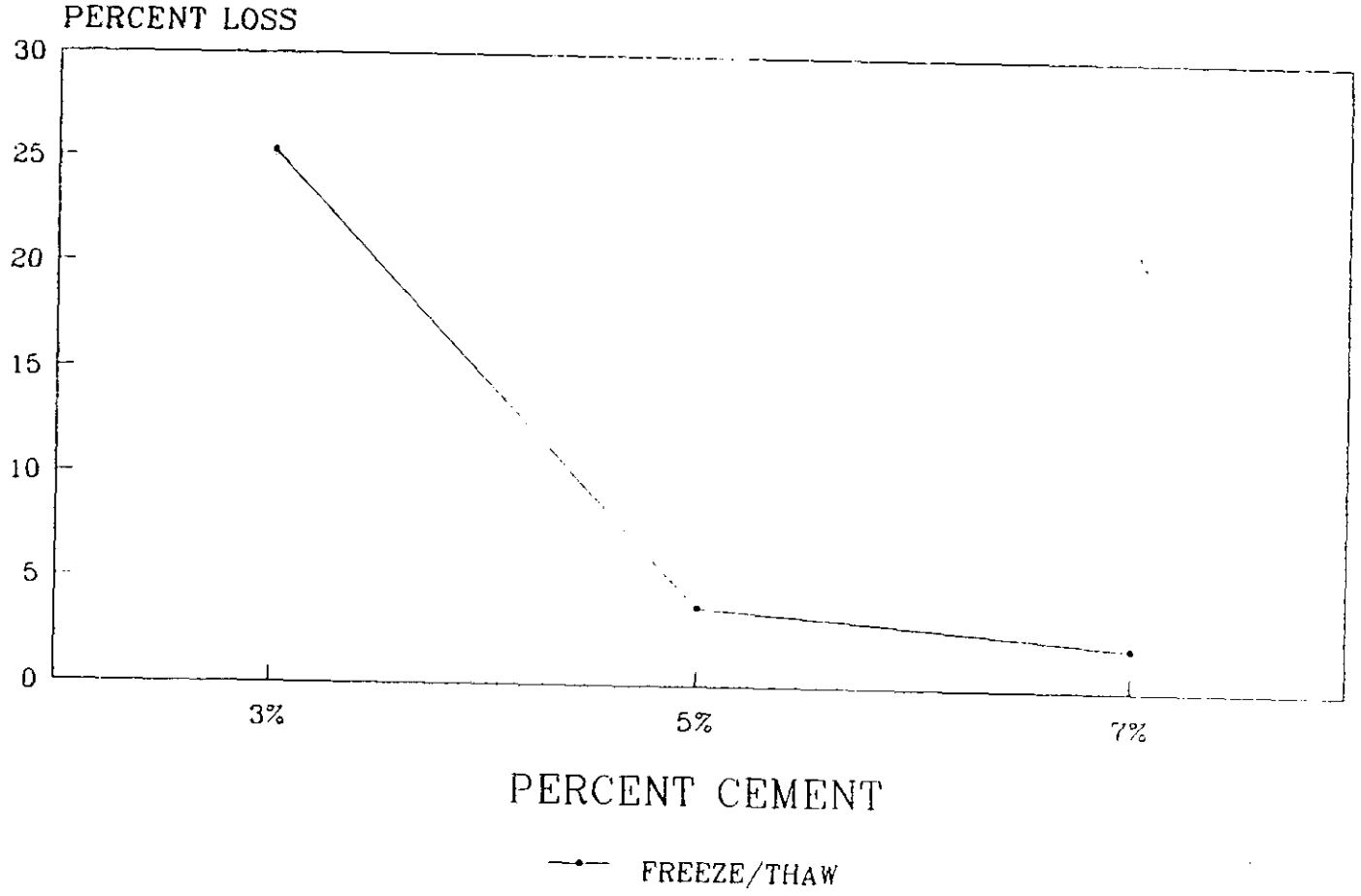


14% MAXIMUM ALLOWABLE LOSS

Converse Consultants Southwest, Inc.

SOIL CEMENT

FREEZE/THAW TRENCH 19

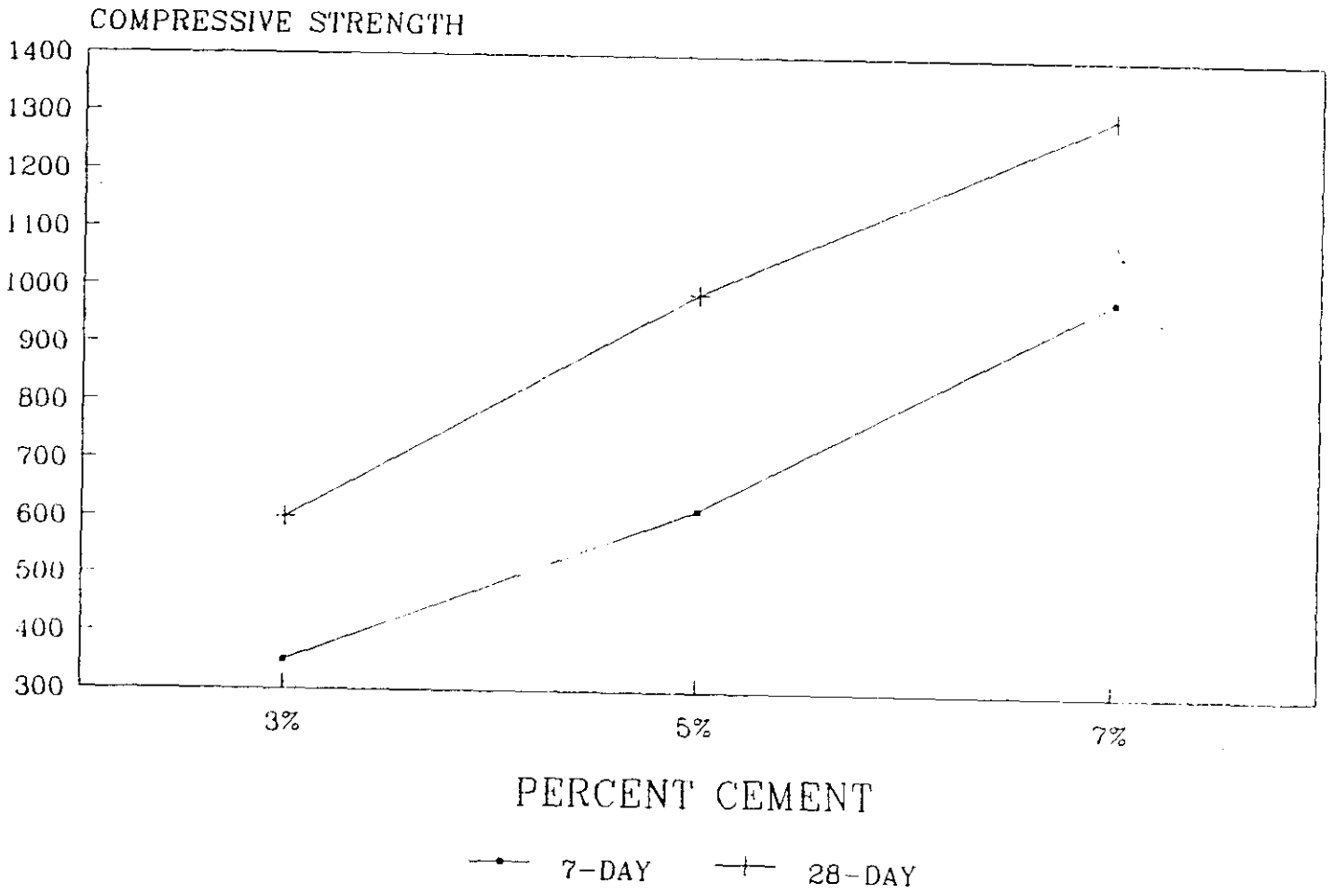


14% MAXIMUM ALLOWABLE LOSS

Converse Consultants Southwest, Inc.

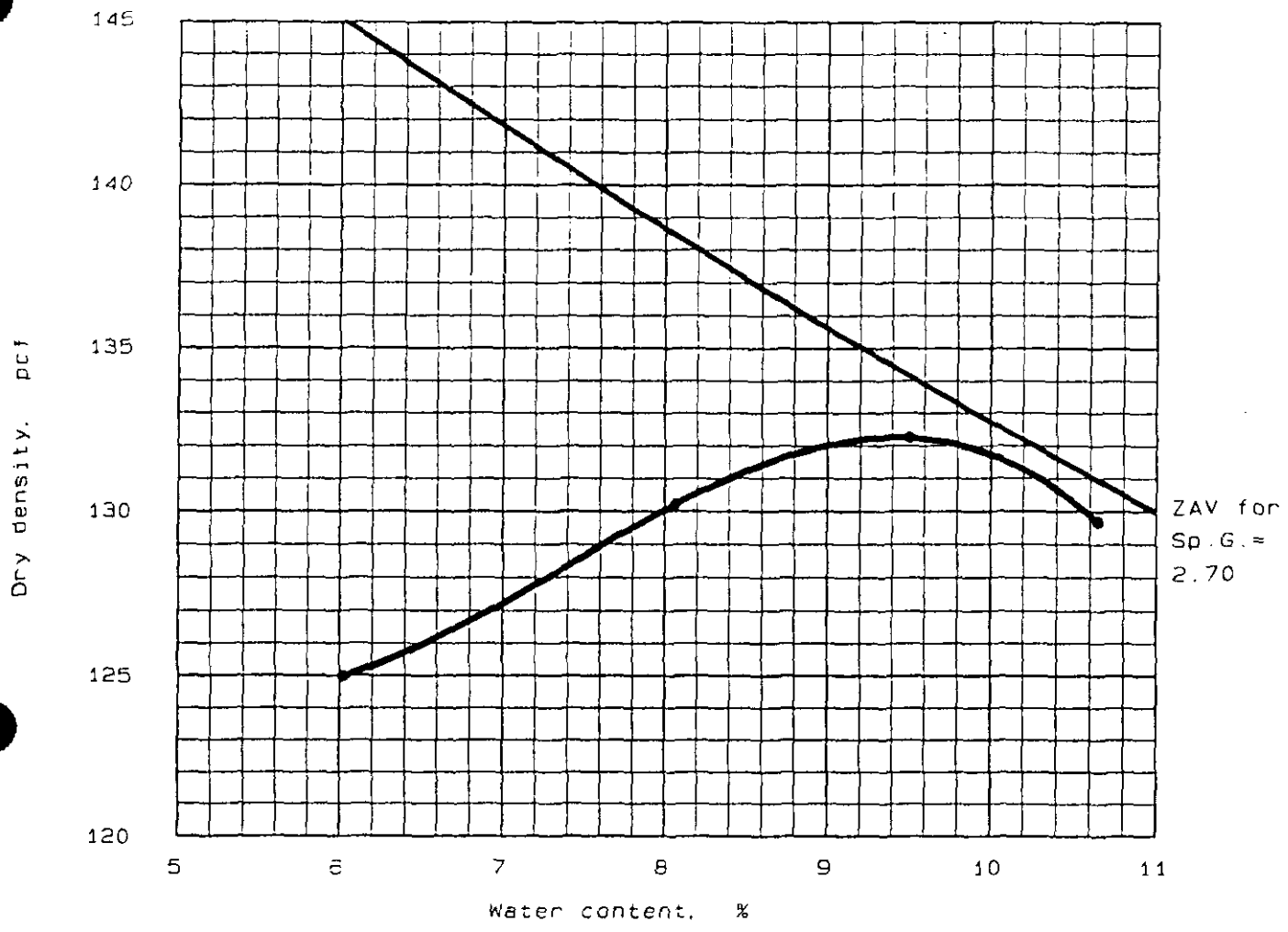
SOIL CEMENT

COMPRESSIVE STRENGTH – 7 & 28 DAY



Converse Consultants Southwest, Inc.

MOISTURE-DENSITY RELATIONSHIPS



"Standard" Proctor, ASTM D 698, Method D

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				2.70				

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 9.4 % Maximum dry density = 132.3 pcf	Brn Sandy Gravel

Project No.: 91-3342-01

Project: Range Wash Soil Cement

Location: T-19

Date: 9-26-1991

Remarks:

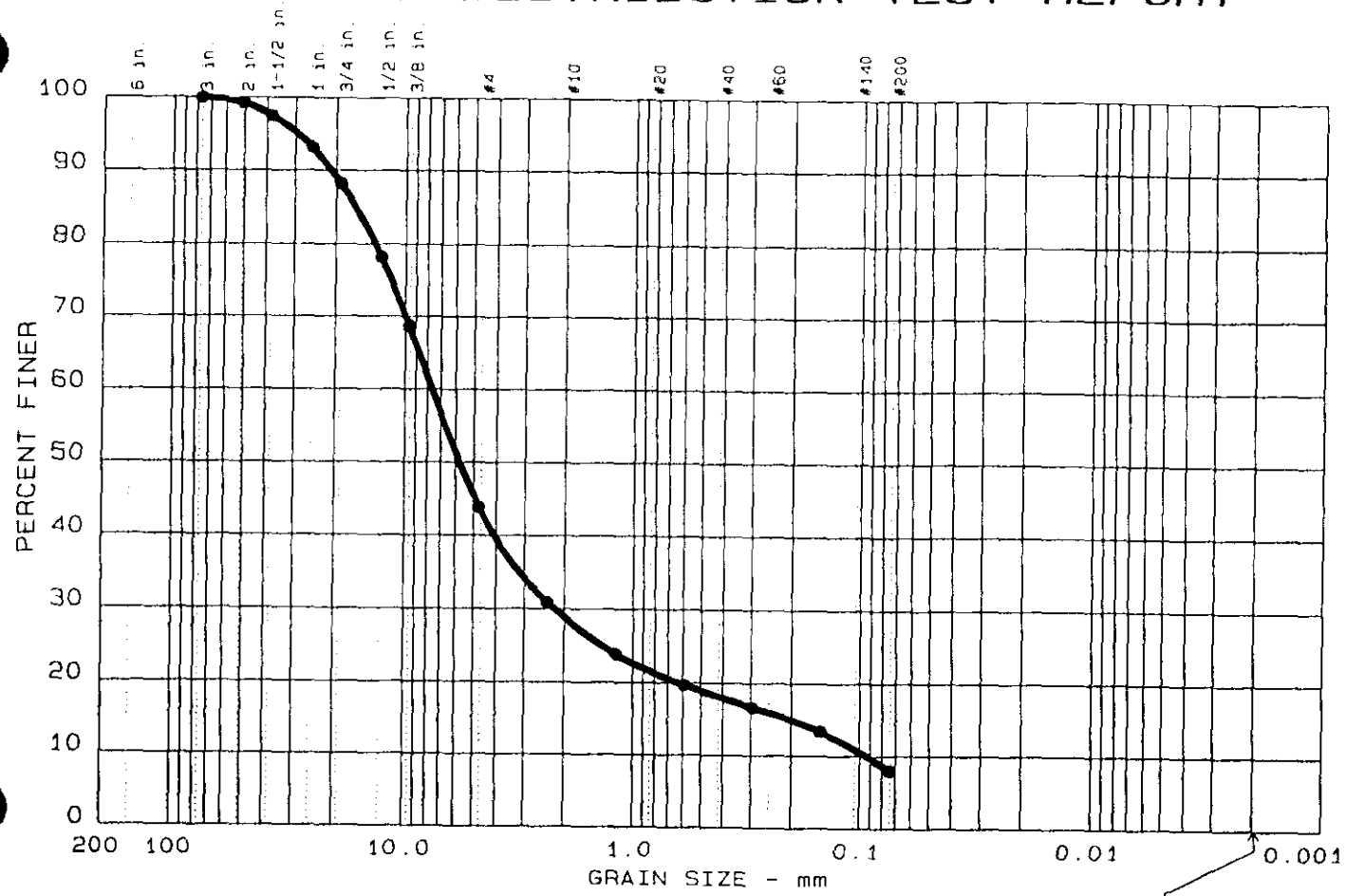
Checked By MCB

MOISTURE-DENSITY RELATIONSHIPS

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	16	0.0	56.1	35.9	8.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	16.37	7.64	5.79	2.200	0.2007	0.0939	6.75	81.4

	MATERIAL DESCRIPTION	USCS	AASHTO
●	Brn Poorly Graded Silty Gravel With Sand	GP-GM	

Project No.: 91-33421-01
Project: Range Wash Soil Cement
● Location: T-19

Note: Native material contains aggregate particles larger than 3" in size. This material was removed for mix design purposes.

Date: 9/25/91

Remarks:

Checked By MCB

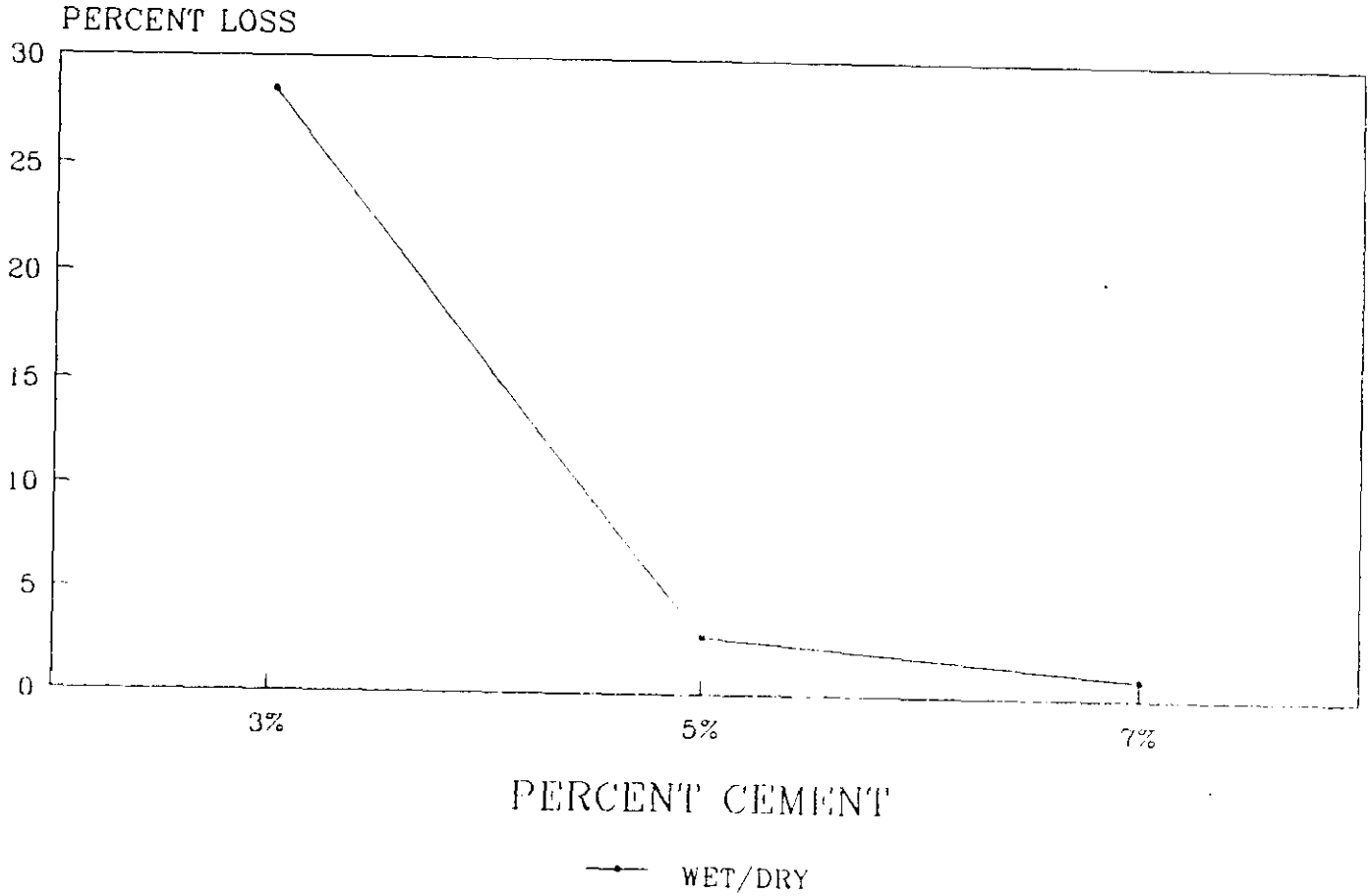
NP = Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 2

SOIL CEMENT
WET/DRY TRENCH-6

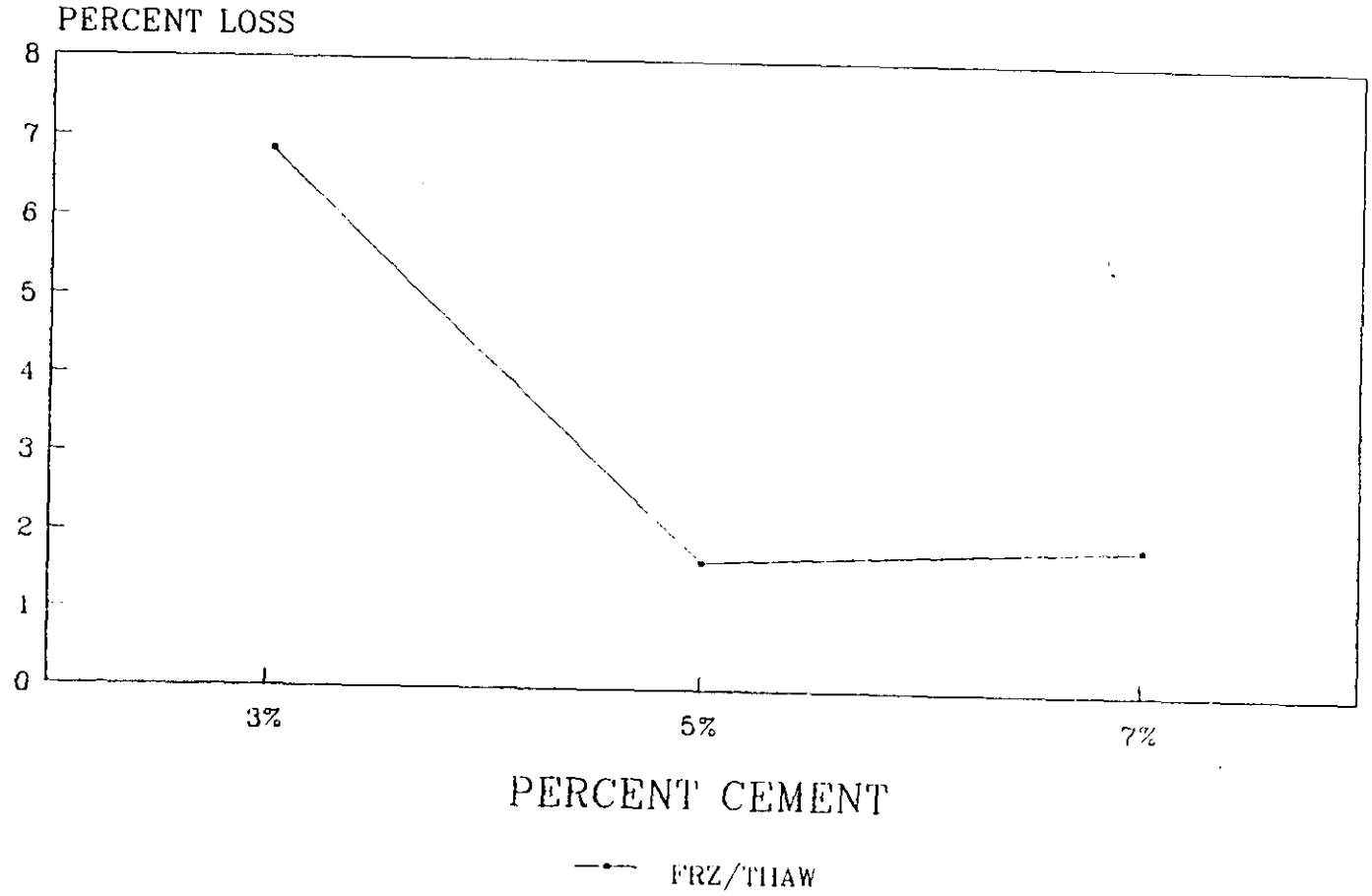


14% MAXIMUM ALLOWABLE LOSS

Converse Consultants Southwest, Inc.

SOIL CEMENT MIX DESIGN

FREEZE/THAW TRENCH-6

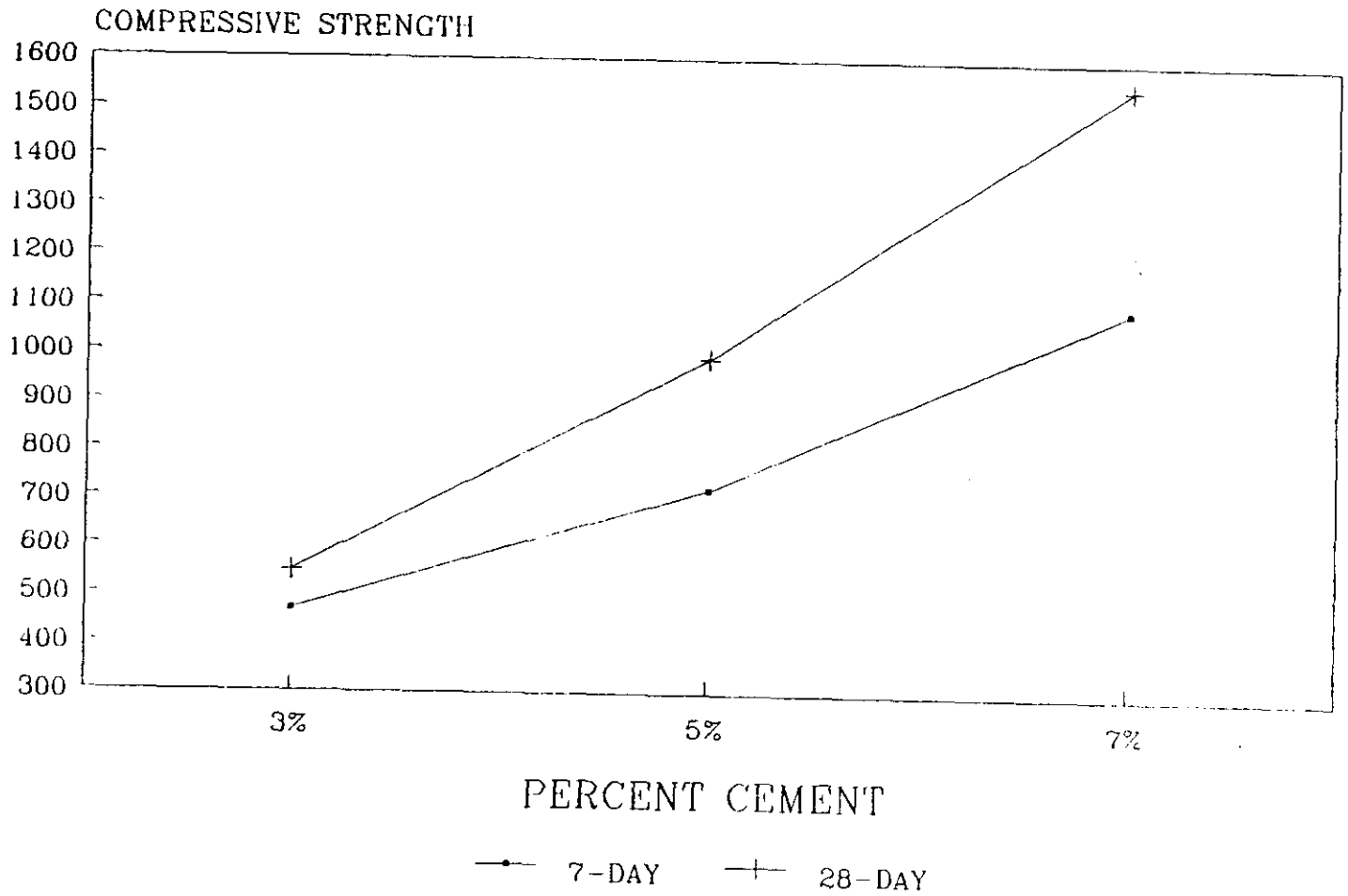


14% MAXIMUM ALLOWABLE LOSS

Converse Consultants Southwest, Inc.

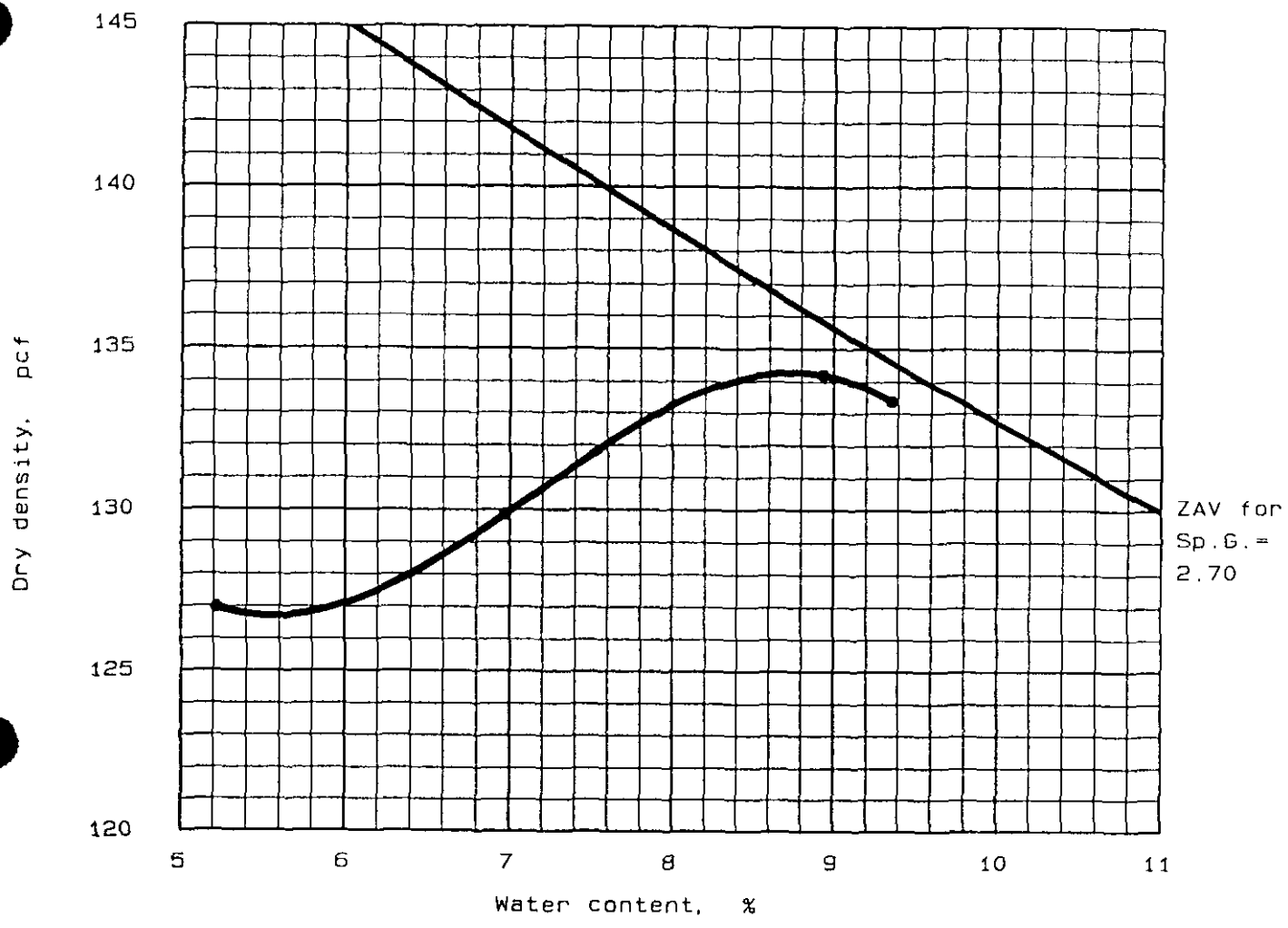
SOIL CEMENT

COMPRESSIVE STRENGTH – 7 & 28 DAY



Converse Consultants Southwest, Inc.

MOISTURE-DENSITY RELATIONSHIPS



"Standard" Proctor, ASTM D 698, Method D

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
				2.70				

TEST RESULTS	MATERIAL DESCRIPTION
Optimum moisture = 8.7 % Maximum dry density = 134.3 pcf	Brn Sandy Gravel

Project No.: 91-33421-01
Project: Range Wash Soil Cement
Location: T-6

Date: 9-26-1991

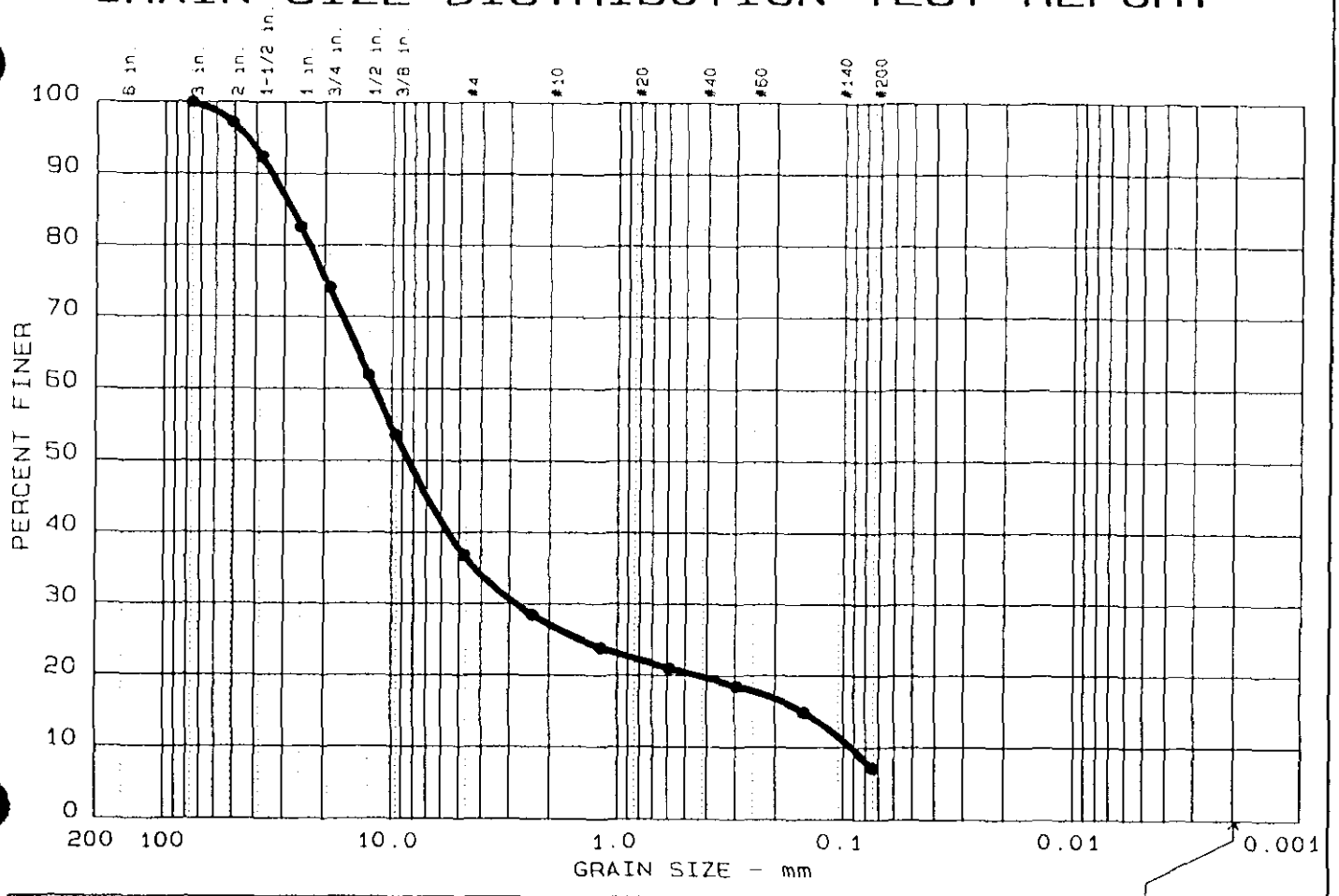
Remarks:
Checked By MCB

MOISTURE-DENSITY RELATIONSHIPS

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	11	0.0	63.1	29.7	7.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	NP	NP	27.77	11.93	8.44	2.796	0.1501	0.0926	7.08	128.8

MATERIAL DESCRIPTION	USCS	AASHTO
● Brn Poorly Graded Silty Gravel With Sand	GP-GM	

Project No.: 91-33421-01

Project: Range Wash Soil Cement

● Location: T-6

Note: Native material contains aggregate particles larger than 3" in size. This material was removed for mix design purposes.

Date: 9/25/91

Remarks:

Checked By MCB

NP= Non-Plastic

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

Figure No. 1

5.3.5 Geotechnical Investigation Addendum #1

RECEIVED

MAY 21 1992

REGIONAL
FLOOD CONTROL DISTRICT

ADDENDUM NO. 1
RIPPABILITY STUDY OBSERVATIONS
RANGE WASH FLOOD CONTROL PROJECT
NORTH LAS VEGAS, NEVADA

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

ADDENDUM NO. 1
RIPPABILITY STUDY OBSERVATIONS
RANGE WASH FLOOD CONTROL PROJECT
NORTH LAS VEGAS, NEVADA

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33298-03

May 15, 1992

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

May 15, 1992

91-33298-03

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Addendum No. 1
Rippability Study Observations
Range Wash Flood Control Project
North Las Vegas, Nevada

Gentlemen:

INTRODUCTION

This report presents the results of our rippability study observations conducted for the construction of the Range Wash Flood Control Project located near Range Road in North Las Vegas, Nevada. This study was performed in general accordance with our signed Addendum No. 3 to the Standard Form of Agreement With Consultant for Professional Service dated July 26, 1991. Geotechnical recommendations relative to this project were provided in our Geotechnical Investigation report, dated January 8, 1992 (CCSW Project No. 91-33298-01). The findings and conclusions of this study supplement those provided in the previous report.

SCOPE OF WORK

1. A field exploration program was conducted which consisted of trenching/ripping ten (10) locations along the alignment to depths generally ranging from 10 to 10½ feet. The depth of the tenth exploration at the northeastern end of the project was 6½ feet. The trenching/ripping locations were determined by Boyle Engineering personnel. The subsurface conditions, difficulty of ripping, and the size and characteristics of the ripped material as encountered in the explorations were observed at the time of excavation by a field engineer. The trenching/ripping was conducted utilizing a Caterpillar D10N bulldozer equipped with one ripping tooth.

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

2. Results of the field exploration program were evaluated and this report was prepared to present the findings, conclusions and recommendations of this firm.

FIELD INVESTIGATION

The approximate bulldozer exploration locations relative to the borings and test pits from the previous investigation are presented in the following table:

Bulldozer Exploration Location	Boring or Test Pit Location*
1	Near B-5 south of Range Road
2	Near B-5 north of Range Road
3	T-9
4	B-12
5	B-16
6	Between T-19 and T-20
7	T-22
8	T-25
9	T-27
10	Between T-28 and T-29

*Refer to CCSW report dated January 8, 1992, Drawing No. 2 for boring and test pit locations.

OBSERVATIONS

The subsoils encountered in the explorations generally consisted of 0 to 1 foot of loose sands and gravels overlying medium dense to very dense sands and gravels and slightly to partially cemented (moderately hard) soils. The hardest soils were encountered near the bottom of the explorations. The cemented soils encountered during our previous investigation were generally classified as moderately hard (partially cemented). Based on our observations during this investigation, the bulldozer started ripping at depths ranging from 3 to 4 feet to loosen the soils for dozing. The moderately hard partially cemented soils were generally rippable to the depths explored for this study. The bulldozer did encounter some minor difficulties near the bottom of some of the explorations while ripping.

Generally all of the material excavated from the explorations would be usable for the project. Minor amounts of large cobbles and small boulders were encountered in the explorations. Some of the ripped material near the bottom of some of the explorations ranged in size from 6 to 24 inches. These "chunks" were slightly to partially cemented and were easily broken up by hitting them with a hammer or by dropping.

CONCLUSIONS

The on-site soils along the alignment of the dike and floodway channel, at the locations evaluated, are excavatable and/or rippable to about 10 feet below the existing ground surface with a Caterpillar D10N bulldozer and a single tooth ripper. The cemented soils are slightly to partially cemented. The resulting materials from ripping operations appeared to break down into manageable sized particles. Some minor processing of oversize materials such as cobbles, small boulders and ripped material should be anticipated.

CLOSURE

The observations, opinions, recommendations and conclusions given in this report are: (1) based upon our interpretation of the findings of the field exploration program, (2) based on our geotechnical experience in the locale, (3) subject to confirmation of the conditions encountered during construction, and (4) prepared in accordance with generally accepted professional geotechnical engineering principles and practice. We make no other warranty, either express or implied.

It has been our pleasure to be of continued service to you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Brad L. Olsen

Brad L. Olsen, E.I.T.
Senior Staff Engineer

Reviewed by:

Al Stilley, P.E.
Principal Engineer

BLO:ANS:sc
76/41S

Dist: 20/Addressee

5.3.6 Geotechnical Investigation Addendum #2

[redacted]

ADDENDUM NO. 2
ADDITIONAL SLOPE STABILITY ANALYSIS
RANGE WASH FLOOD CONTROL PROJECT
NORTH LAS VEGAS, NEVADA

RECEIVED

JUN 26 1992

REGIONAL
FLOOD CONTROL DISTRICT

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

ADDENDUM NO. 2
ADDITIONAL SLOPE STABILITY ANALYSIS
RANGE WASH FLOOD CONTROL PROJECT
NORTH LAS VEGAS, NEVADA

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33298-02

June 22, 1992

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

June 22, 1992 91-33298-02

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Addendum No. 2
Additional Slope Stability Analysis
Range Wash Flood Control Project
North Las Vegas, Nevada

Gentlemen:

INTRODUCTION

This report presents the results of our slope stability analysis conducted for the new profile of the Range Wash Flood Control Project located near Range Road in North Las Vegas, Nevada. This study was performed in general accordance with our signed confirmation letter dated February 3, 1992. Geotechnical recommendations relative to this project were provided in our Geotechnical Investigation report, dated January 8, 1992 (CCSW Project No. 91-33298-01). The findings and conclusions of this study supplement those provided in the previous report.

We understand that the dike will be 15.2 feet in height above the earthern channel bottom, and that the soil-cement facing on the upstream face of the dike may not be used. A 3:1 (horizontal to vertical) slope is planned for the downstream slope, and a 4:1 (horizontal to vertical) for the upstream face of the dike. We also understand that the crest width of the dike is 12 feet, and the water depth within the channel is on the order of 10 feet.

SLOPE STABILITY ANALYSIS

The stability analyses were conducted in general accordance with the Nevada State Statutes, the Clark County Regional Flood Control District "Hydrologic Criteria and Drainage Design Manual." The anticipated maximum dike slope sections were analyzed for four separate cases; (1) end of construction, (2) sudden drawdown, (3) steady state seepage, and (4) seismic analysis under steady state seepage. The dike was analyzed for a height of 15.2 feet with 10 feet of impounded water. The computer program SB-Slope, Version 3.0, developed by von Gunten Engineering Software, Inc. was used to calculate the minimum factor of safety by Bishop's simplified method of slices for circular failure surfaces. Based on

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4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

previously performed laboratory tests, an average saturated angle of internal friction of 38 degrees, and a cohesion intercept of zero, were used, for both the foundation soil and the compacted embankment. A summary of the minimum acceptable factors of safety, and calculated factors of safety is presented in the following table. The results of the slope stability analyses are presented in Appendix A.

Calculated and Required Factors of Safety for Slope Stability

Loading Condition	Case	Required[1] F.S.	Calculated F.S.
End of Construction	1	1.3	2.5
Sudden Drawdown	2	1.2	1.8
Static-Steady State Seepage	3	1.5	1.7
Seismic-Steady[2] State Seepage	4	1.0	1.4

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers (1973).
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.05.

It has been our pleasure to be of continued service to you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Hector E. Marin, E.I.T.
Staff Engineer

Reviewed by:

Al Stilley, P.E.
Principal Engineer

6-23-92

HEM:ANS:sc
46/43S

Encl: Appendix A

Dist: 10/Addressee

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities; and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage*, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

Prepared by

ASFE THE ASSOCIATION OF ENGINEERING FIRMS PRACTICING IN THE GEOSCIENCES

8811 Colesville Road/Suite G106 / Silver Spring, Maryland 20910 / (301) 565-2733

[illegible]

Appendix A

APPENDIX A

RESULTS OF SLOPE STABILITY ANALYSIS

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project ccsw no. 91-33298-02

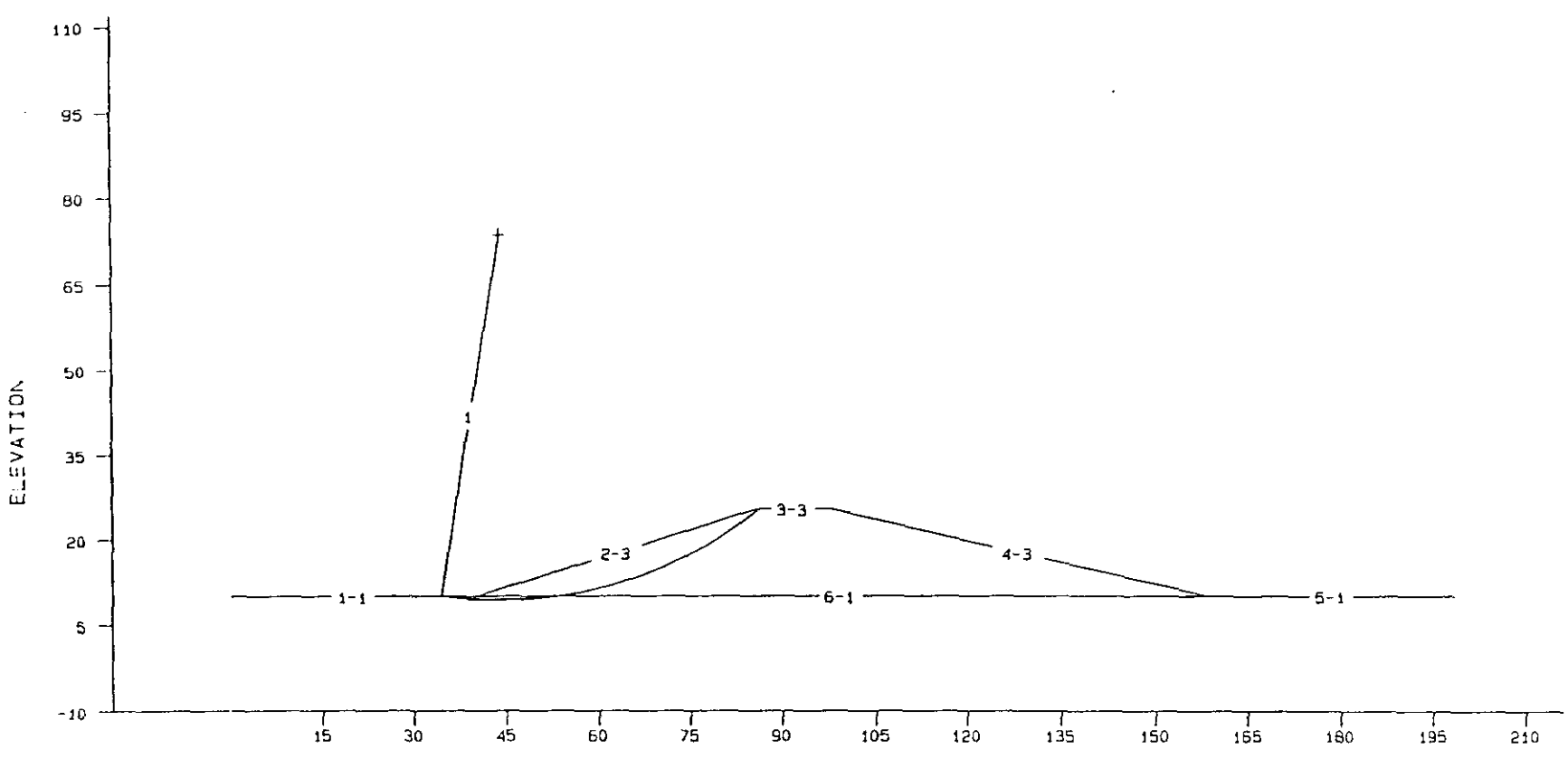
LOCATION: North Las Vegas, Nevada

FILE: RANG3

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	43.7	73.4	64.1	2.55

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG3 - end of construction
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 43.7, Y= 73.4
2.547 at R= 64.1

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project ccsw no. 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG3 Description: end of construction

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	10.0	1	1	2	1
2	40.0	10.0	2	2	3	3
3	85.6	25.2	3	3	4	3
4	97.6	25.2	4	4	5	3
5	158.4	10.0	5	5	6	1
6	198.0	10.0	6	2	5	1
7	0.0	0.0				
8	0.0	0.0				
9	0.0	0.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.0
2	135.0	0	38.0
3	135.0	0	38.0
4	140.0	0	38.0

File: RANG2 - rapid draw-down
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 148.7, Y= 61.9
1.833 at R= 53.6

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG2 Description: rapid draw-down

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	40.0	10.0	2	2	3	4	Y
3	55.0	15.0	3	3	4	3	N
4	85.6	25.2	4	4	5	3	N
5	97.6	25.2	5	5	6	3	N
6	118.4	20.0	6	6	7	4	Y
7	158.4	10.0	7	7	8	2	Y
8	198.0	10.0	8	3	6	4	Y
9	198.0	20.0	9	2	7	2	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.
2	135.0	0	38.
3	135.0	0	38.
4	140.0	0	38.

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project 91-33298-02

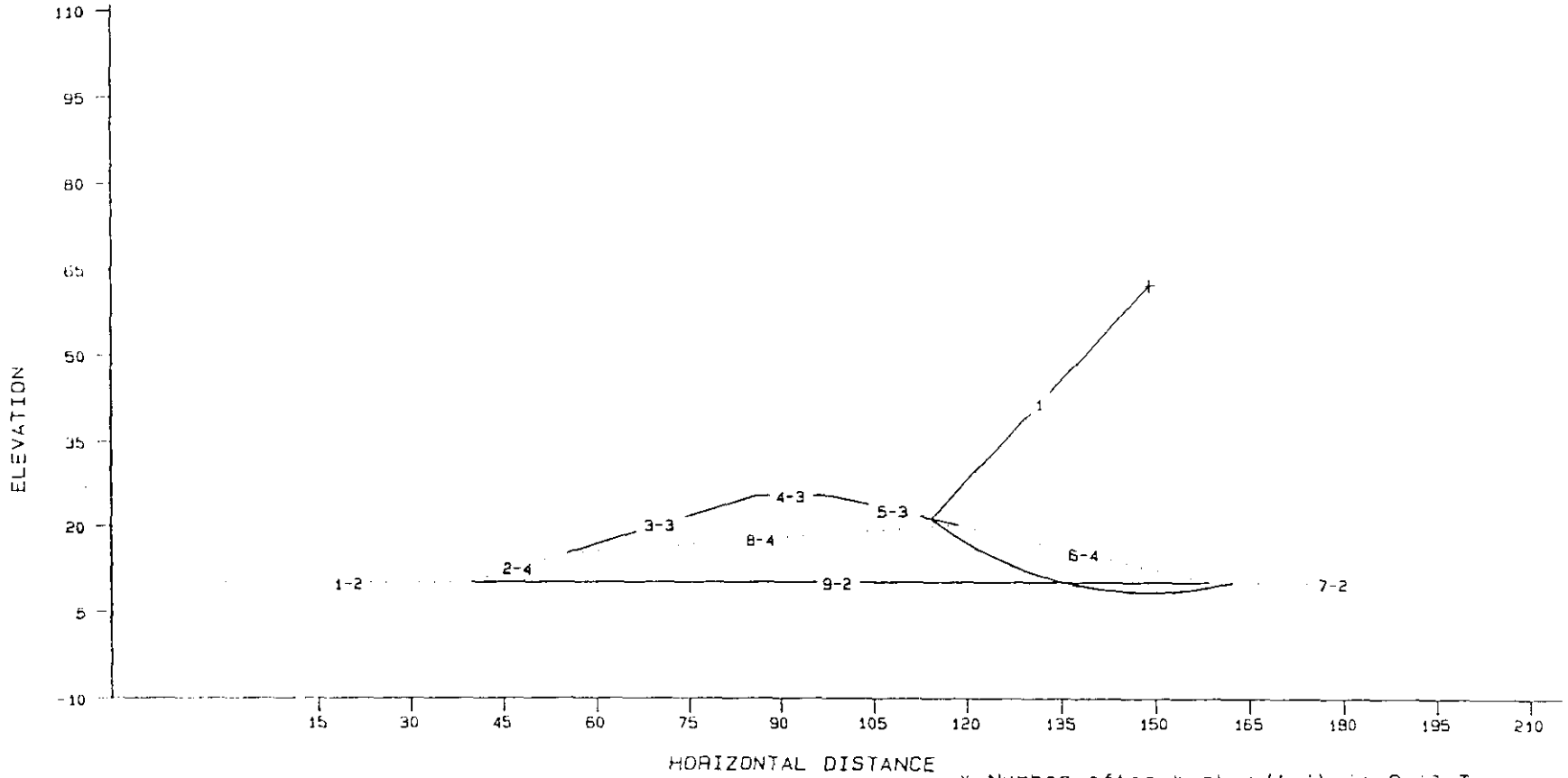
LOCATION: North Las Vegas, Nevada

FILE: RANG2

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	148.7	61.9	53.6	1.83

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG1 - steady state
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 45.7, Y= 38.7
F[redacted]1.693 at R= 30.6

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash flood control project ccsw no. 91-33298 02
Location: North Las Vegas, Nevada
Filename: RANG1 Description: steady state

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	40.0	10.0	2	2	3	4	Y
3	55.0	15.0	3	3	4	3	N
4	85.6	25.2	4	4	5	3	N
5	97.6	25.2	5	5	6	3	N
6	118.4	20.0	6	6	7	4	N
7	158.4	10.0	7	7	8	2	N
8	198.0	10.0	8	3	6	4	Y
9	198.0	20.0	9	2	7	2	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	130.0	0	38.0
2	135.0	0	38.0
3	135.0	0	38.0
4	140.0	0	38.0

[redacted] water surface, left point = 6
right point = 9

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: range wash flood control project ccsw no. 91-33298 02

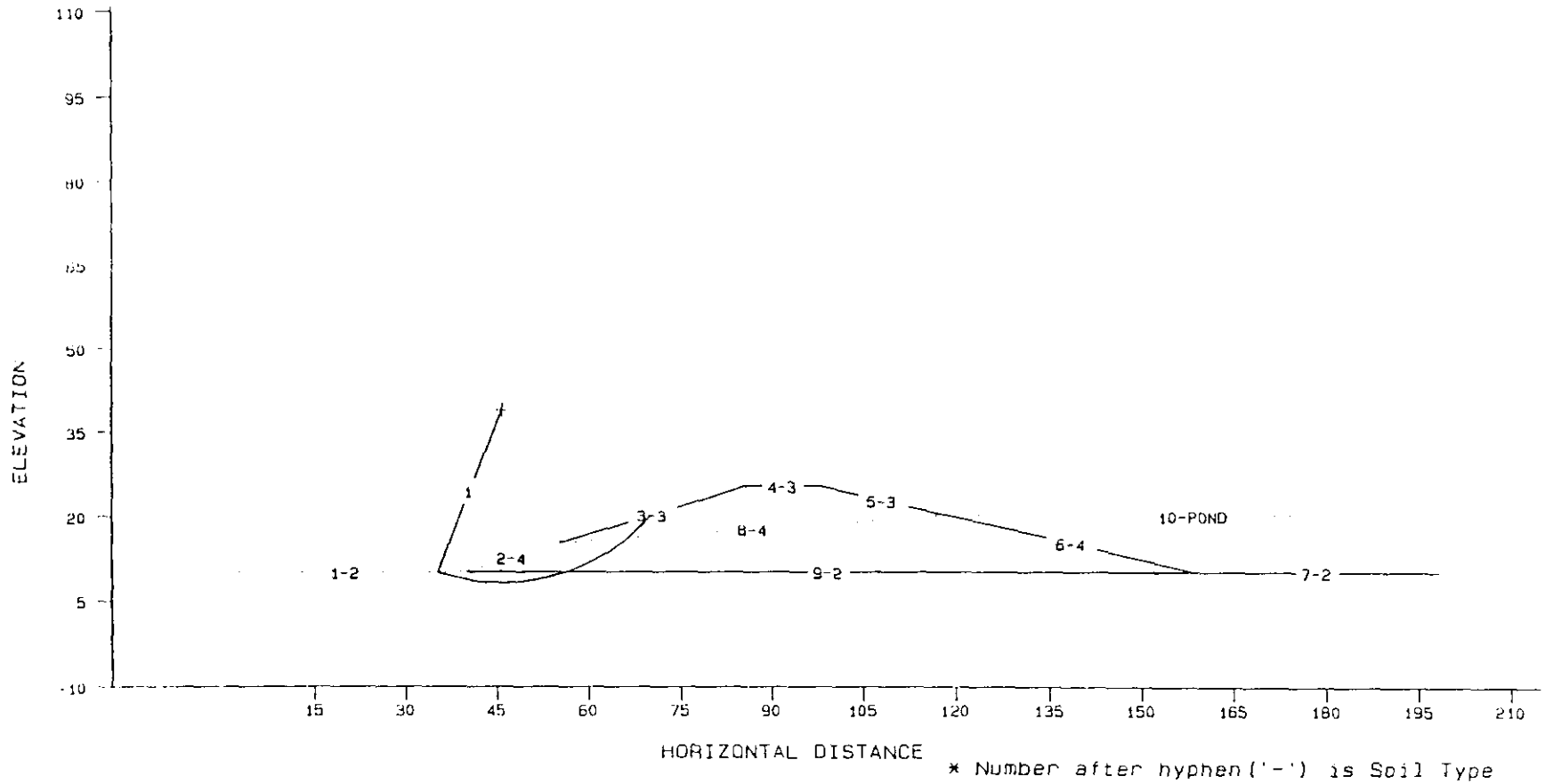
LOCATION: North Las Vegas, Nevada

FILE: RANG1

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	45.7	38.7	30.6	1.69

SOIL*	DENSITY	COHESION	PHI
1	130.0	0.0	38.0
2	135.0	0.0	38.0
3	135.0	0.0	38.0
4	140.0	0.0	38.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: RANG1S - steady state with seismic coeffs
SINGLE CENTER ANALYSIS
Approximately 30 slices selected
Circle center at X= 45.6, Y= 35.4
1.432 at R= 27.5

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: range wash control project ccsw no. 91-33298-02
Location: North Las Vegas, Nevada
Filename: RANG1S Description: steady state with seismic coeffs

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line	Soil No.	Density pcf	Cohesion psf	Phi Deg
1	0.0	10.0	1	1	2	2	Y	1	130.0	0	38.(
2	40.0	10.0	2	2	3	4	Y	2	135.0	0	38.(
3	55.0	15.0	3	3	4	3	N	3	135.0	0	38.(
4	85.6	25.2	4	4	5	3	N	4	140.0	0	38.(
5	97.6	25.2	5	5	6	3	N				
6	118.4	20.0	6	6	7	4	N				
7	158.4	10.0	7	7	8	2	N				
8	198.0	10.0	8	3	6	4	Y				
9	198.0	20.0	9	2	7	2	N				

e water surface, left point = 6
right point = 9

Seismic coefficient, horizontal = 0.050
vertical = 0.000

5.3.7 Clark County Regional Flood Control District Maintenance Work Program

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:

MAINTENANCE WORK PROGRAM -
FY 1995/96 BUDGET, PLAN, AND INTERLOCAL CONTRACTS

RECOMMENDATION SUMMARY

STAFF: (July 3, 1995)	Approve and authorize the Chairman to sign.
TECHNICAL ADVISORY: (May 25, 1995)	Approve.
CITIZENS ADVISORY: (May 30, 1995)	Approve.
BOARD: (June 8, 1995)	No quorum.

RFCD AGENDA
ITEM # 06
Date: 07/13/95

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:

MAINTENANCE WORK PROGRAM -
FY 1995/96 BUDGET, PLAN, AND INTERLOCAL CONTRACTS

PETITIONER:

GALE WM. FRASER, II, P.E., GENERAL MANAGER/CHIEF ENGINEER

RECOMMENDATION OF PETITIONER:

THAT THE BOARD APPROVE THE BUDGET, PLAN, AND INTERLOCAL CONTRACTS FOR THE FISCAL YEAR 1995/96 ANNUAL MAINTENANCE WORK PROGRAM AND AUTHORIZE THE CHAIRMAN TO SIGN

FISCAL IMPACT:

$1,897,774 (Fund 286)

BACKGROUND:

Staff requested each of the entities to prepare their Fiscal Year 1995/96 Maintenance Work Program plan and budget, and submit the Interlocals for approval by the Board. The Interlocal Contracts, along with an itemized listing of the facilities identified in each work plan, are attached for your review and approval. The following provides a comparison of the current year's budget and last year's expeditures to the requested budgets:

	FY 93/94 Expended	FY 94/95 Budget	FY 95/96 Request	Percent Change	FY 95/96 Initial Request
Boulder City	$ 145,617	$ 90,200	$ 87,200	-3%	$ 25,000
Clark County	902,432	1,283,000	1,301,700	1%	1,301,700
Henderson	116,978	186,229	168,299	-10%	168,299
Las Vegas	89,130	881,500	896,500	2%	225,000
Mesquite	14,522	44,760	44,760	0%	44,760
North Las Vegas	70,700	104,030	133,015	28%	133,015
	$1,339,379	$2,589,719	$2,631,474	0%	$1,897,774

TAC AGENDA	RFCD AGENDA
ITEM #5	ITEM #04
Date: 05/25/95	Date:06/08/95
	ITEM #6
	07/13/95

Upon approval, the Interlocal Contracts will become effective July 1, 1995, and expire June 30, 1996. Requested funding amounts will be available July 1, 1995. The remaining unencumbered fund balances for each entity at the end of FY 1994/95 will be returned to the District's operating fund for subsequent reallocation. Staff has requested that any incompleted scope of work be included within the new fiscal year programs.

Respectfully submitted,

Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

TAC AGENDA ITEM #5 Date: 05/25/95	RFCD AGENDA ITEM # 04 Date: 06/08/95 ITEM #6 07/13/95

0525_mwp.itm

Regional Flood Control District

AGENDA ITEM DEVELOPMENT

Staff Discussion: **Date:** 07/03/95

MAINTENANCE WORK PROGRAM -
FY 1995/96 BUDGET, PLAN, AND INTERLOCAL CONTRACTS

In accordance with the Operations and Maintenance Manual, the entities have prepared Interlocal Contracts to request funding for maintenance of flood control facilities. The related work plans and budgets for FY 95/96 are included with the Interlocal Contracts.

As in FY 94/95, staff requested that the entities consider the "authorization to proceed" method of funding their next fiscal year maintenance budgets. The Cities of Boulder City and Las Vegas opted to request funding using this alternative method, whereby their full budget is approved; however, funding is made available on an as-needed basis via Board approved Authorizations to Proceed. The remaining entities' budgets are available in full on July 1, 1995.

This request totals $2,631,474. The Project Priority and Estimated Funding Schedule, which includes FY 95/96 Maintenance Work Program requested funding, is included in the backup for review. The District Attorney has reviewed the contracts as to form.

Staff Recommendation:

Approve and authorize the Chairman to sign the FY 1995/96 Maintenance Work Program interlocal contracts.

Discussion by Technical Advisory Committee: **AGENDA #5 Date: 05/25/95**

Recommendation:

Approve.

Discussion by Citizens Advisory Committee: **AGENDA #5 Date: 05/30/95**

Recommendation:

Approve.

Discussion by Board: **AGENDA #4 Date: 06/08/95**

Board Action:

No quorum.

Project Priority and Estimated Funding Schedule

6/16/95

Month	Funding Requests Received	Amount	Estimated Funding			Priority		Notes
			Revenues	Available	Remaining	Number	Date Established	
Jul-95				$4,372,757				Includes Range Wash FIS
	Annual MWP	1,897,774			$2,474,983			
	Washington Ave. ATP	320,000			$2,154,983			
	Lone Mt. ATP	18,750			$2,136,233			
	Gowan Ch-DB to Durango	300,000			$1,836,233			
	Washington I-15 to MLK	70,000			$1,766,233			
Aug-95			$900,000	$2,666,233				
Sep-95			$900,000	$3,566,233				
Oct-95			$900,000	$4,466,233				
Nov-95			$900,000	$5,366,233				
Dec-95			$900,000	$6,266,233				
	Equestrian Detention Basin	5,800,000			$466,233	1	1/12/95	Construction
Jan-96			$900,000	$1,366,233				
Feb-96			$900,000	$2,266,233				
	Muddy River West Levee	1,650,000			$616,233	2	1/12/95	ROW
Mar-96			$900,000	$1,516,233				
Apr-96			$900,000	$2,416,233				
	Angel Park Det. Basin	1,785,000			$631,233	3	2/9/95	Construction
May-96			$900,000	$1,531,233				
Jun-96			$900,000	$2,431,233				
Jul-96			$900,000	$3,331,233				
Aug-96			$900,000	$4,231,233				
	Washington, Eastern - Sagman	3,805,000			$426,233	4	4/13/95	Construction
Sep-96			$900,000	$1,326,233				
Oct-96			$900,000	$2,226,233				
Nov-96			$900,000	$3,126,233				
Dec-96			$900,000	$4,026,233				
Jan-97			$900,000	$4,926,233				
Feb-97			$900,000	$5,826,233				
	Mission Hills Western Intercep.	5,458,000			$368,233	5	4/13/95	Construction
Mar-97			$900,000	$1,268,233				
Apr-97			$900,000	$2,168,233				
May-97			$900,000	$3,068,233				
Jun-97			$900,000	$3,968,233				
Jul-97			$900,000	$4,868,233				

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT: 1995-96 Annual Maintenance Program for Boulder City.

PETITIONER: City of Boulder City.

RECOMMENDATION:

That the Clark County Regional Flood Control District authorize the Chairman to sign an Interlocal Contract for the 1995-96 Flood Control Facilities Annual Maintenance Program for Boulder City.

FISCAL IMPACT:

The 1995-1996 Interlocal Contract is for $87,200.00.

BACKGROUND:

The proposed contract provides for maintenance by the City of Boulder City of certain flood control facilities identified in the District's Master Plan. The work will be in accordance with Performance Standards of the Clark County Regional Flood Control District Operation and Maintenance Manual.

The Interlocal Contract will include channel inspections, cleaning & reshaping channels, vegetation control, repair of lined channels, cleaning & flushing culverts, erosion control maintenance and repair & maintenance of fencing.

See Exhibit "A" (attached) for specifics.

Respectfully submitted,

Phillip T. Henry

Phillip T. Henry, City Engineer

Boulder City, Nevada

3/13/95

TAC AGENDA
ITEM #
Date:

RFCD AGENDA
ITEM #
Date:

INTERLOCAL CONTRACT
BOULDER CITY 1995-96
ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this _____ day of _____ _____, 1995, by and between the CITY OF BOULDER CITY, a political subdivision of the State of Nevada, hereinafter referred to as "City", and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "District."

W I T N E S S E T H:

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the District may approve and fund projects to maintain flood control improvements; and

WHEREAS, the City desires to maintain flood control improvements within the City in accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the facility upon which maintenance will be done is a facility described in the District's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements and promises of the parties hereto, the District authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the District's Master Plan facilities including updates and amendments subsequently approved. The basic improvements to the facility will be: channel inspections, cleaning and reshaping channels, vegetation control, repair of lined channels, cleaning and flushing culverts, erosion control maintenance and repair, and maintenance of fencing. The Project is more specifically described in Exhibit "A" which is attached hereto and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The District agrees to provide reimbursement for Project costs within the limits specified below:

1. The Project costs shall not exceed $87,200.00. The amounts allocated to each individual facility within the Project must be specified in Exhibit "A." Any changes to said allocated amounts must be approved by the District's Chief Engineer.

2. "Authorization to Proceed" is herein granted for maintenance of facilities in Exhibit "A" in an amount not to exceed $25,000.00, effective July 1.

3. A separate request for an "Authorization to Proceed" will be required for additional facility maintenance funds.

4. A written request must be made to the District and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

5. The City and District will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the City shall submit invoices together with a detailed summary report of the maintenance service performed. The City shall submit an Invoice Voucher prepared in duplicate in the manner prescribed by the District. The vouchers shall include such information as is necessary for the District to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program. All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101
Attention: Gale Fraser
General Manager/Chief Engineer

Payment shall be considered timely if made by the District within 45 days. Pursuant to Section IV, Paragraph 6, the District may, in its sole discretion, withhold payments to the City for services rendered if the City fails to satisfactorily comply with any term or condition of this contract and/or the District's Operation and Maintenance Manual.

SECTION III - PROJECT TIME

The City agrees to perform the Project to the satisfaction of the District prior to June 30, 1996. The District may grant extensions or terminate this contract and require all sums advanced to the City to be repaid if the City fails to perform by said date.

SECTION IV - GENERAL

1. The city will complete the Project as set forth in Exhibit "A". The City staff personnel responsible for coordination work under this contract are as listed below:

Mr. Alan F. Gove, Director of Public Works
City Engineer
Mr. Howard Clarke, Public Works Superintendent

It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the District is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract the parties hereto shall be subject to and governed by the District's Operation and Maintenance Manual, and any applicable portions of the Policies and Procedures adopted by the District.

3. It is the intent of the District that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved and District-funded projects have regional flood control significance impacting more than one entity, the City will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the District shall be responsible for monitoring the performance of the City, approval for payment of billings and expenses submitted by the City and the acceptance of any reports provided by the City. The City shall be responsible for monitoring performance of City staff or private contractors, and the City shall maintain detailed records of all payments made to contractors and make such records available to the District upon request.

5. The City shall provide right of access to its facilities to the District or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the City fails to perform the maintenance according to the standards specified in this contract and in the District's Operation and Maintenance Manual, the District may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the District shall be reimbursed by the City or be deducted from the amount authorized by this contract. The District may not exercise the right without giving the City specific written notice of the maintenance required and allowing the City 60 days within which to perform said maintenance. The notice required by this provision must be sent to:

Mr. Alan F. Gove, Director of Public Works
401 California Avenue
P. O. Box 61350
Boulder City, NV 89006-1350

7. The records of the City and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the District, County Auditor or an Agent of the District.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the project will be refunded by the City to the District.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The City hereby indemnifies and shall defend and hold harmless the District, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the City, of anyone acting under its direction or control, or on its behalf in connection with or incident to the performance of this Contract. The City's aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

****

ATTEST:

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

_____

DEANNA LEFKO, Secretary

BY_____

IRIS BLETSCH, Chairman

Date of Board Action:

_____

Approved as to Legality and Form:

BY:_____

CHRISTOPHER FIGGINS
Deputy District Attorney

****

ATTEST:

CITY OF BOULDER CITY

By:_____

VICKI G. BERGDALE, City Clerk

_____

IRIS BLETSCH, Mayor

Date of Council Action:

_____

****

CITY OF BOULDER CITY FISCAL YEAR 199[illegible] MAINTENANCE WORK PROGRAM BUDGET REQUEST

		BOU01 HEMENWAY WASH	BOU02 AIRPORT CHANNEL	BOU03 GEORGIA CHANNEL	BOU04 BUCHANAN CHANNEL	BOU05 BOOTLEG CANYON	BOU06 GINGERWD WASH	BOU07 CEMETERY WASH	95-96 BUDGET TOTALS
0005	CLEAN/INSP IN/OUTLET STRUC								
0010	INSPECTION (CHANNELS)	$200	$200	$200	$200	$200	$100	$100	$1,200
0015	CLEAN STORM SEWER LINES								
0020	VEGETATION CONTROL	$15,000		$1,000	$1,000				$17,000
0025	STORM SEWER REPAIR								
0030	CLEAN & RESHAPE CHANNELS		$4,000			$1,000	$1,000	$1,000	$7,000
0035	CLEAN/INSPECT DET BASINS								
0040	REPAIR LINED CHANNELS				$1,000				$1,000
0045	VEGETATION CONTROL DET BASIN								
0050	CLEAN/FLUSH PIPES/CULVERTS								
0055	PROVIDE/MAINT EROSION CNTRL	$12,000		$15,000	$5,000	$5,000	$5,000		$42,000
0060	DEBRIS CONTROL	$4,000							$4,000
0065	EROSION REPAIR								
0070	FENCE REPAIR								
0075	REPAIR IN/OUTLET STRUCTURE	$15,000							$15,000
0080	MISCELLANEOUS								
0085	MAINTAIN ACCESS ROADS								
0090	SUPV ANNUAL BID CONTRACTS								
0095	DESIGN ENGINEERING								
		$46,200	$4,200	$16,200	$7,200	$6,200	$6,100	$1,100	$87,200

Exhibit "A"

PTH/BC FY95/96 MntWrkBgtRq
3/13/95
PTH:db

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:
FLOOD CONTROL FACILITY MAINTENANCE

PETITIONER:

M. J. MANNING, DIRECTOR OF PUBLIC WORKS

RECOMMENDATION OF PETITIONER:
THAT THE REGIONAL FLOOD CONTROL DISTRICT APPROVE THE INTERLOCAL CONTRACT FOR THE MAINTENANCE OF FLOOD CONTROL FACILITIES IN THE UNINCORPORATED AREAS OF CLARK COUNTY.

FISCAL IMPACT:

$ 1,301,700.00 FUNDED BY THE REGIONAL FLOOD CONTROL DISTRICT

BACKGROUND:

The Clark County Regional Flood Control District has programmed funds for the maintenance of flood control facilities which are shown on the Master Plan. Clark County Public Works is proposing this Interlocal Contract to provide funds to maintain those facilities shown on the Master Plan and located in the unincorporated areas of Clark County. The maintenance program is identified in Exhibit "A" of the Interlocal Contract.

Respectfully submitted,

TAC AGENDA ITEM # **Date:**	**RFCD AGENDA ITEM #** **Date:**

M. J. MANNING
Director of Public Works
MJM:GS:dfe Attach.

INTERLOCAL CONTRACT

ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this __ day of _____, 1995, by and between the County of Clark, a political subdivision of the State of Nevada, hereinafter referred to as "County", and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "District".

W I T N E S S E T H

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the District may approve and fund projects to maintain flood control improvements; and

WHEREAS, The County desires to maintain flood control improvements located in (see Exhibit "A") accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the facility upon which maintenance will be done is a facility described in the District's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the District authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the District's Master Plan facilities including updates and amendments subsequently approved. The basic maintenance to the facilities will be in accordance with

performance standards of the Operations and Maintenance Manual. The Project is more specifically described in Exhibit "A" which is attached hereto and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The District agrees to provide reimbursement for Project costs within the limits specified below:

1. The Project costs shall not exceed $1,301,700.00. The amounts allocated to each individual facility within the Project must be specified in Exhibit "A". Any changes to said allocated amounts must be approved by the District's Chief Engineer.

   A written request must be made to the District and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

2. The County and District will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the County shall submit invoices together with a detailed summary report of the maintenance service performed. The County shall submit an Invoice Voucher prepared in duplicate in the manner prescribed by the District. The vouchers shall include such information as is necessary for the District to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the County stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program.

All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite 301
Las Vegas, Nevada 89101
Attn: Gale Wm. Fraser, P.E.
General Manager/Chief Engineer

Payment shall be considered timely if made by the District within 45 days. Pursuant to Section IV, Paragraph 6, the District may, in its sole discretion, withhold payments to the County for services rendered if the County fails to satisfactorily comply with any term or condition of this contract and/or the District's Operation and Maintenance Manual.

SECTION III - PROJECT TIME

The County agrees to perform the Project to the satisfaction of the District prior to June 30, 1996. The District may grant extensions or terminate this contract and require all sums advanced to the County to be repaid if the County fails to perform by said date.

SECTION IV - GENERAL

1. The County will complete the Project as set forth in Exhibit "A". The County staff personnel responsible for coordination work under this contract are as listed below:
M. J. Manning, Director of Public Works, or his designee:
It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the District is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract the parties hereto shall be subject to and governed by the District's Operation and Maintenance Manual, and any applicable portions of the Policies and Procedures adopted by the District.

3. It is the intent of the District that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved,

and District - funded projects have regional flood control significance impacting more than one entity, the County will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the District shall be responsible for monitoring the performance of the County, approval for payment of billings and expenses submitted by the County, and the acceptance of any reports provided by the County. The County shall be responsible for monitoring performance of County staff or private contractors, and the County shall maintain detailed records of all payments made to contractors and make such records available to the District upon request.

5. The County shall provide right of access to its facilities to the District or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the County fails to perform the maintenance according to the standards specified in this contract and in the District's Operation and Maintenance Manual, the District may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the District shall be reimbursed by the County or be deducted from the amount authorized by this contract. The District may not exercise this right without giving the County specific written notice of the maintenance required and allowing the County 60 days within which to perform said maintenance.

The notice required by this provision must be sent to:

M. J. Manning, Director
Department of Public Works
6655 W. Sahara Ave. Bldg. C-204
Las Vegas, Nevada 89102

7. The records of the County and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the District, County Auditor or an Agent of the District.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the project will be refunded by the County to the District.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms of provisions of this contract.

12. The County hereby indemnifies and shall defend and hold harmless the District, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in

part, by reason of any act, omission, fault or negligence whether active or passive of the County, of anyone acting under its direction or control, or on its behalf in connection with or incident to the performance of this Contract. The County's aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

IN WITNESS WHEREOF: The parties have caused this contract to be executed the day and year first above written.

ATTEST:

CLARK COUNTY
BOARD OF COUNTY COMMISSIONERS

LORETTA BOWMAN, County Clerk

BY: _____
YVONNE ATKINSON GATES, Chair

ATTEST:

REGIONAL FLOOD CONTROL DISTRICT

DEANNA LEFKO,
Secretary to the Board

BY: _____
IRIS BLETSCH
Chairman

Approved as to Legality and Form:

BY: _____
CHRISTOPHER FIGGINS
Deputy District Attorney

LARK COUNTY FISCAL YEAR 1995-96 MAINTENANCE WORK PROGRAM BUDGET REQUEST

		CLA01 FLAMINGO WASH	CLA02 LAS VEGAS WASH	CLA03 DUCK CREEK	CLA05 LV RANGE WASH	CLA06 TROPICANA WASH	PAGE TOTALS
0005	CLEAN/INSP IN/OUTLET STRUCTURES	4,500	2,000	3,500	2,000	1,700	13,700
0010	INSPECTION (CHANNELS)	5,000	2,500	3,000	3,000	2,000	15,500
0015	CLEAN STORM SEWER LINES						
0020	VEGETATION CONTROL	45,000	40,000	36,400	8,000	4,000	133,400
0025	STORM SEWER REPAIR						
0030	CLEAN & RESHAPE CHANNELS	245,000		265,000	5,000		515,000
0035	CLEAN/INSPECT DET BASINS						
0040	REPAIR LINED CHANNELS	10,000	10,000	30,000	5,000		55,000
0045	VEGETATION CNTRL/DET BASIN						
0050	CLEAN/FLUSH PIPES/CULVERTS						
0055	PROVIDE/MAINT EROSION CONTROL	50,000					50,000
0060	DEBRIS REMOVAL		5,000				5,000
0065	EROSION REPAIR	50,000					50,000
0070	FENCE REPAIR	1,500	1,000	1,500	3,000		7,000
0075	REPAIR IN/OUTLET STRUCTURE	20,000	10,000	10,000		5,000	45,000
0080	MISCELLANEOUS	5,500	1,500	4,500	7,700		19,200
0085	MAINTAIN ACCESS ROADS	20,000	1,000	3,000	3,000	1,000	28,000
0095	DESIGN/ENGINEERING	18,500		20,000			38,500
		$475,000	$ 73,000	$ 376,900	$36,700	$ 13,700	$ 975,300

EXHIBIT A

CLARK CO[illegible] FISCAL YEAR 1995-96 MAINTENANCE WORK P[illegible] RAM BUDGET REQUEST

		CLA07 AIRPORT CHANNEL	CLA08 MONSON CHANNEL	CLA09 RAWHIDE CHANNEL	CLA10 VAN BUSKIRK CHANNEL	CLA11 FLAM WASH NO FORK	PAGE TOTALS
0005	CLEAN/INSP IN/OUTLET STRUCTURES	2,000	2,000	2,000	1,500	1,500	9,000
0010	INSPECTION (CHANNELS)	2,000	1,500	2,000	2,000	2,000	9,500
0015	CLEAN STORM SEWER LINES						
0020	VEGETATION CONTROL	3,000	6,000	4,000	2,000	3,000	18,000
0025	STORM SEWER REPAIR						
0030	CLEAN & RESHAPE CHANNELS					18,000	18,000
0035	CLEAN/INSPECT DET BASINS						
0040	REPAIR LINED CHANNELS		20,000	5,000			25,000
0045	VEGETATION CNTRL/DET BASIN						
0050	CLEAN/FLUSH PIPES/CULVERTS						
0055	PROVIDE/MAINT EROSION CONTROL			147,400			147,400
0060	DEBRIS REMOVAL						
0065	EROSION REPAIR						
0070	FENCE REPAIR	1,000	1,500	1,000	1,000	1,500	6,000
0075	REPAIR IN/OUTLET STRUCTURE			5,000			5,000
0080	MISCELLANEOUS	5,000		3,000	3,000	3,000	14,000
0085	MAINTAIN ACCESS ROADS	1,000	1,000	1,000		2,000	5,000
0095	DESIGN / ENGINEERING			14,000			14,000
		$ 14,000	$ 32,000	$184,400	$9,500	$31,000	$270,900

ARK COUNTY FISCAL YEAR 1995-96 MAINTENANCE WORK PROGRAM BUDGET REQUEST
GE 3 OF 3

		CLA12 DETENTION BASINS	CLA14 LAUGHLIN WASHES	CLA15 OVERTON TOWN WASH	CLA16 BLUE DIAMOND WASH		1995/96 BUDGET REQUEST TOTALS
0005	CLEAN/INSP IN/OUTLET STRUCTURES	1,500	3,500	2,500	500		30,700
0010	INSPECTION (CHANNELS)	1,000	3,000	2,000	500		31,500
0015	CLEAN STORM SEWER LINES						
0020	VEGETATION CONTROL	1,000	1,000	2,000			155,400
0025	STORM SEWER REPAIR						
0030	CLEAN & RESHAPE CHANNELS						533,000
0035	CLEAN/INSPECT DET BASINS	6,500					6,500
0040	REPAIR LINED CHANNELS						80,000
0045	VEGETATION CNTRL/DET BASIN						
0050	CLEAN/FLUSH PIPES/CULVERTS						
0055	PROVIDE/MAINT EROSION CONTROL						197,400
0060	DEBRIS REMOVAL		22,000				27,000
0065	EROSION REPAIR						50,000
0070	FENCE REPAIR			500			13,500
0075	REPAIR IN/OUTLET STRUCTURE						50,000
0080	MISCELLANEOUS	3,000		1,000			37,200
0085	MAINTAIN ACCESS ROADS	1,000	1,000	2,000			37,000
0095	DESIGN / ENGINEERING						52,500
		$ 14,000	$ 30,500	$10,000	$ 1,000		$1,301,700

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

ECT: FLAMINGO WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	4,500			
	INSPECTION (CHANNELS)	0010	5,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	45,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030	245,000			
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	10,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055	50,000			
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065	50,000			
	FENCE REPAIR	0070	1,500			
	REPAIR IN/OUTLET STRUCTURE	0075	20,000			
	MISCELLANEOUS	0080	5,500			
	MAINTAIN ACCESS ROADS	0085	20,000			
	DESIGN/ENGINEERING	0095	18,500			
		TOTAL	$475,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

'ECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: LAS VEGAS WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,000			
	INSPECTION (CHANNELS)	0010	2,500			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	40,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	10,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060	5,000			
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,000			
	REPAIR IN/OUTLET STRUCTURE	0075	10,000			
	MISCELLANEOUS	0080	1,500			
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
	TOTAL		$73,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

IECT: DUCK CREEK

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	3,500			
	INSPECTION (CHANNELS)	0010	3,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	36,400			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030	265,000			
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	30,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,500			
	REPAIR IN/OUTLET STRUCTURE	0075	10,000			
	MISCELLANEOUS	0080	4,500			
	MAINTAIN ACCESS ROADS	0085	3,000			
	DESIGN/ENGINEERING	0095	20,000			
		TOTAL	$376,900	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

SULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: LAS VEGAS RANGE WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,000			
	INSPECTION (CHANNELS)	0010	3,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	8,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030	5,000			
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	5,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	3,000			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	7,700			
	MAINTAIN ACCESS ROADS	0085	3,000			
	DESIGN/ENGINEERING	0095				
		TOTAL	$36,700	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

ECT: TROPICANA WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	1,700	$		
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	4,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070				
	REPAIR IN/OUTLET STRUCTURE	0075	5,000			
	MISCELLANEOUS	0080				
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
	TOTAL		$13,700	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

ONSULTANT/CONTRACTOR:

ECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: AIRPORT CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,000	$		
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	3,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,000			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	5,000			
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
		TOTAL	$14,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

/ECT: MONSON CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,000	$		
	INSPECTION (CHANNELS)	0010	1,500			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	6,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	20,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,500			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080				
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
		TOTAL	$32,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

ONSULTANT/CONTRACTOR:

ECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: RAWHIDE CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,000	$		
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	4,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040	5,000			
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055	147,400			
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,000			
	REPAIR IN/OUTLET STRUCTURE	0075	5,000			
	MISCELLANEOUS	0080	3,000			
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095	14,000			
	TOTAL		$184,400	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

JECT: VAN BUSKIRK CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	1,500	$		
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	2,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,000			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	3,000			
	MAINTAIN ACCESS ROADS	0085				
	DESIGN/ENGINEERING	0095				
	TOTAL		$9,500	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

JECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: FLAMINGO WASH - NORTH FORK

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	1,500	$0		
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	3,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030	18,000			
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	1,500			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	3,000			
	MAINTAIN ACCESS ROADS	0085	2,000			
	DESIGN/ENGINEERING	0095				
	TOTAL		$31,000			

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

)ECT: DETENTION BASINS

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	1,500			
	INSPECTION (CHANNELS)	0010	1,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	1,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035	6,500			
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070				
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	3,000			
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
		TOTAL	$14,000			

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

)ECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-6569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: LAUGHLIN WASHES

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	3,500			
	INSPECTION (CHANNELS)	0010	3,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	1,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060	22,000			
	EROSION REPAIR	0065				
	FENCE REPAIR	0070				
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080				
	MAINTAIN ACCESS ROADS	0085	1,000			
	DESIGN/ENGINEERING	0095				
		TOTAL	$30,600			

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

JECT: OVERTON TOWN WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	2,500			
	INSPECTION (CHANNELS)	0010	2,000			
	CLEAN STORM SEWER LINES	0015				
	VEGETATION CONTROL	0020	2,000			
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070	500			
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080	1,000			
	MAINTAIN ACCESS ROADS	0085	2,000			
	DESIGN/ENGINEERING	0095				
	TOTAL		$10,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

ONSULTANT/CONTRACTOR:

JECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

ENTITY: CLARK COUNTY 1995-96 DATE PREPARED: MARCH 10, 1995

PROJECT: BLUE DIAMOND WASH

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	CLEAN & INSPECT IN/OUTLET STRUCTURES	0005	500	$		
	INSPECTION (CHANNELS)	0010	500			
	CLEAN STORM SEWER LINES	*0015*				
	VEGETATION CONTROL	0020				
	STORM SEWER REPAIR	0025				
	CLEAN & RESHAPE CHANNELS	0030				
	CLEAN/INSPECT DETENTION BASINS	0035				
	REPAIR LINED CHANNELS	0040				
	VEGETATION CONTROL/DETENSION BASINS	0045				
	CLEAN/FLUSH PIPES/CULVERTS	0050				
	PROVIDE/MAINTAIN EROSION CONTROL	0055				
	DEBRIS REMOVAL	0060				
	EROSION REPAIR	0065				
	FENCE REPAIR	0070				
	REPAIR IN/OUTLET STRUCTURE	0075				
	MISCELLANEOUS	0080				
	MAINTAIN ACCESS ROADS	0085				
	DESIGN/ENGINEERING	0095				
	TOTAL		$1,000	$		

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR:

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569

CLARK COUNTY

REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT: Interlocal Agreement 1995/1996 Maintenance Work Program
PETITIONER: City of Henderson

RECOMMENDATION OF PETITIONER:

That the Clark County Regional Flood Control District approve the 1995/1996 Interlocal Agreement for the Maintenance Work Program.

FISCAL IMPACT: $168,299.00 from Maintenance funds.

BACKGROUND: The 1995/1996 Maintenance Work Program has been developed to maintain Regional Flood Control facilities within the City of Henderson. The locations of the facilities to be maintained are shown on Exhibit "A" of the proposed Interlocal Agreement, and the work to be performed is described in the work program which is attached.

Respectfully submitted,

Mark T. Calhoun

Mark T. Calhoun, P.E.
Director of Public Works

EJL:jn
February 7, 1995

TAC AGENDA ITEM #	**RFCD AGENDA ITEM #**
Date:	**Date:**

INTERLOCAL CONTRACT

1995/1996 ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this _____ day of _____, 1995, by and between the CITY OF HENDERSON, a political subdivision of the State of Nevada, hereinafter referred to as "City", and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "District".

W I T N E S S E T H:

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the District may approve and fund projects to maintain flood control improvements; and

WHEREAS, the City desires to maintain flood control improvements within the City in accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the facility upon which maintenance will be done is a facility described in the District's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the District authorizes the project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the District's Master Plan facilities including updates and amendments subsequently approved. The basic maintenance to the facilities will be in accordance with performance standards of the Operation and Maintenance Manual. The Project is more specifically described in Exhibit "A", which is attached hereto, and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The District agrees to provide reimbursement for Project costs within the limits specified below:

1. The Project costs shall not exceed $168,299.00.

The amounts allocated to each individual facility within the Project must be specified in Exhibit A. Any changes to said allocated amounts must be approved by the Chief Engineer of the Clark County Regional Flood Control District.

A written request must be made to the District and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

2. The City and District will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the City shall submit invoices together with a detailed summary report of the maintenance service performed. The City shall submit an Invoice Voucher prepared in duplicate in the manner prescribed by the District. The vouchers shall include such information as is necessary for the District to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the City stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program. All invoices must be submitted for payment to:

Gale W. Fraser, II, P.E., General Manager/Chief Engineer
Clark County Regional Flood Control District
301 East Clark, Suite 301
Las Vegas, NV 89101

Payment shall be considered timely if made by the District within 45 days. Pursuant to Section IV, Paragraph 6, the District may, in its sole discretion, withhold payments to the City for services rendered if the City fails to satisfactorily comply with any term or condition of this contract and/or the District's Operation and Maintenance Manual.

SECTION III - PROJECT TIME

The City agrees to perform the Project to the satisfaction of the District prior to June 30, 1996. The District may grant extensions or terminate this contract and require all sums advanced to the city to

be repaid if the City fails to perform by said date.

SECTION IV - GENERAL

1. The City will complete the Project as set forth in Exhibit "A". The City staff personnel responsible for coordination work under this contract are as listed below:

Mark T. Calhoun, Director of Public Works
W. Curtis Chandler, Land Development Manager
Carl Noyes, Support Services Manager

It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the District is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract, the parties hereto shall be subject to and governed by the District's Operation and Maintenance Manual, and any applicable portions of the Policies and Procedures adopted by the District.

3. It is the intent of the District that scheduling of maintenance and repair of drainage flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved and District-funded projects have regional flood control significance impacting more than one entity, the City will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the District shall be responsible for monitoring the performance of the City, approval for payment of billings and expenses submitted by the City and the acceptance of any reports provided by the City. The City shall be responsible for monitoring performance of City staff or private contractors, and the City shall maintain detailed records of all payments made to contractors and make such records available to the District upon request.

5. The City shall provide right of access to its facilities to the District or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assuran

under this contract.

6. In the event the City fails to perform the maintenance according to the standards specified in this contract and in the District's Operation and Maintenance Manual, the District may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the District shall be reimbursed by the city or be deducted from the amount authorized by this contract. The District may not exercise this right without giving the City specific written notice of the maintenance required and allowing the City 60 days within which to perform said maintenance. The notice required by this provision must be sent to:

Mark T. Calhoun, Director of Public Works
240 Water Street
Henderson, NV 89015

7. The records of the City and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the District, County Auditor, or an Agent of the District.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the project will be refunded by the City to the District.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The City hereby indemnifies and shall defend and hold harmless the District, its representatives and their employees (or their authorized representatives) from and against any and all

suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the City, of anyone acting under its direction or control, or on its behalf in connection with or incident to the performance of this Contract. The City's aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

****

CITY OF HENDERSON

Date of Council Action:

_____ BY: _____
ROBERT A. GROESBECK, Mayor

ATTEST:

_____
SUSAN ROBISON, City Clerk

****

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

Date of District Action:

_____ BY: _____
IRIS BLETSCH, Chairman

ATTEST:

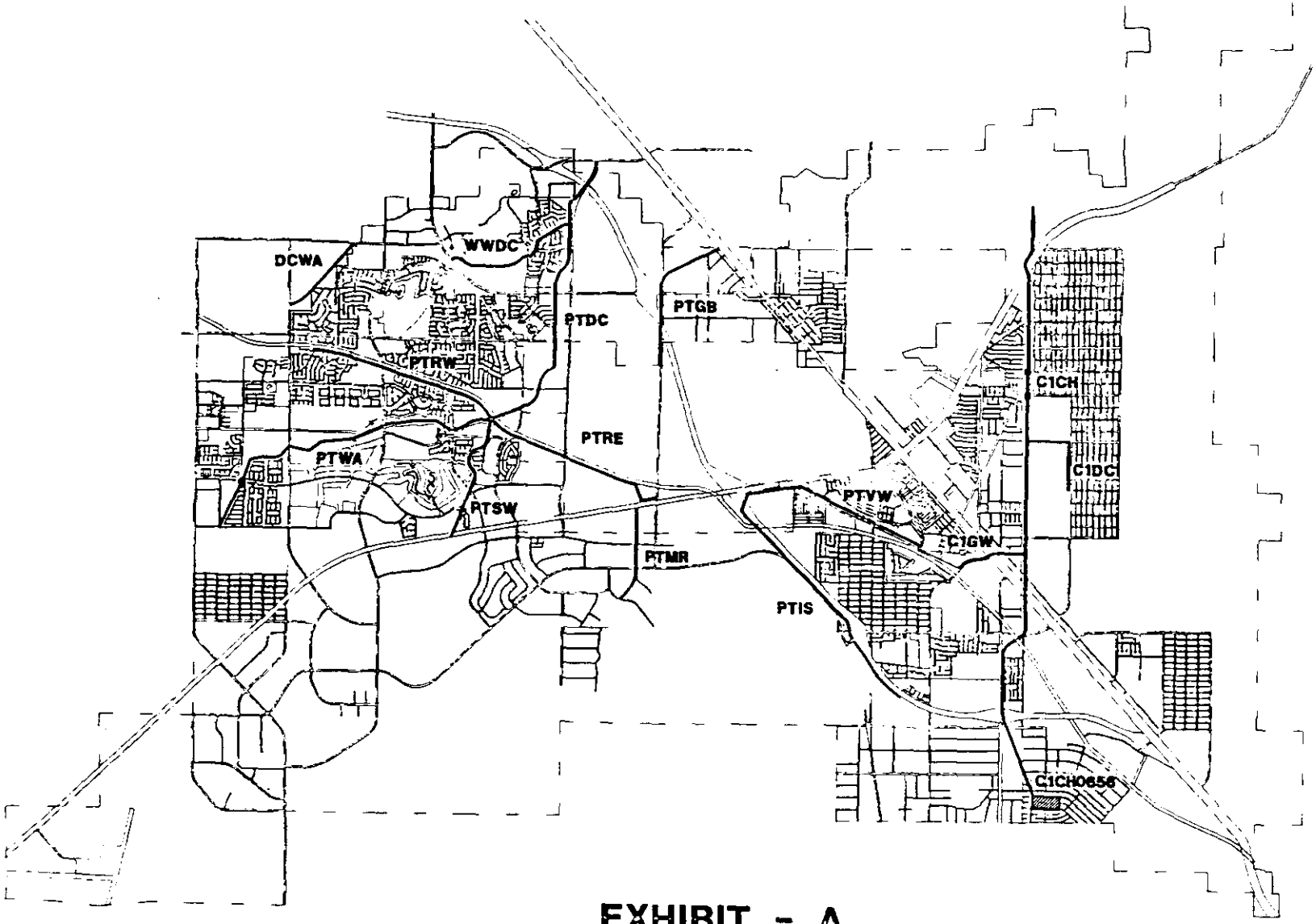
APPROVED AS TO FORM:

_____
DEANNA LEFKO, Board Secretary

_____
CHRISTOPHER FIGGINS, Deputy District Attorney

1995-1996 MAINTENANCE PROGRAM

CITY OF HENDERSON



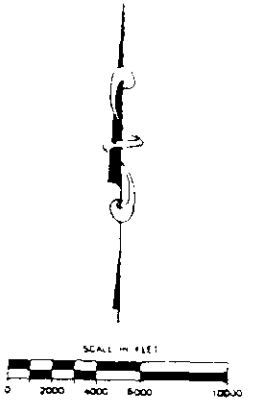


EXHIBIT - A

MAINTENANCE PROGRAM SUMMARY

Master Plan Number	Program Number HEN	Channel Name	From	To	Maintenance Amount
C1CH	01	C-1 Channel	Mission Drive	SNWS Lateral	17,998
C1GW	02	Greenway Channel	C-1 Channel	Black Mtn Golf Course	12,062
PTVW	03	Van Wagenen Channel	Lake Mead Drive	Major Avenue	6,696
PTGB	04	Gibson Channel	Boulder Highway	Warm Springs Road	2,374
PTDC	05	Lower Pittman Channel	Russell Road	Warm Springs Road	4,927
PTWA	06	Upper Pittman Wash	Warm Springs Road	Pebble Road	30,531
PTRW	07	UPRR Channel	Pittman Wash	Pecos Road	10,746
PTSW	08	Sandwedge Channel	Pittman Wash	Lake Mead Drive	7,411
WWDC	09	Whitney Ranch Channel	Pittman Wash	Sunset Road	10,339
DCWA	10	Duck Creek Channel	Sunset Road	Pecos Road	8,305
C1CH0656	11	Mission Hills Detention Basin	Mission Drive	Mission Drive	20,796
PTRE	12	Railroad East Channel	Pittman Wash	Lake Mead Drive	10,308
PTMR	13	McDonald Ranch Channel	Lake Mead Drive	Thompson Drive	1,837
C1DC	14	Drake Channel	Pittman Wash	Burkholder Blvd	8,598
PTIS	15	I-515 Channel	Pittman Wash	Burkholder Blvd	15,372
PTEA	16	Eastern Channel	Serene Avenue	Lake Mead Drive	0
				City Total	$168,299

FACILITY	C-1 Channel
FACILITY NUMBER	C1CH
	0000-0658

REN	01	1995/1996
FROM:	Mission Drive	
TO:	SNWS Lateral	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maintenance Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	5.7	Miles	100	$0	$57	$96	$125	$0	$0	$0	$0	$0	$0	$278
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	4.4	Miles	50	$264	$110	$185	$242	$880	$0	$2,860	$0	$1,540	$0	$6,081
0035	Clean/Inspect Detention Basins	20	Acres	5	$400	$83	$140	$367	$1,333	$0	$2,167	$1,167	$1,167	$0	$6,823
0040	Repair Lined Channels	2	Each	10	$6	$10	$8	$22	$0	$140	$0	$0	$0	$1,000	$1,186
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	17	Each	100	$102	$43	$71	$187	$340	$595	$0	$0	$595	$0	$1,933
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yar	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	100	Feet	100	$12	$20	$17	$22	$80	$140	$0	$0	$140	$400	$831
0070	Fence Repair	16800	Feet	0.5	$0	$42	$18	$92	$0	$294	$0	$0	$0	$420	$866
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$784	$365	$535	$1,057	$2,633	$1,169	$5,027	$1,167	$3,442	$1,820	$17,998

FACILITY	Greenway Channel
FACILITY NUMBER	C1GW
	0000-0083

YEN	02	1995/1996
FROM:	C-1 Channel	
TO:	Black Mtn Golf Course	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	0.8	Miles	100	$0	$8	$13	$18	$0	$0	$0	$0	$0	$0	$39
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0.2	Miles	100	$0	$7	$8	$7	$27	$0	$0	$0	$0	$13	$60
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	0.4	Miles	50	$24	$10	$17	$22	$80	$0	$280	$0	$140	$0	$553
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	5	Each	100	$30	$13	$21	$55	$100	$175	$0	$0	$175	$0	$569
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	1000	Feet	100	$120	$200	$168	$220	$800	$1,400	$0	$0	$1,400	$4,000	$8,308
0070	Fence Repair	8000	Feet	0.5	$0	$15	$6	$33	$0	$105	$0	$0	$0	$150	$309
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0.5	Miles	100	$60	$25	$42	$55	$200	$350	$0	$350	$350	$200	$1,632
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$237	$282	$277	$421	$1,207	$2,100	$280	$350	$2,065	$4,863	$12,062

FACILITY	Van Wagenen Channel
FACILITY NUMBER	PTVW 0237-0389

WHEN	03	1995/1996
FROM:	Lake Mead Drive	
TO:	Major Avenue	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.5	Miles	100	$0	$15	$25	$33	$0	$0	$0	$0	$0	$0	$73
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.5	Miles	50	$90	$38	$83	$83	$300	$0	$975	$0	$525	$0	$2,073
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	4	Each	100	$24	$10	$17	$44	$80	$140	$0	$0	$140	$0	$455
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	100	Feet	100	$12	$20	$17	$22	$80	$140	$0	$0	$140	$400	$831
0070	Fence Repair	0	Feet	0.5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	1	Miles	100	$120	$50	$84	$110	$400	$700	$0	$700	$700	$400	$3,264
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$246	$133	$208	$292	$880	$980	$975	$700	$1,505	$800	$6,696

FACILITY	Gibson Channel
FACILITY NUMBER	PTGB
	0057-0206

HEN	04	1995/1996
FROM:	Boulder Highway	
TO:	Warm Springs Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.5	Miles	100	$0	$15	$25	$33	$0	$0	$0	$0	$0	$0	$73
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.5	Miles	50	$90	$38	$83	$83	$300	$0	$975	$0	$525	$0	$2,073
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	2	Each	100	$12	$5	$8	$22	$40	$70	$0	$0	$70	$0	$227
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	0	Feet	0.5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$102	$58	$97	$138	$340	$70	$975	$0	$595	$0	$2,374

FACILITY	Lower Pittman Channel
FACILITY NUMBER	PTDC
	0013-0237

HEN	05	1995/1996
FROM:	Russell Road	
TO:	Warm Springs Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	2.2	Miles	100	$0	$22	$37	$48	$0	$0	$0	$0	$0	$0	$107
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	2.2	Miles	50	$132	$55	$92	$121	$440	$0	$1,430	$0	$770	$0	$3,040
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	23000	Feet	0.5	$0	$58	$24	$126	$0	$403	$0	$0	$0	$575	$1,186
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$135	$140	$158	$307	$440	$473	$1,430	$0	$770	$1,075	$4,927

FACILITY	Upper Pittman Wash
FACILITY NUMBER	PTWA
	0000-0411

HEN	08	1995/1996
FROM:	Warm Springs Road	
TO:	Pebble Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	4.1	Miles	100	$0	$41	$69	$90	$0	$0	$0	$0	$0	$0	$200
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	1	Miles	100	$0	$33	$28	$37	$133	$0	$0	$0	$0	$67	$298
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	4.1	Miles	50	$246	$102	$172	$226	$820	$0	$2,865	$0	$1,435	$0	$5,866
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	1	Each	100	$8	$3	$4	$11	$20	$35	$0	$0	$35	$0	$114
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	2000	Feet	100	$240	$400	$336	$440	$1,600	$2,800	$0	$0	$2,800	$8,000	$16,616
0070	Fence Repair	10000	Feet	0.5	$0	$25	$11	$55	$0	$175	$0	$0	$0	$250	$516
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	2	Miles	100	$240	$100	$168	$220	$800	$1,400	$0	$1,400	$1,400	$800	$6,528
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$735	$709	$792	$1,089	$3,373	$4,480	$2,865	$1,400	$5,670	$9,617	$30,531

FACILITY	UPRR Channel
FACILITY NUMBER	PTRW
	0000-0131

REN	07	1995/1996
FROM:	Pittman Wash	
TO:	Pecos Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.3	Miles	100	$0	$13	$22	$29	$0	$0	$0	$0	$0	$0	$63
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.3	Miles	50	$76	$33	$55	$72	$280	$0	$845	$0	$455	$0	$1,797
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	2	Each	100	$12	$5	$8	$22	$40	$70	$0	$0	$70	$0	$227
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	16000	Feet	0.5	$0	$40	$17	$68	$0	$250	$0	$0	$0	$400	$825
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	2.4	Miles	100	$288	$120	$202	$284	$960	$1,660	$0	$1,660	$1,660	$960	$7,834
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$376	$211	$303	$474	$1,280	$2,030	$845	$1,680	$2,205	$1,360	$10,746

FACILITY	Sandwedge Channel
FACILITY NUMBER	PTSW
	0000-0105

HEN	08	1995/1996
FROM:	Pittman Wash	
TO:	Lake Mead Drive	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.2	Miles	100	$0	$12	$20	$28	$0	$0	$0	$0	$0	$0	$59
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0.5	Miles	100	$0	$17	$14	$18	$67	$0	$0	$0	$0	$33	$149
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.2	Miles	50	$72	$30	$50	$86	$240	$0	$780	$0	$420	$0	$1,656
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	3	Each	100	$18	$8	$13	$33	$60	$105	$0	$0	$105	$0	$341
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	100	Feet	100	$12	$20	$17	$22	$80	$140	$0	$0	$140	$400	$831
0070	Fence Repair	10000	Feet	0.5	$0	$25	$11	$55	$0	$175	$0	$0	$0	$250	$516
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	1	Miles	100	$120	$50	$84	$110	$400	$700	$0	$700	$700	$400	$3,264
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$225	$166	$213	$342	$847	$1,190	$780	$700	$1,365	$1,583	$7,411

FACILITY	Whitney Ranch Channel
FACILITY NUMBER	WWDC 0000-0069

HEN	09	1995/1996
FROM:	Pitman Wash	
TO:	Sunset Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D6 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	0.7	Miles	100	$0	$7	$12	$15	$0	$0	$0	$0	$0	$0	$34
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0.7	Miles	100	$0	$23	$20	$28	$93	$0	$0	$0	$0	$47	$209
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	0.7	Miles	50	$42	$18	$29	$39	$140	$0	$455	$0	$245	$0	$967
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	2	Each	100	$12	$5	$8	$22	$40	$70	$0	$0	$70	$0	$227
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	1000	Feet	100	$120	$200	$168	$220	$800	$1,400	$0	$0	$1,400	$4,000	$8,306
0070	Fence Repair	0	Feet	0.5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$177	$258	$241	$333	$1,073	$1,540	$455	$0	$1,715	$4,547	$10,339

FACILITY	Duck Creek Channel
FACILITY NUMBER	DCWA
	0646-0783

HEN	10	1995/1996
FROM:	Sunset Road	
TO:	Pecos Road	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.2	Miles	100	$0	$12	$20	$28	$0	$0	$0	$0	$0	$0	$59
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	1.2	Miles	100	$0	$40	$34	$44	$160	$0	$0	$0	$0	$80	$358
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.2	Miles	100	$144	$80	$101	$132	$480	$0	$1,560	$0	$640	$0	$3,317
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	100	Cubic Yard	100	$12	$3	$4	$11	$40	$0	$65	$0	$35	$0	$170
0065	Erosion Repair	200	Feet	100	$24	$40	$34	$44	$160	$280	$0	$0	$280	$600	$1,662
0070	Fence Repair	10000	Feet	0.5	$0	$25	$11	$55	$0	$175	$0	$0	$0	$250	$516
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0.5	Miles	100	$80	$25	$42	$55	$200	$350	$0	$350	$350	$200	$1,632
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$243	$210	$249	$378	$1,040	$875	$1,625	$350	$1,505	$1,830	$8,305

FACILITY	Mission Hills Detention Basin
FACILITY NUMBER	C1CH0656
	0660-0737

HEN	11	1995/1996
FROM:	Mission Drive	
TO:	Mission Drive	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	2	Structures	100	$0	$7	$1	$15	$27	$0	$0	$47	$47	$0	$143
0010	Inspect Channels	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	*Clean/Reshape Channels*	*0*	*Miles*	*50*	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0035	Clean/Inspect Detention Basins	50	Acres	5	$1,000	$208	$350	$917	$3,333	$0	$5,417	$2,917	$2,917	$0	$17,058
0040	*Repair Lined Channels*	*0*	*Each*	*10*	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	5	Acres	5	$2	$2	$1	$7	$0	$0	$0	$0	$0	$0	$11
0050	*Clean/Flush Pipes* and Culverts	1	*Each*	100	$8	$3	$4	$11	$20	$35	$0	$0	$35	$0	$114
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	100	Cubic Yard	100	$12	$3	$4	$11	$40	$0	$65	$0	$35	$0	$170
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	*Fence Repair*	3820	*Feet*	*0.5*	$0	$10	$4	$21	$0	$67	$0	$0	$0	$96	$197
0075	Repair Inlet/Outlet Structure	2	Each	100	$0	$100	$84	$220	$0	$700	$0	$0	$0	$2,000	$3,104
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$1,020	$331	$448	$1,201	$3,420	$802	$5,482	$2,963	$3,033	$2,096	$20,796

FACILITY	Railroad East Channel
FACILITY NUMBER	PTRE
	0000-0098

YEN	12	1995/1996
FROM:	Pittman Wash	
TO:	Lake Mead Drive	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	2.4	Miles	100	$0	$24	$40	$53	$0	$0	$0	$0	$0	$0	$117
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	2.4	Miles	50	$144	$60	$101	$132	$480	$0	$1,560	$0	$640	$0	$3,317
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	3	Each	100	$16	$8	$13	$33	$80	$105	$0	$0	$105	$0	$341
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	100	Feet	0.5	$0	$0	$0	$1	$0	$2	$0	$0	$0	$3	$5
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	2	Miles	100	$240	$100	$168	$220	$800	$1,400	$0	$1,400	$1,400	$800	$6,528
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$402	$192	$322	$438	$1,340	$1,507	$1,560	$1,400	$2,345	$803	$10,308

FACILITY	McDonald Ranch Channel
FACILITY NUMBER	PTMR
	0000-0000

MEN	13	1995/1996
FROM:	Lake Mead Drive	
TO:	Thompson Drive	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D6 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1.1	Miles	100	$0	$11	$18	$24	$0	$0	$0	$0	$0	$0	$54
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0.5	Miles	100	$0	$17	$14	$18	$67	$0	$0	$0	$0	$33	$149
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1.1	Miles	50	$66	$28	$48	$81	$220	$0	$715	$0	$385	$0	$1,520
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	1	Each	100	$6	$3	$4	$11	$20	$35	$0	$0	$35	$0	$114
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	0	Cubic Yard	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	0	Feet	0.5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$72	$58	$83	$114	$307	$35	$715	$0	$420	$33	$1,837

FACILITY	Drake Channel
FACILITY NUMBER	C1DC
	0000-0051

HEN	14	1995/1996
FROM:	Pittman Wash	
TO:	Burkholder Blvd	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D8 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	1	Miles	100	$0	$10	$17	$22	$0	$0	$0	$0	$0	$0	$49
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	1	Miles	100	$0	$33	$28	$37	$133	$0	$0	$0	$0	$67	$298
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	1	Miles	50	$60	$25	$42	$55	$200	$0	$650	$0	$350	$0	$1,382
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	1	Each	10	$3	$5	$4	$11	$0	$70	$0	$0	$0	$500	$593
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	5	Each	100	$30	$13	$21	$55	$100	$175	$0	$0	$175	$0	$569
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	50	Cubic Yard	100	$6	$1	$2	$6	$20	$0	$33	$0	$18	$0	$85
0065	Erosion Repair	500	Feet	100	$60	$100	$84	$110	$400	$700	$0	$0	$700	$2,000	$4,154
0070	Fence Repair	3168	Feet	0.5	$0	$6	$3	$17	$0	$55	$0	$0	$0	$79	$183
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	0.4	Miles	100	$48	$20	$34	$44	$160	$280	$0	$280	$280	$160	$1,306
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$207	$215	$236	$357	$1,013	$1,280	$683	$280	$1,523	$2,806	$8,566

FACILITY	I-515 Channel
FACILITY NUMBER	PTIS
	0000-0198

HEN	15	1995/1996
FROM:	Lake Mead Drive	
TO:	Horizon Drive	

Activity Number	Activity Name	Units		Frequency (%)	Labor			Equipment						Material	Total
					Equipment Operator	Maint Worker	Supervisor	Pickup	Dump Truck	Front Loader	D6 Cat	Grader	Water Truck		
0005	Clean and Inspect Inlet/Outlet Stuctures	0	Structures	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0010	Inspect Channels	3.3	Miles	100	$0	$33	$55	$73	$0	$0	$0	$0	$0	$0	$161
0015	Clean Storm Drain Lines	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0020	Vegetation Control	0	Miles	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0025	Repair Storm Drains	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0030	Clean/Reshape Channels	3.3	Miles	50	$198	$83	$139	$182	$880	$0	$2,145	$0	$1,155	$0	$4,561
0035	Clean/Inspect Detention Basins	0	Acres	5	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0040	Repair Lined Channels	0	Each	10	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0045	Vegetation Control Detention Basins	0	Acres	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0050	Clean/Flush Pipes and Culverts	19	Each	100	$114	$48	$80	$209	$380	$665	$0	$0	$665	$0	$2,160
0055	Provide/Maintain Erosion Control	0	Square Ft	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0060	Debris Removal	50	Cubic Yard	100	$6	$1	$2	$6	$20	$0	$33	$0	$18	$0	$65
0065	Erosion Repair	0	Feet	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0070	Fence Repair	17424	Feet	0.5	$0	$44	$18	$96	$0	$305	$0	$0	$0	$436	$896
0075	Repair Inlet/Outlet Structure	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0080	Miscellaneous Work Activities	0	Each	100	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
0085	Maintain Access Roads	2.3	Miles	100	$276	$115	$193	$253	$920	$1,610	$0	$1,610	$1,610	$920	$7,507
0090	Supervise Annual Bid Contracts	0		100											$0
0095	Design/Engineering	0		100											$0
	Total				$594	$323	$487	$817	$1,980	$2,580	$2,178	$1,610	$3,448	$1,356	$15,372

CLARK COUNTY

REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:

INTERLOCAL CONTRACT - ANNUAL MAINTENANCE PROGRAM

PETITIONER:

CITY OF LAS VEGAS

RECOMMENDATION OF PETITIONER:

That the District approve this Interlocal Contract for the maintenance of Regional Flood Control facilities for FY 95-96.

FISCAL IMPACT:

CONTRACT AMOUNT IS $896,500 WITH AUTHORIZATION TO PROCEED IN THE AMOUNT OF $225,000 EFFECTIVE JULY 1, 1995.

BACKGROUND:

The District has contracted with its member entities for the maintenance of Regional Flood Control facilities located within their corporate boundaries. This Interlocal Contract will provide funding for the City of Las Vegas Maintenance Program outlined in Exhibits "A" and "B" to this Interlocal Contract.

Respectfully submitted,

Richard D. Goecke, Director
Department of Public Works

TAC AGENDA ITEM# Date:	RFCD AGENDA ITEM# Date:

INTERLOCAL CONTRACT

ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this _____day of _____, 1995, by and between the CITY OF LAS VEGAS, a political subdivision of the State of Nevada, hereinafter referred to as "CITY", the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "DISTRICT".

W I T N E S S E T H

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the DISTRICT may approve and fund projects to maintain flood control improvements; and

WHEREAS, the CITY desires to maintain flood control improvements within the CITY in accordance with the maintenance program set forth on the attached Exhibits "A" and "B" and hereinafter referred to as "PROJECT"; and

WHEREAS, the facilities upon which maintenance will be done are facilities described in the DISTRICT's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the DISTRICT authorizes the PROJECT as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the DISTRICT's Master Plan Update. The basic maintenance activities will be: channel inspections, cleaning and reshaping channels, vegetation control, repair of lined channels, cleaning and flushing

culverts, erosion control maintenance and repair, and maintenance of fencing. The PROJECT is more specifically described in Exhibits "A" and "B" which are attached hereto and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The District agrees to provide reimbursement for PROJECT costs within the limits specified below:

1. The PROJECT costs shall not exceed $896,500. The amounts allocated to each individual facility within the Project must be specified in Exhibit "A". Any changes to said allocated amounts must be approved by the DISTRICT's Chief Engineer.
2. "Authorization to Proceed" is herein granted for maintenance of facilities in Exhibit "A" in an amount not to exceed $225,000 effective July 1, 1995.
3. A separate request for an "Authorization to Proceed" will be required for additional facility maintenance funds.
4. A written request must be made to the DISTRICT and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.
5. The CITY and DISTRICT will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the CITY shall submit invoices together with a detailed summary report of the maintenance service performed. The CITY shall submit an invoice voucher prepared in duplicate in the manner prescribed by the

DISTRICT. The vouchers shall include such information as is necessary for the DISTRICT to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this Contract. Each voucher will also be accompanied by a written certification from the CITY stating that it is for performance of maintenance activities under this Contract and is composed of completed elements set forth in the annual work program.

All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 East Clark Avenue-Suite 301
Las Vegas, Nevada 89101
Attention: Gale Wm. Fraser II, P.E.
General Manager/Chief Engineer

Payment shall be considered timely if made by the DISTRICT within 45 days. Pursuant to Section IV, Paragraph 6, the DISTRICT may, in its sole discretion, withhold payments to the CITY for services rendered if the CITY fails to satisfactorily comply with any term or condition of this Contract and/or the DISTRICT's Operation and Maintenance Manual.

SECTION III - PROJECT TIME

The CITY agrees to perform the PROJECT to the satisfaction of the DISTRICT prior to June 30, 1996. The DISTRICT may grant extensions or terminate this Contract and require all sums advanced to the CITY to be repaid if the CITY fails

to perform by said date.

SECTION IV - GENERAL

1. The CITY will complete the PROJECT as set forth in Exhibits "A" and "B". The CITY staff personnel responsible for coordination work under this Contract are as listed below:

Richard D. Goecke, Director of Public Works

Charles Kajkowski, City Planning Engineer

It is understood that staff named above will be responsible for work coordination throughout the period of this Contract unless the DISTRICT is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract, the parties hereto shall be subject to and governed by the DISTRICT's Operation and Maintenance Manual and any applicable portions of the Policies and Procedures adopted by the DISTRICT.

3. It is the intent of the DISTRICT that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved and DISTRICT-funded projects have regional flood control significance impacting more than one entity, the CITY will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the DISTRICT shall be responsible for monitoring the performance of the CITY, approval for payment of billings and expenses submitted by the CITY and the acceptance of any reports provided by the CITY. The CITY shall be responsible for monitoring performance of CITY staff or private contractors and the CITY shall maintain detailed records of all payments made to contractors and make such records available to the DISTRICT upon request.

5. The CITY shall provide right of access to its facilities to the Chief Engineer of the DISTRICT at all reasonable times in order to monitor and evaluate performance, compliance, and/or quality assurance under this Contract.

6. In the event the CITY fails to perform the maintenance according to the standards specified in this Contract and in the DISTRICT's operation and Maintenance Manual, the DISTRICT may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Costs incurred by the DISTRICT shall be reimbursed by the CITY or be deducted from the amount authorized by this Contract. The DISTRICT may not exercise this right without giving the CITY specific written notice of the maintenance required and allowing the CITY 60 days within which to perform said maintenance.

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The notice required by this provision must be sent to:

Richard D. Goecke, Director of Public Works
City of Las Vegas
400 East Stewart Avenue
Las Vegas, Nevada 89101

7. The records of the CITY and/or private contractors pertaining to the subject matter of this Contract shall at all reasonable times be subject to inspection and audit by the DISTRICT, County Auditor or an Agent of the DISTRICT.

8. If any provision of this Contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this Contract shall comply with applicable local, state and federal laws.

10. Any costs found to be improperly allocated in the PROJECT will be refunded by the CITY to the DISTRICT.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this Contract to create in the public or any member thereof a third-party beneficiary hereunder or to authorize anyone not a party to this Contract to maintain a suit for personal injuries or property damage pursuant to the terms and provisions of this Contract.

12. The CITY hereby indemnifies and shall defend and hold harmless the DISTRICT, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the CITY, of anyone acting under its direction or control or on its behalf in connection with or incident to the performance of this Contract. The CITY's aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law but, in no event,

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shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

IN WITNESS WHEREOF, this INTERLOCAL CONTRACT is hereby executed as of the date first set forth above.

DATE OF DISTRICT ACTION:

_____

ATTEST:

_____

DEANNA LEFKO, SECRETARY

APPROVED AS TO LEGALITY AND FORM:

_____

CHRISTOPHER D. FIGGINS

DEPUTY DISTRICT ATTORNEY

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

BY: _____

IRIS BLETSCH, CHAIRMAN

DATE OF COUNCIL ACTION:

_____

ATTEST:

_____

KATHLEEN TIGHE, CITY CLERK

CITY OF LAS VEGAS

BY: _____

JAN LAVERTY JONES, MAYOR

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CITY OF LAS VEGAS
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
1995/96 MAINTENANCE WORK PLAN

PROJECT	COST
1 LAS VEGAS WASH – Charleston to Owens (LVMD – 1069 to 1354)	$500,000
2 WASHINGTON AVENUE CHANNEL (Bruce to LV Wash) (LVWH – 0086 to 0298)	$8,000
3 MEADOWS DETENTION BASIN COLLECTION & DISCHARGE SYSTEM) (MECH – 0000 to 0058, MEAL – 0000 to 0160, LCME – 0000 to 0084)	$16,000
4 EXPRESSWAY CHANNEL (Rancho Dr. to Martin Luther King) (LCRA – 0038 to 0113)	$6,000
5 ANGEL PARK DETENTION BASIN (South Half) (APNO – 0000)	$9,000
6 ANGEL PARK OUTFALL AND BUFFALO CHANNEL (APOF – 0000 to 0147, GOSO – 0068 to 0343)	$20,000
7 GOWAN DETENTION BASINS (GONO – 0000 & 0008, GOSO – 0000 & 0051)	$250,000
8 GOWAN OUTFALL (Tenaya to Decatur) (GOOF – 0486 to 0511)	$7,000
9 CEDAR AVENUE CHANNEL (Pecos to LV Wash) (CACH – 0000 to 0147)	$15,000
10 OAKEY DETENTION BASIN (MECH – 0324)	$9,500
11 OAKEY DETENTION COLLECTION SYSTEM & OUTFALL MECH – 0338, 0380 to 0337, 0059 to 0108)	$11,000
12 SMOKE RANCH STORM DRAIN – Jones to Rancho Dr.) LVSR – 0360 to 0500)	$5,500
13 LAKE MEAD STORM DRAIN (Jones to Rancho Dr.) LVLM – 0336 to 0453	$6,000
14 CHEYENNE CHANNEL (Outer Beltway to Gowan Detention) (GOO2 – 0000 to 0112)	$14,000
15 ANGEL PARK/DURANGO STORM DRAIN – Charleston to AP (APDG – 0000 & 0060)	$5,000
16 BONANZA STORM DRAIN – Eastern to Pecos & Sandhill to LV Wash (CABZ – 0000 to 0028)	$5,500
17 PECOS STORM DRAIN – Charleston to Bonanza (CACN – 0000 to 0026)	$5,000
18 BUFFALO CHANNEL (Westcliff to Vegas) (GOSO – 0344, 0394, 0395, 0415)	$4,000
TOTAL 1995/96 O&M	$896,500

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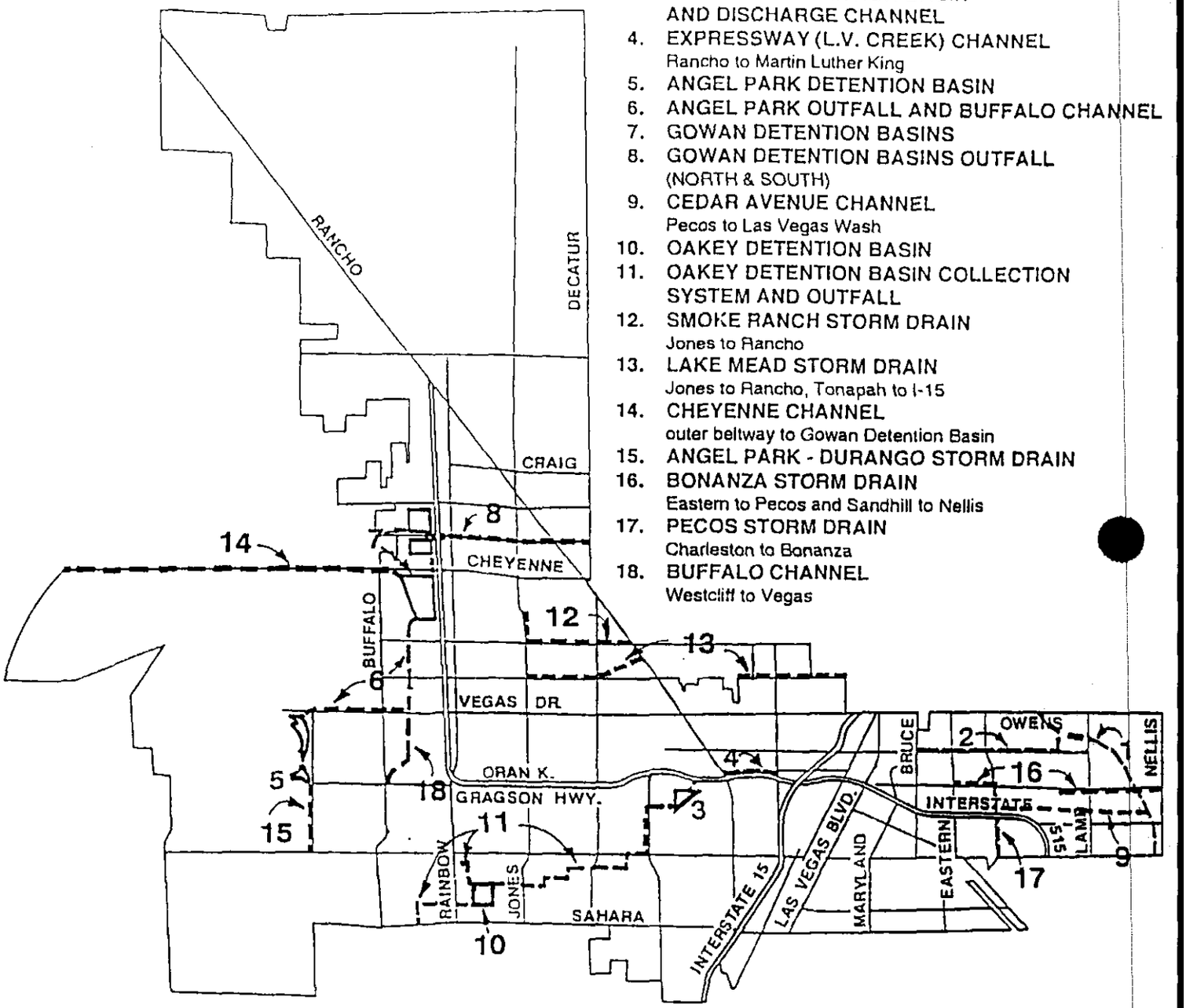
EXHIBIT A

1. LAS VEGAS WASH
   Owens to Charleston
2. WASHINGTON CHANNEL
   Bruce to Las Vegas Wash
3. MEADOWS DETENTION BASIN
   AND DISCHARGE CHANNEL
4. EXPRESSWAY (L.V. CREEK) CHANNEL
   Rancho to Martin Luther King
5. ANGEL PARK DETENTION BASIN
6. ANGEL PARK OUTFALL AND BUFFALO CHANNEL
7. GOWAN DETENTION BASINS
8. GOWAN DETENTION BASINS OUTFALL
   (NORTH & SOUTH)
9. CEDAR AVENUE CHANNEL
   Pecos to Las Vegas Wash
10. OAKEY DETENTION BASIN
11. OAKEY DETENTION BASIN COLLECTION
    SYSTEM AND OUTFALL
12. SMOKE RANCH STORM DRAIN
    Jones to Rancho
13. LAKE MEAD STORM DRAIN
    Jones to Rancho, Tonapah to I-15
14. CHEYENNE CHANNEL
    outer beltway to Gowan Detention Basin
15. ANGEL PARK - DURANGO STORM DRAIN
16. BONANZA STORM DRAIN
    Eastern to Pecos and Sandhill to Nellis
17. PECOS STORM DRAIN
    Charleston to Bonanza
18. BUFFALO CHANNEL
    Westcliff to Vegas



Operation and Maintenance Projects

EXHIBIT B

REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 1 LAS VEGAS WASH (Charleston to Owens)

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean and Inspect Inlet/Outlet Structures				
	Inspect Channels				
Contract	Clear and Reshape Channels	$500,000		0%	6/96
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $500,000

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96

'SULTANT/CONTRACTOR: N/A

PROJECT MANAGER: ED Nettenstrom, P.E. PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 2 WASHINGTON AVENUE CHANNEL (Bruce Street to Las Vegas Wash)

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean and Inspect Inlet/Outlet Structures				
	Inspect Channels				
	Clear and Reshape Channels				
FA	Vegetation Control	$3000		0%	6/96*
	Repair Lined channels				
FA	Clean/Flush Culverts	$3000		0%	6/96*
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
FA	Erosion Repair	$2000		0%	6/96
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $ 8,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6227

REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 3 MEADOWS DETENTION BASIN AND DISCHARGE CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$4,800		0 %	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
FA	Clean and Inspect Detention Basins	$11,200		0 %	6/96*
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $16,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

JECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 4 EXPRESSWAY CHANNEL (Rancho to Martin Luther King)

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$3000		0 %	6/96*
FA	Inspect Channels	$1500		0 %	6/96*
	Clear and Reshape Channels				
FA	Vegetation Control	$1500		0 %	6/96*
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $6,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6227

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

ECT: No. 5 ANGEL PARK DETENTION BASIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$1000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
FA	Clean and Inspect Detention Basins	$8000		0%	6/96*
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $9,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 6 ANGEL PARK OUTFALL AND BUFFALO CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2000		0%	6/96*
FA	Inspect Channels	$400		0%	6/96*
FA	Clear and Reshape Channels	$2000		0%	6/96*
	Vegetation Control				
	Repair Lined channels				
FA	Clean/Flush Culverts	$1000		0%	6/96*
FA	Clean Storm Sewer Lines	$3000		0%	6/96*
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
FA	Fence Repair	$11,600		0%	6/96*
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $20,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

CITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 7 GOWAN DETENTION BASINS

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$3,000		0%	6/96*
	Inspect Channels				
FA	Clear and Reshape Channels	$200,000		0%	6/69*
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
FA	Clean and Inspect Detention Basins	$47,000		0%	6/96*
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $250,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 8 GOWAN OUTFALL (Detention Basin to Decatur Boulevard)

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$5,000		0%	6/96*
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $7,000

• Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No. 9 CEDAR AVENUE CHANNEL (Pecos to LV Wash)

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean and Inspect Inlet/Outlet Structures				
	Inspect Channels				
	Clear and Reshape Channels				
FA	Vegetation Control	$1,000		0%	6/96*
	Repair Lined channels				
FA	Clean/Flush Culverts	$2,000		0%	6/96*
FA	Clean Storm Sewer Lines	$6,000		0%	6/96*
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
FA	Erosion Repair	$6,000		0%	6/96*
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $15,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.10 OAKEY DETENTION BASIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$3,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
FA	Clean and Inspect Detention Basins	$6,500		0%	6/96*
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $9,500

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.11 OAKEY DETENTION BASIN COLLECTION SYSTEM & OUTFALL

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$3,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
FA	Clean/Flush Culverts	$1,000		0%	6/96*
FA	Clean Storm Sewer Lines	$5,000		0%	6/96*
FA	Storm Sewer Repair	$2,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $11,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

JECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.12 SMOKE RANCH STORM DRAIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$1,500		0%	6/96*
FA	Storm Sewer Repair	$2,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $5,500

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

CITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.13 LAKE MEAD STORM DRAIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$2,000		0%	6/96*
FA	Storm Sewer Repair	$2,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $6,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.14 CHEYENNE CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean and Inspect Inlet/Outlet Structures				
FA	Inspect Channels	$1,000		0%	6/96*
FA	Clear and Reshape Channels	$6,000		0%	6/96*
	Vegetation Control				
FA	Repair Lined channels	$4,000		0%	6/96*
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
FA	Fence Repair	$3,000		0%	6/96*
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $14,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.15 ANGEL PARK/DURANGO STORM DRAIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$2,000		0%	6/96*
FA	Storm Sewer Repair	$1,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $5,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.16 BONANZA STORM DRAIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,500		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$2,000		0%	6/96*
FA	Storm Sewer Repair	$1,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $5,500

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

TY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.17 PECOS STORM DRAIN

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$2,000		0%	6/96*
	Inspect Channels				
	Clear and Reshape Channels				
	Vegetation Control				
	Repair Lined channels				
	Clean/Flush Culverts				
FA	Clean Storm Sewer Lines	$2,000		0%	6/96*
FA	Storm Sewer Repair	$1,000		0%	6/96*
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair				
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $5,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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REGIONAL FLOOD CONTROL DISTRICT
PROPOSED MAINTENANCE WORK PROGRAM FY 95/96

ENTITY: City of Las Vegas DATE PREPARED: March 13, 1995

PROJECT: No.18 BUFFALO CHANNEL

FORCE ACCOUNT/ CONTRACT	ACTIVITY	PROPOSED WORK PLAN	AMENDED WORK PLAN	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
FA	Clean and Inspect Inlet/Outlet Structures	$1,000		0%	6/96*
FA	Inspect Channels	$1,000		0%	6/96*
	Clear and Reshape Channels				
	Vegetation Control				
FA	Repair Lined channels	$1,000		0%	6/96*
	Clean/Flush Culverts				
	Clean Storm Sewer Lines				
	Storm Sewer Repair				
	Clean and Inspect Detention Basins				
	Vegetation Control Detention Basins				
	Provide/Maintain Erosion Control				
	Erosion Repair				
	Repair Inlet/Outflow Structures				
	Fence Repair	$1,000		0%	6/96*
	Maintain Access Road				
	Miscellaneous Work Activities				

DELAYS OR PROBLEM AREAS: TOTAL $4,000

* Typically these activities are storm related.

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Programmed for Fiscal Year 1995/96.

CONSULTANT/CONTRACTOR: N/A

PROJECT MANAGER: Larry Haugsness PHONE NUMBER: 229-6272

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CLARK COUNTY

REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT: Interlocal Agreement 1995/1996 Maintenance Work Program

PETITIONER: City of Mesquite

RECOMMENDATION OF PETITIONER:

That the Clark County Regional Flood Control District approve the 1995/1996 Interlocal Agreement for the Maintenance Work Program.

FISCAL IMPACT: $44,760 from Maintenance funds.

BACKGROUND: The 1995/1996 Maintenance Work Program has been developed to maintain Regional Flood Control facilities within the City of Mesquite. The locations of the facilities to be maintained are shown on Exhibit "A" of the proposed Interlocal Agreement, and the work to be performed is described in the work program which is attached.

Respectfully submitted,

Allen Bell, P.E.
Director of Public Works

TAC AGENDA ITEM #
Date:

RFCD AGENDA ITEM #
Date:

INTERLOCAL CONTRACT

CITY OF MESQUITE

ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this ____ day of _____, 1995, by and between the CITY OF MESQUITE, a political subdivision of the State of Nevada, hereinafter referred to as "City", and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "District".

W I T N E S S E T H:

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the District may approve and fund projects to maintain flood control improvements; and

WHEREAS, the City desires to maintain flood control improvements within the City in accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the facility upon which maintenance will be done is a facility described in the District's Master Plan.

NOW THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the District authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the District's Master Plan facilities including updates and amendments subsequently approved. The basic maintenance to the facilities will be in accordance with performance standards of the Operation and Maintenance Manual. The Project is more specifically described in Exhibit "A", which is attached hereto, and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The District agrees to provide reimbursement for Project costs within the limits specified below:

1. The project costs shall not exceed $44,760.00.

The amounts allocated to each individual facility within the Project are specified in Exhibit

A. Any changes to said allocated amounts must be approved by the Chief Engineer of the Clark County Regional Flood Control District.

A written request must be made to the District and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

2. The City and District will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual, the City shall submit invoices together with a detailed summary report of the maintenance service performed. The City shall submit an Invoice Voucher prepared in duplicate in the manner prescribed by the District. The vouchers shall include such information as is necessary for the District to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the City stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program. All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, NV 89101
Attention: Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

Payment shall be considered timely if made by the District within 45 days. Pursuant to Section IV, Paragraph 6, the District may, in its sole discretion, withhold payments to the City for services rendered if the City fails to satisfactorily comply with any term or condition of this contract and/or the District's Operation and Maintenance Manual.

SECTION III - PROJECT TIME

The City agrees to perform the Project to the satisfaction of the District, prior to June 30, 1996. The District may grant extensions or terminate this contract and require all sums advanced to the City to be repaid if the City fails to perform by said date.

SECTION IV - GENERAL

1. The City will complete the project as set forth in Exhibit "A". The City staff personnel responsible for coordination work under this contract are as listed below:

Allen Bell, Flood Control Administrator
Paul Henderson, City Manager

It is understood that the staff named above will be responsible for work coordination throughout the period of this contract unless the District is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract, the parties hereto shall be subject to and governed by the District's Operation and Maintenance Manual, and any applicable portions of the policies and procedures adopted by the District.

3. It is the intent of the District that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan facilities specifically be coordinated among entities. Therefore, in those cases where Master plan approved, the District-funded projects have regional flood control significance impacting more than one entity, the City will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the District shall be responsible for monitoring the performance of the City, approval for payment of billings an and expenses submitted by the City and. the acceptance of any reports provided by the City. The City shall be responsible for monitoring performance of City staff or private contractors, and the City shall maintain detailed records of all payments made to contractors and make such records available to the District upon request.

5. The City shall provide right of access to its facilities to the District or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the City fails to perform the maintenance according to the standards specified in this contract and in the District's Operation and Maintenance Manual, the District may perform or cause to be performed the maintenance necessary to assure proper operations of the facility. Cost incurred by the District shall be reimbursed by the City or be deducted from the amount authorized by this contract. The District may not exercise this right without giving the City specific written notice of the maintenance required and allowing the City 60 days within which to perform said maintenance. The notice required by this provision must be sent to:

Allen Bell, Flood Control Administrator
City of Mesquite
P.O. Box 69
Mesquite, NV 89024

7. The records of the City and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the District, County Auditor or an Agent of the District.

8. If any provision of this contract shall be deemed in conflict with any statute or law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the project will be refunded by the City to the District.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The City hereby indemnifies and shall defend and hold harmless the District, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the City, of anyone acting under its direction or control, or on its behalf in connection with or incident to the performance of this Contract. The City's aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by sole negligence or willful misconduct of the party indemnified or held harmless.

CITY OF MESQUITE

Date of Council Action:

_____ By: _____
KEN CARTER, MAYOR

ATTEST:

_____
CAROL WOODS, CITY CLERK

REGIONAL FLOOD CONTROL DISTRICT

Date of District Action:

_____ By: _____
IRIS BLETSCH, CHAIRMAN

CITY OF .SQUITE
1995-96 MAINTENANCE WORK PROGRAM BUDGET REQUEST

		MES 01 MESQUITE TOWN WASH	MES 02 ABBOTT WASH CHANNEL	MES 03 MESQUITE BLVD. BRIDGE	MES 04 TOWN WASH DETENTION BASIN	MES 05 MESQUITE BLVD. STORM SEWER	1995-96 BUDGET REQUEST TOTAL
0005	CLEAN/INSP IN/OUTLET STRUC	$ 1000	$ 500	$ 1000			$ 2500
0010	INSPECTION (CHANNELS)	$ 310	$ 310				$ 620
0015	CLEAN STORM SEWER LINES					$ 5800	$ 5800
0020	VEGETATION CONTROL	$ 3400	$ 5540		$ 1000		$ 9940
0025	STORM SEWER REPAIR						
0030	CLEAN & RESHAPE CHANNELS	$ 3900	$ 8000		$ 2480		$14380
0035	CLEAN/INSPECT DET BASINS						
0040	REPAIR LINED CHANNELS						
0045	VEGETATION CONTROL DET BASIN						
0050	CLEAN/FLUSH PIPES/CULVERTS	$ 3640	$ 1500				$ 5140
0055	PROVIDE/MAINT EROSION CONTROL						
0060	DEBRIS REMOVAL			$ 200	$ 2080		$ 2280
0065	EROSION REPAIR	$ 2800	$ 2300				$ 5100
0070	FENCE REPAIR						
0075	REPAIR IN/OUTLET STRUCTURE						
0080	MISCELLANEOUS						
0085	MAINTAIN ACCESS ROADS						
0090	SUPV ANNUAL BID CONTRACTS						
0095	DESIGN/ENGINEERING						
		$15050	$18150	$ 1200	$ 5560	$ 5800	$45760

EXHIBIT A

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

Entity: CITY OF MESQUITE Date Prepared: April 1, 1995

Project: MESQUITE TOWN WASH - MES01

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean & Inspect Inlet/Outlet Structures	0005	$1000.00	$	0%	6/30/96
	Inspection (Channels)	0010	$ 310.00		0%	6/30/96
	Clean Storm Sewer Lines	0015				
	Vegetation Control	0020	$3400.00		0%	6/30/96
	Storm Sewer Repair	0025				
	Clean & Reshape Channels	0030	$3900.00		0%	6/30/96
	Clean/Inspect Detention Basins	0035				
	Repair Lined Channels	0040				
	Vegetation Control (Detention Basins)	0045				
	Clean/Flush Pipes/Culverts	0050	$3640.00		0%	6/30/96
	Provide/Maint Erosion Control	0055				
	Debris Removal	0060				
	Erosion Repair	0065	$1800.00		0%	6/30/96
	Fence Repair	0070				
	Repair In/Outlet Structure	0075				
	Miscellaneous	0080				
	Maintain Access Roads	0085				
	Supv Annual Bid Contracts	0090				
	Design/Engineering	0095				
	TOTALS		$14050.50	$		

DELAYS OR PROBLEM AREAS:

NONE

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Cleaning and inspection, vegetation control, reshaping, culvert flushing and erosion repair as required.

Consultant/Contractor:

Project Manager: Allen Bell, P.E. Phone No. (702) 346-5295

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

Entity: CITY OF MESQUITE Date Prepared: April 1, 1995
Project: ABBOTT WASH - MES02

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean & Inspect Inlet/Outlet Structures	0005	$ 500.00		0%	6/30/96
	Inspection (Channels)	0010	310.00		0%	6/30/96
	Clean Storm Sewer Lines	0015				
	Vegetation Control	0020	$5540.00		0%	6/30/96
	Storm Sewer Repair	0025				
	Clean & Reshape Channels	0030	$2000.00		0%	6/30/96
	Clean/Inspect Detention Basins	0035				
	Repair Lined Channels	0040				
	Vegetation Control (Detention Basins)	0045				
	Clean/Flush Pipes/Culverts	0050	$1500.00		0%	6/30/96
	Provide/Maint Erosion Control	0055				
	Debris Removal	0060				
	Erosion Repair	0065	$2300.00		0%	6/30/96
	Fence Repair	0070				
	Repair In/Outlet Structure	0075				
	Miscellaneous	0080				
	Maintain Access Roads	0085				
	Supv Annual Bid Contracts	0090				
	Design/Engineering	0095				
	TOTALS		$18,150.00			

DELAYS OR PROBLEM AREAS:

NONE

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Cleaning and inspection, vegetation control, reshaping, culvert flushing, and erosion repair as required.

sultant/Contractor: _____

Project Manager: Allen Bell, P.E. Phone No. (702) 346-5295

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

Entity: CITY OF MESQUITE Date Prepared: April 1, 1995
Project: MESQUITE BOULEVARD BRIDGE - MES03

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean & Inspect Inlet/Outlet Structures	0005	$1000.00	$		6/30/96
	Inspection (Channels)	0010				
	Clean Storm Sewer Lines	0015				
	Vegetation Control	0020				
	Storm Sewer Repair	0025				
	Clean & Reshape Channels	0030				
	Clean/Inspect Detention Basins	0035				
	Repair Lined Channels	0040				
	Vegetation Control (Detention Basins)	0045				
	Clean/Flush Pipes/Culverts	0050				
	Provide/Maint Erosion Control	0055				
	Debris Removal	0060	$ 200.00		0%	6/30/96
	Erosion Repair	006				
	Fence Repair	0070				
	Repair In/Outlet Structure	0075				
	Miscellaneous	0080				
	Maintain Access Roads	0085				
	Supv Annual Bid Contracts	0090				
	Design/Engineering	0095				
	TOTALS		$1200.00			

DELAYS OR PROBLEM AREAS:

NONE

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Structure cleaning and debris removal, as required.

Consultant/Contractor: _____

Project Manager: Allen Bell, P.E. Phone No. (702) 346-5295

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

Entity: CITY OF MESQUITE Date Prepared: April 1, 1995
Project: TOWN WASH DETENTION BASIN - MES04

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean & Inspect Inlet/Outlet Structures	0005	$	$		
	Inspection (Channels)	0010				
	Clean Storm Sewer Lines	0015				
	Vegetation Control	0020	$1000.00		0%	6/30/96
	Storm Sewer Repair	0025				
	Clean & Reshape Channels	0030	$2480.00		0%	6/30/96
	Clean/Inspect Detention Basins	0035				
	Repair Lined Channels	0040				
	Vegetation Control (Detention Basins)	0045				
	Clean/Flush Pipes/Culverts	0050				
	Provide/Maint Erosion Control	0055				
	Debris Removal	0060	$2080.00		0%	6/30/96
	Erosion Repair	0065				
	Fence Repair	0070				
	Repair In/Outlet Structure	0075				
	Miscellaneous	0080				
	Maintain Access Roads	0085				
	Supv Annual Bid Contracts	0090				
	Design/Engineering	0095				
	TOTALS		$5560.00	$		

DELAYS OR PROBLEM AREAS:

NONE

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Vegetation control, basin cleaning, debris removal, as required.

Consultant/Contractor:

Project Manager: Allen Bell, P.E. Phone No. (702) 346-5295

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM STATUS REPORT

Entity: CITY OF MESQUITE Date Prepared: April 1, 1995
Project: MESQUITE BLVD. STORM SEWER - MES05

FORCE ACCOUNT/ CONTRACT	ACTIVITY		APPROVED WORK PLAN $ AMOUNT	AMENDED WORK PLAN $ AMOUNT	PERCENT COMPLETE	SCHEDULED COMPLETION DATE
	Clean & Inspect Inlet/Outlet Structures	0005				
	Inspection (Channels)	0010				
	Clean Storm Sewer Lines	0015	$5800.00		0%	6/30/96
	Vegetation Control	0020				
	Storm Sewer Repair	0025				
	Clean & Reshape Channels	0030				
	Clean/Inspect Detention Basins	0035				
	Repair Lined Channels	0040				
	Vegetation Control (Detention Basins)	0045				
	Clean/Flush Pipes/Culverts	0050				
	Provide/Maint Erosion Control	0055				
	Debris Removal	0060				
	Erosion Repair	0065				
	Fence Repair	0070				
	Repair In/Outlet Structure	0075				
	Miscellaneous	0080				
	Maintain Access Roads	0085				
	Supv Annual Bid Contracts	0090				
	Design/Engineering	0095				
	TOTALS		$5,800.00			

DELAYS OR PROBLEM AREAS:

NONE

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

Cleaning and inspection, vegetation control, reshaping, culvert flushing, and erosion repair as required.

Consultant/Contractor: _____

Project Manager: Allen Bell, P.E. **Phone No.** (702) 346-5295

CLARK COUNTY

REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT: Interlocal Contract for the 1995/96 Annual Maintenance Program
PETITIONER: James A. Bell, P.E., Public Works Deputy Director City of North Las Vegas

RECOMMENDATION OF PETITIONER:

It is recommended that the Clark County Regional Flood Control District Board approve and authorize the Chairman to sign the Interlocal Contract for the 1995/96 Annual Maintenance Program

FISCAL IMPACT:

$237,015

BACKGROUND:

The proposed contract provides for maintenance by the City of North Las Vegas of certain flood control facilities identified in the District's Master Plan. The work will be in accordance with performance standards of the Clark County Regional Flood Control District's Operation and Maintenance Manual. The program is more specifically described in Exhibit "A" of the proposed contract attached.

Respectfully submitted,

TAC AGENDA ITEM # **Date:**	**RFCD AGENDA ITEM #** **Date:**

INTERLOCAL CONTRACT
ANNUAL MAINTENANCE PROGRAM

THIS CONTRACT, made and entered into this _____ day of _____, 1995, by and between the City of North Las Vegas, a political subdivision of the State of Nevada, hereinafter referred to as "City"; and the Clark County Regional Flood Control District, hereinafter referred to as "District".

WITNESSETH

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the District may approve and fund projects to maintain flood control improvements; and

WHEREAS, the City desires to maintain flood control improvements located on The 1995/96 Annual Maintenance Work Plan in accordance with the maintenance program set forth herein and hereinafter referred to as "Project", and

WHEREAS, the facility upon which maintenance will be done is a facility described in the District's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the District authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This interlocal contract applies to the maintenance of flood control facilities which

are identified in the District's Master Plan, including updates and amendments subsequently approved. The basic maintenance of the facilities will be in accordance with performance standards of the Operation and Maintenance Manual. The Project is more specifically described in Exhibit "A" which is attached hereto and by this reference incorporated herein.

SECTION II-PROJECT COSTS

The District agrees to provide reimbursement for Project cost within the limits specified below:

1. The Project costs shall not exceed $237,015. The amounts allocated to each individual facility within the Project must be specified in Exhibit "A". Any changes to said allocated amounts must be approved by the District's Chief Engineer.

A written request must be made to the District and a supplemental interlocal contract approved to increase the amount noted above prior to payment of any additional funds.

2. The City and District will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual, the City shall submit invoices together with a detailed summary report of the maintenance service performed. The City shall submit an invoice voucher prepared in duplicate in the manner prescribed by the District. The vouchers shall include such information as is necessary for the

District to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the City stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in annual work program.

All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101
Attention: Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

Payment shall be considered timely if made by the District within 45 days. Pursuant to Section IV, Paragraph 6, the District may, in this sole discretion, withhold payment to the City for services rendered if the City fails to satisfactorily comply with any term or condition of this contract and/or the District's Operation and Maintenance Manual.

SECTION III-PROJECT TIME

The City agrees to perform the Project to the satisfaction of the District prior to June 30, 1996. The District may grant extensions or terminate this contract and require all sums advanced to the City to be repaid if the City fails to perform by said date.

SECTION IV-GENERAL

1. The City will complete the Project as set forth in Exhibit "A". The City staff personnel responsible for coordination work under this contract are as listed below:

Gary W. Holler, P.E., Director of Public Works, or his designee.

It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the District is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this contract, the parties hereto shall be subject to and governed by the District's Operation and Maintenance Manual and any applicable portions of the Policies and Procedures adopted by the District.

3. It is the intent of the District that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved and District-funded projects have regional flood control significance impacting more than one entity, the City will allow all impacted entities an op portunity to review the maintenance schedule in order to coordinate maintenance

efforts.

4. The Chief Engineer of the District shall be responsible for monitoring the performance of the City, approval for payment of billings and expenses submitted by the City, and the acceptance of any reports provided by the City. The City shall be responsible for monitoring performance of City staff or private contractors, and City shall maintain detailed records of all payments made to contractors and make such records available to the District upon request.

5. The City shall provide right of access to its facilities to the District or Chief Engineer at all reasonable times in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the City fails to perform the maintenance according to the standards specified in this contract and in the District's Operation and Maintenance Manual, the District may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the District shall be reimbursed by the City or be deducted from the amount authorized by this contract. The District may not exercise this right without giving the City specific written notice of the maintenance required and allowing the City 60 days within which to perform said maintenance.

The notice required by this provision must be sent to:

Gary W. Holler, P.E.
Director of Public Works
City of North Las Vegas
Post Office Box 4086
North Las Vegas, Nevada 89036-4086

7. The records of the City and/or private contractors pertaining to the subject matter of this contract shall, at all reasonable times, be subject to inspection and audit by the District, County Auditor, or an agent of the District.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the project will be refunded by the City to the District.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The City hereby indemnifies and shall defend and hold harmless the District its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs or expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned, or contributed to in whole or in part, by reason of any act, omission, fault, or negligence, whether active or passive of the City, of anyone acting under its direction or control or on its behalf in connection with or incident to the performance of this Contract. The City's aforesaid indemnity and hold harmless obligations, or portions of applications thereof, shall apply to the fullest extent permitted by law but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

IN WITNESS WHEREOF, the parties have caused this contract to be executed the day and year first above written.

****

****

CITY OF NORTH LAS VEGAS

Date of Council Action:

_____ _____

JAMES K. SEASTRAND, Mayor

Attest:

_____

EILEEN SEVIGNY, City Clerk

****

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

Date of District Action:

_____ _____

IRIS BLETSCH, Chairman

Attest:

_____ _____

DEANNA LEFKO
Board Secretary

CHRISTOPHER FIGGINS
Deputy District Attorney

EXHIBIT "A"

CITY OF NORTH LAS VEGAS
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
1995/96 MAINTENANCE WORK PLAN

SUMMARY

	FACILITY DESCRIPTION	COST
NLV 01	LAS VEGAS WASH - NORTH REACH	16,250
NLV 02	LAS VEGAS WASH	114,560
NLV 03	NORTHERN TRIBUTARY OF NW TRIBUTARIES OF LAS VEGAS WASH	18,355
NLV 04	LAS VEGAS RANGE WASH WEST BRANCH	14,910
NLV 05	NORTH LAS VEGAS DETENTION BASIN	16,600
NLV 06	UPPER WASH DETENTION BASIN	13,150
NLV 07	CAREY AVE./W. LAKE MEAD DETENTION BASIN	13,150
NLV 08	GOWAN OUTFALL CHANNEL	16,890
NLV 09	KYLE CANYON DETENTION BASIN	13,150
	TOTAL	**$ 237,015**

CITY OF NORTH LAS VEGAS
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
1995/96 ANNUAL MAINTENANCE WORK PLAN

FACILITY	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP OPR & SUPR ANNUAL MAN DAYS	MAINT WKR ANNUAL MAN DAYS	MAINT WORKER $125 / DAY	EQUIP OPR & SUPR $160/DAY	EQUIP & MATERIALS	COST TOTAL
NLV01 - LAS VEGAS WASH - NORTH REACH DECATUR BLVD TO NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUTARIES	10	Inspect All Master Plan Designated Channels	10 Miles	100 % / Year	2.5 Mi/Day	1 Supervisor	4.0			$640	$185	$825
	80	Miscellaneous/Unspecified Response	10 EA	200 % / Year	2 EA/ Day	1 Maint. Worker/ 1 Equip. Opr.	5.0	5	$625	$800	$225	$1,650
NLV01 - LAS VEGAS WASH - NORTH REACH BETWEEN CHEYENNE AVE & HAMMER	30	Clean and Reshape	2.25 Miles	67 % / Year	0.5 Mi/Day	1 Supervisor 3.5 Equip Oprs.	30.0		$0	$6,300	$4,500	$10,800
	45	Perform Vegetation Control	3 Miles	100 % /Year	1.5 Mi/Day	2 Maint. Workers		4.0	$500	$0	$600	$1,100
	70	Maintenance/ Repair of Fencing	300 LF	20 % / Year	100 LF/Day	2 Maint. Workers 1.5 Equip. Oprs.	5.0	7	$875	$800	$200	$1,875
										SUBTOTAL		$16,250
NLV02 - LAS VEGAS WASH	10	Inspect All Master Plan Designated Channels	2 Miles	100 % / Year	1.0 Mi /Day	1 Supervisor				$160	$50	$210
	45	Perform Vegetation Control	2.0 Miles	100 % / Year		2 Maint. Workers		3.0	$375	$0	$450	$825
	70	Maintenance/ Repair of Fencing	300 LF	20 % / Year	100 LF/Day	2 Maint. Workers 1.5 Equip. Oprs.	5.0	7	$875	$800	$200	$1,875
	80	Miscellaneous/Unspecified Response	10 EA	100 % / Year	2 EA/ Day	1 Maint. Worker/	5.0	5	$625	$800	$225	$1,650
NLV02 - LAS VEGAS WASH E LAKE MEAD BL TO CONFLUENCE OF NLVW1 AND NORTH REACH	30	Clean and Reshape	2.00 Miles	100 % / Year							Outside Cost	$110,000
										SUBTOTAL		$114,560

	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP OPR & SUPR ANNUAL MAN DAYS	MAINT. WKR. ANNUAL MAN DAYS	MAINT. WORKER $125 / DAY	EQUIP OPR & SUPR $160/DAY	EQUIP. & MATERIALS	COST TOTAL
NEVA3	NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT	10	Inspect All Master Plan Designated Channels	9 Miles	100 % / Year	2.5 Mi/Day	1 Supervisor	2.0			$-	$480	$140	$620
	ALTEN LANE TO LAS VEGAS WASH NORTH REACH JUNCTION	80	Miscellaneous/Compl. Response	10 EA	100 % / Year	2 EA/ Day	1 Maint. Worker	5.0	5	$625	$800	$225	$1,650
		70	Maintenance/ Repair of Fencing	300 LF	20 % / Year	100 LF/Day	2 Maint. Workers 1.5 Equip. Oprs.	5.0	7	$875	$800	$200	$1,875
NEVA3	NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT	30	Clean and Reshape	2.25 Miles	67 % / Year	0.5 MI / Day	1 Supervisor 3.5 Equip Oprs.	30.0		$0	$6,300	$4,500	$10,800
	CONFLUENCE OF STNWT & NORTH REACH TO ALEXANDER	45	Perform Vegetation Control	5 Miles	100 % /Year	1.5 Mi/Day	2 Maint. Workers		4.0	$500	$0	$600	$1,100
NEVA3	NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT.	50	Clean and Flush Culverts	3 EA.	50 % / Year	10 EA /Day	1 Equipment Opr. 1 Maint. Worker	0.3	0.3	$38	$48	$264	$350
	OF THE LAS VEGAS WASH @ CIVIC CENTER DR THREE 30' x 9' RCB												
NEVA3	NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT.	50	Clean and Flush Culverts	3 EA.	50 % / Year	10 EA /Day	1 Equipment Opr. 1 Maint. Worker	0.3	0.3	$38	$48	$264	$350
	OF THE LAS VEGAS WASH @ LOSEE 90' BY 9' TRAPEZOIDAL BRIDGE												
NEVA3	NORTHERN TRIBUTARY OF NORTHWEST TRIBUT.	50	Clean and Flush Culverts	4 EA.	50% / Year	10 EA / Day	1 Equipment Opr. 1 Maint. Worker	0.4	0.4	$50	$64	$346	$460
	OF THE LAS VEGAS WASH @ FIFTH ST FOUR 8 X 8 R.C.B.												
NEVA3	NORTHERN TRIBUTARY OF NORTHWEST TRIBUT.	50	Clean and Flush Culverts	6 EA.	50% / Year	10 EA / Day	1 Equipment Opr. 1 Maint. Worker	0.6	0.6	$75	$96	$519	$690
	OF THE LAS VEGAS WASH @ CRAIG RD. DBI 6.5 X 8 & FOUR 8 X 8 R.C.B.												
NEVA3	NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT.	50	Clean and Flush Culverts	2 EA.	50 % / Year	10 EA /Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$173	$230
	OF THE LAS VEGAS WASH @ CAMINO AL NORTE DBI 20' X 10'												

	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP OPR & SUPR ANNUAL MAN DAYS	MAINT WKR ANNUAL MAN DAYS	MAINT WORKR $125 / DAY	EQUIP OPR & SUPR $160/DAY	EQUIP & MATERIALS	COST TOTAL
NLV03 - NORTHERN TRIBUTARY OF NORTHWESTERN TRIBUT. OF THE LAS VEGAS WASH @ CRAIG RD -1/4 MI W. OF 5TH DBL 10' X 5' R.C.B.	50	Clean and Flush Culverts	2 EA.	50 % / Year	10 EA /Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
										SUBTOTAL		$18,355
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH TROPICAL PARKWAY TO CRAIG ROAD	10	Inspect All Master Plan Designated Channels	3 Miles	100 % / Year	2.5 Mi/Day	1 Supervisor	1.0			$160	$50	$210
	30	Clean and Reshape	2.25 Miles	67 % / Year	0.5 Mi/Day	1 Supervisor 3.5 Equip Oprs.	30.0			$6,300	$4,500	$10,800
	45	Perform Vegetation Control	3 Miles	100 % / Year	1.5 Mi / Day	3 Maintenance Wkrs.		4.0	$500	$0	$600	$1,100
	80	Miscellaneous/Unpgd. Response	10 EA	100 % / Year	2 EA/ Day	3 Maint. Workers/	5.0	5	$625	$800	$225	$1,650
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH @ CRAIG R DBL 10 X 4 R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH @ 1st CULVERTS NORTH OF CRAIG RD DBL 10 X 4 R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH @ 2nd CULVERTS NORTH OF CRAIG RD DBL 10 X 3 R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH @ 3rd CULVERTS NORTH OF CRAIG RD DBL 10 X 3 R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
NLV04 - LAS VEGAS RANGE WASH - WEST BRANCH @ LONE M DBL 10 X 3 R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$175	$230
										SUBTOTAL		$14,910

EXHIBIT "A"

Page 4

FACILITY	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP. OPR. & SUPR. ANNUAL MAN DAYS	MAINT. WKR. ANNUAL MAN DAYS	MAINT. WORKR $125 / DAY	EQUIP. OPR. & SUPR. $160/DAY	EQUIP. & MATERIALS	COST TOTAL
NLV05 - NORTH LAS VEGAS DETENTION BASIN	05	Clean and Inspect	1 EA.	100 % / Year	1 EA / Day	3 Equipment Oprs. 2 Maint. Workers	6.0	4.0	$500	$1,000	$2,000	$3,500
	45	Vegetation Control	40 Ac	50 % /Year	4 AC / Day	1 Equipment Opr.	10			$1,600	$2,000	$3,600
	70	Maintenance/Repair Fencing	500 LF	20 % / Year	100 LF / Day	1.5 Equip. Oprs. 2 Maint. Workers	15	20	$1,250	$1,200	$300	$2,750
	85	Maintain Access Road	.75 MI	50 % / Year	0.5 MI / Day	2 Equip. Oprs.	6			$950	$2,500	$3,450
	88	Miscellaneous/ Complaint Response	20 EA.	100 % / Year	3 EA / Day	1 Equipment Opr. 1 Maint. Worker	10	10	$1,250	$1,600	$450	$3,300
											SUBTOTAL	$16,600
NLV06 - UPPER WASH DETENTION BASIN (MOCASSIN ROAD)	05	Clean and Inspect	1 EA.	100 % / Year	1 EA / Day	3 Equipment Oprs. 2 Maint. Workers	6.0	4.0	$500	$1,000	$2,000	$3,500
	45	Vegetation Control	40 Ac	50 % /Year	4 AC / Day	1 Equipment Opr.	10			$1,600	$2,000	$3,600
	70	Maintenance/Repair Fencing	500 LF	20 % / Year	100 LF / Day	1.5 Equip. Oprs. 2 Maint. Workers	15	20	$1,250	$1,200	$300	$2,750
	88	Miscellaneous/ Complaint Response	20 EA.	100 % / Year	3 EA / Day	1 Equipment Opr.	10	10	$1,250	$1,600	$450	$3,300
											SUBTOTAL	$13,150

FACILITY	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP OPR & SUPR ANNUAL MAN DAYS	MAINT WKR ANNUAL MAN DAYS	MAINT WORKER $125 / DAY	EQUIP OPR & SUPR $160/DAY	EQUIP & MATERIALS	COST TOTAL
SLV07 - WEST LAKE MEAD/CAREY DETENTION BASIN	05	Clean and Inspect	1 EA.	100 % / Year	1 EA / Day	3 Equipment Oprs. 2 Maint. Workers	6.0	4.0	$500	$1,000	$2,000	$3,500
	45	Vegetation Control	40 Ac	50 % /Year	4 AC / Day	1 Equipment Opr.	10			$1,600	$2,000	$3,600
	70	Maintenance/Repair Fencing	500 LF	20 % / Year	100 LF / Day	1.5 Equip. Oprs. 2 Maint. Workers	15	20	$1,250	$1,200	$300	$2,750
	80	Miscellaneous/Complaint Response	20 EA.	100 % / Year	2 EA / Day	1 Equipment Opr.	10	10	$1,250	$1,600	$450	$3,300
										SUBTOTAL		$13,150
SLV08 - GOWAN OUTFALL CHANNEL COMMERCE ST TO FERRELL	30	Clean and Reshape	2.25 Miles	67 % / Year	0.5 Mi/Day	1 Supervisor 3.5 Equip Oprs.	30.0			$6,300	$4,500	$10,800
	70	Maintenance/ Repair of Fencing	4.0 Miles	20 % / Year	100 LF/Day	2 Maint. Workers 1.5 Equip. Oprs.	10.0	14	$1,750	$1,600	$400	$3,750
	80	Miscellaneous/Complt. Response	20 EA.	100 % / Year	2 EA/ Day	1 Maint. Worker	5.0	5	$625	$800	$225	$1,650
SLV08 GOWAN OUTFALL CHANNEL @ CAMINO AL NORTE 3.16'X 7' R.C.B.	50	Clean and Flush Culverts	1 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$173	$230
SLV08 GOWAN OUTFALL CHANNEL @ CLAYTON 3.12'X 5' R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$173	$230
SLV08 GOWAN OUTFALL CHANNEL @ CAMINO AL NORTE 3.12'X 5' R.C.B.	50	Clean and Flush Culverts	2 EA	50% / Year	10 EA/Day	1 Equipment Opr. 1 Maint. Worker	0.2	0.2	$25	$32	$173	$230
										SUB-TOTAL		$16,890

FACILITY	ITEM #	MAINTENANCE CATEGORY	UNITS TO MAINTAIN	RECOMMEND FREQUENCY	PLANNING STANDARD	LABOR REQUIREMENT	EQUIP. OPR. & SUPR. ANNUAL MAN DAYS	MAINT. WKR. ANNUAL MAN DAYS	MAINT. WORKR $125 / DAY	EQUIP. OPR. & SUPR. $160/DAY	EQUIP. & MATERIALS	COST TOTAL
ALY09 - KYLE CANYON DETENTION BASIN	05	Clean and Inspect	1 EA.	100 % / Year	1 EA / Day	3 Equipment Oprs. 2 Maint. Workers	6.0	4.0	$500	$1,000	$2,000	$3,500
	45	Vegetation Control	40 Ac	50 % /Year	4 AC / Day	1 Equipment Opr.	10			$1,600	$2,000	$3,600
	70	Maintenance/Repair Fencing	500 LF	20 % / Year	100 LF / Day	1.5 Equip. Oprs. 2 Maint. Workers	15	20	$1,250	$1,200	$300	$2,750
	80	Miscellaneous/ Complaint Response	20 EA	100 % / Year	2 EA / Day	1 Equipment Opr.	10	10	$1,250	$1,600	$450	$3,300
											SUBTOTAL	$13,150
											TOTALS BY FACILITY	$237,015

5	$14,000
10	$1,865
30	$153,200
45	$18,525
50	$4,150
70	$20,375
80	$21,450
85	$3,450
TOTAL BY ITEMS	$237,015

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:

RFCD OPERATIONS AND MAINTENANCE MANUAL - 1995 REVIEW

RECOMMENDATION SUMMARY

STAFF: Adopt the amendments.

TECHNICAL ADVISORY: Adopt the amendments.

CITIZENS ADVISORY: Adopt the amendments.

RFCD AGENDA
ITEM # 11
Date: 07/13/95

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

AGENDA ITEM

SUBJECT:

RFCD OPERATIONS AND MAINTENANCE MANUAL - 1995 REVIEW

PETITIONER:

GALE WM. FRASER, II, P.E., GENERAL MANAGER/CHIEF ENGINEER

RECOMMENDATION OF PETITIONER:

ADOPT THE AMENDMENTS TO THE RFCD OPERATIONS AND MAINTENANCE MANUAL AND AUTHORIZATION TO REPRODUCE AND DISTRIBUTE THE MANUAL TO APPROPRIATE ENTITY STAFF AT NO COST

FISCAL IMPACT:

$200 (estimated - Fund 286)

BACKGROUND:

In 1990, the District authorized URS Consultants to prepare the District *Operations and Maintenance Manual*, in accordance with NRS 543.340(4) and the Uniform Regulations. The original document, prepared through the District with the support and cooperation of each affected Entity, was ultimately adopted by the Board on November 8, 1990.

In accordance with Section 4.21 of the Operations and Maintenance Manual, the manual is being updated at this time to reflect fiscal implications and experience gained.

Staff recommends adoption of the proposed amendments to the *Operations and Maintenance Manual* effective upon Board approval, and authorization to reproduce and distribute updated manuals to the appropriate Public Works staffs.

Respectfully submitted,

Gale Wm. Fraser, II, P.E.
General Manager/Chief Engineer

TAC AGENDA	RFCD AGENDA
ITEM #8	ITEM # II
Date: 05/25/95	Date: 07/13/95

TAC AGENDA
ITEM #4
DATE: 06/29/95

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Regional Flood Control District

AGENDA ITEM DEVELOPMENT

Staff Discussion: **Date:** 07/03/95

RFCD OPERATIONS AND MAINTENANCE MANUAL - 1995 REVIEW

The agenda backup includes the proposed amendments to the *Operations and Maintenance Manual.* The Technical Advisory Committee first heard this item on May 25, 1995, and held it until the June 29 meeting to further review the changes. Staff has been working with the individual entities to incorporate their suggested changes. The District Attorney has reviewed the amendments.

Staff Recommendation:

Adopt the amendments.

Discussion by Technical Advisory Committee: **AGENDA** #4 Date: 06/29/95

Recommendation:

Adopt the amendments.

Discussion by Citizens Advisory Committee: **AGENDA** #4 Date: 07/03/95

Recommendation:

Adopt the amendments.

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CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

OPERATIONS AND MAINTENANCE MANUAL

~~URS Consultants~~
~~Roy Jorgensen Associates~~

October 1990
Revised June 1995

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Printed: May 16, 1995

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

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CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

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CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

APPENDICES

APPENDIX A: The District's Statutory Responsibility for Maintenance

APPENDIX B: ~~System Inventory~~Sample Authorization-To-Proceed Interlocal Contract

APPENDIX C: ~~Example~~Sample Interlocal Contract

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

CHAPTER 1
EXECUTIVE SUMMARY

1.10 EXECUTIVE SUMMARY

The Clark County Regional Flood Control District (District) was created under NRS 543 with responsibility to plan, construct and maintain drainage and flood control facilities throughout Clark County. In order to comply with NRS 543.340(4), this Operations and Maintenance Manual has been prepared through the cooperation and support of all of the affected Entities in the County. The document sets forth both policies and procedures by which the maintenance of the drainage and flood control facilities will be achieved to assure their proper working order at the time of need. The overall goal of the maintenance program as adopted by the District Board is as follows:

> *Comply with the provisions of NRS 543.340(4) and assure that facilities in the master plan are maintained in a manner that maximizes their useful life and ensures their operation at design capacity during a storm event.*

Ten policy statements were also adopted supporting the above goal.

In order to achieve the goal, and to comply with the adopted policies, the following procedures have been developed in an open and very participatory manner.

Funding Procedure - Provides for a means by which the Entities can be reimbursed for activities associated with maintenance of drainage and flood control facilities on the Master Plan provided they meet criteria as set forth in the manual.

Administrative Procedure - Provides for establishing standards and levels of service by which maintenance will be achieved. This procedure includes the steps and schedule by which an annual work plan is established and adopted by the District Board. It also provides for the certification of performance by each Entity in accordance with the annual interlocal contract. The ability for the Entity to contract maintenance activities to private contractors is also authorized under this procedure.

Maintenance Procedures - This procedure provides the specific activities under which the maintenance program is to be carried out as listed below:

ACTIVITY NUMBER	ACTIVITY NAME	WORK MEASURE UNIT
~~2.05~~	Inspect Channels	Miles
~~3.10~~	Clean and Reshape Channels	Cubic Yards
~~5.15~~	Repair Lined Channel	~~Repairs~~Each
~~11.20~~	Provide/Maintain Erosion Control	Square Feet
~~9.25~~	Clean and Inspect Detention/Debris Basins	Cubic Yards
~~12.30~~	Erosion Repair	Cubic Yards
~~14.35~~	Fence Repair	Linear Feet
~~4.40~~	Vegetation Control - Chemical	~~Gallons~~Acres
~~10.45~~	Vegetation Control ~~Detention Basins~~ - Mechanical	Acres
~~15.50~~	Maintain Access Road	Miles
~~1.55~~	Clean and Inspect Inlet/Outlet Structures	~~Structures~~Each
~~13.60~~	Repair Inlet/Out~~flowlet~~ Structures	~~Repairs~~Each
~~7.65~~	Clean Storm Sewer Lines	Linear Feet
~~8.70~~	Storm Sewer Repair	Repairs
~~6.75~~	Clean/Flush Culverts & Bridges	~~Culverts~~Each
~~16.80~~	Misc. Work Activities	Labor Hours
85	Engineering	Labor Hours

A specific performance standard has been developed for each activity setting forth the following elements:

- The most effective crew size.
- The kinds and number of equipment required.
- The major types of material that should be used.
- Recommended procedures for performing the work.
- An estimate of expected average daily accomplishment with standard crew size, equipment and procedures.
- Authorization and scheduling criteria.

Inventory Procedures - A critical element of any maintenance program is the identification and condition of the overall drainage and flood control system. In the case of this program, the inventory also identifies those facilities that are "eligible" for reimbursement of maintenance activities, provided the work is a part of the annual plan. ~~A physical inventory list was developed by each Entity and a map developed identifying those facilities on the Master Plan. The inventory and maps are incomplete due to limited available documentation, but will be updated over the next several months as Master Plans are likewise updated. This procedure also provides for a means by which new facilities are added to the inventory and mapping system.~~ Facilities eligible are those identified in the Regional Flood Control District's Master Plan and any revisions, amendments, and/or changes subsequently approved. Only those facilities that exist as Master Plan facilities, or exist in the same alignment as a proposed Master Plan facility and appurtenant facilities are eligible.

Maintenance is an ongoing and very dynamic function of a successful drainage and flood control program. This Operations and Maintenance Manual sets forth an initial set of policies and procedures, including the various actions required to achieve the maintenance goal. The manual will need to be updated on a regular basis to reflect fiscal implications and the experience gained as the District continuous to grow and to serve the citizens and tax payers of Clark County.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

CHAPTER 2
INTRODUCTION

2.10 BACKGROUND

The Clark County Regional Flood Control District (District) was established in 1986 to plan, construct, and maintain drainage and flood control facilities. These responsibilities focused on alleviating the potential for flooding and protecting the lives and property of District residents. The initial phases of the District's program succeeded in preparing a Master Plan, uniform design criteria, regulatory standards, and constructing facilities. As these areas have progressed, the District, along with other agencies and Entities in the County, has oriented its efforts towards assuring adequate maintenance of flood control facilities and conveyance systems. This orientation is consistent with the vital role maintenance plays in all comprehensive flood control programs. This *Operations and Maintenance Manual* has been prepared through the District with the support and cooperation of each affected Entity. It represents a commitment to uniform flood control system standards and establishes a blueprint for a cost effective and consistent maintenance program throughout the District.

2.20 AUTHORITY

Nevada Revised Statute (NRS) 543 mandates that the District shall undertake programs for both construction and maintenance of flood control facilities. A commitment to building and maintaining flood control facilities within Clark County is reiterated in the District's *Uniform Regulations for the Control of Drainage* which states that capital improvements, operation, **and** maintenance are all interrelated parts of the District's overall flood control program. In accordance with NRS 543.340(4) and the Uniform Regulations, the District authorized URS Consultants to prepare a specific *Operations and Maintenance Manual* ~~for adoption~~, which was adopted by the ~~Flood Control~~ District Board on November 8, 1990. To reflect fiscal implications and experience gained, the manual was updated in 1995.

2.30 RESPONSIBILITY

The District was formed, in part, to fund and coordinate the construction and maintenance of facilities to alleviate flooding and protect the life and property of citizens within the boundaries of the District. It is the responsibility of the District to prepare and update the Master Plan for the control of floods, and manage the Regional Fund for the Control of Floods in a manner consistent with NRS 543.

2.40 APPROACH

~~The District, to date, has undertaken an aggressive program of facility planning, regulation development and capital construction, however, the District has recognized that a maintenance program must be implemented as part of its comprehensive planning process. In addition, this~~ The maintenance program must assure that the flood control projects funded by the District are maintained at a level which maximizes their useful life and assures that facilities operate to design capacity. As an interconnected network of conveyances and structures, failure of any flood control facility to operate properly may affect the performance of the overall system within a specific watershed.

Flood control facilities require regular maintenance if they are to be functional, visually attractive, and last through their design life. Accordingly, the development of a maintenance program is just as critical to the overall success of a comprehensive flood control effort as basin planning and regulation enforcement. As stormwater and flood control programs begin to address nonpoint pollution/water quality issues, the maintenance program will play an even greater role by enabling cost effective reductions in pollutant loadings to receiving waters. Finally, visibility of the program to the public, which a comprehensive maintenance program affords, is an important factor in demonstrating that flood control management is truly a full-time commitment and not simply a priority only after a storm event. The primary objectives of the District's maintenance program are:

- To develop a complete physical feature inventory for the system.
- To establish overall policies and levels of service.
- To develop operating procedures.

It is also critical that ~~an~~ ongoing inspection and reporting ~~process be implemented~~ procedures continue to assure all systems are ready when needed.

Due to the multiple jurisdictions involved with maintenance of the flood control system, ~~the project recognized that~~ a commitment to this program from all Entities within the Flood Control District was essential. This commitment was made through the Maintenance Technical Committee during the development of the manual in 1990. It was also recognized that coordination of this maintenance program with state transportation programs was critical. The level and consistency of the long range commitment has a direct impact on how effective the resulting maintenance system becomes. This commitment begins with a credible *Operations and Maintenance Manual.*

~~As illustrated on Figure 2-1, an~~ An essential building block for a successful flood control maintenance program in Clark County is a complete physical feature inventory of the system. ~~At this time the District does not have such an inventory, although a system inventory is expected to be prepared as part of the Master Plan update process.~~ It is also important to note that no maintenance program is ever truly "complete". Rather, these programs are constantly

evolving as inventories are defined and standards/costs are further refined. A similar evolution is anticipated for this program. The flexibility to adjust to this evolutionary process has been built into this manual.

2.50 DEFINITIONS

In addition to the definitions of terms and phrases set forth in other District documents, the following apply to operation and maintenance:

Annual Budget: "Annual Budget" means the anticipated costs associated with completion of each activity outlined within the annual work plan submitted by each of the Entities, and ultimately approved by the District Board of Directors prior to the start of each fiscal year.

Annual Work Plan: "Annual work plan" means a plan submitted by each of the Entities setting forth the type and quantity of maintenance to be performed during the ensuing budget year in a form prescribed by the District specifically requesting funds for budgeting purposes.

Certification: "Certification" means the documentation which evidences that required maintenance by an Entity has been completed in accordance with established standards.

Maintenance Program: "Maintenance Program" means that program set annually by the Board based upon the annual work programs submitted by each Entity. The work activities undertaken through the Maintenance Program are funded and contracted for through the annual ~~intergovernmental agreement~~interlocal contracts between ~~the~~each Entity and the District. No matching funds are required, except in those cases where an arrangement has been made to cooperatively fund a particular field activity.

Maintenance work typically excludes local drainageway maintenance such as curb and gutter work, inlet maintenance, and repairs to small piped storm sewer systems. The Maintenance Program contains three broad categories of work.

Routine and/or Preventive Maintenance: "Routine and/or Preventive Maintenance" means work on existing facilities to keep them in proper working conditions, including but not limited to, debris/sedimentation removal, vegetative control, and reshaping.

Restoration: "Restoration" means the repair to existing facilities after a storm event including, erosion repair fence replacement, repairing/replacing trash racks, major debris removal, and similar "one time" work activity.

Rehabilitation: "Rehabilitation" means rebuilding a facility or conveyance after it is destroyed by an event or has deteriorated to the extent that it must be replaced "in kind" including, replacing drop structures, reshaping channels, bank protection restoration, etc. In general, the rehabilitative projects are designed by consultants and the construction contracts are awarded through a bid process.

Acceptance for Maintenance: "Acceptance for Maintenance" means that a project funded by the District, Entity, or other public/private funds is a part of the Master Plan and has been constructed in accordance with District standards and therefore eligible for maintenance funding by the District.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

CHAPTER 3
POLICY STATEMENT

It is important that a maintenance policy statement be adopted which reflects the objectives of both the elected officials and the operations staff charged with its implemention. The initial policy document was prepared and reviewed by District staff and the Maintenance Committee. Following input from the group, it was reviewed by the respective Public Works Directors of all Entities and further revised to reflect their input. The document was then reviewed by the Technical Advisory Committee (TAC) and the Citizens Advisory Committee (CAC) before ~~being presented to the Board at their June 14, 1990 meeting.~~ final adoption by the Board on November 8, 1990. The final adopted policy statement is as follows:

3.10 GOAL

Comply with the provisions of **NRS 543.340 (4)** and assure that facilities in the Master Plan are maintained in a manner that maximizes their useful life and ensures their operation at design capacity during a storm event.

3.20 POLICIES

1. Flood control facilities identified in the Master Plan are eligible for District maintenance funding.

2. As specified in the *Uniform Regulation for the Control of Drainage* **Section 12.050**, facilities funded through the District shall be inspected on an annual basis to assure proper maintenance has been provided.

3. In cases where funded maintenance by the lead Entity is not performed to the standards specified, the District shall perform or cause to be performed the maintenance necessary to assure proper operations of the facility. Costs incurred by the District shall be deducted from the amount authorized in the maintenance agreement between the lead Entity and the District.

4. Flood control facilities improved or constructed after adoption of this policy, must be designed in accordance with District criteria and standards to be eligible for maintenance funding.

5. Access to the facility must be guaranteed to the lead Entity and the District in order to be eligible for maintenance funding.

6. The maintenance requirements applied to these facilities shall be based on the standards contained in the District's *Operations and Maintenance Manual.*

7. The lead Entity must develop an annual work plan to be eligible for maintenance funds. Upon completion of the work, the Entity must certify that the work was completed in accordance with the standards contained in the District's *Operation and Maintenance Manual.*

8. Maintenance funding is available only for repair or maintenance of existing facilities and is not intended to supplement the District's capital improvement program. For example, if the intent of the field activity is to increase the designed capacity of a facility or conveyance, then that function is capital in nature.

9. All facilities eligible for maintenance funding must be publicly owned.

10. Funds may be provided by the District for maintenance of Master Plan facilities by outside contractors under conditions where the use of such an approach is deemed the most efficient and cost effective by the lead Entity.

~~The maintenance program of the District will change over time. As it evolves, this policy statement should be reviewed to assure that represents the direction and desires of the elected representatives of the District.~~

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

CHAPTER 4
PROCEDURES

4.10 FUNDING PROCEDURES

4.11 Purpose

This element of the *Operations and Maintenance Manual* provides the Entities with procedures for the appropriation, expenditure and reimbursement of funds to perform maintenance activities. A principle role of the District shall be to manage and disburse payments to the Entities for maintenance that is performed in compliance with the approved plans. A diagram of the funding flow is shown on **Figure 4-1**.

The District has authorized funding to assist the Entities with major drainageway maintenance in accordance with the priorities listed below:

1. First priority - District owned facilities.

2. Second priority - facilities owned by other public agencies, but totally or partly financed by District funds. (Capital Improvement and Maintenance Project)

3. Third priority - facilities owned by others and constructed by others without District assistance.

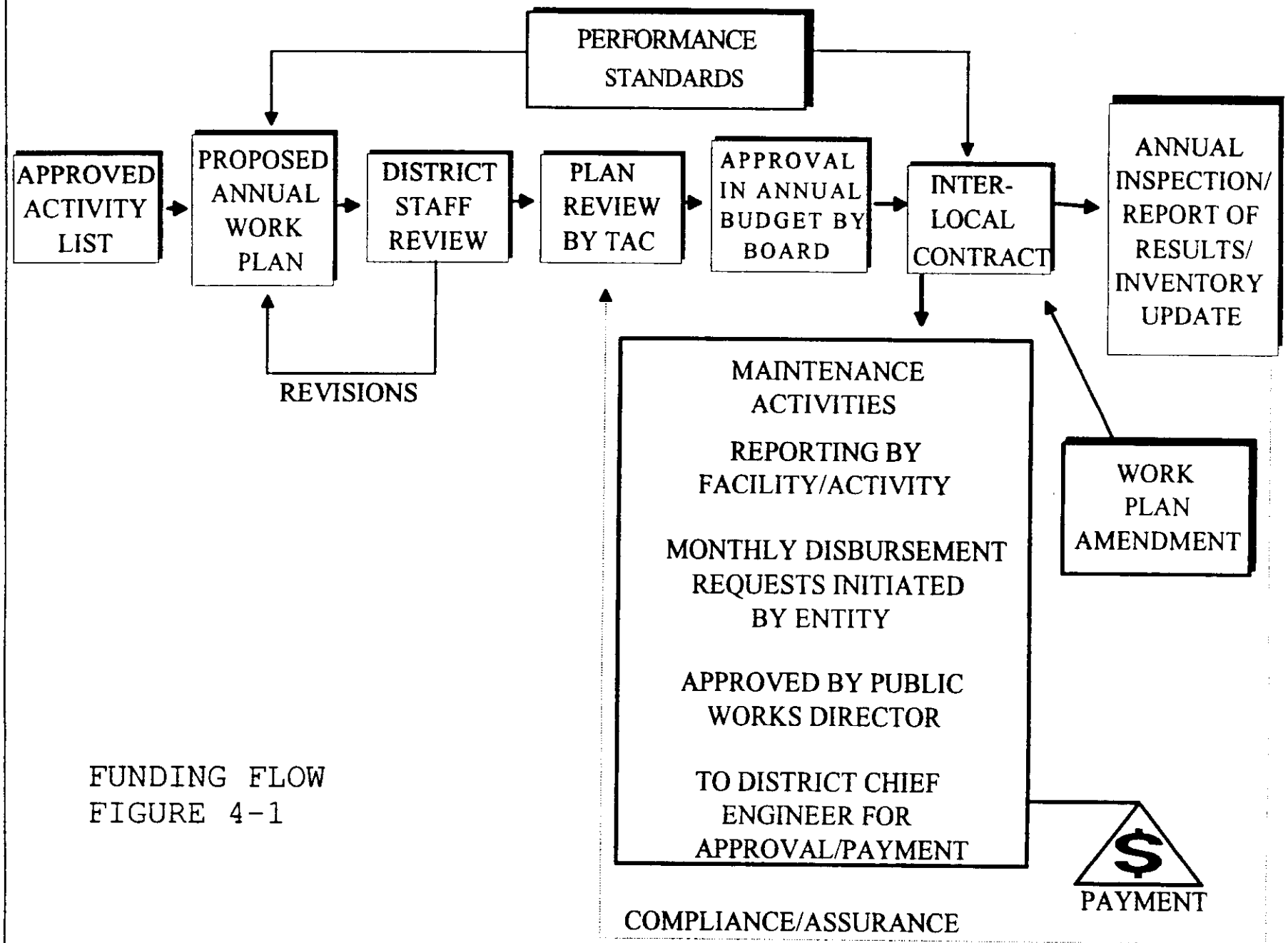
4. Fourth priority - unimproved drainageways.

Projects eligible for District maintenance funding ~~must be on the Master Plan, have plans approved by the District, or must be a part of the Master Plan prior to the adoption of this document. They must also be publicly owned facilities, or have public maintenance/access easements.~~ are those identified in the Regional Flood Control District's Master Plan and any revisions, amendments, and/or changes subsequently approved. Only those facilities that exist as Master Plan Facilities or exist in the same alignment as a proposed Master Plan facility, and appurtenant facilities are eligible.

4.12 ~~Reimbursement~~Payment Procedures

Payment for work performed will be made in accordance with the annual interlocal contract executed as part of the approved work plan and the ~~reimbursement~~payment procedures outlined herein. The primary mechanism for reimbursements shall occur through a purchase order established between the District and each Entity. ~~The purchase order shall stipulate a maximum contract amount to cover the approved work activities in the annual work plans. The purchase order agreement shall be divided into subcategories that correspond with the major work activities outlined in the approved plan. Payment requests shall be submitted on an approved District purchase order draw down request form shown on Figure 4-2.~~ In cases where the Entity directs the District to make payments to a contractor or supplier directly, the purchase

orders will be established between the District and the contractor, consultant, or supplier, at the Entity's request. Unless otherwise contained within this manual, all District *Policies and Procedures* relating to disbursement of funds and reimbursement to Entities apply.



FUNDING FLOW
FIGURE 4-1

Schedule

~~Draw down~~Disbursement requests (invoices) from each Entity may only be submitted for completed work activity and may not be submitted more than once in a 30-day period. ~~Payment~~Disbursement requests must be accompanied by a verification statement from the Entity that the work for which payment is due has been completed in accordance with the standards contained in this manual. The disbursement request ~~for payment~~must identify the Master Plan facility maintained, specific plan activity or activities for which reimbursement is sought, and separately identify personnel, equipment, and other related costs. **(Figure 4-2 represents a sample of the reporting required, and can be obtained on diskette from the District.)** Administrative costs incurred by the Entity in the management of the interlocal contract are not reimbursable. Examples include cost accounting work, secretarial/clerical work, the preparation of requests for payment, and certification statements for work performed under the contract.

All invoices from the Entities requesting reimbursement to the Entity or direct payment to the Entity contractor or vendor must first be submitted to and approved by the Entity's Public Works Director or other designated responsible person in charge of the project. The Chief Engineeror designated District staff will process and approve such payments within 30 days providing the required approval has been obtained and terms of the interlocal contract have been satisfied.

~~The District shall process payment requests from Entities within 45 days.~~ Direct payments to ~~subcontractors~~contractors ~~may be made, however, all payment requests~~ must originate from the Entity, ~~not the contractor. Requests for payments to contractors must~~ be accompanied by a written invoice to the Entity from the contractor, and a certification of work performed by the contractor signed by the Entity. ~~The District shall provide the Entity a statement regarding purchase order balances for all plan activities with each payment.~~

Reporting

Monthly and annual summaries of ~~reimbursement requests, and disbursement amounts~~ purchase order balances, budget status, and facility expenditures shall be prepared by the District as a part of the routine financial reporting procedures to the Board.

REGIONAL FLOOD CONTROL DISTRICT FACILITIES
MAINTENANCE WORK PROGRAM
FISCAL YEAR 1995/96

ENTITY: _____

[ ] Disbursement Request

Vendor Name: _____

Invoice Number: _____

Amount Requested: _____

RFCD Purchase Order #:

[ ] Amended Annual Budget Request

Approved: _____

General Manager/Chief Engineer Date

Clark County Regional Flood Control District

Master Plan No./ Facility Number	____	____	____	____	____	____	____	____	____	____	TOTAL
Activity 05											0.00
Activity 10											0.00
Activity 15											0.00
Activity 20											0.00
Activity 25											0.00
Activity 30											0.00
Activity 35											0.00
Activity 40											0.00
Activity 45											0.00
Activity 50											0.00
Activity 55											0.00
Activity 60											0.00
Activity 65											0.00
Activity 70											0.00
Activity 75											0.00
Activity 80											0.00
Activity 85											0.00
											0.00

I certify that the above described maintenance was performed in accordance with the criteria/standards contained in the District's Operations and Maintenance Manual. Further, the information contained in this Disbursement Request accurately reflects those costs incurred during the performance of this work.

m:\o\fig4_2.xls

FIGURE 4-2

_____
Signed Date

4.20 ADMINISTRATIVE PROCEDURES

4.21 Purpose

The purpose of this element of the *Operations and Maintenance Manual* is to provide specific procedures for establishing standards and levels of service, preparing the annual work plan, administrating the planning, approval and enforcement elements and updating the ~~policy and procedures~~manual over time. The principal role of the District shall be to review and approve annual maintenance work plans and monitor the performance of work activities. The principal role of the Entities shall be development of annual work plans that are consistent with the District's approved maintenance activity list; performance of the maintenance work set forth in the approved work plans; and the ~~preparation~~submittal of ~~an annual~~ quarterly reports that summarize work performance while certifying compliance with maintenance activity performance standards as set forth in the *Operations and Maintenance Manual.*

4.22 Annual Work Plans

In accordance with the schedule on the following page, each Entity shall submit a proposed annual maintenance work plan containing the following components:~~ shown on Figure 4-3 to the District in accordance with the schedule below.~~

Section 1	Program Summary by Maintenance Project Including Cost for Each Project
Section 2	Summary by Maintenance Activity
Section 3	Individual Maintenance Projects Showing Narrative, Location Map, Work Activities, Results, Costs

District staff shall review the proposed plans and work with the Entities to resolve any discrepancies found with District maintenance standards and policy objectives. After the initial staff review, the plans shall be forwarded to the ~~TAC~~Technical Advisory Committee. Lastly, the plans will be incorporated in the annual District budget and submitted to the Board for final approval.

The activities in the work plan shall be consistent with the District's approved activity list for maintenance of flood control and drainage facilities. Work plans should also describe locally funded work activities that may be linked to the District maintenance work activities to show overlapping areas of responsibility for personnel and equipment. Where local personnel and equipment are going to be used to perform both District funded activities and locally funded activities, the Entity will describe how these resources are to be managed and the procedures for tracking costs related to both sets of activities.

Entities may contract for the performance of maintenance work activities. The proposed work plan must specify that a contractor is to be utilized and the time frame for selection of a contractor. In the event that maintenance work is performed under contract, the contract must specify that the District has the authority to inspect all work performed under the contract and approve or deny payments to contractors based on inspection findings.

All work performed must comply with District approved maintenance activity performance standards as set forth in subsequent sections of this Manual. The Entity is required to inspect Master Plan facilities annually, including any maintenance work performed by Entities on Master Plan Facilities and shall notify the District prior to the annual inspection of completed maintenance work. Entities shall facilitate the inspection of maintenance work by the District. The District may withhold funding, require additional maintenance work, or seek repayment of disbursed funds when an inspection reveals that work activities were not performed in conformance with activity performance standards.

Schedule

~~November 1~~February 1	-	Submittal of preliminary work plan proposal to District staff for review~~—and~~, recommendations, and coordination with entities.
~~December 1~~	~~—~~	~~Submittal of proposed work plans to Technical Advisory Committee (TAC) for incorporation into the District budget review cycle.~~
~~March 10~~	~~—~~	~~Submittal of District budget to the Board for final review and approval.~~
April 10	-	Submittal of the Entities' final annual work plans, budgets, and interlocal contracts to TAC, CAC, and to the Board for final approval and authorization of the interlocal contracts.
July 1	-	Beginning of maintenance plan contract period.

Reporting

Each Entity will submit quarterly reports indicating the status of the work completed under the current fiscal year's program (Figure 4-3). The reports are due 30 days after the close of the quarter, and will be submitted to the Board for review. Also, each Entity shall submit an annual certification to the District stating that all work contained in the work plan and reimbursed through the interlocal contract has been performed to the specifications established in this manual.

REGIONAL FLOOD CONTROL DISTRICT
MAINTENANCE WORK PROGRAM
QUARTERLY STATUS REPORT - FY 1995/96

Entity: _____ Date Prepared: _____

Facility: _____

Force Account/ Contract	Activity	Approved Work Plan Amount ($)	Amended Work Plan Amount ($)	Percent Complete	Scheduled Completion Date
	5 Inspect Channels				
	10 Clean and Reshape Channels				
	15 Repair Lined Channel				
	20 Provide/Maintain Erosion Control				
	25 Clean & Inspect DetentionDebris Basins				
	30 Erosion Repair				
	35 Fence Repair				
	40 Vegetation Control - Chemical				
	45 Vegetation Control - Mechanical				
	50 Maintain Access Road				
	55 Clean & Inspect Inlet/Outlet Structures				
	60 Repair Inlet/Outlet Structures				
	65 Clean Storm Sewer Lines				
	70 Storm Sewer Repair				
	75 Clean/Flush Culverts & Bridges				
	80 Miscellaneous Work Activities				
	85 Engineering				
	TOTALS	$0	$0		

Delays or Problem Areas:

Work to be Completed During Current Quarter:

Work to be Completed during Next Quarter:

Consultant/
Contractor: _____

Project
Manager: _____ Phone Number: _____

m:o\fig4_3.xls

FIGURE 4-3

4.23 Approval of Annual Work Plan

The work plans received by the District will be reviewed and budget requests compiled into a summary showing the dollar amount by Entity for each of the priority areas set forth in **Section 4.11.** The Chief Engineer shall review the total maintenance budget requests against the District's proposed annual total budget for facility maintenance and make a recommendation to the District as to the amount of maintenance funds to be disbursed to each respective Entity based upon equity and need.

Once the ~~TAC~~Technical Advisory Committee has reviewed the maintenance work plans and budget appropriation recommendation, the Chief Engineer will forward the compiled summary to the Board for consideration and approval as a key element of the Annual District Budget.

Schedule

The Entities will submit the proposed work plan to the Chief Engineer as outlined in **Section 4.22** ~~a minimum of two months prior to the month in which the Board will approve the Districts Annual Budget.~~

Reporting

The Chief Engineer's report to the District Board shall show both the budget requested by the agency and the recommended amount to be appropriated, the report will also make comments on any adjustments made to the initial request.

4.24 Work Plan and Budget Amendments

Requests for amendments to approved work plans and budgets must be submitted to the ~~District~~Chief Engineer in writing. The amendment request must specify the work elements affected, describe the reasons for the amendment request, and describe the impact of the proposed amendment on the affected work plan objectives.

Formal approval of work plan and/or budget amendments requiring a reallocation of funds between facilities must be obtained from the ~~District~~Chief Engineer prior to submittal of payment requests. **(See Figure 4-2.)** The Entity shall also notify District staff of work plan and/or budget amendments within a facility. Requests requiring an increase in the overall work plan budget must be submitted to the Board for approval with a supplemental interlocal contract for the amended work in accordance with **Section 4.6** of the ~~CCRFCD~~District *Policy and Procedures Manual.*

Schedule

Amendment requests shall be reviewed by District staff ~~for not longer than 30 days~~ and responded to in writing within 15 days of receipt of the original request. ~~Staff shall forward the amendment request to the TAC with a recommendation for action. Within 45 days after~~

~~receiving the amendment and staff recommendation, the TAC shall forward the amendment request to the board and either support the staff recommendation or prepare a separate recommendation. Final approval of amendment requests rests with the Board.~~ Work plan amendments which require an increase in the Entity's annual budget will require submittal of an item and supplemental interlocal contract for approval by the District Board of Directors.

Reporting

Annual certification of results will include addressing all amendments made to the annual work plan.

4.25 Certification of Compliance

It is the intent of the District to rely to the maximum extent possible on the Entities to carry out the maintenance activities and comply "voluntarily" with the procedures and standards set forth in this manual. The District shall from time to time inspect facilities funded by the District or those on the Master Plan to assure compliance with the interlocal contract. Each Entity shall submit an annual certification to the District stating that all work contained in the work plan and reimbursed through the interlocal contract has been performed to the specifications established in this manual. This certification shall be signed by the person executing the interlocal contract or designee. The certification should summarize proposed and actual plan accomplishments. It should also describe any major maintenance problems that have implications for the District as a whole, such as significant deterioration of major conveyance system components, or the failure of system components to perform as intended, and suggest revisions to the activity list provisions.

Schedule

The certification and final payment requests shall be submitted to the District within ~~2030~~ calendar days of the termination of the annual interlocal ~~agreement~~contract for maintenance funding.

Reporting

The certification shall be brief and may be in the form of ~~either~~ a letter ~~or a resolution~~.

4.26 Interlocal Contract Document

The performance of work outlined in the approved maintenance plan shall be guided by an interlocal contract entered into annually between the District and each Entity. ~~A s~~Sample contracts ~~is~~are contained in ~~Appendix C~~**Appendices B and C**. Major provisions of the contract include: the adoption of the Board approved work plan as the document outlining the work to be performed; references to the performance standards, reimbursement and payment procedures, and plan amendment procedures outlined in this manual for governing maintenance work performance evaluations, ~~reimbursement,~~ and contract amendments; and a requirement for submittal of an annual certification of results.

Schedule

All Entities will enter into an "annual" interlocal contract in conjunction with adoption of the District and respective agency budgets.

Reporting

Reporting requirements will be as prescribed in the respective interlocal contracts.

4.27 Contract for Maintenance Performance

Where, in the opinion Entities, it appears to be most cost effective (or due to an emergency) to utilize the services of private contractors to perform maintenance functions, the Entity shall solicit bids from qualified contractors in compliance with their statutory procedures for the necessary work. The Entity will provide to the District copies of bid specifications and bid tabulation as well as copies of the respective contract documents. All expenditures must comply with **NRS 332**, Local Government Purchasing Act, ~~and~~ **NRS 338**, the Public Works Act, **and all relevant statutes, rules, regulations, and policies**.

Schedule

All contracts for maintenance services shall be bid on an annual basis or for a specific projection location.

Reporting

The Entity shall advise the District in advance that they intend to utilize a private contractor (may be included as part of annual work plan). They shall also provide a summary of work performed, as well as a statement of inspection, as a part of the request for reimbursement to the Entity or directly by the District to the contractor.

4.3 MAINTENANCE PROCEDURES

4.31 Purpose

As a part of the overall operations and maintenance procedures adopted by the District, an outline for specific maintenance procedures has been developed. The accepted maintenance procedures are centered around specific elements of a management system for field maintenance, and include defined maintenance activities, standards, ~~and~~ scheduling, and reporting procedures.

Due to the diversity in physical features among the various agencies involved, and the varied resources employed in maintenance activities, it is essential to treat these procedures as general guidelines which must be tailored to meet the situation at hand. It is also essential that these procedures remain dynamic, ~~and~~ be actively reviewed, and periodically updated. An annual review is recommended.

4.32 Activities

Maintenance work activities identify all major maintenance work and include all activities which are performed frequently and in amounts that make them a significant part of the total work program. Each activity must be clearly defined so maintenance personnel at all levels of management uniformly understand the operation to be performed and the type of deficiency to be corrected.

Personnel who plan, schedule, perform, report, or evaluate maintenance work must know what each work activity means. Work activities are used for the following purposes:

- Planned maintenance work is identified in the annual maintenance work plan by activity name and number.
- Activity names and numbers are used for authorizing, assigning, and reporting work.
- Activity names and numbers are used on work scheduling guides and work performance summaries.

Work measurement units are established for the major maintenance activities. For example, "Acres Covered" is the work measurement unit for vegetation control while "Cubic Yards Removed" is the work unit for cleaning and reshaping channels. These measurement units are used to describe how much work is planned and to report how much work is accomplished for each activity.

For some activities, specific work measurement units--other than labor hours--would not be meaningful. For example, the miscellaneous maintenance activity includes a number of different operations. This activity cannot be measured by a common unit other than labor hours.

Following is the accepted maintenance activity list for the District including work measure units.

ACTIVITY NUMBER	ACTIVITY NAME	WORK MEASURE UNIT
2.05	Inspect Channels	Miles
3.10	Clean and Reshape Channels	Cubic Yards
5.15	Repair Lined Channel	RepairsEach
11.20	Provide/Maintain Erosion Control	Square Feet
9.25	Clean and Inspect Detention/Debris Basins	Cubic Yards
12.30	Erosion Repair	Cubic Yards
14.35	Fence Repair	Linear Feet
4.40	Vegetation Control - Chemical	GallonsAcres
10.45	Vegetation Control Detention Basins - Mechanical	Acres
15.50	Maintain Access Road	Miles
1.55	Clean and Inspect Inlet/Outlet Structures	StructuresEach
13.60	Repair Inlet/Outflowlet Structures	RepairsEach
7.65	Clean Storm Sewer Lines	Linear Feet
8.70	Storm Sewer Repair	Repairs
6.75	Clean/Flush Culverts & Bridges	CulvertsEach
16.80	Misc. Work Activities	Labor Hours
85	Engineering	Labor Hours

4.33 Standards

"Performance Standards" have been established for each of the major maintenance work activities. These performance standards specify:

- The most effective crew size.
- The kinds and number of equipment required.
- The major types of material that should be used.
- Recommended procedures for performing the work.
- An estimate of expected average daily accomplishment with standard crew size, equipment and procedures.
- Authorization and scheduling criteria.

Following is an item-by-item description of the format of the performance standards.

1. Activity Identification/Date. The activity number and name are shown as well as the "effective date" of the performance standard--to be used when updating or replacing performance standards.

2. Description and Purpose. The Description and Purpose section of the performance standards explains the work activity and the kinds of defects to be corrected or reasons for doing the work.

3. Authorized By and Work Control Category. The level of management responsible for authorizing the work is identified. Certain activities requiring special equipment, coordination, or expertise are Engineer-authorized activities and should not be scheduled or performed without the Engineer's approval.

   The type of control to be placed on the quantity of work performed is identified. This control is unlimited or limited in terms of the amount of work done (accomplishment) or the amount of labor input (crew-day).

4. Performance Criteria. This section includes important information for the "scheduler" about when to schedule the work and for the crew leader to identify the work to be done.

5. Crew Size. The crew size outlines the numbers of personnel needed to do the work. The crew size is based on average conditions. Sometimes, there will be a need to add or delete people to satisfy special traffic safety conditions or hauling requirements.

6. Equipment. The basic requirements for major pieces of equipment are listed. Situations such as the breakdown or unavailability of equipment or special materials hauling requirements may require the addition, deletion or substitution of equipment.

7. Materials. The materials section includes a list of the major materials to be used for the activity.

8. Work Method. The work method outlines, step-by-step, the recommended procedures for performing the work. Each step should be performed in order to correctly maintain the feature as well as provide the quality of work desired.

9. Average Daily Production. The average daily production is an estimate of the amount of work a crew can accomplish during a day using the recommended crew size, equipment, materials and work method. This estimate is shown as a range and should be attainable over a period of time. Some days the accomplishment may be more or less than the estimate, but eventually, the average should fall in line.

10. Notes. Any other relevant, helpful information or instructions.

Use of Performance Standards

Maintenance supervisory personnel should become thoroughly familiar with these performance standards. It is important that the performance standards be used when making assignments and performing work. Some situations will require deviation from the performance standards--such as more or less flagmen or additional haul trucks. These situations are recognized, and crew leaders are expected to consider such situations when organizing and managing their activities.

Haul truck needs should be determined using factors such as haul distance and time estimates (spot, dump, load, and cycle times.)

The performance standards also provide guidance and a measure for supervisors to use when evaluating work in progress and completed.

Field personnel are in the best position to identify new or better work methods or difficulties with the current performance standards. These suggestions for improvements or questions should be directed to the crew leader or supervisor.

The performance standards should be reviewed and updated annually. If other changes occur that require more frequent review and update or development, the performance standards can be changed to suit these needs.

4.34 Scheduling

The objectives of work scheduling are:

- To do the planned amount of work.
- To perform the work when it should be done.
- To do the work where it should be done.
- To use the proper people, equipment and supplies to do the work.

Three tools are available to help supervisors meet these objectives. The WORK PROGRAM defines the estimated amount of work and the estimated labor-days required for each activity to provide the desired levels of service; a WORK CALENDAR helps to establish when the various activities should be done; and the PERFORMANCE STANDARDS provide information about quantity standards, personnel requirements and how much work can be done in a given time.

The annual work program establishes the kinds and amount of work to be done during the year and the resources that will be required to do that work. This annual plan needs to be broken into a monthly plan for effective scheduling of work and to permit timely evaluations of work program performance.

The process of "distributing" the annual work load throughout the year is done by allocating a part of the work (in labor-hours, by activity) to specific months. Some types of work -- emergency or service activities -- must be done throughout the year as the need arises. Other types of work must be done on a regularly scheduled basis -- such as preventive maintenance work. Finally, some types of work can be done during certain periods but can be shifted from one month to the other, and still other work can be done almost any time during the year.

These factors must be considered when distributing the different types of work. Preventive maintenance and other types of work which must be performed on a regularly scheduled basis are distributed so as to level labor power needs as much as possible. Finally, work which can be performed any time is distributed to those months with the fewest labor-days. In this way, staffing needs are kept as uniform as possible resulting in more efficient use of available labor power.

A work calendar lists -- activity by activity -- the labor-hours for each month. These labor-hours are used in conjunction with the work program annual work quantities for work scheduling and the preparation of periodic Activity Status Reports. A sample work calendar is included on **Figure 4-4**.

Once the work program and staffing levels have been set, the work load distribution can be finalized and the calendar prepared to summarize/communicate the planned monthly distribution of the work program.

Work scheduling is the process of using the Work Calendar and specific scheduling procedures to plan ahead, establish work priorities and accomplish the work.

The performance standards outlined in the previous sections apply to corrective and preventive maintenance activities. These procedures are not as rigid or foolproof as implied by the description. Equipment breakdowns, emergencies, or bad weather will disrupt a schedule -- but part of the scheduling process is to be aware that these situations will occur and to be prepared to respond with little or no difficulty. Because of these situations, supervisors should <u>not</u> expect to accomplish <u>all</u> of the work as scheduled. Generally, a supervisor can consider his scheduling efforts to be successful if 75 to 80 percent of the scheduled work is completed as planned.

SAMPLE WORK CALENDAR

REPORT NO. 603 | YEAR CY 1983 | WORK MANAGEMENT SYSTEM | DATE 10/11/82 | PAGE 1

WATER UTILITY DEPARTMENT

WORK CALENDAR

MANAGEMENT UNIT VALVE/HYDRANT

ACTIVITY NO	ACTIVITY NAME	SUB UNIT	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL CREW DAYS
2010	INSTALL HYDRANT	0	1	1	1	1	1	2	2	2	1	1	1	1	15
2020	REPLACE HYDRANT	0	7	6	8	4	7	6	7	6	4	6	7	7	75
2030	REMOVE HYDRANT	0												4	4
2040	REPAIR HYDRANT	0	2	2	2	2	2	1	1	1	1	2	2	2	20
2041	REPAIR HYDR-OT	0	1		1	1		1	1		1	1		1	8
2050	RELOCATE HYDRANT	0	2	6	2	5	6	7	2	2	7	1	5		45
2060	ADJUST HYDRANT	0	2	1	4	1	4	4	1		1		1	1	20
2100	FLOW TEST HYD	0	8	8	8	8	8	8	8	8	8	8	8	8	96
2110	HYDRANT P M	0	15	14	17	15	15	13	14	17	18	17	13	16	184
2120	FLUSH SYSTEM	0	38	38	37	37	37	37	38	38	37	37	38	38	450
2210	INSTALL NEW VALVE	0	5	4	6	6	2	10	7	3		3	2	2	50
2220	REPLACE VALVE	0	10	12	16	6	10	6	6	6	4	14	6	4	100
2230	REPAIR VALVE	0	12	12	12	10	12	12	12	10	12	12	12	12	140
2231	REPAIR VALV-OT	0		1	1	1	1	1	1	1	1	1	1		10
2240	LOC/REF VALVES	0	20	22	20	35	20	20	10	20	25	25	23	10	250
2300	EXERC LGE VALVES	0	9	8	9	9	9	9	8	9	9	9	9	8	105
2310	VALVE P M) 16"	0	6	6	6	6	6	6	6	6	6	6	4	5	67
2320	SYSTEM SHUTDOWN	0	7	2	5	4	5	4	3	4	3	6	5	4	52
2410	IST NEW VLV (SHUP)	0	1	1	1	1	1	1	1	1	1	1	1	1	12
2420	RENEW VLV/HYD (SHUP)	0	2	2	2	3	3	3	3	3	2	2	2	2	29
2510	TANK MAINT-GROUND	0				1	1	1	1	1					5
2520	TANK MAINT-HIGH	0			1	1	1	1	1	1	1	1	1	1	10
3300	MISC WORK ACTS	0	6	6	6	6	6	6	6	6	6	6	6	6	72

FIGURE 4-4

Following are some additional hints or techniques to consider:

- It is not necessary to "formally schedule" the daily, routine activities. It is necessary, however, to regularly check the work reports and accomplishments to verify the distribution of work assignments. A periodic review and adjustment of the work assignments may be necessary to maintain a "balanced work load."

- It is usually best to prepare a schedule (and work assignments) assuming everything will work as planned -- no equipment breakdowns, no emergencies, etc. But make sure a backlog of "alternate" work is available so that little time is wasted when adjustments to the schedule must be made.

- Some guidelines for identifying alternate work:

  + Low priority work that needs to be done, but not necessarily during the next week or so.

  + Work that does not require special equipment or a lot of preparation time.

  + Preventive maintenance on light equipment.

- Take time to estimate the amount of work needed and the number of hours required to do the work. Good estimates will improve the scheduling process significantly. The performance standards, inspections and sound judgment based on experience all help the estimating process.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
05	INSPECT CHANNELS	6/95

DESCRIPTION & PURPOSE

Inspect both improved and unimproved flood channels for proper cross-section, sedimentation, debris and erosion damage, in order to schedule cleaning or repairs as needed.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Perform complete inspection of channels on an annual basis and after major storm events.

CREW SIZE

- 1 Crew Supervisor
- 1 TOTAL

EQUIPMENT

- 1 Pickup

WORK METHOD

1. Use safety devices, as required.
2. Visually inspect channels for cross-section, sediment, debris, erosion, and vegetation.
3. Prioritize a list of channels requiring maintenance.
4. Schedule cleaning of channels referring to prioritized list.

MATERIAL

AVERAGE DAILY PRODUCTION

8 miles/day

NOTES:

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Printed: May 16, 1995

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
10	CLEAN & RESHAPE CHANNELS	6/95

DESCRIPTION & PURPOSE

Mechanical silt, ~~and~~ vegetation, and debris removal, and reshaping of unlined channels to restore adequate flow.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Improved earth channels should be scheduled for cleaning and reprofiling on an annual schedule, or as appropriate following a flood event. Natural channels on a 3-year cycle.

CREW SIZE

- 2 Equipment Operators
- 1 Truck Driver
- .5 Foreman
- 3.5 TOTAL

EQUIPMENT

- 1* 10-wheel Dump Truck
- 1 Scraper
- 1 Gradall

WORK METHOD

1. Set up safety devices as required.
2. Remove silt and vegetation.
3. Load and haul removed material to proper disposal site.
4. Reshape channel.
5. Clean up work site.
6. Remove safety devices.

MATERIAL

- *Disposal Fees*

AVERAGE DAILY PRODUCTION

300 Cubic Yards/day

NOTES:

*Schedule sufficient trucks to insure maximum utilization of excavation equipment.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
15	REPAIR LINED CHANNELS	6/95

DESCRIPTION & PURPOSE

Repair of damaged concrete, rip rap, gabion, or other channel linings, retaining walls, etc., to restore to original condition and prevent further deterioration.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Repairs of channel linings, retaining walls, and other structures critical to the protection of a facility are to be scheduled immediately upon detection of damage.

CREW SIZE

- 1 Maintenance Foreman
- 2 Maintenance Workers
-
-
- 3 TOTAL

EQUIPMENT

- Pickup
- Flatbed Dump
- Concrete Mixer
-
-
-

WORK METHOD

1. Obtain from storekeeper safety equipment, materials, tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Clean and prepare damaged area.
4. Build and place forms as necessary.
5. Place and finish concrete.
6. Remove forms and backfill.

MATERIAL

- Assorted lumber
- 6-30 bags sacked concrete
- 3-15 tons concrete gravel mix
- 2-10 CY ready-mix concrete

AVERAGE DAILY PRODUCTION

1 ~~Repair~~Each/Day

NOTES:

Crew size and equipment may vary significantly depending on urgency, extent and complexity of repair.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
20	PROVIDE / MAINTAIN EROSION CONTROL	6/95

DESCRIPTION & PURPOSE

Placement of rip rap, sand bags, or other erosion control materials and repair of damaged areas of erosion protection to restore material to original condition. This work is done to prevent further deterioration and eliminate potential erosion problems.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Work is to be scheduled when damage or deterioration is severe enough to present potential erosion problems. Erosion undercutting roadways, sidewalks, or prepared embankments/improvements shall be repaired immediately. Repair of undermined stabilizers shall be scheduled immediately.

CREW SIZE

- 1 Foreman
- 2 Equipment Operators
- 2 Maintenance Workers
-
- 5 TOTAL

EQUIPMENT

- 1 Truck Crane
- -or- Backhoe
- 1 Dump Truck
- 1 Pickup
-
-

WORK METHOD

1. Obtain from storekeeper safety equipment, materials and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Shape work area to receive riprap, or other erosion control materials.
4. Place material and grout where applicable.
5. Backfill as necessary.

MATERIAL

- 20-50 Tons Rock for riprap (delivered)
- 5-12 yards ready mix concrete (if needed)
- 5,000-15,000 gal Water
-

AVERAGE DAILY PRODUCTION

1300 Square Feet/day

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
25	CLEAN & INSPECT DETENTION/DEBRIS BASINS	6/95

DESCRIPTION & PURPOSE

Inspection and removal, by loader (including hauling and disposal), of sediment and debris deposited in detention and debris basins to restore full capacity and original shape.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Remove sediment bi-annually or when debris basins or dams detention capacity is significantly reduced. Cleanout is normally justified when the sedimentation reaches 1 to 2 feet in depth or as established by the design.

CREW SIZE

- 1 Foreman
- 3 Equipment Operators
- 1 Maintenance Worker
-
- 5 TOTAL

EQUIPMENT

- 1 Pickup
- 1 Loader
- 2* Dump Trucks
-
-
-

WORK METHOD

1. Obtain from storekeeper safety equipment, materials and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Prepare removal and disposal sites for access.
4. Stockpile material for removal.
5. Load material and haul to designated disposal site.
6. Shape dam or basin to desired line and grade.
7. Grade disposal site as necessary.

MATERIAL

- Disposal Fees
-
-
-
-
-

AVERAGE DAILY PRODUCTION

1000 Cubic Yards/day

NOTES:

*Schedule sufficient trucks to insure maximum utilization of excavation equipment.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
30	EROSION REPAIR	6/95

DESCRIPTION & PURPOSE

The replacement and compaction of material removed by erosion, using hand tools or other methods, to restore Flood Control channels, supporting embankments, levees or access roads.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

As needed when damage has occurred which has affected or will affect the structural integrity of a channel embankment, levee, or access road,at a location where mechanical methods cannot be used.

CREW SIZE

- 1 Foreman
- 2 Maintenance Workers
-
-
- 3 **TOTAL**

EQUIPMENT

- 1 1-Ton Dump
- -or- Flatbed
- 1 Air Compressor w/compactor
- 1 Pickup w/Water Tank
- -or- Auxillary Spray Truck

WORK METHOD

1. Obtain from storekeeper safety equipment, materials, and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Remove debris and growth from damage location.
4. Haul fill material from pre-determined source.
5. Place and compact fill material in lifts.
6. Shape repair area to conform to adjacent areas.
7. Clean up work area as necessary.

MATERIAL

- 15-30 Tons Select Fill Material
-
-
-
-

AVERAGE DAILY PRODUCTION

15 Cubic Yards

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
35	FENCE REPAIR	6/95

DESCRIPTION & PURPOSE

The repair and/or re-establishment of downed or damaged fences to restore fence to proper condition and to provide right-of-way control.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Repair of downed or open fence areas to be performed upon detection. Repairs to damaged locations that remain partially functional are to be scheduled in priority with other work.

CREW SIZE

- 2 Maintenance Workers
- 2 TOTAL

EQUIPMENT

- 1 Fence Truck
- 1 Concrete Mixer (if needed)

WORK METHOD

1. Obtain from storekeeper safety equipment, materials and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Perform necessary repairs to:
   - Posts
   - Fabric
   - Top rail

MATERIAL

- 40-50 Linear Ft Fence Fabric
- Miscellaneous Hardware
- 5 bags "Readycrete"

AVERAGE DAILY PRODUCTION

100 Linear Feet/day

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
40	VEGETATION CONTROL • CHEMICAL	6/95

DESCRIPTION & PURPOSE

The application of herbicides, to designated areas, with a boom-mounted spray bar to prevent new growth and/or control existing vegetation, for the purpose of insuring the capacity and integrity of Flood Control facilities.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Spray pre-emergence herbicide and post-emergence herbicide annually to designated areas combining applications where possible.

CREW SIZE

- 2 Maintenance Workers
- 2 TOTAL

EQUIPMENT

- 1 Truck-mounted chemical tank with spray bar and hand sprayer

WORK METHOD

1. Set up safety devices as required.
2. Treat channel areas as required.
3. Remove safety devices.

MATERIAL

- Pre 12.5-25 lb/Ac
- Emerg Contact: 12.5-25 lb/Ac
- Post Brush: 120 lb/Ac
- Emerg Grass: 30 lb/Ac
- Waterweed: 1 gal/Ac
- Spreader: 1 gal/Ac
- Water 200 gal/Ac

AVERAGE DAILY PRODUCTION

~~1400 Gallons~~ Acres

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
45	VEGETATION CONTROL - ~~DETENTION/DEBRIS BASINS~~ MECHANICAL	6/95

DESCRIPTION & PURPOSE

The mechanical removal of brush and weeds to maintain detention, ~~and~~ debris basins, and channels free of vegetation.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Work to be scheduled when weeds and willows grow up at unsprayable locations, or when growth is too high for effective spraying.

CREW SIZE

- 1 Equipment Operator
- 1 TOTAL

EQUIPMENT

- 1 Mower or Grader
- 1 Tilt Trailer (if needed)
- 1 Pickup

WORK METHOD

1. Obtain from storekeeper safety equipment, materials, and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Mow, blade down, or turn under unwanted vegetation.

MATERIAL

AVERAGE DAILY PRODUCTION

4 Acres/day

NOTES:

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Printed: June 21, 1995

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
50	MAINTAIN ACCESS ROADS	6/95

DESCRIPTION & PURPOSE

Mechanical grading of access roads to remove minor ruts and erosion,and restore normal shape and cross slope, for access to Flood Control facilities.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

As needed prior to rainy season, or when the weather affects the road condition. Plan to re-profile access roads on a bi-annual (two year) frequency.

CREW SIZE

- 2 Equipment Operators
- 1 Maintenance Workers
-
-
- 3 **TOTAL**

EQUIPMENT

- 1 Grader
- 0-1 Water Truck
- 0-1 Roller
- 1 Pickup
-
-

WORK METHOD

1. Obtain from storekeeper equipment and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Grade access roads:
   - •Restoring X-section shape
   - •Filling potholes
   - •Grading out ruts
   - •*Restoring ditches and drainage.*
4. Roll and compact regraded.

MATERIAL

- 10,000 Gal Water (if needed)
-
-
-
-
-

AVERAGE DAILY PRODUCTION

.5 Mile/day

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
55	CLEAN & INSPECT INLET/OUT~~FLOWLET~~ STRUCTURES	6/95

DESCRIPTION & PURPOSE

Cleaning and inspection of catch basins, inlets, sumps, grates, outflow and other structures to remove silt and debris and to inspect for structural integrity and proper functioning.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Plan for structures to be inspected and cleaned a miminum of once per year. Annual cleaning shall be the major effort to allow thorough inspection of structure in order to schedule repairs.

CREW SIZE

- .25 Foreman
- 2 Maintenance Workers
- 2.25 TOTAL

EQUIPMENT

- 1 1-Ton Truck
- 1 Water Tanker (1500 gal)
- -or-
- 1 High Pressure Vacuum (Vactor)
- Appropropriate Hand Tools

WORK METHOD

1. Perform daily vehicle P.M. check and check equipment.
2. Place signs/traffic control devices as required.
3. Locate truck in the best working psoition and as far off roadway as practical.
4. Remove grate. Then remove debris, trash & sediment from grate.
5. Loosen solids with spade if necessary.
6. Flush/vacuum basin.
7. Inspect structure visually to determine if further cleaning or repair is necessary.
8. Dispose of debris at designated dump site.
9. Check and clean equipment after use.

MATERIAL

- Water

AVERAGE DAILY PRODUCTION

15 ~~Structures~~Each/day

NOTES:

Structures that cannot be cleaned shall be reported to the Maintenance Supervisor for initiation of corrective action.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
60	REPAIR INLET / OUTLET STRUCTURES	6/95

DESCRIPTION & PURPOSE

Repair of catch basins, grates, inlets, control gates, outfalls, weirs, manholes, sumps, and other spot structures to restore elements to their original operational condition.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Based on detailed inspection of repair, ~~or~~ replace components, or entire structure as conditions warrant. Plan repair of five percent (5 %) of system structures per year.

CREW SIZE

- 1 Foreman
- 2 Maintenance Workers
-
-
- 3 TOTAL

EQUIPMENT

- 1 Pickup
- 1 Compressor w/accessories
-
-
-
-

WORK METHOD

1. Obtain necessary safety equipment, tools, and materials.
2. Initiate applicable safety procedures and traffic control.
3. Remove and clean area of damage/failure.
4. Repair as necessary to original condition and test operation as appropropriate.

MATERIAL

- Concrete
- Aggregates
- Miscellaneous parts, as required
-
-
-

AVERAGE DAILY PRODUCTION

1 ~~Repair~~Each/day

NOTES:

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
65	CLEAN STORM SEWER LINES	6/95

DESCRIPTION & PURPOSE

The removal of debris of any type from within conduits by: flushing with water; the use of a sewer cleaning machine; or by physicially entering the conduit and manually removing debris, to restore full capacity.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Plan cleaning of storm sewer lines on an average 5-year cycle. Specific areas may require annual cleaning while others will require less than 5-year cleaning.

CREW SIZE

- 1 Maintenance Foreman
- 2 Maintenance Workers
- 3 TOTAL

EQUIPMENT

- 1 Sewer Cleaner

WORK METHOD

1. Obtain from storekeeper safety equipment and tools necessary for the day's work.
2. Begin applicable safety procedures and/or traffic control.
3. Remove debris from conduit.
4. Load debris and haul to designated disposal site if necessary.
5. Clean up work area as necessary.

MATERIAL

- 0-5,000 Gallons Water

AVERAGE DAILY PRODUCTION

1500 linear feet/day

NOTES:

Work should be scheduled whenever possible, in conjunction with annual cleaning of adjacent structures.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
70	STORM SEWER LINE REPAIR	6/95

DESCRIPTION & PURPOSE

Excavation and repair of storm sewer lines to eliminate blockages and repair failed pipes.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Priority of repairs:

1. *eliminate blockages and hazards to public safety;*
2. remove flow restrictions and repair damaged/failed pipe sections.

CREW SIZE

- 1 Foreman
- 1 Equipment Operator
- 2 Maintenance Workers
-
- 4 TOTAL

EQUIPMENT

- 1 Dump Truck
- 1 Backhoe/Util Tractor
- 1 Air Compressor w/accessories
- Appropropriate Hand Tools
-
-

WORK METHOD

1. Set up warning signs and traffic control devices.
2. Take necessary measures to control flow -- providing uninterrupted service whenever possible.
3. Cut pavement and/or excavate to the extent required to determine necessary scope of repairs.
4. Remove flow restrictions, as necessary.
5. Backfill and compact in lifts to within 10 inches of surface.
6. Place select material (rock or shell) and compact to within 2 inches of surface* (See Note below.)
7. Coordinate density test and request repaving as required.
8. Clean work area. Remove signs and warning devices.
9. Record work accomplishment.

MATERIAL

- Pipe/fittings
- Sand
- Cement
- Rock
- Asphalt, as required
-

AVERAGE DAILY PRODUCTION

1 Repair/day

NOTES:

Verify location of other utilities prior to excavaction.

*Backfill specifications apply to paved areas. In easements and other unpaved areas, backfill and compact in 2-foot lifts to grade; re-sod as necessary. Install safety fence and secure jobsite at end of workday as required.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
75	CLEAN / FLUSH ~~PIPES &~~ CULVERTS & BRIDGES	6/95

DESCRIPTION & PURPOSE

Cleaning/flushing of culverts and bridges to remove silt and debris, and eliminate restriction to flow.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Plan for all culverts to be cleaned/flushed annually.

CREW SIZE

- 1 Maintenance Supervisor
- 1 Maintenance Worker
-
-
- 2 TOTAL

EQUIPMENT

- 1 1-Ton Dump Truck
- 1 Water Tanker (1500 gal)
- -or- High Pressure/Vacuum cleaner/Vactor
- Safety Equipment
- Appropriate Hand Tools

WORK METHOD

1. Place signs and safety devices.
2. Locate truck in best working position and as far off roadway as possible.
3. Clean out ends of culvert.
4. Flush culverts until flow is unrestricted.
5. Load excess material/debris into truck for disposal at designated dump area.
6. Pick up signs and safety devices.

MATERIAL

- Water
-
-
-
-
-

AVERAGE DAILY PRODUCTION

5-7 ~~Culverts~~Each/Day

NOTES:

1. Inform Maintenance Supervisor of any non-cleanable culverts or those that can only be partially cleaned.
2. Avoid damaging downstream property when flushing culverts.
3. Work should be scheduled, whenever possible, in conjunction with annual cleaning of adjacent structures.

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Printed: May 16, 1995

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
80	MISCELLANEOUS ~~MAINTENANCE~~ WORK ACTIVITIES	6/95

DESCRIPTION & PURPOSE

All work performed that is not described in previous activities. This includes, among others, activities such as catwalk repair, rodent control, pump maintenance, concrete spalled area repair, painting, building and grounds maintenance, trash pickup*, graffiti abatement, sign installation and maintenance.

AUTHORIZED BY	LIMITS ON WORK
Maintenance Supervisor	

PERFORMANCE CRITERIA

Plan 8 labor hours per channel mile per year for miscellaneous maintenance work.

CREW SIZE	WORK METHOD
▪ 1 Maintenance Worker ▪ ▪ ▪ ▪ 1 TOTAL	1. Obtain from storekeeper safety equipment, materials, and tools necessary for the day's work. 2. Begin applicable safety procedures and/or traffic control.
EQUIPMENT	
▪ 1 Pickup ▪ Handtools ▪ ▪ ▪ ▪	
PMATERIAL	**AVERAGE DAILY PRODUCTION**
▪As required ▪ ▪ ▪ ▪ ▪	8 Labor Hours

NOTES:

*Includes appliances, tires, car bodies, and other large objects dumped in channels/basins.

PERFORMANCE STANDARD

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

ACTIVITY NUMBER	NAME	DATE
85	ENGINEERING	6/95

DESCRIPTION & PURPOSE

All work that is by nature engineering. This includes, among others, surveying and preparation of plans and specifications for maintenance work.

AUTHORIZED BY	LIMITS ON WORK
Director of Public Works for designee	

PERFORMANCE CRITERIA

CREW SIZE	WORK METHOD
■ N/A ■ ■ ■ ■ TOTAL	1. As deemed most cost effective.
EQUIPMENT	
■ N/A ■ ■ ■ ■ ■	
MATERIAL	**AVERAGE DAILY PRODUCTION**
■ N/A ■ ■ ■ ■ ■	8 Hours/Day

NOTES:

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Printed: May 16, 1995

4.35 Reporting

Comprehensive maintenance programs include procedures for reporting and summarizing work accomplished and labor-hours used for maintenance activities. This information enables managers and supervisors to compare actual performance with the planned work program. These planned-actual comparisons -- on a regular basis -- are essential for effective management and control of the work program.

The reporting procedures provide specific information:

- What Master Plan facility required work.
- What work was done by activity.
- How much of each activity was done.
- The labor-hours used to accomplish the work.

This information is used by managers in their effort to:

- Make sure the right kinds and amounts of maintenance work are done.
- Identify the problem areas and related corrective actions.
- Develop future work programs and budgets.
- Identify opportunities for improved productivity.

The work reporting process can consist of a simple form as outlined in the following section.

Daily Work Activity Report

The Daily Work Activity Report may be used to record and summarize (1) the kinds and amounts of work performed by maintenance personnel, and (2) the number of labor-hours used to do that work. The report can be used to summarize all work activities. Each Entity may use its standard accounting/reporting procedures for the Daily Work Activity Report.

The Maintenance Supervisor or crew leader usually prepares the Daily Work Activity Report. Following are instructions for the completion of the sample report shown on **Figure 4-5**.

1. Identification Data -- Fill in all blanks: the Entity, date, ~~and~~ name of person preparing the report, and the names and employee numbers of all persons to perform work to be reported for the day. (The form provides for several combinations of activities and employees. If ~~a second page is~~additional pages ~~are~~ needed, number ~~that second page~~ the pages accordingly).

~~2. Employee Name -- Enter in the diagonal blanks the names of all persons to perform work to be reported. Hours of leave or absenteeism should also be reported since it is helpful to account for all personnel.~~

2. Master Plan Facility Number - Enter the specific 4 digit-4 letter Master Plan Facility number (and reach, if possible). (This number directly corresponds to the specific Master Plan location as identified on current MP maps.)

3. MWP Facility Number - Enter the identifying Maintenance Work Plan facility number. (This number directly corresponds to the budget approved for the facility and will typically include a range of Master Plan facilities and reach.)

~~3~~4. Activity Number -- Enter the number of each activity performed. Use the Work Activity Directory or Performance Standards to complete the blank.

5. Employee Number - Enter the employee number of the person working a specific activity at the specific facility.

6. Hours Worked by Each Employee -- Record the number of hours worked by each employee, by the appropriate activity. Record the time spent to the nearest quarter-hour. For example, record 1 hour and 45 minutes as ~~2.01~~1.75 hours and 3 hours and 20 minutes as ~~3.03~~3.25 hours.

~~Be sure each employee has the full day's work recorded.~~

~~4.~~7. Equipment Number -- Enter the assigned equipment number for any mechanical equipment on which work was performed for preventive and corrective maintenance only.

~~5.~~8. Work Performed -- Enter the location and a brief description of the work performed.

~~7. Total Hours -- Total all hours for each activity, and record in the space designated as "Total Hours."~~

8. Accomplishment -- Measure and record the amount of work done on each activity. Use the correct measurement unit for each activity -- see the Activity Directory.

Record the amount of work done to the nearest whole unit. Record labor-hours to the nearest hour. For activities with labor-hours as the unit of measure, the "quantity" will be exactly the same as "total hours" for the activity.

9. Notes/Comments -- Record any additional relevant information that may be of use in summarizing and analyzing work activity data.

The completed reports ~~are to be held~~can be used for monthly summarization and report preparation, and serve as completion certification backup for the monthly force account reimbursement billings. ~~After this process, the completed reports, which serve as documentation of completed work, should be filed and retained in accordance with local filing and retention policies.~~

REGIONAL FLOOD CONTROL DISTRICT FACILITIES DAILY WORK ACTIVITY REPORT

ENTITY: _____

Date Work Performed: _____ 19____

Supervisor Name: _____

Employee Name: _____ No._____

Employee Name: _____ No._____

Employee Name: _____ No._____

Employee Name: _____ No._____

Employee Name: _____ No._____

Master Plan Facility Number	MWP Facility Number	Activity Number Worked	Empl. Number	Hours Worked by Activity	Equip. Number Used	Work Performance (Location, Brief Description, Materials Used, Etc.)	Accomplishment	
							Amount	Unit of Measure

NOTES/COMMENTS: _____

_____

The undersigned hereby certifies that the above described maintenance was performed in accordance with the criteria/standards contained in the District's **Operations and Maintenance Manual.** *Further, that the information contained herein accurately reflects the time and accomplishments reported during the performance of this work.*

_____ _____

Supervisor's Signature **Title**

Page _____ of _____

FIGURE 4-5

FORM 100-4

4.40 INVENTORY PROCEDURES

4.41 Purpose

The purpose of this element of the *Operations and Maintenance Manual* is to provide a record of the existing physical flood control system that is eligible for maintenance funding assistance by the District. The physical facilities that make up the collection and conveyance system have in many instances been paid for in whole or part by the District, however, they are not "owned" or operated, let alone maintained by the District. If, however, the total flood control system does not function properly when needed, it is ultimately the responsibility of the District to determine why and to take corrective action. A critical key to assuring the system functions properly is an up-to-date inventory of the physical system.

4.42 Physical System ~~Summary~~

In 1990, each agency ~~has~~ provided a list of measurable quantities that make up the flood control system in their jurisdiction. Facilities eligible are those identified in the Regional Flood Control District's Master Plan and any revisions, amendments, and/or changes subsequently approved. Only those facilities that exist as Master Plan facilities, or exist in the same alignment as a proposed Master Plan facility and appurtenant facilities are eligible.

~~Clark County~~
~~Las Vegas~~
~~North Las Vegas~~
~~Henderson~~
~~Boulder City~~
~~Mesquite~~

~~This information is not totally complete, however, it does represent the available information at this time.~~

Schedule

The inventory work sheets must be expanded to represent a true and accurate accounting of facilities on the Master Plan and tributary (drainage) systems and updated as a part of the annual certification process.

Reporting

The Entities should submit annual updates of the physical system inventory on the form required by the District.

4.43 Physical System Maps

Each Entity must have a map that shows the physical system for drainage and flood control. This map should reflect that portion that is on the Master Plan and also that portion that is eligible for maintenance funding by the District. ~~There is currently not a uniform comprehensive drainage and flood control system map that reflects the current system. The most current record is shown on the "marked up" plates from the Comprehensive Master Plan included in Appendix B of this manual.~~

Schedule

The individual Entities should submit to the District updated maps annually, or more frequently as project completion dictates, reflecting the size, location and material elements of their drainage and flood control system. The update should show those systems that are eligible for Flood Control District funding under the categories shown in **Section 4.11** of this manual.

Reporting

The system update should be provided or maps provided by the District and be in a form that is readily reproducible.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

APPENDICES

APPENDIX A: The District's Statutory Responsibility for Maintenance

APPENDIX B: ~~System Inventory~~Sample Authorization-To-Proceed Interlocal Contract

APPENDIX C: ~~Example Inter-Local Agency~~Sample Interlocal Contract

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

APPENDIX A
THE DISTRICT'S STATUTORY RESPONSIBILITY FOR MAINTENANCE

Key Statutory and Regulatory References

-- Flood Control Facility Maintenance --

NEVADA REVISED STATUTE - CHAPTER 543 CONTROL OF FLOODS

543.340 Meeting; quorum; written policies and procedures.

1. In addition to the requirements of NRS 543.330, the board may meet at such time or times and at such regular meeting place within the district as it determines by resolution.

2. Special meetings may be held on notice to each member of the board as often as, and at such place or places within the district as, the needs of the district require.

3. A majority of the members of the board constitutes a quorum at any meeting.

4. The board shall adopt written policies and procedures for administering the district and for operating and maintaining its projects and improvements.

UNIFORM REGULATIONS FOR THE CONTROL OF DRAINAGE

12.050 Construction/Operation/Maintenance

Construction, operation and maintenance of Master Plan facilities shall be the responsibility of the Lead Entity as described in ~~Section 11.012~~the most recent edition of the District's Policy and Procedures Manual and delineated in the interlocal ~~funding agreement~~contract between the District and Lead Entity. The District may also function as the Lead Entity for construction, operation and maintenance of Master Plan facilities.

The role of the District and Lead Entity in funding regular maintenance of the facility shall be established through the interlocal ~~agreement~~contract formed as part of the District's policies and procedures for facility funding. ~~An inspection of all Master Plan facilities shall be conducted at least annually. This inspection and immediate correction of any identified maintenance deficiencies shall be the responsibility of the Lead Entity.~~Maintenance shall be performed in compliance with the most recent edition of the Operations and Maintenance Manual.

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

APPENDIX B
~~SYSTEM INVENTORY~~
SAMPLE AUTHORIZATION TO PROCEED INTERLOCAL CONTRACT

~~The following maps represent the existing flood control system as provided by the various agencies.~~

~~EXAMPLE~~SAMPLE AUTHORIZATION-TO-PROCEED

INTERLOCAL CONTRACT
ANNUAL MAINTENANCE WORK PROGRAM

THIS CONTRACT, made and entered into this ____ day of _____, ~~1990~~19____, by and between the ~~COUNTY OF CLARK~~[legal name of CITY or COUNTY], a political subdivision of the State of Nevada, hereinafter referred to as ~~"County"~~"CITY" (or "COUNTY"), and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "DISTRICT".

W I T N E S S E T H:

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the DISTRICT may approve and fund projects to maintain flood control improvements; and

WHEREAS, the ~~County~~CITY (or COUNTY) desires to maintain flood control improvements ~~located on _____~~within the CITY (or COUNTY) in accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the ~~facility~~facilities upon which maintenance will be done ~~is a facility~~are facilities described in the DISTRICT's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the DISTRICT authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the DISTRICT's Master Plan facilities including updates and amendments subsequently approved. The basic ~~improvements to the facility will be _____~~maintenance to the facilities will be in accordance with performance standards set forth in the current District *Operations and Maintenance Manual*.

The Project is more specifically described in Exhibit "A" which is attached hereto and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The DISTRICT agrees to provide reimbursement for Project costs within the limits specified below:

1. The Projects costs shall not exceed $.

The amounts allocated to each individual facility within the Project must be specified in **Exhibit "A"**. Any changes to said allocated amounts must be approved by the DISTRICT's Chief Engineer in accordance with Section 4.24 of the District *Operations and Maintenance Manual*.

2. "Authorization to Proceed" is herein granted for maintenance of facilities in Exhibit "A" in an amount not to exceed _____, effective _____.

3. A separate request for an "Authorization to Proceed" will be required for additional facility maintenance funds.

4. A written request must be made to the DISTRICT and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

~~2~~5. The ~~County~~CITY (or COUNTY) and DISTRICT will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the ~~County~~CITY (or COUNTY) shall submit invoices together with a detailed summary report of the maintenance service performed. The ~~County~~CITY (or COUNTY) shall submit an invoice voucher ~~prepared in duplicate~~ in the manner prescribed by the DISTRICT. The vouchers shall include such information as is necessary for the DISTRICT to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the ~~County~~CITY (or COUNTY) stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program.

All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite ~~300~~301
Las Vegas, Nevada ~~89155~~89101
Attn: ~~Virginia Bax-Valentine~~
General Manager/Chief Engineer

Payment shall be considered timely if made by the DISTRICT within ~~45~~30 days. Pursuant to Section IV, Paragraph 6, the DISTRICT may, in its sole discretion, withhold payments to the ~~County~~CITY (or COUNTY) for services rendered if the ~~County~~CITY (or COUNTY) fails to satisfactorily comply with any term or condition of this contract and/or the DISTRICT *Operations and Maintenance Manual.*

SECTION III - PROJECT TIME

The ~~County~~CITY (or COUNTY) agrees to perform the Project to the satisfaction of the DISTRICT ~~prior to June 30, 1991~~on or before June 30, 19__. The DISTRICT may grant extensions or terminate this contract and require all sums advanced to the ~~County~~CITY (or COUNTY) to be repaid if the ~~County~~CITY (or COUNTY) fails to perform by said date.

SECTION IV - GENERAL

1. The ~~County~~CITY (or COUNTY) will complete the Project as set forth in **Exhibit "A"**. The ~~County~~CITY (or COUNTY) staff personnel responsible for coordination work under this contract are as listed below:

~~M.J. Manning, Director of Public Works~~
~~Michael O. Pullen, Deputy Director, Field Services~~
~~Richard J. Brennan, Manager, Maintenance Management Division~~
(list names and titles of CITY or COUNTY staff)

It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the DISTRICT is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract, the parties hereto shall be subject to and governed by the District *Operations and Maintenance Manual*, and any applicable portions of the Policies and Procedures adopted by the DISTRICT.

3. It is the intent of the DISTRICT that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved, and District-funded projects have regional fund control significance impacting more than one entity, the ~~County~~CITY (or COUNTY) will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the DISTRICT shall be responsible for monitoring the performance of the ~~County~~CITY (or COUNTY), approval for payment of billings and expenses submitted by the ~~County~~CITY (or COUNTY) and the acceptance of any report provided by the ~~County~~CITY (or COUNTY). The ~~County~~CITY (or COUNTY) shall be responsible for monitoring performance of ~~County~~CITY (or COUNTY) staff or private contractors, and the ~~County~~CITY (or COUNTY) shall maintain detailed records of all payments made to contractors and make such records available to the DISTRICT upon request.

5. The ~~County~~CITY (or COUNTY) shall provide right of access to its facilities to the DISTRICT or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the ~~County~~CITY (or COUNTY) fails to perform the maintenance according to the standards specified in this contract and in the District *Operations and Maintenance Manual*, the DISTRICT may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the DISTRICT shall be

reimbursed by the ~~County~~CITY (or COUNTY) or be deducted from the amount authorized by this contract. The DISTRICT may not exercise this right without giving the ~~County~~CITY (or COUNTY) specific written notice of the maintenance required and allowing the ~~County~~CITY (or COUNTY) 60 days within which to perform said maintenance. The notice required by this provision must be sent to:

~~MARTIN J. MANNING~~
~~Director~~
~~Department of Public Works~~
~~401 S. Fourth Street~~
~~Las Vegas, Nevada 89101~~
(insert name of City or County staff)
(insert title)
insert City or County mailing address)

7. The records of the ~~County~~CITY (or COUNTY) and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the DISTRICT~~, County Auditor~~ or an Agent of the DISTRICT.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the Project will be refunded by the ~~County~~CITY (or COUNTY) to the DISTRICT.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to

this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The ~~County~~CITY (or COUNTY) hereby indemnifies and shall defend and hold harmless the DISTRICT, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the ~~County~~CITY (or COUNTY), of anyone acting under its direction or control, or on its behalf in connection with or incident to the performance of this Contract. The ~~County's~~CITY'S (or COUNTY'S) aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

IN WITNESS WHEREOF, the parties have caused this contract to be executed the day and year first above written.

BOARD OF COUNTY COMMISSIONERS
ATTEST: CLARK COUNTY, NEVADA

By: _____ By: _____
LORETTA BOWMAN BRUCE L. WOODBURY
County Clerk Chairman

ATTEST: REGIONAL FLOOD CONTROL DISTRICT

By: _____ By: _____
KATHY RAZOR ERIC LUNDGARRD
Secretary Chairman

APPROVED AS TO LEGALITY AND FORM:

REX BELL
DISTRICT Attorney

By: _____
Deputy DISTRICT Attorney

Date of District Action: REGIONAL FLOOD CONTROL DISTRICT

BY:

ATTEST: Chairman

Secretary to the Board

Approved as to Form:

BY:

Deputy District Attorney

****

Date of Council Action: CITY (or COUNTY) OF
(or Commission Action)

BY:

ATTEST: (Mayor or Board Chairman)

City (or County Clerk)

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
OPERATIONS AND MAINTENANCE MANUAL

APPENDIX C
SAMPLE INTERLOCAL CONTRACT

~~EXAMPLE~~SAMPLE

INTERLOCAL CONTRACT
ANNUAL MAINTENANCE WORK PROGRAM

THIS CONTRACT, made and entered into this ____ day of _____, ~~1990~~19____, by and between the ~~COUNTY OF CLARK~~[legal name of CITY or COUNTY], a political subdivision of the State of Nevada, hereinafter referred to as ~~"County"~~"CITY" (or "COUNTY"), and the CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT, hereinafter referred to as "DISTRICT".

W I T N E S S E T H:

WHEREAS, pursuant to Chapter 543 of the Nevada Revised Statutes, the DISTRICT may approve and fund projects to maintain flood control improvements; and

WHEREAS, the ~~County~~CITY (or COUNTY) desires to maintain flood control improvements ~~located on _____~~within the CITY (or COUNTY) in accordance with the maintenance program set forth herein, and hereinafter referred to as "Project"; and

WHEREAS, the ~~facility~~facilities upon which maintenance will be done ~~is a facility~~are facilities described in the DISTRICT's Master Plan.

NOW, THEREFORE, in consideration of the covenants, conditions, agreements, and promises of the parties hereto, the DISTRICT authorizes the Project as it is mutually understood and agreed as follows:

SECTION I - SCOPE OF PROJECT

This Interlocal Contract applies to the maintenance of flood control facilities, which are identified in the DISTRICT's Master Plan facilities including updates and amendments subsequently approved. The basic ~~improvements to the facility will be _____~~maintenance to the facilities will be in accordance with performance standards set forth in the current District *Operations and Maintenance Manual*.

The Project is more specifically described in Exhibit "A" which is attached hereto and by this reference incorporated herein.

SECTION II - PROJECT COSTS

The DISTRICT agrees to provide reimbursement for Project costs within the limits specified below:

1. The Projects costs shall not exceed $_____.

The amounts allocated to each individual facility within the Project must be specified in **Exhibit "A"**. Any changes to said allocated amounts must be approved by the DISTRICT's Chief Engineer in accordance with **Section 4.24** of the District *Operations and Maintenance Manual.*.

A written request must be made to the DISTRICT and a Supplemental Interlocal Contract approved to increase the amount noted above prior to payment of any additional funds.

2. The ~~County~~CITY (or COUNTY) and DISTRICT will comply with Section 4.12 of the Operation and Maintenance Manual. In accordance with said manual the ~~County~~CITY (or COUNTY) shall submit invoices together with a detailed summary report of the maintenance service performed. The ~~County~~CITY (or COUNTY) shall submit an invoice voucher ~~prepared in duplicate~~ in the manner prescribed by the DISTRICT. The vouchers shall include such

information as is necessary for the DISTRICT to determine the nature of all expenditures. Each voucher will clearly indicate that it is for services rendered in performance under this contract. Each voucher will also be accompanied by a written certification from the ~~County~~CITY (or COUNTY) stating that it is for performance of maintenance activities under this contract and is composed of completed elements set forth in the annual work program.

All invoices must be submitted for payment to:

Clark County Regional Flood Control District
301 E. Clark Avenue, Suite ~~300~~301
Las Vegas, Nevada ~~89155~~89101
Attn: ~~Virginia Bax-Valentine~~General Manager/Chief Engineer

Payment shall be considered timely if made by the DISTRICT within ~~45~~30 days. Pursuant to Section IV, Paragraph 6, the DISTRICT may, in its sole discretion, withhold payments to the ~~County~~CITY (or COUNTY) for services rendered if the ~~County~~CITY (or COUNTY) fails to satisfactorily comply with any term or condition of this contract and/or the DISTRICT *Operations and Maintenance Manual.*

SECTION III - PROJECT TIME

The ~~County~~CITY (or COUNTY) agrees to perform the Project to the satisfaction of the DISTRICT ~~prior to June 30, 1991~~on or before June 30, 19__. The DISTRICT may grant extensions or terminate this contract and require all sums advanced to the ~~County~~CITY (or COUNTY) to be repaid if the ~~County~~CITY (or COUNTY) fails to perform by said date.

SECTION IV - GENERAL

1. The ~~County~~CITY (or COUNTY) will complete the Project as set forth in **Exhibit "A"**. The ~~County~~CITY (or COUNTY) staff personnel responsible for coordination work under this contract are as listed below:

~~M.J. Manning, Director of Public Works~~
~~Michael O. Pullen, Deputy Director, Field Services~~
~~Richard J. Brennan, Manager, Maintenance Management Division~~
(list names and titles of CITY or COUNTY staff)

It is understood that staff named above will be responsible for work coordination throughout the period of this contract unless the DISTRICT is informed in writing of changes in these personnel assignments.

2. In addition to the specific terms set forth in this Contract, the parties hereto shall be subject to and governed by the District *Operations and Maintenance Manual*, and any applicable portions of the Policies and Procedures adopted by the DISTRICT.

3. It is the intent of the DISTRICT that scheduling of maintenance and repair of drainage and flood control facilities in general and Master Plan Facilities specifically be coordinated among entities. Therefore, in those cases where Master Plan approved, and District-funded projects have regional fund control significance impacting more than one entity, the ~~County~~CITY (or COUNTY) will allow all impacted entities an opportunity to review the maintenance schedule in order to coordinate maintenance efforts.

4. The Chief Engineer of the DISTRICT shall be responsible for monitoring the performance of the ~~County~~CITY (or COUNTY), approval for payment of billings and expenses submitted by the ~~County~~CITY (or COUNTY) and the acceptance of any report provided by the

~~County~~CITY (or COUNTY). The ~~County~~CITY (or COUNTY) shall be responsible for monitoring performance of ~~County~~CITY (or COUNTY) staff or private contractors, and the ~~County~~CITY (or COUNTY) shall maintain detailed records of all payments made to contractors and make such records available to the DISTRICT upon request.

5. The ~~County~~CITY (or COUNTY) shall provide right of access to its facilities to the DISTRICT or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

6. In the event the ~~County~~CITY (or COUNTY) fails to perform the maintenance according to the standards specified in this contract and in the District *Operations and Maintenance Manual,* the DISTRICT may perform or cause to be performed the maintenance necessary to assure proper operation of the facility. Cost incurred by the DISTRICT shall be reimbursed by the ~~County~~CITY (or COUNTY) or be deducted from the amount authorized by this contract. The DISTRICT may not exercise this right without giving the ~~County~~CITY (or COUNTY) specific written notice of the maintenance required and allowing the ~~County~~CITY (or COUNTY) 60 days within which to perform said maintenance. The notice required by this provision must be sent to:

~~MARTIN J. MANNING~~
~~Director~~
~~Department of Public Works~~
~~401 S. Fourth Street~~
~~Las Vegas, Nevada 89101~~
(insert name of City or County staff)
(insert title)
(insert City or County mailing address)

7. The records of the ~~County~~CITY (or COUNTY) and/or private contractors pertaining to the subject matter of this contract shall at all reasonable times be subject to inspection and audit by the DISTRICT~~, County Auditor~~ or an Agent of the DISTRICT.

8. If any provision of this contract shall be deemed in conflict with any statute or rule of law, such provision shall be deemed modified to be in conformance with said statute or rule of law.

9. All parties to this contract shall comply with applicable local, state, and federal laws.

10. Any costs found to be improperly allocated in the Project will be refunded by the ~~County~~CITY (or COUNTY) to the DISTRICT.

11. It is specifically understood and agreed to by and between the parties hereto that it is not intended by any of the provisions of any part of this contract to create in the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to this contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this contract.

12. The ~~County~~CITY (or COUNTY) hereby indemnifies and shall defend and hold harmless the DISTRICT, its representatives and their employees (or their authorized representatives) from and against any and all suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses whatsoever of any kind or nature whether arising before or after completion of the work hereunder and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part, by reason of any act, omission, fault or negligence whether active or passive of the ~~County~~CITY (or COUNTY), of anyone acting under its direction or control, or on its behalf in connection

with or incident to the performance of this Contract. The ~~County's~~CITY'S (or COUNTY'S) aforesaid indemnity and hold harmless obligations, or portions or applications thereof, shall apply to the fullest extent permitted by law, but in no event shall they apply to liability caused by the sole negligence or willful misconduct of the party indemnified or held harmless.

IN WITNESS WHEREOF, the parties have caused this contract to be executed the day and year first above written.

~~BOARD OF COUNTY COMMISSIONERS~~
~~ATTEST: _____ CLARK COUNTY, NEVADA~~

~~By: _____ By: _____~~
~~LORETTA BOWMAN BRUCE L. WOODBURY~~
~~County Clerk Chairman~~

~~ATTEST: REGIONAL FLOOD CONTROL DISTRICT~~

~~By: _____ By: _____~~
~~KATHY RAZOR ERIC LUNDGARRD~~
~~Secretary Chairman~~

~~APPROVED AS TO LEGALITY AND FORM:~~

~~REX BELL~~
~~DISTRICT Attorney~~

~~By: _____~~
~~Deputy DISTRICT Attorney~~

Date of District Action: REGIONAL FLOOD CONTROL DISTRICT

ATTEST: _____ BY: _____
Chairman

_____
Secretary to the Board

Approved as to Form:

BY: _____
Deputy District Attorney

****

Date of Council Action: CITY (or COUNTY) OF _____
(or Commission Action)

ATTEST: _____ BY: _____
(Mayor or Board Chairman)

_____
City (or County Clerk)

SAMPLE

Exhibit A

ANNUAL MAINTENANCE WORK PLAN SUMMARY

PART I

Summary of overall work plan listing specific projects and associated costs attributable to each.

PART II

Facility map(s) which identify location of planned maintenance work by project.

PART III

Summary of work plan broken into maintenance activities to be completed, with associated costs, for all projects identified in Part I.

~~Exhibit B~~

~~GENERAL TERMS AND CONDITIONS~~

~~DEFINITIONS -- As used throughout the contract, the following terms shall have the meaning set forth below:~~

~~A. "DISTRICT" shall mean the Clark County Regional Flood Control DISTRICT.~~

~~B. "Certification" shall mean the documentation which evidences that a maintenance activity by an Entity has been completed in accordance with established standards.~~

~~C. "Chief Engineer" shall mean the Chief Engineer and General Manager of the DISTRICT or authorized agent as delineated in NRS 543.510.~~

~~D. "Entity" shall mean the singular reference to either the county or one of the incorporated cities within the DISTRICT.~~

~~E. "Master Plan" shall mean the most recent edition of the Flood Control Master Plan adopted by the Board and Entities.~~

~~F. "Regional Fund" shall mean the monies described in NRS 543.595(2) and managed by the DISTRICT for funding of maintenance activities on flood control facilities identified in the Master Plan.~~

~~ENTITY NOT EMPLOYEE OF THE DISTRICT -- The Lead Entity and its employees or agents performing under this contract are not employees or agents of the DISTRICT. The Lead Entity will not hold itself out as nor claim to be an employee of the DISTRICT by reason hereof.~~

~~COMPLIANCE -- During the performance of this contract, the Lead Entity shall comply with all applicable local, federal and state regulations.~~

~~INDEMNIFICATION - The Lead Entity shall defend, protect and hold harmless the DISTRICT, or any employees thereof, from and against all claims, suits or actions arising from the Lead Entity's acts which are libelous or slanderous, result in injury to persons or property, violate a right of confidentiality, or use or reproduce material of any kind which constitutes an infringement of any copyright, patent, trademark or tradename.~~

~~TREATMENT OF ASSETS~~

~~A. Any property of the DISTRICT furnished to the Lead Entity shall, unless otherwise provided herein or approved by the DISTRICT, be used only for the performance of this contract.~~

B. The Lead Entity shall be responsible for any loss or damage to property of the DISTRICT which results from the negligence of the Lead Entity or which results from the failure on the part of the Lead Entity to maintain and administer that property in accordance with sound management practices.

C. Upon loss or destruction of, or damage to, any DISTRICT property, the Lead Entity shall notify the DISTRICT thereof and shall take all reasonable steps to protect that property from further damage.

D. The Lead Entity shall surrender to the DISTRICT all property of the DISTRICT prior to completion, termination or cancellation of this contract.

E. All reference to the Lead Entity under this clause shall also include Lead Entity's employees, agents, or subcontractors.

NONASSIGNABILITY - Neither this contract, nor any claim arising under this contract, shall be transferred or assigned by the Lead Entity without the written authorization of the DISTRICT.

RECORDS, DOCUMENTS, AND REPORTS - The Lead Entity shall maintain books, records, documents and other evidence of accounting procedures and practices which sufficiently and properly reflect all direct and indirect costs of any nature expended in the performance of maintenance activity under this contract. These records shall be subject at all reasonable times to inspection, review, or audit by personnel duly authorized by law, rule, regulation, or contract. The Lead Entity will retain all books, records, documents, and other materials relevant to this contract for three years after completion of the contract, and make them available for inspection by persons authorized under this contract.

RIGHT OF INSPECTION - The Lead Entity shall provide right of access to its facilities to the DISTRICT or Chief Engineer at all reasonable times, in order to monitor and evaluate performance, compliance, and/or quality assurance under this contract.

LICENSING, ACCREDITATION AND REGISTRATION - The Lead Entity shall comply with all applicable local, state and federal licensing, accreditation and registration requirements/standards, necessary for the performance of this contract.

ADVANCE PAYMENTS PROHIBITED - No payment in advance or in anticipation of services or supplies to be provided under this contract shall be made by the DISTRICT.

LIMITATION OF AUTHORITY - Only the DISTRICT shall have the express, implied, or apparent authority to alter, amend, modify, or waive any clause or condition of this contract. Any alteration, amendment, modification, or waiver of any clause or condition of this contract is not effective or binding unless made in writing and signed by the DISTRICT.

~~WAIVER OF DEFAULT -- Waiver of any default shall not be deemed to be a waiver of any subsequent default. Waiver of breach of any provision of the contract shall not be deemed to be a waiver of any other or subsequent breach and shall not be construed to be a modification of the terms of the contract unless stated to be such in writing, signed by the DISTRICT and attached to the original contract.~~

~~CHANGES AND MODIFICATIONS -- The DISTRICT may, at any time, by written notification to the Lead Entity and without notice to any known guarantor or surety, make changes in the general scope of the services to be performed under this contract. If any such changes cause an increase or decrease in the cost of, or the time required for the performance of this contract, an equitable adjustment may be made in the contract price or period of performance, or both, and the contract shall be modified in writing accordingly. Any claim by the Lead Entity for adjustment under this clause must be asserted within 10 days from the date of the Lead Entity's receipt of the notice of such change; Provided, however, that the DISTRICT may, upon determining that the facts justify such action, receive and act upon such claim asserted at any time prior to final payment under this contract. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes". However, nothing in this clause shall excuse the Lead Entity from proceeding with the contract as changed.~~

~~DISPUTES -- Except as otherwise provided in this contract, when a bona fide dispute arises between the DISTRICT and the Lead Entity and it cannot be resolved, either party may request a dispute hearing before the DISTRICT. Such a request for review must be in writing and clearly state:~~

~~1. the disputed issue(s), and~~
~~2. the relative positions of the parties.~~

~~These requests must be mailed to the DISTRICT in care of the Chief Engineer. The parties agree that this dispute process shall precede any action in a judicial or quasi-judicial tribunal.~~

~~TERMINATION FOR DEFAULT -- By written notice the DISTRICT may terminate the contract, in whole or in part, for failure of the Lead Entity to perform any of the provisions hereof.~~

~~UNCONTROLLABLE FORCES -- Neither Party shall be considered to be in default in the performance of any of the agreements contained in this Contract, except for obligations to pay money, when and to the extent failure of performance shall be caused by an uncontrollable force. If either Party because of an uncontrollable force is rendered wholly or partly unable to perform its obligations under the Contract, the Party shall be excused from whatever performance is affected by the uncontrollable force to the extent so affected provided that:~~

~~1. the nonperforming Party, within two weeks after the occurrence of the uncontrollable force, gives the other Party written notice describing the particulars of the occurrence,~~

2. the suspension of performance is of no greater scope and of no longer duration than is required by the uncontrollable force;

3. the nonperforming Party uses its best efforts to remedy its inability to perform (this subsection shall not require the settlement of any strike, walkout, lockout or other labor dispute on terms which, in the sole judgment of the Party involved in the dispute, are contrary to its interest. It is understood and agreed that the settlement of strikes, walkouts, lockouts or other labor disputes shall be at the sole discretion of the Party having the difficulty);

4. when the nonperforming Party is able to resume performance of its obligations under this Contract, that Party shall give the other Party written notice to that effect.

In the event that either Party's ability to perform cannot be corrected when the uncontrollable force is caused by the actions or inactions of legislative, judicial or regulatory agencies or other proper authority, this Contract may be amended to comply with the legal or regulatory change which caused the nonperformance.

TERMINATION PROCEDURE - After receipt of a notice of termination, and except as otherwise directed by the DISTRICT, the Lead Entity shall:

1. Stop work under the contract on the date, and to the extent specified, in the notice;

2. Place no further orders or contracts for materials, services, or facilities except as may be necessary for completion of such portion of the work under the contract as is not terminated;

3. Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of the DISTRICT to the extent DISTRICT may require, which approval or ratification shall be final for all purposes of this clause;

4. Complete performance of such part of the work as shall not have been terminated by the DISTRICT; and

5. Take such action as may be necessary, or as the DISTRICT may direct, for the protection and preservation of the property related to this contract which is in the possession of the Lead Entity and in which the DISTRICT has or may acquire an interest.

GOVERNING LAW - This contract shall be governed by the laws of the State of Nevada. The Lead Entity, by execution of this contract, acknowledges the jurisdiction of the courts of the State of Nevada in this matter.

NATIONAL WILDLIFE RANGE

NELLIS AIR FORCE BASE

(SMALL ARMS RANGE)

APPROXIMATE DIVERSION DIKE & 50 TO 150 FT. WIDE EARTHEN CHANNEL ALIGNMENT

OPEN FLOOD WAY CHANNEL (300 FT WIDE)

INLET AREA

NORTH LAS VEGAS DETENTION BASIN

TRANSITION BEND

BORROW SOURCE #1 FOR SOIL CEMENT DESIGN

BORROW SOURCE #2 FOR SOIL CEMENT DESIGN

MILITARY ROAD

MILITARY RESERVATION BOUNDARY

RANGE ROAD

PACIFIC UNION

INTERSTATE 15

BORROW PITS

Lovell

Valley

Dike

Substation

Gravel Pit

Borrow Pit

Sharon

Jet

Snipe

Olke

FORRESTAL BLVD

NELLIS AFB

AMB BLVD

25TH STREET

T 18 S

T 19 S

T 19 S

T 18 S

EXPLANATION

B-1 APPROXIMATE BORING LOCATION

T-1 APPROXIMATE TRENCH LOCATION

BS-1 APPROXIMATE BULK SAMPLE LOCATION FOR SEDIMENT TRANSPORT ANALYSIS

RANGE WASH FLOOD CONTROL PROJECT
Range Road
North Las Vegas, Nevada

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Sciences

Scale 1"=1000'
Date 10/30/91
Prepared by TA
Checked by BLO
Approved by
Project No. 91-33298-01
Drawing No. 2

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

VOLUME 4

SECTION 5 REFERENCE MATERIALS
Confluence Detention Basin Documentation

Submitted by:	**Clark County Regional Flood Control District**
Study Contractor:	**Post, Buckley, Schuh & Jernigan, Inc.**
Date Submitted:	**February 27, 1996**

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5.4.1 Detention Basin Design Correspondence

Clark County

Department of Public Works

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DIRECTOR

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455-4600

October 19, 1992

Mr. Gale Fraser, P.E.
Assistant General Manager
CC Regional Flood Control District
300 East Clark Avenue, Suite 301
Las Vegas, Nevada 89101

Dear Mr. Fraser:

SLOAN CHANNEL IMPROVEMENTS, CONFLUENCE DETENTION BASIN AND APPURTENANT COLLECTION AND DISCHARGE FACILITIES - FINAL PREDESIGN MEMORANDUM SUBMITTAL

For your review and comments please find enclosed a Final Predesign Memorandum for the Range Wash Confluence Detention Basin and Sloan Channel Improvements. Also enclosed for your perusal and file are copies of the Draft Predesign Memorandum comments and Boyle Engineering's response.

Kindly be advised that a meeting is scheduled for all interested parties on Tuesday, October 27, 1992 at 1:30 pm in the Clark County Regional Flood Control District conference room at the "District" office, 300 East Clark Avenue, Suite 301. This meeting will entertain comments, suggestions, and recommendations relative to this Final Predesign Memorandum submitted by Boyle Engineering Corporation on October 16, 1992.

Kindly be present or arrange to be represented for participation in discussion of any comments or concerns regarding these improvements. In addition to attendance at this meeting, we encourage written comments either prior to or for distribution and resolution at this meeting.

COMMISSIONERS
Jay Bingham, Chairman • Karen Hayes, Vice-Chairman
Paul J. Christensen, Thalia M. Dondero, William U. Pearson, Don Schlesinger, Bruce L. Woodbury
Donald L. "Pat" Shalmy, County Manager

Should there be questions, please call me at 455-7707.

M. J. MANNING
DIRECTOR OF PUBLIC WORKS

BY: William C. Brandt
WILLIAM C. BRANDT, P.E.
Project Coordinator

WCB:bat
Enclosures

cc: Colonel David L. Puzas, USAF
Mary Ann Cox, USAF
Donald W. Davis, Boyle Engineering w/o enclosures
Kevin Eubanks, CC Regional Flood Control District
M. J. Manning
Urb Livengood
Jim Mulcahy, w/o enclosures
John Murdoch
Terry Johnson
Brett Lane
Rich Romer
Herb Arnold
Carla Pearson
Les Henley
Ken Tischer
Gus Cederburg
Denis Cederburg

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OCT 16 1992
DESIGN & CONST. MGMT. DIVISION

Boyle Engineering Corporation consulting engineers

Suite 300
1785 East Sahara Avenue
Las Vegas, Nevada 89104

702 / 731-5511
FAX 702 / 731-5095

Mr. William C. Brandt, PE
Clark County Department of Public Works
Design Engineering Department
6655 West Sahara Avenue, C-204
Las Vegas, NV 89102

October 16, 1992

Re: Confluence Detention Basin

Dear Mr. Brandt:

Transmitted herewith are 25 copies of the Final Predesign Memorandum for the *Confluence Detention Basin and Sloan Channel Improvements*.

Summarized below is Boyle Engineering Corporation's (Boyle's) response to the Draft Predesign Memorandum comments received from the Clark County Public Works Department (County) on October 8, 1992.

Section I - Clark County Regional Flood Control District (CCRFCD) Comments

1) The directional references have been corrected in the text.

2) The project location indicated on Figure 1 has been corrected.

3) a) Additional text has been added to Section 2.B. of the memorandum to indicate the need for a Section 14 Site Specific Analysis in accordance with the CCRFCD's Environmental Impact Statement, to be performed concurrently with the design phase of the project.

3) b) Additional text has been added to Section 2.B. of the memorandum to include the CCRFCD's comment that no further paleontological work should be required.

3) c) Additional text has been added to Section 2.B. of the memorandum to include the CCRFCD's comments regarding the mitigation measures to protect the desert tortoise.

.....Continued

4) Inflow and outflow hydrographs, stage/storage/discharge curves and calculations have been added to the memorandum as Appendix E. This data, however, is preliminary and will change in final design. Diversion to the basin, grading plan, and outlet conditions have not been finalized.

The 84-inch outlet pipe indicated in the HEC-1 model was a text error resulting from not changing the comment from a previous model run. The stage discharge data in the model, however, correctly corresponded to the 5' x 3' RCB outlets indicated in the text and figures of the memorandum.

5) An additional HEC-1 model without the East Range Wash Detention Basin was executed. However, stage/storage/discharge data is only preliminary and the impact of omitting the upstream basin cannot be accurately determined at this time. The model used fully developed conditions, but without the upstream detention basin. The results indicated the maximum stage increased by .48 feet, still below the spillway in the preliminary model. The maximum storage increased by 68 acre-feet.

6) Refinements in the design phase of the project will focus on further limiting the construction costs.

Section II - County Comments

1. Toiyabe Street at this location is a low-speed, low-volume residential street, therefore, a guardrail should not be required.

2. The directional references have been corrected.

3. Converse Consultants Southwest, Inc. (Converse) has done further evaluation of impacts to groundwater and determined criteria to avoid negative impacts. A letter from Converse on this subject has been added to Appendix B, as well as additional text to Section 3.B. of the memorandum. The Section 14 Site Specific Analysis will also address this issue.

4. Alternative 2 is a more favorable alternative in terms of maintenance, as well as other considerations. Additional text in regard to maintenance differences and costs have been added to Section 5.E. and 10. of the memorandum.

5. The directional reference has been corrected.

.....Continued

6. Figure 9 has been changed to indicate a conceptual design of a diversion structure to split flows.

7. Cut-off walls will be used to protect structures and, as shown in Figure 18, to protect the channel lining of the outlet channel.

8. Clarifications have been made to Figure 15.

9. Erosion and bank protection will be provided at the location of major inflows into the golf course channel. Additional text has been added to Section 5.D.

10. Additional text has been added to Section 10, relating to cost comparisons of alternative materials.

11. Figure 19 has been modified to indicate Nellis Air Force Base, private, and public lands.

12. Land costs have been reviewed and additional text has been added to Section 10 for clarification.

13. The final design memorandum is a report which utilized engineering analysis and was stamped and sealed by the preparer.

Boyle has appreciated the opportunity to work with the County on this project and is eager to proceed with the design phase of the project, upon notification from the County.

Very truly yours,

BOYLE ENGINEERING CORPORATION

Donald W. Davis, PE
Project Manager

submittals

LV-C07-250-00/jk

Clark County

Progress As Promised

Department of Public Works

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October 5, 1992

Donald W. Davis, P.E.
Project Manager
Boyle Engineering Corporation
1785 E. Sahara Avenue, Suite 300
Las Vegas, Nevada 89104

Dear Mr. Davis:

SLOAN CHANNEL IMPROVEMENTS, CONFLUENCE DETENTION BASIN AND APPURTENANT COLLECTION AND DISCHARGE FACILITIES - DRAFT PREDESIGN MEMORANDUM COMMENTS

We are herewith forwarding a marked-up copy of the "Draft Predesign Memorandum" for Sloan Channel Improvements, Confluence Detention Basin and Discharge Facilities submitted by Boyle Consulting Engineers on August 6, 1992.

In addition to the marked-up document, we are tendering the following general comments for your perusal and incorporation with the Final Predesign Memorandum.

I. REGIONAL FLOOD CONTROL DISTRICT

Please refer to the attached letter copy for pertinent concerns.

II. CLARK COUNTY DEPARTMENT OF PUBLIC WORKS

1. The section of Toiyabe Street that will be located adjacent to the outlet channel needs to be evaluated for guardrail placement. The "Roadside Design Guide" by AASHTO is to be used to establish guardrail installation criteria. From the preliminary report, a guardrail installation seems mandatory.

2. On page 1, A. Background, under subparagraph 2) the west should read: "just east of the NAFB Golf Course."

COMMISSIONERS
Jay Bingham, Chairman • Karen Hayes, Vice-Chairman
Paul J. Christensen, Dunlin M. Doubleo, William U. Pearson, Don Schlesinger, Bruce L. Woodbury
Donald L. "Pat" Sunday, County Manager

3. Converse Environmental Consultants Southwest had expressed concern as to leachate from landfills impacting low and downstream areas. A question of actual effect and possible containment must be resolved in this regard, as concluded in the environmental report. It should be recognized that a Section 14 (EIS Report) analysis must be performed to "clear" the area(s) of concern.

4. It was discussed and agreed that probably the optimum route to pursue, subject to issuance of the Final Predesign Memorandum (FPM) and authorization to proceed by the Director, would be Alternative 2.

   Annualized maintenance costs must be submitted in the FPM to compare Alternates 1 & 2.

5. On page 9, we again have the Confluence Basin indicated as being west of the NAFB Golf Course when it should be "east".

6. Figure 9 should indicate the relationship of a control structure (Alt. 2 as recommended by Boyle Engineering) to the redesigned roadway.

7. The Draft Predesign Memorandum does not indicate use of cut-off walls.

8. Figure 15 should indicate direction of flow and incorporate elevations where applicable.

9. Consideration should be given to handling flow into the Confluence Basin from the "major drainage route" carrying water from runways as shown on Fig. 20.

10. Due to monetary constraints, a comparison of alternative construction methods must be included in the FPM; e.g. soil cement vs. roller compacted concrete, etc.

11. Fig. 19 should be modified to indicate NAFB property, private land, and public lands.

12. Tables 2 and 3 utilize a $ 10,000.00 per acre land acquisition cost. This figure appears to be somewhat low; please review.

13. Note that the Nevada State Board of Registered Professional Engineers and Land Surveyors has taken the position (see attached) that preliminary submittals should be stamped but not signed. Please submit the FPM with a seal (not signed or dated) representing the engineer in responsible charge of work.

Kindly address issues raised and submit a FPM prior to receiving authorization on actual design work (Contract Section 2.03).

Should there be questions or if you require any additional information, feel free to call me at 455-7707.

M. J. MANNING
DIRECTOR OF PUBLIC WORKS

BY: William C. Brandt
WILLIAM C. BRANDT, P.E.
Project Coordinator

MJM:WCB:bat
Enclosure

cc: Gale Fraser, CCRFCD
M. J. Manning
Urb Livengood
Denis Cederburg

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

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MGMT. DIVISION

Virginia Bax-Valentine, P.E.
Chief Engineer/General Manager

BOARD OF DIRECTORS

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Jan Laverty Jones
City of Las Vegas

Tom R. Leavitt
City of Mesquite

Bruce L. Woodbury
Clark County

August 19, 1992

William C. Brandt, P.E.
Clark County Public Works
Design Engineering Division
6655 West Sahara, Bldg. C-204
Las Vegas, Nevada 89102

Range Wash Confluence Detention Basin and Sloan Channel
Draft Predesign Memorandum

Dear Mr. Brandt:

After review of the Draft predesign memorandum for the referenced project, the following comments are offered for your consideration:

1) It seems that the directional references in items 1 and 2 of section 1.A should be reversed;

2) The project location appears to be incorrect on Figure 1;

3) With respect to the statements regarding environmental issues, the following are noted:

   a) The environmental regulations and mitigations which apply to this project are outlined in the District's EIS and Record of Decision (ROD), whether on public or private lands. In accordance with the stipulations of the ROD, as project specific elements become available through final design, further environmental documentation must be performed as outlined in Section 14 of the EIS. Where no public lands are involved the District is charged with administering the site specific analyses (Section 14) and mitigation measures required by the EIS. A Section 14 analysis will be require for this project and should be coordinated with and submitted to the District.

   b) The paleontological assessment for the District's master plan has been completed and accepted by the Bureau of Land Management (BLM). A copy of the assessment can be obtained from the District upon request. The assessment does not identify the project area as one of concern; therefore, no further paleontological work should be required.

   c) Mitigation measures to protect the existence of the desert tortoise will

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be in accordance with the District's biological opinion (Opinion) as amended. Recent amendments to the Opinion have revised mitigation measures to be consistent with those required by the Habitat Conservation Program (HCP). Temporary tortoise proof fencing will not be required. Mitigation fees for the loss of tortoise habitat have already been paid by the District for this and other projects. It should be clear that the HCP does not apply to this project.

4) Stage/storage and stage/discharge curves and calculations should be included to support the values used in the hydrologic model. The HEC-1 models refer to the outlet structure as an 84" RCP, while the plans show a multiple cell 5' X 3' RCB. Inflow and outflow hydrographs should be included.

5) It may be prudent to execute one additional HEC-1 model to simulate the basin function in the absence of the East Range Wash Detention Basin (RWEA 0625, F-7&8).

6) The preliminary cost estimates for alternatives 1 and 2 are $10,194,500 and $9,387,500, respectively. It should be noted that $8,620,000 is programmed on the Bond Project List for this project.

If you should have any questions or if I can be of any assistance, please give me a call.

VIRGINIA BAX-VALENTINE, P.E.
General Manager/Chief Engineer

BY: Kevin L. Eubanks, P.E.
Senior Engineer

cc: Denis Cederburg, Clark County Public Works

KLE:mak

FILE:CLA.06.A.91

ROBISON, BELAUSTEGUI, ROBB AND SHARP
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MNGT. DIVISION

August 29, 1990

William C. Brandt
Clark County Department of Public Works
401 South Fourth Street
Las Vegas, Nevada 89101

Dear Mr. Brandt:

This firm represents the Nevada State Board of Registered Professional Engineers and Land Surveyors which has requested this firm to respond to your letter of May 1, 1990. The Board has devoted a great deal of effort and time on the issue of stamping and sealing of documents, specifications, plats and reports submitted to public entities. The Board is in the process of preparing a regulation that will detail the procedures to be followed in the stamping and sealing of such documents.

The Board will solicit the input of its registrants and the building officials prior to the enactment of the regulation. However, the Board's position on the issues raised in your letter of May 1, 1990 now stands as follows:

1. Preliminary items should be stamped and noted as preliminary and not for construction. The stamp should not be signed. It is stamped solely to identify the professional who prepared the preliminary plan.

2. The Board discourages the submittal of final plans to a developer. The Board prefers that the professional be responsible for the delivery of the final stamped plans to the public entity. However, the public entity should in all cases require final plans to be stamped and signed by the professional irrespective of whether the plans are submitted by the professional or by a developer.

The Board looks forward to working with you in the drafting of the forth coming regulation. Your further input would be greatly appreciated.

Sincerely,

BRUCE ROBB
of ROBISON, BELAUSTEGUI,
ROBB & SHARP

BR:cz
cc: George Ball
George Brizendine

C.C.A.06.A.91

Clark County

Progress As Promised

Department of Public Works

Kevin file

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December 17, 1992

Mr. Gale Fraser, P.E.
Assistant General Manager
Clark County Regional Flood Control District
301 E. Clark Ave., Suite 301
Las Vegas, NV 89101

Dear Mr. Fraser:

RANGE WASH - SLOAN CHANNEL CONFLUENCE BASIN

Subsequent to our December 10, 1992 meeting, the State Of Nevada, Division of Water Resources (DWR), has accepted Boyle Engineering's design concept for the Confluence Basin.

For your perusal and file, you will find enclosed copies of Boyle Engineering's 12/14/92 letter conveying the above information, together with the 11/24/92 spillway concept letter to DWR and their Confluence Detention Basin Design Memo.

Recognizing initial tacit acceptance of the Boyle Engineering spillway concept by DWR and coupling that with apparent cost savings from utilizing the modified Alternate 2 - two stage discharge, it appears we should now actively pursue design and forego additional spillway evaluations.

Please review the enclosed material and advise your thoughts at the earliest, possible convenience. We, of course, would prefer to avoid the propensity for design delays, additional engineering costs and supplemental DWR review if substantive benefits cannot be determined beforehand.

sandy\brandt\fraser.rw
F910619

COMMISSIONERS
Jay Bingham, Chairman • Karen Hayes, Vice-Chairman
Paul J. Christensen, Thalia M. Dondero, William U. Pearson, Don Schlesinger, Bruce L. Woodbury
Donald L. "Pat" Shalmy, County Manager

Should there be questions, please call me at 455-7707.

M. J. MANNING
DIRECTOR OF PUBLIC WORKS

BY: William C. Brandt
WILLIAM C. BRANDT, P.E.
Project Coordinator

WCB:slh
Enclosure

cc: Don Davis, Boyle Engineering, w/encl.
Urb Livengood, w/encl.
Denis Cederburg, w/encl.

sandy\brandt\fraser.rw
F910619

1992

Boyle Engineering Corporation

consulting engineers

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1765 East Sahara Avenue
Las Vegas, Nevada 89104

702 / 731-5511
FAX 702 / 731-5095

December 14, 1992

Mr. Bill Brandt, PE
Clark County Public Works Department
6655 West Sahara Avenue, Building C-204
Las Vegas, NV 89102

Re: Confluence Detention Basin

Transmitted herewith is a copy of minutes to the meeting held at the Clark County Regional Flood Control District (District) on December 10, 1992.

Boyle has been delayed in design due to the time which transpired to coordinate with the District and resolve the issues regarding the requirements of the PMF pool elevation and land acquisition. There has also been delay regarding acceptance of the diversion and two-level outlet system. These issues were discussed in a meeting held at Clark County Public Works Department (County) on November 13, 1992. The meeting of December 10, 1992 resolved these issues, as indicated in the attached minutes, after approximately four weeks have transpired..

Subsequent to the meeting, Boyle Engineering Corporation (Boyle) received notification from the State Engineer, Division of Water Resources, that there are no objections to the spillway concept which was presented in the letter of November 24, 1992. A copy of the letter from the Division of Water Resources is enclosed.

The spillway concept presented is an economical solution and has now been determined acceptable by the Division of Water Resources. As noted in the attached meeting minutes, Boyle has been requested to evaluate additional spillway concepts, particularly, using the entire west embankment length for a spillway. The additional evaluation and the associated review and comments may cause additional delays to our schedule.

If spillway concepts can be resolved quickly, Boyle expects to make the 60 percent design submittal three weeks behind the previously submitted schedule, on February 1, 1993. Delayed acceptance of a spillway length alternative by the District or the County would further delay the date of the submittal.

Please contact Boyle if there are any additional comments or revisions to the minutes.

BOYLE ENGINEERING CORPORATION

Donald W. Davis, PE
Senior Civil Engineer

enclosure

cc: Gale Fraser, Clark County Regional Flood Control District

MINUTES OF MEETING
CONFLUENCE DETENTION BASIN

December 10, 1992

Attendees:

Bill Brandt, Clark County Public Works
Gale Fraser, Clark County Regional Flood Control District
Kevin Eubanks, Clark County Regional Flood Control District
Don Davis, Boyle Engineering Corporation

Summary:

1. The proposed diversion and two-level outlet concept to reduce detention basin storage requirements, presented in the design memo transmitted on November 30, 1992, was accepted. However, more calculations and refinement related to the function of the outlet structure needs to be performed and provided.

2. The District indicated that land would need to be acquired up to the elevation of the dam embankment or the PMF pool, whichever is higher, from the properties on the east side of the Detention Basin. The low elevation areas to the north and west, primarily Nellis Air Force Base property, would not have to be acquired to this elevation since there are no reasonable means to protect this area from the PMF.

3. The spillway concept and letter sent to the State Engineer was discussed, wherein some of the flows of the PMF back up into the golf course area and flow around the detention basin. The State Engineer had not yet responded to the letter.

4. The District proposed that the spillway be increased to the full length of the dam embankment on the west side. This would resolve some concerns about the presently proposed spillway not passing the entire PMF amount. It would reduce the height of the dam embankment by approximately one foot, and reduce the land acquisition requirements on the east side of the basin. The flow which would back up and flow around the basin through the golf course would be assumed to be non-effective flow. Since some flows are likely to bypass the basin, the District would be satisfied with no freeboard above the calculated PMF pool elevation. The amount of freeboard required will need to be discussed with, and meet the requirements of, the State Engineer.

5. The District requested that, in conjunction with geotechnical findings and recommendations, additional evaluation of cross-section, length, cost, and materials of spillway alternatives be performed.

BOB MILLER
Governor

STATE OF NEVADA

PETER G. MORROS
Director

R. MICHAEL TURNIPSEED, P.E.
State Engineer

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

DIVISION OF WATER RESOURCES

Capitol Complex
123 W. Nye Lane
Carson City, Nevada 89710
(702) 687-4380

December 8, 1992

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DEC 11 1992
BOYLE/LAS VEGAS

Donald W. Davis, P.E.
Boyle Engineering Corporation
1785 E. Sahara Avenue, Suite 300
Las Vegas, Nevada 89104

Re: Confluence Detention Basin

Dear Mr. Davis:

I have reviewed your submission of November 24, 1992, illustrating the pre-design concept for the referenced structure.

The Division of Water Resources has no objections to design concept as presented.

Please find enclosed the appropriate application forms for approval of the final design. Should you have any questions, please contact me.

Sincerely,

J. Stephen Folk

J. Stephen Folk, P.E.
Hydraulic Engineer

JSF/bk
Enclosure

cc: Southern Nevada Branch Office

Boyle Engineering Corporation consulting engineers

Suite 300
1785 East Sahara Avenue
Las Vegas, Nevada 89104

702 / 731-5511
FAX 702 / 731-5095

RECEIVED
54
NOV 1992
DESIGN & CONST. MGMT. DIVISION

Mr. Bill Brandt, PE
Clark County Public Works Department
6655 West Sahara Avenue, Building C-204
Las Vegas, NV 89102

November 30, 1992

Re: Confluence Detention Basin

Transmitted herewith are the following items:

2 copies — *Confluence Detention Basin Memo*. This memo explains revised hydrology and proposed design changes.

2 copies — Letter to State of Nevada Department of Conservation and Natural Resources. This letter is in regard to the proposed spillway concept.

1 copy — Legal description and parcel maps for the following parcels:

260-290-002	260-290-003	260-290-017
260-290-009	260-290-010	260-290-013
260-290-023	260-290-024	260-290-025
260-290-022		

1 copy — Stamped legal description for channel easement through golf course and accompanying exhibit.

Please forward a copy of the design memo and letter to State of Nevada to Mr Denis Cederburg. Copies of these two items have been sent direct to the Clark County Regional Flood Control District per your request.

Boyle is presently assuming that the land affected by the Probable Maximum Flood (PMF) pool will not be required to be obtained. Please notify us as soon as possible to resolve and clarify the requirements regarding the PMF.

Please call if you have any questions regarding the items transmitted.

BOYLE ENGINEERING CORPORATION

Donald W. Davis, PE
Senior Civil Engineer

enclosures

LV-C07-250-00/jk

CONFLUENCE DETENTION BASIN
DESIGN MEMO

INTRODUCTION

Boyle Engineering Corporation (Boyle) has prepared this memo to explain required changes in hydrology and proposed changes to the design of facilities for the *Confluence Detention Basin and Sloan Channel Improvements.*

REVISED HYDROLOGY

The hydrologic model used for the Predesign Memorandum Confluence Detention Basin and Sloan Channel Improvements was originally developed for the Western and Eastern Tributaries of Range Wash Flood Control Facility Plan. The model was developed in accordance with the directions of The Clark County Regional Flood Control District (CCRFCD). After the model was initially developed, the CCRFCD directed it to be calibrated to meet the accepted flow, at the confluence with the Las Vegas Wash, established by the U. S. Army Corps of Engineers (COE). The calibration was achieved by using factored Soil Conservation Service (SCS) curve numbers corresponding to an Antecedent Moisture Condition (AMC) of 1.8. The depth area reduction factors applied to point precipitation values were taken from HYDRO-40 per the direction of CCRFCD at that time. This hydrologic model was developed prior to the acceptance of the Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual (CCRFCD Manual). The current project requires conformance with the CCRFCD Manual. The new criteria uses a depth area reduction factors developed by the COE, which have a greater reduction in average rainfall over larger areas. The manual also indicates that curve numbers associated with an AMC 2 (average) be utilized. Table 1 indicates the resulting changes in SCS CN values. The differences in depth area reduction are shown in Table 2.

Revising the model to conform with the present criteria results in similar flows at the Las Vegas Wash. This is because the new curve numbers increase the amount of runoff, but the new depth area reduction factors reduce the average rainfall. However, the new criteria produces higher flows and greater volumes for upstream and smaller areas.

For the Alternative 2 conditions presented in the Predesign Memorandum, the revised hydrology increases the calculated peak storage volume by approximately 150 acre-feet.

A storm located below the detention basin (Area E only) produces a flow at the Las Vegas Wash of approximately 3,600 cfs, approximately 400 cfs more than the previous model produced. Since downstream Sloan Channel requirements will be 3,600 cfs

based on the Area E Storm, and existing lined portions of Sloan Channel have sufficient capacity, the target discharge for an area wide storm (BCDE) including detention basin outflow may be increased to 3,600 cfs at the Las Vegas Wash.

TWO LEVEL OUTLET

As discussed in progress meetings the storage requirements of the detention basin may be reduced if a two level outlet is utilized. A greater amount of flow may bypass the detention basin in the existing Sloan Channel if the flow released from the detention basin is relatively low. The combined flow of the Sloan Channel Bypass and the Detention Basin Outflow added to the downstream flows should not produce a peak discharge greater than 3,600 cfs at the Las Vegas Wash. After the peak flow generated from the downstream area passes, the flow released from the detention basin may be increased. Thus the hydrograph generated from the downstream area is dropping, while the detention basin outflow hydrograph is rising, and the net discharge remains below 3,600 cfs.

The release rate from the detention basin outflow may be increased by means of a secondary outlet, which begins to operate after the detention basin has filled to a higher level. The initial low level outlet will have an orifice control with invert elevation at 1799. The higher level outlet may be accomplished by a large box structure into which the low level outlet also enters. The top of the box will form a weir. The total proposed weir length is 96 feet with crest elevation at 1813. The maximum 100 year water surface elevation is 1816. The stage discharge relationships are summarized in Table 3. Two 10' x 5' RCB culverts will convey flow from the outlet structure through the embankment to the outfall channel.

The inflow and outflow hydrographs for the detention basin with the proposed two level outlet is shown in Figure 1. Figure 2 shows the relationship of the three hydrographs which contribute to the total hydrograph, and the total hydrograph at the Las Vegas Wash.

The two level outlet optimizes the use of existing facilities, and reduces the storage requirements of the detention basin by approximately 400 acre-feet (645,000 CY of excavation). This also makes it more feasible to move the embankment further north off of the more expensive land and avoiding the recently constructed electrical transmission facilities.

DIVERSION

The diversion from Sloan Channel through the Golf Course has also been revised. The existing soil cement portion of Sloan Channel had an original design capacity of 2,600 cfs, however, to meet current freeboard criteria and to limit flow velocity to 10 fps the proposed capacity limit is 1,400 cfs. The diversion structure will cause flow to begin to

spill into the golf course channel when the flow exceeds 800 cfs. A constriction in Sloan Channel will produce increased backwater depth and diverted flows will spill over a control weir 200 feet long and 6 feet above the invert. This diversion reduces the volume of flow into the detention basin and maximizes the use of the existing Sloan Channel.

RESULTS

The new hydrology, two level outlet, and diversion produce the design flows as indicated in Table 4 and as shown in Figure 3.

COSTS

The revised hydrology increased the storage requirements for the Alternative 2 presented in the Predesign Report. It has also been determined that land costs south of Alto are approximately $35,000 per acre and it is better to move the embankment north of Alto. It has also been determined that haul and disposal costs have declined. The cost estimate for Alternative 2 has been revised to reflect these changes and is shown in Table 5.

The newly proposed diversion and two level outlet design reduces the storage requirements of the detention basin. This alternative is labeled Alternative 3 and costs are presented in Table 6. As indicated from the cost estimates this alternative produces a savings of approximately $2,300,000.

TABLE 1

SCS CURVE NUMBERS

PREVIOUS HYDROLOGY AMC 1.8	REVISED HYDROLOGY AMC 2
72	76
73	77
75	79
84	87
85	88
97	98

TABLE 2

DEPTH AREA REDUCTION FACTORS

AREA SQUARE MILES	PREVIOUS HYDROLOGY HYDRO-40	REVISED HYDROLOGY CCRFCD MANUAL
.00	1.00	1.00
.50	.98	.98
1.00	.97	.97
2.00	.93	.93
4.00	.91	.91
6.00	.90	.90
8.00	.88	.88
10.00	.86	.86
20.00	.78	.79
30.00	.75	.74
50.00	.70	.68
100.00	.65	.60
150.00	.62	.55

TABLE 3

CONFLUENCE DETENTION BASIN
STAGE DISCHARGE RELATIONSHIPS

LOW LEVEL OUTLET				
ORIFICE	B	D	AREA	COEF
	5	4	20	.64

SECONDARY OUTLET	
WEIR LENGTH	96

ELEV	ORIFICE HEAD	ORIFICE Q	WEIR HEAD	WEIR Q	SPILLWAY HEAD	SPILLWAY Q	TOTAL Q
1817	18	410.9	4	2,304	1	3,810	6,525
1816	17	397.8	3	1,496			1,894
1815	16	384.3	2	815			1,199
1814	15	370.4	1	288			658
1813	14	355.8	0	0			356
1812	13	340.7					341
1811	12	324.8					325
1810	11	308.2					308
1809	10	290.5					291
1808	9	271.8					272
1807	8	251.6					252
1806	7	229.7					230
1805	6	227.0					227
1804	5	172.7					173
1803	4	123.6					124
1802	3	80.2					80
1801	2	43.7					44
1800	1	15.4					15
1799	0	.0					0

TABLE 4

HYDROLOGIC RESULTS

LOCATION	STORM D	STORM E	STORM BCD	STORM BCDE	UNITS
GOLF COURSE CHANNEL	2,500	0	1,590	1,360	CFS
SLOAN CHANNEL BYPASS	1,400	0	1,240	1,190	CFS
DETENTION BASIN INFLOW	2,500	0	4,610	4,030	CFS
DETENTION BASIN OUTFLOW	500	0	1,890	1,670	CFS
DETENTION BASIN PEAK STORAGE	480	0	860	750	ACRE-FT
SLOAN CHANNEL BYPASS COMBINED WITH DETENTION BASIN OUTFLOW	1,725	0	2,980	2,670	CFS
SLOAN CHANNEL AT LAS VEGAS WASH	1,725	3,630	2,980	3,590	CFS

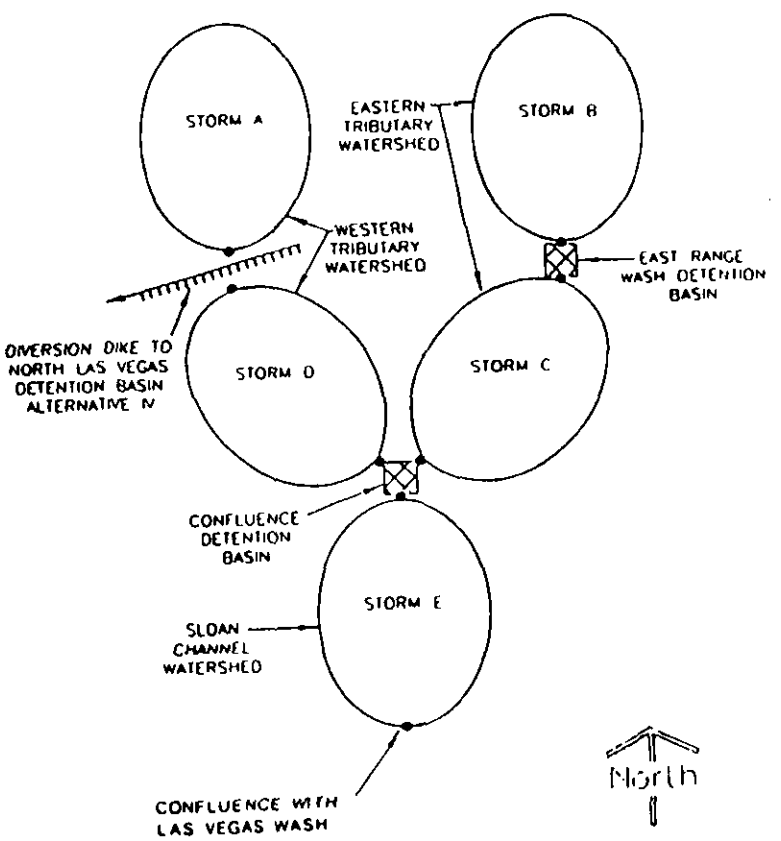


TABLE 5

REVISED ALTERNATIVE 2
ESTIMATE OF PROBABLE CONSTRUCTION COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
INLET CHANNEL				
DIVERSION STRUCTURE & CONCRETE CHANNEL	1	LS	$110,000	$110,000
MAJOR ROADWAY CROSSING	1	LS	$90,000	$90,000
ROADWAY IMPROVEMENTS	1	LS	$40,000	$40,000
EARTHWORK GOLF COURSE	100,000	CY	$6	$600,000
GRAVEL DRAIN	4,000	LF	$10	$40,000
STEEL BRIDGE CROSSING	2	EA	$65,000	$130,000
RETAINING WALLS	1	LS	$50,000	$50,000
TURF REPLACEMENT	1	LS	$35,000	$35,000
UTILITY CONFLICTS	1	LS	$40,000	$40,000
LAND ACQUISITION	14	ACRES	$10,000	$140,000
SUBTOTAL INLET CHANNEL				**$1,275,000**
DETENTION BASIN				
EXCAVATION	1,320,000	CY	$1	$1,320,000
EMBANKMENT FILL	90,000	CY	$1.50	$135,000
DISPOSAL & HAUL	835,000	CY	$3	$2,505,000
OUTLET WORKS	1	LS	$150,000	$150,000
SPILLWAY/EROSION PROTECTION	1	LS	$100,000	$100,000
LAND ACQUISTION	163	ACRES	$10,000	$1,630,000
SUBTOTAL DETENTION BASIN				**$5,840,000**
OUTLET CHANNNEL				
OUTLET CHANNEL	2,500	LF	$180	$450,000
CONFLUENCE STRUCTURE	1	LS	$15,000	$15,000
LAND ACQUISTION	.8	ACRES	$35,000	$28,000
SUBTOTAL OUTLET CHANNEL				**$493,000**
SUBTOTAL ALTERNATIVE 2				**$7,608,000**
CONTINGENCY (20%)				$1,522,000
TOTAL ALTERNATIVE 2				**$9,130,000**

TABLE 6

ALTERNATIVE 3
ESTIMATE OF PROBABLE CONSTRUCTION COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
INLET CHANNEL				
DIVERSION STRUCTURE & CONCRETE CHANNEL	1	LS	$110,000	$110,000
MAJOR ROADWAY CROSSING	1	LS	$90,000	$90,000
ROADWAY IMPROVEMENTS	1	LS	$40,000	$40,000
EARTHWORK GOLF COURSE	100,000	CY	$6	$600,000
GRAVEL DRAIN	4,000	LF	$10	$40,000
STEEL BRIDGE CROSSING	2	EA	$65,000	$130,000
RETAINING WALLS	1	LS	$50,000	$50,000
TURF REPLACEMENT	1	LS	$35,000	$35,000
UTILITY CONFLICTS	1	LS	$40,000	$40,000
LAND ACQUISITION	14	ACRES	$10,000	$140,000
SUBTOTAL INLET CHANNEL				**$1,275,000**
DETENTION BASIN				
EXCAVATION	629,000	CY	$1	$629,000
EMBANKMENT FILL	90,000	CY	$1.50	$135,000
DISPOSAL & HAUL	350,000	CY	$3	$1,050,000
OUTLET WORKS	1	LS	$230,000	$230,000
SPILLWAY/EROSION PROTECTION	1	LS	$100,000	$100,000
LAND ACQUISTION	163	ACRES	$10,000	$1,630,000
SUBTOTAL DETENTION BASIN				**$3,774,000**
OUTLET CHANNNEL				
OUTLET CHANNEL	2,500	LF	$230	$575,000
CONFLUENCE STRUCTURE	1	LS	$15,000	$15,000
LAND ACQUISTION	.8	ACRES	$35,000	$28,000
SUBTOTAL OUTLET CHANNEL				**$618,000**
SUBTOTAL ALTERNATIVE 3				**$5,667,000**
CONTINGENCY (20%)				$1,133,000
TOTAL ALTERNATIVE 3				**$6,800,000**

CONFLUENCE DETENTION BASIN
INFLOW / OUTFLOW HYDROGRAHPS

100-YR 6-HR STORM AREA BCDE

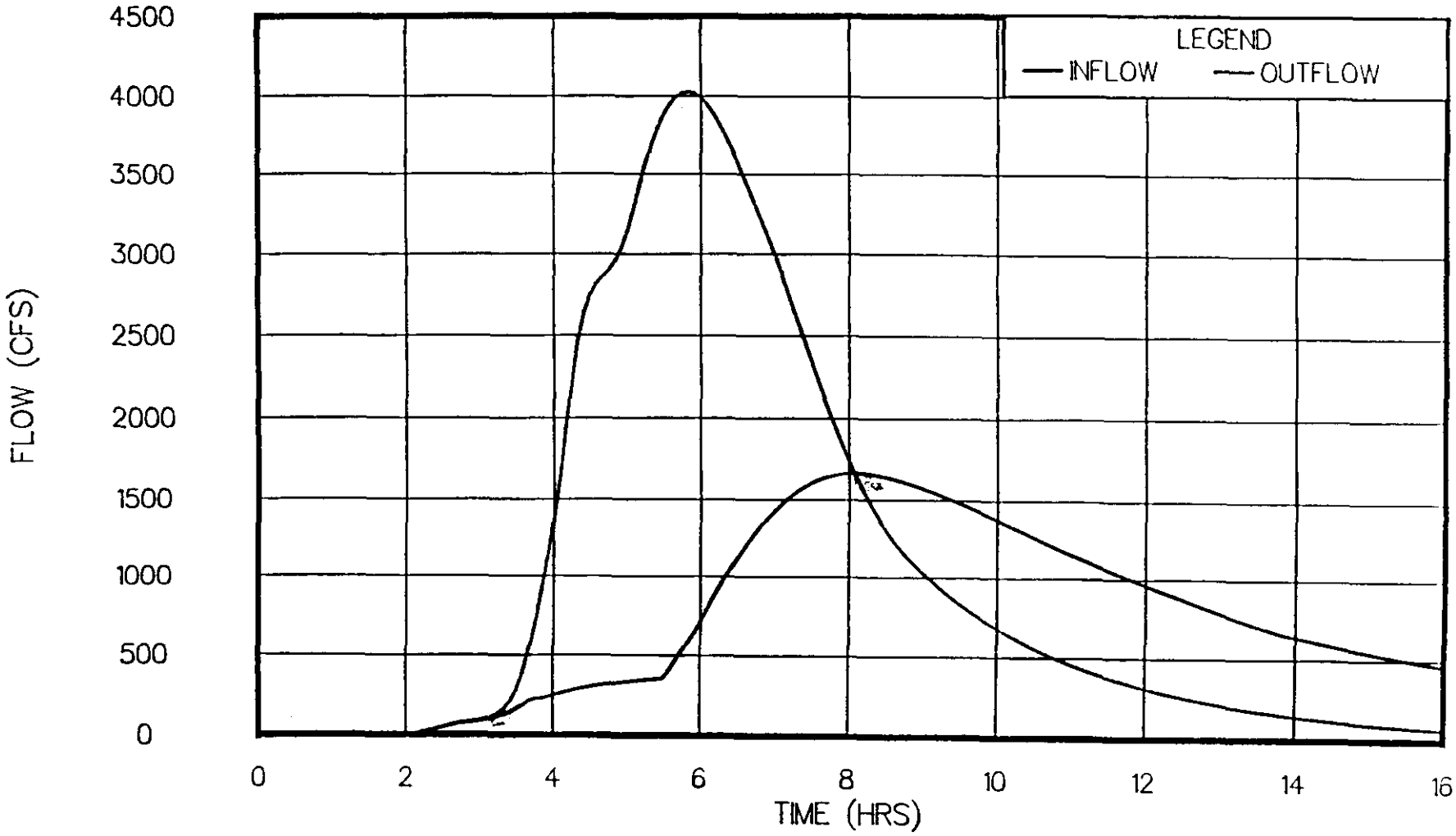


FIGURE 1

CONFLUENCE DETENTION BASIN HYDROGRAPHS

100–YR 6–HR STORM AREA BCDE

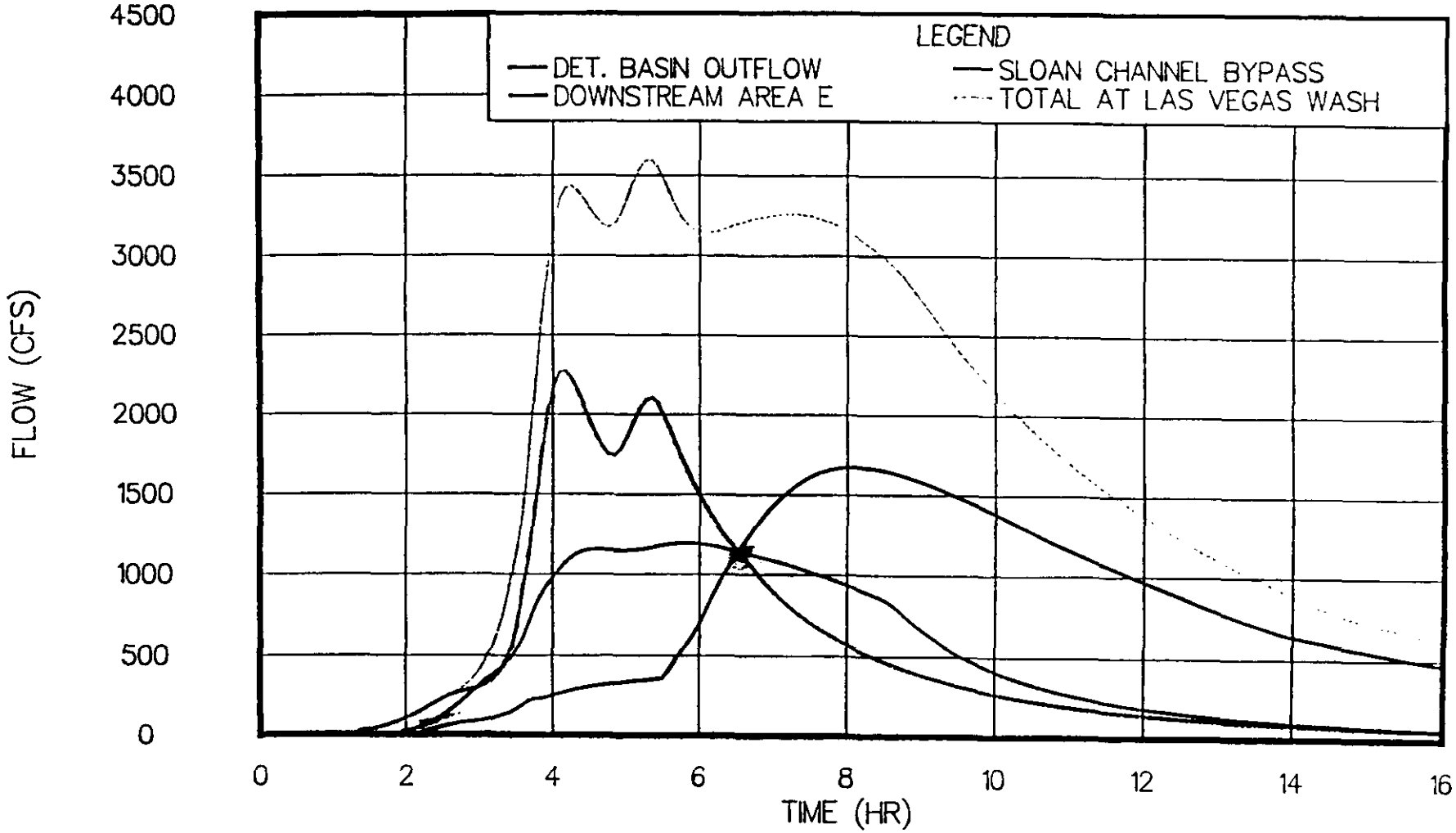


FIGURE 2

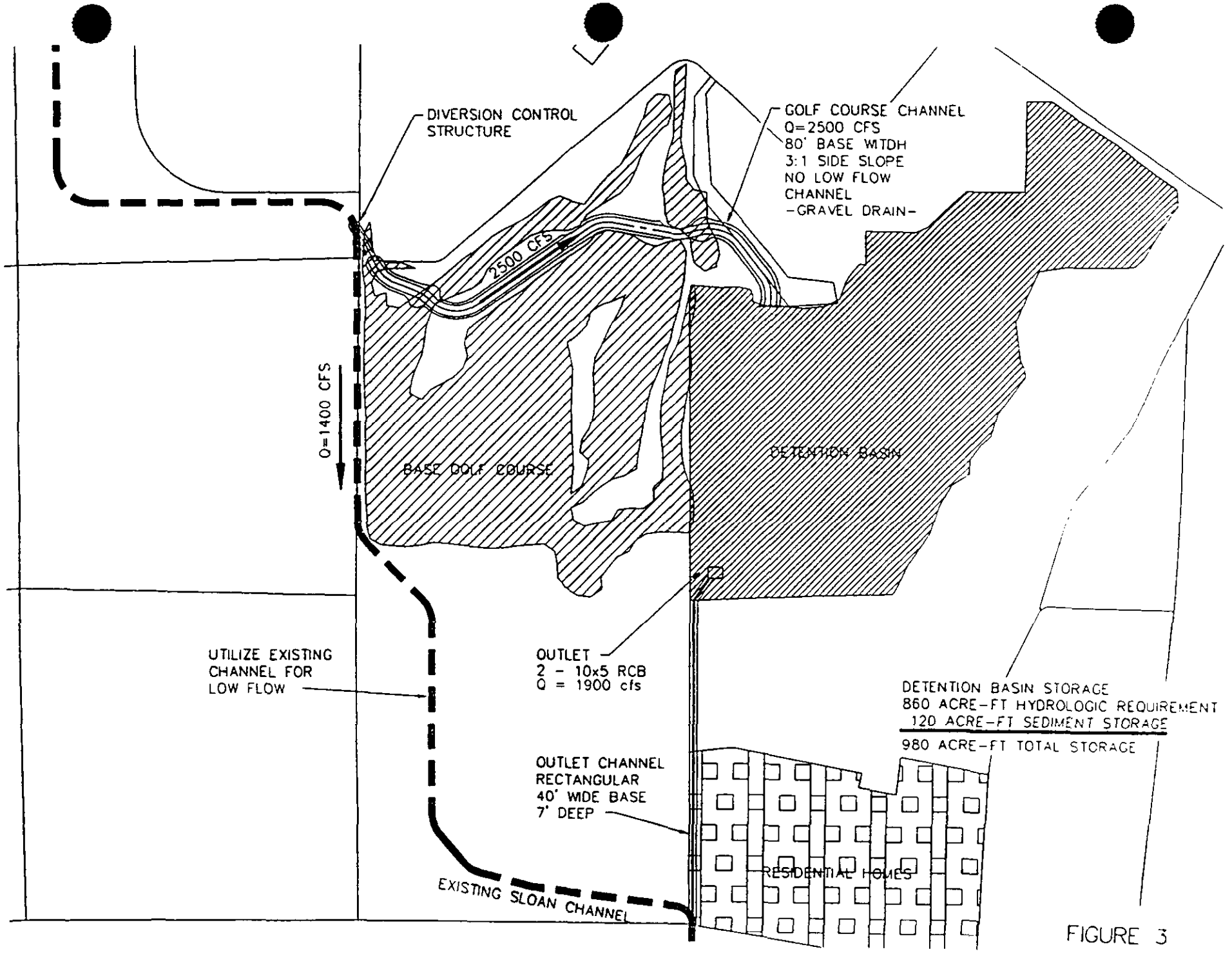

DIVERSION CONTROL STRUCTURE
GOLF COURSE CHANNEL
Q=2500 CFS
80' BASE WITDH
3:1 SIDE SLOPE
NO LOW FLOW CHANNEL
-GRAVEL DRAIN-
2500 CFS
Q=1400 CFS
BASE GOLF COURSE
DETENTION BASIN
UTILIZE EXISTING CHANNEL FOR LOW FLOW
OUTLET
2 - 10x5 RCB
Q = 1900 cfs
DETENTION BASIN STORAGE
860 ACRE-FT HYDROLOGIC REQUIREMENT
120 ACRE-FT SEDIMENT STORAGE
980 ACRE-FT TOTAL STORAGE
OUTLET CHANNEL
RECTANGULAR
40' WIDE BASE
7' DEEP
RESIDENTIAL HOMES
EXISTING SLOAN CHANNEL

FIGURE 3

Boyle Engineering Corporation consulting engineers

Suite 300
1785 East Sahara Avenue
Las Vegas, Nevada 89104

702 / 731-5511
FAX 702 / 731-5095

State of Nevada
Department of Conservation and Natural Resources
Division of Water Resources
Attention Steve Folk
Capitol Complex
201 South Fall Street
Carson City, NV 89710

November 24, 1992

Dear Mr. Folk:

Boyle Engineering Corporation (Boyle) has been performing predesign engineering for the Confluence Detention Basin. The detention basin is located near Nellis Air Force Base in the north east portion of the Las Vegas Valley near the confluence of the East and West Range Washes. The Clark County Regional Flood Control District (CCRFCD) has requested that Boyle submit the proposed concept for the Probable Maximum Flood (PMF) emergency spillway to the State Engineer for review and comment.

The detention basin is located on the East Range Wash, east of the Nellis Air Force Base Golf Course. A diversion will divert high flows through the golf course to the detention basin, approximately 1000 cfs, during the 100-year event, will remain in the existing Sloan Channel and bypass the detention basin. Enclosed is a figure indicating the proposed facilities and a copy of USGS map with the detention basin location indicated.

The PMF reaching the basin was evaluated two ways. (1) A storm over both East and West Range Washes had an average areally reduced rainfall of 9.2 inches. Approximately 3000 cfs (full capacity of the golf course channel) was estimated to be diverted to the basin from the West Range Wash. 59,000 cfs was generated from the East Range Wash. This created a total flow of 62,000 cfs to the Detention Basin. (2) With a storm centered over just the East Range Wash, the areally reduced rainfall was 10.0 inches. This produced a flow of 74,000 cfs on the East Range Wash. The larger flow of 74,000 cfs will be used for design. The HEC-1 hydrologic analysis is enclosed.

The proposed spillway concept utilizes the golf course area to convey PMF flows. As the water surface in the detention basin rises, the flow begins to flow around the detention basin and through the golf course. A portion of the west embankment of the detention basin, 1000 feet long, would also serve as a spillway. The crest at elevation 1816, would vary from 0 to 2 feet above existing grade, therefore, it would not require extensive erosion protection or energy dissipation. The spillway would be constructed of soil cement or roller compacted concrete. As the water surface rises above elevation 1816 it begins to overtop the spillway on the west embankment, it also begins to back up into the golf course area to the north and west. The banks of the channel through the golf course would begin to be overtopped. The flow through the golf course negates the need for the full PMF spillway on the detention basin embankment. Calculations for the stage and discharge relationships for the PMF are enclosed.

. . . continued

It may be noted that the detention basin and conveyance facilities provide 100-year flood protection to the golf course, which it presently does not have. Also, for major flood events such as the PMF, the golf course area would be flooded with or without the detention basin and regardless of its configuration.

The west dam embankment downstream of the spillway section is proposed to be armored with soil cement to protect the toe while the PMF flows around the detention basin. The proposed height of the embankment crest is 1823. Cross-sections of the spillway and the west embankment are shown in the attached Figures labeled 13 and 14.

Boyle is proceeding with design under the assumption that the proposed concept will be acceptable. Please review the attached calculations and proposed spillway concept and notify Boyle with your comments. Please call if you require any additional information.

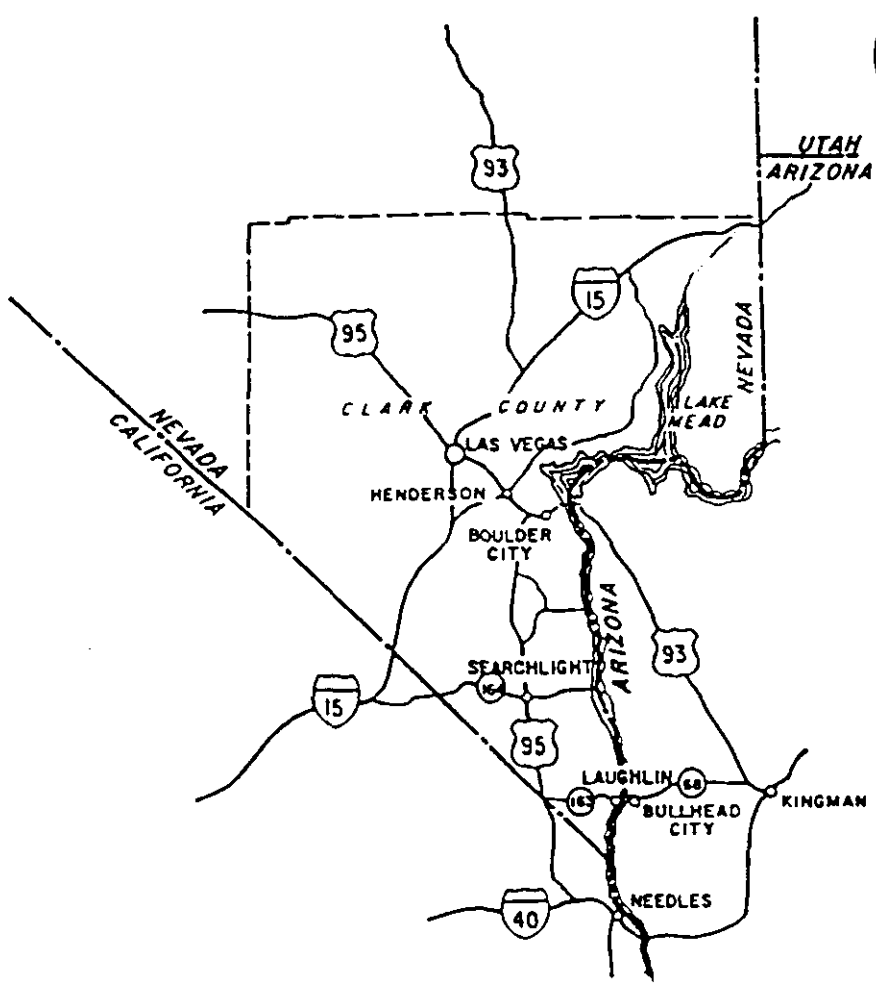
Very truly yours,

BOYLE ENGINEERING CORPORATION

Donald W. Davis, PE
Project Manager

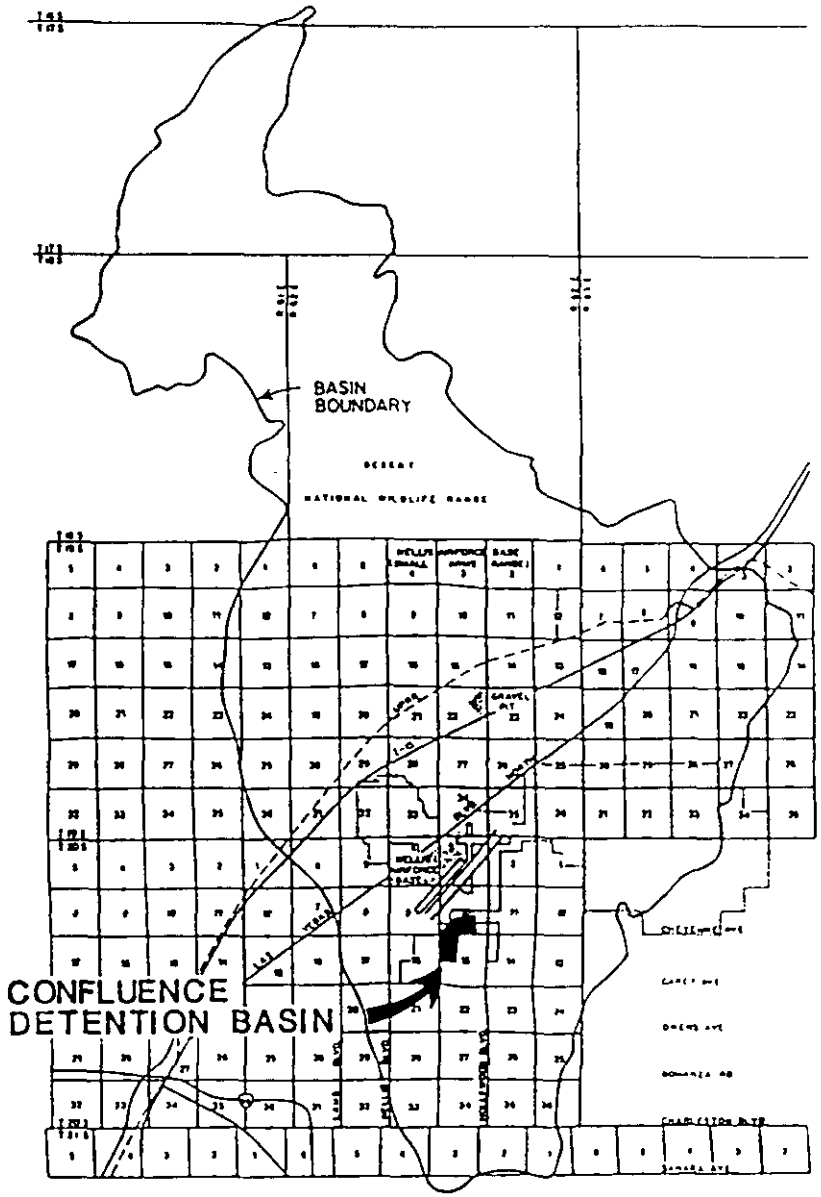
Attachments

LV-C07-250-02/lh



LOCATION MAP

NOT TO SCALE

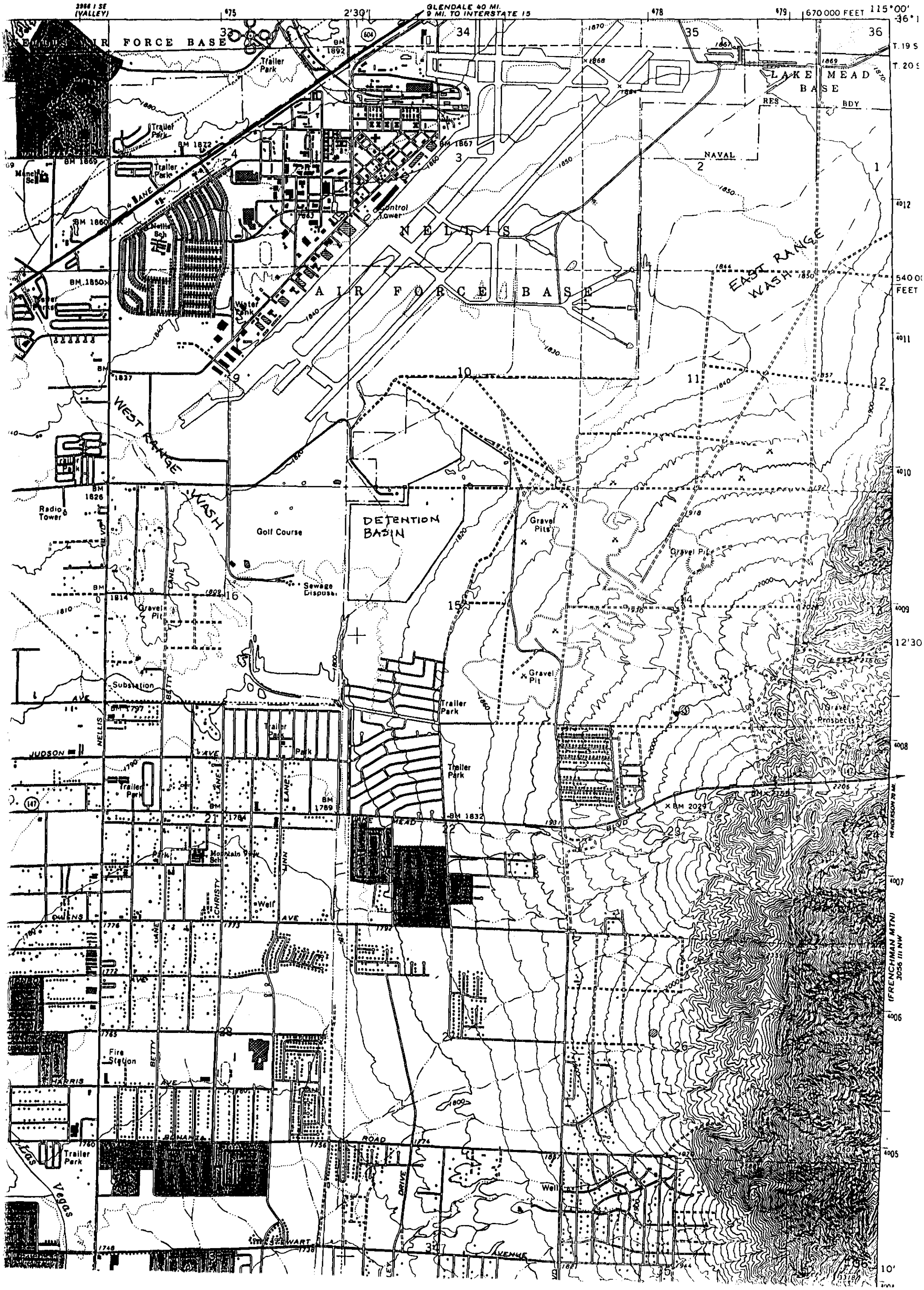


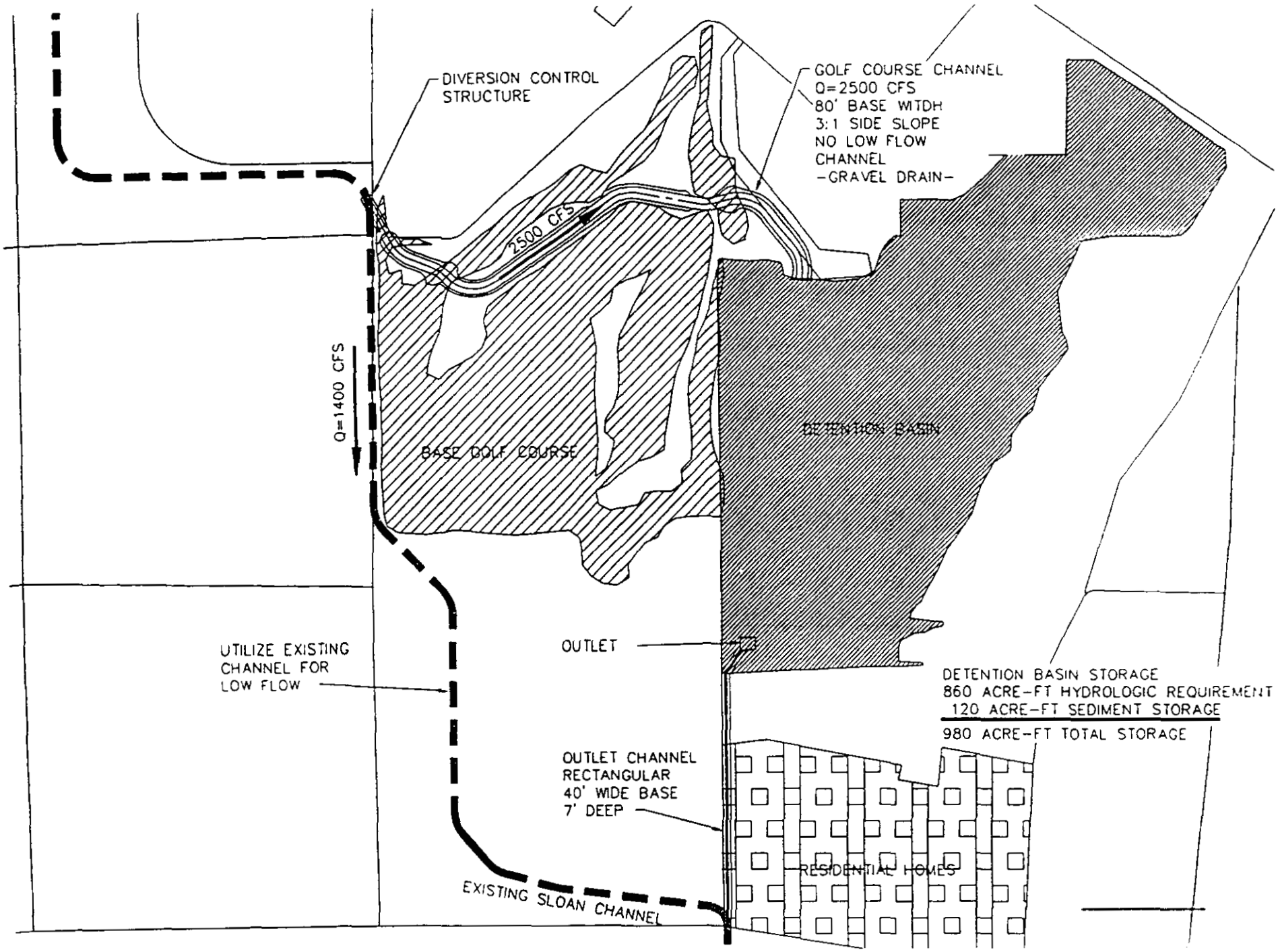
VICINITY MAP

NOT TO SCALE

FIGURE 1

LAS VEGAS NE QUADRANGLE
NEVADA—CLARK CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

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80' BASE WITDH
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NO LOW FLOW CHANNEL
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40' WIDE BASE
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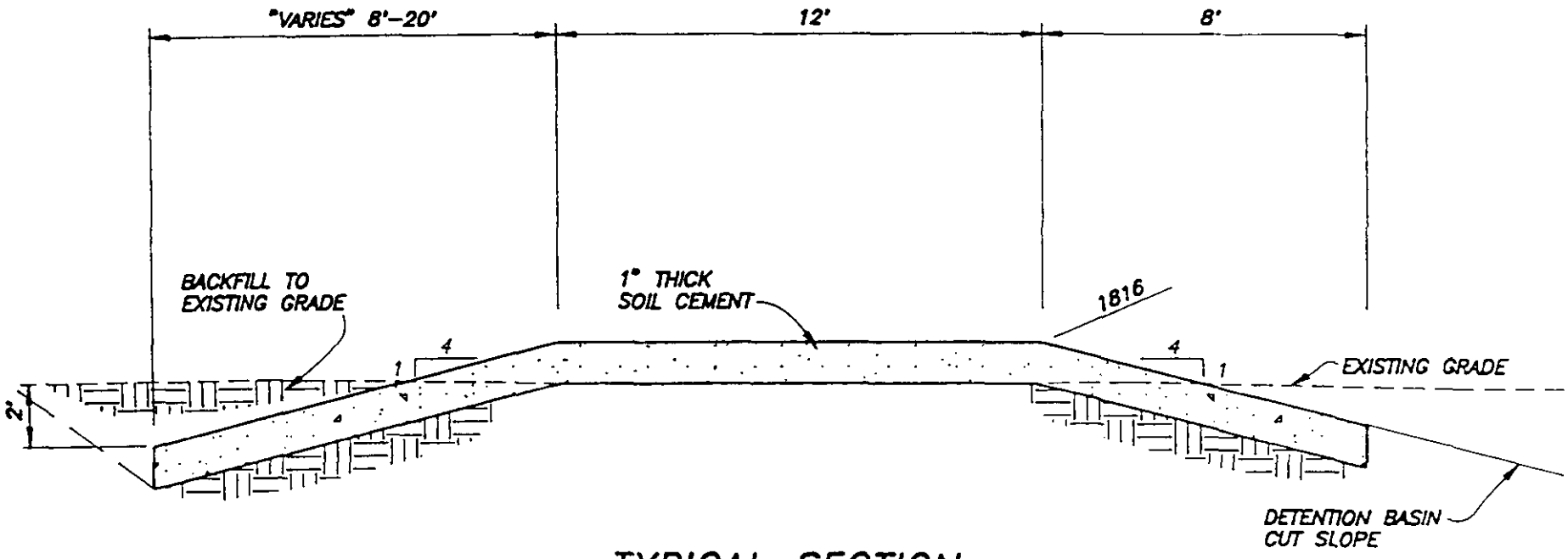
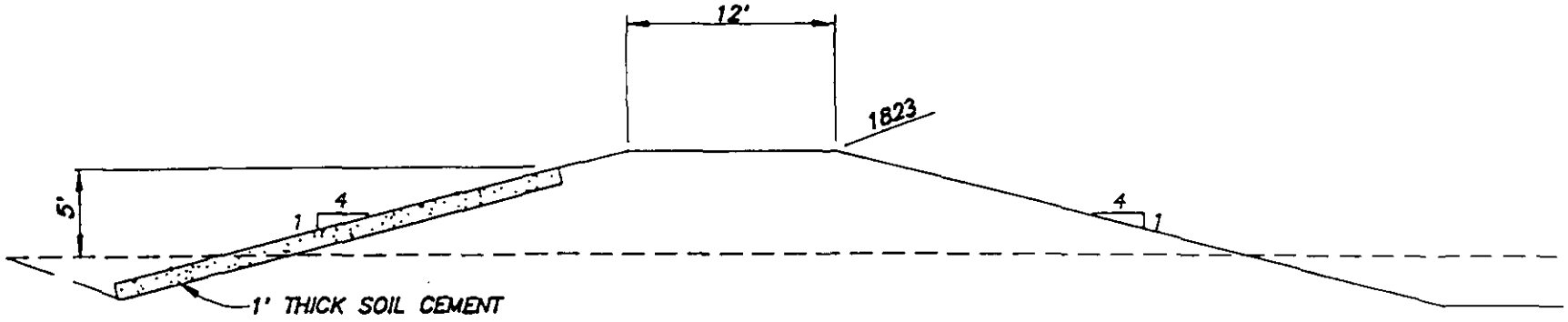
RESIDENTIAL HOMES
EXISTING SLOAN CHANNEL



TYPICAL SECTION EMERGENCY SPILLWAY

SCALE: 1/4"=1'–0"

FIGURE 13



TYPICAL SECTION
WEST EMBANKMENT

SCALE: 1"=10'

FIGURE 14

11/20/92

Table 6.3A.--Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage GILA RIVER JEFFERSON HWY TRIB Area 52.27 mi^2 (km^2)
Latitude 33 Longitude 115 Minimum Elevation 1800 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 10.5 in. (cm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 1 by step 2a. 10.5 in. (cm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.32

	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	72	88	95	100	115	122	126	129	132 %
5. 1-mi^2 (2.6-km^2) PMP for indicated durations [step 2b X step 4].	7.6	9.2	9.8	10.5	12.1	12.8	13.2	13.5	13.9 in. (cm)
6. Areal reduction [fig. 4.9].	45	54	57	59	63	67	69	70	72 %
7. Areal reduced PMP [steps 5 X 6].	3.4	4.9	5.6	6.2	7.6	2.6	9.1	9.5	10.0 in. (cm)
8. Incremental PMP [successive subtraction in step 7].				6.2	1.4	1.0	0.5	0.4	0.5 in. (cm)
	3.4	1.5	0.7	0.6	) 15-min. increments				

9. Time sequence of incremental PMP according to:

   Hourly increments [table 4.7]. 1.5 1.0 6.2 1.4 ~~1.0~~ 0.5 0.4 in. (cm)

   Four largest 15-min. increments [table 4.8]. 3.4 1.5 0.7 0.6 in. (cm)

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*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         FEBRUARY 1981                 *
*         REVISED 01 JUN 88             *
*                                       *
*   RUN DATE  11/20/1992  TIME  09:31:51 *
*                                       *
*****************************************
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*         (916) 551-1748                *
*                                       *
*****************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
   LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
     1        ID                CONFLUENCE DETENTION BASIN
     2        ID                NOV 20, 1992 PMP STORM EVENT
     3        ID                COMPOSIT CONDITIONS
     4        IT      15        0         0      100
     5        IO       5        0         0

     6        KK     N-E
     7        KM     NORTH-EAST TRIBUTARY
     8        BA    25.11
     9        PB     10.0
    10        IN       15
    11        PC     .013     .025     .038     .05     .075      .1     .125     .15     .49     .64
    12        PC      .71      .77      .805     .84     .875     .91     .923     .935    .948    .96
    13        PC      .97      .98      .99       1
    14        LS        0      77         0
    15        UD    1.60

    16        KK    ROUTE
    17        KM     ROUTE N-E THROUGH S-E
    18        RM        3     .75      .45

    19        KK     S-E
    20        KM     SOUTH-EAST TRIBUTARY
    21        BA    28.16
    22        LS        0      79         0
    23        UD    1.64

    24        KK        X
    25        KM     COMBINE ROUTED N-E AND S-E
    26        HC        2
    27        ZZ
```

```
1*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE (HEC-1)     *
*            FEBRUARY 1981              *
*          REVISED 01 JUN 88            *
*                                       *
*  RUN DATE  11/20/1992  TIME  09:31:51 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*          609 SECOND STREET            *
*        DAVIS, CALIFORNIA 95616        *
*          (916) 551-1748               *
*                                       *
*****************************************
```

CONFLUENCE DETENTION BASIN
NOV 20, 1992 PMP STORM EVENT
COMPOSIT CONDITIONS

5 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		15	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		100	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0045	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .25 HOURS
TOTAL TIME BASE 24.75 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
					6-HOUR	24-HOUR	72-HOUR			
+	HYDROGRAPH AT	N-E	36355.	4.00	18634.	4818.	4672.	25.11		
+	ROUTED TO	ROUTE	36120.	4.75	18607.	4818.	4672.	25.11		
+	HYDROGRAPH AT	S-E	41779.	4.00	21598.	5598.	5428.	28.16		
+	2 COMBINED AT	X	74146.	4.25	39886.	10416.	10100.	53.27		

*** NORMAL END OF HEC-1 ***

BOYLE ENGINEERING CORPORATION

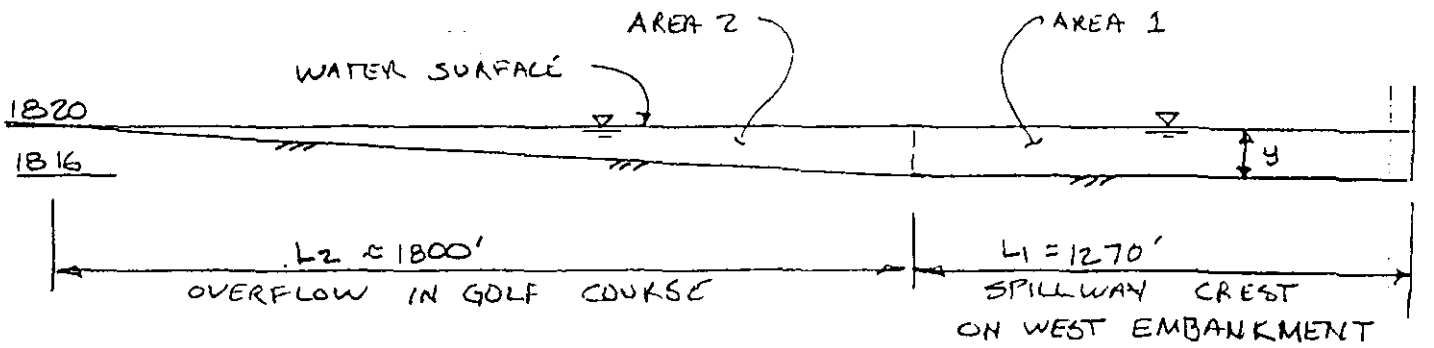
Project CONFLUENCE DET BASIN Description _____ SHEET

Job No. LV-607-250-02

By DWM Date 11/20/91 Chkd.By _____ Date _____

HYDRAULIC EVALUATION OF SPILLWAY

CONTROL SECTION



GOLF COURSE AREA 2

TRANSVERSE SLOPE = $4'/1800' = 0.0022$

$L_2 = y/.0022$

AREA $= 1/2\,(y)(y/.0022)$

$A_2 = y^2/.0044$

$P_2 = y/.0022$

$R_2 = A/P = y/2$

LONGITUDINAL SLOPE = 0.0033

MANNING'S EQUATION

$V_2 = \frac{1.49}{n} R^{2/3} S^{1/2}$

$V_2 = \frac{1.49}{n} \left(\frac{y}{2}\right)^{2/3} (.0033)^{1/2}$

$V_2 = \frac{.0539}{n} y^{2/3}$

n varies from .052 @ low depth and velocity to .030 at higher depth and velocity

$Q_2 = A_2 V_2$

SPILLWAY AREA 1

y critical @ crest

y = 2/3 Head

AREA $A_1 = Ly$

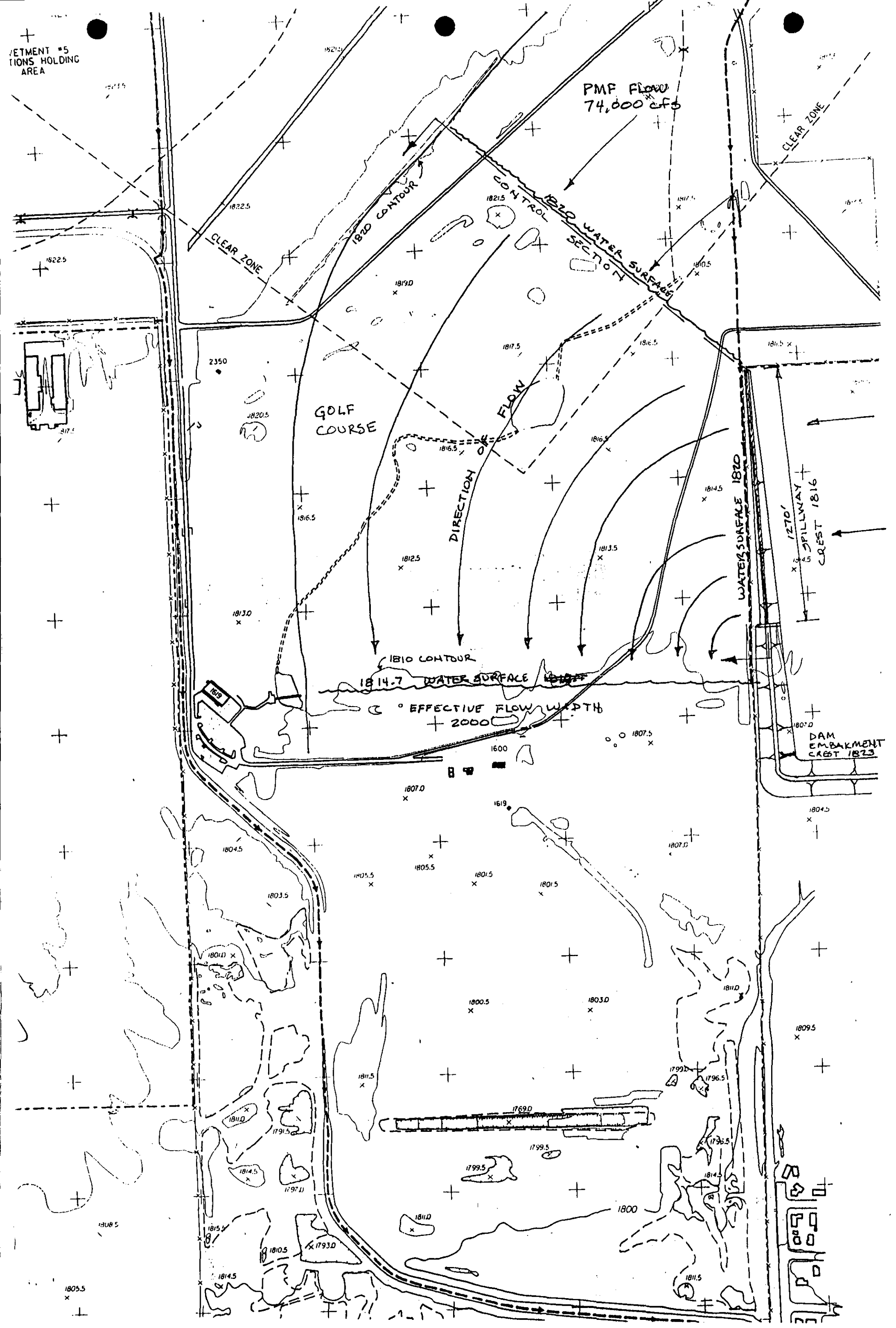
L = Length = 1270' by trial & error for target discharge of 74,000 cfs with depth equal to 4'

V_1 = critical velocity = $(gy)^{1/2}$

$Q_1 = A_1 V_1$

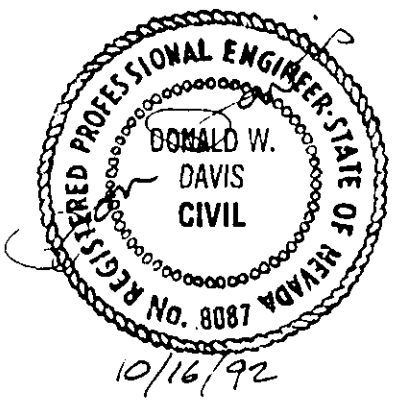
Total $Q = Q_1 + Q_2$

See Spreadsheet for Calculations


VETMENT #5
TIONS HOLDING
AREA
PMF FLOW
74,000 cfs
CLEAR ZONE
1820 CONTOUR
CONTROL
1820 WATER SURFACE
SECTION
CLEAR ZONE
1822.5
1821.5
1819.0
1817.5
1816.5
1810.5
2350
1820.5
GOLF
COURSE
FLOW
DIRECTION OF
1816.5
1812.5
1813.5
1814.5
WATER SURFACE 1820
1270'
SPILLWAY
CREST 1816
1813.0
1810 CONTOUR
1814.7 WATER SURFACE
EFFECTIVE FLOW WIDTH
2000
1600
1807.5
1807.0
1619
DAM
EMBAKMENT
CREST 1823
1804.5
1805.5
1801.5
1803.5
1801.0
1800.5
1803.0
1809.5
1811.5
1799.0
1796.5
1769.0
1799.5
1811.0
1791.5
1814.5
1797.0
1800
1808.5
1815.5
1810.5
1793.0
1805.5

5.4.2 Predesign Report
Confluence Detention Basin
and Sloan Channel Improvements

DEPARTMENT OF
PUBLIC WORKS



FINAL PREDESIGN
MEMORANDUM

CONFLUENCE DETENTION BASIN AND SLOAN CHANNEL IMPROVEMENTS

Prepared for
**CLARK COUNTY
DEPARTMENT
OF PUBLIC WORKS**

Funded by
**CLARK COUNTY
REGIONAL FLOOD
CONTROL DISTRICT**

OCTOBER 16, 1992

BOYLE ENGINEERING CORPORATION

PREDESIGN MEMORANDUM

CONFLUENCE DETENTION BASIN AND SLOAN CHANNEL IMPROVEMENTS

Prepared for

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS

Funded by

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

BOYLE ENGINEERING CORPORATION

October 16, 1992

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APPENDIX B

Preliminary Environmental Site Assessment
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HEC-1 Input/Output Alternative 2 Storm BCD
HEC-1 Input/Output Alternative 2 Storm D
HEC-1 Input/Output PMF

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4. 1"=80' Golf Course Channel P&P w/HGL
5. 1"=80' Outlet Channel P&P w/HGL
6. 1"=80' Outlet Channel P&P w/HGL

1. INTRODUCTION

A. Background

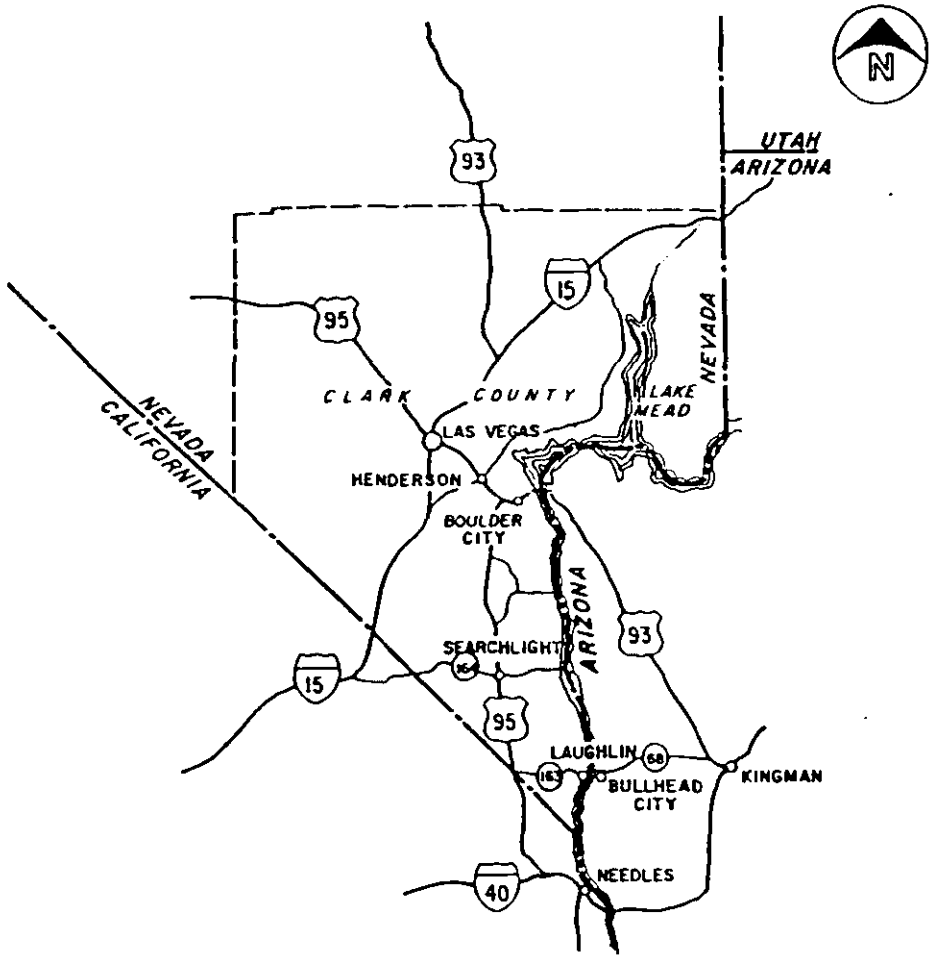
The proposed Confluence Detention Basin and Sloan Channel Improvements are part of the current Clark County Regional Flood Control District (CCRFCD) Flood Control Master Plan for the 150-square-mile Range Wash drainage basin. A description of the study area, a basinwide hydrologic evaluation, evaluation of alternative facilities, recommended facilities for the entire basin, and preliminary designs are presented in "Western and Eastern Tributaries of Range Wash Flood Control Facility Plan, prepared for the City of North Las Vegas by Boyle Engineering *Corporation (Boyle), June 1991" (Facility Plan).*

The proposed facilities are located in the southern portion of the Range Wash basin in northeastern Las Vegas Valley within and adjacent to Nellis Air Force Base (NAFB) (Figures 1 and 2). The proposed facilities depicted in Figure 2 consist of the following major components:

western?

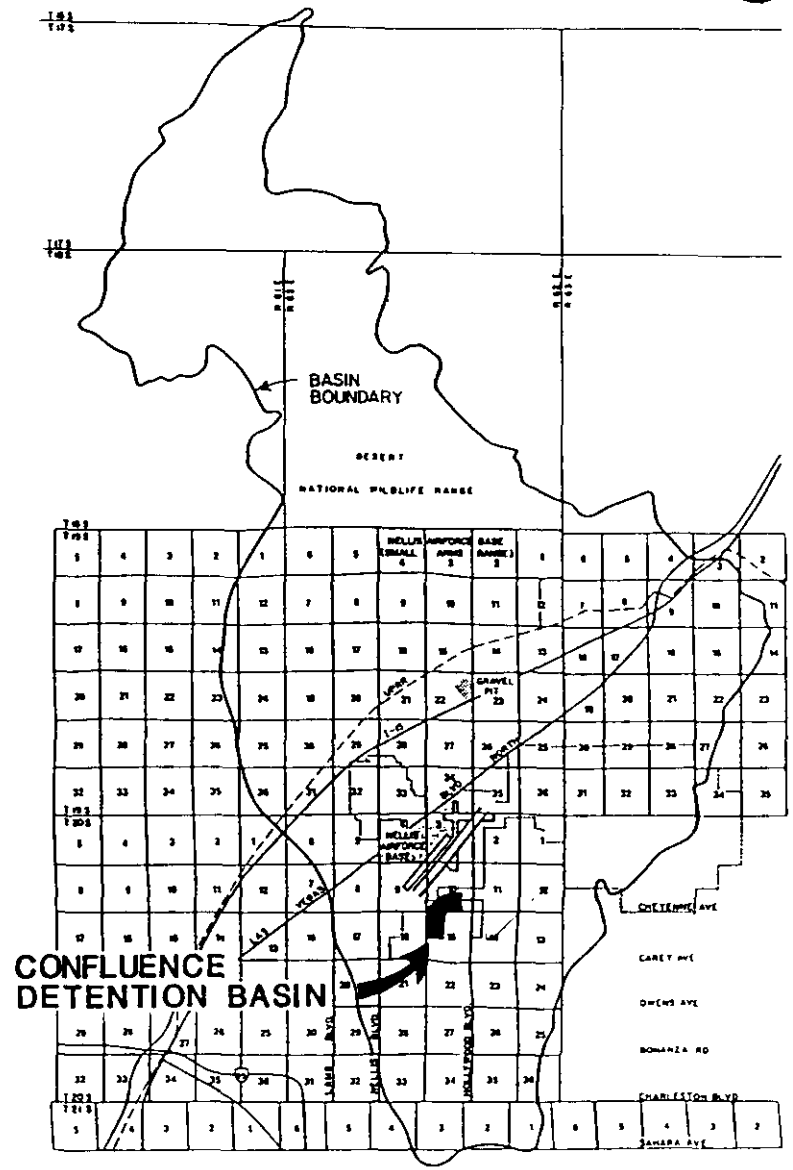
1) An eastern inlet channel, approximately 4,400 feet long, which diverts flood waters east from the existing lined Sloan Channel *across the NAFB Golf Course and to the proposed Confluence* Detention Basin.
2) The Confluence Detention Basin with approximately 1,300 AF of storage capacity, just east of the NAFB Golf Course.
3) A concrete-lined outlet channel extending southerly for about 1,900 feet from the detention basin to a connection with the existing Sloan Channel.

The proposed improvements are intended to provide immediate relief from flooding problems to low-lying areas adjacent to the under-capacity, Sloan Channel several miles downstream of the proposed detention basin. This area is presently mapped as an "A Zone" on FEMA Flood Insurance Rate Maps.



LOCATION MAP

NOT TO SCALE



VICINITY MAP

NOT TO SCALE

FIGURE 1

PMF SPILLWAY CHARACTERISTICS

AREA 1 = SPILLWAY ON DETENTION BASIN EMBANKMENT
AREA 2 = THROUGH THE GOLF COURSE AROUND DETENTION BASIN

ELEV	HEAD (ft)	DEPTH y (ft)	LENGTH L1 (ft)	AREA 1 A1 (sq ft)	VEL 1 v1 (fps)	LENGTH L2 (ft)	AREA 2 A2 (sq ft)	n GOLF COURSE	VEL 2 v2 (fps)	FLOW 1 Q1 (cfs)	FLOW 2 Q2 (cfs)	TOTAL QT (cfs)
1,816.00	0	.00	1,270	.00	.00		.00					
1,816.50	.5	.33	1,270	423.33	3.28	152	25.25	.052	.50	1,387	13	1,400
1,817.00	1	.67	1,270	846.67	4.63	303	101.01	.05	.83	3,923	84	4,006
1,817.50	1.5	1.00	1,270	1,270.00	5.67	455	227.27	.048	1.13	7,207	257	7,463
1,818.00	2	1.33	1,270	1,693.33	6.55	606	404.04	.046	1.43	11,095	576	11,672
1,818.50	2.5	1.67	1,270	2,116.67	7.33	758	631.31	.044	1.73	15,506	1,093	16,599
1,819.00	3	2.00	1,270	2,540.00	8.02	909	909.09	.042	2.05	20,383	1,861	22,245
1,819.50	3.5	2.33	1,270	2,963.33	8.67	1,061	1,237.37	.04	2.38	25,686	2,948	28,634
1,820.00	4	2.67	1,270	3,386.67	9.27	1,212	1,616.16	.038	2.74	31,382	4,431	35,813
1,820.50	4.5	3.00	1,270	3,810.00	9.83	1,364	2,045.45	.036	3.13	37,447	6,403	43,850
1,821.00	5	3.33	1,270	4,233.33	10.36	1,515	2,525.25	.034	3.56	43,858	8,979	52,837
1,821.50	5.5	3.67	1,270	4,656.67	10.87	1,667	3,055.56	.032	4.03	50,599	12,301	62,899
1,822.00	6	4.00	1,270	5,080.00	11.35	1,818	3,636.36	.03	4.55	57,653	16,547	74,200

SOLUTION FOR A RECTANGULAR CHANNEL

PMF FLOW THROUGH GOLF COURSE

DISCHARGE	74000.00 CFS	BASE WIDTH	%2000.00 FEET
VELOCITY	7.92 FPS	SIDE SLOPE	0.00 TO 1
NORMAL DEPTH	4.67 FEET	AREA	9338.29 SQ.FT.
BOTTOM SLOPE	0.00330	TOP WIDTH	2000.00 FEET
MANNING'S N	0.0300		
CRITICAL DEPTH	3.49 FEET	VELOCITY HEAD	0.98 FEET
FROUDE NUMBER	0.65	P + M	2497821 POUNDS
CRITICAL SLOPE	0.00868		

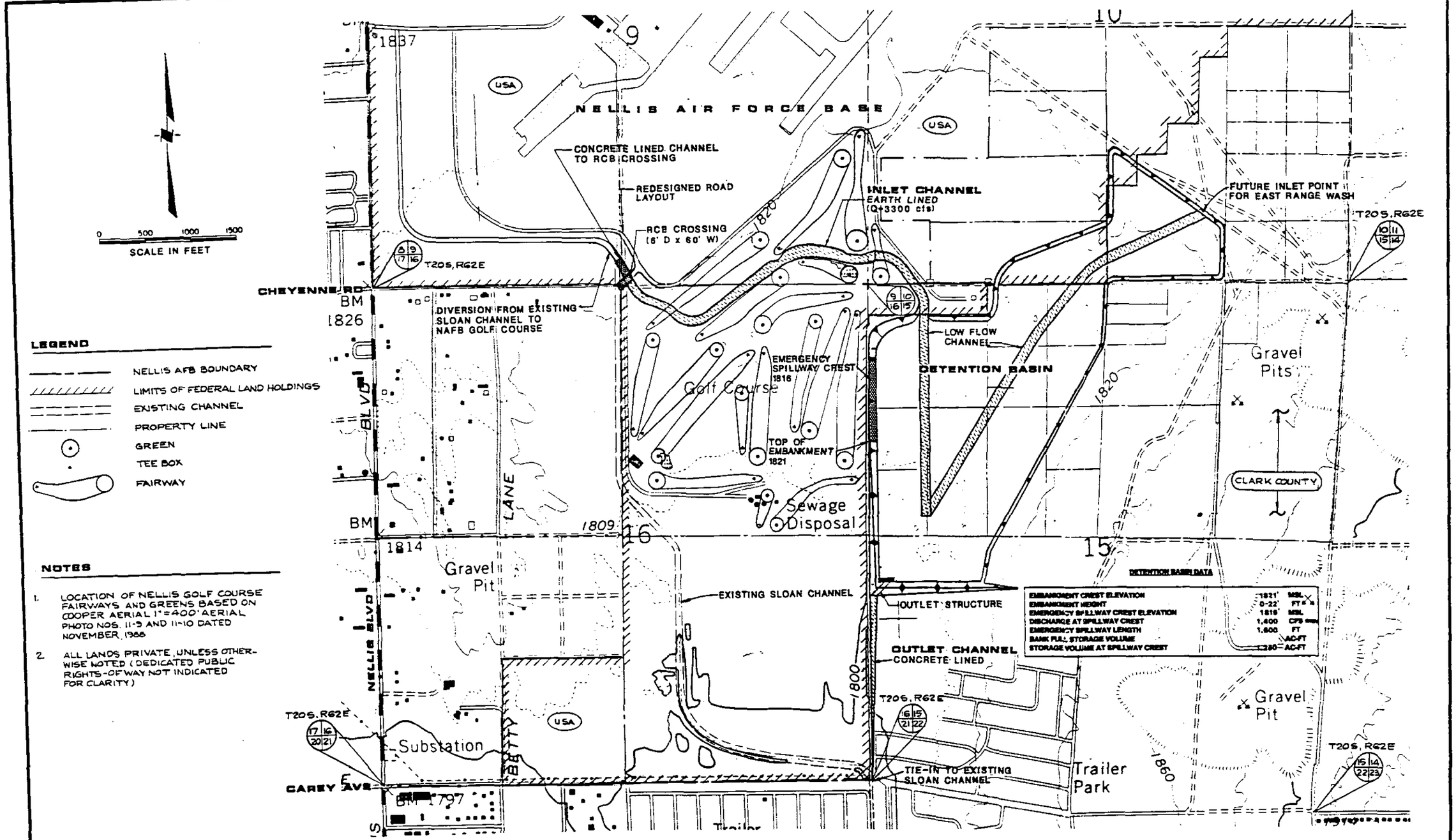


FIGURE 2

SITE LAYOUT MAP
CONFLUENCE DETENTION BASIN
AND SLOAN CHANNEL IMPROVEMENTS

Boyle Engineering Corporation | JULY 31,1992

B. Purpose and Scope

The purpose and scope of this Predesign Memorandum is to:

1) Present a preliminary environmental site assessment report on the project area to identify the potential for environmental problems that might be encountered on private properties proposed for right-of-way in the area of the Confluence Detention Basin.
2) Present results of a reconnaissance geotechnical investigation intended to document engineering properties of surficial soils and subsurface conditions along the channel alignments and in the area of the detention basin, and provide an initial assessment of the suitability of on-site soils for embankment and soil cement construction.
3) Present preliminary analysis of the hydraulic and hydrologic considerations establishing the peak flows (e.g., 100-year, PMF) and other criteria important to the design of the proposed facilities.
4) Summarize the design features and dimensions of proposed channels, crossing structures, dam embankment, spillway and basin outlet works.
5) Determine the availability of land (land ownership) and probable right-of-way needs for the proposed facilities.
6) Provide a preliminary estimate of the quantities and costs for the project.
7) Provide a preliminary evaluation of other construction issues, including: impact of construction on the operation of NAFB Golf Course and possible utility conflicts.

2. SUMMARY OF PRELIMINARY ENVIRONMENTAL AND GEOTECHNICAL ASSESSMENTS

As part of the predesign investigations, Converse Environmental Consultants Southwest and Converse Consultants Southwest (Converse) undertook preliminary environmental and geotechnical studies in the project area. Full reports on both studies are included in Appendix A and B to this Predesign Memorandum. Brief summaries of both reports are provide below:

A. Results of Geotechnical Assessment

Converse performed a soils and geologic reconnaissance of the project site, including the proposed NAFB golf course channel, Confluence Basin area, and the outlet channel reach. The investigation included a total of eight (8) borings and test pits of varying depth from 10 to 30 feet, and various laboratory and field tests on the materials encountered.

Surficial soils (0-3 feet) were generally found to consist of sandy or silty loams. Underlying materials were generally soft to firm clays and silts, stiff clays and intermixed sand and gravel layers. Caliche was not encountered in the upper 10 feet of the borings or test pits.

The report states:

> Laboratory test results indicate that the on-site soils have low to moderate dry densities, a low to moderate shear strength, a low to moderate permeability, a low to high potential for gypsum solubility, a low to moderate clay swell potential, a low chemical (salt) heave potential, and contain sulfate salts in sufficient concentrations to be severely corrosive to concrete, soil cement and metal. The on-site soils should be considered to be moderately to highly susceptible to hydro-collapse. Silts and fine sands are susceptible to piping. . .
>
> The on-site soils are suitable for use as materials for embankment fill and soil-cement. . . Based on preliminary slope stability analyses, the planned 2-1/2:1 or 3:1 (horizontal to vertical) slopes for the embankment appear to be stable. . . Seepage through and stability of the embankment should not be a concern.
>
> In order to provide (final) geotechnical design recommendations for the proposed project, additional field exploration, laboratory testing and engineering analysis should be performed. The amount of loose, soft and hydro-collapsible surficial soils present on the site and the extent of the cemented soils should be further investigated during the design level geotechnical investigation. The permeability and the corrosion and solubility potentials of the on-site soils should also be further evaluated.

Converse noted no significant geologic or seismic hazards during their preliminary investigation. Ground water was not encountered in any of the test pits or borings.

B. Results of Environmental Assessment

Converse's preliminary environmental assessment covered an area surrounding the proposed site of the Confluence Basin and south along the outlet channel (along Toyiabe Street) to the Sloan Channel. Work included a site reconnaissance, review of historic air photos, review of zoning history, several soil samples for lab analysis and a review of agency records regarding hazardous wastes, environmental issues, etc.

Converse noted considerable amounts of domestic and construction debris on-site, including concrete waste, tires, abandoned furniture and appliances, and waste wood products. The site does not appear to have a history of industrial/chemical uses and no other issues of "obvious environmental concern" were encountered.

Converse also evaluated limited records made available by NAFB regarding a landfill located just west of the proposed detention basin. It did not appear that old landfill operations had extended into the detention basin site. However, the Converse report (page 10) noted a possibility of seepage of alteration of ground water gradients and a subsequent environmental impact caused by leaching of landfill deposits. The Converse Environmental report was completed before the geotechnical investigations Summarized in Section A. above.

After the geotechnical investigation, Converse further evaluated the possibility of impact to groundwater quality. A letter from Converse is included in Appendix B. The letter concludes:

> With the anticipated low permeability of the on-site soils, the short detention time, the depth to groundwater and the distance of the old landfill from the basin, it appears that

water detained from the embankment will not influence the old landfill and the existing groundwater quality.

Design of the detention basin will be further coordinated with Converse to insure that criteria to avoid negative impacts to groundwater quality are satisfied.

A Draft Environmental Impact Statement (DEIS) has been prepared for the CCRFCD Flood Control Master Plan of 1986. Since the Confluence Detention Basin was not included in the 1986 plan, a site specific analysis will be required in accordance with Section 14 of the DEIS. The Section 14 analysis will further clarify environmental issues and establish implementation and mitigation requirements, and will be performed concurrent with the design phase of the project.

Converse reviewed the DEIS and concluded that the Confluence Detention Basin was not impacted by designated culturally sensitive areas and that federally listed plant species are not expected to occur in the area. A letter from Converse, reviewing environmental issues, is included in Appendix B.

Relating to Paleontological assessment, the CCRFCD sent a letter, to the County, regarding this project which set forth the following:

> The paleontological assessment for the District's master plan has been completed and accepted by the Bureau of Land Management (BLM). . . . The assessment does not identify the project area as one of concern; therefore, no further paleontological work should be required.

Relating to desert tortoise mitigation, the letter stated the following

> Mitigation measures to protect the existence of the desert tortoise will be in accordance with the District's biological opinion (Opinion) as amended. Recent amendments to the Opinion have revised mitigation measures to be consistent with those required by the Habitat Conservation Program (HCP). Temporary tortoise proof fencing will not be required. Mitigation fees for the loss of tortoise habitat have already been paid by the District for this and other projects. It should be clear that the HCP does not apply to this project.

A desert tortoise survey will be performed, by Dames and Moore per contractual agreement with the CCRFCD, within 90 days prior to construction. 30?

3. OVERVIEW OF PROJECT FLOOD CONTROL ALTERNATIVES

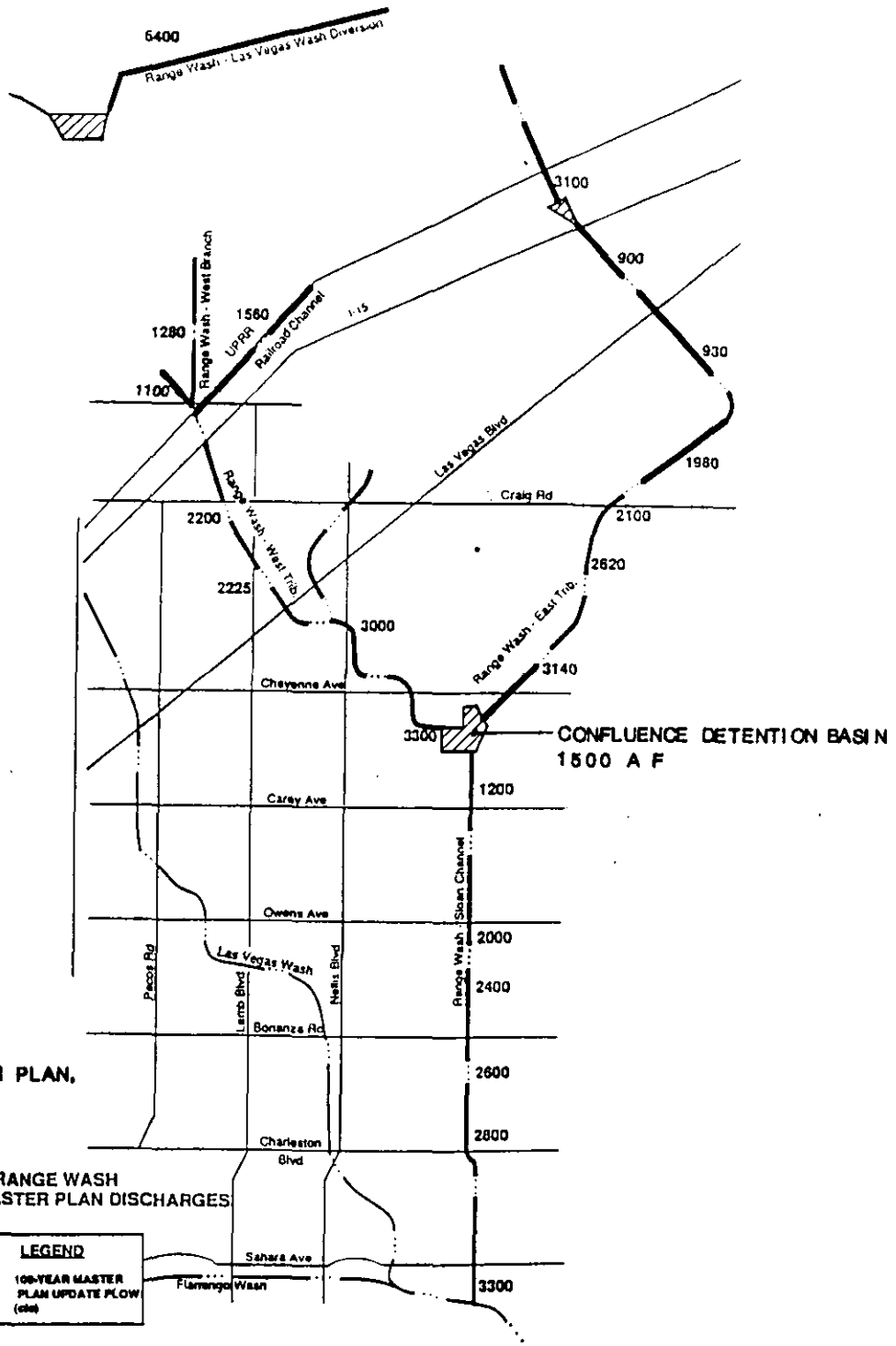
A. Previous Investigations

After considerable study, Alternative IV of the 1991 Range Wash Facility Plan was selected for inclusion in the CCRFCD Master Plan. Figure 3 shows the overall flood control concept, 100-year flows, and the location of the Confluence Detention Basin. Note that the design flows (fully developed land use conditions) into the Confluence Basin are 3,300 cfs from the West Range Wash and 3,140 cfs from the East Range Wash. The 3,300 cfs flow from the West Range Wash was to be diverted from the existing Sloan Channel at NAFB, across the golf course, and into the Confluence Basin (See Figure 2). The Facility Plan estimate the required capacity of the Confluence Basin at 1,500 AF.

For this predesign investigation, the original concept for the diversion of West Range Wash flows through the NAFB Golf Course and the Confluence Basin was examined in more detail. Two alternatives emerged -- Alternatives 1 and 2, as described below.

B. Alternative 1 -- Full Conveyance of 100-Year Flood in NAFB Golf Course Channel to Confluence Basin

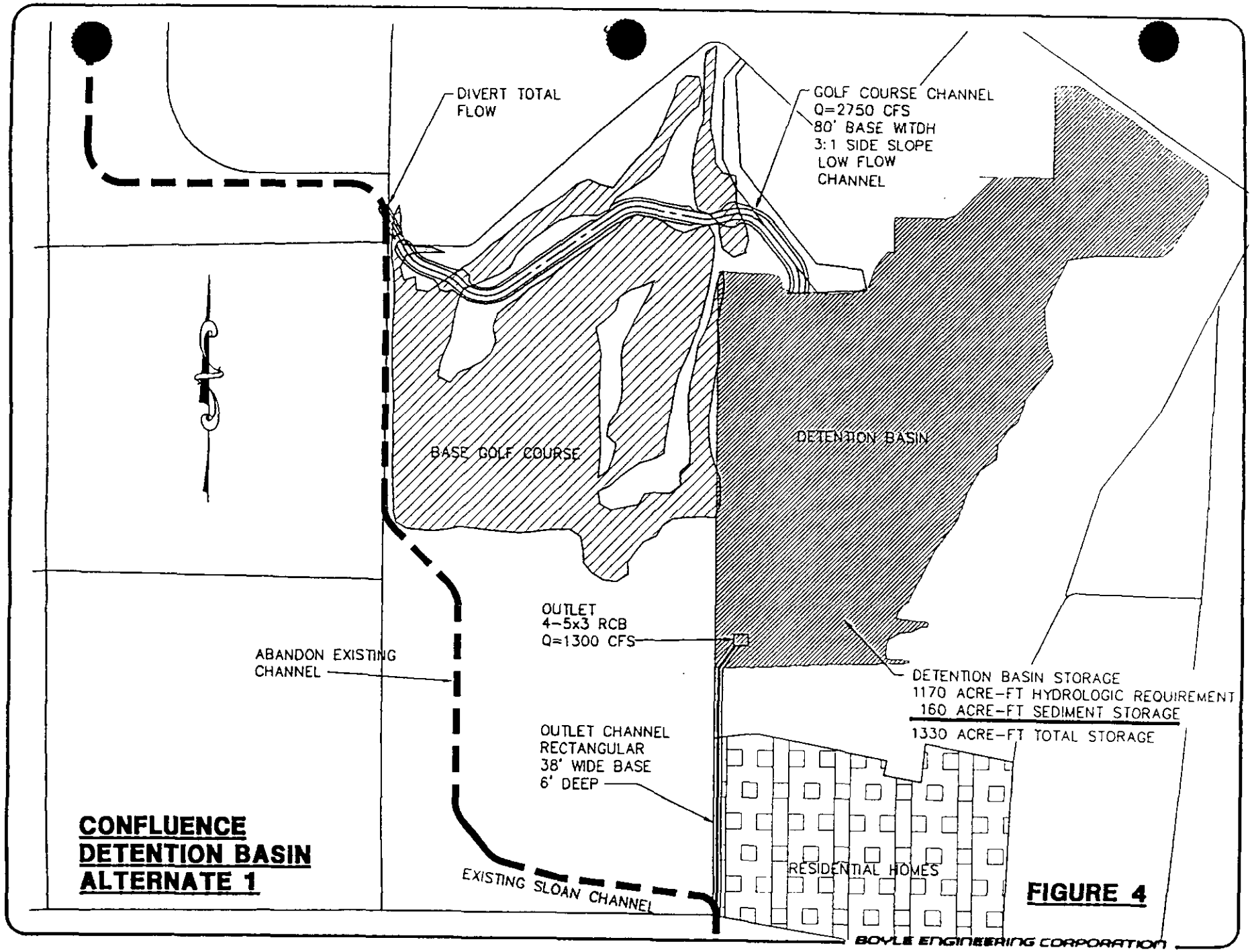
Alternative 1 is essentially identical to the original concept developed in the Facility Plan. As shown in Figure 4, it involves the complete diversion of the 100-year peak flow (3,350 cfs) from the existing Sloan Channel, a 90-foot wide base, 3:1 side slope, trapezoidal earth-lined channel through the NAFB Golf Course. A concrete-lined (6'x 2') low-flow channel would be constructed to convey a design flow of 1% of the 100-year flow. The existing Sloan Channel in NAFB would be abandoned.



ADAPTED FROM CCRFCD FLOOD CONTROL MASTER PLAN, FIGURE 3-1

ORIGINAL CONCEPT FOR CONFLUENCE BASIN/SLOAN CHANNEL IMPROVEMENTS

FIGURE 3.


DIVERT TOTAL FLOW
GOLF COURSE CHANNEL
Q=2750 CFS
80' BASE WIDTH
3:1 SIDE SLOPE
LOW FLOW CHANNEL
BASE GOLF COURSE
DETENTION BASIN
OUTLET
4-5x3 RCB
Q=1300 CFS
ABANDON EXISTING CHANNEL
DETENTION BASIN STORAGE
1170 ACRE-FT HYDROLOGIC REQUIREMENT
160 ACRE-FT SEDIMENT STORAGE
1330 ACRE-FT TOTAL STORAGE
OUTLET CHANNEL
RECTANGULAR
38' WIDE BASE
6' DEEP
RESIDENTIAL HOMES
EXISTING SLOAN CHANNEL
CONFLUENCE
DETENTION BASIN
ALTERNATE 1
FIGURE 4
BOYLE ENGINEERING CORPORATION

Refined hydrologic analysis (see Sections 4 and 6) performed for this memorandum showed that the capacity of the Confluence Basin could be reduced from 1,500 AF to 1,330 AF. The design outlet flow from the basin was determined to be 1,300 cfs as opposed to 1,200 cfs estimated in the *Facility Plan (see Figure 3).*

C. Alternative 2 -- Split Conveyance of 100-Year Flood in NAFB Golf Course And Existing Sloan Channels

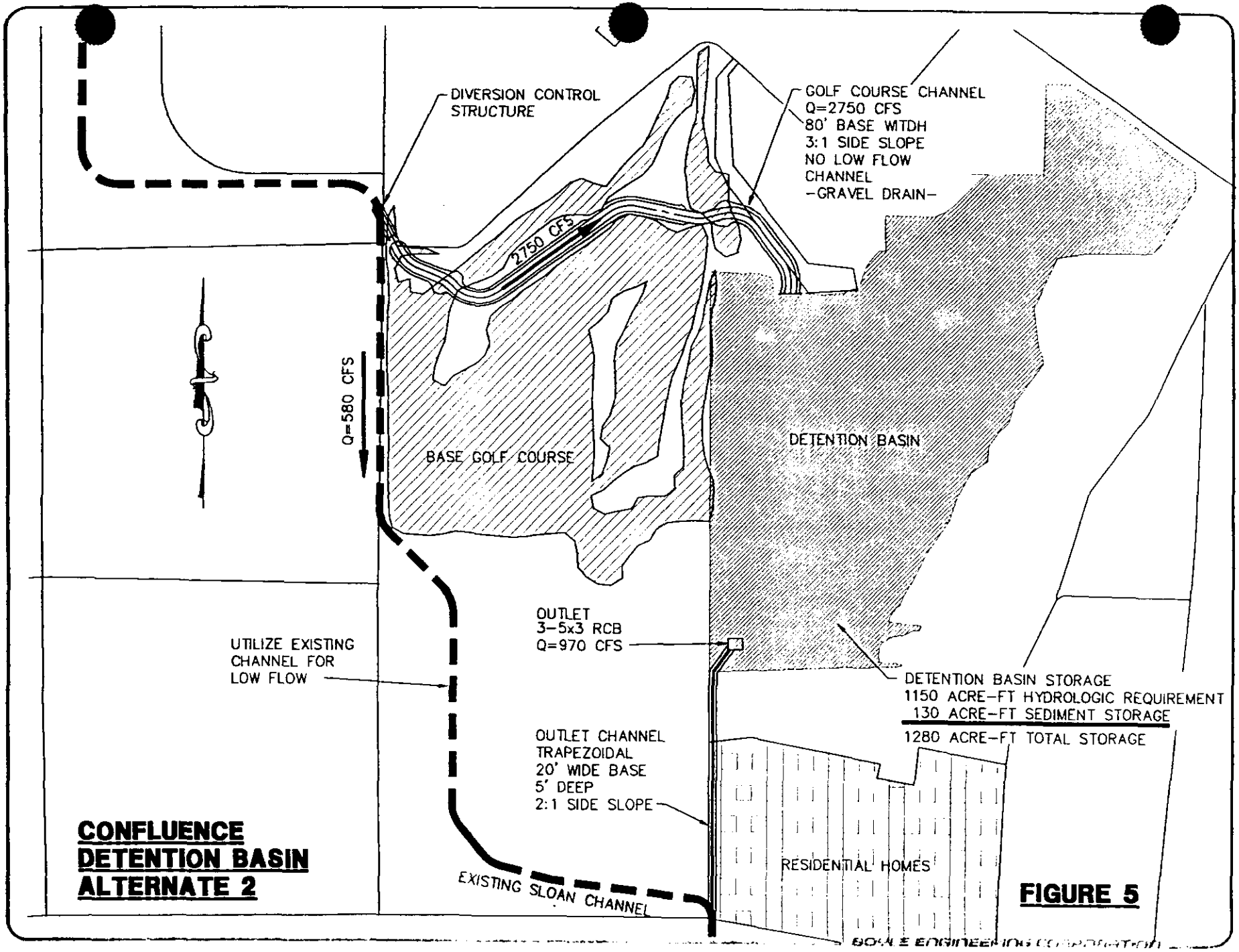
This alternative would entail the splitting of flows between existing Sloan Channel and the proposed NAFB Golf Course Channel. Several hydrologic evaluations of differing diversion ratios and detention basin outflow rates were performed. The runs were used to roughly optimize the facilities. As shown in Figure 5 at the 100-year design flow of 3,300 cfs Sloan Channel would convey 580 cfs; the golf course channel would convey 2,750 cfs. The low flow would remain in Sloan Channel. A diversion control structure would be needed at the juncture of the existing Sloan and proposed NAFB Golf Course Channels.

Refined hydrologic analysis indicates that under Alternative 2, the capacity requirement for Confluence Basin would be 1,280 AF. The design outlet flow from the basin would be about 970 cfs.

D. Comparison of Alternatives

Comparison of the two alternatives suggests that Alternative 2 (split conveyance) has several advantages over Alternative 1.

1) *The 4,000-foot long low-flow channel in the NAFB Golf Course* Channel is eliminated (as are two low-water culverts for golf course vehicles).
2) The golf course channel width can be narrowed (by about 10 feet) thereby reducing excavation quantities and costs.
3) Sediment transport in the golf course channel and to the detention basin will be reduced since the bed load would be conveyed along the bottom of the existing Sloan Channel.


DIVERSION CONTROL STRUCTURE
GOLF COURSE CHANNEL
Q=2750 CFS
80' BASE WITDH
3:1 SIDE SLOPE
NO LOW FLOW CHANNEL
-GRAVEL DRAIN-
2750 CFS
Q=580 CFS
BASE GOLF COURSE
DETENTION BASIN
OUTLET
3-5x3 RCB
Q=970 CFS
UTILIZE EXISTING CHANNEL FOR LOW FLOW
DETENTION BASIN STORAGE
1150 ACRE-FT HYDROLOGIC REQUIREMENT
130 ACRE-FT SEDIMENT STORAGE
1280 ACRE-FT TOTAL STORAGE
OUTLET CHANNEL
TRAPEZOIDAL
20' WIDE BASE
5' DEEP
2:1 SIDE SLOPE
RESIDENTIAL HOMES
EXISTING SLOAN CHANNEL
CONFLUENCE DETENTION BASIN ALTERNATE 2
FIGURE 5

4) Storage and excavation volumes required for the Confluence Basin are reduced by about 50 AF (100,000 CY).
5) The size and cost of the detention basin outlet works would be reduced.
6) The outfall channel from the basin (existing right-of-way width of 40 feet) could be a less costly trapezoidal channel (rather than a rectangular channel) due to the reduced design flow (970 versus 1,300 cfs).

Disadvantages of Alternative 2 include the following:

1) The existing Sloan Channel through NAFB and its associated right-of-way could not be abandoned and put to other uses.
2) Both the Sloan and NAFB Golf Course Channels would require maintenance.

Preliminary cost estimates presented in Section 10 of this Predesign Memorandum indicate that construction of Alternative 2 would probably be $800,000 less than Alternative 1. For this reason, and based on the other advantages cited above, Boyle recommends that the Alternative 2 concept be adopted for final design.

4. HYDROLOGIC EVALUATION

A. Design Storms and Peak Flows for Sizing of Proposed Facilities

The basic hydrologic analysis used in this investigation was originally developed in the Facility Plan. Hydrologic methods and assumptions were all in compliance with the CCRFCD Hydrologic Criteria and Drainage Design Manual (Criteria Manual). Details of the hydrologic analysis were fully documented in a special Technical Appendix to the Facility Plan and, therefore, will not be represented here.

The hydrologic subbasin boundaries used are shown in Figure 6. The hydrologic analysis employed the Corps HEC-1 model as applied to designated storm areas A, B, C, D and E shown in Figure 7. For this

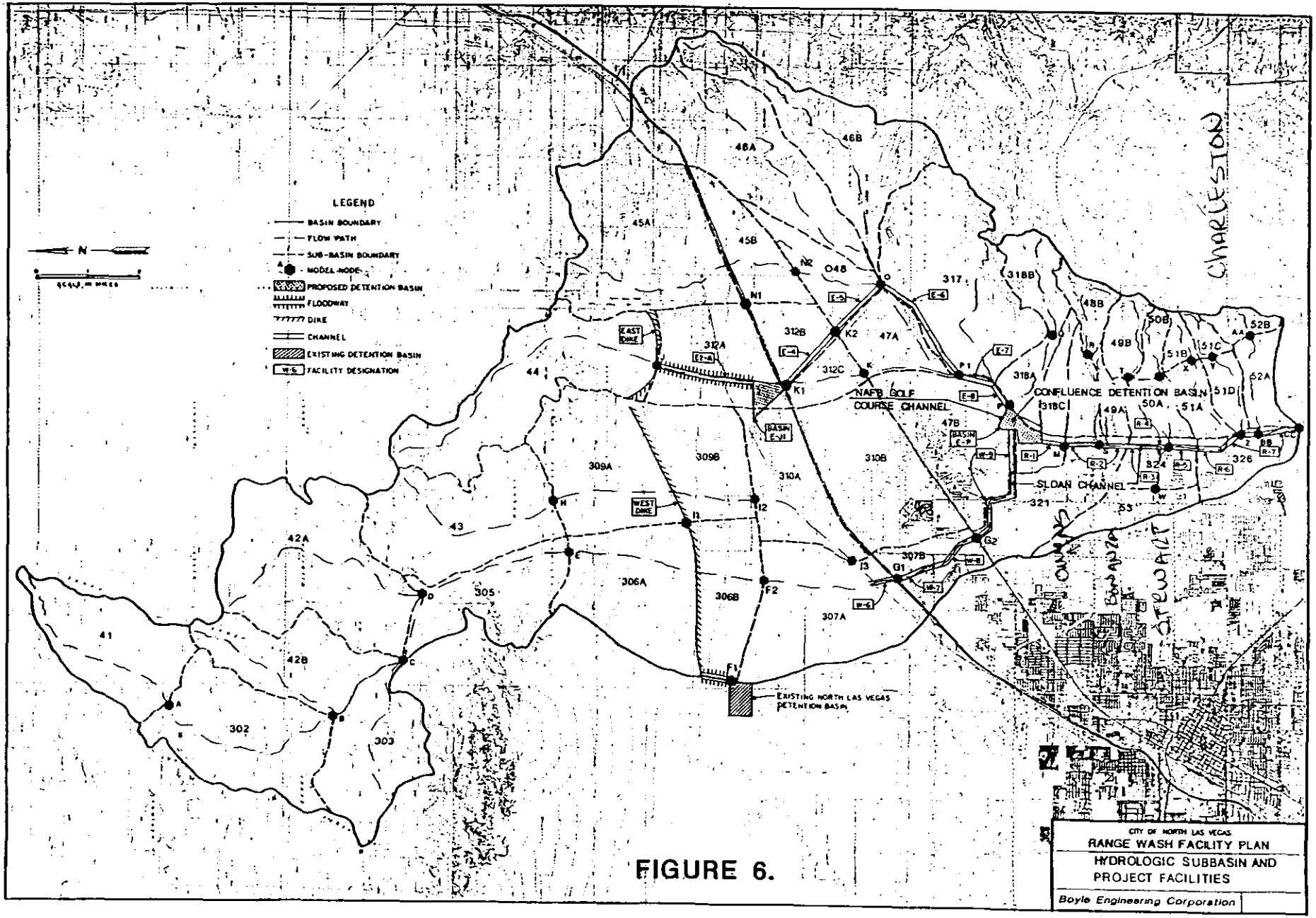
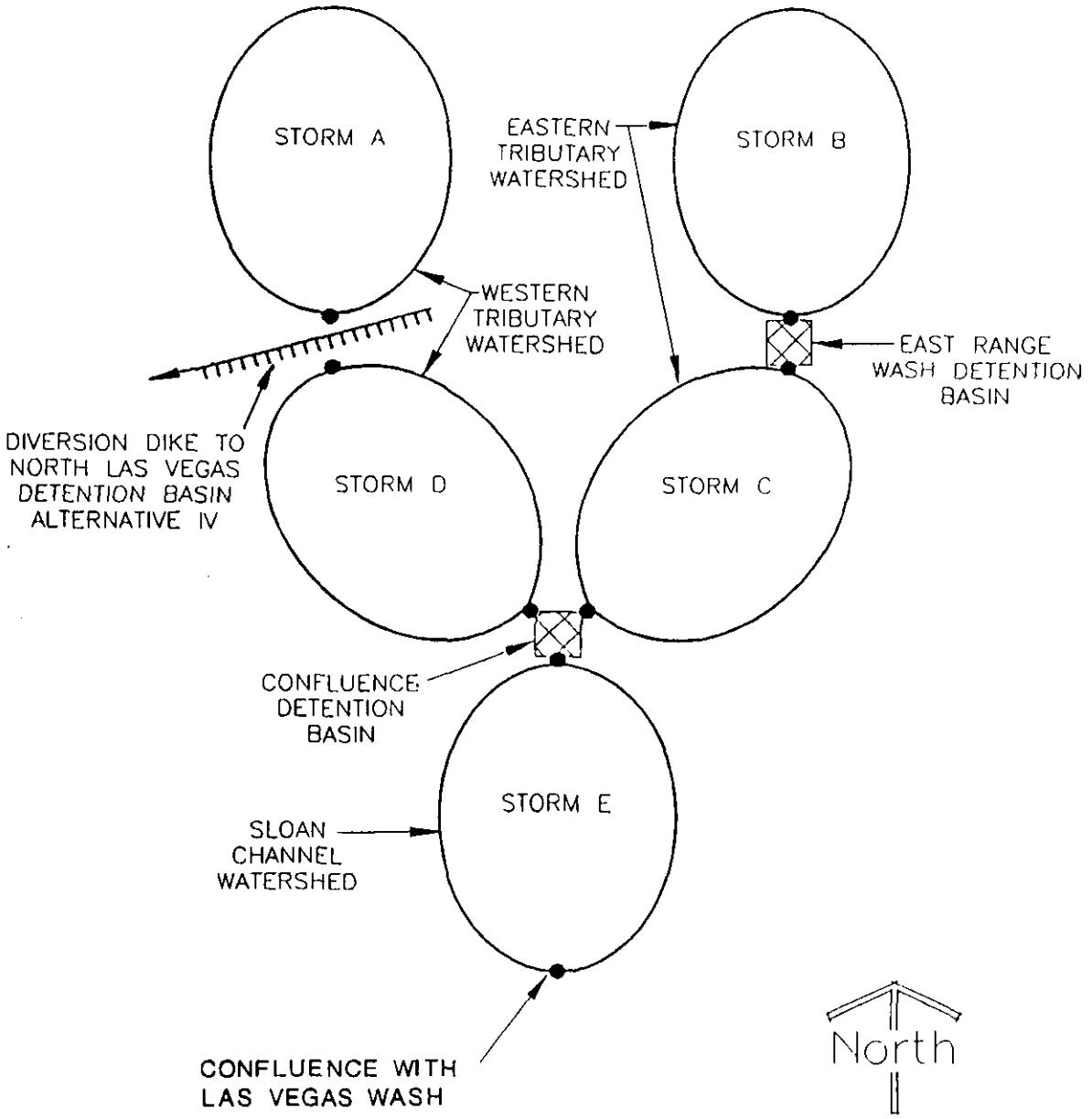

LEGEND
BASIN BOUNDARY
FLOW PATH
SUB-BASIN BOUNDARY
MODEL NODE
PROPOSED DETENTION BASIN
FLOODWAY
DIKE
CHANNEL
EXISTING DETENTION BASIN
FACILITY DESIGNATION
N
CHARLESTON
NAFB GOLF COURSE CHANNEL
CONFLUENCE DETENTION BASIN
SLOAN CHANNEL
EAST DIKE
WEST DIKE
EXISTING NORTH LAS VEGAS DETENTION BASIN
CITY OF NORTH LAS VEGAS
RANGE WASH FACILITY PLAN
HYDROLOGIC SUBBASIN AND PROJECT FACILITIES
Boyle Engineering Corporation

FIGURE 6.



STORM SCHEMATIC

FIGURE 7.

Predesign Memorandum, minor modifications were made to the original HEC-1 model as a basis for evaluation of the "split conveyance" concept described in Alternative 2 (Section 3.C.); and to further refine the capacity requirements of the Confluence Basin.

Design capacity of the inlet channel (NAFB Golf Course Channel), the Confluence Basin, and the outlet channel were based on the design storm producing the most severe conditions. For the inlet channel, a capacity requirement of 3,350 cfs (2,750 cfs under Alternative 2) was derived from Storm D in Figure 7. The capacity of the Confluence Basin was determined at 1,330 AF (or 1,280 under Alternative 2) based on a design storm covering areas B, C and D in Figure 7. The outlet channel capacity was determined at 1,300 cfs (970 cfs under Alternative 2) based on Storm B, C, D.

Applicable HEC-1 model runs for the above cases are provided in Appendix C.

B. Probable Maximum Flood

To meet requirements of the Nevada State Engineer (NSE), the dam embankment must be protected against failure during the PMF. Discussion with NSE indicated it was acceptable to base design on the PMF for the East Tributary of the Range Wash (area BC, Figure 7) plus the full capacity of the channel from the West Tributary of the Range Wash (assumed at 4,000 cfs). Larger flows would overflow existing and future Sloan Channel and bypass the Confluence Basin, generally draining to the Las Vegas Wash several miles south (see Figure 3).

The PMF flow based on the above assumptions was determined to be 57,000 cfs. See Appendix C for HEC-1 model run for the PMF.

5. PROPOSED DESIGN FEATURES OF INLET CHANNEL

A. Alignment Consideration

The alignment of the inlet channel from the existing Sloan Channel to the proposed Confluence Basin has received much study over a 3-year period. The Facility Plan originally examined the area due south of the NAFB Golf Course as the optimum location for the Confluence Basin. With a basin in this location, the inlet channel from the West Tributary could have utilized the existing Sloan Channel. However, further evaluation showed the proposed site would conflict with an historic NAFB landfill having the potential for hazardous waste problems.

Consequently, Boyle, the City of North Las Vegas and CCRFCD decided to locate the Confluence Basin due east of the NAFB Golf Course at the location shown in Figure 2. This required that the inlet channel traverse the NAFB Golf Course. A number of negotiating meetings were held with NAFB in 1989 and 1990 resulting in general agreement on the concept of golf course channel. More than a half dozen alignment alternatives were investigated. On April 15, 1991 Mr. Gary Holler of the City of North Las Vegas received a letter from Colonel Blair agreeing to the present alignment concept, contingent upon a number of conditions. These conditions included maintenance of access roads, relocation of utilities, decorative bridges, and other terms.

During the present Predesign investigation, Boyle refined the agreed upon alignment and met again with CCRFCD, CCPW and NAFB personnel to discuss various details. A landscape architect was employed to produce colored renderings of the proposed channel alignment, fairway and bridge crossings, and other features. A more detailed hydraulic analysis was used to minimize the width (and impact) of the proposed channel in the golf course operation.

The work described above resulted in the colored concept schematic shown in Figure 8. Major features include: a diversion structure at the junction with the existing Sloan Channel, a rerouted roadway to allow for

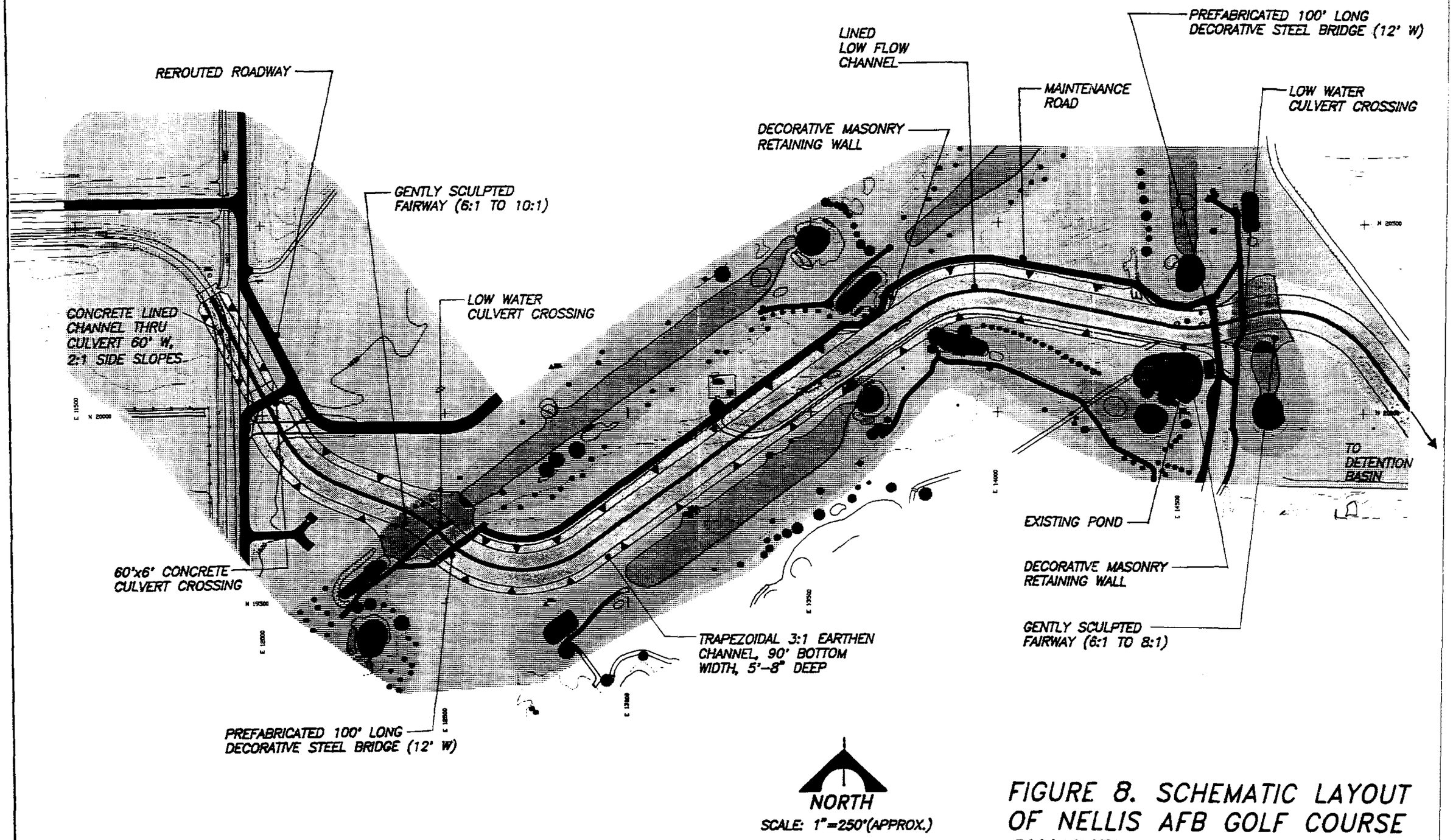


FIGURE 8. SCHEMATIC LAYOUT OF NELLIS AFB GOLF COURSE CHANNEL

single 90^{O} culvert crossing, 300 feet of trapezoidal concrete-lined channel with 50-foot base width and 2:1 side slopes, 4,000 feet of trapezoidal unlined channel with 80- to 90-foot base width and 3:1 side slopes through the golf course, several low- and high-water crossings in the golf course, and a lined (or graveled) low-flow section in the middle of the earth-lined channel. Further details of the proposed channel features and design criteria are described in the sections following.

B. Hydraulic Considerations

The inlet channel will be designed in conformance with Section 7.0 of the CCRFCD Criteria Manual.

The preliminary geotechnical investigation included two borings in the channel alignment, which indicated the channel to be in clay soils. Maximum velocities in the 90-foot wide earthen channel through the NAFB Golf Course will be slightly less than 6.0 fps, the allowable velocity for clay soils, at the 3,350 cfs 100-year flow. Slopes are quite flat, ranging between 0.1% and 0.2%. Maximum velocities in the uppermost concrete-lined section of the inlet channel (50-foot wide, 2:1 sides) will be less than 10 fps, except immediately below the diversion structure at the existing Sloan Channel where velocities may approach 15 fps.

Flow depths in the channel will generally reach 5.5 feet. The flow regime will remain subcritical throughout. Plan and profile sheets for the channel, including preliminary hydraulic grade lines, are provided in Plates 1, 2, 3 and 4.

Rip-rap lining will be utilized immediately downstream of the roadway culvert crossing (see Figure 8) at the point of transition to the earthen channel.

C. Sloan Channel-to-NAFB Channel Diversion

The proposed diversion structure for Alternative 1 would divert the total flow of the existing Sloan Channel (3,350 cfs) through the golf course and

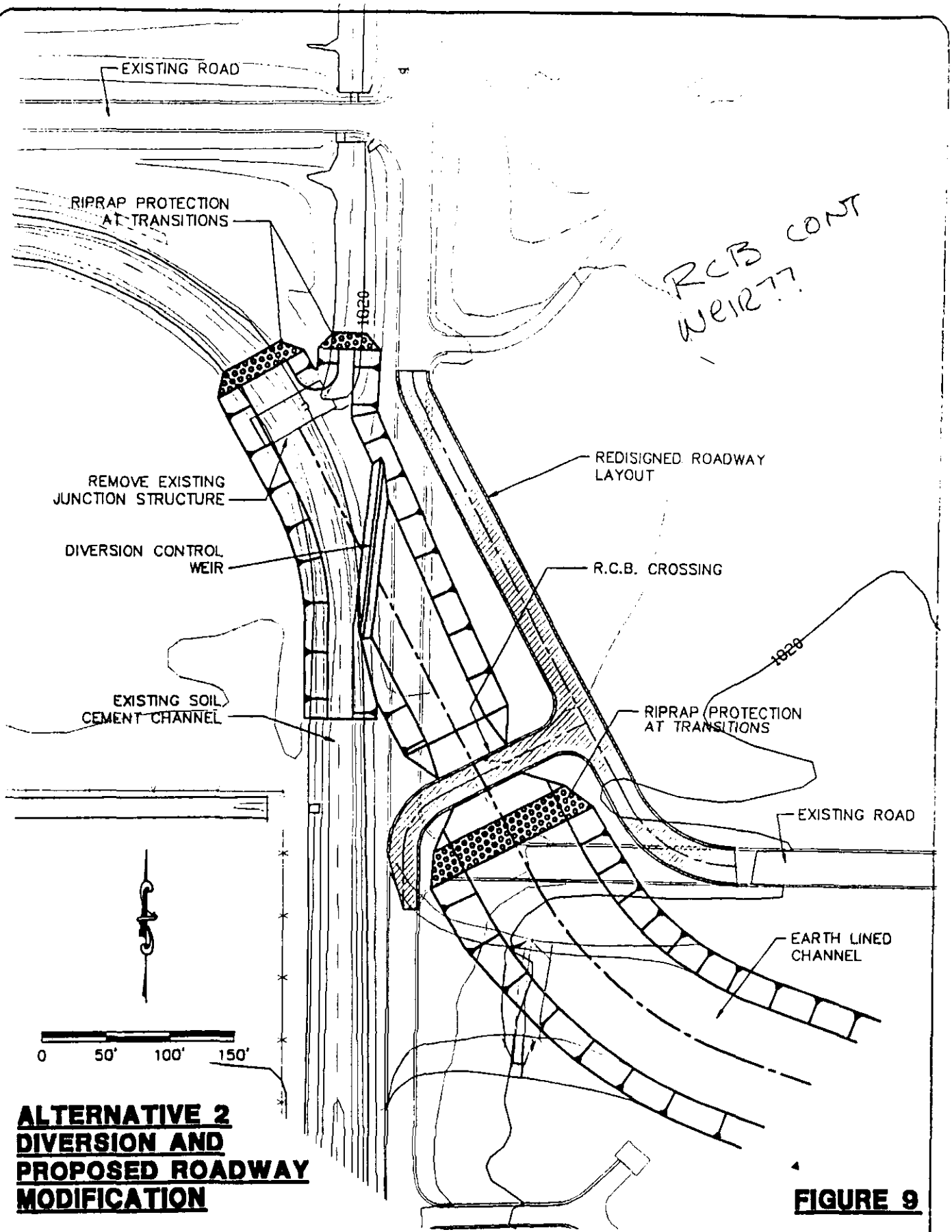
into the detention basin. The diversion would transition from an existing concrete section (14-foot wide base, 2:1 sides) of Sloan Channel to a new 50-foot wide base, 2:1 concrete section; and then through the culvert crossing at the redesigned roadway as shown in Figure 8.

The proposed diversion structure for Alternative 2 would confine low flows to the existing channel (14-foot base width and 2:1 side slopes). The west bank of the existing channel would be reduced in height to form a sill to allow controlled spill into the golf course channel. A conceptual design of the diversion is shown in Figure 9. At peak discharge 580 cfs would remain in Sloan Channel and 2,750 cfs would spill into the golf course channel. Final design of this diversion structure will require a more detailed analysis not undertaken for this memorandum. Additional analysis to further optimize the facilities and the amount of flow diverted in each direction will be performed in the design phase.

As mentioned previously, the diversion from the existing Sloan Channel will also involve the need for a new crossing structure (five 12'x 6' RCB culverts) under a modified roadway (Figures 8 and 9). The roadway will be redesigned to preclude the need for two skewed crossing structures for the diversion channel, NAFB officials have given tentative approval to the new roadway concept.

D. Channel Features and Dimensions

Below the modified roadway culvert, the inlet channel will transition to an earthen trapezoidal section with 80- to 90-foot base width and 3:1 side slopes. Through the two golf course fairways, the channel will be grass-lined with 6:1 to 10:1 side slopes. At the location where a drainage channel from the north joins the golf course channel, the embankment will be armored and protected from erosion. The inlet channel, which will be approximately 4,400 feet in length from Sloan Channel to the Confluence Basin, will also have a low-flow channel (Alternative 1) or gravel drain (Alternative 2).



ALTERNATIVE 2 DIVERSION AND PROPOSED ROADWAY MODIFICATION

FIGURE 9

Decorative masonry retaining walls will be equipped at two locations (Figure 9) to preclude modification of a tee box and a green otherwise required by staying with a 3:1 channel side slope.

For Alternative 1, two low-water culvert crossings (6'x 3' RCB, 12-foot roadway) would be located as shown in Figure 8. Both Alternatives 1 and 2 would include two 100-foot long, 12-foot wide prefabricated (decorative) steel bridges constructed at locations shown in Figure 8.

Examples of the features described above are shown in Figures 10, 11 and 12.

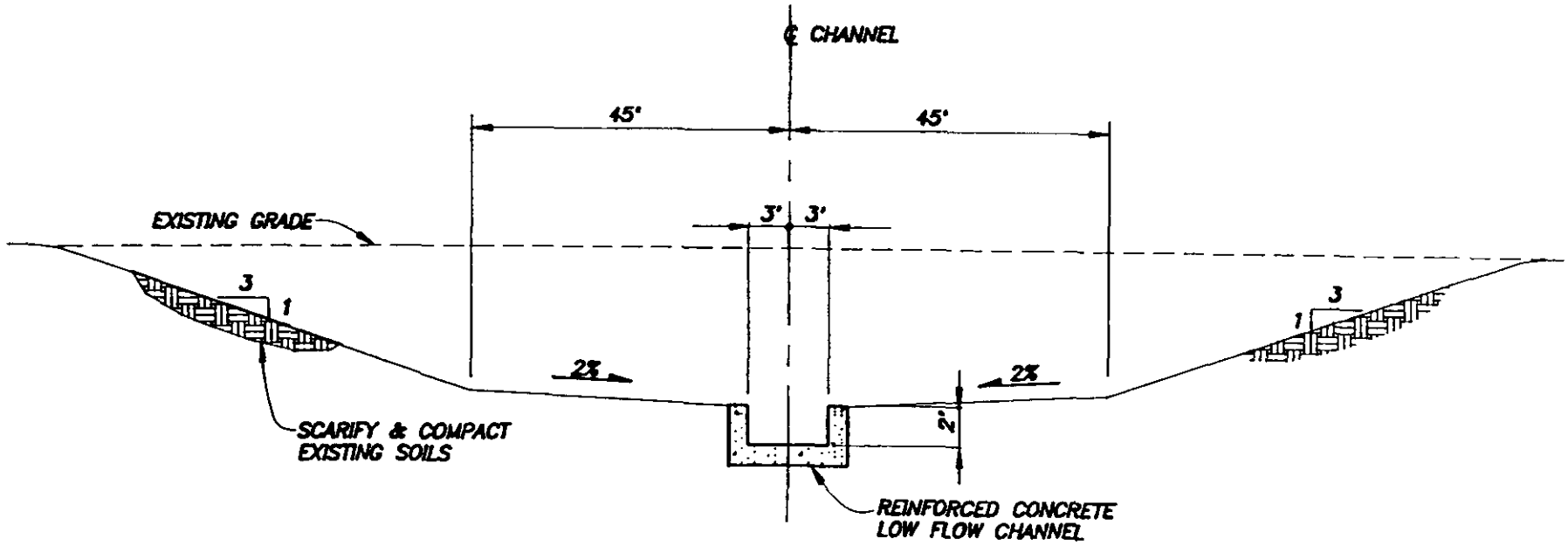
E. Maintenance Issues

Since the slope of the golf course channel is so mild, 100-year velocities (up to 6 fps) should be non-erosive to the naturally clay-lined earthen channel. The 10-foot wide by 2-foot deep coarse gravel drain proposed for Alternative 2 should also be non-erosive. Some erosion may occur in localized areas (e.g., bends) under high flows. Sediment deposition is likely to occur in the channel after major events and require maintenance. The concrete low-flow channel of Alternative 1 would probably collect much of the sediment, but would be relatively easy to clean. Under Alternative 2, the golf course channel would likely exhibit only minor sediment deposition because low flows and most of the bed load conveyed during high flows would continue in the existing Sloan Channel. Low flows from smaller storms would stay in the Sloan Channel, therefore, the Golf Course Channel would require less frequent maintenance with Alternative 2.

6. PROPOSED DESIGN FEATURES OF DETENTION BASIN

A. Location and Layout

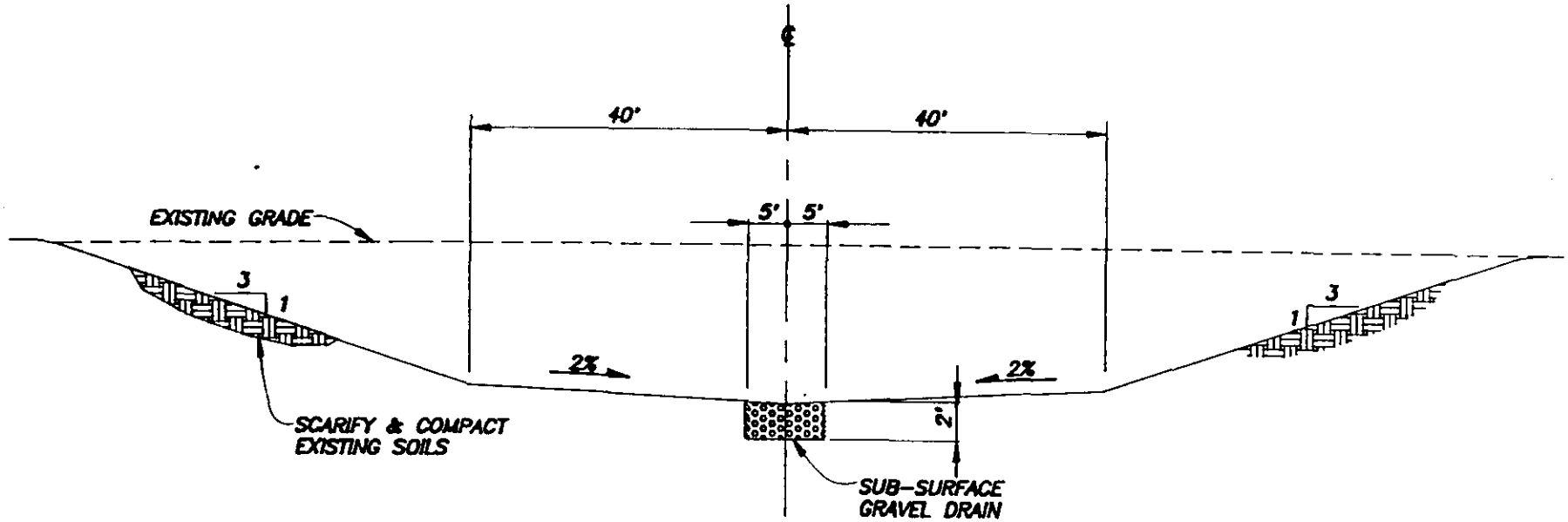
The general location of the detention basin is similar to that proposed in the 1991 Facility Plan, however, availability of more detailed topography and land ownership patterns for this project led to several proposed changes in



ALTERNATE 1 TYPICAL SECTION
GOLF COURSE CHANNEL

N.T.S.

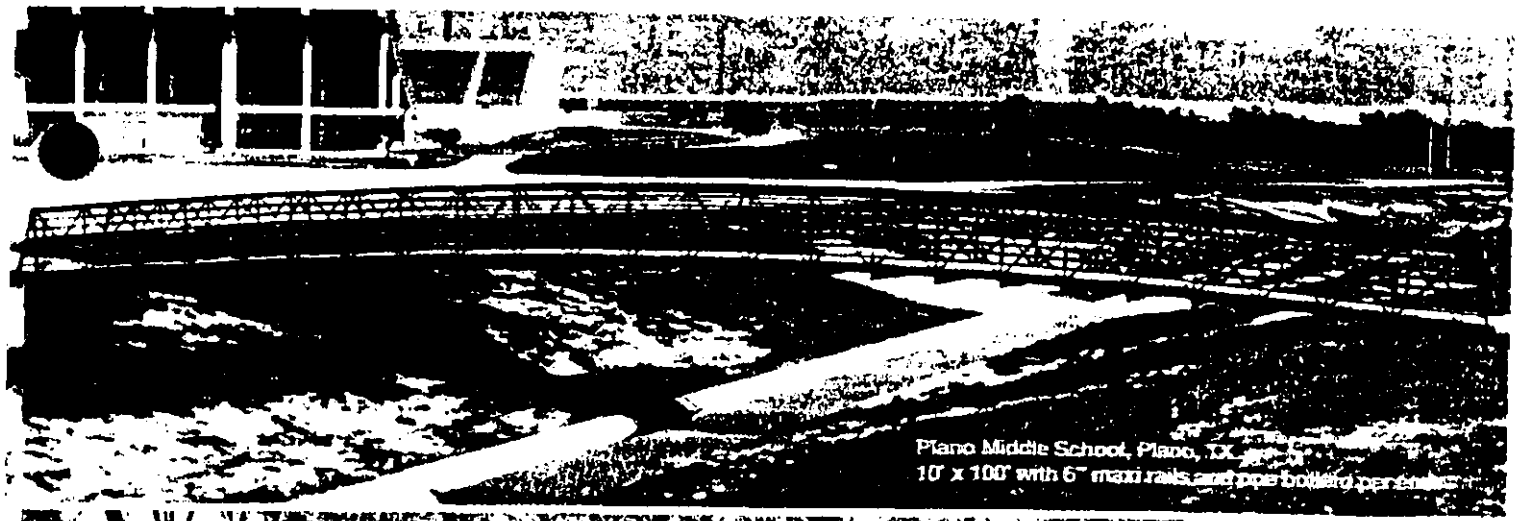
FIGURE 10.



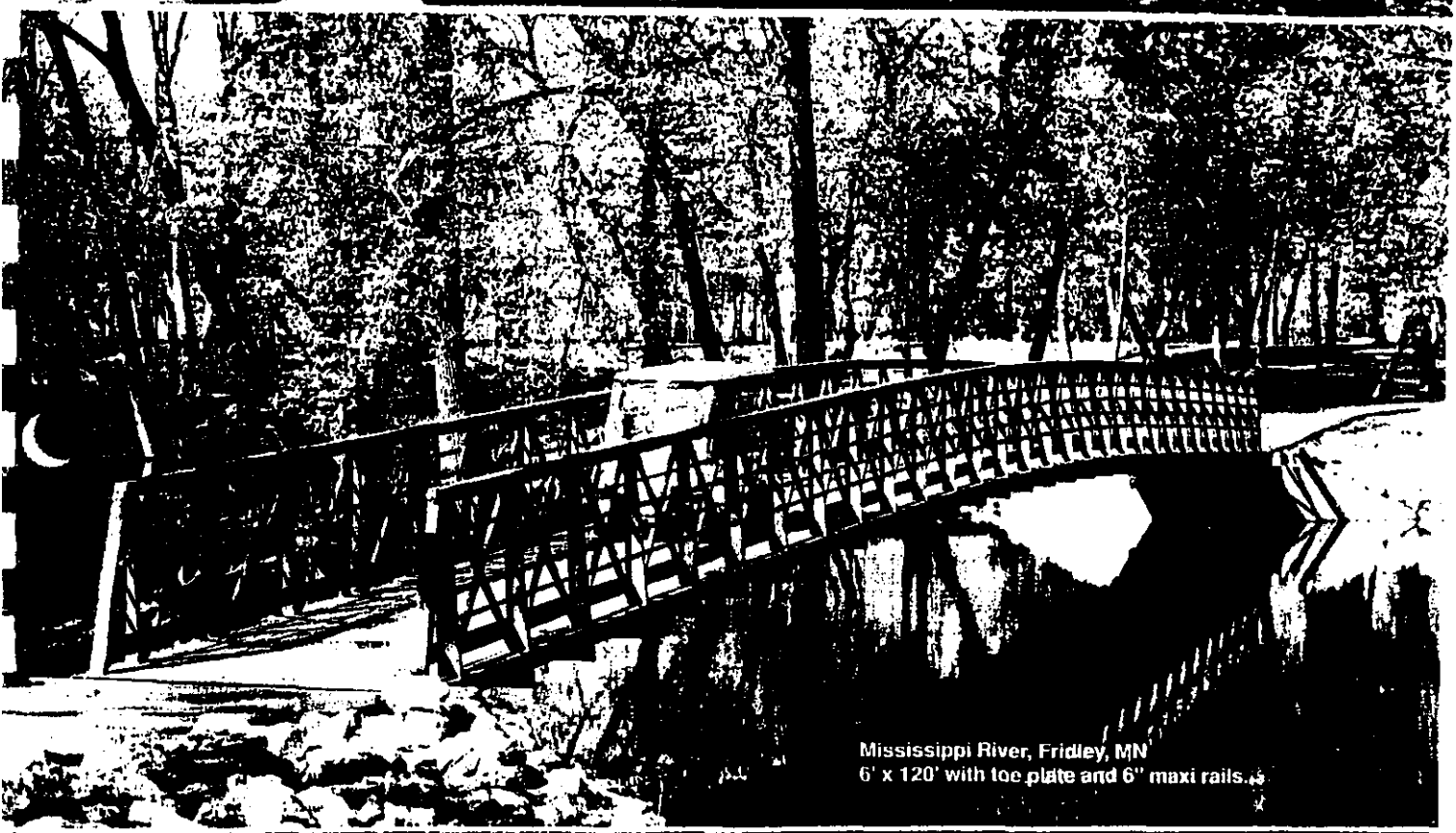
ALTERNATE 2 TYPICAL SECTION
GOLF COURSE CHANNEL
W/LINED LOW FLOW SECTION

N.T.S.

FIGURE 11.

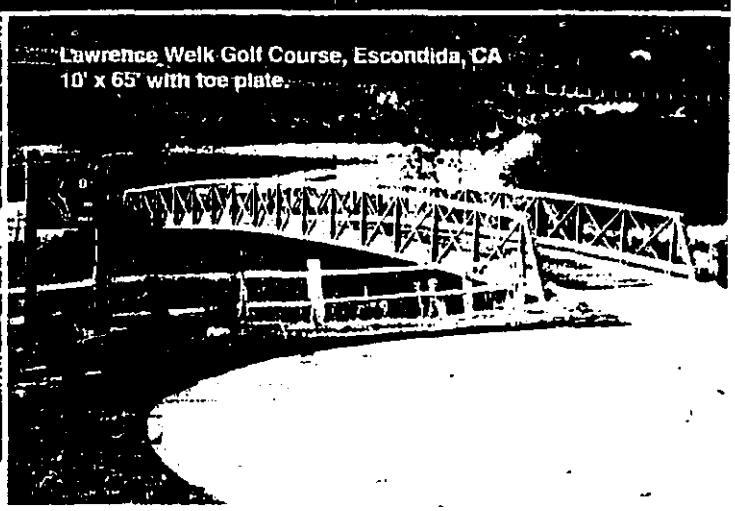


Plano Middle School, Plano, TX
10' x 100' with 6" maxi rails and pipe bollard pendants



Mississippi River, Fridley, MN
6' x 120' with toe plate and 6" maxi rails.

riar Golf Course, Frisco, TX
d with concrete deck, pipe bracket
maxi rails, square ends and approach rails.



Lawrence Welk Golf Course, Escondida, CA
10' x 65' with toe plate.

FIGURE 12.

basin layout. The basin was extended approximately 700 feet further south to reduce the amount of excavation and to increase the natural storage. Also, the proposed basin does not extend as far to the east or north as originally proposed, but incorporates a low-lying area at the northeast end where the future channel from the East Tributary of Range Wash will enter the basin.

B. Hydrologic Analysis and Sizing

The required storage capacity of the basin estimated in the Facility Plan was 1,500 AF. Based on the updated hydrologic analysis described in Section 4 and Appendix C, the required storage has been reduced to 1,330 AF for Alternative 1, and 1,280 AF for Alternative 2, by increasing the efficiency of proposed outlet works.

The required storage capacity is determined by minimizing the costs of the detention and downstream conveyance improvements. The majority of Sloan Channel downstream of the detention basin is unlined. Conceptual analysis performed in the Facility Plan determined that, for Range Wash, maximizing detention is more cost effective than improving (enlarging) downstream conveyance capacity. The optimum release rate from the Confluence Basin was determined to be such that the flow at the juncture of Sloan Channel with Las Vegas Wash (Figure 3) resulting from a total storm area (storm over BCDE, Figure 7) was approximately equal to the flow resulting from a more intense storm centered below the detention basin (Storm E). This "target discharge" at the confluence with Las Vegas Wash was determined to be 3,100 to 3,200 cfs. (Note this is 100-200 cfs less that indicated in Figure 3).

The optimization effort for Alternative 2 (split conveyance) focused on meeting the 3,100-3,200 cfs "target discharge" at Las Vegas Wash. It was determined that to meet this target discharge, the release flow from detention basin combined with flow remaining in the existing Sloan Channel had to be limited to approximately 1,300 cfs during the total area storm (BCDE). It was found that diverting less flow from Sloan Channel (i.e., less flow to the basin, more in Sloan Channel) required a lower

release rate from the basin. This was found to increase the storage capacity requirements of the basin despite the smaller inflow to the basin. The optimized condition of Alternative 2 resulted in basin storage requirement of 1,280 AF (includes 130 AF for sediment storage).

A sediment yield analysis was performed and presented in the Facility Plan. The values from the Facility Plan were used to determine the sediment storage requirements of the detention basin. The estimated average annual sediment yield was .37 AF/square mile/year. The tributary area of the confluence detention basin is 82 square miles, resulting in an average annual yield of 30 AF/year. Per the Facility Plan, this volume was multiplied by a factor of 5.3 to estimate the 100-year design storm volume. The resulting volume is 160 AF. This is the proposed volume of sediment storage required for Alternative 1. The proposed volume for Alternative 2 was reduced by 20% to account for the bed load and portion of the flow which would continue to be conveyed in Sloan Channel.

C. Spillway

The Facility Plan proposed a spillway over a soil cement embankment section with a length of 1,600 feet and 15-foot drop located on the southerly embankment of the detention basin.

The newly proposed spillway concept is to allow a portion of the detention basin overflow to occur by overtopping of the banks of the inlet channel through the golf course.

It may be noted that the detention basin and conveyance facilities provide 100-year flood protection to the golf course which it presently does not have. Also, for major flood events such as the PMF, the golf course area would be flooded with or without the detention basin and regardless of its configuration.

A portion of the detention basin along the golf course, with bank at or near the existing grade (1,816 feet), would also be overtopped. Since this overtopping would occur near existing grade, it would not require extensive

erosion protection or energy dissipation. A cross-section of the emergency spillway on the detention basin west embankment is shown in Figure 13.

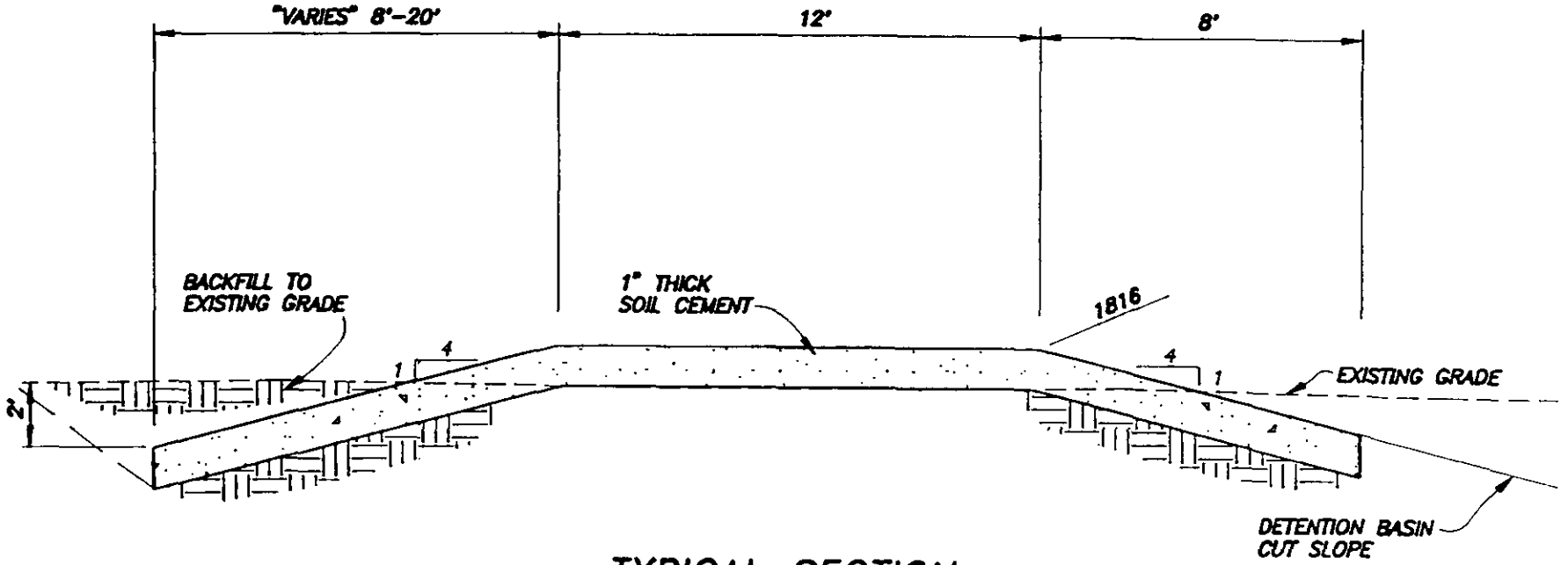
During the PMF, the emergency spillway on the west embankment would begin to spill when the water surface rises above an elevation of 1,816. When the water surface exceeds 1,816.5 feet it would begin to overtop the banks of the inlet (NAFB Golf Course) channel. The length (4,000 feet) of the inlet channel through the golf course contributes to the length of the spillway negating the need for the full PMF spillway on the detention basin embankment. The total length of the channel would not function as an effective weir length due to curves in the alignment and the general inundation of the golf course, however the PMF would simply flow around the detention basin and through the golf course with an effective flow width of approximately 3,000 feet.

The west dam embankment is proposed fo be armored with soil cement to protect the toe while PMF flows flow around the detention basin. A typical cross-section of the west dam embankment is shown in Figure 14.

The emergency spillway concept described also allows the 100-year water surface in the detention basin to be raised to 1,816 feet; thereby reducing the amount of excavation required for storage in the basin by more than 180 AF (290,000 CY).

D. Outlet Works

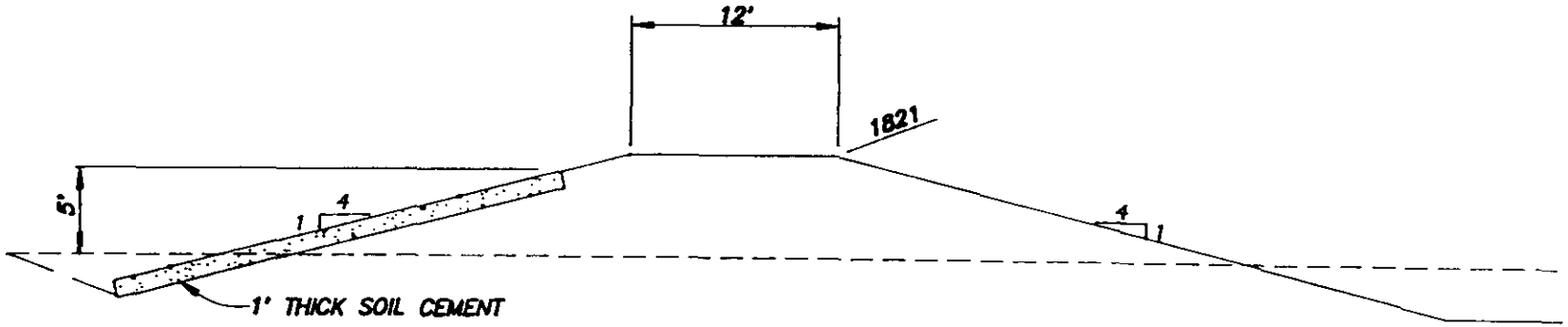
To minimize storage requirements in the detention basin, the outlet works will be designed for efficiency at low head. The proposed outlet structure has a lip raised above the basin floor to help trap sediment, a gravel drain with perforated pipes to drain the bottom of the basin, a trashrack, and four 5' x 3' RCB outlet culverts. The proposed outlet works are shown in Figure 15. The outlet works for Alternative 2 must have a lower release rate due to the flow remaining in the existing Sloan Channel. This outlet would have three 5' x 3' RCB culverts.



TYPICAL SECTION EMERGENCY SPILLWAY

SCALE: 1/4"=1'-0"

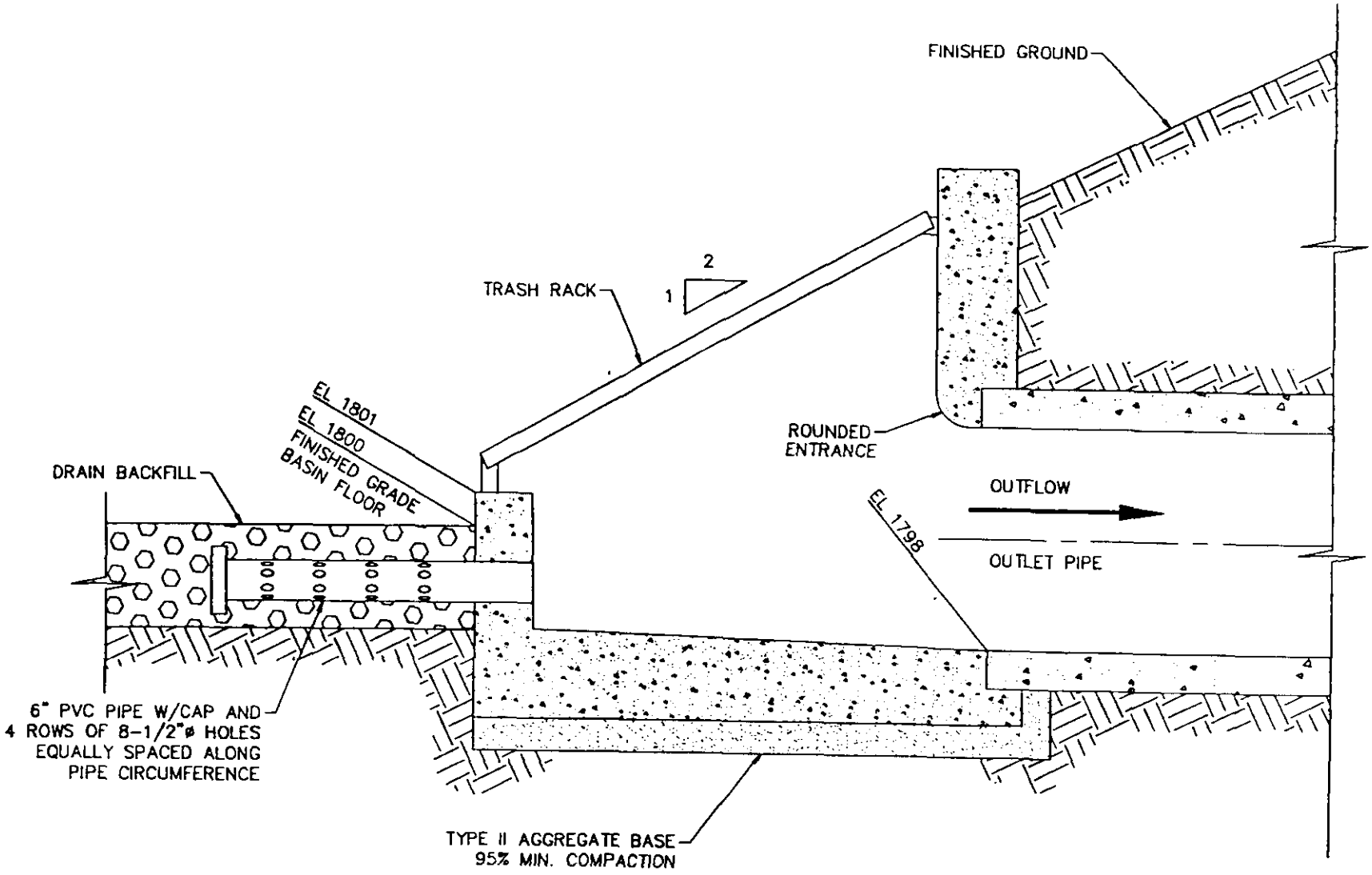
FIGURE 13



TYPICAL SECTION
WEST EMBANKMENT

SCALE: 1"=10'

FIGURE 14



TYPICAL BASIN OUTLET STRUCTURE

FIGURE 15

The outlets for Alternatives 1 and 2 would utilize a hydraulic concept whereby initial operation would be by "inlet control"; as the depth or head increases there is a change to "outlet control". This minimizes the changes in discharge with respect to changes in head.

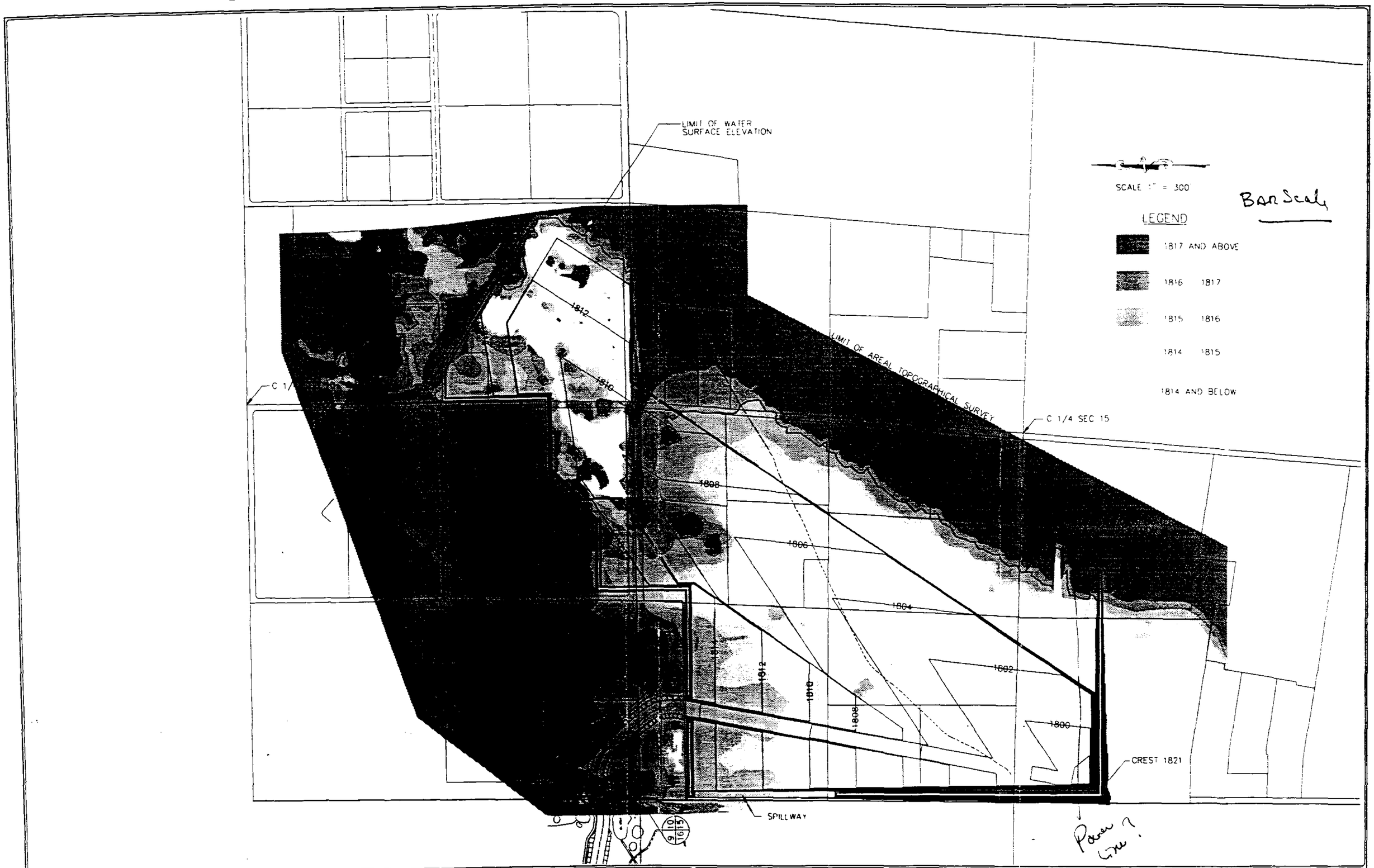
One option considered a larger flow remaining in Sloan Channel and less flow diverted to the detention basin. To delay and reduce the peak flow out of the basin, a less efficient (strictly outlet control) 84-inch RCP outlet was considered. It produced acceptable downstream flows, but increased the storage requirements of the detention basin by approximately 50 AF (81,000 CY of additional excavation). Additional efforts to optimize the basin will be performed in the design phase as refinements are made.

E. Grading Plan

The grading plan for the basin will not be finalized until the design phase of the project. Figure 16 shows the preliminary grading concept. The basin is proposed to have a minimum cross-slope of 0.5% in accordance with the CCRFCD Criteria Manual. There will be low-flow channels (from West and East Tributaries) through the basin with a minimum slope if 0.25%. The grading plan may be different depending on the Alternative selected for final design. It is important for Alternative 1 to have a more efficient outlet at lower head, therefore, it is proposed to have a smaller, deeper area at the downstream end of the basin that would quickly increase the head on the outlet.

The preliminary grading plan utilizes an embankment with a top width of 12 feet and 3:1 (horizontal to vertical) embankment slopes. Final design may consider a flatter slope and wider top width to reduce the amount of excess material, improve aesthetic appearance and reduce erosion potential.

Preliminary earthwork estimates for the basin indicate approximately 1,000,000 CY of excavation and 125,000 CY of fill. Assuming a 30% compaction factor, approximately 575,000 CY would require haul and



Bar Scale

Pour Inv?

MARK | DATE | BY : REVISION	DESIGNED WJH DRAWN WJH CHECKED DWD	PROJECT ENGINEER DATE PROJECT MANAGER DATE	Boyle Engineering Corporation consulting engineers / surveyors 1785 E. Sahara Ave. 300 Las Vegas, Nev. 89104 (702) 731-3344	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	KEY MAP	CONFLUENCE DETENTION BASIN BASIN GRADING PLAN	DRAWING G1 OF 1a3 dwg

disposal. Several nearby areas have been tentatively identified for disposal.

7. PROPOSED DESIGN FEATURES OF OUTLET CHANNEL

The proposed outlet channel would follow a straight alignment southerly for approximately 1,900 feet on the west side of Toyiabe Street. This alignment allows the use of an existing 40-foot wide channel right-of-way and an existing unlined drainage ditch.

The concrete-lined channel will be designed per the Criteria Manual with subcritical flow on a mild slope. The design flow for the outlet channel was based on a storm over the area BCD and is dependent on the outlet works of the detention basin.

Alternative 1 has a design discharge of 1,300 cfs. To confine this flow to within the existing right-of-way, a reinforced concrete rectangular channel with 38-foot wide base width is proposed. The channel cross-section is shown in Figure 17.

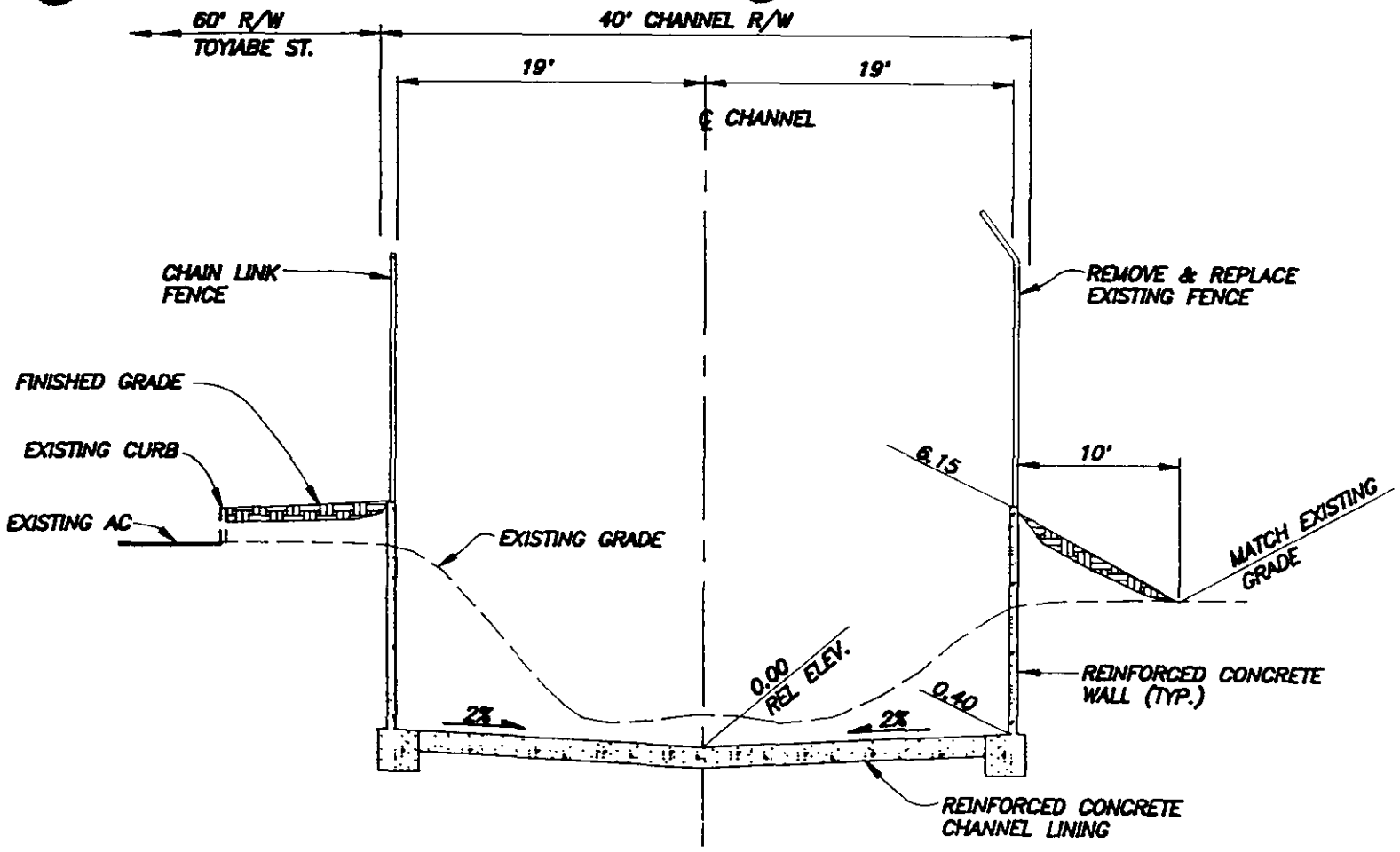
Alternative 2 has a design discharge of 970 cfs. This flow would be conveyed in a trapezoidal channel with 20-foot base width and 2:1 side slopes, as shown in Figure 18.

The confluence of the outlet channel with the existing Sloan Channel will require removal and reconstruction of the existing junction.

Plates 4 and 5 provide a preliminary profile of the outlet channel with hydraulic gradeline. Depth of flow will be approximately 4 feet. Velocities will be less than 10 fps.

8. RIGHT-OF WAY REQUIREMENTS

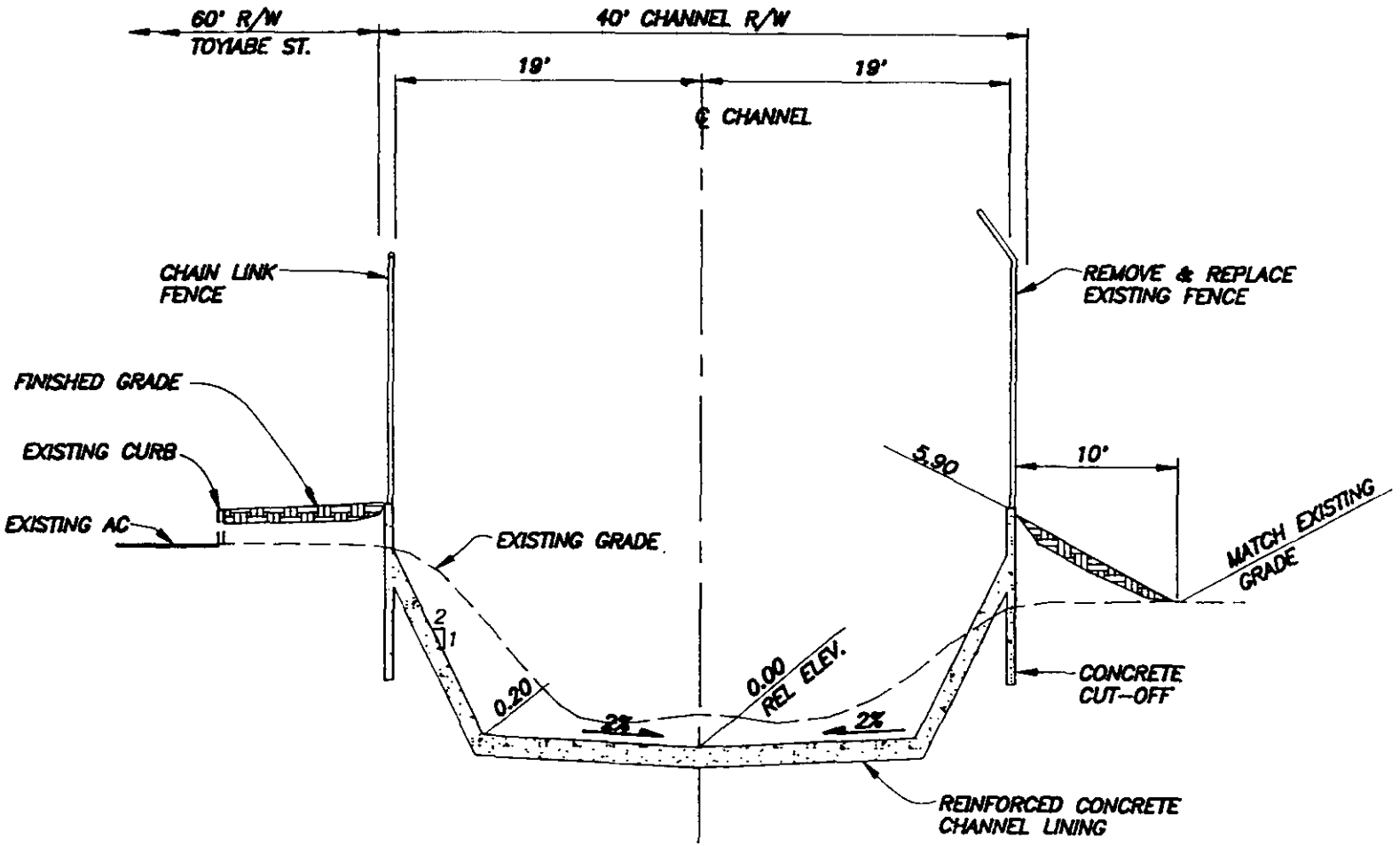
The preliminary land acquisition requirements for the Detention Basin are shown in Figure 19. A corresponding listing of the property owners and the land areas are given in Table 1.



OUTLET CHANNEL
TYPICAL SECTION ALTERNATE 1

SCALE: HORIZ. 1"=10'
VERT. 1"=4'

FIGURE 17.



OUTLET CHANNEL
TYPICAL SECTION ALTERNATE 2

SCALE: HORIZ. 1"=10'
VERT. 1"=4'

FIGURE 18.

11 | 14
10 | 15

SEC 15 T20S R62E

14 | 23
15 | 22

SCALE 1" = 300'

AREA OF TAKE

26-81-22 PRIVATE
26-81-24 PRIVATE
26-81-17 PRIVATE
26-81-19 PRIVATE
26-81-10 PRIVATE
26-81-21 PRIVATE
26-81-23 PRIVATE
26-29-8 PRIVATE
26-29-11 CLARK CO.
26-29-15 PRIVATE
26-29-6 PRIVATE
26-29-20 PRIVATE
26-29-14 PRIVATE
26-29-7 PRIVATE
26-81-9 PRIVATE
26-81-8 U.S.A.
26-29-18 PRIVATE
26-29-21 PRIVATE
26-29-5 PRIVATE
26-29-19 PRIVATE
26-29-16 PRIVATE
26-29-12 PRIVATE
ALTO DR.
26-81-4 PRIVATE
26-81-5 PRIVATE
26-81-6 PRIVATE
26-81-7 PRIVATE
26-29-24 PRIVATE
26-29-22 PRIVATE
26-29-26 PRIVATE
26-29-4 PRIVATE
26-30-1 PRIVATE
CASA LOMA EST. No. 1 PRIVATE
26-29-23 PRIVATE
26-29-25 PRIVATE
26-29-10 PRIVATE
26-29-13 PRIVATE
SUNRISE TRAILER EST. No. 5B PRIVATE
CASA LOMA EST. No. 2B PRIVATE
26-81-2 U.S.A.
26-29-9 PRIVATE
26-81-1 U.S.A.
26-29-2 PRIVATE
26-30-33 PRIVATE
CHEYENNE AVE.
26-29-1 U.S.A.
26-81-3 U.S.A.
26-29-3 PRIVATE
26-29-17 PRIVATE
CASA LOMA EST. No. 2A PRIVATE
CASA LOMA EST. No. 2C PRIVATE
15 | 22
16 | 21
10 | 15
9 | 16
26-47-1 U.S.A.
26-24-1 U.S.A.
SLOAN LANE
26-23-1 U.S.A.
26-24-1 U.S.A.

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

CONFLUENCE DETENTION BASIN

PRELIMINARY R/W MAP

sect.dwg

TABLE 1

PRELIMINARY LAND ACQUISITION REQUIREMENTS

PARCEL NUMBER	PROPERTY OWNER NAME	ACCESSED PROPERTY (acres)	TAKE AREA (acres)	REMAINING PROPERTY (acres)
26-29-1	USA	10.32	3.89	6.43
26-29-2	Gubler, Mollie	30.36	30.36	0.00
26-29-3	Sloan Ventures LTD	9.80	9.80	0.00
26-29-5	Yerushalmi Mordechai & V ETAL	3.50	1.05	2.45
26-29-6	Airway Rock Products	32.21	1.19	31.02
26-29-9	Domanico LTD Ptnrshp	19.59	19.59	0.00
26-29-10	Domanico-Brogan LTD Ptnrshp	19.82	19.82	0.00
26-29-13	Johnson, Layle G.	1.28	1.28	0.00
26-29-17	Kohn, Joseph ETAL	9.79	9.79	0.00
26-29-18	Yerushalmi Mordechai & V ETAL	3.50	0.40	3.10
26-29-21	Yerushalmi Mordechai & V ETAL	3.00	0.40	2.60
26-29-22	French, Paul Eugene ETAL	9.39	9.39	0.00
26-29-23	Tierra Del Mar ETAL	9.28	9.28	0.00
26-29-24	Oden, Earl Jr. ETAL	9.43	9.43	0.00
26-29-25	Ashby, Lee Allen & Marilyn Kay	10.05	10.05	0.00
26-29-26	Schooler, E Andrew ETAL	9.98	4.49	5.49
26-30-1	P S M PPTYS	34.02	7.12	26.90
26-30-33	P S M PPTYS	37.13	19.03	18.10
26-81-7	Sigel & CO LTD ETAL	18.46	12.80	5.66
26-81-8	USA Corps of Engineers Army	33.87	2.62	31.25
26-81-9	Worthen, James Lynn & Loa Rae	48.10	26.08	22.02

Total Take = 207.86 acres

The inlet channel through the NAFB Golf Course will require a right-of-way width of approximately 150 feet, amounting to approximately 15 acres of required land acquisition from the U. S. A.

The outlet channel will be confined to a 40-foot right-of-way width. This will require 0.26 acres of acquisition from parcel 26-30-33, owner: PSM PPTYS. South of said parcel, there is an existing 40-foot wide right-of-way for drainage on the west side of Toyiabe Street.

9. UTILITY CONFLICTS

There are no records of existing utilities in the area of the detention basin. There are also no conflicts in the outlet channel alignment.

The inlet channel through the NAFB Golf Course will require the relocation of water mains and buried electrical cables. The major utilities in the area of the inlet channel are indicated in Figure 20. Irrigation facilities servicing the golf course are not shown due to lack of information. The project will require a field survey to identify and locate irrigation facilities. The water mains in the vicinity of the roadway crossing will require potholing. Final design will minimize the utility conflicts, if possible. The 8-inch water main, which crosses the channel at two locations, is assumed to require relocation at both locations.

10. PRELIMINARY ESTIMATE OF QUANTITIES AND COSTS

The preliminary estimates of quantities and costs for Alternatives 1 and 2 are summarized in Tables 2 and 3, respectively.

Land costs of $10,000/acre are assumed based on the most recent acquisitions of NAFB of properties in this vicinity. The relatively low land costs are due to the lands being unimproved, without utilities, in a flood prone area, and with high noise levels, adjacent to Nellis Air Force Base.

The largest cost associated with the proposed facilities is related to the quantity of disposal and haul required for detention basin construction. The final design will attempt to further reduce this quantity.

TABLE 2

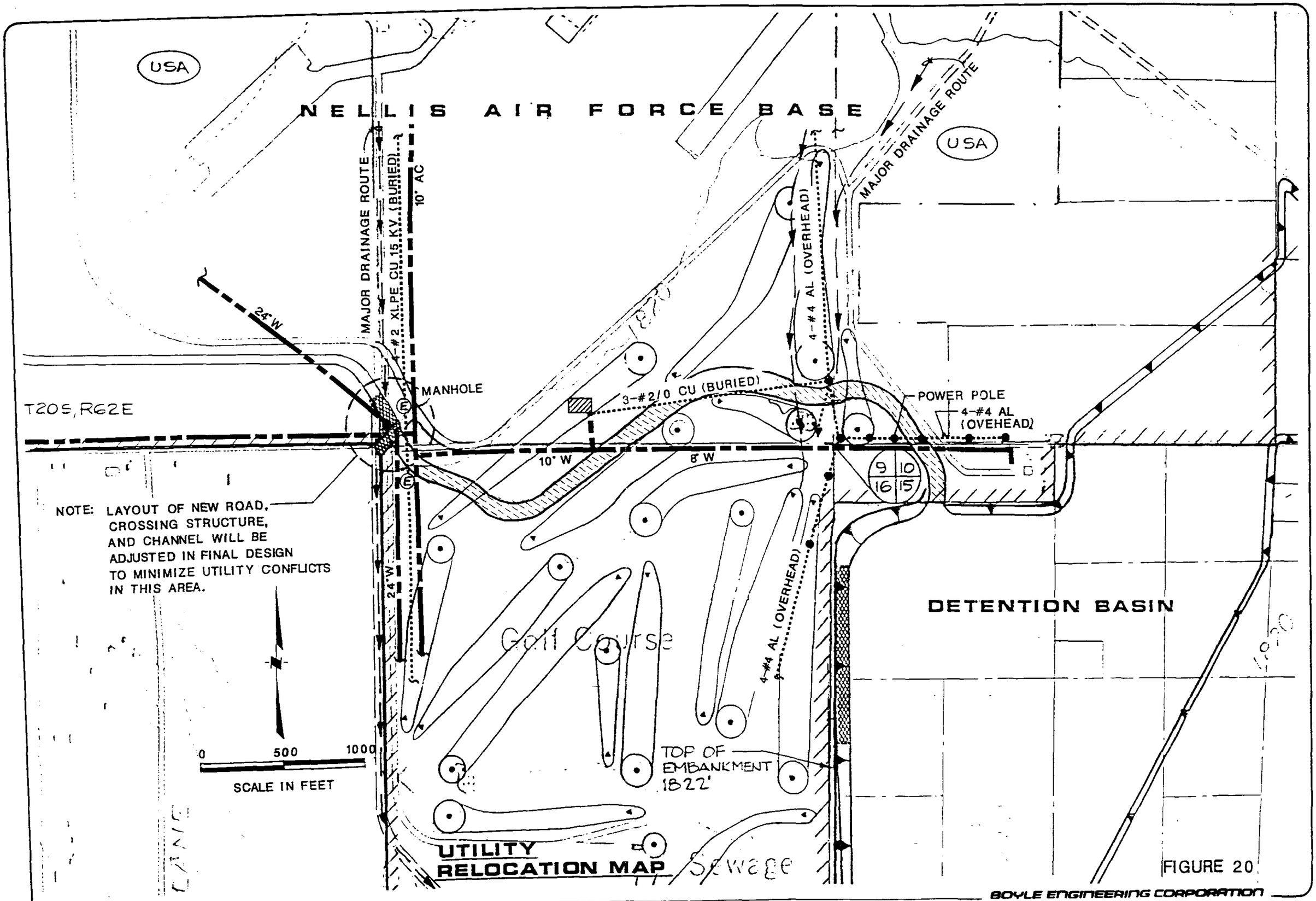
ALTERNATIVE 1
ESTIMATE OF PROBABLE CONSTRUCTION COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
INLET CHANNEL				
DIVERSION STRUCTURE & CONCRETE CHANNEL	1	LS	$110,000	$110,000
MAJOR ROADWAY CROSSING	1	LS	$90,000	$90,000
ROADWAY IMPROVEMENTS	1	LS	$40,000	$40,000
EARTHWORK GOLF COURSE	110,000	CY	$6	$660,000
LOW-FLOW CHANNEL	7,000	LF	$45	$315,000
LOW-FLOW CROSSING	2	EA	$6,000	$12,000
STEEL BRIDGE CROSSING	2	EA	$70,000	$140,000
RETAINING WALLS	1	LS	$50,000	$50,000
TURF REPLACEMENT	1	LS	$35,000	$35,000
UTILITY CONFLICTS	1	LS	$40,000	$40,000
LAND ACQUISITION	15	ACRES	$10,000	$150,000
SUBTOTAL INLET CHANNEL				$1,642,000
DETENTION BASIN				
EXCAVATION	1,000,000	CY	$1	$1,000,000
EMBANKMENT FILL	125,000	CY	$1.50	$187,500
DISPOSAL & HAUL	575,000	CY	$5	$2,875,000
OUTLET WORKS	1	LS	$175,000	$175,000
SPILLWAY/EROSION PROTECTION	1	LS	$100,000	$100,000
LAND ACQUISTION	208	ACRES	$10,000	$2,080,000
SUBTOTAL DETENTION BASIN				$6,417,500
OUTLET CHANNNEL				
OUTLET CHANNEL	1,900	LF	$220	$418,000
CONFLUENCE STRUCTURE	1	LS	$15,000	$15,000
LAND ACQUISTION	.3	ACRES	$10,000	$3,000
SUBTOTAL OUTLET CHANNEL				$436,000
SUBTOTAL ALTERNATIVE 1				$8,495,500
CONTINGENCY (20%)				$1,699,000
TOTAL ALTERNATIVE 1				$10,194,500

TABLE 3

ALTERNATIVE 2
ESTIMATE OF PROBABLE CONSTRUCTION COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
INLET CHANNEL				
DIVERSION STRUCTURE & CONCRETE CHANNEL	1	LS	$110,000	$110,000
MAJOR ROADWAY CROSSING	1	LS	$90,000	$90,000
ROADWAY IMPROVEMENTS	1	LS	$40,000	$40,000
EARTHWORK GOLF COURSE	100,000	CY	$6	$600,000
GRAVEL DRAIN	4,000	LF	$10	$40,000
LOW-FLOW CROSSING	0	EA	$6,000	$0
STEEL BRIDGE CROSSING	2	EA	$65,000	$130,000
RETAINING WALLS	1	LS	$50,000	$50,000
TURF REPLACEMENT	1	LS	$35,000	$35,000
UTILITY CONFLICTS	1	LS	$40,000	$40,000
LAND ACQUISITION	14	ACRES	$10,000	$140,000
SUBTOTAL INLET CHANNEL				$1,275,000
DETENTION BASIN				
EXCAVATION	920,000	CY	$1	$920,000
EMBANKMENT FILL	125,000	CY	$1.50	$187,500
DISPOSAL & HAUL	550,000	CY	$5	$2,750,000
OUTLET WORKS	1	LS	$150,000	$150,000
SPILLWAY/EROSION PROTECTION	1	LS	$100,000	$100,000
LAND ACQUISTION	208	ACRES	$10,000	$2,080,000
SUBTOTAL DETENTION BASIN				$6,187,500
OUTLET CHANNNEL				
OUTLET CHANNEL	1,900	LF	$180	$342,000
CONFLUENCE STRUCTURE	1	LS	$15,000	$15,000
LAND ACQUISTION	.3	ACRES	$10,000	$3,000
SUBTOTAL OUTLET CHANNEL				$360,000
SUBTOTAL ALTERNATIVE 2				$7,822,500
CONTINGENCY (20%)				$1,565,000
TOTAL ALTERNATIVE 2				$9,387,500


USA
NELLIS AIR FORCE BASE
MAJOR DRAINAGE ROUTE
10" AC
4-#2 XLPE CU 15 KV (BURIED)
24" W
MANHOLE
T20S, R62E
3-#2/0 CU (BURIED)
10" W
8" W
24" W
4-#4 AL (OVERHEAD)
MAJOR DRAINAGE ROUTE
USA
POWER POLE
4-#4 AL (OVEHEAD)
9 10
16 15
NOTE: LAYOUT OF NEW ROAD, CROSSING STRUCTURE, AND CHANNEL WILL BE ADJUSTED IN FINAL DESIGN TO MINIMIZE UTILITY CONFLICTS IN THIS AREA.
0 500 1000
SCALE IN FEET
Golf Course
4-#4 AL (OVERHEAD)
TOP OF EMBANKMENT 1822'
DETENTION BASIN
UTILITY RELOCATION MAP
Sewage
FIGURE 20
BOYLE ENGINEERING CORPORATION

A cost comparison of alternative embankment sections found that the proposed earth embankment was considerably less expensive than a roller compacted concrete embankment with a much smaller cross-section.

Soil cement was the most economical alternative for the spillway and for erosion protection of the embankment. The on-site soils are suitable for use in soil cement. Roller Compacted Concrete (RCC) would require import and mixing of additional aggregate and typically more cement. The extra strength of RCC or concrete lining is not warranted since velocities will be low. Rip rap would be more expensive since it is not available from on-site excavation.

Alternative 2 has less construction costs and would also have less maintenance costs, since more frequent smaller storm flows would remain in Sloan Channel and not affect the Golf Course Channel or detention basin. Alternative 1 may require maintenance in the golf course after every storm.

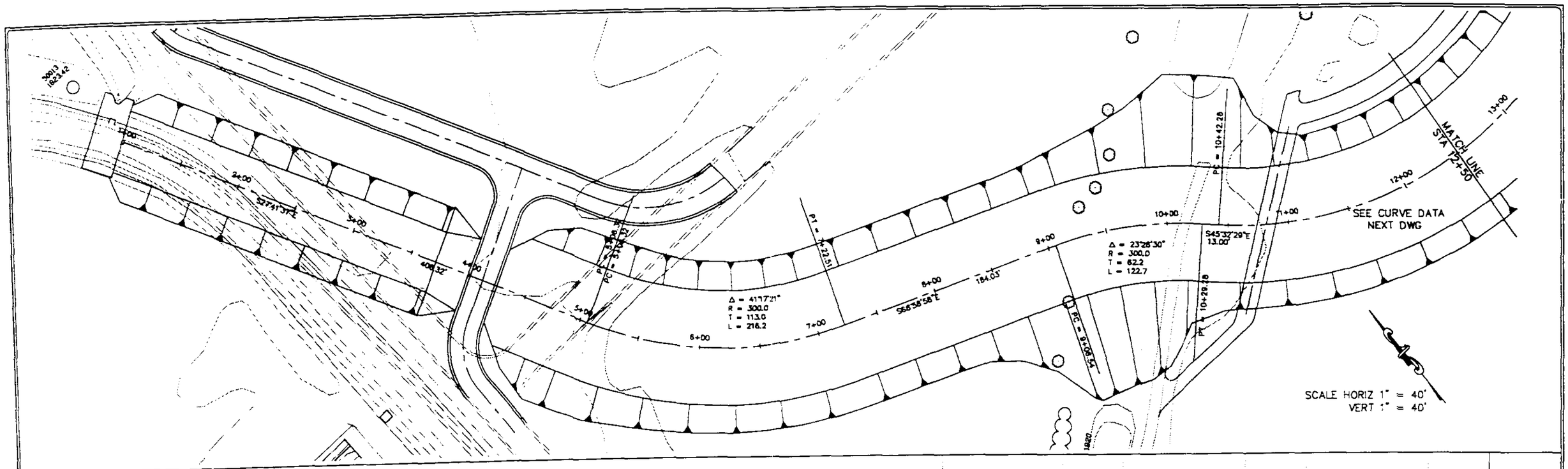
11. CONSTRUCTION ISSUES

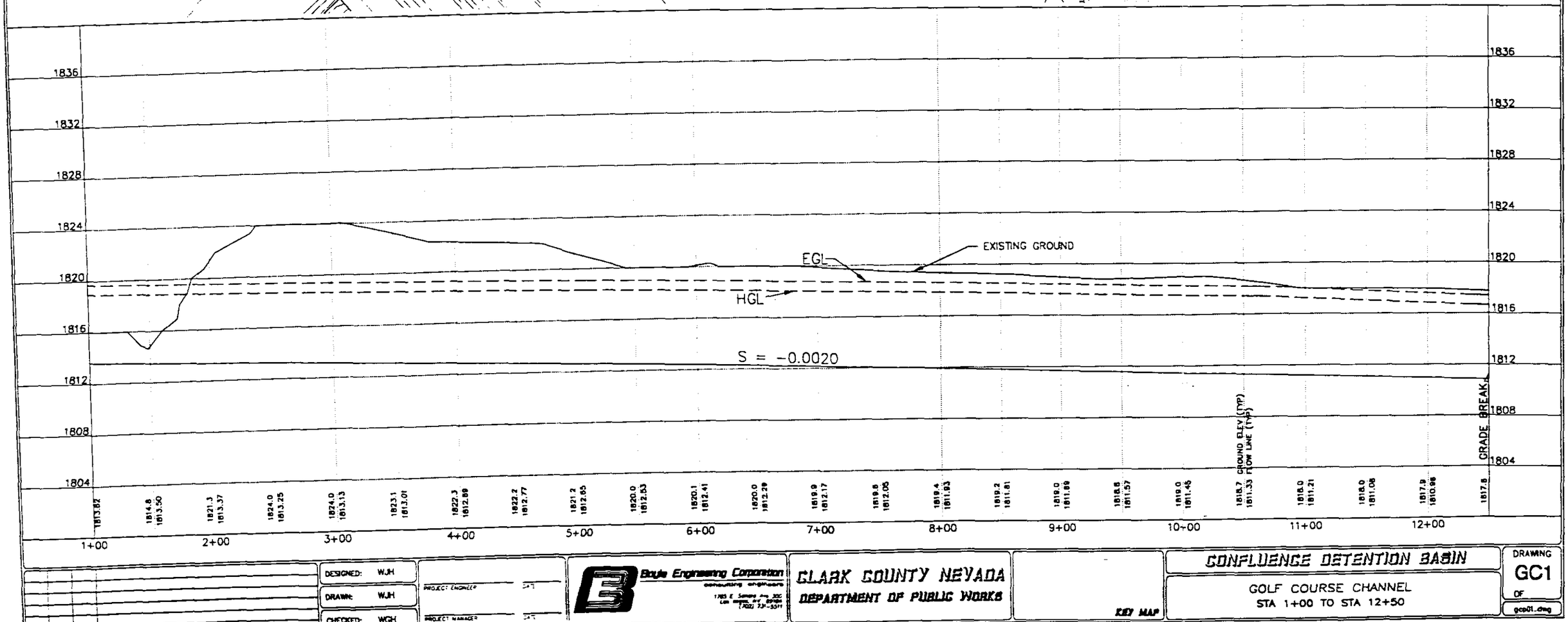
A major construction issue is maintaining access roads and the integrity of golf course irrigation system during construction. NAFB also requests that golf course construction be scheduled for January 1993. This would require two separate construction contracts. The construction of the Confluence Basin and other appurtenant work would involve a separate contract of later date.

Boyle recommends there be a public presentation to the Sunrise Manor Town Board, to inform them of the project, and minimize the possibility of future objections.

Prior to construction the project will require standard approvals from the Director of Public Works, the County officials indicated in the County's standard title block, and public utilities. Approval by NAFB officials will also be required. A dam permit will be required from the Nevada State Engineer.

PLATES





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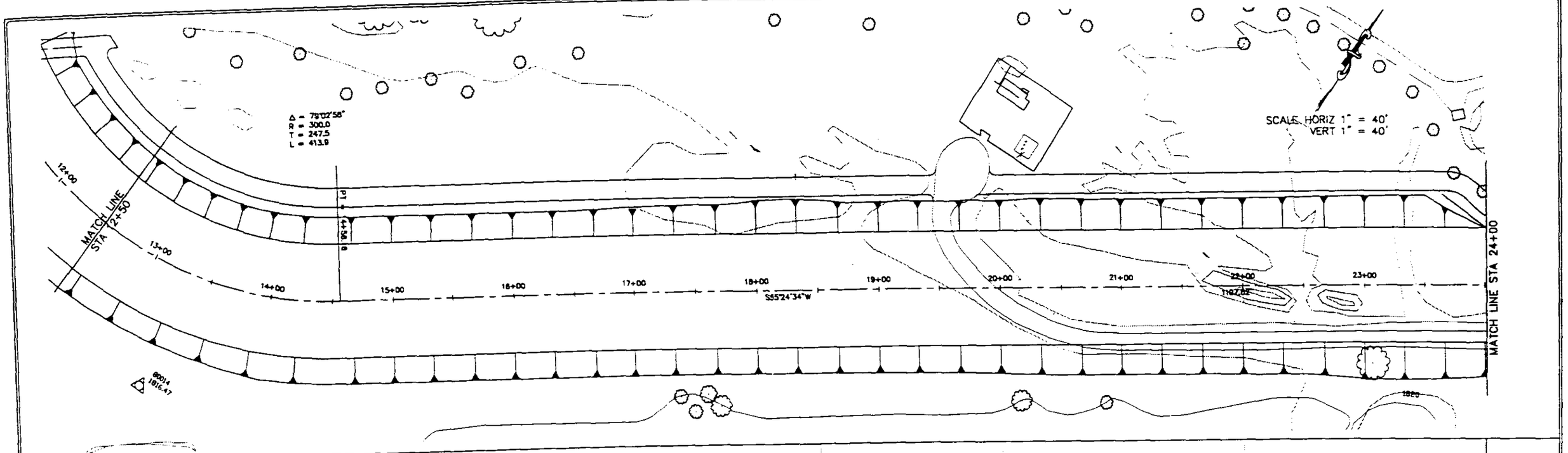
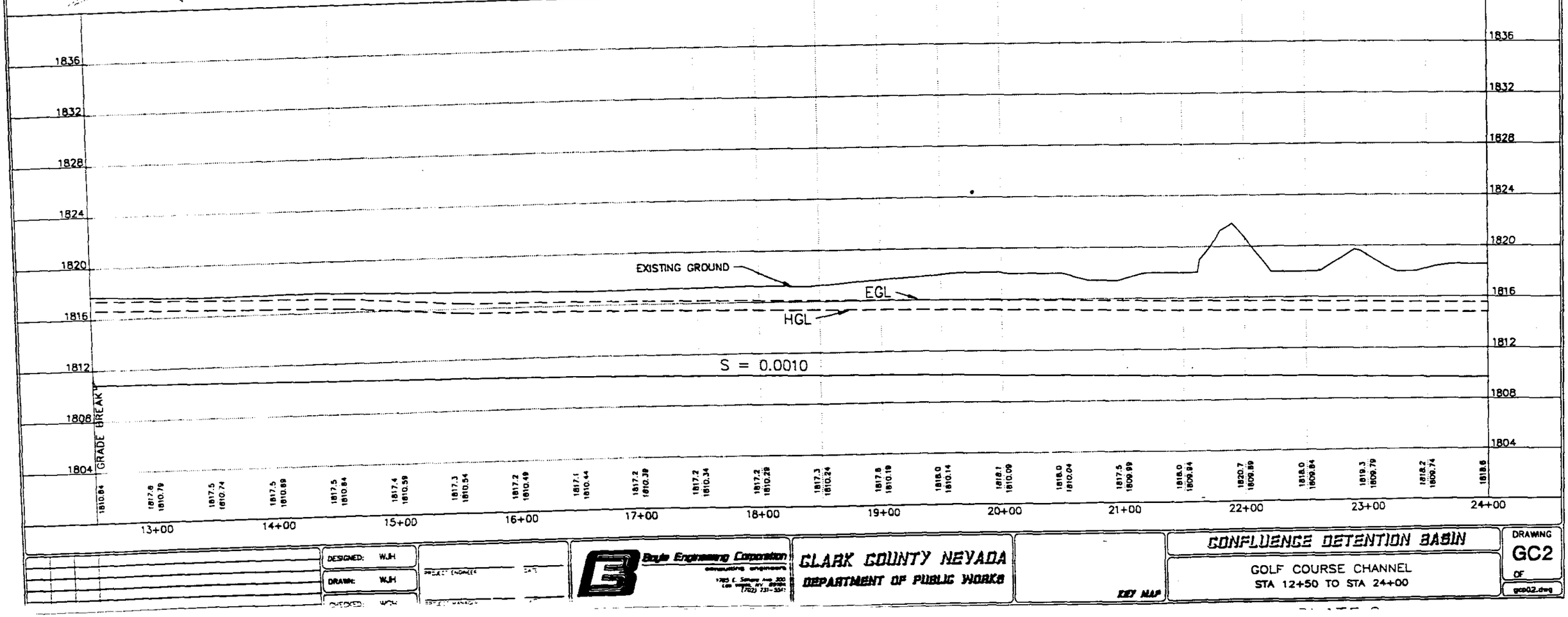
DRAWN: WJH		DEPARTMENT OF PUBLIC WORKS		GOLF COURSE CHANNEL STA 1+00 TO STA 12+50	OF
CHECKED: WGH	PROJECT ENGINEER / DATE				gcs01.dwg
	PROJECT MANAGER / DATE				





DESIGNED: WJH
DRAWN: WJH
CHECKED: WJH
PROJECT ENGINEER
PROJECT MANAGER
DATE

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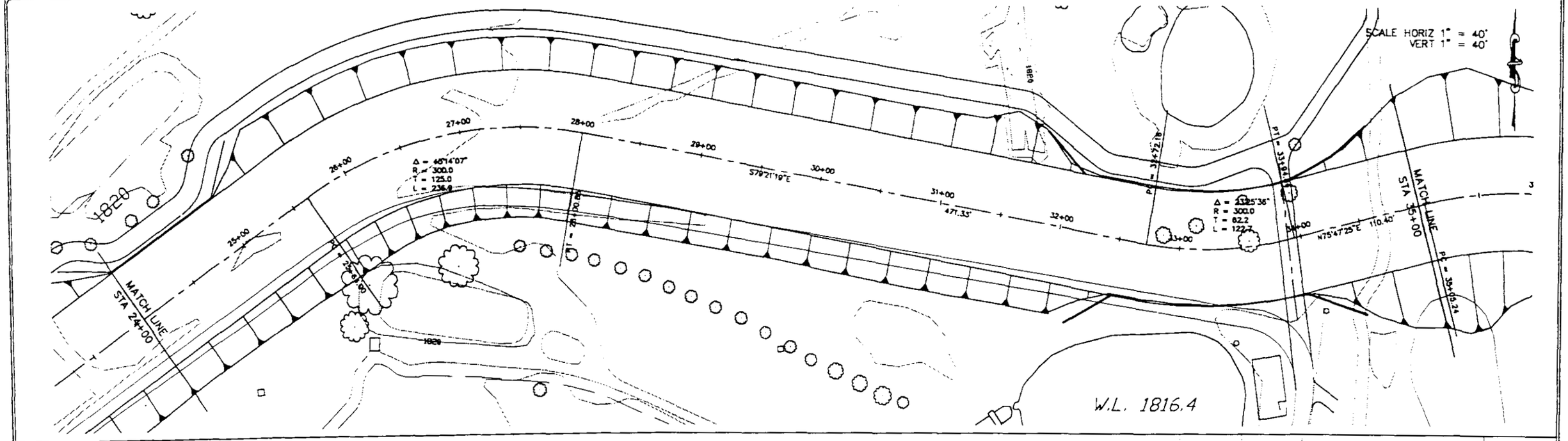
Las Vegas, NV 89104
(702) 731-5511

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

KEY MAP

CONFLUENCE DETENTION BASIN
GOLF COURSE CHANNEL
STA 12+50 TO STA 24+00

DRAWING
GC2
OF
gcp02.dwg



DESIGNED: WJH	PROJECT ENGINEER DATE	Boyle Engineering Corporation consulting engineers	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	KEY MAP	CONFLUENCE DETENTION BASIN GOLF COURSE CHANNEL STA 24+00 TO STA 35+50
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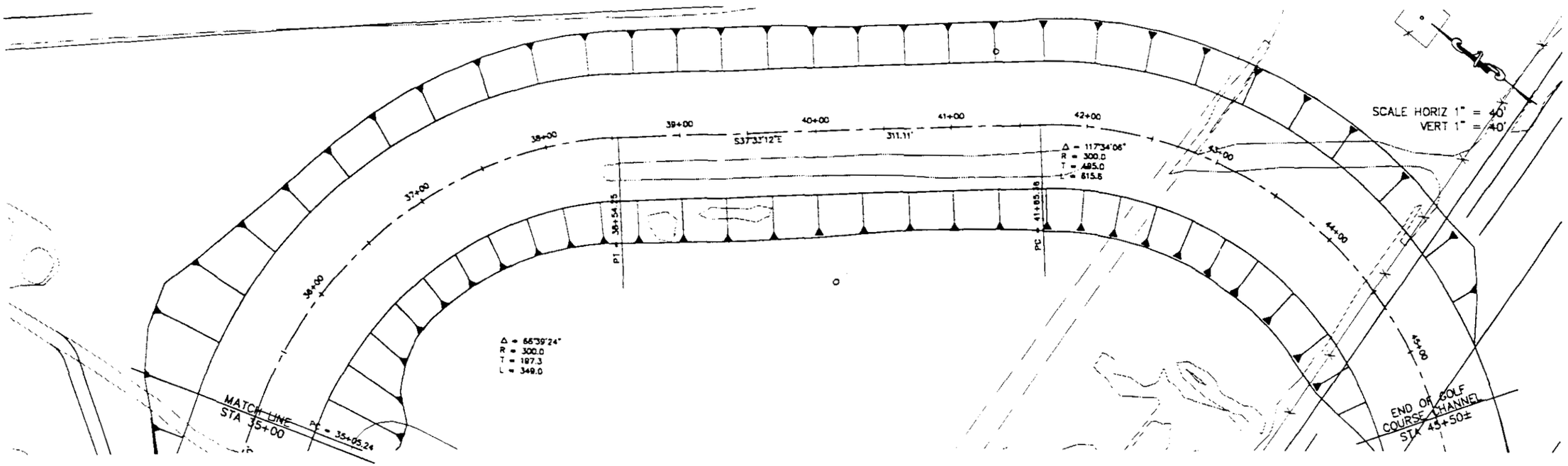
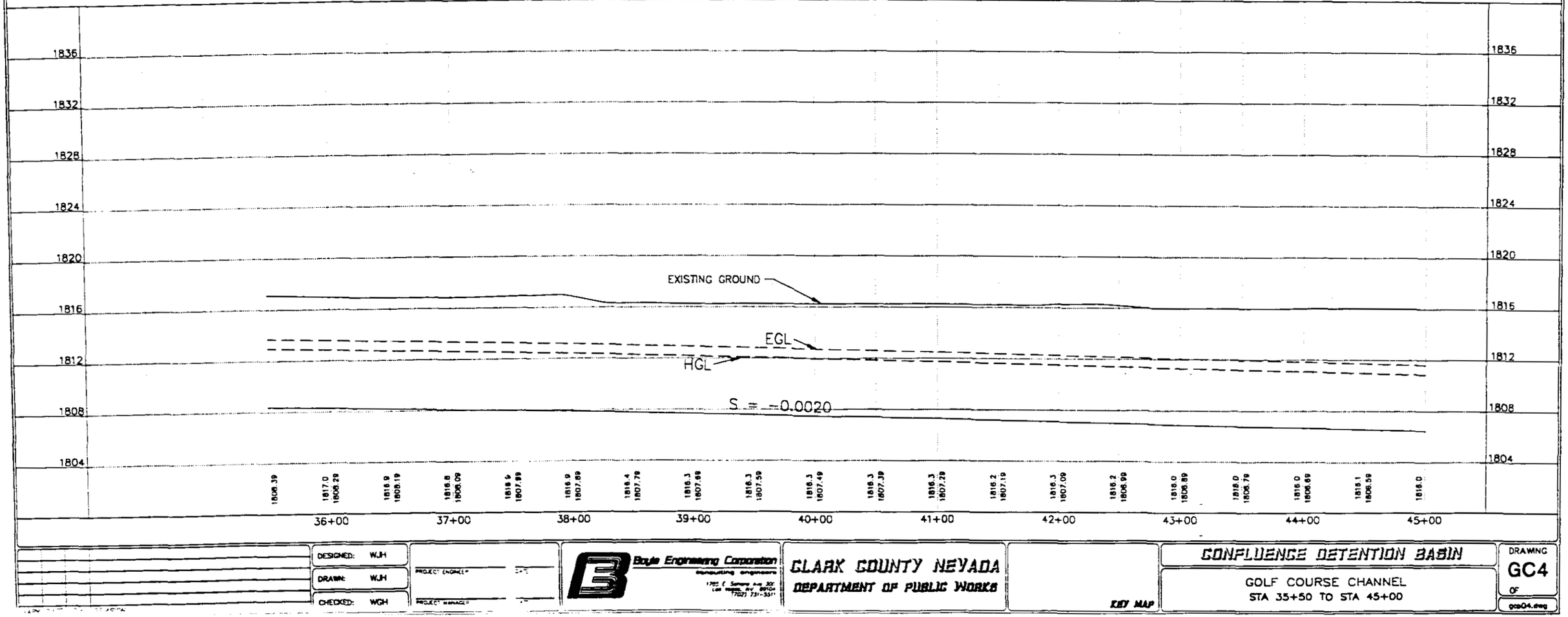
CHECKED: WGH	PROJECT MANAGER DATE				





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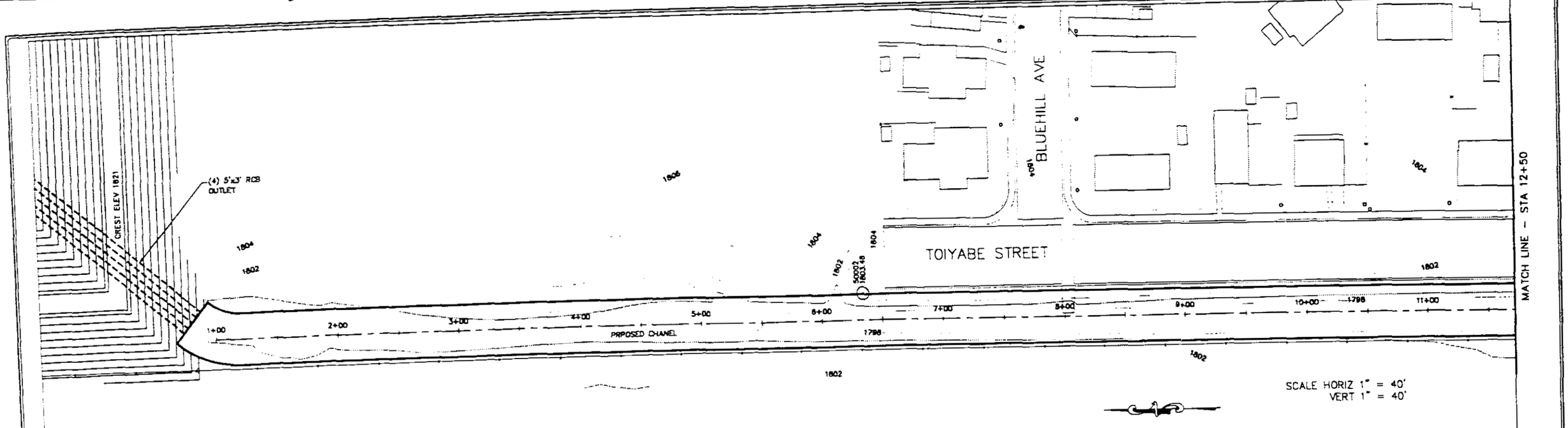
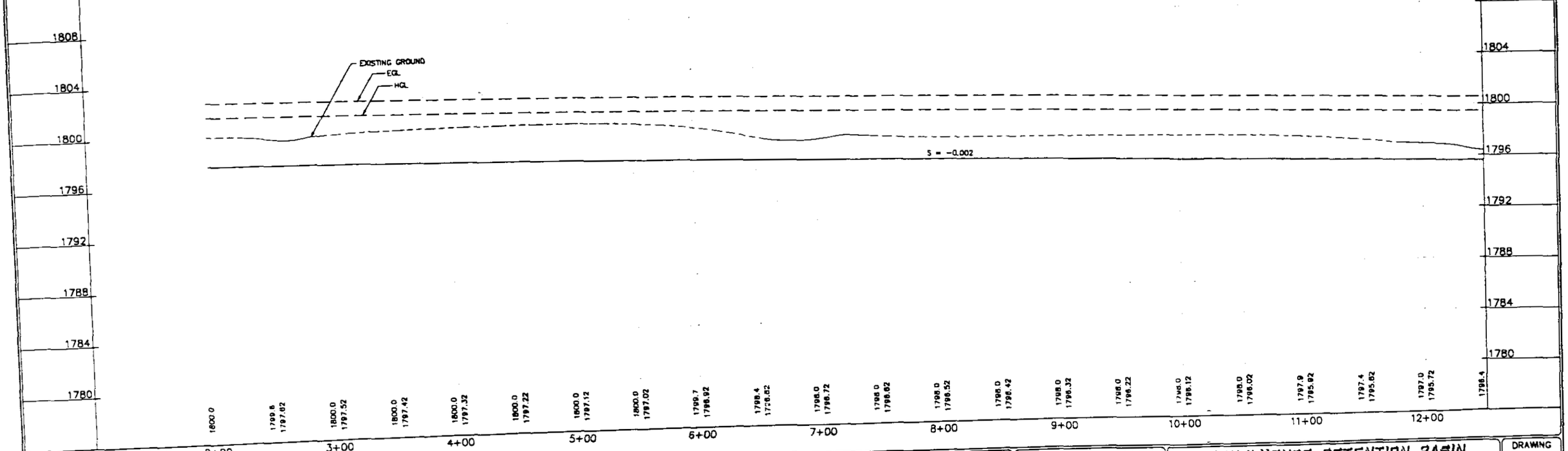
CHECKED: WGH					gcs04.dwg





DESIGNED: WJH
DRAWN: WJH
CHECKED: WGH
PROJECT ENGINEER
DATE
PROJECT MANAGER

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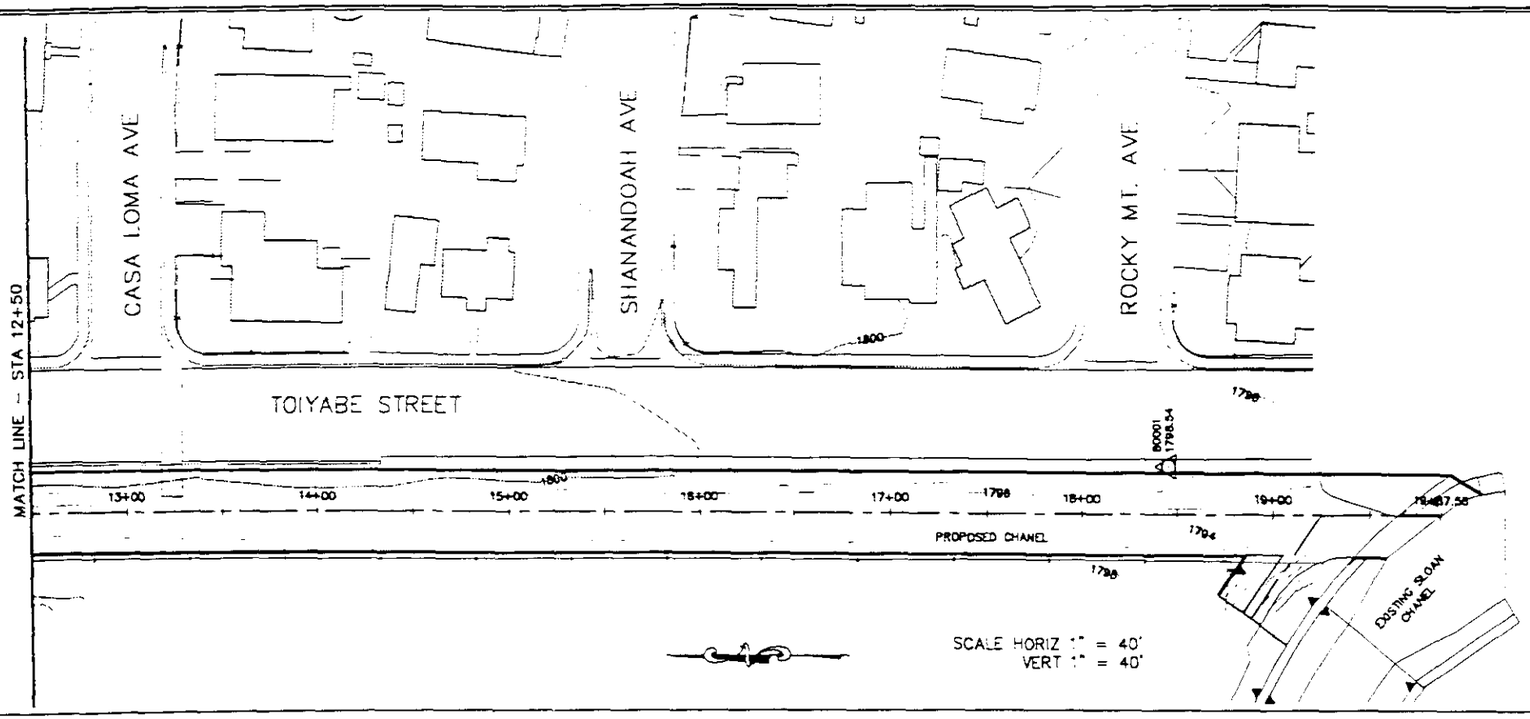
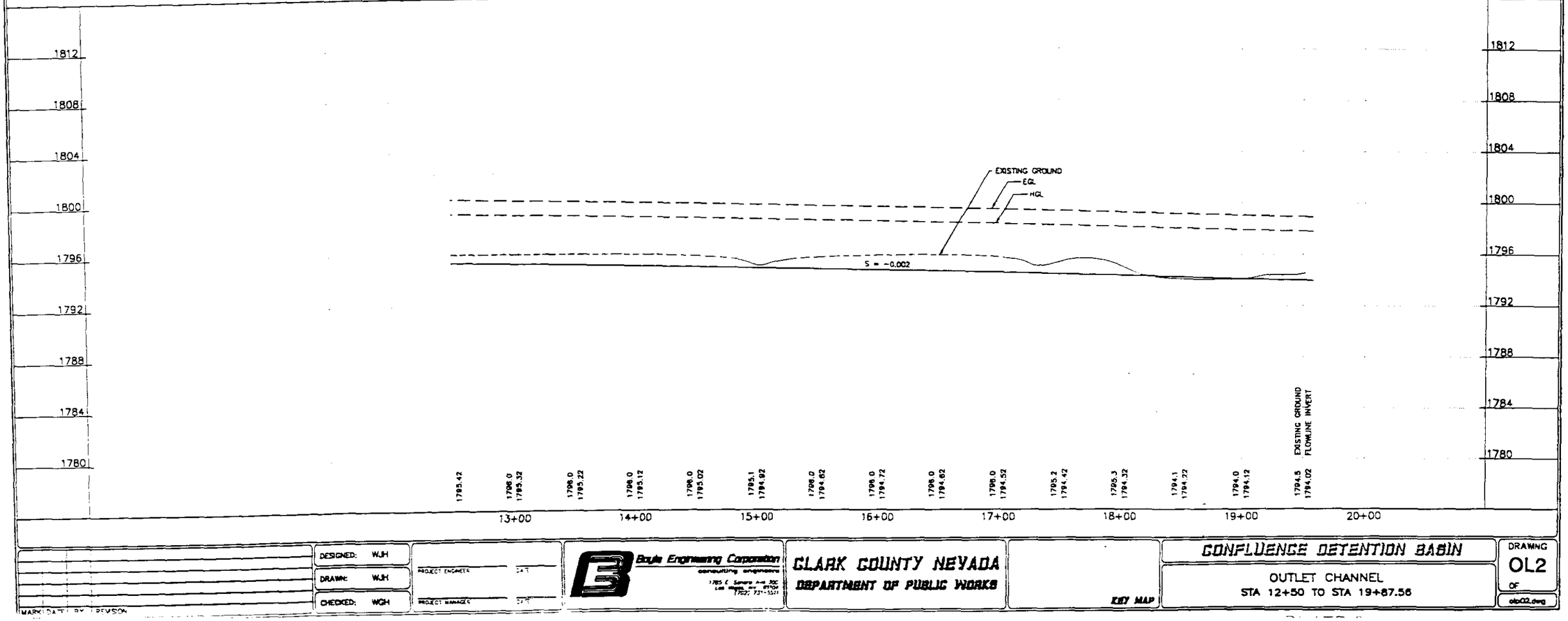
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

KEY MAP

CONFLUENCE DETENTION BASIN
OUTLET CHANNEL
STA 1+00 TO STA 12+50

DRAWING
OL1
OF
olp01.dwg





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DRAWN: WJH
CHECKED: WGH
PROJECT ENGINEER
PROJECT MANAGER
DATE

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

KEY MAP

CONFLUENCE DETENTION BASIN
OUTLET CHANNEL
STA 12+50 TO STA 19+87.56

DRAWING OL2 OF
olpc02.dwg

APPENDIX A

PRELIMINARY GEOTECHNICAL AND GEOLOGIC INVESTIGATIONS CONFLUENCE DETENTION BASIN/SLOAN CHANNEL NEAR NELLIS AIR FORCE BASE CLARK COUNTY, NEVADA

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

DRAFT

PRELIMINARY GEOTECHNICAL AND GEOLOGIC INVESTIGATIONS CONFLUENCE DETENTION BASIN/SLOAN CHANNEL NEAR NELLIS AIR FORCE BASE CLARK COUNTY, NEVADA

DRAFT

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33647-01

July 14, 1992

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

July 14, 1992

91-33647-01

DRAFT

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines, P.E.

Subject: Preliminary Geotechnical and Geologic Investigations
Sloan Channel/Confluence Detention Basin
Near Nellis Air Force Base
Clark County, Nevada

Gentlemen:

We are pleased to submit the results of our preliminary geotechnical and geologic investigations conducted for the Sloan Channel/Confluence Detention Basin project located near Nellis Air Force Base in Clark County, Nevada. The study was performed in general accordance with our signed Standard Form of Agreement with Consultant for Professional Services, dated May 4, 1992.

The detention basin embankment should receive adequate support from a zone of properly placed and compacted structural fill. The on-site soils are suitable for use as materials for dike embankment fill. There do not appear to be adverse geologic or engineering considerations that would severely restrict the development of the proposed flood control facility.

Groundwater was not encountered to the depths explored for this project. Hard caliche and/or moderately hard partially cemented soils were encountered at one of the boring locations at a depth of about 19 feet. Rock excavation techniques may be required for any areas with deep cuts.

If you have questions concerning information contained in this report, please contact us at your convenience.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

DRAFT

Algirdas G. Leskys, P.E.
President

AGL:---
---/---

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Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities; and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

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INTRODUCTION

This report presents the results of our preliminary geotechnical and geologic investigations performed for the proposed Sloan Channel/Confluence Detention Basin Project in Clark County, Nevada. A vicinity map showing the location of the project within the Las Vegas Valley area is provided on Drawing No. 1. The purposes of this investigation were to (1) determine the geologic conditions and presence of any hazards or controlling features; (2) define general conditions in the area of the proposed facility, and delineate or determine the presence of any features which might impact location of the facility and (3) provide preliminary geotechnical recommendations for the proposed embankment/dike and channel. This study was performed in conjunction with a Preliminary Environmental Site Assessment (CECSW Project No. 92-43281-01).

We understand the project will consist of an earthen embankment and reservoir with emergency overflow spillway, outlet works, and inlet and outlet channels. The location and alignment of the spillway have not yet been finalized. Preliminary plans indicate that the maximum embankment height will be on the order of about 22 feet. It is assumed that the crest width will be a minimum of 12 feet. A slope of 2½:1 or 3:1 (horizontal to vertical) is planned for the embankment. The embankment will be about 8,000 feet in length and the inlet and outlet channels will be about 4,000 and 2,000 feet in length, respectively. The channels will be concrete or soil-cement lined in some sections and grass-lined in others. Some channel areas may use riprap or other erosion control measures. The project will be located adjacent to and on the Nellis Air Force Base golf course. The embankment and reservoir are tentatively located just east of the golf course. In the reservoir area, excavations are anticipated to be on the order of 6 to 8 feet. Preliminary plans indicate the detention basin will cover an area of about 150 acres and will have a maximum holding time of about 36 hours at full reservoir. Any seepage losses from the facility are not a concern, as long as stability of the structure is adequate and downstream development is not affected. Erosion protection will be required for the emergency spillway, channel slopes and the upstream face of the embankment. Erosion protection alternatives include graded riprap and soil cement. We were requested to evaluate soils for potential use as material for soil cement or roller compacted concrete (RCC).

In 1989, Converse Consultants Southwest, Inc. (CCSW) performed a Preliminary Geotechnical Evaluation for Facility Planning Upper Las Vegas Flood Control Projects in North Las Vegas (CCSW Project No. 88-33195-01). Our report, dated November 20, 1989 presented our findings and preliminary recommendations. The proposed project lies within the limits of the previous investigation. The detention basin will be located near the site referred to as *Potential Detention Site 1* in the previous investigation. Pertinent boring logs from the previous investigation are provided in Appendix C. The approximate location of the previous borings are indicated on Drawing No. 2.

SCOPE OF SERVICES

The following tasks were included in our scope of services:

1. A field reconnaissance of the area and mapping of the surface geology was performed by our field geologist. The surface geology was mapped in detail and the presence of different materials were either verified or determined. The results of the mapping are shown on Drawing No. 3 and are further explained in the following subsection *Geologic Soil Units*.

2. A field exploration program was conducted which consisted of drilling and excavating, logging, and sampling of two (2) exploratory borings to a depth of 30 feet and six (6) test pits to depths varying from 9 to 10 feet. The approximate location of the explorations are shown on Drawing No. 2. A description of the equipment and procedures used during the exploration program is presented in Appendix A. Summaries of the boring and test pit logs are also presented in Appendix A. Samples of the subsurface soils were obtained from the borings and test pits and were taken to our laboratory for further evaluation and testing.

DRAFT

3. Limited laboratory tests were conducted on selected soil samples. Tests included moisture content, in-place densities, permeability, solubility, clay swell, Atterberg limits, chemical analyses, maximum density, sieve analyses, and direct shear tests. Descriptions and results of the laboratory tests are presented in Appendix A.

4. Results of the field exploration and limited laboratory testing were evaluated and engineering analyses were performed to develop appropriate preliminary recommendations for the design and construction of the proposed project.

5. This geotechnical report was prepared to present the findings, conclusions and preliminary recommendations of this firm.

SITE CONDITIONS

TOPOGRAPHY AND VEGETATION

The topography of the site is characterized by the steep to moderately steep bedrock hills to the east, north, and northeast and the overall gentle slope of the alluvial fans to the north and east, and the alluvial flat at the site. Two small to medium-sized washes flow south and southeast, through the site and join near the center of the site and flow southeast off the site. These washes range in size from approximately 10 to 30 feet across. The flow grades of the these washes are gentle and fairly uniform through the site, averaging about a 10 foot vertical drop over 1000 feet horizontally. Areas between the washes are generally flat, with occasional refuse piles.

The subject site was sparsely vegetated with creosote and bursage. Scattered mesquite bushes were encountered near or in the wash channels. At the time of our investigation abundant desert grasses were present in areas outside of the wash channels.

An old Air Force Base landfill and gravel pits existed immediately west and east of the the site, respectively. The approximate limits of the landfill (dump) and gravel pits are indicated on Drawing No. 3.

GEOLOGIC SOIL UNITS

Within the project vicinity, six different geologic units were distinguished for the purposes of this work. Our mapping has been based upon aerial photographs, published geologic and soil maps, site reconnaissance and our field exploration program. Drawing No. 3 of this report shows the surface exposure and the approximate boundary of each unit. The geologic descriptions for the units are given below:

Goodsprings Soil (Unit 1)

This soil is described as a gravelly fine sandy loam with 2 to 4 percent slopes. It is a shallow, well drained soil located on erosional fan remnants and formed in mixed alluvium derived mainly from limestone and sandstone. Typically, about 90 percent of the surface is covered with a well developed pavement of pebbles. The subsurface is predominantly a pink gravelly fine sandy loam overlying a reddish brown and pinkish white, strongly cemented caliche. This caliche overlies a pink extremely gravelly loamy fine sand. The depth to cemented materials ranges from 9 to 20 inches. Permeability is moderate above the cemented materials; available water capacity is very low; and runoff is medium. The hazard of water erosion is slight and the hazard of soil blowing is high if the desert pavement is disturbed.

Weiser Soil (Unit 2)

This soil is described as an extremely gravelly fine sandy loam with 2 to 8 percent slopes. It is a very deep, well drained soil located on summits and side slopes of erosional fan remnants and formed in alluvium derived from various kinds of rock that have a high content of lime. Approximately 80 percent of the surface is covered with a desert pavement of pebbles. The subsurface is a light brown extremely gravelly fine sandy loam. Some areas of this soil have caliche at a depth of 40 to 60 inches or more. Permeability of this soil is moderately rapid; available water capacity is very low; and runoff is medium. The hazard of water erosion is slight and the hazard of soil blowing is moderate if the desert pavement is disturbed.

Caliza Soil (Unit 3)

This soil is described as a very gravelly sandy loam with 2 to 8 percent slopes. It is a very deep, well drained soil on erosional fan remnants and formed in alluvium derived from various kinds of rock. Typically, the surface layer is light brown very gravelly sandy loam about 3 inches thick. This overlies light brown very gravelly sandy loam which overlies light brown, stratified very gravelly coarse sand to very gravelly loamy sand. Permeability of this soil is moderately rapid; available water capacity is very low; and runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is moderate. This soil is subject to rare periods of flooding during prolonged, high intensity storms.

Glencarb Soils (Unit 4)

This soil is described as a silt loam with 0 to 2 percent slopes. It is a very deep, well drained soil on recent alluvial flats and formed in alluvium derived from various kinds of rock. Typically, the surface layer is pale brown silt loam, about 6 inches thick. Below this, to a depth of approximately 60 inches, are alternating layers of very pale brown clay loams, silty clay loams, and very fine sandy loams. Permeability of this soil is moderately slow; available water capacity is high; and runoff is slow. The hazard of water erosion is slight and the hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high intensity storms.

Bracken Soil (Unit 5)

This soil is described as a very gravelly fine sandy loam with 2 to 8 percent slopes. It is a deep, somewhat excessively drained soil on pediments and alluvial flats and formed in gypsiferous alluvium derived from various kinds of rock high in gypsum. Approximately 90 percent of the surface is covered with a desert pavement of pebbles and cobbles. The surface layer is pink very gravelly fine sandy loam, about 5 inches thick. Underlying the surface is a pink to white gravelly sandy loam with some gypsum crystals. Below this is weakly consolidated, gypsiferous sediment to approximately 60 inches. Permeability of this soil is moderately rapid; available water capacity is very low; and runoff is medium. The hazard of water erosion is slight, and the hazard of soil blowing is high if the surface is disturbed.

Las Vegas-Destazo Soil Complex (Unit 6)

This soil is described as mostly gravelly fine sandy loam with 0 to 2 percent slopes. This soil is shallow to very deep and well drained and forms on relict alluvial flats and formed in alluvium derived dominantly from limestone and dolomite and some sediment with a high content of lime. Approximately 25 percent of the surface is covered with a desert pavement of pebbles and lime nodules. The surface layer is very pale brown fine sandy loam and gravelly fine sandy loam, approximately 2 to 11 inches thick. The underlying soil units consist of very pale brown fine sandy loam, gravelly sandy clay loam, gravelly loam to very pale brown to white very gravelly sandy clay loam and light brown sandy loam. In some areas of this soil unit, depth to caliche ranges from 3 to 14 inches. Permeability of this soil is moderately slow; available water capacity is very low to moderate; and runoff is slow. The hazard of water erosion is slight, and the hazard of soil blowing is high. This soil is subject to rare periods of flooding during prolonged, high-intensity storms.

SUBSURFACE

Based on results of our subsurface explorations, the subsoils generally consisted of 1 to 3 feet of loose granular soils and soft to firm clays and silts overlying medium dense granular soils, stiff to very stiff clays and silts and moderately hard to hard cemented soils (caliche). The majority of the silts and clays and some sands were found to be porous. The soils also contained varying amounts of soluble gypsum. The depths to the cemented soils are provided below in Table No. 1. Free groundwater was not encountered to the depths explored for this project. Groundwater in the area should be at a depth in excess of 35 feet and should probably not affect the proposed project.

Table No. 1: Depths to Cemented Soils

Boring Location	Depth to Cemented Soils (ft)	Thickness of Cemented Soils (ft)	Soil Description
B-2	19	1½	Hard
B-3*	19	2	Moderately Hard

* From previous investigation

Laboratory test results indicate that the on-site soils have, low to moderate dry densities, a low to moderate shear strength, a low to moderate permeability, a low to high potential for gypsum solubility, a low to moderate clay swell potential, a low chemical (salt) heave potential, and contain sulfate salts in sufficient concentrations to be severely corrosive to concrete, soil cement and metal. The on-site soils should be considered to be moderately to highly susceptible to hydro-collapse. Silts and fine sands are susceptible to piping. Based on the preliminary test results, the native soils can be used as material for soil-cement. The laboratory test results of the native soils presented in Appendix A are summarized in Table No. 2.

Table No. 2: Summary of Laboratory Test Results and Soil Characteristics

Characteristic	Range of Results
Maximum Density	117 to 120 pcf
Optimum Moisture Content	11 percent
Solubility	0.1 to 3.7 percent
Coefficient of Permeability "K"	(1.5 to 3.5) X 10^{-5} cm/sec
Angle of Internal Friction	10 to 39 degrees
Sulfate	0.01 to 0.69 percent
Clay Swell	1 to 7 percent

Based on the results of our subsurface exploration and our experience, variations in the continuity and depth of subsoil deposits should be anticipated. Due to the nature and depositional characteristics of the natural soils, care should be exercised in interpolating subsurface soil conditions beyond the boring and test pit locations.

GEOLOGIC AND SEISMIC CONDITIONS

GEOLOGIC SETTING

The project area is located in the northeastern portion of the Las Vegas Valley, a structural basin of late Mesozoic and Tertiary block faulting origin. The Valley is physiographically characteristic of the Basin and Range Province. Valley deposits are Tertiary and Quaternary Age unconsolidated sediments derived from the surrounding mountains; the local sources of deposition being Frenchman Mountain immediately to the east and areas to the north and northeast such as the Las Vegas Range, Arrow Canyon Range, Dry Lake Range, and the Muddy Mountains. Alluvial deposits consisting of gravel, sand, silt and clay are locally overlain by lacustrine deposits of sand, silt and clay. The alluvial and lacustrine sediments can be up to 4000 feet thick. Coarser-grained alluvial fan deposits are located near the base of the mountains and grade into and interfinger with fine-grained sand, silt and clay deposits toward the central portion of the valley.

The bedrock within Frenchman Mountain and the ranges to the north and northeast of the subject site is predominantly clastic and non-clastic sedimentary rock. The clastic material which comprises the valley fill within the proposed site vicinity is therefore derived from sedimentary rock.

DRAINAGE

Primary drainage for the valley is to the southeast along four major wash systems: the Las Vegas Wash, the Flamingo Wash, the Tropicana Wash and the Duck Creek Wash. The four systems consist of a series of channels of varying lengths and depths which originate along the mountain aprons. The channels drain the valley to the southeast where they all become part of the Las Vegas Wash.

The Range Wash system is a northern tributary of the Las Vegas Wash system. Range Wash is divided into eastern and western tributaries. The eastern tributary system originates in the northeast part of the valley, from Frenchman Mountain to the Las Vegas Range. The western tributary of Range Wash originates exclusively in the Las Vegas Range. The two tributary systems join to form one wash near the intersection of Carey Avenue and Sloan Lane, at the southern end of Nellis Air Force Base. Range Wash empties into Las Vegas Wash near Sloan Lane and Vegas Valley Drive.

CLIMATE

Las Vegas is located in the central portion of a broad desert valley which is almost surrounded by mountains ranging from 2,000 to 10,000 feet higher than the valley floor. The area is arid to semi-arid with an average annual precipitation of less than 5 inches. Most of the rainfall occurs during the winter and in July and August. Strong winds are common, particularly during the spring. Summer typically has maximum temperatures in the 100°F plus range and minimum temperatures are usually between 70° and 75°F. There is usually a period of about two weeks every summer when warm, moist, tropical air predominates and causes scattered thunderstorms (sometimes quite severe) along with higher than average humidity. Severe thunderstorms can cause extensive flooding and soil erosion. Winters are generally mild and pleasant with average daytime temperatures near 60°F and minimum temperatures averaging about 35°F.

GEOLOGIC HAZARDS REVIEW

Existing geologic data, including past CCSW project files and references from the U. S. Soil Conservation Service, U. S. Geological Survey, Nevada Bureau of Mines and Geology, aerial photographs, and information available through the State Universities, were reviewed for the purpose of assessing any known geologic hazard in the vicinity of the subject site. No major geologic hazards were associated with the proposed detention basin site.

Possible recent or active seismic faulting in the vicinity of the proposed Confluence Detention Basin and Sloan Channel include a series of north-northeast striking faults along the west rangefront of Frenchman Mountain, approximately 2 miles to the east of the proposed subject site, east of Hollywood Boulevard. These faults are mapped as mostly inferred and concealed faults by Bell and Price (1991). One north-south striking fault was observed approximately one-half mile east of the subject site but does not appear to project toward the subject site. Also, one inferred northwest striking fault crosses Bonanza Boulevard, approximately 3 miles south of the subject site, west of Hollywood Boulevard and projects toward the Nellis Air Force Base garbage dump, just west of the subject site.

The site is located approximately 2½ miles southwest of a topographic lineation regarded as a compaction fault and 4 to 5 miles north and southwest of mapped fissure zones, as mapped on the Subsidence-Related Faults and Fissures of the Las Vegas Valley Map, published by the Nevada Bureau of Mines and Geology, Subsidence in Las Vegas Valley 1980-91 Final Project Report, John W. Bell and Jonathan G. Price, 1991. It is generally agreed that compaction faults are not bedrock faults, although their displacement may have been at least partly induced by a seismic event. The age of these escarpments have been dated by others at about 14,000 years old. Fissures, surface expressions of differential stress resulting from regional and local subsidence due to withdrawal of groundwater have been localized near compaction faults. Some fissure features were observed at the site. These features are believed to be caused from erosion and not subsidence.

The potential for landslides is believed to be low due to the nature and proximity of the topographic highlands to the project area and low precipitation in the region.

ESTIMATED GROUND ACCELERATIONS

Las Vegas Valley is located in Seismic Zone 2B as categorized in the Uniform Building Code. Zone 2B represents a low to moderately active seismic area. A regional map published by Algermissen and Perkins (1976) presents the expected peak horizontal ground acceleration for the Las Vegas Valley as approximately 0.1g. This value has a 10 percent chance of being exceeded in a 50-year period. Site specific seismicity model analyses have been performed by CCSW on other projects in the Las Vegas Valley. This analysis has typically found the maximum credible peak horizontal ground acceleration to range between 0.2g and 0.3g. For an event having a 10 percent chance of exceedance during a 100-year design life the peak horizontal ground acceleration has ranged between 0.1g and 0.2 g. The peak horizontal ground acceleration recommended for the design of the project is 0.15g.

SITE EVALUATION AND PRELIMINARY RECOMMENDATIONS

GENERAL

Based on (1) our review of published geologic maps; (2) our geologic site reconnaissance; (3) the results of the field and laboratory investigations and (4) our review of the previous preliminary report, it is our opinion that with proper preparation, the site can be utilized for the proposed project. The near surface on-site soils are porous and slightly subject to hydro-collapse. This will probably require overexcavating and recompacting below the embankment and construction of a keyway below the embankment.

The on-site soils are suitable for use as materials for embankment fill and soil-cement. The on-site soils are generally not suitable for use as materials for roller compacted concrete (RCC). The availability of aggregate for RCC, and cobble size material and small boulders for use as riprap appears to be low on site, although commercial gravel pits are located just east of the site. Potential quarry sources for rock riprap are present as bedrock outcrops in the hills east of the project. Based on preliminary slope stability analyses, the planned 2½:1 or 3:1 (horizontal to vertical) slopes for the embankment appear to be stable. The on-site soils consist primarily of fine-grained soils with some interbedded granular materials. The fine-grained soils are porous and potentially hydro-collapsible, have low to moderate strength and low to moderate permeability. The granular soils have high strength and moderate to high permeability. Seepage through and stability of the embankment should not be a concern.

In order to provide geotechnical design recommendations for the proposed project, additional field exploration, laboratory testing and engineering analysis should be performed. The amount of loose, soft and hydro-collapsible surficial soils present on the site and the extent of the cemented soils should be further investigated during the design level geotechnical investigation. The permeability and the corrosion and solubility potentials of the on-site soils should also be further evaluated.

The following sections present an engineering evaluation and preliminary considerations for the proposed site and facility. The preliminary recommendations are for planning and should be confirmed with a final design level investigation.

EMBANKMENT/DIKE SECTION CONSIDERATIONS

A zone of properly placed and compacted structural fill should provide adequate support for the embankment after the surface vegetation and organics have been removed and the foundation preparation has been conducted. We recommend a homogeneous embankment section consisting of on-site soils. The on-site soils are suitable for use as materials for dike embankment fill or other structural fills. It may be necessary to construct a shallow keyway beneath the embankment. The foundation soils beneath the embankment and outside the keyway section will require overexcavation. Due to the clay swell potential of the on-site soils any concrete slabs constructed for project structure will require steel reinforcement.

The preliminary stability analyses indicates that 2½:1 or 3:1 (horizontal to vertical) embankment slopes on both the upstream and downstream faces are stable. The slope stability analyses assumes that all of the exposed embankment surfaces will be adequately protected from erosional forces with either riprap or soil cement. The final thickness of the soil-cement erosion protection layer, should be determined by a qualified hydraulic engineer, after water velocities, and the soil-cement strength and durability characteristics have been determined. The stability of any cut slopes should be analyzed during the final design level investigation.

The preliminary slope stability analyses were performed on the embankment in general accordance with the Nevada State Statutes, Corps of Engineers and the Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual*. The dike was analyzed with the computer program SB-Slope, Version 3.0. It was used to calculate the minimum factor of safety for three separate cases; (1) sudden drawdown, (2) steady state seepage, and (3) seismic steady state seepage. The SB-Slope program utilizes the simplified Bishop Method of slope stability analysis for circular failure surfaces. Based on laboratory tests, average angles of internal friction of 30 and 28 degrees with no cohesion were used for in-situ and saturated undisturbed native soils. Angles of internal friction of 27 and 25 degrees with 200 pounds per square foot (psf) cohesion were used for unsaturated and unsaturated compacted fill soils, respectively. A pore pressure coefficient (Ru) of 0.5 was used for the sudden drawdown case. The maximum failure surface depth was assumed to be 10 feet below the embankment. A summary of the minimum acceptable factors of safety, and calculated factors of safety is presented on the following table. The results of the slope stability analysis are presented and further explained in Appendix B.

Table No. 3: Calculated and Required Factors of Safety for Slope Stability

Loading Condition	Case	Required[1] F.S.	Calculated F.S.
Sudden Drawdown	1	1.2	1.3
Static-Steady State Seepage	2	1.5	1.6
Seismic-Steady[2] State Seepage	3	1.0	1.3

[1] In accordance with the *Recommended Guidelines for Safety Inspection of Dams* published by the Corps of Engineers (1973).
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.05.

SEEPAGE CONTROL

Based on the fine-grained and relatively impervious nature of the soils present at the site, and a detention time of 36 hours, it appears that seepage through the proposed embankment should not be a problem. We recommend that additional seepage studies be conducted in the final design level investigation. If seepage is a problem, it might be necessary to incorporate an internal drain.

EROSION PROTECTION

Based on the results of our field and laboratory investigations, it is our opinion that the on-site soils will be subject to erosion and/or undercutting due to high water velocities and significant wave action. Therefore, erosion protection will be required for inlet structures, embankment slopes, and along channels. Erosion protection may be provided by soil-cement, roller compacted concrete (RCC), riprap or gabions. Soil-cement or RCC should be 12 to 24 inches thick. However, the soil-cement or RCC thickness should be designed based on water velocity, and strength and durability of the soil-cement or RCC. Soil-cement is not as strong or durable as RCC. Soil-cement is made from adding cement to the on-site soils, while RCC is made from processed aggregate and is basically the

same as Portland Cement concrete. If riprap is used for erosion protection, the riprap rock size and section thicknesses should be designed after flow velocities and wave heights are determined by a hydraulic engineer. If riprap or gabions are used, a puncture-resistant synthetic filter cloth may be required to reduce the amount of scour and piping of natural soils during heavy flows.

OVERFLOW SPILLWAY

The location and type of overflow spillway have not been finalized. The spillway area should be protected from erosion. Alternatives would include concrete slab lining, soil cement or even RCC. The placement of RCC would start from the base of the embankment. The concrete slab lining may require a 4 to 8 inch thick gravel blanket beneath the slabs. The slabs will require reinforcement for clay swell and should be designed to prevent the buildup of hydrostatic pressures behind them.

CHANNELS

The proposed channels may be concrete or soil-cement lined in some sections and grass-lined in others. Due to the porous and expansive nature of the clayey soils, overexcavation and recompaction may be required for the support of channel linings. In the channel areas lined with concrete or soil-cement, permanent unreinforced cut and fill side slopes should be constructed at a minimum ratio of 2:1 (horizontal to vertical). Unreinforced side slopes in the grass-lined areas should be constructed no steeper than 3:1. For steeper channel side slopes, recommendations will be required for slope reinforcement.

CONSTRUCTION CONSIDERATIONS

SITE GRADING

Site grading will generally consist of: (1) the removal of existing vegetation and any rubble, trash or debris from the site; (2) the loose, soft or disturbed native soils should be removed from within the proposed embankment and all other structure areas; (3) the loose or disturbed native soils should be processed and stockpiled for later use as engineered fill; (4) the exposed surficial soils (which are considered porous and hydro-collapsible) will require overexcavation to depths

ranging from 18 to 36 inches, (5) the exposed native soils will require scarification, moisture conditioning and recompaction prior to placing structural fill. Scarification and overexcavation can be terminated where cemented soils are exposed.

The existing on-site soils should be suitable for use as compacted structural fill. There will be shrinkage losses when excavating and compacting the uncemented on-site soils and swell when excavating any cemented soils. The anticipated shrinkage and swell factors for the on-site soils should be determined in the design level investigation.

EXCAVATIONS

Based on observations made during our field explorations, the non-cemented soils should be readily excavatable with conventional earthwork equipment. Partially cemented (moderately hard) to fully cemented (hard) soils were encountered during this and the previous investigation at a depth of 19 feet below the existing ground surface. Heavy-duty ripping, heavy-duty backhoe, headache ball or Ho-ram should be anticipated for any deep excavations. The Contractor should be aware of the potential for vibrational damage to adjacent or nearby structures when using heavy impact equipment during removal of the hard cemented materials.

SOIL CORROSIVITY

Laboratory test results indicate that the on-site soils should be considered corrosive to buried metal and have sulfate levels above that considered harmful to normal strength concrete and soil cement. Consideration should be given to corrosion protection systems for buried metal or the use of PVC. Any concrete and/or soil cement in contact with the on-site soils should contain Type V cement. A soil-cement mix design should be conducted.

FINAL DESIGN RECOMMENDATIONS

Additional design level investigations will be required, when final facility layout and dimensions have been determined. Borings and test pits should be located within and beyond the detention basin and channel alignment to fully evaluate the subsurface conditions. Additional laboratory testing will also be required to further evaluate the nature and engineering properties of the native subsoils. The hydro-collapse potential of the on-site soils and the effects of seepage should be further evaluated.

CLOSURE

Our assumptions, conclusions, recommendations, and opinions presented herein are: (1) based upon the geologic site reconnaissance, (2) based upon our evaluation and interpretation of the findings of the limited field exploration and laboratory programs, (3) based upon an interpolation of soil conditions between and extrapolation beyond the explored locations, (4) based on our geotechnical experience in the locale, (5) subject to confirmation of the conditions encountered during a design investigation, and (6) prepared in accordance with generally accepted professional geotechnical engineering principles and practice. We make no other warranty, either express or implied.

It has been our pleasure to serve you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

DRAFT

Brad L. Olsen, E.I.T.
Senior Staff Engineer

Reviewed by:

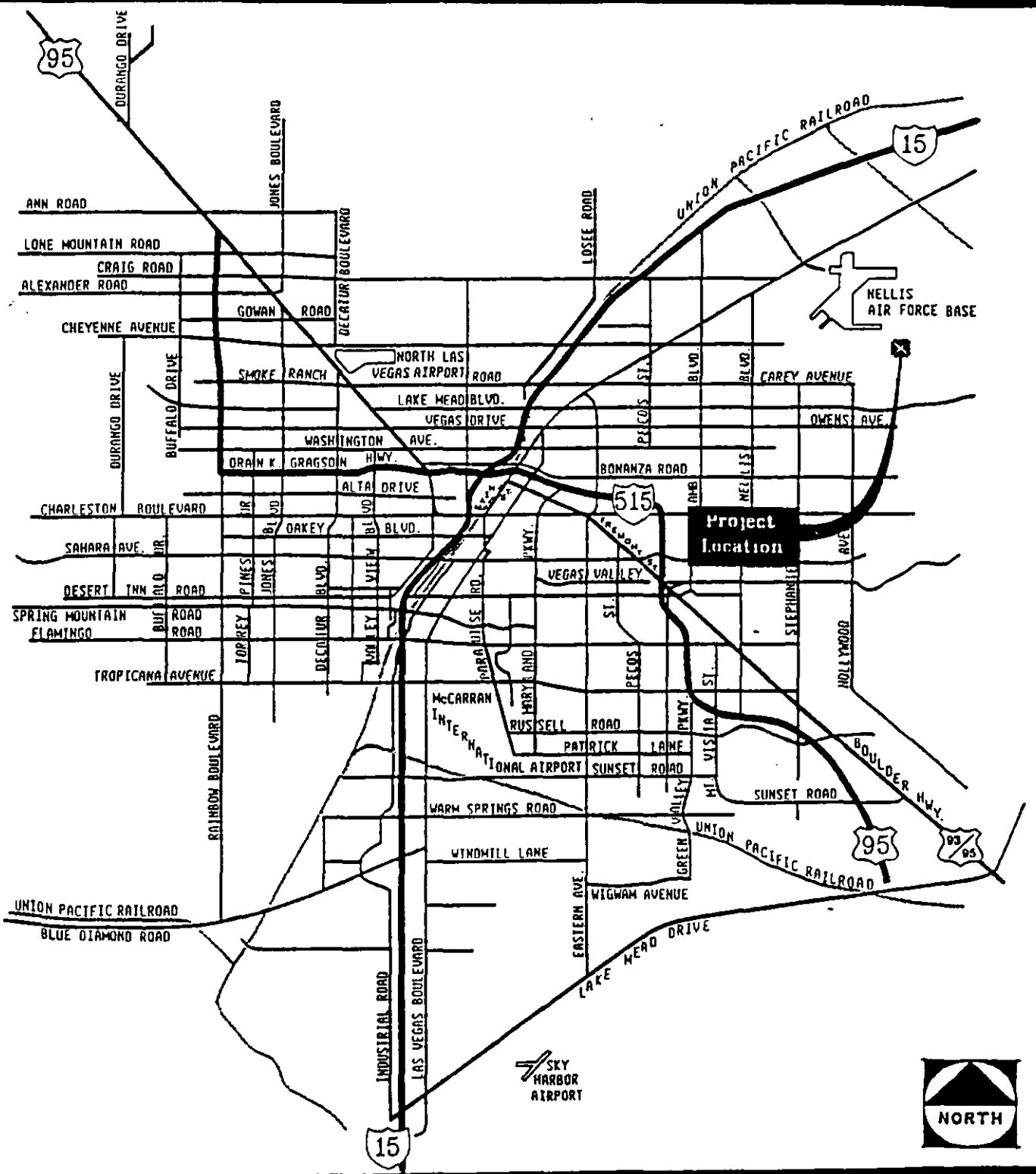
DRAFT

Al Stilley, P.E.
Principal Engineer

BLO:ANS:---
—/—

Encl: Drawing Nos. 1 through 3
Appendices A, B and C

Dist: 8/Addressee



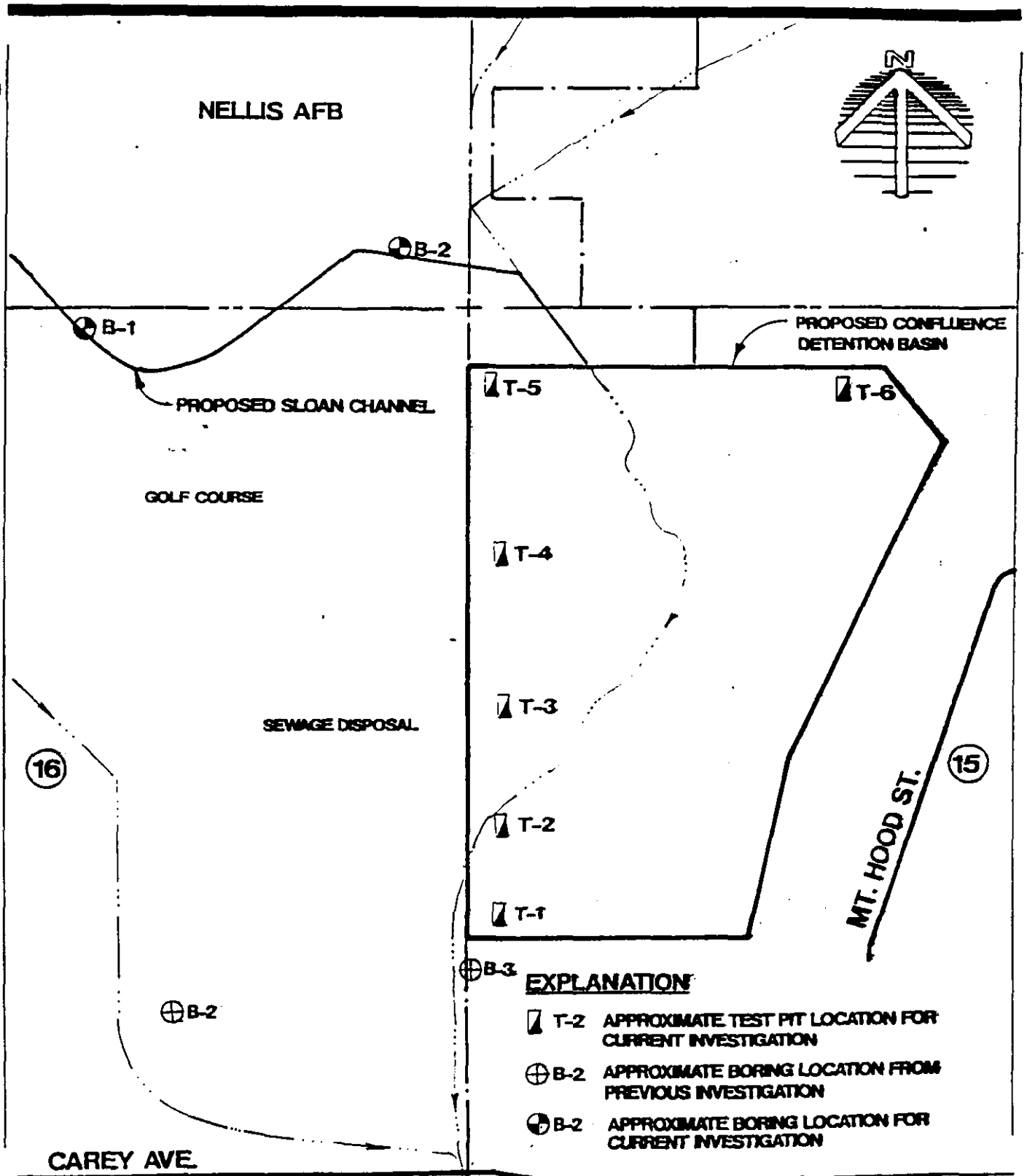
LAS VEGAS VICINITY

CONFLUENCE DETENTION BASIN/SLOAN CHANNEL
NEAR NELLIS AFB
CLARK COUNTY, NEVADA

Converse Consultants Southwest, Inc.

PROJECT NO. 91-33647-01

DRAWING NO. 1



LOCATION OF SUBSURFACE EXPLORATIONS

CONFLUENCE DETENTION BASIN/SLOAN CHANNEL
NEAR NELLIS AFB
CLARK COUNTY, NEVADA

Scale: NTS	Project No.: 91-33647-01
Prepared by: EWS	Date: 6.30.92
Checked by:	Drawing No.: 2
Approved by:	

Converse Consultants Southwest, Inc.

Geotechnical Engineering and Applied Sciences

LEGEND

UNIT 1

GOOD SPRINGS SOIL

GRAVELLEY FINE SANDY LOAM, 2-4% SLOPES, SHALLOW, WELL-DRAINED SOIL ON EROSIONAL FAN REMNANTS.

UNIT 2

WEISER SOIL

EXTREMELY GRAVELLEY FINE SANDY LOAM, 2-8% SLOPES, VERY DEEP, WELL-DRAINED SOIL ON EROSIONAL FAN REMNANTS.

UNIT 3

CALIZA SOIL

VERY GRAVELLEY SANDY LOAM, 2-8% SLOPES, VERY DEEP, WELL-DRAINED SOIL ON EROSIONAL FAN REMNANTS.

UNIT 4

GLENCARB SOILS

SILT LOAM TO VERY FINE SANDY LOAM, 0-2% SLOPES, VERY DEEP, WELL-DRAINED SOIL ON RECENT ALLUVIAL FLATS.

UNIT 5

BRACKEN SOIL

VERY GRAVELLEY FINE SANDY LOAM, 2-8% SLOPES, DEEP, SOMEWHAT EXCESSIVELY-DRAINED SOIL ON PEDIMENTS AND ALLUVIAL FLATS.

UNIT 6

LAS VEGAS - DESTAZO SOIL COMPLEX

MOSTLY GRAVELLEY FINE SANDY LOAM, 0-2% SLOPES, ON RELICT ALLUVIAL FLATS.

LIMITS OF RESEARCH

ACTIVE DRAINAGE

INFERRED FAULT

FAULT

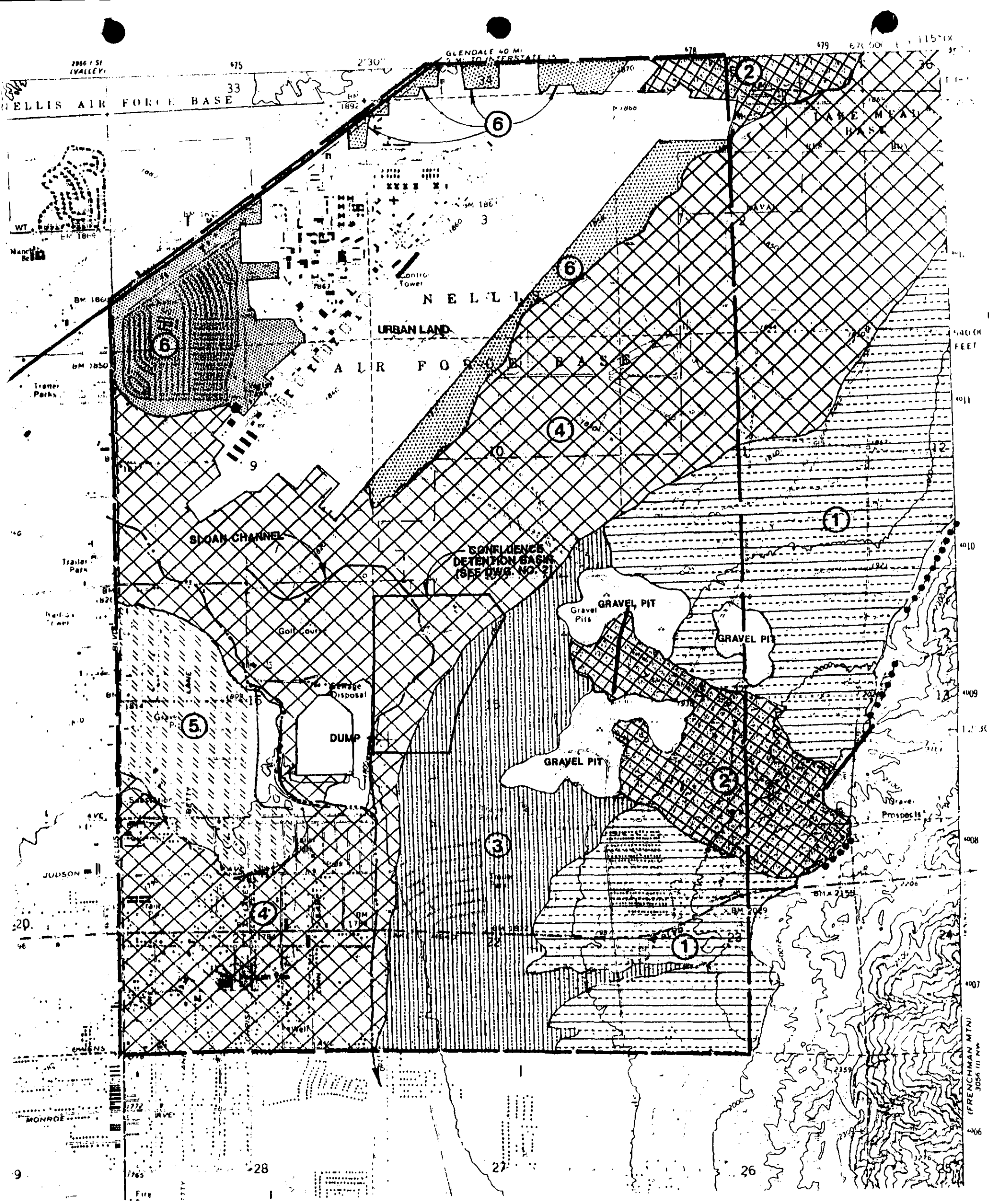
MAP SHOWING DISTRIBUTION OF SOILS

CONFLUENCE DETENTION BASIN/SLOAN CHANNEL
NEAR NELLIS AFB
CLARK COUNTY, NEVADA

DRAFT

Converse Consultants
Geotechnical Engineering and Applied Sciences

Scale	NTS
Date	6.29.92
Prepared by	EWS
Checked by	
Approved By	
Project No	91-33647-01
Drawing No	3A



MAP SHOWING DISTRIBUTION OF SOILS

CONFLUENCE DETENTION BASIN/SLOAN CHANNEL
NEAR NELLIS AFB
CLARK COUNTY, NEVADA

DRAFT

Scale	NTS
Date	6.29.92
Prepared by	EWS
Checked by	
Approved By	
Project No	91-33647-01
Drawing No	3 B

Converse Consultants

Geotechnical Engineering and Applied Sciences

Appendix A

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 2

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		SILTY GRAVEL With Sand (GM); loose, light orange-brown, slightly moist					
2		SILT With Sand (ML); stiff, light orange-brown, slightly moist					
4		LEAN CLAY With Sand (CL); stiff, light orange-brown, slightly moist					
6		CLAYEY GRAVEL (GC); medium dense, light grayish orange, slightly moist					
8		SILTY CLAY (CL); stiff, light orange brown, slightly moisr					

APPROVED BY ON

Groundwater: None Observed

Bottom of Trench at 9.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Drawing No.
A-6

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 3

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0						
2						SILTY CLAY (ML-CL); porous, firm to stiff, light orange brown, dry
4						LEAN CLAY (CL); porous, stiff, light brown, slightly moist
						SANDY SILT (ML); porous, light brown, slightly moist
6						LEAN CLAY (CL); porous, light brown, slightly moist
8						FAT CLAY (CH); very stiff, slightly moist, light brown
10						

APPROVED BY ON

Groundwater: None Observed

Bottom of Trench at 10.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-7

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 4

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		POORLY GRADED SAND (SP); very loose, light yellow brown, dry					
4		SILTY SAND (SM); porous, loose to medium dense, light brown, slightly moist					
6		SILTY CLAY (CL-ML); porous, stiff, light orange brown, slightly moist					
8		FAT CLAY (CL); very stiff, light orange brown, slightly moist					
10		LEAN CLAY (CL); with caliche nodules (no cemented), stiff, white to light orange brown					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY ON

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Drawing No.
A-8

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 5

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
2		SANDY LEAN CLAY (CL); stiff, light orange brown, dry					
4		----firm to stiff, moist		■			
6		FAT CLAY (CL); very stiff, light orange-brown, moist					
8							
10		LEAN CLAY (CL); with caliche nodules, stiff, orange beige					

APPROVED BY ON

Groundwater: None Observed

Bottom of Trench at 10.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Drawing No.
A-9

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 6

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		SILTY SAND (SM); loose, light orange brown, dry					
2							
4		---few caliche nodules, medium dense					
6							
8		LEAN CLAY/FAT CLAY (CL/CH); few caliche nodules, very stiff, light orange-brown, slightly moist					
10		LEAN CLAY (CL); with caliche nodules, stiff, light orange- beige					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY ON

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-10

KEY TO SOILS SYMBOLS AND TERMS

TERMS USED IN THIS REPORT FOR DESCRIBING SOILS ACCORDING TO THEIR TEXTURE OR GRAIN SIZE DISTRIBUTIONS ARE GENERALLY IN ACCORDANCE WITH THE UNIFIED SOILS CLASSIFICATION SYSTEM.

TERMS DESCRIBING CONDITION, CONSISTENCY AND HARDNESS

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): includes (1) clean gravels, (2) silty or clayey gravels and (3) silty, clayey or gravelly sands. *Consistency is rated according to relative density, as determined by laboratory tests.*

Descriptive Term	Relative Density
Very loose	0 to 15%
Loose	15 to 40%
Medium Dense	40 to 70%
Dense	70 to 85%
Very Dense	85 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength as indicated by penetrometer readings or by direct shear tests.

Description Term	Shear Strength (ksf)
Very soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very stiff	2.00 to 4.00
Hard	4.00 and higher

ROCK: Includes gravels, cobbles, rock, caliche and bedrock materials. Hardness is related to field identification procedures described below.

Descriptive Term	Field Identification Test
Soft	*Can be dug by hand and crushed* by fingers
Moderately hard	Friable, can be gouged deeply with knife and will crumble readily under light hammer blows.
Hard	Knife scratch leaves dust trace, will withstand a few hammer blows before breaking.
Very Hard	Scratched with knife with difficulty, difficult to break with hammer blows.

LEGEND OF LABORATORY TESTS

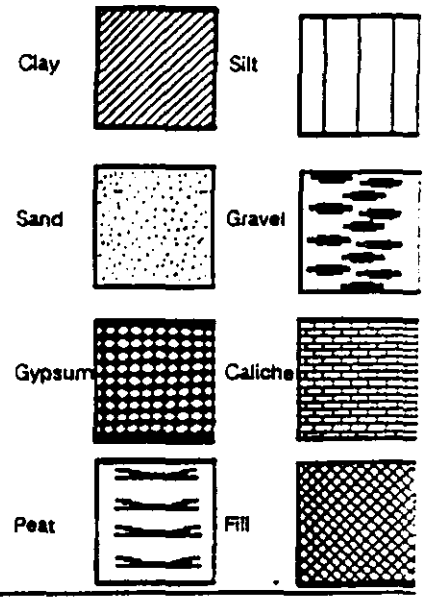
G-Grain	S-Swell	DS-Direct Shear
A-Liquid & Plastic Limits	*Ch-Chemical*	T-Triaxial
PP-Pocket Penetrometer	N-Chemical Heave	Sol-Solubility
U-Unconfined	C-Consolidation	P-Compaction

SAMPLER TYPES

SIZE PROPORTIONS

Designation	Percent by Weight
Trace	0 to 5
Few	5 to 10
Little	15 to 25
Some	30 to 45

SOIL TYPE KEY

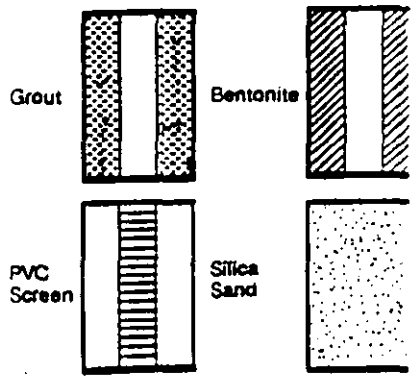


SOIL MOISTURE

From low to high the soil moisture is indicated by:

Dry
Slightly moist
Moist
Very moist
Wet

WELL DESIGN KEY



Converse Consultants Southwest, Inc.

Drawing No. A-11

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 - 90
(Based on Unified Soil Classification System)

			Soil Classification		
Criteria for Assigned Group Symbols and Groups Names Using Laboratory Tests[A]				Group Symbol	Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravel Less than 5% fines[C]	$Cc \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F G H]
			Fines classify as CL or CH	GC	Clayey gravel[F G H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G H I]
			Fines classify as CL or CH	SC	Clayey sand[G H I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limits less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K L M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OL	Organic clay[K L M N] Organic silt[K L M O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	OL	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OH	Organic clay[K L M P] Organic silt[K L M O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

$$[E] Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

[F] If soil contains $\geq 15\%$ sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soils is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No.200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

[M] If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

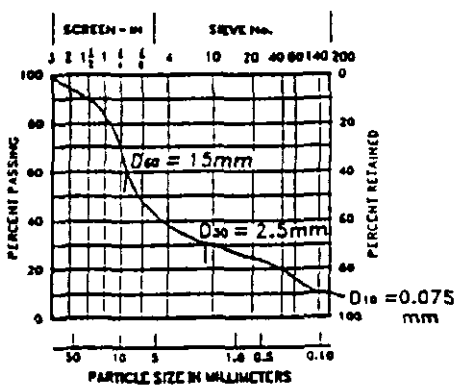
[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

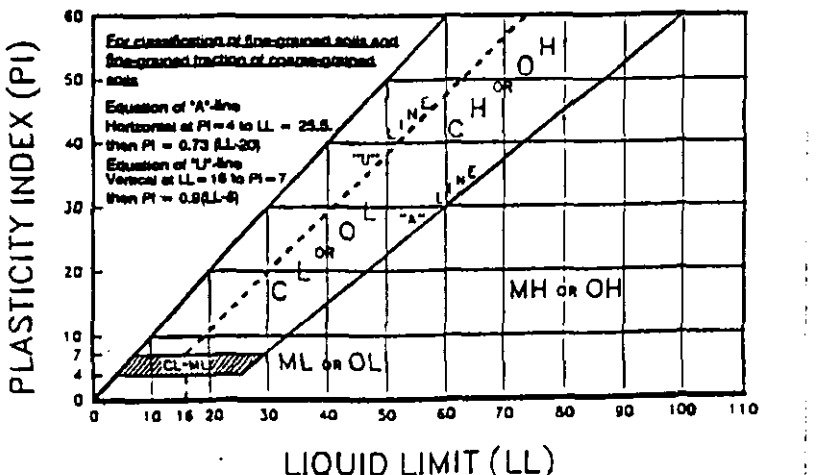
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

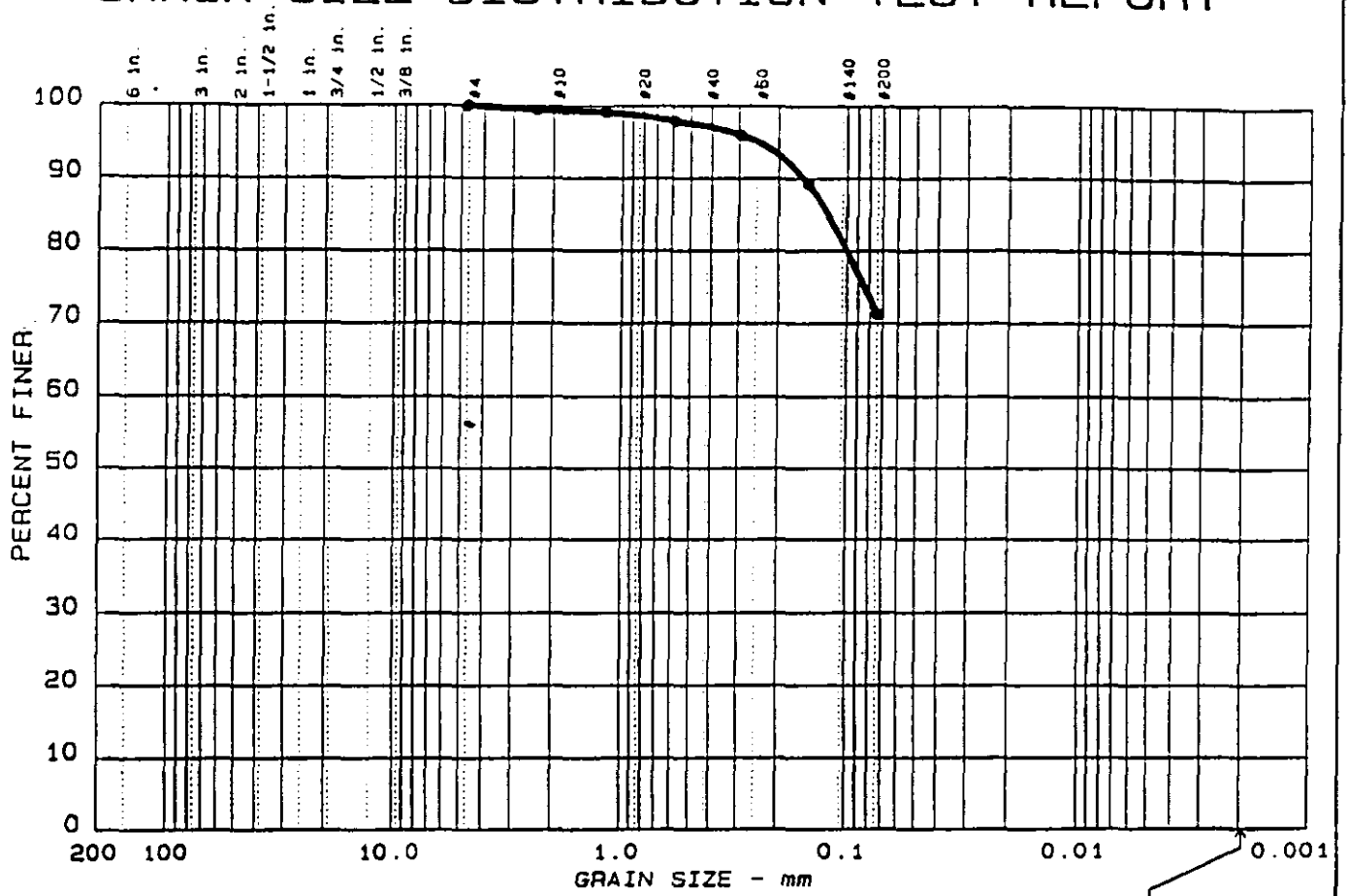
SIEVE ANALYSIS



$$C_u = \frac{D_{60}}{D_{10}} \quad \frac{15}{0.075} = 200 \qquad C_c = \frac{(D_{30})}{D_{10} \times D_{60}} = \frac{(2.5)}{0.075 \times 15} = 5.6$$



GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	28.8	71.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	25	7	0.12							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. **SILTY CLAY With Sand**	CL - ML	

Project No.: 91-33647-01

Project: Confluence

● Location: T-1; depth: 3-5'

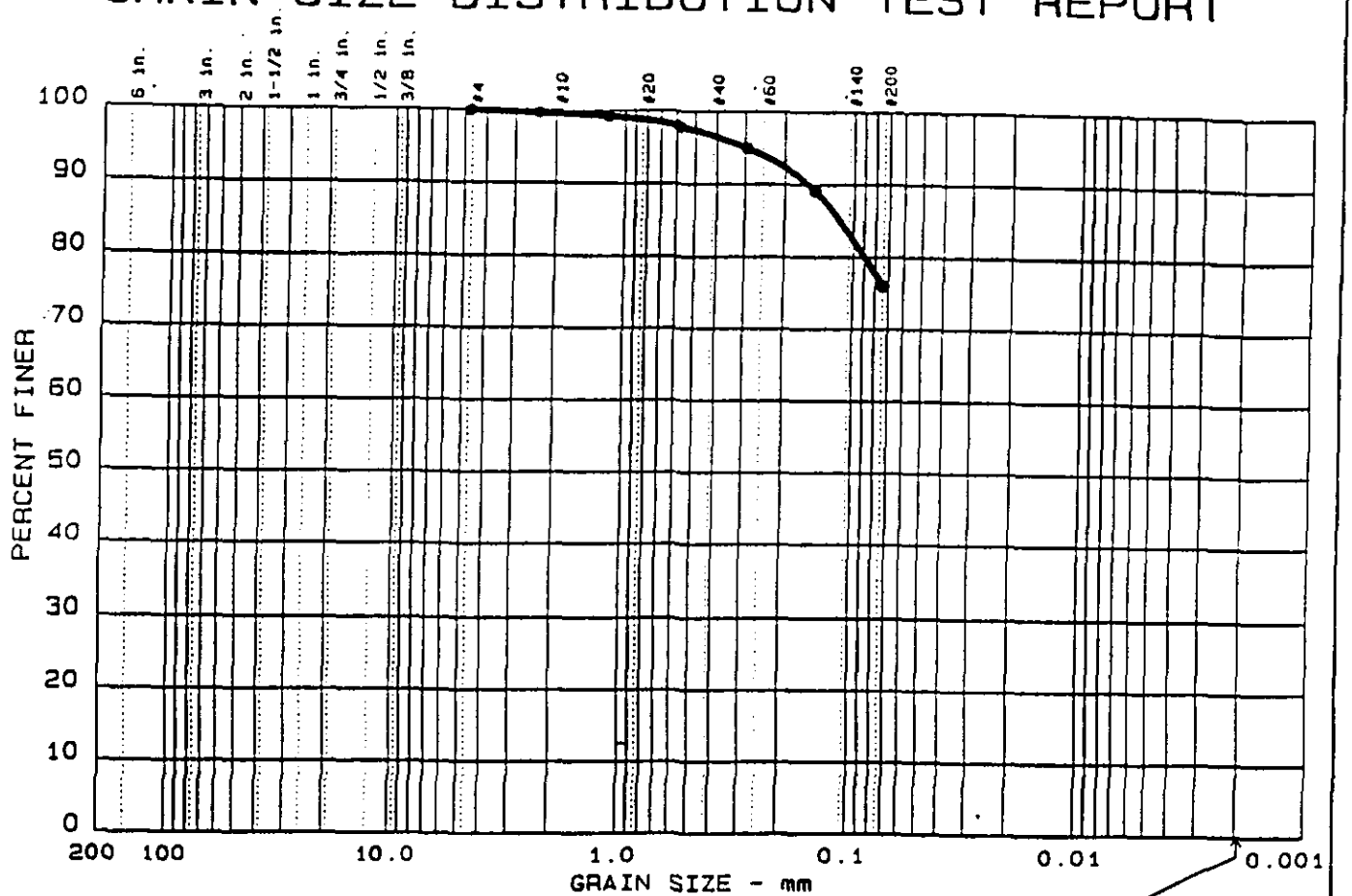
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-13

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	24.0	76.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	35.9	15	0.11							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. br. **LEAN CLAY With Sand**	CL	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 2, depth: 3 - 5'

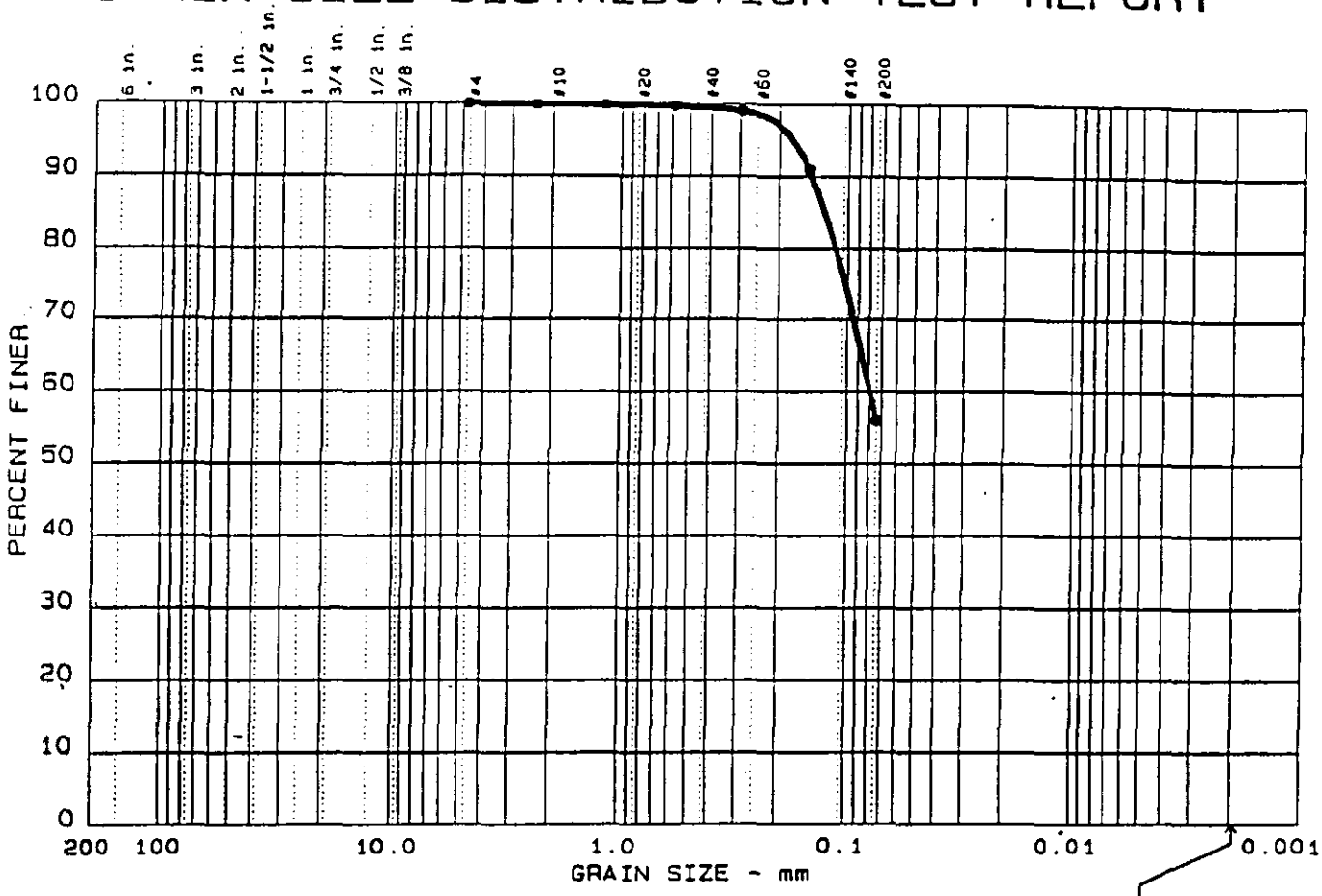
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-14

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	44.0	56.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.13	0.08						

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SANDY SILT	ML	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 3, depth: 4-6'

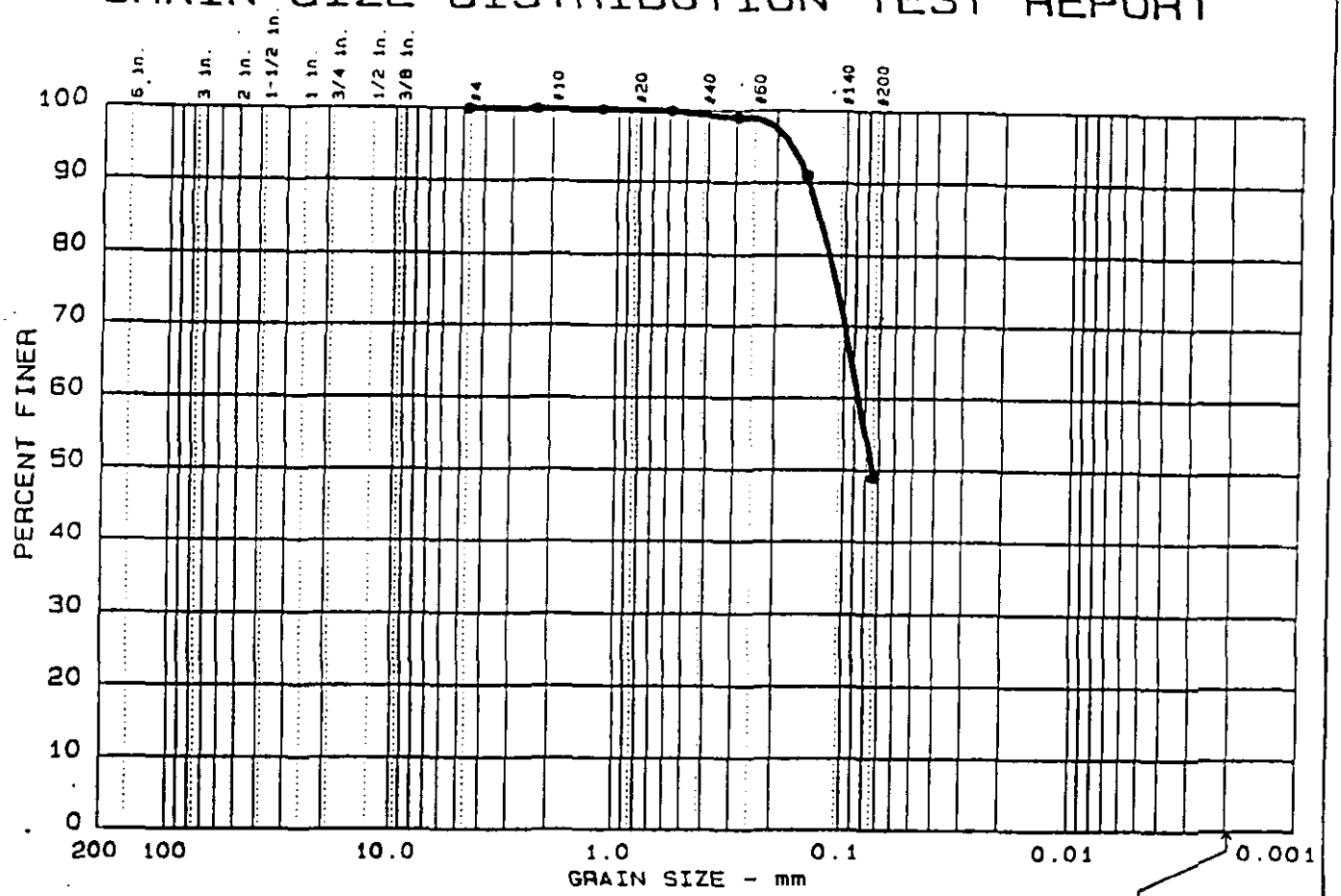
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-15

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	0.0	51.0	49.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	21.7	4	0.13	0.09	0.07					

	MATERIAL DESCRIPTION	USCS	AASHTO
●	lt. brn. SILTY SAND	SC - SM	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 4, depth: 3 - 5'

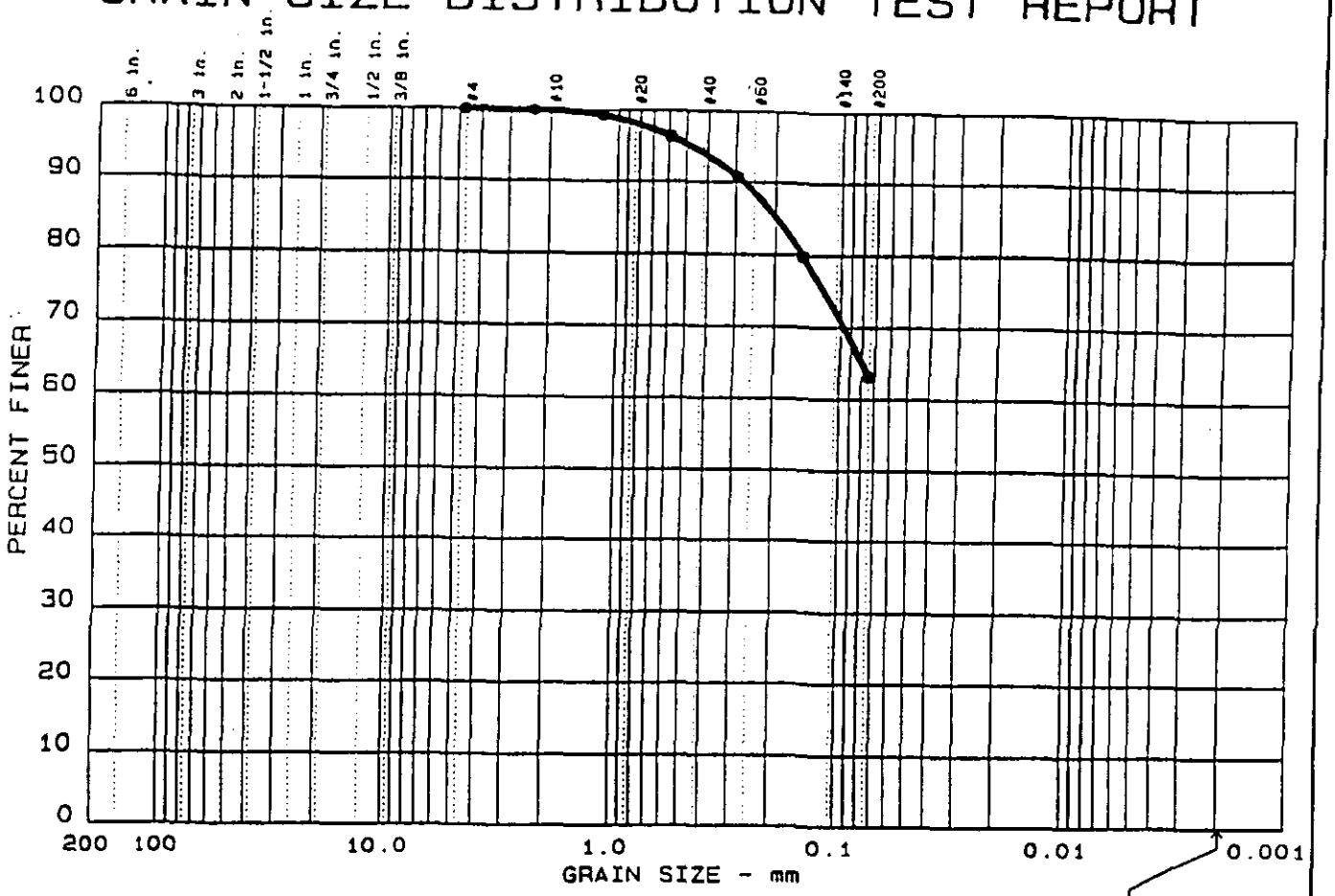
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-16

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	36.9	63.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	35	17	0.20							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. br. - br. **SANDY LEAN CLAY**	CL	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 5, depth: 3 - 5'

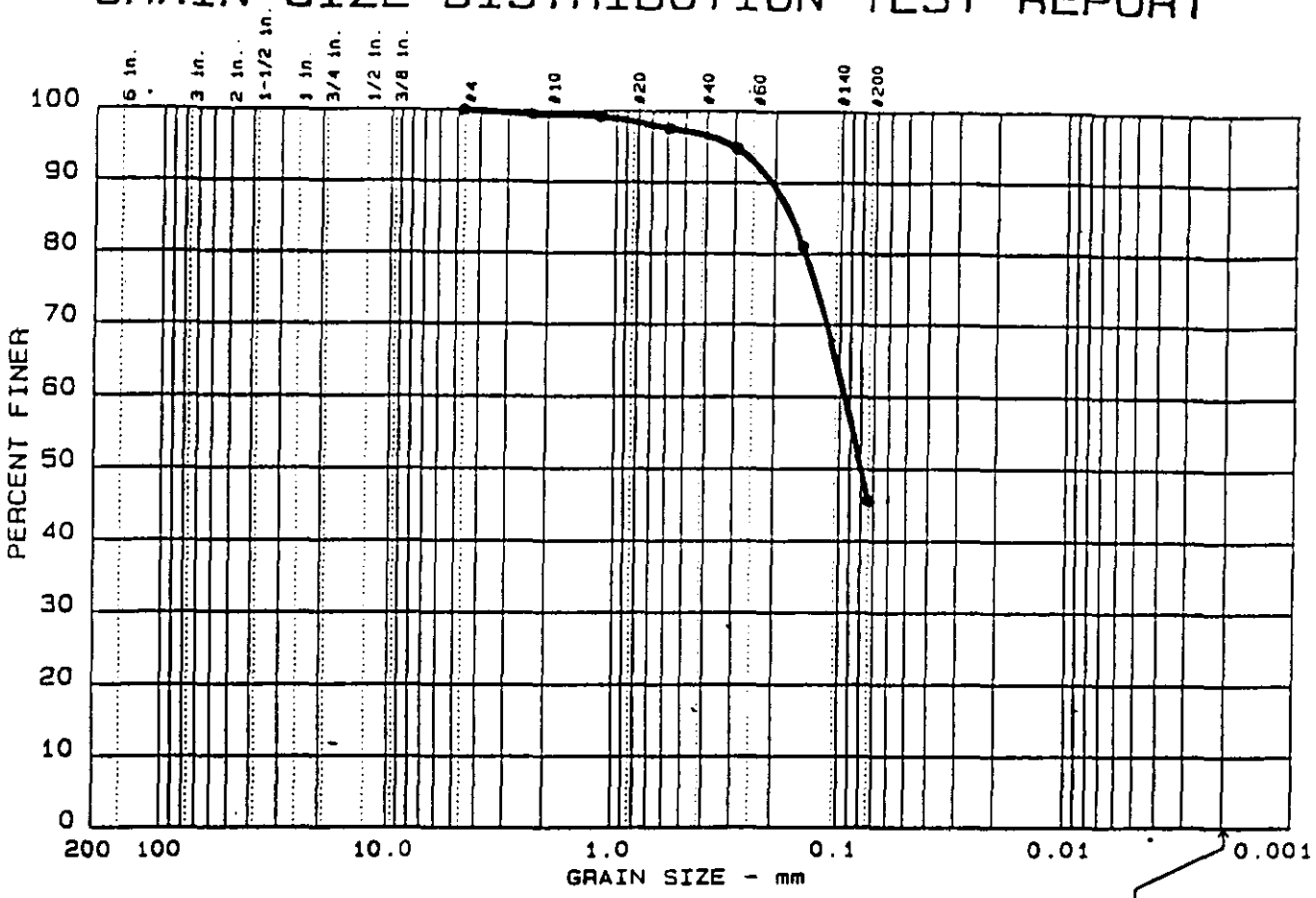
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-17

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	0.0	54.4	45.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.17	0.10	0.08					

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY SAND	SM	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 6, depth: 3 - 5'

Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-18

APPENDIX B

SLOPE STABILITY ANALYSIS

Based on the results of the geologic/seismic evaluation and the field and laboratory investigations, preliminary slope stability analyses of the proposed dike embankment were performed. The stability analyses were conducted in general accordance with the Nevada State Statutes, the Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual*. The anticipated maximum embankment slope sections were analyzed for three separate cases; (1) sudden drawdown, (2) steady state seepage and (3) seismic steady state seepage. The embankment was analyzed for a height of 22 feet with 19 feet of water. Based on laboratory tests, average angles of internal friction of 30 and 28 degrees with no cohesion were used for in-situ and saturated undisturbed native soils. Angles of internal friction of 27 and 25 degrees with 200 pounds per square foot (psf) cohesion were used for unsaturated and unsaturated compacted fill soils, respectively. A pore pressure coefficient (Ru) of 0.5 was used for the sudden drawdown case. The maximum failure surface depth was assumed to be 10 feet below the embankment. The computer program SB-Slope, Version 3.0, developed by Von Gunten Engineering Software, Inc. was used to calculate the minimum factor of safety for each of the three cases for the embankment. The program utilizes the simplified Bishop Method of slope stability analysis for circular failure surfaces. The computer printouts showing the results of the stability analyses for the maximum anticipated embankment section are also presented in this Appendix. The soil densities shown for each soil number on the computer printouts are as follows: (Soil No. 1) moist undisturbed native soils; (Soil No. 2) saturated undisturbed native soils, (Soil No. 3) compacted embankment fill soils, and (Soil No. 4) saturated compacted embankment fill soils.

File: CON2DRA2 - 91-33647-01 SUDDEN DRAWDOWN-2.5:1 Slopes
GRID SEARCH ANALYSIS
Approximately 30 slices selected

Xmin=	121.0	Xmax=	127.0	Increment=	1.0
Ymin=	52.0	Ymax=	57.0	Increment=	1.0
Rmin=	44.0	Rmax=	53.0	Increment=	1.0

Minimum FS found during grid pattern = 1.27
Found at X= 127.0, Y= 57.0, R= 53.0

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin/Sloan Channel
Location: Near Nellis Air Force Base
Filename: CON2DRA2 Description: 91-33647-01 SUDDEN DRAWDOWN-2.5:1 Slopes

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	10.0	1	1	2	2
2	20.0	10.0	2	2	3	3
3	75.0	32.0	3	3	4	3
4	87.0	32.0	4	4	5	3
5	94.5	29.0	5	5	6	4
6	142.0	10.0	6	6	7	2
7	162.0	10.0	7	2	5	4
8	162.0	29.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg	Ru
1	110.0	0	30.0	0.00
2	115.0	0	28.0	0.50
3	120.0	200	27.0	0.00
4	125.0	200	25.0	0.50

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin/Sloan Channel

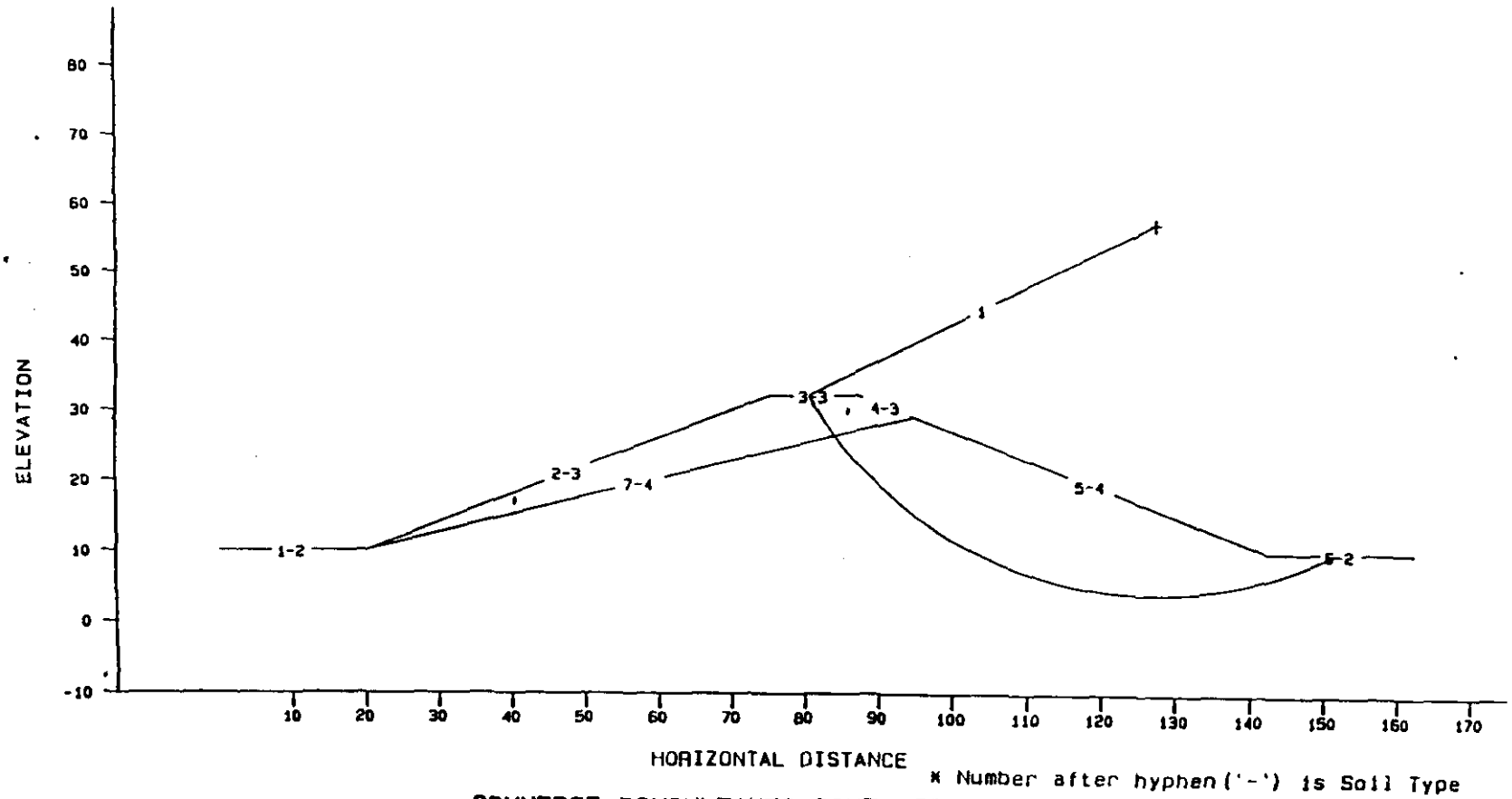
LOCATION: Near Nellis Air Force Base

FILE: CON2DRA2

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	127.0	57.0	53.0	1.27

SOIL*	DENSITY	COHESION	PHI'	RU
1	110.0	0.0	30.0	0.0
2	115.0	0.0	28.0	0.5
3	120.0	200.0	27.0	0.0
4	125.0	200.0	25.0	0.5



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

File: CON2STE2 - 91-33647-01 STEADY STATE SEEPAGE-2.5:1 Slope
GRID SEARCH ANALYSIS
Approximately 30 slices selected

Xmin=	35.0	Xmax=	37.0	Increment=	0.7
Ymin=	58.0	Ymax=	60.0	Increment=	1.0
Rmin=	54.0	Rmax=	56.0	Increment=	0.7

Minimum FS found during grid pattern = 1.54
Found at X= 35.0, Y= 58.0, R= 55.4

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin/Sloan Channel
Location: Near Nellis Air Force Base
Filename: CON2STE2 Description: 91-33647-01 STEADY STATE SEEPAGE-2.5:1 Slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	10.0	1	1	2	2	Y
2	20.0	10.0	2	2	3	3	N
3	75.0	32.0	3	3	4	3	N
4	87.0	32.0	4	4	5	3	N
5	94.5	29.0	5	5	6	4	N
6	142.0	10.0	6	6	7	2	N
7	162.0	10.0	7	2	5	4	Y
8	162.0	29.0					

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	110.0	0	30.0
2	115.0	0	28.0
3	120.0	200	27.0
4	125.0	200	25.0

Free water surface, left point = 5
right point = 8

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin/Sloan Channel

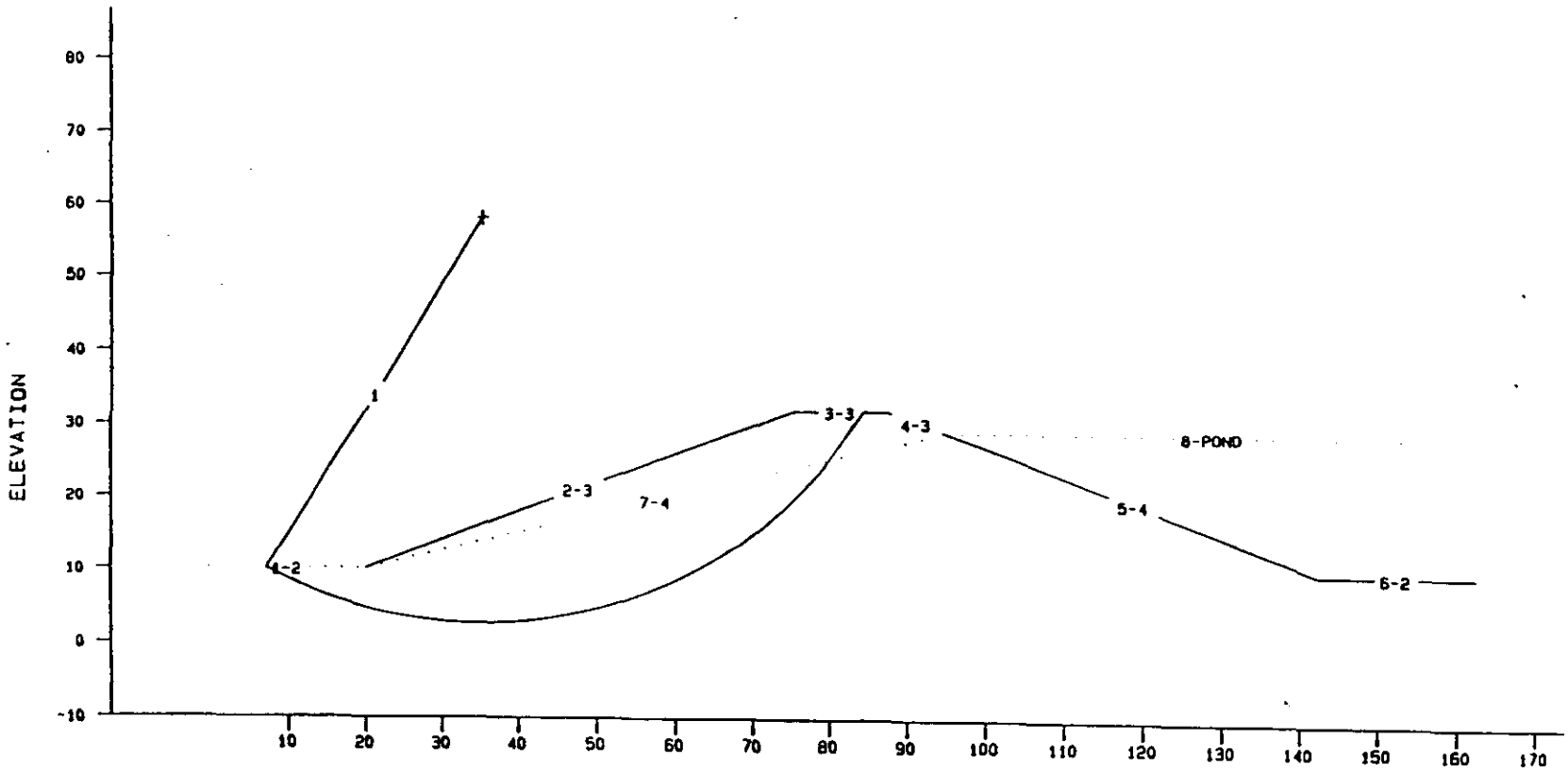
LOCATION: Near Nellis Air Force Base

FILE: CON2STE2

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	35.0	58.0	55.4	1.54

SOIL*	DENSITY	COHESION	PHI
1	110.0	0.0	30.0
2	115.0	0.0	28.0
3	120.0	200.0	27.0
4	125.0	200.0	25.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

Found at X= 33.0, Y= 66.0, R= 65.0

Minimum FS found during grid pat

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin/Sloan Channel
Location: Near Nellis Air Force Base
Filename: CON2SEI2 Description: 91-33647-01 SEISMIC STEADY STATE-2.5:1 Slope

ANALYSIS DATA:

Point No.	Coordinates X	Y
1	0.0	10.0
2	20.0	10.0
3	75.0	32.0
4	87.0	32.0
5	94.5	29.0
6	142.0	10.0
7	162.0	10.0
8	162.0	29.0

Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	1	2	2	Y
2	2	3	3	N
3	3	4	3	N
4	4	5	3	N
5	5	6	4	N
6	6	7	2	N
7	2	5	4	Y

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	110.0	0	30.0
2	115.0	0	28.0
3	120.0	200	27.0
4	125.0	200	25.0

Free water surface, left point = 5
right point = 8

Seismic coefficient, horizontal = 0.050
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin/Sloan Channel

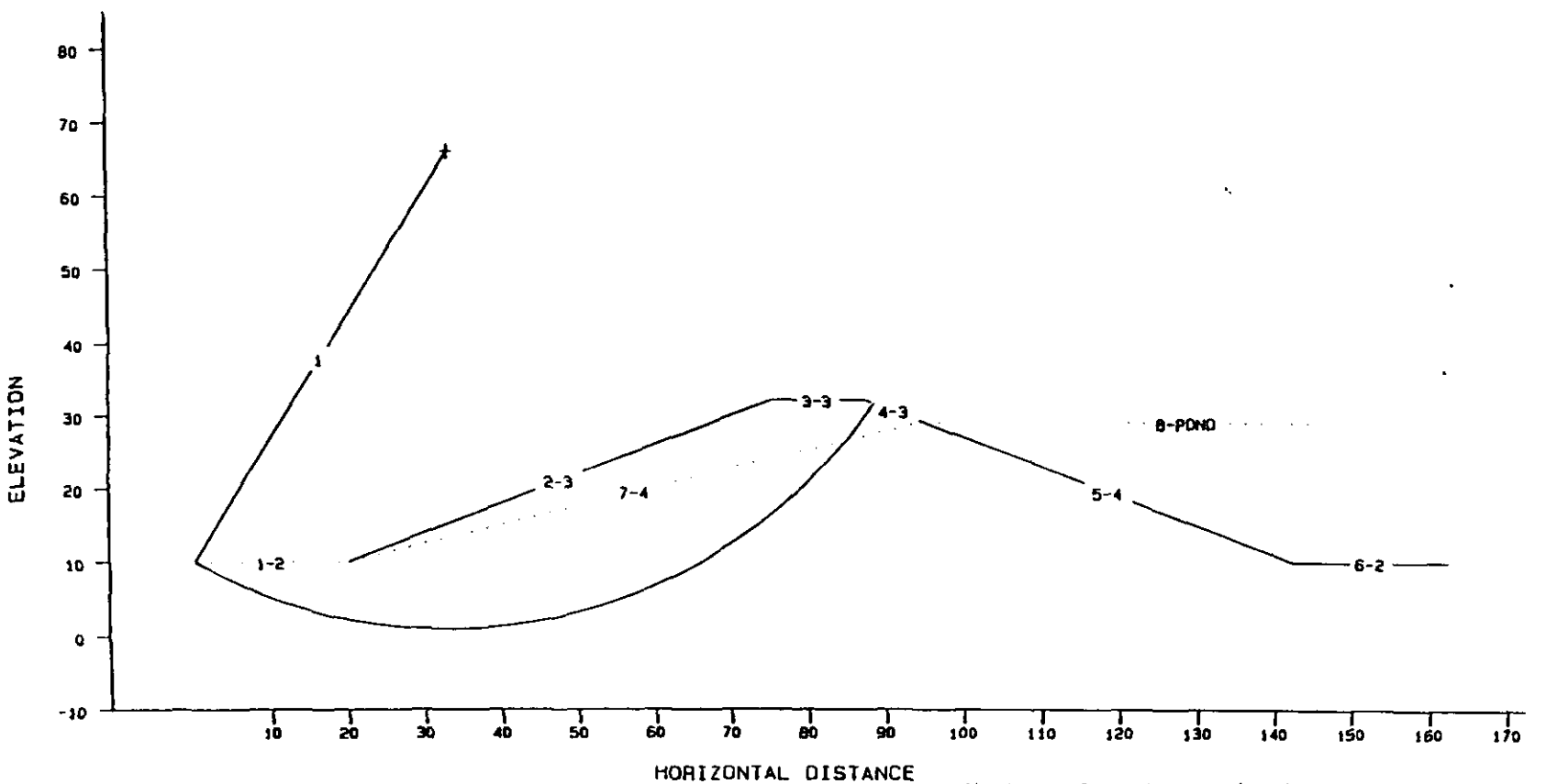
LOCATION: Near Nellis Air Force Base

FILE: CON2SEI2

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	33.0	66.0	65.0	1.30

SOIL*	DENSITY	COHESION	PHI
1	110.0	0.0	30.0
2	115.0	0.0	28.0
3	120.0	200.0	27.0
4	125.0	200.0	25.0



* Number after hyphen('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

APPENDIX C

REFERENCED BORING LOGS FROM PREVIOUS INVESTIGATION

DATE DRILLED: 09/25/89

SUMMARY OF BORING NO. B-2

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES (1)	BLOWS/FT. (2)	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION	SYMBOL (1)	MOISTURE, %	DRY DENSITY, PCF
0			dry		light brown	FILL: CLAYEY SILT with sand, trace gravel			
5						---organics from 4' to 6'			
						---with debris			
10	20		sl. moist	very stiff		SILTY CLAY/ CLAYEY SILT with sand, trace salts, porous	CL-ML	8	91
15	35				brown	SILTY CLAY with sand, trace gypsum, porous	CL	8	123
					tan to light brown	SANDY CLAY trace sand, sl. porous			
20									

▽ GROUNDWATER none observed

END OF BORING AT 30 FEET

(1) REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

(2) USING 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

UPPER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

Converse Consultants Southwest — Geotechnical Engineering and Applied Sciences

DRAWING NO. A-2

DATE DRILLED: . 09/25/89

SUMMARY OF BORING NO. B-2

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES [1]	BLOWS/FT. [2]	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION	SYMBOL [3]	MOISTURE, %	DRY DENSITY, PCF
20	X	40	sl. moist	very stiff	tan to light brown	SILTY CLAY trace sand, sl. porous	CL		
			moist						
25		40							
		20							
30									
35									
40									

GROUNDWATER none observed

END OF BORING AT 30 FEET

[1] REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

[2] USING 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

UPPER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

DRAWING NO. A-3

Converse Consultants Southwest

Geotechnical Engineering and Applied Sciences

SUMMARY OF BORING NO. B-3

DATE DRILLED: 08/15/89

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES (1)	BLOWS/FT. (2)	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION		SYMBOL (1)	MOISTURE, %	DRY DENSITY, PCF
0		6	dry	loose	light brown	SILTY SAND	trace gravel	SM	5	87
			sl. moist	firm to stiff		SANDY SILT	trace salts, porous	ML		
5		20		very stiff	tan	CLAYEY SILT	with sand, trace caliche nodules, porous	ML	5	94
					light brown	SILTY CLAY	trace sand, trace caliche nodules, trace gypsum, porous	CL		
10		30							10	93
15		25								
						CLAYEY SILT	with sand, porous	ML		
		40/6"	dry	mod. hard			—partially cemented to 21'			
20										

GROUNDWATER none observed

END OF BORING AT 30 FEET

(1) REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

(2) USING 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

UPPER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

DRAWING NO. A-4

Converse Consultants Southwest

Geotechnical Engineering and Applied Sciences

DATE DRILLED: 08/15/89

SUMMARY OF BORING NO. B-3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES (1)	BLOWS/FT. (2)	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION	SYMBOL (1)	MOISTURE, %	DRY DENSITY, PCF
20			dry	mod. hard	light brown	CLAYEY SILT with sand, porous partially cemented to 21'			
			sl. moist	very stiff					
25	25			medium dense		SILTY SAND trace gravel	SM		
30									
35									
40									

▼ GROUNDWATER none observed

END OF BORING AT 30 FEET

(1) REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

(2) USING 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

UPPER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

DRAWING NO. A-5

Converse Consultants Southwest — Geotechnical Engineering and Applied Sciences

APPENDIX B

PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT
ADDITIONAL ENVIRONMENTAL SURVEYS
OVERVIEW LETTER
ADDITIONAL GROUNDWATER QUALITY LETTER

Converse Environmental Consultants Southwest, Inc.

A Wholly Owned Subsidiary of
The Converse Professional Group

PRELIMINARY ENVIRONMENTAL SITE ASSESSMENT SLOAN CHANNEL/CONFLUENCE BASIN CLARK COUNTY, NEVADA

Prepared For:

Boyle Engineering
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CECSW Project No.92-43-28101

July 9, 1992

Converse Environmental Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 739-8811
Facsimile (702) 798-0098

Converse Environmental Consultants Southwest, Inc.

A Wholly Owned Subsidiary of
The Converse Professional Group

July 9, 1992

92-43281-01

Boyle Engineering
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines

Subject: Preliminary Environmental Site Assessment
Sloan Channel/Confluence Basin
Clark County, Nevada

Gentlemen:

We are pleased to submit the results of our Preliminary Environmental Site Assessment conducted at the proposed site of the Sloan Channel/Confluence Basin project located in Clark County, Nevada. The site assessment has consisted of research of readily available documents, review of aerial photographs, site examination, shallow subsurface sampling, and preparation of this report. The study was performed in general accordance with our proposal dated December 12, 1991, and your authorization on March 26, 1992.

Our investigation indicates the site is vacant and undeveloped. No previous site uses with a potential for adverse environmental impact were identified. It is recommended that analysis of impacts to adjacent lands to the west of the subject site be undertaken prior to construction.

If you have any questions concerning information contained in this report, please contact us at your convenience.

Respectfully submitted,

CONVERSE ENVIRONMENTAL CONSULTANTS SOUTHWEST, INC.

for John R. Worlund, P.E.
Principal Environmental Engineer

JRW:MJP:sc
92/43S

Converse Environmental Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 739-8811
Facsimile (702) 798-0098

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INTRODUCTION

This report presents the results of our Preliminary Environmental Site Assessment performed at the proposed Range Wash Detention Basin located in Clark County, Nevada. Our study has been conducted in order to determine prior land use, particularly any industrial/chemical activity and its potential environmental impact on the site. Work has been performed in accordance with our contract dated May 4, 1992, and has consisted of:

- Site reconnaissance
- Review of readily available records
- Aerial photograph review
- Soil Sampling
- Laboratory analysis of soil samples
- Preparation of this report

SITE DESCRIPTION

We understand that the site is located in portions of section 10 and 15 of Township 20 South, Range 62 East MDB&M, Clark County, Nevada. The site is currently vacant except for gravel extraction operations in the northern portion.

The site is located in the unincorporated Town of Sunrise Manor. Sunrise Manor covers approximately 32 square miles in the east and the northeast urban area of the Las Vegas Valley. A vicinity map showing the location of the project within the the Vegas area is enclosed as Drawing No. 1. A land use plan is enclosed as Drawing No. 2.

GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

The site is located in the northeast portion of the Las Vegas Valley, an alluvium-filled structural basin. Review of geologic and hydrogeologic conditions from published information and nearby geotechnical investigations conducted by Converse Consultants Southwest, Inc. indicate the local valley fill deposits consist of coarse-grained alluvial deposits and fine-grained playa/lacustrine

(lakebed) deposits that interfinger with occasional wind-blown sand deposits. Soil deposits underlying the site may be at least 2,500, feet thick based on well drillers' logs and contain zones with calcareous cementation and occasional clayey soils.

Two separate aquifers exist in the Las Vegas Valley, a shallow relatively unconfined aquifer and a series of deep, confined water-bearing zones. The majority of the groundwater withdrawn in the Valley is from the deeper aquifer zone and is at depths estimated to be greater than 200 feet at the site. The near-surface groundwater has relatively poor water quality and is occasionally withdrawn in the Valley, principally for irrigation and industrial uses. The near-surface groundwater flow gradient is not well-defined in the area, but is presumed to be southwesterly, toward the lower part of the Valley. Based on public information in the area, shallow groundwater is anticipated at depths of approximately 80 feet below the ground surface.

SITE USE INVESTIGATION

The site use investigation was based on a site reconnaissance, examination of available aerial photographs, review of zoning history for the site, and review of the following agency listings:

- USEPA, National Priorities List (NPL), updated through February, 1991.
- U.S. Environmental Protection Agency (USEPA), Region 9, listing of hazardous waste sites in Clark County, Nevada (CERCLIS), dated October 23, 1991.
- U.S. Environmental Protection Agency SARA Title III Tier 2 Listing obtained from Clark County Fire Department files on March 2, 1992.
- State of Nevada, Division of Environmental Protection (NDEP) Underground Storage Tank Active Case Listing (USTACL), dated July 8, 1991.
- USEPA, Region 9, Resource Conservation and Recovery Act (RCRA) data base list dated November 5, 1991.
- Clark County Health District (CCHD) Underground Storage Tank Owner's and Operator's List (USTOOL), updated March 28, 1991.
- Clark County Fire Department Records (CCFD).

AERIAL PHOTOGRAPH REVIEW

Aerial photographs taken of the Las Vegas area and the vicinity of the subject site were examined for the purpose of tracing the development history of the subject property and immediate vicinity. The aerial photos reviewed were taken in 1950, 1962, 1964, 1968, 1972, 1977,1980, 1983, 1987, and 1990.

1950

The subject site generally appeared undeveloped and in a natural state. Nellis Air Force Base was in place to the northwest of the site along the western border. Nellis Air Force Base was comprised of runways and general support buildings. A sewage treatment plant for Nellis Air Force Base borders the subject property on the west at the southern end of Nellis Air Force Base. Unpaved roads were noted approximately 1/4 mile to the south and west of the subject site. Gravel extraction operations appeared 1/2 mile to the southeast. A vegetated wash appeared on the subject site. It ran diagonally from the northeast boundary to the southwest portion of the site. The closest paved municipal road was Nellis Boulevard, a two lane road.

1962

The site appeared undeveloped and in a natural state. Unpaved roads appeared along the south and eastern boundary of the site. Gravel extraction operations that were previously noted were in place and their boundaries had been greatly expanded. Some homes on estate size lots were being developed southwest of the Nellis Air Force Base site. All other surrounding lands other than Nellis Air Force Base were undeveloped and appeared in a natural state. Some off-road trails appeared traversing the property from east to west and vegetation appears along areas of the natural wash.

1964

The site appeared undeveloped with sparse vegetation. Gravel operations appeared to overlap the subject site on the northern boundary. Nellis Air Force Base golf course appeared to be graded and landscaped. The sewage treatment plant bordering the subject property appeared to have had one

treatment pond removed from operations. One of the base landfills was evident to the west of the sewage treatment plant. To the south of the site approximately 1/4 mile, a residential subdivision was under construction between Lake Mead Boulevard and Carey. Roads had been paved in the subdivision and Lake Mead Boulevard appeared as a paved two lane road.

1968

The area south of the subject was undeveloped with unpaved roads along the southern and eastern boundaries. The site appeared generally unchanged. Nellis Air Force Base to the northwest and the gravel pit operations to the east appeared to be active. The adjacent land use to the south had added additional residential homes. The Nellis Air Force Base golf course appeared to the west of the subject site. The sewage treatment plant appeared to the south of the Nellis Golf course, immediately to the west of the subject site. The base landfill adjacent to the sewage treatment plant west of the subject site appeared to be in operation.

1972

The site appeared vacant and undeveloped. Adjacent land use appeared unchanged on the north, west, and east. To the south of the site, a subdivision had been completed including streets and residential housing. The southwest portion of the site had been graded and preliminary roads had been cut but no paving had ensued. This graded area lies at the southern portion of the subject site.

1977

The site appeared generally unchanged, vacant, and sparsely vegetated. The subdivision to the south of the site appeared completed. The sewage treatment plant to the west of the site appeared reduced in size by the elimination of the two most southern ponds. To the south of the site additional residential housing had begun to appear in a 1/2 mile radius.

1980

Nellis Air Force Base Golf Course appeared fully developed. Sewage treatment pond to the west of the subject site appeared closed. All remaining

sludge ponds appeared inactive. To the south of the subject site, residential development had increased. The graded areas at the southern end of the subject site remained unchanged.

1983

The site appeared undeveloped and vacant. Gravel operations had increased their boundaries of excavation. A large increase of residential development had taken place to the south of the project including single family and multi-family units within a 1/2 mile of the southern boundary. Vegetation had begun to appear in the graded areas in the southern portion of the site. No further development of this area had taken place.

1991

The site appeared generally unchanged and in a natural state. Sparse vegetation appeared on the western section of the site. The surrounding area to the south remains as single and multi-family units. A convenience store had been constructed on the southeast corner of Carey and Mt. Hood. Gravel extraction operations appeared active on the northern and eastern boundaries of the site. Nellis Air Force Base Golf Course appeared fully developed and no evidence of the former sewage treatment plant was noted.

SANBORN MAPS

The Sanborn Map Company maintained fire insurance maps for various cities from 1867 through the 1950s. These maps often identify site uses and features which are not ordinarily available from other sources. The maps generally encompassed a one mile radius from the Court House and offer no information for this assessment.

POTENTIAL OFF-SITE CONTAMINATION GENERATORS

Agency List Review: As of February 1991, the only site in Nevada on the NPL is located 350 miles northwest of Las Vegas in Lyon/Churchill County.

USEPA has a list of potential uncontrolled hazardous waste sites which has been brought to their attention within its Superfund data base. As of October 23,

1991, sites within a one-mile radius of the subject property were included on the list and can be found in Appendix A at the end of this report.

The Emergency Planning and Community Right-to-Know Act was enacted as Title III of Superfund Amendment Reauthorization Act (SARA) in October, 1986. This act requires owners and operators of facilities with specified hazardous substances to give notice to specified state agencies of releases or spills and to comply with other applicable requirements.

CCFD maintains a listing for sites complying with the SARA Title III Tier 2 Regulations. As of the March 2, 1992 list, no sites were listed that are located within 1 mile of the subject site.

NDEP maintains USTACL for reported hydrocarbon spills and leaks. As of July 8, 1991, sites within a one-mile radius of the subject site are included at the end of this report in the Appendix A.

Region 9 of USEPA has also compiled a data base of notifiers complying with the provisions of the RCRA. The notifiers on this list are involved with the storage, treatment, disposal, and/or handling of hazardous waste from their own or other sites/facilities. As of November 5, 1991, RCRA notifiers which can be found within a one-quarter mile radius of the subject site can be found in the Appendix A the end of this report.

CCHD maintains the USTOOL for registered underground storage tanks (USTs) in Clark County, Nevada. As of March 28, 1991, the following facilities which are within a one-half mile radius of the subject site appear on the USTOOL can be found in the Appendix A which appears at the end of this report.

ZONING

According to the Clark County Department of Comprehensive Planning, Zoning Division, at the time of this report, the subject property is designated R-E, Rural Estates. Parcels surrounding the subject site are currently designated with various zoning classifications, as follows:

North:	R-E Rural Estates
Northeast:	R-E Rural Estates
East:	R-E Rural Estates
South	R-T Mobile Home Residential

West: P-F Public Facility
Northwest: P-F Public Facility

A portion of the subject parcel bordering Nellis Air Force Base falls under the Airport Overlay District. This overlay district designates noise levels based upon impacts from military aircraft landing/takeoffs. Noise level designations range from 75 Ldn to 80 Ldn or higher. Ldn is the noise scale most commonly used to measure day-night noise levels. (Ldn mathematically computes time weighted energy related to the source; in this case aircraft type and operation. The results are reduced to noise level contours based upon sound exposure levels.)

According to the Federal Emergency Management Agency Flood Insurance Rate Maps, the site location is designated as Zone X. This zone represents an area which is an area to be determined to be out of the 500 year floodplain.

SITE RECONNAISSANCE

On May 7 1992, we visited the site to determine present use and to identify areas of environmental concern. At the site during our visit, we did not observe obvious evidence of the following:

- Wetland-type areas
- Stained or discolored soil
- Active, inactive or abandoned water wells
- Surficial water run-on to the site
- Process tanks, vats, pits, ponds or lagoons
- Manholes, drainage ditches, culverts or gullies
- UST fill pipes or vent pipes
- Storage tanks or transfer lines
- Roads, tracks, railroad tracks or spurs
- Flowing, standing or ponded liquids other than water
- Absence of vegetation, stressed or dead vegetation
- Hills, mounds, fill piles or unnatural depressions
- Fumes or objectionable odors
- Pollution control equipment

At the site visit we observed evidence of the following:

- General and domestic dumping/debris
- Horizontal depressions, cuts
- Sand and Gravel extraction

During our site reconnaissance we observed evidence of general and domestic debris. Findings included general construction debris, concrete and caliche waste, tires, abandoned furniture and used appliances, and construction tailings mix.

The debris, if disposed of in the proper manner, does not appear to pose an environmental threat to the site. Preliminary road cuts appearing to be an extension of the subdivision to the south of the subject site are evident in the southern portion of the site. These preliminary road cuts are not recent excavations as natural revegetation has occurred. These cuts do not pose an environmental threat to the site.

The Sloan Channel lies on the southwestern boundary of the subject site. The Sloan Channel in this area separates the site from Nellis Air Force Base properties. Nellis Air Force Base Golf Course lies immediately adjacent to the site along the south western boundary. To the south of the subject site is a single family subdivision. The eastern boundary of the site lies adjacent to rural open space. The northern portion of the site contains a sand and gravel extraction operation. Extraction operations appeared to be active with screening in evidence. Gravel extraction operations are a removal process and do not appear to adversely impact the site.

The site, except for areas of dumping and preliminary road cuts, appeared in undisturbed state. Vegetation was abundant and did not appear stressed. The natural extension of Mt. Hood Street became a gravel road at the end of the pavement. Domestic dumping was prevalent along the gravel portion of Mt. Hood Street. When disposed of properly, the domestic dumping/debris should not pose an environmental threat to the site.

Adjacent Lands: Adjacent lands to the west of the subject site have raised a number of concerns. The site known as LF-01 as per Nellis Air Force Base records was reportedly a former base landfill. It was active since 1942, except for a period from 1968 to 1974.

The United States Air Force commissioned a remedial investigation in the late 1989s for 16 designated sites at Nellis Air force Base. Areas of study included the sewage treatment plant percolation ponds adjacent to the base landfill. Monitoring wells and soil borings provided data related to the percolation ponds. The following was reported by JMM regarding the landfill.

All types of solid waste have been reported to have been disposed of in the landfill. Industrial and commercial wastes which may have been disposed include: thinners, paint, solvents such as methyl ethyl ketone (MEK) and trichlorethlene (TCE), waste oil, lubricants, and petroleum. Area fill and trench techniques have been employed at the site (JMM, 1989). The landfill has only been used for the disposal of demolition and construction debris (JMM, 1989).

The groundwater flow direction is southwesterly from the subject site (JMM, 1989). This raises concerns of direct impact arising from the the construction of the detention basin.

These concerns are:

- Potential recharge altering of groundwater levels in the area of the detention basin.
- Raising of the water levels in the area of the former landfill.
- Altering of groundwater flow direction and increasing the gradient through the landfill.

Further, these impacts associated with the potential infiltration related to the subject site may directly affect the adjacent landfill. Infiltration may raise water tables and alter flow direction across the landfill. This may saturate hazardous materials, increase leaching, initiate groundwater flow direction changes, and increase the groundwater gradient. There is potential for increased environmental hazards related to public safety issues by the production of methane gases and or other harmful odors, vapors, or fumes.

Plans to extend construction across the Nellis AFB landfill should be thoroughly investigated for impacts to changes in groundwater levels, flow direction and gradient, and its potential human health risks. Potential hazards associated with construction over an existing landfill need to be investigated.

SUBSURFACE SAMPLING

On May 29, 1992 soil samples were taken from site T-2. The approximate location of this site is shown on Drawing No 2. The samples were taken in conjunction with the concurrent investigation conducted by our affiliate Converse

Consultants Southwest, Inc. Sampling was accomplished by taking a sample from the backhoe bucket using a clean trowel. Soil samples were placed in sampling containers using appropriate protocol and chain of custody procedures. Field vapor readings of volatile organic compounds were monitored in the soil sampling using a photoionization detector (PID). A second soil sample was taken using the same sampling methodology. The samples were sent to an accredited laboratory for analysis. During soil sampling, no unusual soil discolorations odors which may indicate pollutant presence were observed. Anomalous levels of volatile organic compounds were not encountered.

LABORATORY ANALYSIS

Samples were analyzed using EPA Method 8240 and EPA 8015. All results indicated non-detect for Total Petroleum Hydrocarbons (TPH), and non-detect for semi-volatiles which includes most solvents. Results of the laboratory analysis can be found in Appendix B.

CONCLUSIONS AND RECOMMENDATIONS

Our research indicates that the subject site does not have a history of industrial/chemical uses which may have had an adverse environmental impact on the site. The site is located in an area which, until residential and commercial and military installation development located to the south and west of the site, was undeveloped desert. Areas of significant obvious environmental concern were not encountered during our on-site examination. However, with the very close proximity of Nellis Air Force Base Landfill No 1 to the site, the possibility does exist for potential impacts to the groundwater quality and gradient by the completion of this project.

In light of the above discussion, CECSW would recommend analysis of the monitoring well data compiled by the Army Corps of Engineers-Omaha District Nellis AFB, Nevada Final Remedial Investigation Report. In conjunction with this analysis, a hydrological assessment including modeling of the subsurface conditions of the proposed basin and its environs should be conducted to determine potential impacts to adjacent lands.

CLOSURE

This report is for the use of Boyle Engineering as it applies to the proposed Sloan Channel/Confluence Basin project. Its preparation has been in accordance with generally accepted practices in geotechnical engineering, environmental and engineering geology, and hydrogeology. No other warranty, either expressed or implied is made.

This preliminary site assessment should not be regarded as a guarantee that no further contamination beyond that which could be detected within the scope of this investigation is present at the site.

Thank you for the opportunity to be of service. Should you have any questions or comments regarding this report, please do not hesitate to call.

Respectfully submitted,

CONVERSE ENVIRONMENTAL CONSULTANTS SOUTHWEST, INC.

Marilyn J. Ponton
Senior Environmental Planner

Reviewed and approved:

FOR John R. Worlund, P.E.
Principal Environmental Engineer

JRW:MJP:sc
92/43S

Encl: References
Drawings Nos. 1 and 2
Appendices

Dist: 4/Addressee

REFERENCES

Hopper, Eloisa, Chief, Environmental Management, USAF, Nellis Air Force Base, Nevada. Personal Communication May 15, 1992.

Katzer, Terry, 1977, "Water Level Changes Associated with Groundwater Development in Las Vegas Valley, Nevada, March 1976 to March 1977," Report 27, State of Nevada, Department of Conservation and Natural Resources.

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USEPA, List of Hazardous Waste Sites in Clark County, Nevada, (CERCLIS) Dated October 23, 1991.

USEPA, SARA Title III Tier 2 List obtained from the Clark County Fire Department files on March 2, 1992.

USEPA, RCRA Notifier List, Dated November 5, 1991.

USGS, Unpublished Water Well Level Measurements.

USGS, Aerial Photographs of Las Vegas Area, 1" = 3,933' Scale, Flown 7/3/50.

American Aerial Surveys, Covina, California, 1" = 2000' Scale, Flown 6/62.

American Aerial Surveys, Covina, California, 1" = 2000' Scale, Flown 10/64.

Landis Aerial Surveys, Covina, California, 1" = 2,000' Scale, Flown 5/68.

Bureau of Land Management, Washington, D.C., 1" = 3,000' Scale, Flown 6/77.

Cooper Aerial Survey, Las Vegas, Nevada, 1" = 1,666' Scale, Flown 7/80.

Cooper Aerial Survey, Las Vegas, Nevada, 1" = 1,666' Scale, Flown 12/83.

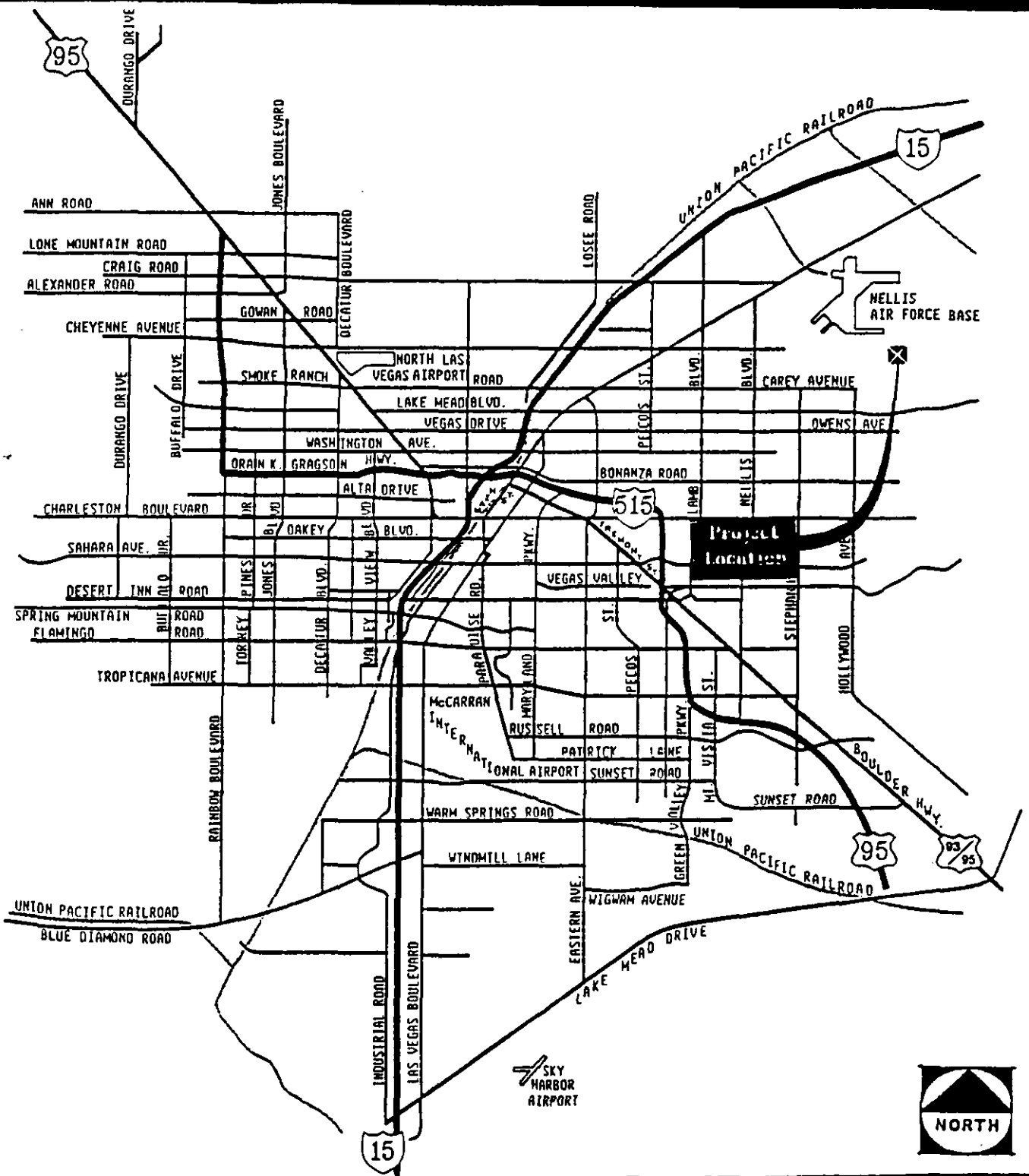
Cooper Aerial Survey, Las Vegas, Nevada, 1" = 400' Scale, Flown 4/91.

Clark County Health District Underground Storage Tank Owner's and Operator's List, Updated March 28, 1991.

Clark County Assessors Office Records.

Clark County Fire Prevention Bureau Records.

Federal Emergency Management Agency, Flood Insurance Rate Map, Community Panel Number 325276, Map Revised October 18, 1983.



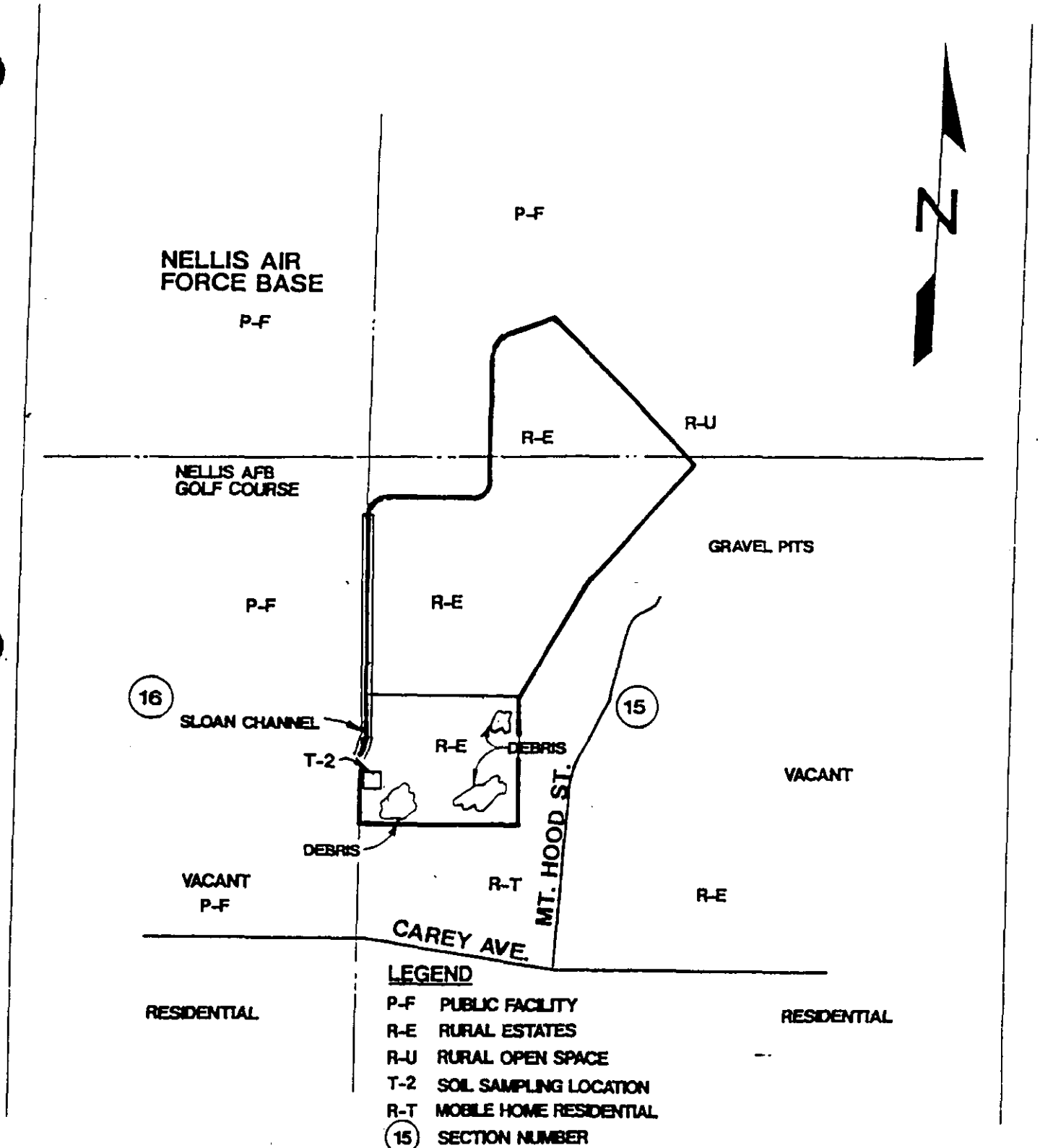
LAS VEGAS VICINITY

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN PROJECT

Converse Consultants Southwest, Inc.

PROJECT NO. 92-43281-00

DRAWING NO. 1



SITE PLAN, ZONING & LAND USE

CONFLUENCE DETENTION BASIN/SLOAN CHANNEL
NEAR NELLIS AFB
CLARK COUNTY, NEVADA

Converse Environmental Consultants Southwest, Inc.

Scale: NTS	Project No.: 92-43281-00
Prepared by: EWS	Date: 6.26.92
Checked by: MJP	Drawing No.: 2
Approved by:	

APPENDIX A

AGENCY LIST

RCRA NOTIFIERS

Nellis Air Force Base- Hobby Shop Building 448

CERCLIS

Nellis Air Force Base

CLARK COUNTY HEALTH DISTRICT

Underground Storage Tank (UST) List
March 28, 1991

Nellis Air Force Base (in excess of 65 listed USTs)

NEVADA DEPARTMENT OF ENVIRONMENTAL PROTECTION
WASTE MANAGEMENT BUREAU

Active Case Listing
July 8, 1991

<u>One mile radius of site</u>

Nellis Air Force Base - Building 267 - Leaking UST

Nellis Air Force Base - Building 415 - Leaking UST

APPENDIX B

LABORATORY RESULTS

NEVADA ENVIRONMENTAL LABORATORY

1030 Matley Lane · Reno, Nevada 89502
(702) 348-2522 · Fax (702) 348-2546
1-800-368-5221 (1-800-ENV LAB 1)

Client: Converse Consultants
4670 Polaris Ave Bldg 1
Las Vegas, NV 89103

Project: Confluence
Lake Mead/Nellis
Job #: 91-33647-01

Attn: Diane Donovan

Phone #: (702) 739-8811
Fax #: (702) 798-0098

Sampled: May 29, 1992

Analyzed: June 8, 1992

Method: EPA 8015 (Modified)

Sample Type: Soil

Client ID/ Lab ID	Parameter	Results	Detection
T-2-B CEC060292-05	TPH	ND	10 mg/kg

ND - Not Detected

Marie Ott Theisen

Marie Ott Theisen, Ph.D.
Laboratory Manager

June 8, 1992

Date

NEVADA ENVIRONMENTAL LABORATORY

1030 Matley Lane · Reno, Nevada 89502
(702) 348-2522 · Fax (702) 348-2546
1-800-368-5221 (1-800-ENV LAB 1)

Client: Converse Consultants
4670 Polaris Ave Bldg 1
Las Vegas, NV 89103

Attn: Diane Donovan

Sampled: May 29, 1992
Lab ID Number: CEC060292-05
Client ID Number: T-2-B

Project: Confluence
Lake Mead/Nellis
Job #: 91-33647-01

Phone #: (702) 739-8811
Fax #: (702) 798-0098
Analyzed: June 4, 1992

EPA METHOD 8240 (Modified*)

Compound	Amount (ug/kg)	Detection Limit (ug/kg)
1. Benzene	ND	20 ug/kg
2. Bromodichloromethane	ND	20 ug/kg
3. Bromoform	ND	20 ug/kg
4. Bromomethane	ND	20 ug/kg
5. Carbon tetrachloride	ND	20 ug/kg
6. Chlorobenzene	ND	20 ug/kg
7. Chloroethane	ND	20 ug/kg
8. 2-Chloroethylvinyl ether	ND	20 ug/kg
9. Chloroform	ND	20 ug/kg
10. Chloromethane	ND	20 ug/kg
11. Dibromochloromethane	ND	20 ug/kg
12. 1,2-Dichlorobenzene	ND	20 ug/kg
13. 1,3-Dichlorobenzene	ND	20 ug/kg
14. 1,4-Dichlorobenzene	ND	20 ug/kg
15. 1,1-Dichloroethane	ND	20 ug/kg
16. 1,2-Dichloroethane	ND	20 ug/kg
17. 1,1-Dichloroethene	ND	20 ug/kg
18. trans-1,2-Dichloroethene	ND	20 ug/kg
19. 1,2-Dichloropropane	ND	20 ug/kg
20. cis-1,3-Dichloropropane	ND	20 ug/kg
21. trans-1,3-Dichloropropane	ND	20 ug/kg
22. Ethylbenzene	ND	20 ug/kg
23. Methylene chloride	ND	20 ug/kg
24. Styrene	ND	20 ug/kg
25. Tetrachloroethene	ND	20 ug/kg
26. 1,1,2,2-Tetrachloroethane	ND	20 ug/kg
27. Toluene	ND	20 ug/kg
28. 1,1,1-Trichloroethane	ND	20 ug/kg
29. 1,1,2-Trichloroethane	ND	20 ug/kg
30. Trichloroethene	ND	20 ug/kg
31. Trichlorofluoromethane	ND	20 ug/kg
32. Vinyl chloride	ND	20 ug/kg
33. m,p-Xylene	ND	20 ug/kg
34. o-Xylene	ND	20 ug/kg

ND - Not Detected
* - Modified for Capillary Column

David J. Howard
GC/MS Associate Scientist

6/8/92
Date

NEVADA ENVIRONMENTAL LABORATORY

1030 Matley Lane • Reno, Nevada 89502
(702) 348-2522 • Fax (702) 348-2546
1-800-368-5221 (1-800-ENV LAB 1)

Client: Converse Consultants
4670 Polaris Ave Bldg 1
Las Vegas, NV 89103

Attn: Diane Donovan

Sampled:
Lab ID Number: Method Blank
Client ID Number:

Project: Confluence
Lake Mead/Nellis
Job #: 91-33647-01

Phone #: (702) 739-8811
Fax #: (702) 798-0098
Analyzed: June 4, 1992

EPA METHOD 8240 (Modified*)

Compound	Amount (ug/kg)	Detection Limit (ug/kg)
1. Benzene	ND	20 ug/kg
2. Bromodichloromethane	ND	20 ug/kg
3. Bromoform	ND	20 ug/kg
4. Bromomethane	ND	20 ug/kg
5. Carbon tetrachloride	ND	20 ug/kg
6. Chlorobenzene	ND	20 ug/kg
7. Chloroethane	ND	20 ug/kg
8. 2-Chloroethylvinyl ether	ND	20 ug/kg
9. Chloroform	ND	20 ug/kg
10. Chloromethane	ND	20 ug/kg
11. Dibromochloromethane	ND	20 ug/kg
12. 1,2-Dichlorobenzene	ND	20 ug/kg
13. 1,3-Dichlorobenzene	ND	20 ug/kg
14. 1,4-Dichlorobenzene	ND	20 ug/kg
15. 1,1-Dichloroethane	ND	20 ug/kg
16. 1,2-Dichloroethane	ND	20 ug/kg
17. 1,1-Dichloroethene	ND	20 ug/kg
18. trans-1,2-Dichloroethene	ND	20 ug/kg
19. 1,2-Dichloropropane	ND	20 ug/kg
20. cis-1,3-Dichloropropane	ND	20 ug/kg
21. trans-1,3-Dichloropropane	ND	20 ug/kg
22. Ethylbenzene	ND	20 ug/kg
23. Methylene chloride	ND	20 ug/kg
24. Styrene	ND	20 ug/kg
25. Tetrachloroethene	ND	20 ug/kg
26. 1,1,2,2-Tetrachloroethane	ND	20 ug/kg
27. Toluene	ND	20 ug/kg
28. 1,1,1-Trichloroethane	ND	20 ug/kg
29. 1,1,2-Trichloroethane	ND	20 ug/kg
30. Trichloroethene	ND	20 ug/kg
31. Trichlorofluoromethane	ND	20 ug/kg
32. Vinyl chloride	ND	20 ug/kg
33. m,p-Xylene	ND	20 ug/kg
34. o-Xylene	ND	20 ug/kg

ND - Not Detected
* - Modified for Capillary Column

David J. Howard
GC/MS Associate Scientist

6/18/92
Date

NEV ADA ENVIRONMENTAL
LABORATORY

CHAIN OF CUSTODY

1030 Malley Lane • Reno, Nevada 89502
(702) 348-2522 • FAX (702) 348-2546
1-800-368-5221 (1-800-ENV LAB 1)

Special Instructions:

Site Confluence Lake Mead/Nellis

Project # 91-33647-01

Client Name:

Company: Converse Consultants

Mail Results To:

1. 2.

Address:

Billing Address If Different Than Mailing:

Phone No.: FAX No.:

Sampled by: Attn.: Diane Donovan

Date/Time Sampled	Sample Type	Client I.D.	N.E.L. Identification	# Samples	Condition of Sample	8240	8015				Preservation	Remarks
5-29-92 10:35	SOIL	T-2-B	CEC060292-05	2	good	X	X					Regular

Analysis Requested

So (Soil), W (Water), O (Other)

This report is applicable only to the sample received by the laboratory. The liability of the laboratory is limited to the amount paid for this report. This report is for the exclusive use of the client to whom it is addressed and upon the condition that the client assumes all liability for the further distribution of the report or its contents.

	Print Name	Company	Date	Time
Relinquished by: (Signature)	Federal Express			
Received by: (Signature) Dulcy Rosaschi	Dulcy Rosaschi	NEL	6-2-92	11:05 AM
Relinquished by: (Signature)				
Received by: (Signature)				
Relinquished by: (Signature)				
Received by: (Signature)				

White – Client Copy • Yellow – Lab Copy • Pink – Analytical Package

Converse Environmental Consultants Southwest, Inc.

A Wholly Owned Subsidiary of
The Converse Professional Group

July 17, 1992 92-43281-01

Mr. Walter G. Hines, P.E.
Boyle Engineering
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Subject: Additional Environmental Surveys
East Range Wash
Sloan Channel Confluence Basin

Dear Walter:

As you requested, we have assessed the previous studies completed for the Clark County Flood Control District Master Plan. We have reviewed the studies as they pertain to cultural resources, threatened and rare plants and paleontological resources. Additionally, we have discussed the need for additional surveys with Clark County Flood Control District personnel. Based on this review we present the following.

Cultural Resources

Cultural resource analysis includes an overview of three types of resources: historical, archaeological and ethnographic resources. For the purposes of this report, the findings described in the Clark County Regional Flood Control District Draft Environmental Impact Statement (DEIS) for the proposed sites will be summarized.

Cultural resources, specifically archeological sites, provide information about past societies. Physical evidence found during these studies are the only form of record of these societies. Ethnographic resources include sites which are of current importance to Native American groups for religious reasons and the preservation of heritage.

According to surveys completed in the DEIS for the Northern Las Vegas Valley, the proposed Confluence Basin does not fall in an area of high sensitivity. Nearby Sunrise and Frenchman Mountains are considered areas of religious significance and rated as exclusionary areas. The Las Vegas Colony, a Paiute Indian reservation, is located approximately five miles to the north of the subject. It is considered to be of moderate sensitivity level.

Converse Environmental Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 739-8811
Facsimile (702) 798-0098

The proposed Confluence Basin does not directly impact these known sites. Further study would be required to determine the indirect impacts of flow channels or other appurtenances related to the Confluence Basin. The Colony is located over 10 miles to the north of the site. Sunrise and Frenchman Mountains are located to the east of the site. The Old Arrowhead Road, an historic trail located to the northeast of the site, is considered to be of moderate sensitivity. No specific impacts related to these sites are expected to the Confluence Basin project area. A literature review to determine sensitivity levels would be required to determine the need for further site specific studies.

Rare and Threatened Species

Plants:

According to preliminary surveys conducted for the DEIS, no federally listed species are expected to occur in the area of the Confluence Basin. A state listed specie known as the golden bear poppy, *Arctomecon californica*, has been identified five miles north of Nellis Air Force Base. No impacts are expected related to the construction of Confluence Basin based on existing inventories as provided in the DEIS. A complete on-site survey by trained botanists would be necessary to verify the existing data.

Wildlife:

A review of the Biological Assessment prepared for U.S. Fish and Wildlife Service identifies the Northern Las Vegas Valley as containing sensitive biological resources. The DEIS identifies a survey methodology for Desert Tortoise and other sensitive species. In discussions with Clark County Flood Control District personnel, biological resource issues will be assessed in accordance with the Biological Opinion and Short Term Habitat Conservation Plan as adopted in compliance with the Endangered Species Act. Compliance with the Short Term Habitat Conservation Plan will require surveys 90 days prior to construction grading.

Paleontological Resources

Paleontological resources were not originally identified in the DEIS. A complete paleoentological assessment is currently underway for Clark County Flood Control District by San Bernardino County Museum personnel. It is anticipated these will be complete by September, 1992.

Conclusions

The conclusions regarding additional surveys in relation to the Sloan Channel/Confluence Basin have been summarized from the initial data and reports compiled for the preparation of the DEIS. This firm and their

respective resource specialists have not conducted surveys for a complete evaluation of the proposed site for a formal opinion on the aforementioned resources. This overview has been compiled from existing data sources related to the Clark County Flood Control District Master Plan. The DEIS contains specific mitigation measures related to the resources which may be impacted by the implementation of the plan. It is recommended that consultation be initiated with the lead agency which oversees the compliance with the DEIS and Clark County Flood Control District. The consultation process would review the mitigation measures outlined in Sections 14 and 15 and their effects on the proposed Sloan Channel/Confluence Basin.

We appreciate the opportunity to be of service to your work regarding the Sloan Channel/Confluence Basin project. If you have questions or comments regarding this overview, please contact the undersigned.

Sincerely;

CONVERSE ENVIRONMENTAL CONSULTANTS SOUTHWEST, INC.

Marilyn J. Ponton
Senior Environmental Planner

MJP:glt
15/47G

Dist: 1/Addressee

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

August 4, 1992 91-33647-01

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Walter Hines, P.E.

Subject: Impact on Groundwater
Sloan Channel/Confluence Detention Basin
Near Nellis Air Force Base
Clark County, Nevada

Gentlemen:

This letter is in response to our discussions with you concerning the Nellis Air Force Base Landfill and its potential impact to the groundwater quality and gradient by the completion of the Sloan Channel/Confluence Detention Basin project. Converse Consultants Southwest, Inc. performed a Preliminary Geotechnical and Geologic Investigations for the subject project. Our report (draft) dated July 14, 1992 (CCSW Project No. 91-33647-01) presented our findings and recommendations. Converse Environmental Consultants Southwest, Inc. performed a Preliminary Environmental Site Assessment for the project. Their report dated July 9, 1992 (CECSW Project No. 92-43281-01) presented their findings and recommendations.

Based on our review of laboratory test results and our understanding of the project, it is our opinion that the water stored in the detention basin will not infiltrate into the landfill provided the following:

a. The maximum detention time and water level at full reservoir of the detention basin does not exceed 36 hours and 20 feet, respectively.

b. The permeability of the native on-site soils is low. The permeability tests conducted on remolded on-site soils were found to be low (1×10^{-5} cm/sec).

c. The groundwater elevation is not shallower than 60 feet. It appears that groundwater is at an elevation of 80 feet below the existing ground surface.

d. The limits of the landfill are not within 200 feet of the detention basin. Based on our review of available air photos, it appears that the old landfill is greater than 200 feet from the basin embankment centerline.

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Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

With the anticipated low permeability of the on-site soils, the short detention time, the depth to groundwater and the distance of the old landfill from the basin, it appears that water detained from the embankment will not influence the old landfill and the existing groundwater quality.

It has been our pleasure to be of continued service to you on this project. If you have any questions, please contact this office.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Brad L. Olsen

Brad L. Olsen, E.I.T.
Senior Staff Engineer

Reviewed by:

Al Stilley

Al Stilley, P.E.
Principal Engineer

BLO:ANS:glt
88/47G

Dist: 4/Addressee

APPENDIX C

HEC-1 INPUT/OUTPUT ALTERNATIVE I STORM BCD

HEC-1 INPUT/OUTPUT ALTERNATIVE 2 STORM BCD

HEC-1 INPUT/OUTPUT ALTERNATIVE 2 STORM D

HEC-1 INPUT/OUTPUT PMF

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
    1     ID  **********ALTERNATIVE 1 **********
    2     ID
    3     ID                    EAST AND WEST RANGE WASHES
    4     ID                       100-YR, 6-HR STORM
    5     ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
    6     ID               DIVERSION FROM SLOAN CHANNEL TO D8
    7     ID                  BOYLE ENGINEERING CORPORATION
    8     ID                   STORM 8CD (DARF=.67)
    9     ID                AMC 1.8 (309, 317, 305, 303 AMC 1.77)
   10     ID                NEW FUTURE DEVELOPMENT IN 306, 307, 310
   11     IT    05      0       0     200
   12     IO     5      0       0
   13     JR   PREC    .67

   14     KK   309B  SUB-BASIN 309B HYDROGRAPH
   15     KM          KINEMATIC WAVE RUNOFF COMPUTATION
   16     BA   3.64
   17     PB   2.86
   18     PC    .00   2.00   5.90   8.00  11.00  14.40  15.00  16.00  16.80  17.10
   19     PC  18.00  18.20  18.70  19.00  19.70  20.20  21.00  22.00  23.00  24.10
   20     PC  25.00  25.90  26.50  28.00  29.00  30.00  30.50  30.90  31.00  31.70
   21     PC  32.10  32.70  33.30  34.60  36.10  38.10  40.80  43.00  47.70  51.40
   22     PC  56.10  63.00  71.00  72.00  73.10  75.20  77.90  79.00  79.50  80.40
   23     PC  81.00  82.00  82.60  84.00  85.90  88.90  91.00  93.80  96.60  97.00
   24     PC  97.40  97.90  98.10  98.30  98.50  98.90  99.00  99.20  99.30  99.60
   25     PC  99.70  99.90 100.00
   26     LS     0     75
   27     UD  2.07

   28     KK  I2-I3  ROUTE FLOWS TO NODE I3
   29     RK  13830  .0109   .015      0   TRAP     30      2

   30     KK   310A  SUB-BASIN 310A HYDROGRAPH
   31     KM          KINEMATIC WAVE RUNOFF COMPUTATION
   32     BA   3.56
   33     PB   2.86
   34     LS     0     73      0      0     97
   35     UK   800   .015    .20     68
   36     UK   300   .020    .10     32
   37     RK  2750    .01    .05    .25   TRAP     30      50
   38     RK  7300    .01    .05   1.01   TRAP     30      50
   39     RK 19360  .0036    .05      0   TRAP     30      2      NO

   40     KK  NODEI3    COMBINE FLOWS AT NODE I3
   41     HC     2

   42     KK  I3-G1  ROUTE FLOWS TO NODE G1
   43     RK  6125   .0082    .015      0   TRAP     50      2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK    3068  SUB-BASIN 306B HYDROGRAPH
  45      KM          SCS RUNOFF COMPUTATION
  46      BA    4.54
  47      PB    2.86
  48      LS       0      80
  49      UD     .79

  50      KK    F2-G1   ROUTE FLOWS TO NODE G1
  51      RM       18   1.57     .10

  52      KK    307A  SUB-BASIN 307A HYDROGRAPH
  53      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  54      BA    6.23
  55      PB    2.86
  56      LS       0      73        0        0      97
  57      UK     800   .0123      .20       51
  58      UK     300    .015      .10       49
  59      RK    5000     .01      .05      .25    TRAP      30       50
  60      RK    3200    .013      .05     1.01    TRAP      30       50
  61      RK   13430   .0134      .03        0    TRAP      60      1.5      NO

  62      KK    NODE G1   COMBINE FLOWS AT G1
  63      HC       3

  64      KK    G1-G2  ROUTE FLOWS TO NODE G2
  65      RK     9880   .0030     .015        0    TRAP      60        2

  66      KK    307B  SUB-BASIN 307B HYDROGRAPH
  67      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  68      BA    1.84
  69      PB    2.86
  70      LS       0      73        0        0      97
  71      UK     800   .0123      .20       51
  72      UK     300    .015      .10       49
  73      RK    5000     .01      .05      .25
  74      RK    3200    .013      .05     1.01
  75      RK    9880    .003      .03        0    TRAP      60        2      NO

  76      KK    310B  SUB-BASIN 310B HYDROGRAPH
  77      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  78      BA    5.58
  79      PB    2.86
  80      LS       0      73        0        0      97
  81      UK     800    .015      .20       68
  82      UK     300    .020      .10       32
  83      RK    2750     .01      .05      .25    TRAP      30       50
  84      RK    7300     .01      .05     1.01    TRAP      30       50
  85      RK   17775    .009      .05        0    TRAP      60        1      NO
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  86      KK    NODE G2    COMBINE ALL FLOWS AT NODE G2
  87      HC       3

  88      KK     47B   SUB-BASIN 47B HYDROGRAPH
  89      KM           KINEMATIC RUNOFF COMPUTATION
  90      BA    4.72
  91      PB    2.86
  92      LS       0      73       0       0      97
  93      UK     800    .008     .20      69
  94      UK      80    .012     .10      31
  95      RK    2000    .003     .05     .25    TRAP      30      50
  96      RK    7000    .007     .05    1.23    TRAP      30      50
  97      RK   20150    .005     .03       0    TRAP      40       1      NO

  98      KK  G2-DIV ROUTE FLOWS TO DIVERSION
  99      RK    8100   .0022     .015      0    TRAP      60       2

 100      KK   NODEW    COMBINE FLOWS AT NODE
 101      HC       2

 102      KK     DIV
 103      DT    SLOAN
 104      DI       0     220     620    1275    2100    3060    4140
 105      DQ       0       0       0       0       0       0       0       0       0

 106      KK  DIV-DB ROUTE FLOWS THROUGH GOLF COURSE
 107      RK    4000   .0010     .030      0    TRAP      90       3

 108      KK      44   SUB-BASIN 44 HYDROGRAPH
 109      KM           SCS RUNOFF COMPUTATION
 110      BA    7.23
 111      PB    2.86
 112      LS       0      76
 113      UD    1.22

 114      KK    J-K1  ROUTE FLOW TO NODE K1
 115      RM       8     .58     .15

 116      KK    312A SUB-BASIN 312A HYDROGRAPH
 117      KM          SCS RUNOFF COMPUTATION
 118      BA    4.00
 119      PB    2.86
 120      LS       0      73
 121      UD    1.57

 122      KK     45A SUB-BASIN 45A HYDROGRAPH
 123      KM           SCS RUNOFF COMPUTATION
 124      BA    8.38
 125      PB    2.86
 126      LS       0      72       0       0       0       0
 127      UD    2.31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  128     KK   N1-K1  ROUTE FLOW TO NODE K1
  129     RK    8300   .0157    .035       0    TRAP      50       3

  130     KK   NODEK1  COMBINE FLOW AT NODE K1
  131     HC       3
  132     KO       3

  133     KK   E-J1  DETENTION BASIN E-J1
  134     RS       1    STOR       0       0
  135     SV       0      13     120     220     250     290     380     480
  136     SQ       0      60     700     920     980    4340   18385   38350
  137     KO       3

  138     KK   K1-K2  ROUTE FLOW TO NODE K2
  139     RK    7900   .0127    .015       0    TRAP      14       2

  140     KK    312B SUB-BASIN 312B HYDROGRAPH
  141     KM           SCS RUNOFF COMPUTATION
  142     BA    1.49
  143     PB    2.86
  144     LS       0      73
  145     UD    1.33

  146     KK   NODEK2   COMBINE FLOWS AT NODE K2
  147     HC       2

  148     KK   K2-O  ROUTE FLOW TO NODE O
  149     RK    6520   .0031    .015       0    TRAP      24       2

  150     KK    45B SUB-BASIN 45B HYDROGRAPH
  151     KM           SCS RUNOFF COMPUTATION
  152     BA    2.35
  153     PB    2.86
  154     LS       0      72       0       0       0       0
  155     UD    1.81

  156     KK   N2-O  ROUTE FLOW TO NODE O
  157     RK    9550   .0157    .035       0    TRAP      50       1

  158     KK    048   SUB-BASIN 048 HYDROGRAPH
  159     KM           SCS RUNOFF COMPUTATION
  160     BA    2.07
  161     PB    2.86
  162     LS       0      72
  163     UD    1.97

  164     KK    46A  SUB-BASIN 46A HYDROGRAPH
  165     KM           SCS RUNOFF COMPUTATION
  166     BA    7.35
  167     PB    3.00
  168     LS       0      73
  169     UD    1.60
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  170     KK     468  SUB-BASIN 468 HYDROGRAPH
  171     KM          SCS RUNOFF COMPUTATION
  172     BA    6.02
  173     PB    3.00
  174     LS       0      73
  175     UD    1.71

  176     KK    NODEO  COMBINE ALL FLOW AT NODE O
  177     HC       5

  178     KK    O-P1  ROUTE FLOW TO NODE P1
  179     RK   11850   .0056     .03       0    TRAP      32       2

  180     KK    312C SUB-BASIN 312C HYDROGRAPH
  181     KM          SCS RUNOFF COMPUTATION
  182     BA    1.28
  183     PB    2.86
  184     LS       0      73
  185     UD    1.51

  186     KK    L-P1  ROUTE FLOW TO NODE P1
  187     RK   10000   .0071     .03       0    TRAP      60       3

  188     KK     47A   SUB-BASIN 47A HYDROGRAPH
  189     KM          KINEMATIC RUNOFF COMPUTATION
  190     BA    2.07
  191     PB    2.86
  192     LS       0      73       0       0      97
  193     UK     800    .008     .20      69
  194     UK      80    .012     .10      31
  195     RK    2000    .003     .05     .25    TRAP      30      50
  196     RK    7000    .007     .05    1.23    TRAP      30      50
  197     RK   12250    .007     .03       0    TRAP      40       1

  198     KK      P1    COMBINE FLOWS AT P1
  199     HC       3

  200     KK    P1-P  ROUTE FLOW TO NODE P
  201     RK    6120   .0041     .015      0    TRAP      10       2

  202     KK     317   SUB-BASIN 317 HYDROGRAPH
  203     KM          SCS RUNOFF COMPUTATION
  204     BA    7.66
  205     PB    3.15
  206     LS       0      76
  207     UD     .97

  208     KK    3188   SUB-BASIN 318B HYDROGRAPH
  209     KM          SCS RUNOFF COMPUTATION
  210     BA    1.61
  211     PB    3.15
  212     LS       0      84       0
  213     UD     .37
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 214      KK     Q-P   ROUTE FLOW TO NODE P
 215      RM       4     .26     .15

 216      KK    318A   SUB BASIN 318A HYDROGRAPH
 217      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 218      BA    0.76
 219      PB    2.93
 220      LS       0      73       0       0      97
 221      UK     700    .020     .30      74
 222      UK      50    .025     .10      26
 223      RK    2000    .035     .05     .06    TRAP      30      50
 224      RK    7000    .014     .05     .55    TRAP      30      50
 225      RK    9200   .0043     .03       0    TRAP      30       1

 226      KK   NODEP  COMBINE FLOWS AT NODE P
 227      HC       4

 228      KK    P-M1   ROUTE FLOWS TO NODE M1
 229      RK    4800   .0034    .015       0    TRAP      40       1

 230      KK  NODEM1 COMBINE FLOW AT NODE M1
 231      HC       2
 232      KO       3

 233      KK     E-P DETENTION BASIN E-P
 234      KM   CONFLUENCE BASIN       4 - 5'X 3' RCB OUTLET PIPES

 235      RS       1    STOR       0
 236      SV       0       1      10      43     116     446    1085    1369
 237      SQ       0     170     421     645     810    1065    1270    1361
 238      SE       0       2       4       6       8      12      16      18
 239      KO       3
 240      ZZ
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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

**********ALTERNATIVE 1 **********

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCD (DARF=.67)
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

12 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

JP *MULTI-PLAN OPTION*
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.67

*** ***

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          **************
          *            *
130 KK    *    NODE    *    K1  COMBINE FLOW AT NODE K1
          *            *
          **************
```

132 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

131 HC HYDROGRAPH COMBINATION

ICOMP	3	NUMBER OF HYDROGRAPHS TO COMBINE

*** *** *** *** ***

HYDROGRAPH AT STATION NODE
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1213.	6.17		616.	233.	233.	233.
		(INCHES)	.292	.305	.305	.305
		(AC-FT)	305.	319.	319.	319.

CUMULATIVE AREA = 19.61 SQ MI

*** ***

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          **************
          *            *
133 KK    *     E-J1   *      DETENTION BASIN E-J1
          *            *
          **************
```

137 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

134 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	*STOR*	*TYPE OF INITIAL CONDITION*
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

135 SV	STORAGE	.0	13.0	120.0	220.0	250.0	290.0	380.0	480.0
136 SQ	DISCHARGE	0.	60.	700.	920.	980.	4340.	18385.	38350.

*** *** *** *** ***

HYDROGRAPH AT STATION E-J1
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	16.58-HR
• (CFS)	(HR)	(CFS)				
+ 725.	7.42		527.	228.	228.	228.
		(INCHES)	.250	.299	.299	.299
		(AC-FT)	261.	312.	312.	312.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	16.58-HR
• (AC-FT)	(HR)				
131.	7.42	92.	41.	41.	41.

CUMULATIVE AREA = 19.61 SQ MI

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          **************
          *            *
233 KK    *     E-P    *     DETENTION BASIN E-P
          *            *
          **************
```

239 KO OUTPUT CONTROL VARIABLES

IPRNT	3	*PRINT CONTROL*
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

235 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	*TYPE OF INITIAL CONDITION*
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

236 SV	STORAGE	.0	1.0	10.0	43.0	116.0	446.0	1085.0	1369.0
237 SQ	DISCHARGE	0.	170.	421.	645.	810.	1065.	1270.	1361.
238 SE	ELEVATION	.00	2.00	4.00	6.00	8.00	12.00	16.00	18.00

*** *** *** *** ***

HYDROGRAPH AT STATION E-P
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
• (CFS)	(HR)					
		(CFS)				
+ 1298.	9.58		1277.	933.	933.	933.
		(INCHES)	.144	.291	.291	.291
		(AC-FT)	633.	1279.	1279.	1279.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
• (AC-FT)	(HR)				
1172.	9.58	1107.	673.	673.	673.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
16.61	9.58	16.17	11.36	11.36	11.36

CUMULATIVE AREA = 82.38 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	*STATION*	*AREA*	*PLAN*		*RATIO 1*
					.67
HYDROGRAPH AT					
•	3098	3.64	1	FLOW	235.
				TIME	6.25
ROUTED TO					
+	I2-I3	3.64	1	FLOW	234.
				TIME	6.42
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	332.
				TIME	5.42
2 COMBINED AT					
+	NODE	7.20	1	FLOW	528.
				TIME	6.00
ROUTED TO					
+	I3-G1	7.20	1	FLOW	528.
				TIME	6.08
HYDROGRAPH AT					
+	3068	4.54	1	FLOW	654.
				TIME	4.25
ROUTED TO					
+	F2-G1	4.54	1	FLOW	581.
				TIME	6.00
HYDROGRAPH AT					
•	307A	6.23	1	FLOW	1261.
				TIME	4.08
3 COMBINED AT					
+	NODE	17.97	1	FLOW	1704.
				TIME	5.75
ROUTED TO					
+	G1-G2	17.97	1	FLOW	1696.
				TIME	5.83
HYDROGRAPH AT					
+	307B	1.84	1	FLOW	389.
				TIME	3.92
HYDROGRAPH AT					
+	3108	5.58	1	FLOW	534.
				TIME	4.67
3 COMBINED AT					

+	NODE	25.39	1	FLOW	2354.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	452.
				TIME	4.50
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	446.
				TIME	4.75
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	2746.
				TIME	5.67
DIVERSION TO					
+	SLOAN	30.11	1	FLOW	0.
				TIME	.08
HYDROGRAPH AT					
+	DIV	30.11	1	FLOW	2746.
				TIME	5.67
ROUTED TO					
+	DIV-DB	30.11	1	FLOW	2739.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	642.
				TIME	5.50
ROUTED TO					
+	J-K1	7.23	1	FLOW	635.
				TIME	6.00
HYDROGRAPH AT					
+	312A	4.00	1	FLOW	254.
				TIME	5.83
HYDROGRAPH AT					
+	45A	8.38	1	FLOW	384.
				TIME	6.58
ROUTED TO					
+	N1-K1	8.38	1	FLOW	383.
				TIME	6.75
3 COMBINED AT					
+	NODE	19.61	1	FLOW	1213.
				TIME	6.17
ROUTED TO					
+	E-J1	19.61	1	FLOW	725.
				TIME	7.42
ROUTED TO					
+	K1-K2	19.61	1	FLOW	725.
				TIME	7.50
HYDROGRAPH AT					

+	312B	1.49	1	FLOW	101.
				TIME	5.58
2 COMBINED AT					
+	NODE	21.10	1	FLOW	758.
				TIME	7.08
ROUTED TO					
+	K2-O	21.10	1	FLOW	757.
				TIME	7.17
HYDROGRAPH AT					
•	45B	2.35	1	FLOW	127.
				TIME	6.08
ROUTED TO					
•	N2-O	2.35	1	FLOW	123.
				TIME	6.42
HYDROGRAPH AT					
•	04B	2.07	1	FLOW	106.
				TIME	6.25
HYDROGRAPH AT					
•	46A	7.35	1	FLOW	526.
				TIME	5.83
HYDROGRAPH AT					
+	46B	6.02	1	FLOW	417.
				TIME	5.92
5 COMBINED AT					
•	NODE	38.89	1	FLOW	1719.
				TIME	6.33
ROUTED TO					
+	O-P1	38.89	1	FLOW	1710.
				TIME	6.58
HYDROGRAPH AT					
+	312C	1.28	1	FLOW	83.
				TIME	5.75
ROUTED TO					
+	L-P1	1.28	1	FLOW	79.
				TIME	6.42
HYDROGRAPH AT					
+	47A	2.07	1	FLOW	219.
				TIME	4.42
3 COMBINED AT					
•	P1	42.24	1	FLOW	1903.
				TIME	6.50
ROUTED TO					
+	P1-P	42.24	1	FLOW	1902.
				TIME	6.50
HYDROGRAPH AT					

+	317	7.66	1	FLOW	892.
				TIME	5.33
HYDROGRAPH AT					
+	3188	1.61	1	FLOW	558.
				TIME	3.75
ROUTED TO					
•	Q-P	1.61	1	FLOW	522.
				TIME	4.00
HYDROGRAPH AT					
+	318A	.76	1	FLOW	71.
				TIME	4.33
4 COMBINED AT					
+	NODE	52.27	1	FLOW	2545.
				TIME	5.83
ROUTED TO					
+	P-M1	52.27	1	FLOW	2544.
				TIME	5.83
2 COMBINED AT					
•	NODEM1	82.38	1	FLOW	5284.
				TIME	5.83
ROUTED TO					
+	E-P	82.38	1	FLOW	1298.
				TIME	9.58

** PEAK STAGES IN FEET **

1	STAGE	16.61
	TIME	9.58

*** NORMAL END OF HEC-1 ***

```
      LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
           1    ID  **********ALTERNATIVE 2**********
           2    ID
           3    ID                    EAST AND WEST RANGE WASHES
           4    ID                      100-YR, 6-HR STORM
           5    ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
           6    ID               DIVERSION FROM SLOAN CHANNEL TO DB
           7    ID                   BOYLE ENGINEERING CORPORATION
           8    ID                    STORM BCD (DARF=.67)
           9    ID                AMC 1.8 (309, 317, 305, 303 AMC 1.77)
          10    ID                NEW FUTURE DEVELOPMENT IN 306, 307, 310
          11    IT     05       0       0     200
          12    IO      5       0       0
          13    JR    PREC     .67

          14    KK    3098  SUB-BASIN 3098 HYDROGRAPH
          15    KM            KINEMATIC WAVE RUNOFF COMPUTATION
          16    BA    3.64
          17    PB    2.86
          18    PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
          19    PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.10
          20    PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
          21    PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
          22    PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
          23    PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.00
          24    PC   97.40   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60
          25    PC   99.70   99.90  100.00
          26    LS       0      75
          27    UD    2.07

          28    KK   I2-I3  ROUTE FLOWS TO NODE I3
          29    RK   13830   .0109    .015       0    TRAP      30       2

          30    KK    310A  SUB-BASIN 310A HYDROGRAPH
          31    KM            KINEMATIC WAVE RUNOFF COMPUTATION
          32    BA    3.56
          33    PB    2.86
          34    LS       0      73       0       0      97
          35    UK     800    .015     .20      68
          36    UK     300    .020     .10      32
          37    RK    2750     .01     .05     .25    TRAP      30      50
          38    RK    7300     .01     .05    1.01    TRAP      30      50
          39    RK   19360   .0036     .05       0    TRAP      30       2      NO

          40    KK  NODEI3    COMBINE FLOWS AT NODE I3
          41    HC       2

          42    KK   I3-G1  ROUTE FLOWS TO NODE G1
          43    RK    6125   .0082    .015       0    TRAP      50       2
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```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK    3068  SUB-BASIN 3068 HYDROGRAPH
  45      KM          SCS RUNOFF COMPUTATION
  46      BA    4.54
  47      PB    2.86
  48      LS       0      80
  49      UD     .79

  50      KK    F2-G1   ROUTE FLOWS TO NODE G1
  51      RM       18   1.57     .10

  52      KK    307A  SUB-BASIN 307A HYDROGRAPH
  53      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  54      BA    6.23
  55      PB    2.86
  56      LS       0      73       0       0      97
  57      UK     800   .0123     .20      51
  58      UK     300    .015     .10      49
  59      RK    5000     .01     .05     .25    TRAP     30      50
  60      RK    3200    .013     .05    1.01    TRAP     30      50
  61      RK   13430   .0134     .03       0    TRAP     60     1.5     NO

  62      KK    NODE G1    COMBINE FLOWS AT G1
  63      HC       3

  64      KK    G1-G2  ROUTE FLOWS TO NODE G2
  65      RK    9880   .0030    .015       0    TRAP     60       2

  66      KK    307B  SUB-BASIN 307B HYDROGRAPH
  67      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  68      BA    1.84
  69      PB    2.86
  70      LS       0      73       0       0      97
  71      UK     800   .0123     .20      51
  72      UK     300    .015     .10      49
  73      RK    5000     .01     .05     .25
  74      RK    3200    .013     .05    1.01
  75      RK    9880    .003     .03       0    TRAP     60       2     NO

  76      KK    310B  SUB-BASIN 310B HYDROGRAPH
  77      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  78      BA    5.58
  79      PB    2.86
  80      LS       0      73       0       0      97
  81      UK     800    .015     .20      68
  82      UK     300    .020     .10      32
  83      RK    2750     .01     .05     .25    TRAP     30      50
  84      RK    7300     .01     .05    1.01    TRAP     30      50
  85      RK   17775    .009     .05       0    TRAP     60       1     NO
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  86      KK    NODE G2    COMBINE ALL FLOWS AT NODE G2
  87      HC       3

  88      KK     478   SUB-BASIN 478 HYDROGRAPH
  89      KM           KINEMATIC RUNOFF COMPUTATION
  90      BA    4.72
  91      PB    2.86
  92      LS       0      73       0       0      97
  93      UK     800    .008     .20      69
  94      UK      80    .012     .10      31
  95      RK    2000    .003     .05     .25    TRAP     30      50
  96      RK    7000    .007     .05    1.23    TRAP     30      50
  97      RK   20150    .005     .03       0    TRAP     40       1      NO

  98      KK  G2-DIV ROUTE FLOWS TO DIVERSION
  99      RK    8100   .0022     .015      0    TRAP     60       2

 100      KK   NODEW    COMBINE FLOWS AT NODE
 101      HC       2

 102      KK     DIV
 103      DT   SLOAN
 104      DI       0      50     295     720    1265    1910    2650    3460
 105      DQ       0      50     100     170     250     350     470     600

 106      KK  DIV-DB ROUTE FLOWS THROUGH GOLF COURSE
 107      RK    4000   .0010     .030      0    TRAP     90       3

 108      KK      44   SUB-BASIN 44 HYDROGRAPH
 109      KM           SCS RUNOFF COMPUTATION
 110      BA    7.23
 111      PB    2.86
 112      LS       0      76
 113      UD    1.22

 114      KK    J-K1  ROUTE FLOW TO NODE K1
 115      RM       8     .58     .15

 116      KK    312A SUB-BASIN 312A HYDROGRAPH
 117      KM          SCS RUNOFF COMPUTATION
 118      BA    4.00
 119      PB    2.86
 120      LS       0      73
 121      UD    1.57

 122      KK     45A SUB-BASIN 45A HYDROGRAPH
 123      KM          SCS RUNOFF COMPUTATION
 124      BA    8.38
 125      PB    2.86
 126      LS       0      72       0       0       0       0
 127      UD    2.31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  128     KK   N1-K1  ROUTE FLOW TO NODE K1
  129     RK    8300   .0157    .035       0    TRAP      50       3

  130     KK   NODEK1  COMBINE FLOW AT NODE K1
  131     HC       3
  132     KO       3

  133     KK   E-J1  DETENTION BASIN E-J1
  134     RS       1    STOR       0       0
  135     SV       0      13     120     220     250     290     380     480
  136     SQ       0      60     700     920     980    4340   18385   38350
  137     KO       3

  138     KK   K1-K2  ROUTE FLOW TO NODE K2
  139     RK    7900   .0127    .015       0    TRAP      14       2

  140     KK   312B SUB-BASIN 312B HYDROGRAPH
  141     KM          SCS RUNOFF COMPUTATION
  142     BA   1.49
  143     PB   2.86
  144     LS       0      73
  145     UD   1.33

  146     KK   NODEK2   COMBINE FLOWS AT NODE K2
  147     HC       2

  148     KK   K2-O  ROUTE FLOW TO NODE O
  149     RK    6520   .0031    .015       0    TRAP      24       2

  150     KK    45B SUB-BASIN 45B HYDROGRAPH
  151     KM          SCS RUNOFF COMPUTATION
  152     BA   2.35
  153     PB   2.86
  154     LS       0      72       0       0       0       0
  155     UD   1.81

  156     KK   N2-O  ROUTE FLOW TO NODE O
  157     RK    9550   .0157    .035       0    TRAP      50       1

  158     KK    04B   SUB-BASIN 04B HYDROGRAPH
  159     KM          SCS RUNOFF COMPUTATION
  160     BA   2.07
  161     PB   2.86
  162     LS       0      72
  163     UD   1.97

  164     KK    46A  SUB-BASIN 46A HYDROGRAPH
  165     KM          SCS RUNOFF COMPUTATION
  166     BA   7.35
  167     PB   3.00
  168     LS       0      73
  169     UD   1.60
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  170     KK     468  SUB-BASIN 468 HYDROGRAPH
  171     KM          SCS RUNOFF COMPUTATION
  172     BA    6.02
  173     PB    3.00
  174     LS       0      73
  175     UD    1.71

  176     KK    NODEO  COMBINE ALL FLOW AT NODE O
  177     HC       5

  178     KK    O-P1  ROUTE FLOW TO NODE P1
  179     RK   11850   .0056     .03        0    TRAP       32        2

  180     KK    312C SUB-BASIN 312C HYDROGRAPH
  181     KM          SCS RUNOFF COMPUTATION
  182     BA    1.28
  183     PB    2.86
  184     LS       0      73
  185     UD    1.51

  186     KK    L-P1  ROUTE FLOW TO NODE P1
  187     RK   10000   .0071     .03        0    TRAP       60        3

  188     KK     47A   SUB-BASIN 47A HYDROGRAPH
  189     KM           KINEMATIC RUNOFF COMPUTATION
  190     BA    2.07
  191     PB    2.86
  192     LS       0      73        0        0      97
  193     UK     800    .008      .20       69
  194     UK      80    .012      .10       31
  195     RK    2000    .003      .05      .25    TRAP       30       50
  196     RK    7000    .007      .05     1.23    TRAP       30       50
  197     RK   12250    .007      .03        0    TRAP       40        1

  198     KK      P1    COMBINE FLOWS AT P1
  199     HC       3

  200     KK    P1-P  ROUTE FLOW TO NODE P
  201     RK    6120   .0041     .015        0    TRAP       10        2

  202     KK     317   SUB-BASIN 317 HYDROGRAPH
  203     KM           SCS RUNOFF COMPUTATION
  204     BA    7.66
  205     PB    3.15
  206     LS       0      76
  207     UD     .97

  208     KK    3188   SUB-BASIN 3188 HYDROGRAPH
  209     KM           SCS RUNOFF COMPUTATION
  210     BA    1.61
  211     PB    3.15
  212     LS       0      84        0
  213     UD     .37
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  214     KK     Q-P   ROUTE FLOW TO NODE P
  215     RM       4     .26     .15

  216     KK    318A   SUB BASIN 318A HYDROGRAPH
  217     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  218     BA    0.76
  219     PB    2.93
  220     LS       0      73       0       0      97
  221     UK     700    .020     .30      74
  222     UK      50    .025     .10      26
  223     RK    2000    .035     .05     .06    TRAP      30      50
  224     RK    7000    .014     .05     .55    TRAP      30      50
  225     RK    9200   .0043     .03       0    TRAP      30       1

  226     KK   NODEP  COMBINE FLOWS AT NODE P
  227     HC       4

  228     KK   P-M1   ROUTE FLOWS TO NODE M1
  229     RK    4800   .0034    .015       0    TRAP      40       1

  230     KK  NODEM1 COMBINE FLOW AT NODE M1
  231     HC       2
  232     KO       3

  233     KK    E-P DETENTION BASIN E-P
  234     KM  CONFLUENCE BASIN   3 - 5'X 3' RCB OUTLET PIPES
  235     RS       1    STOR       0
  236     SV       0       1      10      43     116     446    1085    1369
  237     SQ       0     125     316     484     607     799     952    1020
  238     SE       0       2       4       6       8      12      16      18
  239     KO       3
  240     ZZ
```

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FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

**********ALTERNATIVE 2**********

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCD (DARF=.67)
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

12 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.67

*** ***

```
              **************
              *            *
 130 KK       *      NODE  *     K1  COMBINE FLOW AT NODE K1
              *            *
              **************

 132 KO           OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

 131 HC           HYDROGRAPH COMBINATION
                       ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

        ***             ***             ***             ***             ***

                          HYDROGRAPH AT STATION     NODE
                            FOR PLAN 1, RATIO =  .67

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR     16.58-HR
+    (CFS)       (HR)
                          (CFS)
+     1213.      6.17                616.        233.        233.        233.
                        (INCHES)      .292        .305        .305        .305
                        (AC-FT)       305.        319.        319.        319.

                          CUMULATIVE AREA =   19.61 SQ MI
```

*** ***

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          **************
          *            *
230 KK    *   NODEM1   *      COMBINE FLOW AT NODE M1
          *            *
          **************

232 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

231 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                        ***

     ***             ***             ***             ***             ***

                       HYDROGRAPH AT STATION   NODEM1
                         FOR PLAN 1, RATIO =  .67

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      16.58-HR
+   (CFS)       (HR)
                          (CFS)
+    5284.      5.83                3440.       1456.       1456.       1456.
                         (INCHES)     .388         .454        .454        .454
                         (AC-FT)     1706.       1995.       1995.       1995.

                       CUMULATIVE AREA =   82.38 SQ MI
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .67
HYDROGRAPH AT					
•	309B	3.64	1	FLOW	235.
				TIME	6.25
ROUTED TO					
+	I2-I3	3.64	1	FLOW	234.
				TIME	6.42
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	332.
				TIME	5.42
2 COMBINED AT					
•	NODE	7.20	1	FLOW	528.
				TIME	6.00
ROUTED TO					
+	I3-G1	7.20	1	FLOW	528.
				TIME	6.08
HYDROGRAPH AT					
•	306B	4.54	1	FLOW	654.
				TIME	4.25
ROUTED TO					
+	F2-G1	4.54	1	FLOW	581.
				TIME	6.00
HYDROGRAPH AT					
+	307A	6.23	1	FLOW	1261.
				TIME	4.08
3 COMBINED AT					
+	NODE	17.97	1	FLOW	1704.
				TIME	5.75
ROUTED TO					
•	G1-G2	17.97	1	FLOW	1696.
				TIME	5.83
HYDROGRAPH AT					
•	307B	1.84	1	FLOW	389.
				TIME	3.92
HYDROGRAPH AT					
+	310B	5.58	1	FLOW	534.
				TIME	4.67
3 COMBINED AT					

+	NODE	25.39	1	FLOW	2354.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	452.
				TIME	4.50
ROUTED TO					
•	G2-DIV	4.72	1	FLOW	446.
				TIME	4.75
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	2746.
				TIME	5.67
DIVERSION TO					
+	SLOAN	30.11	1	FLOW	0.
				TIME	.08
HYDROGRAPH AT					
+	DIV	30.11	1	FLOW	2746.
				TIME	5.67
ROUTED TO					
+	DIV-DB	30.11	1	FLOW	2739.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	642.
				TIME	5.50
ROUTED TO					
•	J-K1	7.23	1	FLOW	635.
				TIME	6.00
HYDROGRAPH AT					
•	312A	4.00	1	FLOW	254.
				TIME	5.83
HYDROGRAPH AT					
+	45A	8.38	1	FLOW	384.
				TIME	6.58
ROUTED TO					
+	N1-K1	8.38	1	FLOW	383.
				TIME	6.75
3 COMBINED AT					
•	NODE	19.61	1	FLOW	1213.
				TIME	6.17
ROUTED TO					
•	E-J1	19.61	1	FLOW	725.
				TIME	7.42
ROUTED TO					
+	K1-K2	19.61	1	FLOW	725.
				TIME	7.50
HYDROGRAPH AT					

+	312B	1.49	1	FLOW	101.
				TIME	5.58
2 COMBINED AT					
+	NODE	21.10	1	FLOW	758.
				TIME	7.08
ROUTED TO					
•	K2-O	21.10	1	FLOW	757.
				TIME	7.17
HYDROGRAPH AT					
+	45B	2.35	1	FLOW	127.
				TIME	6.08
ROUTED TO					
+	N2-O	2.35	1	FLOW	123.
				TIME	6.42
HYDROGRAPH AT					
+	048	2.07	1	FLOW	106.
				TIME	6.25
HYDROGRAPH AT					
+	46A	7.35	1	FLOW	526.
				TIME	5.83
HYDROGRAPH AT					
+	46B	6.02	1	FLOW	417.
				TIME	5.92
5 COMBINED AT					
•	NODE	38.89	1	FLOW	1719.
				TIME	6.33
ROUTED TO					
+	O-P1	38.89	1	FLOW	1710.
				TIME	6.58
HYDROGRAPH AT					
+	312C	1.28	1	FLOW	83.
				TIME	5.75
ROUTED TO					
+	L-P1	1.28	1	FLOW	79.
				TIME	6.42
HYDROGRAPH AT					
+	47A	2.07	1	FLOW	219.
				TIME	4.42
3 COMBINED AT					
+	P1	42.24	1	FLOW	1903.
				TIME	6.50
ROUTED TO					
+	P1-P	42.24	1	FLOW	1902.
				TIME	6.50
HYDROGRAPH AT					

+	317	7.66	1	FLOW	892.
				TIME	5.33
HYDROGRAPH AT					
+	3188	1.61	1	FLOW	558.
				TIME	3.75
ROUTED TO					
+	Q-P	1.61	1	FLOW	522.
				TIME	4.00
HYDROGRAPH AT					
+	318A	.76	1	FLOW	71.
				TIME	4.33
4 COMBINED AT					
+	NODE	52.27	1	FLOW	2545.
				TIME	5.83
ROUTED TO					
•	P-M1	52.27	1	FLOW	2544.
				TIME	5.83
2 COMBINED AT					
+	NODEM1	82.38	1	FLOW	5284.
				TIME	5.83
ROUTED TO					
•	E-P	82.38	1	FLOW	1298.
				TIME	9.58

** PEAK STAGES IN FEET **

1	STAGE	16.61
	TIME	9.58

*** NORMAL END OF HEC-1 ***

1 ****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
****

**********ALTERNATIVE 2**********

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCD (DARF=.67)
AMC 1.8 (309, 317, 305, 303 AMC 1.77)
NEW FUTURE DEVELOPMENT IN 306, 307, 310

12 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.67

*** ***

```
          **************
          *            *
130 KK    *      NODE  *     K1  COMBINE FLOW AT NODE K1
          *            *
          **************
```

132 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

131 HC HYDROGRAPH COMBINATION

ICOMP	3	NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION NODE
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
(CFS)	(HR)	(CFS)				
1213.	6.17		616.	233.	233.	233.
		(INCHES)	.292	.305	.305	.305
		(AC-FT)	305.	319.	319.	319.

CUMULATIVE AREA = 19.61 SQ MI

*** ***

```
          **************
          *            *
133 KK    *     E-J1   *      DETENTION BASIN E-J1
          *            *
          **************
```

137 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

134 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

135 SV	STORAGE	.0	13.0	120.0	220.0	250.0	290.0	380.0	480.0
136 SQ	DISCHARGE	0.	60.	700.	920.	980.	4340.	18385.	38350.

*** *** *** *** ***

HYDROGRAPH AT STATION E-J1
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
• (CFS)	(HR)					
		(CFS)				
• 725.	7.42		527.	228.	228.	228.
		(INCHES)	.250	.299	.299	.299
		(AC-FT)	261.	312.	312.	312.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	16.58-HR
• (AC-FT)	(HR)					
131.	7.42		92.	41.	41.	41.

CUMULATIVE AREA = 19.61 SQ MI

*** ***

```
          **************
          *            *
230 KK    *   NODEM1   *      COMBINE FLOW AT NODE M1
          *            *
          **************

232 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

231 HC          HYDROGRAPH COMBINATION
                     ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

     ***            ***            ***            ***            ***

                       HYDROGRAPH AT STATION   NODEM1
                         FOR PLAN 1, RATIO =  .67

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR        24-HR       72-HR      16.58-HR
+   (CFS)       (HR)
                        (CFS)
+    4799.      5.83                 3109.       1298.       1298.       1298.
                      (INCHES)        .351        .405        .405        .405
                      (AC-FT)        1542.       1779.       1779.       1779.

                       CUMULATIVE AREA =   82.38 SQ MI
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*** ***

```
          **************
          *            *
233 KK    *     E-P    *     DETENTION BASIN E-P
          *            *
          **************
```

239 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

235 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

236 SV	STORAGE	.0	1.0	10.0	43.0	116.0	446.0	1085.0	1369.0
237 SQ	DISCHARGE	0.	125.	316.	484.	607.	799.	952.	1020.
238 SE	ELEVATION	.00	2.00	4.00	6.00	8.00	12.00	16.00	18.00

*** *** *** *** ***

HYDROGRAPH AT STATION E-P
FOR PLAN 1, RATIO = .67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 967.	10.00		956.	697.	697.	697.
		(INCHES)	.108	.218	.218	.218
		(AC-FT)	474.	956.	956.	956.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
1149.	10.00	1101.	678.	678.	678.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
16.45	10.00	16.12	11.34	11.34	11.34

CUMULATIVE AREA = 82.38 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .67
HYDROGRAPH AT					
+	309B	3.64	1	FLOW	235.
				TIME	6.25
ROUTED TO					
+	I2-I3	3.64	1	FLOW	234.
				TIME	6.42
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	332.
				TIME	5.42
2 COMBINED AT					
•	NODE	7.20	1	FLOW	528.
				TIME	6.00
ROUTED TO					
+	I3-G1	7.20	1	FLOW	528.
				TIME	6.08
HYDROGRAPH AT					
•	306B	4.54	1	FLOW	654.
				TIME	4.25
ROUTED TO					
+	F2-G1	4.54	1	FLOW	581.
				TIME	6.00
HYDROGRAPH AT					
•	307A	6.23	1	FLOW	1261.
				TIME	4.08
3 COMBINED AT					
+	NODE	17.97	1	FLOW	1704.
				TIME	5.75
ROUTED TO					
•	G1-G2	17.97	1	FLOW	1696.
				TIME	5.83
HYDROGRAPH AT					
+	307B	1.84	1	FLOW	389.
				TIME	3.92
HYDROGRAPH AT					
+	310B	5.58	1	FLOW	534.
				TIME	4.67
3 COMBINED AT					

+	NODE	25.39	1	FLOW	2354.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	452.
				TIME	4.50
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	446.
				TIME	4.75
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	2746.
				TIME	5.67
DIVERSION TO					
•	SLOAN	30.11	1	FLOW	485.
				TIME	5.67
HYDROGRAPH AT					
•	DIV	30.11	1	FLOW	2260.
				TIME	5.67
ROUTED TO					
+	DIV-OB	30.11	1	FLOW	2254.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	642.
				TIME	5.50
ROUTED TO					
•	J-K1	7.23	1	FLOW	635.
				TIME	6.00
HYDROGRAPH AT					
+	312A	4.00	1	FLOW	254.
				TIME	5.83
HYDROGRAPH AT					
•	45A	8.38	1	FLOW	384.
				TIME	6.58
ROUTED TO					
•	N1-K1	8.38	1	FLOW	383.
				TIME	6.75
3 COMBINED AT					
+	NODE	19.61	1	FLOW	1213.
				TIME	6.17
ROUTED TO					
+	E-J1	19.61	1	FLOW	725.
				TIME	7.42
ROUTED TO					
+	K1-K2	19.61	1	FLOW	725.
				TIME	7.50
HYDROGRAPH AT					

•	312B	1.49	1	FLOW	101.
				TIME	5.58
2 COMBINED AT					
•	NODE	21.10	1	FLOW	758.
				TIME	7.08
ROUTED TO					
•	K2-O	21.10	1	FLOW	757.
				TIME	7.17
HYDROGRAPH AT					
+	458	2.35	1	FLOW	127.
				TIME	6.08
ROUTED TO					
•	N2-O	2.35	1	FLOW	123.
				TIME	6.42
HYDROGRAPH AT					
+	048	2.07	1	FLOW	106.
				TIME	6.25
HYDROGRAPH AT					
+	46A	7.35	1	FLOW	526.
				TIME	5.83
HYDROGRAPH AT					
•	468	6.02	1	FLOW	417.
				TIME	5.92
5 COMBINED AT					
+	NODE	38.89	1	FLOW	1719.
				TIME	6.33
ROUTED TO					
+	O-P1	38.89	1	FLOW	1710.
				TIME	6.58
HYDROGRAPH AT					
•	312C	1.28	1	FLOW	83.
				TIME	5.75
ROUTED TO					
+	L-P1	1.28	1	FLOW	79.
				TIME	6.42
HYDROGRAPH AT					
•	47A	2.07	1	FLOW	219.
				TIME	4.42
3 COMBINED AT					
+	P1	42.24	1	FLOW	1903.
				TIME	6.50
ROUTED TO					
+	P1-P	42.24	1	FLOW	1902.
				TIME	6.50
HYDROGRAPH AT					

+	317	7.66	1	FLOW	892.
				TIME	5.33
HYDROGRAPH AT					
+	318B	1.61	1	FLOW	558.
				TIME	3.75
ROUTED TO					
+	O-P	1.61	1	FLOW	522.
				TIME	4.00
HYDROGRAPH AT					
+	318A	.76	1	FLOW	71.
				TIME	4.33
4 COMBINED AT					
+	NODE	52.27	1	FLOW	2545.
				TIME	5.83
ROUTED TO					
+	P-M1	52.27	1	FLOW	2544.
				TIME	5.83
2 COMBINED AT					
+	NODEM1	82.38	1	FLOW	4799.
				TIME	5.83
ROUTED TO					
+	E-P	82.38	1	FLOW	967.
				TIME	10.00

** PEAK STAGES IN FEET **

1	STAGE	16.45
	TIME	10.00

*** NORMAL END OF HEC-1 ***

```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
*** NOLIST ***
1                                                    ****
                          FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
                    U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                                    ****

                                  **********ALTERNATIVE 2**********

                                          EAST AND WEST RANGE WASHES
                                             100-YR, 6-HR STORM
                                       FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
                                            DIVERSION FROM SLOAN CHANNEL TO DB
                                               BOYLE ENGINEERING CORPORATION
                                                STORM D (DARF=.74)
                                             AMC 1.8 (309, 317, 305, 303 AMC 1.77)
                                            NEW FUTURE DEVELOPMENT IN 306, 307, 310

  10 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          5  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                        NMIN          5  MINUTES IN COMPUTATION INTERVAL
                       IDATE      1   0  STARTING DATE
                       ITIME       0000  STARTING TIME
                          NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                       NQDATE     1   0  ENDING DATE
                       NQTIME       1635  ENDING TIME

                     COMPUTATION INTERVAL      .08 HOURS
                          TOTAL TIME BASE    16.58 HOURS

          ENGLISH UNITS

     JP          MULTI-PLAN OPTION
                       NPLAN          1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                     RATIOS OF PRECIPITATION
                     .74
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .74
HYDROGRAPH AT					
•	3098	3.64	1	FLOW	301.
				TIME	6.17
ROUTED TO					
•	I2-I3	3.64	1	FLOW	299.
				TIME	6.42
HYDROGRAPH AT					
•	310A	3.56	1	FLOW	400.
				TIME	5.50
2 COMBINED AT					
•	NODE	7.20	1	FLOW	659.
				TIME	6.00
ROUTED TO					
•	I3-G1	7.20	1	FLOW	659.
				TIME	6.08
HYDROGRAPH AT					
•	3068	4.54	1	FLOW	819.
				TIME	4.25
ROUTED TO					
•	F2-G1	4.54	1	FLOW	722.
				TIME	6.00
HYDROGRAPH AT					
•	307A	6.23	1	FLOW	1421.
				TIME	4.08
3 COMBINED AT					
•	NODE	17.97	1	FLOW	2085.
				TIME	5.67
ROUTED TO					
•	G1-G2	17.97	1	FLOW	2078.
				TIME	5.83
HYDROGRAPH AT					
•	3078	1.84	1	FLOW	432.
				TIME	3.92
HYDROGRAPH AT					
•	3108	5.58	1	FLOW	634.
				TIME	4.58
3 COMBINED AT					

+	NODE	25.39	1	FLOW	2877.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	521.
				TIME	4.50
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	516.
				TIME	4.67
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	3342.
				TIME	5.67
DIVERSION TO					
•	SLOAN	30.11	1	FLOW	581.
				TIME	5.67
HYDROGRAPH AT					
+	DIV	30.11	1	FLOW	2761.
				TIME	5.67
ROUTED TO					
•	DIV-DB	30.11	1	FLOW	2754.
				TIME	5.83
HYDROGRAPH AT					
+	SLOAN	.00	1	FLOW	581.
				TIME	5.67

*** NORMAL END OF HEC-1 ***

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         FEBRUARY 1981                 *
*        REVISED 01 JUN 88              *
*                                       *
*  RUN DATE  06/30/1992  TIME  16:54:57 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```


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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*** FREE ***
    1     ID                CONFLUENCE DETENTION BASIN
    2     ID                JUNE 30, 1992 PMP STORM EVENT
    3     ID                COMPOSIT CONDITIONS
    4     IT      15        0        0      100
    5     IO       5        0        0

    6     KK     N-E
    7     KM    NORTH-EAST TRIBUTARY
    8     BA   24.73
    9     PB    7.2
   10     IN     15
   11     PC   .009    .019    .028    .037    .058    .079      .1    .12    .519    .667
   12     PC   .741    .787    .819    .852    .884    .917    .931    .944    .958    .972
   13     PC   .979    .986    .993       1
   14     LS      0      73       0
   15     UD   0.87

   16     KK   ROUTE
   17     KM    ROUTE N-E THROUGH S-E
   18     RM       3     .75     .45

   19     KK     S-E
   20     KM    SOUTH-EAST TRIBUTARY
   21     BA   24.54
   22     LS      0      77       0
   23     UD   0.89

   24     KK       X
   25     KM    COMBINE ROUTED N-E AND S-E
   26     HC       2

   27     KK    WEST
   28     KM    WEST TRIBUTARY
   29     BA   30.11
   30     LS      0      81       0
   31     UD   1.18

   32     KK  DIVERT
   33     KM    DIVERT OVERFLOW FROM CHANNEL
   34     DT    OVRT
   35     DI      0    4000   38000
   36     DQ      0       0   34000

   37     KK   BASIN
   38     KM    COMBINE FLOWS AT BASIN

   39     HC       2
   40     ZZ
```

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*        FEBRUARY 1981                  *
*       REVISED 01 JUN 88               *
*                                       *
*  RUN DATE  06/30/1992  TIME  16:54:57 *
*                                       *
*****************************************
```


```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 551-1748                *
*                                       *
*****************************************
```


CONFLUENCE DETENTION BASIN
JUNE 30, 1992 PMP STORM EVENT
COMPOSIT CONDITIONS

5 IO	OUTPUT CONTROL VARIABLES			
	IPRNT		5	PRINT CONTROL
	IPLOT		0	PLOT CONTROL
	QSCAL		0.	HYDROGRAPH PLOT SCALE
IT	HYDROGRAPH TIME DATA			
	NMIN		15	MINUTES IN COMPUTATION INTERVAL
	IDATE	1	0	STARTING DATE
	ITIME		0000	STARTING TIME
	NQ		100	NUMBER OF HYDROGRAPH ORDINATES
	NDDATE	2	0	ENDING DATE
	NDTIME		0045	ENDING TIME
	ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .25 HOURS
TOTAL TIME BASE 24.75 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
					6-HOUR	24-HOUR	72-HOUR			
+	HYDROGRAPH AT	N-E	29978.	3.00	10893.	2732.	2649.	24.73		
+	ROUTED TO	ROUTE	29329.	3.75	10885.	2732.	2649.	24.73		
+	HYDROGRAPH AT	S-E	33229.	3.00	11959.	3000.	2909.	24.54		
+	2 COMBINED AT	X	53256.	3.50	22760.	5732.	5558.	49.27		
+	HYDROGRAPH AT	WEST	37874.	3.25	15994.	4041.	3919.	30.11		
+	DIVERSION TO	DVRT	33874.	2.25	12355.	3089.	2995.	30.11		
+	HYDROGRAPH AT	DIVERT	4000.	2.25	3639.	952.	923.	30.11		
+	2 COMBINED AT	BASIN	57256.	3.50	26398.	6684.	6481.	79.38		

*** NORMAL END OF HEC-1 ***

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE BASIN Description PMP

Job No. SHEET /

By Date Chkd.By Date

SOUTH + EAST TRIBUTARY

Subbasin	Area	CN
46A	7.35	78
46B	6.02	78
048	2.07	72
317	7.66	76
47A	2.07	80
318A	0.76	79
318B	1.61	84
	27.54	AVE 77

$T_{LAG} = 20 K_n (L L_c / \sqrt{S})^{1/3}$

$K_n = 0.030$

$L = 9.18$ mi

$L_c = 4.89$ mi

$S = 185$ ft/mi (3.5%)

$T_{LAG} = 20(0.03)(9.18(4.89/\sqrt{185})^{1/3} = 0.89$

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE BASIN Description PMP

Job No. SHEET /

By Date Chkd.By Date

NORTH-EAST TRIBUTARY

Subbasin	Area	CN
44	7.28	76
45A	8.38	72
45B	2.35	72
312A	4.00	73
312B	1.49	73
312C	1.28	73
	24.73 mi^2	USE 73

$$TLAG = 20\ K_m\ (L\ L_c / \sqrt{S})^{1/3}$$

K_m = 0.030
L = 9.52
L_c = 5.01
S = 240 Ft/mi (4.5 %)

$$TLAG = 20(0.03)(9.52(5.01/\sqrt{240}))^{1/3} = 0.87\ hr$$

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE BASIN Description PMP

Job No.

By Date Chkd.By Date

SHEET /

MUSKINGUM ROUTING

X = 0.45 (MOSTLY CHANNEL FLOW)

L = 2.83 mi = 14,900 ft

V = 6 fps

$\Delta t = \frac{L}{V} = \frac{14900 \text{ ft}}{6 \text{ ft/sec}} = \frac{2483 \text{ sec}}{3600} = 0.69 \text{ hr} = AMSKK$

NMIN = 15 min

$$\frac{1}{2(1-0.45)} \leq \frac{AMSKK \quad 60 \text{ min/hr}}{(1) \quad (15 \text{ min}) \quad (\text{hr})} \leq \frac{1}{2(0.45)}$$

2.76

$0.23 \leq AMSKK \leq 0.28$

$.91 \leq \frac{.69(60)}{15 \text{ MINS}} \leq 1.11$

$K = 0.69$

$\frac{2.76}{NPT} \approx 1$

$n = 2.76$

$n = 3$

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE DETENTION BASIN Description PMF - WEST TRIBUTARY
Job No. DETERMINE WEIGHTED AVE SCS CN
By FJO Date 6/25/92 Chkd.By ____ Date ____ SHEET /

WEST TRIB

Subbasin	A	CN Pervious	CN Impervious
309 B	3.64	75	—
310 A	3.56	73 (68)	97 (32)
306 B	4.54	80	—
307 A	6.23	73 (51)	97 (49)
307 B	1.84	73 (51)	97 (49)
310 B	5.58	73 (68)	97 (32)
47 B	4.72	73 (69)	97 (31)
	30.11 mi^2		

WEIGHTED CN

Subbasin	Area		CN			% Area	CN x %
309 B	3.64	x	75	=	273	11 %	8.25
310 A	3.56	x	81	=	288	12 %	9.72
306 B	4.54	x	80	=	363	15 %	12.00
307 A	6.23	x	85	=	530	22 %	18.70
307 B	1.84	x	85	=	156	6 %	5.1
310 B	5.58	x	81	=	452	19 %	15.39
47 B	4.72	x	80	=	378	15 %	12.00
	30.11		AVE 81		2440	100 %	81.16
					Ave = 349		

USE 81 AS SCS CN FOR WEST TRIB

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE DETENTION
Job No.
By FJO Date 6/25/92 Chkd.By ____ Date ____

Description PMF - EAST TRIBUTARY
DETERMINE WEIGHTED AVE SCS CN

SHEET /

EAST TRIB

SUBBASIN	AREA	PERVIOUS	IMPERVIOUS	$\hat{CN}$	WEIGHTED AREA $CN * AREA$
44	7.23	76		76	549
45 A	8.38	72		72	603
312 A	4.00	73		73	292
45 B	2.35	72		72	169
46 A	7.35	73		73	537
46 B	6.02	73		73	439
048	2.07	72		72	149
312 B	1.49	73		73	109
312 C	1.28	73		73	93
47 A	2.07	73(69)	97(31)	80	166
317	7.66	76		76	582
318 A	0.76	73(74)	97(26)	79	60
318 B	1.61	84		84	135
	52.27				

WEIGHTED CN SUBBASIN	WEIGHTED AREA	% of AREA	% * $\hat{CN}$	
44	549	14	10.64	
45A	603	16	11.52	USE 74 AS
312A	292	8	5.84	
45B	169	4	2.88	SCS CN FOR
46A	537	14	10.22	EAST TRIB
46B	439	11	8.03	
048	149	4	2.88	
312B	109	3	2.19	
312C	93	2	1.46	
47A	166	4	3.20	
317	582	15	11.40	
318A	60	1	.79	
318B	135	4	3.36	
	3883	100%	74.01	

MR 299

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE BASIN Description TLAG

Job No. SHEET /

By Date Chkd.By Date

WEST TRIBUTARY

$$T_{LAG} = 20\, K_m (L\, L_c / \sqrt{S})^{1/3}$$

K_m = 0.1030

S = 26.4 ft/mi (0.5%)

L = 10.2 mi

L_c = 3.8 mi

$$T_{LAG} = 20(0.103)(10.2\ (3.8/\sqrt{26.4}))^{1/3} = 1.18\ hr$$

EAST TRIBUTARY

K_m = 0.030

S = 52.8 ft/mi (1.0%)

L = 11.7 mi

L_c = 5.8 mi

$$T_{LAG} = 20(0.03)(11.7\ (5.8/\sqrt{52.8}))^{1/3} = 1.26\ hr$$

Table 6.3A.—Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required.

Drainage CONFLUENCE DETENTION Area 82.4 (mi²) (km²)
Latitude 37 Longitude 115 Minimum Elevation 2125 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi² (2.6-km²) PMP for drainage [fig. 4.5]. 10.5 in. (cm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 1 by step 2a. 10.5 in. (cm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.32

	Duration (hr)								
	1/4	1/2	3/4	1	2	3	4	5	6
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	74	89	95	100	114	121	125	128	130 %
5. 1-mi² (2.6-km²) PMP for indicated durations [step 2b X step 4].	7.8	9.3	10.0	10.5	12.0	12.7	13.1	13.4	13.7 in. (mm)
6. Areal reduction [fig. 4.9].	55	63	67	69	72	75	77	78	79 %
7. Areal reduced PMP [steps 5 X 6].	4.3	5.9	6.7	7.2	8.6	9.5	10.1	10.5	10.8 in. (mm)
8. Incremental PMP [successive subtraction in step 7].				7.2	1.4	0.9	0.6	0.4	0.3 in. (mm)
	4.3	1.6	0.8	0.5	} 15-min. increments				

9. Time sequence of incremental PMP according to:

Hourly increments [table 4.7].	0.4	0.9	7.2	1.4	0.6	0.3	in. (mm)
Four largest 15-min. increments [table 4.8].	4.3	1.6	0.8	0.5			in. (mm)

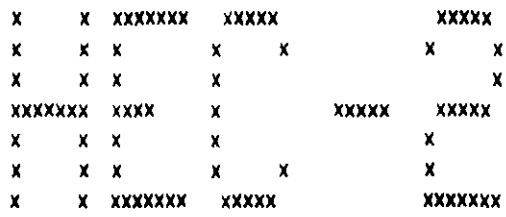
APPENDIX D

HEC-2 INPUT/OUTPUT GOLF COURSE CHANNEL

MISC. HYDRAULIC CALCULATIONS

```
*********************************************
*  WATER SURFACE PROFILES                   *
*  VERSION OF NOVEMBER 1976                 *
*  UPDATED MAY 1984                         *
*  IBM-PC-XT VERSION AUGUST 1985            *
*  RUN DATE  07-02-92   TIME  15:47:38      *
*********************************************
```


```
*****************************************
*  U.S. ARMY CORPS OF ENGINEERS         *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616              *
*  (916) 440-2105 (FTS) 448-2105        *
*****************************************
```

THIS RUN EXECUTED 07-02-92

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1      CONFLUENCE GOLF COURSE CHANNEL
T2      HYDROLIC MODELING
T3      Q = 3300 cfs

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0.       0.        0.        0. -1.000000       .00       .1     3300.    12.320      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      .000      .000      .000      .000      .000      .000    -1.000      .000      .000      .000


NC     .025      .025      .025      .100      .200      .000      .000      .000      .000      .000
X1    1.000    4.000      .000   210.000      .000      .000      .000      .000      .000      .000
GR   26.300      .000    6.300    60.000    6.300   150.000   26.300    210.000      .000      .000

X1    2.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   26.500      .000    6.300    60.000    6.300   150.000   26.500    210.000      .000      .000

X1    3.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   26.700      .000    6.500    60.000    6.500   150.000   26.700    210.000      .000      .000

X1    4.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   26.900      .000    6.700    60.000    6.700   150.000   26.900    210.000      .000      .000

X1    5.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   27.100      .000    6.900    60.000    6.900   150.000   27.100    210.000      .000      .000

X1    6.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   27.300      .000    7.100    60.000    7.100   150.000   27.300    210.000      .000      .000

X1    7.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   27.500      .000    7.300    60.000    7.300   150.000   27.500    210.000      .000      .000

X1    8.000    4.000      .000   210.000   100.000   100.000   100.000      .000      .000      .000
GR   27.700      .000    7.500    60.000    7.500   150.000   27.700    210.000      .000      .000

X1    9.000    4.000      .000   210.000    48.000    48.000    48.000      .000      .000      .000
GR   27.800      .000    7.596    60.000    7.596   150.000   27.796    210.000      .000      .000
```

X1	10.000	4.000	.000	210.000	152.000	152.000	152.000	.000	.000	.000
GR	28.100	.000	7.900	60.000	7.900	150.000	28.100	210.000	.000	.000
X1	11.000	4.000	.000	210.000	66.000	66.000	66.000	.000	.000	.000
GR	28.230	.000	8.032	60.000	8.032	150.000	28.232	210.000	.000	.000
X1	12.000	4.000	.000	390.000	94.000	94.000	94.000	.000	.000	.000
GR	28.420	.000	8.220	140.000	8.220	230.000	28.420	390.000	.000	.000
X1	13.000	4.000	.000	310.000	40.000	40.000	40.000	.000	.000	.000
GR	28.500	.000	8.300	100.000	8.300	190.000	28.500	310.000	.000	.000
X1	14.000	4.000	.000	250.000	30.000	30.000	30.000	.000	.000	.000
GR	28.560	.000	8.360	60.000	8.360	150.000	28.560	250.000	.000	.000
X1	15.000	4.000	.000	170.000	33.000	33.000	33.000	.000	.000	.000
GR	28.630	.000	8.426	20.000	8.426	110.000	28.626	170.000	.000	.000
X1	16.000	4.000	.000	90.002	43.000	43.000	43.000	.000	.000	.000
GR	28.710	.000	8.512	.001	8.512	90.001	28.712	90.002	.000	.000
NC	.017	.017	.017	.100	.200	.000	.000	.000	.000	.000
X1	9.000	4.000	.000	90.001	144.000	144.000	144.000	.000	.000	.000
GR	28.860	.000	8.656	.001	8.656	90.000	28.856	90.001	.000	.000
NC	.019	.019	.019	.100	.200	.000	.000	.000	.000	.000
X1	10.000	4.000	.000	150.000	36.000	36.000	36.000	.000	.000	.000
GR	28.890	.000	8.692	.001	8.692	90.000	28.892	150.000	.000	.000
NC	.020	.020	.020	.100	.200	.000	.000	.000	.000	.000
X1	11.000	4.000	.000	210.000	36.000	36.000	36.000	.000	.000	.000
GR	28.930	.000	8.728	60.000	8.728	150.000	28.928	210.000	.000	.000
X1	12.000	4.000	.000	210.000	378.000	378.000	378.000	.000	.000	.000
GR	29.310	.000	9.106	60.000	9.106	150.000	29.306	210.000	.000	.000
X1	13.000	4.000	.000	210.000	235.000	235.000	235.000	.000	.000	.000
GR	29.540	.000	9.341	60.000	9.341	150.000	29.541	210.000	.000	.000
X1	14.000	4.000	.000	210.000	30.000	30.000	30.000	.000	.000	.000
GR	29.570	.000	9.371	60.000	9.371	150.000	29.571	210.000	.000	.000
X1	15.000	4.000	.000	150.000	35.000	35.000	35.000	.000	.000	.000
GR	29.610	.000	9.406	.001	9.406	90.000	29.606	150.000	.000	.000
X1	16.000	4.000	.000	150.000	100.000	100.000	100.000	.000	.000	.000
GR	29.710	.000	9.506	.001	9.506	90.000	29.706	150.000	.000	.000

X1	17.000	4.000	.000	210.000	35.000	35.000	35.000	.000	.000	.000
GR	29.740	.000	9.541	60.000	9.541	150.000	29.741	210.000	.000	.000
X1	18.000	4.000	.000	210.000	910.000	910.000	910.000	.000	.000	.000
GR	30.650	.000	10.451	60.000	10.451	150.000	30.651	210.000	.000	.000
X1	19.000	4.000	.000	210.000	205.000	205.000	205.000	.000	.000	.000
GR	30.860	.000	10.656	60.000	10.656	150.000	30.856	210.000	.000	.000
X1	20.000	4.000	.000	210.000	132.000	132.000	132.000	.000	.000	.000
GR	31.170	.000	10.974	60.000	10.974	150.000	31.174	210.000	.000	.000
X1	21.000	4.000	.000	350.000	60.000	60.000	60.000	.000	.000	.000
GR	31.320	.000	11.119	200.000	11.119	290.000	31.319	350.000	.000	.000
X1	22.000	4.000	.000	550.000	60.000	60.000	60.000	.000	.000	.000
GR	31.460	.000	11.264	200.000	11.264	290.000	31.464	550.000	.000	.000
X1	23.000	4.000	.000	350.000	105.000	105.000	105.000	.000	.000	.000
GR	31.720	.000	11.517	1.000	11.517	150.000	31.717	350.000	.000	.000
X1	24.000	4.000	.000	210.000	72.000	72.000	72.000	.000	.000	.000
GR	31.890	.000	11.690	60.000	11.690	150.000	31.890	210.000	.000	.000
X1	25.000	4.000	.000	210.000	96.000	96.000	96.000	.000	.000	.000
GR	32.120	.000	11.922	60.000	11.922	150.000	32.122	210.000	.000	.000
X1	26.000	4.000	.000	210.000	220.000	220.000	220.000	.000	.000	.000
GR	32.650	.000	12.452	60.000	12.452	150.000	32.652	210.000	.000	.000
X1	27.000	4.000	.000	90.001	75.000	75.000	75.000	.000	.000	.000
GR	32.830	.000	12.633	.001	12.633	90.000	32.833	90.001	.000	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .200
*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED

1.00	3.33	9.63	9.63	12.32	11.16	1.53	.00	.00	26.30
3300.	0.	3300.	0.	0.	333.	0.	0.	0.	26.30
.00	.00	9.91	.00	.025	.025	.025	.000	6.30	50.01
.006433	0.	0.	0.	0	10	0	.00	109.98	159.99

0
*SECNO 2.000

1645 INT SEC ADDED BY RAISING SEC 2.00, .000FT AND MULTIPLYING BY .992

3301 HV CHANGED MORE THAN HVINS

1.01	3.98	10.28	9.65	.00	11.32	1.04	.12	.05	26.50
3300.	0.	3300.	0.	0.	403.	0.	0.	0.	26.50
.00	.00	8.18	.00	.025	.025	.025	.000	6.30	47.79
.003519	25.	25.	25.	5	5	0	.00	112.85	160.64

0

1645 INT SEC ADDED BY RAISING SEC 1.01, .000FT AND MULTIPLYING BY 1.003

3301 HV CHANGED MORE THAN HVINS

1.02	4.19	10.49	9.65	.00	11.41	.92	.08	.01	26.50
3300.	0.	3300.	0.	0.	428.	0.	0.	0.	26.50
.00	.00	7.71	.00	.025	.025	.025	.000	6.30	47.30
.002947	25.	25.	25.	2	11	0	.00	114.35	161.65

0

1645 INT SEC ADDED BY RAISING SEC 1.02, .000FT AND MULTIPLYING BY 1.003

1.03	4.34	10.64	9.63	.00	11.49	.85	.07	.01	26.50
3300.	0.	3300.	0.	0.	445.	0.	1.	0.	26.50
.00	.00	7.41	.00	.025	.025	.025	.000	6.30	46.99
.002613	25.	25.	25.	2	15	0	.00	115.49	162.48

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1645 INT SEC ADDED BY RAISING SEC 1.03, .000FT AND MULTIPLYING BY 1.003

2.00	4.46	10.76	9.63	.00	11.56	.80	.06	.01	26.50
3300.	0.	3300.	0.	0.	461.	0.	1.	0.	26.50
.00	.00	7.16	.00	.025	.025	.025	.000	6.30	46.75
.002363	25.	25.	25.	2	15	0	.00	116.50	163.25

0

*SECNO 3.000

3.00	4.51	11.01	9.83	.00	11.79	.78	.23	.00	26.70
3300.	0.	3300.	0.	0.	467.	0.	2.	1.	26.70
.01	.00	7.07	.00	.025	.025	.025	.000	6.50	46.59
.002270	100.	100.	100.	2	15	0	.00	116.81	163.41

0

*SECNO 4.000

4.00	4.55	11.25	10.03	.00	12.01	.76	.22	.00	26.90
3300.	0.	3300.	0.	0.	471.	0.	3.	1.	26.90
.01	.00	7.00	.00	.025	.025	.025	.000	6.70	46.47
.002200	100.	100.	100.	2	15	0	.00	117.06	163.53

0

*SECNO 5.000

5.00	4.58	11.48	10.23	.00	12.23	.75	.22	.00	27.10
3300.	0.	3300.	0.	0.	475.	0.	4.	1.	27.10
.02	.00	6.95	.00	.025	.025	.025	.000	6.90	46.38
.002151	100.	100.	100.	2	15	0	.00	117.23	163.62

0

*SECNO 6.000

6.00	4.61	11.71	10.43	.00	12.45	.74	.21	.00	27.30
3300.	0.	3300.	0.	0.	478.	0.	5.	1.	27.30
.02	.00	6.91	.00	.025	.025	.025	.000	7.10	46.32
.002116	100.	100.	100.	2	15	0	.00	117.36	163.68

0

*SECNO 7.000

7.00	4.62	11.92	10.64	.00	12.66	.74	.21	.00	27.50
3300.	0.	3300.	0.	0.	478.	0.	6.	2.	27.50
.02	.00	6.90	.00	.025	.025	.025	.000	7.30	46.30
.002106	100.	100.	100.	1	15	0	.00	117.40	163.70

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 8.000

8.00	4.63	12.13	10.84	.00	12.87	.73	.21	.00	27.70
3300.	0.	3300.	0.	0.	480.	0.	7.	2.	27.70
.03	.00	6.88	.00	.025	.025	.025	.000	7.50	46.26
.002084	100.	100.	100.	1	15	0	.00	117.48	163.74

0

*SECNO 9.000

9.00	4.64	12.24	10.93	.00	12.97	.73	.10	.00	27.80
3300.	0.	3300.	0.	0.	481.	0.	8.	2.	27.80
.03	.00	6.86	.00	.025	.025	.025	.000	7.60	46.24
.002071	48.	48.	48.	0	15	0	.00	117.53	163.77

0

*SECNO 10.000

10.00	4.66	12.56	11.24	.00	13.28	.73	.31	.00	28.10
3300.	0.	3300.	0.	0.	483.	0.	10.	2.	28.10
.04	.00	6.84	.00	.025	.025	.025	.000	7.90	46.19
.002050	152.	152.	152.	1	15	0	.00	117.61	163.81

0

*SECNO 11.000

11.00	4.66	12.69	11.37	.00	13.42	.72	.13	.00	28.23
3300.	0.	3300.	0.	0.	483.	0.	10.	3.	28.23
.04	.00	6.83	.00	.025	.025	.025	.000	8.03	46.17
.002038	66.	66.	66.	0	15	0	.00	117.66	163.83

0

*SECNO 12.000

1645 INT SEC ADDED BY RAISING SEC 12.00, -.125FT AND MULTIPLYING BY .888

3301 HV CHANGED MORE THAN HVINS

1.01	4.81	12.91	11.49	.00	13.49	.58	.06	.01	28.29
3300.	0.	3300.	0.	0.	538.	0.	11.	3.	28.29
.04	.00	6.14	.00	.025	.025	.025	.000	8.09	94.69
.001843	31.	31.	31.	2	15	0	.00	143.43	238.12

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1645 INT SEC ADDED BY RAISING SEC 1.01, .063FT AND MULTIPLYING BY 1.063

1.02	4.90	13.06	11.43	.00	13.55	.49	.05	.01	28.36
3300.	0.	3300.	0.	0.	585.	0.	11.	3.	28.36
.04	.00	5.64	.00	.025	.025	.025	.000	8.16	100.08
.001524	31.	31.	31.	2	14	0	.00	153.71	253.79

0

1645 INT SEC ADDED BY RAISING SEC 1.02, .063FT AND MULTIPLYING BY 1.059

12.00	4.96	13.18	11.37	.00	13.60	.43	.04	.01	28.42
3300.	0.	3300.	0.	0.	629.	0.	12.	3.	28.42
.04	.00	5.25	.00	.025	.025	.025	.000	8.22	105.65
.001304	31.	31.	31.	2	14	0	.00	163.62	269.26

0

*SECNO 13.000

3301 HV CHANGED MORE THAN HVINS

13.00	4.85	13.15	11.53	.00	13.68	.53	.06	.02	28.50
3300.	0.	3300.	0.	0.	565.	0.	12.	3.	28.50
.04	.00	5.84	.00	.025	.025	.025	.000	8.30	75.98
.001557	40.	40.	40.	2	14	0	.00	142.85	218.83

0

*SECNO 14.000

14.00	4.76	13.12	11.65	.00	13.75	.63	.05	.02	28.56
3300.	0.	3300.	0.	0.	519.	0.	13.	3.	28.56
.05	.00	6.36	.00	.025	.025	.025	.000	8.36	45.85
.001793	30.	30.	30.	2	14	0	.00	127.73	173.58

0

*SECNO 15.000

3301 HV CHANGED MORE THAN HVINS

15.00	4.62	13.05	11.80	.00	13.85	.80	.07	.04	28.63
3300.	0.	3300.	0.	0.	458.	0.	13.	3.	28.63
.05	.00	7.20	.00	.025	.025	.025	.000	8.43	15.42
.002214	33.	33.	33.	2	19	0	.00	108.31	123.73

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 16.000

3301 HV CHANGED MORE THAN HVINS

16.00	4.44	12.96	11.97	.00	14.01	1.06	.11	.05	28.71
3300.	0.	3300.	0.	0.	400.	0.	13.	3.	28.71
.05	.00	8.24	.00	.025	.025	.025	.000	8.51	.00
.002983	43.	43.	43.	2	15	0	.00	90.00	90.00

0
CCHV= .100 CEHV= .200
*SECNO 9.000

9.00	4.66	13.32	12.11	.00	14.28	.96	.26	.01	28.86
3300.	0.	3300.	0.	0.	420.	0.	15.	4.	28.86
.05	.00	7.85	.00	.017	.017	.017	.000	8.66	.00
.001180	144.	144.	144.	2	15	0	.00	90.00	90.00

0
CCHV= .100 CEHV= .200
*SECNO 10.000

3301 HV CHANGED MORE THAN HVINS

10.00	4.91	13.60	12.09	.00	14.34	.74	.04	.02	28.89
3300.	0.	3300.	0.	0.	478.	0.	15.	4.	28.89
.06	.00	6.90	.00	.019	.019	.019	.000	8.69	.00
.001101	36.	36.	36.	2	15	0	.00	104.60	104.60

0
CCHV= .100 CEHV= .200
*SECNO 11.000

3301 HV CHANGED MORE THAN HVINS

11.00	5.07	13.80	12.06	.00	14.39	.60	.04	.01	28.93
3300.	0.	3300.	0.	0.	533.	0.	15.	4.	28.93
.06	.00	6.19	.00	.020	.020	.020	.000	8.73	44.94
.000971	36.	36.	36.	2	14	0	.00	120.12	165.06

0
*SECNO 12.000

12.00	5.06	14.16	12.43	.00	14.76	.60	.37	.00	29.31
3300.	0.	3300.	0.	0.	532.	0.	20.	5.	29.31
.07	.00	6.20	.00	.020	.020	.020	.000	9.11	44.96
.000976	378.	378.	378.	1	14	0	.00	120.08	165.04

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 13.000

13.00	5.05	14.39	12.67	.00	14.99	.60	.23	.00	29.54
3300.	0.	3300.	0.	0.	531.	0.	23.	5.	29.54
.08	.00	6.21	.00	.020	.020	.020	.000	9.34	44.98
.000980	235.	235.	235.	0	14	0	.00	120.05	165.02

0

*SECNO 14.000

14.00	5.05	14.42	12.70	.00	15.02	.60	.03	.00	29.57
3300.	0.	3300.	0.	0.	530.	0.	23.	6.	29.57
.09	.00	6.22	.00	.020	.020	.020	.000	9.37	45.00
.000984	30.	30.	30.	0	14	0	.00	120.01	165.00

0

*SECNO 15.000

3301 HV CHANGED MORE THAN HVINS

15.00	4.95	14.36	12.80	.00	15.08	.73	.04	.03	29.61
3300.	0.	3300.	0.	0.	482.	0.	24.	6.	29.61
.09	.00	6.85	.00	.020	.020	.020	.000	9.41	.00
.001191	35.	35.	35.	2	14	0	.00	104.71	104.71

0

*SECNO 16.000

16.00	4.98	14.48	12.90	.00	15.20	.72	.12	.00	29.71
3300.	0.	3300.	0.	0.	485.	0.	25.	6.	29.71
.09	.00	6.81	.00	.020	.020	.020	.000	9.51	.00
.001169	100.	100.	100.	2	14	0	.00	104.79	104.79

0

*SECNO 17.000

3301 HV CHANGED MORE THAN HVINS

17.00	5.13	14.68	12.87	.00	15.25	.58	.04	.01	29.74
3300.	0.	3300.	0.	0.	541.	0.	25.	6.	29.74
.09	.00	6.10	.00	.020	.020	.020	.000	9.54	44.75
.000930	35.	35.	35.	2	14	0	.00	120.51	165.25

0

*SECNO 18.000

18.00	5.07	15.53	13.78	.00	16.12	.59	.86	.00	30.65
3300.	0.	3300.	0.	0.	533.	0.	36.	9.	30.65
.13	.00	6.19	.00	.020	.020	.020	.000	10.45	44.93
.000969	910.	910.	910.	2	14	0	.00	120.15	165.07

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 19.000

19.00	5.07	15.72	13.98	.00	16.32	.59	.20	.00	30.86
3300.	0.	3300.	0.	0.	533.	0.	39.	9.	30.86
.14	.00	6.19	.00	.020	.020	.020	.000	10.66	44.93
.000969	205.	205.	205.	0	14	0	.00	120.14	165.07

0

*SECNO 20.000

20.00	4.83	15.81	14.30	.00	16.47	.66	.14	.01	31.17
3300.	0.	3300.	0.	0.	505.	0.	41.	9.	31.17
.15	.00	6.54	.00	.020	.020	.020	.000	10.97	45.63
.001145	132.	132.	132.	2	14	0	.00	118.73	164.36

0

*SECNO 21.000

1645 INT SEC ADDED BY RAISING SEC 21.00, -.096FT AND MULTIPLYING BY .908

1.01	4.90	15.93	14.41	.00	16.50	.58	.02	.01	31.22
3300.	0.	3300.	0.	0.	541.	0.	41.	9.	31.22
.15	.00	6.10	.00	.020	.020	.020	.000	11.02	137.53
.001111	20.	20.	20.	2	19	0	.00	139.04	276.57

0

1645 INT SEC ADDED BY RAISING SEC 1.01, .048FT AND MULTIPLYING BY 1.051

1.02	4.95	16.02	14.36	.00	16.53	.51	.02	.01	31.27
3300.	0.	3300.	0.	0.	575.	0.	41.	10.	31.27
.15	.00	5.74	.00	.020	.020	.020	.000	11.07	144.07
.000973	20.	20.	20.	2	14	0	.00	146.63	290.70

0

1645 INT SEC ADDED BY RAISING SEC 1.02, .048FT AND MULTIPLYING BY 1.048

21.00	4.98	16.10	14.31	.00	16.55	.46	.02	.01	31.32
3300.	0.	3300.	0.	0.	607.	0.	41.	10.	31.32
.15	.00	5.43	.00	.020	.020	.020	.000	11.12	150.73
.000867	20.	20.	20.	2	14	0	.00	154.05	304.78

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 22.000

1645 INT SEC ADDED BY RAISING SEC 22.00, -.072FT AND MULTIPLYING BY .916

1.01	5.03	16.22	14.37	.00	16.59	.37	.02	.01	31.39
3300.	0.	3300.	0.	0.	678.	0.	42.	10.	31.39
.15	.00	4.86	.00	.020	.020	.020	.000	11.19	137.58
.000773	30.	30.	30.	2	14	0	.00	187.35	324.93

0

1645 INT SEC ADDED BY RAISING SEC 1.01, .072FT AND MULTIPLYING BY 1.092

22.00	5.04	16.31	14.28	.00	16.61	.31	.02	.01	31.46
3300.	0.	3300.	0.	0.	742.	0.	42.	10.	31.46
.16	.00	4.45	.00	.020	.020	.020	.000	11.26	150.13
.000645	30.	30.	30.	1	14	0	.00	204.69	354.82

0

*SECNO 23.000

23.00	4.93	16.44	13.93	.00	16.67	.23	.05	.01	31.72
3300.	0.	3300.	0.	0.	855.	0.	44.	10.	31.72
.16	.00	3.86	.00	.020	.020	.020	.000	11.52	.76
.000397	105.	105.	105.	2	11	0	.00	198.02	198.78

0

*SECNO 24.000

1645 INT SEC ADDED BY RAISING SEC 24.00, -.130FT AND MULTIPLYING BY 1.494

1.01	4.84	16.40	14.13	.00	16.70	.30	.01	.01	31.76
3300.	0.	3300.	0.	0.	754.	0.	45.	10.	31.76
.16	.00	4.37	.00	.020	.020	.020	.000	11.56	68.16
.000507	18.	18.	18.	2	11	0	.00	177.38	245.54

0

1645 INT SEC ADDED BY RAISING SEC 1.01, .043FT AND MULTIPLYING BY .890

1.02	4.73	16.33	14.38	.00	16.73	.40	.01	.02	31.80
3300.	0.	3300.	0.	0.	654.	0.	45.	11.	31.80
.16	.00	5.05	.00	.020	.020	.020	.000	11.60	61.09
.000696	18.	18.	18.	2	11	0	.00	156.95	218.04

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1645 INT SEC ADDED BY RAISING SEC 1.02, .043FT AND MULTIPLYING BY .876

3301 HV CHANGED MORE THAN HVINS

1.03	4.57	16.22	14.66	.00	16.77	.56	.02	.03	31.85
3300.	0.	3300.	0.	0.	551.	0.	45.	11.	31.85
.17	.00	5.98	.00	.020	.020	.020	.000	11.65	54.06
.001020	18.	18.	18.	2	14	0	.00	136.44	190.50

0

1645 INT SEC ADDED BY RAISING SEC 1.03, .043FT AND MULTIPLYING BY .859

3301 HV CHANGED MORE THAN HVINS

24.00	4.31	16.00	15.02	.00	16.86	.86	.02	.06	31.89
3300.	0.	3300.	0.	0.	443.	0.	45.	11.	31.89
.17	.00	7.44	.00	.020	.020	.020	.000	11.69	47.19
.001700	18.	18.	18.	2	15	0	.00	115.61	162.81

0

*SECNO 25.000

25.00	4.21	16.13	15.25	.00	17.04	.91	.17	.01	32.12
3300.	0.	3300.	0.	0.	431.	0.	46.	11.	32.12
.17	.00	7.65	.00	.020	.020	.020	.000	11.92	47.50
.001850	96.	96.	96.	2	15	0	.00	114.99	162.50

0

*SECNO 26.000

26.00	4.04	16.50	15.78	.00	17.49	.99	.43	.02	32.65
3300.	0.	3300.	0.	0.	413.	0.	48.	11.	32.65
.18	.00	7.99	.00	.020	.020	.020	.000	12.45	47.98
.002115	220.	220.	220.	2	15	0	.00	114.04	162.02

0

*SECNO 27.000

1645 INT SEC ADDED BY RAISING SEC 27.00, -.136FT AND MULTIPLYING BY 1.101

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

1.01	3.95	16.45	15.74	.00	17.55	1.10	.04	.02	32.69
3300.	0.	3300.	0.	0.	391.	0.	49.	12.	32.70
.18	.00	8.43	.00	.020	.020	.020	.000	12.50	.00
.002282	19.	19.	19.	2	15	0	.00	99.05	99.05

0

1645 INT SEC ADDED BY RAISING SEC 1.01, .045FT AND MULTIPLYING BY .970

3301 HV CHANGED MORE THAN HVINS

1.02	3.84	16.38	15.86	.00	17.63	1.24	.05	.03	32.74
3300.	0.	3300.	0.	0.	369.	0.	49.	12.	32.74
.18	.00	8.94	.00	.020	.020	.020	.000	12.54	.00
.002664	19.	19.	19.	2	11	0	.00	96.03	96.03

0

1645 INT SEC ADDED BY RAISING SEC 1.02, .045FT AND MULTIPLYING BY .969

3301 HV CHANGED MORE THAN HVINS

1.03	3.71	16.30	15.97	.00	17.72	1.42	.05	.04	32.78
3300.	0.	3300.	0.	0.	345.	0.	49.	12.	32.79
.18	.00	9.55	.00	.020	.020	.020	.000	12.59	.00
.003186	19.	19.	19.	2	11	0	.00	93.02	93.02

0

1645 INT SEC ADDED BY RAISING SEC 1.03, .045FT AND MULTIPLYING BY .968

3301 HV CHANGED MORE THAN HVINS

27.00	3.53	16.17	16.09	.00	17.83	1.67	.07	.05	32.83
3300.	0.	3300.	0.	0.	319.	0.	49.	12.	32.83
.18	.00	10.36	.00	.020	.020	.020	.000	12.63	.00
.003988	19.	19.	19.	2	11	0	.00	90.00	90.00

0

PROFILE FOR STREAM Q = 3300 cfs

PLOTTED POINTS (BY PRIORITY)-E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION SECNO	5. CUMDIS	10.	15.	20.	25.	30.	35.	40.	45.	50.
1.00	0.	I	W. E			L				
	20.	I	CW E			L				
1.01	40.	I	C.W E			L				
1.02	60.	I	C.W E			L				
1.03	80.	I	C.W E			L				
2.00	100.	I	C. WE			L				
	120.	I	C. WE			L				
	140.	I	C. WE			L				
	160.	I	C WE			L				
	180.	I	C WE			L				
3.00	200.	I	C W E			L				
	220.	I	C W E			L				
	240.	I	C W E			L				
	260.	I	C W E			L				
	280.	I	C W E			L				
4.00	300.	I	C WE			L				
	320.	I	C WE			L				
	340.	I	C WE			L				
	360.	I	C WE			L				
	380.	I	C WE			L				
5.00	400.	I	C WE			L				
	420.	I	.C W E			L				
	440.	I	.C W E			L				
	460.	I	.C W E			L				
	480.	I	.C W E			L				
6.00	500.	I	.C W E			L				
	520.	I	.C WE			L				
	540.	I	.C WE			L				
	560.	I	.C WE			L				
	580.	I	.C WE			L				
7.00	600.	I	.C WE			L				
	620.	I	.C WE			L				
	640.	I	.C WE			L				
	660.	I	. C W E			L				
	680.	I	. C W E			L				
8.00	700.	I	. C W E			L				
	720.	I	. C W E			L				
	740.	I	. C W E			L				
9.00	760.	I	. C W E			L				
	780.	I	. C WE			L				
	800.	I	. C WE			L				
	820.	I	. C WE			L				
	840.	I	. C WE			L				
	860.	I	. C WE			L				

```
        880.  .   I  . C  WE  .  .  .  L  .  .  .  .  .  .  .
10.00   900.  .   I  . C  W E  .  .  .  L  .  .  .  .  .  .  .
        920.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
        940.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
        960.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
11.00   980.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
 1.01  1000.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
       1020.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
 1.02  1040.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
12.00  1060.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
       1080.  .    I .  C  WE  .  .  .  L  .  .  .  .  .  .  .
13.00  1100.  .    I .  C  WE  .  .  .  L  .  .  .  .  .  .  .
       1120.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
14.00  1140.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1160.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
15.00  1180.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1200.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
16.00  1220.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1240.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1260.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1280.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1300.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1320.  .   I  .  C W E  .  .  .  L  .  .  .  .  .  .  .
       1340.  .   I  .  C  WE  .  .  .  L  .  .  .  .  .  .  .
 9.00  1360.  .   I  .  C  W E  .  .  .  L  .  .  .  .  .  .  .
       1380.  .   I  .  C  W E  .  .  .  L  .  .  .  .  .  .  .
10.00  1400.  .   I  .  C  W E  .  .  .  L  .  .  .  .  .  .  .
       1420.  .   I  .  C  W E  .  .  .  L  .  .  .  .  .  .  .
11.00  1440.  .   I  .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1460.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1480.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1500.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1520.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1540.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1560.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1580.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1600.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1620.  .    I .  C   WE  .  .  .  L  .  .  .  .  .  .  .
       1640.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1660.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1680.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1700.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1720.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1740.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1760.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
       1780.  .    I .   C  WE  .  .  .  L  .  .  .  .  .  .  .
12.00  1800.  .    I .   C  W E  .  .  .  L  .  .  .  .  .  .  .
       1820.  .    I .   C  W E  .  .  .  L  .  .  .  .  .  .  .
       1840.  .    I .   C  W E  .  .  .  L  .  .  .  .  .  .  .
       1860.  .    I .   C  W E  .  .  .  L  .  .  .  .  .  .  .
       1880.  .    I .   C  W E  .  .  .  L  .  .  .  .  .  .  .
       1900.  .    I .   C   WE  .  .  .  L  .  .  .  .  .  .  .
       1920.  .    I .   C   WE  .  .  .  L  .  .  .  .  .  .  .
       1940.  .    I .   C   WE  .  .  .  L  .  .  .  .  .  .  .
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	1960.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	1980.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2000.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2020.	.	I.	C	WE	.	.	L.	.	.	.	.	.
13.00	2040.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2060.	.	I.	C	WE	.	.	L.	.	.	.	.	.
14.00	2080.	.	I.	C	WE	.	.	L.	.	.	.	.	.
15.00	2100.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2120.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2140.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2160.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2180.	.	I.	C	WE	.	.	L.	.	.	.	.	.
16.00	2200.	.	I.	C	WE	.	.	L.	.	.	.	.	.
	2220.	.	I.	C	WE	.	.	L.	.	.	.	.	.
17.00	2240.	.	I.	C	W.E	.	.	L.	.	.	.	.	.
	2260.	.	I.	C	W.E	.	.	L	.	.	.	.	.
	2280.	.	I.	C	W.E	.	.	L	.	.	.	.	.
	2300.	.	I.	C	W.E	.	.	L	.	.	.	.	.
	2320.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2340.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2360.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2380.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2400.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2420.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2440.	.	I.	C	WE	.	.	L	.	.	.	.	.
	2460.	.	I	C	WE	.	.	L	.	.	.	.	.
	2480.	.	I	C	WE	.	.	L	.	.	.	.	.
	2500.	.	I	C	WE	.	.	L	.	.	.	.	.
	2520.	.	I	C	WE	.	.	L	.	.	.	.	.
	2540.	.	I	C	WE	.	.	L	.	.	.	.	.
	2560.	.	I	C	WE	.	.	L	.	.	.	.	.
	2580.	.	I	C	WE	.	.	L	.	.	.	.	.
	2600.	.	I	C	WE	.	.	L	.	.	.	.	.
	2620.	.	I	C	WE	.	.	L	.	.	.	.	.
	2640.	.	I	C	WE	.	.	L	.	.	.	.	.
	2660.	.	I	C	WE	.	.	L	.	.	.	.	.
	2680.	.	I	C	WE	.	.	L	.	.	.	.	.
	2700.	.	I	C	WE	.	.	L	.	.	.	.	.
	2720.	.	I	C	WE	.	.	L	.	.	.	.	.
	2740.	.	I	C	WE	.	.	L	.	.	.	.	.
	2760.	.	I	C	WE	.	.	.L	.	.	.	.	.
	2780.	.	I	C	W E	.	.	.L	.	.	.	.	.
	2800.	.	I	C	W E	.	.	.L	.	.	.	.	.
	2820.	.	I	C	W E	.	.	.L	.	.	.	.	.
	2840.	.	I	C	W E	.	.	.L	.	.	.	.	.
	2860.	.	I	C	.WE	.	.	.L	.	.	.	.	.
	2880.	.	I	C	.WE	.	.	.L	.	.	.	.	.
	2900.	.	I	C	.WE	.	.	.L	.	.	.	.	.
	2920.	.	I	C	.WE	.	.	.L	.	.	.	.	.
	2940.	.	I	C	.WE	.	.	.L	.	.	.	.	.
	2960.	.	.I	C	.WE	.	.	.L	.	.	.	.	.
	2980.	.	.I	C	.WE	.	.	.L	.	.	.	.	.
	3000.	.	.I	C	.WE	.	.	.L	.	.	.	.	.
	3020.	.	.I	C	.WE	.	.	.L	.	.	.	.	.

```
        3040.  .     .I     C  .WE     .     .     .L     .     .     .     .     .
        3060.  .     .I     C  .WE     .     .     .L     .     .     .     .     .
        3080.  .     .I     C  .WE     .     .     .L     .     .     .     .     .
        3100.  .     .I     C  .WE     .     .     .L     .     .     .     .     .
        3120.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3140.  .     .I      C .WE     .     .     .L     .     .     .     .     .
18.00   3160.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3180.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3200.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3220.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3240.  .     .I      C .WE     .     .     .L     .     .     .     .     .
        3260.  .     .I      C .WE     .     .     . L    .     .     .     .     .
        3280.  .     .I      C .WE     .     .     . L    .     .     .     .     .
        3300.  .     .I      C .W E    .     .     . L    .     .     .     .     .
        3320.  .     .I      C .W E    .     .     . L    .     .     .     .     .
        3340.  .     .I      C .W E    .     .     . L    .     .     .     .     .
19.00   3360.  .     .I      C .W E    .     .     . L    .     .     .     .     .
        3380.  .     .I      C .W E    .     .     . L    .     .     .     .     .
        3400.  .     . I     C . WE    .     .     . L    .     .     .     .     .
        3420.  .     . I     C . WE    .     .     . L    .     .     .     .     .
        3440.  .     . I     C . WE    .     .     . L    .     .     .     .     .
        3460.  .     . I     C . WE    .     .     . L    .     .     .     .     .
        3480.  .     . I      C. WE    .     .     . L    .     .     .     .     .
20.00   3500.  .     . I      C. WE    .     .     . L    .     .     .     .     .
 1.01   3520.  .     . I      C. WE    .     .     . L    .     .     .     .     .
 1.02   3540.  .     . I      C. WE    .     .     .  L   .     .     .     .     .
21.00   3560.  .     . I      C: WE    .     .     .  L   .     .     .     .     .
 1.01   3580.  .     . I      C. WE    .     .     .  L   .     .     .     .     .
        3600.  .     . I      C.  E    .     .     .  L   .     .     .     .     .
22.00   3620.  .     .  I     C.  E    .     .     .  L   .     .     .     .     .
        3640.  .     .  I    C .  E    .     .     .  L   .     .     .     .     .
        3660.  .     .  I    C .  E    .     .     .  L   .     .     .     .     .
        3680.  .     .  I    C .  E    .     .     .  L   .     .     .     .     .
        3700.  .     .  I    C .  E    .     .     .  L   .     .     .     .     .
23.00   3720.  .     .  I    C .  E    .     .     .  L   .     .     .     .     .
 1.01   3740.  .     .  I    C .  E    .     .     .   L  .     .     .     .     .
 1.02   3760.  .     .  I     C.  E    .     .     .   L  .     .     .     .     .
 1.03   3780.  .     .  I     C. W E   .     .     .   L  .     .     .     .     .
24.00   3800.  .     .  I      C W E   .     .     .   L  .     .     .     .     .
        3820.  .     .  I      C W E   .     .     .   L  .     .     .     .     .
        3840.  .     .   I     C W E   .     .     .   L  .     .     .     .     .
        3860.  .     .   I     C W E   .     .     .   L  .     .     .     .     .
25.00   3880.  .     .   I     .CW E   .     .     .   L  .     .     .     .     .
        3900.  .     .   I     .CW E   .     .     .   L  .     .     .     .     .
        3920.  .     .   I     .CW E   .     .     .   L  .     .     .     .     .
        3940.  .     .   I     .CW E   .     .     .    L .     .     .     .     .
        3960.  .     .   I     .C WE   .     .     .    L .     .     .     .     .
        3980.  .     .   I     .C WE   .     .     .    L .     .     .     .     .
        4000.  .     .   I     .C W E  .     .     .    L .     .     .     .     .
        4020.  .     .    I    .C W E  .     .     .    L .     .     .     .     .
        4040.  .     .    I    .C W E  .     .     .    L .     .     .     .     .
        4060.  .     .    I    .C W E  .     .     .    L .     .     .     .     .
        4080.  .     .    I    .C W E  .     .     .    L .     .     .     .     .
26.00   4100.  .     .    I    . CW E  .     .     .    L .     .     .     .     .
```

| | | |

THIS RUN EXECUTED 07-02-92

****

HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
IBM-PC-XT VERSION AUGUST 1985

****

SOLUTION FOR A RECTANGULAR CHANNEL

OUTLET CHANNEL

DISCHARGE	1300.00 CFS	BASE WIDTH	38.00 FEET
VELOCITY	9.35 FPS	SIDE SLOPE	0.00 TO 1
NORMAL DEPTH	3.66 FEET	AREA	139.00 SQ.FT.
BOTTOM SLOPE	0.00200	TOP WIDTH	38.00 FEET
MANNING'S N	0.0150		
CRITICAL DEPTH	3.31 FEET	VELOCITY HEAD	1.36 FEET
FROUDE NUMBER	0.86	P + M	39447 POUNDS
CRITICAL SLOPE	0.00272		

SOLUTION FOR A TRAPEZOIDAL CHANNEL

OUTLET CHANNEL ALTERNATIVE 2

DISCHARGE	970.00 CFS	BASE WIDTH	20.00 FEET
VELOCITY	8.66 FPS	SIDE SLOPE	2.00 TO 1
NORMAL DEPTH	4.00 FEET	AREA	112.03 SQ.FT.
BOTTOM SLOPE	0.00180	TOP WIDTH	36.00 FEET
MANNING'S N	0.0150		
CRITICAL DEPTH	3.67 FEET	VELOCITY HEAD	1.17 FEET
FROUDE NUMBER	0.87	P + M	28943 POUNDS
CRITICAL SLOPE	0.00245		

EXISTING SLOAN CHANNEL
TRAP CHANNEL
B=14' z=2 n=.020 S=.0022

y	Q	V	VH	H
1	50.66663	3.166665	.1557106	1.155711
1.5	102.0952	4.003735	.2489114	1.748911
2	169.4031	4.705643	.3438366	2.343837
2.5	252.7251	5.320529	.4395657	2.939566
3	352.4616	5.874361	.5358403	3.535840
3.5	469.1428	6.382896	.6326298	4.132630
4	603.3669	6.856442	.7299813	4.729981
4.5	755.7687	7.302113	.8279637	5.327964
5	927.0025	7.725021	.9266451	5.926645
5.5	1117.732	8.128957	1.026086	6.526086
6	1328.622	8.516811	1.126336	7.126336
6.5	1560.341	8.890834	1.227437	7.727437
7	1813.551	9.252812	1.329418	8.329418
7.5	2088.911	9.604188	1.432305	8.932305
8	2387.074	9.946142	1.536114	9.536114
8.5	2708.688	10.27965	1.640858	10.14086
9	3054.396	10.60554	1.746545	10.74654
9.5	3424.831	10.92450	1.853179	11.35318
10	3820.624	11.23713	1.960762	11.96076
10.5	4242.397	11.54394	2.069293	12.56929
11	4690.767	11.84537	2.178771	13.17877

DIVERSION THROUGH GOLF COURSE

y	h	B	Q	A	V	VH
.5	.75	100	194.8557	50	3.897114	.2358307
1	1.5	100	551.1352	100	5.511352	.4716615
1.5	2.25	100	1012.5	150	6.75	.7074922
2	3	100	1558.846	200	7.794229	.9433230
2.5	3.75	100	2178.553	250	8.714213	1.179154
3	4.5	100	2863.782	300	9.545942	1.414984
3.5	5.25	100	3608.778	350	10.31080	1.650815
4	6	100	4409.082	400	11.02270	1.886646

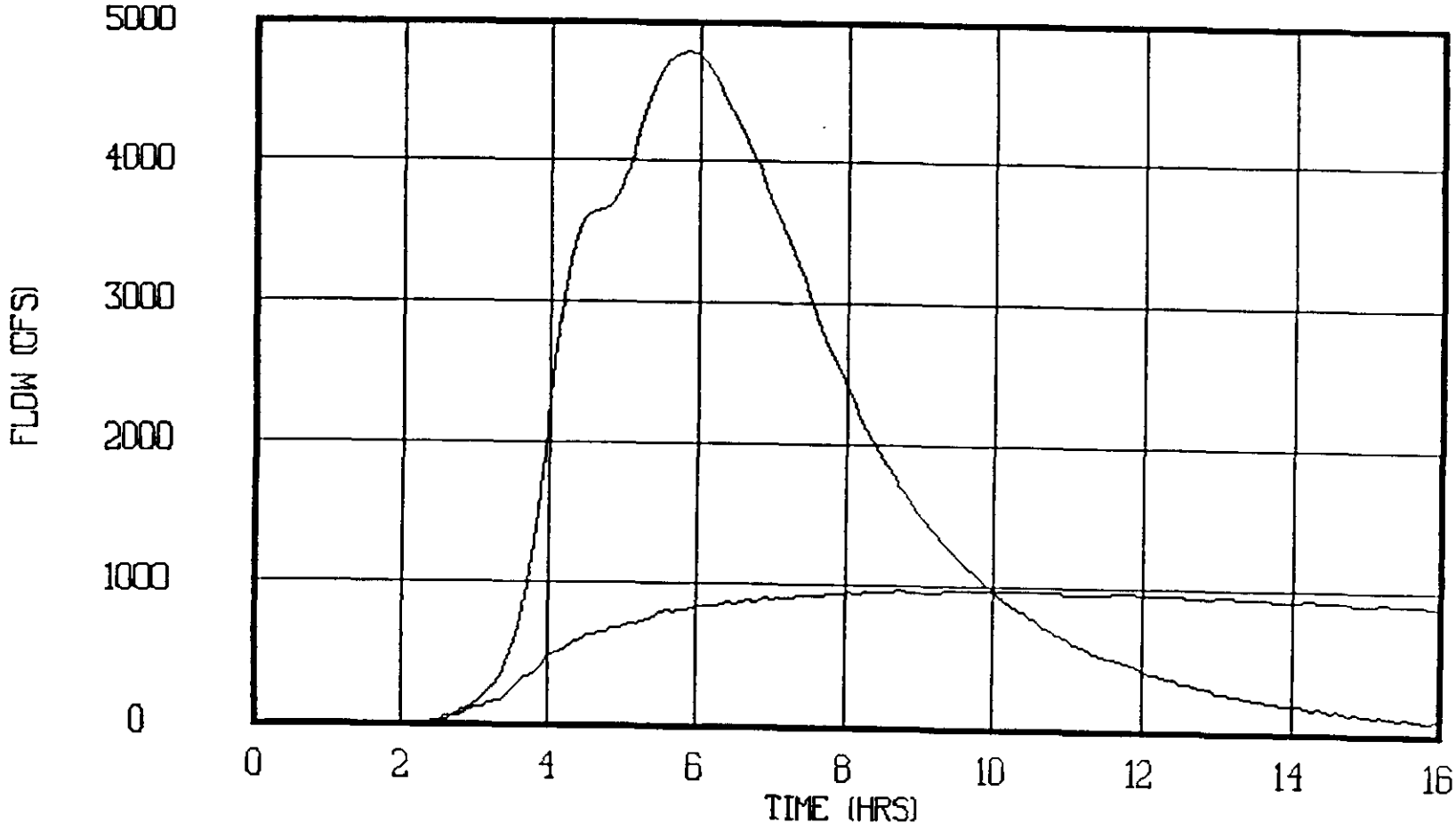
DIVERSION
CONDITION 4

EXISTING SLOAN CHANNEL		GOLF COURSE CHANNEL		TOTAL
DEPTH	FLOW	DEPTH ON WEIR	FLOW	FLOW
1	51	0	0	51
1.5	102	.5	195	297
2	169	1	551	721
2.5	253	1.5	1,013	1,265
3	352	2	1,559	1,911
3.5	469	2.5	2,179	2,648
4	603	3	2,864	3,467
4.5	756	3.5	3,609	4,365
5	927	4	4,409	5,336

APPENDIX E

INFLOW/OUTFLOW HYDROGRAPHY
STAGE/STORAGE/DISCHARGE CURVES
AND CALCULATIONS

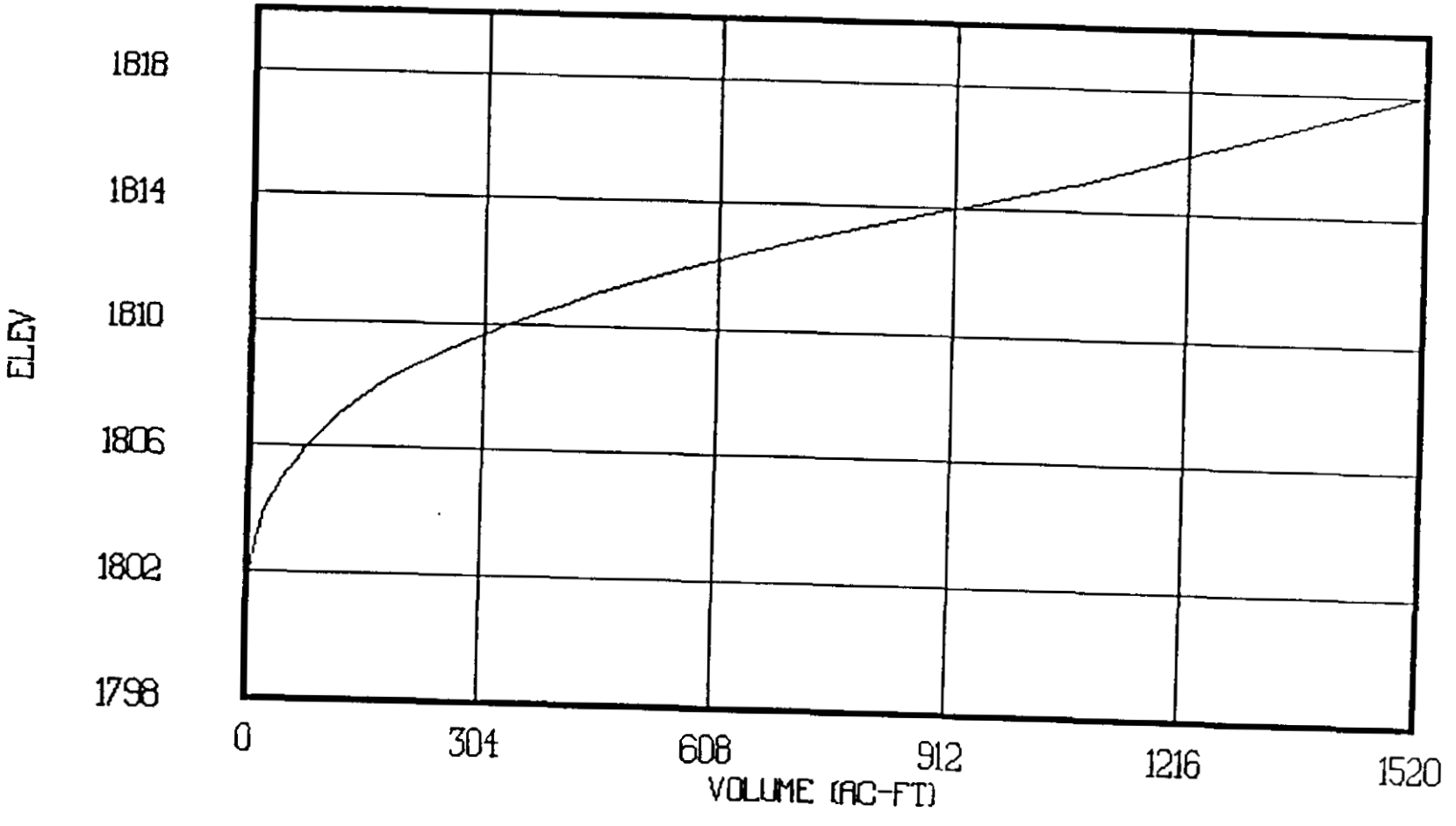
CONFLUENCE DETENTION BASIN
ALTERNATIVE 2 INFLOW/OUTFLOW HYDROGRAPHS



STAGE/STORAGE

ELEV	VOLUME (AC-FT)
1818	1514
1817	1369
1816	1226
1815	1085
1814	917
1813	735
1812	578
1811	446
1810	335
1809	245
1808	172
1807	116
1806	73
1805	43
1804	22
1803	10
1802	3
1801	1
1800	0
1799	0

STAGE/STORAGE



BOYLE ENGINEERING CORPORATION

Project CONFLUENCE DET BASIN
Job No. LV-C07-250-00
By MWS Date ____ Chkd.By ____ Date ____
Description ____
SHEET /

OUTLET CONTROL STAGE/DISCHARGE EQUATION

$$H = V_H + LS_f + k_E V_H + D - LS_o$$

4 - 5X3 RCB $A = 14.5$ $C = 1630$

$Q = 350$

$V = 24.14$

$V_H = 9.05$

$S_f = .046$

$H \approx 20$ SAY $k_E = .2$ ROUNDED ENTRANCE

$$20 = 9.05 + L(.046) + .2(9.05) + 3 - L(.004)$$

$$6.14 = .05L$$

$$L = 122.8 \quad \text{SAY} \quad 120'$$

$$H = \frac{1.2}{2g}\left(\frac{Q}{A}\right)^2 + L\left(\frac{Q}{C}\right)^2 + D - LS_o$$

$$Q = \left(\frac{H + LS_o - D}{\frac{1.2}{2gA^2} + \frac{L}{C^2}}\right)^{1/2}$$

$$Q = \left(\frac{H + 120(.004) - 3}{\frac{1.2}{2(32.2)(14.5)^2} + \frac{120}{(1630)^2}}\right)^{1/2}$$

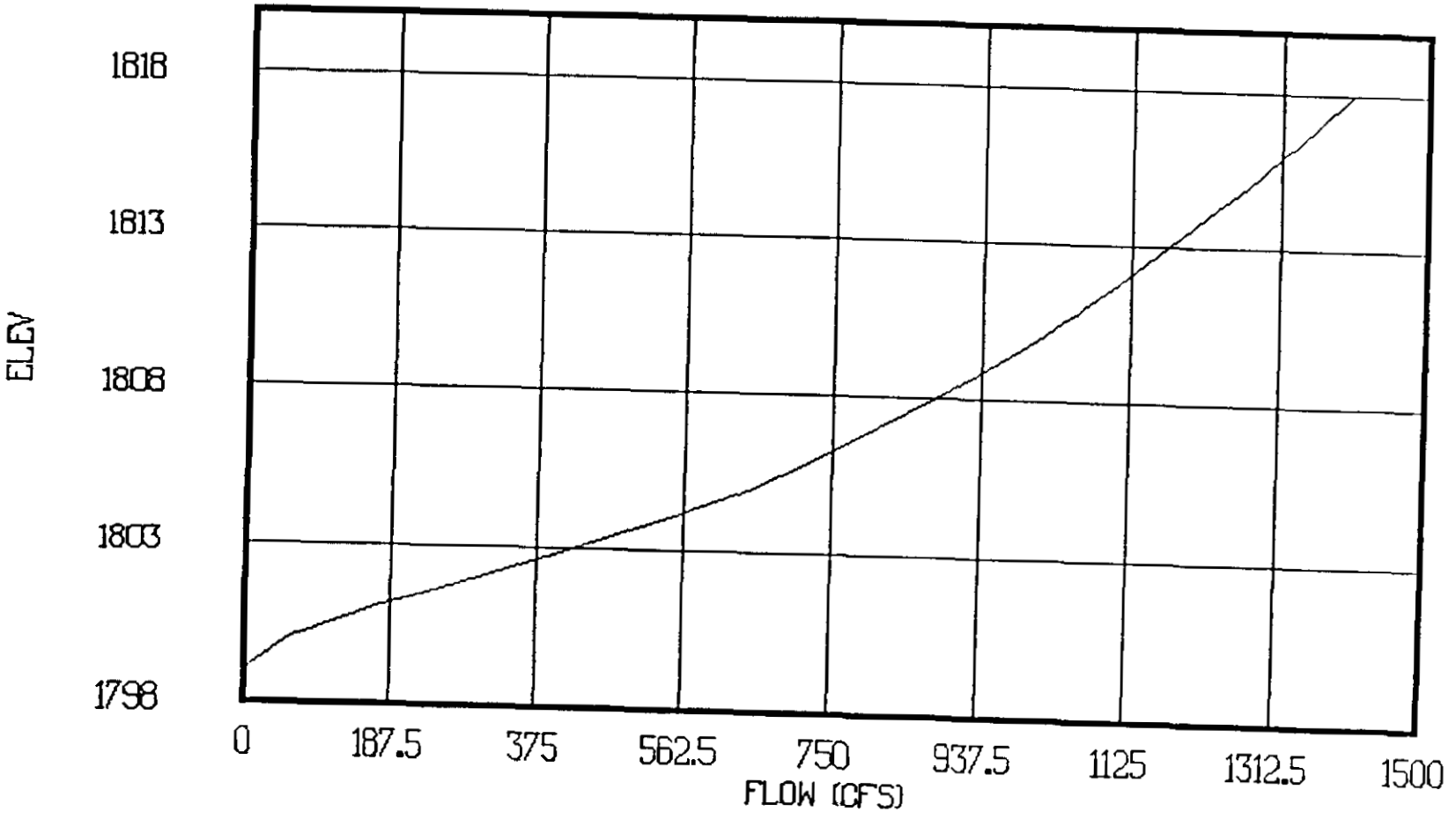
$$Q = \left(\frac{H - 2.52}{.0001338}\right)^{1/2}$$

STAGE/DISCHARGE
OUTLET CONDITION 3

4 - 5 X 3 RCB OUTLETS

ELEV	HW	Q
1818	19	1,404
1817	18	1,361
1816	17	1,316
1815	16	1,270
1814	15	1,222
1813	14	1,172
1812	13	1,119
1811	12	1,065
1810	11	1,007
1809	10	946
1808	9	880
1807	8	810
1806	7	732
1805	6	645
1804	5	545
1803	4	421
1802	3	300
1801	2	170
1800	1	60
1799	0	0

STAGE/DISCHARGE
4 - 5 X 3 RCB OUTLETS

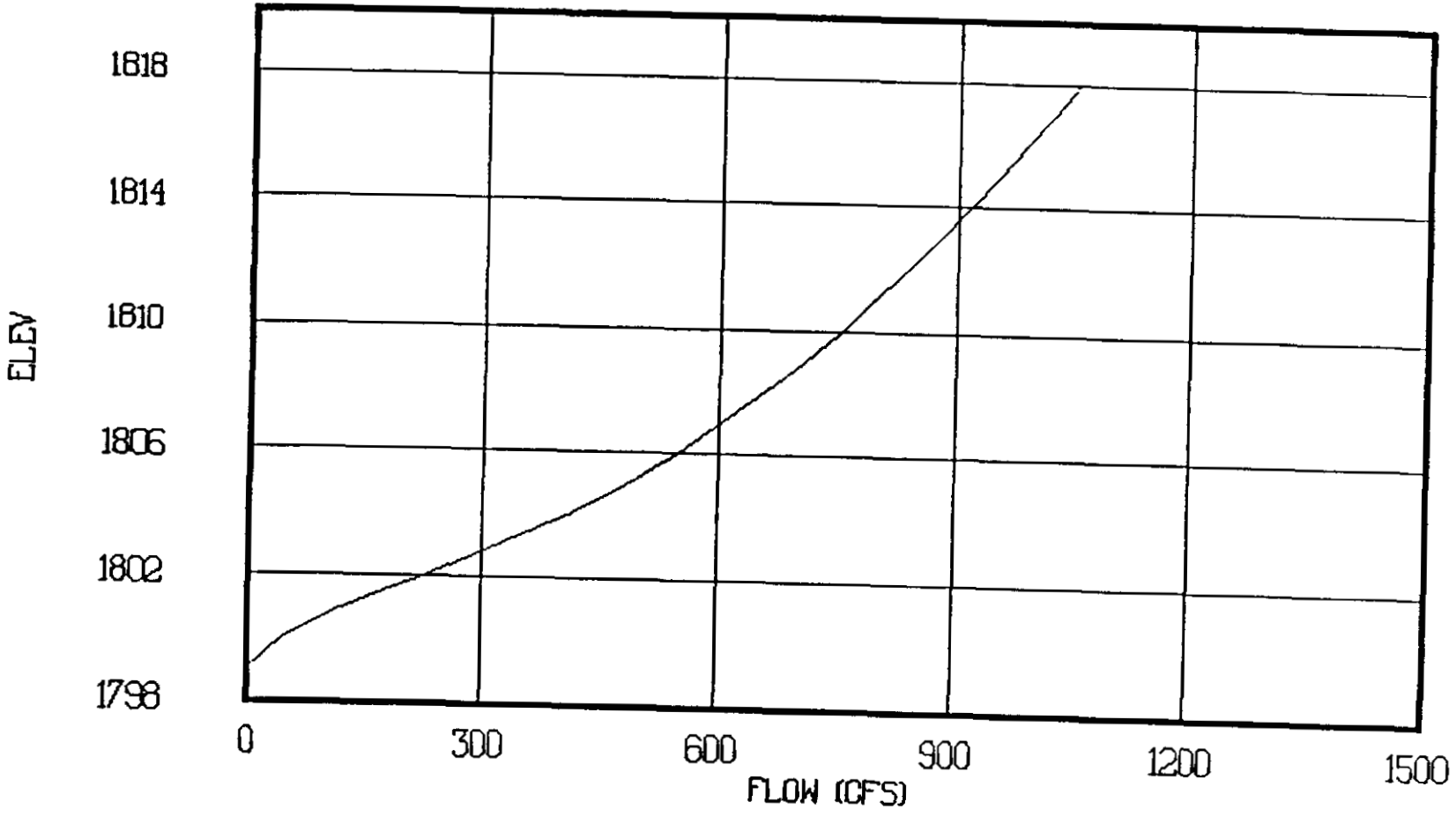


STAGE/DISCHARGE
OUTLET CONDITION 1

3 - 5 X 3 RCB OUTLETS

ELEV	HW	Q
1818	19	1,053
1817	18	1,020
1816	17	987
1815	16	952
1814	15	916
1813	14	879
1812	13	840
1811	12	799
1810	11	755
1809	10	709
1808	9	660
1807	8	607
1806	7	549
1805	6	484
1804	5	408
1803	4	316
1802	3	225
1801	2	125
1800	1	45
1799	0	0

STAGE/DISCHARGE
3 - 5 X 3 RCB OUTLETS



5.4.3 Calculations Summary
Range Wash/Sloan Channel
Confluence Detention Basin

CLA.06.A.91

CLARK COUNTY PUBLIC WORKS

RANGE WASH/SLOAN CHANNEL CONFLUENCE DETENTION BASIN

CALCULATIONS SUMMARY

RECEIVED
JUN 15 1993

BOYLE ENGINEERING CORPORATION

June 11, 1993

RANGE WASH/SLOAN CHANNEL CONFLUENCE DETENTION BASIN CALCULATIONS SUMMARY

TABLE OF CONTENTS

HEC-1 HYDROLOGIC CALCULATIONS

1. FUTURE CONDITIONS DETENTION BASIN DESIGN STORM INFLOW
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3. EXISTING CONDITIONS WITH DETENTION BASIN IMPROVEMENTS
4. FUTURE CONDITIONS WITHOUT UPSTREAM DETENTION BASIN E-J1 TO EVALUATE IMPACTS

HEC-2 WATER SURFACE PROFILE CALCULATIONS

1. GOLF COURSE CHANNEL
2. OUTFALL CHANNEL SUBCRITICAL REACH
3. OUTFALL CHANNEL SUPERCRITICAL REACH

DIVERSION STRUCTURE HYDRAULIC CALCULATIONS

SPILLWAY CALCULATIONS

OUTLET WORKS HYDRAULIC CALCULATIONS

STRUCTURAL CALCULATIONS

HEC-1

HYDROLOGIC CALCULATIONS

1

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
*** FREE ***
    1     ID                    EAST AND WEST RANGE WASHES
    2     ID                      100-YR, 6-HR STORM
    3     ID             FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
    4     ID                  DIVERSION FROM SLOAN CHANNEL TO DB
    5     ID                      BOYLE ENGINEERING CORPORATION
    6     ID                      STORM BCD (DARF=.63)
    7     ID                AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
    8     ID                   NEW FUTURE DEVELOPMENT IN 306, 307, 310
    9     IT     05       0       0     300
   10     IO      5       0       0
   11     JR    PREC     .63
   12     VS    DBIN   DBOUT
   13     VV    2.11    2.11

   14     KK    309B  SUB-BASIN 309B HYDROGRAPH
   15     KM            KINEMATIC WAVE RUNOFF COMPUTATION
   16     BA    3.64
   17     PB    2.86
   18     PC     .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   19     PC   18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.10
   20     PC   25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   21     PC   32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   22     PC   56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   23     PC   81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.00
   24     PC   97.40   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60
   25     PC   99.70   99.90  100.00
   26     LS       0      79
   27     UD    2.07

   28     KK   I2-I3  ROUTE FLOWS TO NODE I3
   29     RK   13830   .0109    .015       0   TRAP      30       2

   30     KK    310A  SUB-BASIN 310A HYDROGRAPH
   31     KM            KINEMATIC WAVE RUNOFF COMPUTATION
   32     BA    3.56
   33     PB    2.86
   34     LS       0      77       0       0      98
   35     UK     800    .015     .20      68
   36     UK     300    .020     .10      32
   37     RK    2750     .01     .05     .25   TRAP      30       50
   38     RK    7300     .01     .05    1.01   TRAP      30       50
   39     RK   19360   .0036     .05       0   TRAP      30       2      NO

   40     KK   NODEI3    COMBINE FLOWS AT NODE I3
   41     HC       2

   42     KK   I3-G1  ROUTE FLOWS TO NODE G1
   43     RK    6125   .0082    .015       0   TRAP      50       2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK    306B  SUB-BASIN 306B HYDROGRAPH
  45      KM          SCS RUNOFF COMPUTATION
  46      BA    4.54
  47      PB    2.86
  48      LS       0      80
  49      UO     .79

  50      KK    F2-G1   ROUTE FLOWS TO NODE G1
  51      RM       18   1.57     .10

  52      KK    307A  SUB-BASIN 307A HYDROGRAPH
  53      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  54      BA    6.23
  55      PB    2.86
  56      LS       0      77       0       0      98
  57      UK     800   .0123     .20      51
  58      UK     300    .015     .10      49
  59      RK    5000     .01     .05     .25    TRAP      30      50
  60      RK    3200    .013     .05    1.01    TRAP      30      50
  61      RK   13430   .0134     .03       0    TRAP      60     1.5     NO

  62      KK    NODE G1    COMBINE FLOWS AT G1
  63      HC       3

  64      KK    G1-G2  ROUTE FLOWS TO NODE G2
  65      RK    9880   .0030    .015       0    TRAP      60       2

  66      KK    307B  SUB-BASIN 307B HYDROGRAPH
  67      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  68      BA    1.84
  69      PB    2.86
  70      LS       0      77       0       0      98
  71      UK     800   .0123     .20      51
  72      UK     300    .015     .10      49
  73      RK    5000     .01     .05     .25
  74      RK    3200    .013     .05    1.01
  75      RK    9880    .003     .03       0    TRAP      60       2     NO

  76      KK    310B  SUB-BASIN 310B HYDROGRAPH
  77      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  78      BA    5.58
  79      PB    2.86
  80      LS       0      77       0       0      98
  81      UK     800    .015     .20      68
  82      UK     300    .020     .10      32
  83      RK    2750     .01     .05     .25    TRAP      30      50
  84      RK    7300     .01     .05    1.01    TRAP      30      50
  85      RK   17775    .009     .05       0    TRAP      60       1     NO
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  86      KK    NODE G2    COMBINE ALL FLOWS AT NODE G2
  87      HC       3

  88      KK     47B   SUB-BASIN 47B HYDROGRAPH
  89      KM           KINEMATIC RUNOFF COMPUTATION
  90      BA    4.72
  91      PB    2.86
  92      LS       0      77       0       0      98
  93      UK     800    .008     .20      69
  94      UK      80    .012     .10      31
  95      RK    2000    .003     .05     .25    TRAP      30      50
  96      RK    7000    .007     .05    1.23    TRAP      30      50
  97      RK   20150    .005     .03       0    TRAP      40       1      NO

  98      KK  G2-DIV ROUTE FLOWS TO DIVERSION
  99      RK    8100   .0022     .015      0    TRAP      60       2

 100      KK   NODEW    COMBINE FLOWS AT NODE
 101      HC       2

 102      KK     DIV
 103      DT   SLOAN
 104      DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
 105      DQ       0     850     900     950    1000    1050    1100    1200    1300    1400

 106      KK    GOLF
 107      RK    4000   .0010     .030      0    TRAP      70       3

 108      KK      44   SUB-BASIN 44 HYDROGRAPH
 109      KM           SCS RUNOFF COMPUTATION
 110      BA    7.23
 111      PB    2.86
 112      LS       0      79
 113      UD    1.22

 114      KK    J-K1  ROUTE FLOW TO NODE K1
 115      RM       8     .58     .15

 116      KK    312A SUB-BASIN 312A HYDROGRAPH
 117      KM         SCS RUNOFF COMPUTATION
 118      BA    4.00
 119      PB    2.86
 120      LS       0      77
 121      UD    1.57

 122      KK     45A SUB-BASIN 45A HYDROGRAPH
 123      KM           SCS RUNOFF COMPUTATION
 124      BA    8.38
 125      PB    2.86
 126      LS       0      76       0       0       0       0
 127      UD    2.31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  128     KK   N1-K1  ROUTE FLOW TO NODE K1
  129     RK    8300   .0157    .035       0    TRAP      50       3

  130     KK    NODEK1  COMBINE FLOW AT NODE K1
  131     HC       3
  132     KO       3

  133     KK    E-J1  DETENTION BASIN E-J1
  134     RS       1    STOR       0       0
  135     SV       0      13     120     220     250     290     380     480
  136     SQ       0      60     700     920     980    4340   18385   38350
  137     KO       3

  138     KK   K1-K2  ROUTE FLOW TO NODE K2
  139     RK    7900   .0127    .015       0    TRAP      14       2

  140     KK    312B SUB-BASIN 312B HYDROGRAPH
  141     KM          SCS RUNOFF COMPUTATION
  142     BA   1.49
  143     PB   2.86
  144     LS       0      77
  145     UD   1.33

  146     KK    NODEK2   COMBINE FLOWS AT NODE K2
  147     HC       2

  148     KK    K2-O  ROUTE FLOW TO NODE O
  149     RK    6520   .0031    .015       0    TRAP      24       2

  150     KK     45B SUB-BASIN 45B HYDROGRAPH
  151     KM           SCS RUNOFF COMPUTATION
  152     BA   2.35
  153     PB   2.86
  154     LS       0      76       0       0       0       0
  155     UD   1.81

  156     KK    N2-O  ROUTE FLOW TO NODE O
  157     RK    9550   .0157    .035       0    TRAP      50       1

  158     KK .   048   SUB-BASIN 048 HYDROGRAPH
  159     KM           SCS RUNOFF COMPUTATION
  160     BA   2.07
  161     PB   2.86
  162     LS       0      76
  163     UD   1.97

  164     KK     46A  SUB-BASIN 46A HYDROGRAPH
  165     KM           SCS RUNOFF COMPUTATION
  166     BA   7.35
  167     PB   3.00
  168     LS       0      77
  169     UD   1.60
```

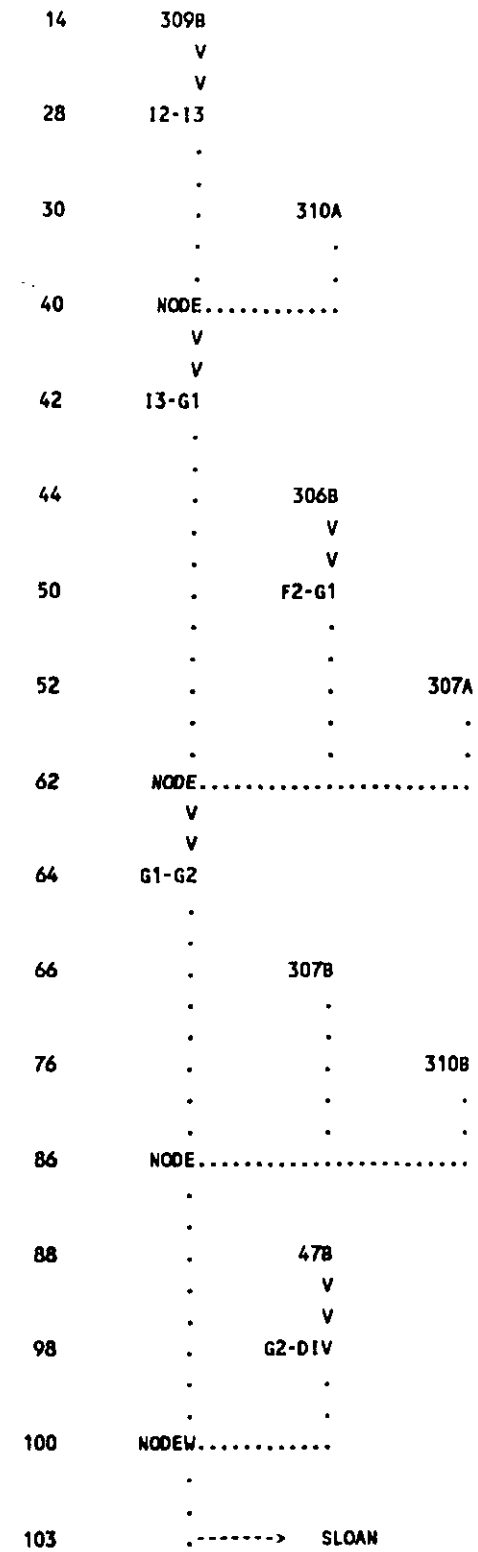
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  170     KK    468  SUB-BASIN 46B HYDROGRAPH
  171     KM           SCS RUNOFF COMPUTATION
  172     BA   6.02
  173     PB   3.00
  174     LS      0      77
  175     UD   1.71

  176     KK   NODEO  COMBINE ALL FLOW AT NODE O
  177     HC      5

  178     KK   O-P1  ROUTE FLOW TO NODE P1
  179     RK  11850   .0056     .03       0    TRAP      32       2.

  180     KK   312C SUB-BASIN 312C HYDROGRAPH
  181     KM          SCS RUNOFF COMPUTATION
  182     BA   1.28
  183     PB   2.86
  184     LS      0      77
  185     UD   1.51

  186     KK   L-P1  ROUTE FLOW TO NODE P1
  187     RK  10000   .0071     .03       0    TRAP      60       3

  188     KK    47A   SUB-BASIN 47A HYDROGRAPH
  189     KM          KINEMATIC RUNOFF COMPUTATION
  190     BA   2.07
  191     PB   2.86
  192     LS      0      77        0        0      98
  193     UK    800    .008      .20       69
  194     UK     80    .012      .10       31
  195     RK   2000    .003      .05      .25    TRAP      30       50
  196     RK   7000    .007      .05     1.23    TRAP      30       50
  197     RK  12250    .007      .03        0    TRAP      40        1

  198     KK     P1    COMBINE FLOWS AT P1
  199     HC      3

  200     KK   P1-P  ROUTE FLOW TO NODE P
  201     RK   6120   .0041     .015       0    TRAP      10       2

  202     KK    317   SUB-BASIN 317 HYDROGRAPH
  203     KM          SCS RUNOFF COMPUTATION
  204     BA   7.66
  205     PB   3.15
  206     LS      0      80
  207     UD    .97

  208     KK   318B   SUB-BASIN 318B HYDROGRAPH
  209     KM          SCS RUNOFF COMPUTATION
  210     BA   1.61
  211     PB   3.15
  212     LS      0      87        0
  213     UD    .37
```

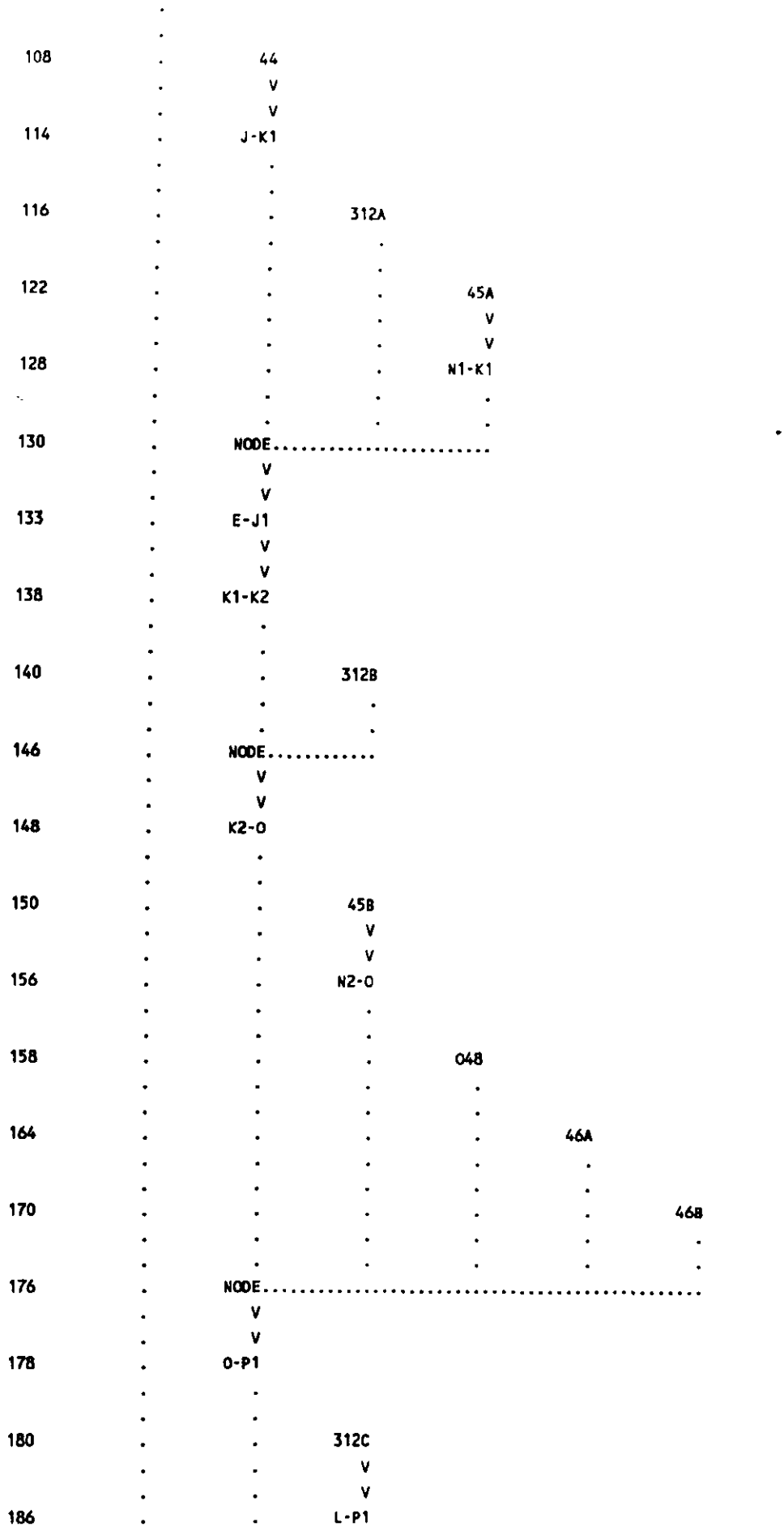
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  214     KK     Q-P   ROUTE FLOW TO NODE P
  215     RM       4     .26     .15

  216     KK     318A  SUB BASIN 318A HYDROGRAPH
  217     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  218     BA     0.76
  219     PB     2.93
  220     LS       0      77       0       0      98
  221     UK     700    .020     .30      74
  222     UK      50    .025     .10      26
  223     RK    2000    .035     .05     .06    TRAP     30      50
  224     RK    7000    .014     .05     .55    TRAP     30      50
  225     RK    9200   .0043     .03       0    TRAP     30       1

  226     KK    NODEP  CONBINE FLOWS AT NODE P
  227     HC       4

  228     KK    P-M1   ROUTE FLOWS TO NODE M1
  229     RK    4800   .0034    .015       0    TRAP     40       1

  230     KK    DBIN
  231     HC       2
  232     KO       3

  233     KK    DBOUT
  234     KM    CONFLUENCE BASIN 2 LEVEL OUTLET
  235     RS       1    ELEV       2
  236     SV       0     3.2     9.9    21.4    39.2     102     217     533     658     794
  237     SV     925
  238     SQ       0      54     153     214     238     280     317     367     688    1263
  239     SQ    1938
  240     SE       2       3       4       5       6       8      10      13      14      15
  241     SE      16
  242     KO       3
  243     ZZ
```

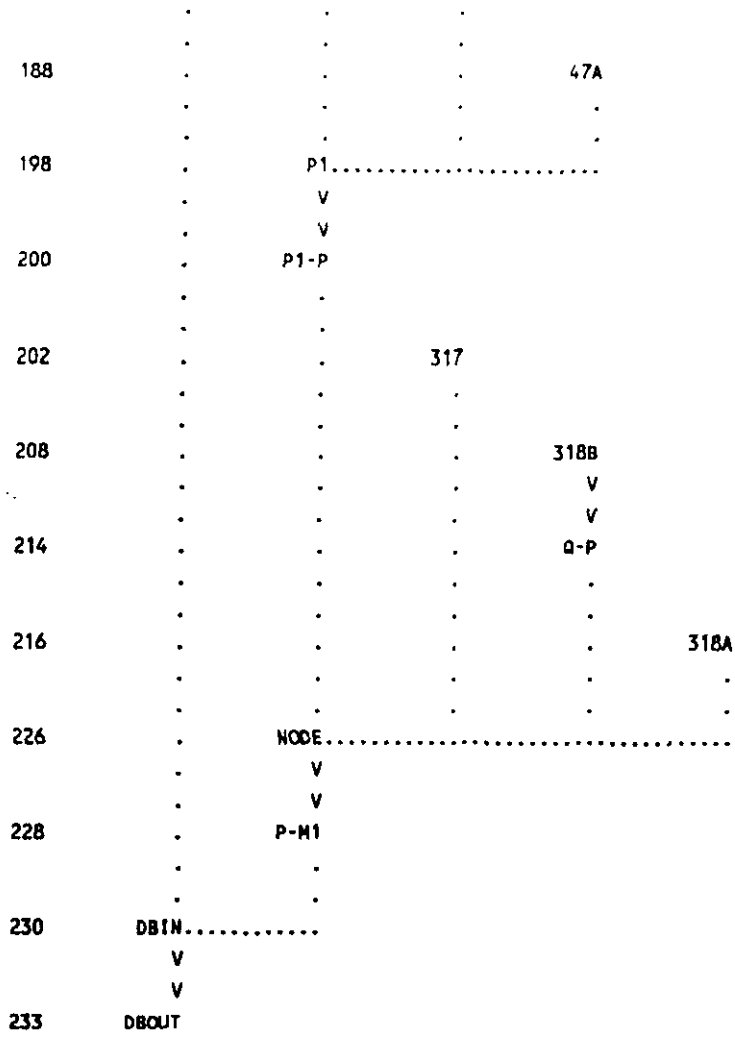
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR
(<---) RETURN OF DIVERTED OR PUMPED FLOW
(---->) DIVERSION OR PUMP FLOW




108
44
114
J-K1
116
312A
122
45A
128
N1-K1
130
NODE
133
E-J1
138
K1-K2
140
312B
146
NODE
148
K2-O
150
45B
156
N2-O
158
O48
164
46A
170
46B
176
NODE
178
O-P1
180
312C
186
L-P1



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCD (DARF=.63)
AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
NEW FUTURE DEVELOPMENT IN 306, 307, 310

IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	DBIN	DBOUT								
VV	VARIABLE CODE	2.11	2.11	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.63

*** *** *** *

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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

**************
*            *
*     E-J1   *      DETENTION BASIN E-J1
*            *
**************

 7 KO        OUTPUT CONTROL VARIABLES
                IPRNT        3  PRINT CONTROL
                IPLOT        0  PLOT CONTROL
                QSCAL       0.  HYDROGRAPH PLOT SCALE

           HYDROGRAPH ROUTING DATA

 6 RS        STORAGE ROUTING
                NSTPS        1  NUMBER OF SUBREACHES
                 ITYP     STOR  TYPE OF INITIAL CONDITION
                RSVRIC     .00  INITIAL CONDITION
                    X      .00 WORKING R AND D COEFFICIENT

 75 SV         STORAGE      .0     13.0    120.0    220.0    250.0    290.0    380.0    480.0

136 SQ         DISCHARGE    0.     60.     700.     920.     980.    4340.   18385.   38350.

                                                      ***

   ***           ***           ***           ***           ***

                HYDROGRAPH AT STATION     E-J1
                 FOR PLAN 1, RATIO =  .63

 1 AK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR        72-HR     24.92-HR
+  (CFS)       (HR)
                          (CFS)
+    783.      7.50                611.         188.         181.         181.
                       (INCHES)    .290         .357         .357         .357
                       (AC-FT)     303.         373.         373.         373.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                    6-HR        24-HR        72-HR     24.92-HR
+  AC-FT)      (HR)
     158.      7.50                112.          35.          34.          34.

                CUMULATIVE AREA =  19.61 SQ MI
```

```
**********
*        *
*  DBIN  *
*        *
**********

 2 KO        OUTPUT CONTROL VARIABLES
                IPRNT        3  PRINT CONTROL
                IPLOT        0  PLOT CONTROL
                QSCAL        0.  HYDROGRAPH PLOT SCALE

 231 HC      HYDROGRAPH COMBINATION
                ICOMP        2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***

    ***          ***          ***          ***          ***

                  HYDROGRAPH AT STATION     DBIN
                    FOR PLAN 1, RATIO =  .63

 PEAK FLOW    TIME                      MAXIMUM AVERAGE FLOW
                                  6-HR        24-HR       72-HR     24.92-HR
  (CFS)       (HR)
                        (CFS)
  4577.       5.83                2707.        784.        755.        755.
                      (INCHES)      .305        .354        .354        .354
                      (AC-FT)     1342.       1554.       1554.       1554.

                      CUMULATIVE AREA =   82.38 SQ MI
```

****
* *
* DBOUT *
* *
****

2 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

5 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	2.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

236 SV	STORAGE	.0	3.2	9.9	21.4	39.2	102.0	217.0	533.0	658.0	794.0
		925.0									
238 SQ	DISCHARGE	0.	54.	153.	214.	238.	280.	317.	367.	688.	1263.
		1938.									
240 SE	ELEVATION	2.00	3.00	4.00	5.00	6.00	8.00	10.00	13.00	14.00	15.00
		16.00									

***

*** *** *** *** ***

HYDROGRAPH AT STATION DBOUT
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)					
		(CFS)				
1822.	8.08		1403.	621.	598.	598.
		(INCHES)	.158	.280	.280	.280
		(AC-FT)	696.	1231.	1231.	1231.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.92-HR
(AC-FT)	(HR)				
903.	8.08	818.	497.	479.	479.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.92-HR
(FEET)	(HR)				
15.83	8.08	15.19	11.80	11.44	11.44

CUMULATIVE AREA = 82.38 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.63
HYDROGRAPH AT					
+	309B	3.64	1	FLOW	280.
				TIME	6.17
ROUTED TO					
+	I2-I3	3.64	1	FLOW	279.
				TIME	6.33
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	348.
				TIME	5.58
2 COMBINED AT					
+	NODE	7.20	1	FLOW	601.
				TIME	6.00
ROUTED TO					
+	I3-G1	7.20	1	FLOW	601.
				TIME	6.08
HYDROGRAPH AT					
+	306B	4.54	1	FLOW	565.
				TIME	4.33
ROUTED TO					
+	F2-G1	4.54	1	FLOW	503.
				TIME	6.08
HYDROGRAPH AT					
+	307A	6.23	1	FLOW	1228.
				TIME	4.08
3 COMBINED AT					
*	NODE	17.97	1	FLOW	1722.
				TIME	5.75
ROUTED TO					
+	G1-G2	17.97	1	FLOW	1714.
				TIME	5.83
HYDROGRAPH AT					
*	307B	1.84	1	FLOW	379.
				TIME	3.92
HYDROGRAPH AT					
+	310B	5.58	1	FLOW	545.
				TIME	5.42

3 COMBINED AT					
+	NODE	25.39	1	FLOW	2416.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	442.
				TIME	4.58
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	437.
				TIME	4.83
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	2822.
				TIME	5.75
DIVERSION TO					
+	SLOAN	30.11	1	FLOW	1261.
				TIME	5.75
HYDROGRAPH AT					
+	DIV	30.11	1	FLOW	1561.
				TIME	5.75
ROUTED TO					
+	GOLF	30.11	1	FLOW	1553.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	695.
				TIME	5.42
ROUTED TO					
+	J-K1	7.23	1	FLOW	690.
				TIME	5.92
HYDROGRAPH AT					
+	312A	4.00	1	FLOW	304.
				TIME	5.75
HYDROGRAPH AT					
+	45A	8.38	1	FLOW	467.
				TIME	6.50
ROUTED TO					
+	N1-K1	8.38	1	FLOW	466.
				TIME	6.67
3 COMBINED AT					
+	NODE	19.61	1	FLOW	1396.
				TIME	6.08
ROUTED TO					
•	E-J1	19.61	1	FLOW	783.
				TIME	7.50
ROUTED TO					
+	K1-K2	19.61	1	FLOW	783.
				TIME	7.50

HYDROGRAPH AT					
•	312B	1.49	1	FLOW	120.
				TIME	5.50
2 COMBINED AT					
+	NODE	21.10	1	FLOW	819.
				TIME	7.08
ROUTED TO					
+	K2-O	21.10	1	FLOW	819.
				TIME	7.17
HYDROGRAPH AT					
+	45B	2.35	1	FLOW	153.
				TIME	6.00
ROUTED TO					
+	N2-O	2.35	1	FLOW	150.
				TIME	6.33
HYDROGRAPH AT					
+	04B	2.07	1	FLOW	128.
				TIME	6.17
HYDROGRAPH AT					
+	46A	7.35	1	FLOW	622.
				TIME	5.75
HYDROGRAPH AT					
+	46B	6.02	1	FLOW	494.
				TIME	5.83
5 COMBINED AT					
•	NODE	38.89	1	FLOW	2048.
				TIME	6.25
ROUTED TO					
+	O-P1	38.89	1	FLOW	2039.
				TIME	6.42
HYDROGRAPH AT					
•	312C	1.28	1	FLOW	99.
				TIME	5.67
ROUTED TO					
•	L-P1	1.28	1	FLOW	95.
				TIME	6.25
HYDROGRAPH AT					
+	47A	2.07	1	FLOW	213.
				TIME	4.42
3 COMBINED AT					
+	P1	42.24	1	FLOW	2268.
				TIME	6.33
ROUTED TO					
+	P1-P	42.24	1	FLOW	2268.
				TIME	6.42

HYDROGRAPH AT					
+	317	7.66	1	FLOW	1059.
				TIME	4.50
HYDROGRAPH AT					
+	318B	1.61	1	FLOW	603.
				TIME	3.75
ROUTED TO					
•	Q-P	1.61	1	FLOW	565.
				TIME	4.00
HYDROGRAPH AT					
+	318A	.76	1	FLOW	71.
				TIME	4.33
4 COMBINED AT					
+	NODE	52.27	1	FLOW	3025.
				TIME	5.75
ROUTED TO					
+	P-M1	52.27	1	FLOW	3024.
				TIME	5.83
2 COMBINED AT					
+	DBIN	82.38	1	FLOW	4577.
				TIME	5.83
ROUTED TO					
+	DBOUT	82.38	1	FLOW	1822.
				TIME	8.08

** PEAK STAGES IN FEET **

1	STAGE	15.83
	TIME	8.08

1TABLE 1		STATION	DBIN FLOW	DBOUT FLOW
		PLAN	1	1
		RATIO	.63	.63
PER	DAY	MON HRMN		
1	1	0000	.00	.00
2	1	0005	.00	.00
3	1	0010	.00	.00
4	1	0015	.00	.00
5	1	0020	.00	.00
6	1	0025	.00	.00
7	1	0030	.00	.00
8	1	0035	.00	.00
9	1	0040	.00	.00
10	1	0045	.00	.00
11	1	0050	.00	.00
12	1	0055	.00	.00
13	1	0100	.00	.00
14	1	0105	.00	.00
15	1	0110	.01	.00
16	1	0115	.03	.00
17	1	0120	.08	.01
18	1	0125	.22	.02
19	1	0130	.52	.06
20	1	0135	1.06	.14
21	1	0140	1.97	.29
22	1	0145	3.42	.56
23	1	0150	5.63	.99
24	1	0155	8.87	1.68
25	1	0200	13.47	2.72
26	1	0205	19.62	4.24
27	1	0210	27.35	6.35
28	1	0215	36.47	9.16
29	1	0220	46.74	12.72
30	1	0225	57.86	17.07
31	1	0230	69.38	22.18
32	1	0235	80.50	27.98
33	1	0240	90.31	34.29
34	1	0245	98.23	40.87
35	1	0250	104.47	47.52
36	1	0255	110.03	54.07
37	1	0300	116.50	59.80
38	1	0305	125.90	65.75
39	1	0310	140.81	72.29
40	1	0315	164.89	80.10
41	1	0320	202.87	90.15
42	1	0325	260.70	103.86
43	1	0330	346.43	123.20
44	1	0335	468.49	150.73
45	1	0340	629.02	166.44
46	1	0345	824.00	186.53
47	1	0350	1046.12	213.38
48	1	0355	1288.64	222.66
49	1	0400	1480.15	233.40
50	1	0405	1824.64	242.23

1TABLE 1 (CONT.)	STATION	OBIN FLOW	OBOUT FLOW
	PLAN	1	1
	RATIO	.63	.63

PER	DAY	MON	HRMN		
51	1		0410	2196.81	250.36
52	1		0415	2540.08	260.09
53	1		0420	2807.15	271.18
54	1		0425	2988.34	281.57
55	1		0430	3101.05	287.68
56	1		0435	3171.20	293.99
57	1		0440	3219.23	300.41
58	1		0445	3265.27	306.92
59	1		0450	3326.29	313.54
60	1		0455	3413.25	318.62
61	1		0500	3530.15	322.06
62	1		0505	3677.59	325.63
63	1		0510	3849.42	329.38
64	1		0515	4028.90	333.31
65	1		0520	4196.64	337.42
66	1		0525	4337.45	341.70
67	1		0530	4432.34	346.11
68	1		0535	4478.76	350.58
69	1		0540	4533.52	355.11
70	1		0545	4564.95	359.68
71	1		0550	4576.90	364.26
72	1		0555	4570.18	396.76
73	1		0600	4543.32	469.69
74	1		0605	4496.61	540.69
75	1		0610	4432.45	609.48
76	1		0615	4353.54	675.81
77	1		0620	4263.30	772.30
78	1		0625	4165.50	871.09
79	1		0630	4062.73	964.17
80	1		0635	3955.26	1051.55
81	1		0640	3841.98	1133.26
82	1		0645	3722.96	1209.30
83	1		0650	3600.03	1283.26
84	1		0655	3474.69	1361.86
85	1		0700	3348.08	1433.32
86	1		0705	3221.13	1497.87
87	1		0710	3094.01	1555.74
88	1		0715	2966.79	1607.16
89	1		0720	2839.77	1652.35
90	1		0725	2713.11	1691.55
91	1		0730	2588.06	1724.99
92	1		0735	2466.02	1752.95
93	1		0740	2347.57	1775.75
94	1		0745	2233.23	1793.70
95	1		0750	2123.50	1807.11
96	1		0755	2016.12	1816.27
97	1		0800	1896.52	1821.15
98	1		0805	1802.61	1822.14
99	1		0810	1713.58	1819.91
100	1		0815	1629.48	1814.74

ITABLE 1 (CONT.)		STATION	DBIN FLOW	DBOUT FLOW
		PLAN	1	1
		RATIO	.63	.63
PER	DAY	MON HRMN		
101	1	0820	1550.81	1806.91
102	1	0825	1478.36	1796.71
103	1	0830	1412.18	1784.46
104	1	0835	1352.25	1770.43
105	1	0840	1298.31	1754.91
106	1	0845	1249.81	1738.15
107	1	0850	1205.92	1720.35
108	1	0855	1151.74	1701.47
109	1	0900	1116.07	1681.68
110	1	0905	1083.15	1661.39
111	1	0910	1052.53	1640.69
112	1	0915	1023.70	1619.68
113	1	0920	995.92	1598.41
114	1	0925	968.36	1576.93
115	1	0930	940.46	1555.22
116	1	0935	912.16	1533.29
117	1	0940	883.75	1511.14
118	1	0945	855.52	1488.77
119	1	0950	827.78	1466.21
120	1	0955	800.72	1443.47
121	1	1000	774.44	1420.60
122	1	1005	748.97	1397.63
123	1	1010	724.33	1374.58
124	1	1015	700.52	1351.49
125	1	1020	677.53	1328.40
126	1	1025	655.35	1305.31
127	1	1030	633.93	1282.28
128	1	1035	613.27	1259.96
129	1	1040	593.31	1241.12
130	1	1045	574.05	1222.25
131	1	1050	555.44	1203.38
132	1	1055	537.47	1184.52
133	1	1100	520.10	1165.70
134	1	1105	503.32	1146.93
135	1	1110	487.11	1128.23
136	1	1115	471.43	1109.60
137	1	1120	456.26	1091.07
138	1	1125	441.60	1072.64
139	1	1130	427.43	1054.33
140	1	1135	413.71	1036.14
141	1	1140	400.45	1018.08
142	1	1145	387.63	1000.17
143	1	1150	375.24	982.42
144	1	1155	363.25	964.82
145	1	1200	351.67	947.39
146	1	1205	340.47	930.13
147	1	1210	329.65	913.05
148	1	1215	319.18	896.16
149	1	1220	309.06	879.45
150	1	1225	299.28	862.94

1TABLE 1 (CONT.)		STATION	DBIN FLOW	DBOUT FLOW
		PLAN	1	1
		RATIO	.63	.63
PER	DAY	MON HRMN		
151	1	1230	289.82	846.63
152	1	1235	280.68	830.52
153	1	1240	271.84	814.61
154	1	1245	263.29	798.91
155	1	1250	255.02	783.42
156	1	1255	247.02	768.14
157	1	1300	239.29	753.07
158	1	1305	231.82	738.22
159	1	1310	224.59	723.58
160	1	1315	217.60	709.16
161	1	1320	210.85	694.95
162	1	1325	204.31	683.70
163	1	1330	198.00	675.24
164	1	1335	191.90	666.82
165	1	1340	186.00	658.45
166	1	1345	180.29	650.11
167	1	1350	174.78	641.83
168	1	1355	169.45	633.59
169	1	1400	164.31	625.41
170	1	1405	159.33	617.29
171	1	1410	154.52	609.21
172	1	1415	149.87	601.20
173	1	1420	145.38	593.25
174	1	1425	141.03	585.36
175	1	1430	136.82	577.54
176	1	1435	132.75	569.77
177	1	1440	128.82	562.08
178	1	1445	125.01	554.45
179	1	1450	121.32	546.89
180	1	1455	117.75	539.40
181	1	1500	114.30	531.97
182	1	1505	110.95	524.62
183	1	1510	107.72	517.34
184	1	1515	104.58	510.13
185	1	1520	101.55	503.00
186	1	1525	98.61	495.93
187	1	1530	95.78	488.94
188	1	1535	93.03	482.03
189	1	1540	90.38	475.18
190	1	1545	87.83	468.42
191	1	1550	85.37	461.72
192	1	1555	83.01	455.10
193	1	1600	80.74	448.56
194	1	1605	78.55	442.09
195	1	1610	76.46	435.70
196	1	1615	74.44	429.39
197	1	1620	72.50	423.15
198	1	1625	70.64	416.98
199	1	1630	68.84	410.90
200	1	1635	67.11	404.88

ITABLE 1 (CONT.)		STATION	OBIN FLOW	OBOUT FLOW
		PLAN	1	1
		RATIO	.63	.63
PER	DAY	MON HRMN		
201	1	1640	65.45	398.95
202	1	1645	63.83	393.09
203	1	1650	62.28	387.30
204	1	1655	60.77	381.59
205	1	1700	59.31	375.95
206	1	1705	57.89	370.39
207	1	1710	56.52	366.87
208	1	1715	55.19	366.53
209	1	1720	53.89	366.19
210	1	1725	52.64	365.85
211	1	1730	51.41	365.51
212	1	1735	50.22	365.17
213	1	1740	49.06	364.82
214	1	1745	47.94	364.48
215	1	1750	46.84	364.13
216	1	1755	45.77	363.79
217	1	1800	44.72	363.44
218	1	1805	43.71	363.09
219	1	1810	42.72	362.74
220	1	1815	41.75	362.39
221	1	1820	40.81	362.04
222	1	1825	39.89	361.69
223	1	1830	39.00	361.34
224	1	1835	38.12	360.99
225	1	1840	37.27	360.64
226	1	1845	36.44	360.29
227	1	1850	35.63	359.93
228	1	1855	34.83	359.58
229	1	1900	34.06	359.23
230	1	1905	33.31	358.87
231	1	1910	32.57	358.52
232	1	1915	31.86	358.16
233	1	1920	31.16	357.80
234	1	1925	30.47	357.45
235	1	1930	29.81	357.09
236	1	1935	29.15	356.74
237	1	1940	28.52	356.38
238	1	1945	27.90	356.02
239	1	1950	27.29	355.66
240	1	1955	26.70	355.31
241	1	2000	26.13	354.95
242	1	2005	25.56	354.59
243	1	2010	25.01	354.23
244	1	2015	24.48	353.87
245	1	2020	23.95	353.51
246	1	2025	23.44	353.15
247	1	2030	22.94	352.79
248	1	2035	22.46	352.43
249	1	2040	21.98	352.07
250	1	2045	21.52	351.71

ITABLE 1 (CONT.)		STATION	DBIN FLOW	DBOUT FLOW
		PLAN	1	1
		RATIO	.63	.63
PER	DAY	MON HRMN		
251	1	2050	21.06	351.35
252	1	2055	20.62	350.99
253	1	2100	20.19	350.63
254	1	2105	19.77	350.27
255	1	2110	19.35	349.91
256	1	2115	18.95	349.55
257	1	2120	18.56	349.19
258	1	2125	18.17	348.83
259	1	2130	17.80	348.47
260	1	2135	17.43	348.11
261	1	2140	17.07	347.75
262	1	2145	16.73	347.39
263	1	2150	16.38	347.03
264	1	2155	16.05	346.67
265	1	2200	15.73	346.31
266	1	2205	15.41	345.95
267	1	2210	15.10	345.59
268	1	2215	14.79	345.23
269	1	2220	14.50	344.87
270	1	2225	14.21	344.51
271	1	2230	13.92	344.15
272	1	2235	13.65	343.79
273	1	2240	13.38	343.43
274	1	2245	13.11	343.07
275	1	2250	12.85	342.71
276	1	2255	12.60	342.35
277	1	2300	12.36	341.99
278	1	2305	12.11	341.63
279	1	2310	11.88	341.28
280	1	2315	11.65	340.92
281	1	2320	11.42	340.56
282	1	2325	11.20	340.20
283	1	2330	10.99	339.84
284	1	2335	10.78	339.48
285	1	2340	10.57	339.12
286	1	2345	10.37	338.77
287	1	2350	10.17	338.41
288	1	2355	9.98	338.05
289	2	0000	9.79	337.69
290	2	0005	9.61	337.34
291	2	0010	9.43	336.98
292	2	0015	9.26	336.62
293	2	0020	9.08	336.27
294	2	0025	8.92	335.91
295	2	0030	8.75	335.55
296	2	0035	8.59	335.20
297	2	0040	8.43	334.84
298	2	0045	8.28	334.49
299	2	0050	8.13	334.13
300	2	0055	7.98	333.78

MAX	4576.90	1822.14
MIN	.00	.00
AVE	752.18	596.39

*** NORMAL END OF HEC-1 ***

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
    1     ID                    EAST AND WEST RANGE WASHES
    2     ID                       100-YR, 6-HR STORM
    3     ID             FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
    4     ID                  DIVERSION FROM SLOAN CHANNEL TO DB
    5     ID                      BOYLE ENGINEERING CORPORATION
    6     ID                    STORM BCDE (DARF=.60)
    7     ID               AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
    8     ID                   NEW FUTURE DEVELOPMENT IN 306, 307, 310
    9     IT     05       0       0     200
   10     IO      5       0       0
   11     JR   PREC     .60
   12     VS  NODEW    GOLF    DBIN   DBOUT    SC-M   NODEM    WASH
   13     VV   2.11    2.11    2.11    2.11    2.11    2.11    2.11

   14     KK   309B  SUB-BASIN 309B HYDROGRAPH
   15     KM           KINEMATIC WAVE RUNOFF COMPUTATION
   16     BA   3.64
   17     PB   2.86
   18     PC    .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   19     PC  18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.10
   20     PC  25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   21     PC  32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   22     PC  56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   23     PC  81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.00
   24     PC  97.40   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60
   25     PC  99.70   99.90  100.00
   26     LS      0      79
   27     UD   2.07

   28     KK   I2-I3  ROUTE FLOWS TO NODE I3
   29     RK  13830   .0109    .015       0   TRAP      30       2

   30     KK   310A  SUB-BASIN 310A HYDROGRAPH
   31     KM           KINEMATIC WAVE RUNOFF COMPUTATION
   32     BA   3.56
   33     PB   2.86
   34     LS      0      77       0       0      98
   35     UK    800    .015     .20      68
   36     UK    300    .020     .10      32
   37     RK   2750     .01     .05     .25   TRAP      30      50
   38     RK   7300     .01     .05    1.01   TRAP      30      50
   39     RK  19360   .0036     .05       0   TRAP      30       2      NO

   40     KK   NODEI3   COMBINE FLOWS AT NODE I3
   41     HC      2

   42     KK   I3-G1  ROUTE FLOWS TO NODE G1
   43     RK   6125   .0082    .015       0   TRAP      50       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK    306B  SUB-BASIN 306B HYDROGRAPH
  45      KM          SCS RUNOFF COMPUTATION
  46      BA    4.54
  47      PB    2.86
  48      LS       0      80
  49      UD     .79

  50      KK    F2-G1   ROUTE FLOWS TO NODE G1
  51      RM       18   1.57     .10

  52      KK    307A  SUB-BASIN 307A HYDROGRAPH
  53      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  54      BA    6.23
  55      PB    2.86
  56      LS       0      77       0       0      98
  57      UK     800   .0123     .20      51
  58      UK     300    .015     .10      49
  59      RK    5000     .01     .05     .25    TRAP      30      50
  60      RK    3200    .013     .05    1.01    TRAP      30      50
  61      RK   13430   .0134     .03       0    TRAP      60     1.5      NO

  62      KK    NODE G1   COMBINE FLOWS AT G1
  63      HC       3

  64      KK    G1-G2  ROUTE FLOWS TO NODE G2
  65      RK    9880   .0030    .015       0    TRAP      60       2

  66      KK    307B  SUB-BASIN 307B HYDROGRAPH
  67      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  68      BA    1.84
  69      PB    2.86
  70      LS       0      77       0       0      98
  71      UK     800   .0123     .20      51
  72      UK     300    .015     .10      49
  73      RK    5000     .01     .05     .25
  74      RK    3200    .013     .05    1.01
  75      RK    9880    .003     .03       0    TRAP      60       2      NO

  76      KK    310B  SUB-BASIN 310B HYDROGRAPH
  77      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  78      BA    5.58
  79      PB    2.86
  80      LS       0      77       0       0      98
  81      UK     800    .015     .20      68
  82      UK     300    .020     .10      32
  83      RK    2750     .01     .05     .25    TRAP      30      50
  84      RK    7300     .01     .05    1.01    TRAP      30      50
  85      RK   17775    .009     .05       0    TRAP      60       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  86      KK    NODE G2    COMBINE ALL FLOWS AT NODE G2
  87      HC       3

  88      KK     47B   SUB-BASIN 47B HYDROGRAPH
  89      KM           KINEMATIC RUNOFF COMPUTATION
  90      BA    4.72
  91      PB    2.86
  92      LS       0      77       0       0      98
  93      UK     800    .008     .20      69
  94      UK      80    .012     .10      31
  95      RK    2000    .003     .05     .25    TRAP      30      50
  96      RK    7000    .007     .05    1.23    TRAP      30      50*
  97      RK   20150    .005     .03       0    TRAP      40       1      NO

  98      KK  G2-DIV ROUTE FLOWS TO DIVERSION
  99      RK    8100   .0022     .015      0    TRAP      60       2

 100      KK   NODEW    COMBINE FLOWS AT NODE
 101      HC       2

 102      KK     DIV
 103      DT   SLOAN
 104      DI       0     850      920     1020    1230    1440    1685    2390    3100    3900
 105      DQ       0     850      900      950    1000    1050    1100    1200    1300    1400

 106      KK    GOLF
 107      RK    4000   .0010     .030       0    TRAP      70       3

 108      KK      44   SUB-BASIN 44 HYDROGRAPH
 109      KM           SCS RUNOFF COMPUTATION
 110      BA    7.23
 111      PB    2.86
 112      LS       0      79
 113      UD    1.22

 114      KK    J-K1  ROUTE FLOW TO NODE K1
 115      RM       8     .58      .15

 116      KK    312A SUB-BASIN 312A HYDROGRAPH
 117      KM           SCS RUNOFF COMPUTATION
 118      BA    4.00
 119      PB    2.86
 120      LS       0      77
 121      UD    1.57

 122      KK     45A SUB-BASIN 45A HYDROGRAPH
 123      KM           SCS RUNOFF COMPUTATION
 124      BA    8.38
 125      PB    2.86
 126      LS       0      76       0       0       0       0
 127      UD    2.31
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  128     KK   N1-K1  ROUTE FLOW TO NODE K1
  129     RK    8300   .0157    .035       0    TRAP      50       3

  130     KK    NODEK1  COMBINE FLOW AT NODE K1
  131     HC       3
  132     KO       3

  133     KK    E-J1  DETENTION BASIN E-J1
  134     RS       1    STOR       0       0
  135     SV       0      13     120     220     250     290     380     480
  136     SQ       0      60     700     920     980    4340   18385   38350
  137     KO       3

  138     KK   K1-K2  ROUTE FLOW TO NODE K2
  139     RK    7900   .0127    .015       0    TRAP      14       2

  140     KK    312B SUB-BASIN 312B HYDROGRAPH
  141     KM          SCS RUNOFF COMPUTATION
  142     BA   1.49
  143     PB   2.86
  144     LS       0      77
  145     UD   1.33

  146     KK    NODEK2   COMBINE FLOWS AT NODE K2
  147     HC       2

  148     KK   K2-O  ROUTE FLOW TO NODE O
  149     RK    6520   .0031    .015       0    TRAP      24       2

  150     KK     45B SUB-BASIN 45B HYDROGRAPH
  151     KM           SCS RUNOFF COMPUTATION
  152     BA   2.35
  153     PB   2.86
  154     LS       0      76       0       0       0       0
  155     UD   1.81

  156     KK   N2-O  ROUTE FLOW TO NODE O
  157     RK    9550   .0157    .035       0    TRAP      50       1

  158     KK     O48   SUB-BASIN O48 HYDROGRAPH
  159     KM           SCS RUNOFF COMPUTATION
  160     BA   2.07
  161     PB   2.86
  162     LS       0      76
  163     UD   1.97

  164     KK     46A  SUB-BASIN 46A HYDROGRAPH
  165     KM           SCS RUNOFF COMPUTATION
  166     BA   7.35
  167     PB   3.00
  168     LS       0      77
  169     UD   1.60
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  170     KK    468  SUB-BASIN 468 HYDROGRAPH
  171     KM         SCS RUNOFF COMPUTATION
  172     BA   6.02
  173     PB   3.00
  174     LS      0     77
  175     UD   1.71

  176     KK   NODE0  COMBINE ALL FLOW AT NODE 0
  177     HC      5

  178     KK   0-P1  ROUTE FLOW TO NODE P1
  179     RK  11850  .0056    .03       0    TRAP     32      2.

  180     KK   312C SUB-BASIN 312C HYDROGRAPH
  181     KM         SCS RUNOFF COMPUTATION
  182     BA   1.28
  183     PB   2.86
  184     LS      0     77
  185     UD   1.51

  186     KK   L-P1  ROUTE FLOW TO NODE P1
  187     RK  10000  .0071    .03       0    TRAP     60      3

  188     KK    47A  SUB-BASIN 47A HYDROGRAPH
  189     KM         KINEMATIC RUNOFF COMPUTATION
  190     BA   2.07
  191     PB   2.86
  192     LS      0     77        0       0     98
  193     UK    800   .008      .20      69
  194     UK     80   .012      .10      31
  195     RK   2000   .003      .05     .25    TRAP     30      50
  196     RK   7000   .007      .05    1.23    TRAP     30      50
  197     RK  12250   .007      .03       0    TRAP     40       1

  198     KK     P1   COMBINE FLOWS AT P1
  199     HC      3

  200     KK   P1-P  ROUTE FLOW TO NODE P
  201     RK   6120  .0041    .015       0    TRAP     10       2

  202     KK    317  SUB-BASIN 317 HYDROGRAPH
  203     KM         SCS RUNOFF COMPUTATION
  204     BA   7.66
  205     PB   3.15
  206     LS      0     80
  207     UD    .97

  208     KK   3188  SUB-BASIN 318B HYDROGRAPH
  209     KM         SCS RUNOFF COMPUTATION
  210     BA   1.61
  211     PB   3.15
  212     LS      0     87        0
  213     UD    .37
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  214     KK     Q-P   ROUTE FLOW TO NODE P
  215     RM       4     .26     .15

  216     KK     318A  SUB BASIN 318A HYDROGRAPH
  217     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  218     BA    0.76
  219     PB    2.93
  220     LS       0      77       0       0      98
  221     UK     700    .020     .30      74
  222     UK      50    .025     .10      26
  223     RK    2000    .035     .05     .06    TRAP     30      50
  224     RK    7000    .014     .05     .55    TRAP     30      50.
  225     RK    9200   .0043     .03       0    TRAP     30       1

  226     KK    NODEP  COMBINE FLOWS AT NODE P
  227     HC       4

  228     KK    P-M1   ROUTE FLOWS TO NODE M1
  229     RK    4800   .0034    .015       0    TRAP     40       1

  230     KK    DBIN
  231     HC       2
  232     KO       3

  233     KK    DBOUT
  234     KM    CONFLUENCE BASIN 2 LEVEL OUTLET
  235     RS       1    ELEV       2
  236     SV       0     3.2     8.9    19.4    36.2    97.1     210     523     648     783
  237     SV     908
  238     SQ       0      54     153     214     238     280     317     367     688    1263
  239     SQ    1938
  240     SE       2       3       4       5       6       8      10      13      14      15
  241     SE      16
  242     KO       3

  243     KK    DB-M    ROUTE DB OUTFLOW TO NODE M
  244     RK    2500    .002    .015       0    TRAP     40       0

  245     KK    318C   SUB-BASIN 318C
  246     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  247     BA    1.26
  248     PB    2.93
  249     LS       0      77       0       0      98
  250     UK     700    .020     .30      74
  251     UK      50    .025     .10      26
  252     RK    2000    .035     .05     .06    TRAP     30      50
  253     RK    7000    .014     .05     .55    TRAP     30      50
  254     RK    9200   .0043     .03       0    TRAP     30       1
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  255     KK   SCHAN
  256     DR   SLOAN

  257     KK    SC-M ROUTE SLOAN CHANNEL TO NODE M
  258     RK   7500   .0022    .015       0    TRAP      14       2

  259     KK   NODEM
  260     HC       3

  261     KK     M-S   ROUTE FLOWS TO NODE S  (SLOAN CHANNEL)
  262     RK    4600   .0028    .015       0    TRAP      40       2

  263     KK     48B   SUB-BASIN 48B HYDROGRAPH
  264     KM           SCS RUNOFF COMPUTATION
  265     BA     .99
  266     PB    3.00
  267     LS       0      87       0       0       0       0
  268     UD     .24

  269     KK     R-S   ROUTE FLOW TO NODE S
  270     RK    9100   .0316    .035       0    TRAP      80       1

  271     KK     48A   SUB-BASIN 48A HYDROGRAPH
  272     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  273     BA    0.94
  274     PB    2.93
  275     LS       0      76       0       0      98
  276     UK     700    .025     .30      73
  277     UK      60     .03     .10      27
  278     RK    2000     .02    .050     .04    TRAP      30      50
  279     RK     800     .02    .050     .12    TRAP      30      50
  280     RK    9000    .033     .02       0    TRAP      20       1      NO

  281     KK     321   SUB-BASIN 321 HYDROGRAPH
  282     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  283     BA    4.03
  284     PB    2.86
  285     LS       0      76       0       0      98
  286     UK     800    .010     .30      54
  287     UK      50    .020     .10      46
  288     RK    3500    .006    .050     .14    TRAP      30      50
  289     RK    7400   .0014    .050     .58    TRAP      30      50
  290     RK  21200.   .0035    .035       0    TRAP     70.      1.     NO

  291     KK     49A   SUB-BASIN 49A HYDROGRAPH
  292     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  293     BA    0.60
  294     PB    2.86
  295     LS       0      76       0       0      98
  296     UK     700    .034     .30      73
  297     UK      60     .04     .10      27
  298     RK    2000     .03     .05     .04    TRAP      30      50
  299     RK    1000    .003    .050     .12    TRAP      30      50
  300     RK    9200    .034    .035       0    TRAP      20       1      NO
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  301     KK    NODES  COMBINE ALL FLOWS AT NODE S
  302     HC        5

  303     KK      S-V  ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)
  304     RK     6800  .0038    .015       0   TRAP      40       2

  305     KK      324  SUB-BASIN 324 HYDROGRAPH
  306     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  307     BA     1.40
  308     PB     2.86
  309     LS        0      77       0       0      98
  310     UK      800     .01     .30      56
  311     UK       60     .01     .10      44
  312     RK    1300.    .004     .05     .07   TRAP      30      50
  313     RK     2500   .0017     .05     .28   TRAP      30      50
  314     RK    7000.    .005    .035       0   TRAP      70       1      NO

  315     KK      49B  SUB-BASIN 49B HYDROGRAPH
  316     KM           SCS RUNOFF COMPUTATION
  317     BA     1.04
  318     PB     2.93
  319     LS        0      88       0       0       0       0
  320     UD      .25

  321     KK      T-V  ROUTE FLOWS TO NODE V
  322     RM        3     .52     .10

  323     KK    NODEV  COMBINE ALL FLOWS AT NODE V
  324     HC        3

  325     KK      50B  SUB-BASIN 50B HYDROGRAPH
  326     KM           SCS RUNOFF COMPUTATION
  327     BA      .55
  328     PB     3.00
  329     LS        0      88       0       0       0       0
  330     UD      .17

  331     KK      U-V  ROUTE FLOWS TO NODE V
  332     RM        3     .43     .10

  333     KK      50A  SUB-BASIN 50A HYDROGRAPH
  334     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  335     BA     1.78
  336     PB     2.86
  337     LS        0      76       0       0      98       0
  338     UK      800    .025     .30      73
  339     UK       60     .03     .10      27
  340     RK     1000    .030    .050     .12   TRAP      30      50
  341     RK     3000    .010    .050     .45   TRAP      30      50
  342     RK     7500    .029    .035       0   TRAP      40       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  343     KK      53    SUB-BASIN 53 HYDROGRAPH
  344     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  345     BA    1.44
  346     PB    2.86
  347     LS       0      77       0       0      98       0
  348     UK     600    .010     .30      56
  349     UK      50    .010     .10      44
  350     RK    1300.   .0033    .050    .053    TRAP     30      50
  351     RK    3100.   .0017    .050     .21    TRAP     30      50
  352     RK   12300.   .0033    .02       0     TRAP     20       1      NO

  353     KK     W-V   ROUTE FLOWS TO NODE V                              .
  354     RM       3     .36     .10

  355     KK   NODEV   COMBINE ALL FLOWS AT NODE V
  356     HC       4

  357     KK     V-Z   ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  358     RK    7780   .0041    .015       0     TRAP     60       2

  359     KK     51B   SUB-BASIN 51B HYDROGRAPH
  360     KM           SCS RUNOFF COMPUTATION
  361     BA    0.47
  362     PB    2.86
  363     LS       0      88       0       0       0       0
  364     UD     .13

  365     KK     X-Z   ROUTE FLOWS TO NODE Z
  366     RM       3     .54     .10

  367     KK     51A    SUB-BASIN 51A HYDROGRAPH
  368     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  369     BA     .99
  370     PB    2.93
  371     LS       0      77       0       0      98       0
  372     UK     600     .03     .30      73
  373     UK      60    .030     .10      27
  374     RK    1000.    .03    .050     .05    TRAP     30      50
  375     RK    2500.  .0075    .050    .100    TRAP     30      50
  376     RK    8000.  .0400    .025       0    TRAP     50       1      NO

  377     KK     51C    SUB-BASIN 51C HYDROGRAPH
  378     KM            SCS RUNOFF COMPUTATION
  379     BA     .43
  380     PB    2.93
  381     LS       0      87       0
  382     UD     .19

  383     KK     Y-Z   ROUTE FLOWS TO NODE Z
  384     RM       3     .54     .10
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  385     KK     510   SUB-BASIN 51D HYDROGRAPH
  386     KM           KINEMATIC WAVE RUNOFF COMPUTATION
  387     BA    .83
  388     PB   2.86
  389     LS      0     76      0       0      98
  390     UK    600    .03     .30      77
  391     UK     60    .035    .10      23
  392     RK   1000    .03     .05     .02    TRAP     30      50
  393     RK   2500   .0240    .050    .080   TRAP     30      50
  394     RK   8000   .0300    .025       0   TRAP     50       1

  395     KK   NODEZ   COMBINE ALL FLOWS AT NODE Z
  396     HC      5

  397     KK   Z-BB   ROUTE FLOWS TO NODE BB  (SLOAN CHANNEL)
  398     RK   2680   .0044    .015       0   TRAP     60       2

  399     KK    52B   SUB-BASIN 52B HYDROLOGY
  400     KM          SCS RUNOFF COMPUTATION
  401     BA    .70
  402     PB   2.86
  403     LS      0     87
  404     UD    .11

  405     KK   AA-BB   ROUTE FLOWS TO NODE BB
  406     RM      4     .62     .10

  407     KK  NODEBB   COMBINE ALL FLOWS AT NODE BB
  408     HC      2

  409     KK    52A   SUB-BASIN 52A HYDROGRAPH
  410     KM          KINEMATIC WAVE RUNOFF COMPUTATION
  411     BA   1.18
  412     PB   2.86
  413     LS      0     78      0       0      98       0
  414     UK    600    .025    .30      91
  415     UK     60    .035    .10       9
  416     RK   1000    .03     .050     .04    TRAP     30      50
  417     RK   2000    .025    .050     .24    TRAP     30      50
  418     RK  11200.   .028    .035       0   TRAP     30       1      NO

  419     KK  NODEBB   COMBINE ALL FLOWS AT NODE BB
  420     HC      2

  421     KK   BB-CC   ROUTE FLOWS TO NODE CC
  422     RK   4000     55    .015       0   TRAP     60       2

  423     KK    326   SUB-BASIN 326 HYDROGRAPH
  424     KM          KINEMATIC WAVE COMPUTATION
  425     BA   1.71
  426     PB   2.86
  427     LS      0     76      0       0      98       0
  428     UK    700    .010    .30      73
  429     UK     60   .0100    .10      27
```

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10							
430	RK	1800	.0035	.050	.11	TRAP	30	50
431	RK	4000	.0014	.050	.43	TRAP	30	50
432	RK	12500	.0038	.035	0	TRAP	80	1
433	KK	WASH						
434	HC	2						
435	ZZ							

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCDE (DARF=.60)
AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
NEW FUTURE DEVELOPMENT IN 306, 307, 310

IO 10 OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	NODEW	GOLF	DBIN	DBOUT	SC-M	NODEM	WASH			
VV	VARIABLE CODE	2.11	2.11	2.11	2.11	2.11	2.11	2.11	.00	.00	.00

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.60

*** *** *** *

*** ***

****
* *
K * E-J1 * DETENTION BASIN E-J1
* *
****

'7 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

*4 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

*75 SV	STORAGE	.0	13.0	120.0	220.0	250.0	290.0	380.0	480.0
136 SQ	DISCHARGE	0.	60.	700.	920.	980.	4340.	18385.	38350.

***

*** *** *** *** ***

HYDROGRAPH AT STATION E-J1
FOR PLAN 1, RATIO = .60

AK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 734.	7.42		543.	236.	236.	236.
		(INCHES)	.257	.309	.309	.309
		(AC-FT)	269.	323.	323.	323.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ AC-FT)	(HR)				
136.	7.42	96.	42.	42.	42.

CUMULATIVE AREA = 19.61 SQ MI

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**************
*            *
*     DBIN   *
*            *
**************

 ? KO          OUTPUT CONTROL VARIABLES
                    IPRNT          3  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

 ?? HC         HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                    ***

     ***           ***           ***           ***           ***

                      HYDROGRAPH AT STATION     DBIN
                        FOR PLAN 1, RATIO =  .60

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                   6-HR        24-HR        72-HR      16.58-HR
+   (CFS)      (HR)
                          (CFS)
+   3997.      5.83                2378.        985.         985.         985.
                        (INCHES)    .268         .307         .307         .307
                        (AC-FT)    1179.        1350.        1350.        1350.

                      CUMULATIVE AREA =   82.38 SQ MI
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*** ***

****
* *
* DBOUT *
* *
****

2 KO OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

5 RS STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC 2.00 INITIAL CONDITION
X .00 WORKING R AND D COEFFICIENT

6 SV	STORAGE	.0	3.2	8.9	19.4	36.2	97.1	210.0	523.0	648.0	783.0
		908.0									
238 SQ	DISCHARGE	0.	54.	153.	214.	238.	280.	317.	367.	688.	1263.
		1938.									
240 SE	ELEVATION	2.00	3.00	4.00	5.00	6.00	8.00	10.00	13.00	14.00	15.00
		16.00									

***

*** *** *** *** ***

HYDROGRAPH AT STATION DBOUT
FOR PLAN 1, RATIO = .60

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1447.	8.25		1137.	602.	602.	602.
		(INCHES)	.128	.188	.188	.188
		(AC-FT)	564.	825.	825.	825.

P K STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
817.	8.25	751.	461.	461.	461.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
• (FEET)	(HR)				
27	8.25	14.77	10.84	10.84	10.84

CUMULATIVE AREA = 82.38 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.60
HYDROGRAPH AT					
+	3098	3.64	1	FLOW	250.
				TIME	6.17
ROUTED TO					
+	I2-I3	3.64	1	FLOW	249.
				TIME	6.42
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	317.
				TIME	5.50
2 COMBINED AT					
+	NODE	7.20	1	FLOW	540.
				TIME	6.08
ROUTED TO					
+	I3-G1	7.20	1	FLOW	539.
				TIME	6.08
HYDROGRAPH AT					
+	306B	4.54	1	FLOW	501.
				TIME	4.33
ROUTED TO					
+	F2-G1	4.54	1	FLOW	448.
				TIME	6.08
HYDROGRAPH AT					
+	307A	6.23	1	FLOW	1142.
				TIME	4.08
3 COMBINED AT					
+	NODE	17.97	1	FLOW	1554.
				TIME	5.75
ROUTED TO					
•	G1-G2	17.97	1	FLOW	1546.
				TIME	5.92
HYDROGRAPH AT					
•	307B	1.84	1	FLOW	353.
				TIME	3.92
HYDROGRAPH AT					
+	310B	5.58	1	FLOW	499.
				TIME	4.83

3 COMBINED AT					
+	NODE	25.39	1	FLOW	2184.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	416.
				TIME	4.58
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	411.
				TIME	4.83
2 COMBINED AT					
•	NODEW	30.11	1	FLOW	2557.
				TIME	5.75
DIVERSION TO					
+	SLOAN	30.11	1	FLOW	1224.
				TIME	5.75
HYDROGRAPH AT					
•	DIV	30.11	1	FLOW	1334.
				TIME	5.75
ROUTED TO					
+	GOLF	30.11	1	FLOW	1325.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	623.
				TIME	5.42
ROUTED TO					
+	J-K1	7.23	1	FLOW	618.
				TIME	6.00
HYDROGRAPH AT					
+	312A	4.00	1	FLOW	270.
				TIME	5.75
HYDROGRAPH AT					
+	45A	8.38	1	FLOW	411.
				TIME	6.50
ROUTED TO					
+	N1-K1	8.38	1	FLOW	409.
				TIME	6.67
3 COMBINED AT					
+	NODE	19.61	1	FLOW	1237.
				TIME	6.17
ROUTED TO					
+	E-J1	19.61	1	FLOW	734.
				TIME	7.42
ROUTED TO					
+	K1-K2	19.61	1	FLOW	734.
				TIME	7.50

HYDROGRAPH AT					
+	312B	1.49	1	FLOW	107.
				TIME	5.58
2 COMBINED AT					
+	NODE	21.10	1	FLOW	768.
				TIME	7.00
ROUTED TO					
+	K2-O	21.10	1	FLOW	768.
				TIME	7.08
HYDROGRAPH AT					
+	45B	2.35	1	FLOW	135.
				TIME	6.00
ROUTED TO					
+	N2-O	2.35	1	FLOW	132.
				TIME	6.33
HYDROGRAPH AT					
+	04B	2.07	1	FLOW	113.
				TIME	6.17
HYDROGRAPH AT					
+	46A	7.35	1	FLOW	553.
				TIME	5.75
HYDROGRAPH AT					
+	46B	6.02	1	FLOW	438.
				TIME	5.83
5 COMBINED AT					
+	NODE	38.89	1	FLOW	1797.
				TIME	6.25
ROUTED TO					
+	O-P1	38.89	1	FLOW	1788.
				TIME	6.50
HYDROGRAPH AT					
+	312C	1.28	1	FLOW	88.
				TIME	5.67
ROUTED TO					
+	L-P1	1.28	1	FLOW	84.
				TIME	6.33
HYDROGRAPH AT					
•	47A	2.07	1	FLOW	201.
				TIME	4.42
3 COMBINED AT					
+	P1	42.24	1	FLOW	1990.
				TIME	6.42
ROUTED TO					
+	P1-P	42.24	1	FLOW	1989.
				TIME	6.50

HYDROGRAPH AT					
+	317	7.66	1	FLOW	947.
				TIME	4.50
HYDROGRAPH AT					
+	318B	1.61	1	FLOW	555.
				TIME	3.75
ROUTED TO					
+	Q-P	1.61	1	FLOW	520.
				TIME	4.00
HYDROGRAPH AT					
•	318A	.76	1	FLOW	66.
				TIME	4.33
4 COMBINED AT					
•	NODE	52.27	1	FLOW	2673.
				TIME	5.75
ROUTED TO					
+	P-M1	52.27	1	FLOW	2672.
				TIME	5.83
2 COMBINED AT					
•	DBIN	82.38	1	FLOW	3997.
				TIME	5.83
ROUTED TO					
+	DBOUT	82.38	1	FLOW	1447.
				TIME	8.25
			** PEAK STAGES IN FEET **		
			1	STAGE	15.27
				TIME	8.25
ROUTED TO					
+	DB-M	82.38	1	FLOW	1447.
				TIME	8.33
HYDROGRAPH AT					
+	318C	1.26	1	FLOW	110.
				TIME	4.25
HYDROGRAPH AT					
•	SCHAN	.00	1	FLOW	1224.
				TIME	5.75
ROUTED TO					
+	SC-M	.00	1	FLOW	1223.
				TIME	5.83
3 COMBINED AT					
+	NODEM	83.64	1	FLOW	2450.
				TIME	7.92
ROUTED TO					
+	M-S	83.64	1	FLOW	2449.
				TIME	8.00

HYDROGRAPH AT					
+	48B	.99	1	FLOW	376.
				TIME	3.67
ROUTED TO					
+	R-S	.99	1	FLOW	325.
				TIME	3.83
HYDROGRAPH AT					
•	48A	.94	1	FLOW	155.
				TIME	3.67
HYDROGRAPH AT					
+	321	4.03	1	FLOW	418.
				TIME	5.83
HYDROGRAPH AT					
•	49A	.60	1	FLOW	79.
				TIME	3.75
5 COMBINED AT					
+	NODE	90.20	1	FLOW	2714.
				TIME	7.75
ROUTED TO					
+	S-V	90.20	1	FLOW	2713.
				TIME	7.83
HYDROGRAPH AT					
+	324	1.40	1	FLOW	227.
				TIME	4.08
HYDROGRAPH AT					
+	49B	1.04	1	FLOW	401.
				TIME	3.67
ROUTED TO					
+	T-V	1.04	1	FLOW	288.
				TIME	4.17
3 COMBINED AT					
•	NODE	92.64	1	FLOW	2749.
				TIME	7.83
HYDROGRAPH AT					
+	50B	.55	1	FLOW	261.
				TIME	3.58
ROUTED TO					
+	U-V	.55	1	FLOW	179.
				TIME	3.92
HYDROGRAPH AT					
•	50A	1.78	1	FLOW	270.
				TIME	3.67
HYDROGRAPH AT					
+	53	1.44	1	FLOW	211.
				TIME	4.33

ROUTED TO

+	W-V	1.44	1	FLOW	202.
				TIME	4.67

4 COMBINED AT

+	NODE	96.41	1	FLOW	2993.
				TIME	5.25

ROUTED TO

+	V-Z	96.41	1	FLOW	2985.
				TIME	5.33

HYDROGRAPH AT

+	51B	.47	1	FLOW	216.
				TIME	3.58

ROUTED TO

+	X-Z	.47	1	FLOW	132.
				TIME	4.00

HYDROGRAPH AT

+	51A	.99	1	FLOW	134.
				TIME	3.75

HYDROGRAPH AT

+	51C	.43	1	FLOW	176.
				TIME	3.58

ROUTED TO

+	Y-Z	.43	1	FLOW	114.
				TIME	4.08

HYDROGRAPH AT

+	51D	.83	1	FLOW	93.
				TIME	3.75

5 COMBINED AT

+	NODE	99.13	1	FLOW	3301.
				TIME	5.25

ROUTED TO

•	Z-BB	99.13	1	FLOW	3294.
				TIME	5.33

HYDROGRAPH AT

+	52B	.70	1	FLOW	316.
				TIME	3.50

ROUTED TO

+	AA-BB	.70	1	FLOW	184.
				TIME	4.08

2 COMBINED AT

+	NODEBB	99.83	1	FLOW	3409.
				TIME	5.33

HYDROGRAPH AT

+	52A	1.18	1	FLOW	83.
				TIME	5.33

2 COMBINED AT					
+	NODEBB	101.01	1	FLOW	3492.
				TIME	5.33
ROUTED TO					
+	BB-CC	101.01	1	FLOW	3491.
				TIME	5.33
HYDROGRAPH AT					
+	326	1.71	1	FLOW	123.
				TIME	5.33
2 COMBINED AT					
+	WASH	102.72	1	FLOW	3614.
				TIME	5.33

1TABLE 1		STATION	NODEW	GOLF	DBIN	DBOUT	SC-M	NODEM	WASH
			FLOW	FLOW	FLOW	FLOW	FLOW	FLOW	FLOW
		PLAN	1	1	1	1	1	1	1
		RATIO	.60	.60	.60	.60	.60	.60	.60
PER	DAY	MON HRMN							
1	1	0000	.00	.00	.00	.00	.00	.00	.00
2	1	0005	.00	.00	.00	.00	.00	.00	.00
3	1	0010	.00	.00	.00	.00	.00	.00	.00
4	1	0015	.00	.00	.00	.00	.00	.00	.00
5	1	0020	.00	.00	.00	.00	.00	.00	.00
6	1	0025	.00	.00	.00	.00	.00	.00	.00
7	1	0030	.01	.00	.00	.00	.00	.01	.00
8	1	0035	.07	.00	.00	.00	.00	.04	.01
9	1	0040	.25	.00	.00	.00	.00	.09	.11
10	1	0045	.68	.00	.00	.00	.00	.19	.38
11	1	0050	1.51	.00	.00	.00	.00	.34	.80
12	1	0055	2.82	.00	.00	.00	.00	.55	1.29
13	1	0100	4.60	.00	.00	.00	.01	.84	2.54
14	1	0105	6.80	.00	.00	.00	.04	1.22	4.94
15	1	0110	9.35	.00	.00	.00	.12	1.74	8.76
16	1	0115	12.18	.00	.01	.00	.31	2.45	13.85
17	1	0120	15.24	.00	.02	.00	.71	3.45	19.83
18	1	0125	18.53	.00	.06	.01	1.43	4.85	26.43
19	1	0130	22.09	.00	.15	.02	2.59	6.79	33.67
20	1	0135	26.05	.00	.36	.04	4.31	9.38	41.82
21	1	0140	30.59	.00	.75	.10	6.66	12.70	51.26
22	1	0145	35.98	.00	1.47	.21	9.73	16.82	62.32
23	1	0150	42.62	.00	2.69	.42	13.58	21.80	75.15
24	1	0155	51.11	.00	4.69	.78	18.32	27.74	89.71
25	1	0200	62.18	.00	7.75	1.37	24.18	34.88	105.87
26	1	0205	76.54	.00	12.12	2.31	31.54	43.59	123.53
27	1	0210	94.61	.00	17.90	3.71	41.00	54.45	142.64
28	1	0215	116.42	.00	25.02	5.66	53.31	68.24	163.18
29	1	0220	141.56	.00	33.27	8.24	69.26	85.81	184.85
30	1	0225	169.34	.00	42.39	11.49	89.43	108.00	207.01
31	1	0230	198.89	.00	51.99	15.41	114.00	135.35	228.90
32	1	0235	229.26	.00	61.45	19.95	142.53	167.86	249.98
33	1	0240	259.57	.00	70.03	24.98	174.07	204.75	270.44
34	1	0245	289.19	.00	77.21	30.32	207.36	244.57	291.33
35	1	0250	317.80	.00	83.03	35.79	241.11	285.59	314.63
36	1	0255	345.40	.00	88.16	41.26	274.30	326.32	343.29
37	1	0300	372.51	.00	93.82	46.72	306.37	365.95	381.28
38	1	0305	399.97	.00	101.61	52.32	337.28	404.40	433.36
39	1	0310	429.39	.00	113.67	58.52	367.57	442.56	504.80
40	1	0315	464.42	.00	132.99	65.83	398.55	482.37	601.62
41	1	0320	508.28	.00	163.59	75.14	432.70	527.19	730.71
42	1	0325	567.03	.00	210.67	87.78	473.54	582.05	902.20
43	1	0330	650.05	.00	281.28	105.64	526.64	654.89	1063.75
44	1	0335	761.98	.00	383.15	131.21	599.91	756.04	1344.78
45	1	0340	902.12	.00	519.84	157.99	698.95	891.12	1698.63
46	1	0345	1072.30	.01	689.23	175.51	812.08	1040.53	2096.97
47	1	0350	1270.21	.63	883.96	199.48	907.40	1168.34	2500.59
48	1	0355	1488.81	8.17	1093.15	218.10	977.66	1270.96	2866.35
49	1	0400	1713.21	45.79	1314.20	227.75	1034.79	1352.73	3152.77
50	1	0405	1920.23	150.30	1562.10	238.77	1082.06	1417.31	3338.40

1TABLE 1 (CONT.)		STATION	NODEW FLOW	GOLF FLOW	DBIN FLOW	DBOUT FLOW	SC-M FLOW	NODEM FLOW	WASH FLOW
		PLAN	1	1	1	1	1	1	1
		RATIO	.60	.60	.60	.60	.60	.60	.60
PER	DAY	MON HRMN							
51	1	0410	2089.06	336.77	1847.46	245.72	1118.18	1466.92	3431.90
52	1	0415	2209.97	567.82	2142.40	254.01	1145.69	1503.98	3456.83
53	1	0420	2284.27	781.98	2396.45	263.56	1165.73	1532.71	3435.15
54	1	0425	2319.64	941.28	2580.87	274.10	1178.96	1554.34	3384.36
55	1	0430	2326.24	1040.80	2699.89	282.53	1186.35	1568.93	3320.34
56	1	0435	2314.82	1092.55	2772.80	288.06	1189.22	1576.36	3258.49
57	1	0440	2295.42	1111.86	2820.99	293.72	1189.01	1579.38	3212.78
58	1	0445	2276.75	1112.06	2865.18	299.46	1187.16	1581.36	3194.71
59	1	0450	2266.47	1103.65	2921.62	305.31	1184.94	1583.96	3213.66
60	1	0455	2269.02	1094.77	2999.63	311.30	1183.44	1588.19	3273.41
61	1	0500	2285.06	1091.14	3103.06	317.23	1183.38	1594.33	3365.34
62	1	0505	2313.19	1096.01	3231.99	320.37	1185.04	1600.97	3468.60
63	1	0510	2350.67	1110.51	3378.43	323.65	1188.38	1607.81	3557.21
64	1	0515	2393.76	1134.09	3527.07	327.09	1193.10	1615.89	3609.16
65	1	0520	2438.30	1164.83	3661.63	330.68	1198.75	1624.73	3614.35
66	1	0525	2480.13	1199.87	3772.39	334.41	1204.77	1633.71	3576.66
67	1	0530	2515.49	1235.80	3857.77	338.23	1210.59	1642.26	3508.43
68	1	0535	2541.31	1269.07	3920.19	342.14	1215.69	1649.82	3423.55
69	1	0540	2555.59	1296.53	3962.31	346.09	1219.62	1655.97	3333.29
70	1	0545	2557.41	1315.75	3987.17	350.08	1222.07	1660.43	3245.06
71	1	0550	2546.85	1325.22	3996.82	354.09	1222.85	1663.05	3162.67
72	1	0555	2524.71	1324.41	3990.22	358.09	1221.93	1663.85	3087.40
73	1	0600	2492.28	1313.55	3965.74	362.07	1219.37	1662.92	3019.18
74	1	0605	2451.58	1293.51	3924.03	366.01	1215.35	1660.46	2957.28
75	1	0610	2404.57	1265.61	3867.09	413.10	1210.10	1679.03	2900.89
76	1	0615	2353.14	1231.42	3797.35	473.04	1203.88	1725.94	2851.13
77	1	0620	2298.99	1192.50	3718.08	530.62	1196.92	1777.51	2812.55
78	1	0625	2243.48	1150.31	3632.50	585.75	1189.49	1825.66	2789.84
79	1	0630	2187.57	1106.10	3542.82	638.38	1181.77	1870.58	2781.92
80	1	0635	2131.78	1060.82	3450.04	688.79	1173.93	1912.69	2782.36
81	1	0640	2076.22	1015.13	3354.62	767.24	1166.07	1947.52	2785.08
82	1	0645	2020.68	969.40	3257.28	840.63	1158.21	2015.87	2787.72
83	1	0650	1964.73	923.73	3158.16	909.07	1150.34	2078.68	2792.71
84	1	0655	1907.84	878.00	3056.65	972.62	1142.43	2136.14	2805.39
85	1	0700	1849.58	832.00	2952.36	1031.36	1134.41	2188.36	2826.92
86	1	0705	1789.65	785.47	2845.37	1085.35	1126.23	2235.44	2852.48
87	1	0710	1727.98	738.19	2736.05	1134.65	1117.83	2277.43	2877.20
88	1	0715	1664.67	690.14	2625.24	1179.35	1109.00	2314.22	2899.02
89	1	0720	1600.08	641.75	2514.01	1219.54	1098.90	2345.12	2917.29
90	1	0725	1534.67	593.66	2403.57	1255.36	1087.02	2369.75	2931.66
91	1	0730	1469.04	545.93	2294.68	1293.29	1074.22	2392.25	2941.80
92	1	0735	1403.81	498.63	2187.99	1327.91	1060.89	2413.72	2947.93
93	1	0740	1339.58	452.19	2084.33	1357.42	1046.80	2430.22	2951.00
94	1	0745	1276.87	407.01	1984.26	1382.13	1032.12	2441.17	2951.86
95	1	0750	1216.09	363.28	1888.07	1402.36	1017.39	2447.44	2950.21
96	1	0755	1157.54	321.17	1795.98	1418.41	1002.94	2449.68	2945.14
97	1	0800	1101.41	280.86	1708.04	1430.59	988.93	2448.37	2936.27
98	1	0805	1047.79	242.52	1624.36	1439.19	975.45	2443.91	2923.84
99	1	0810	996.71	206.47	1545.14	1444.51	961.62	2435.71	2908.28
100	1	0815	948.16	173.53	1471.16	1446.83	944.63	2421.26	2889.79

ITABLE 1 (CONT.)		STATION	NODEW FLOW	GOLF FLOW	DBIN FLOW	DBOUT FLOW	SC-M FLOW	NODEM FLOW	WASH FLOW
		PLAN	1	1	1	1	1	1	1
		RATIO	.60	.60	.60	.60	.60	.60	.60
PER	DAY	MON HRMN							
101	1	0820	902.09	144.37	1403.03	1446.48	923.33	2399.72	2868.04
102	1	0825	858.45	119.12	1340.75	1443.75	898.32	2372.01	2842.12
103	1	0830	817.18	97.76	1284.23	1438.96	869.03	2337.85	2811.12
104	1	0835	778.20	80.27	1233.25	1432.38	834.93	2297.01	2774.60
105	1	0840	741.43	66.26	1187.04	1424.27	798.72	2252.45	2732.57
106	1	0845	706.79	55.13	1144.41	1414.83	762.82	2206.81	2685.41
107	1	0850	674.17	46.25	1104.32	1404.22	728.30	2161.37	2634.26
108	1	0855	643.48	39.14	1066.08	1392.57	695.53	2116.61	2580.75
109	1	0900	614.63	33.40	1029.31	1379.98	664.56	2072.70	2526.48
110	1	0905	587.49	28.72	993.84	1366.53	635.35	2029.69	2472.51
111	1	0910	561.98	24.87	959.64	1352.30	607.82	1987.58	2419.41
112	1	0915	537.99	21.69	926.71	1337.36	581.88	1946.36	2367.41
113	1	0920	515.41	19.03	895.03	1321.79	557.44	1906.00	2316.59
114	1	0925	494.15	16.79	864.56	1305.65	534.40	1866.48	2266.97
115	1	0930	474.12	14.89	835.26	1289.01	512.68	1827.78	2218.53
116	1	0935	455.22	13.27	807.09	1271.93	492.18	1789.86	2171.23
117	1	0940	437.38	11.89	780.02	1256.24	472.82	1753.56	2125.04
118	1	0945	420.50	10.69	754.02	1242.10	454.53	1719.80	2080.03
119	1	0950	404.53	9.65	729.03	1227.63	437.22	1687.68	2036.41
120	1	0955	389.39	8.74	705.02	1212.87	420.82	1656.19	1994.49
121	1	1000	375.03	7.95	681.92	1197.85	405.27	1625.31	1954.40
122	1	1005	361.38	7.25	659.67	1182.61	390.51	1594.99	1915.94
123	1	1010	348.41	6.63	638.22	1167.18	376.48	1565.23	1878.72
124	1	1015	336.07	6.08	617.53	1151.59	363.14	1536.00	1842.48
125	1	1020	324.32	5.59	597.58	1135.86	350.45	1507.27	1807.06
126	1	1025	313.13	5.16	578.32	1120.02	338.35	1479.04	1772.39
127	1	1030	302.46	4.77	559.73	1104.10	326.82	1451.30	1738.45
128	1	1035	292.28	4.41	541.79	1088.10	315.82	1424.02	1705.19
129	1	1040	282.56	4.10	524.45	1072.05	305.32	1397.20	1672.59
130	1	1045	273.28	3.81	507.71	1055.98	295.29	1370.83	1640.63
131	1	1050	264.41	3.55	491.53	1039.90	285.71	1344.90	1609.30
132	1	1055	255.93	3.31	475.89	1023.82	276.55	1319.39	1578.56
133	1	1100	247.82	3.10	460.78	1007.76	267.78	1294.31	1548.42
134	1	1105	240.05	2.90	446.16	991.73	259.39	1269.64	1518.85
135	1	1110	232.60	2.72	432.03	975.76	251.35	1245.38	1489.83
136	1	1115	225.46	2.56	418.35	959.84	243.64	1221.52	1461.36
137	1	1120	218.62	2.41	405.12	944.00	236.26	1198.04	1433.42
138	1	1125	212.05	2.27	392.32	928.23	229.17	1174.95	1405.99
139	1	1130	205.74	2.14	379.93	912.56	222.36	1152.24	1379.07
140	1	1135	199.67	2.02	367.94	896.99	215.82	1129.91	1352.64
141	1	1140	193.85	1.91	356.34	881.53	209.53	1107.94	1326.69
142	1	1145	188.25	1.81	345.12	866.18	203.49	1086.33	1301.22
143	1	1150	182.86	1.71	334.26	850.96	197.68	1065.08	1276.20
144	1	1155	177.67	1.62	323.75	835.87	192.09	1044.19	1251.64
145	1	1200	172.68	1.54	313.59	820.92	186.70	1023.64	1227.53
146	1	1205	167.87	1.46	303.75	806.11	181.52	1003.44	1203.85
147	1	1210	163.24	1.39	294.24	791.45	176.52	983.58	1180.59
148	1	1215	158.78	1.33	285.04	776.94	171.71	964.06	1157.76
149	1	1220	154.48	1.26	276.14	762.59	167.07	944.87	1135.34
150	1	1225	150.34	1.21	267.53	748.41	162.59	926.02	1113.33

1TABLE 1 (CONT.)	STATION	NODEW FLOW	GOLF FLOW	DBIN FLOW	DBOUT FLOW	SC-M FLOW	NODEM FLOW	WASH FLOW
	PLAN	1	1	1	1	1	1	1
	RATIO	.60	.60	.60	.60	.60	.60	.60
PER	DAY MON HRMN							
151	1 1230	146.34	1.15	259.20	734.38	158.28	907.48	1091.71
152	1 1235	142.48	1.10	251.15	720.53	154.11	889.28	1070.49
153	1 1240	138.75	1.05	243.35	706.85	150.09	871.39	1049.65
154	1 1245	135.16	1.01	235.81	693.34	146.21	853.81	1029.20
155	1 1250	131.69	.96	228.51	683.15	142.46	837.62	1009.12
156	1 1255	128.33	.92	221.45	675.12	138.84	824.46	989.44
157	1 1300	125.09	.88	214.62	667.11	135.34	812.83	970.28
158	1 1305	121.96	.85	208.01	659.12	131.95	801.34	951.94
159	1 1310	118.93	.81	201.62	651.15	128.68	789.99	934.79
160	1 1315	116.00	.78	195.44	643.22	125.52	776.15	918.99
161	1 1320	113.17	.75	189.46	635.31	122.46	765.09	904.35
162	1 1325	110.43	.72	183.67	627.45	119.50	754.16	890.42
163	1 1330	107.78	.70	178.07	619.62	116.63	743.38	872.62
164	1 1335	105.21	.67	172.66	611.83	113.86	732.73	859.11
165	1 1340	102.72	.65	167.43	604.09	111.17	722.21	846.19
166	1 1345	100.32	.62	162.36	596.39	108.57	711.82	833.66
167	1 1350	97.98	.60	157.47	588.73	106.04	701.56	821.45
168	1 1355	95.72	.58	152.74	581.13	103.60	691.44	809.48
169	1 1400	93.53	.56	148.16	573.58	101.23	681.44	797.73
170	1 1405	91.40	.54	143.73	566.09	98.93	671.57	786.17
171	1 1410	89.34	.52	139.45	558.64	96.70	661.82	774.77
172	1 1415	87.34	.50	135.32	551.26	94.54	652.20	763.54
173	1 1420	85.40	.49	131.31	543.93	92.44	642.71	752.47
174	1 1425	83.52	.47	127.44	536.66	90.41	633.33	741.55
175	1 1430	81.69	.46	123.69	529.46	88.43	624.08	730.79
176	1 1435	79.92	.44	120.07	522.31	86.51	614.95	720.18
177	1 1440	78.19	.43	116.56	515.23	84.65	605.94	709.72
178	1 1445	76.52	.41	113.16	508.21	82.84	597.04	699.40
179	1 1450	74.89	.40	109.87	501.26	81.08	588.27	689.24
180	1 1455	73.31	.39	106.68	494.37	79.37	579.61	679.21
181	1 1500	71.77	.38	103.60	487.54	77.70	571.06	669.33
182	1 1505	70.28	.37	100.62	480.79	76.09	562.63	659.58
183	1 1510	68.83	.35	97.73	474.10	74.52	554.31	649.98
184	1 1515	67.41	.34	94.94	467.47	72.99	546.10	640.50
185	1 1520	66.04	.33	92.24	460.92	71.50	538.01	631.17
186	1 1525	64.70	.32	89.64	454.43	70.06	530.02	621.96
187	1 1530	63.40	.32	87.14	448.02	68.65	522.14	612.89
188	1 1535	62.14	.31	84.73	441.67	67.28	514.37	603.95
189	1 1540	60.91	.30	82.41	435.39	65.95	506.71	595.13
190	1 1545	59.71	.29	80.18	429.18	64.65	499.15	586.44
191	1 1550	58.54	.28	78.04	423.05	63.39	491.70	577.87
192	1 1555	57.41	.27	75.98	416.98	62.16	484.35	569.43
193	1 1600	56.30	.27	74.00	410.98	60.96	477.11	561.10
194	1 1605	55.22	.26	72.09	405.06	59.79	469.97	552.90
195	1 1610	54.18	.25	70.26	399.21	58.66	462.93	544.82
196	1 1615	53.15	.25	68.49	393.42	57.55	455.99	536.85
197	1 1620	52.16	.24	66.79	387.71	56.47	449.15	529.00
198	1 1625	51.19	.23	65.14	382.07	55.42	442.41	521.26
199	1 1630	50.24	.23	63.55	376.50	54.39	435.77	513.64
200	1 1635	49.32	.22	62.01	371.00	53.39	429.22	506.13

MAX	2557.41	1325.22	3996.82	1446.83	1222.85	2449.68	3614.35
MIN	.00	.00	.00	.00	.00	.00	.00
AVE	697.37	230.55	980.06	600.01	465.13	1091.22	1553.55

*** NORMAL END OF HEC-1 ***

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID          EXISING CONDITIONS EXCEPT
    2     ID          WITH DIVERSION AND DETENTION BASIN
    3     ID   FROM:      CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
    4     ID                    RANGE WASH WATERSHED
    5     ID             JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
    6     ID                       JANUARY 1991
    7     ID              100-YR, 6-HR STORM    PB CARD FOR DARF = 0.55
    8     ID             PRESENT CONDITIONS, EXISTING FACILITIES
    9     ID                       AMC 2.0
   10     ID              BASED ON RANGE WASH FACILITIES STUDY
   11     ID                BOYLE ENGINEERS CORP-JULY 1989
   12     ID             (CONVERTED RK TO RM IN UPLAND SUBAREAS)  .
   13     ID
   14     ID   MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)
   15     ID
   16     ID     JR RATIOS FOR DARF .63 AT DETENTION BASIN AND .60 AT LAS VEGAS WASH
   17     IT     05       0       0     200
   18     IO      5       0       0
   19     JR   PREC   1.093   1.147

   20     KK   306B    SUB-BASIN 306B HYDROGRAPH
   21     KM           SCS RUNOFF COMPUTATION
   22     BA   3.37
   23     PB   1.57
   24     PC    0.0     2.0     5.90    8.00    11.0    14.40   15.00   16.00   16.80   17.10
   25     PC   18.0    18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.00
   26     PC   25.0    25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   27     PC  32.10    32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   28     PC   56.1    63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   29     PC   81.0    82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.40
   30     PC   97.9    98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60   99.70
   31     PC   99.9   100.00
   32     LS      0       76
   33     UD   0.75

   34     KK   F-F1      ROUTE FLOW TO NODE F1
   35     RM      5    0.42     .10

   36     KK   307A    SU-BASIN 307A HYDROGRAPH
   37     BA   5.65
   38     PB   1.57
   39     LS      0       78
   40     UD    .44

   41     KK  NOD-F1    COMBINE FLOW AT NODE F1
   42     HC      2

   43     KK   F1-G    ROUTE FLOW TO G
   44     RK  12000   .0075     .03           TRAP      40      1.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  45      KK    307B    SUB-BASIN 307B HYDROGRAPH
  46      KM            KINEMATIC WAVE RUNOFF COMPUTATION
  47      BA    2.42
  48      PB    1.57
  49      LS       0      78       0       0      97
  50      UK     800   .0123     .20      59
  51      UK      60    .015     .10      41
  52      RK    2640   .0075   .0375   0.125    TRAP      40       1
  53      RK    3080   .0075   .0375     .30    TRAP      40       1
  54      RK   12000    .075     .03            TRAP      40     1.5      NO

  55      KK       G    COMBINE FLOW AT NODE G
  56      HC       2

  57      KK    G-G1    ROUTE FLOW TO G1
  58      RK    2700   .0035    .015            TRAP      12     1.5

  59      KK    309B    SUB-BASIN 309B HYDROGRAPH
  60      KM            SCS RUNOFF COMPUTATION
  61      BA    3.64
  62      PB    1.57
  63      LS       0      79
  64      UD    0.59

  65      KK    I-11     ROUTE FLOW FROM NODE I TO NODE I1
  66      RM       1     .11     .10

  67      KK    310A
  68      BA    1.29
  69      PB    1.57
  70      LS       0      79
  71      UD     .09

  72      KK  NOD-I1    COMBINE FLOW AT NODE I1
  73      HC       2

  74      KK   I1-I2    ROUTE FLOW I2
  75      RM       6     .52     .10

  76      KK    310B    SUB-BASIN 310B HYDROGRAPH
  77      KM            KINEMATIC WAVE RUNOFF COMPUTATION
  78      BA    7.85
  79      PB    1.57
  80      LS       0      78       0       0      97
  81      UK     800    .015     .20      87
  82      UK      60    .020     .10      13
  83      RK   15000    .012    .030    .86    TRAP      20       3
  84      RK   15800    .006    .025            TRAP      80       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  85      KK   NOD12  COMBINE FLOW AT 12
  86      HC       2

  87      KK   12-G1  ROUTE FLOW TO G1
  88      RK    2100    .002    .015            TRAP      15     1.5

  89      KK  NOD-G1  COMBINE ALL FLOW AT NODE G1
  90      KM          COMBINE EAST AND WEST BRANCH CHANNELS
  91      HC       2

  92      KK   G1-DIV    ROUTE FLOW FROM G1 TO DIVESION
  93      RK    6100 0.0035    .023            TRAP      50      1.

  94      KK   DIV
  95      DT   SLOAN
  96      DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
  97      DQ       0     850     900     950    1000    1050    1100    1200    1300    1400

  98      KK   GOLF
  99      RK    4000    .002    .03       0    TRAP      70       3

 100      KK      44    SUB-BASIN 44 HYDROGRAPH
 101      KM            SCS RUNOFF COMPUTATION
 102      BA    7.23
 103      PB    1.57
 104      LS       0      79
 105      UD    1.22

 106      KK     J-K      ROUTE FLOW FROM J TO NODE K
 107      RM       8     .58     .10

 108      KK     312    SUB-BASIN 312 HYDROGRAPH
 109      KM            SCS RUNOFF COMPUTATION
 110      BA    6.77
 111      PB    1.57
 112      LS       0      77
 113      UD    2.83

 114      KK  NODE K   COMBINE FLOW AT NODE K
 115      HC       2

 116      KK     K-P      ROUTE FLOW FROM NODE K TO NODE P
 117      RM      12    1.03     .15

 118      KK      45    SUB-BASIN  45 HYDROGRAPH
 119      KM            SCS RUNOFF COMPUTATION
 120      BA   10.73
 121      PB    1.57
 122      LS       0      76       0       0       0       0
 123      UD    1.31
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  124     KK     N-O      ROUTE FLOW TO NODE O
  125     RM       5     .38     .15

  126     KK     048     SUB-BASIN 048 HYDROGRAPH
  127     KM             SCS RUNOFF COMPUTATION
  128     BA    2.07
  129     PB    1.57
  130     LS       0      76
  131     UD    1.97

  132     KK     46A     SUB-BASIN 46A HYDROGRAPH
  133     KM             SCS RUNOFF COMPUTATION
  134     BA    7.35
  135     PB    1.65
  136     LS       0      77
  137     UD    1.60

  138     KK     46B     SUB-BASIN 46B HYDROGRAPH
  139     KM             SCS RUNOFF COMPUTATION
  140     BA    6.02
  141     PB    1.65
  142     LS       0      77
  143     UD    1.71

  144     KK  NODE O    COMBINE FLOW AT NODE O
  145     HC       4

  146     KK    O-P1      ROUTE FLOW FROM NODE O TO NODE P1
  147     RM       8    0.68     .15

  148     KK      P1    COMBINE FLOW AT P1
  149     HC       2

  150     KK    P1-P      ROUTE FROM P1 TO P
  151     RM       6     .48     .15

  152     KK     317     SUB-BASIN 317 HYDROGRAPH
  153     KM             SCS RUNOFF COMPUTATION
  154     BA    7.66
  155     PB    1.73
  156     LS       0      80
  157     UD     .97

  158     KK    318B     SUB-BASIN 318B HYDROGRAPH
  159     KM             SCS RUNOFF COMPUTATION
  160     BA    1.86
  161     PB    1.73
  162     LS       0      87
  163     UD     .37
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  164     KK     Q-P      ROUTE FLOW TO NODE P
  165     RM       4     .26     .15

  166     KK     318A     SUB-BASIN 318A HYDROGRAPH
  167     KM              KINEMATIC WAVE RUNOFF COMPUTATION
  168     BA     0.76
  169     PB     1.61
  170     LS       0      78       0       0      97
  171     UK     700     .020     .30      89
  172     UK      50     .025     .10      11
  173     RK    2000     .035   .0375     .06              30      50
  174     RK    7000     .014     .05     .55              30      50.
  175     RK    9200    .0043     .03            TRAP      30       1

  176     KK   NODE P    COMBINE FLOWS AT NODE P
  177     HC       4

  178     KK    P-DB      ROUTE FLOW TO DET BASIN
  179     RK    4800    .0034    0.03            TRAP      80       1

  180     KK     047     SUB-BASIN 047 HYDROGRAPH
  181     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  182     BA    7.40
  183     PB    1.57
  184     LS       0      78       0       0      97
  185     UK     800     .008     .20      74
  186     UK      80     .012     .10      26
  187     RK    7000     .007    .050    1.23              30      50
  188     RK   22000     .005     .03            TRAP      40       1

  189     KK   DBNIN
  190     HC       3
  191     KO       3

  192     KK   DBOUT
  193     KM   CONFLUNENCE DETENTION BASIN
  194     RS       1    ELEV       2
  195     SV       0     3.2      9.9    21.4    39.2     102     217     533     658     794
  196     SV     925
  197     SQ       0      54      153     214     238     280     317     367     688    1263
  198     SQ    1938
  199     SE       2       3       4       5       6       8      10      13      14      15
  200     SE      16
  201     KO       3

  202     KK    DB-M   ROUTE DB OUTFLOW TO NODE M
  203     RK    2500    .002    .015       0    TRAP      40

  204     KK    318C     SUB-BASIN 318C HYDROGRAPH
  205     KM             KINEMATIC WAVE RUNOFF COMPUTATION
  206     BA    2.93
  207     PB    1.61
  208     LS       0      78       0       0      97
  209     UK     700     .020     .30      89
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 210      UK    50   .025    .10     11
 211      RK  2000   .035   .0375    .06            30      50
 212      RK  7000   .014    .05     .55            30      50
 213      RK  9200  .0043    .03          TRAP      30       1

 214      KK  SCHAN
 215      DR  SLOAN

 216      KK  SC-M  ROUTE SLOAN CHANNEL FROM DIV TO NODE M
 217      RK  7500  .0022    .015     0    TRAP      14       2

 218      KK  NODE M  COMBINE FLOWS AT NODE M
 219      HC     3

 220      KK    M-S     ROUTE FLOW TO NODE S (SLOAN CHANNEL)
 221      RK   4600  .0028  0.023          TRAP      80       1

 222      KK    488    SUB-BASIN  488 HYDROGRAPH
 223      KM           SCS RUNOFF COMPUTATION
 224      BA    .99
 225      PB   1.65
 226      LS     0     87       0       0       0       0
 227      UD    .24

 228      KK    R-S     ROUTE FLOW TO NODE S
 229      RK   9100  .0316  0.035          TRAP      80       1

 230      KK    48A    SUB-BASIN 48A HYDROGRAPH
 231      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 232      BA    .49
 233      PB   1.61
 234      LS     0     78       0       0      97
 235      UK   700   .025     .30      77
 236      UK    60   0.03     .10      23
 237      RK   800    .02    .050    0.12            30      50
 238      RK  9000   .033     .02          TRAP      20       1      NO

 239      KK   321    SUB-BASIN 321 HYDROGRAPH
 240      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 241      BA  3.42
 242      PB  1.57
 243      LS     0     78       0       0      97
 244      UK   800   .010     .30      78
 245      UK    50  0.020     .10      22
 246      RK  3500   .006    .050    0.14            30      50
 247      RK  7400  .0014    .050    0.58            30      50
 248      RK 21200  .0035    .035          TRAP      70       1      NO

 249      KK    49A    SUB-BASIN 49A HYDROGRAPH
 250      KM           KINEMATIC WAVE RUNOFF COMPUTATION
 251      BA   0.60
 252      PB   1.57
 253      LS     0     78       0       0      97
 254      UK   700   .034     .30      80
 255      UK    60    .04     .10      20
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  256     RK    1000    .003    .050    0.12              30      50
  257     RK    9200    .034    .035            TRAP      20       1      NO

  258     KK  NODE S   COMBINE ALL FLOWS AT S
  259     HC       5

  260     KK     S-V     ROUTE FLOWS TO NODE V  (SLOAN CHANNEL)
  261     RK    6800   .0038    .023            TRAP      80       1

  262     KK     324    SUB-BASIN 324 HYDROGRAPH
  263     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  264     BA    1.40
  265     PB    1.57
  266     LS       0      77       0       0      97
  267     UK     800     .01     .30      74
  268     UK      60     .01     .10      26
  269     RK    1300    .004     .05    0.07    TRAP      30      50
  270     RK    2500   .0017     .05    0.28              30      50
  271     RK    7000    .005    .035            TRAP      70       1      NO

  272     KK     49B    SUB-BASIN  49B HYDROGRAPH
  273     KM            SCS RUNOFF COMPUTATION
  274     BA    1.04
  275     PB    1.61
  276     LS       0      87       0       0       0       0
  277     UD     .25

  278     KK     T-V     ROUTE FLOWS TO NODE V
  279     RM       3     .52     .10

  280     KK  NODE V    COMBINE ALL FLOWS AT NODE V
  281     HC       3

  282     KK     50B    SUB-BASIN  50B HYDROGRAPH
  283     KM            SCS RUNOFF COMPUTATION
  284     BA     .55
  285     PB    1.65
  286     LS       0      87       0       0       0       0
  287     UD     .17

  288     KK     U-V     ROUTE FLOWS TO NODE V
  289     RM       3     .43     .10

  290     KK     50A    SUB-BASIN 50A HYDROGRAPH
  291     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  292     BA    1.78
  293     PB    1.57
  294     LS       0      78       0       0      97       0
  295     UK     800    .025     .30      89
  296     UK      60     .03     .10      11
  297     RK    3000    .010    .050    0.45              30      50
  298     RK    7500    .029    .035            TRAP      40       1      NO
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  299     KK      53    SUB-BASIN 53 HYDROGRAPH
  300     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  301     BA    1.44
  302     PB    1.57
  303     LS       0      77       0       0      97       0
  304     UK     600    .010     .30      70
  305     UK      50    .010     .10      30
  306     RK    1300   .0033    .050    .053    TRAP      30      50
  307     RK    3100   .0017    .050     .21    TRAP      30      50
  308     RK   12300   .0033     .02            TRAP      20       1      NO

  309     KK     W-V     ROUTE FLOWS TO NODE V                              .
  310     RM       3     .36     .10

  311     KK  NODE V    COMBINE ALL FLOWS AT NODE V
  312     HC       4

  313     KK     V-Z     ROUTE FLOWS TO NODE V (SLOAN CHANNEL)
  314     RK    7780   .0041     .23            TRAP      80       1

  315     KK     51B    SUB-BASIN  51B HYDROGRAPH
  316     KM            SCS RUNOFF COMPUTATION
  317     BA    0.47
  318     PB    1.57
  319     LS       0      87       0       0       0       0
  320     UD     .13

  321     KK     X-Z     ROUTE FLOWS TO NODE Z
  322     RM       3     .54     .10

  323     KK     51A    SUB-BASIN 51A HYDROGRAPH
  324     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  325     BA     .99
  326     PB    1.61
  327     LS       0      78       0       0      97       0
  328     UK     600     .03     .30      86
  329     UK      60    .030     .10      14
  330     RK    2500   .0075    .050    .100    TRAP      30      50
  331     RK    8000   .0400    .025            TRAP      50       1      NO

  332     KK     51C    SUB-BASIN  51C HYDROGRAPH
  333     KM            SCS RUNOFF COMPUTATION
  334     BA    0.43
  335     PB    1.61
  336     LS       0      87       0       0       0       0
  337     UD     .19

  338     KK     Y-Z     ROUTE FLOWS TO NODE Z
  339     RM       3     .54     .10
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  340     KK     51D    SUB-BASIN 51D HYDROGRAPH
  341     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  342     BA     .83
  343     PB    1.57
  344     LS       0      78       0       0      97       0
  345     UK     600     .03      .30      88
  346     UK      60     .035     .10      12
  347     RK    2500    .0240     .050    .080              30      50
  348     RK    8000    .0300     .025            TRAP      50       1

  349     KK   NODE Z     COMBINE ALL FLOWS AT NODE Z
  350     HC       5

  351     KK    Z-BB      ROUTE FLOWS TO NODE BB (SLOAN CHANNEL)
  352     RK    2680    .0044     .023            TRAP      80       1

  353     KK     52B    SUB-BASIN  52B HYDROGRAPH
  354     KM            SCS RUNOFF COMPUTATION
  355     BA    0.70
  356     PB    1.57
  357     LS       0      87       0       0       0       0
  358     UD     .11

  359     KK   AA-BB      ROUTE FLOWS TO NODE BB
  360     RM       4     .62      .10

  361     KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
  362     HC       2

  363     KK     52A    SUB-BASIN 52A HYDROGRAPH
  364     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  365     BA    1.18
  366     PB    1.57
  367     LS       0      78       0       0      97       0
  368     UK     600     .025     .30      93
  369     UK      60     .035     .10       7
  370     RK    2000     .025     .050     .24              30      50
  371     RK   11200     .028     .035             TRAP     30       1      NO

  372     KK   NO.BB      COMBINE ALL FLOWS AT NODE BB
  373     HC       2

  374     KK   BB-CC      ROUTE FLOWS TO NODE CC
  375     RK    4000    .055     .023            TRAP      80       1

  376     KK     326    SUB-BASIN 326 HYDROGRAPH
  377     KM            KINEMATIC WAVE RUNOFF COMPUTATION
  378     BA    1.71
  379     PB    1.57
  380     LS       0      78       0       0      97       0
  381     UK     700     .010     .30      80
  382     UK      60    .0100     .10      20
  383     RK    1800    .0035     .050     .11              30      50
  384     RK    4000    .0014     .050     .43              30      50
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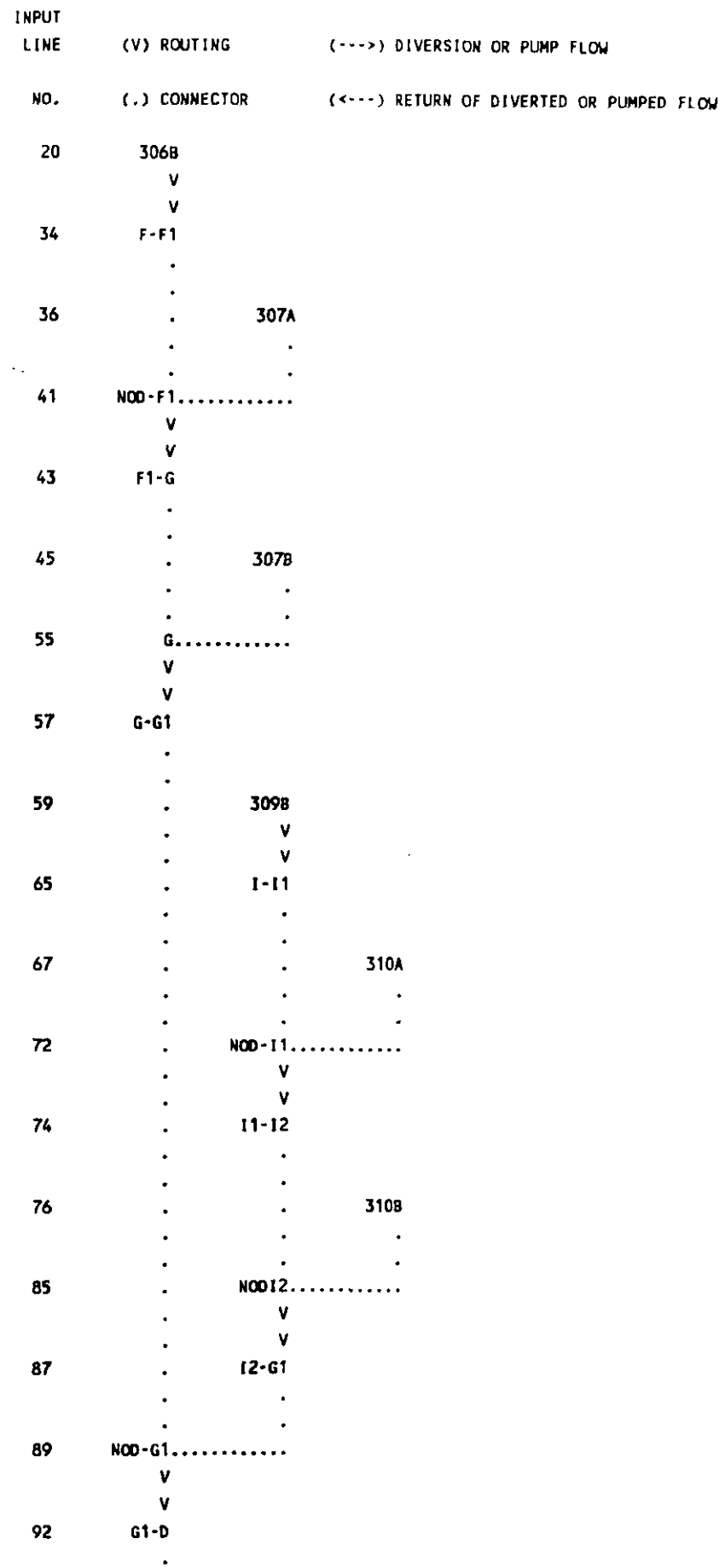
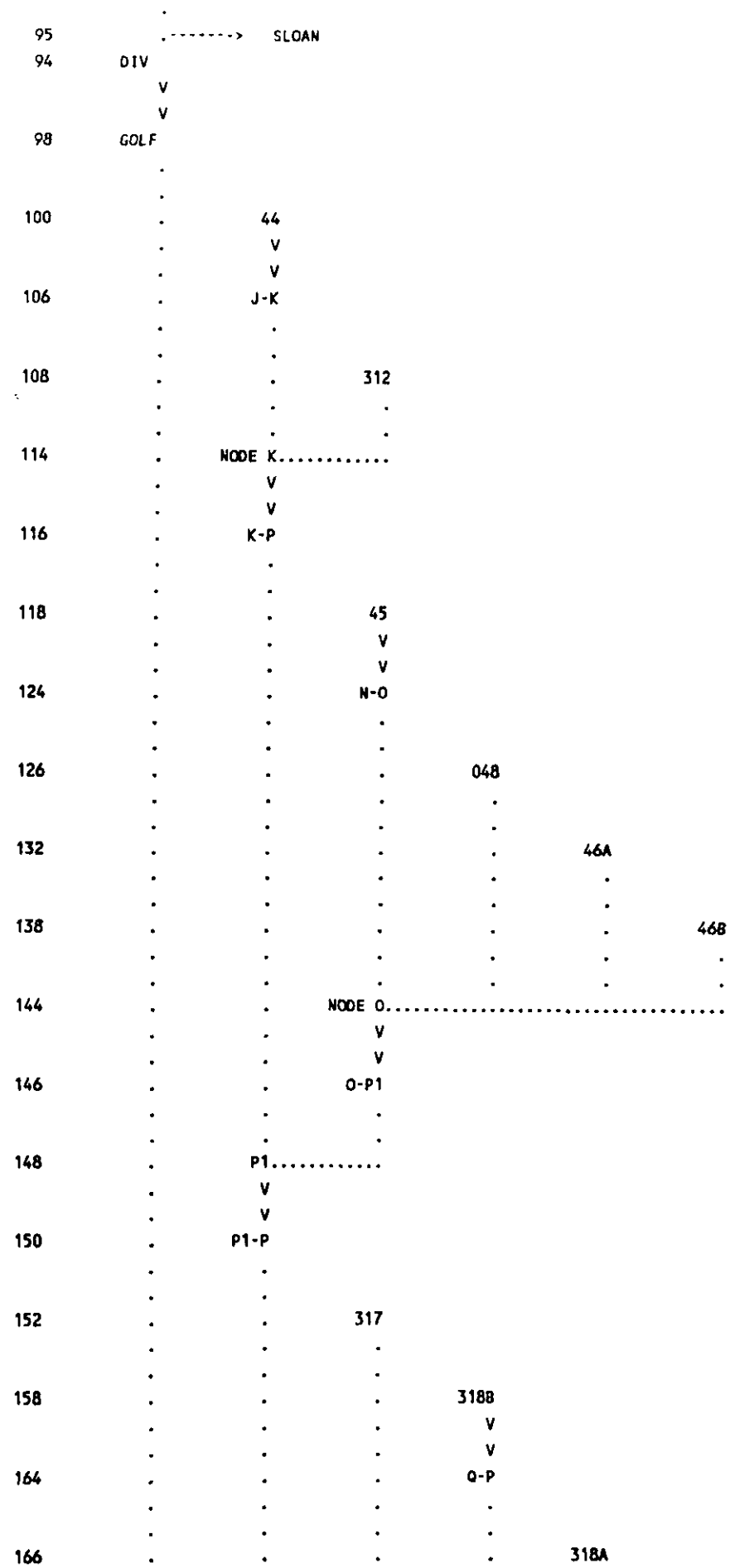
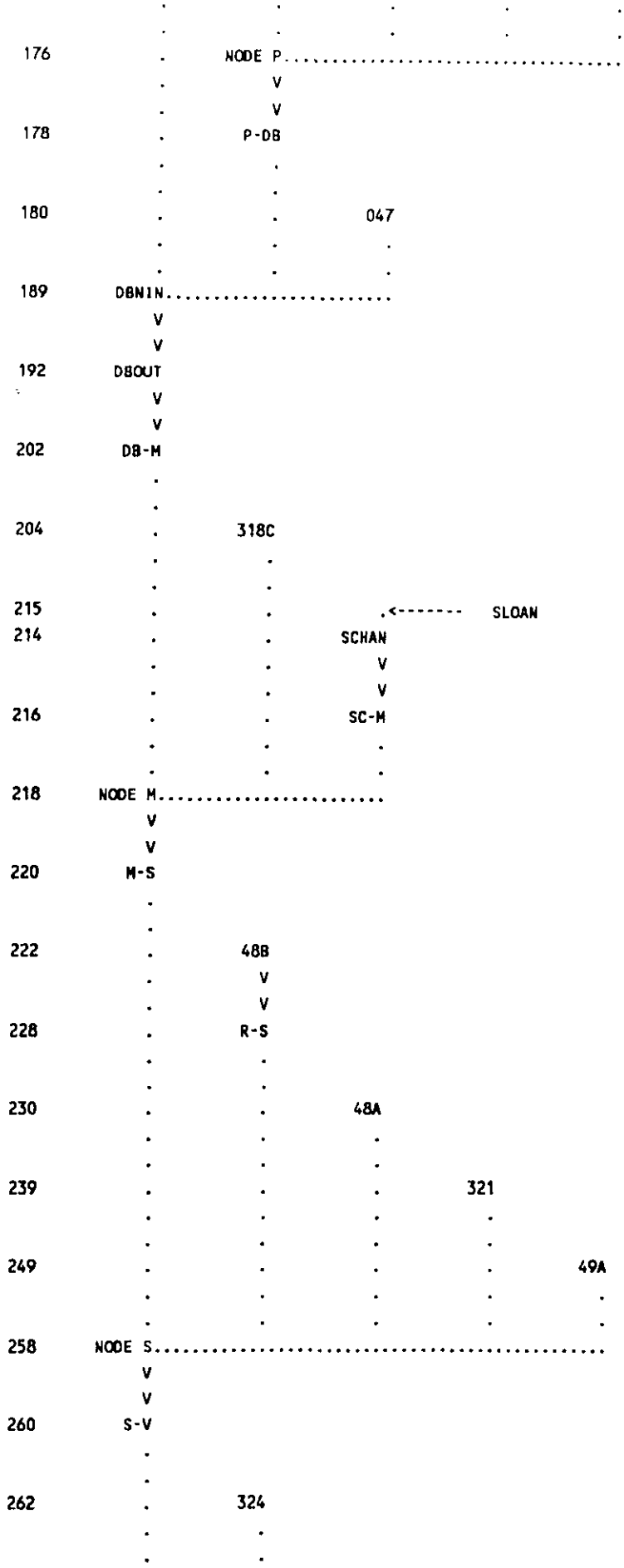
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
  385     RK   12500   .0038    .035           TRAP      80       1
  386     KK   NO.CC      COMBINE ALL FLOWS AT NODE CC
  387     HC        2
  388     ZZ
```

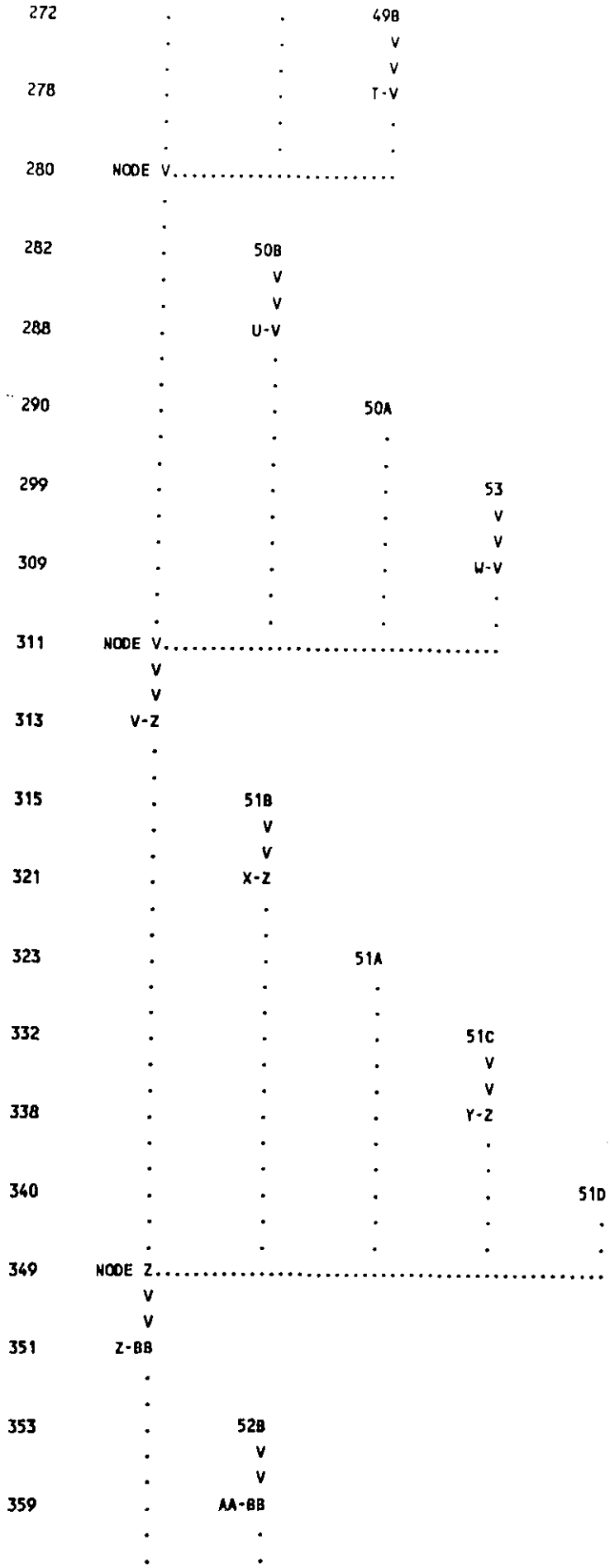
1

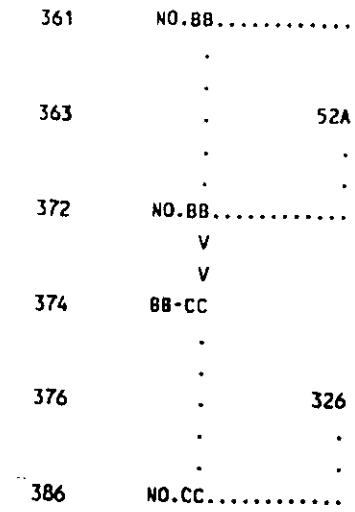
SCHEMATIC DIAGRAM OF STREAM NETWORK




95
SLOAN
94
DIV
98
GOLF
100
44
106
J-K
108
312
114
NODE K
116
K-P
118
45
124
N-O
126
048
132
46A
138
468
144
NODE O
146
O-P1
148
P1
150
P1-P
152
317
158
3188
164
Q-P
166
318A


176
NODE P
178
P-DB
180
047
189
DBNIN
192
DBOUT
202
DB-M
204
318C
215
SLOAN
214
SCHAN
216
SC-M
218
NODE M
220
M-S
222
48B
228
R-S
230
48A
239
321
249
49A
258
NODE S
260
S-V
262
324


272
278
280
NODE V
282
288
290
299
309
311
NODE V
313
V-Z
315
321
323
332
338
340
349
NODE Z
351
Z-BB
353
359
AA-BB
49B
T-V
50B
U-V
50A
53
W-V
51B
X-Z
51A
51C
Y-Z
51D



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

EXISING CONDITIONS EXCEPT
WITH DIVERSION AND DETENTION BASIN
FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE
RANGE WASH WATERSHED
JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.
JANUARY 1991
100-YR, 6-HR STORM PB CARD FOR DARF = 0.55
PRESENT CONDITIONS, EXISTING FACILITIES
AMC 2.0
BASED ON RANGE WASH FACILITIES STUDY
BOYLE ENGINEERS CORP-JULY 1989
(CONVERTED RK TO RM IN UPLAND SUBAREAS)

MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)

JR RATIOS FOR DARF .63 AT DETENTION BASIN AND .60 AT LAS VEGAS WASH

B IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		200	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1	0	ENDING DATE
NDTIME		1635	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 16.58 HOURS

ENGLISH UNITS

JP MULTI-PLAN OPTION

NPLAN	1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.09 1.15

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

IT HYDROGRAPH TRUNCATED FROM 172 TO 150 INT ERVALS

*** ***

39 KK

****
* *
* DBNIN *
* *
****

191 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

)0 HC HYDROGRAPH COMBINATION

ICOMP	3	NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION DBNIN
FOR PLAN 1, RATIO = 1.09

:AK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 27.	5.67		2398.	964.	964.	964.
		(INCHES)	.272	.302	.302	.302
		(AC-FT)	1189.	1321.	1321.	1321.

CUMULATIVE AREA = 82.07 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DBNIN
FOR PLAN 1, RATIO = 1.15

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
• 3850.	5.67		2734.	1096.	1096.	1096.
		(INCHES)	.310	.343	.343	.343
		(AC-FT)	1356.	1502.	1502.	1502.

CUMULATIVE AREA = 82.07 SQ MI

*** *** *** *

*** *** *** *** ***

HYDROGRAPH AT STATION DBOUT
FOR PLAN 1, RATIO = 1.15

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
(CFS)	(HR)					
		(CFS)				
1920.	8.67		1417.	710.	710.	710.
		(INCHES)	.160	.222	.222	.222
		(AC-FT)	702.	973.	973.	973.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
(AC-FT)	(HR)				
922.	8.67	820.	492.	492.	492.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
(FEET)	(HR)				
15.97	8.67	15.20	11.10	11.10	11.10

CUMULATIVE AREA = 82.07 SQ MI

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1	RATIO 2
					1.09	1.15
HYDROGRAPH AT						
+	3068	3.37	1	FLOW	271.	303.
				TIME	5.33	5.33
ROUTED TO						
+	F-F1	3.37	1	FLOW	261.	292.
				TIME	5.67	5.67
HYDROGRAPH AT						
+	307A	5.65	1	FLOW	690.	787.
				TIME	3.92	3.92
2 COMBINED AT						
+	NOD-F1	9.02	1	FLOW	855.	951.
				TIME	5.08	5.08
ROUTED TO						
+	F1-G	9.02	1	FLOW	815.	913.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	307B	2.42	1	FLOW	526.	570.
				TIME	3.67	3.67
2 COMBINED AT						
+	G	11.44	1	FLOW	1066.	1189.
				TIME	5.25	5.17
ROUTED TO						
+	G-G1	11.44	1	FLOW	1064.	1188.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	309B	3.64	1	FLOW	428.	485.
				TIME	4.08	4.08
ROUTED TO						
+	I-I1	3.64	1	FLOW	417.	474.
				TIME	4.17	4.17
HYDROGRAPH AT						
•	310A	1.29	1	FLOW	341.	384.
				TIME	3.50	3.50
2 COMBINED AT						
+	NOD-I1	4.93	1	FLOW	518.	572.
				TIME	4.83	4.83

ROUTED TO						
+	I1-I2	4.93	1	FLOW	484.	538.
				TIME	5.17	5.17
HYDROGRAPH AT						
+	3108	7.85	1	FLOW	512.	599.
				TIME	5.67	5.58
2 COMBINED AT						
+	NOD12	12.78	1	FLOW	968.	1108.
				TIME	5.33	5.33
ROUTED TO						
+	I2-G1	12.78	1	FLOW	966.	1106.
				TIME	5.33	5.33
2 COMBINED AT						
+	NOD-G1	24.22	1	FLOW	2021.	2284.
				TIME	5.25	5.25
ROUTED TO						
+	G1-D	24.22	1	FLOW	2014.	2276.
				TIME	5.33	5.33
DIVERSION TO						
+	SLOAN	24.22	1	FLOW	1147.	1184.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	DIV	24.22	1	FLOW	867.	1092.
				TIME	5.33	5.33
ROUTED TO						
•	GOLF	24.22	1	FLOW	848.	1070.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	44	7.23	1	FLOW	627.	698.
				TIME	5.50	5.42
ROUTED TO						
•	J-K	7.23	1	FLOW	620.	691.
				TIME	6.00	6.00
HYDROGRAPH AT						
+	312	6.77	1	FLOW	314.	355.
				TIME	7.00	7.00
2 COMBINED AT						
+	NODE K	14.00	1	FLOW	884.	990.
				TIME	6.25	6.17
ROUTED TO						
+	K-P	14.00	1	FLOW	867.	972.
				TIME	7.25	7.17
HYDROGRAPH AT						
•	45	10.73	1	FLOW	715.	807.
				TIME	5.58	5.58

ROUTED TO						
+	N-O	10.73	1	FLOW	708.	800.
				TIME	6.00	5.92
HYDROGRAPH AT						
+	048	2.07	1	FLOW	114.	129.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	46A	7.35	1	FLOW	559.	628.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	468	6.02	1	FLOW	443.	498.
				TIME	5.92	5.83
4 COMBINED AT						
+	NODE O	26.17	1	FLOW	1814.	2044.
				TIME	5.92	5.83
ROUTED TO						
+	O-P1	26.17	1	FLOW	1784.	2011.
				TIME	6.58	6.58
2 COMBINED AT						
+	P1	40.17	1	FLOW	2575.	2900.
				TIME	6.75	6.67
ROUTED TO						
+	P1-P	40.17	1	FLOW	2552.	2876.
				TIME	7.25	7.17
HYDROGRAPH AT						
+	317	7.66	1	FLOW	948.	1059.
				TIME	4.50	4.50
HYDROGRAPH AT						
+	318B	1.86	1	FLOW	642.	697.
				TIME	3.75	3.75
ROUTED TO						
+	Q-P	1.86	1	FLOW	601.	653.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	318A	.76	1	FLOW	47.	56.
				TIME	6.08	6.00
4 COMBINED AT						
+	NODE P	50.45	1	FLOW	2731.	3079.
				TIME	7.08	7.00
ROUTED TO						
+	P-OB	50.45	1	FLOW	2729.	3078.
				TIME	7.08	7.08
HYDROGRAPH AT						
+	047	7.40	1	FLOW	569.	610.
				TIME	4.33	5.25

3 COMBINED AT						
+	DBNIN	82.07	1	FLOW	3327.	3850.
				TIME	5.67	5.67
ROUTED TO						
+	DBOUT	82.07	1	FLOW	1521.	1920.
				TIME	8.83	8.67
			** PEAK STAGES IN FEET **			
			1	STAGE	15.38	15.97
				TIME	8.83	8.67
ROUTED TO						
+	DB-M	82.07	1	FLOW	1521.	1920.
				TIME	8.92	8.67
HYDROGRAPH AT						
+	318C	2.93	1	FLOW	186.	219.
				TIME	5.92	5.83
HYDROGRAPH AT						
+	SCHAN	.00	1	FLOW	1147.	1184.
				TIME	5.33	5.33
ROUTED TO						
+	SC-M	.00	1	FLOW	1145.	1182.
				TIME	5.50	5.42
3 COMBINED AT						
+	NODE M	85.00	1	FLOW	1833.	2284.
				TIME	8.50	8.25
ROUTED TO						
+	M-S	85.00	1	FLOW	1832.	2283.
				TIME	8.58	8.33
HYDROGRAPH AT						
+	48B	.99	1	FLOW	378.	410.
				TIME	3.67	3.67
ROUTED TO						
+	R-S	.99	1	FLOW	327.	360.
				TIME	3.83	3.83
HYDROGRAPH AT						
+	48A	.49	1	FLOW	84.	90.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	321	3.42	1	FLOW	172.	193.
				TIME	7.17	7.08
HYDROGRAPH AT						
•	49A	.60	1	FLOW	63.	68.
				TIME	3.67	3.67
5 COMBINED AT						
+	NODE S	90.50	1	FLOW	1989.	2468.
				TIME	8.50	8.25

ROUTED TO						
+	S-V	90.50	1	FLOW	1987.	2466.
				TIME	8.67	8.42
HYDROGRAPH AT						
+	324	1.40	1	FLOW	120.	123.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	49B	1.04	1	FLOW	376.	409.
				TIME	3.67	3.67
ROUTED TO						
+	T-V	1.04	1	FLOW	270.	293.
				TIME	4.17	4.17
3 COMBINED AT						
+	NODE V	92.94	1	FLOW	2182.	2505.
				TIME	5.33	8.33
HYDROGRAPH AT						
+	50B	.55	1	FLOW	246.	267.
				TIME	3.58	3.58
ROUTED TO						
+	U-V	.55	1	FLOW	168.	183.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	50A	1.78	1	FLOW	115.	138.
				TIME	5.17	5.17
HYDROGRAPH AT						
+	53	1.44	1	FLOW	130.	138.
				TIME	4.50	4.50
ROUTED TO						
+	W-V	1.44	1	FLOW	127.	135.
				TIME	4.92	4.92
4 COMBINED AT						
+	NODE V	96.71	1	FLOW	2514.	2680.
				TIME	5.33	5.33
ROUTED TO						
+	V-Z	96.71	1	FLOW	2369.	2561.
				TIME	5.92	8.75
HYDROGRAPH AT						
+	51B	.47	1	FLOW	203.	220.
				TIME	3.58	3.58
ROUTED TO						
+	X-Z	.47	1	FLOW	123.	135.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	51A	.99	1	FLOW	90.	105.
				TIME	5.25	5.17

HYDROGRAPH AT						
+	51C	.43	1	FLOW	176.	192.
				TIME	3.58	3.58
ROUTED TO						
+	Y-Z	.43	1	FLOW	114.	124.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	51D	.83	1	FLOW	69.	81.
				TIME	5.17	5.17
5 COMBINED AT						
+	NODE Z	99.43	1	FLOW	2552.	2745.
				TIME	5.75	5.67
ROUTED TO						
+	Z-BB	99.43	1	FLOW	2550.	2744.
				TIME	5.83	5.75
HYDROGRAPH AT						
+	52B	.70	1	FLOW	316.	343.
				TIME	3.50	3.50
ROUTED TO						
•	AA-BB	.70	1	FLOW	184.	201.
				TIME	4.08	4.08
2 COMBINED AT						
+	NO.BB	100.13	1	FLOW	2610.	2817.
				TIME	5.67	5.67
HYDROGRAPH AT						
+	52A	1.18	1	FLOW	86.	101.
				TIME	5.33	5.25
2 COMBINED AT						
+	NO.BB	101.31	1	FLOW	2690.	2907.
				TIME	5.67	5.58
ROUTED TO						
•	BB-CC	101.31	1	FLOW	2688.	2906.
				TIME	5.75	5.67
HYDROGRAPH AT						
+	326	1.71	1	FLOW	97.	109.
				TIME	6.00	6.08
2 COMBINED AT						
+	NO.CC	103.02	1	FLOW	2784.	3013.
				TIME	5.75	5.67

*** NORMAL END OF HEC-1 ***

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

*** FREE ***
    1     ID                    EAST AND WEST RANGE WASHES
    2     ID                      100-YR, 6-HR STORM
    3     ID          FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
    4     ID       EXCEPT UPPER EAST RANGE WASH DET. BASIN E-J1 NOT INCLUDED
    5     ID              DIVERSION FROM SLOAN CHANNEL TO D8
    6     ID                  BOYLE ENGINEERING CORPORATION
    7     ID                   STORM BCD (DARF=.63)
    8     ID            AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
    9     ID               NEW FUTURE DEVELOPMENT IN 306, 307, 310
   10     IT     05       0       0     300
   11     IO      5       0       0
   12     JR   PREC     .63
   13     VS   DBIN   DBOUT
   14     VV   2.11    2.11

   15     KK   3098  SUB-BASIN 3098 HYDROGRAPH
   16     KM           KINEMATIC WAVE RUNOFF COMPUTATION
   17     BA   3.64
   18     PB   2.86
   19     PC    .00    2.00    5.90    8.00   11.00   14.40   15.00   16.00   16.80   17.10
   20     PC  18.00   18.20   18.70   19.00   19.70   20.20   21.00   22.00   23.00   24.10
   21     PC  25.00   25.90   26.50   28.00   29.00   30.00   30.50   30.90   31.00   31.70
   22     PC  32.10   32.70   33.30   34.60   36.10   38.10   40.80   43.00   47.70   51.40
   23     PC  56.10   63.00   71.00   72.00   73.10   75.20   77.90   79.00   79.50   80.40
   24     PC  81.00   82.00   82.60   84.00   85.90   88.90   91.00   93.80   96.60   97.00
   25     PC  97.40   97.90   98.10   98.30   98.50   98.90   99.00   99.20   99.30   99.60
   26     PC  99.70   99.90  100.00
   27     LS      0      79
   28     UD   2.07

   29     KK   I2-I3  ROUTE FLOWS TO NODE I3
   30     RK   13830   .0109    .015       0   TRAP      30       2

   31     KK   310A  SUB-BASIN 310A HYDROGRAPH
   32     KM           KINEMATIC WAVE RUNOFF COMPUTATION
   33     BA   3.56
   34     PB   2.86
   35     LS      0      77       0       0      98
   36     UK    800    .015     .20      68
   37     UK    300    .020     .10      32
   38     RK   2750     .01     .05     .25   TRAP      30      50
   39     RK   7300     .01     .05    1.01   TRAP      30      50
   40     RK  19360   .0036     .05       0   TRAP      30       2      NO

   41     KK   NODE13    COMBINE FLOWS AT NODE I3
   42     HC       2

   43     KK   I3-G1  ROUTE FLOWS TO NODE G1
   44     RK   6125   .0082    .015       0   TRAP      50       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  45      KK    306B  SUB-BASIN 306B HYDROGRAPH
  46      KM          SCS RUNOFF COMPUTATION
  47      BA    4.54
  48      PB    2.86
  49      LS       0      80
  50      UD     .79

  51      KK    F2-G1   ROUTE FLOWS TO NODE G1
  52      RM       18    1.57     .10

  53      KK    307A  SUB-BASIN 307A HYDROGRAPH
  54      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  55      BA    6.23
  56      PB    2.86
  57      LS       0      77       0       0      98
  58      UK     800   .0123     .20      51
  59      UK     300    .015     .10      49
  60      RK    5000     .01     .05     .25    TRAP      30      50
  61      RK    3200    .013     .05    1.01    TRAP      30      50
  62      RK   13430   .0134     .03       0    TRAP      60     1.5      NO

  63      KK    NODE G1   COMBINE FLOWS AT G1
  64      HC       3

  65      KK    G1-G2  ROUTE FLOWS TO NODE G2
  66      RK    9880   .0030    .015       0    TRAP      60       2

  67      KK    307B  SUB-BASIN 307B HYDROGRAPH
  68      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  69      BA    1.84
  70      PB    2.86
  71      LS       0      77       0       0      98
  72      UK     800   .0123     .20      51
  73      UK     300    .015     .10      49
  74      RK    5000     .01     .05     .25
  75      RK    3200    .013     .05    1.01
  76      RK    9880    .003     .03       0    TRAP      60       2      NO

  77      KK    310B  SUB-BASIN 310B HYDROGRAPH
  78      KM          KINEMATIC WAVE RUNOFF COMPUTATION
  79      BA    5.58
  80      PB    2.86
  81      LS       0      77       0       0      98
  82      UK     800    .015     .20      68
  83      UK     300    .020     .10      32
  84      RK    2750     .01     .05     .25    TRAP      30      50
  85      RK    7300     .01     .05    1.01    TRAP      30      50
  86      RK   17775    .009     .05       0    TRAP      60       1      NO
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  87      KK    NODE G2    COMBINE ALL FLOWS AT NODE G2
  88      HC       3

  89      KK     47B   SUB-BASIN 47B HYDROGRAPH
  90      KM           KINEMATIC RUNOFF COMPUTATION
  91      BA    4.72
  92      PB    2.86
  93      LS       0      77       0       0      98
  94      UK     800    .008     .20      69
  95      UK      80    .012     .10      31
  96      RK    2000    .003     .05     .25    TRAP      30      50
  97      RK    7000    .007     .05    1.23    TRAP      30      50
  98      RK   20150    .005     .03       0    TRAP      40       1      NO

  99      KK  G2-DIV ROUTE FLOWS TO DIVERSION
 100      RK    8100   .0022     .015      0    TRAP      60       2

 101      KK   NODEW    COMBINE FLOWS AT NODE
 102      HC       2

 103      KK     DIV
 104      DT   SLOAN
 105      DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
 106      DQ       0     850     900     950    1000    1050    1100    1200    1300    1400

 107      KK    GOLF
 108      RK    4000   .0010     .030      0    TRAP      70       3

 109      KK      44   SUB-BASIN 44 HYDROGRAPH
 110      KM           SCS RUNOFF COMPUTATION
 111      BA    7.23
 112      PB    2.86
 113      LS       0      79
 114      UD    1.22

 115      KK    J-K1  ROUTE FLOW TO NODE K1
 116      RM       8     .58     .15

 117      KK    312A SUB-BASIN 312A HYDROGRAPH
 118      KM         SCS RUNOFF COMPUTATION
 119      BA    4.00
 120      PB    2.86
 121      LS       0      77
 122      UD    1.57

 123      KK     45A SUB-BASIN 45A HYDROGRAPH
 124      KM         SCS RUNOFF COMPUTATION
 125      BA    8.38
 126      PB    2.86
 127      LS       0      76       0       0       0       0
 128      UD    2.31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  129     KK   N1-K1  ROUTE FLOW TO NODE K1
  130     RK    8300   .0157    .035       0    TRAP      50       3

  131     KK    NODEK1  COMBINE FLOW AT NODE K1
  132     HC       3
  133     KO       3

  134     KK   K1-K2  ROUTE FLOW TO NODE K2
  135     RK    7900   .0127    .015       0    TRAP      14       2

  136     KK    312B SUB-BASIN 312B HYDROGRAPH
  137     KM           SCS RUNOFF COMPUTATION
  138     BA   1.49
  139     PB   2.86
  140     LS      0      77
  141     UD   1.33

  142     KK    NODEK2   COMBINE FLOWS AT NODE K2
  143     HC       2

  144     KK    K2-O  ROUTE FLOW TO NODE O
  145     RK    6520   .0031    .015       0    TRAP      24       2

  146     KK     45B SUB-BASIN 45B HYDROGRAPH
  147     KM           SCS RUNOFF COMPUTATION
  148     BA   2.35
  149     PB   2.86
  150     LS      0      76       0       0       0       0
  151     UD   1.81

  152     KK    N2-O  ROUTE FLOW TO NODE O
  153     RK    9550   .0157    .035       0    TRAP      50       1

  154     KK     048   SUB-BASIN 048 HYDROGRAPH
  155     KM           SCS RUNOFF COMPUTATION
  156     BA   2.07
  157     PB   2.86
  158     LS      0      76
  159     UD   1.97

  160     KK     46A  SUB-BASIN 46A HYDROGRAPH
  161     KM           SCS RUNOFF COMPUTATION
  162     BA   7.35
  163     PB   3.00
  164     LS      0      77
  165     UD   1.60

  166     KK     46B  SUB-BASIN 46B HYDROGRAPH
  167     KM           SCS RUNOFF COMPUTATION
  168     BA   6.02
  169     PB   3.00
  170     LS      0      77
  171     UD   1.71
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  172     KK    NODEO  COMBINE ALL FLOW AT NODE O
  173     HC       5

  174     KK    O-P1  ROUTE FLOW TO NODE P1
  175     RK   11850   .0056     .03       0    TRAP      32       2

  176     KK    312C SUB-BASIN 312C HYDROGRAPH
  177     KM          SCS RUNOFF COMPUTATION
  178     BA    1.28
  179     PB    2.86
  180     LS       0      77
  181     UD    1.51

  182     KK    L-P1  ROUTE FLOW TO NODE P1
  183     RK   10000   .0071     .03       0    TRAP      60       3

  184     KK     47A   SUB-BASIN 47A HYDROGRAPH
  185     KM           KINEMATIC RUNOFF COMPUTATION
  186     BA    2.07
  187     PB    2.86
  188     LS       0      77       0       0      98
  189     UK     800    .008     .20      69
  190     UK      80    .012     .10      31
  191     RK    2000    .003     .05     .25    TRAP      30      50
  192     RK    7000    .007     .05    1.23    TRAP      30      50
  193     RK   12250    .007     .03       0    TRAP      40       1

  194     KK      P1    COMBINE FLOWS AT P1
  195     HC       3

  196     KK    P1-P  ROUTE FLOW TO NODE P
  197     RK    6120   .0041    .015       0    TRAP      10       2

  198     KK     317   SUB-BASIN 317 HYDROGRAPH
  199     KM           SCS RUNOFF COMPUTATION
  200     BA    7.66
  201     PB    3.15
  202     LS       0      80
  203     UD     .97

  204     KK    318B   SUB-BASIN 318B HYDROGRAPH
  205     KM           SCS RUNOFF COMPUTATION
  206     BA    1.61
  207     PB    3.15
  208     LS       0      87       0
  209     UD     .37

  210     KK     Q-P   ROUTE FLOW TO NODE P
  211     RM       4     .26      .15
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  212     KK   318A   SUB BASIN 318A HYDROGRAPH
  213     KM          KINEMATIC WAVE RUNOFF COMPUTATION
  214     BA   0.76
  215     PB   2.93
  216     LS      0     77      0      0     98
  217     UK    700   .020    .30     74
  218     UK     50   .025    .10     26
  219     RK   2000   .035    .05    .06   TRAP    30     50
  220     RK   7000   .014    .05    .55   TRAP    30     50
  221     RK   9200  .0043    .03      0   TRAP    30      1

  222     KK   NODEP  COMBINE FLOWS AT NODE P
  223     HC      4

  224     KK   P-M1   ROUTE FLOWS TO NODE M1
  225     RK   4800  .0034    .015      0   TRAP    40      1

  226     KK   DBIN
  227     HC      2
  228     KO      3

  229     KK   DBOUT
  230     KM   CONFLUENCE BASIN 2 LEVEL OUTLET
  231     RS      1   ELEV      2
  232     SV      0    3.2     9.9    21.4   39.2   102    217    533    658    794
  233     SV    925
  234     SQ      0     54     153    214    238    280    317    367    688   1263
  235     SQ   1938
  236     SE      2      3       4      5      6      8     10     13     14     15
  237     SE     16
  238     KO      3
  239     ZZ
```

EAST AND WEST RANGE WASHES
100-YR, 6-HR STORM
FUTURE CONDITIONS WITH ALTERNATIVE IV FACILITIES
EXCEPT UPPER EAST RANGE WASH DET. BASIN E-J1 NOT INCLUDED
DIVERSION FROM SLOAN CHANNEL TO DB
BOYLE ENGINEERING CORPORATION
STORM BCD (DARF=.63)
AMC 2, DARF & AMC PER CCRFCD CRITERIA MANUAL
NEW FUTURE DEVELOPMENT IN 306, 307, 310

11 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

USER-DEFINED OUTPUT SPECIFICATIONS

TABLE 1

VS	STATION	DBIN	DBOUT								
VV	VARIABLE CODE	2.11	2.11	.00	.00	.00	.00	.00	.00	.00	.00

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.63

*** *** *** *

*** ***

```
**************
*            *
KK  *      DBIN  *
*            *
**************
```

28 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

227 HC HYDROGRAPH COMBINATION

ICOMP	2	NUMBER OF HYDROGRAPHS TO COMBINE

***

*** *** *** *** ***

HYDROGRAPH AT STATION DBIN
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 5484.	5.83		2947.	785.	756.	756.
		(INCHES)	.333	.354	.354	.354
		(AC-FT)	1461.	1557.	1557.	1557.

CUMULATIVE AREA = 82.38 SQ MI

*** ***

****
* DBOUT *
****

58 KO OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

61 RS STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC 2.00 INITIAL CONDITION
X .00 WORKING R AND D COEFFICIENT

62 SV STORAGE .0 3.2 9.9 21.4 39.2 102.0 217.0 533.0 658.0 794.0
925.0

74 SQ DISCHARGE 0. 54. 153. 214. 238. 280. 317. 367. 688. 1263.
1938.

236 SE ELEVATION 2.00 3.00 4.00 5.00 6.00 8.00 10.00 13.00 14.00 15.00
16.00

***

*** *** *** *** ***

HYDROGRAPH AT STATION DBOUT
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 2256.	7.83		1570.	645.	621.	621.
		(INCHES)	.177	.291	.291	.291
		(AC-FT)	778.	1278.	1278.	1278.

P < STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (AC-FT)	(HR)				
987.	7.83	850.	485.	468.	468.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	24.92-HR
+ (FEET)	(HR)				
47	7.83	15.43	11.68	11.33	11.33

CUMULATIVE AREA = 82.38 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					.63
HYDROGRAPH AT					
+	309B	3.64	1	FLOW	280.
				TIME	6.17
ROUTED TO					
+	I2-I3	3.64	1	FLOW	279.
				TIME	6.33
HYDROGRAPH AT					
+	310A	3.56	1	FLOW	348.
				TIME	5.58
2 COMBINED AT					
+	NODE	7.20	1	FLOW	601.
				TIME	6.00
ROUTED TO					
+	I3-G1	7.20	1	FLOW	601.
				TIME	6.08
HYDROGRAPH AT					
+	306B	4.54	1	FLOW	565.
				TIME	4.33
ROUTED TO					
+	F2-G1	4.54	1	FLOW	503.
				TIME	6.08
HYDROGRAPH AT					
+	307A	6.23	1	FLOW	1228.
				TIME	4.08
3 COMBINED AT					
•	NODE	17.97	1	FLOW	1722.
				TIME	5.75
ROUTED TO					
+	G1-G2	17.97	1	FLOW	1714.
				TIME	5.83
HYDROGRAPH AT					
•	307B	1.84	1	FLOW	379.
				TIME	3.92
HYDROGRAPH AT					
•	310B	5.58	1	FLOW	545.
				TIME	5.42

3 COMBINED AT					
+	NODE	25.39	1	FLOW	2416.
				TIME	5.75
HYDROGRAPH AT					
+	47B	4.72	1	FLOW	442.
				TIME	4.58
ROUTED TO					
+	G2-DIV	4.72	1	FLOW	437.
				TIME	4.83
2 COMBINED AT					
+	NODEW	30.11	1	FLOW	2822.
				TIME	5.75
DIVERSION TO					
+	SLOAN	30.11	1	FLOW	1261.
				TIME	5.75
HYDROGRAPH AT					
+	DIV	30.11	1	FLOW	1561.
				TIME	5.75
ROUTED TO					
+	GOLF	30.11	1	FLOW	1553.
				TIME	5.83
HYDROGRAPH AT					
+	44	7.23	1	FLOW	695.
				TIME	5.42
ROUTED TO					
+	J-K1	7.23	1	FLOW	690.
				TIME	5.92
HYDROGRAPH AT					
+	312A	4.00	1	FLOW	304.
				TIME	5.75
HYDROGRAPH AT					
+	45A	8.38	1	FLOW	467.
				TIME	6.50
ROUTED TO					
+	N1-K1	8.38	1	FLOW	466.
				TIME	6.67
3 COMBINED AT					
+	NODE	19.61	1	FLOW	1396.
				TIME	6.08
ROUTED TO					
+	K1-K2	19.61	1	FLOW	1396.
				TIME	6.17
HYDROGRAPH AT					
+	312B	1.49	1	FLOW	120.
				TIME	5.50

2 COMBINED AT					
+	NODE	21.10	1	FLOW	1498.
				TIME	6.08
ROUTED TO					
+	K2-O	21.10	1	FLOW	1497.
				TIME	6.17
HYDROGRAPH AT					
+	458	2.35	1	FLOW	153.
				TIME	6.00
ROUTED TO					
+	N2-O	2.35	1	FLOW	150.
				TIME	6.33
HYDROGRAPH AT					
+	048	2.07	1	FLOW	128.
				TIME	6.17
HYDROGRAPH AT					
+	46A	7.35	1	FLOW	622.
				TIME	5.75
HYDROGRAPH AT					
+	468	6.02	1	FLOW	494.
				TIME	5.83
5 COMBINED AT					
+	NODE	38.89	1	FLOW	2846.
				TIME	6.00
ROUTED TO					
+	O-P1	38.89	1	FLOW	2834.
				TIME	6.17
HYDROGRAPH AT					
+	312C	1.28	1	FLOW	99.
				TIME	5.67
ROUTED TO					
+	L-P1	1.28	1	FLOW	95.
				TIME	6.25
HYDROGRAPH AT					
+	47A	2.07	1	FLOW	213.
				TIME	4.42
3 COMBINED AT					
•	P1	42.24	1	FLOW	3076.
				TIME	6.17
ROUTED TO					
+	P1-P	42.24	1	FLOW	3074.
				TIME	6.25
HYDROGRAPH AT					
+	317	7.66	1	FLOW	1059.
				TIME	4.50

HYDROGRAPH AT					
+	318B	1.61	1	FLOW	603.
				TIME	3.75
ROUTED TO					
+	Q-P	1.61	1	FLOW	565.
				TIME	4.00
HYDROGRAPH AT					
+	318A	.76	1	FLOW	71.
				TIME	4.33
4 COMBINED AT					
+	NODE	52.27	1	FLOW	3933.
				TIME	5.75
ROUTED TO					
+	P-M1	52.27	1	FLOW	3931.
				TIME	5.83
2 COMBINED AT					
+	DBIN	82.38	1	FLOW	5484.
				TIME	5.83
ROUTED TO					
+	DBOUT	82.38	1	FLOW	2256.
				TIME	7.83

** PEAK STAGES IN FEET **

1	STAGE	16.47
	TIME	7.83

HEC-2

WATER SURFACE PROFILE CALCULATIONS

```
**************************************************
*  WATER SURFACE PROFILES                        *
*  VERSION OF NOVEMBER 1976                      *
*  UPDATED MAY 1984                              *
*  IBM-PC-XT VERSION AUGUST 1985                 *
*  RUN DATE  01-07-93   TIME  10:22:03           *
**************************************************
```


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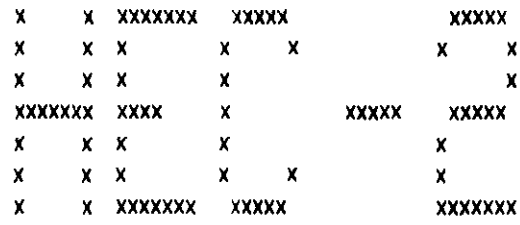
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616             *
*  (916) 440-2105 (FTS) 448-2105       *
****************************************
```

THIS RUN EXECUTED 01-07-93

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**************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1     CONFLUENCE DETENTION BASIN
T2     100-YEAR FLOW
T3     GOLF COURSE CHANNEL

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0.       0.        0.        0. -1.000000       .00       .3     2500.    13.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      .000      .000      .000      .000      .000      .000    -1.000      .000      .000      .000


NC     .025      .025      .025      .100      .300      .000      .000      .000      .000      .000
       1.000     5.000     .000      100.000   .000      .000      .000      .000      .000      .000
GR     17.500    .000      7.500     30.000    6.500     50.000    7.500     70.000    17.500    100.000

X1     2.000     5.000     .000      100.000   10.000    10.000    10.000    .000      .000      .000
GR     17.510    .000      7.514     30.000    6.514     50.000    7.514     70.000    17.514    100.000

X1     3.000     5.000     .000      120.000   10.000    10.000    10.000    .000      .000      .000
GR     17.530    .000      7.528     30.000    6.528     60.000    7.528     90.000    17.528    120.000

X1     4.000     .000      .000      .000      30.000    30.000    30.000    .000      .042      .000

X1     5.000     .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     6.000     .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     7.000     .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     8.000     .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     9.000     .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     10.000    .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

X1     11.000    .000      .000      .000      100.000   100.000   100.000   .000      .140      .000

       12.000    .000      .000      .000      100.000   100.000   100.000   .000      .140      .000
```

X1	13.000	5.000	.000	250.000	50.000	50.000	50.000	.000	.000	.000
GR	18.760	.000	8.760	100.000	7.760	125.000	8.760	150.000	18.760	250.000
X1	14.000	.000	.000	.000	10.000	10.000	10.000	.000	.014	.000
X1	15.000	5.000	.000	120.000	115.000	115.000	115.000	.000	.000	.000
GR	18.940	.000	8.935	30.000	7.935	60.000	8.935	90.000	18.935	120.000
NC	.030	.030	.030	.000	.000	.000	.000	.000	.000	.000
X1	16.000	5.000	.000	50.000	25.000	25.000	25.000	.000	.000	.000
GR	18.970	.000	8.970	.000	7.970	25.000	8.970	50.000	18.970	50.000
X1	17.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	18.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
NC	.025	.025	.025	.000	.000	.000	.000	.000	.000	.000
X1	19.000	5.000	.000	120.000	20.000	20.000	20.000	.000	.028	.000
GR	19.280	.000	9.278	30.000	8.278	60.000	9.278	90.000	19.278	120.000
X1	20.000	.000	.000	.000	30.000	30.000	30.000	.000	.042	.000
X1	21.000	.000	.000	.000	50.000	50.000	50.000	.000	.070	.000
	22.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	23.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	24.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	25.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	26.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	27.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	28.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	29.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	30.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	31.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	32.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	33.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000

X1	34.000	5.000	.000	120.000	50.000	50.000	50.000	.000	.070	.000
GR	21.140	.000	11.140	30.000	10.140	60.000	11.140	90.000	21.140	120.000
X1	35.000	.000	.000	.000	50.000	50.000	50.000	.000	.070	.000
X1	36.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	37.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	38.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	39.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	40.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	41.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	42.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	43.000	.000	.000	.000	20.000	20.000	20.000	.000	.028	.000
X1	44.000	5.000	.000	180.000	30.000	30.000	30.000	.000	.042	.000
GR	22.260	.000	12.260	100.000	11.260	125.000	12.260	150.000	22.260	180.000
	45.000	5.000	.000	240.000	50.000	50.000	50.000	.000	.000	.000
GR	22.330	.000	12.330	100.000	11.330	120.000	12.330	140.000	22.330	240.000
X1	46.000	5.000	.000	180.000	100.000	100.000	100.000	.000	.000	.000
GR	22.470	.000	12.470	30.000	11.470	55.000	12.470	80.000	22.470	180.000
X1	47.000	5.000	.000	120.000	90.000	90.000	90.000	.000	.000	.000
GR	22.600	.000	12.596	30.000	11.596	60.000	12.596	90.000	22.596	120.000
X1	48.000	.000	.000	.000	10.000	10.000	10.000	.000	.014	.000
X1	49.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	50.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
X1	51.000	.000	.000	.000	100.000	100.000	100.000	.000	.140	.000
NC	.030	.030	.030	.000	.000	.000	.000	.000	.000	.000
X1	52.000	8.000	.000	50.000	80.000	80.000	80.000	.000	.112	.000
GR	22.140	.000	12.142	.000	12.142	24.000	22.142	24.000	22.142	26.000
GR	12.140	26.000	12.142	50.000	22.142	50.000	.000	.000	.000	.000
X1	53.000	.000	.000	.000	40.000	40.000	40.000	.000	.056	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300

*SECNO 1.000

3720 CRITICAL DEPTH ASSUMED

1.00	5.04	11.54	11.54	13.00	13.37	1.82	.00	.00	17.50
2500.	0.	2500.	0.	0.	231.	0.	0.	0.	17.50
.00	.00	10.84	.00	.025	.025	.025	.000	6.50	17.88
.006224	0.	0.	0.	0	14	0	.00	64.24	82.12

0

*SECNO 2.000

3301 HV CHANGED MORE THAN HVINS

2.00	5.55	12.06	11.56	.00	13.46	1.39	.05	.04	17.51
2500.	0.	2500.	0.	0.	264.	0.	0.	0.	17.51
.00	.00	9.48	.00	.025	.025	.025	.000	6.51	16.36
.004236	10.	10.	10.	8	5	0	.00	67.28	83.63

0

*SECNO 3.000

3301 HV CHANGED MORE THAN HVINS

3.00	6.58	13.11	10.66	.00	13.57	.46	.02	.09	17.53
2500.	0.	2500.	0.	0.	458.	0.	0.	0.	17.53
.00	.00	5.46	.00	.025	.025	.025	.000	6.53	13.27
.001041	10.	10.	10.	3	15	0	.00	93.46	106.73

0

*SECNO 4.000

4.00	6.57	13.14	10.70	.00	13.60	.46	.03	.00	17.57
2500.	0.	2500.	0.	0.	458.	0.	0.	0.	17.57
.00	.00	5.46	.00	.025	.025	.025	.000	6.57	13.28
.001041	30.	30.	30.	1	14	0	.00	93.45	106.73

0

*SECNO 5.000

5.00	6.53	13.24	10.84	.00	13.71	.47	.11	.00	17.71
2500.	0.	2500.	0.	0.	453.	0.	2.	0.	17.71
.01	.00	5.51	.00	.025	.025	.025	.000	6.71	13.42
.001071	100.	100.	100.	2	14	0	.00	93.17	106.59

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 6.000									
6.00	6.49	13.34	10.98	.00	13.82	.48	.11	.00	17.85
2500.	0.	2500.	0.	0.	450.	0.	3.	1.	17.85
.01	.00	5.56	.00	.025	.025	.025	.000	6.85	13.53
.001094	100.	100.	100.	2	14	0	.00	92.95	106.48
0									
*SECNO 7.000									
7.00	6.46	13.45	11.12	.00	13.93	.49	.11	.00	17.99
2500.	0.	2500.	0.	0.	447.	0.	4.	1.	17.99
.02	.00	5.60	.00	.025	.025	.025	.000	6.99	13.63
.001117	100.	100.	100.	2	14	0	.00	92.74	106.37
0									
*SECNO 8.000									
8.00	6.43	13.56	11.26	.00	14.05	.49	.11	.00	18.13
2500.	0.	2500.	0.	0.	444.	0.	5.	1.	18.13
.02	.00	5.63	.00	.025	.025	.025	.000	7.13	13.73
.001139	100.	100.	100.	2	14	0	.00	92.55	106.28
0									
*SECNO 9.000									
9.00	6.40	13.67	11.40	.00	14.17	.50	.11	.00	18.27
2500.	0.	2500.	0.	0.	441.	0.	6.	1.	18.27
.03	.00	5.67	.00	.025	.025	.025	.000	7.27	13.81
.001159	100.	100.	100.	2	14	0	.00	92.38	106.19
0									
*SECNO 10.000									
10.00	6.37	13.78	11.54	.00	14.28	.50	.12	.00	18.41
2500.	0.	2500.	0.	0.	439.	0.	7.	1.	18.41
.03	.00	5.70	.00	.025	.025	.025	.000	7.41	13.89
.001179	100.	100.	100.	2	14	0	.00	92.21	106.11
0									
*SECNO 11.000									
11.00	6.34	13.89	11.68	.00	14.40	.51	.12	.00	18.55
2500.	0.	2500.	0.	0.	436.	0.	8.	2.	18.55
.04	.00	5.73	.00	.025	.025	.025	.000	7.55	13.97
.001197	100.	100.	100.	2	14	0	.00	92.06	106.03
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 12.000									
12.00	6.32	14.01	11.82	.00	14.53	.51	.12	.00	18.69
2500.	0.	2500.	0.	0.	434.	0.	9.	2.	18.69
.04	.00	5.76	.00	.025	.025	.025	.000	7.69	14.04
.001214	100.	100.	100.	2	14	0	.00	91.93	105.96
0									
*SECNO 13.000									
13.00	6.59	14.35	11.87	.00	14.60	.26	.05	.03	18.76
2500.	0.	2500.	0.	0.	617.	0.	9.	2.	18.76
.05	.00	4.05	.00	.025	.025	.025	.000	7.76	44.13
.000785	50.	50.	50.	2	14	0	.00	161.74	205.87
0									
*SECNO 14.000									
14.00	6.58	14.35	11.88	.00	14.61	.26	.01	.00	18.77
2500.	0.	2500.	0.	0.	616.	0.	9.	2.	18.77
.05	.00	4.06	.00	.025	.025	.025	.000	7.77	44.15
.000787	10.	10.	10.	0	14	0	.00	161.70	205.85
0									
*SECNO 15.000									
15.00	6.35	14.29	12.06	.00	14.79	.51	.11	.08	18.94
2500.	0.	2500.	0.	0.	437.	0.	11.	2.	18.93
.05	.00	5.72	.00	.025	.025	.025	.000	7.93	13.95
.001191	115.	115.	115.	2	14	0	.00	92.11	106.06
0									
*SECNO 16.000									
3301 HV CHANGED MORE THAN HVINS									
16.00	5.74	13.71	12.72	.00	15.12	1.42	.05	.27	18.97
2500.	0.	2500.	0.	0.	262.	0.	11.	2.	18.97
.05	.00	9.55	.00	.030	.030	.030	.000	7.97	.00
.005155	25.	25.	25.	3	15	0	.00	50.00	50.00
0									
*SECNO 17.000									
17.00	6.33	14.44	12.86	.00	15.58	1.14	.43	.03	19.11
2500.	0.	2500.	0.	0.	291.	0.	12.	2.	19.11
.06	.00	8.58	.00	.030	.030	.030	.000	8.11	.00
.003706	100.	100.	100.	3	15	0	.00	50.00	50.00
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 18.000

18.00	6.66	14.91	13.00	.00	15.93	1.02	.34	.01	19.25
2500.	0.	2500.	0.	0.	309.	0.	12.	3.	19.25
.06	.00	8.10	.00	.030	.030	.030	.000	8.25	.00
.003108	100.	100.	100.	2	15	0	.00	50.00	50.00

0

*SECNO 19.000

3301 HV CHANGED MORE THAN HVINS

19.00	7.38	15.69	12.43	.00	16.03	.34	.02	.07	19.31
2500.	0.	2500.	0.	0.	535.	0.	12.	3.	19.31
.06	.00	4.67	.00	.025	.025	.025	.000	8.31	10.86
.000664	20.	20.	20.	3	14	0	.00	98.28	109.14

0

*SECNO 20.000

20.00	7.36	15.71	12.48	.00	16.05	.34	.02	.00	19.35
2500.	0.	2500.	0.	0.	533.	0.	13.	3.	19.35
.06	.00	4.69	.00	.025	.025	.025	.000	8.35	10.93
.000672	30.	30.	30.	2	11	0	.00	98.14	109.07

*SECNO 21.000

21.00	7.32	15.74	12.55	.00	16.08	.35	.03	.00	19.42
2500.	0.	2500.	0.	0.	529.	0.	13.	3.	19.42
.06	.00	4.73	.00	.025	.025	.025	.000	8.42	11.05
.000687	50.	50.	50.	2	11	0	.00	97.90	108.95

0

*SECNO 22.000

22.00	7.24	15.80	12.70	.00	16.16	.36	.07	.00	19.56
2500.	0.	2500.	0.	0.	521.	0.	15.	3.	19.56
.07	.00	4.80	.00	.025	.025	.025	.000	8.56	11.28
.000715	100.	100.	100.	2	11	0	.00	97.44	108.72

0

*SECNO 23.000

23.00	7.17	15.86	12.84	.00	16.23	.37	.07	.00	19.70
2500.	0.	2500.	0.	0.	514.	0.	16.	3.	19.70
.08	.00	4.86	.00	.025	.025	.025	.000	8.70	11.50
.000745	100.	100.	100.	2	11	0	.00	97.00	108.50

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 24.000									
24.00	7.10	15.93	12.98	.00	16.31	.38	.08	.00	19.84
2500.	0.	2500.	0.	0.	507.	0.	17.	3.	19.84
.08	.00	4.93	.00	.025	.025	.025	.000	8.84	11.72
.000774	100.	100.	100.	2	11	0	.00	96.57	108.29
0									
*SECNO 25.000									
25.00	7.03	16.01	13.12	.00	16.39	.39	.08	.00	19.98
2500.	0.	2500.	0.	0.	501.	0.	18.	4.	19.98
.09	.00	4.99	.00	.025	.025	.025	.000	8.98	11.92
.000804	100.	100.	100.	2	11	0	.00	96.16	108.08
0									
*SECNO 26.000									
26.00	6.96	16.08	13.24	.00	16.48	.40	.08	.00	20.12
2500.	0.	2500.	0.	0.	494.	0.	19.	4.	20.12
.09	.00	5.06	.00	.025	.025	.025	.000	9.12	12.12
.000833	100.	100.	100.	2	14	0	.00	95.77	107.89
0									
*SECNO 27.000									
27.00	6.90	16.16	13.38	.00	16.57	.41	.08	.00	20.26
2500.	0.	2500.	0.	0.	488.	0.	20.	4.	20.26
.10	.00	5.12	.00	.025	.025	.025	.000	9.26	12.30
.000863	100.	100.	100.	2	14	0	.00	95.40	107.70
0									
*SECNO 28.000									
28.00	6.84	16.24	13.52	.00	16.66	.42	.09	.00	20.40
2500.	0.	2500.	0.	0.	483.	0.	22.	4.	20.40
.10	.00	5.18	.00	.025	.025	.025	.000	9.40	12.48
.000892	100.	100.	100.	2	14	0	.00	95.05	107.52
0									
*SECNO 29.000									
29.00	6.79	16.32	13.66	.00	16.75	.43	.09	.00	20.54
2500.	0.	2500.	0.	0.	478.	0.	23.	5.	20.54
.11	.00	5.24	.00	.025	.025	.025	.000	9.54	12.65
.000921	100.	100.	100.	2	14	0	.00	94.71	107.36
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 30.000									
30.00	6.73	16.41	13.80	.00	16.85	.43	.09	.00	20.68
2500.	0.	2500.	0.	0.	473.	0.	24.	5.	20.68
.11	.00	5.29	.00	.025	.025	.025	.000	9.68	12.80
.000950	100.	100.	100.	2	14	0	.00	94.39	107.20
0									
*SECNO 31.000									
31.00	6.68	16.50	13.94	.00	16.94	.44	.10	.00	20.82
2500.	0.	2500.	0.	0.	468.	0.	25.	5.	20.82
.12	.00	5.34	.00	.025	.025	.025	.000	9.82	12.95
.000978	100.	100.	100.	2	14	0	.00	94.09	107.05
0									
*SECNO 32.000									
32.00	6.64	16.59	14.08	.00	17.05	.45	.10	.00	20.96
2500.	0.	2500.	0.	0.	463.	0.	26.	5.	20.96
.12	.00	5.39	.00	.025	.025	.025	.000	9.96	13.09
.001005	100.	100.	100.	2	14	0	.00	93.81	106.91
0									
*SECNO 33.000									
33.00	6.59	16.69	14.22	.00	17.15	.46	.10	.00	21.10
2500.	0.	2500.	0.	0.	459.	0.	27.	5.	21.10
.13	.00	5.44	.00	.025	.025	.025	.000	10.10	13.23
.001031	100.	100.	100.	2	14	0	.00	93.55	106.78
0									
*SECNO 34.000									
34.00	6.52	16.73	14.34	.00	17.21	.47	.05	.00	21.21
2500.	0.	2500.	0.	0.	453.	0.	27.	6.	21.21
.13	.00	5.52	.00	.025	.025	.025	.000	10.21	13.43
.001074	50.	50.	50.	2	14	0	.00	93.14	106.57
0									
*SECNO 35.000									
35.00	6.51	16.79	14.41	.00	17.26	.47	.05	.00	21.28
2500.	0.	2500.	0.	0.	452.	0.	28.	6.	21.28
.13	.00	5.53	.00	.025	.025	.025	.000	10.28	13.45
.001079	50.	50.	50.	1	14	0	.00	93.09	106.55
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 36.000									
36.00	6.47	16.89	14.55	.00	17.37	.48	.11	.00	21.42
2500.	0.	2500.	0.	0.	448.	0.	29.	6.	21.42
.14	.00	5.58	.00	.025	.025	.025	.000	10.42	13.59
.001109	100.	100.	100.	2	14	0	.00	92.82	106.41
0									
*SECNO 37.000									
37.00	6.44	17.00	14.69	.00	17.49	.49	.11	.00	21.56
2500.	0.	2500.	0.	0.	445.	0.	30.	6.	21.56
.14	.00	5.62	.00	.025	.025	.025	.000	10.56	13.69
.001131	100.	100.	100.	2	14	0	.00	92.62	106.31
0									
*SECNO 38.000									
38.00	6.41	17.11	14.83	.00	17.60	.50	.11	.00	21.70
2500.	0.	2500.	0.	0.	442.	0.	31.	6.	21.70
.15	.00	5.65	.00	.025	.025	.025	.000	10.70	13.78
.001152	100.	100.	100.	2	14	0	.00	92.44	106.22
0									
*SECNO 39.000									
39.00	6.38	17.22	14.97	.00	17.72	.50	.12	.00	21.84
2500.	0.	2500.	0.	0.	440.	0.	32.	6.	21.84
.15	.00	5.69	.00	.025	.025	.025	.000	10.84	13.86
.001172	100.	100.	100.	2	14	0	.00	92.27	106.14
0									
*SECNO 40.000									
40.00	6.35	17.33	15.11	.00	17.84	.51	.12	.00	21.98
2500.	0.	2500.	0.	0.	437.	0.	33.	7.	21.98
.16	.00	5.72	.00	.025	.025	.025	.000	10.98	13.94
.001190	100.	100.	100.	2	14	0	.00	92.12	106.06
0									
*SECNO 41.000									
41.00	6.33	17.45	15.25	.00	17.96	.51	.12	.00	22.12
2500.	0.	2500.	0.	0.	435.	0.	34.	7.	22.12
.16	.00	5.75	.00	.025	.025	.025	.000	11.12	14.01
.001208	100.	100.	100.	2	14	0	.00	91.98	105.99
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 42.000
42.00 6.31 17.57 15.39 .00 18.09 .52 .12 .00 22.26
2500. 0. 2500. 0. 0. 433. 0. 35. 7. 22.26
.17 .00 5.77 .00 .025 .025 .025 .000 11.26 14.08
.001224 100. 100. 100. 2 14 0 .00 91.85 105.92
0
*SECNO 43.000
43.00 6.30 17.59 15.42 .00 18.11 .52 .02 .00 22.29
2500. 0. 2500. 0. 0. 433. 0. 35. 7. 22.29
.17 .00 5.77 .00 .025 .025 .025 .000 11.29 14.08
.001224 20. 20. 20. 0 14 0 .00 91.85 105.92
0
*SECNO 44.000
44.00 6.45 17.75 15.60 .00 18.16 .40 .04 .01 22.30
2500. 0. 2500. 0. 0. 491. 0. 36. 7. 22.30
.17 .00 5.09 .00 .025 .025 .025 .000 11.30 45.47
.001148 30. 30. 30. 2 19 0 .00 120.89 166.36
0
*SECNO 45.000
45.00 6.57 17.90 15.75 .00 18.22 .32 .05 .01 22.33
2500. 0. 2500. 0. 0. 554. 0. 36. 7. 22.33
.17 .00 4.52 .00 .025 .025 .025 .000 11.33 44.26
.001031 50. 50. 50. 2 19 0 .00 151.48 195.74
0
*SECNO 46.000
46.00 6.48 17.95 15.77 .00 18.35 .40 .11 .02 22.47
2500. 0. 2500. 0. 0. 495. 0. 37. 8. 22.47
.18 .00 5.05 .00 .025 .025 .025 .000 11.47 13.54
.001123 100. 100. 100. 2 14 0 .00 121.31 134.85
0
*SECNO 47.000
47.00 6.39 17.99 15.72 .00 18.49 .50 .10 .03 22.60
2500. 0. 2500. 0. 0. 440. 0. 38. 8. 22.60
.18 .00 5.68 .00 .025 .025 .025 .000 11.60 13.84
.001164 90. 90. 90. 2 14 0 .00 92.33 106.17
0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 48.000									
48.00	6.39	18.00	15.74	.00	18.50	.50	.01	.00	22.61
2500.	0.	2500.	0.	0.	440.	0.	38.	8.	22.61
.19	.00	5.68	.00	.025	.025	.025	.000	11.61	13.84
.001165	10.	10.	10.	0	14	0	.00	92.33	106.17
0									
*SECNO 49.000									
49.00	6.36	18.11	15.88	.00	18.62	.51	.12	.00	22.75
2500.	0.	2500.	0.	0.	438.	0.	39.	8.	22.75
.19	.00	5.71	.00	.025	.025	.025	.000	11.75	13.93
.001186	100.	100.	100.	2	14	0	.00	92.15	106.08
0									
*SECNO 50.000									
50.00	6.34	18.23	16.02	.00	18.74	.51	.12	.00	22.89
2500.	0.	2500.	0.	0.	436.	0.	40.	8.	22.89
.19	.00	5.74	.00	.025	.025	.025	.000	11.89	14.00
.001203	100.	100.	100.	2	14	0	.00	92.01	106.01
0									
*SECNO 51.000									
51.00	6.31	18.34	16.16	.00	18.86	.52	.12	.00	23.03
2500.	0.	2500.	0.	0.	433.	0.	41.	9.	23.03
.20	.00	5.77	.00	.025	.025	.025	.000	12.03	14.07
.001220	100.	100.	100.	2	14	0	.00	91.87	105.94
0									
*SECNO 52.000									

1645 INT SEC ADDED BY RAISING SEC 52.00, -.148FT AND MULTIPLYING BY 1.287

3265 DIVIDED FLOW

1.01	6.18	18.28	15.81	.00	18.95	.67	.04	.04	22.10
2500.	0.	2500.	0.	0.	382.	0.	42.	9.	22.11
.20	.00	6.55	.00	.030	.030	.030	.000	12.10	.00
.002415	27.	27.	27.	2	11	0	.00	61.79	64.36
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1645 INT SEC ADDED BY RAISING SEC 1.01, .074FT AND MULTIPLYING BY .888

3265 DIVIDED FLOW

1.02	6.03	18.21	16.17	.00	19.09	.89	.08	.07	22.18
2500.	0.	2500.	0.	0.	331.	0.	42.	9.	22.18
.20	.00	7.56	.00	.030	.030	.030	.000	12.18	.00
.003449	27.	27.	27.	2	14	0	.00	54.89	57.18

0

1645 INT SEC ADDED BY RAISING SEC 1.02, .074FT AND MULTIPLYING BY .874

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

52.00	5.81	18.07	16.63	.00	19.31	1.25	.11	.11	22.25
2500.	0.	2500.	0.	0.	279.	0.	42.	9.	22.25
.20	.00	8.96	.00	.030	.030	.030	.000	12.25	.00
.005295	27.	27.	27.	2	15	0	.00	48.00	50.00

0

*SECNO 53.000

3265 DIVIDED FLOW

53.00	6.07	18.38	16.68	.00	19.52	1.14	.20	.01	22.31
2500.	0.	2500.	0.	0.	292.	0.	42.	9.	22.31
.20	.00	8.57	.00	.030	.030	.030	.000	12.31	.00
.004667	40.	40.	40.	2	15	0	.00	48.00	50.00

0

PROFILE FOR STREAM GOLF COURSE CHANNEL

PLOTTED POINTS (BY PRIORITY)-E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION SECNO	6. CUMDIS	8.	10.	12.	14.	16.	18.	20.	22.	24.
1.00	0.	I		W	E		L			
2.00	10.	I		C W	E		L			
3.00	20.	I		C	W E		L			
	30.	I		C	W E		L			
	40.	I		C	W E		L			
4.00	50.	I		C	W E		L			
	60.	I		C	W E		L			
	70.	I		C	W E		L			
	80.	I		C	W E		L			
	90.	I		C	W E		L			
	100.	I		C	W E		L			
	110.	I		C	W E		L			
	120.	I		C	W E		L			
	130.	I		C	W E		L			
	140.	I		C	W E		L			
5.00	150.	I		C	W E		L			
	160.	I		C	W E		L			
	170.	I		C	W E		L			
	180.	I		C	W E		L			
	190.	I		C	W E		L			
	200.	I		C	W E		L			
	210.	I		C	W E		L			
	220.	I		C	W E		L			
	230.	I		C	W E		L			
	240.	I		C	W E		L			
6.00	250.	I		C	W E		L			
	260.	I		C	W E		L			
	270.	I		C	W E		L			
	280.	I		C	W E		L			
	290.	I		C	W E		L			
	300.	I		C	W E		L			
	310.	I		C	W E		L			
	320.	I		C	W E		L			
	330.	I		C	W E		L			
	340.	I		C	W E		L			
7.00	350.	I		C	W E		L			
	360.	I		C	W E		L			
	370.	I		C	W E		L			
	380.	I		C	W E		L			
	390.	I		C	W E		L			
	400.	I		C	W E		L			
	410.	I		C	W E		L			
	420.	I		C	W E		L			
	430.	I		C	W E		L			
	440.	I		C	W E		L			
8.00	450.	I		C	W E		L			
	460.	I		C	W E		L			
	470.	I		C	W E		L			
	480.	I		C	W E		L			

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        2290.  .  .  I.  .  C.  . W E  .  .  L  .  .  .
        2300.  .  .  I.  .  C.  . W E  .  .  L  .  .  .
        2310.  .  .  I.  .  C.  . W  E .  .  L  .  .  .
        2320.  .  .  I.  .  C.  . W  E .  .  L  .  .  .
        2330.  .  .  I.  .  C   . W  E .  .  L  .  .  .
        2340.  .  .  I.  .  C   . W  E .  .  L  .  .  .
31.00   2350.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2360.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2370.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2380.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2390.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2400.  .  .  I.  .  C   .  W E .  .  L  .  .  .
        2410.  .  .  I   .  C   .  W E .  .  L  .  .  .
        2420.  .  .  I   .  C   .  W E .  .  L  .  .  .
        2430.  .  .  I   .  C   .  W E .  .  L  .  .  .
        2440.  .  .  I   .  C   .  W E .  .  L  .  .  .
32.00   2450.  .  .  I   .  C   .  W E .  .  L  .  .  .
        2460.  .  .  I   .  C   .  W E .  .  L  .  .  .
        2470.  .  .  I   .  .C  .  W E .  .  L  .  .  .
        2480.  .  .  I   .  .C  .  W E .  .  L  .  .  .
        2490.  .  .  I   .  .C  .  W E .  .  L  .  .  .
        2500.  .  .  I   .  .C  .  W E .  .  L  .  .  .
        2510.  .  .  I   .  .C  .  W  E .  .  L  .  .  .
        2520.  .  .  I   .  .C  .  W  E .  .  L  .  .  .
        2530.  .  .  I   .  .C  .  W  E .  .  L  .  .  .
        2540.  .  .  I   .  .C  .  W  E .  .  L  .  .  .
33.00   2550.  .  .  .I  .  .C  .  W  E .  .  L  .  .  .
        2560.  .  .  .I  .  .C  .  W  E .  .  L  .  .  .
        2570.  .  .  .I  .  .C  .  W E  .  .  L  .  .  .
        2580.  .  .  .I  .  .C  .  W E  .  .  L  .  .  .
        2590.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
34.00   2600.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2610.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2620.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2630.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2640.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
35.00   2650.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2660.  .  .  .I  .  . C .  W E  .  .  L  .  .  .
        2670.  .  .  . I .  . C .  W E  .  .  L  .  .  .
        2680.  .  .  . I .  . C .  W E  .  .  L  .  .  .
        2690.  .  .  . I .  . C .  W  E .  .  L  .  .  .
        2700.  .  .  . I .  . C .  W  E .  .  L  .  .  .
        2710.  .  .  . I .  . C .  W  E .  .  L  .  .  .
        2720.  .  .  . I .  .  C .  W  E .  .  L  .  .  .
        2730.  .  .  . I .  .  C .  W  E .  .  L  .  .  .
        2740.  .  .  . I .  .  C .  W  E .  .  L  .  .  .
36.00   2750.  .  .  . I .  .  C .  W  E .  .  L  .  .  .
        2760.  .  .  . I .  .  C .  W E  .  .  L  .  .  .
        2770.  .  .  . I .  .  C .  W E  .  .  L  .  .  .
        2780.  .  .  . I .  .  C .  W E  .  .  L  .  .  .
        2790.  .  .  . I .  .  C .  W E  .  .  L  .  .  .
        2800.  .  .  . I .  .  C .  W E  .  .  L  .  .  .
        2810.  .  .  .  I .  .  C .  W E  .  .  L  .  .  .
        2820.  .  .  .  I .  .  C .  W E  .  .  L  .  .  .
        2830.  .  .  .  I .  .  C .  W E  .  .  L  .  .  .
        2840.  .  .  .  I .  .  C .  W E  .  .  L  .  .  .
37.00   2850.  .  .  .  I .  .  C .  W E  .  .  L  .  .  .
        2860.  .  .  .  I .  .  C .  W  E .  .  L  .  .  .
        2870.  .  .  .  I .  .  C .  W  E .  .  L  .  .  .
        2880.  .  .  .  I .  .  C .  W  E .  .  L  .  .  .
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        2890.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
        2900.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
        2910.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
        2920.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
        2930.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
        2940.  .  .  .  I  .  .  C  .  W  E  .  .  L  .  .  .
38.00   2950.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        2960.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        2970.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        2980.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        2990.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        3000.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        3010.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        3020.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        3030.  .  .  .  I  .  .  C  .  W E  .  .  L.  .  .  .
        3040.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
39.00   3050.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
        3060.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
        3070.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
        3080.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
        3090.  .  .  .  I  .  .  C  .  W  E.  .  L.  .  .  .
        3100.  .  .  .  I  .  .  C  .  W  E.  .  L  .  .  .
        3110.  .  .  .  I  .  .  C  .  W  E.  .  L  .  .  .
        3120.  .  .  .  I  .  .  C  .  W  E.  .  L  .  .  .
        3130.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3140.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
40.00   3150.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3160.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3170.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3180.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3190.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3200.  .  .  .  I  .  .  C  .  W E.  .  L  .  .  .
        3210.  .  .  .  I  .  .  C  .  W  E  .  L  .  .  .
        3220.  .  .  .  I  .  .  C  .  W  E  .  L  .  .  .
        3230.  .  .  .  I  .  .  C  .  W  E  .  L  .  .  .
        3240.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
41.00   3250.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
        3260.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
        3270.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
        3280.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
        3290.  .  .  .  I  .  .  C  .  W  E  .  .L  .  .  .
        3300.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
        3310.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
        3320.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
        3330.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
        3340.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
42.00   3350.  .  .  .  I  .  .  C  .  W E  .  .L  .  .  .
        3360.  .  .  .  I  .  .  C  .  W .E  .  .L  .  .  .
43.00   3370.  .  .  .  I  .  .  C  .  W .E  .  .L  .  .  .
        3380.  .  .  .  I  .  .  C  .  W .E  .  .L  .  .  .
        3390.  .  .  .  I  .  .  C .  W.E  .  .L  .  .  .
44.00   3400.  .  .  .  I  .  .  C .  W.E  .  .L  .  .  .
        3410.  .  .  .  I  .  .  C .  W.E  .  . L  .  .  .
        3420.  .  .  .  I  .  .  C .  W.E  .  . L  .  .  .
        3430.  .  .  .  I  .  .  C .  W.E  .  . L  .  .  .
        3440.  .  .  .  I  .  .  C.  W.E  .  . L  .  .  .
45.00   3450.  .  .  .  I  .  .  C.  W.E  .  . L  .  .  .
        3460.  .  .  .  I  .  .  C.  WE  .  . L  .  .  .
        3470.  .  .  .  I  .  .  C.  WE  .  . L  .  .  .
        3480.  .  .  .  I  .  .  C.  WE  .  . L  .  .  .
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        3490.  .  .  .  I  .  .  C.   WE   .  .  L  .  .
        3500.  .  .  .  I  .  .  C.   WE   .  .  L  .  .
        3510.  .  .  .  I  .  .  C.   WE   .  .  L  .  .
        3520.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3530.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3540.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
46.00   3550.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3560.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3570.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3580.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3590.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3600.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3610.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3620.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
        3630.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
47.00   3640.  .  .  .  I  .  .  C.   W E  .  .  L  .  .
48.00   3650.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3660.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3670.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3680.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3690.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3700.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3710.  .  .  .  I  .  .  C.   W  E  .  .  L  .  .
        3720.  .  .  .  I. .  .  C.   W  E  .  .  L  .  .
        3730.  .  .  .  I. .  .  C.   W  E  .  .  L  .  .
        3740.  .  .  .  I. .  .  C.   W  E  .  .  L  .  .
49.00   3750.  .  .  .  I. .  .  C.   .W E  .  .  L  .  .
        3760.  .  .  .  I. .  .  C.   .W E  .  .  L  .  .
        3770.  .  .  .  I. .  .  C    .W E  .  .  L  .  .
        3780.  .  .  .  I. .  .  C    .W E  .  .  L  .  .
        3790.  .  .  .  I. .  .  C    .W E  .  .  L  .  .
        3800.  .  .  .  I. .  .  C    .W E  .  .  L  .  .
        3810.  .  .  .  I. .  .  C    .W E  .  .  L  .  .
        3820.  .  .  .  I. .  .  C    .W  E  .  .  L  .  .
        3830.  .  .  .  I. .  .  C    .W  E  .  .  L  .  .
        3840.  .  .  .  I. .  .  C    .W  E  .  .  L  .  .
50.00   3850.  .  .  .  I. .  .  C    .W  E  .  .  L  .  .
        3860.  .  .  .  I  .  .  C    .W  E  .  .  L  .  .
        3870.  .  .  .  I  .  .  C    .W  E  .  .  L  .  .
        3880.  .  .  .  I  .  .  C    .W  E  .  .  L  .  .
        3890.  .  .  .  I  .  .  C    .W  E  .  .  L  .  .
        3900.  .  .  .  I  .  .  C    .W  E  .  .  L  .  .
        3910.  .  .  .  I  .  .  .C   .W  E  .  .  L  .  .
        3920.  .  .  .  I  .  .  .C   . W E  .  .  L  .  .
        3930.  .  .  .  I  .  .  .C   . W E  .  .  L  .  .
        3940.  .  .  .  I  .  .  .C   . W E  .  .  L  .  .
51.00   3950.  .  .  .  I  .  .  .C   . W E  .  .  L  .  .
        3960.  .  .  .  I  .  .  C    . W E  .  .  L  .  .
        3970.  .  .  .  I  .  .  C.   .W  E  .  .  L  .  .
 1.01   3980.  .  .  .  .I .  .  C.   .W  E  .  .  .L .  .
        3990.  .  .  .  .I .  .  C    .W  E  .  .  .L .  .
        4000.  .  .  .  .I .  .  C    .W  E  .  .  .L .  .
 1.02   4010.  .  .  .  .I .  .  .C   .W  E  .  .  .L .  .
        4020.  .  .  .  .I .  .  . C  .W  E  .  .  .L .  .
52.00   4030.  .  .  .  .I .  .  . C  W   E  .  .  .L .  .
        4040.  .  .  .  .I .  .  . C  .W  E  .  .  .L .  .
        4050.  .  .  .  .I .  .  . C  .W  E  .  .  .L .  .
        4060.  .  .  .  .I .  .  . C  . W  E  .  .  .L .  .
53.00   4070.  .  .  .  . I .  .  . C  . W  E  .  .  . L .  .
```

THIS RUN EXECUTED 01-07-93

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************
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1**************************************************
*  WATER SURFACE PROFILES                        *
*  VERSION OF NOVEMBER 1976                      *
*  UPDATED MAY 1984                              *
*  IBM-PC-XT VERSION AUGUST 1985                 *
*  RUN DATE  05-04-93   TIME  13:18:56           *
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**************************************
*  U.S. ARMY CORPS OF ENGINEERS      *
*  THE HYDROLOGIC ENGINEERING CENTER *
*  609 SECOND STREET, SUITE D        *
*  DAVIS, CALIFORNIA 95616           *
*  (916) 440-2105 (FTS) 448-2105     *
**************************************
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X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
**************************************************

T1      CONFLUENCE DETENTION BASIN
T2      100-YEAR FLOW   SUBCRITICAL UPSTREAM FROM STA 16+00
T3      OUTFALL CHANNEL

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0.       0.        0.        0. -1.000000       .00       .3    1800.   103.000      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      .000      .000      .000      .000      .000      .000    -1.000      .000      .000      .000


NC      .013      .013      .013      .100      .300      .000      .000      .000      .000
X1     1.000    5.000      .000    52.000      .000      .000      .000      .000      .000
GR   104.600      .000    96.570    16.000    96.370    26.000    96.570    36.000   104.570

X1     2.000    5.000      .000    62.000    40.000    40.000    40.000      .000      .000
GR   104.800      .000    96.818    16.000    96.418    36.000    96.618    46.000   104.618

X1     3.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.800      .000    97.830    14.000    97.630    24.000    96.630    26.000    96.430
GR    96.630    46.000   104.630    62.000      .000      .000      .000      .000      .000

X1     4.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.800      .000    98.842    12.000    98.642    22.000    96.642    26.000    96.442
GR    96.640    46.000   104.642    62.000      .000      .000      .000      .000      .000

X1     5.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.900      .000    99.854    10.000    99.654    20.000    96.654    26.000    96.454
GR    96.650    46.000   104.654    62.000      .000      .000      .000      .000      .000

X1     6.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.900      .000   100.866     8.000   100.666    18.000    96.666    26.000    96.466
GR    96.670    46.000   104.666    62.000      .000      .000      .000      .000      .000

X1     7.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.900      .000   101.878     6.000   101.678    16.000    96.678    26.000    96.478
GR    96.680    46.000   104.678    62.000      .000      .000      .000      .000      .000

X1     8.000    7.000      .000    62.000    10.000    10.000    10.000      .000      .000
GR   104.900      .000   102.890     4.000   102.690    14.000    96.690    26.000    96.490
GR    96.690    46.000   104.690    62.000      .000      .000      .000      .000      .000
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GR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
X1	10.000	5.000	.000	52.000	10.000	10.000	10.000	.000	.000
GR	104.700	.000	96.714	16.000	96.514	26.000	96.714	36.000	104.714
X1	11.000	.000	.000	.000	80.000	80.000	80.000	.000	.096
X1	12.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	13.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	14.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	15.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	16.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	17.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	18.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	19.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	20.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	21.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
X1	22.000	.000	.000	.000	100.000	100.000	100.000	.000	.120
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000

SLOPE XLOBL XLCH XLOBR ITRIAL IOC ICONT CORAR TOPWID ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300

*SECNO 1.000

3720 CRITICAL DEPTH ASSUMED

1.00	5.38	101.75	101.75	103.00	103.74	1.99	.00	.00	104.60
1800.	0.	1800.	0.	0.	159.	0.	0.	0.	104.57
.00	.00	11.31	.00	.013	.013	.013	.000	96.37	5.68
.001717	0.	0.	0.	0	14	0	.00	40.68	46.36

0

*SECNO 2.000

3301 HV CHANGED MORE THAN HVINS

2.00	6.88	103.29	100.95	.00	103.90	.61	.03	.14	104.80
1800.	0.	1800.	0.	0.	288.	0.	0.	0.	104.62
.00	.00	6.25	.00	.013	.013	.013	.000	96.42	3.02
.000365	40.	40.	40.	4	15	0	.00	56.33	59.35

0

*SECNO 3.000

3.00	6.83	103.26	101.19	.00	103.92	.66	.00	.02	104.80
1800.	0.	1800.	0.	0.	276.	0.	0.	0.	104.63
.00	.00	6.53	.00	.013	.013	.013	.000	96.43	3.09
.000420	10.	10.	10.	2	19	0	.00	56.17	59.26

0

*SECNO 4.000

4.00	6.78	103.22	101.42	.00	103.95	.73	.00	.02	104.80
1800.	0.	1800.	0.	0.	263.	0.	0.	0.	104.64
.00	.00	6.84	.00	.013	.013	.013	.000	96.44	3.18
.000488	10.	10.	10.	2	19	0	.00	55.97	59.16

0

*SECNO 5.000

5.00	6.71	103.17	101.64	.00	103.97	.81	.01	.02	104.90
1800.	0.	1800.	0.	0.	250.	0.	0.	0.	104.65
.00	.00	7.20	.00	.013	.013	.013	.000	96.45	3.43
.000574	10.	10.	10.	2	15	0	.00	55.60	59.03

0

SLOPE	XLOBL	XLCH	XLOBR						
*SECNO 6.000									
6.00	6.64	103.11	101.86	.00	104.01	.90	.01	.03	104.90
1800.	0.	1800.	0.	0.	236.	0.	0.	0.	104.67
.00	.00	7.62	.00	.013	.013	.013	.000	96.47	3.55
.000688	10.	10.	10.	2	15	0	.00	55.33	58.88
0									
*SECNO 7.000									
7.00	6.55	103.03	102.08	.00	104.05	1.02	.01	.04	104.90
1800.	0.	1800.	0.	0.	222.	0.	0.	0.	104.68
.00	.00	8.12	.00	.013	.013	.013	.000	96.48	3.71
.000842	10.	10.	10.	2	15	0	.00	55.00	58.71
0									
*SECNO 8.000									
8.00	6.43	102.92	101.87	.00	104.11	1.19	.01	.05	104.90
1800.	0.	1800.	0.	0.	206.	0.	1.	0.	104.69
.00	.00	8.75	.00	.013	.013	.013	.000	96.49	3.93
.001068	10.	10.	10.	2	11	0	.00	54.54	58.47
0									
*SECNO 9.000									
9.00	6.42	102.92	101.88	.00	104.13	1.21	.01	.01	104.90
1800.	0.	1800.	0.	0.	204.	0.	1.	0.	104.70
.00	.00	8.82	.00	.013	.013	.013	.000	96.50	13.54
.000860	10.	10.	10.	1	15	0	.00	44.91	58.46
0									
*SECNO 10.000									
10.00	6.41	102.93	101.89	.00	104.14	1.21	.01	.00	104.70
1800.	0.	1800.	0.	0.	204.	0.	1.	0.	104.71
.00	.00	8.83	.00	.013	.013	.013	.000	96.51	3.54
.000865	10.	10.	10.	0	15	0	.00	44.90	48.44
0									
*SECNO 11.000									
11.00	6.37	102.98	101.99	.00	104.22	1.24	.07	.01	104.80
1800.	0.	1800.	0.	0.	201.	0.	1.	0.	104.81
.01	.00	8.93	.00	.013	.013	.013	.000	96.61	3.64
.000892	80.	80.	80.	2	15	0	.00	44.69	48.33
0									

SLOPE	XLOBL	XLCH	XLOBR	TITAL	TOC	TCONT	COKAK	TOPWID	ENDST
*SECNO 12.000									
12.00	6.32	103.05	102.11	.00	104.31	1.27	.09	.01	104.92
1800.	0.	1800.	0.	0.	199.	0.	1.	0.	104.93
.01	.00	9.03	.00	.013	.013	.013	.000	96.73	3.74
.000919	100.	100.	100.	2	15	0	.00	44.50	48.24
0									
*SECNO 13.000									
13.00	6.27	103.12	102.23	.00	104.42	1.29	.09	.01	105.04
1800.	0.	1800.	0.	0.	197.	0.	2.	0.	105.05
.01	.00	9.12	.00	.013	.013	.013	.000	96.85	3.83
.000945	100.	100.	100.	2	15	0	.00	44.32	48.15
0									
*SECNO 14.000									
14.00	6.23	103.20	102.37	.00	104.52	1.32	.10	.01	105.16
1800.	0.	1800.	0.	0.	196.	0.	2.	1.	105.17
.02	.00	9.21	.00	.013	.013	.013	.000	96.97	3.91
.000970	100.	100.	100.	2	11	0	.00	44.15	48.07
0									
*SECNO 15.000									
15.00	6.19	103.28	102.48	.00	104.62	1.34	.10	.01	105.28
1800.	0.	1800.	0.	0.	194.	0.	3.	1.	105.29
.02	.00	9.29	.00	.013	.013	.013	.000	97.09	3.99
.000993	100.	100.	100.	2	11	0	.00	44.00	47.99
0									
*SECNO 16.000									
16.00	6.16	103.37	102.60	.00	104.73	1.36	.10	.01	105.40
1800.	0.	1800.	0.	0.	192.	0.	3.	1.	105.41
.02	.00	9.36	.00	.013	.013	.013	.000	97.21	4.06
.001015	100.	100.	100.	2	11	0	.00	43.86	47.92
0									
*SECNO 17.000									
17.00	6.13	103.46	102.72	.00	104.84	1.38	.10	.01	105.52
1800.	0.	1800.	0.	0.	191.	0.	4.	1.	105.53
.03	.00	9.43	.00	.013	.013	.013	.000	97.33	4.12
.001035	100.	100.	100.	2	11	0	.00	43.74	47.86
0									

SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	EINDEX
*SECNO 18.000									
18.00	6.10	103.55	102.83	.00	104.95	1.40	.10	.01	105.64
1800.	0.	1800.	0.	0.	190.	0.	4.	1.	105.65
.03	.00	9.49	.00	.013	.013	.013	.000	97.45	4.18
.001054	100.	100.	100.	2	11	0	.00	43.62	47.80
0									
*SECNO 19.000									
19.00	6.08	103.65	102.95	.00	105.06	1.41	.11	.00	105.76
1800.	0.	1800.	0.	0.	189.	0.	5.	1.	105.77
.03	.00	9.54	.00	.013	.013	.013	.000	97.57	4.23
.001071	100.	100.	100.	2	11	0	.00	43.52	47.75
0									
*SECNO 20.000									
20.00	6.06	103.75	103.07	.00	105.17	1.42	.11	.00	105.88
1800.	0.	1800.	0.	0.	188.	0.	5.	1.	105.89
.03	.00	9.56	.00	.013	.013	.013	.000	97.69	4.24
.001075	100.	100.	100.	1	11	0	.00	43.50	47.74
0									
*SECNO 21.000									
21.00	6.03	103.84	103.19	.00	105.28	1.44	.11	.01	106.00
1800.	0.	1800.	0.	0.	187.	0.	5.	1.	106.01
.04	.00	9.64	.00	.013	.013	.013	.000	97.81	4.32
.001102	100.	100.	100.	2	11	0	.00	43.35	47.66
0									
*SECNO 22.000									
22.00	6.02	103.95	103.31	.00	105.39	1.44	.11	.00	106.12
1800.	0.	1800.	0.	0.	187.	0.	6.	1.	106.13
.04	.00	9.64	.00	.013	.013	.013	.000	97.93	4.32
.001102	100.	100.	100.	0	11	0	.00	43.35	47.66
0									

```
ELEVATION   96.      98.      100.     102.     104.     106.     108.     110.     112.     114.
  SECNO   CUMDIS

  1.00      0.  . I      .        .       W.       E.  L    .        .        .        .        .
            10.  . I      .        .      C .W      E.  L    .        .        .        .        .
            20.  . I      .        .      C  .  W   E.  L    .        .        .        .        .
            30.  . I      .        .      C  .   W  E.  RL   .        .        .        .        .
  2.00      40.  . I      .        .      C  .   W  E  RL    .        .        .        .        .
  3.00      50.  . I      .        .      C  .   W  E  RL    .        .        .        .        .
  4.00      60.  . I      .        .      C  .   W  E  RL    .        .        .        .        .
  5.00      70.  . I      .        .      C  .   W  E  R L   .        .        .        .        .
  6.00      80.  . I      .        .      C.     W  E  R L   .        .        .        .        .
  7.00      90.  . I      .        .      C      W  E  R L   .        .        .        .        .
  8.00     100.  . I      .        .      C.     W  .E R L   .        .        .        .        .
  9.00     110.  .  I     .        .      C.     W  .E R L   .        .        .        .        .
 10.00     120.  .  I     .        .      C.     W  .E LR    .        .        .        .        .
           130.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           140.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           150.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           160.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           170.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           180.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           190.  .  I     .        .       C     W  .E  L    .        .        .        .        .
 11.00     200.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           210.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           220.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           230.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           240.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           250.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           260.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           270.  .  I     .        .       C     W  .E  L    .        .        .        .        .
           280.  .   I    .        .       C     W  .E  LR   .        .        .        .        .
           290.  .   I    .        .       C     W  . E  L   .        .        .        .        .
 12.00     300.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           310.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           320.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           330.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           340.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           350.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           360.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           370.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           380.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           390.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
 13.00     400.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           410.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           420.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           430.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           440.  .   I    .        .      .C     W  . E  L   .        .        .        .        .
           450.  .    I   .        .      . C    W  . E   L  .        .        .        .        .
           460.  .    I   .        .      . C    W  . E   L  .        .        .        .        .
           470.  .    I   .        .      . C    W  . E   L  .        .        .        .        .
           480.  .    I   .        .      . C    W  .  E  L  .        .        .        .        .
```

| | | |

	1160.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1170.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1180.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1190.	.	I.	.	.	C	W.	E	L	.	.	.	.
21.00	1200.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1210.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1220.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1230.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1240.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1250.	.	I.	.	.	C	W.	E	L	.	.	.	.
	1260.	.	I.	.	.	C	W	E	L	.	.	.	.
	1270.	.	I.	.	.	C	W	E	L	.	.	.	.
	1280.	.	I	.	.	C	W	E	LR	.	.	.	.
	1290.	.	I	.	.	C	W	E	.L	.	.	.	.
22.00	1300.	.	I	.	.	C	W	E	.L	.	.	.	.

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984

ERROR CORR - 01,02,03,04,05,06

MODIFICATION - 50,51,52,53,54,55,56

IBM-PC-XT VERSION AUGUST 1985

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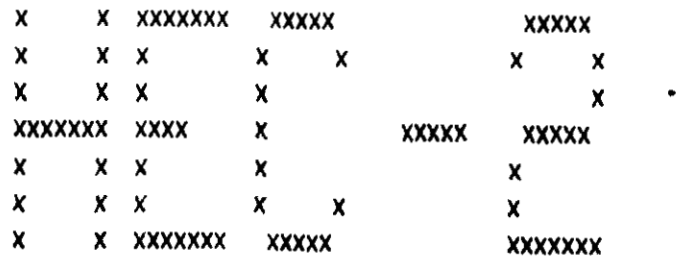

THIS RUN EXECUTED 05-05-93

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  HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55,56
  IBM-PC-XT VERSION AUGUST 1985
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T1 CONFLUENCE DETENTION BASIN
T2 100-YEAR FLOW SUPERCRITICAL DOWNSTREAM FROM STA 16+00
T3 OUTFALL CHANNEL

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	0.	0.	1.	-1.000000	.00	.3	1800.	103.000	.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	.000	.000	.000	.000	.000	.000	-1.000	.000	.000	.000

NC	.013	.013	.013	.010	.030	.000	.000	.000	.000	.000
	1.000	5.000	.000	60.000	5.000	5.000	5.000	.000	.000	.000
GR	106.600	.000	96.570	20.000	96.370	30.000	96.570	40.000	106.570	60.000
X1	2.000	.000	.000	.000	20.000	20.000	20.000	.000	-.011	.000
X1	3.000	.000	.000	.000	25.000	25.000	25.000	.000	-.044	.000
X1	4.000	.000	.000	.000	50.000	50.000	50.000	.000	-.055	.000
X1	5.000	.000	.000	.000	50.000	50.000	50.000	.000	-.110	.000
X1	6.000	.000	.000	.000	50.000	50.000	50.000	.000	-.110	.000
X1	7.000	.000	.000	.000	100.000	100.000	100.000	.000	-.110	.000
X1	8.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
X1	9.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
X1	10.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
X1	11.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
X1	12.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
	13.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000

X1	14.000	.000	.000	.000	100.000	100.000	100.000	.000	-.220	.000
X1	15.000	.000	.000	.000	25.000	25.000	25.000	.000	-.220	.000
X1	16.000	.000	.000	.000	25.000	25.000	25.000	.000	-.100	.000
X1	17.000	.000	.000	.000	25.000	25.000	25.000	.000	-.100	.000
X1	18.000	.000	.000	.000	25.000	25.000	25.000	.000	-.100	.000
X1	19.000	.000	.000	.000	25.000	25.000	25.000	.000	-.100	.000
X1	20.000	.000	.000	.000	25.000	25.000	25.000	.000	-.100	.000
X1	21.000	.000	.000	.000	75.000	75.000	75.000	.000	-.100	.000
X1	22.000	4.000	.000	54.000	200.000	200.000	200.000	.000	.000	.000
GR	103.200	.000	93.200	20.000	93.200	54.000	103.200	54.000	.000	.000
X1	23.000	4.000	.000	48.000	.000	.000	.000	.000	.000	.000
GR	102.300	.000	92.250	20.000	92.250	48.000	102.300	48.000	.000	.000
EJ	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .010 CEHV= .030
*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED

1.00	5.38	101.75	101.75	103.00	103.74	1.99	.00	.00	106.60
1800.	0.	1800.	0.	0.	159.	0.	0.	0.	106.57
.00	.00	11.31	.00	.013	.013	.013	.000	96.37	9.67
.001717	0.	0.	0.	0	14	0	.00	40.69	50.36

0
*SECNO 2.000

2.00	5.38	101.74	101.75	.00	103.73	1.99	.01	.00	106.59
1800.	0.	1800.	0.	0.	159.	0.	0.	0.	106.56
.00	.00	11.31	.00	.013	.013	.013	.000	96.36	9.67
.001717	5.	5.	5.	0	5	0	.00	40.69	50.36

0
*SECNO 3.000

3.00	5.34	101.66	101.70	.00	103.69	2.03	.03	.00	106.54
1800.	0.	1800.	0.	0.	157.	0.	0.	0.	106.51
.00	.00	11.45	.00	.013	.013	.013	.000	96.32	9.77
.001775	20.	20.	20.	1	5	0	.00	40.50	50.27

0
*SECNO 4.000

4.00	5.12	101.38	101.65	.00	103.64	2.26	.05	.00	106.49
1800.	0.	1800.	0.	0.	149.	0.	0.	0.	106.46
.00	.00	12.06	.00	.013	.013	.013	.000	96.26	10.16
.002054	25.	25.	25.	5	5	0	.00	39.70	49.87

0
*SECNO 5.000

5.00	5.12	101.27	101.53	.00	103.54	2.27	.10	.00	106.38
1800.	0.	1800.	0.	0.	149.	0.	0.	0.	106.35
.00	.00	12.09	.00	.013	.013	.013	.000	96.15	10.18
.002069	50.	50.	50.	0	8	0	.00	39.67	49.85

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 6.000

6.00	5.12	101.16	101.42	.00	103.43	2.28	.10	.00	106.27
1800.	0.	1800.	0.	0.	149.	0.	1.	0.	106.24
.00	.00	12.11	.00	.013	.013	.013	.000	96.04	10.19
.002077	50.	50.	50.	0	8	0	.00	39.65	49.84

0

*SECNO 7.000

7.00	5.13	101.06	101.31	.00	103.33	2.27	.10	.00	106.16
1800.	0.	1800.	0.	0.	149.	0.	1.	0.	106.13
.00	.00	12.10	.00	.013	.013	.013	.000	95.93	10.19
.002076	50.	50.	50.	0	8	0	.00	39.65	49.84

0

*SECNO 8.000

8.00	5.03	100.74	101.09	.00	103.12	2.37	.21	.00	105.94
1800.	0.	1800.	0.	0.	146.	0.	1.	0.	105.91
.01	.00	12.36	.00	.013	.013	.013	.000	95.71	10.35
.002202	100.	100.	100.	2	8	0	.00	39.33	49.68

0

*SECNO 9.000

9.00	5.06	100.55	100.87	.00	102.90	2.35	.22	.00	105.72
1800.	0.	1800.	0.	0.	146.	0.	1.	0.	105.69
.01	.00	12.30	.00	.013	.013	.013	.000	95.49	10.31
.002169	100.	100.	100.	2	8	0	.00	39.41	49.72

0

*SECNO 10.000

10.00	5.06	100.33	100.65	.00	102.68	2.35	.22	.00	105.50
1800.	0.	1800.	0.	0.	146.	0.	2.	0.	105.47
.01	.00	12.30	.00	.013	.013	.013	.000	95.27	10.31
.002172	100.	100.	100.	0	8	0	.00	39.41	49.72

0

*SECNO 11.000

11.00	5.06	100.11	100.43	.00	102.46	2.35	.22	.00	105.28
1800.	0.	1800.	0.	0.	146.	0.	2.	1.	105.25
.01	.00	12.30	.00	.013	.013	.013	.000	95.05	10.31
.002170	100.	100.	100.	0	8	0	.00	39.41	49.72

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 12.000									
12.00	5.07	99.90	100.21	.00	102.25	2.34	.22	.00	105.06
1800.	0.	1800.	0.	0.	147.	0.	2.	1.	105.03
.02	.00	12.28	.00	.013	.013	.013	.000	94.83	10.30
.002163	100.	100.	100.	0	8	0	.00	39.43	49.73
0									
*SECNO 13.000									
13.00	5.02	99.63	99.99	.00	102.03	2.40	.22	.00	104.84
1800.	0.	1800.	0.	0.	145.	0.	3.	1.	104.81
.02	.00	12.42	.00	.013	.013	.013	.000	94.61	10.38
.002234	100.	100.	100.	2	8	0	.00	39.26	49.64
0									
*SECNO 14.000									
14.00	5.01	99.40	99.77	.00	101.80	2.40	.22	.00	104.62
1800.	0.	1800.	0.	0.	145.	0.	3.	1.	104.59
.02	.00	12.44	.00	.013	.013	.013	.000	94.39	10.39
.002240	100.	100.	100.	0	8	0	.00	39.25	49.64
0									
*SECNO 15.000									
15.00	5.05	99.22	99.55	.00	101.58	2.36	.22	.00	104.40
1800.	0.	1800.	0.	0.	146.	0.	3.	1.	104.37
.02	.00	12.34	.00	.013	.013	.013	.000	94.17	10.33
.002190	100.	100.	100.	2	8	0	.00	39.36	49.70
0									
*SECNO 16.000									
16.00	4.94	99.01	99.45	.00	101.52	2.51	.06	.00	104.30
1800.	0.	1800.	0.	0.	142.	0.	3.	1.	104.27
.02	.00	12.71	.00	.013	.013	.013	.000	94.07	10.55
.002378	25.	25.	25.	3	8	0	.00	38.93	49.48
0									
*SECNO 17.000									
17.00	4.85	98.82	99.35	.00	101.46	2.64	.06	.00	104.20
1800.	0.	1800.	0.	0.	138.	0.	4.	1.	104.17
.02	.00	13.03	.00	.013	.013	.013	.000	93.97	10.73
.002552	25.	25.	25.	3	8	0	.00	38.57	49.30
0									

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 18.000

18.00	4.78	98.65	99.26	.00	101.39	2.74	.07	.00	104.10
1800.	0.	1800.	0.	0.	136.	0.	4.	1.	104.07
.02	.00	13.28	.00	.013	.013	.013	.000	93.87	10.87
.002694	25.	25.	25.	3	8	0	.00	38.30	49.16

0

*SECNO 19.000

19.00	4.71	98.48	99.16	.00	101.32	2.84	.07	.00	104.00
1800.	0.	1800.	0.	0.	133.	0.	4.	1.	103.97
.02	.00	13.53	.00	.013	.013	.013	.000	93.77	11.00
.002839	25.	25.	25.	2	8	0	.00	38.03	49.03

0

*SECNO 20.000

20.00	4.68	98.35	99.07	.00	101.25	2.90	.07	.00	103.90
1800.	0.	1800.	0.	0.	132.	0.	4.	1.	103.87
.03	.00	13.66	.00	.013	.013	.013	.000	93.67	11.06
.002914	25.	25.	25.	2	8	0	.00	37.91	48.97

0

*SECNO 21.000

21.00	4.64	98.21	98.97	.00	101.17	2.97	.07	.00	103.80
1800.	0.	1800.	0.	0.	130.	0.	4.	1.	103.77
.03	.00	13.82	.00	.013	.013	.013	.000	93.57	11.14
.003013	25.	25.	25.	2	8	0	.00	37.74	48.88

0

*SECNO 22.000

1645 INT SEC ADDED BY RAISING SEC 22.00, .278FT AND MULTIPLYING BY .861

3301 HV CHANGED MORE THAN HVINS

1.01	3.39	96.86	98.13	.00	101.09	4.22	.07	.01	103.48
1800.	0.	1800.	0.	0.	109.	0.	4.	1.	103.48
.03	.00	16.49	.00	.013	.013	.013	.000	93.48	11.39
.005355	19.	19.	19.	5	5	0	.00	35.12	46.50

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

1645 INT SEC ADDED BY RAISING SEC 1.01, -.093FT AND MULTIPLYING BY 1.054

1.02	3.17	96.55	97.88	.00	100.98	4.43	.11	.00	103.39
1800.	0.	1800.	0.	0.	107.	0.	4.	1.	103.39
.03	.00	16.89	.00	.013	.013	.013	.000	93.39	12.41
.006018	19.	19.	19.	4	11	0	.00	36.59	49.00

0

1645 INT SEC ADDED BY RAISING SEC 1.02, -.093FT AND MULTIPLYING BY 1.051

1.03	2.97	96.26	97.66	.00	100.86	4.59	.12	.00	103.29
1800.	0.	1800.	0.	0.	105.	0.	4.	1.	103.29
.03	.00	17.20	.00	.013	.013	.013	.000	93.29	13.41
.006658	19.	19.	19.	4	11	0	.00	38.09	51.50

0

1645 INT SEC ADDED BY RAISING SEC 1.03, -.093FT AND MULTIPLYING BY 1.049

22.00	2.81	96.01	97.44	.00	100.73	4.72	.13	.00	103.20
1800.	0.	1800.	0.	0.	103.	0.	4.	1.	103.20
.03	.00	17.43	.00	.013	.013	.013	.000	93.20	14.39
.007253	19.	19.	19.	4	11	0	.00	39.61	54.00

0

*SECNO 23.000

1645 INT SEC ADDED BY RAISING SEC 23.00, .713FT AND MULTIPLYING BY 1.146

3301 HV CHANGED MORE THAN HVINS

1.01	3.01	95.97	97.31	.00	100.38	4.41	.34	.01	103.01
1800.	0.	1800.	0.	0.	107.	0.	4.	1.	103.01
.03	.00	16.85	.00	.013	.013	.013	.000	92.96	16.06
.006376	50.	50.	50.	4	14	0	.00	38.94	54.99

0

1645 INT SEC ADDED BY RAISING SEC 1.01, -.238FT AND MULTIPLYING BY .958

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	*XLOBL*	*XLCH*	*XLOBR*	*ITRIAL*	*IOC*	*ICONT*	*CORAR*	*TOPWID*	ENDST
1.02	3.22	95.95	97.21	.00	100.07	4.12	.30	.01	102.78
1800.	0.	1800.	0.	0.	110.	0.	4.	1.	102.78
.03	.00	16.30	.00	.013	.013	.013	.000	92.72	14.90
.005545	50.	50.	50.	4	11	0	.00	37.76	52.66

0

1645 INT SEC ADDED BY RAISING SEC 1.02, -.238FT AND MULTIPLYING BY .956

1.03	3.46	95.95	97.10	.00	99.81	3.86	.26	.01	102.54
1800.	0.	1800.	0.	0.	114.	0.	4.	1.	102.54
.03	.00	15.76	.00	.013	.013	.013	.000	92.49	13.74
.004825	50.	50.	50.	4	11	0	.00	36.59	50.33

0

1645 INT SEC ADDED BY RAISING SEC 1.03, -.238FT AND MULTIPLYING BY .954

23.00	3.73	95.98	96.99	.00	99.57	3.60	.22	.01	102.30
1800.	0.	1800.	0.	0.	118.	0.	5.	1.	102.30
.03	.00	15.22	.00	.013	.013	.013	.000	92.25	12.58
.004182	50.	50.	50.	4	11	0	.00	35.42	48.00

1

PROFILE FOR STREAM OUTFALL CHANNEL

PLOTTED POINTS (BY PRIORITY)-E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION SECNO	92. CUMDIS	94.	96.	98.	100.	102.	104.	106.	108.	110.
1.00	0.		. I			W.	E.	. L		
2.00	10.		. I			W.	E.	. L		
	20.		. I			WC.	E.	. L		
3.00	30.		. I			W .	E .	. L		
	40.		.I			W .	E .	. RL		
4.00	50.		.I			WC .	E .	. L		
	60.		.I			WC .	E .	. L		
	70.		.I			WC .	E .	. L		
	80.		.I			WC .	E .	. L		
	90.		.I			W C .	E .	. L		
5.00	100.		.I			W C .	E .	. L		
	110.		.I			W C .	E .	. L		
	120.		.I			WC .	E .	. L		
	130.		I			WC .	E .	.RL		
	140.		I			WC .	E .	.L		
6.00	150.		I			WC .	E .	.L		
	160.		I			WC .	E .	.L		
	170.		I			WC .	E .	.L		
	180.		I			W C .	E .	.L		
	190.		I			W C .	E .	.L		
7.00	200.		I			W C .	E .	.L		
	210.		I			WC .	E .	.L		
	220.		I.			WC .	E .	RL		
	230.		I.			WC .	E .	L		
	240.		I.			WC .	E .	L		
	250.		I.			WC .	E .	L		
	260.		I.			W C .	E .	L		
	270.		I.			W C .	E .	L		
	280.		I.			W C .	E .	L		
	290.		I.			W C .	E .	L		
8.00	300.		I.			WC .	E .	L		
	310.		I .			WC .	E .	RL		
	320.		I .			WC .	E .	L.		
	330.		I .			W C .	E .	L.		
	340.		I .			W C .	E .	L.		
	350.		I .			W C .	E .	L.		
	360.		I .			W C .	E .	L.		
	370.		I .			W C .	E .	L.		
	380.		I .			W C .	E .	L.		
	390.		I .			WC .	E .	L.		
9.00	400.		I .			WC .	E .	RL.		
	410.		I .			WC .	E .	L .		
	420.		I .			WC .	E .	L .		
	430.		I .			W C .	E .	L .		
	440.		I .			W C .	E .	L .		
	450.		I .			W C .	E .	L .		
	460.		I .			W C .	E .	L .		
	470.		I .			W C .	E .	L .		
	480.		I .			WC .	E .	L .		

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        1090.  .      I.      .       .  W  C  .     E  .      L      .  .  .  .
19.00   1100.  .      I.      .       .  W  C  .     E  .      L      .  .  .  .
        1110.  .      I.      .       .  W  C  .     E  .      L      .  .  .  .
        1120.  .     I .      .       .  W  C  .     E  .     RL      .  .  .  .
20.00   1130.  .     I .      .       .  W  C  .     E  .     RL      .  .  .  .
        1140.  .     I .      .       .W  C  .     E  .     L.      .  .  .  .
21.00   1150.  .     I .      .       .W  C  .     E  .     L.      .  .  .  .
        1160.  .     I .      .    W  .  C     .  E  .    L .      .  .  .  .
 1.01   1170.  .    I  .      .  W    .C      .  E  .    L  .      .  .  .  .
        1180.  .    I  .      .  W    C       .  E  .    L  .      .  .  .  .
 1.02   1190.  .    I  .      .  W    C.      .  E  .    L  .      .  .  .  .
        1200.  .    I  .      . W     C.      .  E  .    L  .      .  .  .  .
 1.03   1210.  .   I   .      .W     C .      .  E  .   L   .      .  .  .  .
        1220.  .   I   .      .W     C .      .  E  .   L   .      .  .  .  .
22.00   1230.  .   I   .      W      C .      .  E  .   L   .      .  .  .  .
        1240.  .   I   .      W      C .      . E   .   L   .      .  .  .  .
        1250.  .   I   .      W      C .      . E   .   L   .      .  .  .  .
        1260.  .  I    .      W      C .      . E   .  L    .      .  .  .  .
        1270.  .  I    .      W      C .      .E    .  L    .      .  .  .  .
 1.01   1280.  .  I    .      W      C .      .E    .  L    .      .  .  .  .
        1290.  .  I    .      W     C  .      .E    .  L    .      .  .  .  .
        1300.  .  I    .      W     C  .      .E    .  L    .      .  .  .  .
        1310.  .  I    .      W     C  .      .E    . L     .      .  .  .  .
        1320.  .  I    .      W     C  .      .E    . L     .      .  .  .  .
 1.02   1330.  .  I    .      W     C  .      E     . L     .      .  .  .  .
        1340.  . I     .      W     C  .      E     . L     .      .  .  .  .
        1350.  . I     .      W     C  .      E     .L      .      .  .  .  .
        1360.  . I     .      W     C  .      E     .L      .      .  .  .  .
        1370.  . I     .      W     C  .     E.     .L      .      .  .  .  .
 1.03   1380.  .I     .      W     C  .     E.     .L      .      .  .  .  .
        1390.  .I     .      W     C  .     E.     .L      .      .  .  .  .
        1400.  .I     .      W     C  .     E.     .L      .      .  .  .  .
        1410.  .I     .      W     C  .    E .     .L      .      .  .  .  .
        1420.  .I     .      W     C  .    E .     .L      .      .  .  .  .
23.00   1430.  .I     .      W     C  .    E .     .L      .      .  .  .  .
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THIS RUN EXECUTED 05-05-93

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
IBM-PC-XT VERSION AUGUST 1985
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DIVERSION STRUCTURE

HYDRAULIC CALCULATIONS

PROJECT: CONFLUENCE DETENTION BASIN
CALCULATE INITIAL DEPTHS AT DIVERSION WEIR

Q	B	q	CRIT. y	CRIT. V	CRIT. Vh	CRIT. H	AT WEIR U/S y
1,400	18	77.78	5.73	13.58	2.86	8.59	8.80
1,300	18	72.22	5.45	13.25	2.73	8.18	8.40
1,200	18	66.67	5.17	12.90	2.58	7.75	8.00
1,100	18	61.11	4.88	12.53	2.44	7.32	7.50
1,050	18	58.33	4.73	12.34	2.36	7.09	7.30
1,000	18	55.56	4.58	12.14	2.29	6.86	7.10
950	18	52.78	4.42	11.93	2.21	6.63	6.80
900	18	50.00	4.27	11.72	2.13	6.40	6.60
870	18	48.33	4.17	11.59	2.09	6.26	6.40
850	18	47.22	4.11	11.50	2.05	6.16	6.30
830	18	46.11	4.04	11.41	2.02	6.06	6.20
810	18	45.00	3.98	11.32	1.99	5.97	6.10

Project CONFLUENCE DET BASIN Description

Job No. LV-C07-250-07 SHEET /

By DWI Date Chkd.By Date

DIVERSION STRUCTURE

SPATIALLY VARIED FLOW WITH DECREASING DISCHARGE BY NUMERICAL INTEGRATION USING FOLLOWING EQUATION:

CHANGE IN DEPTH = MOMENTUM LOSS + ENERGY LOSS

$$\Delta y = dy_C = \frac{\alpha Q_1 (V_1 + V_2) \Delta V}{g (Q_1 + Q_2)} \left(1 - \frac{\Delta Q}{2Q_1}\right) + S_f \Delta x$$

"OPEN CHANNEL HYDRAULICS", CHOW EQU. (12-40)

OR

$$\Delta y = dy_C = dy_m + h_f$$

$$\Delta y = dy_T = HGL_2 - HGL_1$$

TRIAL & ERROR BALANCE $dy_C = dy_T$

SIMILAR INCREASING FLOW

$$\Delta y = \frac{\alpha Q_1 (V_1 + V_2)}{g (Q_1 + Q_2)} \left(\Delta V + \frac{V_2}{Q_1} \Delta Q\right) + S_f \Delta x$$

EQU. (12-38)

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	1400
ALPHA	1.3

U/S FLOW 3900 DIVERTED FLOW 2500

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	Y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyT
0		12.500	8.800	609.312	1,400.00	2.30	8.882	21.300	21.382	18.800	2.500	11.859						6.883	.000		
10	10	12.536	8.784	608.057	1,518.59	2.50	8.881	21.320	21.417	18.836	2.484	11.745	118.585	2,918.59	4.795	.200	.019	6.873	.000	.020	.020
20	10	12.572	8.769	606.880	1,636.03	2.70	8.882	21.341	21.454	18.872	2.469	11.639	117.449	3,154.62	5.193	.198	.021	6.864	.001	.021	.021
30	10	12.608	8.756	605.861	1,752.42	2.89	8.886	21.364	21.494	18.908	2.456	11.547	116.387	3,388.46	5.588	.197	.022	6.855	.001	.023	.023
40	10	12.644	8.744	604.920	1,867.89	3.09	8.892	21.388	21.536	18.944	2.444	11.462	115.469	3,620.31	5.980	.195	.024	6.848	.001	.024	.024
50	10	12.680	8.734	604.137	1,982.51	3.28	8.901	21.414	21.581	18.980	2.434	11.392	114.623	3,850.40	6.369	.194	.025	6.841	.001	.026	.026
60	10	12.716	8.725	603.432	2,096.43	3.47	8.912	21.441	21.628	19.016	2.425	11.329	113.921	4,078.95	6.756	.193	.026	6.836	.001	.027	.027
70	10	12.752	8.718	602.884	2,209.72	3.67	8.927	21.470	21.679	19.052	2.418	11.280	113.289	4,306.16	7.139	.191	.028	6.831	.001	.029	.029
80	10	12.788	8.712	602.414	2,322.52	3.86	8.943	21.500	21.731	19.088	2.412	11.238	112.799	4,532.24	7.521	.190	.029	6.827	.001	.030	.030
90	10	12.824	8.707	602.022	2,434.90	4.04	8.961	21.531	21.785	19.124	2.407	11.203	112.380	4,757.42	7.900	.189	.030	6.824	.001	.031	.031
100	10	12.860	8.704	601.788	2,546.93	4.23	8.982	21.564	21.842	19.160	2.404	11.182	112.030	4,981.83	8.277	.188	.031	6.822	.001	.033	.033
110	10	12.896	8.702	601.631	2,658.75	4.42	9.005	21.598	21.901	19.196	2.402	11.168	111.821	5,205.68	8.652	.187	.033	6.821	.002	.034	.034
120	10	12.932	8.702	601.631	2,770.43	4.60	9.031	21.634	21.963	19.232	2.402	11.168	111.681	5,429.19	9.024	.186	.034	6.821	.002	.035	.036
130	10	12.968	8.703	601.709	2,882.12	4.79	9.059	21.671	22.027	19.268	2.403	11.175	111.681	5,652.55	9.395	.185	.035	6.822	.002	.037	.037
140	10	13.004	8.705	601.866	2,993.87	4.97	9.089	21.709	22.093	19.304	2.405	11.189	111.751	5,875.98	9.764	.184	.036	6.823	.002	.038	.038
150	10	13.040	8.709	602.179	3,105.76	5.16	9.122	21.749	22.162	19.340	2.409	11.217	111.891	6,099.62	10.132	.183	.037	6.825	.002	.040	.040
160	10	13.076	8.714	602.570	3,217.93	5.34	9.157	21.790	22.233	19.376	2.414	11.252	112.170	6,323.68	10.498	.183	.039	6.829	.002	.041	.041
170	10	13.112	8.720	603.040	3,330.45	5.52	9.194	21.832	22.306	19.412	2.420	11.294	112.519	6,548.37	10.863	.182	.040	6.832	.002	.042	.042
180	10	13.148	8.728	603.667	3,443.39	5.70	9.233	21.876	22.381	19.448	2.428	11.350	112.939	6,773.83	11.227	.181	.041	6.837	.003	.044	.044
190	10	13.184	8.737	604.372	3,556.88	5.89	9.275	21.921	22.459	19.484	2.437	11.413	113.500	7,000.27	11.589	.181	.042	6.843	.003	.045	.045
200	10	13.220	8.747	605.156	3,671.02	6.07	9.318	21.967	22.538	19.520	2.447	11.483	114.131	7,227.98	11.951	.181	.044	6.850	.003	.047	.046
210	10	13.256	8.759	606.096	3,785.85	6.25	9.365	22.015	22.621	19.556	2.459	11.568	114.834	7,456.87	12.313	.180	.045	6.857	.003	.048	.048
220	10	13.292	8.772	607.115	3,901.53	6.43	9.413	22.064	22.705	19.592	2.472	11.660	115.680	7,687.38	12.673	.180	.046	6.865	.003	.049	.049

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

GOLF COURSE CHANNEL

Z LEFT	.1		
Z RIGHT	2		
H SILL	6.3		
SLOPE	.008		
n	.015		
D/S FLOW	2500	U/S FLOW	0
ALPHA	1.3		

SUBCRITICAL INCREASING FLOW

STA	INC	INV	y	B	A	Q	V	H	HGL ELEV	EGL ELEV	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyT
0		12.300	7.100	50.000	407.931	2501.5	6.13	7.684	19.400	19.984						5.587	0		
10	10	12.380	7.168	49.545	409.088	2382.9	5.83	7.695	19.548	20.075	118.59	4884.48	11.957	.307	.144	5.621	.003	.148	.148
20	10	12.460	7.224	49.090	409.422	2265.5	5.53	7.699	19.684	20.159	117.45	4648.44	11.358	.292	.133	5.647	.003	.136	.136
30	10	12.540	7.270	48.635	409.072	2149.1	5.25	7.699	19.810	20.239	116.39	4414.61	10.787	.280	.123	5.666	.003	.126	.126
40	10	12.620	7.307	48.180	408.113	2033.6	4.98	7.693	19.927	20.313	115.47	4182.75	10.237	.271	.114	5.679	.002	.117	.117
50	10	12.700	7.336	47.725	406.618	1919.0	4.72	7.682	20.036	20.382	114.62	3952.66	9.702	.264	.107	5.687	.002	.109	.109
60	10	12.780	7.358	47.270	404.660	1805.1	4.46	7.667	20.138	20.447	113.92	3724.12	9.180	.259	.100	5.690	.002	.102	.102
70	10	12.860	7.374	46.815	402.308	1691.8	4.21	7.649	20.234	20.509	113.29	3496.91	8.666	.256	.094	5.689	.002	.096	.096
80	10	12.940	7.384	46.360	399.572	1579.0	3.95	7.626	20.324	20.566	112.80	3270.82	8.157	.253	.088	5.684	.002	.090	.090
90	10	13.020	7.388	45.905	396.458	1466.6	3.70	7.601	20.408	20.621	112.38	3045.64	7.651	.252	.083	5.676	.001	.084	.084
100	10	13.100	7.387	45.450	393.035	1354.6	3.45	7.571	20.487	20.671	112.03	2821.23	7.146	.253	.077	5.664	.001	.079	.079
110	10	13.180	7.380	44.995	389.251	1242.8	3.19	7.538	20.560	20.718	111.82	2597.38	6.639	.254	.072	5.648	.001	.073	.073
120	10	13.260	7.356	42.722	371.079	1131.1	3.05	7.500	20.616	20.760	111.68	2373.88	6.241	.145	.055	5.575	.001	.056	.056
130	10	13.340	7.335	40.449	353.074	1019.4	2.89	7.462	20.673	20.802	111.68	2150.51	5.935	.161	.056	5.498	.001	.057	.057
140	10	13.420	7.311	38.176	335.228	907.66	2.71	7.425	20.731	20.845	111.75	1927.08	5.595	.180	.057	5.418	.001	.058	.058
150	10	13.500	7.289	35.903	317.483	795.77	2.51	7.387	20.789	20.887	111.89	1703.44	5.214	.201	.057	5.333	.001	.058	.058
160	10	13.580	7.267	33.630	299.839	683.60	2.28	7.348	20.847	20.928	112.17	1479.38	4.786	.227	.057	5.244	.001	.058	.058
170	10	13.660	7.243	31.357	282.203	571.08	2.02	7.307	20.903	20.967	112.52	1254.69	4.304	.256	.056	5.147	.000	.056	.056
180	10	13.740	7.217	29.084	264.589	458.15	1.73	7.264	20.957	21.004	112.94	1029.23	3.755	.292	.053	5.042	.000	.054	.054
190	10	13.820	7.186	26.811	246.884	344.65	1.40	7.216	21.006	21.036	113.50	802.792	3.128	.336	.049	4.928	.000	.049	.049
200	10	13.900	7.148	24.538	229.046	230.51	1.01	7.164	21.048	21.064	114.13	575.161	2.402	.390	.042	4.801	.000	.042	.042
210	10	13.980	7.099	22.265	210.975	115.68	.55	7.104	21.079	21.084	114.83	346.195	1.555	.458	.031	4.660	.000	.031	.031
220	10	14.060	7.031	19.992	192.470	.00022	.00	7.031	21.091	21.091	115.68	115.681	.548	.548	.012	4.499	.000	.012	.012

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

D/S FLOW: 1400
U/S FLOW: 3900
DIV. FLOW: 2500

STATION	CRITICAL WATER SURFACE ELEV ON WEIR	HGL ELEV GOLF COURSE CHANNEL
0	20.467	19.400
10	20.492	19.548
20	20.518	19.684
30	20.545	19.810
40	20.573	19.927
50	20.603	20.036
60	20.633	20.138
70	20.664	20.234
80	20.696	20.324
90	20.729	20.408
100	20.763	20.487
110	20.797	20.560
120	20.833	20.616
130	20.870	20.673
140	20.907	20.731
150	20.946	20.789
160	20.985	20.847
170	21.025	20.903
180	21.067	20.957
190	21.109	21.006
200	21.151	21.048
210	21.195	21.079
220	21.240	21.091

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	1300
ALPHA	1.3

U/S FLOW 3100 DIVERTED FLOW 1800

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyI
0		12.500	8.400	578.088	1,300.00	2.25	8.479	20.900	20.979	18.800	2.100	9.130						6.628	.000		
10	10	12.536	8.380	576.536	1,391.30	2.41	8.470	20.916	21.006	18.836	2.080	8.999	91.296	2,691.30	4.662	.164	.015	6.615	.000	.016	.016
20	10	12.572	8.361	575.062	1,481.29	2.58	8.464	20.933	21.036	18.872	2.061	8.876	89.995	2,872.59	4.989	.163	.016	6.602	.001	.017	.017
30	10	12.608	8.343	573.666	1,570.05	2.74	8.459	20.951	21.067	18.908	2.043	8.760	88.764	3,051.34	5.313	.161	.017	6.591	.001	.018	.018
40	10	12.644	8.326	572.348	1,657.66	2.90	8.456	20.970	21.100	18.944	2.026	8.651	87.604	3,227.71	5.633	.159	.018	6.580	.001	.019	.019
50	10	12.680	8.310	571.109	1,744.17	3.05	8.455	20.990	21.135	18.980	2.010	8.549	86.513	3,401.83	5.950	.158	.019	6.570	.001	.020	.020
60	10	12.716	8.295	569.947	1,829.66	3.21	8.455	21.011	21.171	19.016	1.995	8.453	85.490	3,573.83	6.264	.156	.020	6.560	.001	.021	.021
70	10	12.752	8.281	568.825	1,914.20	3.37	8.456	21.033	21.208	19.052	1.981	8.361	84.535	3,743.86	6.575	.155	.021	6.550	.001	.022	.022
80	10	12.788	8.267	567.780	1,997.81	3.52	8.459	21.055	21.247	19.088	1.967	8.276	83.615	3,912.01	6.884	.153	.021	6.542	.001	.022	.023
90	10	12.824	8.254	566.775	2,080.57	3.67	8.463	21.078	21.287	19.124	1.954	8.194	82.761	4,078.38	7.190	.152	.022	6.533	.001	.023	.023
100	10	12.860	8.242	565.847	2,162.51	3.82	8.469	21.102	21.329	19.160	1.942	8.119	81.942	4,243.09	7.493	.151	.023	6.526	.001	.024	.024
110	10	12.896	8.231	564.997	2,243.70	3.97	8.476	21.127	21.372	19.196	1.931	8.050	81.189	4,406.22	7.793	.149	.024	6.518	.001	.025	.025
120	10	12.932	8.221	564.224	2,324.20	4.12	8.484	21.153	21.416	19.232	1.921	7.988	80.500	4,567.91	8.090	.148	.024	6.512	.001	.026	.026
130	10	12.968	8.212	563.490	2,404.08	4.27	8.494	21.180	21.462	19.268	1.912	7.928	79.875	4,728.28	8.386	.147	.025	6.506	.002	.026	.027
140	10	13.004	8.203	562.834	2,483.36	4.41	8.505	21.207	21.509	19.304	1.903	7.876	79.283	4,887.44	8.679	.146	.026	6.500	.002	.027	.028
150	10	13.040	8.195	562.216	2,562.12	4.56	8.517	21.235	21.557	19.340	1.895	7.826	78.755	5,045.48	8.969	.145	.026	6.495	.002	.028	.028
160	10	13.076	8.188	561.676	2,640.38	4.70	8.531	21.264	21.607	19.376	1.888	7.783	78.259	5,202.49	9.258	.144	.027	6.491	.002	.029	.029
170	10	13.112	8.182	561.174	2,718.20	4.84	8.546	21.294	21.658	19.412	1.882	7.742	77.826	5,358.58	9.545	.143	.028	6.486	.002	.029	.030
180	10	13.148	8.176	560.749	2,795.63	4.99	8.562	21.324	21.710	19.448	1.876	7.709	77.424	5,513.83	9.829	.142	.028	6.483	.002	.030	.031
190	10	13.184	8.171	560.364	2,872.71	5.13	8.579	21.355	21.763	19.484	1.871	7.678	77.085	5,668.34	10.112	.141	.029	6.479	.002	.031	.031
200	10	13.220	8.167	560.055	2,949.49	5.27	8.598	21.387	21.818	19.520	1.867	7.653	76.777	5,822.20	10.393	.140	.029	6.477	.002	.032	.032
210	10	13.256	8.163	559.746	3,026.02	5.41	8.617	21.419	21.873	19.556	1.863	7.629	76.531	5,975.51	10.672	.140	.030	6.474	.002	.033	.032
220	10	13.292	8.160	559.515	3,102.31	5.54	8.637	21.452	21.929	19.592	1.860	7.610	76.285	6,128.32	10.951	.139	.031	6.472	.003	.033	.033

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	1200
ALPHA	1.3

U/S FLOW 2390 DIVERTED FLOW 1190

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyT
0		12.500	8.000	547.200	1,200.00	2.19	8.075	20.500	20.575	18.800	1.700	6.650						6.368	.000		
10	10	12.536	7.976	545.357	1,266.50	2.32	8.060	20.512	20.596	18.836	1.676	6.509	66.496	2,466.50	4.515	.129	.012	6.352	.000	.012	.012
20	10	12.572	7.953	543.593	1,331.59	2.45	8.046	20.525	20.618	18.872	1.653	6.376	65.093	2,598.08	4.772	.127	.012	6.337	.001	.013	.013
30	10	12.608	7.930	541.829	1,395.35	2.58	8.033	20.538	20.641	18.908	1.630	6.243	63.757	2,726.93	5.025	.126	.013	6.322	.001	.013	.013
40	10	12.644	7.908	540.143	1,457.78	2.70	8.021	20.552	20.665	18.944	1.608	6.117	62.431	2,853.12	5.274	.124	.013	6.308	.001	.014	.014
50	10	12.680	7.886	538.458	1,518.95	2.82	8.010	20.566	20.690	18.980	1.586	5.992	61.172	2,976.73	5.520	.122	.014	6.293	.001	.014	.014
60	10	12.716	7.865	536.851	1,578.87	2.94	7.999	20.581	20.715	19.016	1.565	5.873	59.921	3,097.82	5.762	.120	.014	6.280	.001	.015	.015
70	10	12.752	7.844	535.245	1,637.60	3.06	7.989	20.596	20.741	19.052	1.544	5.756	58.734	3,216.47	6.001	.119	.014	6.266	.001	.015	.015
80	10	12.788	7.824	533.716	1,695.16	3.18	7.981	20.612	20.769	19.088	1.524	5.644	57.556	3,332.76	6.236	.117	.015	6.253	.001	.016	.016
90	10	12.824	7.804	532.188	1,751.60	3.29	7.972	20.628	20.796	19.124	1.504	5.533	56.442	3,446.76	6.467	.115	.015	6.240	.001	.016	.016
100	10	12.860	7.784	530.660	1,806.94	3.41	7.964	20.644	20.824	19.160	1.484	5.423	55.334	3,558.54	6.696	.114	.015	6.226	.001	.016	.016
110	10	12.896	7.765	529.210	1,861.17	3.52	7.957	20.661	20.853	19.196	1.465	5.320	54.234	3,668.11	6.922	.112	.016	6.214	.001	.017	.017
120	10	12.932	7.746	527.761	1,914.37	3.63	7.950	20.678	20.882	19.232	1.446	5.216	53.196	3,775.54	7.144	.110	.016	6.201	.001	.017	.017
130	10	12.968	7.728	526.350	1,966.53	3.74	7.944	20.696	20.912	19.268	1.428	5.117	52.164	3,880.90	7.364	.109	.016	6.189	.001	.017	.018
140	10	13.004	7.709	524.940	2,017.70	3.84	7.938	20.713	20.942	19.304	1.409	5.018	51.166	3,984.23	7.580	.108	.016	6.177	.001	.018	.018
150	10	13.040	7.691	523.569	2,067.87	3.95	7.933	20.731	20.973	19.340	1.391	4.922	50.175	4,085.57	7.793	.106	.017	6.165	.001	.018	.018
160	10	13.076	7.673	522.199	2,117.09	4.05	7.928	20.749	21.004	19.376	1.373	4.826	49.217	4,184.96	8.004	.105	.017	6.153	.001	.018	.018
170	10	13.112	7.656	520.905	2,165.35	4.16	7.924	20.768	21.036	19.412	1.356	4.737	48.264	4,282.44	8.211	.103	.017	6.142	.002	.019	.019
180	10	13.148	7.639	519.612	2,212.72	4.26	7.921	20.787	21.069	19.448	1.339	4.648	47.371	4,378.08	8.415	.102	.017	6.131	.002	.019	.019
190	10	13.184	7.622	518.320	2,259.21	4.36	7.917	20.806	21.101	19.484	1.322	4.560	46.483	4,471.93	8.617	.100	.017	6.119	.002	.019	.019
200	10	13.220	7.605	517.028	2,304.81	4.46	7.914	20.825	21.134	19.520	1.305	4.472	45.600	4,564.01	8.817	.099	.018	6.108	.002	.019	.019
210	10	13.256	7.589	515.813	2,349.53	4.56	7.911	20.845	21.167	19.556	1.289	4.390	44.724	4,654.34	9.013	.097	.018	6.097	.002	.020	.020
220	10	13.292	7.573	514.598	2,393.43	4.65	7.909	20.865	21.201	19.592	1.273	4.309	43.904	4,742.96	9.206	.096	.018	6.087	.002	.020	.020

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	1100
ALPHA	1.3

U/S FLOW 1685 DIVERTED FLOW 585

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyI
0		12.500	7.500	509.063	1,100.00	2.16	7.573	20.000	20.073	18.800	1.200	3.944						6.038	.000		
10	10	12.536	7.472	506.942	1,139.44	2.25	7.550	20.008	20.086	18.836	1.172	3.806	39.436	2,239.44	4.408	.087	.008	6.019	.000	.008	.008
20	10	12.572	7.444	504.824	1,177.50	2.33	7.528	20.016	20.100	18.872	1.144	3.671	38.064	2,316.94	4.580	.085	.008	6.001	.001	.008	.008
30	10	12.608	7.416	502.707	1,214.21	2.42	7.507	20.024	20.115	18.908	1.116	3.537	36.708	2,391.71	4.748	.083	.008	5.982	.001	.008	.008
40	10	12.644	7.389	500.667	1,249.58	2.50	7.486	20.033	20.130	18.944	1.089	3.409	35.369	2,463.78	4.911	.080	.008	5.964	.001	.009	.009
50	10	12.680	7.362	498.629	1,283.67	2.57	7.465	20.042	20.145	18.980	1.062	3.283	34.093	2,533.25	5.070	.079	.008	5.946	.001	.009	.009
60	10	12.716	7.335	496.592	1,316.50	2.65	7.444	20.051	20.160	19.016	1.035	3.159	32.833	2,600.17	5.225	.077	.008	5.928	.001	.009	.009
70	10	12.752	7.308	494.557	1,348.09	2.73	7.423	20.060	20.175	19.052	1.008	3.036	31.589	2,664.59	5.377	.075	.008	5.910	.001	.009	.009
80	10	12.788	7.281	492.524	1,378.45	2.80	7.403	20.069	20.191	19.088	.981	2.915	30.361	2,726.54	5.525	.073	.008	5.892	.001	.009	.009
90	10	12.824	7.254	490.492	1,407.60	2.87	7.382	20.078	20.206	19.124	.954	2.795	29.149	2,786.05	5.669	.071	.008	5.873	.001	.009	.009
100	10	12.860	7.227	488.461	1,435.55	2.94	7.361	20.087	20.221	19.160	.927	2.678	27.954	2,843.16	5.809	.069	.008	5.855	.001	.009	.009
110	10	12.896	7.200	486.432	1,462.33	3.01	7.340	20.096	20.236	19.196	.900	2.561	26.776	2,897.88	5.945	.067	.008	5.837	.001	.009	.009
120	10	12.932	7.173	484.405	1,487.94	3.07	7.320	20.105	20.252	19.232	.873	2.447	25.614	2,950.27	6.078	.065	.008	5.819	.001	.009	.009
130	10	12.968	7.146	482.379	1,512.42	3.14	7.299	20.114	20.267	19.268	.846	2.334	24.470	3,000.36	6.207	.064	.008	5.801	.001	.009	.009
140	10	13.004	7.119	480.354	1,535.76	3.20	7.278	20.123	20.282	19.304	.819	2.224	23.344	3,048.17	6.332	.062	.008	5.782	.001	.009	.009
150	10	13.040	7.092	478.331	1,557.99	3.26	7.257	20.132	20.297	19.340	.792	2.115	22.236	3,093.75	6.454	.060	.008	5.764	.001	.009	.009
160	10	13.076	7.065	476.310	1,579.14	3.32	7.236	20.141	20.312	19.376	.765	2.007	21.145	3,137.13	6.573	.058	.008	5.746	.001	.009	.009
170	10	13.112	7.038	474.290	1,599.21	3.37	7.215	20.150	20.327	19.412	.738	1.902	20.073	3,178.35	6.687	.056	.008	5.727	.001	.009	.009
180	10	13.148	7.011	472.272	1,618.23	3.43	7.193	20.159	20.341	19.448	.711	1.799	19.020	3,217.45	6.798	.055	.008	5.709	.001	.009	.009
190	10	13.184	6.984	470.255	1,636.22	3.48	7.172	20.168	20.356	19.484	.684	1.697	17.986	3,254.45	6.906	.053	.007	5.691	.001	.009	.009
200	10	13.220	6.957	468.240	1,653.19	3.53	7.151	20.177	20.371	19.520	.657	1.598	16.971	3,289.41	7.010	.051	.007	5.672	.001	.008	.009
210	10	13.256	6.929	466.152	1,669.17	3.58	7.128	20.185	20.384	19.556	.629	1.497	15.976	3,322.35	7.111	.050	.007	5.653	.001	.008	.008
220	10	13.292	6.901	464.065	1,684.13	3.63	7.106	20.193	20.398	19.592	.601	1.398	14.966	3,353.30	7.210	.048	.007	5.634	.001	.008	.008

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	1000
ALPHA	1.3

U/S FLOW 1230 DIVERTED FLOW 230

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyI
0		12.500	7.100	478.931	1,000.00	2.09	7.168	19.600	19.668	18.800	.800	2.147						5.769	.000		
10	10	12.536	7.069	476.609	1,021.47	2.14	7.140	19.605	19.676	18.836	.769	2.023	21.466	2,021.47	4.231	.055	.005	5.748	.000	.005	.005
20	10	12.572	7.038	474.290	1,041.70	2.20	7.113	19.610	19.685	18.872	.738	1.902	20.231	2,063.16	4.340	.053	.005	5.727	.000	.005	.005
30	10	12.608	7.007	471.973	1,060.72	2.25	7.085	19.615	19.693	18.908	.707	1.783	19.020	2,102.41	4.444	.051	.005	5.706	.001	.005	.005
40	10	12.644	6.976	469.658	1,078.55	2.30	7.058	19.620	19.702	18.944	.676	1.667	17.834	2,139.27	4.544	.049	.004	5.685	.001	.005	.005
50	10	12.680	6.945	467.345	1,095.22	2.34	7.030	19.625	19.710	18.980	.645	1.554	16.674	2,173.78	4.640	.047	.004	5.664	.001	.005	.005
60	10	12.716	6.914	465.034	1,110.77	2.39	7.003	19.630	19.719	19.016	.614	1.443	15.540	2,205.99	4.732	.045	.004	5.643	.001	.005	.005
70	10	12.752	6.883	462.724	1,125.20	2.43	6.975	19.635	19.727	19.052	.583	1.335	14.434	2,235.96	4.820	.043	.004	5.622	.001	.005	.005
80	10	12.788	6.852	460.417	1,138.55	2.47	6.947	19.640	19.735	19.088	.552	1.230	13.354	2,263.75	4.905	.041	.004	5.601	.001	.005	.005
90	10	12.824	6.821	458.112	1,150.86	2.51	6.919	19.645	19.743	19.124	.521	1.128	12.304	2,289.41	4.985	.039	.004	5.579	.001	.005	.005
100	10	12.860	6.790	455.772	1,162.14	2.55	6.890	19.650	19.750	19.160	.490	1.027	11.282	2,313.00	5.062	.038	.004	5.558	.001	.005	.005
110	10	12.896	6.758	453.434	1,172.41	2.59	6.862	19.654	19.758	19.196	.458	.930	10.274	2,334.55	5.135	.036	.004	5.536	.001	.004	.005
120	10	12.932	6.726	451.061	1,181.71	2.62	6.833	19.658	19.765	19.232	.426	.834	9.299	2,354.12	5.205	.034	.004	5.514	.001	.004	.004
130	10	12.968	6.694	448.690	1,190.05	2.65	6.803	19.662	19.771	19.268	.394	.742	8.341	2,371.76	5.272	.032	.003	5.492	.001	.004	.004
140	10	13.004	6.662	446.321	1,197.47	2.68	6.774	19.666	19.778	19.304	.362	.653	7.419	2,387.52	5.335	.031	.003	5.470	.001	.004	.004
150	10	13.040	6.630	443.955	1,204.01	2.71	6.744	19.670	19.784	19.340	.330	.569	6.534	2,401.48	5.395	.029	.003	5.448	.001	.004	.004
160	10	13.076	6.598	441.590	1,209.69	2.74	6.715	19.674	19.791	19.376	.298	.488	5.687	2,413.70	5.451	.027	.003	5.426	.001	.004	.004
170	10	13.112	6.566	439.228	1,214.57	2.77	6.685	19.678	19.797	19.412	.266	.412	4.880	2,424.27	5.505	.026	.003	5.404	.001	.004	.004
180	10	13.148	6.534	436.868	1,218.69	2.79	6.655	19.682	19.803	19.448	.234	.340	4.116	2,433.26	5.555	.024	.003	5.382	.001	.004	.004
190	10	13.184	6.502	434.473	1,222.09	2.81	6.624	19.686	19.808	19.484	.202	.271	3.396	2,440.77	5.602	.023	.003	5.359	.001	.003	.004
200	10	13.220	6.469	432.080	1,224.80	2.83	6.594	19.689	19.814	19.520	.169	.208	2.714	2,446.88	5.647	.022	.002	5.337	.001	.003	.004
210	10	13.256	6.436	429.653	1,226.88	2.86	6.563	19.692	19.819	19.556	.136	.150	2.084	2,451.68	5.690	.021	.002	5.314	.001	.003	.003
220	10	13.292	6.403	427.228	1,228.39	2.88	6.531	19.695	19.823	19.592	.103	.099	1.505	2,455.27	5.731	.020	.002	5.291	.001	.003	.003

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	950
ALPHA	1.3

U/S FLOW 1020 DIVERTED FLOW 70

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyT
0		12.500	6.800	456.552	950.00	2.08	6.867	19.300	19.367	18.800	.500	1.061						5.565	.000		
10	10	12.536	6.767	454.102	960.61	2.12	6.836	19.303	19.372	18.836	.467	.957	10.607	1,910.61	4.196	.035	.003	5.542	.000	.003	.003
20	10	12.572	6.734	451.654	970.18	2.15	6.806	19.306	19.378	18.872	.434	.858	9.574	1,930.79	4.263	.033	.003	5.520	.000	.003	.003
30	10	12.608	6.701	449.209	978.76	2.18	6.775	19.309	19.383	18.908	.401	.762	8.577	1,948.94	4.327	.031	.003	5.497	.000	.003	.003
40	10	12.644	6.668	446.765	986.38	2.21	6.744	19.312	19.388	18.944	.368	.670	7.618	1,965.13	4.387	.029	.003	5.474	.001	.003	.003
50	10	12.680	6.635	444.324	993.07	2.24	6.713	19.315	19.393	18.980	.335	.582	6.697	1,979.45	4.443	.027	.002	5.452	.001	.003	.003
60	10	12.716	6.602	441.886	998.89	2.26	6.681	19.318	19.397	19.016	.302	.498	5.817	1,991.96	4.496	.025	.002	5.429	.001	.003	.003
70	10	12.752	6.569	439.449	1,003.87	2.28	6.650	19.321	19.402	19.052	.269	.419	4.979	2,002.76	4.545	.024	.002	5.406	.001	.003	.003
80	10	12.788	6.536	437.015	1,008.05	2.31	6.619	19.324	19.407	19.088	.236	.344	4.186	2,011.92	4.591	.022	.002	5.383	.001	.003	.003
90	10	12.824	6.503	434.583	1,011.49	2.33	6.587	19.327	19.411	19.124	.203	.274	3.439	2,019.55	4.634	.021	.002	5.360	.001	.003	.003
100	10	12.860	6.469	432.080	1,014.24	2.35	6.555	19.329	19.415	19.160	.169	.208	2.744	2,025.73	4.675	.020	.002	5.337	.001	.002	.002
110	10	12.896	6.435	429.580	1,016.32	2.37	6.522	19.331	19.418	19.196	.135	.149	2.084	2,030.56	4.713	.019	.002	5.313	.001	.002	.002
120	10	12.932	6.401	427.081	1,017.81	2.38	6.489	19.333	19.421	19.232	.101	.096	1.488	2,034.13	4.749	.017	.002	5.289	.001	.002	.002
130	10	12.968	6.367	424.586	1,018.77	2.40	6.456	19.335	19.424	19.268	.067	.052	.963	2,036.58	4.783	.016	.002	5.265	.001	.002	.002
140	10	13.004	6.333	422.092	1,019.29	2.41	6.424	19.337	19.428	19.304	.033	.018	.520	2,038.07	4.814	.015	.001	5.242	.001	.002	.002
150	10	13.040	6.300	419.675	1,019.47	2.43	6.392	19.340	19.432	19.340	.000	.000	.180	2,038.77	4.844	.014	.001	5.219	.001	.002	.003

SPATIALLY VARIED FLOW

PROJECT: CONFLUENCE DETENTION BASIN

DESCRIPITION: DIVERSION STRUCTURE ON SLOAN CHANNEL

CHANNEL CONFIGURATION

BASE	60
Z LEFT	2
Z RIGHT	.1
H SILL	6.3
SLOPE	.0036
n	.015
D/S FLOW	900
U/S FLOW	920
DIVERTED FLOW	20
ALPHA	1.3

SUBCRITICAL DECREASING FLOW OUT OF SLOAN CHANNEL

STA	INC	INV	y	A	Q	V	H	HGL ELEV	EGL ELEV	ELEV SILL	SPILL HEAD	SPILL RATE	dQ	Q1+Q2	V1+V2	dV	dym	R	hf	dyC	dyT
0		12.500	6.600	441.738	900.00	2.04	6.664	19.100	19.164	18.800	.300	.493						5.427	.000		
10	10	12.536	6.566	439.228	904.93	2.06	6.632	19.102	19.168	18.836	.266	.412	4.930	1,804.93	4.098	.023	.002	5.404	.000	.002	.002
20	10	12.572	6.532	436.720	909.05	2.08	6.599	19.104	19.171	18.872	.232	.335	4.116	1,813.97	4.142	.021	.002	5.380	.000	.002	.002
30	10	12.608	6.498	434.215	912.40	2.10	6.567	19.106	19.175	18.908	.198	.264	3.352	1,821.44	4.183	.020	.002	5.357	.000	.002	.002
40	10	12.644	6.464	431.712	915.04	2.12	6.534	19.108	19.178	18.944	.164	.199	2.643	1,827.44	4.221	.018	.002	5.333	.000	.002	.002
50	10	12.680	6.430	429.212	917.03	2.14	6.501	19.110	19.181	18.980	.130	.141	1.992	1,832.07	4.256	.017	.001	5.309	.000	.002	.002
60	10	12.716	6.396	426.714	918.44	2.15	6.468	19.112	19.184	19.016	.096	.089	1.406	1,835.47	4.289	.016	.001	5.286	.001	.002	.002
70	10	12.752	6.362	424.219	919.33	2.17	6.435	19.114	19.187	19.052	.062	.046	.892	1,837.77	4.319	.015	.001	5.262	.001	.002	.002
80	10	12.788	6.328	421.726	919.79	2.18	6.402	19.116	19.190	19.088	.028	.014	.463	1,839.13	4.348	.014	.001	5.238	.001	.002	.002
90	10	12.824	6.300	419.675	919.94	2.19	6.375	19.124	19.199	19.124	.000	.000	.141	1,839.73	4.373	.011	.001	5.219	.001	.002	.008

SPILLWAY CALCULATIONS

Project CONEWENCL
Job No. LV-CW7-250-02
By DWD Date ____ Chkd.By ____ Date ____
Description ____
SHEET /

EMERGENCY SPILLWAY.

SOIL CEMENT BROAD CRESTED WEIR

$Q = 3Lh^{3/2}$

L = 2200' FULL LENGTH OF WEST EMBANKMENT PER CCRFCD & COUNTY

PMF Q = 74,000 cfs

$h = \left(\frac{Q}{3L}\right)^{2/3} = 5'$

USE 5' MAX HEAD DESIGN
ASSUME FLOW THROUGH GOLF COURSE NORTH OF SPILLWAY INEFFECTIVE AND NEGLIGIBLE

SCOUR DEPTH PLUNGE POOL IN SANDY SOILS = 1/2 SEQUENT DEPTH
CONSERVATIVELY USE MIN DEPTH OF 1/2 SEQUENT DEPTH + 2' FOR CUTOFF
NOTE: NATURAL SOILS ARE MORE RESISTENT THAN SAND

REFERENCE: "DESIGN GUIDELINES & CRITERIA CHANNELS & HYDRAULIC STRUCTURES ON SANDY SOIL", SIMONS, LI & ASSOCIATES, JUNE 1981

DETERMINE SEQUENT DEPTH DEPENDING ON HEIGHT OF DROP
q = 34.5 cfs / ft

CONFLUENCE DETENTION BASIN SPILLWAY
VERTICAL DROP STRUCTURE
TIAL AND ERROR SOLUTIONS

EP 1 CRITICAL AT CREST

GIVEN	Q	B	z
	1000	29	.001

SOLVE y	TRIAL	y	A	TW	Z	Z-Q/g**1/2
	1	3.32	96.29102	29.00664	175.4406	-.786292
	2	3.33	96.58109	29.00666	176.2338	.0069876
	3	3.34	96.87116	29.00668	177.0283	.8014599

SOLUTION y = 3.33

A = 96.58109
V = 10.35399
H = 4.994677

STEP 2 DROP CONSERVATION OF ENERGY

GIVEN	h	H	H1
	2	4.994677	6.994677

SOLVE y1	TRIAL	y1	A	V1	Vh	H1-y1-Vh
	1	1.89	54.81357	18.24366	5.168183	-.063507
	2	1.9	55.10361	18.14763	5.113921	-.019244
	3	1.91	55.39365	18.05261	5.060509	.0241679

SOLUTION y1 = 1.9

A1 = 55.10361
V1 = 18.14763

STEP 3 JUMP CONSERVATION OF MOMENTUM

GIVEN	y1	A1	V1
	1.9	55.10361	18.14763

VE y2	TRIAL	y2	A2	M1	M2	M1-M2
	1	5.18	150.2468	615.9383	615.0139	.9244167
	2	5.19	150.5369	615.9383	616.0825	-.144169
	3	5.2	150.8270	615.9383	617.1557	-1.21733

SOLUTION y2 = 5.19

A2 = 150.5369
V2 = 6.642888
H2 = 5.875217

CONFLUENCE DETENTION BASIN SPILLWAY
VERTICAL DROP STRUCTURE
TRIAL AND ERROR SOLUTIONS

STEP 1 CRITICAL AT CREST

GIVEN	Q	B	z
	1000	29	.001

SOLVE y	TRIAL	y	A	TW	Z	Z-Q/g**1/2
	1	3.32	96.29102	29.00664	175.4406	-.786292
	2	3.33	96.58109	29.00666	176.2338	.0069876
	3	3.34	96.87116	29.00668	177.0283	.8014599

SOLUTION y = 3.33

A = 96.58109
V = 10.35399
H = 4.994677

STEP 2 DROP CONSERVATION OF ENERGY

GIVEN	h	H	H1
	4	4.994677	8.994677

SOLVE y1	TRIAL	y1	A	V1	Vh	H1-y1-Vh
	1	1.57	45.53246	21.96235	7.489827	-.065151
	2	1.58	45.82250	21.82334	7.395314	.0193625
	3	1.59	46.11253	21.68608	7.302579	.1020978

SOLUTION y1 = 1.58

A1 = 45.82250
V1 = 21.82334

STEP 3 JUMP CONSERVATION OF MOMENTUM

GIVEN	y1	A1	V1
	1.58	45.82250	21.82334

SOLVE y2	TRIAL	y2	A2	M1	M2	M1-M2
	1	6.02	174.6162	713.9426	712.9101	1.032512
	2	6.03	174.9064	713.9426	714.3470	-.404337
	3	6.04	175.1965	713.9426	715.7878	-1.84512

SOLUTION y2 = 6.03

A2 = 174.9064
V2 = 5.717345
H2 = 6.537578

CONFLUENCE DETENTION BASIN SPILLWAY
VERTICAL DROP STRUCTURE
TIAL AND ERROR SOLUTIONS

TEP 1 CRITICAL AT CREST

GIVEN	Q	B	z
	1000	29	.001

SOLVE y	TRIAL	y	A	TW	Z	Z-Q/g**1/2
	1	3.32	96.29102	29.00664	175.4406	-.786292
	2	3.33	96.58109	29.00666	176.2338	.0069876
	3	3.34	96.87116	29.00668	177.0283	.8014599

SOLUTION y = 3.33

A = 96.58109
V = 10.35399
H = 4.994677

STEP 2 DROP CONSERVATION OF ENERGY

GIVEN	h	H	H1
	6	4.994677	10.99468

SOLVE y1	TRIAL	y1	A	V1	Vh	H1-y1-Vh
	1	1.38	40.02190	24.98632	9.694349	-.079672
	2	1.39	40.31193	24.80655	9.555357	.0493201
	3	1.4	40.60196	24.62935	9.419333	.1753442

SOLUTION y1 = 1.39

A1 = 40.31193
V1 = 24.80655

STEP 3 JUMP CONSERVATION OF MOMENTUM

GIVEN	y1	A1	V1
	1.39	40.31193	24.80655

VE y2	TRIAL	y2	A2	M1	M2	M1-M2
	1	6.58	190.8633	798.4061	796.5228	1.883281
	2	6.59	191.1534	798.4061	798.1770	.2291434
	3	6.6	191.4436	798.4061	799.8348	-1.42867

SOLUTION y2 = 6.59

A2 = 191.1534
V2 = 5.231400
H2 = 7.014962

CONFLUENCE DETENTION BASIN SPILLWAY
VERTICAL DROP STRUCTURE
IAL AND ERROR SOLUTIONS

'EP 1 CRITICAL AT CREST

GIVEN	Q	B	z
	1000	29	.001

SOLVE y	TRIAL	y	A	TW	Z	Z-Q/g**1/2
	1	3.32	96.29102	29.00664	175.4406	-.786292
	2	3.33	96.58109	29.00666	176.2338	.0069876
	3	3.34	96.87116	29.00668	177.0283	.8014599

SOLUTION y = 3.33

A = 96.58109
V = 10.35399
H = 4.994677

STEP 2 DROP CONSERVATION OF ENERGY

GIVEN	h	H	H1
	8	4.994677	12.99468

SOLVE y1	TRIAL	y1	A	V1	Vh	H1-y1-Vh
	1	1.24	35.96154	27.80749	12.00709	-.252409
	2	1.25	36.25156	27.58502	11.81573	-.071056
	3	1.26	36.54159	27.36608	11.62892	.1057588

SOLUTION y1 = 1.25

A1 = 36.25156
V1 = 27.58502

STEP 3 JUMP CONSERVATION OF MOMENTUM

GIVEN	y1	A1	V1
	1.25	36.25156	27.58502

VE y2	TRIAL	y2	A2	M1	M2	M1-M2
	1	7.05	204.4997	879.3345	876.6822	2.652231
	2	7.06	204.7898	879.3345	878.5078	.8266288
	3	7.07	205.0800	879.3345	880.3370	-1.00250

SOLUTION y2 = 7.06

A2 = 204.7898
V2 = 4.883055
H2 = 7.430252

TRAPEZOIDAL CHANNEL
VERTICAL DROP STRUCTURE
TRIAL AND ERROR SOLUTIONS

STEP 1 CRITICAL AT CREST

GIVEN	Q	B	z
	2500	200	.0001

SOLVE y	TRIAL	y	A	TW	Z	Z-Q/g**1/2
	1	1.68	336.0003	200.0003	435.5060	-5.06115
	2	1.69	338.0003	200.0003	439.4002	-1.16692
	3	1.7	340.0003	200.0003	443.3060	2.738841

SOLUTION y = 1.68

A = 336.0003
V = 7.440470
H = 2.539637

STEP 2 DROP CONSERVATION OF ENERGY

GIVEN	h	H	H1
	6	2.539637	8.539637

SOLVE y1	TRIAL	y1	A	V1	Vh	H1-y1-Vh
	1	.54	108.0000	23.14814	8.320442	-.320806
	2	.55	110.0000	22.72727	8.020631	-.030995
	3	.56	112.0000	22.32142	7.736737	.2428990

SOLUTION y1 = .55

A1 = 110.0000
V1 = 22.72727

STEP 3 JUMP CONSERVATION OF MOMENTUM

GIVEN	y1	A1	V1
	.55	110.0000	22.72727

SOLVE y2	TRIAL	y2	A2	M1	M2	M1-M2
	1	3.92	784.0015	1794.789	1788.462	6.327813
	2	3.93	786.0015	1794.789	1795.671	-.881439
	3	3.94	788.0016	1794.789	1802.903	-8.11394

SOLUTION y2 = 3.93

A2 = 786.0015
V2 = 3.180655
H2 = 4.087090

OUTLET WORKS

HYDRAULIC CALCULATIONS

CULVERT FILE: HIGH
TAILWATER FILE: REGULAR

FHWA CULVERT ANALYSIS
SUMMARY TABLE

DATE: 04-07-1993
CULVERT NO. 1 OF 1

	<S> SITE DATA			<C> CULVERT SHAPE, MATERIAL, INLET				
LV NO.	INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	98.65	97.92	290	2 - RCB	7.87	7.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

PRESS	TO REVIEW	PRESS	TO
<C>	CULVERT DATA	<E>	EDIT CULVERT SIZE
<D>	DISCHARGE DATA	<M>	MINIMIZE CULVERT SPAN
<R>	ROADWAY DATA	<A>	ADD OR DELETE CULVERTS
<S>	SITE DATA	<N>	EDIT NUMBER OF BARRELS
<T>	TAILWATER RATING CURVE		

<ENTER> TO CONTINUE

1-HELP 2 3 4 5-END 6 7 8 9-SHELL 10

CULVERT FILE: HIGH
TAILWATER FILE: REGULAR

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

DATE: 04-07-1993
CULVERT NO. 1 OF 1

TAILWATER RATING CURVE

NO.	FLOW(CFS)	T.W.E.(FT)	VEL.(FPS)	SHEAR(PSF)
1	360.00	100.30	6.12	0.18
2	514.00	100.83	6.85	0.22
3	668.00	101.29	7.43	0.25
4	822.00	101.69	7.91	0.28
5	976.00	102.07	8.32	0.31
6	1130.00	102.41	8.68	0.34
7	1284.00	102.73	9.01	0.36
8	1438.00	103.03	9.31	0.38
9	1592.00	103.31	9.59	0.40
10	1746.00	103.58	9.84	0.42
11	1900.00	103.84	10.08	0.44

PRESS:
<D> FOR DATA
<P> TO PLOT RATING CURVE
<ESC> FOR CHANNEL SHAPE MENU
<ENTER> TO CONTINUE

-HELP 2 3 4 5-END 6 7 8 9-SHELL 10

CULVERT # 1 PERFORMANCE CURVE
FOR 2 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
360	102.70	100.30	3.99	4.05	2-M2	0.00	0.00	0.00	9.01
514	103.79	100.83	5.01	5.14	2-M2	0.00	0.00	0.00	10.15
668	104.77	101.29	5.96	6.12	2-M2	0.00	0.00	0.00	11.07
822	105.70	101.69	6.89	7.05	2-M2	0.00	0.00	0.00	11.87
976	106.56	102.07	7.83	7.91	2-M2	0.00	0.00	0.00	12.57
1130	107.46	102.41	8.81	8.73	2-M2	0.00	0.00	0.00	13.19
1284	108.51	102.73	9.86	9.62	7-FF	0.00	0.00	0.00	13.77
1438	109.64	103.03	10.99	10.94	7-FF	0.00	0.00	0.00	14.30
1592	110.87	103.31	12.22	12.18	7-FF	0.00	0.00	0.00	14.79
1746	112.21	103.58	13.56	13.39	4-FF	0.00	0.00	0.00	15.85
1900	113.66	103.84	15.01	14.70	4-FF	0.00	0.00	0.00	17.24

El. inlet face invert 98.65 ft El. outlet invert 97.92 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

PRESS <P> TO PLOT PRESS <ENTER> TO CONTINUE

1-HELP 2 3-TYPE 4 5-END 6 7 8 9-SHELL 10

HWE = TWE FOR ORIFICE

RANGE WASH/SLOAN CHANNEL CONFLUENCE DETENTION BASIN
OUTLET WORKS STAGE/DISCHARGE CALCULATION SUMMARY

TRIAL FLOW	TWE	HWE	LOW WEIR HEAD	LOW WEIR CAPACITY	ORIFICE h	ORIFICE CAPACITY	LOW LEVEL FLOW	HIGH WEIR HEAD	HIGH WEIR FLOW	TOTAL FLOW
0	98.65	102.00	.00	0	3.35	210	0	0	0	0
54	99.79	103.00	1.00	54	3.21	206	54	0	0	54
99	100.36	103.50	1.50	99	3.14	203	99	0	0	99
153	100.93	104.00	2.00	153	3.07	201	153	0	0	153
214	101.51	105.00	3.00	281	3.49	214	214	0	0	214
238	101.72	106.00	4.00	432	4.28	238	238	0	0	238
280	102.07	108.00	6.00	794	5.93	280	280	0	0	280
317	102.37	110.00	8.00	1,222	7.63	317	317	0	0	317
367	102.75	113.00	11.00	1,970	10.25	367	367	0	0	367
483	103.57	113.50	11.50	2,106	9.93	362	362	.5	121	483
577	104.19	113.75	11.75	2,175	9.56	355	355	.75	222	577
688	104.89	114.00	12.00	2,245	9.11	346	346	1	342	688
954	106.44	114.50	12.50	2,386	8.06	326	326	1.5	628	954
1,105	107.31	114.75	12.75	2,458	7.44	313	313	1.75	792	1,105
1,263	108.37	115.00	13.00	2,531	6.63	296	296	2	967	1,263
1,428	109.57	115.25	13.25	2,604	5.68	274	274	2.25	1,154	1,428
1,529	110.37	115.40	13.40	2,649	5.03	257	257	2.4	1,272	1,529
1,598	110.92	115.50	13.50	2,679	4.58	246	246	2.5	1,352	1,598
1,871	113.39	115.90	13.90	2,798	2.51	182	182	2.9	1,689	1,871
1,938	114.04	116.00	14.00	2,829	1.96	160	160	3	1,777	1,938

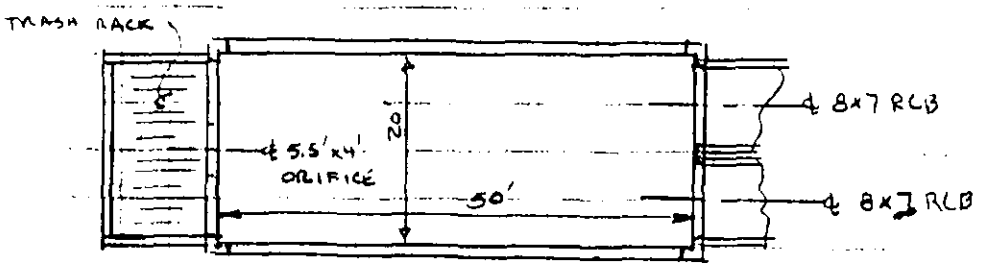
STRUCTURAL CALCULATIONS

BOYLE ENGINEERING CORPORATION

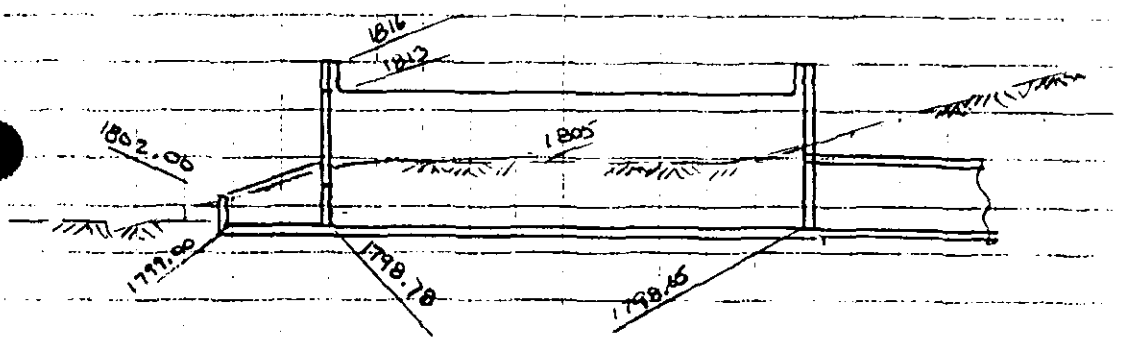
Project CONFLUENCE DET BASIN
Job No.
By [illegible] Date DLN Chkd.By ____ Date ____

Description OUTLET STRUCTURE
STRUCTURAL CALCULATION

SHEET 1/10



PLAN

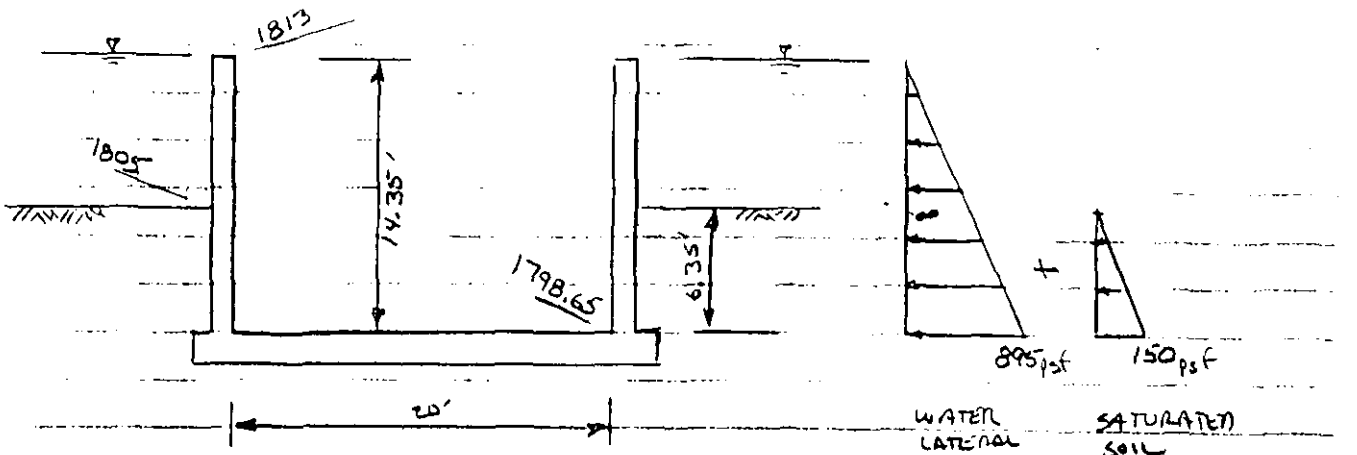


PROFILE

SCALE 1" = 20'

SIMPLIFIED DESIGN CONDITION

ASSUME BOX EMPTY - WATER @ TOP OF BOX



@ BASE OF WALL

HYDROSTATIC PRESSURE

$14.35' (62.4\ lb/ft^3) = 895\ psf$

SATURATED SOIL

P= 86Hw / SOILS REPORT

86 - 62.4 = 23.6 pcf equiv liq saturated soil w/o water pressure

$6.35' (23.6\ pcf) = 150\ psf$

Total @ base 1045 psf

USE SIMPLIFIED TRIANGULAR DISTRIBUTION

$\frac{1045\ psf}{14.35'} = 72.8\ pcf$ equiv. liq., say 73 pcf

SIDE WALL

$M = \frac{1}{2}(73\ pcf)(14.4')^2\left(\frac{14.4'}{3}\right) = 36{,}329'\text{-}lb$ /LF

$M_u = 1.7\ (36329'\text{-}lb)\ (12''/1')\ (1k/1000lb) = 741''\text{-}k$

$t = 15''$ $d = 13''$

$A_s = 1.16\ in^2$

USE #7 @ 6" $A_s = 1.20\ in^2$ ←

$\rho = \frac{A_s}{bd} = \frac{1.20}{12(13)} = .0077$ OK

Reduce to #7 @ 12" upper portion of wall

Capacity #7 @ 12" $A_s = .60$

$M_u = \phi A_s f_y (d - a/2)$ $a/2 = .98\ A_s$

$M_u = .9\ (.60)(60ksi)(13 - .98(.60))$

$M_u = 402''\text{-}k$

$M = 402/1.7 = 236''\text{-}k = 19{,}713'\text{-}lb$

$M = \frac{\pi}{6} y^3$

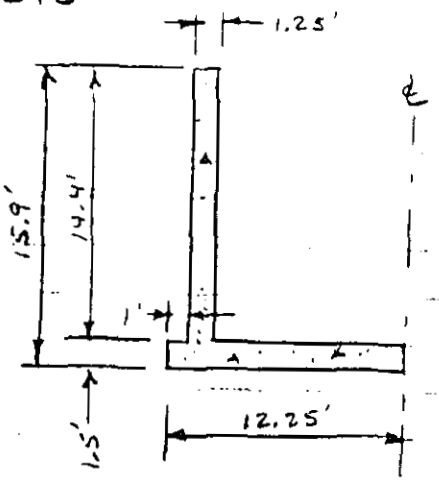
$y = \left(\frac{6M}{\pi}\right)^{1/3} = \left[\frac{6(19713'\text{-}lb)}{73\ lb/ft^3}\right]^{1/3} = 11.7'$

$14.4 - 11.7 = 2.7'$ extend 12 d_b or $d \approx 1.1'$

$2.7 + 1.1 = 3.8'$

SAY END BARS @ 4' ABOVE SLAB

FLOOR SLAB



ITEM		V	H	ARM	M
WALL	(1.25')(14.4')(150 pcf) =	2700 lb		1.625	4388
BACKFILL ON HEEL	(1')(14.4')(130 pcf) =	1872 lb		.5	936
SLAB	(1.5')(12.25')(150 pcf) =	2756 lb		6.125	16,881
SOIL PRESSURE	1/2 (73 pcf)(15.9')^2 =		9227 lb	5.3	48,906
		7328 lb			71,111 '-lb

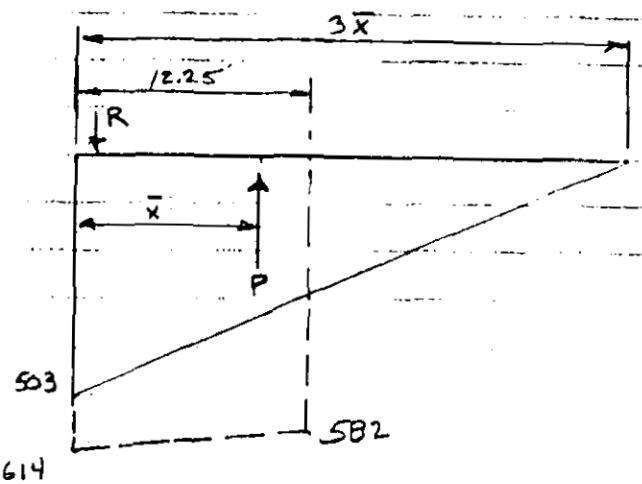
$\bar{X} = \frac{71,111}{7328} = 9.70'$

$3\bar{X} = 29.11'$

$P = \frac{2V}{3\bar{X}} = 2\frac{(7328)}{29.11} = 503$

$X = 503 - \frac{12.25}{29.11}(503) = 291$

$2x = 582$



$\frac{y + 582}{2}(12.25) = 7328$

$y = 614$

$R = \frac{614+582}{2}(12.25) - 12.25(1.5)(150) = 4569$ lb

RATE 2.61 lb/ LF

MOMENT @ base of wall

$M = 1/6\,(73\ pcf)(14.4')^3 = 36{,}329'\text{-}lb$

$R = 4569\ lb$

SLAB WEIGHT: $1.5'(150\ pcf) = 225\ lb/LF$

$x = 0$ @ ℄ of wall soil pressure $= 614\ psf - 1.625'(2.61\ lb/LF)$
$= 610\ psf$

$$M = 36{,}329'\text{-}lb - 4569x + 610\frac{x^2}{2} - 2.61\frac{x^3}{6} - 225\frac{x^2}{2}$$

$$M = 36329 - 4569x + 192.5x^2 - .435x^3$$

@ Face of wall $x = .625$ $M = 33{,}548'\text{-}lb$ max

@ ℄ box $x = 10.625$ $M = 8{,}993'\text{-}lb$ min

$Mu = 1.7\,(33{,}548'\text{-}lb)(12''/1')(1K/1000\ lb) = 684''\text{-}K$

$t = 18''$ $d = 14''$

$A_s = .97\ in^2$

USE #7 @ 6" SAME AS WALL

Reduce to #7@12" near center

capacity of #7@12"

$M_u = \phi A_s f_y (d - a/2) = .9(.60)(60\ ksi)(14 - .98(.60)) = 435''\text{-}K$

$M = \frac{435}{1.7} = 256''\text{-}K = 21{,}300'\text{-}lb$

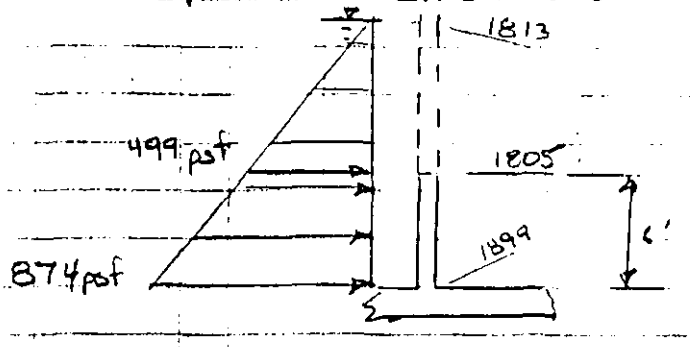
@ $x = 3.95'$

$12 d_b = 12(7/8'') = 10.5''$ or $d = 14''$ USE $\ell = 14'' = 1.16'$

extend bars $3.95 + 1.16' = 5.11'$ MIN

SAY $5.25'$

LOWER PORTION OF FRONT END WALL
EACH SIDE OF ORIFICE
DESIGN AS CANTILEVER



$14' (62.4\ lb/ft^3) = 874$

$8 (62.4\ lb/ft^3) = 499$

@ base

$$M = (499\ psf)(6')(6'/2) + 375\ psf\left(\frac{6'}{2}\right)\left(\frac{6'}{3}\right) = 11{,}232'\text{-}lb$$

$$M_u = 1.7\ (11{,}232'\text{-}lb)\ (12''/1')\ (1K/1000\ lb) = 229''\text{-}K$$

$t = 15''$ $d = 13''$

req $A_s = .33\ in^2$

$\rho < 200/f_y$

$4/3\ .33 = .44\ in^2$

USE #7 @ 12" $A_s = .60\ in^2$

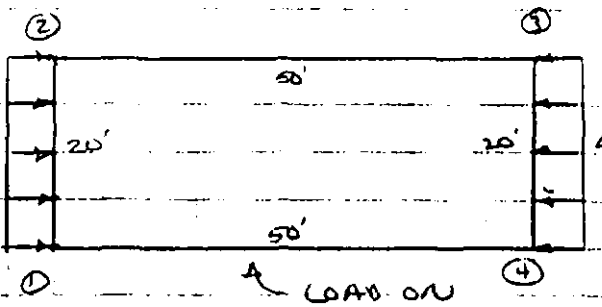
UPPER END WALLS

DESIGN END WALLS (20' SPAN) AS HORIZONTAL STRIP

TAKE STRIP @ ELEV 1006 – HYDROSTATIC PRESSURE ONLY (ABOVE SOIL)

H = 1813 - 1806 = 7'

pressure = 7' (62.4 lb/cf) = 437 psf



LOAD ON SIDE WALLS RESISTED BY VERTICAL STEEL

FIXED END MOMENT $M = \frac{wl^2}{12} = \frac{437\ (20')^2}{12} = 14,567'\text{-}lb$

END WALL STIFFNESS COEF $= \frac{4EI}{L} = \frac{4EI}{20}$

SIDE WALL STIFFNESS COEF $= \frac{4EI}{L} = \frac{4EI}{50}$

DISTRIBUTION FACTORS

END WALL $\frac{\frac{4}{20}EI}{\frac{4}{20}EI + \frac{4}{50}EI} = .714$

SIDE WALL $= .286$

BY MOMENT DISTRIBUTION

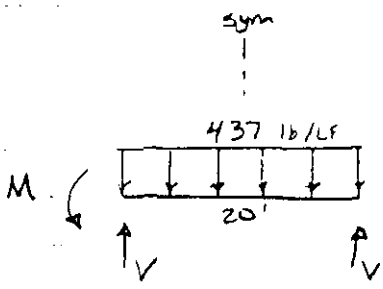
MOMENT AT CORNERS = 4,166'-lb

MOMENT DISTRIBUTION CALCULATION
CONFLUENCE DETENTION BASIN OUTLET STRUCTURE

NODE	1		2		3		4	
DF	.286	.714	.714	.286	.286	.714	.714	.286
FEM		14567	-14567			14567	-14567	
1ST D	-4166.16	-10400.8	10400.84	4166.162	-4166.16	-10400.8	10400.84	4166.162
CO	2083.081	5200.419	-5200.42	-2083.08	2083.081	5200.419	-5200.42	-2083.08
2ND D	-2083.08	-5200.42	5200.419	2083.081	-2083.08	-5200.42	5200.419	2083.081
CO	1041.541	2600.210	-2600.21	-1041.54	1041.541	2600.210	-2600.21	-1041.54
3RD D	-1041.54	-2600.21	2600.210	1041.541	-1041.54	-2600.21	2600.210	1041.541
CO	520.7703	1300.105	-1300.10	-520.770	520.7703	1300.105	-1300.10	-520.770
4TH D	-520.770	-1300.10	1300.105	520.7703	-520.770	-1300.10	1300.105	520.7703
CO	260.3851	650.0524	-650.052	-260.385	260.3851	650.0524	-650.052	-260.385
5TH D	-260.385	-650.052	650.0524	260.3851	-260.385	-650.052	650.0524	260.3851
CO	130.1926	325.0262	-325.026	-130.193	130.1926	325.0262	-325.026	-130.193
6TH D	-130.193	-325.026	325.0262	130.1926	-130.193	-325.026	325.0262	130.1926
CO	65.09628	162.5131	-162.513	-65.0963	65.09628	162.5131	-162.513	-65.0963
7TH D	-65.0963	-162.513	162.5131	65.09628	-65.0963	-162.513	162.5131	65.09628
CO	32.54814	81.25655	-81.2565	-32.5481	32.54814	81.25655	-81.2565	-32.5481
8TH D	-32.5481	-81.2565	81.25655	32.54814	-32.5481	-81.2565	81.25655	32.54814
CO	16.27407	40.62827	-40.6283	-16.2741	16.27407	40.62827	-40.6283	-16.2741
9TH D	-16.2741	-40.6283	40.62827	16.27407	-16.2741	-40.6283	40.62827	16.27407
CO	8.137035	20.31414	-20.3141	-8.13704	8.137035	20.31414	-20.3141	-8.13704
10TH D	-8.13704	-20.3141	20.31414	8.137035	-8.13704	-20.3141	20.31414	8.137035
CO	4.068518	10.15707	-10.1571	-4.06852	4.068518	10.15707	-10.1571	-4.06852
11TH D	-4.06852	-10.1571	10.15707	4.068518	-4.06852	-10.1571	10.15707	4.068518
CO	2.034259	5.078534	-5.07853	-2.03426	2.034259	5.078534	-5.07853	-2.03426
12TH D	-2.03426	-5.07853	5.078534	2.034259	-2.03426	-5.07853	5.078534	2.034259
CO	1.017129	2.539267	-2.53927	-1.01713	1.017129	2.539267	-2.53927	-1.01713
13TH D	-1.01713	-2.53927	2.539267	1.017129	-1.01713	-2.53927	2.539267	1.017129
SUM	-4166.16	4166.162	-4166.16	4166.162	-4166.16	4166.162	-4166.16	4166.162

SHEET 8/10

END WALL



$M = 4166'\text{-}lb$

$V = 437(20/2) = 4370\ lb$

MAX POSITIVE MOMENT @ CENTER

$$M = -4166'\text{-}lb + 4370\ lb\,(10') - (437\ lb/LF)\frac{(10')^2}{2}$$

$M = 17,684'\text{-}lb$

$M_u = 1.7\,(17684)(12/1)(1/1000) = 361''\text{-}K$

$t = 15''$ $d = 12''$

$A_s = .58\ in^2$

HORIZ INSIDE FACE

USE #7 @ 12" $A_s = .60\ in^2$ ←

$\rho = \frac{.60}{(12)(12)} = .0042$ OK

NEG MOMENT

$M_u = 1.7\,(4166)(12/1000) = 85''\text{-}K$

$t = 15''$ $d = 12''$

req $A_s = .13$

$\rho > 200/f_y$

$4/3\ A_{s\ req} = .17\ in^2$

USE #5 @ 12"

REDUCE STEEL HIGHER K IN WALL

CAPACITY #5 @ 12" $A_s = .31$

$M_u = \phi A_s f_y (d - a/2)$

$M_u = .9(.31)(60ksi)\left(12 - [.98(.31)]\right) = 196'' \cdot k$

$$M = \frac{196'' \cdot k}{1.7}(1000/12) = 9598' \cdot lb$$

$$M = \frac{wl^2}{12}$$

$$w = \frac{12M}{L^2} = \frac{12(9598' \cdot lb)}{(20')^2} = 288\ lb/LF$$

$$w = \gamma y$$

$$y = \frac{w}{\gamma} = \frac{288\ lb/LF}{62.4\ lb/ft^3} = 4.6'$$

USE #5 @ 12" TOP 3"

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE DET BASIN
Job No. LV-607-250-02
DW Date 4/2 Chkd.By ____ Date ____

Description CONSPAN FOOTING DESIGN

SHEET 1/6

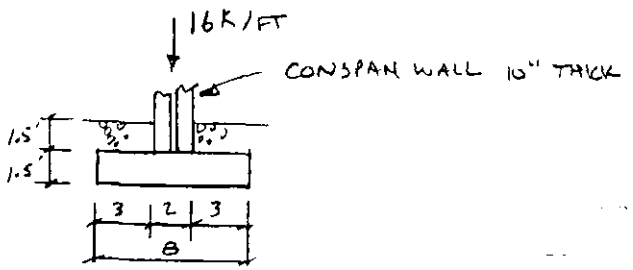
CONSPAN FOOTING DESIGN

FROM ATTACHED GRAPH (PAGE 6)
1' OF COVER & HS20 44 LOAD

INTERIOR REACTION 16 K/ft

EXTERIOR REACTION 9.5 K/Ft

INTERIOR FOOTING
TRY 8' WIDE FTG



SOIL	(1.5')(6')(130 pcf) =	1170
CONCRETE	(1.5')(8')(150 pcf) =	1800
BRIDGE LOAD		16000
		18970 lb/FT

BEARING PRESSURE

$$q = \frac{18970 \text{ lb/FT}}{8'} = 2371 \text{ psf}$$

ALLOWABLE PRESSURE

$$q_a = 2000 + 150(6) = 2900 \text{ psf}$$

$q_a > q$ OK

CHECK 7' WIDE FTG

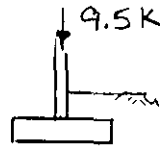
SOIL	1.5 (5)(130) =	975
CONCRETE	1.5 (7)(150) =	1575
BRIDGE LOAD	=	16000
		18555

$q = 18555 \text{ lb} / 7' = 2650 \text{ psf}$
$q_a = 2000 + 5(150) = 2750 \text{ psf}$ OK

EXTERIOR FTG

BRIDGE LOAD = 9.5 K/FT

TRY 5' FTG



SOIL 1	(2.08')(11')(130) =	2974
SOIL 2	(2.08)(1.5')(130) =	405
CONCRETE	5'(1.5)(150) =	1125
BRIDGE LOAD		9500
		14,004 lb/ft

$q \approx 14004 / 5' = 2800$ psf

$q_a = 2000 + 3(150) = 2450$ psf $q > q_a$ NG

TRY 6'

			ARM	M
SOIL 1	2.58(11)(130)	3689	1.29	4759
SOIL 2	2.58(1.5)(130	503	4.71	2369
CONC	6(1.5)(150)	1350	3	4050
BRIDGE		9500	3	28500
	ΣW	15042		$\Sigma M = 39,678$

$q \approx 15042/6 = 2507$ psf

$q_a = 2000 + 4(150) = 2600$ psf

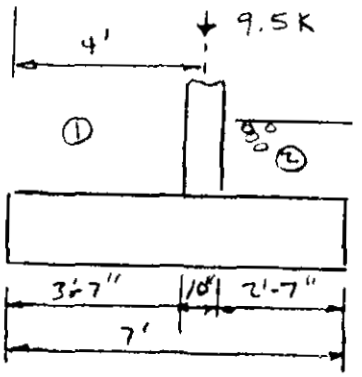
$q \approx q_a$ check eccentricity

$$\bar{x} = \frac{\Sigma M}{\Sigma W} = \frac{39678}{15042} = 2.64'$$

$$e = \frac{B}{2} - \bar{x} = \frac{6}{2} - 2.64 = .36 \quad < \frac{B}{6} = 1 \quad \text{OK}$$

$$q_{max} = \frac{\Sigma W}{B}\left(1 + \frac{6e}{B}\right) = \frac{15042}{6}\left(1 + \frac{6(.36)}{6}\right) = 3,409 \text{ psf NG}$$

TRY LARGER FTG W/ OFF-CENTER BRIDGE LOAD



		W	ARM	M
SOIL 1	(3.583)(11')(130pcf) =	5124	1.792	9181
SOIL 2	(2.583)(1.5')(130pcf) =	504	5.708	2875
CONCRETE	7 (1.5')(150pcf) =	1575	3.5	5512
BRIDGE		9500	4	38000
	ΣW	16703	ΣM	55569

$$\bar{X} = \frac{\Sigma M}{\Sigma W} = 3.327$$

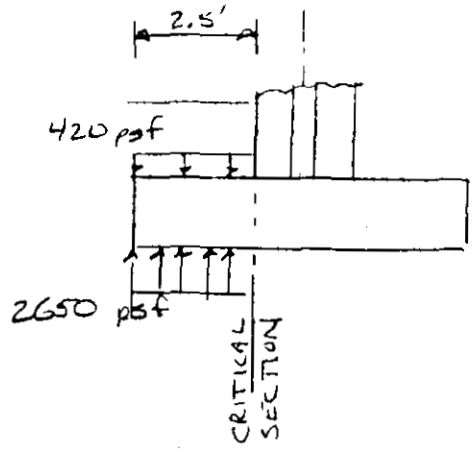
$$e = 7/2 - 3.327 = .173$$

$$q_{max} = \frac{16703}{7}\left(1 + 6\left(\frac{.173}{7}\right)\right) = 2740 \text{ psf}$$

$$q_a = 2000 + 5(150) = 2750 \text{ psf}$$

$q_{max} < q_a$ OK

REINFORCEMENT INTERIOR FTG



CONCRETE	1.5'(150)	225 psf
SOIL	1.5(130)	195 psf
		420 psf

$w = 2650 - 420 = 2230$ lb/LF

$$M = \frac{wl^2}{2} = \frac{2230\,(2.5')^2}{2} = 6969'\text{-lb} = 83.6''\text{-k}$$

$t = 18''$ $d = 14.5''$ A_s req = .11

$4/3\ A_s$ req = .14 in^2

TEMP & SHRINK

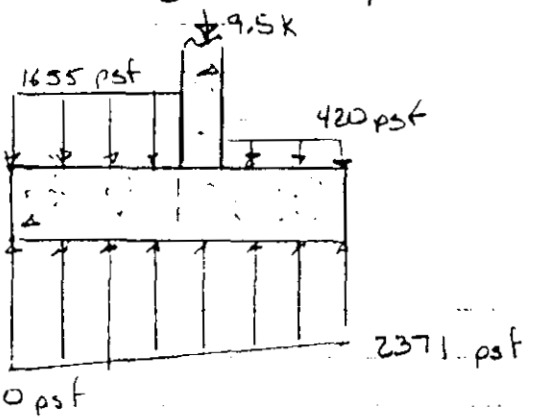
$.0018\,(12)(18) = .38\ in^2$

USE 2 MATS #4 @ 12'' $A_s = .40\ in^2$

REINFORCEMENT EXTERIOR FTG

$q_{max} = 2740$ psf

$q_{min} = \frac{16}{6}(1 - 6\frac{(1.73)}{7}) = 2371$ psf



OUTER PORTION

$w = 2740 - 1655 = 1085$ lb/LF

$M = \frac{wl^2}{2} = \frac{1085(3.583)^2}{2} = 6965'\text{-lb} = 83.6''\text{-K}$

INNER PORTION

$w = 2510 - 420 = 2090$ lb/LF

$M = \frac{wl^2}{2} = \frac{2090(2.583)^2}{2} = 6972'\text{-lb} = 83.7''\text{-K}$

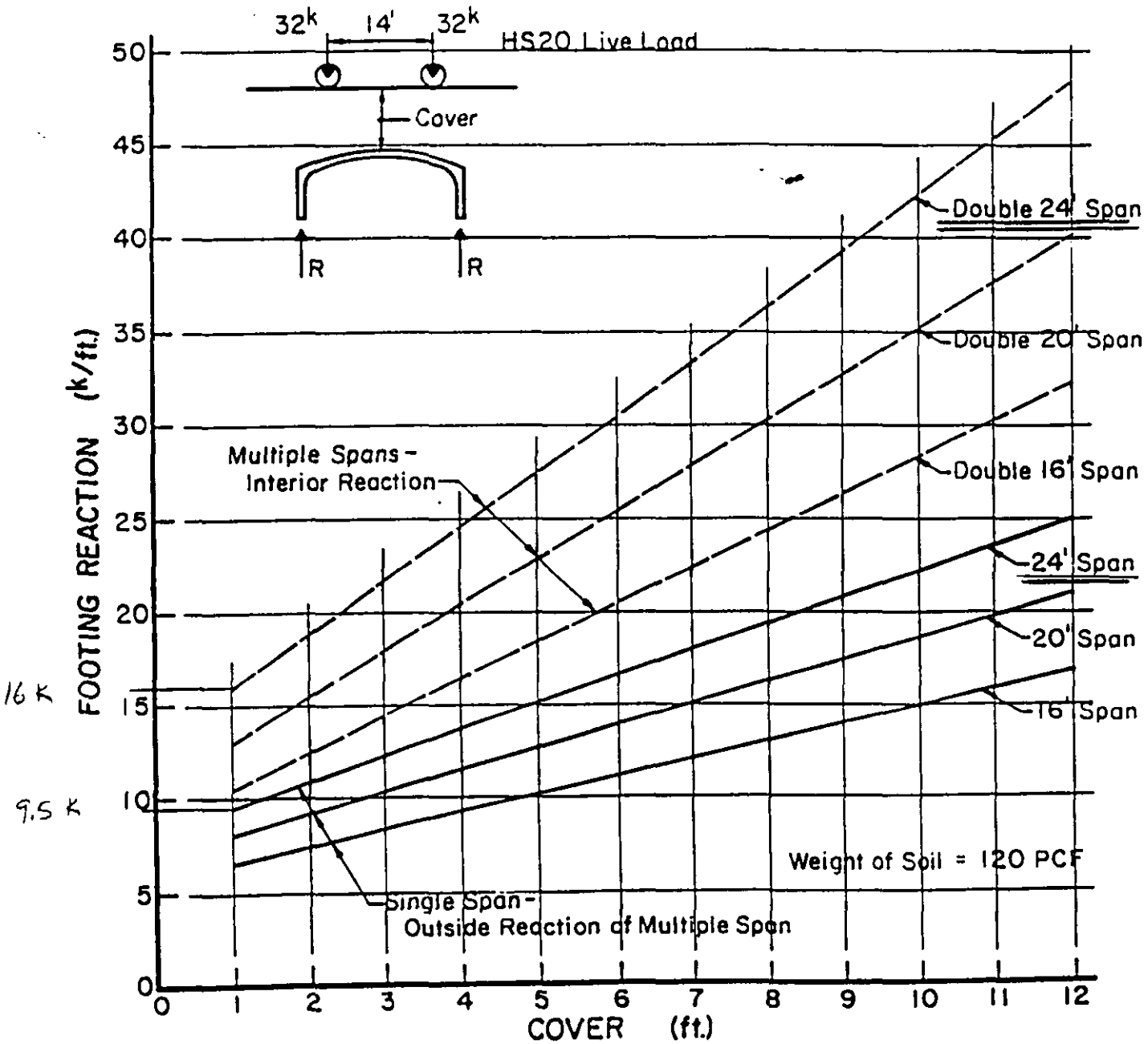
MOMENTS SIMILAR TO INTERIOR FTG

USE 2 MATS #4 @ 12"

SHEET 6/6

CON/SPAN® CULVERT SYSTEMS

FOOTING REACTIONS
(SERVICE LOADS)



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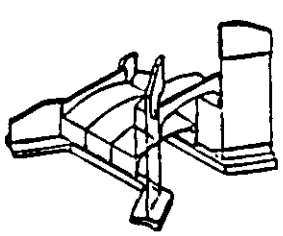


FOUNDATION DESIGN

Con/Span® Culvert Systems

BOYLE ENGINEERING CORPORATION

Project CONFLUENCE DET BASIN Description FREFAB GIRDER ABUTMENTS

Job No. LV-167-250-02

By [illegible] Date 11/25 Chkd.By _____ Date _____

SHEET 1/3

120' SPAN PREFAB BRIDGE

DL	DEAD LOAD / BASE PLATE	=	13,875	lb
LL	LIVE LOAD (60 PSF)	=	21,600	lb
WL	WIND VERTICAL	=	4,620	lb
SL	SEISMAC	=	940	lb

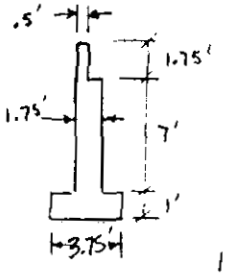
WIND > SEISMAC USE WIND

DL + LL = 35,475 lb ← CONTROLS

.75 (DL + LL + WL) = 30,071 lb

WEIGHT OF ABUTMENT

$14.5' \left[(1')(3.75') + 7'(1.75') + (.5')(1.75')\right] 150\ lb/ft = 36,703\ lb$



14.5' LONG ABUTMENT

WEIGHT OF BACKFILL

$14.5' \left(7(1) + 8.75(1)\right) 130\ lb/ft^3 = 29,689\ lb$

LOAD = 2(35,475 lb) + 36,703 lb + 29,689 lb = 137,342 lb

BEARING PRESSURE $\frac{137,342\ lb}{(3.75')(14.5')} = 2526\ psf$

ALLOWABLE

BASE ALLOWABLE		2000	psf
4' ADD'L EMBEDMENT	4 (500)	2000	psf
1.75' ADD'L WIDTH	1.75 (150)	262	psf
		4262 > 3500 psf max	

2526 psf OK

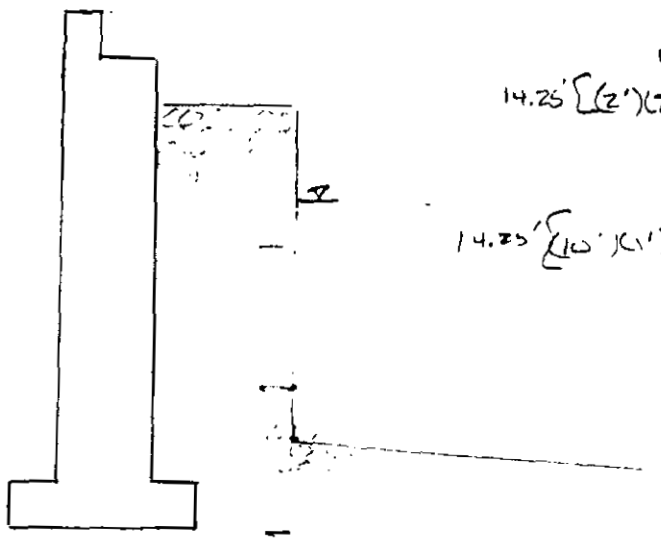
60' SPAN BRIDGE

DL	DEAD LOAD	5000 lb
LL	LIVE LOAD	10800 lb
WL	WIND LOAD	1240 lb
SL	SEISMAC LOAD	340 lb

DL + LL = 10800 + 5000 = 15,800 lb ← CONTROLS

.75 (DL + LL + WL) = 12,780 lb

USE FOOTING BELOW BOTTOM OF CHANNEL



WEIGHT OF ABUTMENT

$14.25' [(2')(7') + (1')(4') + .781 \text{ sf}] 150 \text{ pcf} = 48,695 \text{ lb}$

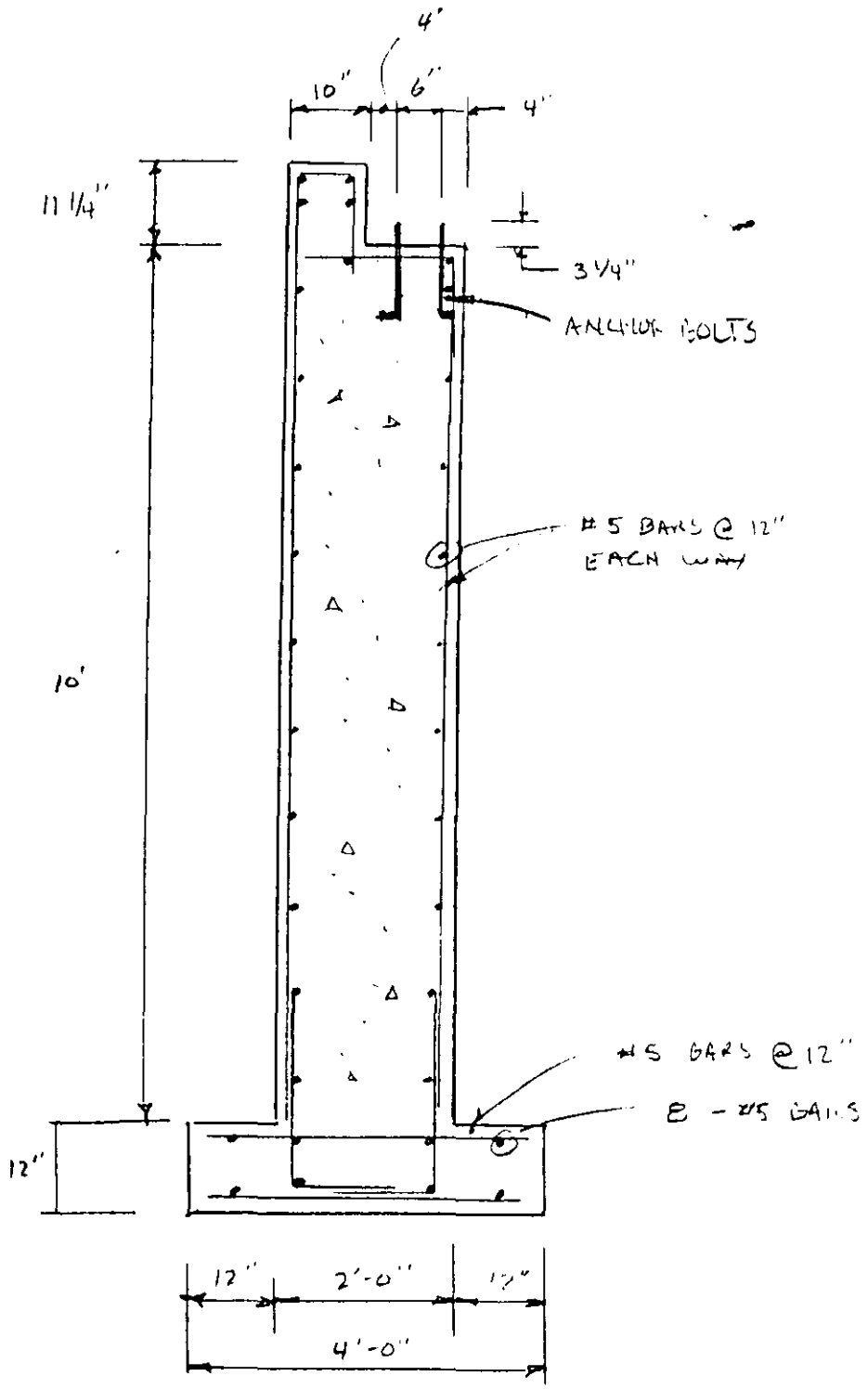
WEIGHT OF SOIL

$14.25' [(10')(1') + 8(1')](130 \text{ pcf}) = 33,345 \text{ lb}$

TOTAL $2(15800) + 48,695 + 33,345 = 113,640 \text{ lb}$

BEARING PRESSURE $\frac{113,640 \text{ lb}}{4'(14.25')} = 1994 \text{ psf} < 2000$ OK

60' SPAN [illegible] ABUTMENT



BOYLE ENGINEERING CORPORATION

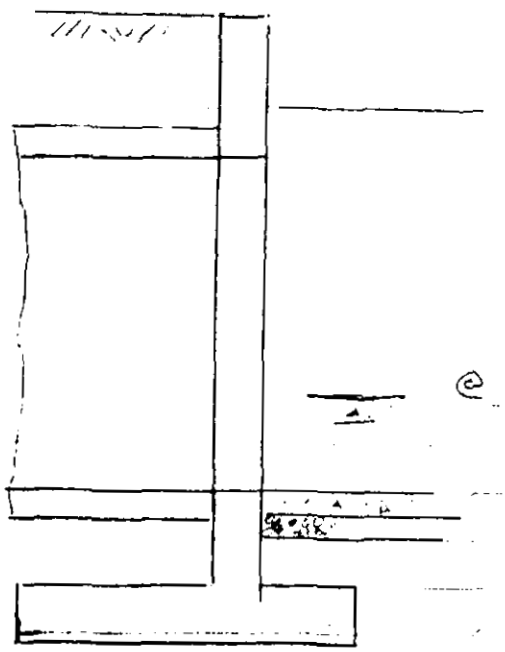
Project CONFLUENCE DET BASIN Description OUTFALL HEADWALL

Job No. LV-607-250.02

DWH Date 5/7/93 Chkd.By ____ Date ____

SHEET 1/6

HEADWALL



@ DESIGN SECTION

$P = \frac{1}{2}(43\,pcf)(13.25)^2 = 3775$ lb

$M = \frac{1}{6}(43)(13.25)^3 = 16671$ ft-lb

		W	Arm	M
SOIL 1	(4)(12)(130) =	6240	5	31200
SOIL 2	(2)(3.75)(130) =	975	1	975
FOOTING	(7)(1.25)(150) =	1313	3.5	4594
STEM WALL	(1)(12)(150) =	1800	2.5	4500
		10328		41269

OVERTURNING

FS $\frac{41269}{16671} = 2.48$ OK

SLIDING

Passive Pressure $\frac{1}{2}\ 190(5)^2 =$ 2375

Friction $.35(10328) =$ 3615

$F_R =$ 5990

FS $\frac{5990}{3775} = 1.59 > 1.5$ OK

$$\bar{x} = \frac{\Sigma M - M_o}{\Sigma V} = \frac{41269 - 16671}{10328} = 2.38$$

$$e = \frac{B}{2} - \bar{x} = 1.12$$

$$e < \frac{B}{6} = \frac{7}{6} = 1.17 \quad \text{OK}$$

$$q_{max} = \frac{10328}{7}\left(1 + 6\left(\frac{1.12}{7}\right)\right) = 2890 \text{ psf}$$

$$q_a = 2000 + 150(5) = 2750$$

$q > q_a$ NG

close consider passive pressure moment

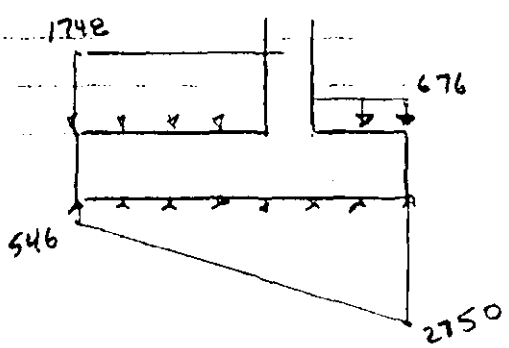
$$M_p = 1/6\,(190)(5^3) = 3958' \text{-lb}$$

$$\bar{x} = \frac{41269 + 3958 - 16671}{10328} = 2.765$$

$e = .735$

$q_{max} = 2404$ psf $<$ 2750 psf OK

$q_{min} = 546$ psf



HEAD LOAD

12(130) = 1560

1.25(150) = 188

1748 psf

TOE LOAD

3.75(130) 488

1.25(150) 188

676 psf

RATE 314.85 pf/ft

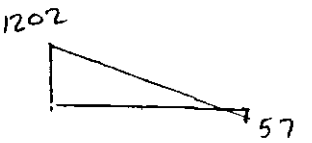
HEEL

NET $1748 - 546 = 1202$

$4(314.85) = 1259$

$546 + 1259 = 1805$

$1805 - 1748 = 57$



$M = \left(\frac{2}{L}\right) 1202 (4')^2 = 6411'\text{-}lb$

$M_u = 1.7 (6411)(12/1000) = 131''\text{-}k$

$t = 15''$ $d = 12''$ $A_{s\,req} = .21$

$4/3\ A_{s\,req} = .28$

USE #5 @ 12" $A_s = .31$

TOE

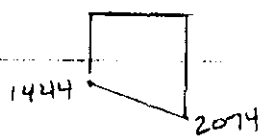
$2750 - 676 = 2074$

$2(314.85) = 630$

$2750 - 630 = 2120$

$2120 - 676 = 1444$

$2074 - 1444 = 630$

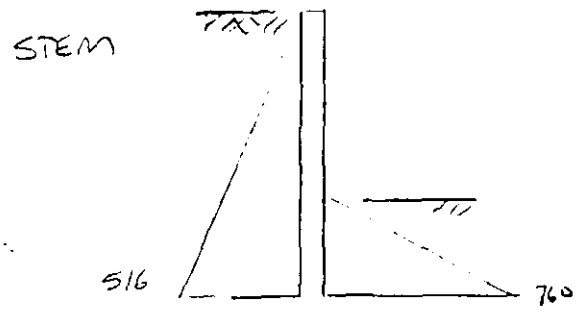


$M = 1444(2)(1) + \frac{1}{2}(630)(2)\frac{2}{3}(2) = 3728'\text{-}lb$

$M_u = 1.7 (3728)(12/1000) = 76''\text{-}k$

$A_{s\,req} = .12$

USE #4 @ 12"



12 (43) = 516
4 (190) = 760

$P_a = \frac{1}{2}\ 43(12)^2 = 3096$ lb
$P_p = \frac{1}{2}\ (190)(4)^2 = 1520$ lb

$M = 3096\ (12/3) - 1520\ (4/3) = 10357$ ft-lb

$M_u = 1.7\ (10357\ \text{ft-lb})\ (12/1000) = 211$ in-k

t = 12" d = 9.5" A_s = .43

Use #6 @ 12"

EXTEND UP 3' SAME AS WING WALL
AT JUNCTION

REDUCE TO #5 @ 12" 9' FROM TOP OF WALL

BOYLE ENGINEERING CORPORATION

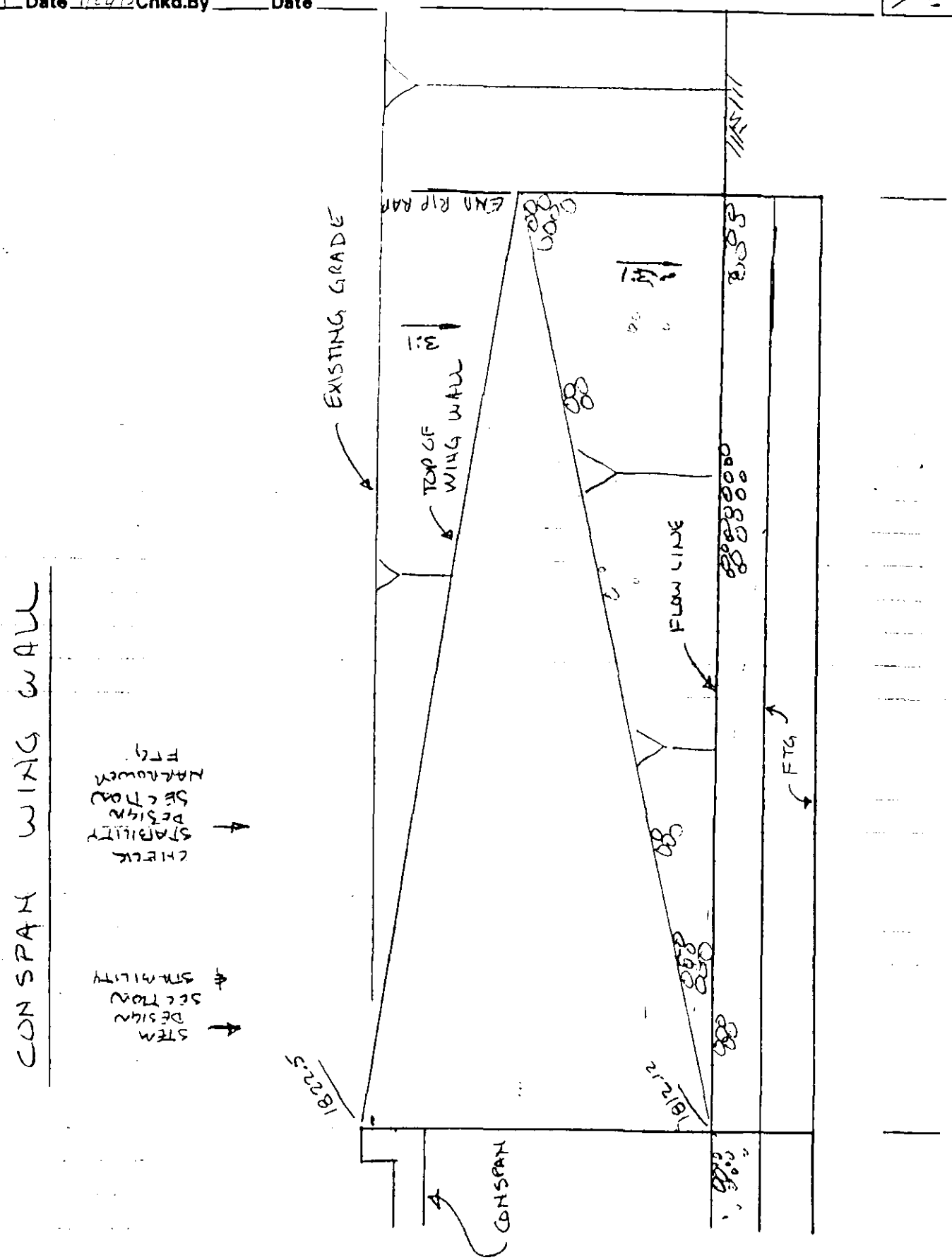
Project CANYON LAKE DAM — Description CONSPAN WING WALL

Job No. LD-007-250-02

(Init) Date 4/22/93 Chkd.By ____ Date ____

SHEET 1 / 1

CONSPAN WING WALL



CHECK STABILITY BY DESIGN SEE THIS MARGIN FOR FTG.

STEM DESIGN SEE THIS & STABILITY

CHECK STEM REQUIREMENTS

11.5' HEIGHT OF WALL

$P = \frac{1}{2}\ 43\ (11.5')^2 = 2843\ lb$

CHECK SHEAR

$V_c = 2\phi\sqrt{f'_c} = 93\ psi$

$t_{min} = \frac{(2843\ lb)(1.8)}{(93\ psi)(12")} = 4.6"$

$M = \frac{1}{6}\ 43\ (11.5)^3 = 10{,}900'\text{-}lb = 131"\text{-}k$

$M_u = 1.7\ (131) = 223"\text{-}k$

TRY 8" WALL $d = 5.5"$

$A_{s\ req} = .89\ in^2$

TRY 12" WALL $d = 9.5"$

$A_{s\ req} = .46$

$\approx$ #6 @ 12"

USE 12" WALL

UPPER WALL REDUCE TO #5 @12" $A_s = .31$

$M_u = .9\ (.31)(60\ ksi)\left[9.5 - \left(\frac{.98(.31)}{2}\right)\right] = 153.9"\text{-}k$

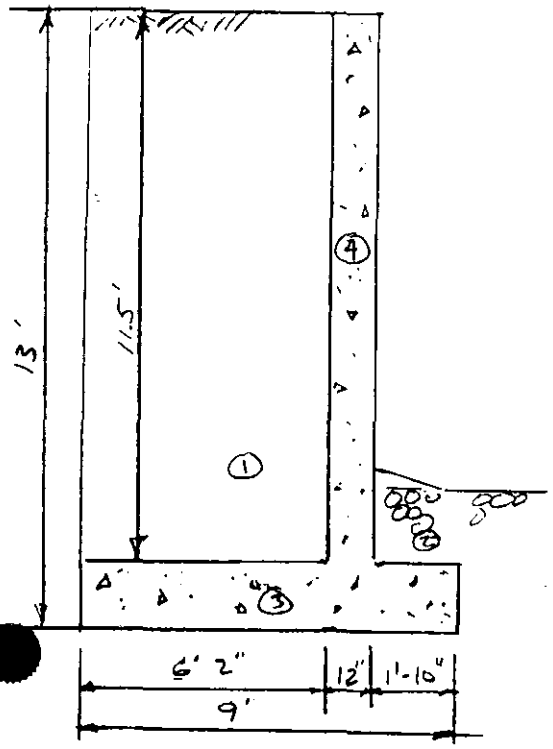
$M = \frac{153.9}{1.7}\left(\frac{1000}{12}\right) = 7546'\text{-}lb$

$H = \left(\frac{6M}{43}\right)^{1/3} = \left\{\frac{6\ (7546'\text{-}lb)}{43\ pcf}\right\}^{1/3} = 10'$

$12\ d_{bg} = \frac{6}{8}"\ 12 = 9"$ or d say 12"

EXTEND #6 BARS TO 9' BELOW TOP OF WALL MINIMUM

USE #6 DOWELS EXTENDED UP 3'



$P = \frac{1}{2}(43\,pcf)(13')^2 = 3634$ lb

$M_o = \frac{1}{6}(43\,pcf)(13')^3 = 15745'\text{-lb}$

PART	STABILITY	ARM	MOMENT
SOIL 1	$6.167(11.5)(130\,pcf) = 9219$	5.917	54547
SOIL 2	$(1.833)(1.5)(130\,pcf) = 358$	.917	328
FOOTING	$9\,(1.5)(150\,pcf) = 2025$	4.5	9113
STEM WALL	$1\,(11.5)(150\,pcf) = 1725$	2.333	4025
	ΣW 13327		ΣM 68011

OVERTURNING:

$$FS = \frac{\Sigma M}{M_o} = \frac{68011}{15745} = 4.32 \quad \text{OK}$$

SLIDING:

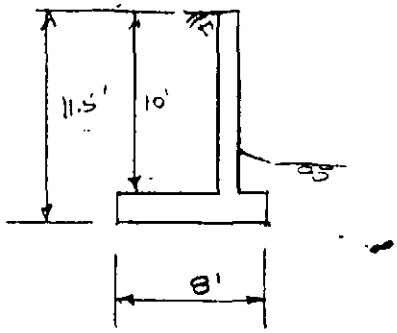
Passive pressure $\frac{1}{2}(190)(3)^2 = 855$ lb

Friction resistance $.35\,(13327) = 4664$ lb

$F_R = 5519$ lb

$$FS = \frac{F_R}{P} = \frac{5519\ lb}{3634\ lb} = 1.52 \quad > 1.5 \quad \text{OK}$$

2ND DESIGN SECTION



$P = \frac{1}{2}(43)(11.5)^2 = 2843$ lb

$M_o = \frac{1}{6}(43)(11.5)^3 = 10900$ ft-lb

Part	Weight		Arm	Moment
Soil 1	(5.167)(10)(130) =	6717	5.417	36382
Soil 2	(1.833)(1.5)(130) =	358	.917	328
Footing	(8)(1.5)(150) =	1800	4	7200
Stem Wall	(1)(10)(150)	1500	2.333	3500
	ΣW	10374	ΣM	47409

OVERTURNING

$$FS = \frac{47409}{10900} = 4.35 \quad \text{OK}$$

SLIDING

$$\frac{.35(10374) + 855}{2843} = 1.58 > 1.5 \quad \text{OK}$$

WALL FTG
1ST DESIGN SECTION

$$\bar{x} = \frac{\sum M_R - M_o}{\sum V} = \frac{52266}{13327} = 3.92$$

$$e = \frac{B}{2} - \bar{x} = .578$$

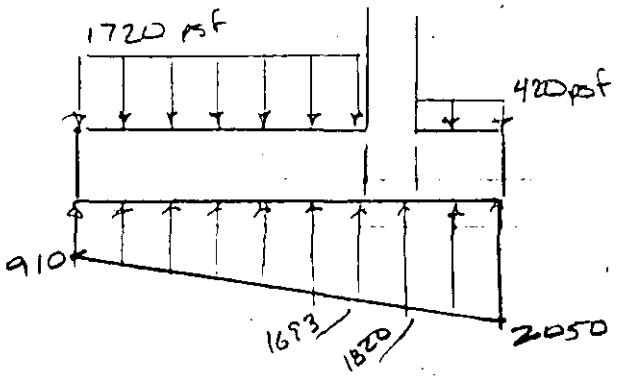
$$q_{max} = \frac{13327}{9}\left(1 + \frac{6(.578)}{9}\right) = 2051 \text{ psf}$$

$$q_a = 2000 + 150(7) = 3050 \text{ psf}$$

$q < q_a$ ...OK

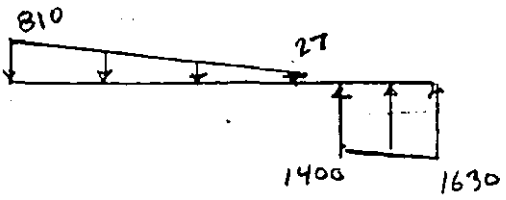
$$q_{min} = \frac{13327}{9}\left(1 - \frac{6(.578)}{9}\right) = 910 \text{ psf}$$

$11.5(130) = 1495$
$1.5(150) \quad 225$
1720



RATE $\frac{2050-910}{9} = 126.67$

NET LOAD



HEEL MOMENT @ CRITICAL SECTION

$M = \frac{1}{2}\,783\,(6.17)\,\frac{2}{3}\,(6.17) + 27\,(6.17)\,\frac{1}{2}(6.17) = 10450'\text{-lb}$

$M_u = 1.7\,(12/1000)\;10450 = 213''\text{-k}$

$t = 18''$ $\quad d = 14''$ $\quad A_{s\,req} = .29\ in^2$

$\frac{4}{3}\,A_{s\,req} = .39\ in^2$ $\qquad .27$

USE #6 @ 12" $\quad .44\ in^2$

TOE

$1400\left(\frac{1}{2}1.83\right)^2 + \frac{2}{6}\,230\,(1.83)^2 = 2600'\text{-lb}$

$M_u = 1.7\,(2600)(12/1000) = 53''\text{-k}$

$t = 18''$ $\quad d = 14''$ $\quad A_{s\,req} = .07\ in^2$

USE #4 @ 12"

BOYLE ENGINEERING CORPORATION

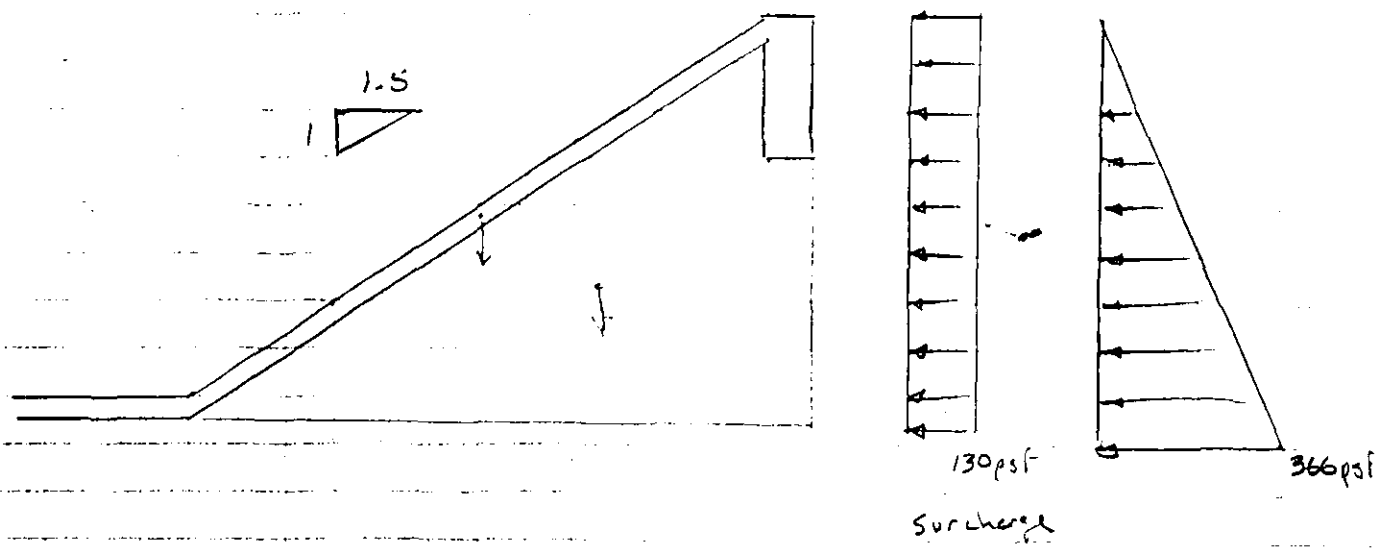
Project _____ Description ACCESS RAMP

Job No. _____ SHEET 1/2

_____ Date _____ Chkd.By _____ Date _____

STEEPER SIDE SLOPE

DESIGN AS RETAINING WALL



$8.5(43) = 366$

$P = 130(8.5') + \frac{1}{2}43(8.5)^2 = 2658$ lb

$M_o = 130\left(\frac{8.5}{2}\right)^2 + \frac{1}{6}43(8.5)^3 = 9097'$·lb

STABILITY

		W	ARM	M
SOIL	$\frac{1}{2}$ 8.5'(12.75')(130 pcf) =	7044 lb	8.5	59,874
CONC	.5 (15.3')(150 pcf) =	1149 lb	6.375	7325
	ΣW	8193 lb		CM_R 67198

OVERTURNING

$FS = \frac{\Sigma M_R}{M_o} = \frac{67198}{9097} = 7.4$ OK

SLIDING

$F_R = \tan 30°(8193) = 4730$ lb

$FS = \frac{4730}{2658} = 1.78$ OK

@ TOE

$M = 9097'$·lb $- 7325'$·lb $= 1772'$·lb

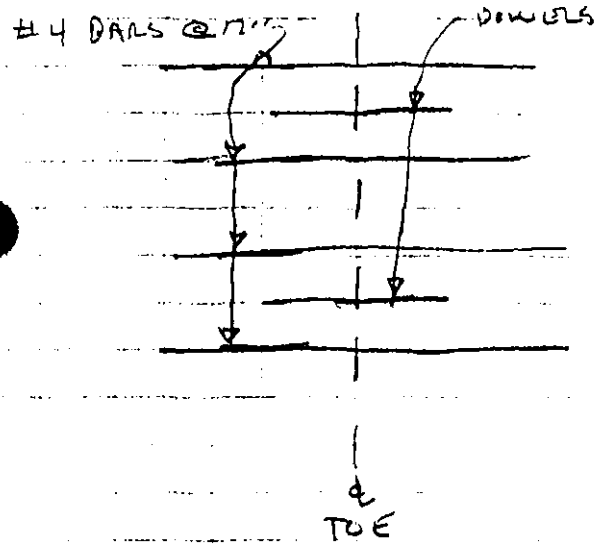
$M_u = 1.7\ (1772 \cdot 16)\ 12/1000 = 36''\text{-}K$

$t = 6''$ $d = 3''$

$A_{s\,req} = .24$

$\rho = \frac{.24}{(12)(3)} = .0067 > \rho_{min}$ ~~.0036~~ .0036 OK

AND # 4 DOWELS @ 24" SPACING



3 BARS / 2'

$3(.20) = .60\ in^2$

$\frac{.60\ in^2}{2'} = .30\ in^2$

BOYLE ENGINEERING CORPORATION

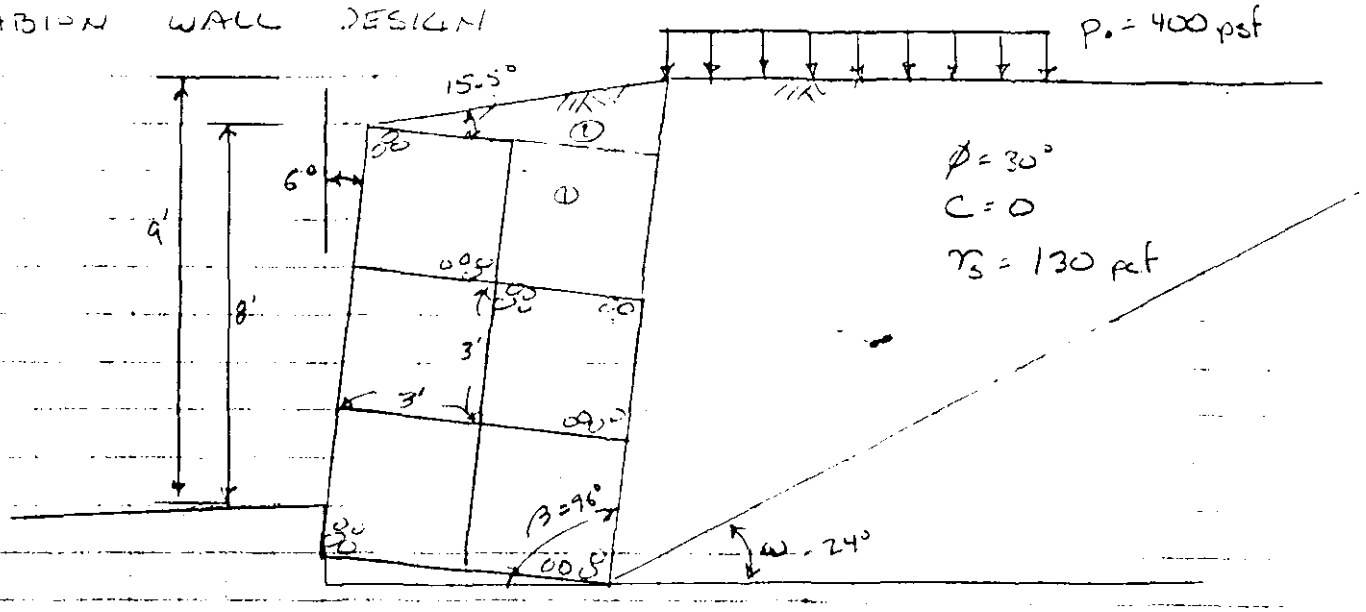
Project CONFLUENCE DET BASIN Description

Job No.

Date Chkd.By Date

SHEET 1/4

GABION WALL DESIGN



GABION DENSITY

$\gamma_{ROCK} = 160$ pcf

$n = .35$ porosity

$\gamma_g = (1-n)\gamma_R = (1-.35)160$ pcf $= 104$ pcf

		WEIGHT		ARM		M_R
GABIONS 1	(3')(9')(104 pcf)	= 2808		1.5 cos6° + 4.5 sin6° =	1.962	5509
GABION 2	(3')(6')(104 pcf)	= 1872		4.5 cos6° + 3 sin6° =	4.789	8965
SOIL 1	(3')(3')(130 pcf)	= 1170		4.5 cos6° + 7.5 sin6° =	5.259	6153
SOIL 2	½(6')(6 tan 15.5°)(130 pcf)	= 649		4 cos6° + 10 sin6° =	5.023	3260
		6499 lb				23887'-lb

$\beta = 96°$ $K_a = .251$

$H = \cos 6°(9 + 6 \tan 15.5) = 10.6'$

$P_a = \frac{1}{2} K_a \gamma_s H^2 + K_a p_o H$

$P_a = \frac{1}{2}(.251)(130)(10.6)^2 + (.251)(400)(10.6) = 2897$ lb

$P_H = P \cos\omega = 2897$ lb $\cos 24° = 2647$ lb

$P_V = P \sin\omega = 2897$ lb $\sin 24° = 1178$ lb

$$M_a = P_H \frac{H}{3}\left(\frac{H + 3p_o/\gamma_s}{H + 2p_o/\gamma_s}\right) - P_V B$$

$$M_a = 2647\,lb \frac{10.6'}{3}\left(\frac{10.6 + 3\,400/130}{10.6 + 2\,400/130}\right) - 1178\,lb\,(6')$$

$$M_a = 4002'\text{-}lb$$

NEGLECT PASSIVE PRESSURE

SLIDING STABILITY

$$F_R = (W + P_v)\tan\phi = (6499 + 1178)\tan 30 = 4432$$

$$F.S = \frac{F_R}{P_H} = \frac{4432\,lb}{2647\,lb} = 1.67 \quad > 1.5 \quad OK$$

OVERTURNING STABILITY

$$F.S. = \frac{M_R}{M_a} = \frac{23\,887'\text{-}lb}{4002'\text{-}lb} = 5.97 \quad OK$$

BEARING PRESSURE

$$N = (W + P_V)\cos 6^\circ + P_H \sin 6^\circ$$
$$N = (6499 + 1178)\cos 6^\circ + 2647 \sin 6^\circ = 7912\,lb$$

$$\bar{X} = \frac{M_R - M_a}{N} = \frac{23\,887 - 4002}{7912} = 2.51'$$

$$e = \frac{B}{2} - \bar{X} = \frac{6}{2} - 2.51 = .49 \qquad e < \frac{B}{6} = 1 \quad OK$$

$$q_{max} = \frac{N}{B}\left(1 + \frac{6e}{B}\right) = \frac{7912}{6'}\left(1 + 6\frac{(.49)}{6}\right) = 1964\,psf$$

$q_{max} < 2000\,psf$ OK

INTERNAL STRESSES CONSERVATIVELY CHECK USING STRESS @ BASE

ALLOWABLE STRESS

$\sigma_a = 5\gamma_g - 3$

w/ σ_a in kg/cm²

γ_g in t/m³

PER MACCAFERRI GABIONS

$\gamma_g = 104 \text{ lb/ft}^3 \left(\frac{.016 \text{ t/m}^3}{1 \text{ lb/ft}^3}\right) = 1.66 \text{ t/m}^3$

$\sigma_a = 5(1.66) - 3 = 5.3 \text{ kg/cm}^2$

$\sigma_a = 5.3 \text{ kg/cm}^2 \left(\frac{2048 \text{ psf}}{1 \text{ kg/cm}^2}\right) = 10{,}854 \text{ psf}$

MAXIMUM STRESS

$\sigma_{max} = \frac{N}{B - 2R}$ PER MACCAFERRI GABIONS

$\sigma_{max} = \frac{7912 \text{ lb}}{6 - 2(.49)} = 1576 \text{ psf}$

$\sigma_{max} < \sigma_a$ OK

ALLOWABLE SHEAR

$T_a = N \tan \phi^* / B + c_g$

$\phi^* = 25\gamma_g - 10°$ γ_g - t/m³

$\phi^* = 25(1.66) - 10 = 31.5$

c_g = say 1.5 t/m² (1.5 to 4 typical)

$N/B = \frac{7912 \text{ lb}}{6'} = 1319 \text{ psf} \left(\frac{.00482 \text{ t/m}}{\text{psf}}\right) = 6.43 \text{ t/m}^2$

$\tau_a = 6.43\ t/m^2 \tan 31.5° + 1.5 = 5.44\ t/m^2$

$\tau_a = 5.44\ t/m^2 \left(204.8 \frac{psf}{t/m^2}\right) = 1115\ psf$

MAXIMUM STRESS

$\tau = \frac{T}{B}$

$T = (W + P_V)\sin 6° + P_H \cos 6°$

$T = (6499 + 1178)\sin 6° + 2647 \cos 6° = 3435\ lb$

$\tau = \frac{3435\ lb}{6'} = 572\ psf$

$\tau = 572 < t_a = 1115$ OK

Continuously Reinforced

Handbook of Concrete Engineering
Mark Fintel

$$\rho = \left(\frac{f_t'}{f_s - n f_t} \right)$$

page 665

f_t' = tensile strength of concrete

$f_t' = 5 \phi \sqrt{f'c} = 5 (.65) \sqrt{3000}$ psi $= 178$ psi

$f_s = .75 f_y = .75 (60{,}000 \text{ psi}) = 45{,}000$ psi

$n = \frac{E_s}{E_c} = 9$

$$\rho = \left(\frac{178}{45000 - 9(178)} \right) = .0041$$

$A_s = \rho b d = .0041 (12)(6") = .295 \text{ in}^2$

MAY USE #5 @ 12" $A_s = .31 \text{ in}^2$

with recommendation of $\rho_{min} = .006$

$A_s = \rho b d = .006 (12")(6") = .43 \text{ in}^2$

#6 @ 12" $A_s = .44$

- CCRFCD Manual suggestion $\rho = .005$
$A_s = .005 (12")(6") = .36 \text{ in}^2$

#5 @ 9" $A_s = .41$

SUBGRADE DRAG THEORY – STEEL & JOINT REQUIREMENTS

TRANSVERSE

LENGTH TO FREE SURFACE SAY 62'

$$A = \frac{L C_f w h}{24 f_s}$$

Handbook of Concrete Engineering
Mark Fintel pg 663

$$A = \frac{62'(1.5)(150\ lb/ft^3)(6")}{24\ (45{,}000\ psi)} = .07\ in^2 / ft$$

LESS THAN MINIMUM #4 @ 12" $A_s = .20\ in^2/ft$

LONGITUDINAL

IF USE #5 BARS @ 12" $A_s = .31$

CALCULATE L

L = DISTANCE BETWEEN FREE JOINTS

$$L = \frac{24 f_s A}{C_f w h} = \frac{24\ (45{,}000\ psi)(.31\ in^2)}{1.5\ (150\ pcf)(6")} = 248'$$

Say contraction Joints @ 200'

Long. #5 @ 12"

Transverse #4 @ 12"

Construction joints at interruptions in concrete placement

REVISED 4/21/93

USE RECOMMENDED $\rho_{min} = .006$

#6 @ 12" LONG

5.4.4 Geotechnical Investigation
Sloan Channel Confluence Detention Basin

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

FINAL DESIGN GEOTECHNICAL INVESTIGATION SLOAN CHANNEL/ CONFLUENCE DETENTION BASIN NEAR NELLIS AIR FORCE BASE CLARK COUNTY, NEVADA

Prepared for:

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

CCSW Project No. 91-33647-02

April 7, 1993

Converse Consultants Southwest, Inc.
4670 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

Converse Consultants Southwest, Inc.

Geotechnical Engineering
and Applied Sciences

April 7, 1993

91-33647-02

Boyle Engineering Corporation
1785 East Sahara Avenue, Suite 300
Las Vegas, NV 89104

Attention: Mr. Don Davis, P.E.

Subject: Final Design Geotechnical Investigation
Sloan Channel/Confluence Detention Basin
Near Nellis Air Force Base
Clark County, Nevada

Gentlemen:

We are pleased to submit the results of our final design geotechnical investigation conducted for the Sloan Channel/Confluence Detention Basin project located near Nellis Air Force Base in Clark County, Nevada. The study was performed in general accordance with our signed Standard Form of Agreement with Consultant for Professional Services, dated May 4, 1992.

The detention basin embankments may be constructed from on-site borrow soils. Foundation systems consisting of conventional spread footings founded on a properly placed and compacted zone of structural fill are recommended for support of structural loads.

Groundwater was not encountered to the depths explored for this project. Hard caliche and/or moderately hard partially cemented soils were encountered at some of the boring locations at various depths. Rock excavation techniques may be required for any areas with deep cuts.

The report which follows presents our recommendations for design and construction of earth structures and foundations. If you have questions concerning information contained in this report, please contact us at your convenience.

Respectfully submitted,

CONVERSE CONSULTANTS SOUTHWEST, INC.

Algirdas G. Leskys, P.E.
President

AGL:glt
15/67G

Converse Consultants Southwest, Inc.
4870 South Polaris Avenue
Las Vegas, Nevada 89103-5615
Telephone (702) 795-2121
Facsimile (702) 798-0098

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

As the client of a consulting geotechnical engineer, you should know that site subsurface conditions cause more construction problems than any other factor. ASFE/The Association of Engineering Firms Practicing in the Geosciences offers the following suggestions and observations to help you manage your risks.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Your geotechnical engineering report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. These factors typically include: the general nature of the structure involved, its size, and configuration; the location of the structure on the site; other improvements, such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask your geotechnical engineer to evaluate how factors that change subsequent to the date of the report may affect the report's recommendations.

Unless your geotechnical engineer indicates otherwise, do not use your geotechnical engineering report:

- when the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size, elevation, or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems that may occur if they are not consulted after factors considered in their report's development have changed.

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time of subsurface exploration. Do not base construction decisions on a geotechnical engineering report whose adequacy may have been affected by time. Speak with your geotechnical consultant to learn if additional tests are advisable before construction starts. Note, too, that additional tests may be required when subsurface conditions are affected by construction operations at or adjacent to the site, or by natural events such as floods, earthquakes, or ground water fluctuations. Keep your geotechnical consultant apprised of any such events.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL JUDGMENTS

Site exploration identifies actual subsurface conditions only at those points where samples are taken. The data were extrapolated by your geotechnical engineer who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your geotechnical engineer can work together to help minimize their impact. Retaining your geotechnical engineer to observe construction can be particularly beneficial in this respect.

A REPORT'S RECOMMENDATIONS CAN ONLY BE PRELIMINARY

The construction recommendations included in your geotechnical engineer's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Because actual subsurface conditions can be discerned only during earthwork, you should retain your geotechnical engineer to observe actual conditions and to finalize recommendations. Only the geotechnical engineer who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations are valid and whether or not the contractor is abiding by applicable recommendations. The geotechnical engineer who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Consulting geotechnical engineers prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your geotechnical engineer prepared your report expressly for you and expressly for purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the geotechnical engineer. No party should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

GEOENVIRONMENTAL CONCERNS ARE NOT AT ISSUE

Your geotechnical engineering report is not likely to relate any findings, conclusions, or recommendations

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INTRODUCTION

GENERAL

This report presents the results of our final design geotechnical investigation performed for the proposed Sloan Channel/Confluence Detention Basin Project in Clark County, Nevada. A vicinity map showing the location of the project within the Las Vegas Valley area is provided on Drawing No. 1. The purposes of this investigation were to:

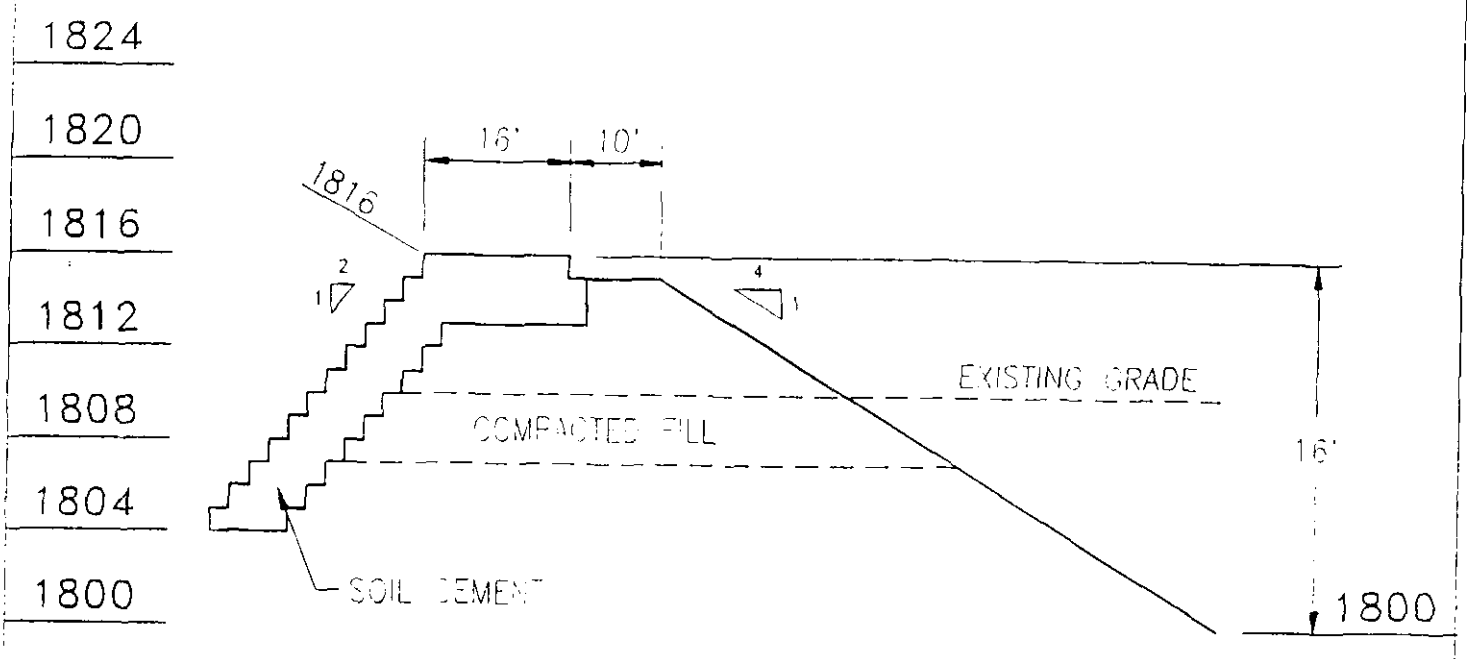
1. Determine the nature and engineering properties of the subsurface and embankment fill soils;
2. Provide recommendations for earthwork requirements; and
3. Provide geotechnical design recommendations for the proposed detention basin and hydraulic structures.

This study was performed in conjunction with an environmental investigation (CECSW Project No. 93-43109-01).

In 1992, Converse Consultants Southwest, Inc. (CCSW) conducted a preliminary geotechnical site assessment for the subject project (CCSW Project No. 91-33647-01, dated July 12, 1992). Data from that investigation was referenced during our study. In 1989, CCSW also performed a Preliminary Geotechnical Evaluation for Facility Planning Upper Las Vegas Flood Control Projects in North Las Vegas (CCSW Project No. 88-33195-01). Our report, dated November 20, 1989, presented our findings and preliminary recommendations. The proposed project lies within the limits of this investigation. The detention basin will be located near the site referred to as *Potential Detention Site 1*. Pertinent boring and trench logs from the previous investigations are provided in Appendix C. The approximate location of the previous borings and trenches are indicated on Drawing No. 2.

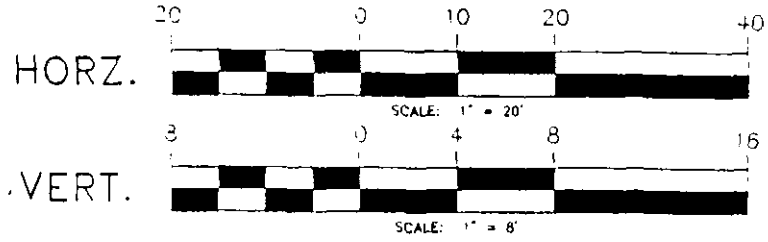
PROJECT DESCRIPTION

We understand the project will consist of embankments and a reservoir with emergency overflow spillway, outlet works, and inlet and outlet channels. One of the embankments will serve as the emergency spillway. The spillway embankment will trend from south to north along the west end of the reservoir and will be approximately 2,200 feet in length. For erosion protection, a soil-cement surface is planned on the crest and on the 2:1 (horizontal to vertical) downstream slope. The upstream slope will have a 4:1 (horizontal to vertical) slope. The maximum upstream and downstream spillway embankment heights will be on the order of about 16 feet and 12 feet, respectively. A typical cross section of the proposed spillway embankment is presented on Figure No. 1. The earthen embankment will trend from west to east along the southern end of the reservoir. The maximum upstream and downstream earthen embankment heights will be on the order of about 23 feet and 16 feet, respectively, with a crest width of about 20 feet. A 4:1 (horizontal to vertical) slope is planned for both sides of the earthen (south) embankment. The maximum height of both embankments will be near the southwest corner of the reservoir. Their heights will gradually decrease to a minimal height as they trend toward their opposite ends (north and east). The inlet and outlet channels will be about 4,000 and 2,400 feet in length, respectively. The existing Sloan Channel alignment west of the Nellis Air Force Base golf course will be diverted from a southerly direction to an easterly direction (inlet channel) across the golf course to the detention basin area. The inlet channel will generally have 3:1 side slopes and will be unlined in some areas and grass-lined in others. The grass-lined areas will have flatter side slopes. Some unlined channel areas may use gabions or other erosion control measures. The outlet channel will be concrete lined with 2:1 side slopes. The embankments and reservoir will be located just east of the golf course. In the reservoir area, excavations are anticipated to be on the order of 6 to 8 feet. The detention basin will cover an area of about 150 acres and will have a maximum holding time of about 36 hours. When the reservoir is full and half full, the water levels will be about 16 feet and 13 feet deep, respectively. Seepage losses from the facility are not a concern, as long as stability of the structure is adequate and downstream development is not affected. Erosion protection alternatives include gabions and soil-cement. We were requested to evaluate two soil types (fine-grained & granular) for potential use as material for



WEST EMBANKMENT
(2200' LONG SPILLWAY)

GRAPHIC SCALE



TYPICAL SECTION

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Sciences

Scale: AS SHOWN
Date: 2/17/93
Prepared by: KJB
Checked by: BLO
Approved by: BLC

Project No.: 91-33647-02
Figure No.: 1

soil cement. The report (CCSW Project No. 93-33131-01) presenting the results of that study, will be provided at a later date.

A prefabricated concrete bridge/culvert (Con/Span) is planned near the Sloan Channel diversion area. It will bridge across the new inlet channel and will be placed in the existing alignment of the road to the golf course clubhouse. The Con/Span structure will be five section panels wide (40 feet) and double spanned. Each span will be 24 feet with a rise of 8 to 10 feet. The structure will have 3 feet of cover. The anticipated maximum abutment and pier loads with HS20 loading were estimated to be about 13 kips per lineal foot (klf) and 23 klf, respectively. The channel underlying the structure will be lined with a one-foot thick gabion blanket. Formed concrete wingwalls will also be placed adjacent to the Con/Span structure. Wingwall footings will be at the same elevation as the abutment footings. The anticipated maximum water velocity at the Con/Span location is 10 feet per second (fps).

Two 12 foot wide prefabricated steel bridges with wood decking will cross the inlet channel in the golf course area. The bridges will be single span and will be about 60 and 120 feet long. They will be used for golf carts and maintenance vehicles.

The outlet works will consist of a box type structure located near the southwest corner of the reservoir. The box structure will be about 20 X 50 feet in size. The top of the box will be open at elevation 1813 and will serve as the main inlet of the outlet works. A smaller inlet consisting of a 5 X 4 foot reinforced concrete box (RCB) covered with a trash rack will be at the bottom of the upstream slope. Two 10 X 5 foot RCB's will extend through the earthen embankment to connect the outlet channel with the box structure.

SCOPE OF SERVICES

The following tasks were included in our scope of services:

1. A field exploration program was conducted which consisted of drilling and excavating, logging, and sampling of thirty-six (36) exploratory borings to depths ranging from 10 to 40 feet and twelve (12) exploratory test pits to depths varying from 5 to 6 feet. The

approximate location of the explorations are shown on Drawing No. 2. A description of the equipment and procedures used during the exploration program is presented in Appendix A. Summaries of the boring logs are also presented in Appendix A. General summaries of the exploratory test pits are presented in Appendix A. Samples of the subsurface soils were obtained from the borings and test pits, and were taken to our laboratory for further evaluation and testing. The samples obtained from the test pits were generally for the soil-cement mix design.

2. Laboratory tests were conducted on selected soil samples. Tests included moisture content, dry densities, permeability, solubility, clay swell, Atterberg limits, chemical analyses, maximum density, sieve analyses, and direct shear tests. Descriptions and results of the laboratory tests are presented in Appendix A. The soil samples presently stored in our laboratory will be discarded after 30 days, unless this office receives a specific request to retain the samples for a longer period.

3. Results of the field exploration and laboratory testing were evaluated and engineering analyses were performed to develop appropriate recommendations for the design and construction of the proposed project.

4. This geotechnical report was prepared to present the findings, conclusions and recommendations of this firm.

SITE CONDITIONS

SURFACE

At the time of our field investigation, the site was generally undeveloped. The area of the unlined inlet channel was generally developed with a golf course and some paved roads. The west end of the proposed inlet channel area was undeveloped desert with vegetation typical for the area. The detention basin area was generally undeveloped desert that was sparsely vegetated with

creosote and bursage. Scattered mesquite bushes were encountered near or in wash channels. The ground surface toward the west was covered with occasional very small "sand dunes" covered with vegetation. Two small to medium-sized washes flow south and southwest, through the proposed detention basin area and join near the center and then flow southwest off the site to an unlined channel that ties into the existing concrete lined Sloan Channel at Carey Avenue. The existing unlined channel will be concrete lined for this project and will be a part of the concrete lined outlet channel. The two washes range in size from approximately 10 to 30 feet across. The flow grades of the these washes are gentle and fairly uniform through the area, averaging about a 10 foot vertical drop over 1000 feet horizontally. Areas between the washes are generally flat, with occasional refuse piles. The northeast section of the proposed detention basin is an old gravel pit borrow area. The southern boundary of the gravel pit is lined with large fill piles. Large power transmission lines trend along the southern boundary of the detention basin just south of the proposed south embankment. The alignment of the transmission lines changes directions near the southwest corner of the reservoir and trends to the south along the proposed outlet channel alignment. The alignment of the outlet channel is undeveloped desert toward the north and is developed as indicated on Drawing No. 2 towards the south near the existing Sloan Channel. The developed area is unlined and is bordered on the east by a paved street (Toiyabe Street). The detention basin area is bounded on the North and West by Nellis Air Force Base, on the east and south by undeveloped desert.

SUBSURFACE

Based on results of our subsurface explorations, the subsoils generally consisted of 1 to 5 feet of soft to firm clays and silts and loose granular soils overlying stiff to very stiff clays and silts, medium dense granular soils, and moderately hard to hard cemented soils (caliche). The majority of the silts and clays and some sands were found to be porous. As indicated on Drawing No. 2, the granular soils were generally encountered towards the east and southeast portions of the site except for the surficial dune sands towards the west. The soils also contained varying amounts of soluble gypsum. The depths to the cemented soils are provided below in Table No. 1.

Free groundwater was not encountered to the depths explored for this project. Groundwater in the area should be at a depth in excess of 40 feet and should probably not affect the proposed project.

Table No. 1: Depths to Cemented Soils

Boring Location	Depth to Cemented Soils (ft)	Thickness of Cemented Soils (ft)	Soil Description
B-112	21	5	Moderately Hard
B-113	2	8	Moderately Hard
B-113	19	8	Moderately Hard
B-114	4	>11	Moderately Hard
B-115	6	7	Moderately Hard
B-116	10	2	Moderately Hard
B-118	5	>10	Moderately Hard
B-133	1½	4	Moderately Hard
B-133	5½	1	Hard
B-134	5	3	Moderately Hard
B-135	6	1	Moderately Hard
B-2*	19	1½	Hard
B-3**	19	2	Moderately Hard

* From preliminary geotechnical site assessment (CCSW Project No. 91-33647-01, dated July 12, 1992).

** From preliminary geotechnical evaluation (CCSW Project No. 88-33195-01, dated November 20, 1989).

Laboratory test results indicate that the on-site soils have, low to moderate dry densities, a moderate to high potential for hydro-collapse (rapid settlement upon saturation), moderate shear strength, low to moderate permeability, a low to moderate potential for gypsum solubility, a low to high clay swell potential, a low chemical (salt) heave potential, and contain sulfate salts in sufficient concentrations to be severely corrosive to concrete, soil-cement and metal. Silts and fine sands are susceptible to piping. Based on the preliminary soil-cement test results, the native soils can be used as material for soil-cement. The laboratory test results of the native soils presented in Appendix A are summarized in Table No. 2.

Table No. 2: Summary of Laboratory Test Results and Soil Characteristics

Characteristic	Range of Results
Maximum Density	117 to 121 pcf
Optimum Moisture Content	11 to 11.5 percent
Solubility	0.1 to 4.6 percent
Coefficient of Permeability "K"	(1.5 to 35) X 10^{-6} cm/sec[2]
Angle of Internal Friction	18 to 39 degrees
Sulfate	0.01 to 0.69 percent
Clay Swell	1 to 10 percent

[2]Remolded Soils

Based on the results of our subsurface exploration and our experience, variations in the continuity and depth of subsoil deposits should be anticipated. Due to the nature and depositional characteristics of the natural soils, care should be exercised in interpolating subsurface soil conditions beyond the boring and test pit locations.

LOCAL FAULTING

No bedrock or tectonic faults are known to transect the lakebed deposits in the area of the project. The nearest fault with evidence of possible geologically recent displacement is located at the foot of Frenchman's Mountain approximately 1 mile east of the site.

The site is located approximately 1½ miles southeast of a topographic lineation regarded as a subsidence-related fault and 5 miles southeast of a mapped fissure zone, as mapped on the Subsidence-Related Faults and Fissures of the Las Vegas Valley Map, published by the Nevada Bureau of Mines and Geology, Subsidence in Las Vegas Valley 1980-91 Final Project Report, John W. Bell and Jonathan G. Price, 1991. It is generally agreed that subsidence-related faults are not bedrock faults, although their displacement may have been at least partly induced by a seismic event. The age of one of these escarpments has been dated by others at about 14,000 years old. Fissures, surface expressions of differential stress resulting from regional and local subsidence due to withdrawal of groundwater have been localized near subsidence-related faults.

Some fissure features were observed at different locations across the site. These features are believed to be related to erosion and/or hydro-collapsible soils and not subsidence.

ESTIMATED GROUND ACCELERATIONS

Las Vegas Valley is located in Seismic Zone 2B as categorized in the Uniform Building Code. Zone 2B represents a low to moderately active seismic area. A regional map published by Algermissen and Perkins (1976) presents the expected peak horizontal ground acceleration for the Las Vegas Valley as approximately 0.1g. This value has a 10 percent chance of being exceeded in a 50-year period. Site specific seismicity model analyses have been performed by CCSW on other projects in the Las Vegas Valley. This analysis has typically found the maximum credible peak horizontal ground acceleration to range between 0.2g and 0.3g. For an event having a 10 percent chance of exceedance during a 100-year design life the peak horizontal ground acceleration has ranged between 0.1g and 0.2 g. The peak horizontal ground acceleration recommended for the design of the project is 0.15g.

EVALUATION AND RECOMMENDATIONS

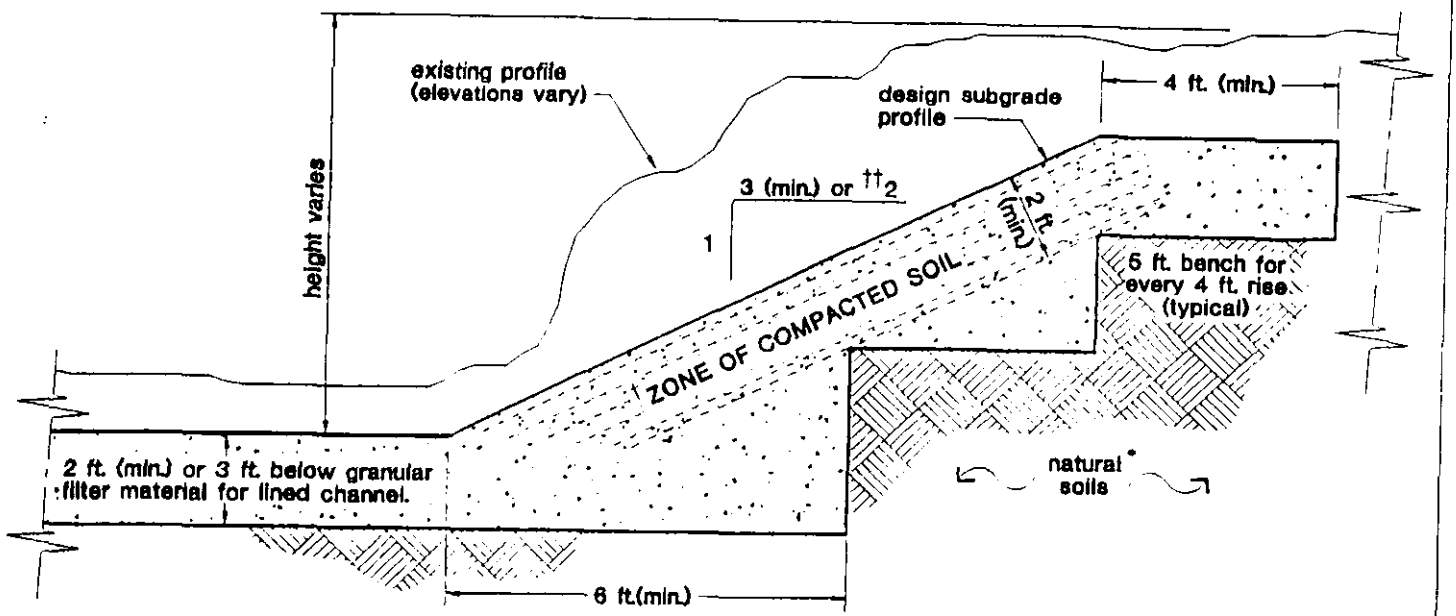
GENERAL

Based on the results of the field and laboratory investigations, it is our opinion that the detention basin embankments may be constructed from on-site borrow soils. The borrow soils should have low permeabilities. A few borrow areas have soils that are low to moderately water soluble (gypsiferous) and may require blending with other on-site or import soils prior to being used as embankment or structural fill. Stability of the embankments should not be a concern if the planned 4:1 (horizontal to vertical) upstream slopes and the 4:1 and 2:1 (spillway) downstream slopes are used. The planned channel side slopes for the unlined (3:1) and concrete lined (2:1) channels should be stable. The native soils in their present condition are subject to hydro-collapse and are not considered suitable for the support of the proposed structures and asphaltic pavements. They could also cause embankment settlement if proper preparation of subgrade soils is not accomplished. The engineering properties of the on-site

soils can be improved by excavating, processing and recompacting. The proposed structures should receive adequate support from conventional footings founded on a zone of properly placed and compacted structural fill. Hydro-collapsible soils were encountered at depth, to help reduce future maintenance due to runoff erosion and settlement, the hydro-collapsible soils should be overexcavated or reworked and recompacted in the unlined channel and detention basin bottom areas. On-site soils with a solubility greater than 2 percent (gypsiferous) may require blending with non-gypsiferous soils prior to being reused as compacted structural fill. Potential sources of cobbles for gabion construction are the gravel pits east of the project. Occasional use of rock excavation techniques for cemented soils should be anticipated for some areas of the project.

EARTHWORK

Site Preparation: Within the areas to be graded, we recommend that all the existing vegetation, undocumented fill, rubble, trash, debris and any loose soft or disturbed native soils should be removed from within the proposed embankment, channel, inlet (diversion) and outlet structure and bridge structure areas. The undocumented fill, loose, soft, firm or disturbed native soils should be excavated, processed, and stockpiled for later use as compacted structural fill. After stripping, the exposed hydro-collapsible native soils should be excavated to provide a zone of structural fill for the support of embankments, concrete channel linings, footings, asphaltic pavements and any concrete slabs-on-grade. A representative of this office should observe the bottom of the overexcavation prior to the continuance of grading to ascertain whether the recommended removals have been made and whether the exposed soils are suitable for the support of structural fill. To help reduce the hydro-collapse potential and erosion and subsequent maintenance of the detention basin bottom, the subgrade soils should be scarified to a depth of 12 inches and recompacted. If excavated on-site soils have a high expansion potential (greater than 8 percent), they should not be reused as structural fill in the lined outlet channel areas. The limits of the structural fill should be as shown on Figure No. 2 for the channels and as summarized in the following table:



Footnotes:

* Exposed natural soils should be scarified to a depth of 6 in., moistened and compacted according to the requirements for structural fill.

† See structural fill section for material and compaction requirements.

†† Concrete lined outlet channel

REQUIREMENTS FOR SUBGRADE PREPARATION

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Scale	NONE
Date	3.2.93
Prepared by	JBM
Checked by	BLO
Approved by	
Project No.	91-33647-02
Figure No.	2

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Sciences

*Depth below embankments	3 to 6 feet[2]
*Depth below all footing bottoms	36 inches
*Depth below unlined channel bottoms	24 inches
*Depth below lined channel bottoms (filter gravel)	36 inches
*Depth below channel side slopes[3]	24 inches
*Depth below slabs-on-grade (supportive gravel)	18 inches
*Depth below asphaltic pavements	18 inches
*Depth below detention basin bottom (Optional)	12 inches
Minimum distance beyond upstream embankment toe	10 feet
Minimum distance beyond footings	5 feet
Minimum distance beyond pavements	2 feet

* Depth includes 6 inches (12 inches for detention basin bottom) of scarified and recompacted subgrade.
[2] See *Embankment* section.
[3] Measured perpendicular to design subgrade.
Note: The required depth of overexcavation can be reduced if moderately hard to hard cemented soils are encountered.

The subgrade in all areas to receive fill should be scarified to a minimum depth of 6 inches, the soil moisture adjusted to at least 2 percent above the optimum moisture content for silty and clayey soils and to within 2 percent of optimum for sandy soils, and then compacted to at least 90 percent for silty and clayey soils, and to at least 95 percent of the maximum laboratory dry density (as determined by ASTM D-1557) for sandy soils.

Structural Fill and Backfill: Structural fill and backfill is defined as fill supporting or placed behind structures. Fill consisting of excavated on-site soils or imported soils approved by the Geotechnical Engineer shall be placed in layers on approved subsoils. Soils used as compacted structural fill shall be free of organic matter and miscellaneous inorganic debris and inert rubble larger than 4 inches nominal size. Imported fill materials should be similar to on-site soils with the following characteristics:

a. be free of organics and inert materials larger than 4 inches,
b. have at least 35 percent passing the No. 200 sieve,
c. have a swell potential less than 5 percent,
d. have a gypsum solubility of 1 percent or less, and
e. have water soluble sodium sulfate percentage less than 0.2.

Based on our experience in the locale, water soluble soils (gypsiferous) may be encountered during grading. On-site gypsiferous soils, if encountered,

with a solubility of 2 percent or more by dry weight should not be used as embankment fill or structural fill. They can be used as embankment fill or structural fill after being thoroughly blended with imported or on-site non-gypsiferous soils at the minimum ratios given in the following table:

% Soluble Gypsum	*Estimated Blending Proportions Non-Gypsiferous Gypsiferous Soil
2 to 4	1:1
4 to 6	2:1
Above 6	cannot be used as structural fill

* Final blending proportions to be established by laboratory testing.

Soils which have more than six percent soluble gypsum, if encountered, cannot be used to produce acceptable structural fill, and must be removed and disposed of off-site or in an area on-site where structural fill will not be placed over this wasted soil.

Embankment fill soils and structural fill soils should be moisture adjusted to at least 2 percent above the optimum moisture content for silty and clayey soils and to within 2 percent of optimum for sandy soils, and then compacted to at least 90 percent of the maximum laboratory dry density (as determined by ASTM D-1557).

Material Volume Changes: There will be shrinkage losses or swell when excavating and compacting the on-site soils. An estimated shrinkage factor of 20 to 30 percent is applicable for the natural non-cemented soils. A subsidence factor of 0.1 feet should be used in all areas where the exposed native soils are compacted to a depth of six inches. An estimated swell factor of 0 to 10 percent is applicable for the natural cemented soils.

Excavations: Based on observations made during our field explorations, the majority of the native soils are noncemented and can be excavated with conventional earthwork equipment. In some areas the materials below the surficial soils contain zones which vary between partially cemented (moderately

hard) to cemented (hard). Heavy-duty ripping, heavy-duty backhoe, headache ball, or Ho-ram should be anticipated. The Contractor should be aware of the potential for vibrational damage to adjacent or nearby structures when using heavy impact equipment during removal of moderately hard to hard cemented materials.

Excavations over 4 feet deep should be laid back to safe slopes. Cut slopes should be in accordance with the *Occupational Safety and Health Standards for the Construction Industry* (29 CFR Part 1926) Section No. 1926.650 through .653 as currently amended. Safety of construction personnel is the responsibility of the Contractor.

STRUCTURE FOUNDATIONS

The proposed bridge and Con/Span structures may be supported by conventional spread footings founded on a properly placed and compacted zone of structural fill. Spread footings founded on structural fill are expected to experience total settlements on the order of ½ to ¾ inch. Differential settlements should be on the order of ½ the total settlements or less. Settlements should occur immediately after loading.

Due to the hydro-collapsible and expansive nature of the foundation soils, slight movement of foundations may occur. For this reason, we have recommended reinforcement of foundations and wingwalls in order to minimize cracking should movement occur. The reinforcement is not intended as a structural solution, but is in accordance with local practice and experience in the area. Specific design recommendations are provided as follows:

1. Spread footings, placed a minimum of 18 inches below adjacent finished grade, and a minimum of 12 inches wide, which bear on structural fill and are above the zone of saturation, may be designed for a maximum allowable bearing pressure of 1,500 pounds per square foot (psf). This allowable value may be increased by 250 psf for each additional foot of footing width and by 750 psf for each additional foot of footing embedment up to a maximum of 3,500 psf. A one-third increase in allowable bearing pressures may be used for short duration loads, such as wind or seismic.

2. Spread footings, placed a minimum of 36 inches below adjacent finished grade, and a minimum of 24 inches wide, which bear on structural fill and are below the zone of saturation, may be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf). This allowable value may be increased by 150 psf for each additional foot of footing width and by 500 psf for each additional foot of footing embedment up to a maximum of 3,500 psf. A one-third increase in allowable bearing pressures may be used for short duration loads, such as wind or seismic.

3. Lateral loads may be resisted by friction between the footing base and supporting soil, and lateral bearing pressure against the sides of footings. For design purposes, a coefficient of friction of 0.35 and a lateral bearing pressure of 190 psf (125 psf below water levels) per foot of depth up to a maximum of 1,500 psf are appropriate. If the design makes use of passive earth pressures, it is important that a representative of this office be present during the placement of any backfill against footings to observe and/or test the backfill.

4. Due to the clay swell potential of the on-site soils, any concrete slab-on-grade floors should be supported by a 4-inch layer of compacted gravel overlying an 18 inch zone of structural fill. The gravel may consist of Type I or Type II Aggregate Base.

5. Due to the clay swell and hydro-collapse potential of the on-site soils, it is our opinion that footings should be reinforced with a minimum of 2 No. 4 bars near the top of any stemwalls, and 2 No. 4 bars near the footing base. Any concrete slab-on-grade floors should be reinforced with 6" x 6", W4 x W4 woven wire fabric or No. 3 bars at 18 inches each way, center to center. Reinforcement should be installed at mid-height in the slab.

6. All concrete placement, curing operations, and control joint spacing should be in accordance with American Concrete Institute (ACI) recommendations.

BOX STRUCTURES

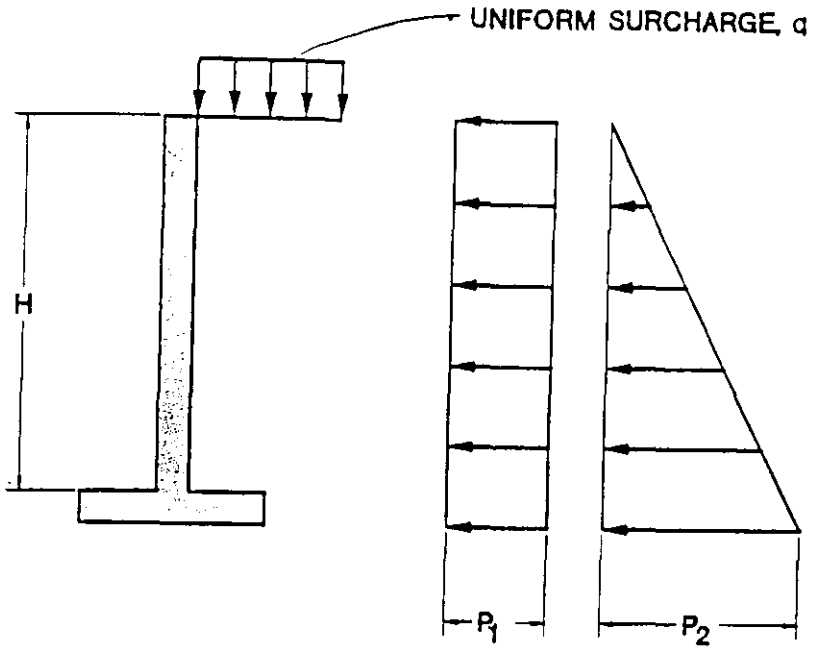
The proposed box structures should receive adequate support from properly placed and compacted structural fill. If undocumented fill soils and/or loose, soft, firm or disturbed soils are exposed at the base of the structure, these unsatisfactory materials should be removed or compacted in place.

The box structures may be designed using a maximum allowable net bearing capacity of 2,000 pounds per square foot (psf). The allowable bearing pressures may be increased by one-third for short term dynamic loads (such as seismic loads). Box structures should also be designed for 130 pounds per cubic foot vertical soil loads.

LATERAL EARTH PRESSURES

Subsurface walls, such as bridge abutments, wingwalls and outlet works (box structures) should be designed to resist lateral soil pressures. Figure No. 3 presents recommended lateral earth pressures for both restrained (rigid) and unrestrained (cantilevered) walls that are above water levels. These pressures assume that compaction within about five feet of the wall will be accomplished with relatively light-weight compaction equipment. The pressures provided assume that hydrostatic pressure build-up will not be permitted. Figure No. 4 presents recommended lateral earth pressures for both restrained (rigid) and unrestrained (cantilevered) walls that are below water levels. These pressures assume that compaction within about five feet of the wall will be accomplished with relatively light weight compaction equipment. The value of the surcharge pressure, "q", is equal to the pressure induced by adjacent uniform loads or traffic loads. As noted on Figure Nos. 3 and 4, the pressure distribution on restrained subsurface walls less than or equal to 12 feet is the same distribution shown on unrestrained subsurface walls. CCSW should review the design of all retaining walls in excess of 20 feet in height.

We recommend that the backfill behind subsurface walls consist of on-site or similar imported soils. Backfill materials should be non-expansive and cleaned of organics and inert materials larger than 4 inches nominal size. Backfill should be placed against undisturbed stiff to very stiff silts and clays, medium dense to dense granular soils, and/or properly placed and compacted structural fill. Prior



TOTAL EARTH PRESSURE, P

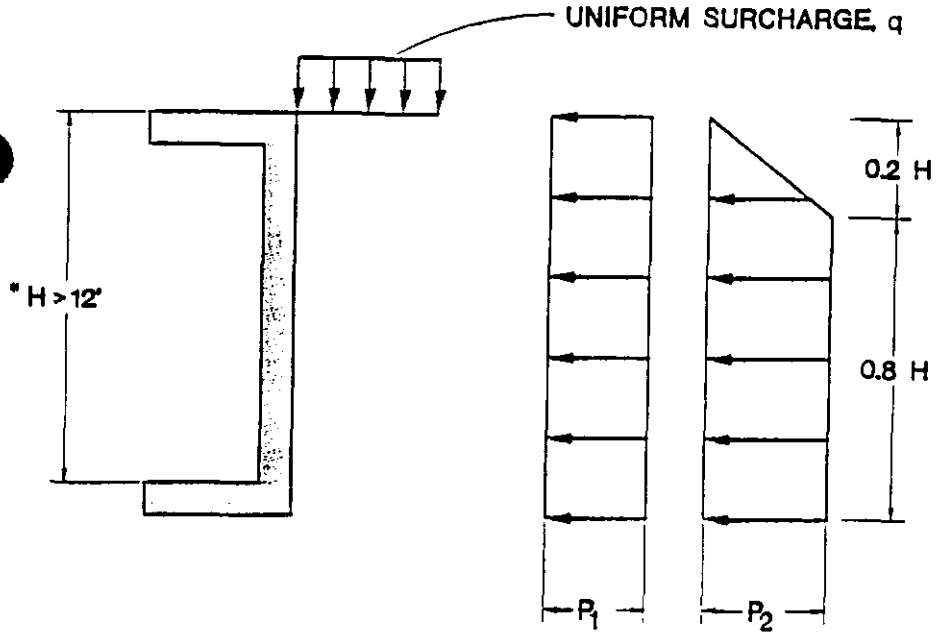
$P = P_1 + P_2$

WHERE:

$P_1 = 0.36q$

$P_2 = 43H$

UNRESTRAINED WALL PRESSURES



TOTAL EARTH PRESSURE, P

$P = P_1 + P_2$

WHERE:

$P_1 = 0.4q$ (H > 12')

$P_2 = 24H$ (H > 12')

$^*P_1 = 0.4q$ (H ≤ 12')

$^*P_2 = 48H$ (H ≤ 12')

* FOR WALLS LESS THAN OR EQUAL TO 12 FEET. THE PRESSURE DISTRIBUTION SHOWN ABOVE FOR UNRESTRAINED WALLS SHOULD BE USED.

RESTRAINED WALL PRESSURES

NOTE: ALL PRESSURES ARE IN psf, ALL HEIGHTS ARE IN FEET

LATERAL EARTH PRESSURES ABOVE WATER LEVELS

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Scale	NONE
Date	3.1.93
Prepared by	DRH
Checked by	SLO
Approved by	

Project No. 91-33647-02

Figure No. 3

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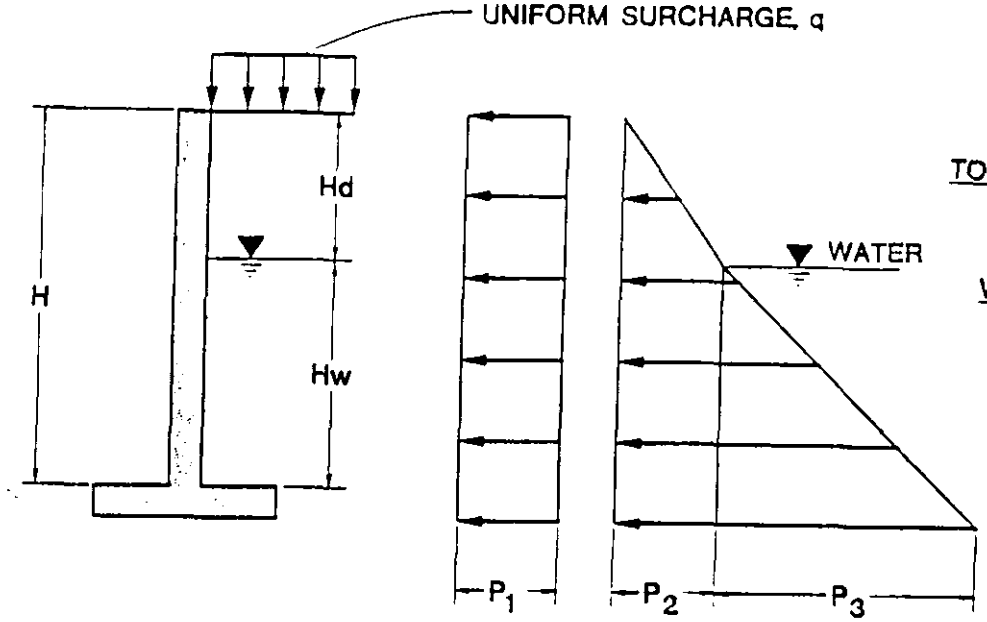
Geotechnical Engineering and Applied Sciences



TOTAL EARTH PRESSURE, P

$P = P_1 + P_2 + P_3$

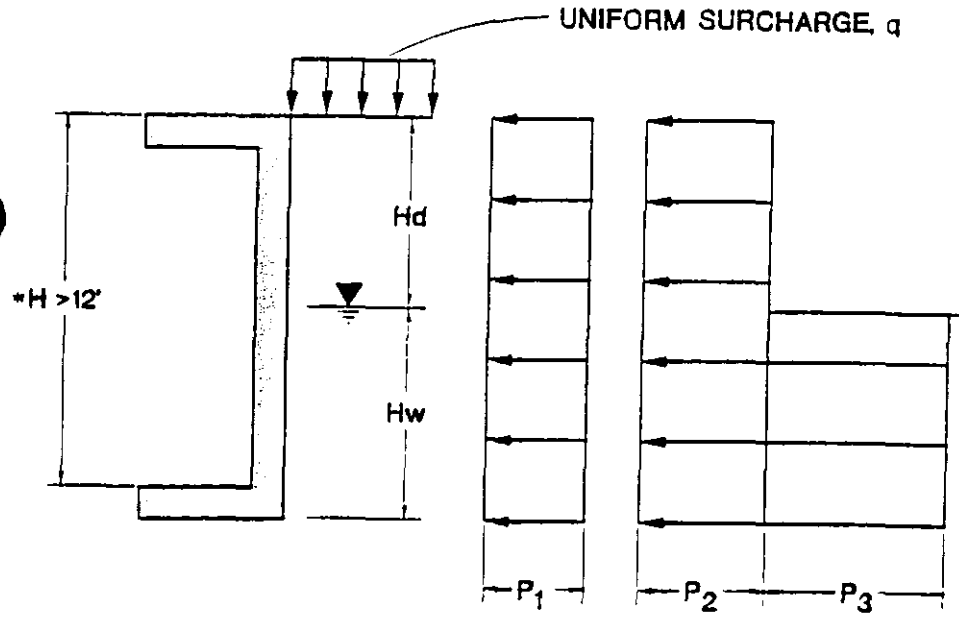
WHERE:

$P_1 = 0.36q$

$P_2 = 43(H-Hw)$

$P_3 = 86HW$

UNRESTRAINED WALL PRESSURES



TOTAL EARTH PRESSURE, P

$P = P_1 + P_2 + P_3$

WHERE:

$P_1 = 0.4q$

$P_2 = 24H$

$P_3 = 22Hw$

$*P_1 = 0.4q$

$*P_2 = 48(H-Hw)$

$*P_3 = 92Hw$

* FOR WALLS LESS THAN OR EQUAL TO 12 FEET. THE PRESSURE DISTRIBUTION SHOWN ABOVE FOR UNRESTRAINED WALLS SHOULD BE USED.

RESTRAINED WALL PRESSURES

NOTE: ALL PRESSURES ARE IN psf, ALL HEIGHTS ARE IN FEET

LATERAL EARTH PRESSURES BELOW WATER LEVELS

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Scale	NONE
Date	3.2.93
Prepared by	DRH
Checked by	BLO
Approved by	TBL

Project No. 91-33647-02

Figure No. 4

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Geotechnical Engineering and Applied Sciences

to placing backfill, the area behind the structures should be cleaned of construction debris and any soft, firm, loose or disturbed soils. The backfill should be placed in maximum 9-inch loose lifts and compacted to between 90 and 95 percent of the maximum laboratory density (ASTM D1557). Over compaction should be avoided.

EMBANKMENT SECTIONS

We understand that the south embankment will have an upstream height of 23 feet and a downstream height of 16 feet. The west spillway embankment will have an upstream height of 16 feet and a downstream height of 12 feet. To prevent settlement of the embankments due to hydro-collapse, a zone of properly placed and compacted structural fill should provide adequate support for the embankments after the surface vegetation and organics have been removed and the foundation preparation has been conducted as explained in the previous *Earthwork* section. The overexcavation depth should extend at least 6 feet below the embankment bottoms. Since the embankment heights gradually decrease to zero, the depth of overexcavation may start to gradually step down from 6 feet to 3 feet where the embankment height has decreased to 12 feet. We recommend a homogeneous embankment section consisting of on-site soils. The on-site soils are generally suitable for use as materials for dike embankment fill or other structural fills. On-site gypsiferous soils with a solubility greater than 2 percent, if encountered should not be used as embankment fill. Gypsiferous soils should be blended, as explained in the *Structural Fill and Backfill* subsection, with on-site or imported non-gypsiferous soils prior to use as embankment fill.

Slope Stability: Our stability analyses performed for the embankment sections were done to determine the steepest allowable upstream and downstream slopes with acceptable factors of safety. The analyses were performed on the upstream and downstream south embankment slopes, the spillway embankment upstream slope and the proposed spillway downstream slope which is 2:1 (horizontal to vertical) with a soil-cement surface. The analyses performed indicated that the south embankment slopes should not be made steeper than 2½:1 (horizontal to vertical). The steepest upstream slope for the

spillway embankment should be 2:1. The planned downstream spillway slope of 2:1 will be stable. The slope stability analyses assumed that all of the exposed embankment surfaces were adequately protected from erosional forces.

The slope stability analyses were performed on the embankments in general accordance with the Nevada State Statutes, U.S. Army Corps of Engineers guidelines, and the Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual.* The dike was analyzed with the computer program SB-Slope, Version 3.0. It was used to calculate the minimum factor of safety for five separate cases: (1) end of construction, (2) end of construction with seismic loading, (3) steady-state seepage, (4) seismic steady-state seepage, and (5) sudden drawdown.

The SB-Slope program utilizes the simplified Bishop method of slope stability analysis for circular failure surfaces. It was assumed that the maximum failure surface extended about 20 feet into native soils. An analysis was also performed on the upstream slopes of both embankments for the sudden drawdown case using a pore pressure coefficient (Ru) of 0.7. Factor of safety values of 1.2 and 1.3 were calculated for the south and west embankments, respectively. A summary of the minimum acceptable factors of safety, and calculated factors of safety for the steepest allowable embankment slopes is presented in Table Nos. 3 and 4 on the following page. The results of the slope stability analysis are presented and further explained in Appendix B.

Embankment Settlement: The proposed embankments are estimated to experience total settlements of about 1 to 2 inches or less. This settlement will be due to the weight of the embankment as it is placed. Most of the settlement will occur as the embankment is constructed. The settlement computations were made in accordance with the procedures discussed in the U.S. Army Corps of Engineers Engineer Manual, EM 1110-1-1904 dated September 30, 1990.

SEEPAGE CONTROL

Based on the fine-grained and relatively impervious nature of the soils present at the site, and a maximum detention time of 36 hours, it appears that seepage through the proposed embankments should not be a problem. However, there is a potential for piping and seepage around and near the box outlet structure if compaction around the structure is not done properly. Compaction

Table No. 3: Calculated and Required Factors of Safety for South Embankment
Upstream Height 23'; Downstream Height 16'

Loading Condition	Case	Required F.S.[1]	Calculated F.S. 2½:1 Slope Upstream	Calculated F.S. 2½:1 Slope Downstream
End of Construction	1	1.3	2.9	3.3
End of Construction With Seismic Loading[2]	2	1.0	2.3	2.5
Static-Steady State Seepage	3	1.5	2.7	2.2
Seismic-Steady[2]State Seepage	4	1.0	1.8	1.7
Sudden Drawdown	5	1.2	1.7	2.2

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers.
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.1.

Table No. 4: Calculated and Required Factors of Safety for West Embankment
Upstream Height 16'; Downstream Height 12'

Loading Condition	Case	Required F.S.[1]	Calculated F.S. 2½:1 Slope Upstream	Calculated F.S. 2½:1 Slope Downstream
End of Construction	1	1.3	3.2	3.4
End of Construction With Seismic Loading[2]	2	1.0	2.5	2.7
Static-Steady State Seepage	3	1.5	3.5	2.5
Seismic-Steady[2] State Seepage	4	1.0	2.3	1.9
Sudden Drawdown	5	1.2	1.8	2.5

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers.
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.10.

around and adjacent to the structure should be observed and adequately test by a representative of this office to insure that there are no under compacted areas. Based on our review of preliminary plans, it is planned to place a blanket of Type II Aggregate Base under the outlet intake box structures. To prevent a potential seepage path through the embankment, we recommend that the blanket not be used under the two 10 X 5 foot reinforced concrete boxes (RCB's) that extend through the embankment. They should be founded on structural fill.

EROSION PROTECTION

Based on the results of our field and laboratory investigations, it is our opinion that the on-site soils will be subject to erosion due to peak water velocities on the order of 10 feet per second. Therefore, erosion protection will be required along the unlined inlet channel near the bridge and transitions. Erosion protection for the channel may consist of gabions. The rock used for gabions should be resistant to weathering and water action, free from spoil and organic materials. Gabions should be designed within the guidelines and standards of the manufacturer. Final water velocities should be verified by a hydraulic engineer. Flow velocities may change due to placement of gabions.

In order to reduce the amount of scour and erosion of structural fill soils during heavy flows, we recommend that a puncture-resistant synthetic filter cloth (Trevira 1135 or approved equivalent) be placed between the structural fill soils and the gabions.

Other generally acceptable methods of erosion protection would include: (1) rip-rap, (2) soil-cement, which is generally placed in 7 to 8-foot wide horizontal lifts, (3) roller-compacted concrete, (4) concrete pavement, and (5) precast concrete blocks.

We are available to provide additional detailed recommendations for erosion protection if other alternates are utilized and information is required.

Some erosion protection for unprotected slopes can be achieved by making the slopes flatter than required for acceptable factors of safety. The areas where grass is planned within the golf course should be protected from surface runoff provided the slopes are fairly flat.

Spillway Embankment: We understand that a part of the spillway embankment crest and downstream slope will be lined with soil-cement. The planned downstream slope is 2:1 (horizontal to vertical). If soil-cement is used on the outer face, it should be a minimum of 12 inches thick (perpendicular to the slope) from a construction standpoint. Soil-cement slope protection is normally placed by one of two methods. Lifts of the soil-cement can be placed parallel to the slope and compacted. This method usually requires a minimum soil-cement lift width equal to the width of the equipment (about 8 feet). The outer face of the slope is normally overbuilt with this method, and trimmed back to the final face. With this method, the planned 2:1 (horizontal to vertical) slope could be constructed.

Soil-cement can also be placed and compacted in lifts perpendicular to the slope. With this method, the soil-cement thickness can be reduced but it is normally necessary to flatten slopes, so that placement and compaction equipment can operate up and down the slope. Our past experience has indicated that with conventional placement and compaction equipment, this usually requires slopes of 4:1 (horizontal to vertical) or flatter.

The final thickness of the soil-cement erosion protection layer, should be determined by a qualified hydraulic engineer, after water velocities, and the soil-cement strength and durability characteristics have been determined. As previously stated, two soil-cement mix designs for the project are currently in progress and will be presented at a future date.

CHANNELS

The proposed inlet channel will generally be unlined. It will be lined with grass or gabions in some areas. The outlet channel will be concrete lined. Due to the porous and expansive nature of the clayey soils, overexcavation and recompaction will be required for the support of channel linings and to help prevent excessive erosion in unlined areas. The depth of overexcavation required should be 2 feet below finished grade in unlined channels and 3 feet below granular filter material in concrete lined areas. Concrete lined and unlined channels should generally conform with the Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Design Manual* (Criteria Manual).

Unlined Channel: Unreinforced side slopes should be constructed no steeper than 3:1 (horizontal to vertical). For steeper channel side slopes, recommendations will be required for slope reinforcement. In cut slope areas after overexcavation, it may be necessary to recompact structural fill beyond the limits of the slope and then recut the slopes to the desired grade. We recommend that converging runoff should be controlled and properly diverted into the unlined channel so that erosion of the slope is minimized.

Concrete Lined Outlet Channel: Permanent unreinforced cut and fill side slopes should be constructed at a maximum slope of 2:1 (horizontal to vertical). In cut slope areas after overexcavation, it may be necessary to recompact structural fill beyond the limits of the slope and then recut the slopes to the desired grade. Satisfactory support for concrete lining panels may be provided by a 6-inch blanket of granular filter material overlying a properly placed and compacted zone of structural fill. The granular filter material should have a maximum size of 2 inches, contain less than 10 percent (preferably less than 5 percent) passing a No. 200 sieve, and be well graded. The filter material should be moisture conditioned to obtain a soil moisture within 2 percent of optimum and compacted to at least 95 percent of the maximum dry density (ASTM D1557). It may be necessary to compact the granular filter material on the side slopes about 1 foot thick and then cut it back to the required 6-inch thickness. Prior to placement of the granular blanket, the subgrade soils should have been processed as recommended in the *Earthwork* section of this report.

Continuity of the concrete surface is essential throughout the reach of the lined area. Accidental offsetting of panels at construction joints could disturb channel flow and may induce cavitation. We suggest that the slabs be dowelled at expansion joints to inhibit offsets. In order to drain accumulated water beneath concrete panels and to prevent the build up of hydrostatic pressures, weep holes, 3 inch in diameter, should be installed in channel bottoms and side panels.

Weep holes should be spaced so there is one set of weep holes located 1 foot upstream of any cutoff walls, and at least one more set located approximately halfway between cutoff walls. The weep holes should be protected against clogging by installing a geotextile filter fabric (at least 1 square foot and consisting of Trevira 1114 or an approved equivalent) behind the weep hole, and by filling the weep hole with the granular filter material as previously described.

To further minimize the accumulation of water behind the panels, we suggest that the concrete panels have a turned down edge (longitudinal cutoff) which extends down to at least 3 feet below the top of slope. We also recommend that converging runoff from the east along Toiyabe Street should be controlled and properly diverted into the channel so that erosion behind the slope does not occur.

We recommend that the concrete panels be designed to minimize shrinkage and development of thermal and flexural stresses. Slab reinforcement should consist of bars rather than mesh and should be installed at mid-height of the slab. Special precautions should be taken during the placement and curing of all concrete panels. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking, or curling in the panels.

CORROSION AND SULFATE PROTECTION

Laboratory test results indicate that the on-site soils are corrosive to buried metal and have sulfate levels above that are considered harmful to normal strength concrete.

1. Consideration should be given to corrosion protection systems for buried metal such as cathodic protection, protective coatings or wrappings, or the use of PVC where permitted by local building codes.

2. All concrete in contact with the on-site soils should have one of the following concrete mixtures.

Type of Cement	Minimum Sacks of Cement per Cubic Yard	Maximum Water Cement (plus Fly Ash) Ratio
Type V	6.0	0.50
Type II and Fly Ash*	6.0 **	0.50
Type V and Fly Ash*	5.5 **	0.53

* Type F fly ash as defined in ASTM C618.

** Cement to be removed and replaced with fly ash shall be 13% to 20% of the weight of cement. Fly ash added at the mixer shall be in a proportion of 1.2 minimum to the weight of cement removed.

3. The concrete should be placed with a maximum 4-inch slump and good densification procedures should be used during placement to prevent honeycombing.

SOIL-CEMENT

A series of twelve (12) test pits were excavated to obtain representative soil samples from the two potential sources to be used for the soil-cement mix designs. The mix designs were to be performed on a fine-grained sample and a granular sample. A 1,000 psi 28-day strength was requested for both mix designs. As previously mentioned the results of the mix designs will be presented in a report at a later date. The test pits were also excavated to try and define where the soils changed from fine-grained on the west to predominantly granular soils towards the east. A general summary of the test pits is presented in Appendix A (page A-8). The estimated boundary between the two soil types is indicated on Drawing No. 2. Based on preliminary results of the mix designs, it appears that the fine-grained soils will require at least 15 to 18 percent cement and the granular soils 9 to 12 percent. It appears that the granular soils would be the desired choice for soil-cement. However, the source of granular material is small as shown on Drawing No. 2. It may be necessary to excavate and stockpile the granular soils from the east for use as aggregate in the soil-cement. The borrow area would then be backfilled with fine-grained structural fill.

ASPHALTIC CONCRETE PAVEMENT

Asphaltic concrete pavement sections were developed for the main road near the project, and the golf cart and maintenance vehicle paths. In developing our recommendations, we have assumed that (1) 18 inches of structural fill will be placed beneath the pavement section, (2) Traffic Index (T.I.) values of 2.0 for golf cart paths, 3.0 for maintenance roads, and 5.5 for the main road, are appropriate, and (3) an R-value of 20 (based on soil classification) is representative of recompacted native soils. If the T.I. values are not considered appropriate, the pavement sections should be re-evaluated. Our design procedures were in accordance with Caltrans method of designing flexible pavement.

1. The following table presents the minimum recommended structural pavement sections:

Traffic Condition	Assumed Traffic Index (T.I.)	Asphalt Thickness (Inches)	Type II Base Thickness (Inches)	*Compacted Subgrade Thickness (Inches)
Golf Carts	2.0	2	0	18
Maintenance Road	3.0	2	4	18
Main Road	5.5	2½	10	18

* Compacted subgrade thickness may be reduced if cemented soils are encountered.

2. Asphaltic concrete should be mixed and placed in accordance with Section 401 of the *Uniform Standard Specifications for Public Works' Construction, Off-Site Improvements, Clark County, Area, Nevada*, 1986 Edition (USSPWC).

3. Type II Aggregate Base should conform with Section 704.03.04, USSPWC. Base materials should be placed and compacted in accordance with Section 302 of USSPWC.

4. Asphaltic concrete and base materials should be tested prior to delivery to the site and during placement to determine conformance with the project specifications.

PROJECT REVIEW AND CONSTRUCTION OBSERVATION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. This office should be provided the opportunity to review the final design drawings and specifications in order to determine whether the assumptions and recommendations presented in this report are valid and have been implemented. Review of the final design drawings and specifications should be noted in writing and become a supplement to this report.

Variations in soil conditions may be encountered during construction of this project. In order to permit correlation between the field conditions encountered in this investigation and the actual conditions encountered during construction, and to confirm recommendations presented herein, this office should be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that the recommended foundation preparations are performed, that suitable fill and backfill soils are placed properly on prepared native soils, and that fills are properly placed and compacted.

CLOSURE

The recommendations given in this report are based on results of field and laboratory investigations, combined with interpolation of subsurface conditions between boring and trench locations. The nature and extent of variations between the explorations may not become evident until construction. If variations are exposed during construction, this office should be notified so the variations can be reviewed and the recommendations of this report modified or verified in writing.

If changes in the nature, design, or location of the facility are planned, the recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report modified or verified in writing.

This report has been prepared only to aid in the evaluation of this site and to provide geotechnical recommendations for the design of this project. Any person using this report for bidding or construction purposes should be aware of the limitations of this report as mentioned above and should conduct an independent investigation as he deems necessary to satisfy himself as to the surface and subsurface conditions to be encountered, and the procedures to be used in the performance of work on this project.

It has been our pleasure to serve you on this project. If you have any questions, please contact this office.

Respectfully submitted,

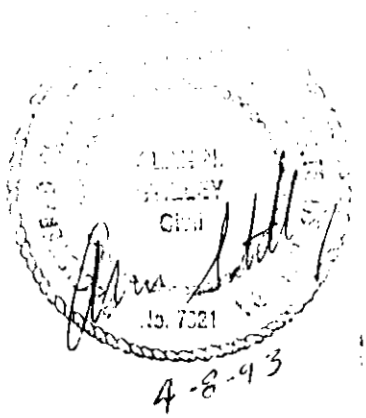
CONVERSE CONSULTANTS SOUTHWEST, INC.

Brad L. Olsen

Brad L. Olsen, E.I.T.
Senior Staff Engineer

Reviewed by:

Al Stilley, P.E.
Principal Engineer



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Encl: Drawing Nos. 1 and 2
Appendices A, B and C

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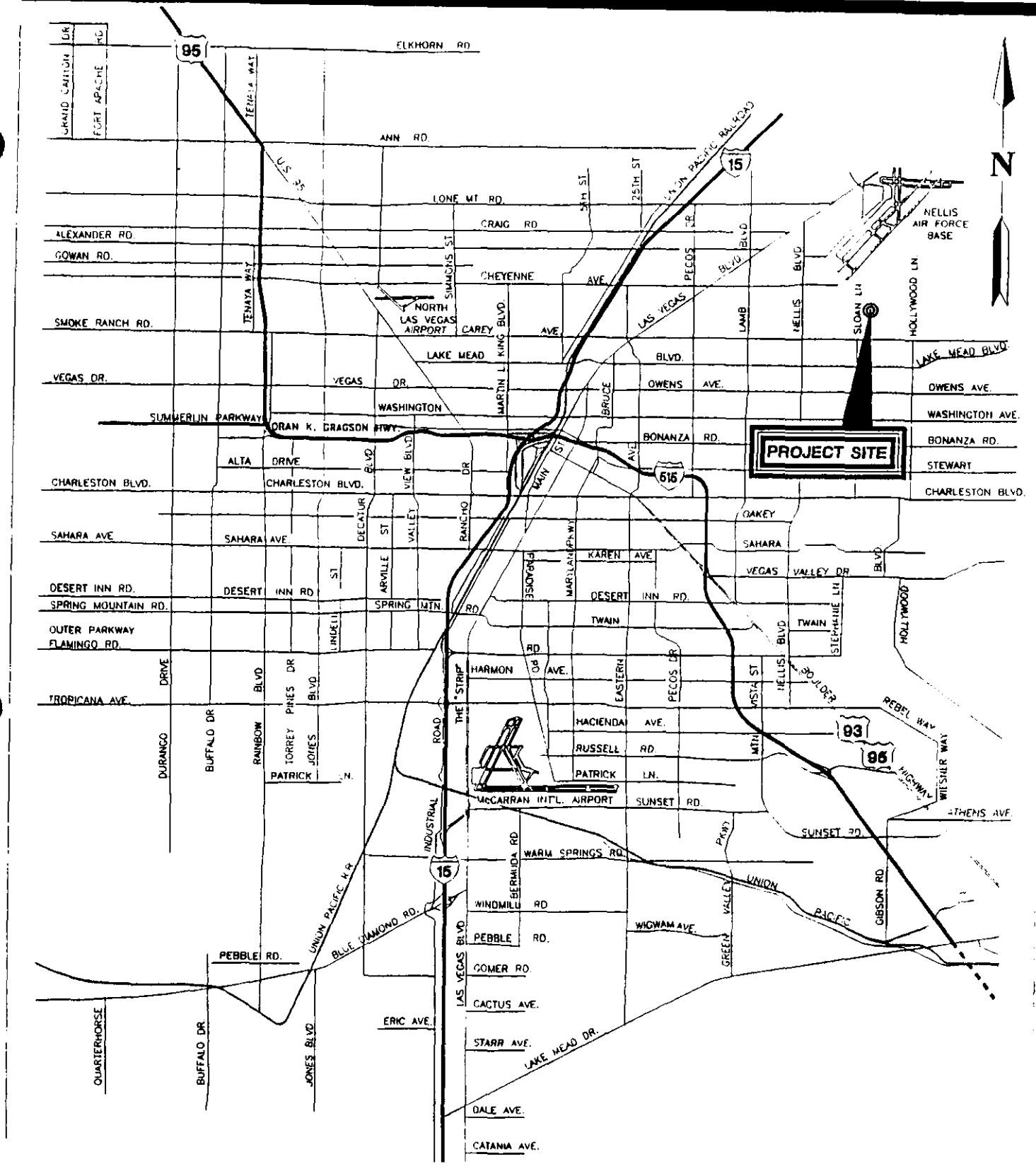

LAS VEGAS VICINITY

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Sciences

Drawing No.
1

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The subsurface soil conditions were explored by drilling thirty-six (36) exploratory borings to depths ranging from 15 to 40 feet. In addition, a series of exploratory test pits were excavated to depths ranging from 5 to 6 feet to try and delineate where the fine-grained soils changed granular soils towards the east side of the project. The approximate locations of the explorations are shown on Drawing No. 2. Continuous logs and general logs of the subsurface conditions as encountered in the borings and test pits, respectively, were recorded at the time of drilling by a field engineer. The subsurface conditions encountered in the borings were visually classified in accordance with ASTM D2487-90, which is based on the Unified Soil Classification System. Summaries of the subsurface conditions encountered in the borings are presented on the boring summary sheets, Drawing Nos. A-1 through A-40. A key to soil symbols and terms is found on Drawing No. A-41. The soil classification system for engineering purposes is further explained on Drawing No. A-42. Summaries of the subsurface conditions encountered in the exploratory test pits are presented in this Appendix.

Drilling was accomplished with truck-mounted air rotary (Mayhew 1000) and hollow-stem (BK-81) drill rigs equipped for soil sampling. Relatively undisturbed soil samples were obtained using a 2.5-inch inside diameter Converse sampler. The sampler was driven with either a 340-pound (air rotary) or 140-pound (hollow-stem) hammer free-falling through a distance of 30 inches. Sampler driving resistance, expressed as blows per foot of penetration, is presented on the boring logs at the respective sampling depths. The test pits were excavated with a Case 580E rubber-tired backhoe.

Laboratory Investigation

Laboratory tests were conducted on representative soil samples for the purpose of classification, and determination of their physical properties and engineering characteristics. The amount and selection of the types of testing for a given study are based on the geotechnical conditions of the project. A summary of the various laboratory tests conducted by our office for engineering purposes is presented below.

MOISTURE CONTENT AND DRY DENSITY: Data obtained from these tests, performed on relatively undisturbed samples obtained from the field, were used in the classification and correlation of the soils and to provide qualitative information regarding soils strength and compressibility. Test results are presented on the summary boring logs, Drawing Nos. A-1 through A-40.

SWELL: Representative undisturbed and remolded samples of the soils were tested in the laboratory to determine their moisture content volume-change characteristics. The remolded samples were compacted to an estimated 85 to 90 percent of the maximum density above the optimum moisture content. Each sample was confined under a normal pressure of 60 pounds per square foot and the percent of vertical movement after introduction of water into the samples was determined. The test results are presented below:

Exploration Location	Depth (feet)	Soil Description	Moisture Content (percent) Initial	Air-Dry	Final	Percent Swell
B-119	14-15	LEAN CLAY	21	15	35	8.4
*B-121	9-10	FAT CLAY	10	6	28	3.6
B-136	4-4½	LEAN CLAY	17	10	41	10.2
*B-1**	9	FAT CLAY	7	2	29	7.3
*B-2**	14	CLAYEY SAND	9	1	18	1.0

* Undisturbed samples
** From preliminary investigation.

DIRECT SHEAR STRENGTH: Progressive direct shear tests were performed on selected relatively undisturbed and remolded samples using a constant strain rate direct shear machine. The remolded samples were compacted to 90 percent of the maximum dry density at above optimum moisture content for fine-grained soils and within 2 percent of optimum for granular soils. The samples were placed in the shear machine, a specified normal load was applied, most of the samples were saturated and then sheared until a maximum shear strength was developed. After the soil specimen had developed maximum shear resistance under the first normal load, the normal load was removed and the specimen was pushed back to its original undeformed configuration. Another normal load was then applied, and the specimen was sheared a second time. This process was repeated for several different normal loads. Results of the direct shear tests are presented in the following table:

Exploration Location	Depth (feet)	Soil Description	Angle of Internal Friction (°)	Coulomb Cohesion (psf)
B-101	7-8	LEAN CLAY	33	50
B-101	14-14½	LEAN CLAY	29	300
B-103	9-10	FAT CLAY	29	800
B-104	14-15	LEAN CLAY	35	250
B-106	9-10	SANDY LEAN CLAY	33	400
B-107 Dry	4-5	LEAN CLAY	39	800
B-108	9-10	GYPS. LEAN CLAY	34	350
*B-125	4-5	SILTY CLAY	34	400
*B-126	0-1½	SANDY LEAN CLAY	18	300
*B-127 Dry	0-1½	SANDY LEAN CLAY	39	250
*B-130 Dry	0-1½	SILTY CLAY	35	250
B-1[2]	19-20	LEAN CLAY	20	220
B-2[2]	1-2	SILT	30	0
B-2[2]	14	CLAYEY SAND	39	250
*T-1[2]	3-5	SILTY CLAY W/Sand	18	400

Dry = Sample was not saturated
* Test performed on remolded sample
[2] From preliminary investigation

SOLUBILITY: Solubility tests were performed to determine the amount of water-soluble materials (principally gypsum) present in the soil. After drying the samples in a 60-degree centigrade oven, about 2.0 liters of tap water was passed through each sample. The samples were then oven-dried and the amount of soluble materials lost was calculated. The results of the solubility tests are presented in the following table:

Exploration Location	Sample Depth (feet)	Soil Description	Solubility (percent by dry weight)
B-110	6-7	LEAN CLAY few gyp	0.6
B-121	0-1	SANDY SILT few gyp	4.6
B-123	1-2	LEAN CLAY	0.2
B-123	4-5	LEAN CLAY	0.4
B-124	4-5	LEAN CLAY	1.0
B-126	1-2	SANDY LEAN CLAY few gyp	0.2
B-129	1-2	SILTY SAND few gyp	2.3
B-130	4-5	SANDY LEAN CLAY few gyp	1.9
B-132	4-5	LEAN CLAY few gyp	1.4
B-133	4-5	FAT CLAY trace gyp	0.4
B-136	1-1½	LEAN CLAY few gyp	1.7
B-1*	9	FAT CLAY	3.7
B-1*	19½	LEAN CLAY	0.1
B-2*	9-10	LEAN CLAY	1.9
B-2*	24½	LEAN CLAY	2.1
T-1*	3½	SILTY CLAY W/ Sand	1.2
T-2*	3½	LEAN CLAY W/ Sand	0.1

* From preliminary investigation

GRAIN SIZE DISTRIBUTION: Grain size distribution for soil samples were determined by sieve analysis in accordance with ASTM C-136. Basically, a sieve analysis is conducted by passing the soil through a number of different sized sieves and measuring the amount of soils retained on each sieve. The test results from the previous investigation are presented in Appendix C, Drawing Nos. A-13 through A-18. The test results from this investigation are presented in the following table:

	Percent Passing Sieve			
Sieve Sizes	*T-101	T-102	T-106	T-108
Depth	3-5'	1-5'	5-6'	2-6'
3"			100	100
2"			96	92
1½"			88	86
1"			80	77
3/4"			73	69
1/2"			61	58
3/8"	100		54	51
No. 4	98		42	40
No. 8	96		39	35
No. 16	94	100	36	31
No. 30	91	99	34	29
No. 50	87	97	30	26
No. 100	76	94	22	17
No. 200	53	88	14	9

* Bulk sample location from which soil sample was obtained.

ATTERBERG LIMITS: The liquid limit, plastic limit and plasticity index of a representative samples of the fine-grained soils were determined to aid in the classification of the soils and in the evaluation of other engineering parameters. The test was performed in general accordance with ASTM test designation D4318 method. The result of the test is tabulated in the following table:

Exploration Location	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Unified Soils Classification
B-105	4-5	29	19	10	CL
B-107	4-5	32	21	11	CL
B-129	4-5	NP	NP	NP	SM
B-1•	5.5	35	20	15	CL
B-2•	6.5	30	15	15	CL
T-1•	3-5	25	18	7	CL-ML
T-2•	3-5	36	21	15	CL
T-4•	3-5	21	17	4	CL-ML
T-5•	3-5	35	18	17	CL

NP = Non-plastic
• From preliminary investigation.

LABORATORY MAXIMUM DENSITY: Laboratory maximum density tests were performed on selected samples. The purpose of the tests was to define the compaction characteristics of these soils, and to aid in estimating soil shrinkage. The laboratory maximum density tests were performed in general accordance with the ASTM D-1557 test method. This test procedure uses 25 blows of a 10-pound hammer falling a height of 18 inches on each of five layers of soil on a 1/30 cubic foot cylinder. The test results are presented in the table below:

Exploration Location	Depth (feet)	Soil Description	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (percent of dry weight)
B-121	0-1	SANDY SILT	118	11.5
B-126	0-1½	SANDY LEAN CLAY	119	11.5
B-130	0-1½	SILTY CLAY	121	11.4
T-1•	3-5	SILTY CLAY w/Sand	117	11.2
T-4•	3-5	SILTY SAND	118	11.0
T-5•	3-5	SANDY LEAN CLAY	120	11.4

• From preliminary investigation

PERMEABILITY: Falling head tests were conducted on remolded samples. The soil was compacted to about 90 percent of the maximum dry density above optimum moisture content in a mold 4.6 inches long and 4.0 inches in diameter. A falling head was applied to the sample and flow of water through the sample was monitored after a saturation period. The permeability was calculated after the flow rate had stabilized. The results of the falling head permeability test are presented in the following table:

Exploration Location	Depth (feet)	Soil Description	Coefficient of Permeability (cm/sec)
T-102	1-5	LEAN CLAY	2.3×10^{-6}
Blended*	1-5	LEAN CLAY	1.5×10^{-6}
T-1**	3-5	SILTY CLAY w/Sand	3.5×10^{-5}
T-4**	3-5	SILTY SAND	1.5×10^{-5}
T-5**	3-5	SANDY LEAN CLAY	2.7×10^{-5}

* Blended samples from T-101, T-102 & T-103.
** From preliminary investigation

CHEMICAL ANALYSIS: Chemical tests were performed on representative soil samples to investigate the potential for soil corrosivity and chemical heave. The chemical analysis for water soluble sulfates and sodium was performed by Atlas Chemical Testing Laboratories, Inc. in Las Vegas, Nevada. The results of the chemical tests are presented in the following table:

Exploration Location	Depth (feet)	Soil Description	Percent Sodium	Percent Sulfate	Total Available Water Soluble Sodium Sulfate (%)
B-123	1-2	LEAN CLAY	<0.01	0.13	<0.01
B-126	0-1½	SANDY LEAN CLAY	0.03	0.22	0.09
B-129	1-2	SILTY SAND	<0.01	0.03	<0.01
B-130	4-5	SANDY LEAN CLAY	0.06	1.14	0.20
B-136	1-1½	LEAN CLAY	0.15	1.30	0.45

GENERAL SUMMARY OF EXPLORATORY TEST PITS

Test Pit Location	Depth of Test Pit (ft)	General Soil Type	Thickness of Soil (ft)
T-101	5	Silt	2
		Clay	>3
T-102	5	Clay	>5
T-103	5	Clay	>5
T-104	5	Clay	1½
		Sandy Gravel	2½
		Clay	>1
T-105	5	Clay	>5
T-106	6	Clay	5
		Sandy Gravel	>1
T-107	6	Clay	4½
		Sandy Gravel	>1½
T-108	6	Clay	2
		Sandy Gravel	>4
T-109	6	Clay	1
		Sandy Gravel	>5
T-110	5	Clay	>5
T-111	5	Clay	>5
T-112	6	Clay	>6

Log of Boring No. B-101

Date Drilled: 1/14/93 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: R.Leblanc Drill Equipment: Hollow Stem Auger BK-81

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
	SANDY LEAN CLAY (CL); firm, light brown, slightly moist						
	---stiff, dry						
2	---porous, very stiff	■		24	7	83	
4							
6							
	---trace sand, stiff, brown, slightly moist	■		16	6	74	C,DS
8							
12	---very porous, high plasticity, very stiff, tan						
14		■		100/6"	4	102	DS

APPROVED BY [illegible] ON 9/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 140lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

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Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-1

Log of Boring No. B-102

Date Drilled: 1/14/93 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: R.Leblanc Drill Equipment: Hollow Stem Auger BK-81

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2		■		12	6	69	C
4							
6							
8		■		80/9"	9	97	
12							
14		■		66	16	81	

SANDY LEAN CLAY (CL); (disturbed to 1'), light brown, dry
---firm
---slightly porous
---porous, very stiff

FAT CLAY (CH); porous, very stiff, brown, slightly moist
---tan

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 140lbs./30in.

End of Boring at 15.0 feet

APPROVED BY DTA ON 7/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Clark County, Nevada

Project No.
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Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-2

Log of Boring No. B-103

Date Drilled: 1/28/93 Location: See Drawing No.2 Coordinates and Elevation: Not Measured
Logged By: L.Linnert Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions *may differ at other locations* and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0		**LEAN CLAY (CL)**; (disturbed to 1'), trace roots, slightly porous, soft, brown, moist	■		4	16	82	
2		**SILTY CLAY (ML-CL)**; porous, firm, light brown, slightly moist						
4			■		8	19	79	
6		**LEAN CLAY (CL)**; trace sand, slightly porous, slight plasticity, firm, light brown, slightly moist ---trace gypsum, stiff						
8		---with gypsum	■		10	18	66	DS
12		**FAT CLAY (CH)**; very porous, stiff, tan-light brown, slightly moist ---scattered cementation, very stiff						
14			■		20	15	101	

APPROVED BY B20 ON 4/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

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Converse Consultants Southwest, Inc.
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Drawing No.
A-3

Log of Boring No. B-104

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (FT.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		LEAN CLAY (CL); (disturbed to 1'), brown, dry						
		---porous, stiff	■		12	6	88	
2		---very stiff						
4			■		20	9	98	C
		---slightly moist						
6								
8								
		---trace gypsum	■		35	13	108	
10		---light brown						
12								
		---high plasticity, very porous						
14			■		35	11	86	DS

APPROVED BY BJO ON 4/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-4

Log of Boring No. B-105

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		SILTY SAND (SM); (disturbed to 1'), brown, slightly moist						
2		LEAN CLAY (CL); porous, trace organics, stiff, brown, slightly moist	■		10			
4		---very stiff	■		20	7	88	A
6								
8			■		20	9	-	
12		FAT CLAY With Gravel (CH); porous, trace organics, very stiff, brown, slightly moist						
14		LEAN CLAY (CL); porous, high plasticity, very stiff, brown, slightly moist	■		30/9"			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY DLO ON 1/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Drawing No.
A-5

Log of Boring No. B-106

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Marin Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
							SANDY SILT (SM); (disturbed to 1'), brown, moist
							---porous, loose, dry
2		■		10	2	-	
							SANDY LEAN CLAY (CL); porous, trace organics, few gypsum, high plasticity, stiff, brown, dry
4		■		15	6	94	C
6							
8							---very porous, dry
							---very stiff
10		■		30	7	95	DS
							---porous, light brown
12							
14							---slightly moist
		■		25			
16							
18							GRAVELLY LEAN CLAY (CL); very stiff, light brown-white, dry
		■		25			

APPROVED BY JSO ON 5/1/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

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Converse Consultants Southwest, Inc.
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Drawing No.
A-6

Log of Boring No. B-106

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
22		FAT CLAY (CH); porous, very stiff, brown, dry						
24		LEAN CLAY (CL); porous, high plasticity, very stiff, light brown, slightly moist						
26								
28								
			■		20/1/2"	15	-	
32		FAT CLAY (CH); porous, very stiff, light brown, slightly moist						
34		LEAN CLAY (CL); porous, high plasticity, very stiff, light brown, slightly moist						
36		FAT CLAY (CH); porous, very stiff, tan, slightly moist						
38		---slightly cemented						
		---very porous, trace gypsum, trace organics	■		30/2"			

APPROVED BY RJD ON 4/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-7

Log of Boring No. B-107

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG		SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0		LEAN CLAY (CL); (disturbed to 1'), brown, slightly moist						
		---porous, stiff	■		10			
2		---dry						
			■		25	10	95	A,DS
4		---very stiff						
6								
8								
		---porous, light brown	■		25	7	92	
12								
14		---slightly moist	■		25	16	99	

End of Boring at 15.0 feet

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

APPROVED BY B20 ON 1/2/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-8

Log of Boring No. B-108

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: L.Linnert Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2		■		9	9	75	
4		■		14	7	88	C
6							
8		■		30	8	89	DS
10							
12							
14		■		30	11	94	
16							
18		■		30	8	-	

LEAN CLAY With Sand (CL); (disturbed to 1'), brown, moist
---very porous, stiff, dry

LEAN CLAY (CL); porous, stiff, brown, dry

GYPSIFEROUS LEAN CLAY (CL); porous, very stiff, brown, dry

LEAN CLAY (CL); porous, very stiff, brown, slightly moist

---few gravel

---very porous, light brown

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

APPROVED BY BLO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
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Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-9

Log of Boring No. B-108

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
22		**LEAN CLAY (CL)**; porous, very stiff, tan, slightly moist						
		---light brown						
24								
26								
28		**SILTY CLAY With Sand (ML-CL)**; porous, very stiff, tan, slightly moist						
		---trace organics						
30		---tan-white	■		25	13	67	
32								
34		**FAT CLAY (CH)**; porous, very stiff, green-white, slightly moist						
36								
38		**LEAN CLAY (CL)**; porous, very stiff, tan, slightly moist						
		---slightly porous, trace organics, trace sand, moist	■		30	19	91	

APPROVED BY B.30 ON 4/2/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-10

Log of Boring No. B-109

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
	LEAN CLAY (CL); firm, light brown, slightly moist						
	---porous, trace gypsum, very stiff						
2	---dry	■		25	18	84	
4		■		25			
6							
8	FAT CLAY (CH); *porous, very stiff, light brown, dry*						
	---few gypsum	■		30/6"			
12	---slightly cemented, very stiff-moderately hard, tan						
	---*no cementation, very stiff*	■		30			
14							

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 15.0 feet

APPROVED BY RLO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-11

Log of Boring No. B-110

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
0		FILL; 3" AC over 13" Granular Base ---tan, slightly moist						
2		CLAYEY SAND (SC); medium dense, light brown, slightly moist	■		25	6	97	
4		SANDY SILT (ML); trace gypsum, porous, very stiff, light brown, slightly moist						
6		LEAN CLAY (CL); porous, few gypsum, very stiff, light brown, moist	■		25			Sol
8								
10		---tan, dry	■		35	14	86	
12								
14			▪	▩	30/9"			

APPROVED BY BZO ON 1/6/93

Groundwater Depth Below Surface: None Observed — End of Boring at 15.0 feet
Driving Weight & Drop: 340lbs./30in.

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-12

Log of Boring No. B-111

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data *presented is a simplification of actual conditions* encountered.

DEPTH	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2	FILL; 4" AC over 13" Granular Base ---tan, slightly moist —Clayey Gravel With Sand, trace gypsum	■		30	13	95	
4							
6	SANDY LEAN CLAY (CL); few gypsum, porous, very stiff, light brown, slightly moist		▨				
8	---tan	▪		30			
12			▨				
14		▪		30			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY-BZO ON 4/5/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-13

Log of Boring No. B-112

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
		CLAYEY SAND (SC); loose, light brown, slightly moist					
		---medium dense, dry					
2		■		14	3	84	
4		■		20	12	86	C
		LEAN CLAY (CL); few gypsum, porous, high plasticity, very stiff, light brown, slightly moist					
6							
8							
		---trace gypsum					
		■		30	15	102	
12							
		CLAYEY SAND With Gravel (SC); trace gypsum, medium dense, light brown, slightly moist					
14		■		30	7	85	
16							
18							
		▪		30			

APPROVED BY BJO ON 4/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-14

Log of Boring No. B-112

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions *encountered.*						
22		**CLAYEY SAND With Gravel (SC)**; medium dense, light brown, slightly moist ---partially cemented, moderately hard						
24								
26								
		LEAN CLAY With Gravel (CL); trace gypsum, very stiff, tan, slightly moist						
28								
			■		40/9"	15	-	
32		**SANDY FAT CLAY (CH)**; trace gypsum, porous, very stiff, tan-white, moist						
34								
36								
38			■		30/9"	36	67	

APPROVED BY BLO ON 1/5/93

Groundwater Depth Below Surface: None Observed — End of Boring at 40.0 feet
Driving Weight & Drop: 340lbs./30in.

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No. **91-33647-02**

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No. **A-15**

Log of Boring No. B-113

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0		**SILTY SAND (SM)**; loose, light brown, slightly moist ---medium dense ---dry			20/9"			
2		**SILTY SAND With Gravel (SM)**; partially cemented, moderately hard, light brown, dry						
4								
6								
8					20/1"			
10		**CEMENTED SAND & GRAVEL**; hard, light brown, dry						
12								
14								
16		**SANDY LEAN CLAY With Gravel (CL)**; very stiff, tan, slightly moist						
18								
20		**CLAYEY GRAVEL With Sand (GC)**; partially cemented, moderately hard, tan, slightly moist			20/1"			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

APPROVED BY LOGON 1/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-16

Log of Boring No. B-113

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
22		**CLAYEY GRAVEL With Sand (GC)**; partially cemented, moderately hard, tan, slightly moist						
24								
26								
28		**CEMENTED SAND & GRAVEL**; hard, tan, slightly moist						
		SANDY FAT CLAY (CH); porous, very stiff, tan-white, moist	■		40	30	86	
32								
34								
36		**LEAN CLAY With Gravel (CL)**; trace gypsum, very stiff, light brown, moist	■		40	22	96	
38								

APPROVED BY B.O ON 1/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 40.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-17

Log of Boring No. B-114

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2	SILTY SAND With Gravel (SM); loose, light brown, slightly moist ---medium dense ---dry	■		30	2	110	
4							
6	SILTY GRAVEL With Sand (GM); partially cemented, moderately hard, light brown, dry						
8							
12							
14							

APPROVED BY DZ ON 1/1/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-18

Log of Boring No. B-115

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		SILTY SAND (SM); loose, light brown, slightly moist ---dry	■		2	6	91	
2		**SILTY SAND With Gravel (SM)**; medium dense, light brown, dry						
4								
6		**SILTY GRAVEL With Sand (GM)**; dense, light brown, dry ---partially cemented, moderately hard, light brown gray						
8								
10								
12								
14		**CEMENTED SAND & GRAVEL**; hard, light brown gray, dry						

APPROVED BY: JZO ON 1/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-19

Log of Boring No. B-116

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by *Converse for this project* and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2		■		9	4	-	
4		■		25	7	96	
6							
8		■		30/6"	11	90	
10							
12							
14		■		40/1"			

SANDY LEAN CLAY (CL); soft, light brown, slightly moist

---porous, firm-stiff, dry

---very stiff

---trace gypsum

LEAN CLAY (CL); trace gypsum, porous, very stiff, light brown, slightly moist

---partially cemented, moderately hard, tan

---no cementation, very stiff, light brown

APPROVED BY BZA ON 4/5/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-20

Log of Boring No. B-117

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2		■		8	4	-	
4		■		16	4	96	
6							
8							
10		■		30/9"			
12							
14		■		25			

SANDY LEAN CLAY (CL); trace gypsum, porous, firm, light brown, slightly moist
---dry

SILTY SAND (SM); medium dense, light brown, dry

LEAN CLAY (CL); trace gypsum, porous, very stiff, light brown, dry

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY: DXO ON 1/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

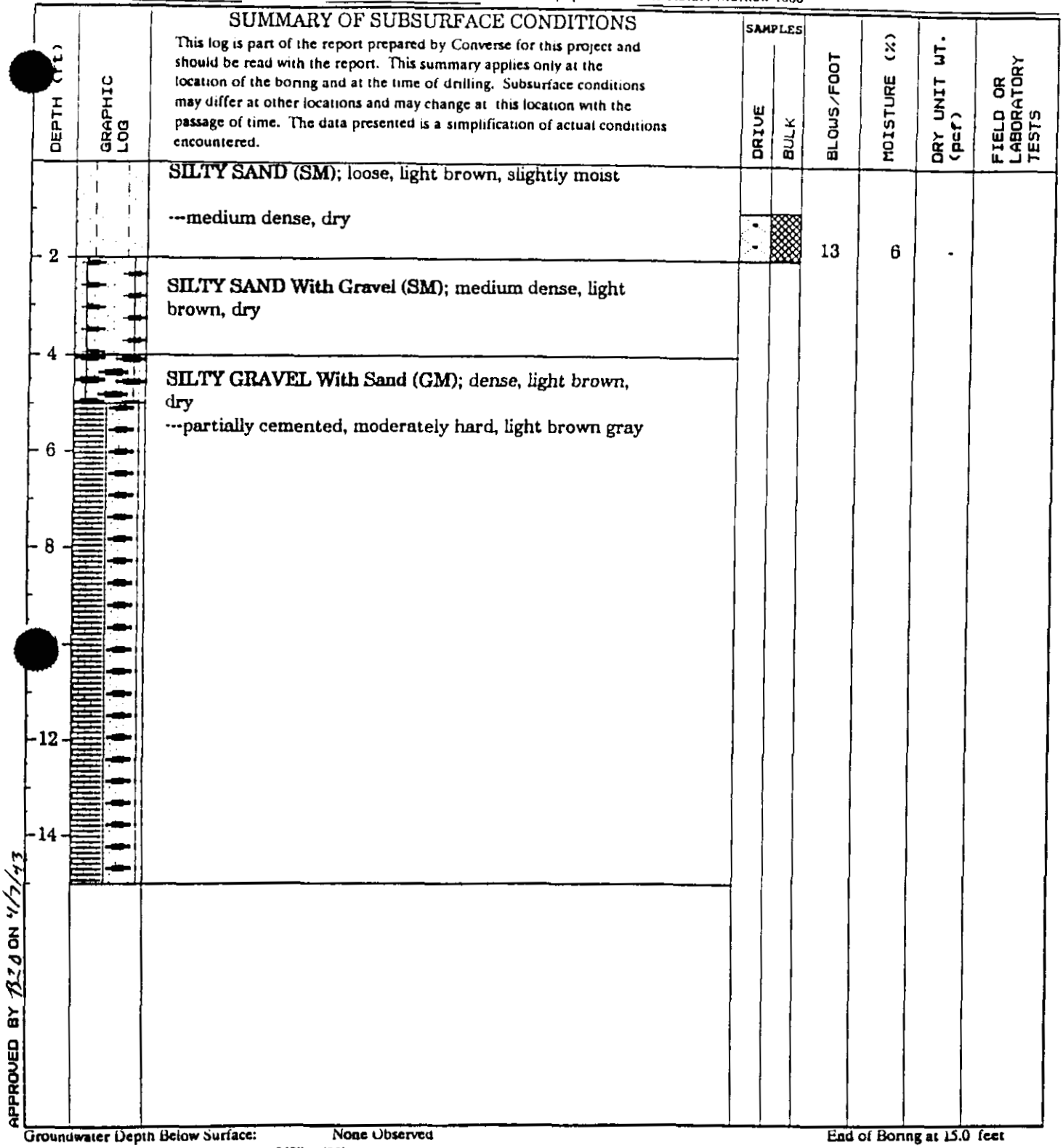
Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-21

Log of Boring No. B-118

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000



APPROVED BY BZO ON 1/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-22

Log of Boring No. B-119

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (FT)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.						
2		LEAN CLAY (CL); porous, firm, light brown, slightly moist ---very stiff ---dry	■		25			
4		---some gypsum	■		30/4"	6	96	
6		FAT CLAY (CH); porous, very stiff, brown, dry						
8		LEAN CLAY (CL); trace gypsum, porous, very stiff, light brown, dry						
10			■		30/9"			
12								
14			■		30/9"			S

APPROVED BY: B20 ON 9/3/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

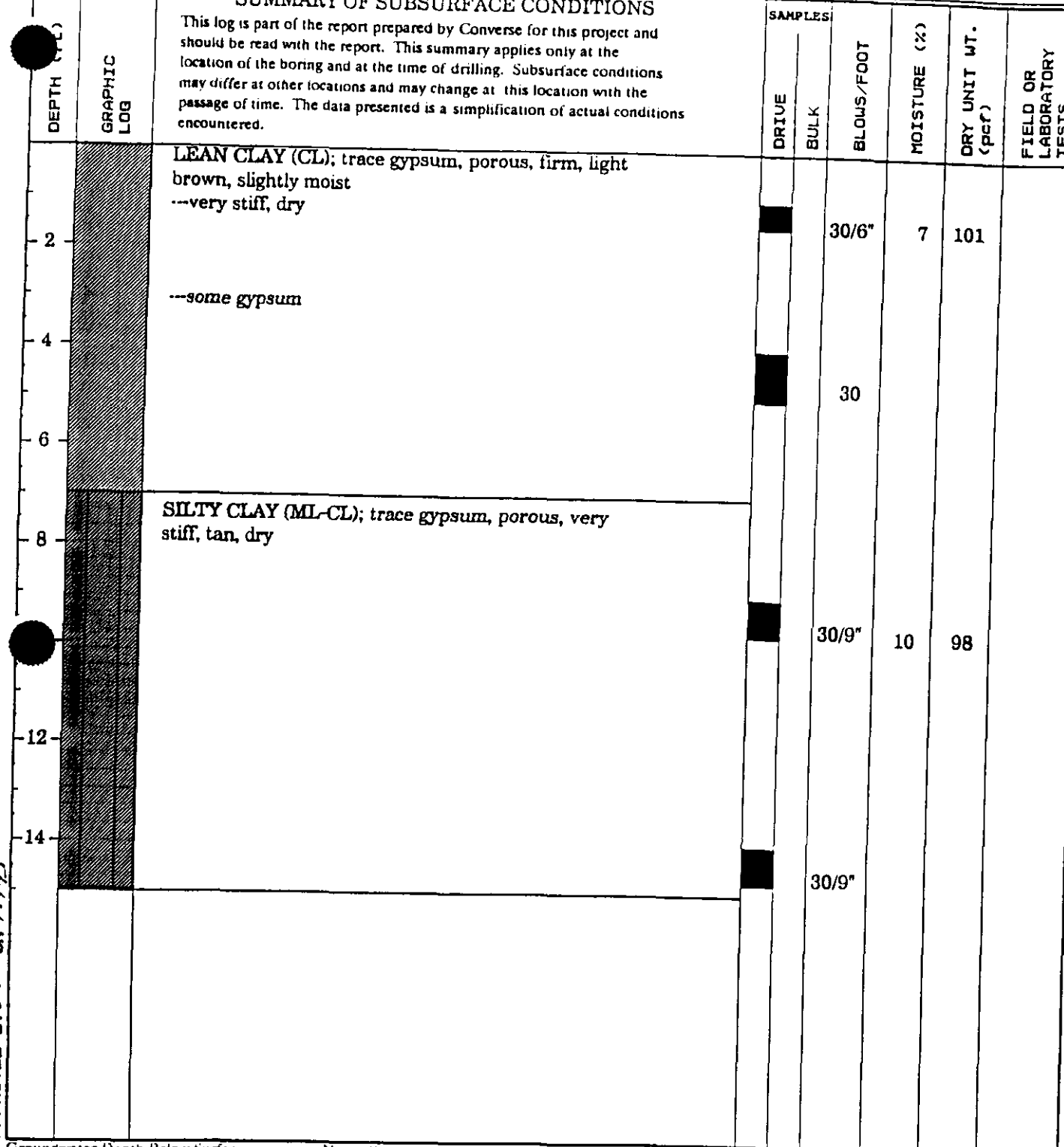
Drawing No.
A-23

Log of Boring No. B-120

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.



Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY [illegible] ON 5/5/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-24

Log of Boring No. B-121

Date Drilled: 1/28/93 Location: See Drawing No.2 Coordinates and Elevation: Not Measured
Logged By: L.Linnert Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS	DESCRIPTION
0							Sol,P	**SANDY SILT (ML)**; slightly porous, soft, light brown, slightly moist
								---firm
2		■		6	14	74		---trace clay
4		■		14	7	74		**LEAN CLAY (CL)**; trace sand, porous, stiff, brown, dry
								---slight plasticity
6								**FAT CLAY (CH)**; very porous, trace gypsum, trace caliche nodules, stiff, brown, dry
8								---very stiff
10		■		30/6"	9	91	S	---slightly moist
12								---trace sand, scattered cementation, light brown, dry
14		■		30/6"	12	79		---extremely porous

APPROVED BY BZO ON 4/7/93

Groundwater Depth Below Surface: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-25

Log of Boring No. B-122

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (FT.)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
		■		6			
2							
4		■		10	9	69	
6							
8							
		■		30/9"			
12							
14		■		25	13	112	

0 — LEAN CLAY (CL); (disturbed to 1'), brown, slightly moist
---porous, firm
---stiff
4 — ---few gypsum
8 — ---some gypsum
FAT CLAY (CH); some gypsum, porous, very stiff, brown, dry
14 — ---very porous, trace organics

APPROVED BY TGO ON 9/3/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-26

Log of Boring No. B-123

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (FT.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		SILTY SAND (SM); (disturbed to 1'), brown, slightly moist						
2		LEAN CLAY (CL); porous, very stiff, brown, slightly moist	■		18			Sol,Ch
4			■		20	13	70	Sol
6								
8		---few gypsum	■		30/9"			

APPROVED BY BJO ON 4/7/93

Groundwater Depth Below Surface: None Observed — End of Boring at 10.0 feet
Driving Weight & Drop: 340lbs./30in.

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No. **91-33647-02**

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No. **A-27**

Log of Boring No. B-124

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: J.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
		LEAN CLAY (CL); (disturbed to 1'), brown, slightly moist					
		---porous, trace organics, firm					
2		---stiff		5			
4				15	9	81	Sol
6							
8		---very stiff					
		---few gypsum		30			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 15.0 feet

APPROVED BY BZO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-28

Log of Boring No. B-125

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
	SILTY CLAY (ML-CL); porous, firm, light brown, dry						
	---stiff	■		10			
2							
	---very stiff						DS
4		■		22	4	85	
	LEAN CLAY (CL); few gypsum, porous, very stiff, light brown, dry						
6							
8		■		30			
	FAT CLAY (CH); few gypsum, porous, very stiff, light brown, dry						
12							
14	LEAN CLAY (CL); few gypsum, porous, very stiff, tan, dry	■		30/2"			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY BZO ON 1/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-29

Log of Boring No. B-126

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		SANDY LEAN CLAY (CL); firm, light brown, slightly moist						P,Ch DS,Sol
2		---porous, few gypsum, stiff, dry			15	5	88	
4		---very porous			15			
6		---very stiff						
8		LEAN CLAY (CL); trace gypsum, porous, very stiff, tan, dry			30	10	96	

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 10.0 feet

APPROVED BY BLO ON 1/2/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-30

Log of Boring No. B-127

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							DS
2		■		25/9"	4	100	
4				25/2"			
6							
8							

SANDY LEAN CLAY (CL); trace gypsum, porous, firm, light brown, slightly moist
---very stiff
---dry

CLAYEY GRAVEL With Sand (GC); medium dense, light brown, dry
---dense

---slightly cemented

APPROVED BY BZO ON 5/5/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 10.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-31

Log of Boring No. B-128

Date Drilled: 12/14/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
2		●		15			
4		■		25/6"	7	-	
6							
8							

CLAYEY SAND (SC); loose, light brown, dry

---medium dense

LEAN CLAY (CL); trace gypsum, porous, very stiff, light brown, dry

CLAYEY GRAVEL With Sand (GC); slightly cemented, dense, light brown gray, dry

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 10.0 feet

APPROVED BY B20 ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-32

Log of Boring No. B-129

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		SILTY SAND (SM); loose, light brown, slightly moist ---medium dense, few gypsum						
2		---dry	■		6			Sol,Ch
4		---slightly porous	■		15	5	91	A
6		**SANDY LEAN CLAY (CL)**; trace gypsum, porous, very stiff, light brown, dry						
8								
			■		20			
12								
14			■		30	11	102	

APPROVED BY BJO ON 1/5/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-33

Log of Boring No. B-130

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							Sol,Ch P,DS
2	SILTY CLAY (ML-CL); few gypsum, firm, light brown, slightly moist ---dry			6			
4	SANDY LEAN CLAY (CL); few gypsum, porous, very stiff, light brown, slightly moist			25	5	88	
6							
8	---scattered cementation			30	8	123	

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 10.0 feet

APPROVED BY BJO ON 4/5/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-34

Log of Boring No. B-131

Date Drilled: 12/11/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft.)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data *presented is a simplification of actual conditions* encountered.						
0		CLAYEY SAND (SC); porous, loose, brown, slightly moist	■		3			
2								
4		---medium dense	■		10	5	85	
6								
8		FAT CLAY (CH); porous, very stiff, brown, dry	■		25			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 10.0 feet

APPROVED BY RJO ON 5/5/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-35

Log of Boring No. B-132

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (FT)	GRAPHIC LOG		SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0		LEAN CLAY (CL); few gypsum, porous, firm, light brown, slightly moist						
		---dry						
2		---very stiff	■		7			
4		---trace sand	■		30	9	72	Sol
6								
8		FAT CLAY (CH); few gypsum, porous, very stiff, light brown, dry						
10		LEAN CLAY (CL); few gypsum, porous, very stiff, light brown, dry	■		30			
12								
14			■		30/4"			

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

APPROVED BY RJO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-36

Log of Boring No. B-133

Date Drilled: 1/28/93 Location: See Drawing No.2 Coordinates and Elevation: Not Measured
Logged By: L.Linnert Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		LEAN CLAY (CL); trace sand, soft, brown, moist						
		FAT CLAY (CH); very porous, very stiff, brown, slightly moist	■		30/6"	10	95	
2		---partially cemented, moderately hard						
		---trace gypsum						
4			■		30/6"	14	95	Sol
6		CALICHE; hard, tan, dry						
		LEAN CLAY (CL); trace caliche nodules, stiff, light brown, slightly moist						
8		FAT CLAY (CH); very porous, scattered cementation, very stiff, brown slightly moist						
			■		30	14	89	

Groundwater Depth Below Surface: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 10.0 feet

APPROVED BY B.JO ON 1/5/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-37

Log of Boring No. B-134

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: H.E.Mann Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
		FILL; Clayey Gravel, light brown, slightly moist						
2		CLAYEY GRAVEL With Sand (GC); dense, light brown, dry	■		30/6"	9	108	
4		SILTY GRAVEL With Sand (GM); dense, light brown, dry						
6		---partially cemented, moderately hard						
8		---no cementation, dense						

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 10.0 feet

RETRIEVED BY/CD ON 7/2/13

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Science

Drawing No.
A-38

Log of Boring No. B-135

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft.)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS
0							
							LEAN CLAY (CL); firm, light brown, slightly moist
							---porous, very stiff, dry
2		■		20	7	81	
							---slight cementation, tan
4							---few gypsum
		■		30/4"			
6							---partially cemented, moderately hard
							---slight cementation, very stiff
8							
							SILTY CLAY (ML-CL); porous, very stiff, light brown, slightly moist
		■		30	13	95	
12							
							SILTY GRAVEL With Sand (GM); dense, light brown gray, slightly moist
14							

APPROVED BY BJO ON 4/5/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.

End of Boring at 15.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Drawing No.
A-39

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Log of Boring No. B-136

Date Drilled: 12/15/92 Location: See Drawing No.2 Ground Surface Elevation: Not Measured
Logged By: B.Olsen Driller: D.Wilson Drill Equipment: Air Rotary Mayhew 1000

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	FIELD OR LABORATORY TESTS	
0								LEAN CLAY (CL); *trace gypsum, firm, light brown, slightly moist*
2		■		25/6"			S,Sol, Ch	---few gypsum, porous, very stiff, light brown, dry
4		■		30/4"	12	102	S	---slightly moist
6								
8								
10		■		30/9"				

APPROVED BY RJO ON 4/12/93

Groundwater Depth Below Surface: None Observed
Driving Weight & Drop: 340lbs./30in.
End of Boring at 10.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-02

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-40

KEY TO SOILS SYMBOLS AND TERMS

Terms used in this report for describing soils according to their texture or grain size distributions are generally in accordance with the UNIFIED SOILS CLASSIFICATION SYSTEM.

TERMS DESCRIBING CONDITION, CONSISTENCY AND HARDNESS

COARSE GRAINED SOILS (major retained on No. 200 sieve): includes (1) clean gravels, (2) silty or clayey gravels and (3) silty, clayey or gravelly sands. Consistency is rated according to relative density, as determined by laboratory tests.

Descriptive Term	Relative Density
very loose	0 to 15%
loose	15 to 40%
medium dense	40 to 70%
dense	70 to 85%
very dense	85 to 100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): includes (1) inorganic and organic silts and clays, (2) gravelly, silty or sandy clays, and (3) clayey silts. Consistency is rated according to shearing strength as indicated by penetrometer readings or by direct shear tests.

Descriptive Term	Relative Density
very soft	less than 0.25
soft	0.25 to 0.50
firm	0.50 to 1.00
stiff	1.00 to 2.00
very stiff	2.00 to 4.00
hard	4.00 and up

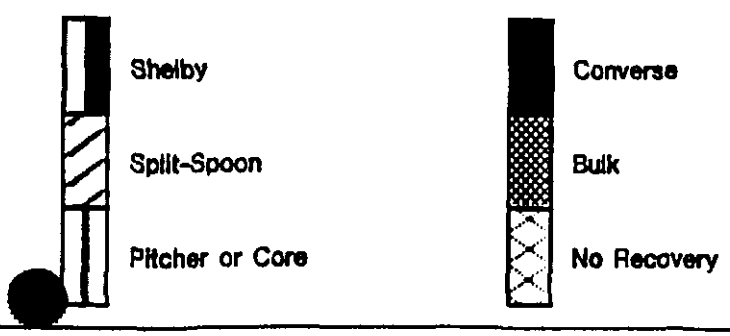
ROCK: includes gravels, cobbles, rock, caliche and bedrock materials. Hardness is related to field identification procedures described below.

Descriptive Term	Relative Density
soft	Can be dug by hand and crushed by fingers.
moderately hard	Friable, can be gouged deeply with knife and will crumble readily under light hammer blows.
hard	Knife scratch leaves dust trace, will withstand a few hammer blows before breaking.
very hard	Scratched with knife with difficulty, difficult to break with hammer blows.

LEGEND OF FIELD AND LABORATORY TESTS

A	Liquid & Plastic limits	G	Grain	P	Compaction
C	Consolidation	N	Chemical Heave	S	Swell
Ch	Chemical	pp	Unconfined compressive strength in tsf from pocket penetrometer	Sol	Solubility
DR	Drill Rate sec./ft.			T	Triaxial
DS	Direct Shear			U	Unconfined

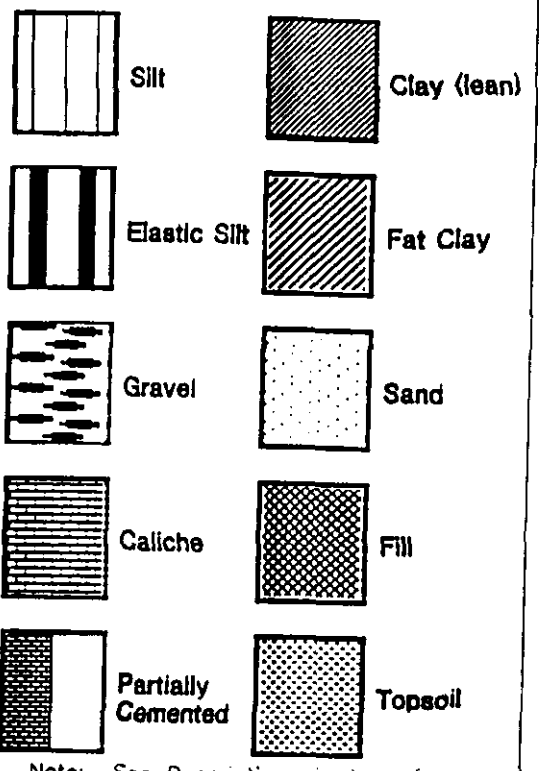
SAMPLER TYPES



SIZE PROPORTIONS

Designation	Percent by Weight
trace	0 to 5
few	5 to 10
little	15 to 25
some	30 to 45

SOIL TYPE GRAPHIC KEY



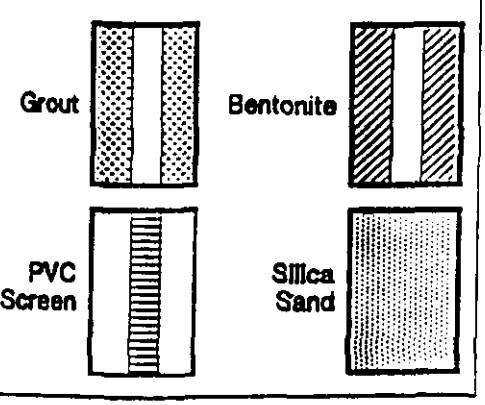
Note: See Descriptions in logs for others not shown here.

SOIL MOISTURE

From low to high the soil moisture is indicated by:

dry
slightly moist
moist
very moist
wet

WELL DESIGN GRAPHIC KEY



CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 - 90
(Based on Unified Soil Classification System)

			Soil Classification: Criteria for Assigned Group Symbols and Groups Names Using Laboratory Tests[A]	Group Symbol	Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravel Less than 5% fines[C]	$Cc \geq 4$ and $1 \leq Cc \leq 3^E$	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3^E$	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F G H]
			Fines classify as CL or CH	GC	Clayey gravel[F G H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3^E$	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3^E$	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G H I]
			Fines classify as CL or CH	SC	Clayey sand[G H I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limits less than 50	Inorganic	$PI > 7$ and plots on or above "A" line[J]	CL	Lean clay[K L M]
			$PI < 4$ or plots below "A" line[J]	ML	Silt[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OL	Organic clay[K L M N] Organic silt[K L M O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	OH	Fat clay[K L M]
			PI plots below "A" line	MH	Elastic silt[K L M]
		organic	$\frac{\text{Liquid limit - oven dried}}{\text{Liquid limit - not dried}} < .75$	OH	Organic clay[K L M P] Organic silt[K L M O]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq 15\%$ sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soils is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No.200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains $\geq 30\%$ plus No. 200, predominantly sand, add "sandy" to group name.

[M] If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

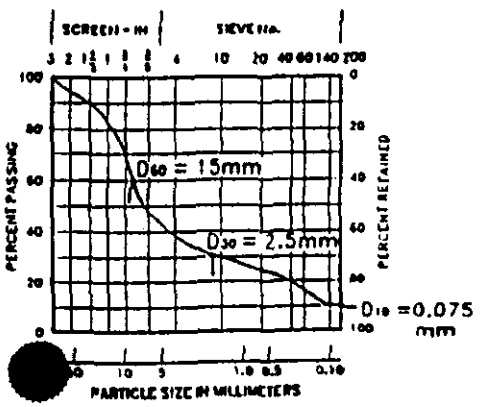
[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

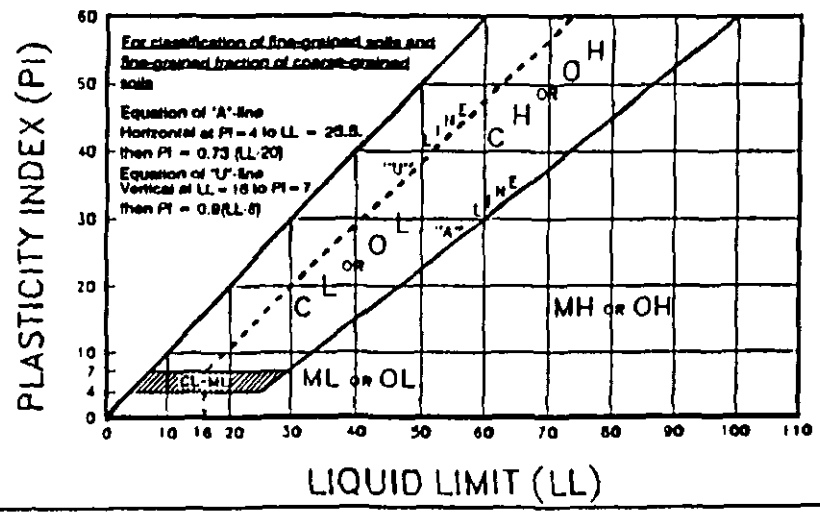
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

SIEVE ANALYSIS

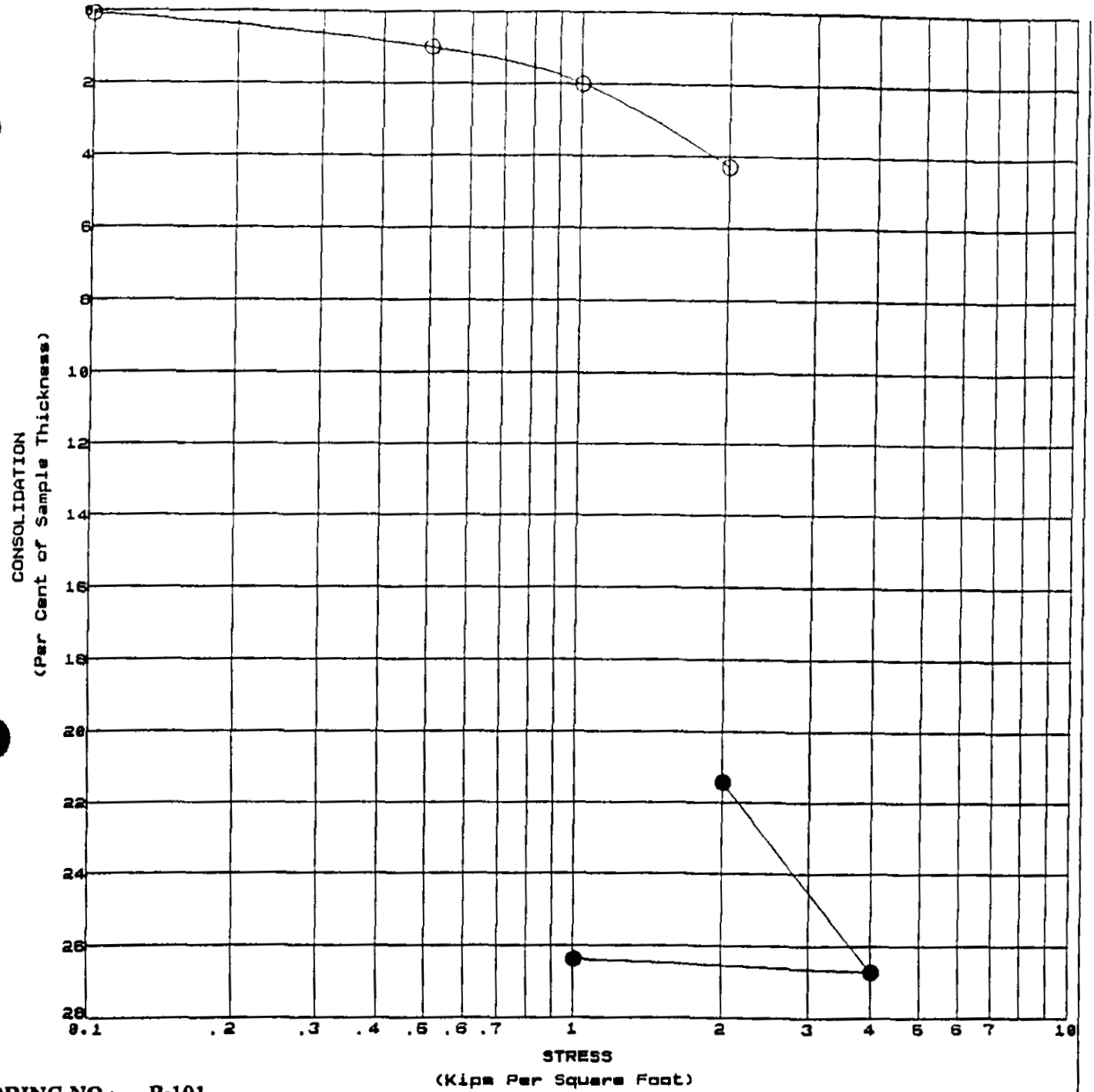


$C_u = \frac{D_{60}}{D_{10}} \frac{15}{0.075} = 200$ $C_c = \frac{(D_{30})}{D_{10} \times D_{60}} = \frac{(2.5)}{0.075 \times 15} = 5.6$



Converse Consultants Southwest, Inc.

Drawing No. A-42



BORING NO : B-101
DEPTH : 8 feet
DESCRIPTION : LEAN CLAY With Sand
DRY DENSITY : 66 PCF
MOISTURE CONTENT : 13%

● READINGS AFTER SATURATION WITH WATER

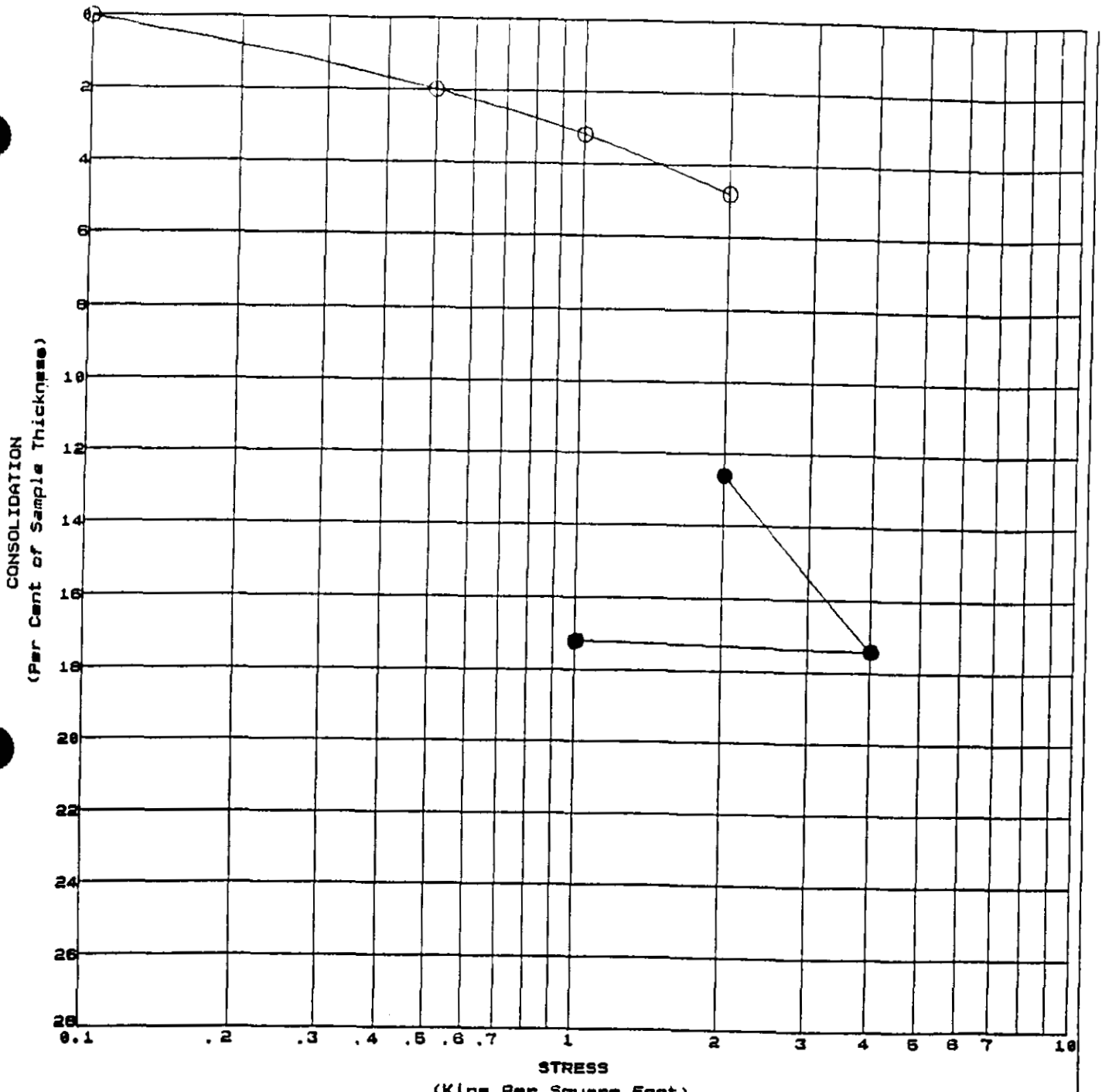
CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Drawing No.
A-43

Converse Consultants Southwest, Inc. *Geotechnical Engineering and Applied Sciences*



BORING NO : B-102
DEPTH : 3 feet
DESCRIPTION : SANDY LEAN CLAY
DRY DENSITY : 73 PCF
MOISTURE CONTENT : 6%

● READINGS AFTER SATURATION WITH WATER

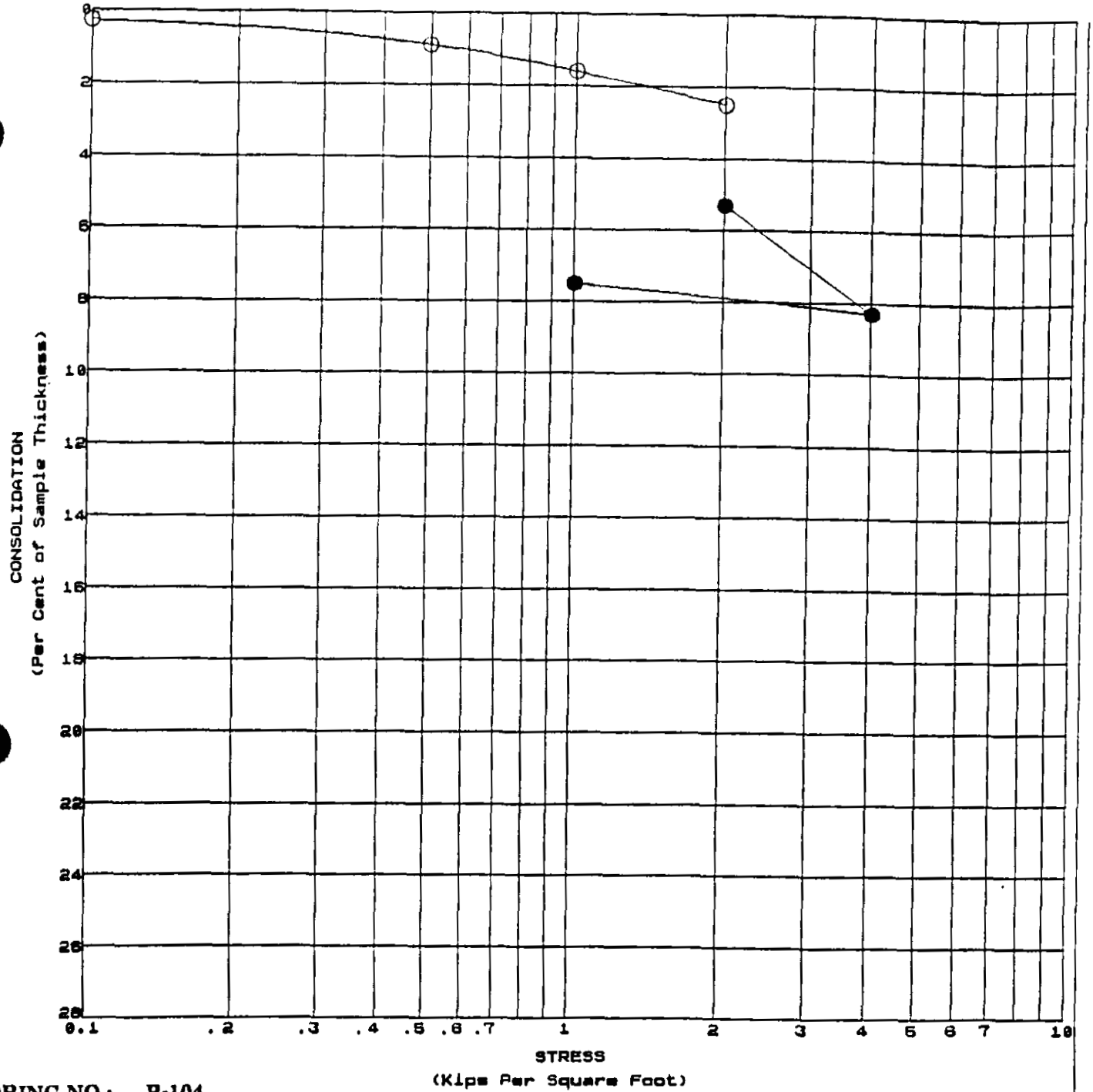
CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Drawing No.
A-44

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Sciences



BORING NO : B-104
DEPTH : 5 feet
DESCRIPTION : LEAN CLAY
DRY DENSITY : 99 PCF
MOISTURE CONTENT : 12%

● READINGS AFTER SATURATION WITH WATER

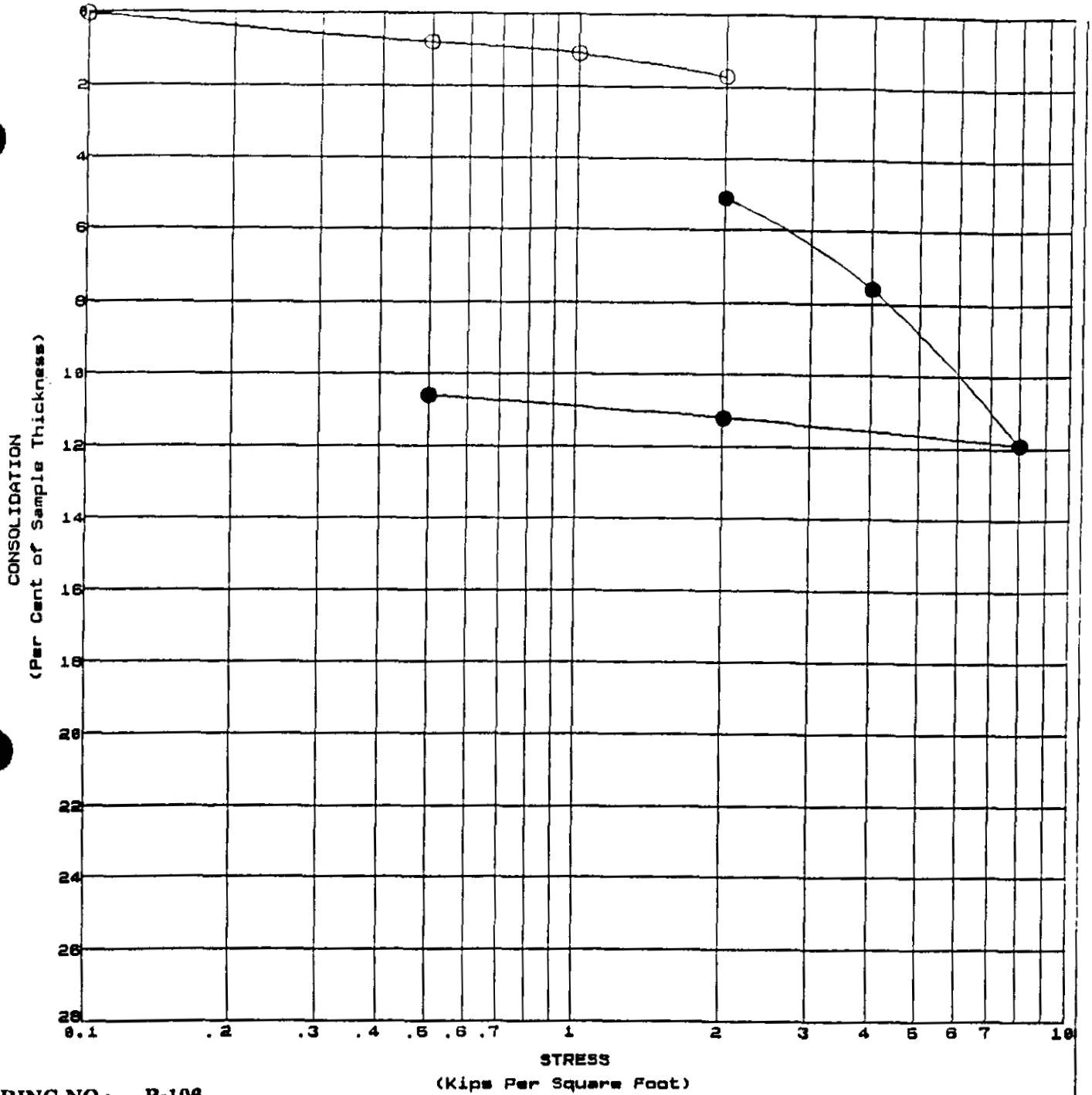
CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Sciences

Drawing No.
A-45



BORING NO : B-106
DEPTH : 5 feet
DESCRIPTION : SANDY LEAN CLAY
DRY DENSITY : 91 PCF
MOISTURE CONTENT : 7%

● READINGS AFTER SATURATION WITH WATER

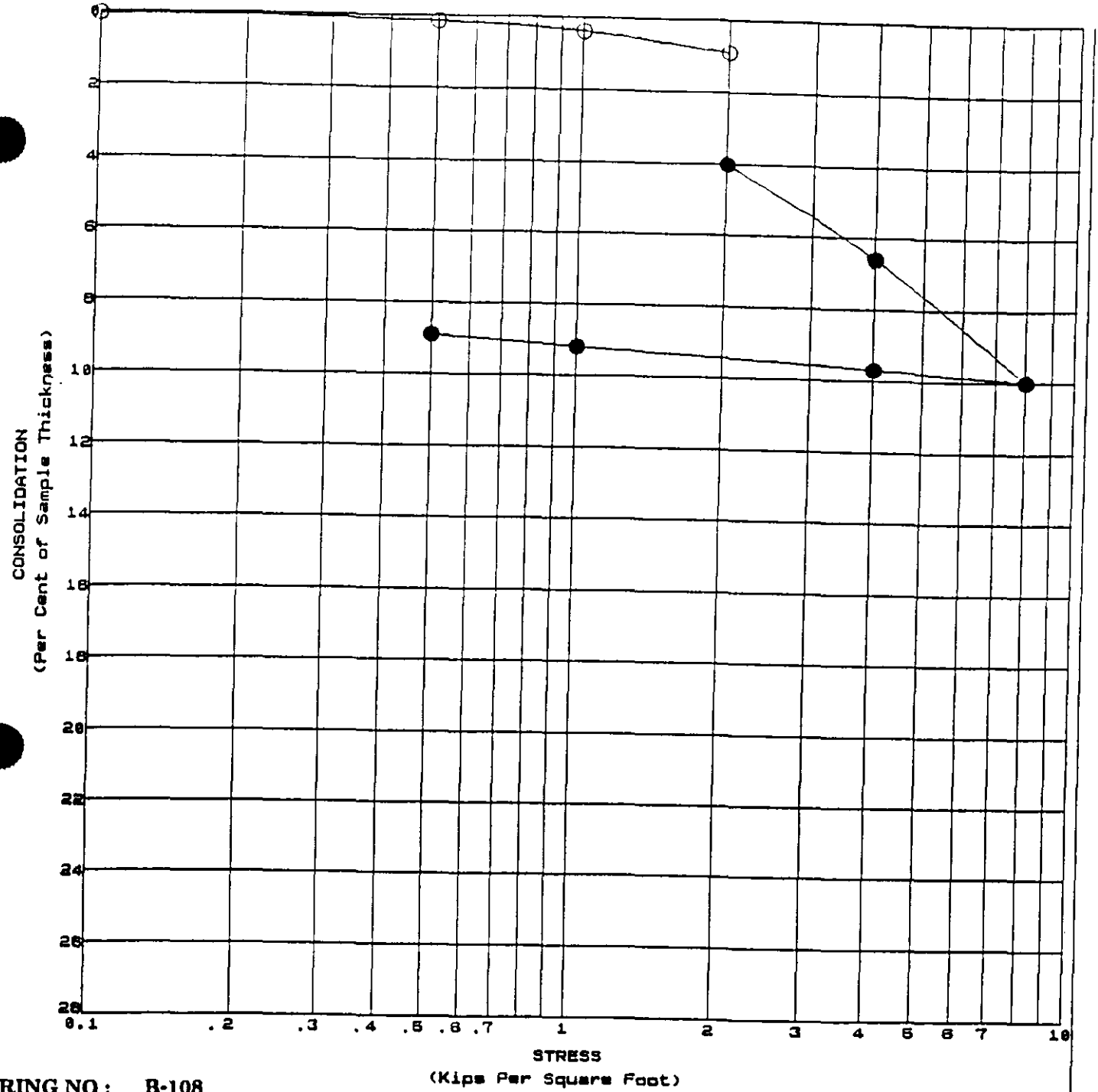
CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Drawing No.
A-46

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Sciences



BORING NO : B-108
DEPTH : 5 feet
DESCRIPTION : LEAN CLAY
DRY DENSITY : 92 PCF
MOISTURE CONTENT : 6%

● READINGS AFTER SATURATION WITH WATER

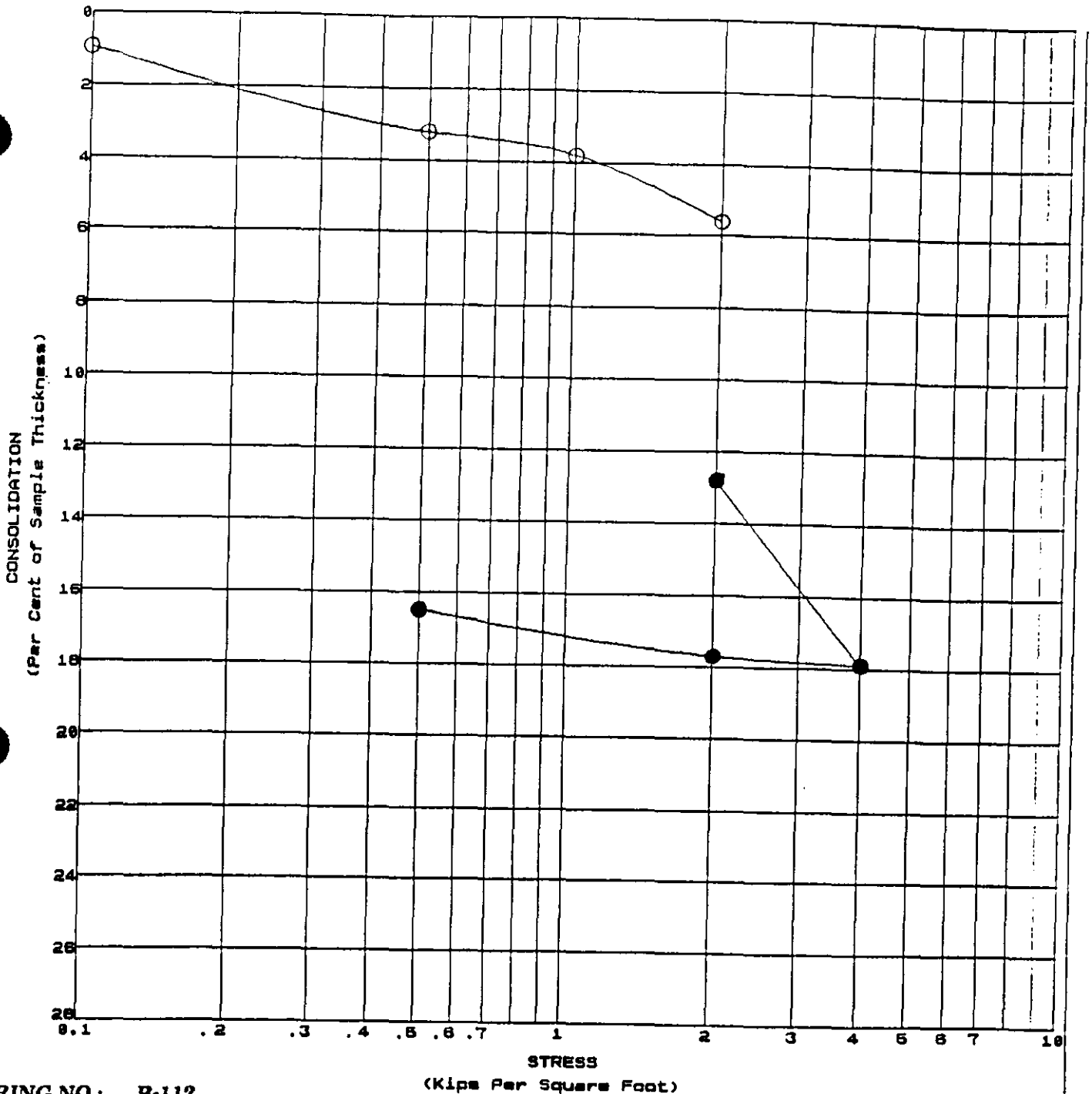
CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Sciences

Drawing No.
A-47



BORING NO : B-112
DEPTH : 5 feet
DESCRIPTION : LEAN CLAY
DRY DENSITY : 86 PCF
MOISTURE CONTENT : 12%

● *READINGS AFTER SATURATION WITH WATER*

CONSOLIDATION TEST

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN

Project No.
91-33647-02

Converse Consultants Southwest, Inc. Geotechnical Engineering and Applied Sciences

Drawing No.
A-48

APPENDIX B

SLOPE STABILITY ANALYSIS

Based on the results of the field and laboratory investigations, slope stability analyses of the proposed embankment were performed. The analyses were performed to determine the steepest allowable slopes with acceptable factors of safety. The analyses were performed on the upstream and downstream south embankment slopes, the upstream spillway embankment slopes and the proposed downstream spillway slope which is 2:1 (horizontal to vertical) with a soil-cement surface. The stability analyses were conducted in general accordance with the Nevada State Statutes, the Clark County Regional Flood Control District *Hydrologic Criteria and Drainage Design Manual* and U.S. Army Corps of Engineers design criteria. The anticipated maximum south and west (spillway) embankment height sections were analyzed for five separate cases; (1) end of construction, (2) seismic end of construction, (3) steady-state seepage (4) seismic steady-state seepage, and (5) sudden drawdown.

The planned elevation of the south and west embankments embankment crests were 1823 and 1816, respectively. The crest widths of the south and west (spillway) embankments are 20 and 26 feet, respectively. The south embankment was analyzed with an upstream height of 23 feet and downstream height of 16 feet. The west (spillway) embankment was analyzed with an upstream height of 16 feet and downstream height of 12 feet. Under water storage conditions, the phreatic surface through the south embankment was assumed to intercept the downstream slope at on-fourth the height. Under water storage conditions, it was assumed that the spillway embankment was saturated and the phreatic surface was just under the soil cement and exited at the toe. The computer program SB-Slope, Version 3.0, developed by Von Gunten Engineering Software, Inc. was used to calculate the minimum factor of safety for each of the five cases for the embankments. The program utilizes the simplified Bishop Method of slope stability analysis for circular failure surfaces. The computer printouts showing the results of the stability analyses for the maximum allowable upstream and downstream slopes are also presented in this Appendix. The maximum slopes for the south embankment were 2½:1

(horizontal to vertical). The maximum upstream slope for the spillway embankment was 2:1. The planned downstream spillway slope of 2:1 appears to be stable. The location of two circular arcs, with the calculated minimum factors of safety for each case are shown on the computer printouts. Each arc represents the minimum factor of safety for the upstream and downstream slopes for each case. A pore pressure coefficient (Ru) of 0.7 was used for the sudden drawdown case for the south embankment. Printouts for the sudden drawdown case with a Ru of 0.7 are not included in this appendix. The maximum failure surface depth was assumed to be 20 feet below the embankments. The soil parameters used for the stability analyses and the calculated minimum factors of safety are presented in the following tables:

Soil Parameters Used For Factor of Safety Calculations

Soil	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Angle of Internal Friction		Cohesion (psf)	
			Moist	Sat	Moist	Sat
Structural Fill	120	130	30°	28°	350	300
Native Soils	95	105	28°	25°	300	250
Soil Cement	140	140	36°	36°	400	400

Note: The soil parameters used for the structural fill and native soils are based on laboratory test results.

Calculated and Required Factors of Safety for South Embankment
Upstream Height 23'; Downstream Height 16'

Loading Condition	Case	Required[1] F.S.	Calculated F.S. 2½:1 Slope Upstream	Calculated F.S. 2½:1 Slope Downstream
End of Construction	1	1.3	2.9	3.3
End of Construction With Seismic Loading[2]	2	1.0	2.3	2.5
Static-Steady State Seepage	3	1.5	2.7	2.2
Seismic-Steady[2] State Seepage	4	1.0	1.8	1.7
Sudden Drawdown	5	1.2	1.7 (1.2)[3]	2.2

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers.
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.1.
[3] Factor of safety with a pore pressure coefficient (Ru) of 0.7.

Calculated and Required Factors of Safety for West Embankment
Upstream Height 16'; Downstream Height 12'

Loading Condition	Case	Required[1] F.S.	Calculated F.S. 2½:1 Slope Upstream	Calculated F.S. 2½:1 Slope Downstream
End of Construction	1	1.3	3.2	3.4
End of Construction With Seismic Loading[2]	2	1.0	2.5	2.7
Static-Steady State Seepage	3	1.5	3.5	2.5
Seismic-Steady[2] State Seepage	4	1.0	2.3	1.9
Sudden Drawdown	5	1.2	1.8 (1.3)[3]	2.5

[1] In accordance with the "Recommended Guidelines for Safety Inspection of Dams" published by the Corps of Engineers.
[2] Seismic evaluation was based on pseudo-static analysis with seismic coefficient of 0.10.
[3] Factor of safety using a pore pressure coefficient (Ru) of 0.7.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: 91-33647-02-Confluence Detention Basin
Location: East of N.A.F.B. in Clark County, Nevada
Filename: CON25END Description: End of Construction Earth. Emb. w/ 2.5:1 slo

ANALYSIS DATA:

Point No.	Coordinates X	Y
1	0.0	100.0
2	20.0	100.0
3	30.0	100.0
4	87.5	123.0
5	107.5	123.0
6	147.5	107.0
7	157.5	106.0
8	177.5	105.0
9	26.0	94.0
10	151.5	100.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0

Line No.	Left Point	Right Point	Soil No.
1	1	2	1
2	2	3	2
3	3	4	2
4	4	5	2
5	5	6	2
6	6	7	2
7	7	8	1
8	2	9	1
9	9	10	1
10	10	7	1

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	95.0	300	28.0
2	120.0	350	30.0
3	0.0	0	0.0
4	0.0	0	0.0

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33647-02-*Confluence* Detention Basin

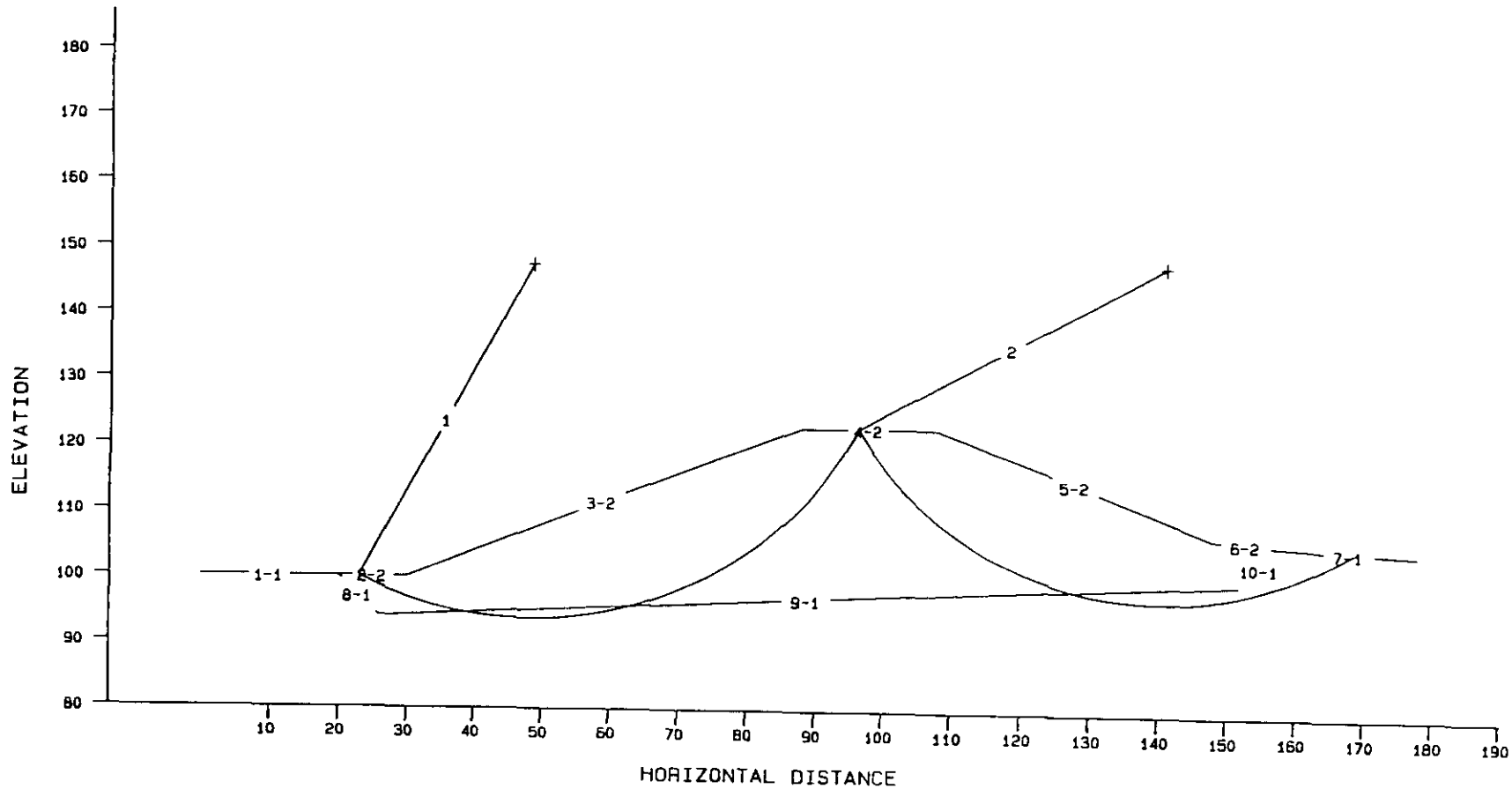
LOCATION: East of N.A.F.B. in Clark County, Nevada

FILE: CON25END

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	48.2	147.5	53.8	2.90
2	140.3	148.1	50.9	3.30

SOIL*	DENSITY	COHESION	PHI
1	95.0	300.0	28.0
2	120.0	350.0	30.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: 91-33647-02-Confluence Detention Basin
Location: East of N.A.F.B. in Clark County, Nevada
Filename: CON25ENS Description: End of Construction w/ Seismic & 2.5:1 slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	100.0	1	1	2	1
2	20.0	100.0	2	2	3	2
3	30.0	100.0	3	3	4	2
4	87.5	123.0	4	4	5	2
5	107.5	123.0	5	5	6	2
6	147.5	107.0	6	6	7	2
7	157.5	106.0	7	7	8	1
8	177.5	105.0	8	2	9	1
9	26.0	94.0	9	9	10	1
10	151.5	100.0	10	10	7	1
11	0.0	0.0				
12	0.0	0.0				
13	0.0	0.0				

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	95.0	300	28.0
2	120.0	350	30.0
3	0.0	0	0.0
4	0.0	0	0.0

Seismic coefficient, horizontal = 0.100
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33647-02-Confluence Detention Basin

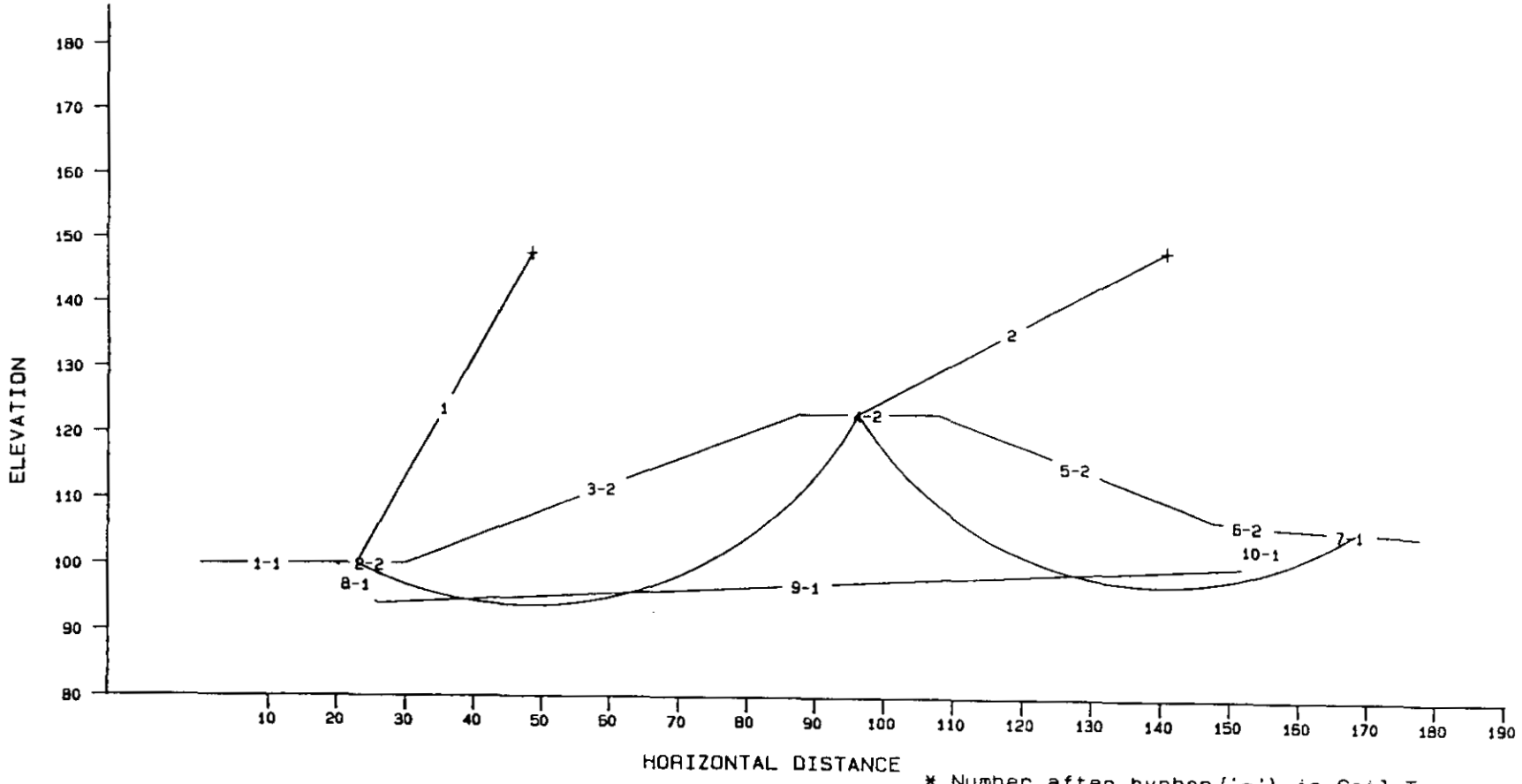
LOCATION: East of N.A.F.B. in Clark County, Nevada

FILE: CON25ENS

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	48.2	147.5	53.8	2.30
2	140.3	148.1	50.9	2.50

SOIL*	DENSITY	COHESION	PHI
1	95.0	300.0	28.0
2	120.0	350.0	30.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: 91-33647-02-Confluence Detention Basin
Location: East of N.A.F.B. in Clark County, Nevada
Filename: CON25STE Description: Steady-State Earth Embank. w/2.5:1 slopes

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	N
2	20.0	100.0	2	2	3	2	N
3	30.0	100.0	3	3	4	2	N
4	70.0	116.0	4	4	5	3	N
5	87.5	123.0	5	5	6	3	N
6	107.5	123.0	6	6	7	3	N
7	137.5	111.0	7	7	8	2	Y
8	147.5	107.0	8	8	9	2	Y
9	157.5	106.0	9	9	10	4	N
10	177.5	105.0	10	2	11	1	N
11	26.0	94.0	11	11	12	1	N
12	151.5	100.0	12	12	9	1	N
13	0.0	116.0	13	4	7	2	Y

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	120.0	350	30.0
4	95.0	300	28.0

Free water surface, left point = 13
right point = 4

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33647-02-Confluence Detention Basin

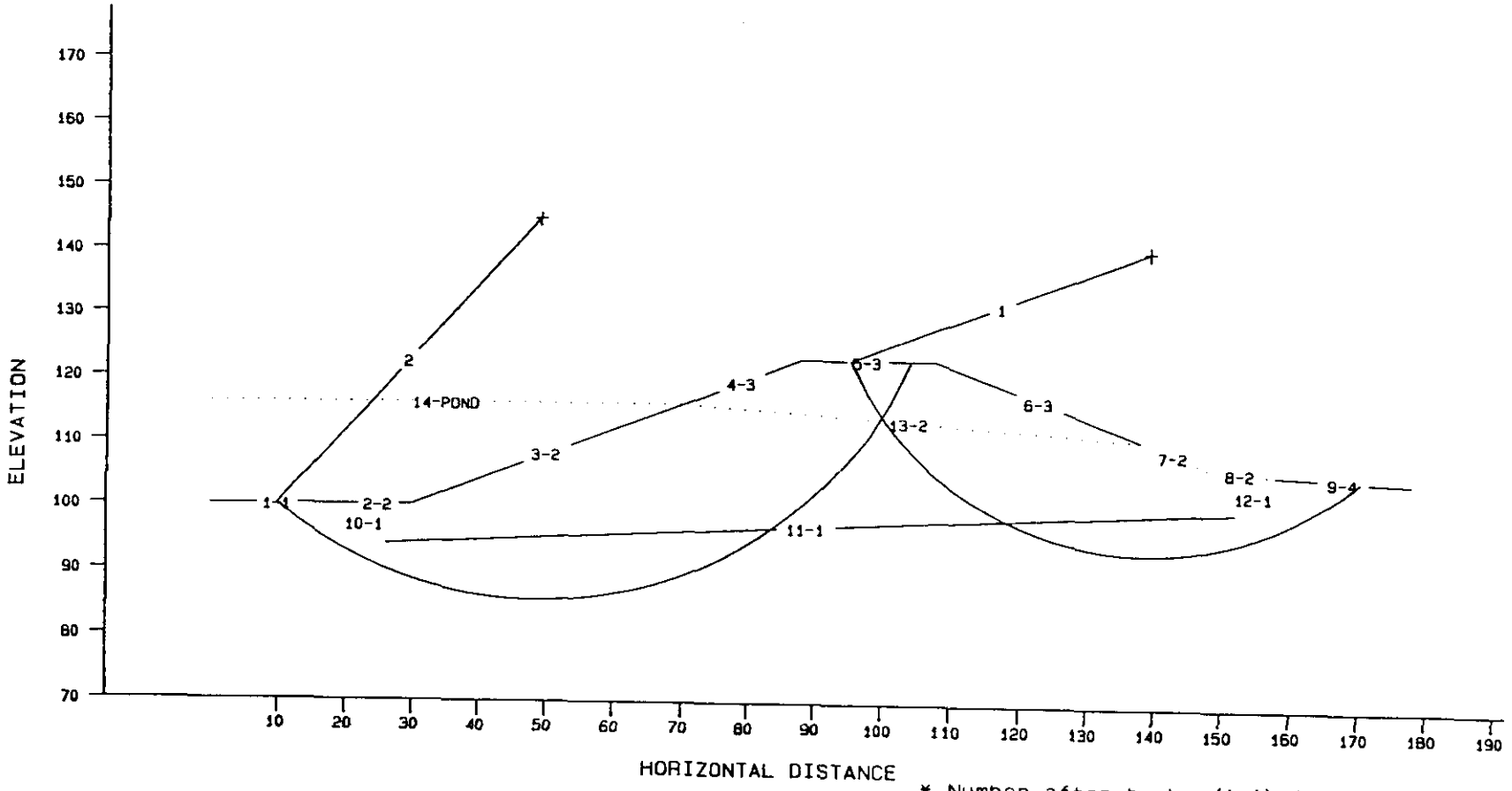
LOCATION: East of N.A.F.B. in Clark County, Nevada

FILE: CON25STE

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	138.7	140.6	47.1	2.20
2	48.8	144.8	59.3	2.70

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	120.0	350.0	30.0
4	95.0	300.0	28.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: 91-33647-02-Confluence Detention Basin
Location: East of N.A.F.B. in Clark County, Nevada
Filename: CON25SEI Description: Seismic Steady-State Earth. Emb 2.5:1 slopes

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	N
2	20.0	100.0	2	2	3	2	N
3	30.0	100.0	3	3	4	2	N
4	70.0	116.0	4	4	5	3	N
5	87.5	123.0	5	5	6	3	N
6	107.5	123.0	6	6	7	3	N
7	137.5	111.0	7	7	8	2	Y
8	147.5	107.0	8	8	9	2	Y
9	157.5	106.0	9	9	10	4	N
10	177.5	105.0	10	2	11	1	N
11	26.0	94.0	11	11	12	1	N
12	151.5	100.0	12	12	9	1	N
13	0.0	116.0	13	4	7	2	Y

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	120.0	350	30.0
4	95.0	300	28.0

Free water surface, left point = 13
right point = 4

Seismic coefficient, horizontal = 0.100
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33647-02-Confluence Detention Basin

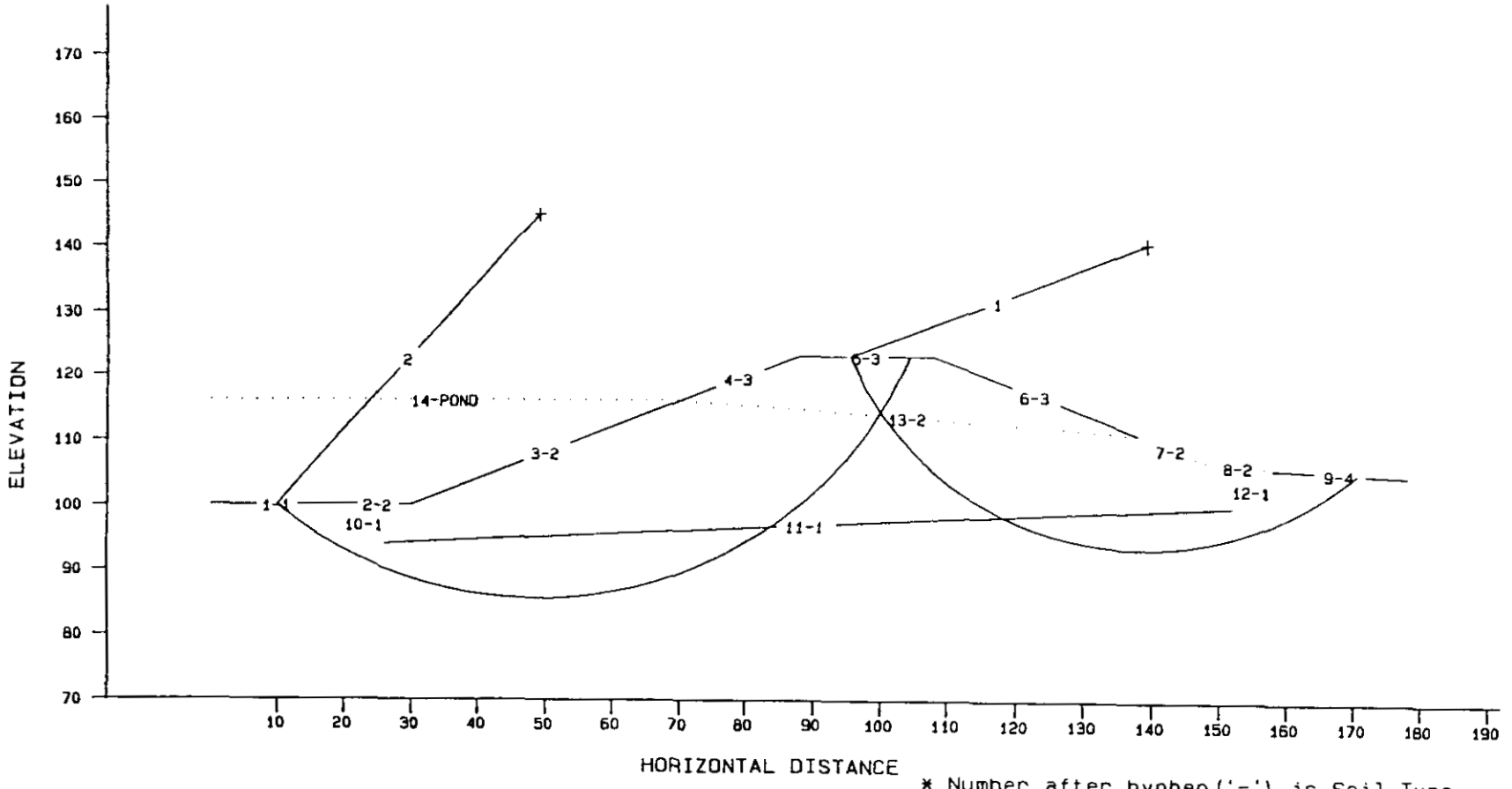
LOCATION: East of N.A.F.B. in Clark County, Nevada

FILE: CON25SEI

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	138.7	140.6	47.1	1.70
2	48.8	144.8	59.3	1.80

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	120.0	350.0	30.0
4	95.0	300.0	28.0



* Number after hyphen('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: 91-33647-02-Confluence Detention Basin
Location: East of N.A.F.B. in Clark County, Nevada
Filename: CON25SUD Description: Sudden Drawdown Earth Embank. w/2.5:1 slopes

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	Y
2	20.0	100.0	2	2	3	2	Y
3	30.0	100.0	3	3	4	2	Y
4	70.0	116.0	4	4	5	3	N
5	87.5	123.0	5	5	6	3	N
6	107.5	123.0	6	6	7	3	N
7	137.5	111.0	7	7	8	2	Y
8	147.5	107.0	8	8	9	2	Y
9	157.5	106.0	9	9	10	4	N
10	177.5	105.0	10	2	11	1	N
11	26.0	94.0	11	11	12	1	N
12	151.5	100.0	12	12	9	1	N
13	0.0	0.0	13	4	7	2	Y

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	120.0	350	30.0
4	95.0	300	28.0

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: 91-33647-02-Confluence Detention Basin

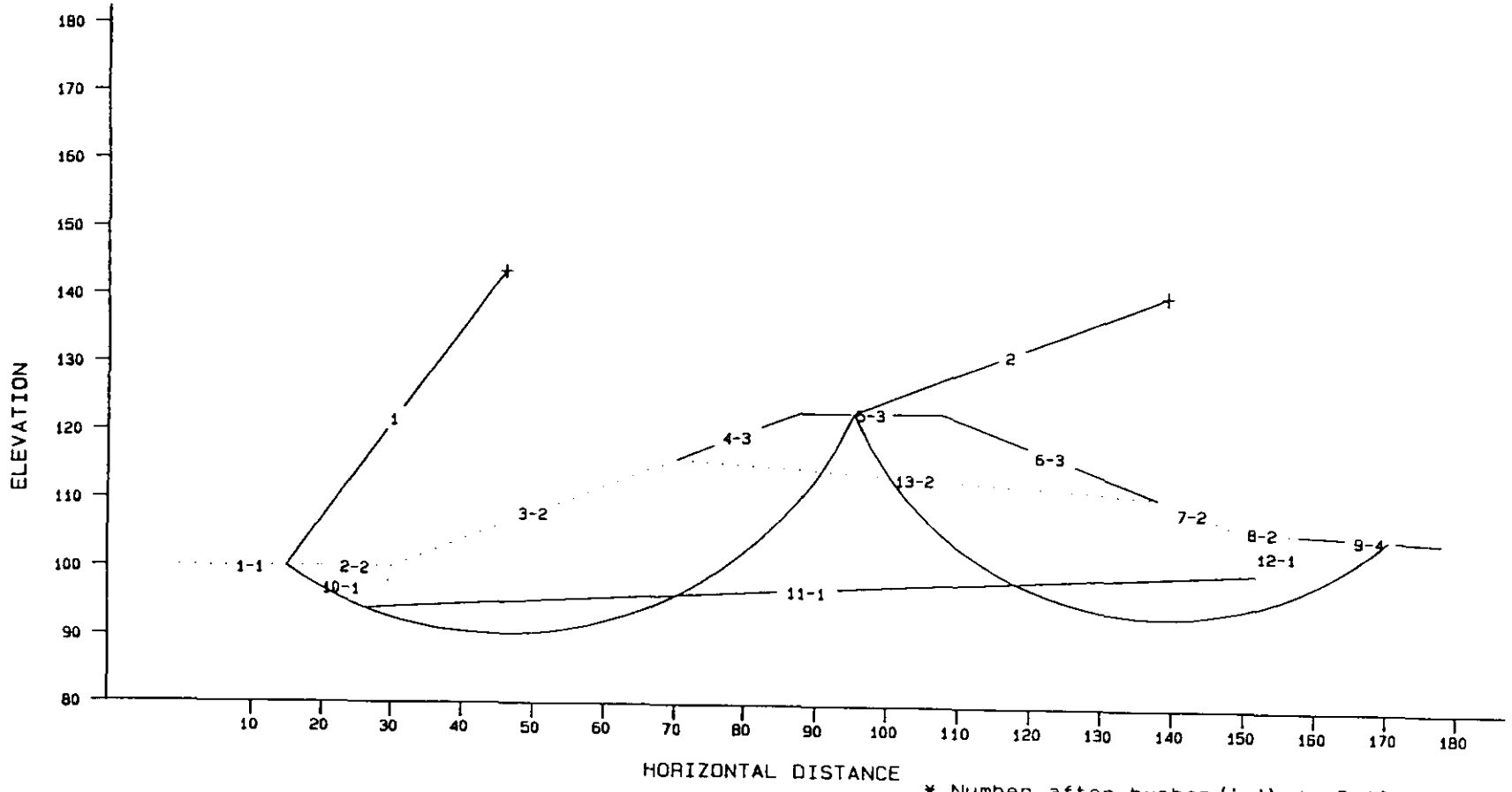
LOCATION: East of N.A.F.B. in Clark County, Nevada

FILE: CON25SUD

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	45.8	143.5	53.3	1.70
2	138.7	140.6	47.1	2.20

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	120.0	350.0	30.0
4	95.0	300.0	28.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin 91-33647-02
Location: Near N.A.F.B. in Clark County, Nevada
Filename: SPIL2END Description: End of Construction-Spillway w/ 2:1 up slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	100.0	1	1	2	1
2	20.0	100.0	2	2	3	2
3	30.0	100.0	3	3	4	2
4	60.0	115.0	4	4	5	2
5	68.0	115.0	5	5	6	3
6	70.0	115.0	6	6	7	3
7	70.1	116.0	7	7	8	3
8	86.0	116.0	8	8	9	3
9	110.0	104.0	9	9	10	2
10	120.0	104.0	10	10	11	2
11	136.0	112.0	11	5	12	2
12	68.1	113.0	12	12	13	2
13	84.0	113.0	13	13	14	2
14	102.0	104.0	14	14	9	2
15	26.0	94.0	15	2	15	1
16	110.0	98.0	16	15	16	1
17	120.0	101.0	17	16	17	1
18	0.0	0.0	18	17	11	1

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	95.0	300	28.0
2	120.0	350	30.0
3	140.0	400	36.0

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin 91-33647-02

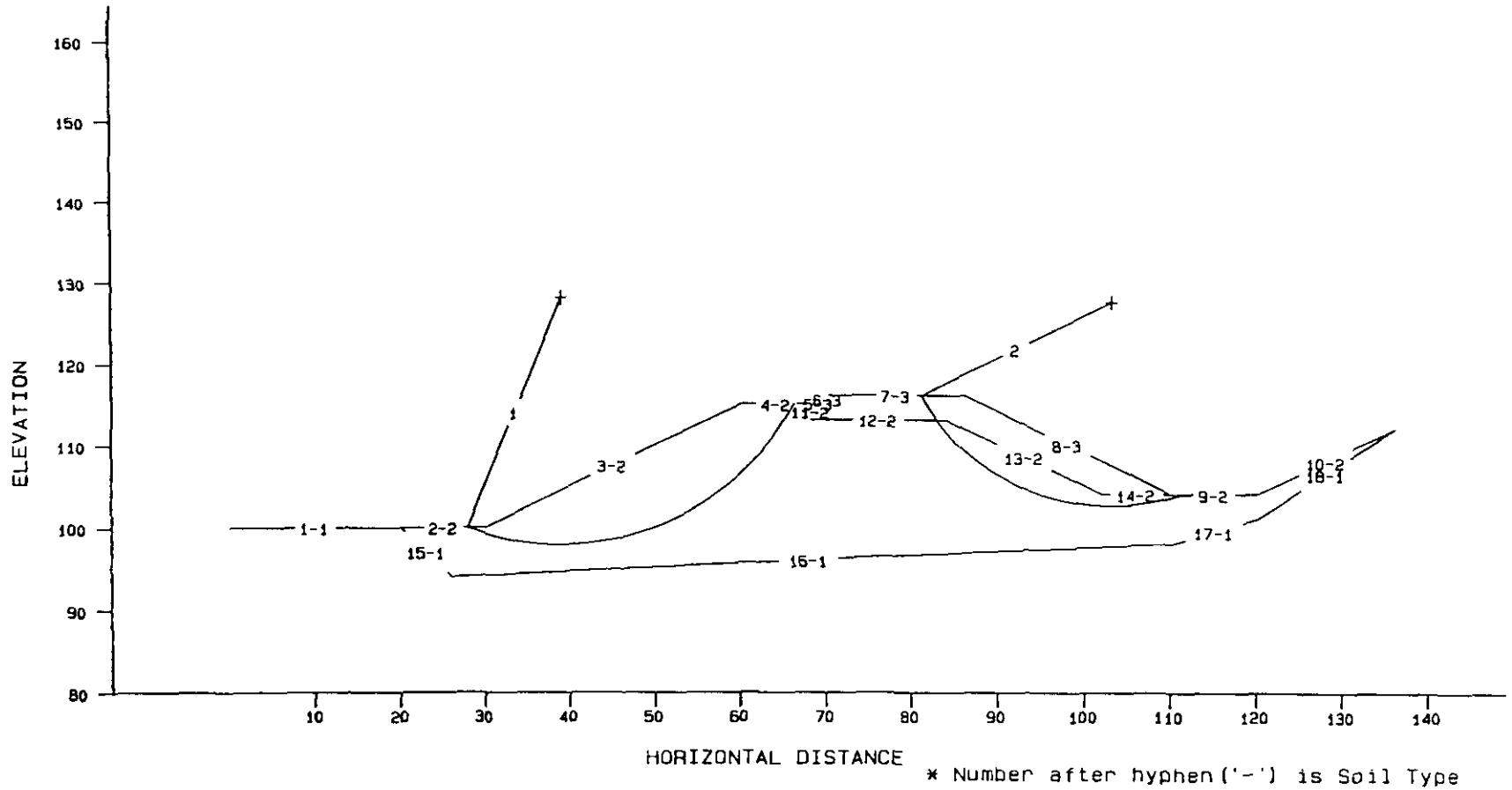
LOCATION: Near N.A.F.B. in Clark County, Nevada

FILE: SPIL2END

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	38.9	128.0	30.1	3.20
2	103.0	127.4	24.8	3.40

SOIL*	DENSITY	COHESION	PHI
1	95.0	300.0	28.0
2	120.0	350.0	30.0
3	140.0	400.0	36.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin 91-33647-02
Location: Near N.A.F.B. in Clark County, Nevada
Filename: SPIL2ENS Description: Seismic End of Cons-Spillway w/ 2:1 up slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.
1	0.0	100.0	1	1	2	1
2	20.0	100.0	2	2	3	2
3	30.0	100.0	3	3	4	2
4	60.0	115.0	4	4	5	2
5	68.0	115.0	5	5	6	3
6	70.0	115.0	6	6	7	3
7	70.1	116.0	7	7	8	3
8	86.0	116.0	8	8	9	3
9	110.0	104.0	9	9	10	2
10	120.0	104.0	10	10	11	2
11	136.0	112.0	11	5	12	2
12	68.1	113.0	12	12	13	2
13	84.0	113.0	13	13	14	2
14	102.0	104.0	14	14	9	2
15	26.0	94.0	15	2	15	1
16	110.0	98.0	16	15	16	1
17	120.0	101.0	17	16	17	1
18	0.0	0.0	18	17	11	1

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	95.0	300	28.0
2	120.0	350	30.0
3	140.0	400	36.0

Seismic coefficient, horizontal = 0.100
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin 91-33647-02

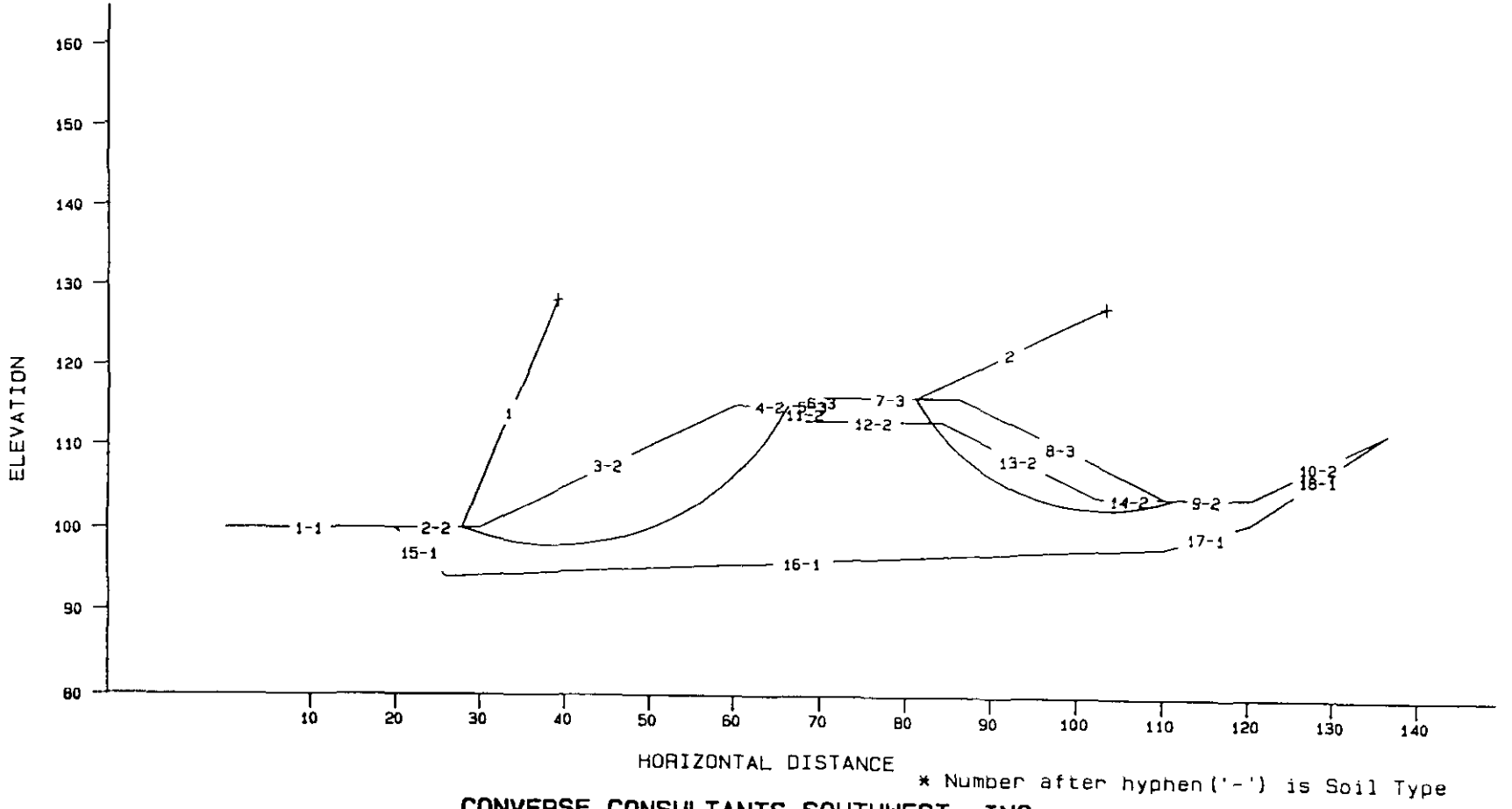
LOCATION: Near N.A.F.B. in Clark County, Nevada

FILE: SPIL2ENS

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	38.9	128.0	30.1	2.50
2	103.0	127.4	24.8	2.70

SOIL*	DENSITY	COHESION	PHI
1	95.0	300.0	28.0
2	120.0	350.0	30.0
3	140.0	400.0	36.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin 91-33647-02
Location: Near N.A.F.B. in Clark County, Nevada
Filename: SPIL2STE Description: Steady-State-Spillway w/2:1 upstream slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	N
2	20.0	100.0	2	2	3	2	N
3	30.0	100.0	3	3	4	2	N
4	60.0	115.0	4	4	5	2	N
5	68.0	115.0	5	5	6	3	N
6	70.0	115.0	6	6	7	3	N
7	70.1	116.0	7	7	8	3	N
8	86.0	116.0	8	8	9	3	N
9	110.0	104.0	9	9	10	2	Y
10	120.0	104.0	10	10	11	2	N
11	136.0	112.0	11	5	12	2	Y
12	68.1	113.0	12	12	13	2	Y
13	84.0	113.0	13	13	14	2	Y
14	102.0	104.0	14	14	9	2	Y
15	26.0	94.0	15	2	15	1	N
16	110.0	98.0	16	15	16	1	N
17	120.0	101.0	17	16	17	1	N
18	0.0	116.0	18	17	11	1	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	140.0	400	36.0

Free water surface, left point = 18
right point = 7

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin 91-33647-02

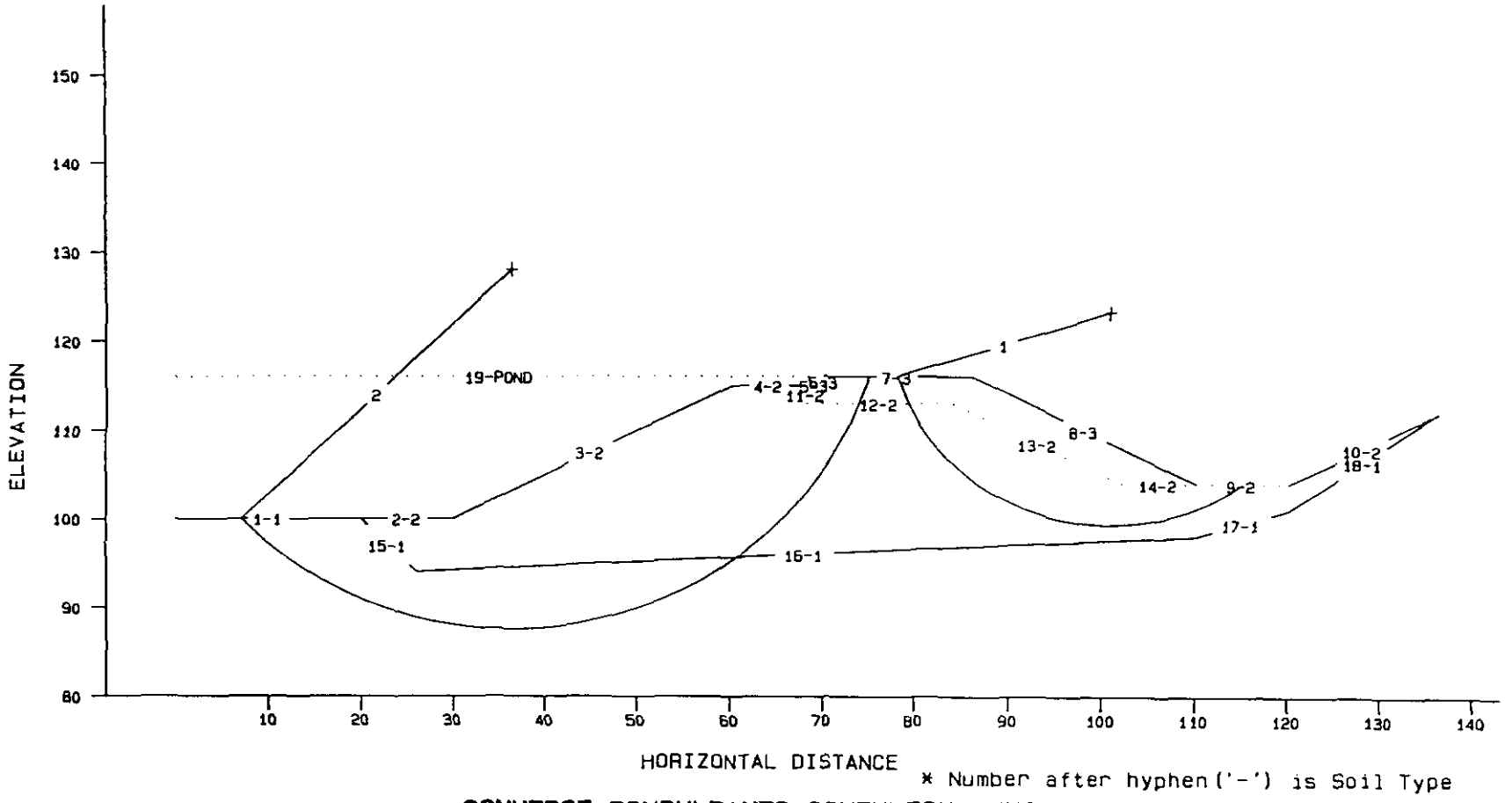
LOCATION: Near N.A.F.B. in Clark County, Nevada

FILE: SPIL2STE

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	100.8	123.2	23.9	2.50
2	36.3	128.0	40.5	3.50

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	140.0	400.0	36.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin 91-33647-02
Location: Near N.A.F.B. in Clark County, Nevada
Filename: SPIL2SEI Description: Seismic Steady-State Spill w/ 2:1 up slope

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	N
2	20.0	100.0	2	2	3	2	N
3	30.0	100.0	3	3	4	2	N
4	60.0	115.0	4	4	5	2	N
5	68.0	115.0	5	5	6	3	N
6	70.0	115.0	6	6	7	3	N
7	70.1	116.0	7	7	8	3	N
8	86.0	116.0	8	8	9	3	N
9	110.0	104.0	9	9	10	2	Y
10	120.0	104.0	10	10	11	2	N
11	136.0	112.0	11	5	12	2	Y
12	68.1	113.0	12	12	13	2	Y
13	84.0	113.0	13	13	14	2	Y
14	102.0	104.0	14	14	9	2	Y
15	26.0	94.0	15	2	15	1	N
16	110.0	98.0	16	15	16	1	N
17	120.0	101.0	17	16	17	1	N
18	0.0	116.0	18	17	11	1	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	140.0	400	36.0

Free water surface, left point = 18
right point = 7

Seismic coefficient, horizontal = 0.100
vertical = 0.000

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin 91-33647-02

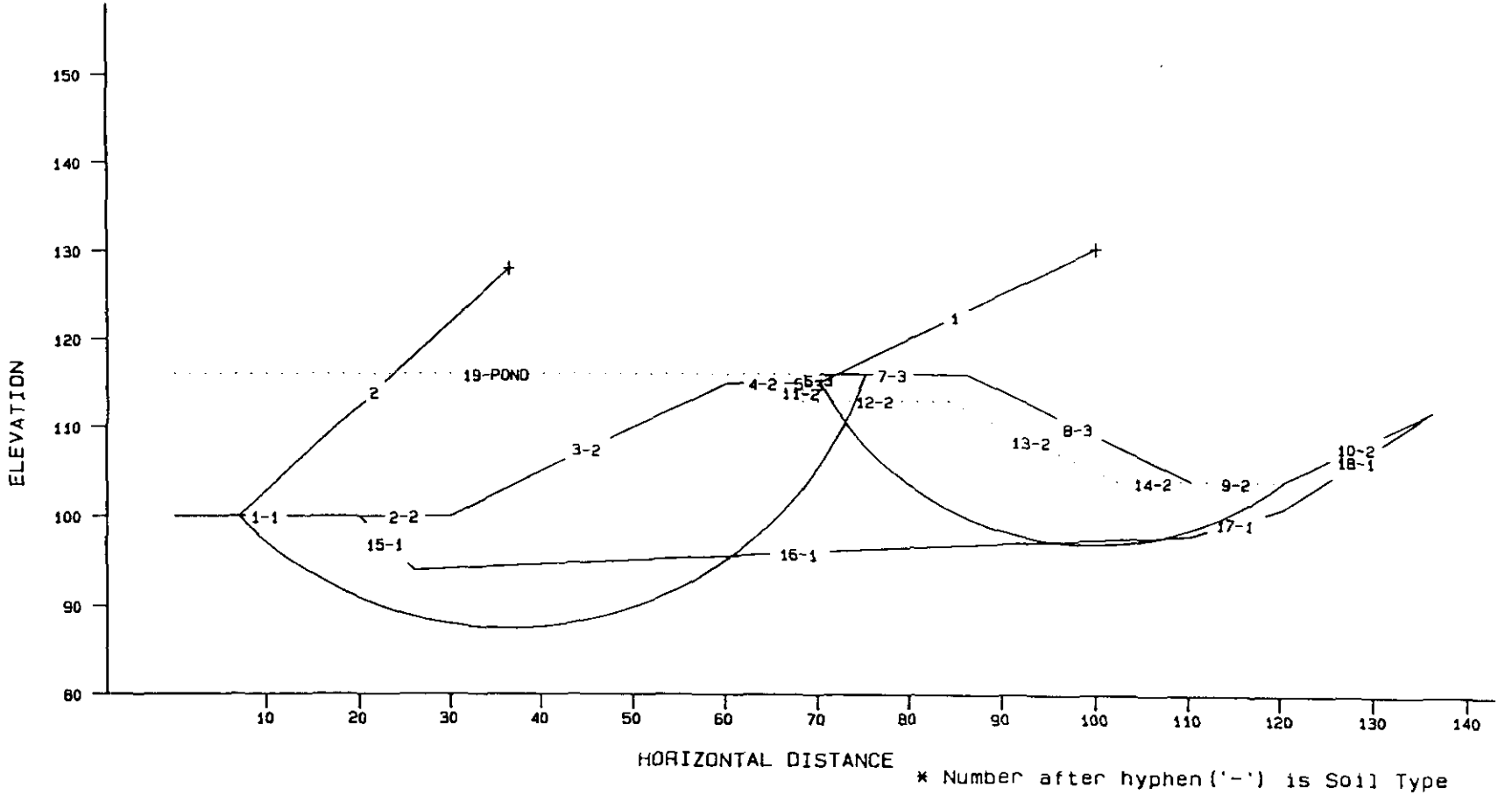
LOCATION: Near N.A.F.B. in Clark County, Nevada

FILE: SPIL2SEI

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	99.6	130.3	33.3	1.90
2	36.3	128.0	40.5	2.30

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	140.0	400.0	36.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

GEOSYSTEM SLOPE STABILITY PROGRAM
SB-SLOPE

PROJECT DATA:
Project: Confluence Detention Basin 91-33647-02
Location: Near N.A.F.B. in Clark County, Nevada
Filename: SPIL2SUD Description: Sudden Drawdown-Spillway w/2:1 upstream slop

ANALYSIS DATA:

Point No.	Coordinates X	Y	Line No.	Left Point	Right Point	Soil No.	Phreatic Line
1	0.0	100.0	1	1	2	1	Y
2	20.0	100.0	2	2	3	2	Y
3	30.0	100.0	3	3	4	2	Y
4	60.0	115.0	4	4	5	2	Y
5	68.0	115.0	5	5	6	3	N
6	70.0	115.0	6	6	7	3	N
7	70.1	116.0	7	7	8	3	N
8	86.0	116.0	8	8	9	3	N
9	110.0	104.0	9	9	10	2	Y
10	120.0	104.0	10	10	11	2	N
11	136.0	112.0	11	5	12	2	Y
12	68.1	113.0	12	12	13	2	Y
13	84.0	113.0	13	13	14	2	Y
14	102.0	104.0	14	14	9	2	Y
15	26.0	94.0	15	2	15	1	N
16	110.0	98.0	16	15	16	1	N
[illegible]	120.0	101.0	17	16	17	1	N
			18	17	11	1	N

Soil No.	Density pcf	Cohesion psf	Phi Deg
1	105.0	250	25.0
2	130.0	300	28.0
3	140.0	400	36.0

SB-SLOPE

Simplified Bishop Slope Stability Analysis

PROJECT: Confluence Detention Basin 91-33647-02

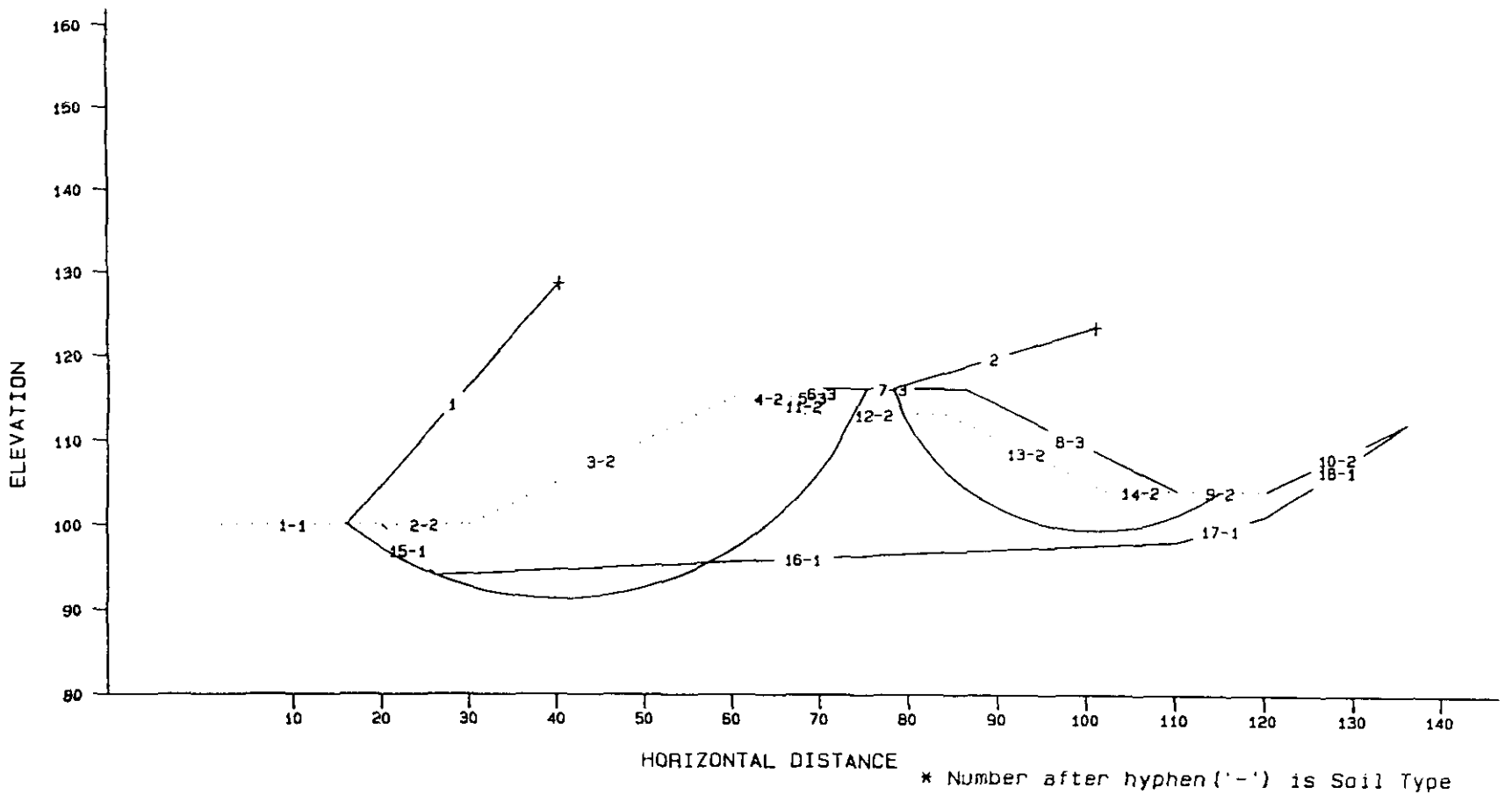
LOCATION: Near N.A.F.B. in Clark County, Nevada

FILE: SPIL2SUD

COMPLETE SLOPE CROSS SECTION SHOWN

CIRCLE	X	Y	RADIUS	FS
1	40.0	128.5	37.2	1.80
2	100.8	123.2	23.9	2.50

SOIL*	DENSITY	COHESION	PHI
1	105.0	250.0	25.0
2	130.0	300.0	28.0
3	140.0	400.0	36.0



* Number after hyphen ('-') is Soil Type

CONVERSE CONSULTANTS SOUTHWEST, INC.

APPENDIX C

PERTINENT DATA FROM *PREVIOUS INVESTIGATIONS*

Log of Boring Nos. B-1 & B-2
CCSW Project No. 91-33647-01
Dated July 12, 1992

Log of Trench Nos. T-1
through T-6
CCSW Project No. 91-33647-01
Dated July 12, 1992

Grain Size Distribution Curves
Drawing Nos. A-13
through A-18
CCSW Project No. 91-33647-01
Dated July 12, 1992

Log of Boring No. B-3
CCSW Project No. 88-33195-01
Dated November 20, 1989

Date Drilled: 6/11/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Boring No. B- 1

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
		SANDY SILT (ML); porous, firm, light brown, dry	■		8	5	85	
2		---slightly moist						
		LEAN CLAY (CL); porous, stiff, light brown, slightly moist						
4								
		---very stiff						
6			■		18	6	86	
8								
		FAT CLAY (CH); few gypsum, very stiff, light gray-white, slightly moist	■		30/6"			
12								
14		LEAN CLAY (CL); porous, trace organics, very stiff, light brown, slightly moist	■		30/6"	10	110	
16								
18		---light brown						
			■		25	9	104	

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 30.0 feet

APPROVED BY DXO ON 1/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-1

Date Drilled: 8/11/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Boring No. B- 1

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
22							
24		■		30/6"	9	103	
26							
28							
		■		30/6"			

LEAN CLAY (CL); porous, trace organics, very stiff, light brown, slightly moist

---slightly porous

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 30.0 feet

APPROVED BY MAD ON 4/13/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-2

Date Drilled: 6/11/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Boring No. B- 2

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SAMPLES DRIVE	SAMPLES BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
0							SILT (ML); trace salts, stiff, light brown-light gray, dry
							---firm, light brown, slightly moist
2		■		7	13	89	
4							LEAN CLAY (CL); trace organics, porous, stiff, light brown, slightly moist
6		■		10	14	104	
8							---few gypsum crystals, moist
		■		15	17	112	---light gray
							---slightly moist
12							
							CLAYEY SAND (SC); dense, light gray, slightly moist
14		■		30/6"	8	119	
16							
18							
		▬		20/0"			CALICHE; hard, white, dry

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 30.0 feet

APPROVED BY BJ ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Drawing No.
A-3

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 1

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0						
	SILTY GRAVEL With Sand (GM); loose to medium dense, light orange-brown, slightly moist					
	SILTY CLAY With Sand (ML-CL); stiff, light orange-brown, slightly moist					
2						
4						
6	CLAYEY GRAVEL (GC); medium dense, light orange-brown, slightly moist					
8						
	SANDY LEAN CLAY With Gravel (CL); stiff, light orange-brown, slightly moist					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY TJO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-5

Date Drilled: 6/11/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Boring No. B- 2

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH (ft)	GRAPHIC LOG	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/FOOT	MOISTURE (%)	DRY UNIT WT. (pcf)	REMARKS
							CALICHE; hard, white, dry
22							LEAN CLAY (CL); porous, very stiff, light gray, moist
24		■		30/9"	19	75	---medium orange-brown
26							
28		■		20/2"	12	99	---few organics

Groundwater: None Observed
Driving Weight and Drop: 340lb/30in

End of Boring at 30.0 feet

APPROVED BY BZO ON 4/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-4

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 2

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
		This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.					
		SILTY GRAVEL With Sand (GM); loose, light orange-brown, slightly moist					
2		SILT With Sand (ML); stiff, light orange-brown, slightly moist					
4		LEAN CLAY With Sand (CL); stiff, light orange-brown, slightly moist					
6		CLAYEY GRAVEL (GC); medium dense, light grayish orange, slightly moist					
8		SILTY CLAY (CL); stiff, light orange brown, slightly moist					

Groundwater: None Observed

Bottom of Trench at 9.0 feet

APPROVED BY DLO ON 7/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-6

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 3

SUMMARY OF SUBSURFACE CONDITIONS

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
2		SILTY CLAY (ML-CL); porous, firm to stiff, light orange brown, dry					
4		LEAN CLAY (CL); porous, stiff, light brown, slightly moist					
		SANDY SILT (ML); porous, light brown, slightly moist					
6		LEAN CLAY (CL); porous, light brown, slightly moist					
8		FAT CLAY (CH); very stiff, slightly moist, light brown					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY DXD ON 7/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-7

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 4

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		POORLY GRADED SAND (SP); very loose, light yellow brown, dry					
2							
4		SILTY SAND (SM); porous, loose to medium dense, light brown, slightly moist					
6		SILTY CLAY (CL-ML); porous, stiff, light orange brown, slightly moist					
8		FAT CLAY (CL); very stiff, light orange brown, slightly moist					
		LEAN CLAY (CL); with caliche nodules (no cemented), stiff, white to light orange brown					

APPROVED BY BZD ON 6/1/93

Groundwater: None Observed

Bottom of Trench at 10.0 feet

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-8

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 5

DEPTH	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		SANDY LEAN CLAY (CL); stiff, light orange brown, dry					
2		----firm to stiff, moist					
4							
6		FAT CLAY (CL); very stiff, light orange-brown, moist					
8							
		LEAN CLAY (CL); with caliche nodules, stiff, orange beige					

This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY BZO ON 5/7/93

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-9

Date Drilled: 5/29/92
Logged By: D.DONOVAN
Ground Surface Elevation: Not Measured
Location: See Drawing No. 2

Log of Trench No. T- 6

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read with the report. This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: BULK	FIELD MOISTURE (%)	FIELD DRY UNIT WT. (pcf)	REMARKS
0		SILTY SAND (SM); loose, light orange brown, dry					
2							
4		---few caliche nodules, medium dense		■			
6							
8		LEAN CLAY/FAT CLAY (CL/CH); few caliche nodules, very stiff, light orange-brown, slightly moist					
		LEAN CLAY (CL); with caliche nodules, stiff, light orange- beige					

Groundwater: None Observed

Bottom of Trench at 10.0 feet

APPROVED BY DJO ON 1/7/93

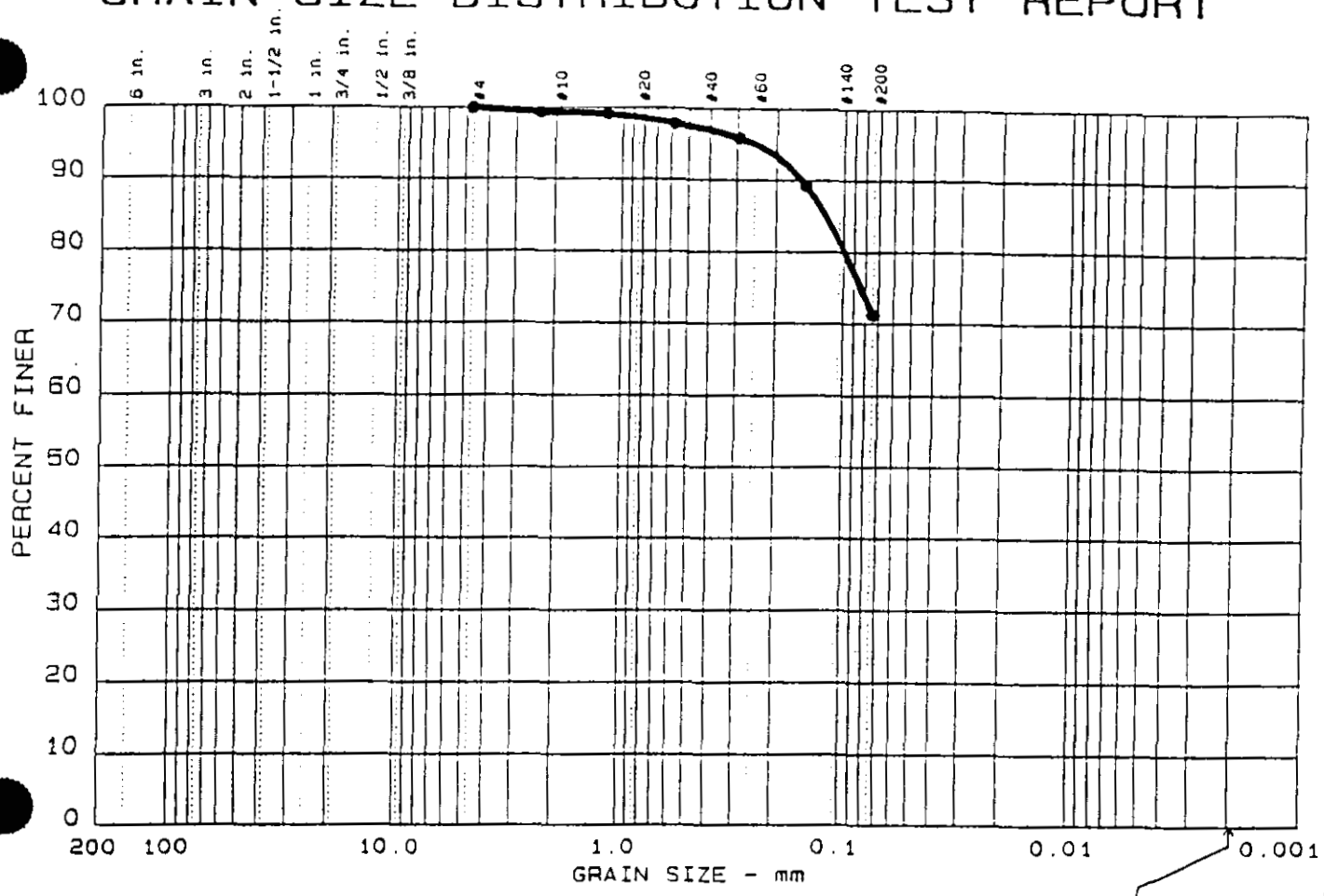
SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
Nellis Air Force Base
Clark County, Nevada

Project No.
91-33647-01

Converse Consultants Southwest, Inc.
Geotechnical Engineering and Applied Science

Drawing No.
A-10

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	28.8	71.2	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	25	7	0.12							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. **SILTY CLAY With Sand**	CL - ML	

Project No.: 91-33647-01

Project: Confluence

● Location: T-1; depth: 3-5'

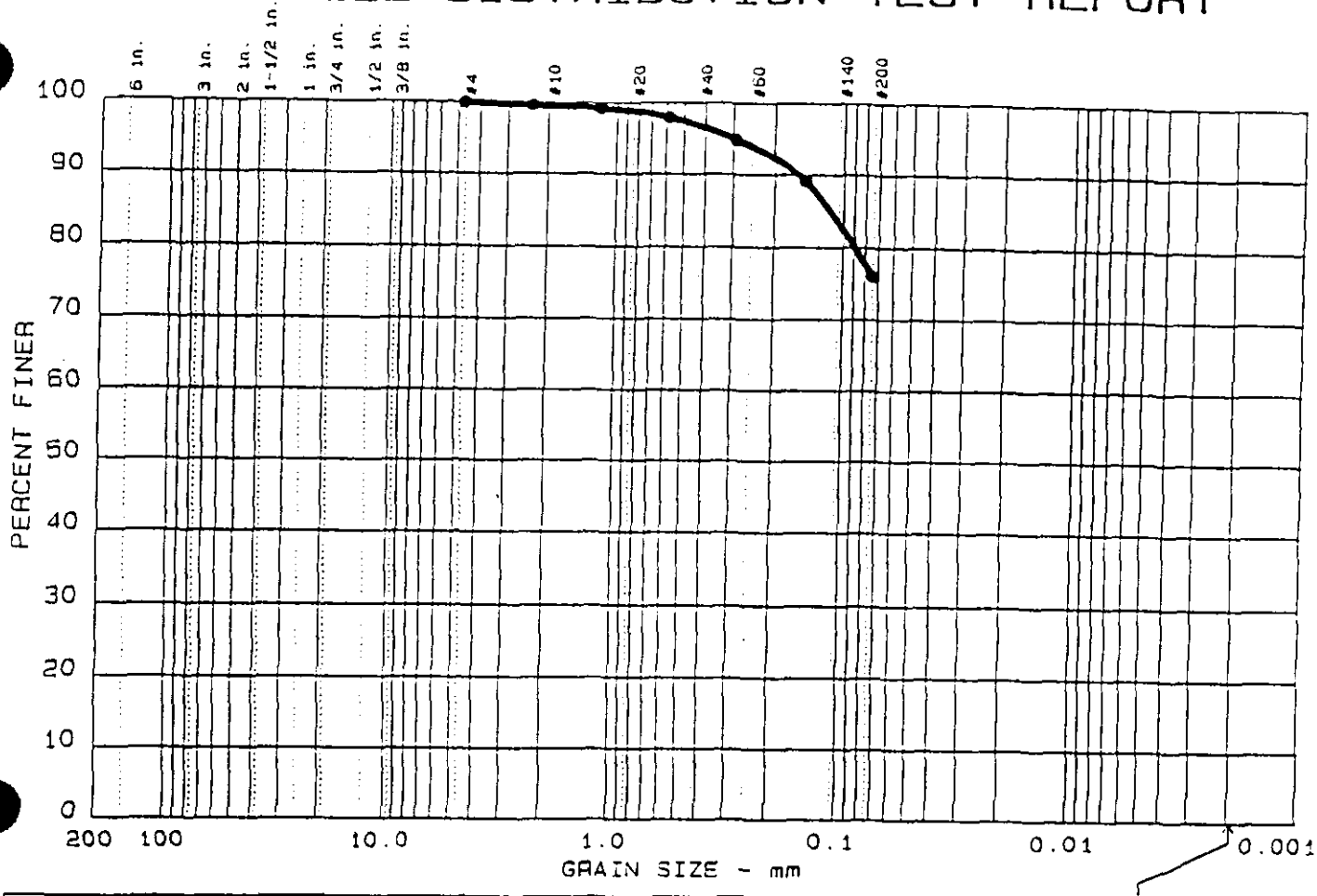
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-13

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	0.0	24.0	76.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_C	C_U
●	35.9	15	0.11							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. br. **LEAN CLAY With Sand**	CL	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 2, depth: 3 - 5'

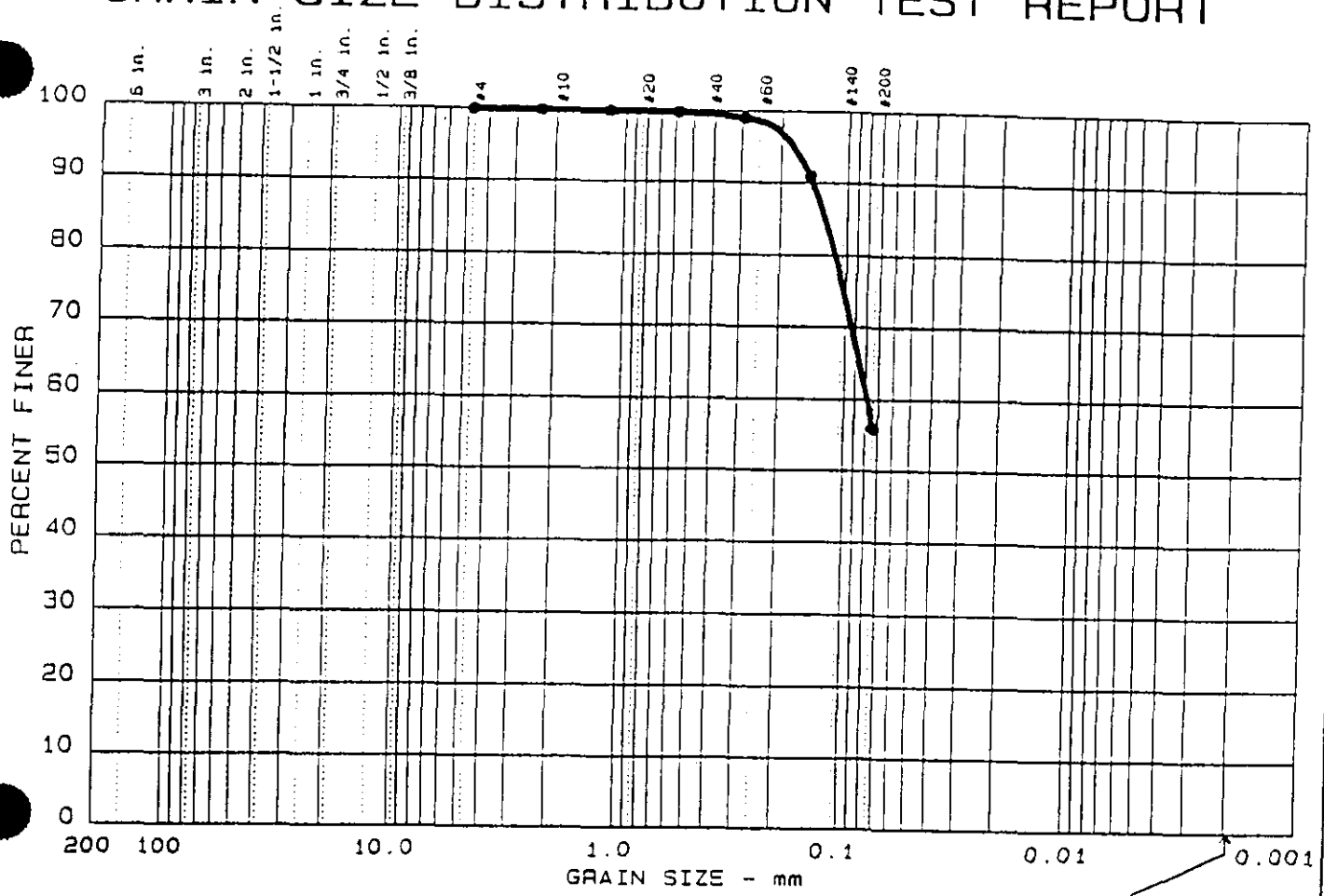
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-14

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	0.0	44.0	56.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.13	0.08						

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SANDY SILT	ML	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 3, depth: 4-6'

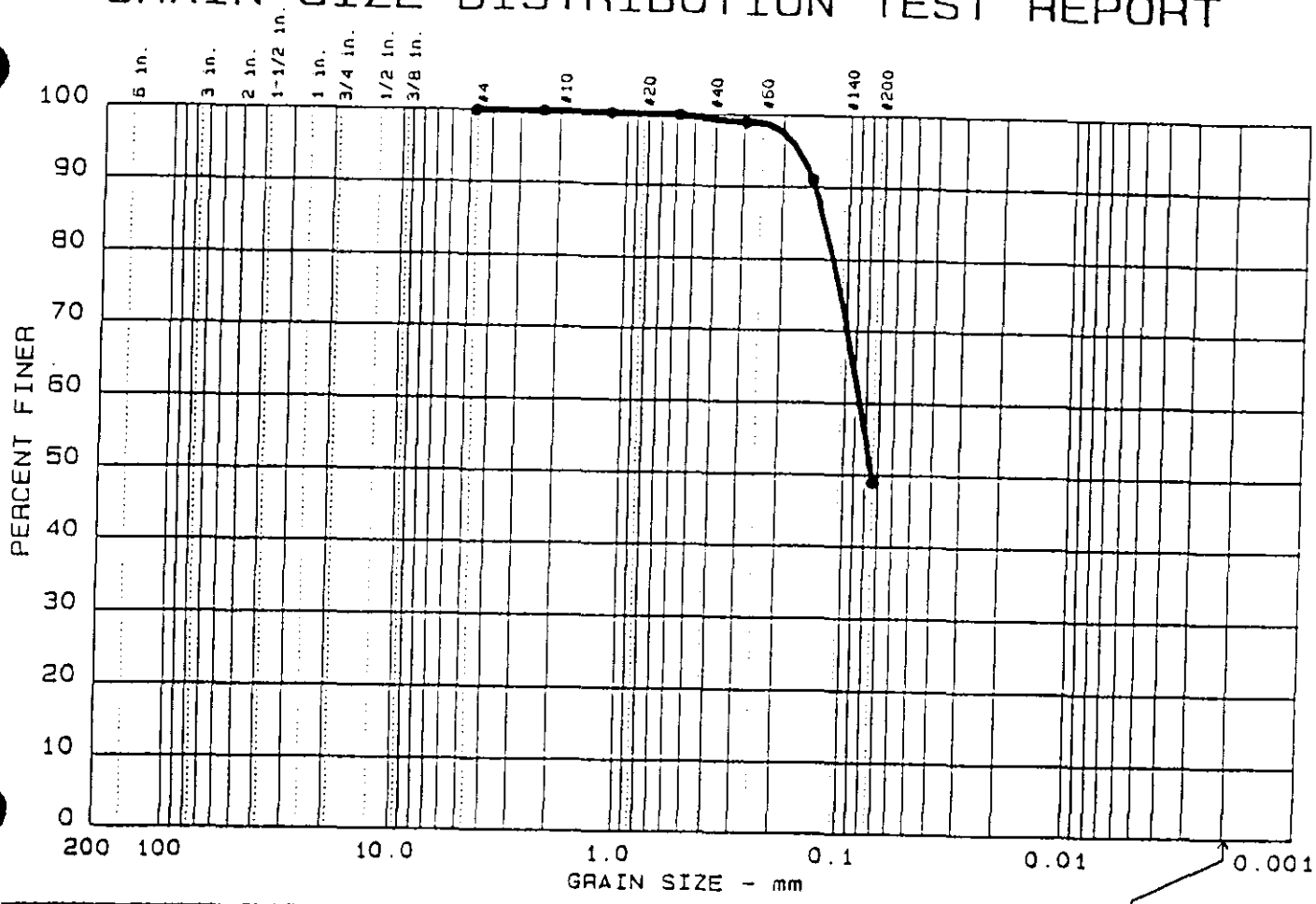
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-15

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	S	0.0	0.0	51.0	49.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	21.7	4	0.13	0.09	0.07					

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY SAND	SC - SM	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 4, depth: 3 - 5'

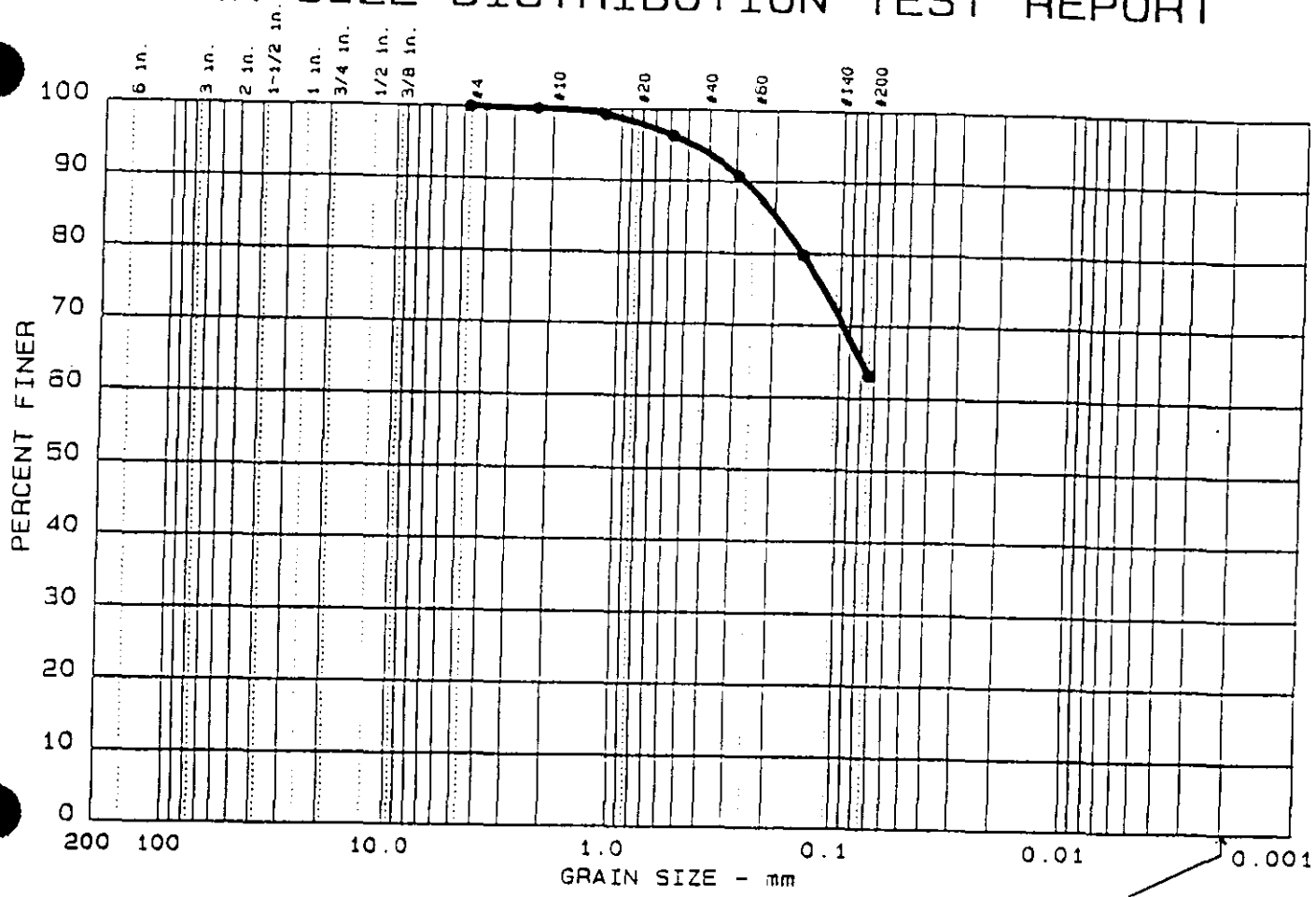
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-16

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	0.0	36.9	63.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	35	17	0.20							

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. br. - br. **SANDY LEAN CLAY**	CL	

Project No.: 91-33647-01
Project: Confluence
● Location: T - 5, depth: 3 - 5'

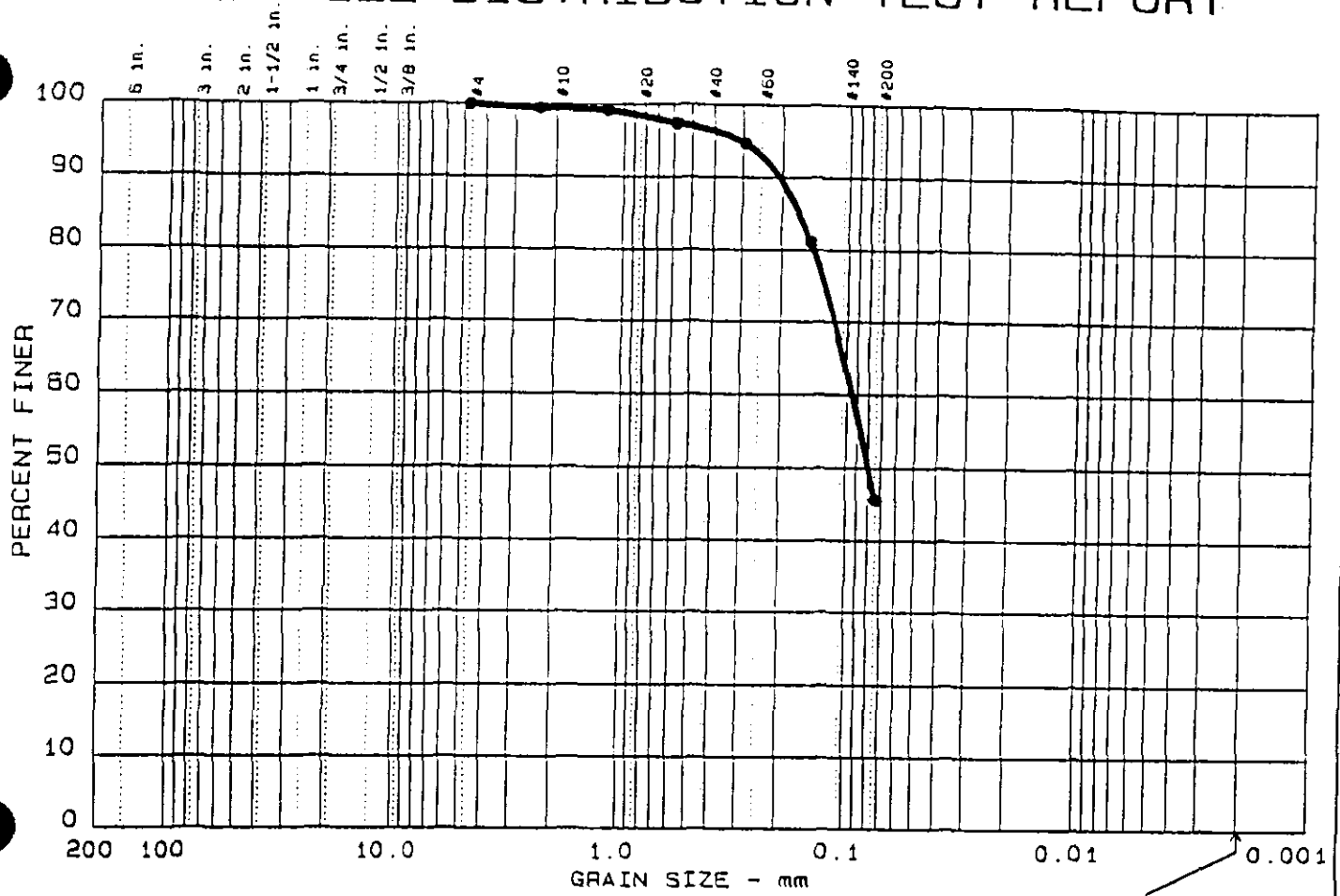
Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-17

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	0.0	54.4	45.6	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.17	0.10	0.08					

MATERIAL DESCRIPTION	USCS	AASHTO
● lt. brn. SILTY SAND	SM	

Project No.: 91-33647-01

Project: Confluence

● Location: T - 6, depth: 3 - 5'

Date: June 9, 1992

GRAIN SIZE DISTRIBUTION TEST REPORT

CONVERSE CONSULTANTS SOUTHWEST

DRAWING NO. A-18

DATE DRILLED: 08/15/89

SUMMARY OF BORING NO. B-3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES (1)	BLOWS/FT. (2)	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION	SYMBOL (1)	MOISTURE, %	DRY DENSITY, PCF
		6	dry	loose	light brown	SILTY SAND trace gravel	SM	5	87
			sl. moist	firm to stiff		SANDY SILT trace salts, porous	ML		
5		20		very stiff	tan	CLAYEY SILT with sand, trace caliche nodules, porous	ML	5	94
					light brown	SILTY CLAY trace sand, trace caliche nodules, trace gypsum, porous	CL		
10		30						10	93
15		25							
		40/6"	dry	mod. hard		CLAYEY SILT with sand, porous ---partially cemented to 21'	ML		
20									

GROUNDWATER none observed

END OF BORING AT 30 FEET

REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

USING 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

ER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

DRAWING NO. A-4

Converse Consultants Southwest

Geotechnical Engineering and Applied Sciences

DATE DRILLED: 08/15/89

SUMMARY OF BORING NO. B-3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ELEVATION: Not Measured

DEPTH IN FEET	SAMPLES (1)	BLOWS/FT. (2)	MOISTURE	CONSISTENCY	COLOR	DESCRIPTION	SYMBOL (1)	MOISTURE, %	DRY DENSITY, PCF
0			dry sl. moist	mod. hard very stiff	light brown	CLAYEY SILT with sand, porous partially cemented to 21'			
25	X	25		medium dense		SILTY SAND trace gravel	SM		
30									
35									
40									

GROUNDWATER none observed

END OF BORING AT 30 FEET

(1) REFER TO KEY TO SOIL SYMBOLS AND TERMS FOR EXPLANATION OF TEST SYMBOLS

(2) 340 LB. DRIVING WEIGHT FALLING 30 INCHES AND 2.5 INCH DIAMETER SAMPLER

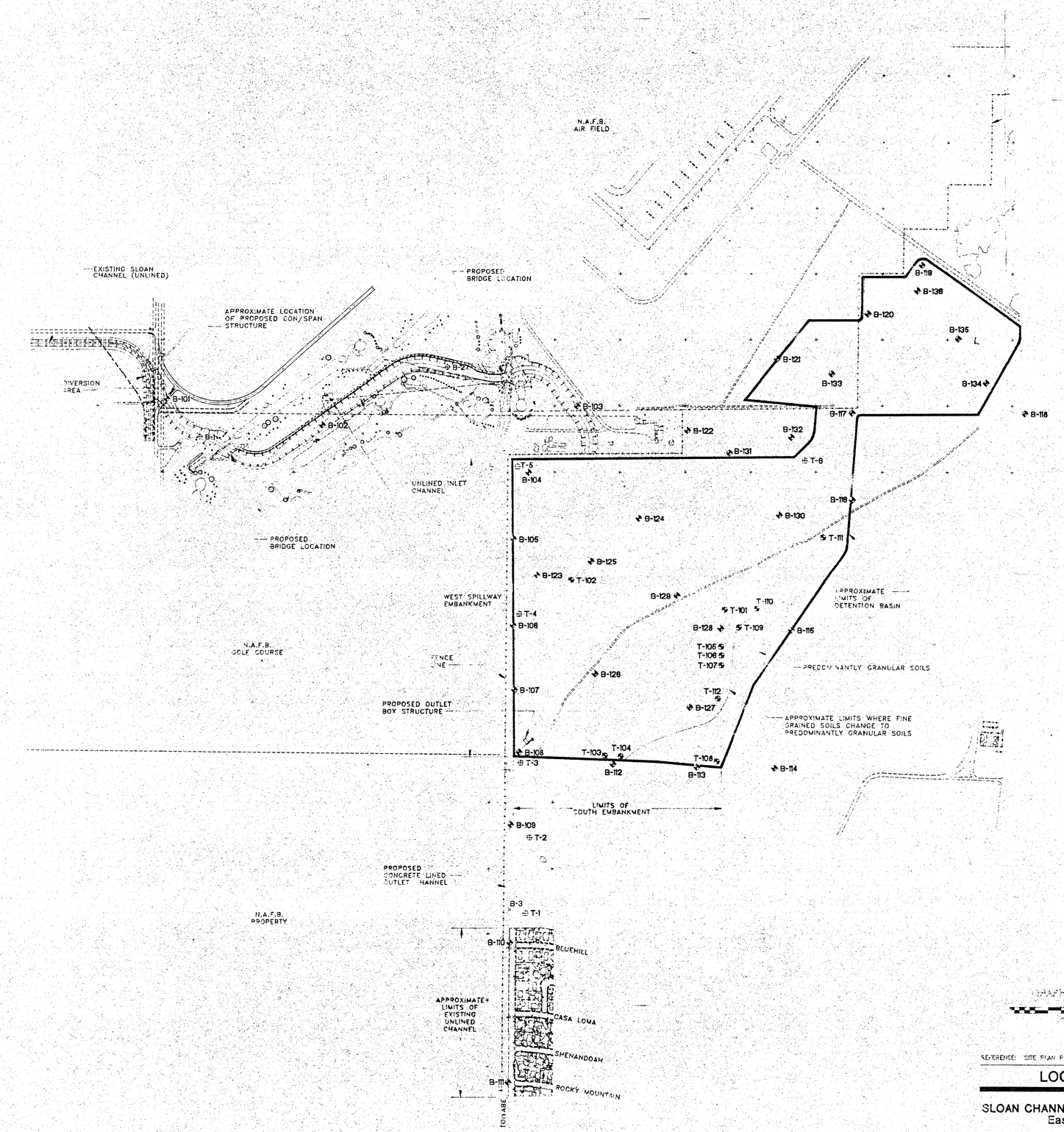
UPPER LAS VEGAS WASH FLOOD CONTROL PROJECTS
NORTH LAS VEGAS, NEVADA

PROJECT NO. 88-33195-01

DRAWING NO.

Converse Consultants Southwest

Geotechnical Engineering and Applied Sciences



EXPLANATION:

- B-101 — APPROXIMATE BORING LOCATION FROM CURRENT INVESTIGATION (91-33647-02)
- T-101 — APPROXIMATE TEST PIT LOCATION FROM CURRENT INVESTIGATION (91-33647-02)
- B-1 — APPROXIMATE BORING LOCATION FROM PRELIMINARY INVESTIGATION (91-33647-01)
- T-1 — APPROXIMATE TEST PIT LOCATION FROM PRELIMINARY INVESTIGATION (91-33647-01)
- B-3 — APPROXIMATE BORING LOCATION FROM PRELIMINARY INVESTIGATION (88-33194-01)

REFERENCE: SITE PLAN PROVIDED BY BOYLE ENGINEERING

LOCATION OF SUBSURFACE EXPLORATIONS

SLOAN CHANNEL/CONFLUENCE DETENTION BASIN
East of Nellis Air Force Base
Clark County, Nevada

Scale	1"=400'
Date	2.17.93
Project No.	91-33647-02
Inspected by	JBM
Drawing No.	2
Approved by	BLO

Converse Consultants — Geotechnical Engineering and Applied Sciences

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

VOLUME 5

SECTION 5 REFERENCE MATERIALS
Sloan Channel & Developer Improvements
Documentation

Submitted by:	**Clark County Regional Flood Control District**
Study Contractor:	**Post, Buckley, Schuh & Jernigan, Inc.**
Date Submitted:	**February 27, 1996**

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VOLUME 5

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5.5.1	Predesign Report Sloan Channel Owens Anvenue to Las Vegas Wash
5.5.2	Cibola Drainage Study
5.5.3	Cibola (Magnolia Estates) Grading Plans
5.5.4	Collins Business Park Hydrology Study

5.5 Sloan Channel & Developer Improvements Documentation

5.5.1 Predesign Report Sloan Channel Owens Avenue to Las Vegas Wash

DRAFT
PREDESIGN MEMORANDUM
SLOAN CHANNEL - OWENS AVENUE TO THE LAS VEGAS WASH

May 1993

Prepared for:

Clark County Public Works
6655 West Sahara Avenue
Las Vegas, Nevada 89102

Prepared by:

G. C. Wallace, Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89102

I. INTRODUCTION

The Sloan Channel improvements from Owens Avenue to the Las Vegas Wash confluence is part of the current Clark County Regional Flood Control District (CCRFCD) Master Plan Update of the Las Vegas Valley. This facility is intended to convey storm flows from the Range Wash drainage basin to the Las Vegas Wash. Other CCRFCD Master Plan facilities will eventually limit the 100-year return period flow in the Sloan Channel to 3,300 cfs. The location of the project is shown on Figure 1.

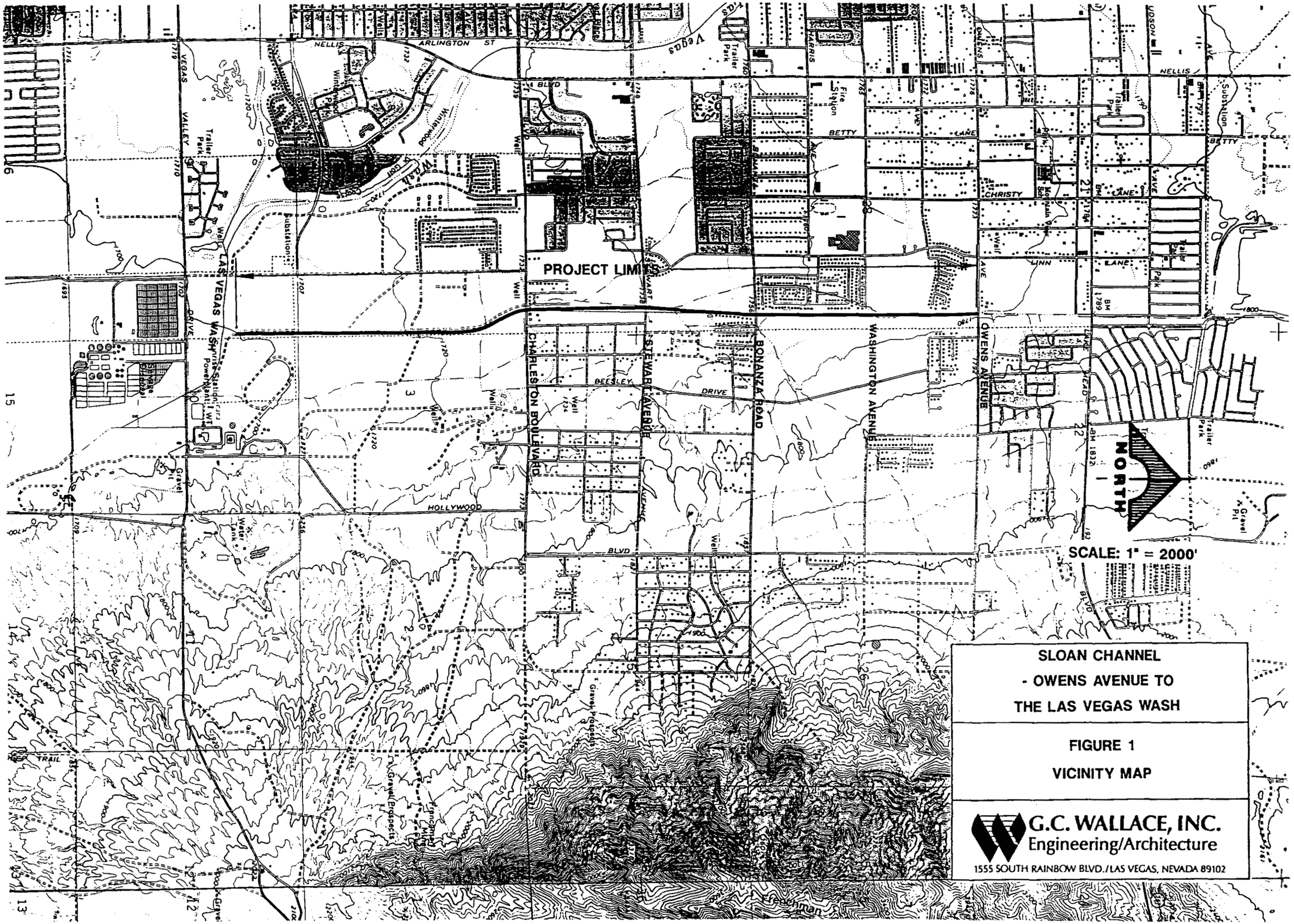
The Sloan Channel from Owens Avenue south to the Las Vegas Wash is currently an excavated, earthlined channel with an approximate bottom width of 60 feet and side slopes of roughly 2:1 (H:V). The Sloan Channel is crossed by five existing roadways in the project area. Bridges are present over the Sloan Channel at Washington Avenue and Charleston Boulevard. Reinforced Concrete Box (RCB) culvert crossings are present at Owens Avenue, Bonanza Road, and Stewart Avenue (see Figure 2). The length of this project is approximately 17,590 feet (3.3 miles).

Improvement drawings for this reach of Sloan Channel were previously prepared by Boyle Engineering Corporation (Boyle) in 1986. However, the project was not constructed. Boyle's design for the Sloan Channel proposed a trapezoidal, concrete-lined channel with side slopes varying from 1.5:1 (H:V) to 2:1 (H:V), and a bottom width varying from 60 feet to 70 feet.

II. SCOPE

The purpose and scope of this Predesign Memorandum is to :

- Present the results of an update to a previous geotechnical investigation and field reconnaissance to document surficial soils and subsurface conditions along the channel alignment.

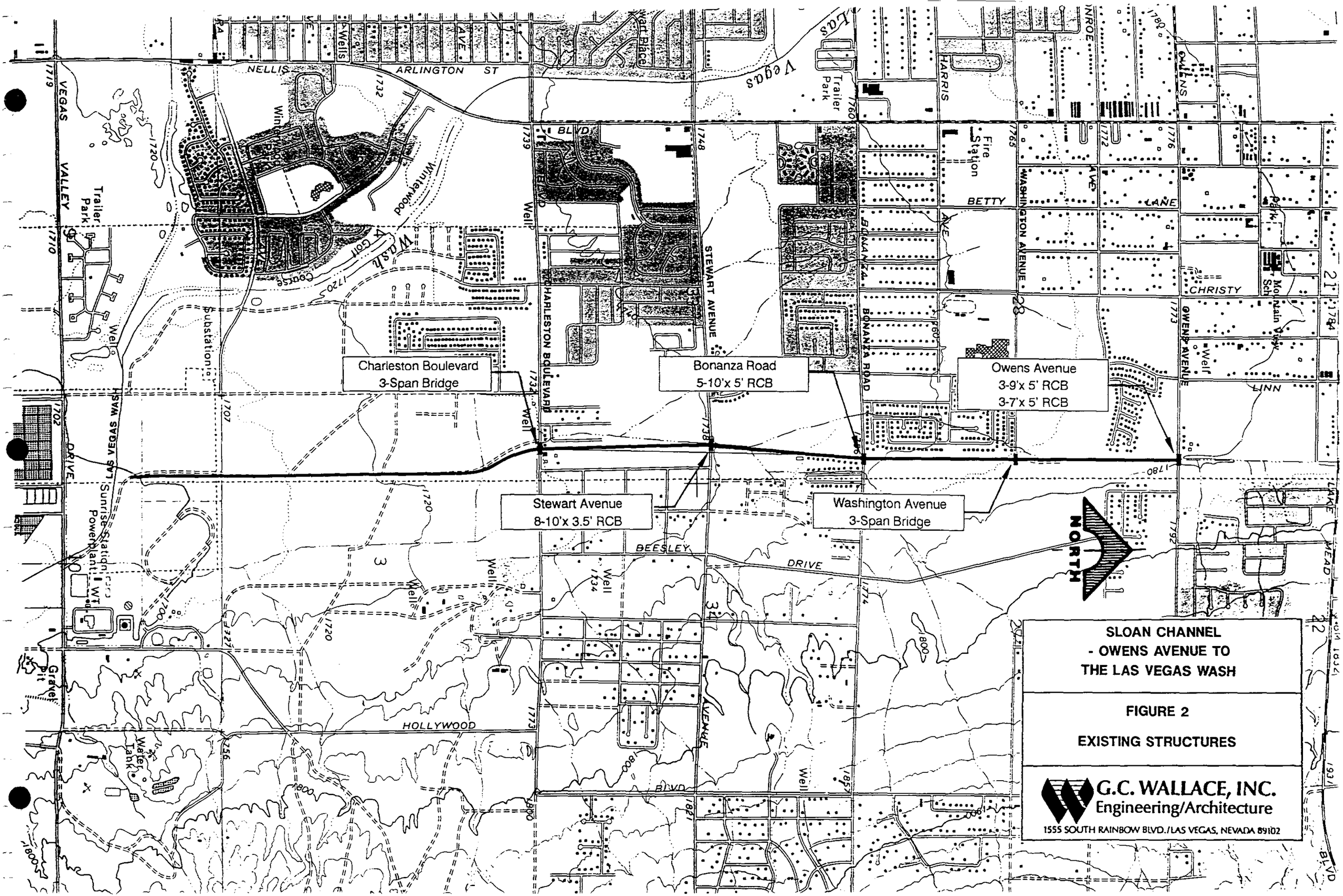


SLOAN CHANNEL
- OWENS AVENUE TO
THE LAS VEGAS WASH

FIGURE 1

VICINITY MAP

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

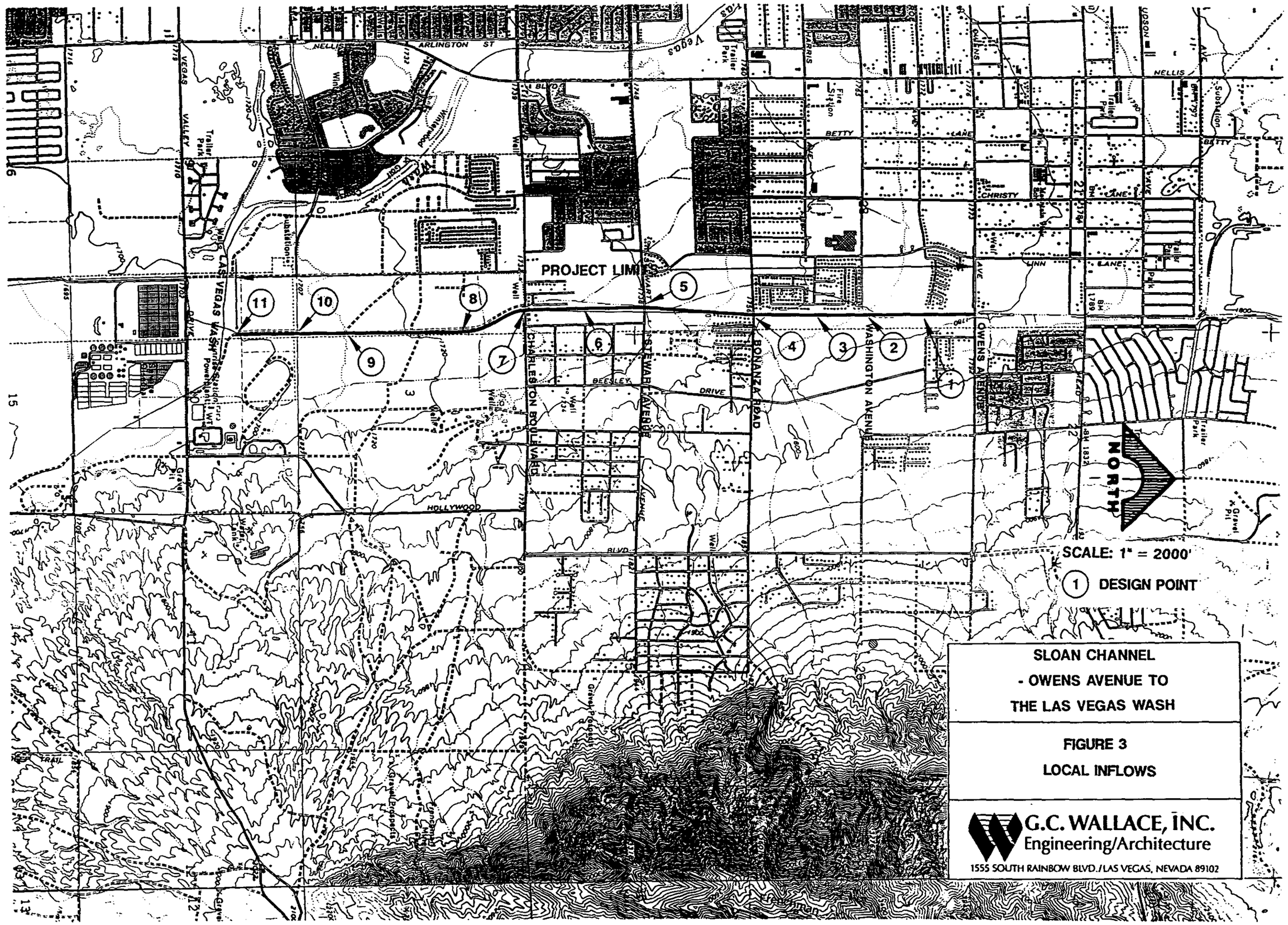


SLOAN CHANNEL
- OWENS AVENUE TO
THE LAS VEGAS WASH

FIGURE 2

EXISTING STRUCTURES

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102



SLOAN CHANNEL
- OWENS AVENUE TO
THE LAS VEGAS WASH

FIGURE 3
LOCAL INFLOWS

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

- Present the results of a hydraulic analysis of the Boyle design using design flows of 3,300 cfs with freeboard as required in the CCRFCD Hydrologic Criteria and Drainage Design Manual (Manual), and 6,000 cfs without freeboard.

  The design flow of 3,300 cfs is the ultimate flow that will be conveyed in the Sloan Channel when the Confluence Detention Basin has been constructed. The Confluence Detention Basin is a CCRFCD Master Plan facility that is to be located just south of Nellis Air Force Base. This detention facility will detain flows from the eastern and western tributaries of the Range Wash watershed. This facility is presently under design.

  The design flow of 6,000 cfs is an interim flow for the Sloan Channel prior to the construction of the Confluence Detention Basin. This design flow is based on existing diversion facilities within the upper portions of the western tributary of the Range Wash being place.

- Provide a review and evaluation of the 1986 Boyle design for the Sloan Channel from Owens Avenue to the Las Vegas Wash using current design as criteria as set forth in the CCRFCD Manual.

- Present a hydrologic analysis of the watershed which contributes storm runoff directly to this reach of the Sloan Channel. The hydrologic analysis will identify points of local inflow into the Sloan Channel within the project limits and quantify the flows at these points.

- Provide recommendations for the following:

  - the adequacy of the previous design to convey the design flows of 3,300 cfs with freeboard and 6,000 cfs without freeboard;

- mitigation measures to protect the channel improvements from local inflows;
- the adequacy of the previous design to meet current design standards;
- the need for additional Special Services as described in Section 2.03 of the Professional Engineering Services Contract for this project.

III. SUMMARY OF UPDATED GEOTECHNICAL INVESTIGATION

As part of this predesign memorandum, the geotechnical investigation for this reach of the Sloan Channel was updated. Converse Consultants Southwest, Inc. (Converse) was employed to update their geotechnical investigation which had been prepared for the 1986 Boyle design of this project. The updated geotechnical report is included in this predesign memorandum as Appendix A.

Converse performed three (3) additional exploratory borings as part of the updated soils report. The subsoils encountered in this update and the previous investigation generally consisted of soft to firm silts and clays overlying very stiff clays and silts, and medium dense sands. The laboratory test results yield soils that are compressible, have low to moderate dry densities, low to high degree of solubility, a low to high clay swell potential, low to moderate chemical heave potential, and contain sulfate salts.

Groundwater was encountered in the three borings performed with the update and several locations in the original investigation. It should be noted that the three borings performed with the update were located south of Charleston Boulevard. These boring locations were selected to identify the extents of groundwater in the reach of this project south of Charleston Boulevard in light of the higher than normal precipitation in the year proceeding the preparation of this report.

No additional geotechnical services for design are anticipated at this time.

IV. REVIEW OF PREVIOUS DESIGN

The 1986 Boyle design of the Sloan Channel from Owens Avenue to the Las Vegas Wash was prepared prior to the publication of the CCRFCD Hydrologic Criteria and Drainage Design Manual (Manual). The Manual has established design parameters for concrete lined channels constructed within the Clark County area. The 1986 design for the Sloan Channel was reviewed using the currently accepted CCRFCD criteria and the updated geotechnical report. The following is a summary of the evaluation of the 1986 Boyle design using current criteria.

- Most of the channel lining (approximately 15,990 feet) is shown to have a side slope of greater than 2:1 (H:V). Section 705.7.1.1 b) of the Manual lists a maximum side os slope of 2:1 (H:V) for non-structurally reinforced walls.

- The longitudinal and transverse reinforcement of the channel lining shown on the Boyle design does not meet current criteria as set forth in Section 705.7.1.5 b) of the Manual. The Boyle design calls for #5 bars at 12-inch spacing for longitudinal reinforcement, and #5 bars at 18-inch spacing for transverse reinforcement. This equates to a steel area to concrete cross sectional area ratio of 0.0043 for the longitudinal reinforcement of 0.0028 for the transverse reinforcement. The Manual requires a ratio of longitudinal steel area to concrete cross sectional area greater than 0.005 (but not less than #4 rebar at 12-inch spacing). The transverse steel area to concrete cross section is to be greater than 0.0025 (but not less than #4 rebar at 12-inch spacing). To meet current CCRFCD Design Standards, the minimum longitudinal steel required for the 6-inch lining shown on the Boyle drawings needs to be #6 rebar at 12-inch spacing, and the transverse steel needs to be #4 rebar at 12-inch spacing.

- The 1986 design does not require the top 12-inches of earth surface within 10-feet of the concrete channel lip to be compacted to at least 90 percent of the

maximum density per ASTM 1557 as required in Section 705.7.1.6 d) of the Manual.

- The Boyle design does not include longitudinal or transverse cutoff walls. The Manual requires that transverse cutoff walls shall be constructed at a maximum spacing of 90 feet and shall extend a minimum of 3-feet below the bottom of the concrete lining. Longitudinal cutoff walls along the top of the bank at a minimum depth of 3-feet are also required by the Manual. However; due to the fact that much of the west side of the channel is protected from the surface inflows by existing masonry walls, the longitudinal cutoff wall could be omitted for portions of the west side of the channel.

- Maintenance access per Section 707.2 of the Manual appears to be met. Since the channel top width is greater than 30-feet, the maintenance road can be located in the bottom of the channel. The 1986 design, apparently, utilized this concept.

- Ladder-type steps per Section 707.3 b) of the Manual need to be incorporated into the channel design.

- The updated geotechnical investigation recommends "Concrete panels on the channel sides and bottom be supported by a blanket of granular filter material that is a least 6-inches and 12-inches thick, respectively." The 1986 design shows a 6-inch blanket of Type 2 drain backfill throughout.

Considerations for development which has occurred or is presently ongoing along the Sloan Channel alignment need to be made. Numerous residential developments have been, or are being constructed along the channel alignment. A number of these developments discharge storm flows directly into the Sloan Channel via storm drains and/or surface outlets. Design consideration should be made to incorporate the features constructed after 1986 into overall design of the channel.

The majority of the development which has taken place since the 1986 design was prepared is located south of Charleston Boulevard. Peachtree, a master planned development on the east side of the Sloan Channel, will discharge approximately 1,200 cfs into the Sloan Channel via a concrete lined channel to be located 1,200 feet north of the Sahara Avenue alignment.

Developments on the west side of the Sloan Channel south of Charleston Boulevard, including Sunrise Valley Garden Homes, Sunrise Valley Unit 8, and Stonebridge D2A, also discharge local storm flows into the Sloan Channel via surface inlets.

The access ramp/surface inlet shown at Station 41+21 should be moved. An apartment development adjacent to this location has intercepted and diverted the surface flows which formerly entered the channel at this location. This access ramp/surface inlet could be relocated approximately 250-feet north at the northern boundary of the aforementioned apartment development and provide surface flow access the channel.

An existing wash intersects the Sloan Channel from the west just south of Stewart Avenue. The 1986 design shows this wash being blocked by the construction of the channel improvements. This wash bisects an undeveloped parcel of land. As will be presented in the section of this Predesign Memorandum entitled Hydrology, a considerable amount of storm runoff (580 cfs in a 100-year storm) presently is conveyed to the Sloan Channel across the undeveloped parcel in this wash. The undeveloped parcel does not have improvements on Stewart Avenue to contain local storm flows within the Stewart Avenue right-of-way. Considerations must be given to either containing storm flow along Stewart Avenue, or providing means to safely introduce flows from this wash into the Sloan Channel.

Since the 1986 design for the Sloan Channel was prepared, the CCRFCD Master Plan (October 1986) and the Master Plan Update (August 1991) have been published. The 1991 Master Plan Update identifies existing and proposed drainage

facilities of regional significance for the Las Vegas Valley area. A review of the Master Plan Update shows existing and proposed collector systems from the east tying into the Sloan Channel. The collector system intersect the Sloan Channel at the major roadway crossings within the project area. The 1991 Master Plan Update lists the following collector facilities (see Figures F-11 and F-15 of the Master Plan Update):

Owens Avenue	60-inch RCP
Washington Avenue	90-inch RCP
Bonanza Road	72-inch RCP (existing)
Stewart Avenue	66-inch RCP
Charleston Boulevard	20 ft. W, 6.5 ft. D, rip-rap channel

The existing facilities and the proposed facilities shown on the Boyle Drawings at these locations are as follows:

Owens Avenue	54-inch RCP (proposed)
Washington Avenue	60-inch RCP stub (existing)
Bonanza Road	72-inch RCP (existing)
Stewart Avenue	43" x 68" HE RCP (54" equiv. stub) (existing)
Charleston Boulevard	48" x 91" in HE RCP (72" equiv.) (existing)

All of the existing facilities and proposed facilities shown on the Boyle drawings are located in the downstream transition structures of the RCB culverts or bridges at these locations. Accommodations could be made to update existing facilities that differ from the Master Plan facilities as part of this project. However, the Master Plan is only a guide, and the facilities at these locations may change when detailed drainage studies and designs are prepared.

Utilities

No utility conflicts are anticipated with the construction of this project. GCW preliminary utility research indicates that, with the exception of the future bridge crossing of Sahara Avenue at the Sloan Channel, all existing utilities are located beneath the existing bridge and RCB culvert structures at major roadway crossings. However, we have not received written responses from all of the utility companies at this time.

An inverted sewer siphon is present under the Sloan Channel in the Sahara Avenue alignment. This inverted siphon was designed to accommodate the future improvements to the Sloan Channel and the future RCB culvert at Sahara Avenue. The top of pipe for the siphon is approximately 6-feet below the proposed invert of the channel.

The Clark County Sanitation District (CCSD) has indicated that the Betty Lane Relief Sewer is currently being designed. The Relief Sewer will be located in the general vicinity of Owens Avenue and the Sloan Channel. The Betty Lane Relief Sewer will approach the Sloan Channel from the east in Owens Avenue. The relief sewer will need to cross the Sloan Channel in the vicinity of Owens Avenue. The sewer line crossing could most easily be accomplished just downstream of the existing concrete transition structure associated with the Owens Avenue RCB culvert. Provided that the sewer line is constructed prior to or in conjunction with the Sloan Channel improvements, the existing RCB and transition structure at Owens Avenue can remain in place. The CCSD has indicated that the construction of this relief sewer is scheduled for late 1993. The design and/or construction of the Sloan Channel will need to be coordinated with the CCSD and their contractor.

Right-of-Way

Preliminary right-of-way research indicates that continuous right-of-way and easements of sufficient width exists to construct the proposed basic channel improvements throughout the project area with the exception of an 873 foot long portion located immediately north of Sahara Avenue. This needed right-of-way is a portion of an undeveloped 25 acre parcel identified by APN 320-160-005.

Additional minor right-of-ways and/or construction easements requirements may be identified during the design phase of the project.

The Record-of-Survey, and right-of-way research are currently ongoing and will be submitted with the final Predesign Memorandum as per Section 2.02 I of the Professional Engineering Services Contract.

V. HYDROLOGY

The purpose and scope of the Hydrology section of this report was to establish the localized inflows to the Sloan Channel between Owens Avenue and the Las Vegas Wash. A detailed explanation of the model and the modeling techniques and calculations are contained in Appendix "B" of this report.

Methodology

The hydrologic methods used to establish the localized inflows to the Sloan Channel between Owens Avenue and Las Vegas Wash are based on methods established in the "Clark County Regional Flood Control District Hydrologic Criteria and Drainage Manual" (Manual). The hydrologic model utilized in this study is an HEC-1 flood hydrograph package developed by the U.S. Army Corps of Engineers, Hydrologic Engineering Center.

The rainfall relationships were generated using adjusted rainfall and a 6 hour SDN-3 distribution curve. A detailed explanation of the methodology and modeling is contained in Appendix "B."

Analysis

Two conditions were analyzed. Alternative 1 assumes existing conditions with ultimate buildout within the drainage area. Alternative 2 is the ultimate development condition and assumes future CCRFCD Master Plan facilities in place. Two detention basins have significant impact to the local runoff generated between Owens Avenue and the Las Vegas Wash. These are identified as facilities SLW/0154 and SLST/0169 on Figures F-12 and F-16 of 1991 Flood Control Master Plan Update. The facilities dampen peak flows generated on the Sunrise Mountain and route flows down Washington Avenue and Stewart Avenue into the Sloan Channel.

Figure No. 3 shows locations where inflow are calculated into the channel. Peak flow values for Alternative 1 and Alternative 2 are contained in Tables 1 and 2, respectively.

TABLE 1
LOCAL INFLOW INTO SLOAN CHANNEL
EXISTING CONDITION

Point Location*	Cross Street	INFLOW (cfs) East 10-Year	East 100-Year	West 10-Year	West 100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	505	1339		
3	Harris Ave.	5	39		
4	Bonanza Road	449	1232		
5	Stewart Ave.	178	665	169	579
6	Sunrise Ave.	44	133		
7	Charleston Blvd.	161	470	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

*See Figure 3

TABLE 2
LOCAL INFLOW INTO SLOAN CHANNEL
ULTIMATE DEVELOPMENT CONDITION

		INFLOW (cfs)			
		East		West	
Point Location*	Cross Street	10-Year	100-Year	10-Year	100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	177	449		
3	Harris Ave.	5	39		
4	Bonanza Road	77	356		
5	Stewart Ave.	196	581	169	579
6	Sunrise Ave	44	133		
7	Charleston Blvd.	46	233	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

*See Figure 3

The detailed HEC-1 model used for this analysis only identified those storm flow that enter the Sloan Channel south of Owens Avenue. The accumulative impact of the inflows generated by the model suggest that, at least under existing conditions in the local watershed, the local inflows may control the 100-year peak storm flow in the Sloan Channel south of Washington Avenue. Therefore, a preliminary hydrologic analysis of the Sloan Channel watershed from Carey Avenue to the Las Vegas Wash was prepared. The model indicates that the local inflows will exceed the design flow of 3,300 cfs as far north as Bonanza Road. The peak flows in the channel generated by the local inflows for existing and ultimate conditions are listed in Table 3 below:

TABLE 3
SLOAN CHANNEL
LOCAL 100-YEAR PEAK FLOWS

Location	Existing Condition (Carey to LV Wash)	Ultimate Local Inflows with Regional Facilities (Carey to LV Wash)
Washington Ave.	3100	1340
Bonanza Road	3400	1640
Stewart Avenue	3660	2010
Charleston Blvd.	4225	2250
Sahara Avenue	4900	3230
Las Vegas Wash	4975	3300

The proposed channel sections will convey the calculated flows within current design standards. Preliminary calculations indicate that the Charleston Bridge has capacity to pass a flow of 4,225, but the culvert at Stewart Avenue may experience some minor overtopping (approximately 50 cfs) for a flow of 3,660 cfs. The County may want to prepare a detailed study of the inflows to the Sloan Channel south of Carey Avenue (the outfall of the Confluence Detention Basin) to determine if the future bridge structure at Sahara Avenue needs to be sized for a flow greater than 3,300 cfs. As Table 3 indicates, ultimately, Regional facilities in the local watershed will reduce the local inflows to less than the design flow of 3,300 cfs.

VI. HYDRAULICS

Methodology

Water surface profiles for the Sloan Channel were calculated using the U.S. Army Corps of Engineers HEC-2 "Water Surface Profiles" computer program. Profiles were calculated assuming both supercritical and subcritical flow regimes. Bridges and culverts were modeled using the special bridge subroutine. Slope and channel

configurations are based on the Boyle drawings provided by the Clark County Public Works Department.

Channel stationings were taken from the above mentioned design drawings. Cross section numbers in the HEC-2 model correspond to the channel stationing. Cross sections were taken approximately every 300 feet with additional sections taken at grade breaks, transitions, bridge crossings and culvert crossings. Per contract requirements, models were prepared for both a 3,300 cfs and a 6,000 cfs flow. The calculated water surface elevation for the two flow models are contained in Tables 4 and 6.

Analysis

In general, it was determined that the typical channel sections proposed by the 1986 Boyle drawings have sufficient capacity to convey the 3,300 cfs, and meet current CCRFCD requirements for depth, velocity and freeboard. However, it was found that the existing culvert crossings at Stewart Avenue and Bonanza Road lack capacity to convey the 3,300 cfs flow with freeboard. The models suggest that the 3,300 cfs will pass through the culvert crossings at these locations in a pressure flow condition. The bridge crossings at Washington Avenue and Charleston Boulevard had sufficient capacity to pass 3,300 cfs with freeboard. A tabulation of the channel and bridge flow depths are contained in Table 5.

With a flow of 6,000 cfs in the channel, both the culvert crossings at Bonanza Road and Stewart Avenue and the bridge crossings at Washington Avenue and Charleston Boulevard are overtopped. The amount of flow overtopping in the case of the culvert crossing is significant (1,700 to 2,100 cfs) and exceeds the depth velocity criteria allowed within the CCRFCD Manual. At Washington Avenue and Charleston Boulevard bridges, the overflow is minimal. The majority of the proposed channel will meet CCRFCD Manual requirement for freeboard and will

convey the 6,000 cfs flow except where the bridge and culvert crossings lack capacity. The data for the 6,000 cfs flow is contained in Table 6.

VII. COST ESTIMATE

A preliminary cost estimate for the construction of this project is presented in Table 8. The cost estimate was prepared for two phases of construction. The limits of Phase I are from Owens Avenue to Stewart Avenue. Phase II extends from Stewart Avenue to the Las Vegas Wash.

The quantities shown for Overexcavation, are based on roughly 2 feet of overexcavation below the invert and benched excavation on the sides as described in the geotechnical report. The quantities for Imported Drain Backfill, and Recompact Native Material are based on 6 inches of drain backfill under the channel lining and the balance of the excavated prism being filled with recompacted native material. Chain-link fence quantities were estimated for portions of the channel with no adjacent, existing development. Channel lining quantities are shown in square feet. The unit price was adjusted to account for incidental items such as cutoff walls and access ramps.

TABLE 4

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

DESIGN FLOW (Q = 3300 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	RB.ELV	LB.ELV	VCH	FB	FB+DEPT	CH.DEPTH
137.48	3300	4.54	771.47	776.01	778.77	778.77	11.37	1.47	6.0	7.3
437.48	3300	3.86	770.31	774.17	777.61	777.61	13.67	1.54	5.4	7.3
737.48	3300	3.85	769.16	773.01	776.46	776.46	13.67	1.54	5.4	7.3
1037.50	3300	3.85	768.00	771.86	775.30	775.30	13.68	1.54	5.4	7.3
1337.50	3300	3.85	766.85	770.70	774.15	774.15	13.66	1.54	5.4	7.3
1637.50	3300	3.85	765.69	769.55	772.99	772.99	13.67	1.54	5.4	7.3
1937.50	3300	3.85	764.54	768.39	771.84	771.84	13.66	1.54	5.4	7.3
2237.50	3300	3.85	763.38	767.24	770.68	770.68	13.67	1.54	5.4	7.3
2532.20	3300	3.86	762.25	766.11	769.55	769.55	13.66	1.54	5.4	7.3
2572.70	3300	5.54	762.10	767.64	769.40	769.40	12.98	1.57	7.1	7.3
2652.70	3300	3.61	761.80	765.41	768.70	768.70	14.10	1.54	5.2	6.9
2712.20	3300	4.48	761.36	765.84	768.33	768.33	11.53	1.48	6.0	6.97
3012.20	3300	3.60	759.83	763.43	766.80	766.80	14.75	1.57	5.2	6.97
3312.20	3300	3.57	758.30	761.88	765.27	765.27	14.90	1.57	5.1	6.97
3612.20	3300	3.56	756.77	760.33	763.74	763.74	14.94	1.57	5.1	6.97
3912.20	3300	3.56	755.24	758.80	762.21	762.21	14.95	1.57	5.1	6.97
4121.00	3300	3.56	754.17	757.73	761.14	761.14	14.95	1.57	5.1	6.97
4222.00	3300	3.56	753.66	757.22	760.63	760.63	14.95	1.57	5.1	6.97
4512.20	3300	3.54	752.13	755.66	759.10	759.10	15.07	1.57	5.1	6.97
4812.20	3300	3.57	750.60	754.16	757.57	757.57	14.93	1.57	5.1	6.97
5100.00	3300	3.56	749.13	752.69	756.10	756.10	14.96	1.57	5.1	6.97
5147.30	3300	3.81	748.94	752.75	755.90	755.91	13.87	1.54	5.4	6.97
5168.30	3300	6.30	747.50	753.80	754.46	754.47	13.20	1.61	7.9	6.97
5268.30	3300	7.37	746.80	754.17	754.00	754.00	8.62	1.42	8.8	7.2
5290.10	3300	3.02	746.86	749.88	753.79	753.79	17.98	1.65	4.7	6.93
5484.00	3300	3.15	745.40	748.56	752.34	752.34	17.18	1.63	4.8	6.94
5590.10	3300	3.15	744.61	747.78	751.55	751.55	17.09	1.63	4.8	6.94
5890.10	3300	3.20	742.36	745.55	749.30	749.30	16.89	1.62	4.8	6.94
6190.10	3300	3.20	740.11	743.30	747.05	747.05	16.91	1.62	4.8	6.94
6208.70	3300	3.17	739.93	743.11	746.87	746.87	17.01	1.62	4.8	6.94
6508.70	3300	3.59	738.46	742.06	745.40	745.40	14.79	1.57	5.2	6.94
6808.70	3300	3.59	736.99	740.59	743.93	743.93	14.77	1.57	5.2	6.94
7108.70	3300	3.59	735.52	739.12	742.46	742.46	14.76	1.57	5.2	6.94
7480.00	3300	3.60	733.70	737.31	740.64	740.64	14.75	1.57	5.2	6.94
7584.70	3300	3.60	733.19	736.80	740.13	740.13	14.75	1.57	5.2	6.94
7662.60	3300	4.31	732.80	737.11	739.10	739.10	11.94	1.49	5.8	6.3
7747.50	3300	4.79	732.19	736.98	738.49	738.49	11.79	1.50	6.3	6.3
7847.50	3300	6.81	731.30	738.11	737.60	737.60	7.03	1.33	8.1	6.3
8049.30	3300	3.11	730.45	733.56	736.75	736.75	17.34	1.63	4.7	6.3
8156.70	3300	3.39	730.00	733.39	736.30	736.70	15.73	1.59	5.0	6.7

TABLE 4 (Cont.)
HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS
SUPERCRITICAL FLOW (Q = 3300 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	RB.ELV	LB.ELV	VCH	FB	FB+DEPT	CH.DEPTH
8349.30	3300	3.70	729.19	732.89	735.49	735.89	14.23	1.55	5.3	6.7
8649.30	3300	3.75	727.92	731.67	734.22	734.62	14.00	1.54	5.3	6.7
8949.30	3300	3.75	726.65	730.40	732.95	733.35	14.02	1.54	5.3	6.7
9249.30	3300	3.75	725.39	729.14	731.69	732.09	14.02	1.54	5.3	6.7
9549.30	3300	3.75	724.12	727.87	730.42	730.82	14.03	1.54	5.3	6.7
9849.30	3300	3.75	722.86	726.60	729.16	729.56	14.03	1.54	5.3	6.7
10149.00	3300	3.89	721.70	725.58	728.00	728.40	13.41	1.53	5.4	6.7
10423.00	3300	3.79	720.43	724.22	728.88	728.13	14.09	1.55	5.3	7.7
10574.00	3300	3.79	719.80	723.59	728.54	727.84	14.09	1.55	5.3	8.04
10623.00	3300	3.40	719.55	722.95	727.70	727.70	14.86	1.56	5.0	8.15
10624.00	3300	5.46	719.54	725.00	727.69	727.69	14.81	1.65	7.1	8.15
10724.00	3300	3.59	719.04	722.63	727.70	727.70	14.35	1.55	5.1	8.66
10725.00	3300	3.05	717.90	720.95	726.56	726.56	17.21	1.62	4.7	8.66
10830.00	3300	4.20	717.80	722.02	723.15	728.10	12.03	1.49	5.7	10.3
10900.00	3300	3.19	717.52	720.71	723.82	723.82	14.57	1.54	4.7	6.3
11191.00	3300	3.65	716.35	720.00	723.85	723.85	12.65	1.49	5.1	7.5
11491.00	3300	3.44	714.99	718.43	722.49	722.49	13.56	1.51	5.0	7.5
11791.00	3300	3.40	713.63	717.04	721.13	721.13	13.70	1.52	4.9	7.5
12091.00	3300	3.40	712.27	715.67	719.77	719.77	13.72	1.52	4.9	7.5
12430.00	3300	3.40	710.74	714.14	718.24	718.24	13.72	1.52	4.9	7.5
12730.00	3300	3.48	709.45	712.93	716.95	716.95	13.38	1.51	5.0	7.5
13030.00	3300	3.45	708.16	711.61	715.66	715.66	13.50	1.51	5.0	7.5
13330.00	3300	3.46	706.87	710.33	714.37	714.37	13.48	1.51	5.0	7.5
13630.00	3300	3.45	705.58	709.03	713.08	713.08	13.51	1.51	5.0	7.5
13930.00	3300	3.46	704.29	707.75	711.79	711.79	13.48	1.51	5.0	7.5
14230.00	3300	3.46	703.00	706.46	710.50	710.50	13.49	1.51	5.0	7.5
14500.00	3300	3.45	701.84	705.28	709.34	709.34	13.52	1.51	5.0	7.5
14900.00	3300	3.45	700.12	703.57	707.62	707.62	13.49	1.51	5.0	7.5
15130.00	3300	3.45	699.13	702.58	706.63	706.63	13.50	1.51	5.0	7.5
15430.00	3300	3.46	697.84	701.30	705.34	705.34	13.48	1.51	5.0	7.5
15730.00	3300	3.45	696.55	700.00	704.05	704.05	13.51	1.51	5.0	7.5
16030.00	3300	3.46	695.26	698.72	702.76	702.76	13.48	1.51	5.0	7.5
16330.00	3300	3.45	693.97	697.42	701.47	701.47	13.51	1.51	5.0	7.5
16630.00	3300	3.46	692.68	696.14	700.18	700.18	13.48	1.51	5.0	7.5
16930.00	3300	3.45	691.39	694.84	698.89	698.89	13.51	1.51	5.0	7.5
17230.00	3300	3.46	690.10	693.56	697.60	697.60	13.49	1.51	5.0	7.5
17410.00	3300	3.45	689.32	692.77	696.82	696.82	13.51	1.51	5.0	7.5

TABLE 5
BRIDGE INFORMATION DESIGN Q = 3300 CFS.

CHANNEL STATION	BRIDGE ID.	UPSTREAM INFO.		BRIDGE INFO.				DOWNSTREAM INFO.	
		DEPTH (FT.)	VELOCITY (FPS)	BRIDGE AREA (SQ.FT.)	DEPTH AT UPSTREAM FACE (FT.)	Q PASSING THRU BRIDGE (CFS)	Q OVERTOPPING ROADWAY (CFS)	DEPTH (FT.)	VELOCITY (FPS)
19+37 *		3.9	13.7						
25+32	WASHINGTON	3.9	13.7						
25+72	BRIDGE			437	5.5	3300	0		
26+52								3.6	14.1
33+12 *								3.6	14.9
33+12 *		3.6	14.9						
51+47	BONANZA	3.8	13.9						
51+68	5(10'X5')			250	6.3	3300	0		
52+68	RCB.							7.4	8.6
52+90								3.0	18.0
58+90 *								3.2	19.9
68+08 *		3.6	14.8						
76+62	STEWART	4.3	11.9						
77+47	8(10'X3.5')			280	4.8	3300	0		
78+47	RCB.							6.8	7.0
80+49								3.1	17.3
83+49 *								3.7	14.2
101+49 *		3.9	13.5						
105+74	CHARLESTON	3.8	14.1						
106+23	BRIDGE	3.4	14.9						
106+24				437	5.5	3300	0		
107+24								3.6	14.4
107+25								3.1	17.2
108+30								4.3	12.0
117+91 *								3.4	13.7

* TYPICAL CHANNEL CROSS SECTIONS

TABLE 6
HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS
DESIGN FLOW (Q = 6000 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	RB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH
137.48	6000	6.55	771.47	778.02	778.77	778.77	13.54	1.63	8.2	7.3
437.48	6000	5.64	770.31	775.96	777.61	777.61	16.12	1.72	7.4	7.3
737.48	6000	5.51	769.16	774.67	776.46	776.46	16.54	1.73	7.2	7.3
1037.50	6000	5.47	768.00	773.47	775.30	775.30	16.70	1.74	7.2	7.3
1337.50	6000	5.45	766.85	772.30	774.15	774.15	16.78	1.74	7.2	7.3
1637.50	6000	5.44	765.69	771.13	772.99	772.99	16.81	1.74	7.2	7.3
1937.50	6000	5.43	764.54	769.97	771.84	771.84	16.83	1.74	7.2	7.3
2237.50	6000	5.43	763.38	768.81	770.68	770.68	16.84	1.74	7.2	7.3
2532.20	*6000*	*5.42*	*762.25*	*767.67*	*769.55*	*769.55*	*16.85*	*1.74*	*7.2*	*7.3*
2572.70	6000	8.01	762.10	770.11	769.40	769.40	13.01	1.65	9.7	7.3
2652.70	6000	8.34	761.80	770.14	768.70	768.70	9.87	1.50	9.8	6.9
2712.20	6000	5.62	761.36	766.98	768.33	768.33	16.19	1.72	7.3	6.97
3012.20	6000	5.25	759.83	765.08	766.80	766.80	17.51	1.76	7.0	6.97
3312.20	6000	5.12	758.30	763.42	765.27	765.27	18.01	1.78	6.9	6.97
3612.20	6000	5.06	756.77	761.85	763.74	763.74	18.24	1.78	6.8	6.97
3912.20	6000	5.04	755.24	760.28	762.21	762.21	18.32	1.79	6.8	6.97
4121.00	6000	5.03	754.17	759.20	761.14	761.14	18.38	1.79	6.8	6.97
4222.00	6000	5.03	753.66	758.69	760.63	760.63	18.39	1.79	6.8	6.97
4512.20	6000	4.99	752.13	757.12	759.10	759.10	18.53	1.79	6.8	6.97
4812.20	6000	4.99	750.60	755.59	757.57	757.57	18.50	1.79	6.8	6.97
5100.00	6000	5.00	749.13	754.13	756.10	756.10	18.48	1.79	6.8	6.97
5147.30	6000	9.32	748.94	758.26	755.90	755.91	9.03	1.48	10.8	6.97
5168.30	6000	9.39	747.50	754.52	756.89	754.47	15.73	1.83	11.2	6.97
5268.30	6000	7.37	746.80	757.65	754.00	754.00	17.30	1.84	9.2	7.2
5290.10	6000	4.26	746.86	751.12	753.79	753.79	20.30	1.82	6.1	6.93
5484.00	6000	4.38	745.40	749.78	752.34	752.34	20.52	1.84	6.2	6.94
5590.10	6000	4.42	744.61	749.02	751.55	751.55	20.60	1.85	6.3	6.94
5890.10	6000	4.47	742.36	746.82	749.30	749.30	20.77	1.86	6.3	6.94
6190.10	6000	4.48	740.11	744.58	747.05	747.05	20.86	1.86	6.3	6.94
6208.70	6000	4.47	739.93	744.40	746.87	746.87	20.93	1.86	6.3	6.94
6508.70	6000	4.88	738.46	743.35	745.40	745.40	18.96	1.80	6.7	6.94
6808.70	6000	5.02	736.99	742.01	743.93	743.93	18.34	1.79	6.8	6.94
7108.70	6000	5.07	735.52	740.60	742.46	742.46	18.24	1.78	6.9	6.94
7480.00	6000	5.06	733.70	738.77	740.64	740.64	18.24	1.78	6.8	6.94
7584.70	6000	5.06	733.19	738.26	740.13	740.13	18.23	1.78	6.8	6.94
7662.60	6000	8.29	732.80	741.09	739.10	739.10	10.21	1.52	9.8	6.3
7747.50	6000	7.14	732.19	739.33	738.49	738.49	15.34	1.74	8.9	6.3
7847.50	6000	10.24	731.30	741.54	737.60	737.60	8.07	1.44	11.7	6.3
8049.30	6000	4.44	730.45	734.89	736.75	736.75	21.01	1.86	6.3	6.3
8156.70	6000	4.69	730.00	734.69	736.30	736.70	19.78	1.83	6.5	6.7

(Cont.)

TABLE 6 (Cont.)
HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS
DESIGN FLOW (Q = 6000 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	RB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH
8349.30	6000	5.00	729.19	734.43	735.49	735.89	17.34	1.74	6.7	6.7
8649.30	6000	5.23	727.92	733.18	734.22	734.62	17.28	1.75	7.0	6.7
8949.30	6000	5.26	726.65	731.93	732.95	733.35	17.26	1.75	7.0	6.7
9249.30	6000	5.27	725.39	730.66	731.69	732.09	17.27	1.75	7.0	6.7
9549.30	6000	5.27	724.12	729.39	730.42	730.82	17.27	1.75	7.0	6.7
9849.30	6000	5.27	722.86	728.13	729.16	729.56	17.28	1.75	7.0	6.7
10149.00	6000	5.41	721.70	727.10	728.00	728.40	16.78	1.74	7.1	6.7
10423.00	6000	5.44	720.43	725.87	728.88	728.13	17.08	1.75	7.2	7.7
10574.00	6000	5.44	719.80	725.24	728.54	727.84	17.13	1.75	7.2	8.04
10623.00	6000	6.31	719.55	725.86	727.70	727.70	13.58	1.63	7.9	8.15
10624.00	6000	7.90	719.54	727.44	727.69	727.69	12.77	1.64	9.5	8.15
10724.00	6000	8.59	719.04	727.63	727.70	727.70	9.68	1.50	10.1	8.66
10725.00	6000	4.78	717.90	722.68	726.56	726.56	18.94	1.80	6.6	8.66
10830.00	6000	5.96	717.80	723.76	723.15	728.10	15.15	1.69	7.6	10.3
10900.00	6000	4.53	717.52	722.05	723.82	723.82	17.74	1.73	6.3	6.3
11191.00	6000	5.01	716.35	721.36	723.85	723.85	16.06	1.69	6.7	7.5
11491.00	6000	4.88	714.99	719.87	722.49	722.49	16.59	1.70	6.6	7.5
11791.00	6000	4.81	713.63	718.44	721.13	721.13	16.85	1.71	6.5	7.5
12091.00	6000	4.78	712.27	717.06	719.77	719.77	16.94	1.71	6.5	7.5
12430.00	6000	4.77	710.74	715.51	718.24	718.24	16.98	1.71	6.5	7.5
12730.00	6000	4.84	709.45	714.29	716.95	716.95	16.72	1.71	6.5	7.5
13030.00	6000	4.85	708.16	713.00	715.66	715.66	16.72	1.71	6.6	7.5
13330.00	6000	4.85	706.87	711.71	714.37	714.37	16.72	1.71	6.6	7.5
13630.00	6000	4.84	705.58	710.42	713.08	713.08	16.73	1.71	6.5	7.5
13930.00	6000	4.83	704.29	709.12	711.79	711.79	16.75	1.71	6.5	7.5
14230.00	6000	4.84	703.00	707.84	710.50	710.50	16.71	1.71	6.5	7.5
14500.00	6000	4.85	701.84	706.68	709.34	709.34	16.71	1.71	6.6	7.5
14900.00	6000	4.83	700.12	704.95	707.62	707.62	16.74	1.71	6.5	7.5
15130.00	6000	4.84	699.13	703.97	706.63	706.63	16.71	1.71	6.5	7.5
15430.00	6000	4.85	697.84	702.69	705.34	705.34	16.71	1.71	6.6	7.5
15730.00	6000	4.85	696.55	701.39	704.05	704.05	16.72	1.71	6.6	7.5
16030.00	6000	4.85	695.26	700.10	702.76	702.76	16.73	1.71	6.6	7.5
16330.00	6000	4.84	693.97	698.81	701.47	701.47	16.73	1.71	6.5	7.5
16630.00	6000	4.84	692.68	697.52	700.18	700.18	16.73	1.71	6.5	7.5
16930.00	6000	4.84	691.39	696.23	698.89	698.89	16.73	1.71	6.5	7.5
17230.00	6000	4.83	690.10	694.93	697.60	697.60	16.75	1.71	6.5	7.5
17410.00	6000	4.84	689.32	694.16	696.82	696.82	16.72	1.71	6.5	7.5

TABLE 7
BRIDGE INFORMATION DESIGN Q = 6000 CFS.

CHANNEL STATION	BRIDGE ID.	UPSTREAM INFO		BRIDGE INFO.				DOWNSTREAM INFO.	
		DEPTH (FT.)	VELOCIT (FPS)	BRIDGE AREA (SQ.FT.)	DEPTH AT UPSTREAM FACE (FT.)	Q PASSING THRU BRIDGE (CFS)	Q OVERTOPPING ROADWAY (CFS)	DEPTH (FT.)	VELOCITY (FPS)
19+37 *		5.4	16.8						
25+32	WASHINGTON	5.4	16.9						
25+72	BRIDGE			437	8.0	5689	319		
26+52								8.3	9.9
27+12								5.6	16.2
33+12 *								5.1	18.2
33+12 *		5.1	18.2						
51+47	BONANZA	9.3	9.0						
51+68	5(10'X5')			250	9.4	3932	2074		
52+68	RCB							10.9	10.6
52+90								4.3	22.2
58+90 *								4.5	21.0
68+08 *		5.0	18.4						
76+62	STEWART	8.3	10.2						
77+47	8(10'X3.5')			280	7.1	4296	1727		
78+47	RCB.							10.2	8.1
80+49								4.4	21.0
83+49 *								5.0	18.4
101+49 *		5.4	16.8						
105+74	CHARLESTON	5.4	17.1						
106+23	BRIDGE	6.3	13.6						
106+24				437	7.9	5580	419		
107+24								8.6	9.7
107+25								4.8	18.9
108+30								4.4	11.9
117+91 *								5.0	16.1

* TYPICAL CHANNEL CROSS SECTIONS

TABLE 8

SLOAN CHANNEL — 7320 LINEAR FEET
PHASE I - OWENS TO STEWART
PRELIMINARY COST ESTIMATE

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
OVEREXCAVATION	CY	54,900	$4.00	$219,600
IMPORTED DRAIN BACKFILL	CY	12,444	$10.00	$124,440
RECOMPACT NATIVE MATERIAL	CY	42,456	$1.50	$63,684
MAJOR SURFACE INLETS	EA	2	$50,000.00	$100,000
CHAIN LINK FENCE	LF	8,700	$10.00	$87,000
CHANNEL LINING	SF	668,316	$6.00	$4,009,896
		TOTAL		$4,604,620

SLOAN CHANNEL — 7682 LINEAR FEET 60' B. WIDTH
PHASE II - STEWART TO LV WASH — 1600 LINEAR FEET 70' B. WIDTH
PRELIMINARY COST ESTIMATE

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	EXTENSION
OVEREXCAVATION	CY	70,735	$4.00	$282,940
IMPORTED DRAIN BACKFILL	CY	16,099	$10.00	$160,994
RECOMPACT NATIVE MATERIAL	CY	54,636	$1.50	$81,953
MAJOR SURFACE INLETS	EA	3	$50,000.00	$150,000
CHAIN LINK FENCE	LF	13,300	$10.00	$133,000
CHANNEL LINING	SF	863,447	$6.00	$5,180,680
		TOTAL		$5,989,567

GRAND TOTAL PHASE I AND PHASE II $10,594,187

VIII. RECOMMENDATIONS AND CONCLUSIONS

The channel section proposed in the 1986 Boyle design has adequate capacity to safely convey the design flows of 3,300 cfs and 6,000 cfs with freeboard except at the bridge and culvert crossings. The existing RCB culverts and bridges within the project limits have adequate capacity to convey the design flow of 3,300 cfs without overtopping. However, all of the culverts and bridges are overtopped for the design flow of 6,000 cfs. The flows that overtop the bridges at Washington Avenue and Charleston Boulevard are relatively minor (319 cfs and 419 cfs, respectively) in respect to the design flow of 6,000 cfs. These flows could be diverted back into the Sloan Channel via a surface inlet constructed within the Sloan Lane right-of-way.

The overtopping flows at the culverts at Bonanza Road and Stewart Avenue for the flow of 6,000 cfs are significant (2,074 cfs and 1,727 cfs, respectively). However, the Confluence Detention Basin is currently under design and is scheduled for a construction start in 1994. The Confluence Detention Basin will reduce the design flow for the Sloan Channel to 3,300 cfs. Based on this information, the detention basin will be in place before the culverts at Bonanza Road and Stewart Avenue could be redesigned and reconstructed. Therefore, the existing facilities are recommended to be left in place.

Provisions to accept local inflows into the Sloan Channel need to be incorporated into the design drawings. Significant inflows will be incurred at the points shown on Table 1 and Table 2. Future Master Plan facilities will eventually reduce the magnitude of the local inflows at some points. The surface inlets shown in the 1986 design were most likely sized for flows determined using hydrologic criteria which is not currently accepted. The surface inlets need to be reanalyzed to account for the updated local inflows and flow patterns presented in this memorandum. Major surface inlets need to be constructed on the east side of the channel at Owens Avenue and Washington Avenue, on the east and west side of the channel at Stewart

Avenue, and on the east side of the channel at Charleston Boulevard. Major surface inlets at existing roadway crossings should be similar in design to the existing surface inlet at Bonanza Road. This inlet consists of a warped pavement section for Sloan Lane adjacent to the Sloan Channel (and a depressed section of curb and gutter and sidewalk to act as the surface inlet. Minor surface inlets or, inlets at inflow points not associated with the major roadway crossing, should be similar to the surface inlets shown on the 1986 design. These inlets will consist of a depressed section of channel lining and upstream erosion protection to prevent undermining of the channel lining. The size and configuration of each inlet will be determined by the amount of inflow, allowable inlet velocities, and local topographic features. Provisions also need to be made to protect the proposed channel improvements from storm flows which are discharged directly into the Sloan Channel from adjacent residential developments.

The 1986 Sloan Channel design does not meet the currently accepted CCRFCD criteria for open channel design for the following items: steel area, transverse and longitudinal cutoff walls, safety ladders, and side slopes.

Based on work performed in the preparation of this Predesign Memorandum, the following recommendations are made:

- Based on the magnitude of the design flows for the Sloan Channel, the portion of Sloan Channel from Owens Avenue to the Las Vegas Wash confluence must be improved as a fully-lined, concrete trapezoidal channel. The existing, earth-lined channel section does not have adequate capacity to safely convey the design flows. The recommended improvements will protect the existing bridge and culvert structures at the major roadway crossings and will protect the surrounding residential developments.

- New design drawing for the Sloan Channel should be prepared that will incorporate current design standards, the updated soils information, and

current development conditions. The updated channel design will include 2:1 (H:V) side slopes, transverse and longitudinal cutoff walls, safety ladders, and steel areas per CCRFCD criteria. Portions of the longitudinal cutoff wall on the west side of the channel could be omitted where the channel will be protected from surface inflows by existing masonry walls. A low flow channel will also be incorporated into the channel design in order to contain nuisance flows in the center of the channel.

- No new bridges or modifications to existing culvert structures are recommended at this time. The existing culverts and bridges have capacity to convey the design flow of 3,300 cfs within the proposed channel sections. Regional facilities will soon be constructed that will limit the upstream inflow into this portion of the Sloan Channel to 3,300 cfs.

- The existing storm drain stubs for future Master Plan storm drains should not be constructed or reconstructed at this time, but rather should be placed at such a time that the future Master Plan facilities are designed.

- Surface runoff approaching the Sloan Channel from the west at Stewart Avenue can be introduced to the Sloan Channel either by perpetuating the existing flow pattern across an undeveloped parcel, or by constructing a channel parallel to Stewart Avenue along the frontage of the vacant parcel to the Sloan Channel. Presently, major storm flows in Stewart Avenue from the west are introduced into the Sloan Channel via an existing wash which bisects an undeveloped parcel located in the southwest quadrant of Sloan Channel and Stewart Avenue. The existing wash could be partially filled and regraded in order to improve the hydraulics of the confluence with Sloan Channel. The invert of the wash should be raised sufficiently so that minor flows conveyed in the Sloan Channel would not inundate this property. The wash should be concrete lined within the right-of-way for Sloan Channel with a concrete cutoff wall at the right-of-way line to prevent undermining the lining. An

easement would be required through this property to construct these improvements.

Runoff in Stewart Avenue could also be conveyed into the Sloan Channel by construction an interceptor channel along the south side of Stewart Avenue adjacent to the vacant parcel. In this option, the channel would act as a side weir to remove flows from Stewart Avenue. This option would require the construction of a warped pavement section in Stewart Avenue to force flows into the interceptor channel. The exact size and configuration of the channel can be determined when more detailed topographic data is available. Preliminary estimates indicated that a 20-foot wide, rectangular, concrete-lined channel at a slope of 0.4% could convey the 100-year flow of 580 cfs at a depth of 2.8 feet. The construction of this channel would require the acquisition of some right-of-way from the vacant parcel.

The construction of the channel along the south side of Stewart Avenue is recommended for construction. This channel will provide a one-time solution to the introduction of surface flows into the Sloan Channel at this location. Whereas, the improvements to the existing wash across the vacant parcel would only be a temporary solution. In the future, if an upsized storm drain is constructed within Stewart Avenue, it could be connected to the proposed channel.

The HEC-1 model prepared to identify local inflows into the Sloan Channel within the project limits for existing conditions suggests that local inflows into the Sloan Channel may exceed the design flow of 3,300 cfs in the middle and lower reaches of the project. A preliminary analysis of the entire watershed that contributes local inflows to the Sloan Channel south of the Confluence Detention Basin (Carey Avenue) indicates that the accumulation of local inflows into the channel will exceed 3,300 cfs as far north as Bonanza Road. A detailed hydrologic analysis of the local watershed for the Sloan Channel

north of Owens Avenue is beyond the scope of this Predesign Memorandum. While it appears that the existing structures will convey these flows, Clark County may want to perform a detailed hydrologic analysis for the Sloan Channel watershed to insure that the future culvert structure at Sahara Avenue is adequately sized.

G.C. WALLACE, INC.
Engineering/Architecture

LETTER OF TRANSMITTAL

TO: Clark County Regional Flood Control Dist. Date May 13, 1993

301 E. Clark Avenue, Ste. 300 Project No. 500.710

Las Vegas, NV 89101

Attention: Kevin Eubanks, P.E.

SUBJECT: **SLOAN CHANNEL - OWENS AVENUE TO THE LAS VEGAS WASH**

Gentlemen: The following items are:

		By way of:	
		___ First Class Mail	___ UPS
___ Forwarded	X Herein	X Hand Delivery	___ Federal Express
___ Returned	___ Under Separate Cover	___ FAX	___ MDS
			___ Other:

One (1) Copy of Draft Predesign Memorandum for the subject (text only)

RECEIVED
MAY 14 1993
REGIONAL FLOOD CONTROL DISTRICT

These items are submitted:

		Acknowledgement of receipt:	
___ At your request	___ For your action		Received by:
___ For your approval	___ For your files	X Not required	Date:
X For your review and comments	___ For your information	___ Acknowledgement required	Time:

Remarks: The Predesign Memo has been revised per our meeting at CCPW on May 6, 1993. Note changes to the text on pages 23 and 26. Please contact me if you have any questions.

Very truly yours,

G.C. WALLACE, INC.

By: Noel C. Laughlin

Noel C. Laughlin, P.E.

Copies to:
Mike Hand, CCPW
Calvin Black, GCW

1555 SOUTH RAINBOW BLVD. / LAS VEGAS, NEVADA 89102 / TELEPHONE: (702) 363-1200 FAX (702) 363-8979

DRAFT
PREDESIGN MEMORANDUM
SLOAN CHANNEL - OWENS AVENUE TO THE LAS VEGAS WASH

APPENDIX B

TABLE B2
LOCAL INFLOW INTO SLOAN CHANNEL
EXISTING CONDITION

Point Location*	Cross Street	INFLOW (cfs) East 10-Year	East 100-Year	West 10-Year	West 100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	505	1339		
3	Harris Ave.	5	39		
4	Bonanza Road	449	1232		
5	Stewart Ave.	178	665	169	579
6	Sunrise Ave.	44	133		
7	Charleston Blvd.	161	470	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

TABLE B3
LOCAL INFLOW INTO SLOAN CHANNEL
ULTIMATE DEVELOPMENT CONDITION

Point Location*	Cross Street	INFLOW (cfs) East 10-Year	East 100-Year	West 10-Year	West 100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	177	449		
3	Harris Ave.	5	39		
4	Bonanza Road	77	356		
5	Stewart Ave.	169	579	169	579
6	Sunrise Ave	44	133		
7	Charleston Blvd.	46	233	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

APPENDIX "B"

HYDROLOGY

Hydrologic Methodology

The hydrologic methods used are in accordance with the adopted "Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual," (Manual).

Hydrologic Model

The hydrologic model utilized in this study is the HEC-1" Flood Hydrograph package" developed by the U.S. Army Corps of Engineers Hydrologic Engineering Center.

HEC-1 is a rainfall runoff event simulation model utilizing an hydraulic components to simulate the surface runoff response of a drainage area to precipitation.

Computed hydrographs were routed using kinematic wave routing technique.

Precipitation

The Manual was used to establish point precipitation values, rainfall distribution and storm frequency.

That western portion of the drainage area, west of Hollywood Drive (see Figure B1), is in the McCarran Airport rainfall area as outlined by the Manual. The point rainfall depths for the six hour, 10-year and 100-year storm intervals were taken directly from Table 505 of the Manual. For the easterly portion of the drainage area, the point precipitation values were established from the NOAA precipitation Frequency Atlas (1973). The NOAA precipitation values were then adjusted by the recommended correction factors to develop point rainfall depths for storm events that best simulate the hydrologic area. The six-hour storm has been selected in accordance with the Manual.

Since the drainage area for the project is less than 10 square miles, a SDN 3 design storm distribution with a 3 minute time increment was selected for use in the HEC-1 computer model.

CURVE NUMBER

The soils information for the study area and the project watershed was obtained from the SCS Soil Survey of Las Vegas Valley Area. This survey delineates families of soil types and the hydrologic soil group of each family. Figure B2 shows the study site on a portion of the soil map for the area. An examination of this map shows a mixture of several types of soil, generally "D" type on the steeper slopes and "A", "B" and "C" types on the lower reaches of the drainage basins.

The curve numbers for each soil group were selected from Table 602 of the Manual for the ultimate development conditions.

Drainage Area

The drainage basins were determined with the use of U.S. Geological Survey 7-1/2 minute quad maps, 400 scale aerial photos, 200 scale County topo maps, field investigations and 100 scale onsite topographic maps. A planimeter was then used to determine the basin areas. The drainage basins are shown on Figure B1.

Lag Time

The Manual recommends that for drainage basins less than one square mile, the lag time be determined using the following equation:

$$\text{Lag} = 0.6\, t_c$$

where t_c is the time of concentration in hours and is calculated by the following equation:

$$t_c = t_i + t_t$$

where

t_i = initial inlet or overland flow time (minutes)

t_t = travel time in ditch, channel, gutter, etc. (minutes)

initial overland flow time was calculated by the following equation:

$$t_i = 1.8\,(1.1 - K)L_o^{1/2}/S^{1/3}$$

(for detailed explanation, see Section 600 CCRFCD Manual).

For this study, time travel (t_t) was computed by using the channel length (i.e., gutter length) divided by street flow velocity for the respective slope. The total travel time was computed as the sum of travel time for each basin. Therefore, the t_c was computed as the initial overland flow time plus travel time, and the lag time as $0.6\ t_c$.

Flood Hazard Designation

The Special Flood Hazard Areas for Clark County, Nevada are outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), dated September 29, 1989. In reviewing Community Panel No. 320005 1250B and 1025B, portions of the drainage basin are located within a designated Special Flood Hazard Area (see Figure B3). However, there has been significant development within the drainage basin since the publication of the FIRM in 1989. LOMR's for the individual subdivisions may have eliminated all or part of the Special Flood Hazard Areas.

Analysis

Figure B1 outlines the contributing drainage area to the Sloan Channel (between Owens Avenue and the Las Vegas Wash confluence) under ultimate developed conditions. To

model the storm flow, the study area was divided into two major areas. Area No. 1 was analyzed in the study entitled "Conceptual Master Drainage Report for Lewis Homes - Orchards," January 1992 by Pentacore Engineering. The study and the resulting flows into the Sloan Channel were accepted by Clark County Public Works. Area No. 2 was divided into drainage areas east and west of the Sloan Channel. The drainage area on each side was in turn, subdivided into subdrainage areas. The drainage subbasin characteristics are contained in Table B1.

The HEC-1 model was used to analyze the study area and consists of data generated for Area No. 2 and data incorporated from the above mentioned drainage report for Area No. 1. Two HEC-1 alternatives are analyzed for the total study area. Alternative 1 assumes existing conditions within the project watershed without any storm water detention in the upper reaches of the watershed. In this alternative, a portion of the flow from Subbasins SB10 and SB11 (see Figure B1) is diverted through SB15 to Charleston Boulevard as occurs in the existing conditions. The resulting flows and related data at points of interest for Alternative 1 are contained in Table B2.

Alternative 2 assumes ultimate conditions with CCRFCD Master Plan facilities in place. Two detention basins that impact this reach of the Sloan Channel are identified in Figures F-12 and F-16 of the 1991 Master Plan Update. Facilities Nos. SLSW/0154 and SLST/0169 have a significant impact on the routing and peak flow rates in the localized watershed. In Alternative 2, the runoff from Subbasins SB10 and SB11 flows along Stewart Avenue to Sloan Channel. The resulting flows and related data at points of interest for Alternative 2 are shown in Table B3.

TABLE B1
SUBBASINS CHARACTERISTICS OF TRIBUTARY BASINS TO SLOAN CHANNEL BETWEEN OWENS AVENUE AND LAS VEGAS WASH

Subbasin No.	Area (Ao)	Area (Sq Mi)	Average St. Slope (%)	Average St. Veloc (FPS)	Length (ft)	LO (Ft)	Ti (Min)	Lag Time (Hr)	CN	K
SB 1	412.0	0.6438	27.0	11.0	7800	500	4.51	0.1633	88.00	0.77
						Total Lag T.		0.1633		
SB 2	132.0	0.2063	5.2	4.5	2600	200	13.74	0.2337	72.00	0.56
						Total Lag T.		0.2337		
SB 3	175.0	0.2734	2.8	3.4	2900	200	12.73	0.2694	75.00	0.60
						Total Lag T.		0.2694		
SB 4	85.0	0.1328	1.8	2.6	2700	200	11.05	0.2836	80.00	0.67
						Total Lag T.		0.2836		
SB 5	75.0	0.1172	1.8	2.6	2500	200	11.05	0.2707	80.00	0.67
						Total Lag T.		0.0500		
SB 6	374.0	0.5844	34.0	13.0	5700	300	4.75	0.1205	88.00	0.77
						Total Lag T.		0.0500		
SB 7	152.0	0.2375	6.3	5.1	3000	200	13.74	0.2354	72.00	0.56
						Total Lag T.		0.2354		
SB 8	230.0	0.3594	1.8	2.7	2400	200	12.73	0.2754	75.00	0.60
			1.5	2.5	2100			0.1400		
						Total Lag T.		0.4154		
SB 8B	34.0	0.0531	1.0	2.0	1600	100	12.06	0.2539	77.00	0.63
						Total Lag T.		0.2539		
SB 9	69.0	0.1078	1.5	2.5	2700	200	15.08	0.3308	68.00	0.51
						Total Lag T.		0.3308		
SB 10	181.0	0.2828	33.0	12.0	4800	300	4.75	0.1141	88.00	0.77
						Total Lag T.		0.1141		
SB 11	210.0	0.328	4.0	4.0	3800	200	12.73	0.2856	75.00	0.60
						Total Lag T.		0.2856		
SB 12	230.0	0.3594	2.0	2.8	4200	200	13.90	0.3890	71.50	0.55
						Total Lag T.		0.3890		
SB 13	114.0	0.1781	0.6	1.7	2300	200	10.04	0.3259	83.00	0.71
						Total Lag T.		0.3259		
SB 14	60.0	0.0938	4.7	4.7	2500	200	12.73	0.2159	75.00	0.60
						Total Lag T.		0.2159		

Subbasin No.	Area (Ac)	Area (Sq Mi)	Average St. Slope (%)	Average St. Veloc (FPS)	Length (ft)	LO (Ft)	TI (Min)	Lag Time (Hr)	CN	K
SB 15	154.0	0.2406	1.1	2.1	2800	200	12.73	0.3495	75.00	0.60
						Total Lag T.		0.3495		
SB 16	80.0	0.1250	3.0	3.5	2700	200	12.73	0.3029	61.00	0.42
						Total Lag T.		0.3029		
SB 16A	102.0	0.1594	0.5	1.5	1800	200	10.71	0.3071	81.00	0.68
						Total Lag T.		0.3071		
	2767.0	4.3								

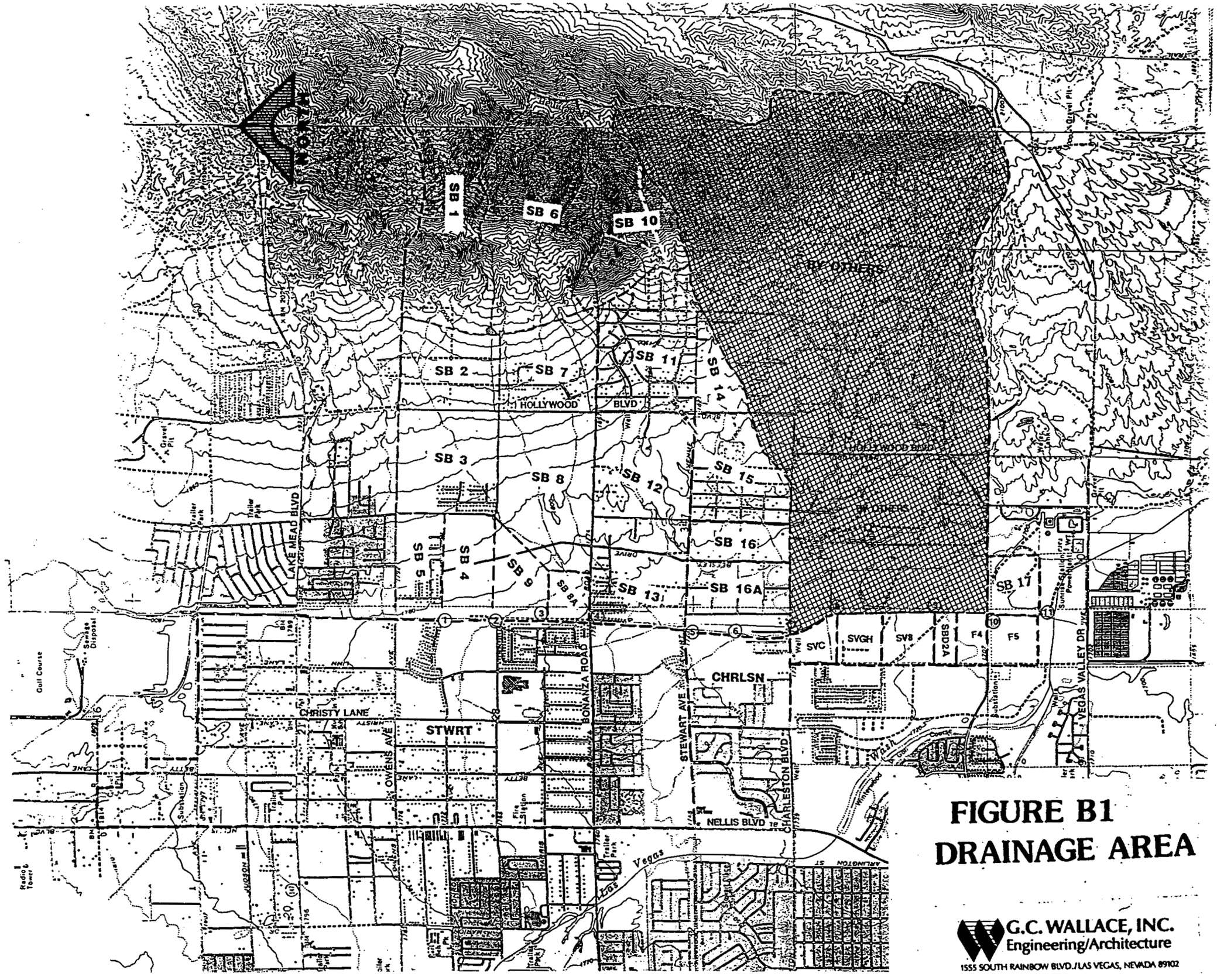


FIGURE B1
DRAINAGE AREA

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

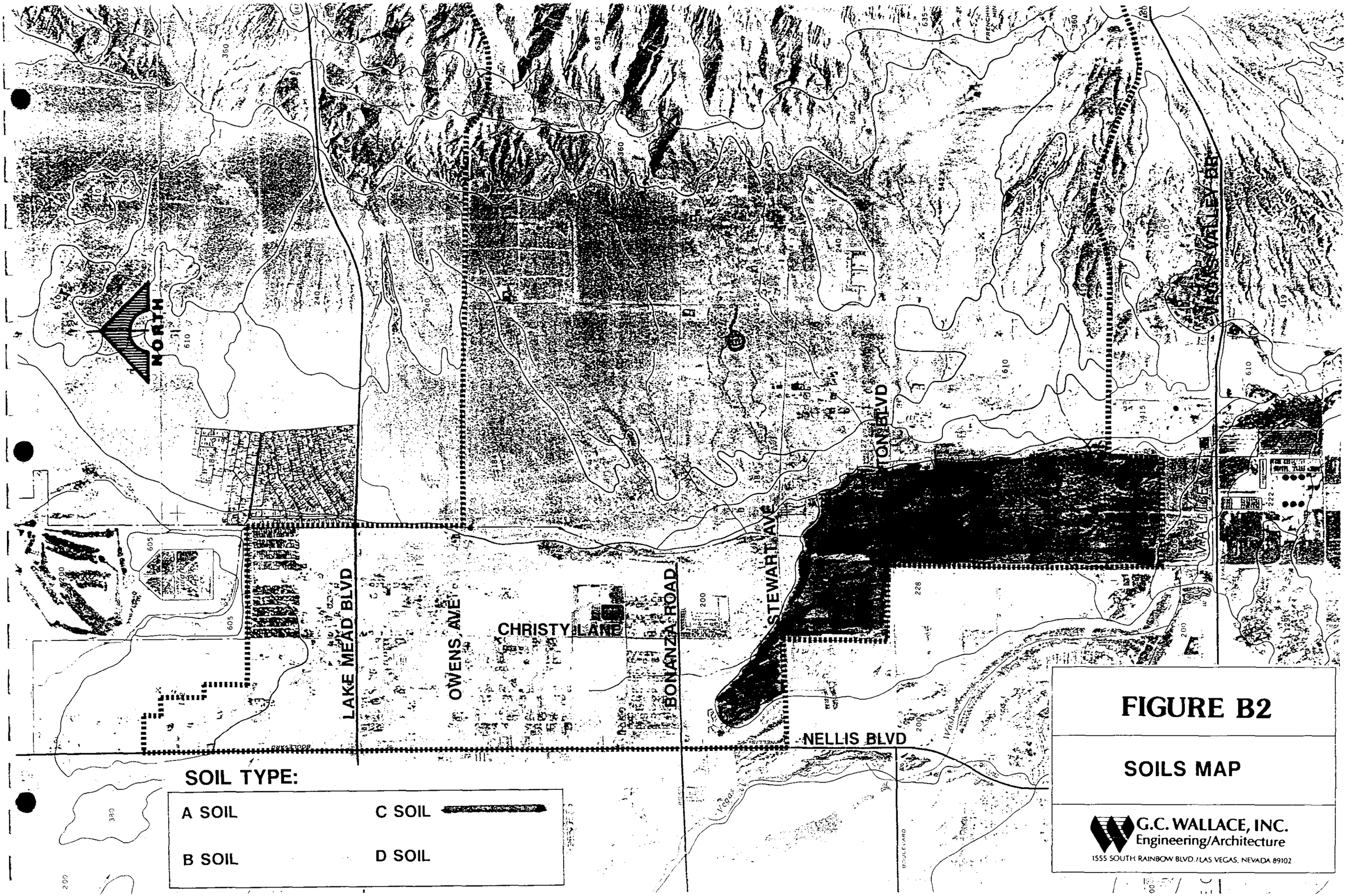
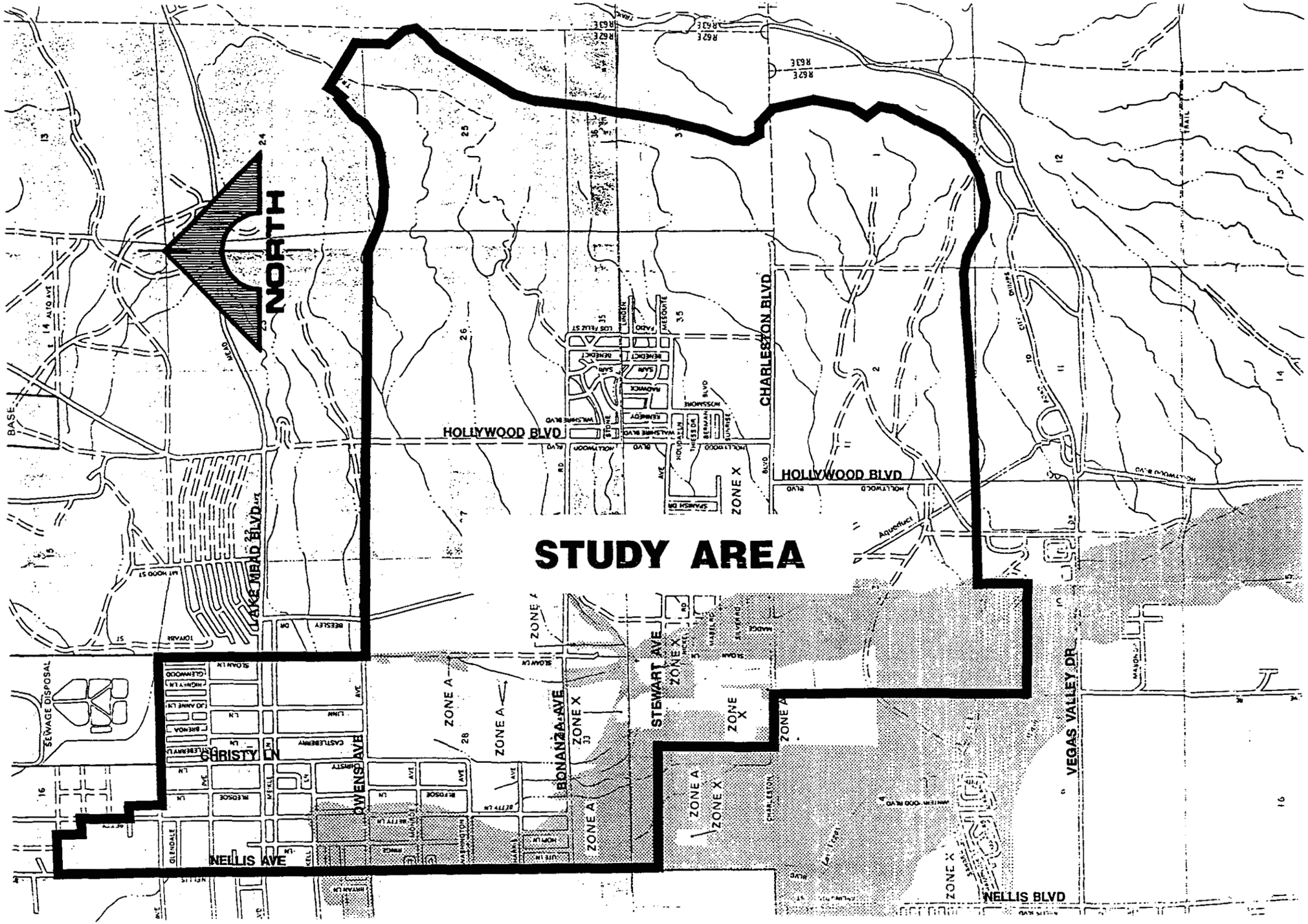


FIGURE B2

SOILS MAP

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD. / LAS VEGAS, NEVADA 89102



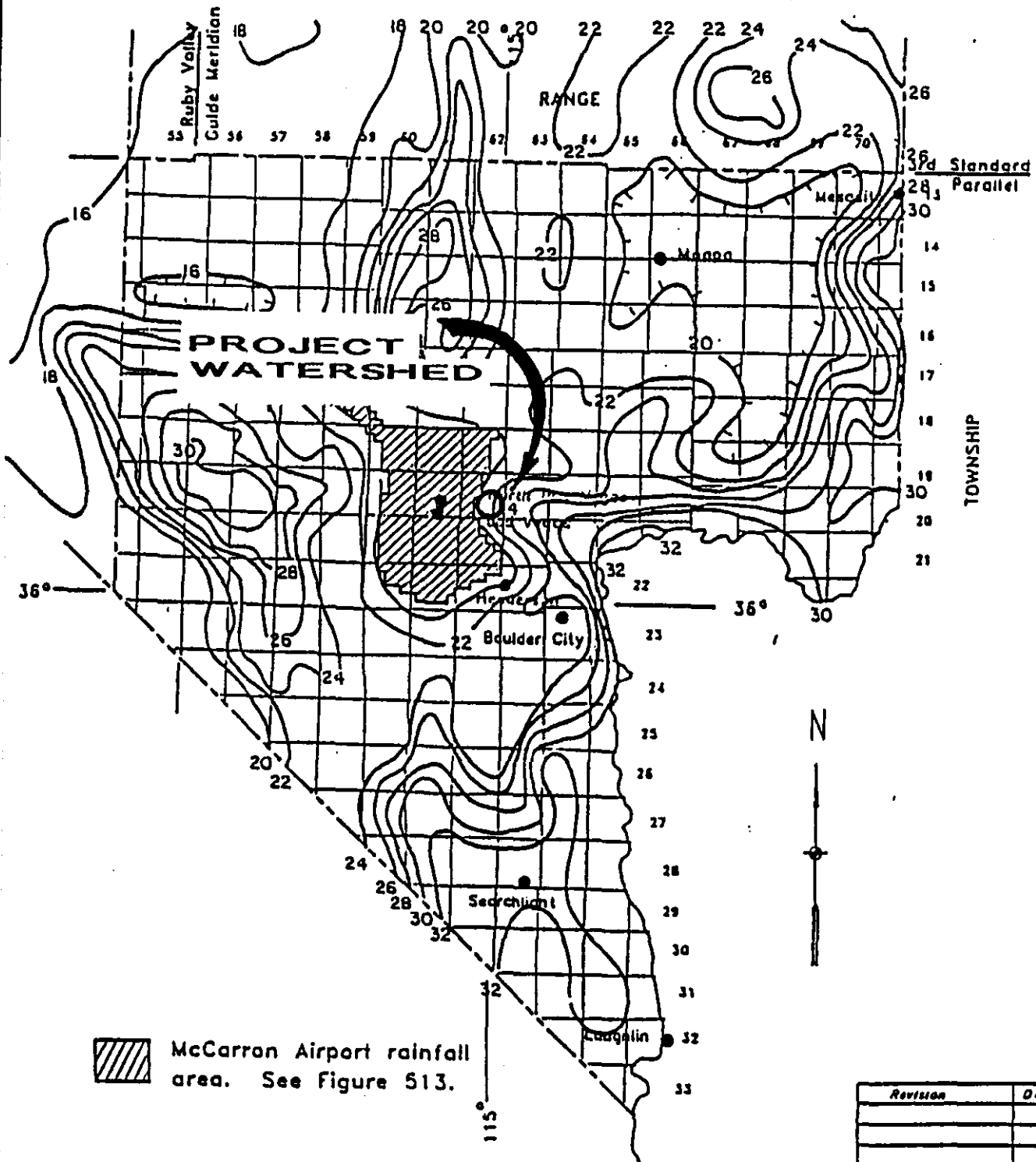
FLOOD INSURANCE RATE MAP

COMMUNITY-PANEL NO. 320003 1250B & 320003 1025B

FIGURE B3

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

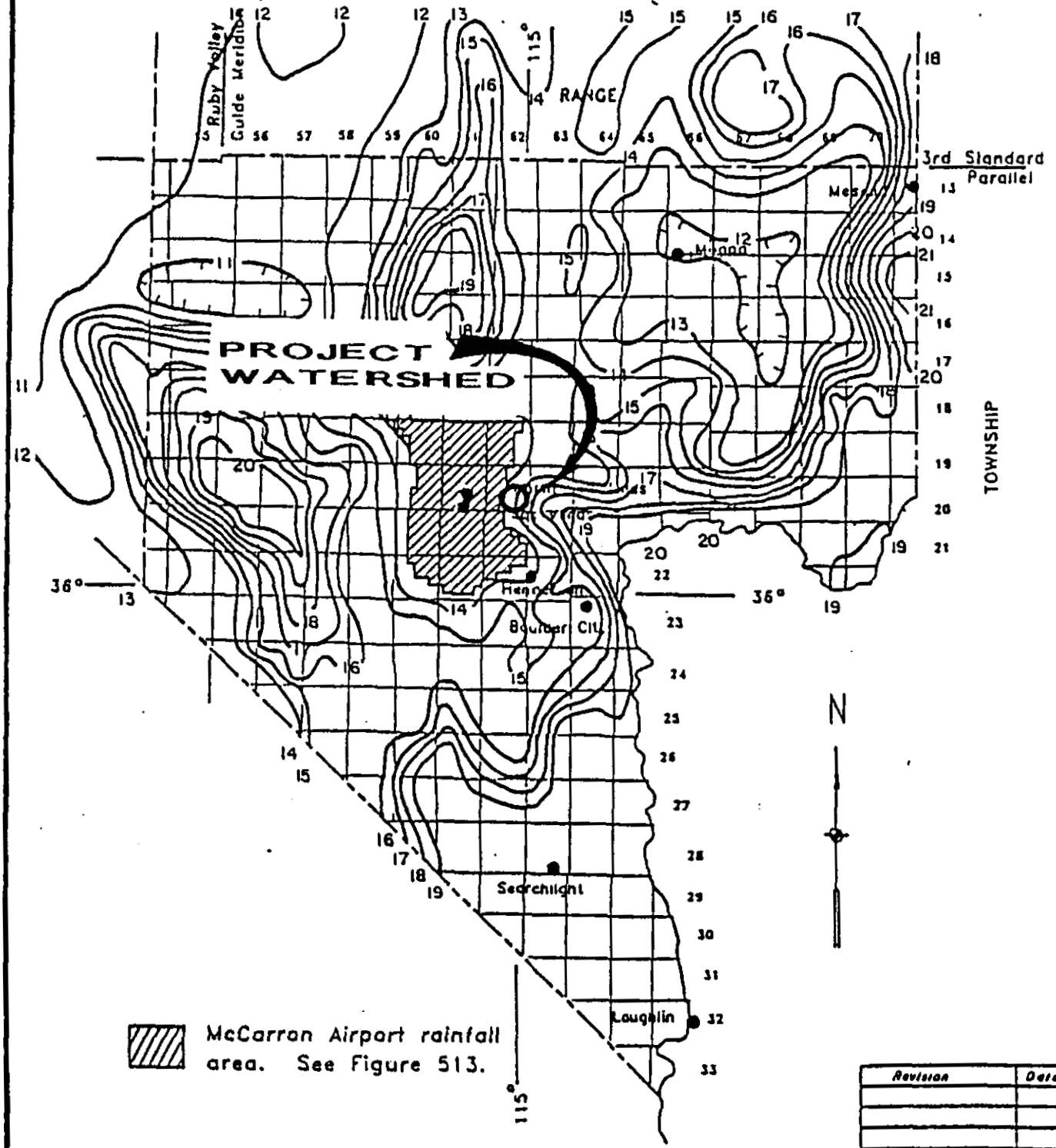
RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 506

RAINFALL DEPTH-DURATION-FREQUENCY
10-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 503

Point Precipitation Calculations

From Standard Form 3

6-hr 100-year = 2.2"

6-hr 10-year = 1.5"

Applying Clark County Correction Factors

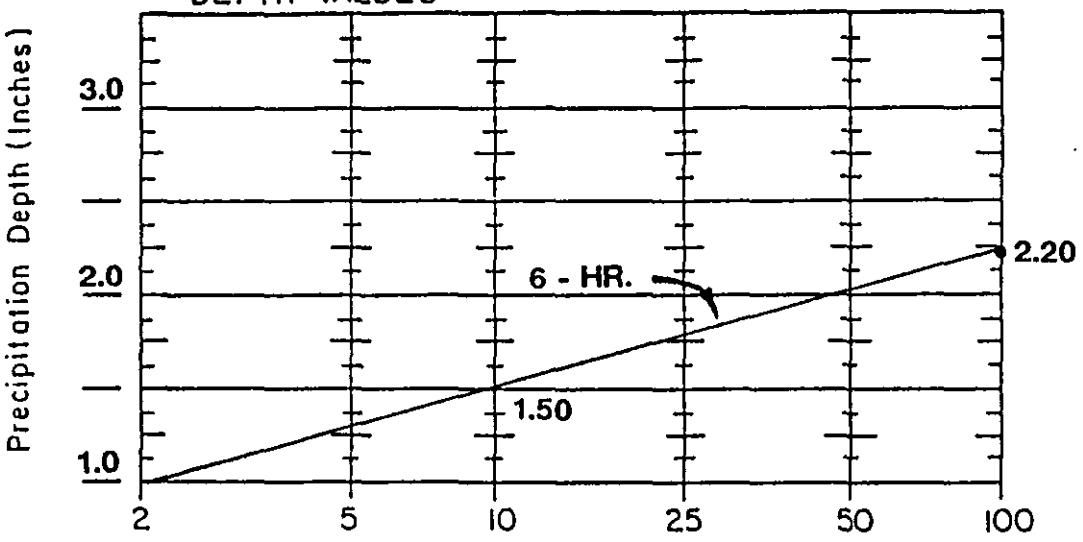
100-year 2.2" x 1.43 = 3.15"

10-year 1.5" x 1.24 = 1.86"

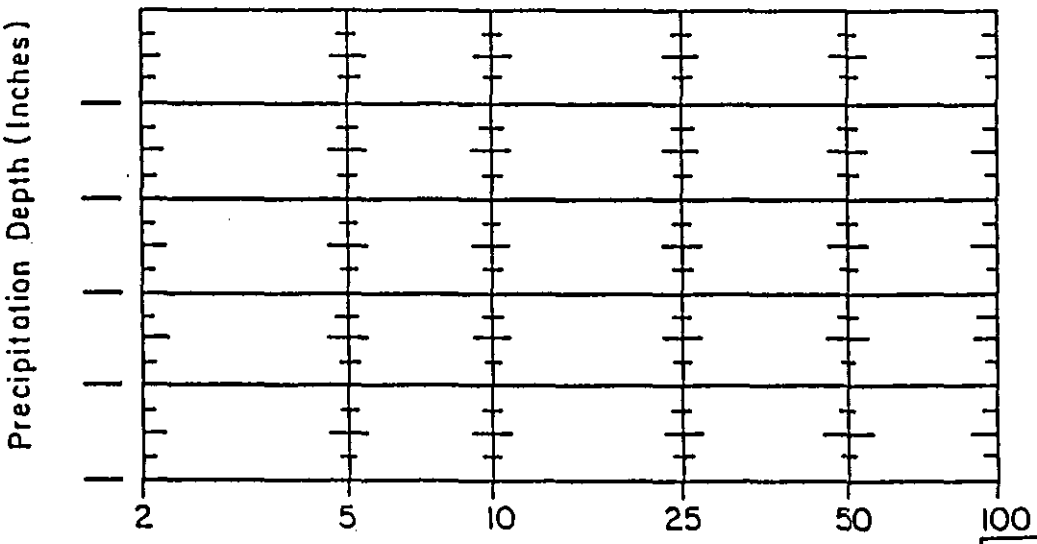
Ratio of 10-year to the 100-year = 0.58

PRECIPITATION DEPTH VERSUS RETURN PERIOD

A. PLOT OF 6-HOUR AND 24-HOUR PRECIPITATION DEPTH VALUES



B. PLOT OF 1-HOUR PRECIPITATION DEPTH VALUES



Revision	Date

REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973.

STANDARD FORM 3

PRECIPITATION ADJUSTMENT RATIOS

Recurrence Interval	Ratio to NOAA Atlas 2
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

NOTE:
1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

Revision	Date

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 603
[3]CN's shown are equivalent to those of pasture. *Composite CN's may be computed for other combinations of open space cover type.*
[4]Composite CN's for natural desert landscaping should be computed using figure 603 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

PRECIPITATION ADJUSTMENT RATIOS

Recurrence Interval	Ratio to NOAA Atlas 2
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

NOTE:
1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

Revision	Date

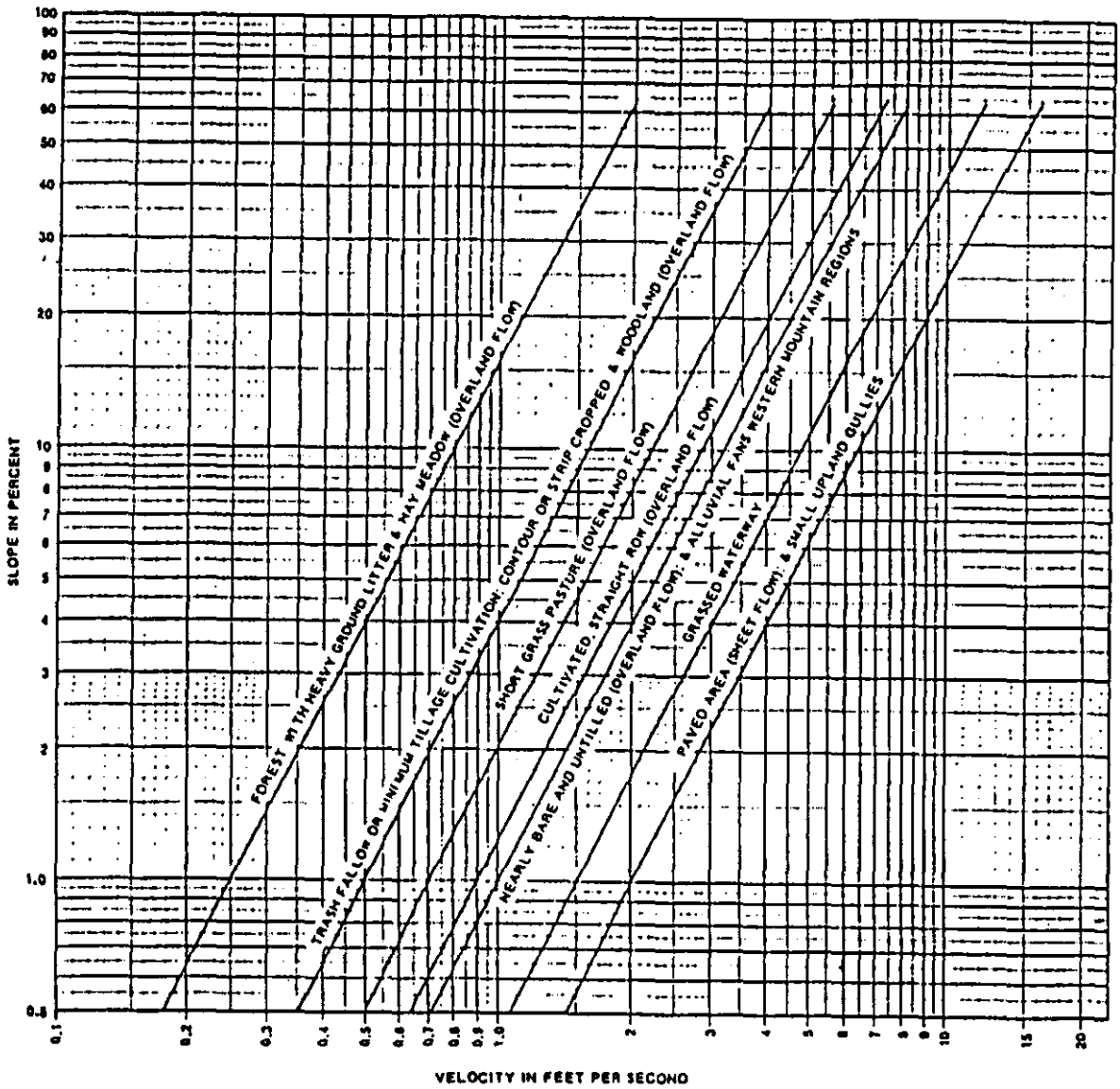
SIX HOUR DEPTH-AREA REDUCTION FACTORS

Drainage Area (Square Miles)	Six-Hour Depth-Area Reduction Factor
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

NOTES:
1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

Revision	Date

TRAVEL TIME VELOCITY



Revision	Date

WRC ENGINEERING	REFERENCE: SCS National Engineering Handbook Section 4, Hydrology, March, 1985	FIGURE 602

HEC-1 MODEL FOR 100-YR. STORM WITHOUT DETENTION IN LOCAL WATERSHED

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID   *          UNDER ULTIMATE DEVELOPMENT CONDITION            *
    2     ID    ****                                                    ****
    3     ID   * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
    4     ID   * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.H1 *
    5     ID   * POINT RAINFALL (100-YR. STORM)            3/16/93  *
    6     IT      3      0      0     300
    7     IO      5      0
    8     IN      5      0      0
    9     JR    PREC    .98    .97    .92    .88    .86

   10     KK    SB 5
   11     BA   .1172
   12     PC   .000   .020   .057   .070   .087   .108   .124   .130   .130   .130
   13     PC   .130   .130   .130   .133   .140   .142   .148   .158   .172   .181
   14     PC   .190   .197   .199   .200   .201   .204   .214   .229   .241   .249
   15     PC   .251   .256   .270   .278   .281   .283   .295   .322   .352   .409
   16     PC   .499   .598   .710   .744   .781   .812   .819   .835   .851   .856
   17     PC   .860   .868   .876   .888   .910   .926   .937   .950   .970   .976
   18     PC   .982   .985   .987   .989   .990   .993   .993   .994   .995   .998
   19     PC   .998   .999   1.00
   20     PB    3.0
   21     LS      0     80
   22     UD   .2707

   23     KK    ROUT
   24     KM    ROUT FROM 1 TO 2
   25     RK    1300  .00385   .015      0    TRAP     60     1.5

   26     KK    SB 1
   27     BA   .6438
   28     PB    3.15
   29     LS      0     88
   30     UD   .1633

   31     KK    ROUT
   32     KM    ROUTE THROUG  H SB 2
   33     RK    3000    .05   .017      0    TRAP     50      0

   34     KK    SB 2
   35     BA   .2063
   36     PB    3.15
   37     LS      0     72
   38     UD   .2337

   39     KK    COMB
   40     HC      2

   41     KK    ROUT
   42     KM    ROUT  THROU WASINGTON AVE.
   43     RK    5500    2.5   .017      0    TRAP     50      0
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK   SB 3
  45      BA  .2734
  46      PB   3.07
  47      LS     0     75
  48      UD  .2694

  49      KK   COMB
  50      HC     2

  51      KK   ROUTE
  52      KM   ROUT  THROU WASINGTON AVE.
  53      RK   5000   .015   .017      0   TRAP     50      0

  54      KK   SB 4
  55      BA  .1328
  56      PB   3.0
  57      LS     0     80
  58      UD  .2836

  59      KK    2E   COMB
  60      HC     2

  61      KK     2   COMB
  62      HC     2

  63      KK   ROUT
  64      KM   ROUTE THROUG  SLOAN CHANNEL
  65      RK   1500  .0051   .015      0   TRAP     60    1.5

  66      KK    3E   SB 9
  67      BA  .1078
  68      PB   3.0
  69      LS     0     68
  70      UD  .3308

  71      KK     3   COMB
  72      HC     2

  73      KK   ROUT
  74      KM   ROUTE THROUG  SLOAN CHANNEL
  75      RK    950  .0051   .015      0   TRAP     60    1.5

  76      KK   SB 6
  77      BA  .5844
  78      PB   3.15
  79      LS     0     88
  80      UD  .1205

  81      KK   ROUT
  82      KM   ROUT  THROU    SB 7
  83      RK   2300   .06   .017      0   TRAP     50      0
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  84      KK   SB 7
  85      BA  .2375
  86      PB   3.15
  87      LS      0     72
  88      UD  .2354

  89      KK   COMB
  90      HC      2

  91      KK   ROUT
  92      KM   ROUT  THROU BONANZA ROAD
  93      RK   4200   .018    .017       0    TRAP      50       0

  94      KK   SB 8
  95      BA  .3594
  96      PB   3.07
  97      LS      0     75
  98      UD  .4154

  99      KK   COMB
 100      HC      2

 101      KK   ROUT
 102      KM   ROUT  THROU BONANZA ROAD
 103      RK   1300    .01    .017       0    TRAP      50       0

 104      KK   SB 8B
 105      BA  .0531
 106      PB    3.0
 107      LS      0     78
 108      UD  .2539

 109      KK     4E   COMB
 110      HC      2

 111      KK      4   COMB
 112      HC      2

 113      KK   ROUT
 114      KM   ROUTE THROUG  SLOAN CHANNEL
 115      RK    900  .0075    .015       0    TRAP      60     1.5

 116      KK   ROUT
 117      KM   ROUTE THROUG  SLOAN CHANNEL
 118      RK   1500  .0049    .015       0    TRAP      60     1.5

 119      KK   SB 10
 120      BA  .2828
 121      PB   3.15
 122      LS      0     88
 123      UD  .1141
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  124     KK    ROUT
  125     KM    ROUT  THROU    SB 11
  126     RK    3800     .04    .017       0    TRAP      50       0

  127     KK   SB 11
  128     BA   .3281
  129     PB    3.15
  130     LS       0      75
  131     UD   .2856

  132     KK    COMB
  133     HC       2

  134     KK  DIVERT
  135     KM   DIVERT 250 CFS TO CHARLESTON BLVD.
  136     DT   CHBLD
  137     DI      30      50     200     400     700
  138     DQ      15      25     100     200     250

  139     KK    ROUT
  140     KM    ROUT  THROU    SB 12
  141     RK    4200     .02    .025       0    TRAP      30       2

  142     KK   SB 12
  143     BA   .3594
  144     PB    3.07
  145     LS       0    71.5
  146     UD   .3890

  147     KK    COMB
  148     HC       2

  149     KK    ROUT
  150     KM    ROUT  THROU STEWART AVE.
  151     RK    1700    .008    .017       0    TRAP      50       0

  152     KK   SB 13
  153     BA   .1781
  154     PB     3.0
  155     LS       0      83
  156     UD   .3259

  157     KK      5E    COMB
  158     HC       2

  159     KK      5W   STWRT
  160     KM  AREA DRAINING TO STEWART AVE & SLOAN CHANNEL
  161     KM  ASSUMED FULLY DEVELOPED AT 5.3 LOTS/ACRE
  162     KM        AREA     1730 AC (2.7  SQ.MI.)
  163     KM        Cn       80
  164     KM        Tl       1.603 hr
  165     KM        DARF     0.92
  166     BA     2.7
  167     PB    2.77
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 168      LS      0     80
 169      UD  1.603

 170      KK      5   COMB
 171      HC      3

 172      KK   ROUT
 173      KM   ROUTE THROUG  SLOAN CHANNEL
 174      RK   2200 .00423   .015       0   TRAP      60     1.5

 175      KK   SB16A
 176      BA   .1594
 177      PB    3.0
 178      LS      0     81
 179      UD  .3071

 180      KK      6   COMB
 181      HC      2

 182      KK   ROUT
 183      KM   ROUTE THROUG  SLOAN CHANNEL
 184      RK    400 .00423   .015       0   TRAP      60     1.5

 185      KK   SB 14
 186      BA   .0938
 187      PB   3.15
 188      LS      0     75
 189      UD  .2159

 190      KK  CAL-CH
 191      DR  CHBLD

 192      KK   COMB
 193      HC      2

 194      KK   ROUT
 195      KM   ROUT  THROU   SB 15
 196      RK   3900    .01   .017       0   TRAP      50       0

 197      KK   SB 15
 198      BA   .2406
 199      PB   3.07
 200      LS      0     75
 201      UD  .3495

 202      KK   COMB
 203      HC      2

 204      KK   ROUT
 205      KM   ROUT  THROU   CHARLESTON BLVD
 206      RK   1000    .008   .017       0   TRAP      50       0
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 207      KK    SB16
 208      BA   .125
 209      PB    3.0
 210      LS      0      61
 211      UD   .3029

 212      KK    COMB
 213      HC      2

 214      KK    ROUT
 215      RK    1500    .005    .017       0    TRAP      50       0

 216      KK      7W  CHRLSN
 217      KM  AREA DRAINING TO CHARLESTON AND SLOAN CHANNEL
 218      KM        AREA    120 AC   (.1875  SQ.MI.)
 219      KM        Cn      86.5
 220      KM        T1      0.446 HR
 221      KM
 222      BA   .1875
 223      PB    2.77
 224      LS      0    86.5
 225      UD    .446

 226      KK      7    COMB
 227      HC      3

 228      KK    ROUT
 229      KM    ROUTE THROUG  SLOAN CHANNEL
 230      RK    1400   .0042    .015       0    TRAP      70     1.5

 231      KK     30 ONSITE BASIN 30
 232      BA   .0256
 233      PB    3.15
 234      LS      0      90
 235      UD     .27

 236      KK     31 ONSITE BASIN 31
 237      BA   .0172
 238      LS      0      87
 239      UD     .17

 240      KK    COMB
 241      HC      2

 242      KK     SVC
 243      KM  FUTURE COMMERCIAL AREA AT SLOAN AND CHARLESTON
 244      KM        AREA    27 AC    (.04219 SQ.MI.)
 245      KM        Cn      94
 246      KM        T1      0.199 HR
 247      BA  .04219
 248      PB    2.77
 249      LS      0      94
 250      UD    .199
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  251     KK    COMB
  252     HC      3

  253     KK    ROUT
  254     KM    ROUTE THROUG  SLOAN CHANNEL
  255     RK    1100   .0045    .015       0    TRAP      70     1.5

  256     KK    SVGH
  257     KM  SUNRISE VALLEY GARDEN HOMES
  258     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  259     KM        AREA    26 AC    (.04063 SQ.MI.)
  260     KM        Cn      90
  261     KM        T1      0.249 HR
  262     BA  .04063
  263     PB    2.77
  264     LS      0      90
  265     UD    .249

  266     KK    COMB
  267     HC      2

  268     KK    ROUT
  269     KM    ROUTE THROUG  SLOAN CHANNEL
  270     RK    1450   .0045    .015       0    TRAP      70     1.5

  271     KK     SV8
  272     KM  SUNRISE VALLEY  UNIT 8
  273     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  274     KM        AREA    27 AC    (.04219 SQ.MI.)
  275     KM        Cn      90
  276     KM        T1      0.273 HR
  277     BA  .04219
  278     PB    2.77
  279     LS      0      90
  280     UD    .273

  281     KK    COMB
  282     HC      2

  283     KK    ROUT
  284     KM    ROUTE THROUG  SLOAN CHANNEL
  285     RK     300   .0045    .015       0    TRAP      70     1.5
  286     KM       ******************

  287     KK      03 OFFSITE BASIN 03
  288     BA    .2125
  289     PB    3.15
  290     LS      0      81
  291     UD    .53
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

292       KK     R3 ROUTE DOWN STORM DRAIN IN STREET C
293       RK   1250  .0085   .013      0    CIRC    4.5

294       KK     04 OFFSITE BASIN 04
295       BA  .4234
296       LS      0     88
297       UD    .32

298       KK     R4 ROUTE FLOWS TO HOLLYWOOD BOULEVARD
299       RM     10     .9    .15

300       KK     05 OFFSITE BASIN 05
301       BA  .4078
302       LS      0     77
303       UD    .58

304       KK     C3 COMBIINE FLOWS AT HOLLYWOOD
305       HC      2

306       KK     R5 ROUTE DOWN STORM DRAIN IN STREET B
307       RK    700  .0308   .013      0    CIRC      5

308       KK     CA COMBIINE FLOWS AT INTERSECTION OF STREET B & C
309       HC      2

310       KK     R6 ROUTE FLOWS DOWN STORM DRAIN IN STREET B TO PARK
311       RK    900   .017   .013      0    CIRC    5.5

312       KK     R7 ROUTE FLOWS TO PARK
313       RK    850  .0188   .013      0    CIRC    5.5

314       KK    06A OFFSITE BASIN 06A
315       BA  .2594
316       LS      0     88
317       UD    .13

318       KK     R8 ROUTE TO C4
319       RM      6    .41    .15

320       KK    06B OFFSITE BASIN 06B
321       BA  .1641
322       LS      0     88
323       UD    .14

324       KK     R9 ROUTE TO C4
325       RM      6    .52    .15

326       KK    06C OFFSITE BASIN 06C
327       BA  .1750
328       LS      0     88
329       UD    .19
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  330     KK    R10 ROUTE TO C4
  331     RM      6    .65    .15

  332     KK      C COMBINE FLOWS
  333     HC      3

  334     KK    R11
  335     RM     10    .89    .15

  336     KK     07 OFFSITE BASIN 07
  337     BA  .6016
  338     LS      0     77
  339     UD    .73

  340     KK     C4 COMBINE FLOWS
  341     HC      2

  342     KK    R12 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  343     RK    880  .0501   .013      0   CIRC      5

  344     KK    R13 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  345     RK    350  .0171   .013      0   CIRC      5

  346     KK      C COMBINE FLOWS FROM BOTH STORM DRAINS IN PARK
  347     HC      2

  348     KK      3 ONSITE BASIN 3
  349     BA  .0063
  350     LS      0     75
  351     UD    .13

  352     KK      R ROUTE FLOWS DOWN STREET C
  353     RK    700   .005   .016      0   TRAP     60

  354     KK    R14 ROUTE FLOWS DOWN STREET B
  355     RK    600  .0171   .016      0   TRAP     60

  356     KK    R15
  357     RK   1050    .02   .016      0   TRAP     60

  358     KK      4 ONSITE BASIN 84
  359     BA  .0774
  360     LS      0     75
  361     UD    .26

  362     KK      5 ONSITE BASIN 5
  363     BA  .0312
  364     LS      0     73
  365     UD    .24
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  366     KK      C COMBINE  SURFACE FLOWS AT LOW POINT IN STREET A
  367     HC      3

  368     KK     CB COMBINE WITH FLOWS FROM STORM DRAIN
  369     HC      2

  370     KK      6 PARK SITE
  371     BA  .0181
  372     LS      0      61
  373     UD    .37

  374     KK     CC COMBINE FLOWS IN PARK
  375     HC      2

  376     KK    DET DETENTION BASIN IN PARK
  377     RS      1    STOR     -1
  378     SV    .03     .42    1.56    4.18    7.11   10.74   15.19   20.69   27.05
  379     SE      9      10      11      12      13      14      15      16      17
  380     SQ      0      25      50     500     700     900    1200    1500    2000

  381     KK      7 ONSITE BASIN 7
  382     BA  .0312
  383     LS      0      75
  384     UD    .19

  385     KK      R ROUTE TO ORCHARD PARK DRIVE
  386     RK    900    .010    .016       0    TRAP      60       0

  387     KK      8 ONSITE BASIN 8
  388     BA  .0245
  389     LS      0      85
  390     UD    .15

  391     KK      9 SCHOOL
  392     BA  .0194
  393     LS      0      61
  394     UD    .54

  395     KK     08 OFFSITE BASIN 08
  396     BA  .0203
  397     LS      0      88
  398     UD    .14

  399     KK     RB ROUTE FLOWS TO HOLLYWOOD
  400     RM     16    1.23     .15

  401     KK     09 OFFSITE BASIN 09
  402     BA  .2891
  403     LS      0      77
  404     UD    .81
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 405      KK      C5 COMBINE FLOWS AT HOLLYWOOD
 406      HC       2

 407      KK       R ROUTE FLOWS TO ORCHARD VALLEY
 408      RK    1320    .02    .016       0    TRAP      60       0

 409      KK       C COMBINE FLOWS
 410      HC       2

 411      KK       C COMBINE FLOWS AT STREET D AND ORCHARD PARK DRIVE
 412      HC       3

 413      KK       R ROUTE FLOWS TO SUMP IN ORCHARD PARK DRIVE
 414      RK     550   .011    .016       0    TRAP      80       0

 415      KK      CD COMBINE ALL FLOWS INTO CHANNEL
 416      HC       2

 417      KK      CE ROUTE FLOWS DOWN CHANNEL TO CP E
 418      RK    1800   .002    .016       0    TRAP      30     1.5

 419      KK       2 ONSITE BASIN 2
 420      BA   .0127
 421      LS       0      75
 422      UD     .11

 423      KK       R ROUTE FLOWS DOWN ORCHARD VALLEY
 424      RK     300    .01    .016       0    TRAP      60       0

 425      KK      13 ONSITE BASIN 13
 426      BA   .0084
 427      LS       0      77
 428      UD     .06

 429      KK       C COMBINE FLOWS
 430      HC       2

 431      KK       R ROUTE FLOWS DOWN ORCHARD VALLEY DR.
 432      RK    1600   .005    .016       0    TRAP      60       0

 433      KK      14 ONSITE BASIN 14
 434      BA   .0218
 435      LS       0      70
 436      UD     .23

 437      KK       C COMBINE FLOWS
 438      HC       2

 439      KK      10 ONSITE BASIN 10
 440      BA   .0050
 441      LS       0      92
 442      UD     .09
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 443      KK      R ROUTE FLOWS THRU NAPOTS TO BASIN 15
 444      RM      6     .33     .15

 445      KK     11 NAPOTS
 446      BA   .0301
 447      LS      0      74
 448      UD    .45

 449      KK      C COMBINE FLOWS AT BASIN 15
 450      HC      2

 451      KK      R ROUTE FLOWS THRU BASIN 15
 452      RK   1000    .006    .016       0    TRAP      50       0

 453      KK     15 ONSITE BASIN 15
 454      BA   .0150
 455      LS      0      49
 456      UD    .42

 457      KK      C COMBINE FLOWS AT INTERSECTION TRELINE DR. AND ORCHARD VALLEY DR.
 458      HC      2

 459      KK     16 ONSITE BASIN 16
 460      BA   .0359
 461      LS      0      84
 462      UD    .32

 463      KK      R ROUTE FLOWS DOWN TREELINE DRIVE
 464      RK    800    .004    .016       0    TRAP      80       0

 465      KK     17 ONSITE BASIN 17
 466      BA   .0115
 467      LS      0      87
 468      UD    .20

 469      KK      C COMBINE FLOWS AT TREELINE DR. AND ORCHARD VALLEY
 470      HC      3

 471      KK      R ROUTE COMBINED FLOWS TO INTERSECTION OF ORCHARD VALLEY AND CHANNEL
 472      RK   2000    .004    .016       0    TRAP      60       0

 473      KK     18 ONSITE BASIN 18
 474      BA   .0457
 475      LS      0      82
 476      UD    .31

 477      KK     19 ONSITE BASIN 19
 478      BA   .0398
 479      LS      0      87
 480      UD    .31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  481     KK       C COMBINE  STREET FLOWS AT CHANNEL CP F
  482     HC       4

  483     KK      CF COMBINE FLOWS IN CHANNEL
  484     HC       2

  485     KK       R ROUTE FLOWS DOWN CHANNEL
  486     RK    1000    .002    .015       0    TRAP       8       2

  487     KK      20 PEACHTREE
  488     BA   .0439
  489     LS       0      87
  490     UD     .29

  491     KK       R ROUTE FLOWS THROUGH BASIN 21
  492     RK    1300    .004    .016       0    TRAP      50       0

  493     KK      21 ONSITE BASIN 21
  494     BA   .0203
  495     LS       0      87
  496     UD     .24

  497     KK      CG COMBINE SURFACE FLOWS AT CP G
  498     HC       2

  499     KK      CG COMBINE ALL FLOWS IN CHANNEL
  500     HC       2

  501     KK    COMB
  502     HC       2

  503     KK   SBD2A
  504     KM  STONEBRIDGE D2A
  505     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  506     KM        AREA    10 AC    (.01563 SQ.MI.)
  507     KM        Cn      90
  508     KM        T1      0.172 HR
  509     BA  .01563
  510     PB    2.77
  511     LS       0      90
  512     UD    .172

  513     KK    COMB
  514     HC       2

  515     KK    ROUT
  516     KM    ROUT THROUGH  SLOAN  CHANNEL
  517     RK     700   .0045    .015       0    TRAP      70     1.5
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  518     KK     F4
  519     KM  FUTURE DEVELOPED AREA
  520     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  521     KM        AREA    23 AC    (.03594 SQ.MI.)
  522     KM        Cn      90
  523     KM        Tl      0.226 HR
  524     BA  .03594
  525     PB   2.77
  526     LS      0      90
  527     UD   .226

  528     KK   COMB
  529     HC      2

  530     KK   22 ONSITE BASIN 22
  531     BA  .0378
  532     PB   3.15
  533     LS      0      84
  534     UD    .43

  535     KK   23 ONSITE BASIN 23
  536     BA  .0201
  537     LS      0      85
  538     UD    .33

  539     KK   24 ONSITE BASIN 24
  540     BA  .0459
  541     LS      0      87
  542     UD    .43

  543     KK   25 ONSITE BASIN 25
  544     BA  .0137
  545     LS      0      87
  546     UD    .23

  547     KK     CH  COMBINE FLOWS INTO SLOAN
  548     HC      4

  549     KK    010  OFFSITE BASIN 010
  550     BA  .0984
  551     LS      0      77
  552     UD    .41

  553     KK      R  ROUTE FLOWS WEST ON SAHARA
  554     RK   1320    .025    .016       0    TRAP     100

  555     KK   26 SCHOOL BASIN 26
  556     BA  .0464
  557     LS      0      90
  558     UD    .48
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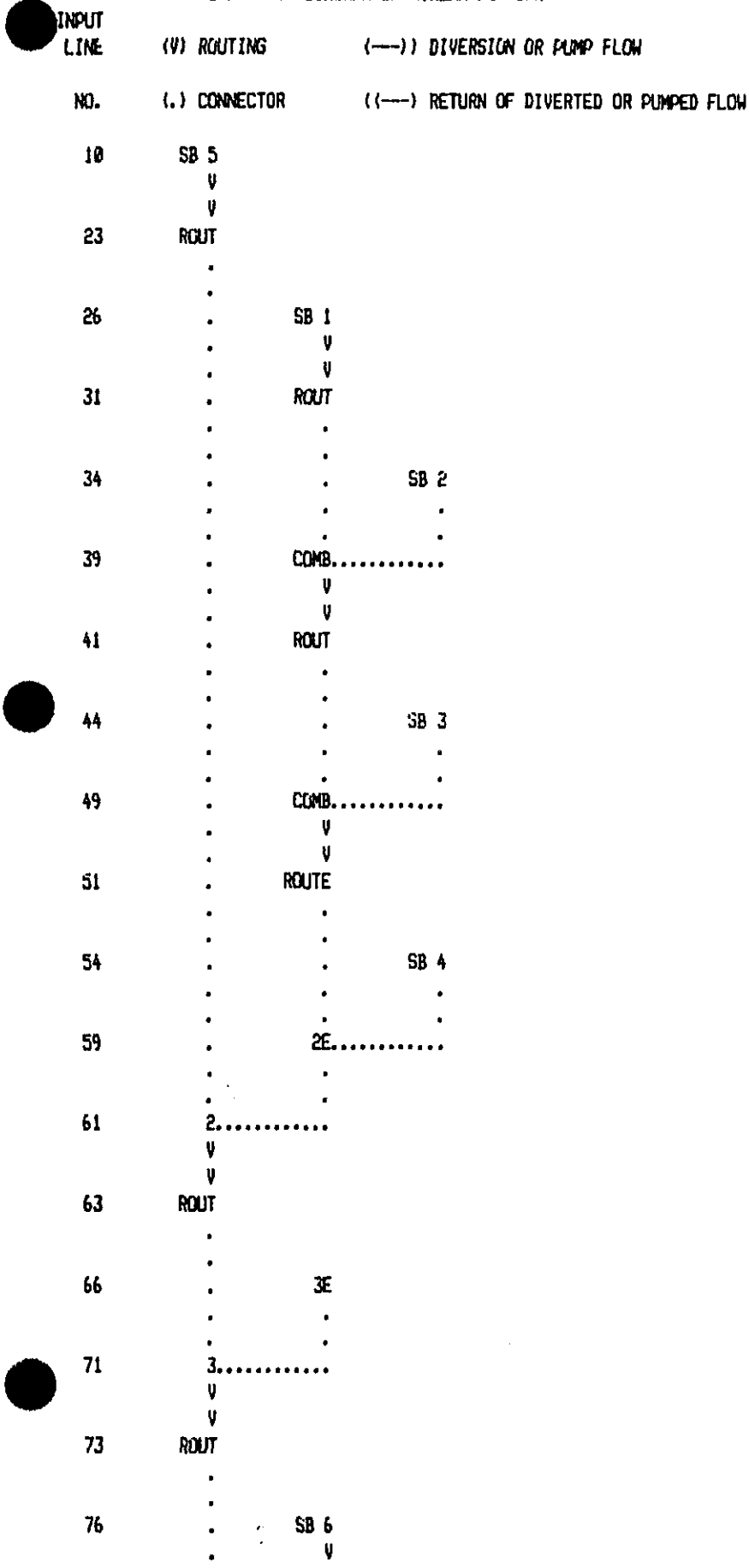
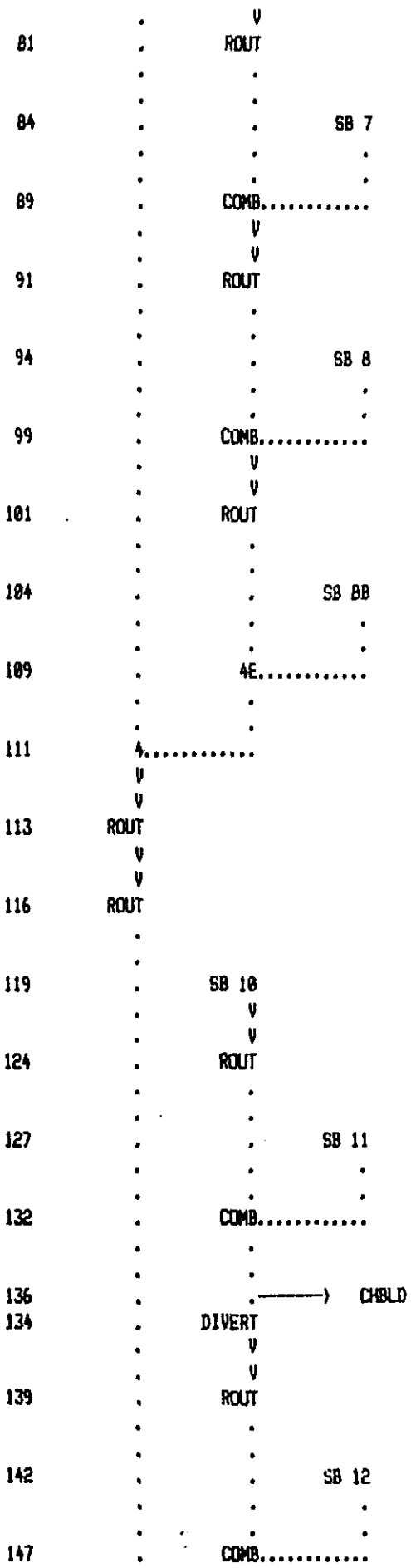
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 559      KK      CI  COMBINE FLOWS IN SAHARA AT TREELINE DR.
 560      HC       2

 561      KK       R  ROUTE FLOWS WEST ON SAHARA
 562      RK    1350   .015   .016       0    TRAP     100

 563      KK    27 ONSITE BASIN 27
 564      BA   .0291
 565      LS       0      86
 566      UD     .24

 567      KK      CJ  COMBINE FLOWS IN SAHARA AT ORCHARD VALLEY
 568      HC       2

 569      KK       R  ROUTE FLOWS WEST ON SAHARA
 570      RK     500   .003   .016       0    TRAP     100

 571      KK    28 ONSITE BASIN 28
 572      BA   .0116
 573      LS       0      94
 574      UD     .18

 575      KK      CK  COMBINE FLOWS IN SAHARA
 576      HC       2

 577      KK       R  ROUTE FLOWS TO SLOAN CHANNEL
 578      RK     750   .003   .016       0    TRAP     100

 579      KK    29 ONSITE BASIN 29
 580      BA   .0145
 581      LS       0      90
 582      UD     .23

 583      KK      CI  COMBINE ALL FLOWS IN SAHARA
 584      HC       2

 585      KK    COMB
 586      HC       3

 587      KK    ROUT
 588      KM    ROUT THROUGH  SLOAN  CHANNEL
 589      RK    1200   .0045   .015       0    TRAP      70     1.5

 590      KK      FS
 591      KM  FUTURE DEVELOPED AREA
 592      KM  DEVELOPED DENSITY = 8 UNITS/ACRE
 593      KM        AREA    34 AC    (.05313 SQ.MI.)
 594      KM        Cn      90
 595      KM        Tl      0.261 HR
 596      BA  .05313
 597      PB    2.77
 598      LS       0      90
 599      UD    .261
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

600       KK   SB 17
601       BA   .1313
602       PB     3.0
603       LS       0      92
604       UD   .1952

605       KK     9CH
606       HC       3
607       ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

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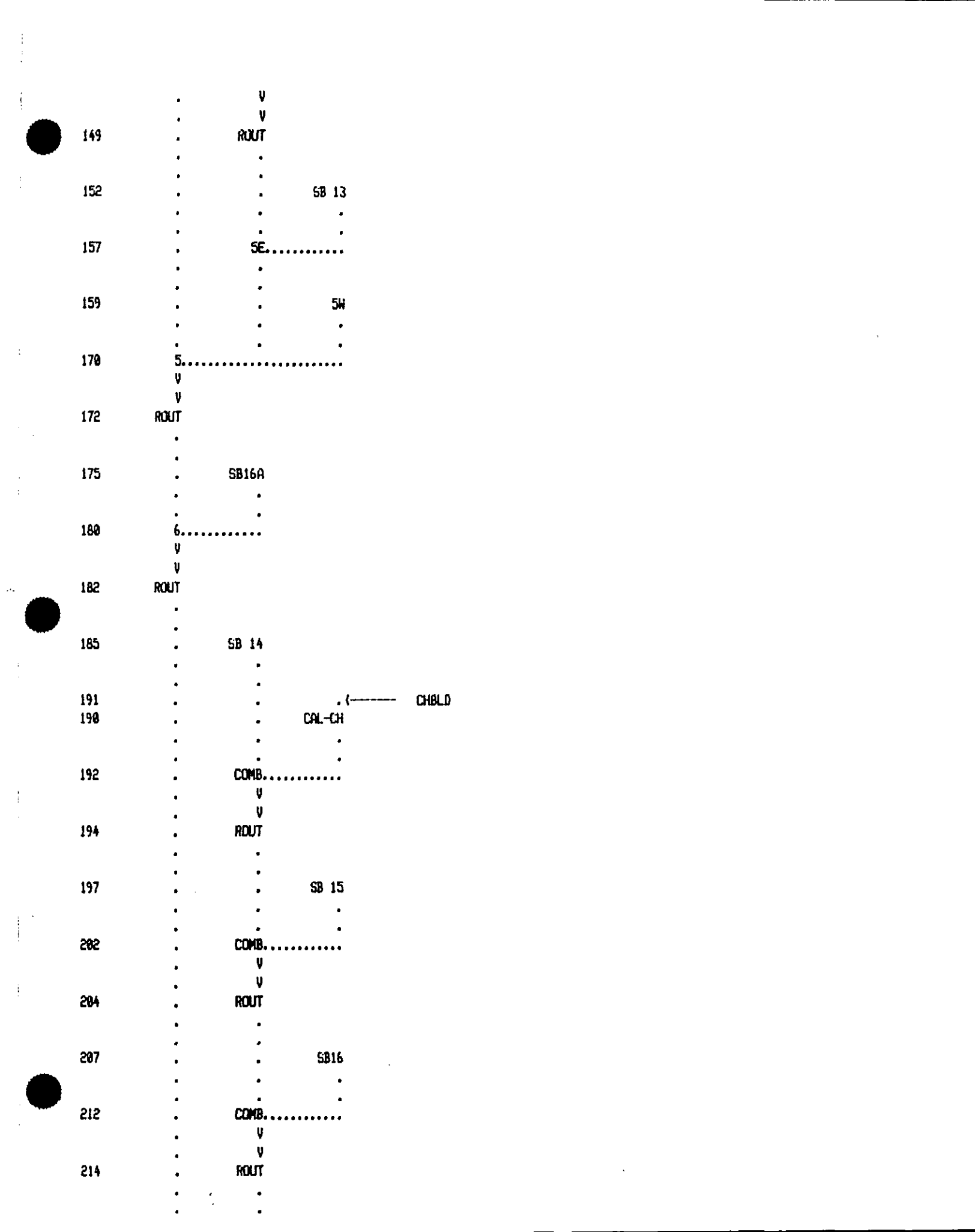
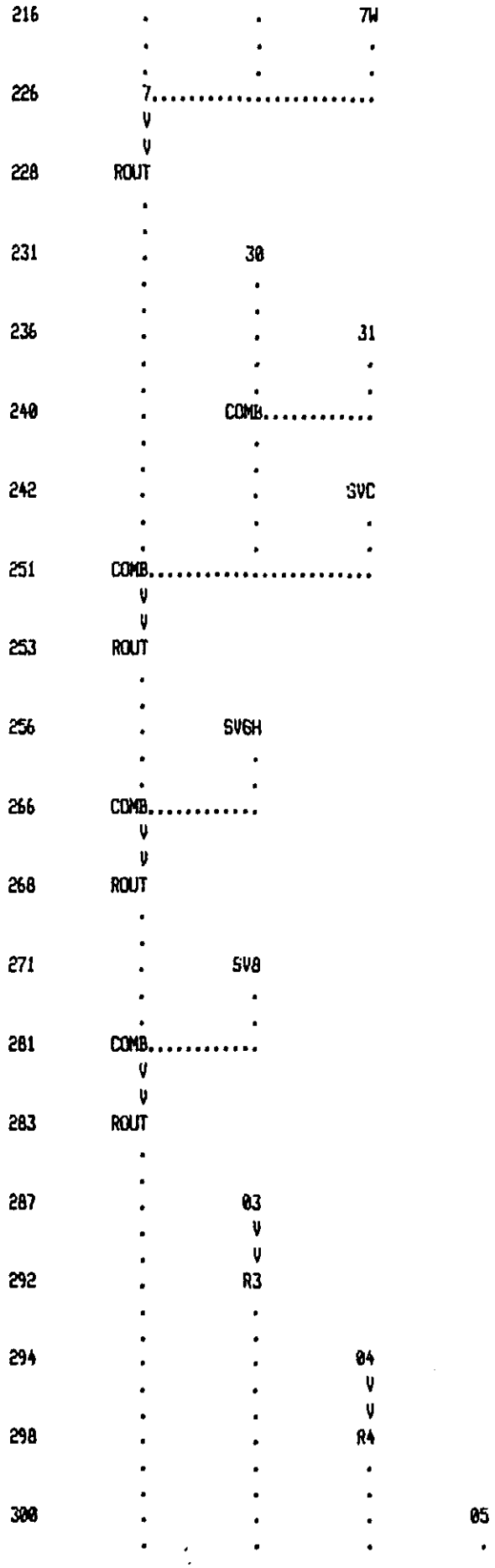
84 SB 7
89 COMB
91 ROUT
94 SB 8
99 COMB
101 ROUT
104 SB 8B
109 4E
111 4
113 ROUT
116 ROUT
119 SB 10
124 ROUT
127 SB 11
132 COMB
136 CHBLD
134 DIVERT
139 ROUT
142 SB 12
147 COMB


149 ROUT
152 SB 13
157 SE
159 SW
170 5
172 ROUT
175 SB16A
180 6
182 ROUT
185 SB 14
191 CHBLD
190 CAL-CH
192 COMB
194 ROUT
197 SB 15
202 COMB
204 ROUT
207 SB16
212 COMB
214 ROUT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236
31
240
COMB
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SVC
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COMB
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ROUT
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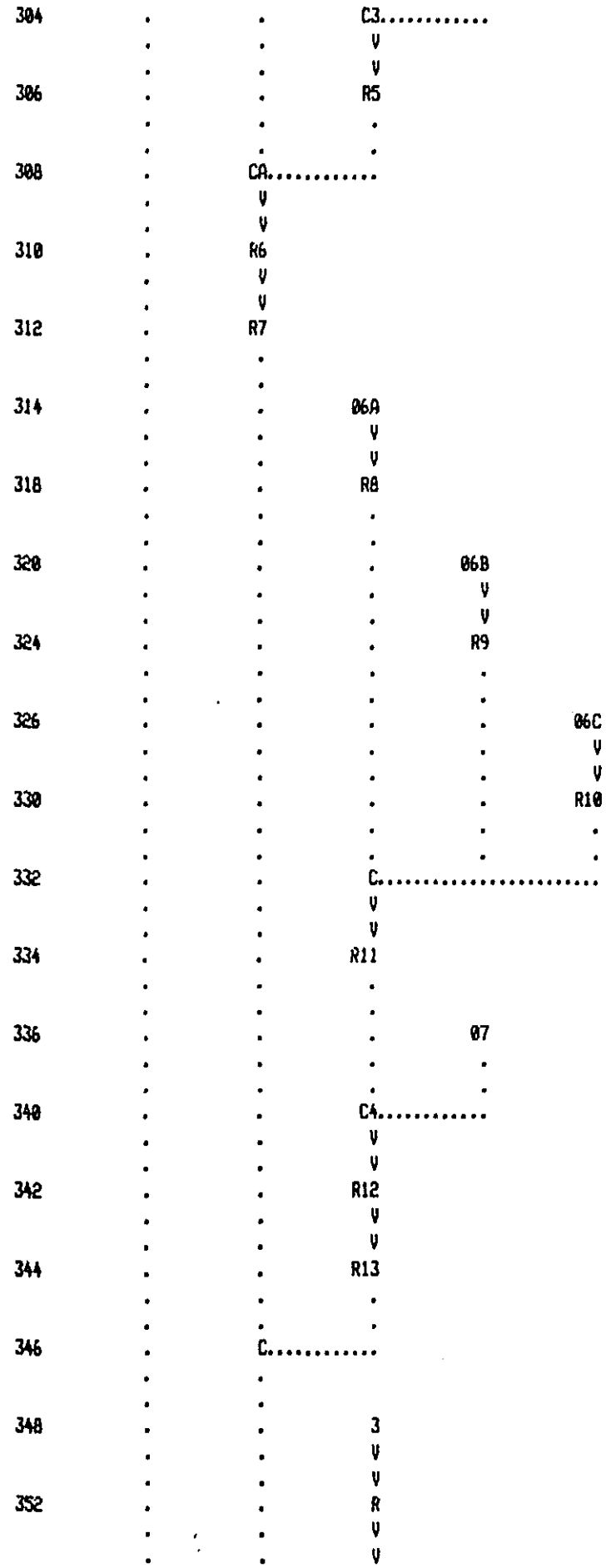
SV6H
266
COMB
268
ROUT
271
SV8
281
COMB
283
ROUT
287
03
292
R3
294
04
298
R4
300
05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R5
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CA
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R6
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R7
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06A
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R8
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06B
324
R9
326
06C
330
R10
332
C
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R11
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07
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C4
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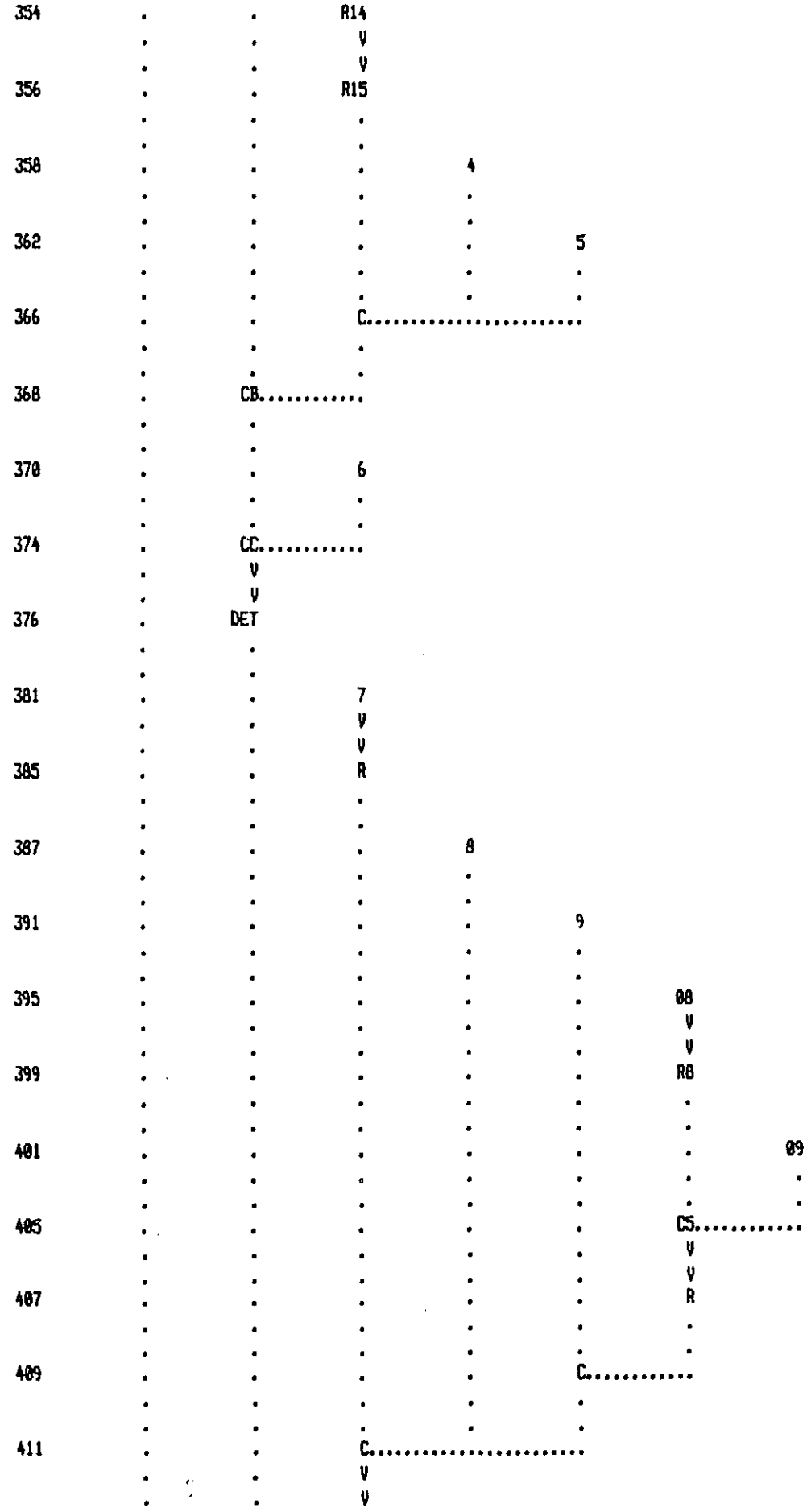
R12
344
R13
346
C
348
3
352
R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C5
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C
411
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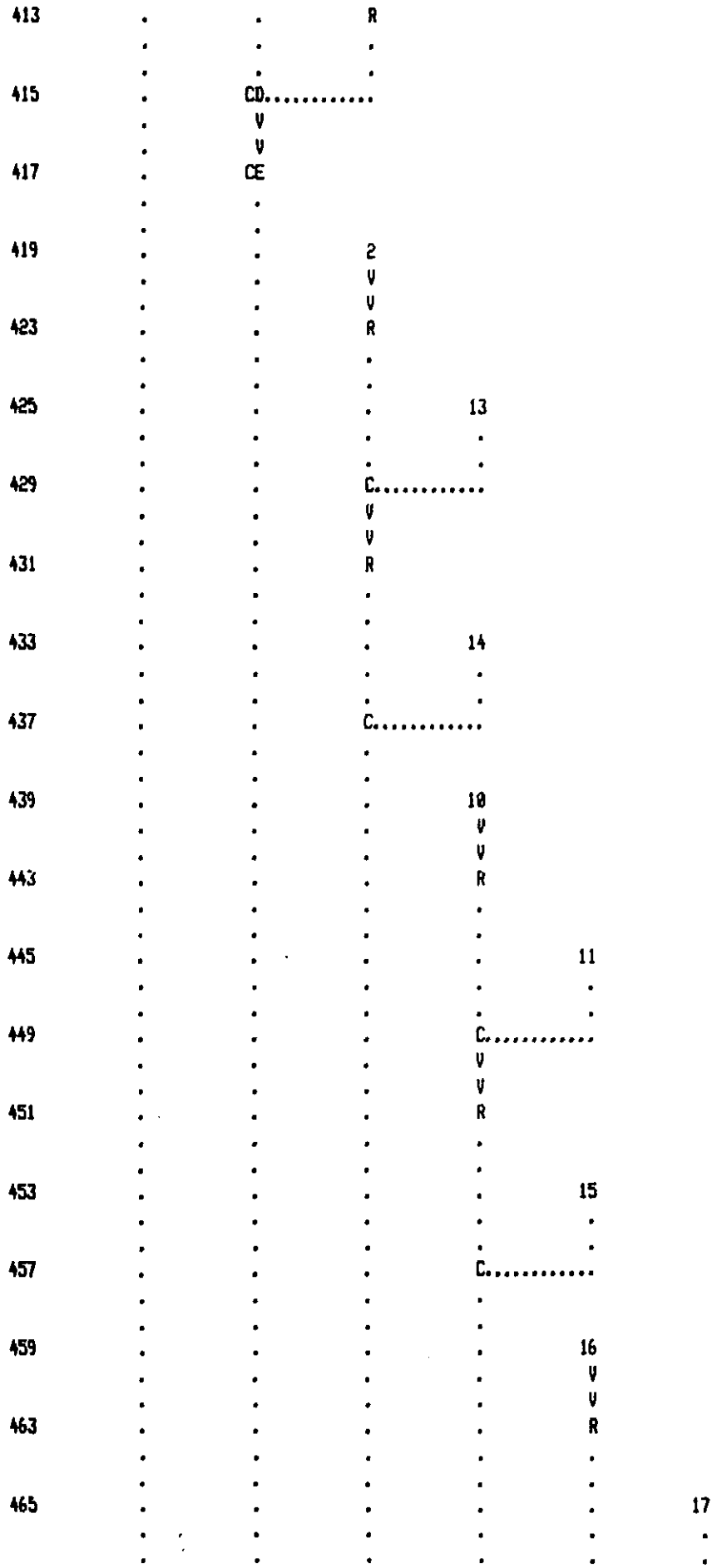
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R
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R
465
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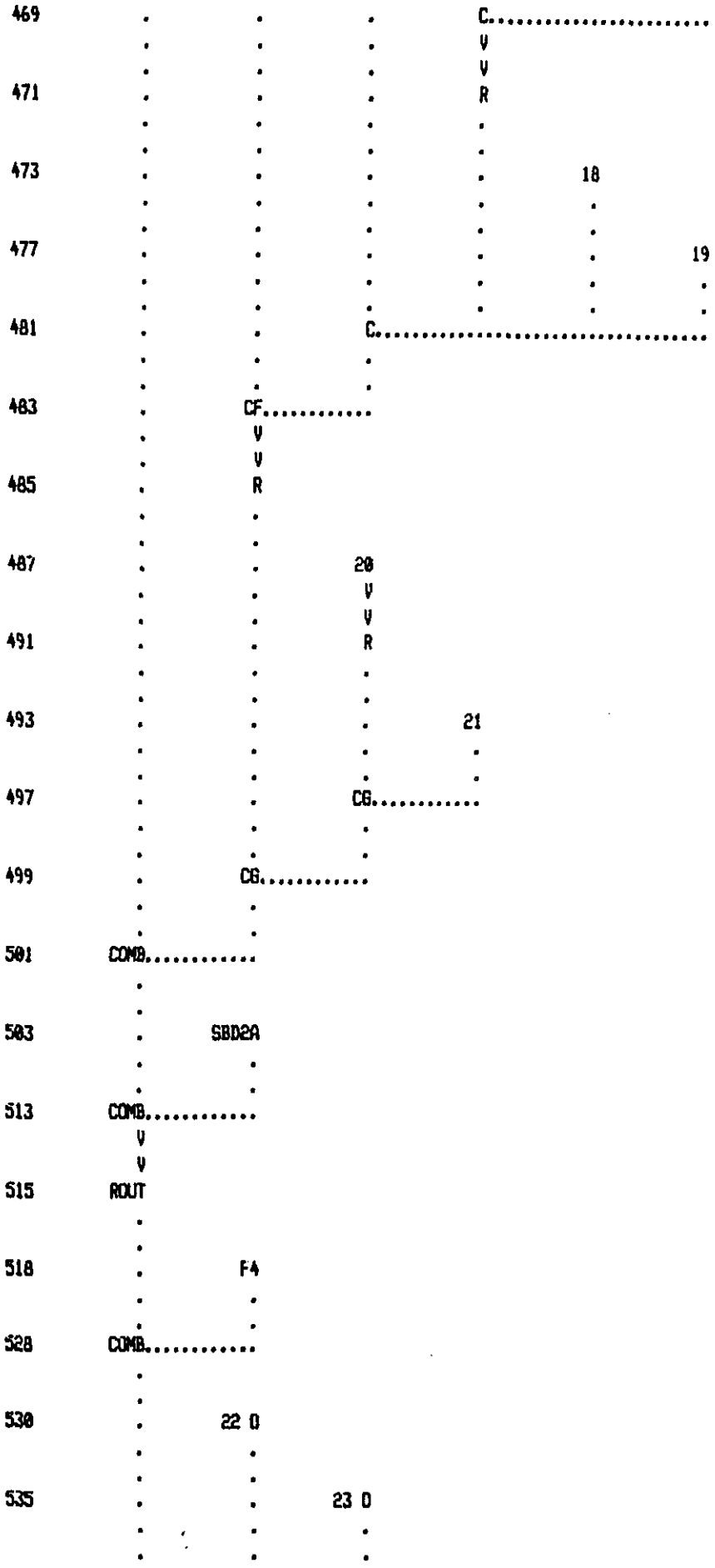
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CG
499
CG
501
COMB
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SBD2A
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COMB
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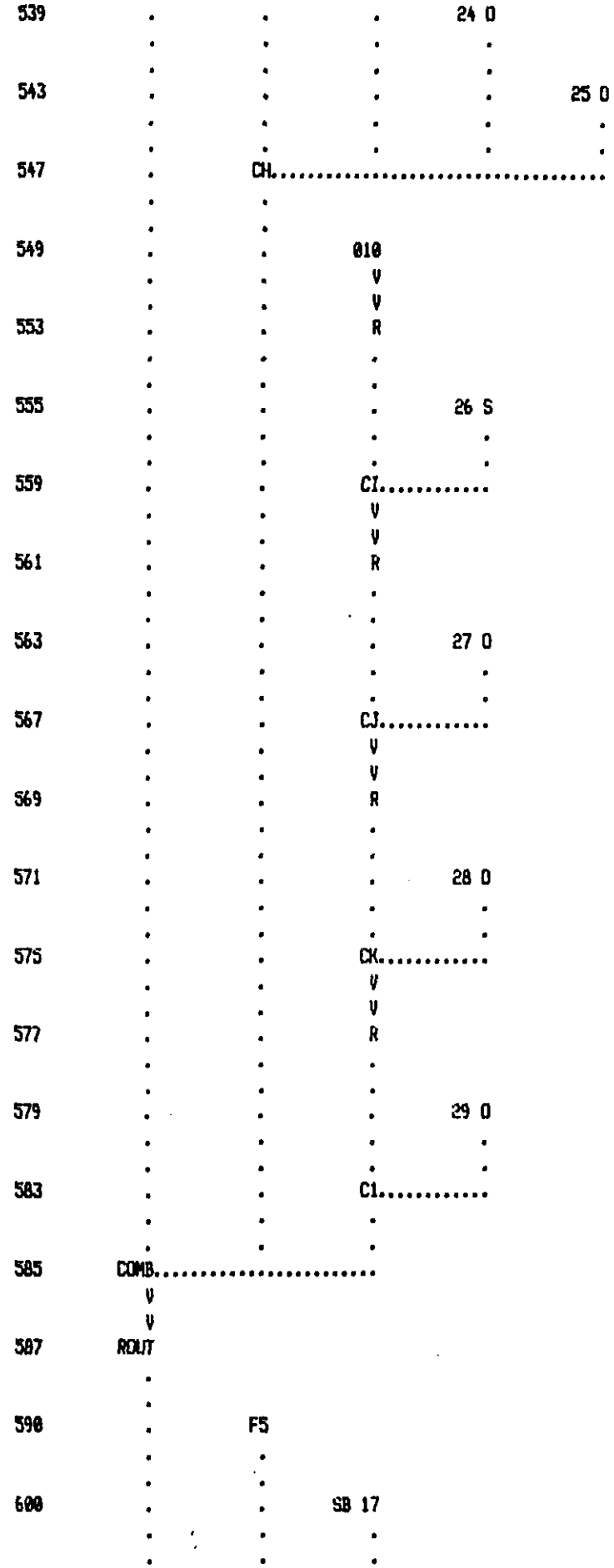
ROUT
518
F4
528
COMB
530
22 D
535
23 D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571
28 0
575
CK
577
579
29 0
583
C1
585
COMB
587
ROUT
590
F5
600
SB 17

605 9CH.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
                    *         UNDER ULTIMATE DEVELOPMENT CONDITION           *
                     ****                                                     ****
                    * TIRBUTRY BASING TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
                    * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.H1 *
                    * POINT RAINFALL (100-YR. STORM)           3/16/93  *

  7 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                    NMIN          3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME         0000  STARTING TIME
                     NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1   0  ENDING DATE
                  NDTIME        1457  ENDING TIME

               COMPUTATION INTERVAL     .05 HOURS
                   TOTAL TIME BASE   14.95 HOURS

        ENGLISH UNITS

    JP        MULTI-PLAN OPTION
                   NPLAN          1  NUMBER OF PLANS

    JR        MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                  .98       .97
                  .92       .88
                  .86

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG


    UNIT HYDROGRAPH TRUNCATED FROM 162 TO 150 INT   ERVALS

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG
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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

.05 1 3 8 10

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .98	RATIO 2 .97	RATIO 3 .92	RATIO 4 .88	RATIO 5 .86
HYDROGRAPH AT	SB 5	.12	1	FLOW	99.	97.	88.	81.	77.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	.12	1	FLOW	98.	96.	87.	80.	76.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 1	.64	1	FLOW	1011.	997.	926.	870.	842.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.64	1	FLOW	996.	982.	912.	855.	827.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 2	.21	1	FLOW	130.	127.	113.	101.	96.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	.85	1	FLOW	1113.	1096.	1011.	944.	910.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.85	1	FLOW	1104.	1088.	1006.	940.	908.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SB 3	.27	1	FLOW	184.	180.	160.	146.	138.
				TIME	3.70	3.70	3.75	3.75	3.75
2 COMBINED AT	COMB	1.12	1	FLOW	1278.	1258.	1157.	1077.	1037.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUTE	1.12	1	FLOW	1252.	1232.	1135.	1057.	1019.
				TIME	3.65	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SB 4	.13	1	FLOW	109.	107.	97.	89.	86.
				TIME	3.70	3.70	3.75	3.75	3.75
2 COMBINED AT	2E	1.26	1	FLOW	1361.	1339.	1232.	1146.	1104.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	2	1.37	1	FLOW	1456.	1432.	1316.	1223.	1177.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	1.37	1	FLOW	1449.	1425.	1304.	1209.	1161.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	3E	.11	1	FLOW	39.	38.	32.	28.	27.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	3	1.48	1	FLOW	1482.	1457.	1332.	1232.	1182.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	1.48	1	FLOW	1462.	1438.	1320.	1225.	1179.

				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 6	.58	1	FLOW	1013.	999.	929.	872.	844.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	ROUT	.58	1	FLOW	983.	969.	899.	843.	815.
				TIME	3.55	3.55	3.55	3.55	3.55
HYDROGRAPH AT	SB 7	.24	1	FLOW	150.	146.	130.	116.	110.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	.82	1	FLOW	1095.	1079.	997.	932.	900.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.82	1	FLOW	1093.	1076.	995.	933.	896.
				TIME	3.60	3.60	3.65	3.65	3.60
HYDROGRAPH AT	SB 8	.36	1	FLOW	195.	190.	170.	154.	146.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	1.18	1	FLOW	1218.	1199.	1105.	1031.	969.
				TIME	3.65	3.65	3.65	3.65	3.60
ROUTED TO	ROUT	1.18	1	FLOW	1211.	1192.	1097.	1023.	955.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SB 8B	.05	1	FLOW	42.	41.	37.	34.	32.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	4E	1.23	1	FLOW	1252.	1232.	1133.	1055.	986.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	4	2.72	1	FLOW	2657.	2613.	2393.	2181.	2078.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	2.72	1	FLOW	2643.	2599.	2376.	2170.	2063.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	2.72	1	FLOW	2598.	2552.	2331.	2138.	2044.
				TIME	3.70	3.70	3.75	3.75	3.75
HYDROGRAPH AT	SB 10	.28	1	FLOW	498.	491.	456.	429.	415.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	ROUT	.28	1	FLOW	494.	487.	454.	428.	414.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 11	.33	1	FLOW	227.	222.	199.	181.	172.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	COMB	.61	1	FLOW	675.	664.	611.	568.	547.
				TIME	3.60	3.60	3.60	3.60	3.60
DIVERSION TO	CHBLD	.61	1	FLOW	246.	244.	235.	228.	225.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	DIVERT	.61	1	FLOW	429.	420.	376.	340.	323.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.61	1	FLOW	403.	394.	347.	313.	296.

				TIME	3.65	3.65	3.65	3.65	3.70
HYDROGRAPH AT	SB 12	.36	1	FLOW	162.	158.	139.	125.	117.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	.97	1	FLOW	530.	518.	455.	408.	385.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	.97	1	FLOW	521.	509.	446.	401.	379.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 13	.18	1	FLOW	159.	156.	143.	132.	127.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	5E	1.15	1	FLOW	680.	665.	588.	533.	506.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	5W	2.70	1	FLOW	652.	640.	579.	531.	508.
				TIME	5.35	5.35	5.35	5.35	5.40
3 COMBINED AT	5	6.56	1	FLOW	3350.	3292.	2992.	2735.	2610.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	6.56	1	FLOW	3347.	3286.	2978.	2718.	2580.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB16A	.16	1	FLOW	133.	131.	119.	110.	105.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	6	6.72	1	FLOW	3480.	3417.	3097.	2827.	2685.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	6.72	1	FLOW	3463.	3400.	3079.	2809.	2679.
				TIME	3.75	3.75	3.75	3.75	3.80
HYDROGRAPH AT	SB 14	.09	1	FLOW	74.	72.	64.	58.	56.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	CAL-CH	.00	1	FLOW	246.	244.	235.	228.	225.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.09	1	FLOW	316.	313.	296.	284.	277.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUT	.09	1	FLOW	315.	312.	296.	283.	277.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SB 15	.24	1	FLOW	143.	140.	125.	113.	107.
				TIME	3.80	3.80	3.80	3.80	3.85
2 COMBINED AT	COMB	.33	1	FLOW	451.	445.	413.	389.	378.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	.33	1	FLOW	448.	442.	411.	387.	375.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB16	.13	1	FLOW	24.	23.	19.	16.	14.
				TIME	3.85	3.85	3.85	3.90	3.90
2 COMBINED AT	COMB	.46	1	FLOW	470.	463.	427.	400.	387.

				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	.46	1	FLOW	469.	462.	427.	400.	386.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	7W	.19	1	FLOW	146.	144.	133.	124.	119.
				TIME	3.90	3.90	3.90	3.90	3.90
3 COMBINED AT	7	7.37	1	FLOW	4052.	3979.	3612.	3320.	3179.
				TIME	3.75	3.75	3.75	3.80	3.80
ROUTED TO	ROUT	7.37	1	FLOW	4033.	3963.	3609.	3315.	3167.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	30	.03	1	FLOW	35.	35.	33.	31.	30.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	31	.02	1	FLOW	26.	25.	24.	22.	21.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.04	1	FLOW	59.	58.	54.	51.	49.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SVC	.04	1	FLOW	64.	64.	60.	57.	55.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	7.46	1	FLOW	4123.	4053.	3694.	3395.	3244.
				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	7.46	1	FLOW	4110.	4038.	3673.	3370.	3215.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SVGH	.04	1	FLOW	49.	48.	45.	42.	41.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	COMB	7.50	1	FLOW	4152.	4079.	3712.	3406.	3250.
				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	7.50	1	FLOW	4110.	4035.	3670.	3382.	3238.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	SV8	.04	1	FLOW	49.	48.	45.	42.	41.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.54	1	FLOW	4154.	4079.	3707.	3417.	3272.
				TIME	3.80	3.80	3.85	3.85	3.85
ROUTED TO	ROUT	7.54	1	FLOW	4138.	4063.	3707.	3415.	3268.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	03	.21	1	FLOW	143.	141.	128.	119.	114.
				TIME	4.00	4.00	4.00	4.00	4.00
ROUTED TO	R3	.21	1	FLOW	143.	140.	128.	118.	113.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	04	.42	1	FLOW	505.	498.	462.	433.	419.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R4	.42	1	FLOW	377.	372.	345.	324.	313.

				TIME	4.65	4.65	4.65	4.65	4.65
HYDROGRAPH AT	05	.41	1	FLOW	213.	209.	188.	171.	163.
				TIME	4.05	4.05	4.05	4.05	4.05
2 COMBINED AT	C3	.83	1	FLOW	490.	482.	445.	416.	401.
				TIME	4.60	4.60	4.60	4.60	4.60
ROUTED TO	R5	.83	1	FLOW	489.	482.	445.	415.	401.
				TIME	4.60	4.60	4.60	4.60	4.60
2 COMBINED AT	CA	1.04	1	FLOW	558.	549.	506.	472.	455.
				TIME	4.55	4.55	4.55	4.60	4.60
ROUTED TO	R6	1.04	1	FLOW	557.	549.	506.	472.	455.
				TIME	4.55	4.55	4.60	4.60	4.60
ROUTED TO	R7	1.04	1	FLOW	557.	548.	506.	472.	455.
				TIME	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	06A	.26	1	FLOW	438.	432.	401.	377.	365.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.26	1	FLOW	334.	330.	306.	287.	278.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	06B	.16	1	FLOW	270.	266.	247.	232.	224.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R9	.16	1	FLOW	192.	189.	176.	165.	159.
				TIME	4.05	4.05	4.05	4.05	4.05
HYDROGRAPH AT	06C	.17	1	FLOW	261.	257.	239.	224.	217.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R10	.17	1	FLOW	179.	176.	164.	154.	149.
				TIME	4.25	4.25	4.25	4.25	4.25
3 COMBINED AT	C	.60	1	FLOW	645.	636.	591.	554.	536.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R11	.60	1	FLOW	512.	504.	468.	439.	425.
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	07	.60	1	FLOW	269.	264.	237.	217.	207.
				TIME	4.20	4.25	4.25	4.25	4.25
2 COMBINED AT	C4	1.20	1	FLOW	669.	659.	608.	568.	549.
				TIME	4.90	4.90	4.90	4.95	4.95
ROUTED TO	R12	1.20	1	FLOW	668.	658.	608.	568.	549.
				TIME	4.90	4.95	4.95	4.95	4.95
ROUTED TO	R13	1.20	1	FLOW	668.	658.	608.	568.	549.
				TIME	4.95	4.95	4.95	4.95	4.95
2 COMBINED AT	C	2.24	1	FLOW	1162.	1144.	1057.	987.	952.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	3	.01	1	FLOW	6.	6.	5.	5.	4.

				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.01	1	FLOW	6.	6.	5.	5.	4.
				TIME	3.60	3.60	3.65	3.65	3.65
ROUTED TO	R14	.01	1	FLOW	6.	6.	5.	5.	4.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	R15	.01	1	FLOW	6.	6.	5.	4.	4.
				TIME	3.75	3.75	3.75	3.85	3.85
HYDROGRAPH AT	4	.08	1	FLOW	56.	55.	49.	44.	42.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	5	.03	1	FLOW	21.	20.	18.	16.	15.
				TIME	3.70	3.70	3.70	3.70	3.70
3 COMBINED AT	C	.11	1	FLOW	82.	80.	71.	64.	61.
				TIME	3.70	3.70	3.70	3.70	3.75
2 COMBINED AT	CB	2.36	1	FLOW	1186.	1168.	1078.	1006.	971.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	6	.02	1	FLOW	4.	4.	3.	3.	2.
				TIME	3.90	3.90	3.95	3.95	3.95
2 COMBINED AT	CC	2.38	1	FLOW	1187.	1169.	1079.	1008.	972.
				TIME	4.80	4.80	4.80	4.80	4.80
ROUTED TO	DET	2.38	1	FLOW	1145.	1127.	1037.	965.	929.
				TIME	4.95	4.95	4.95	5.00	5.00
				** PEAK STAGES IN FEET **					
			1	STAGE	14.82	14.76	14.46	14.22	14.10
				TIME	4.95	4.95	4.95	5.00	5.00
HYDROGRAPH AT	7	.03	1	FLOW	26.	25.	23.	20.	19.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	R	.03	1	FLOW	25.	25.	22.	20.	19.
				TIME	3.65	3.65	3.70	3.70	3.70
HYDROGRAPH AT	8	.02	1	FLOW	35.	35.	32.	30.	29.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	9	.02	1	FLOW	3.	3.	3.	2.	2.
				TIME	4.10	4.15	4.15	4.15	4.15
HYDROGRAPH AT	08	.02	1	FLOW	33.	33.	31.	29.	28.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.02	1	FLOW	20.	19.	18.	17.	16.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	09	.29	1	FLOW	120.	118.	106.	97.	92.
				TIME	4.30	4.30	4.30	4.35	4.35
2 COMBINED AT	C5	.31	1	FLOW	129.	126.	114.	104.	99.
				TIME	4.40	4.40	4.40	4.40	4.45

ROUTED TO	R	.31	1	FLOW	128.	126.	114.	104.	99.
				TIME	4.45	4.45	4.45	4.45	4.45
2 COMBINED AT	C	.33	1	FLOW	131.	128.	116.	106.	101.
				TIME	4.40	4.40	4.45	4.45	4.45
3 COMBINED AT	C	.38	1	FLOW	139.	137.	124.	114.	109.
				TIME	4.55	4.55	4.55	4.60	4.60
ROUTED TO	R	.38	1	FLOW	139.	137.	124.	114.	109.
				TIME	4.55	4.55	4.60	4.60	4.60
2 COMBINED AT	CD	2.76	1	FLOW	1262.	1242.	1143.	1063.	1021.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	CE	2.76	1	FLOW	1261.	1241.	1142.	1062.	1021.
				TIME	4.95	4.95	5.00	5.00	5.00
HYDROGRAPH AT	2	.01	1	FLOW	13.	13.	11.	10.	10.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.01	1	FLOW	12.	12.	11.	10.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	13	.01	1	FLOW	11.	11.	10.	9.	8.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	C	.02	1	FLOW	22.	21.	19.	17.	17.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.02	1	FLOW	21.	21.	19.	18.	17.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	14	.02	1	FLOW	12.	12.	10.	9.	9.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	C	.04	1	FLOW	33.	32.	29.	27.	25.
				TIME	3.70	3.70	3.65	3.65	3.65
HYDROGRAPH AT	10	.00	1	FLOW	10.	10.	10.	9.	9.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.00	1	FLOW	8.	8.	8.	7.	7.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	11	.03	1	FLOW	15.	15.	14.	12.	12.
				TIME	3.95	3.95	3.95	3.95	3.95
2 COMBINED AT	C	.04	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.85	3.85	3.85	3.85	3.90
ROUTED TO	R	.04	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	15	.01	1	FLOW	1.	1.	0.	0.	0.
				TIME	5.10	5.10	5.10	5.10	5.10
2 COMBINED AT	C	.05	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.95	3.95	3.95	3.95	3.95

HYDROGRAPH AT	16	.04	1	FLOW	37.	36.	33.	31.	30.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R	.04	1	FLOW	36.	35.	33.	30.	29.
				TIME	3.80	3.80	3.80	3.85	3.85
HYDROGRAPH AT	17	.01	1	FLOW	16.	16.	15.	14.	13.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	C	.10	1	FLOW	67.	66.	61.	56.	54.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	R	.10	1	FLOW	67.	66.	60.	56.	53.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	18	.05	1	FLOW	43.	43.	39.	36.	35.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	19	.04	1	FLOW	46.	46.	42.	40.	38.
				TIME	3.75	3.75	3.75	3.75	3.75
4 COMBINED AT	C	.23	1	FLOW	176.	173.	159.	146.	139.
				TIME	3.80	3.80	3.75	3.80	3.75
2 COMBINED AT	CF	2.99	1	FLOW	1313.	1293.	1189.	1106.	1064.
				TIME	4.95	4.95	5.00	5.00	5.00
ROUTED TO	R	2.99	1	FLOW	1313.	1292.	1189.	1105.	1062.
				TIME	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT	20	.04	1	FLOW	53.	52.	48.	45.	44.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	R	.04	1	FLOW	52.	52.	48.	45.	43.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	21	.02	1	FLOW	27.	26.	24.	23.	22.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CG	.06	1	FLOW	76.	75.	69.	65.	63.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	CG	3.05	1	FLOW	1331.	1310.	1206.	1121.	1078.
				TIME	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	COMB	10.59	1	FLOW	4944.	4857.	4435.	4074.	3892.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	SBD2A	.02	1	FLOW	22.	22.	20.	19.	18.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	10.61	1	FLOW	4955.	4868.	4445.	4083.	3901.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	10.61	1	FLOW	4950.	4862.	4433.	4067.	3882.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	F4	.04	1	FLOW	45.	45.	42.	39.	38.
				TIME	3.65	3.65	3.65	3.65	3.65

2 COMBINED AT	COMB	10.64	1	FLOW	4981.	4893.	4461.	4094.	3908.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	22 O	.04	1	FLOW	33.	32.	30.	28.	27.
				TIME	3.85	3.85	3.90	3.90	3.90
HYDROGRAPH AT	23 O	.02	1	FLOW	21.	21.	19.	18.	17.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	24 O	.05	1	FLOW	45.	44.	41.	39.	37.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	25 O	.01	1	FLOW	18.	18.	17.	16.	15.
				TIME	3.65	3.65	3.65	3.65	3.65
4 COMBINED AT	CH	.12	1	FLOW	112.	110.	101.	95.	91.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	010	.10	1	FLOW	63.	62.	56.	51.	49.
				TIME	3.85	3.85	3.90	3.90	3.90
ROUTED TO	R	.10	1	FLOW	63.	62.	56.	51.	48.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	26 S	.05	1	FLOW	53.	52.	49.	46.	44.
				TIME	3.80	3.80	3.85	3.85	3.85
2 COMBINED AT	CI	.14	1	FLOW	115.	113.	103.	95.	92.
				TIME	3.85	3.85	3.85	3.90	3.90
ROUTED TO	R	.14	1	FLOW	115.	113.	102.	95.	91.
				TIME	3.90	3.90	3.95	3.95	3.95
HYDROGRAPH AT	27 O	.03	1	FLOW	37.	36.	33.	31.	30.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CJ	.17	1	FLOW	140.	138.	124.	115.	110.
				TIME	3.85	3.85	3.85	3.90	3.90
ROUTED TO	R	.17	1	FLOW	140.	137.	124.	115.	110.
				TIME	3.85	3.85	3.90	3.90	3.90
HYDROGRAPH AT	28 O	.01	1	FLOW	21.	21.	20.	19.	18.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CK	.19	1	FLOW	151.	148.	132.	123.	118.
				TIME	3.85	3.85	3.90	3.90	3.90
ROUTED TO	R	.19	1	FLOW	150.	147.	131.	122.	117.
				TIME	3.90	3.90	3.90	3.95	3.95
HYDROGRAPH AT	29 O	.01	1	FLOW	22.	21.	20.	19.	18.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CI	.20	1	FLOW	164.	160.	143.	132.	127.
				TIME	3.85	3.85	3.90	3.90	3.90
3 COMBINED AT	COMB	10.96	1	FLOW	5255.	5162.	4703.	4319.	4124.
				TIME	3.85	3.85	3.85	3.85	3.85

ROUTED TO	ROUT	10.96	1	FLOW	5236.	5141.	4671.	4294.	4113.
				TIME	3.85	3.85	3.85	3.90	3.90
HYDROGRAPH AT	F5	.05	1	FLOW	63.	62.	57.	54.	52.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SB 17	.13	1	FLOW	208.	206.	193.	182.	177.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	9CH	11.14	1	FLOW	5405.	5308.	4827.	4429.	4235.
				TIME	3.85	3.85	3.85	3.85	3.90

*** NORMAL END OF HEC-1 ***

HEC-1 MODEL FOR 100-YR. STORM W/ CCRFCD DETENTION FACILITIES ON FRENCHMAN MOUNTAIN

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID   *          UNDER ULTIMATE DEVELOPMENT CONDITION            *
    2     ID    ****                                                     ****
    3     ID   * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
    4     ID   * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.H1 *
    5     ID   * POINT RAINFALL (100-YR. STORM)            3/16/93  * INCLUDED D.B.
    6     IT      3       0       0     300
    7     ID      5       0
    8     IN      5       0       0
    9     JR    PREC     .98     .97     .92     .88     .86

   10     KK    SB 5
   11     BA   .1172
   12     PC   .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
   13     PC   .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
   14     PC   .198    .197    .199    .200    .201    .204    .214    .229    .241    .249
   15     PC   .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
   16     PC   .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
   17     PC   .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
   18     PC   .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
   19     PC   .998    .999   1.00
   20     PB    3.0
   21     LS      0      80
   22     UD   .2707

   23     KK    ROUT
   24     KM    ROUT FROM 1 TO 2
   25     RK    1300  .00385    .015       0    TRAP      60     1.5

   26     KK    SB 1
   27     BA   .6438
   28     PB    3.15
   29     LS      0      88
   30     UD   .1633

   31     KK    SB 6
   32     BA   .5844
   33     PB    3.15
   34     LS      0      88
   35     UD   .1205

   36     KK    COMB
   37     HC      2

   38     KK   DIVRT
   39     KM   DIVERT 96 CFS
   40     DT   WHSTN
   41     DI      0      50     200     500     800    1200    1900
   42     DQ      0      50     200     404     704    1104    1804
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  43      KK    ROUT
  44      KM    ROUT  THROU     SB2
  45      RK    2300    .06    .017       0    TRAP      50       0

  46      KK    SB 2
  47      BA   .2063
  48      PB    3.15
  49      LS       0      72
  50      UD   .2337

  51      KK    COMB
  52      HC       2

  53      KK    ROUT
  54      KM    ROUT  THROU WASINGTON AVE.
  55      RK    5500     2.5    .017       0    TRAP      50       0

  56      KK    SB 3
  57      BA   .2734
  58      PB    3.07
  59      LS       0      75
  60      UD   .2694

  61      KK    COMB
  62      HC       2

  63      KK   ROUTE
  64      KM    ROUT  THROU WASINGTON AVE.
  65      RK    5000    .015    .017       0    TRAP      50       0

  66      KK    SB 4
  67      BA   .1328
  68      PB     3.0
  69      LS       0      80
  70      UD   .2836

  71      KK      2E    COMB
  72      HC       2

  73      KK       2    COMB
  74      HC       2

  75      KK    ROUT
  76      KM   ROUTE THROUG  SLOAN CHANNEL
  77      RK    1500   .0051    .015       0    TRAP      60     1.5

  78      KK      3E    SB 9
  79      BA   .1078
  80      PB     3.0
  81      LS       0      68
  82      UD   .3308
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  83      KK      3   COMB
  84      HC      2

  85      KK    ROUT
  86      KM    ROUTE THROUG  SLOAN CHANNEL
  87      RK     950  .0051    .015      0    TRAP      60     1.5

  88      KK    SB 7
  89      BA   .2375
  90      PB    3.15
  91      LS       0      72
  92      UD   .2354

  93      KK    ROUT
  94      KM    ROUT  THROU BONANZA ROAD
  95      RK    4200   .018    .017      0    TRAP      50       0

  96      KK    SB 8
  97      BA   .3594
  98      PB    3.07
  99      LS       0      75
 100      UD   .4154

 101      KK    COMB
 102      HC       2

 103      KK    ROUT
 104      KM    ROUT  THROU BONANZA ROAD
 105      RK    1300    .01    .017      0    TRAP      50       0

 106      KK   SB 88
 107      BA   .0531
 108      PB     3.0
 109      LS       0      78
 110      UD   .2539

 111      KK      4E   COMB
 112      HC       2

 113      KK       4   COMB
 114      HC       2

 115      KK    ROUT
 116      KM    ROUTE THROUG  SLOAN CHANNEL
 117      RK     900  .0075    .015      0    TRAP      60     1.5

 118      KK    ROUT
 119      KM    ROUTE THROUG  SLOAN CHANNEL
 120      RK    1500  .0049    .015      0    TRAP      60     1.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

121       KK  SB 10
122       BA  .2828
123       PB   3.15
124       LS     0     88
125       UD  .1141

126       KK  DIVRT
127       KM  DIVERT 401 CFS
128       DT  STWRT
129       DI     0     50    200    500    800
130       DQ     0     50    200    401    401

131       KK   ROUT
132       KM   ROUT  THROU   SB 11
133       RK   3800   .04   .017      0   TRAP     50      0

134       KK  SB 11
135       BA  .3281
136       PB   3.15
137       LS     0     75
138       UD  .2856

139       KK   COMB
140       HC      2

141       KK   ROUT
142       KM   ROUT  THROU   SB 12
143       RK   4200   .02   .025      0   TRAP     30      2

144       KK  SB 12
145       BA  .3594
146       PB   3.07
147       LS     0   71.5
148       UD  .3890

149       KK   COMB
150       HC      2

151       KK   ROUT
152       KM   ROUT  THROU STEWART AVE.
153       RK   1700   .008   .017      0   TRAP     50      0

154       KK  SB 13
155       BA  .1781
156       PB    3.0
157       LS     0     83
158       UD  .3259

159       KK     5E   COMB
160       HC      2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  161     KK     SW   STWRT
  162     KM  AREA DRAINING TO STEWART AVE & SLOAN CHANNEL
  163     KM  ASSUMED FULLY DEVELOPED AT 5.3 LOTS/ACRE
  164     KM       AREA     1730 AC (2.7  SQ.MI.)
  165     KM       Cn       80
  166     KM       Tl       1.603 hr
  167     KM       DARF     0.92
  168     BA     2.7
  169     PB    2.77
  170     LS       0      80
  171     UD   1.603

  172     KK       5    COMB
  173     HC       3

  174     KK    ROUT
  175     KM    ROUTE THROUG  SLOAN CHANNEL
  176     RK     2200 .00423    .015       0    TRAP      60     1.5

  177     KK   SB16A
  178     BA   .1594
  179     PB     3.0
  180     LS       0      81
  181     UD   .3071

  182     KK       6    COMB
  183     HC       2

  184     KK    ROUT
  185     KM    ROUTE THROUG  SLOAN CHANNEL
  186     RK      400 .00423    .015       0    TRAP      60     1.5

  187     KK   SB 14
  188     BA   .0938
  189     PB    3.15
  190     LS       0      75
  191     UD   .2159

  192     KK    ROUT
  193     KM    ROUT  THROU    SB 15
  194     RK    3900     .01    .017       0    TRAP      50       0

  195     KK   SB 15
  196     BA   .2406
  197     PB    3.07
  198     LS       0      75
  199     UD   .3495

  200     KK    COMB
  201     HC       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  202     KK   ROUT
  203     KM   ROUT  THROU   CHARLESTON BLVD
  204     RK   1000   .008   .017      0   TRAP     50      0

  205     KK   S816
  206     BA   .125
  207     PB    3.0
  208     LS      0     61
  209     UD  .3029

  210     KK   COMB
  211     HC      2

  212     KK   ROUT
  213     RK   1500   .005   .017      0   TRAP     50      0

  214     KK     7W  CHRLSN
  215     KM  AREA DRAINING TO CHARLESTON AND SLOAN CHANNEL
  216     KM        AREA    120 AC   (.1875  SQ.MI.)
  217     KM        Cn      86.5
  218     KM        T1      0.446 HR
  219     KM
  220     BA  .1875
  221     PB   2.77
  222     LS      0    86.5
  223     UD   .446

  224     KK      7    COMB
  225     HC      3

  226     KK   ROUT
  227     KM   ROUTE THROUG  SLOAN CHANNEL
  228     RK   1400   .0042   .015      0   TRAP     70    1.5

  229     KK   30  ONSITE BASIN 30
  230     BA  .0256
  231     PB   3.15
  232     LS      0     90
  233     UD    .27

  234     KK   31  ONSITE B ASIN 31
  235     BA  .0172
  236     PB   3.15
  237     LS      0     87
  238     UD    .17

  239     KK   COMB
  240     HC      2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  241     KK    SVC
  242     KM  FUTURE COMMERCIAL AREA AT SLOAN AND CHARLESTON
  243     KM        AREA    27 AC    (.04219 SQ.MI.)
  244     KM        Cn      94
  245     KM        Tl      0.199 HR
  246     BA  .04219
  247     PB    2.77
  248     LS       0      94
  249     UD    .199

  250     KK    COMB
  251     HC       3

  252     KK    ROUT
  253     KM    ROUTE THROUG  SLOAN CHANNEL
  254     RK    1100   .0045    .015       0    TRAP      70     1.5

  255     KK    SVGH
  256     KM  SUNRISE VALLEY GARDEN HOMES
  257     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  258     KM        AREA    26 AC    (.04063 SQ.MI.)
  259     KM        Cn      90
  260     KM        Tl      0.249 HR
  261     BA  .04063
  262     PB    2.77
  263     LS       0      90
  264     UD    .249

  265     KK    COMB
  266     HC       2

  267     KK    ROUT
  268     KM    ROUTE THROUG  SLOAN CHANNEL
  269     RK    1450   .0045    .015       0    TRAP      70     1.5

  270     KK    SV8
  271     KM  SUNRISE VALLEY  UNIT 8
  272     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  273     KM        AREA    27 AC    (.04219 SQ.MI.)
  274     KM        Cn      90
  275     KM        Tl      0.273 HR
  276     BA  .04219
  277     PB    2.77
  278     LS       0      90
  279     UD    .273

  280     KK    COMB
  281     HC       2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

282       KK   ROUT
283       KM   ROUTE THROUG  SLOAN CHANNEL
284       RK    300  .0045   .015      0   TRAP     70    1.5
285       KM      ********************

286       KK     03 OFFSITE BASIN 03
287       BA  .2125
288       PB   3.15
289       LS      0     31
290       UD    .53

291       KK     R3 ROUTE DOWN STORM DRAIN IN STREET C
292       RK   1250  .0085   .013      0   CIRC    4.5

293       KK     04 OFFSITE BASIN 04
294       BA  .4234
295       LS      0     88
296       UD    .32

297       KK     R4 ROUTE FLOWS TO HOLLYWOOD BOULEVARD
298       RM     10     .9    .15

299       KK     05 OFFSITE BASIN 05
300       BA  .4078
301       LS      0     77
302       UD    .58

303       KK     C3 COMBIINE FLOWS AT HOLLYWOOD
304       HC      2

305       KK     R5 ROUTE DOWN STORM DRAIN IN STREET B
306       RK    700  .0308   .013      0   CIRC     5

307       KK     CA COMBIINE FLOWS AT INTERSECTION OF STREET B & C
308       HC      2

309       KK     R6 ROUTE FLOWS DOWN STORM DRAIN IN STREET B TO PARK
310       RK    900   .017   .013      0   CIRC    5.5

311       KK     R7 ROUTE FLOWS TO PARK
312       RK    850  .0188   .013      0   CIRC    5.5

313       KK    06A OFFSITE BASIN 06A
314       BA  .2594
315       LS      0     88
316       UD    .13

317       KK     R8 ROUTE TO CA
318       RM      6    .41    .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  319     KK    06B OFFSITE BASIN 06B
  320     BA   .1641
  321     LS      0     88
  322     UD    .14

  323     KK     R9 ROUTE TO C4
  324     RM      6    .52    .15

  325     KK    06C OFFSITE BASIN 06C
  326     BA   .1750
  327     LS      0     88
  328     UD    .19

  329     KK    R10 ROUTE TO C4
  330     RM      6    .65    .15

  331     KK      C COMBINE FLOWS
  332     HC      3

  333     KK    R11
  334     RM     10    .89    .15

  335     KK     07 OFFSITE BASIN 07
  336     BA   .6016
  337     LS      0     77
  338     UD    .73

  339     KK     C4 COMBINE FLOWS
  340     HC      2

  341     KK    R12 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  342     RK    800   .0501   .013      0    CIRC      5

  343     KK    R13 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  344     RK    350   .0171   .013      0    CIRC      5

  345     KK      C COMBINE FLOWS FROM BOTH STORM DRAINS IN PARK
  346     HC      2

  347     KK      3 ONSITE BASIN 3
  348     BA   .0063
  349     LS      0     75
  350     UD    .13

  351     KK      R ROUTE FLOWS DOWN STREET C
  352     RK    700    .005   .016      0    TRAP     60

  353     KK    R14 ROUTE FLOWS DOWN STREET B
  354     RK    600   .0171   .016      0    TRAP     60
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

355       KK    R15
356       RK   1050    .02    .016       0    TRAP      60

357       KK       4 ONSITE BASIN B4
358       BA   .0774
359       LS       0      75
360       UD    .26

361       KK       5 ONSITE BASIN 5
362       BA   .0312
363       LS       0      73
364       UD    .24

365       KK       C COMBINE  SURFACE FLOWS AT LOW POINT IN STREET A
366       HC       3

367       KK      CB COMBINE WITH FLOWS FROM STORM DRAIN
368       HC       2

369       KK       6 PARK SITE
370       BA   .0181
371       LS       0      61
372       UD    .37

373       KK      CC COMBINE FLOWS IN PARK
374       HC       2

375       KK     DET DETENTION BASIN IN PARK
376       RS       1    STOR     -1
377       SV     .03     .42    1.56    4.18    7.11   10.74   15.19   20.69   27.05
378       SE       9      10      11      12      13      14      15      16      17
379       SQ       0      25      50     500     700     900    1200    1500    2000

380       KK       7 ONSITE BASIN 7
381       BA   .0312
382       LS       0      75
383       UD    .19

384       KK       R ROUTE TO ORCHARD PARK DRIVE
385       RK     900    .010    .016       0    TRAP      60       0

386       KK       8 ONSITE BASIN 8
387       BA   .0245
388       LS       0      85
389       UD    .15

390       KK       9 SCHOOL
391       BA   .0194
392       LS       0      61
393       UD    .54
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

394       KK     08 OFFSITE BASIN 08
395       BA   .0203
396       LS      0     88
397       UD    .14

398       KK     R8 ROUTE FLOWS TO HOLLYWOOD
399       RM     16   1.23    .15

400       KK     09 OFFSITE BASIN 09
401       BA   .2891
402       LS      0     77
403       UD    .81

404       KK     C5 COMBINE FLOWS AT HOLLYWOOD
405       HC      2

406       KK      R ROUTE FLOWS TO ORCHARD VALLEY
407       RK   1320    .02   .016       0   TRAP     60       0

408       KK      C COMBINE FLOWS
409       HC      2

410       KK      C COMBINE FLOWS AT STREET D AND ORCHARD PARK DRIVE
411       HC      3

412       KK      R ROUTE FLOWS TO SUMP IN ORCHARD PARK DRIVE
413       RK    550   .011   .016       0   TRAP     80       0

414       KK     CD COMBINE ALL FLOWS INTO CHANNEL
415       HC      2

416       KK     CE ROUTE FLOWS DOWN CHANNEL TO CP E
417       RK   1800   .002   .016       0   TRAP     30     1.5

418       KK      2 ONSITE BASIN 2
419       BA   .0127
420       LS      0     75
421       UD    .11

422       KK      R ROUTE FLOWS DOWN ORCHARD VALLEY
423       RK    300    .01   .016       0   TRAP     60       0

424       KK     13 ONSITE BASIN 13
425       BA   .0084
426       LS      0     77
427       UD    .06

428       KK      C COMBINE FLOWS
429       HC      2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

430       KK       R ROUTE FLOWS DOWN ORCHARD VALLEY DR.
431       RK    1600    .005    .016       0    TRAP      60       0

432       KK      14 ONSITE BASIN 14
433       BA   .0218
434       LS       0      70
435       UD     .23

436       KK       C COMBINE FLOWS
437       HC       2

438       KK      10 ONSITE BASIN 10
439       BA   .0050
440       LS       0      92
441       UD     .09

442       KK       R ROUTE FLOWS THRU NAPOTS TO BASIN 15
443       RM       6     .33     .15

444       KK      11 NAPOTS
445       BA   .0301
446       LS       0      74
447       UD     .45

448       KK       C COMBINE FLOWS AT BASIN 15
449       HC       2

450       KK       R ROUTE FLOWS THRU BASIN 15
451       RK    1000    .006    .016       0    TRAP      50       0

452       KK      15 ONSITE BASIN 15
453       BA   .0150
454       LS       0      49
455       UD     .42

456       KK       C COMBINE FLOWS AT INTERSECTION TREELINE DR. AND ORCHARD VALLEY DR.
457       HC       2

458       KK      16 ONSITE BASIN 16
459       BA   .0359
460       LS       0      84
461       UD     .32

462       KK       R ROUTE FLOWS DOWN TREELINE DRIVE
463       RK     800    .004    .016       0    TRAP      80       0

464       KK      17 ONSITE BASIN 17
465       BA   .0115
466       LS       0      87
467       UD     .20
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

468       KK      C COMBINE FLOWS AT TREELINE DR. AND ORCHARD VALLEY
469       HC      3

470       KK      R ROUTE COMBINED FLOWS TO INTERSECTION OF ORCHARD VALLEY AND CHANNEL
471       RK    2000    .004    .016       0    TRAP      60       0

472       KK      18 ONSITE BASIN 18
473       BA   .0457
474       LS       0      82
475       UD     .31

476       KK      19 ONSITE BASIN 19
477       BA   .0398
478       LS       0      87
479       UD     .31

480       KK      C COMBINE  STREET FLOWS AT CHANNEL CP F
481       HC      4

482       KK      CF COMBINE FLOWS IN CHANNEL
483       HC      2

484       KK      R ROUTE FLOWS DOWN CHANNEL
485       RK    1000    .002    .015       0    TRAP       8       2

486       KK      20 PEACHTREE
487       BA   .0439
488       LS       0      87
489       UD     .29

490       KK      R ROUTE FLOWS THROUGH BASIN 21
491       RK    1300    .004    .016       0    TRAP      50       0

492       KK      21 ONSITE BASIN 21
493       BA   .0203
494       LS       0      87
495       UD     .24

496       KK      CG COMBINE SURFACE FLOWS AT CP G
497       HC      2

498       KK      CG COMBINE ALL FLOWS IN CHANNEL
499       HC      2

500       KK    COMB
501       HC      2

502       KK   SBD2A
503       KM  STONEBRIDGE D2A
504       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
505       KM        AREA    10 AC    (.01563 SQ.MI.)
506       KM        Cn      90
507       KM        Tl      0.172 HR
508       BA  .01563
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 509      PB    2.77
 510      LS       0      90
 511      UD    .172

 512      KK    COMB
 513      HC       2

 514      KK    ROUT
 515      KM    ROUT THROUGH  SLOAN  CHANNEL
 516      RK     700   .0045    .015       0    TRAP      70     1.5

 517      KK      F4
 518      KM  FUTURE DEVELOPED AREA
 519      KM  DEVELOPED DENSITY = 8 UNITS/ACRE
 520      KM        AREA    23 AC    (.03594 SQ.MI.)
 521      KM        Cn      90
 522      KM        Tl      0.226 HR
 523      BA  .03594
 524      PB   2.77
 525      LS       0      90
 526      UD    .226

 527      KK    COMB
 528      HC       2

 529      KK    22 ONSITE BASIN 22
 530      BA   .0378
 531      PB    3.15
 532      LS       0      84
 533      UD     .43

 534      KK    23 ONSITE BASIN 23
 535      BA   .0201
 536      LS       0      85
 537      UD     .33

 538      KK    24 ONSITE BASIN 24
 539      BA   .0459
 540      LS       0      87
 541      UD     .43

 542      KK    25 ONSITE BASIN 25
 543      BA   .0137
 544      LS       0      87
 545      UD     .23

 546      KK      CH  COMBINE FLOWS INTO SLOAN
 547      HC       4

 548      KK     010  OFFSITE BASIN 010
 549      BA   .0984
 550      LS       0      77
 551      UD     .41
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

552       KK      R  ROUTE FLOWS WEST ON SAHARA
553       RK   1320   .025   .016       0    TRAP     100

554       KK   26 SCHOOL BASIN 26
555       BA  .0464
556       LS      0      90
557       UD    .40

558       KK     CI  COMBINE FLOWS IN SAHARA AT TREELINE DR.
559       HC      2

560       KK      R  ROUTE FLOWS WEST ON SAHARA
561       RK   1350   .015   .016       0    TRAP     100

562       KK   27 ONSITE BASIN 27
563       BA  .0291
564       LS      0      86
565       UD    .24

566       KK     CJ  COMBINE FLOWS IN SAHARA AT ORCHARD VALLEY
567       HC      2

568       KK      R  ROUTE FLOWS WEST ON SAHARA
569       RK    500   .003   .016       0    TRAP     100

570       KK   28 ONSITE BASIN 28
571       BA  .0116
572       LS      0      94
573       UD    .18

574       KK     CK  COMBINE FLOWS IN SAHARA
575       HC      2

576       KK      R  ROUTE FLOWS TO SLOAN CHANNEL
577       RK    750   .003   .016       0    TRAP     100

578       KK   29 ONSITE BASIN 29
579       BA  .0145
580       LS      0      90
581       UD    .23

582       KK     C1  COMBINE ALL FLOWS IN SAHARA
583       HC      2

584       KK   COMB
585       HC      3

586       KK   ROUT
587       KM   ROUT THROUGH  SLOAN  CHANNEL
588       RK   1200  .0045   .015       0    TRAP      70     1.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

589       KK     F5
590       KM  FUTURE DEVELOPED AREA
591       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
592       KM        AREA    34 AC    (.05313 SQ.MI.)
593       KM        Cn      90
594       KM        TI      0.261 HR
595       BA  .05313
596       PB   2.77
597       LS      0     90
598       UD   .261

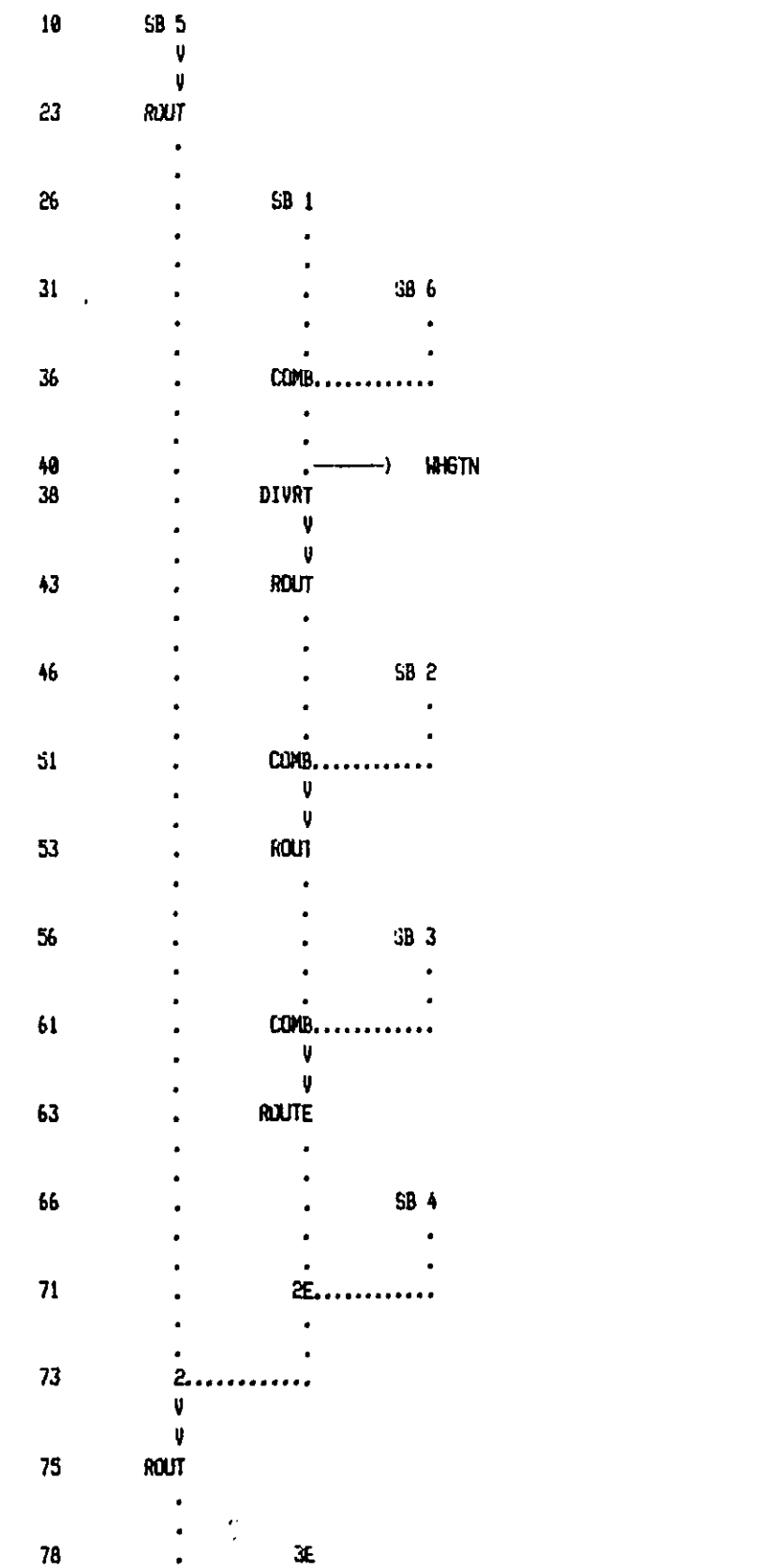
599       KK   SB 17
600       BA   .1313
601       PB    3.0
602       LS      0     92
603       UD   .1952

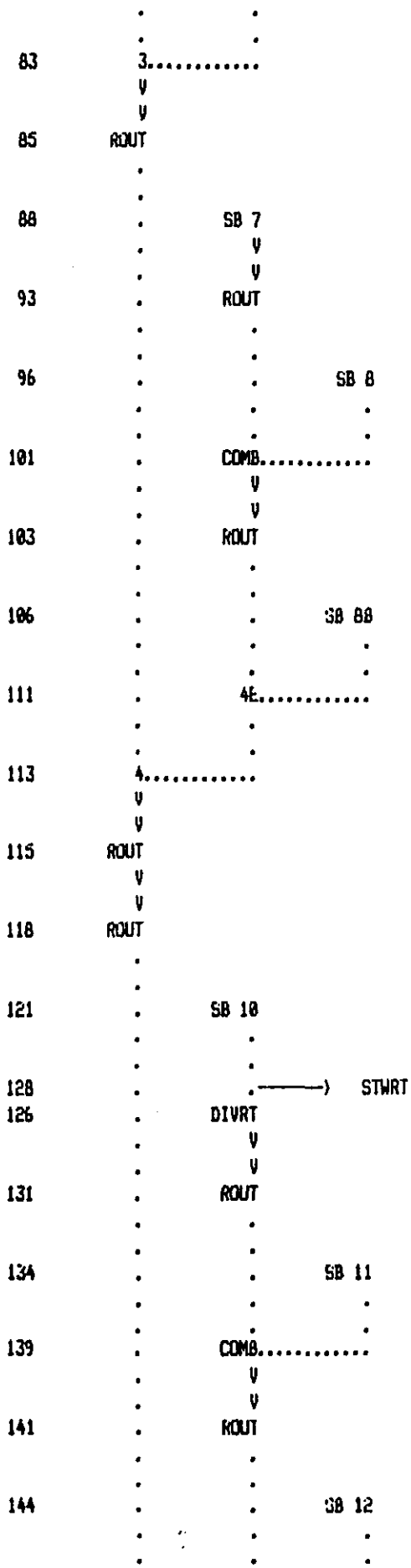
604       KK    COMB
605       HC       3
606       ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR
(—>) DIVERSION OR PUMP FLOW
(<—) RETURN OF DIVERTED OR PUMPED FLOW

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3
85
ROUT
88
SB 7
93
ROUT
96
SB 8
101
COMB
103
ROUT
106
SB 88
111
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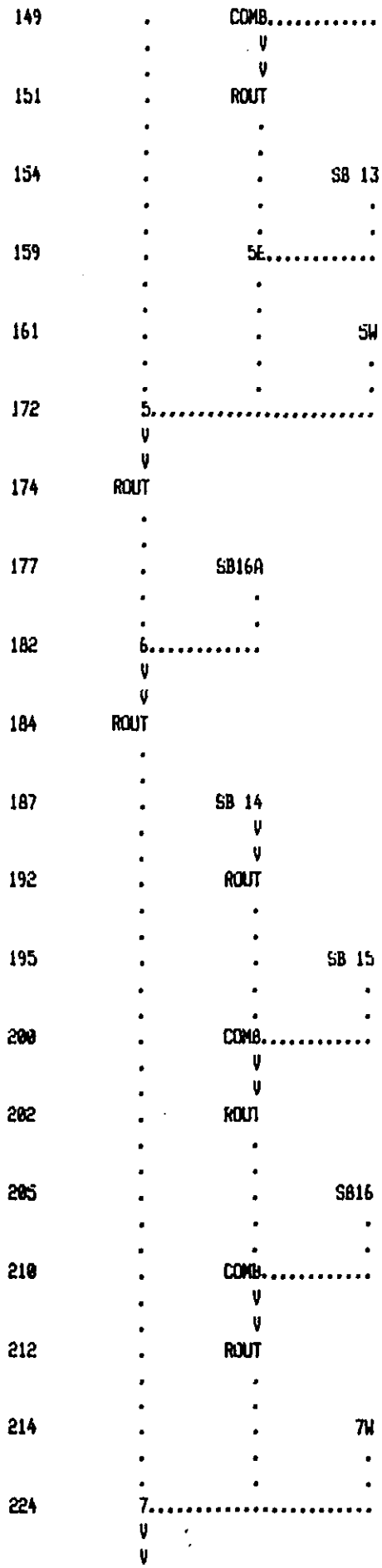
113
4
115
ROUT
118
ROUT
121
SB 10
128
STWRT
126
DIVRT
131
ROUT
134
SB 11
139
COMB
141
ROUT
144
SB 12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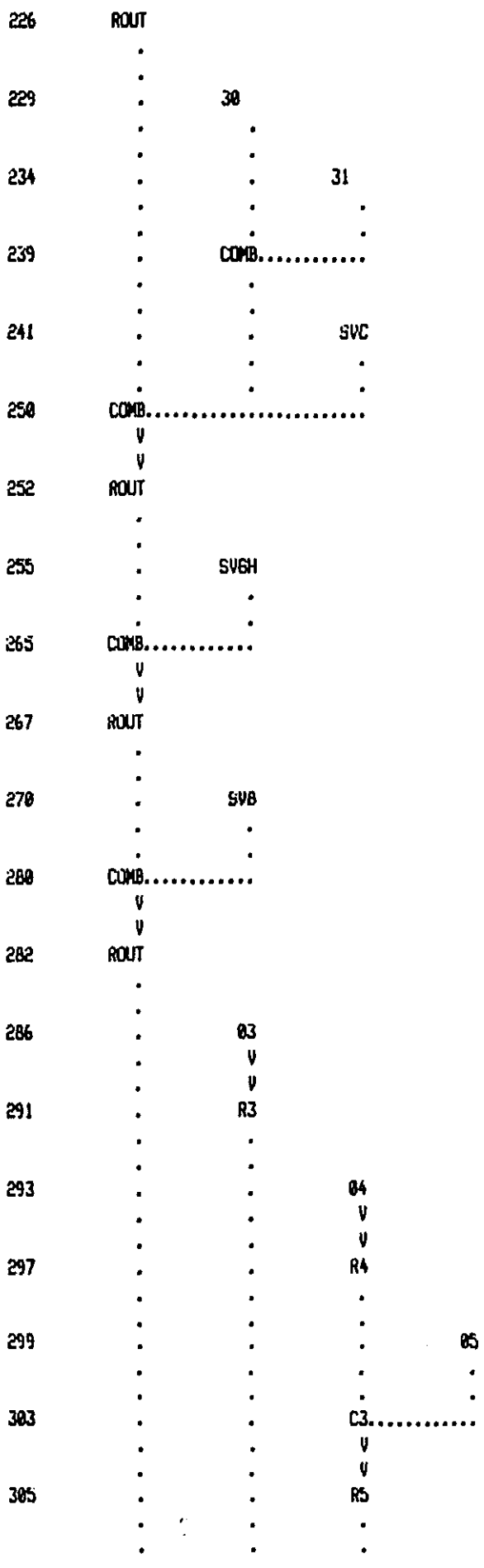
COMB
151
ROUT
154
SB 13
159
5E
161
SW
172
5
174
ROUT
177
SB16A
182
6
184
ROUT
187
SB 14
192
ROUT
195
SB 15
200
COMB
202
ROUT
205
SB16
210
COMB
212
ROUT
214
7W
224
7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229 30
234 31
239 COMB
241 SVC
250 COMB
252 ROUT
255 SVGH
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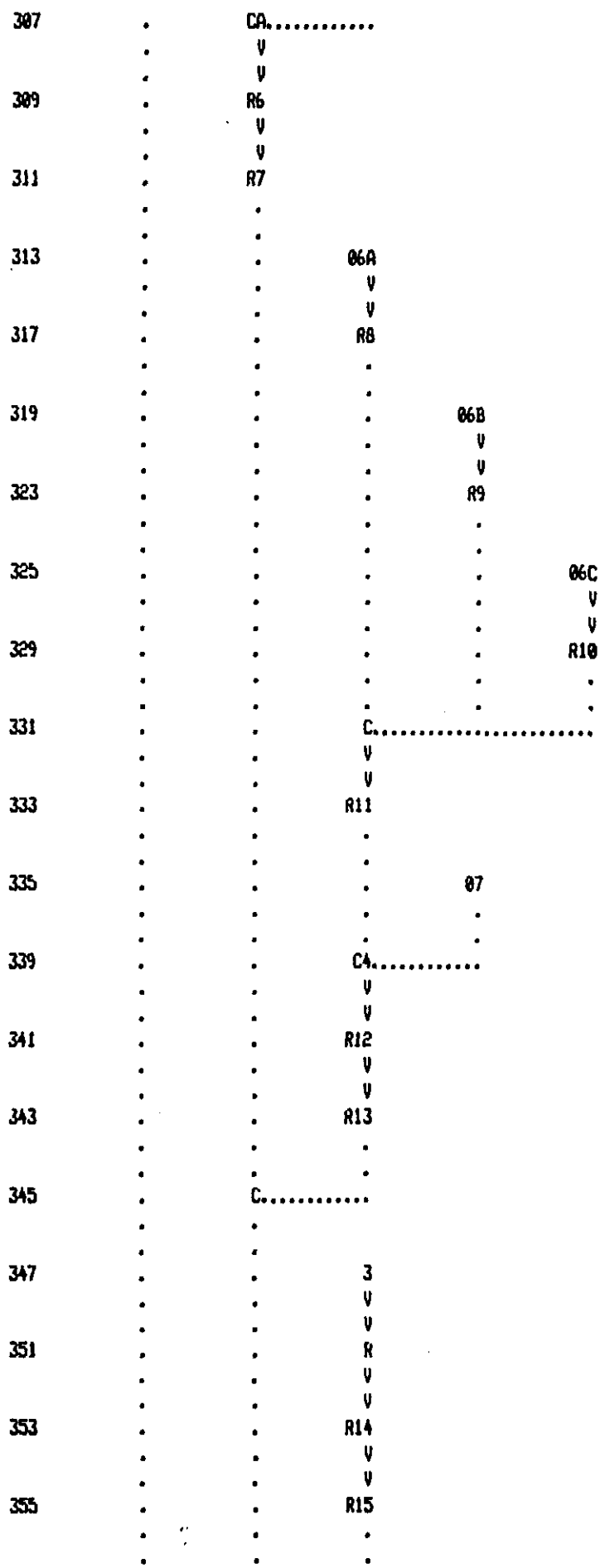
267 ROUT
270 SVB
280 COMB
282 ROUT
286 03
291 R3
293 04
297 R4
299 05
303 C3
305 R5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R7
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R8
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06B
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R9
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R10
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C
333
R11
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07
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C
347
3
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R
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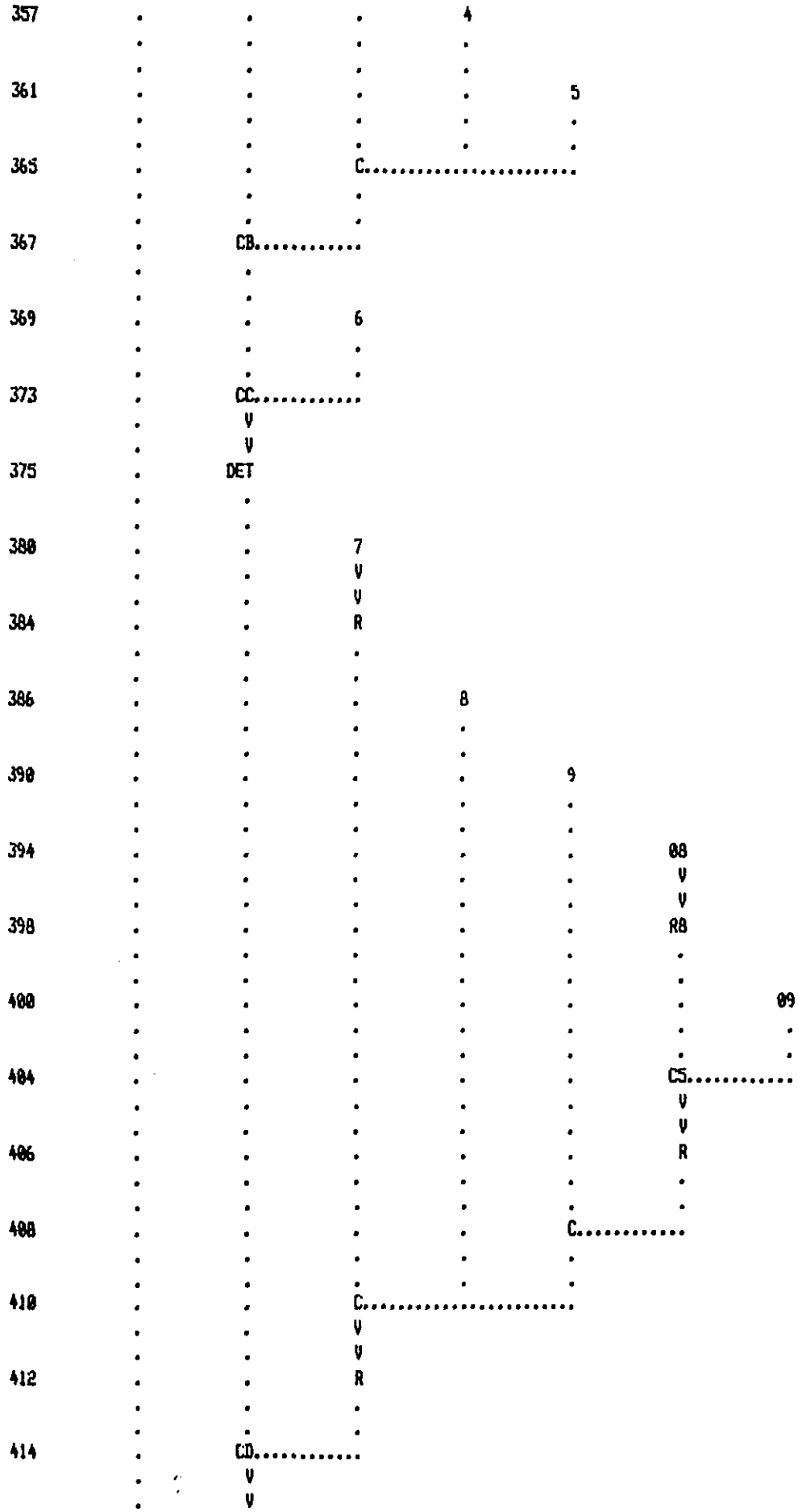
R14
355
R15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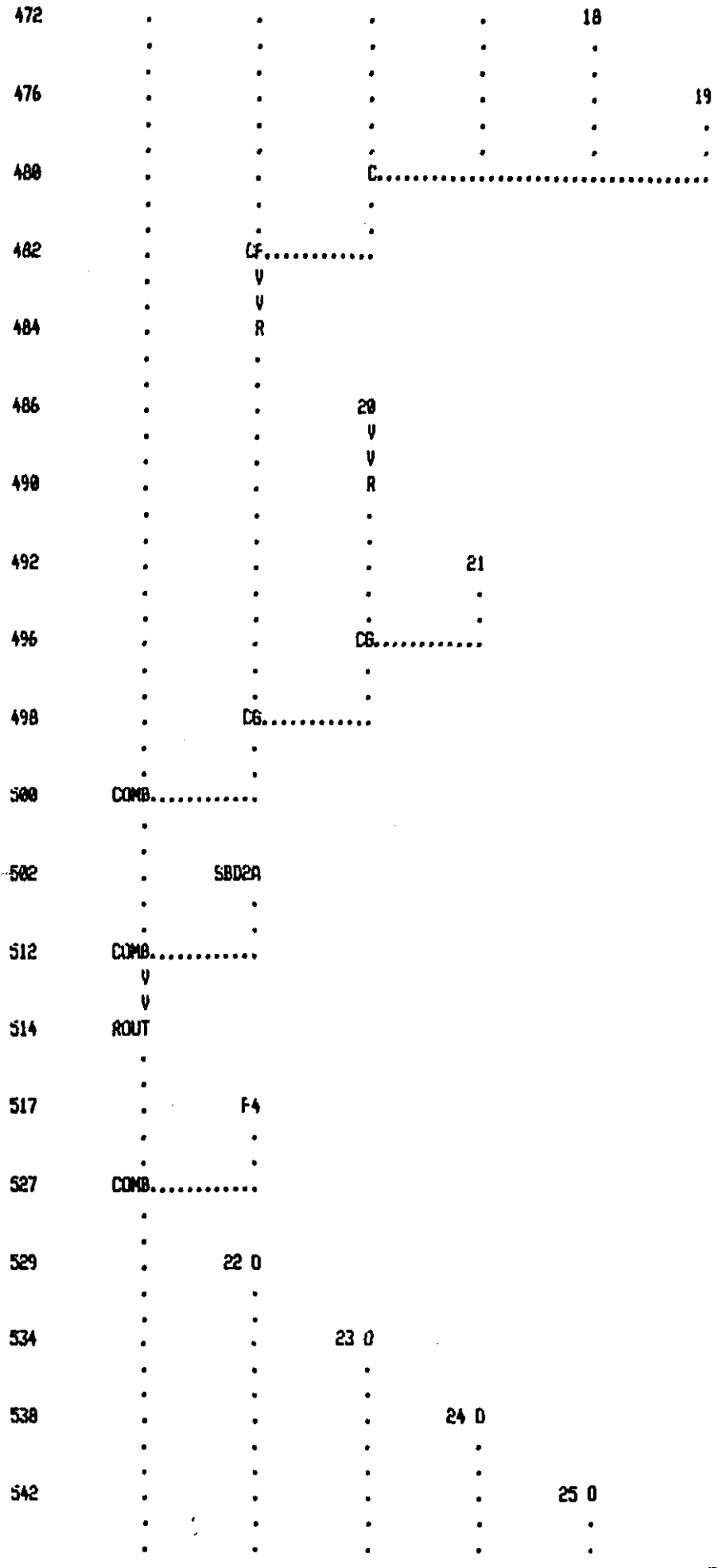
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492
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COMB
502
SBD2R
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24 D
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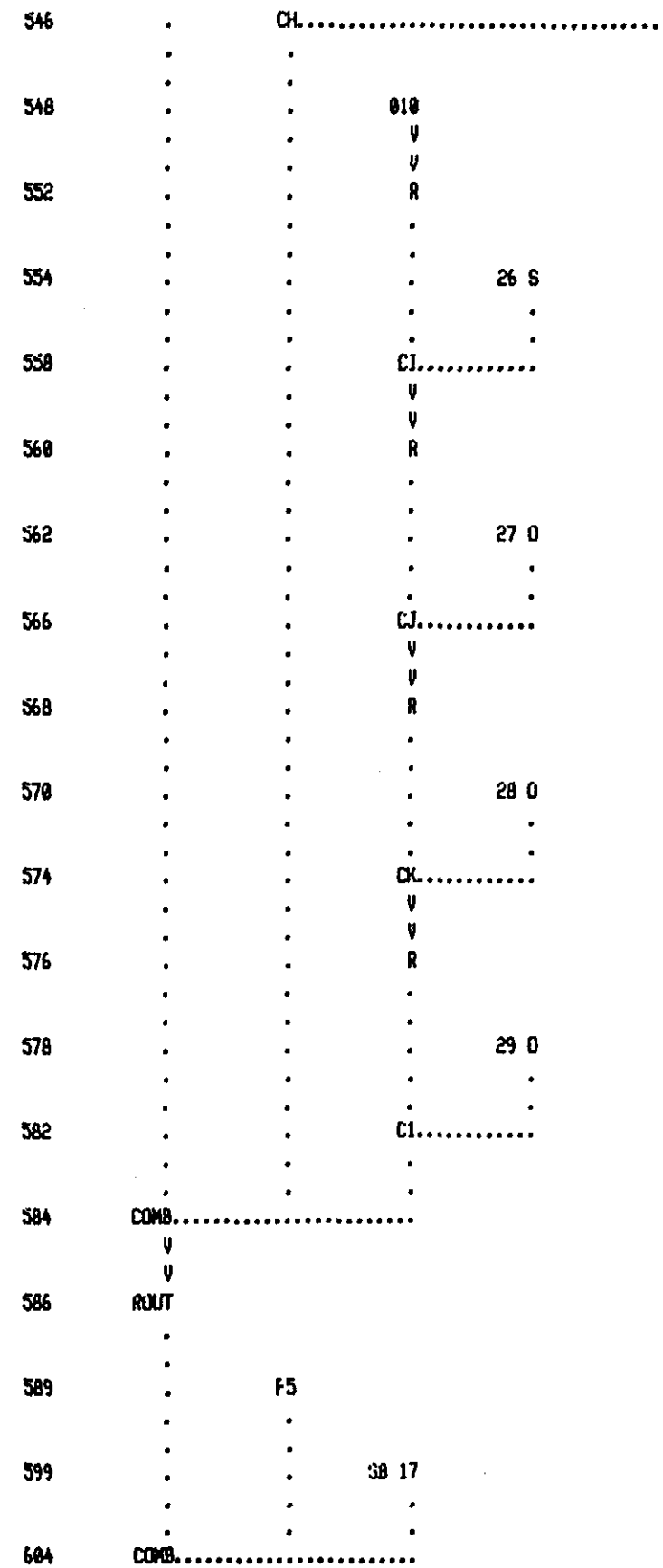
25 D



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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                                    ****
          FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985
     U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616
                                    ****

                    #         UNDER ULTIMATE DEVELOPMENT CONDITION          #
                     ****                                                    ****
                    * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
                    * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.HI *
                    * POINT RAINFALL (100-YR. STORM)            3/16/93  # INCLUDED D.B.

  7 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                    NMIN          3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME         0000  STARTING TIME
                      NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME        1457  ENDING TIME

                 COMPUTATION INTERVAL     .05 HOURS
                     TOTAL TIME BASE   14.95 HOURS

        ENGLISH UNITS

    JP        MULTI-PLAN OPTION
                   NPLAN          1  NUMBER OF PLANS

    JR        MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
                 .98       .97
                 .92       .88
                 .86

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

    UNIT HYDROGRAPH TRUNCATED FROM 162 TO 150 INT   ERVALS

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG
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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .98	RATIO 2 .97	RATIO 3 .92	RATIO 4 .88	RATIO 5 .86
HYDROGRAPH AT	SB 5	.12	1	FLOW	99.	97.	88.	81.	77.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	.12	1	FLOW	98.	96.	87.	80.	76.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 1	.64	1	FLOW	1011.	997.	926.	870.	842.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 6	.58	1	FLOW	1013.	999.	929.	872.	844.
				TIME	3.55	3.55	3.55	3.55	3.55
2 COMBINED AT	COMB	1.23	1	FLOW	1995.	1967.	1827.	1715.	1659.
				TIME	3.55	3.55	3.55	3.55	3.55
DIVERSION TO	WHSTN	1.23	1	FLOW	1899.	1871.	1731.	1619.	1563.
				TIME	3.55	3.55	3.55	3.55	3.55
HYDROGRAPH AT	DIVRT	1.23	1	FLOW	96.	96.	96.	96.	96.
				TIME	3.30	3.30	3.30	3.30	3.30
ROUTED TO	ROUT	1.23	1	FLOW	96.	96.	96.	96.	96.
				TIME	3.35	3.35	3.35	3.35	3.35
HYDROGRAPH AT	SB 2	.21	1	FLOW	130.	127.	113.	101.	96.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	1.43	1	FLOW	226.	223.	209.	197.	192.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	1.43	1	FLOW	225.	222.	208.	196.	191.
				TIME	3.70	3.70	3.70	3.75	3.75
HYDROGRAPH AT	SB 3	.27	1	FLOW	184.	180.	160.	146.	138.
				TIME	3.70	3.70	3.75	3.75	3.75
2 COMBINED AT	COMB	1.71	1	FLOW	409.	402.	368.	342.	329.
				TIME	3.70	3.70	3.70	3.75	3.75
ROUTED TO	ROUTE	1.71	1	FLOW	408.	402.	368.	341.	328.
				TIME	3.80	3.80	3.80	3.80	3.85
HYDROGRAPH AT	SB 4	.13	1	FLOW	109.	107.	97.	89.	86.
				TIME	3.70	3.70	3.75	3.75	3.75
2 COMBINED AT	2E	1.84	1	FLOW	513.	504.	461.	427.	411.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	2	1.96	1	FLOW	609.	599.	547.	506.	486.

				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	1.96	1	FLOW	605.	594.	543.	503.	484.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	3E	.11	1	FLOW	39.	38.	32.	28.	27.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	3	2.07	1	FLOW	644.	632.	575.	532.	510.
				TIME	3.80	3.80	3.85	3.85	3.85
ROUTED TO	ROUT	2.07	1	FLOW	643.	631.	575.	530.	508.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	SB 7	.24	1	FLOW	150.	146.	130.	116.	110.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	ROUT	.24	1	FLOW	143.	140.	123.	114.	107.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SB 8	.36	1	FLOW	195.	190.	170.	154.	146.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	.60	1	FLOW	331.	324.	288.	260.	247.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	.60	1	FLOW	330.	323.	286.	260.	246.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	SB 8B	.05	1	FLOW	42.	41.	37.	34.	32.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	4E	.65	1	FLOW	364.	356.	316.	288.	273.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	4	2.72	1	FLOW	1007.	987.	891.	818.	781.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	2.72	1	FLOW	1002.	982.	884.	815.	777.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	2.72	1	FLOW	998.	979.	883.	813.	776.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	SB 10	.28	1	FLOW	498.	491.	456.	429.	415.
				TIME	3.55	3.55	3.55	3.55	3.55
DIVERSION TO	STWRT	.28	1	FLOW	399.	395.	372.	353.	344.
				TIME	3.55	3.55	3.55	3.55	3.55
HYDROGRAPH AT	DIVRT	.28	1	FLOW	98.	96.	85.	76.	71.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	ROUT	.28	1	FLOW	83.	81.	67.	58.	53.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	SB 11	.33	1	FLOW	227.	222.	199.	181.	172.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	COMB	.61	1	FLOW	289.	282.	249.	224.	212.

				TIME	3.65	3.65	3.70	3.70	3.70
ROUTED TO	ROUT	.61	1	FLOW	290.	283.	249.	224.	211.
				TIME	3.70	3.70	3.75	3.75	3.75
HYDROGRAPH AT	SB 12	.36	1	FLOW	162.	158.	139.	125.	117.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	.97	1	FLOW	441.	431.	382.	333.	315.
				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	.97	1	FLOW	439.	429.	380.	333.	314.
				TIME	3.85	3.85	3.85	3.80	3.80
HYDROGRAPH AT	SB 13	.18	1	FLOW	159.	156.	143.	132.	127.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	5E	1.15	1	FLOW	594.	581.	517.	465.	440.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	5W	2.70	1	FLOW	652.	640.	579.	531.	508.
				TIME	5.35	5.35	5.35	5.35	5.40
3 COMBINED AT	5	6.56	1	FLOW	1703.	1669.	1494.	1356.	1292.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	ROUT	6.56	1	FLOW	1698.	1662.	1485.	1351.	1288.
				TIME	3.90	3.90	3.90	3.95	3.95
HYDROGRAPH AT	SB16A	.16	1	FLOW	133.	131.	119.	110.	105.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	6	6.72	1	FLOW	1812.	1775.	1588.	1445.	1375.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	ROUT	6.72	1	FLOW	1807.	1770.	1582.	1440.	1370.
				TIME	3.90	3.90	3.90	3.90	3.95
HYDROGRAPH AT	SB 14	.09	1	FLOW	74.	72.	64.	58.	56.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUT	.09	1	FLOW	67.	66.	58.	51.	49.
				TIME	3.80	3.80	3.80	3.85	3.85
HYDROGRAPH AT	SB 15	.24	1	FLOW	143.	140.	125.	113.	107.
				TIME	3.80	3.80	3.80	3.80	3.85
2 COMBINED AT	COMB	.33	1	FLOW	210.	206.	183.	164.	156.
				TIME	3.80	3.80	3.80	3.80	3.85
ROUTED TO	ROUT	.33	1	FLOW	209.	204.	182.	164.	155.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	SB16	.13	1	FLOW	24.	23.	19.	16.	14.
				TIME	3.85	3.85	3.85	3.90	3.90
2 COMBINED AT	COMB	.46	1	FLOW	233.	227.	201.	180.	169.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	.46	1	FLOW	232.	227.	201.	179.	169.

				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	7W	.19	1	FLOW	146.	144.	133.	124.	119.
				TIME	3.90	3.90	3.90	3.90	3.90
3 COMBINED AT	7	7.37	1	FLOW	2186.	2141.	1915.	1743.	1657.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	ROUT	7.37	1	FLOW	2174.	2131.	1910.	1737.	1654.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	30	.03	1	FLOW	35.	35.	33.	31.	30.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	31	.02	1	FLOW	26.	25.	24.	22.	21.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.04	1	FLOW	59.	58.	54.	51.	49.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SVC	.04	1	FLOW	64.	64.	60.	57.	55.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	7.46	1	FLOW	2233.	2187.	1962.	1787.	1703.
				TIME	3.90	3.95	3.95	3.95	3.95
ROUTED TO	ROUT	7.46	1	FLOW	2232.	2186.	1958.	1784.	1697.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	SVGH	.04	1	FLOW	49.	48.	45.	42.	41.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	COMB	7.50	1	FLOW	2259.	2214.	1984.	1808.	1721.
				TIME	3.95	3.95	3.95	3.95	3.95
ROUTED TO	ROUT	7.50	1	FLOW	2252.	2205.	1970.	1795.	1711.
				TIME	3.95	3.95	3.95	4.00	4.00
HYDROGRAPH AT	SV8	.04	1	FLOW	49.	48.	45.	42.	41.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.54	1	FLOW	2283.	2236.	1999.	1821.	1734.
				TIME	3.95	3.95	3.95	3.95	4.00
ROUTED TO	ROUT	7.54	1	FLOW	2279.	2231.	1993.	1818.	1733.
				TIME	3.95	3.95	3.95	4.00	4.00
HYDROGRAPH AT	03	.21	1	FLOW	143.	141.	128.	119.	114.
				TIME	4.00	4.00	4.00	4.00	4.00
ROUTED TO	R3	.21	1	FLOW	143.	140.	128.	118.	113.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	04	.42	1	FLOW	505.	498.	462.	433.	419.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R4	.42	1	FLOW	377.	372.	345.	324.	313.
				TIME	4.65	4.65	4.65	4.65	4.65
HYDROGRAPH AT	05	.41	1	FLOW	213.	209.	188.	171.	163.

				TIME	4.05	4.05	4.05	4.05	4.05
2 COMBINED AT	C3	.83	1	FLOW	490.	482.	445.	416.	401.
				TIME	4.60	4.60	4.60	4.60	4.60
ROUTED TO	R5	.83	1	FLOW	489.	482.	445.	415.	401.
				TIME	4.60	4.60	4.60	4.60	4.60
2 COMBINED AT	CA	1.04	1	FLOW	558.	549.	506.	472.	455.
				TIME	4.55	4.55	4.55	4.60	4.60
ROUTED TO	R6	1.04	1	FLOW	557.	549.	506.	472.	455.
				TIME	4.55	4.55	4.60	4.60	4.60
ROUTED TO	R7	1.04	1	FLOW	557.	548.	506.	472.	455.
				TIME	4.60	4.60	4.60	4.60	4.60
HYDROGRAPH AT	06A	.26	1	FLOW	438.	432.	401.	377.	365.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.26	1	FLOW	334.	330.	306.	287.	278.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	06B	.16	1	FLOW	270.	266.	247.	232.	224.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R9	.16	1	FLOW	192.	189.	176.	165.	159.
				TIME	4.05	4.05	4.05	4.05	4.05
HYDROGRAPH AT	06C	.17	1	FLOW	261.	257.	239.	224.	217.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R10	.17	1	FLOW	179.	176.	164.	154.	149.
				TIME	4.25	4.25	4.25	4.25	4.25
3 COMBINED AT	C	.60	1	FLOW	645.	636.	591.	554.	536.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R11	.60	1	FLOW	512.	504.	468.	439.	425.
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	07	.60	1	FLOW	269.	264.	237.	217.	207.
				TIME	4.20	4.25	4.25	4.25	4.25
2 COMBINED AT	C4	1.20	1	FLOW	669.	659.	608.	568.	549.
				TIME	4.90	4.90	4.90	4.95	4.95
ROUTED TO	R12	1.20	1	FLOW	668.	658.	608.	568.	549.
				TIME	4.90	4.95	4.95	4.95	4.95
ROUTED TO	R13	1.20	1	FLOW	668.	658.	608.	568.	549.
				TIME	4.95	4.95	4.95	4.95	4.95
2 COMBINED AT	C	2.24	1	FLOW	1162.	1144.	1057.	987.	952.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	3	.01	1	FLOW	6.	6.	5.	5.	4.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.01	1	FLOW	6.	6.	5.	5.	4.

				TIME	3.60	3.60	3.65	3.65	3.65
ROUTED TO	R14	.01	1	FLOW	6.	6.	5.	5.	4.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	R15	.01	1	FLOW	6.	6.	5.	4.	4.
				TIME	3.75	3.75	3.75	3.85	3.85
HYDROGRAPH AT	4	.08	1	FLOW	56.	55.	49.	44.	42.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	5	.03	1	FLOW	21.	20.	18.	16.	15.
				TIME	3.70	3.70	3.70	3.70	3.70
3 COMBINED AT	C	.11	1	FLOW	82.	80.	71.	64.	61.
				TIME	3.70	3.70	3.70	3.70	3.75
2 COMBINED AT	CB	2.36	1	FLOW	1186.	1168.	1078.	1006.	971.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	6	.02	1	FLOW	4.	4.	3.	3.	2.
				TIME	3.90	3.90	3.95	3.95	3.95
2 COMBINED AT	CC	2.38	1	FLOW	1187.	1169.	1079.	1008.	972.
				TIME	4.80	4.80	4.80	4.80	4.80
ROUTED TO	DET	2.38	1	FLOW	1145.	1127.	1037.	965.	929.
				TIME	4.95	4.95	4.95	5.00	5.00
			** PEAK STAGES IN FEET **						
			1	STAGE	14.82	14.76	14.46	14.22	14.10
				TIME	4.95	4.95	4.95	5.00	5.00
HYDROGRAPH AT	7	.03	1	FLOW	26.	25.	23.	20.	19.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	K	.03	1	FLOW	25.	25.	22.	20.	19.
				TIME	3.65	3.65	3.70	3.70	3.70
HYDROGRAPH AT	8	.02	1	FLOW	35.	35.	32.	30.	29.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	9	.02	1	FLOW	3.	3.	3.	2.	2.
				TIME	4.10	4.15	4.15	4.15	4.15
HYDROGRAPH AT	08	.02	1	FLOW	33.	33.	31.	29.	28.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.02	1	FLOW	20.	19.	18.	17.	16.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	09	.29	1	FLOW	120.	118.	106.	97.	92.
				TIME	4.30	4.30	4.30	4.35	4.35
2 COMBINED AT	C5	.31	1	FLOW	129.	126.	114.	104.	99.
				TIME	4.40	4.40	4.40	4.40	4.45
ROUTED TO	K	.31	1	FLOW	128.	126.	114.	104.	99.
				TIME	4.45	4.45	4.45	4.45	4.45

2 COMBINED AT	C	.33	1	FLOW	131.	128.	116.	106.	101.
				TIME	4.40	4.40	4.45	4.45	4.45
3 COMBINED AT	C	.38	1	FLOW	139.	137.	124.	114.	109.
				TIME	4.55	4.55	4.55	4.60	4.60
ROUTED TO	R	.38	1	FLOW	139.	137.	124.	114.	109.
				TIME	4.55	4.55	4.60	4.60	4.60
2 COMBINED AT	CD	2.76	1	FLOW	1262.	1242.	1143.	1063.	1021.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	CE	2.76	1	FLOW	1261.	1241.	1142.	1062.	1021.
				TIME	4.95	4.95	5.00	5.00	5.00
HYDROGRAPH AT	2	.01	1	FLOW	13.	13.	11.	10.	10.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.01	1	FLOW	12.	12.	11.	10.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	13	.01	1	FLOW	11.	11.	10.	9.	8.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	C	.02	1	FLOW	22.	21.	19.	17.	17.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.02	1	FLOW	21.	21.	19.	18.	17.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	14	.02	1	FLOW	12.	12.	10.	9.	9.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	C	.04	1	FLOW	33.	32.	29.	27.	25.
				TIME	3.70	3.70	3.65	3.65	3.65
HYDROGRAPH AT	10	.00	1	FLOW	10.	10.	10.	9.	9.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.00	1	FLOW	8.	8.	8.	7.	7.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	11	.03	1	FLOW	15.	15.	14.	12.	12.
				TIME	3.95	3.95	3.95	3.95	3.95
2 COMBINED AT	C	.04	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.85	3.85	3.85	3.85	3.90
ROUTED TO	R	.04	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	15	.01	1	FLOW	1.	1.	0.	0.	0.
				TIME	5.10	5.10	5.10	5.10	5.10
2 COMBINED AT	C	.05	1	FLOW	23.	23.	21.	19.	18.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	16	.04	1	FLOW	37.	36.	33.	31.	30.
				TIME	3.75	3.75	3.75	3.75	3.75

ROUTED TO	R	.04	1	FLOW	36.	35.	33.	30.	29.
				TIME	3.80	3.80	3.80	3.85	3.85
HYDROGRAPH AT	17	.01	1	FLOW	16.	16.	15.	14.	13.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	C	.10	1	FLOW	67.	66.	61.	56.	54.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	R	.10	1	FLOW	67.	66.	60.	56.	53.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	18	.05	1	FLOW	43.	43.	39.	36.	35.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	19	.04	1	FLOW	46.	46.	42.	40.	38.
				TIME	3.75	3.75	3.75	3.75	3.75
4 COMBINED AT	C	.23	1	FLOW	176.	173.	159.	146.	139.
				TIME	3.80	3.80	3.75	3.80	3.75
2 COMBINED AT	CF	2.99	1	FLOW	1313.	1293.	1189.	1106.	1064.
				TIME	4.95	4.95	5.00	5.00	5.00
ROUTED TO	R	2.99	1	FLOW	1313.	1292.	1189.	1105.	1062.
				TIME	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT	20	.04	1	FLOW	53.	52.	48.	45.	44.
				TIME	3.70	3.70	3.70	3.70	3.70
ROUTED TO	R	.04	1	FLOW	52.	52.	48.	45.	43.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	21	.02	1	FLOW	27.	26.	24.	23.	22.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CG	.06	1	FLOW	76.	75.	69.	65.	63.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	CG	3.05	1	FLOW	1331.	1310.	1206.	1121.	1078.
				TIME	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	COMB	10.59	1	FLOW	3139.	3088.	2789.	2562.	2448.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	SBD2A	.02	1	FLOW	22.	22.	20.	19.	18.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	10.61	1	FLOW	3145.	3087.	2795.	2567.	2453.
				TIME	4.00	4.00	4.00	4.00	4.00
ROUTED TO	ROUT	10.61	1	FLOW	3144.	3086.	2792.	2564.	2447.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	F4	.04	1	FLOW	45.	45.	42.	39.	38.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	COMB	10.64	1	FLOW	3163.	3104.	2810.	2580.	2463.
				TIME	4.00	4.00	4.00	4.00	4.00

HYDROGRAPH AT	22 0	.04	1	FLOW	33.	32.	30.	28.	27.
				TIME	3.85	3.85	3.90	3.90	3.90
HYDROGRAPH AT	23 0	.02	1	FLOW	21.	21.	19.	18.	17.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	24 0	.05	1	FLOW	45.	44.	41.	39.	37.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	25 0	.01	1	FLOW	18.	18.	17.	16.	15.
				TIME	3.65	3.65	3.65	3.65	3.65
4 COMBINED AT	CH	.12	1	FLOW	112.	110.	101.	95.	91.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	010	.10	1	FLOW	63.	62.	56.	51.	49.
				TIME	3.85	3.85	3.90	3.90	3.90
ROUTED TO	R	.10	1	FLOW	63.	62.	56.	51.	48.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	26 S	.05	1	FLOW	53.	52.	49.	46.	44.
				TIME	3.80	3.80	3.85	3.85	3.85
2 COMBINED AT	CI	.14	1	FLOW	115.	113.	103.	95.	92.
				TIME	3.85	3.85	3.85	3.90	3.90
ROUTED TO	R	.14	1	FLOW	115.	113.	102.	95.	91.
				TIME	3.90	3.90	3.95	3.95	3.95
HYDROGRAPH AT	27 0	.03	1	FLOW	37.	36.	33.	31.	30.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CJ	.17	1	FLOW	140.	138.	124.	115.	110.
				TIME	3.85	3.85	3.85	3.90	3.90
ROUTED TO	R	.17	1	FLOW	140.	137.	124.	115.	110.
				TIME	3.85	3.85	3.90	3.90	3.90
HYDROGRAPH AT	28 0	.01	1	FLOW	21.	21.	20.	19.	18.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CK	.19	1	FLOW	151.	148.	132.	123.	118.
				TIME	3.85	3.85	3.90	3.90	3.90
ROUTED TO	R	.19	1	FLOW	150.	147.	131.	122.	117.
				TIME	3.90	3.90	3.90	3.95	3.95
HYDROGRAPH AT	29 0	.01	1	FLOW	22.	21.	20.	19.	18.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CI	.20	1	FLOW	164.	160.	143.	132.	127.
				TIME	3.85	3.85	3.90	3.90	3.90
3 COMBINED AT	COMB	10.96	1	FLOW	3411.	3347.	3033.	2789.	2664.
				TIME	3.95	4.00	4.00	4.00	4.00
ROUTED TO	ROUT	10.96	1	FLOW	3411.	3347.	3028.	2782.	2652.
				TIME	4.00	4.00	4.00	4.00	4.00

HYDROGRAPH AT	F5	.05	1	FLOW	63.	62.	57.	54.	52.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SB 17	.13	1	FLOW	208.	206.	193.	182.	177.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	11.14	1	FLOW	3512.	3447.	3122.	2871.	2739.
				TIME	4.00	4.00	4.00	4.00	4.00

*** NORMAL END OF HEC-1 ***

HEC-1 MODEL FOR 10-YR. STORM W/ CCRFCD DETENTION FACILITIES ON FRENCHMAN MOUNTAIN

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

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THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          #DIAGRAM
    1     ID   *          UNDER ULTIMATE DEVELOPMENT CONDITION            *
    2     ID    ****                                                    ****
    3     ID   * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
    4     ID   * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLD10.H1 * 3-29-93
    5     ID   * POINT RAINFALL 100-YR. STORM (10-YR FREQUANCY)  * INCLUDED D.B.
    6     IT      3       0       0     300
    7     IO      5       0
    8     IN      5       0       0
    9     JR    PREC     .57     .56     .53     .51     .50

   10     KK    SB 5
   11     BA   .1172
   12     PC   .000    .020    .057    .070    .087    .108    .124    .138    .130    .130
   13     PC   .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
   14     PC   .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
   15     PC   .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
   16     PC   .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
   17     PC   .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
   18     PC   .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
   19     PC   .998    .999    1.00
   20     PB    3.0
   21     LS      0      80
   22     UD   .2707

   23     KK    ROUT
   24     KM    ROUT FROM 1 TO 2
   25     RK    1300  .00385    .015       0    TRAP      60     1.5

   26     KK    SB 1
   27     BA   .6438
   28     PB    3.15
   29     LS      0      88
   30     UD   .1633

   31     KK    SB 6
   32     BA   .5844
   33     PB    3.15
   34     LS      0      88
   35     UD   .1285

   36     KK    COMB
   37     HC      2

   38     KK    DIVRT
   39     KM    DIVRT   OUTFALL 96 CFS
   40     DT    WHSTN
   41     DI      0      50     200     500     800    1000
   42     DQ      0      50     200     404     704     904
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  43      KK    ROUT
  44      KM    ROUT  THROU     382
  45      RK    2300    .06    .017       0   TRAP      50       0

  46      KK    SB 2
  47      BA   .2063
  48      PB    3.15
  49      LS       0      72
  50      UD   .2337

  51      KK    COMB
  52      HC       2

  53      KK    ROUT
  54      KM    ROUT  THROU WASINGTON AVE.
  55      RK    5500     2.5    .017       0   TRAP      50       0

  56      KK    SB 3
  57      BA   .2734
  58      PB    3.07
  59      LS       0      75
  60      UD   .2694

  61      KK    COMB
  62      HC       2

  63      KK    ROUTE
  64      KM    ROUT  THROU WASINGTON AVE.
  65      RK    5000    .015    .017       0   TRAP      50       0

  66      KK    SB 4
  67      BA   .1328
  68      PB     3.0
  69      LS       0      80
  70      UD   .2836

  71      KK      2E    COMB
  72      HC       2

  73      KK       2    COMB
  74      HC       2

  75      KK    ROUT
  76      KM    ROUTE THROUG  SLOAN CHANNEL
  77      RK    1500   .0051    .015       0   TRAP      60     1.5

  78      KK      3E    SB 9
  79      BA   .1078
  80      PB     3.0
  81      LS       0      68
  82      UD   .3308
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  121     KK  SB 10
  122     BA  .2828
  123     PB   3.15
  124     LS     0     88
  125     UD  .1141

  126     KK  DIVRT
  127     KM  DIVERT 124 CFS
  128     DT  STWRT
  129     DI     0     50    250    500    800
  130     DQ     0     50    124    124    124

  131     KK   ROUT
  132     KM   ROUT  THROU   SB 11
  133     RK   3800   .04   .017      0   TRAP     50      0

  134     KK  SB 11
  135     BA  .3281
  136     PB   3.15
  137     LS     0     75
  138     UD  .2856

  139     KK   COMB
  140     HC     2

  141     KK   ROUT
  142     KM   ROUT  THROU   SB 12
  143     RK   4200   .02   .025      0   TRAP     30      2

  144     KK  SB 12
  145     BA  .3594
  146     PB   3.07
  147     LS     0   71.5
  148     UD  .3890

  149     KK   COMB
  150     HC     2

  151     KK   ROUT
  152     KM   ROUT  THROU STEWART AVE.
  153     RK   1700   .008   .017      0   TRAP     50      0

  154     KK  SB 13
  155     BA  .1781
  156     PB    3.0
  157     LS     0     83
  158     UD  .3259

  159     KK     SE   COMB
  160     HC     2
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 161      KK     SW   STWRT
 162      KM  AREA DRAINING TO STEWART AVE & SLOAN CHANNEL
 163      KM  ASSUMED FULLY DEVELOPED AT 5.3 LOTS/ACRE
 164      KM       AREA     1730 AC (2.7  SQ.MI.)
 165      KM       Cn       80
 166      KM       Tl       1.603 hr
 167      KM       DARF     0.92
 168      BA     2.7
 169      PB    2.77
 170      LS       0      80
 171      UD   1.603

 172      KK       5    COMB
 173      HC       3

 174      KK     ROUT
 175      KM     ROUTE THROUG  SLOAN CHANNEL
 176      RK     2200 .00423    .015       0    TRAP      60     1.5

 177      KK   SB16A
 178      BA   .1594
 179      PB     3.0
 180      LS       0      81
 181      UD   .3071

 182      KK       6    COMB
 183      HC       2

 184      KK     ROUT
 185      KM     ROUTE THROUG  SLOAN CHANNEL
 186      RK      400 .00423    .015       0    TRAP      60     1.5

 187      KK   SB 14
 188      BA   .0938
 189      PB    3.15
 190      LS       0      75
 191      UD   .2159

 192      KK     ROUT
 193      KM     ROUT  THROU    SB 15
 194      RK     3900    .01    .017       0    TRAP      50       0

 195      KK   SB 15
 196      BA   .2406
 197      PB    3.07
 198      LS       0      75
 199      UD   .3495

 200      KK     COMB
 201      HC       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  202     KK   ROUT
  203     KM   ROUT  THROU   CHARLESTON BLVD
  204     KK   1000    .008    .017       0    TRAP      50       0

  205     KK   3816
  206     BA   .125
  207     PB    3.0
  208     LS      0      61
  209     UD   .3829

  210     KK   COMB
  211     HC      2

  212     KK   ROUT
  213     RK   1500    .005    .017       0    TRAP      50       0

  214     KK     7W  CHRLSN
  215     KM  AREA DRAINING TO CHARLESTON AND SLOAN CHANNEL
  216     KM        AREA    120 AC   (.1875  SQ.MI.)
  217     KM        Cn      86.5
  218     KM        TI      0.446 HR
  219     KM
  220     BA   .1875
  221     PB   2.77
  222     LS      0    86.5
  223     UD   .446

  224     KK      7    COMB
  225     HC      3

  226     KK   ROUT
  227     KM   ROUTE THROUGH  SLOAN CHANNEL
  228     RK   1400   .0042    .015       0    TRAP      70     1.5

  229     KK   30  ONSITE BASIN 30
  230     BA   .0256
  231     PB   3.15
  232     LS      0      90
  233     UD    .27

  234     KK   31  ONSITE B ASIN 31
  235     BA   .0172
  236     PB   3.15
  237     LS      0      87
  238     UD    .17

  239     KK   COMB
  240     HC      2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  241     KK    SVC
  242     KM  FUTURE COMMERCIAL AREA AT SLOAN AND CHARLESTON
  243     KM        AREA    27 AC    (.04219 SQ.MI.)
  244     KM        Cn      94
  245     KM        T1      0.199 HR
  246     BA  .04219
  247     PB    2.77
  248     LS       0      94
  249     UD    .199

  250     KK    COMB
  251     HC       3

  252     KK    ROUT
  253     KM    ROUTE THROUG  SLOAN CHANNEL
  254     RK    1100   .0045    .015       0    TRAP      70     1.5

  255     KK    SVGH
  256     KM  SUNRISE VALLEY GARDEN HOMES
  257     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  258     KM        AREA    26 AC    (.04063 SQ.MI.)
  259     KM        Cn      90
  260     KM        T1      0.249 HR
  261     BA  .04063
  262     PB    2.77
  263     LS       0      90
  264     UD    .249

  265     KK    COMB
  266     HC       2

  267     KK    ROUT
  268     KM    ROUTE THROUG  SLOAN CHANNEL
  269     RK    1450   .0045    .015       0    TRAP      70     1.5

  270     KK     SV8
  271     KM  SUNRISE VALLEY  UNIT 8
  272     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  273     KM        AREA    27 AC    (.04219 SQ.MI.)
  274     KM        Cn      90
  275     KM        T1      0.273 HR
  276     BA  .04219
  277     PB    2.77
  278     LS       0      90
  279     UD    .273

  280     KK    COMB
  281     HC       2
```

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  282     KK   ROUT
  283     KM   ROUTE THROUG  SLOAN CHANNEL
  284     KK    300   .0045    .015       0    TRAP      70     1.5
  285     KM      **********************

  286     KK     03 OFFSITE BASIN 03
  287     BA   .2125
  288     PB   3.15
  289     LS      0      81
  290     UD    .53

  291     KK     R3 ROUTE DOWN STORM DRAIN IN STREET C
  292     RK   1250   .0085    .013       0    CIRC     4.5

  293     KK     04 OFFSITE BASIN 04
  294     BA   .4234
  295     LS      0      88
  296     UD    .32

  297     KK     R4 ROUTE FLOWS TO HOLLYWOOD BOULEVARD
  298     RM     10      .9     .15

  299     KK     05 OFFSITE BASIN 05
  300     BA   .4078
  301     LS      0      77
  302     UD    .58

  303     KK     C3 COMBIINE FLOWS AT HOLLYWOOD
  304     HC      2

  305     KK     R5 ROUTE DOWN STORM DRAIN IN STREET B
  306     RK    700   .0308    .013       0    CIRC       5

  307     KK     CA COMBIINE FLOWS AT INTERSECTION OF STREET B & C
  308     HC      2

  309     KK     R6 ROUTE FLOWS DOWN STORM DRAIN IN STREET B TO PARK
  310     RK    900    .017    .013       0    CIRC     5.5

  311     KK     R7 ROUTE FLOWS TO PARK
  312     RK    850   .0188    .013       0    CIRC     5.5

  313     KK    06A OFFSITE BASIN 06A
  314     BA   .2594
  315     LS      0      88
  316     UD    .13

  317     KK     R8 ROUTE TO C4
  318     RM      6     .41     .15
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 319      KK    06B OFFSITE BASIN 06B
 320      BA  .1641
 321      LS     0     88
 322      UD   .14

 323      KK    R9 ROUTE TO C4
 324      RM     6    .52    .15

 325      KK    06C OFFSITE BASIN 06C
 326      BA  .1750
 327      LS     0     88
 328      UD   .19

 329      KK    R10 ROUTE TO C4
 330      RM     6    .65    .15

 331      KK     C COMBINE FLOWS
 332      HC     3

 333      KK    R11
 334      RM    10    .89    .15

 335      KK    07 OFFSITE BASIN 07
 336      BA  .6016
 337      LS     0     77
 338      UD   .73

 339      KK    C4 COMBINE FLOWS
 340      HC     2

 341      KK    R12 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
 342      RK   880  .0501   .013      0   CIRC      5

 343      KK    R13 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
 344      RK   350  .0171   .013      0   CIRC      5

 345      KK     C COMBINE FLOWS FROM BOTH STORM DRAINS IN PARK
 346      HC     2

 347      KK     3 ONSITE BASIN 3
 348      BA  .0063
 349      LS     0     75
 350      UD   .13

 351      KK     R ROUTE FLOWS DOWN STREET C
 352      RK   700   .005   .016      0   TRAP     60

 353      KK    R14 ROUTE FLOWS DOWN STREET B
 354      RK   600  .0171   .016      0   TRAP     60
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  355     KK    R15
  356     RK   1050    .02    .016       0    TRAP      60

  357     KK       4 ONSITE BASIN B4
  358     BA   .0774
  359     LS       0      75
  360     UD    .26

  361     KK       5 ONSITE BASIN 5
  362     BA   .0312
  363     LS       0      73
  364     UD    .24

  365     KK       C COMBINE  SURFACE FLOWS AT LOW POINT IN STREET A
  366     HC       3

  367     KK      CB COMBINE WITH FLOWS FROM STORM DRAIN
  368     HC       2

  369     KK       6 PARK SITE
  370     BA   .0181
  371     LS       0      61
  372     UD    .37

  373     KK      CC COMBINE FLOWS IN PARK
  374     HC       2

  375     KK     DET DETENTION BASIN IN PARK
  376     RS       1    STOR      -1
  377     SV     .03     .42    1.56    4.18    7.11   10.74   15.19   20.69   27.05
  378     SE       9      10      11      12      13      14      15      16      17
  379     SQ       0      25      50     500     700     900    1200    1500    2000

  380     KK       7 ONSITE BASIN 7
  381     BA   .0312
  382     LS       0      75
  383     UD    .19

  384     KK       R ROUTE TO ORCHARD PARK DRIVE
  385     RK     900    .010    .016       0    TRAP      60       0

  386     KK       8 ONSITE BASIN 8
  387     BA   .0245
  388     LS       0      85
  389     UD    .15

  390     KK       9 SCHOOL
  391     BA   .0194
  392     LS       0      61
  393     UD    .54
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

394       KK     08 OFFSITE BASIN 08
395       BA   .0303
396       LS      0      88
397       UD    .14

398       KK     R8 ROUTE FLOWS TO HOLLYWOOD
399       RM     16    1.23     .15

400       KK     09 OFFSITE BASIN 09
401       BA   .2891
402       LS      0      77
403       UD    .81

404       KK     C5 COMBINE FLOWS AT HOLLYWOOD
405       HC      2

406       KK      R ROUTE FLOWS TO ORCHARD VALLEY
407       RK   1320     .02    .016       0    TRAP      60       0

408       KK      C COMBINE FLOWS
409       HC      2

410       KK      C COMBINE FLOWS AT STREET D AND ORCHARD PARK DRIVE
411       HC      3

412       KK      R ROUTE FLOWS TO SUMP IN ORCHARD PARK DRIVE
413       RK    550    .011    .016       0    TRAP      80       0

414       KK     CD COMBINE ALL FLOWS INTO CHANNEL
415       HC      2

416       KK     CE ROUTE FLOWS DOWN CHANNEL TO CP E
417       RK   1800    .002    .016       0    TRAP      30     1.5

418       KK      2 ONSITE BASIN 2
419       BA   .0127
420       LS      0      75
421       UD    .11

422       KK      R ROUTE FLOWS DOWN ORCHARD VALLEY
423       RK    300     .01    .016       0    TRAP      60       0

424       KK     13 ONSITE BASIN 13
425       BA   .0084
426       LS      0      77
427       UD    .06

428       KK      C COMBINE FLOWS
429       HC      2
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

430       KK       R ROUTE FLOWS DOWN ORCHARD VALLEY DR.
431       RK    1600    .005    .016       0    TRAP      60       0

432       KK      14 ONSITE BASIN 14
433       BA   .0218
434       LS       0      70
435       UD     .23

436       KK       C COMBINE FLOWS
437       HC       2

438       KK      10 ONSITE BASIN 10
439       BA   .0050
440       LS       0      92
441       UD     .09

442       KK       R ROUTE FLOWS THRU NAPOTS TO BASIN 15
443       RM       6     .33     .15

444       KK      11 NAPOTS
445       BA   .0301
446       LS       0      74
447       UD     .45

448       KK       C COMBINE FLOWS AT BASIN 15
449       HC       2

450       KK       R ROUTE FLOWS THRU BASIN 15
451       RK    1000    .006    .016       0    TRAP      50       0

452       KK      15 ONSITE BASIN 15
453       BA   .0150
454       LS       0      49
455       UD     .42

456       KK       C COMBINE FLOWS AT INTERSECTION TRELINE DR. AND ORCHARD VALLEY DR.
457       HC       2

458       KK      16 ONSITE BASIN 16
459       BA   .0359
460       LS       0      84
461       UD     .32

462       KK       R ROUTE FLOWS DOWN TREELINE DRIVE
463       RK     800    .004    .016       0    TRAP      80       0

464       KK      17 ONSITE BASIN 17
465       BA   .0115
466       LS       0      87
467       UD     .20
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

468       KK       C COMBINE FLOWS AT TREELINE DR. AND ORCHARD VALLEY
469       HC       3

470       KK       R ROUTE COMBINED FLOWS TO INTERSECTION OF ORCHARD VALLEY AND CHANNEL
471       RK    2000    .004    .016       0    TRAP      60       0

472       KK      18 ONSITE BASIN 18
473       BA   .0457
474       LS       0      82
475       UD     .31

476       KK      19 ONSITE BASIN 19
477       BA   .0398
478       LS       0      87
479       UD     .31

480       KK       C COMBINE  STREET FLOWS AT CHANNEL CP F
481       HC       4

482       KK      CF COMBINE FLOWS IN CHANNEL
483       HC       2

484       KK       R ROUTE FLOWS DOWN CHANNEL
485       RK    1000    .002    .015       0    TRAP       8       2

486       KK      20 PEACHTREE
487       BA   .0439
488       LS       0      87
489       UD     .29

490       KK       R ROUTE FLOWS THROUGH BASIN 21
491       RK    1300    .004    .016       0    TRAP      50       0

492       KK      21 ONSITE BASIN 21
493       BA   .0203
494       LS       0      87
495       UD     .24

496       KK      CG COMBINE SURFACE FLOWS AT CP G
497       HC       2

498       KK      CG COMBINE ALL FLOWS IN CHANNEL
499       HC       2

500       KK    COMB
501       HC       2

502       KK   SBD2A
503       KM  STONEBRIDGE D2A
504       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
505       KM        AREA    10 AC    (.01563 SQ.MI.)
506       KM        Cn      90
507       KM        T1      0.172 HR
508       BA  .01563
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

509       PB    2.77
510       LS       0      90
511       UD    .172

512       KK    COMB
513       HC       2

514       KK    ROUT
515       KM    ROUT THROUGH  SLOAN  CHANNEL
516       RK     700   .0045    .015       0    TRAP      70     1.5

517       KK      F4
518       KM  FUTURE DEVELOPED AREA
519       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
520       KM        AREA    23 AC    (.03594 SQ.MI.)
521       KM        Cn      90
522       KM        T1      0.226 HR
523       BA  .03594
524       PB    2.77
525       LS       0      90
526       UD    .226

527       KK    COMB
528       HC       2

529       KK    22 ONSITE BASIN 22
530       BA  .0378
531       PB    3.15
532       LS       0      84
533       UD    .43

534       KK    23 ONSITE BASIN 23
535       BA  .0201
536       LS       0      85
537       UD    .33

538       KK    24 ONSITE BASIN 24
539       BA  .0459
540       LS       0      87
541       UD    .43

542       KK    25 ONSITE BASIN 25
543       BA  .0137
544       LS       0      87
545       UD    .23

546       KK      CH  COMBINE FLOWS INTO SLOAN
547       HC       4

548       KK     010  OFFSITE BASIN 010
549       BA  .0984
550       LS       0      77
551       UD    .41
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

552       KK       R  ROUTE FLOWS WEST ON SAHARA
553       RK    1320   .025   .016       0    TRAP     100

554       KK    26 SCHOOL BASIN 26
555       BA   .0464
556       LS       0      90
557       UD     .40

558       KK      CI  COMBINE FLOWS IN SAHARA AT TREELINE DR.
559       HC       2

560       KK       R  ROUTE FLOWS WEST ON SAHARA
561       RK    1350   .015   .016       0    TRAP     100

562       KK    27 ONSITE BASIN 27
563       BA   .0291
564       LS       0      86
565       UD     .24

566       KK      CJ  COMBINE FLOWS IN SAHARA AT ORCHARD VALLEY
567       HC       2

568       KK       R  ROUTE FLOWS WEST ON SAHARA
569       RK     500   .003   .016       0    TRAP     100

570       KK    28 ONSITE BASIN 28
571       BA   .0116
572       LS       0      94
573       UD     .18

574       KK      CK  COMBINE FLOWS IN SAHARA
575       HC       2

576       KK       R  ROUTE FLOWS TO SLOAN CHANNEL
577       RK     750   .003   .016       0    TRAP     100

578       KK    29 ONSITE BASIN 29
579       BA   .0145
580       LS       0      90
581       UD     .23

582       KK      C1  COMBINE ALL FLOWS IN SAHARA
583       HC       2

584       KK    COMB
585       HC       3

586       KK    ROUT
587       KM    ROUT THROUGH  SLOAN  CHANNEL
588       RK    1200  .0045   .015       0    TRAP      70     1.5
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  589     KK     F5
  590     KM  FUTURE DEVELOPED AREA
  591     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  592     KM        AREA    34 AC    (.05313 SQ.MI.)
  593     KM        Cn      90
  594     KM        T1      0.261 HR
  595     BA  .05313
  596     PB   2.77
  597     LS      0      90
  598     UD   .261

  599     KK   SB 17
  600     BA   .1313
  601     PB    3.0
  602     LS      0      92
  603     UD   .1952

  604     KK    COMB
  605     HC       3
  606     ZZ
```
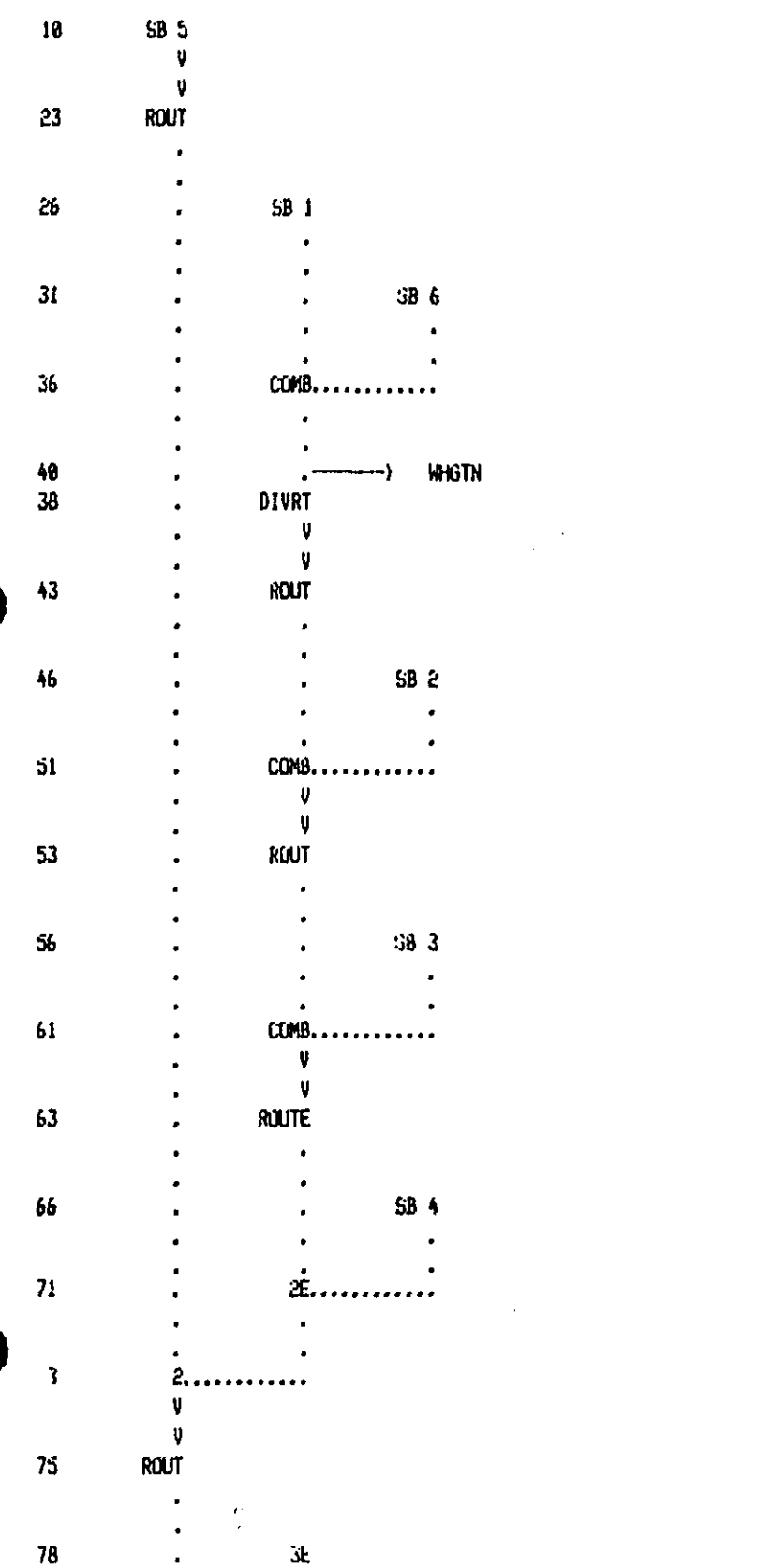
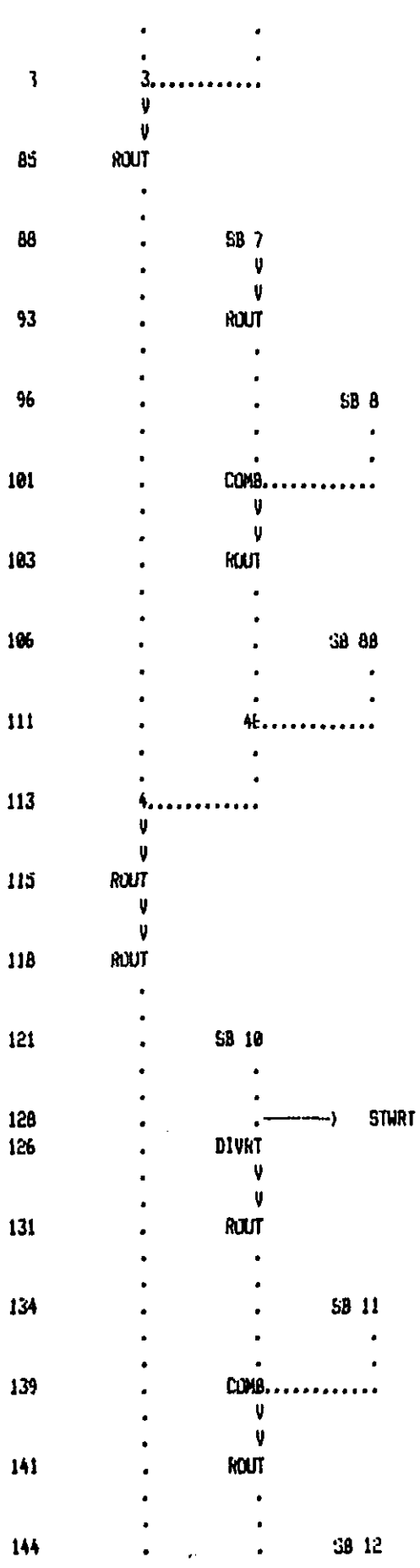

SCHEMATIC DIAGRAM OF STREAM NETWORK

LINE NO.

(V) ROUTING
(.) CONNECTOR
(---)) DIVERSION OR PUMP FLOW
((---) RETURN OF DIVERTED OR PUMPED FLOW

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3
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88
SB 7
93
ROUT
96
SB 8
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COMB
103
ROUT
106
SB 88
111
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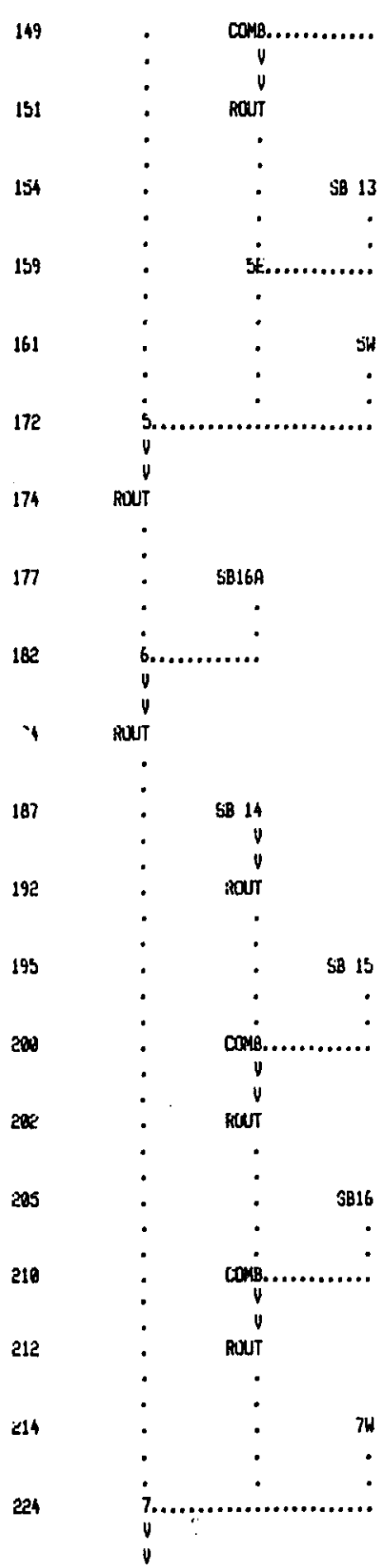
113
4
115
ROUT
118
ROUT
121
SB 10
128
STWRT
126
DIVRT
131
ROUT
134
SB 11
139
COMB
141
ROUT
144
SB 12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154 SB 13
159 5E
161 SW
172 5
174 ROUT
177 SB16A
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205 SB16
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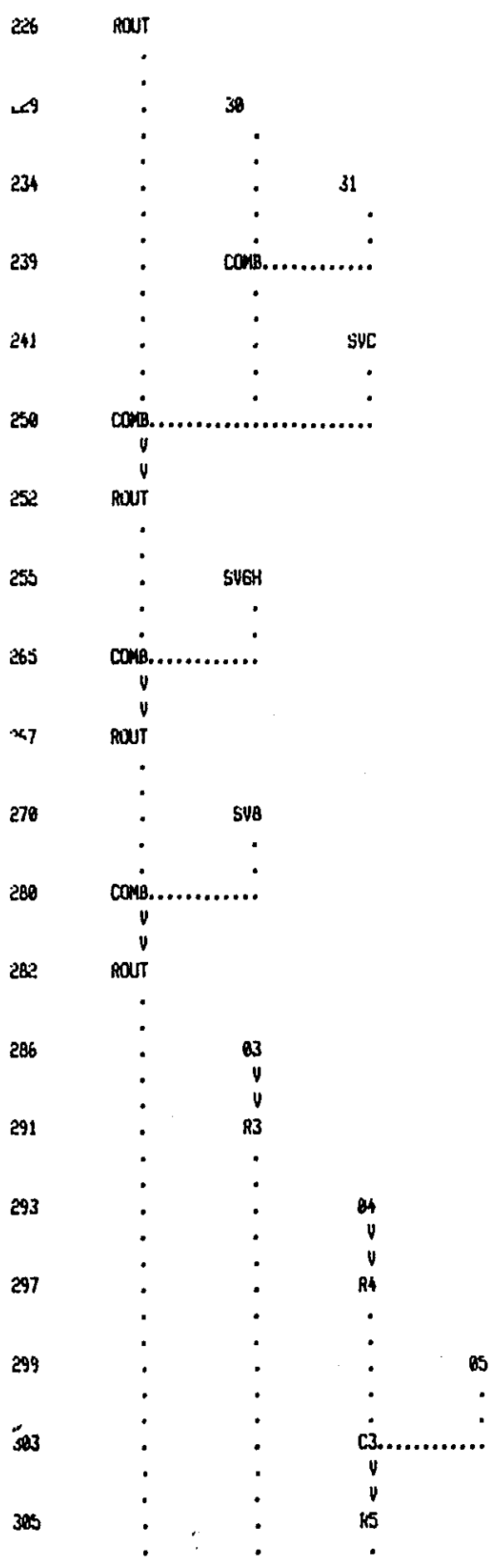
212 ROUT
214 7W
224 7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265 COMB
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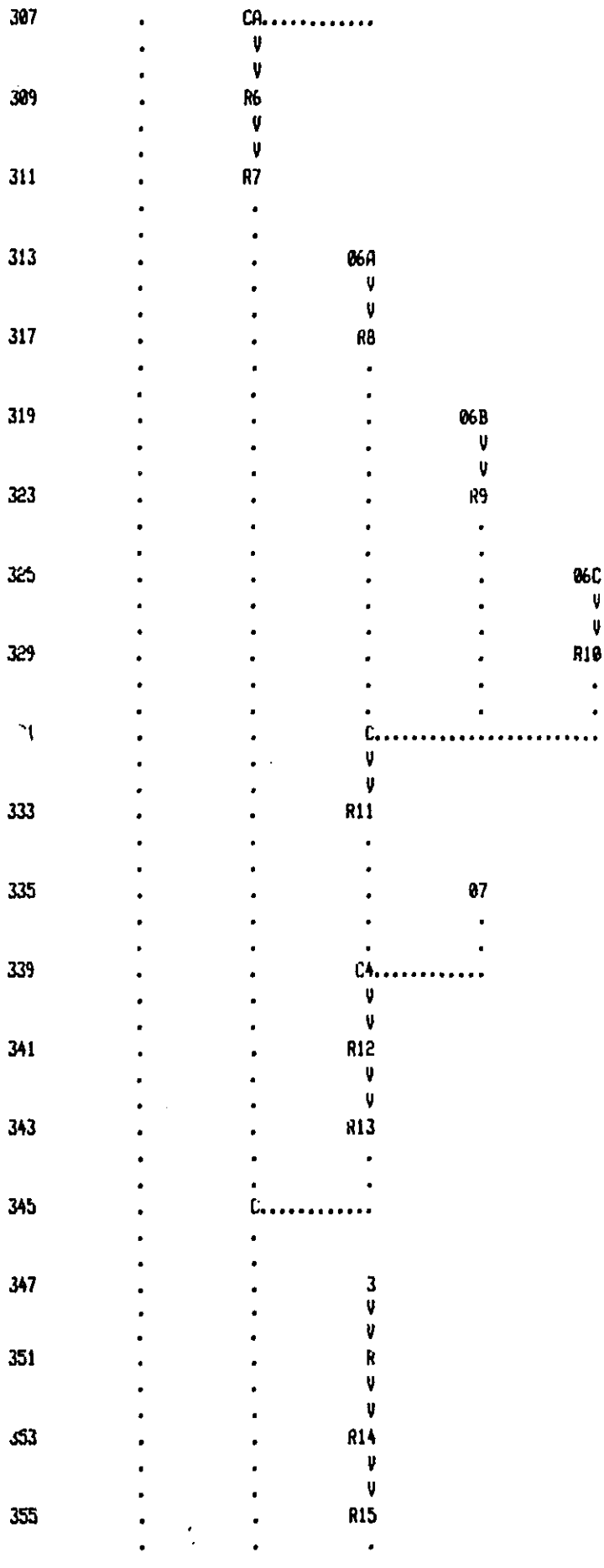
286 03
291 R3
293 04
297 R4
299 05
303 C3
305 R5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CA
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R7
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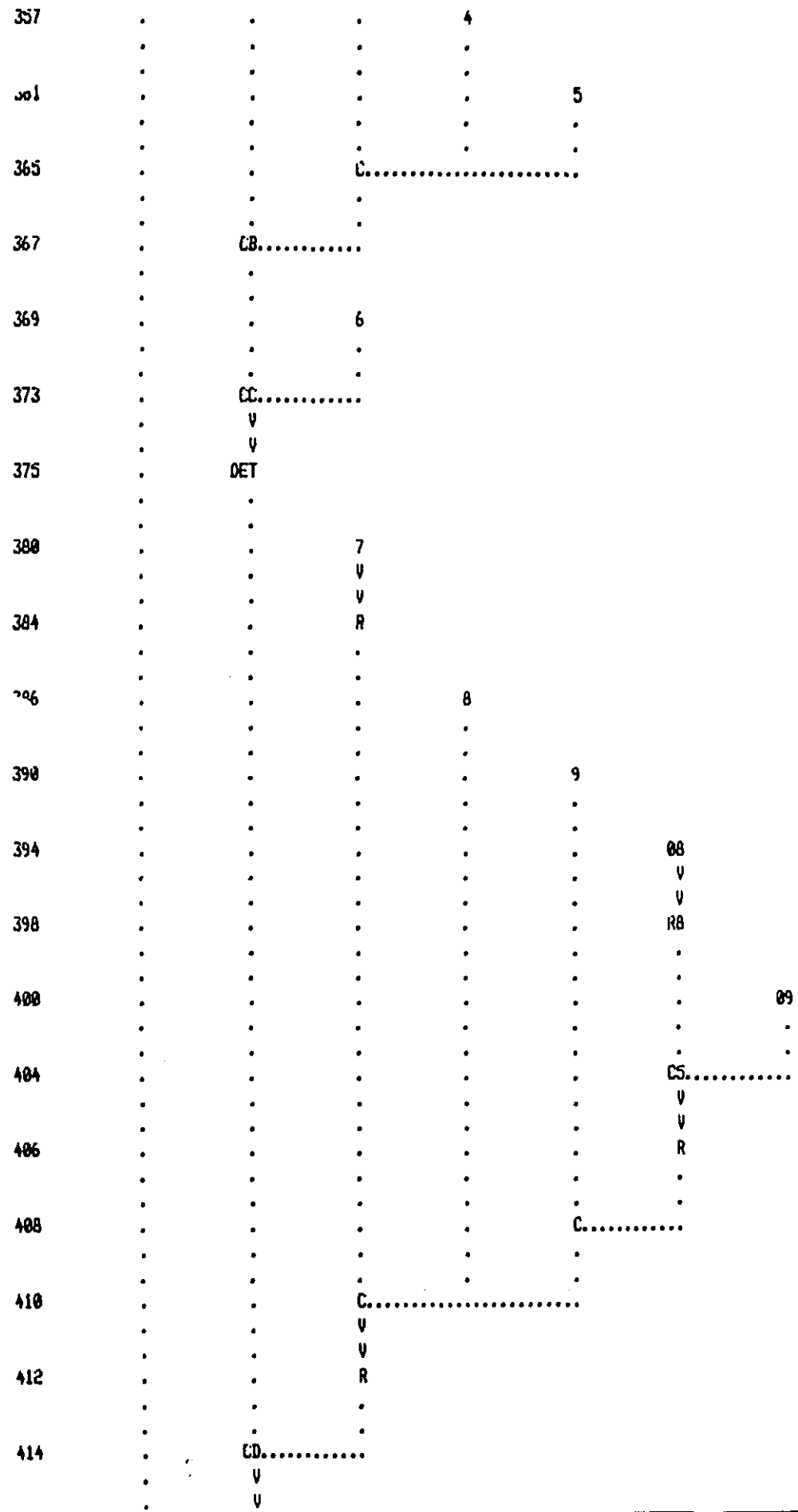
317
R8
319
06B
323
R9
325
06C
329
R10
C
333
R11
335
07
339
C4
341
R12
343
R13
345
C
347
3
351
R
353
R14
355
R15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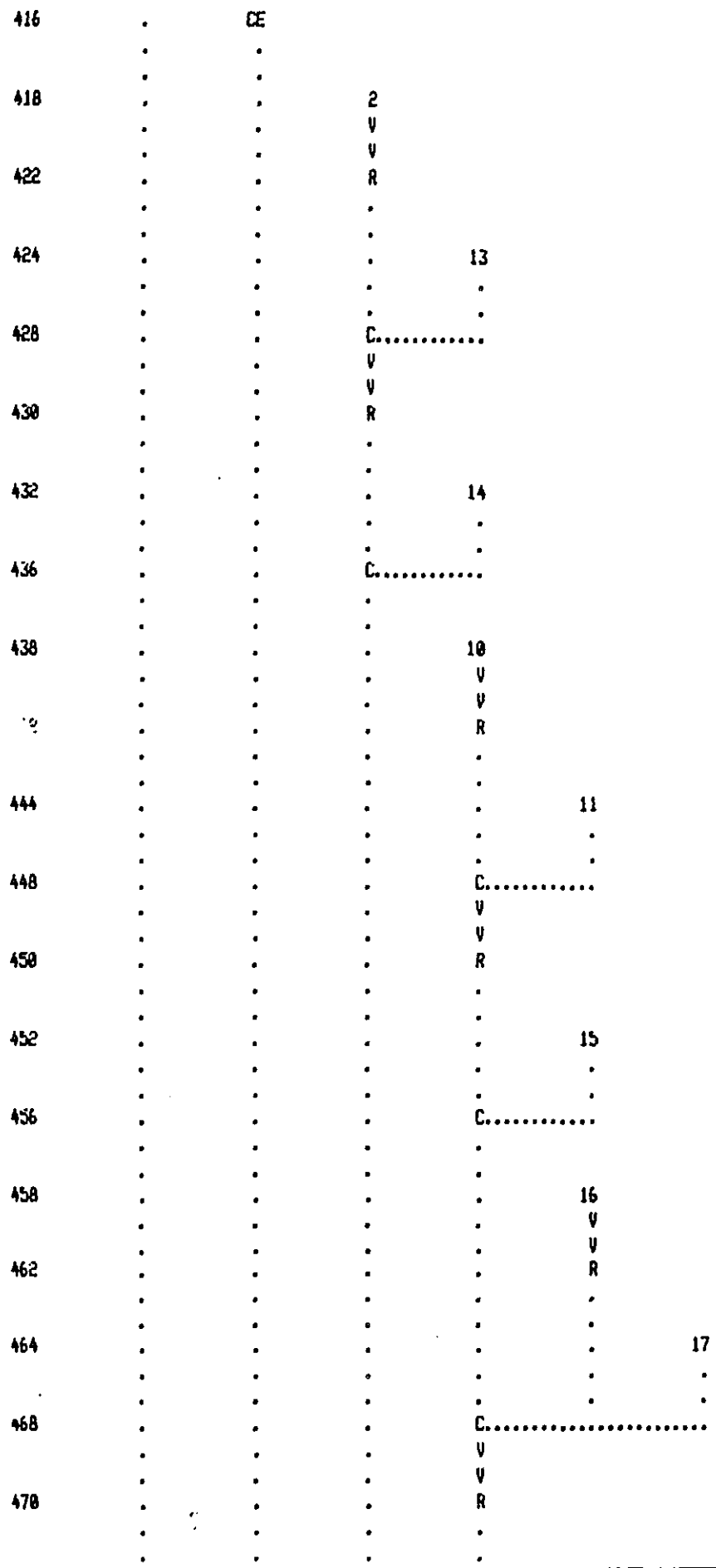
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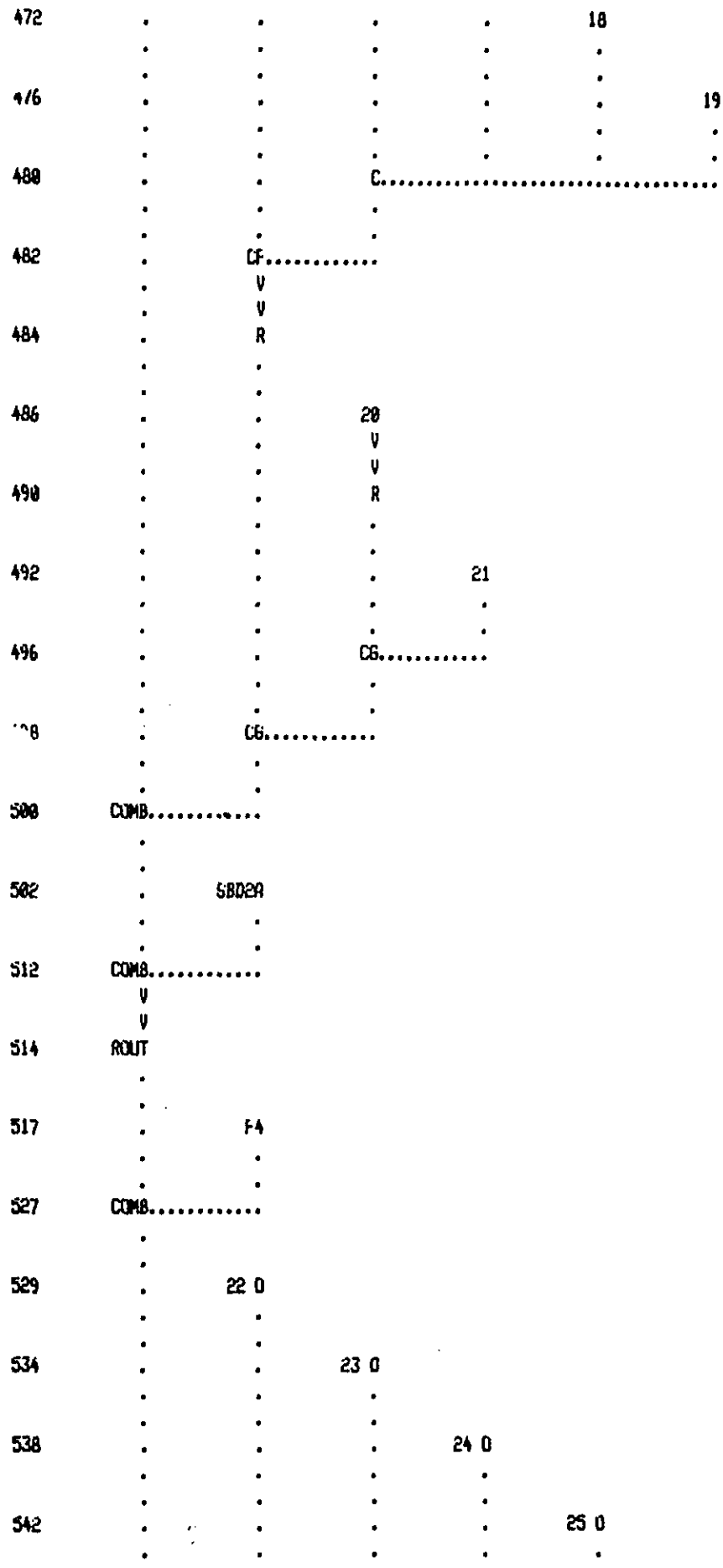
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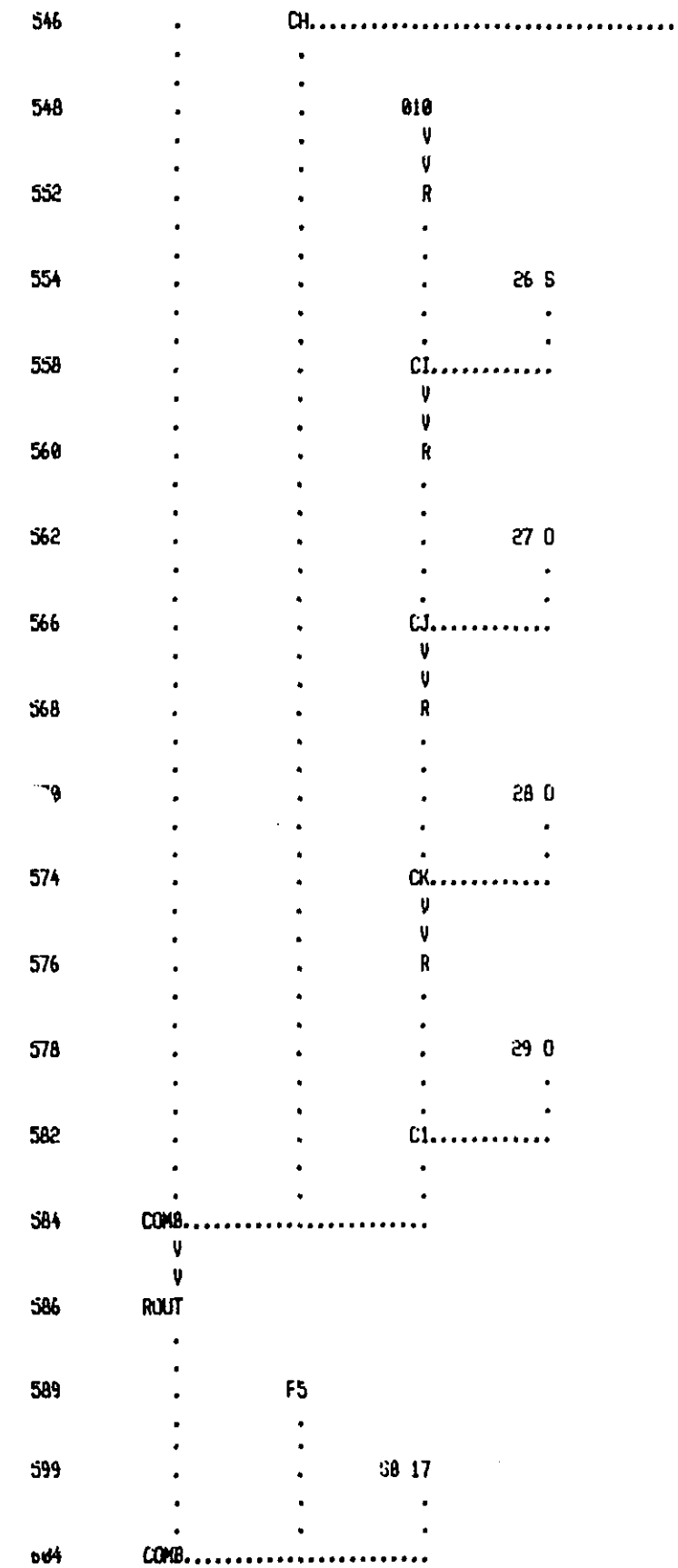

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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                    *         UNDER ULTIMATE DEVELOPMENT CONDITION          *
                     ****                                                   ****
                    * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
                    * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLD10.H1 * 3-29-93
                    * POINT RAINFALL 100-YR. STORM (10-YR FREQUANCY)  * INCLUDED D.B.

 7 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                  NMIN           3  MINUTES IN COMPUTATION INTERVAL
                 IDATE      1    0  STARTING DATE
                 ITIME        0000  STARTING TIME
                    NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                NDDATE      1    0  ENDING DATE
                NDTIME        1457  ENDING TIME

              COMPUTATION INTERVAL     .05 HOURS
                  TOTAL TIME BASE   14.95 HOURS

       ENGLISH UNITS

   JP         MULTI-PLAN OPTION
                  NPLAN          1  NUMBER OF PLANS

   JR         MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
                 .57       .56
                 .53       .51
                 .50

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG


    UNIT HYDROGRAPH TRUNCATED FROM 162 TO 150 INT   ERVALS

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .57	RATIO 2 .56	RATIO 3 .53	RATIO 4 .51	RATIO 5 .50
HYDROGRAPH AT	SB 5	.12	1	FLOW	31.	30.	26.	23.	22.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	.12	1	FLOW	31.	30.	26.	23.	22.
				TIME	3.85	3.80	3.80	3.80	3.85
HYDROGRAPH AT	SB 1	.64	1	FLOW	445.	432.	393.	367.	354.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 6	.58	1	FLOW	447.	434.	395.	369.	356.
				TIME	3.55	3.55	3.55	3.55	3.55
2 COMBINED AT	COMB	1.23	1	FLOW	870.	844.	767.	716.	690.
				TIME	3.55	3.55	3.55	3.55	3.55
DIVERSION TO	WHGTN	1.23	1	FLOW	774.	748.	671.	620.	594.
				TIME	3.55	3.55	3.55	3.55	3.55
HYDROGRAPH AT	DIVRT	1.23	1	FLOW	96.	96.	96.	96.	96.
				TIME	3.45	3.45	3.45	3.50	3.50
ROUTED TO	ROUT	1.23	1	FLOW	96.	96.	96.	96.	96.
				TIME	3.50	3.50	3.50	3.55	3.55
HYDROGRAPH AT	SB 2	.21	1	FLOW	27.	26.	21.	17.	16.
				TIME	3.75	3.75	3.80	3.80	3.80
2 COMBINED AT	COMB	1.43	1	FLOW	123.	122.	116.	113.	111.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	1.43	1	FLOW	123.	121.	116.	112.	110.
				TIME	3.80	3.80	3.80	3.75	3.75
HYDROGRAPH AT	SB 3	.27	1	FLOW	46.	43.	36.	31.	29.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	COMB	1.71	1	FLOW	169.	165.	152.	142.	139.
				TIME	3.80	3.80	3.80	3.75	3.75
ROUTED TO	ROUTE	1.71	1	FLOW	167.	163.	149.	139.	134.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	SB 4	.13	1	FLOW	35.	33.	29.	26.	24.
				TIME	3.75	3.75	3.75	3.80	3.80
2 COMBINED AT	2E	1.84	1	FLOW	200.	194.	177.	164.	158.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	2	1.96	1	FLOW	231.	224.	202.	187.	180.

				TIME	3.85	3.85	3.85	3.85	3.85
f ED TO	ROUT	1.96	1	FLOW	231.	224.	200.	184.	176.
				TIME	3.90	3.90	3.85	3.90	3.90
HYDROGRAPH AT	3E	.11	1	FLOW	5.	5.	3.	3.	3.
				TIME	3.95	3.95	5.00	5.00	5.00
2 COMBINED AT	3	2.07	1	FLOW	236.	228.	203.	186.	178.
				TIME	3.90	3.90	3.85	3.90	3.90
ROUTED TO	ROUT	2.07	1	FLOW	234.	227.	203.	184.	176.
				TIME	3.90	3.90	3.90	3.95	3.95
HYDROGRAPH AT	SB 7	.24	1	FLOW	31.	29.	24.	20.	18.
				TIME	3.75	3.75	3.80	3.80	3.80
ROUTED TO	ROUT	.24	1	FLOW	26.	24.	18.	15.	14.
				TIME	4.00	4.00	4.05	4.10	4.10
HYDROGRAPH AT	SB 8	.36	1	FLOW	48.	46.	38.	33.	31.
				TIME	3.95	3.95	3.95	4.00	4.00
2 COMBINED AT	COMB	.60	1	FLOW	74.	69.	56.	47.	43.
				TIME	3.95	4.00	4.00	4.05	4.05
ROUTED TO	ROUT	.60	1	FLOW	74.	69.	56.	47.	43.
				TIME	4.00	4.00	4.05	4.10	4.10
HYDROGRAPH AT	SB 8B	.05	1	FLOW	12.	11.	10.	9.	8.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	4E	.65	1	FLOW	82.	77.	61.	52.	48.
				TIME	4.00	4.00	4.00	4.05	4.10
2 COMBINED AT	4	2.72	1	FLOW	316.	302.	257.	230.	218.
				TIME	3.95	3.95	3.95	3.95	3.95
ROUTED TO	ROUT	2.72	1	FLOW	314.	300.	257.	227.	215.
				TIME	3.95	3.95	3.95	3.95	3.95
ROUTED TO	ROUT	2.72	1	FLOW	313.	300.	257.	227.	215.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	SB 10	.28	1	FLOW	221.	214.	195.	182.	176.
				TIME	3.55	3.55	3.55	3.55	3.55
DIVERSION TO	STWR1	.28	1	FLOW	113.	111.	104.	99.	97.
				TIME	3.55	3.55	3.55	3.55	3.55
HYDROGRAPH AT	DIVRT	.28	1	FLOW	107.	103.	91.	83.	79.
				TIME	3.55	3.55	3.55	3.55	3.55
f ED TO	ROUT	.28	1	FLOW	96.	91.	78.	70.	66.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	SB 11	.33	1	FLOW	58.	55.	46.	40.	37.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	COMB	.61	1	FLOW	139.	132.	112.	99.	93.

				TIME	3.65	3.65	3.65	3.65	3.65
F ED TO	ROUT	.61	1	FLOW	128.	121.	99.	87.	80.
				TIME	3.75	3.75	3.80	3.80	3.80
HYDROGRAPH AT	SB 12	.36	1	FLOW	32.	29.	23.	20.	18.
				TIME	3.95	3.95	4.00	4.00	4.00
2 COMBINED AT	COMB	.97	1	FLOW	151.	141.	117.	101.	93.
				TIME	3.75	3.75	3.80	3.80	3.85
ROUTED TO	ROUT	.97	1	FLOW	150.	141.	115.	100.	93.
				TIME	3.80	3.80	3.85	3.90	3.90
HYDROGRAPH AT	SB 13	.18	1	FLOW	57.	55.	48.	44.	42.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	5E	1.15	1	FLOW	207.	196.	163.	142.	132.
				TIME	3.80	3.80	3.85	3.85	3.90
HYDROGRAPH AT	5W	2.70	1	FLOW	204.	195.	169.	153.	145.
				TIME	5.55	5.55	5.60	5.60	5.65
3 COMBINED AT	5	6.56	1	FLOW	517.	495.	427.	379.	357.
				TIME	3.95	3.95	3.95	4.00	4.00
ROUTED TO	ROUT	6.56	1	FLOW	516.	494.	426.	376.	355.
				TIME	4.00	4.00	4.00	4.05	4.05
HYDROGRAPH AT	SB16A	.16	1	FLOW	44.	42.	37.	33.	32.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	6	6.72	1	FLOW	549.	525.	454.	402.	377.
				TIME	4.00	4.00	4.00	4.00	4.00
ROUTED TO	ROUT	6.72	1	FLOW	549.	525.	452.	400.	377.
				TIME	4.00	4.00	4.00	4.05	4.05
HYDROGRAPH AT	SB 14	.09	1	FLOW	19.	18.	15.	13.	12.
				TIME	3.70	3.70	3.70	3.75	3.75
ROUTED TO	ROUT	.09	1	FLOW	13.	12.	9.	9.	8.
				TIME	4.05	4.05	4.10	4.15	4.15
HYDROGRAPH AT	SB 15	.24	1	FLOW	35.	34.	28.	24.	23.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	.33	1	FLOW	46.	43.	35.	30.	27.
				TIME	3.95	3.95	3.95	4.00	4.00
ROUTED TO	ROUT	.33	1	FLOW	46.	43.	34.	30.	27.
				TIME	3.95	4.00	4.00	4.05	4.10
I OGRAPH AT	SB16	.13	1	FLOW	2.	2.	1.	1.	1.
				TIME	5.00	5.00	5.05	5.05	5.05
2 COMBINED AT	COMB	.46	1	FLOW	46.	43.	34.	30.	27.
				TIME	3.95	4.00	4.00	4.05	4.10
ROUTED TO	ROUT	.46	1	FLOW	46.	43.	34.	30.	27.

				TIME	4.05	4.10	4.10	4.15	4.15
I JGRAPH AT	7W	.19	1	FLOW	57.	56.	50.	46.	44.
				TIME	3.90	3.90	3.90	3.95	3.95
3 COMBINED AT	7	7.37	1	FLOW	649.	619.	534.	471.	444.
				TIME	4.00	4.00	4.00	4.05	4.05
ROUTED TO	ROUT	7.37	1	FLOW	646.	617.	532.	470.	441.
				TIME	4.05	4.05	4.05	4.05	4.10
HYDROGRAPH AT	30	.03	1	FLOW	16.	16.	15.	14.	13.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	31	.02	1	FLOW	11.	11.	10.	9.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.04	1	FLOW	26.	26.	23.	22.	21.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SVC	.04	1	FLOW	33.	32.	29.	28.	27.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	7.46	1	FLOW	668.	637.	551.	487.	458.
				TIME	4.00	4.05	4.05	4.05	4.05
ROUTED TO	ROUT	7.46	1	FLOW	668.	636.	546.	486.	457.
				TIME	4.05	4.05	4.05	4.10	4.10
HYDROGRAPH AT	SVGH	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.50	1	FLOW	678.	646.	555.	493.	464.
				TIME	4.05	4.05	4.05	4.10	4.10
ROUTED TO	ROUT	7.50	1	FLOW	674.	644.	555.	491.	463.
				TIME	4.10	4.10	4.10	4.15	4.15
HYDROGRAPH AT	SV8	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.54	1	FLOW	684.	653.	563.	498.	470.
				TIME	4.10	4.10	4.10	4.15	4.15
ROUTED TO	ROUT	7.54	1	FLOW	684.	653.	561.	498.	468.
				TIME	4.10	4.10	4.10	4.15	4.15
HYDROGRAPH AT	03	.21	1	FLOW	49.	47.	41.	37.	35.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R3	.21	1	FLOW	49.	47.	41.	37.	35.
				TIME	4.05	4.05	4.05	4.10	4.10
I JGRAPH AT	04	.42	1	FLOW	219.	213.	193.	180.	174.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R4	.42	1	FLOW	163.	159.	144.	134.	130.
				TIME	4.70	4.70	4.70	4.70	4.70
HYDROGRAPH AT	05	.41	1	FLOW	60.	57.	49.	43.	41.

				TIME	4.10	4.15	4.15	4.15	4.15
MBINED AT	C3	.83	1	FLOW	200.	193.	174.	162.	155.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R5	.83	1	FLOW	200.	193.	174.	161.	155.
				TIME	4.65	4.65	4.65	4.70	4.70
2 COMBINED AT	CA	1.04	1	FLOW	224.	217.	195.	181.	174.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R6	1.04	1	FLOW	224.	217.	195.	181.	174.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R7	1.04	1	FLOW	224.	216.	195.	180.	173.
				TIME	4.65	4.65	4.65	4.70	4.70
HYDROGRAPH AT	06A	.26	1	FLOW	192.	187.	170.	158.	153.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.26	1	FLOW	145.	141.	128.	119.	115.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	06B	.16	1	FLOW	118.	114.	104.	97.	94.
				TIME	3.55	3.55	3.60	3.60	3.60
ROUTED TO	R9	.16	1	FLOW	84.	81.	74.	69.	66.
				TIME	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	06C	.17	1	FLOW	113.	110.	100.	93.	90.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R10	.17	1	FLOW	78.	75.	68.	64.	62.
				TIME	4.25	4.25	4.25	4.25	4.25
3 COMBINED AT	C	.60	1	FLOW	280.	272.	247.	230.	222.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R11	.60	1	FLOW	222.	215.	195.	182.	176.
				TIME	4.95	4.95	4.95	5.00	5.00
HYDROGRAPH AT	07	.60	1	FLOW	76.	72.	62.	55.	51.
				TIME	4.30	4.30	4.30	4.30	4.35
2 COMBINED AT	C4	1.20	1	FLOW	275.	266.	240.	223.	214.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	R12	1.20	1	FLOW	275.	266.	239.	222.	214.
				TIME	4.95	4.95	5.00	5.00	5.00
ROUTED TO	R13	1.20	1	FLOW	274.	265.	239.	222.	214.
				TIME	4.95	4.95	5.00	5.00	5.00
MBINED AT	C	2.24	1	FLOW	474.	459.	414.	384.	369.
				TIME	4.85	4.85	4.85	4.90	4.90
HYDROGRAPH AT	3	.01	1	FLOW	2.	1.	1.	1.	1.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R	.01	1	FLOW	1.	1.	1.	1.	1.

				TIME	3.75	3.75	3.80	3.85	3.80
[redacted] ED TO	R14	.01	1	FLOW	1.	1.	1.	1.	1.
				TIME	3.80	3.85	3.90	3.90	3.95
ROUTED TO	R15	.01	1	FLOW	1.	1.	1.	1.	1.
				TIME	4.05	4.05	4.10	4.20	4.20
HYDROGRAPH AT	4	.08	1	FLOW	14.	13.	11.	10.	9.
				TIME	3.75	3.75	3.80	3.80	3.80
HYDROGRAPH AT	5	.03	1	FLOW	5.	4.	4.	3.	3.
				TIME	3.75	3.75	3.80	3.80	3.80
3 COMBINED AT	C	.11	1	FLOW	19.	18.	15.	13.	12.
				TIME	3.75	3.75	3.80	3.80	3.80
2 COMBINED AT	CB	2.36	1	FLOW	483.	467.	421.	391.	376.
				TIME	4.85	4.85	4.85	4.90	4.90
HYDROGRAPH AT	6	.02	1	FLOW	0.	0.	0.	0.	0.
				TIME	5.05	5.05	5.05	5.05	5.10
2 COMBINED AT	CC	2.38	1	FLOW	483.	468.	421.	391.	376.
				TIME	4.85	4.85	4.85	4.90	4.90
ROUTED TO	DET	2.38	1	FLOW	479.	464.	418.	388.	373.
				TIME	4.95	4.95	4.95	4.95	4.95
			** PEAK STAGES IN FEET **						
			1	STAGE	11.95	11.92	11.82	11.75	11.72
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	7	.03	1	FLOW	7.	6.	5.	4.	4.
				TIME	3.65	3.65	3.70	3.70	3.70
ROUTED TO	R	.03	1	FLOW	7.	6.	5.	4.	4.
				TIME	3.70	3.70	3.75	3.75	3.80
HYDROGRAPH AT	8	.02	1	FLOW	14.	14.	12.	11.	11.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	9	.02	1	FLOW	0.	0.	0.	0.	0.
				TIME	5.20	5.20	5.20	5.20	5.25
HYDROGRAPH AT	08	.02	1	FLOW	15.	14.	13.	12.	12.
				TIME	3.55	3.55	3.55	3.60	3.60
ROUTED TO	R8	.02	1	FLOW	9.	8.	8.	7.	7.
				TIME	4.80	4.80	4.80	4.80	4.80
HYDROGRAPH AT	09	.29	1	FLOW	34.	32.	28.	24.	23.
				TIME	4.40	4.40	4.40	4.40	4.45
2 COMBINED AT	C5	.31	1	FLOW	39.	37.	32.	29.	28.
				TIME	4.55	4.60	4.60	4.60	4.60
ROUTED TO	R	.31	1	FLOW	39.	37.	32.	29.	28.
				TIME	4.60	4.60	4.65	4.65	4.70

2 COMBINED AT	C	.33	1	FLOW	39.	38.	32.	29.	28.
				TIME	4.60	4.60	4.65	4.65	4.70
3 COMBINED AT	C	.38	1	FLOW	45.	43.	37.	34.	32.
				TIME	4.65	4.65	4.65	4.70	4.70
ROUTED TO	R	.38	1	FLOW	45.	43.	37.	34.	32.
				TIME	4.70	4.70	4.70	4.70	4.75
2 COMBINED AT	CD	2.76	1	FLOW	521.	503.	453.	420.	404.
				TIME	4.90	4.95	4.95	4.95	4.95
ROUTED TO	CE	2.76	1	FLOW	521.	503.	452.	419.	403.
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	2	.01	1	FLOW	3.	3.	3.	2.	2.
				TIME	3.55	3.55	3.55	3.60	3.60
ROUTED TO	R	.01	1	FLOW	3.	3.	2.	2.	2.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	13	.01	1	FLOW	3.	3.	3.	2.	2.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	C	.02	1	FLOW	6.	5.	4.	4.	3.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.02	1	FLOW	5.	5.	5.	4.	3.
				TIME	3.80	3.80	3.80	3.85	3.90
HYDROGRAPH AT	14	.02	1	FLOW	2.	2.	2.	1.	1.
				TIME	3.80	3.80	3.80	3.80	3.85
2 COMBINED AT	C	.04	1	FLOW	7.	7.	6.	5.	4.
				TIME	3.80	3.80	3.80	3.85	3.90
HYDROGRAPH AT	10	.00	1	FLOW	5.	5.	5.	4.	4.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.00	1	FLOW	4.	4.	4.	3.	3.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	11	.03	1	FLOW	4.	4.	3.	3.	2.
				TIME	4.00	4.00	4.00	4.05	4.05
2 COMBINED AT	C	.04	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	R	.04	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.95	4.00	4.00	4.00	4.00
HYDROGRAPH AT	15	.01	1	FLOW	0.	0.	0.	0.	0.
				TIME	.05	.05	.05	.05	.05
2 COMBINED AT	C	.05	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.95	4.00	4.00	4.00	4.00
HYDROGRAPH AT	16	.04	1	FLOW	14.	13.	12.	11.	11.
				TIME	3.80	3.80	3.80	3.80	3.80

ROUTED TO	R	.04	1	FLOW	14.	13.	12.	11.	11.
				TIME	3.85	3.85	3.90	3.85	3.85
HYDROGRAPH AT	17	.01	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.65	3.65	3.65	3.65	3.65
3 COMBINED AT	C	.10	1	FLOW	25.	23.	21.	19.	19.
				TIME	3.85	3.90	3.85	3.85	3.85
ROUTED TO	R	.10	1	FLOW	25.	23.	21.	19.	18.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	18	.05	1	FLOW	15.	15.	13.	12.	11.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	19	.04	1	FLOW	20.	19.	17.	16.	15.
				TIME	3.75	3.75	3.75	3.75	3.75
4 COMBINED AT	C	.23	1	FLOW	61.	58.	51.	46.	43.
				TIME	3.85	3.85	3.90	3.90	3.90
2 COMBINED AT	CF	2.99	1	FLOW	542.	524.	471.	437.	420.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	R	2.99	1	FLOW	542.	523.	471.	437.	420.
				TIME	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT	20	.04	1	FLOW	22.	22.	19.	18.	17.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	21	.02	1	FLOW	11.	11.	10.	9.	9.
				TIME	3.65	3.65	3.70	3.70	3.70
2 COMBINED AT	CG	.06	1	FLOW	33.	31.	28.	26.	25.
				TIME	3.75	3.75	3.75	3.75	3.80
2 COMBINED AT	CG	3.05	1	FLOW	551.	532.	479.	444.	427.
				TIME	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	COMB	10.59	1	FLOW	970.	926.	810.	743.	711.
				TIME	4.15	4.15	5.10	5.10	5.10
HYDROGRAPH AT	SBD2A	.02	1	FLOW	10.	10.	9.	8.	8.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	10.61	1	FLOW	972.	928.	811.	744.	712.
				TIME	4.15	4.15	5.10	5.05	5.10
ROUTED TO	ROUT	10.61	1	FLOW	972.	927.	811.	744.	712.
				TIME	4.15	4.15	5.10	5.10	5.10
HYDROGRAPH AT	F4	.04	1	FLOW	20.	20.	18.	17.	16.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	COMB	10.64	1	FLOW	978.	932.	815.	747.	715.
				TIME	4.15	4.15	5.10	5.10	5.10

HYDROGRAPH AT	22 0	.04	1	FLOW	13.	12.	11.	10.	9.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	23 0	.02	1	FLOW	8.	8.	7.	7.	6.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	24 0	.05	1	FLOW	19.	18.	17.	15.	15.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	25 0	.01	1	FLOW	8.	7.	7.	6.	6.
				TIME	3.65	3.65	3.65	3.65	3.65
4 COMBINED AT	CH	.12	1	FLOW	45.	44.	39.	36.	35.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	010	.10	1	FLOW	18.	17.	15.	13.	12.
				TIME	3.95	3.95	3.95	3.95	3.95
ROUTED TO	R	.10	1	FLOW	18.	17.	14.	13.	12.
				TIME	4.00	4.00	4.05	4.00	4.00
HYDROGRAPH AT	26 S	.05	1	FLOW	24.	24.	22.	20.	20.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	CI	.14	1	FLOW	40.	39.	35.	32.	31.
				TIME	3.90	3.85	3.90	3.90	3.90
ROUTED TO	R	.14	1	FLOW	40.	39.	35.	32.	31.
				TIME	4.00	3.95	4.00	4.00	4.00
HYDROGRAPH AT	27 0	.03	1	FLOW	15.	14.	13.	12.	12.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CJ	.17	1	FLOW	49.	48.	42.	39.	37.
				TIME	3.90	3.90	3.95	3.95	3.95
ROUTED TO	R	.17	1	FLOW	49.	47.	42.	39.	37.
				TIME	3.95	3.95	4.00	4.00	4.00
HYDROGRAPH AT	28 0	.01	1	FLOW	11.	11.	10.	10.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CK	.19	1	FLOW	53.	51.	45.	41.	40.
				TIME	3.95	3.95	3.95	4.00	4.00
ROUTED TO	R	.19	1	FLOW	52.	51.	45.	41.	39.
				TIME	4.00	4.00	4.05	4.05	4.05
HYDROGRAPH AT	29 0	.01	1	FLOW	10.	10.	9.	8.	8.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	CI	.20	1	FLOW	57.	55.	49.	45.	43.
				TIME	4.00	4.00	4.00	3.95	3.95
3 COMBINED AT	COMB	10.96	1	FLOW	1061.	1012.	870.	779.	746.
				TIME	4.15	4.15	4.15	5.10	5.10
ROUTED TO	ROUT	10.96	1	FLOW	1060.	1009.	868.	779.	745.
				TIME	4.15	4.15	4.20	5.10	5.10

HYDROGRAPH AT	F5	.05	1	FLOW	28.	27.	25.	23.	22.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	SB 17	.13	1	FLOW	101.	98.	91.	85.	83.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	11.14	1	FLOW	1093.	1042.	893.	797.	763.
				TIME	4.15	4.15	4.20	5.05	5.10

*** NORMAL END OF HEC-1 ***

****

FLOOD HYDROGRAPH PACKAGE HEC-1 (IBM XT 512K VERSION) -FEB 1,1985

U.S. ARMY CORPS OF ENGINEERS, THE HYDROLOGIC ENGINEERING CENTER, 609 SECOND STREET, DAVIS, CA. 95616

****

THIS HEC-1 VERSION CONTAINS ALL OPTIONS EXCEPT ECONOMICS, AND THE NUMBER OF PLANS ARE REDUCED TO 3

HEC-1 MODEL FOR 10-YR. STORM WITHOUT DETENTION IN LOCAL WATERSHED

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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

          *DIAGRAM
    1     ID   *         UNDER ULTIMATE DEVELOPMENT CONDITION          *
    2     ID    ****                                                  ****
    3     ID   * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
    4     ID   * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.H1 *
    5     ID   * POINT RAINF ALL(100-YR. STORM)     10-YR. FREQUANCY   3-29-93
    6     IT      3      0      0     300
    7     IO      5      0
    8     IN      5      0      0
    9     JR    PREC    .57    .56    .53    .51    .50

   10     KK    SB 5
   11     BA   .1172
   12     PC   .000   .020   .057   .070   .087   .108   .124   .130   .130   .130
   13     PC   .130   .130   .130   .133   .140   .142   .148   .158   .172   .181
   14     PC   .190   .197   .199   .200   .201   .204   .214   .229   .241   .249
   15     PC   .251   .256   .270   .278   .281   .283   .295   .322   .352   .409
   16     PC   .499   .590   .710   .744   .781   .812   .819   .835   .851   .856
   17     PC   .860   .868   .876   .888   .910   .926   .937   .950   .970   .976
   18     PC   .982   .985   .987   .989   .990   .993   .993   .994   .995   .998
   19     PC   .998   .999   1.00
   20     PB    3.0
   21     LS      0     80
   22     UD   .2707

   23     KK    ROUT
   24     KM    ROUT FROM 1 TO 2
   25     RK    1300  .00385   .015      0    TRAP     60    1.5

   26     KK    SB 1
   27     BA   .6438
   28     PB    3.15
   29     LS      0     88
   30     UD   .1633

   31     KK    ROUT
   32     KM    ROUTE THROUG  H SB 2
   33     RK    3000    .05    .017      0    TRAP     50      0

   34     KK    SB 2
   35     BA   .2063
   36     PB    3.15
   37     LS      0     72
   38     UD   .2337

   39     KK    COMB
   40     HC      2

   41     KK    ROUT
   42     KM    ROUT  THROU WASINGTON AVE.
   43     RK    5500    2.5    .017      0    TRAP     50      0
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  44      KK   SB 3
  45      BA  .2734
  46      PB  3.07
  47      LS     0     75
  48      UD  .2694

  49      KK   COMB
  50      HC     2

  51      KK   ROUTE
  52      KM   ROUT  THROU WASINGTON AVE.
  53      RK   5000   .015   .017      0   TRAP     50      0

  54      KK   SB 4
  55      BA  .1328
  56      PB   3.0
  57      LS     0     80
  58      UD  .2836

  59      KK    2E   COMB
  60      HC     2

  61      KK     2   COMB
  62      HC     2

  63      KK   ROUT
  64      KM   ROUTE THROUG  SLOAN CHANNEL
  65      RK   1500  .0051   .015      0   TRAP     60    1.5

  66      KK    3E   SB 9
  67      BA  .1078
  68      PB   3.0
  69      LS     0     68
  70      UD  .3388

  71      KK     3   COMB
  72      HC     2

  73      KK   ROUT
  74      KM   ROUTE THROUG  SLOAN CHANNEL
  75      RK    950  .0051   .015      0   TRAP     60    1.5

  76      KK   SB 6
  77      BA  .5844
  78      PB  3.15
  79      LS     0     88
  80      UD  .1205

  81      KK   ROUT
  82      KM   ROUT  THROU    SB 7
  83      RK   2300   .06    .017      0   TRAP     50      0
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  84      KK   SB 7
  85      BA  .2375
  86      PB   3.15
  87      LS     0      72
  88      UD  .2354

  89      KK   COMB
  90      HC     2

  91      KK   ROUT
  92      KM   ROUT  THROU BONANZA ROAD
  93      RK   4200   .018    .017       0    TRAP      50       0

  94      KK   SB 8
  95      BA  .3594
  96      PB   3.07
  97      LS     0      75
  98      UD  .4154

  99      KK   COMB
 100      HC     2

 101      KK   ROUT
 102      KM   ROUT  THROU BONANZA ROAD
 103      RK   1300    .01    .017       0    TRAP      50       0

 104      KK   SB 8B
 105      BA  .0531
 106      PB    3.0
 107      LS     0      78
 108      UD  .2539

 109      KK     4E   COMB
 110      HC     2

 111      KK     4    COMB
 112      HC     2

 113      KK   ROUT
 114      KM   ROUTE THROUG  SLOAN CHANNEL
 115      RK    900  .0075    .015       0    TRAP      60     1.5

 116      KK   ROUT
 117      KM   ROUTE THROUG  SLOAN CHANNEL
 118      RK   1500  .0049    .015       0    TRAP      60     1.5

 119      KK   SB 10
 120      BA  .2828
 121      PB   3.15
 122      LS     0      88
 123      UD  .1141
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  124     KK   ROUT
  125     KM   ROUT  THROU   SB 11
  126     RK   3800    .04   .017      0   TRAP     50      0

  127     KK   SB 11
  128     BA   .3281
  129     PB   3.15
  130     LS      0     75
  131     UD   .2856

  132     KK   COMB
  133     HC      2

  134     KK  DIVERT
  135     KM  DIVERT 250 CFS TO CHARLESTON BLVD.
  136     DT   CHBLD
  137     DI     30     50    200    400    700
  138     DQ     15     25    100    200    250

  139     KK   ROUT
  140     KM   ROUT  THROU   SB 12
  141     RK   4200    .02   .025      0   TRAP     30      2

  142     KK   SB 12
  143     BA   .3594
  144     PB   3.07
  145     LS      0   71.5
  146     UD   .3898

  147     KK   COMB
  148     HC      2

  149     KK   ROUT
  150     KM   ROUT  THROU STEWART AVE.
  151     RK   1700   .008   .017      0   TRAP     50      0

  152     KK   SB 13
  153     BA   .1781
  154     PB    3.0
  155     LS      0     83
  156     UD   .3259

  157     KK     5E   COMB
  158     HC      2

  159     KK     5W   STWRT
  160     KM  AREA DRAINING TO STEWART AVE & SLOAN CHANNEL
  161     KM  ASSUMED FULLY DEVELOPED AT 5.3 LOTS/ACRE
  162     KM       AREA     1730 AC (2.7  SQ.MI.)
  163     KM       Cn       88
  164     KM       Tl       1.603 hr
  165     KM       DARF     0.92
  166     BA    2.7
  167     PB   2.77
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 168      LS      0      80
 169      UD  1.603

 170      KK      5    COMB
 171      HC      3

 172      KK    ROUT
 173      KM    ROUTE THROUG  SLOAN CHANNEL
 174      RK     2200 .00423    .015       0    TRAP      60     1.5

 175      KK   SB16A
 176      BA   .1594
 177      PB     3.0
 178      LS      0      81
 179      UD   .3071

 180      KK      6    COMB
 181      HC      2

 182      KK    ROUT
 183      KM    ROUTE THROUG  SLOAN CHANNEL
 184      RK      400 .00423    .015       0    TRAP      60     1.5

 185      KK   SB 14
 186      BA   .0938
 187      PB    3.15
 188      LS      0      75
 189      UD   .2159

 190      KK  CAL-CH
 191      DR   CHBLD

 192      KK    COMB
 193      HC      2

 194      KK    ROUT
 195      KM    ROUT  THROU    SB 15
 196      RK    3900     .01    .017       0    TRAP      50       0

 197      KK   SB 15
 198      BA   .2406
 199      PB    3.07
 200      LS      0      75
 201      UD   .3495

 202      KK    COMB
 203      HC      2

 204      KK    ROUT
 205      KM   ROUT  THROU   CHARLESTON BLVD
 206      RK    1000    .008    .017       0    TRAP      50       0
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  207     KK   SB16
  208     BA   .125
  209     PB    3.0
  210     LS     0      61
  211     UD   .3029

  212     KK   COMB
  213     HC     2

  214     KK   ROUT
  215     RK   1500   .005    .017       0    TRAP      50       0

  216     KK     7W  CHRLSN
  217     KM  AREA DRAINING TO CHARLESTON AND SLOAN CHANNEL
  218     KM        AREA     120 AC    (.1875  SQ.MI.)
  219     KM        Cn       86.5
  220     KM        T1       0.446 HR
  221     KM
  222     BA   .1875
  223     PB   2.77
  224     LS     0    86.5
  225     UD   .446

  226     KK     7    COMB
  227     HC     3

  228     KK   ROUT
  229     KM   ROUTE THROUG  SLOAN CHANNEL
  230     RK   1400   .0042    .015       0    TRAP      70     1.5

  231     KK   30  ONSITE BASIN 30
  232     BA   .0256
  233     PB   3.15
  234     LS     0      90
  235     UD    .27

  236     KK     31ONSITE B ASIN 31
  237     BA   .0172
  238     PB   3.15
  239     LS     0      87
  240     UD    .17

  241     KK   COMB
  242     HC     2

  243     KK    SVC
  244     KM  FUTURE COMMERCIAL AREA AT SLOAN AND CHARLESTON
  245     KM        AREA     27 AC     (.04219 SQ.MI.)
  246     KM        Cn       94
  247     KM        T1       0.199 HR
  248     BA  .04219
  249     PB   2.77
  250     LS     0      94
  251     UD   .199
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  252     KK    COMB
  253     HC      3

  254     KK    ROUT
  255     KM    ROUTE THROUG  SLOAN CHANNEL
  256     RK    1100   .0045    .015       0    TRAP      70     1.5

  257     KK    SVGH
  258     KM  SUNRISE VALLEY GARDEN HOMES
  259     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  260     KM        AREA    26 AC    (.04063 SQ.MI.)
  261     KM        Cn      90
  262     KM        TI      0.249 HR
  263     BA  .04063
  264     PB    2.77
  265     LS      0      90
  266     UD    .249

  267     KK    COMB
  268     HC      2

  269     KK    ROUT
  270     KM    ROUTE THROUG  SLOAN CHANNEL
  271     RK    1450   .0045    .015       0    TRAP      70     1.5

  272     KK     SV8
  273     KM  SUNRISE VALLEY  UNIT 8
  274     KM  DEVELOPED DENSITY = 8 UNITS/ACRE
  275     KM        AREA    27 AC    (.04219 SQ.MI.)
  276     KM        Cn      90
  277     KM        TI      0.273 HR
  278     BA  .04219
  279     PB    2.77
  280     LS      0      90
  281     UD    .273

  282     KK    COMB
  283     HC      2

  284     KK    ROUT
  285     KM    ROUTE THROUG  SLOAN CHANNEL
  286     RK     300   .0045    .015       0    TRAP      70     1.5
  287     KM    ************************

  288     KK      03 OFFSITE BASIN 03
  289     BA   .2125
  290     PB    3.15
  291     LS      0      81
  292     UD     .53
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  293     KK     R3 ROUTE DOWN STORM DRAIN IN STREET C
  294     RK   1250  .0085   .013      0   CIRC    4.5

  295     KK     04 OFFSITE BASIN 04
  296     BA  .4234
  297     LS      0     88
  298     UD    .32

  299     KK     R4 ROUTE FLOWS TO HOLLYWOOD BOULEVARD
  300     RM     10     .9    .15

  301     KK     05 OFFSITE BASIN 05
  302     BA  .4078
  303     LS      0     77
  304     UD    .58

  305     KK     C3 COMBIINE FLOWS AT HOLLYWOOD
  306     HC      2

  307     KK     R5 ROUTE DOWN STORM DRAIN IN STREET B
  308     RK    700  .0308   .013      0   CIRC      5

  309     KK     CA COMBIINE FLOWS AT INTERSECTION OF STREET B & C
  310     HC      2

  311     KK     R6 ROUTE FLOWS DOWN STORM DRAIN IN STREET B TO PARK
  312     RK    900   .017   .013      0   CIRC    5.5

  313     KK     R7 ROUTE FLOWS TO PARK
  314     RK    850  .0188   .013      0   CIRC    5.5

  315     KK    06A OFFSITE BASIN 06A
  316     BA  .2594
  317     LS      0     88
  318     UD    .13

  319     KK     R8 ROUTE TO C4
  320     RM      6    .41    .15

  321     KK    06B OFFSITE BASIN 06B
  322     BA  .1641
  323     LS      0     88
  324     UD    .14

  325     KK     R9 ROUTE TO C4
  326     RM      6    .52    .15

  327     KK    06C OFFSITE BASIN 06C
  328     BA  .1750
  329     LS      0     88
  330     UD    .19
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  331     KK     R10 ROUTE TO C4
  332     RM       6     .65     .15

  333     KK       C COMBINE FLOWS
  334     HC       3

  335     KK     R11
  336     RM      10     .89     .15

  337     KK      07 OFFSITE BASIN 07
  338     BA   .6016
  339     LS       0      77
  340     UD     .73

  341     KK      C4 COMBINE FLOWS
  342     HC       2

  343     KK     R12 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  344     RK     880   .0501    .013       0    CIRC       5

  345     KK     R13 ROUTE FLOWS DOWN STORM DRAIN IN STREET A
  346     RK     350   .0171    .013       0    CIRC       5

  347     KK       C COMBINE FLOWS FROM BOTH STORM DRAINS IN PARK
  348     HC       2

  349     KK       3 ONSITE BASIN 3
  350     BA   .0063
  351     LS       0      75
  352     UD     .13

  353     KK       R ROUTE FLOWS DOWN STREET C
  354     RK     700    .005    .016       0    TRAP      60

  355     KK     R14 ROUTE FLOWS DOWN STREET B
  356     RK     600   .0171    .016       0    TRAP      60

  357     KK     R15
  358     RK    1050     .02    .016       0    TRAP      60

  359     KK       4 ONSITE BASIN B4
  360     BA   .0774
  361     LS       0      75
  362     UD     .26

  363     KK       5 ONSITE BASIN 5
  364     BA   .0312
  365     LS       0      73
  366     UD     .24
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  367     KK      C COMBINE  SURFACE FLOWS AT LOW POINT IN STREET A
  368     HC      3

  369     KK     CB COMBINE WITH FLOWS FROM STORM DRAIN
  370     HC      2

  371     KK      6 PARK SITE
  372     BA  .0181
  373     LS      0      61
  374     UD    .37

  375     KK     CC COMBINE FLOWS IN PARK
  376     HC      2

  377     KK    DET DETENTION BASIN IN PARK
  378     RS      1    STOR     -1
  379     SV    .03     .42    1.56    4.18    7.11   10.74   15.19   20.69   27.05
  380     SE      9      10      11      12      13      14      15      16      17
  381     SQ      0      25      50     500     700     900    1200    1500    2000

  382     KK      7 ONSITE BASIN 7
  383     BA  .0312
  384     LS      0      75
  385     UD    .19

  386     KK      R ROUTE TO ORCHARD PARK DRIVE
  387     RK    900    .010    .016       0    TRAP      60       0

  388     KK      8 ONSITE BASIN 8
  389     BA  .0245
  390     LS      0      85
  391     UD    .15

  392     KK      9 SCHOOL
  393     BA  .0194
  394     LS      0      61
  395     UD    .54

  396     KK     08 OFFSITE BASIN 08
  397     BA  .0203
  398     LS      0      88
  399     UD    .14

  400     KK     R8 ROUTE FLOWS TO HOLLYWOOD
  401     RM     16    1.23     .15

  402     KK     09 OFFSITE BASIN 09
  403     BA  .2891
  404     LS      0      77
  405     UD    .81
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  406     KK      C5 COMBINE FLOWS AT HOLLYWOOD
  407     HC       2

  408     KK       R ROUTE FLOWS TO ORCHARD VALLEY
  409     RK    1320    .02    .016       0    TRAP      60       0

  410     KK       C COMBINE FLOWS
  411     HC       2

  412     KK       C COMBINE FLOWS AT STREET D AND ORCHARD PARK DRIVE
  413     HC       3

  414     KK       R ROUTE FLOWS TO SUMP IN ORCHARD PARK DRIVE
  415     RK     550    .011    .016       0    TRAP      80       0

  416     KK      CD COMBINE ALL FLOWS INTO CHANNEL
  417     HC       2

  418     KK      CE ROUTE FLOWS DOWN CHANNEL TO CP E
  419     RK    1800    .002    .016       0    TRAP      30     1.5

  420     KK       2 ONSITE BASIN 2
  421     BA   .0127
  422     LS       0      75
  423     UD     .11

  424     KK       R ROUTE FLOWS DOWN ORCHARD VALLEY
  425     RK     300     .01    .016       0    TRAP      60       0

  426     KK      13 ONSITE BASIN 13
  427     BA   .0084
  428     LS       0      77
  429     UD     .06

  430     KK       C COMBINE FLOWS
  431     HC       2

  432     KK       R ROUTE FLOWS DOWN ORCHARD VALLEY DR.
  433     RK    1600    .005    .016       0    TRAP      60       0

  434     KK      14 ONSITE BASIN 14
  435     BA   .0218
  436     LS       0      70
  437     UD     .23

  438     KK       C COMBINE FLOWS
  439     HC       2

  440     KK      10 ONSITE BASIN 10
  441     BA   .0050
  442     LS       0      92
  443     UD     .09
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  444     KK      R ROUTE FLOWS THRU NAPOTS TO BASIN 15
  445     RM      6    .33    .15

  446     KK     11 NAPOTS
  447     BA   .0301
  448     LS      0     74
  449     UD    .45

  450     KK      C COMBINE FLOWS AT BASIN 15
  451     HC      2

  452     KK      R ROUTE FLOWS THRU BASIN 15
  453     RK   1000   .006   .016      0   TRAP     50      0

  454     KK     15 ONSITE BASIN 15
  455     BA   .0150
  456     LS      0     49
  457     UD    .42

  458     KK      C COMBINE FLOWS AT INTERSECTION TRELINE DR. AND ORCHARD VALLEY DR.
  459     HC      2

  460     KK     16 ONSITE BASIN 16
  461     BA   .0359
  462     LS      0     84
  463     UD    .32

  464     KK      R ROUTE FLOWS DOWN TREELINE DRIVE
  465     RK    800   .004   .016      0   TRAP     80      0

  466     KK     17 ONSITE BASIN 17
  467     BA   .0115
  468     LS      0     87
  469     UD    .20

  470     KK      C COMBINE FLOWS AT TREELINE DR. AND ORCHARD VALLEY
  471     HC      3

  472     KK      R ROUTE COMBINED FLOWS TO INTERSECTION OF ORCHARD VALLEY AND CHANNEL
  473     RK   2000   .004   .016      0   TRAP     60      0

  474     KK     18 ONSITE BASIN 18
  475     BA   .0457
  476     LS      0     82
  477     UD    .31

  478     KK     19 ONSITE BASIN 19
  479     BA   .0398
  480     LS      0     87
  481     UD    .31
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 482      KK      C COMBINE  STREET FLOWS AT CHANNEL CP F
 483      HC      4

 484      KK     CF COMBINE FLOWS IN CHANNEL
 485      HC      2

 486      KK      R ROUTE FLOWS DOWN CHANNEL
 487      RK   1000    .002    .015       0    TRAP       8      2

 488      KK     20 PEACHTREE
 489      BA   .0439
 490      LS      0      87
 491      UD    .29

 492      KK      R ROUTE FLOWS THROUGH BASIN 21
 493      RK   1300    .004    .016       0    TRAP      50      0

 494      KK     21 ONSITE BASIN 21
 495      BA   .0203
 496      LS      0      87
 497      UD    .24

 498      KK     CG COMBINE SURFACE FLOWS AT CP 6
 499      HC      2

 500      KK     CG COMBINE ALL FLOWS IN CHANNEL
 501      HC      2

 502      KK    COMB
 503      HC      2

 504      KK   SBD2A
 505      KM  STONEBRIDGE D2A
 506      KM  DEVELOPED DENSITY = 8 UNITS/ACRE
 507      KM        AREA    10 AC    (.01563 SQ.MI.)
 508      KM        Cn      90
 509      KM        T1      0.172 HR
 510      BA  .01563
 511      PB   2.77
 512      LS      0      90
 513      UD    .172

 514      KK    COMB
 515      HC      2

 516      KK    ROUT
 517      KM    ROUT THROUGH  SLOAN  CHANNEL
 518      RK     700   .0045    .015       0    TRAP      70    1.5
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

519       KK     F4
520       KM  FUTURE DEVELOPED AREA
521       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
522       KM        AREA    23 AC    (.03594 SQ.MI.)
523       KM        Cn      90
524       KM        T1      0.226 HR
525       BA  .03594
526       PB   2.77
527       LS      0      90
528       UD   .226

529       KK   COMB
530       HC      2

531       KK   22 ONSITE BASIN 22
532       BA  .0378
533       PB   3.15
534       LS      0      84
535       UD    .43

536       KK   23 ONSITE BASIN 23
537       BA  .0201
538       LS      0      85
539       UD    .33

540       KK   24 ONSITE BASIN 24
541       BA  .0459
542       LS      0      87
543       UD    .43

544       KK   25 ONSITE BASIN 25
545       BA  .0137
546       LS      0      87
547       UD    .23

548       KK     CH  COMBINE FLOWS INTO SLOAN
549       HC      4

550       KK    010  OFFSITE BASIN 010
551       BA  .0984
552       LS      0      77
553       UD    .41

554       KK      R  ROUTE FLOWS WEST ON SAHARA
555       RK   1320    .025    .016       0    TRAP     100

556       KK   26 SCHOOL BASIN 26
557       BA  .0464
558       LS      0      90
559       UD    .40
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

560       KK      CI  COMBINE FLOWS IN SAHARA AT TREELINE DR.
561       HC       2

562       KK       R  ROUTE FLOWS WEST ON SAHARA
563       RK    1350   .015   .016       0   TRAP     100

564       KK    27 ONSITE BASIN 27
565       BA   .0291
566       LS       0     86
567       UD     .24

568       KK      CJ  COMBINE FLOWS IN SAHARA AT ORCHARD VALLEY
569       HC       2

570       KK       R  ROUTE FLOWS WEST ON SAHARA
571       RK     500   .003   .016       0   TRAP     100

572       KK    28 ONSITE BASIN 28
573       BA   .0116
574       LS       0     94
575       UD     .18

576       KK      CK  COMBINE FLOWS IN SAHARA
577       HC       2

578       KK       R  ROUTE FLOWS TO SLOAN CHANNEL
579       RK     750   .003   .016       0   TRAP     100

580       KK    29 ONSITE BASIN 29
581       BA   .0145
582       LS       0     90
583       UD     .23

584       KK      C1  COMBINE ALL FLOWS IN SAHARA
585       HC       2

586       KK    COMB
587       HC       3

588       KK    ROUT
589       KM    ROUT THROUGH  SLOAN  CHANNEL
590       RK    1200  .0045   .015       0   TRAP      70     1.5

591       KK      FS
592       KM  FUTURE DEVELOPED AREA
593       KM  DEVELOPED DENSITY = 8 UNITS/ACRE
594       KM        AREA    34 AC    (.05313 SQ.MI.)
595       KM        Cn      90
596       KM        T1      0.261 HR
597       BA  .05313
598       PB    2.77
599       LS       0     90
600       UD     .261
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

601       KK  SB 17
602       BA  .1313
603       PB    3.0
604       LS      0      92
605       UD  .1952

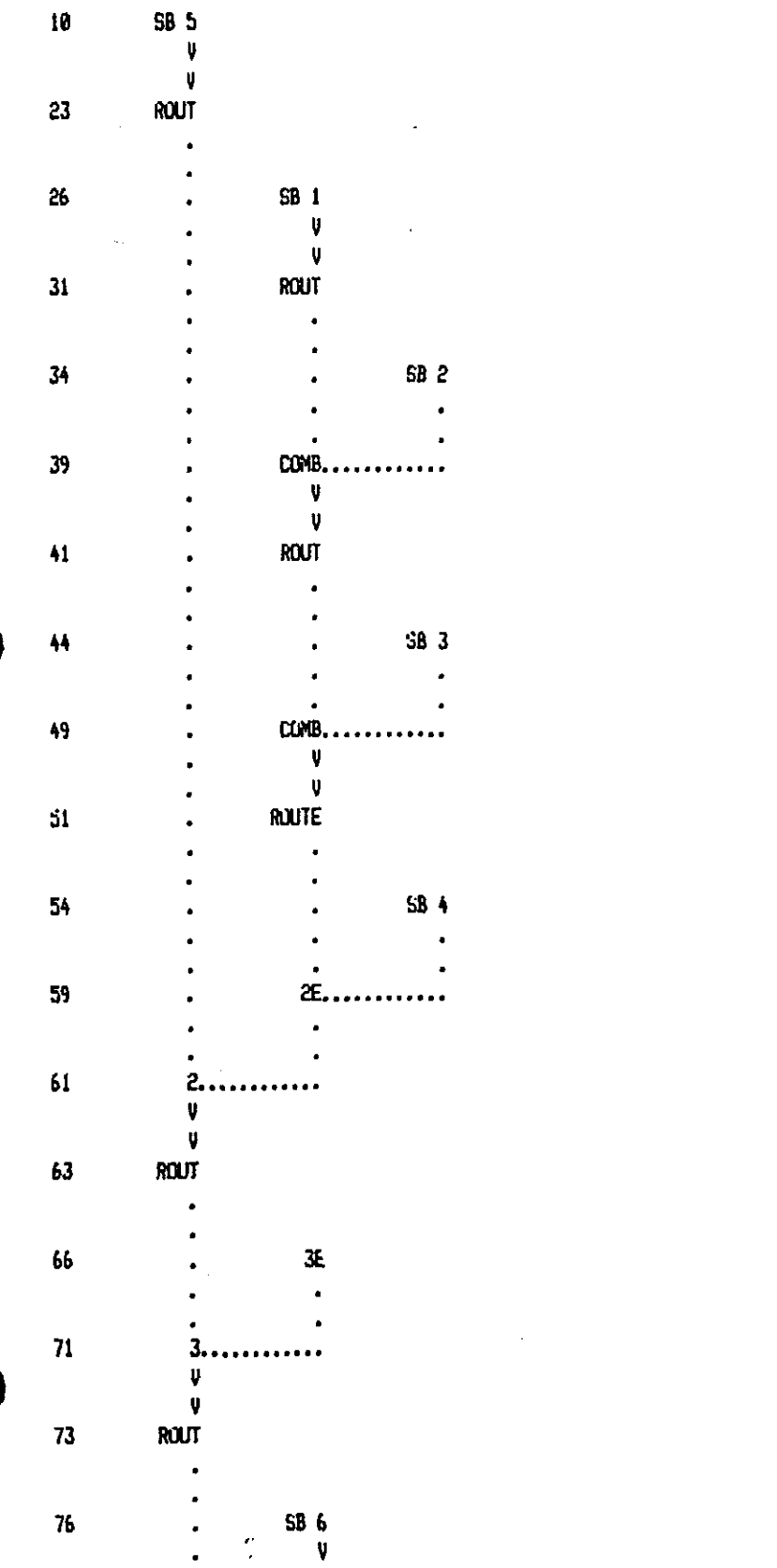
606       KK   9CH     COMB
607       HC       3
608       ZZ
```

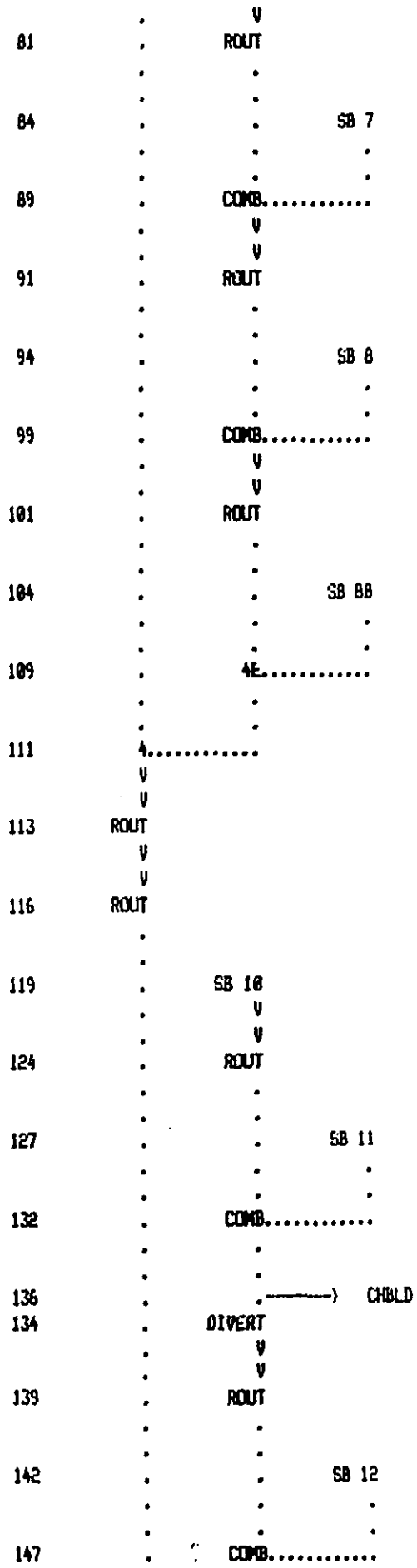
SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (---)) DIVERSION OR PUMP FLOW

(.) CONNECTOR ((---) RETURN OF DIVERTED OR PUMPED FLOW

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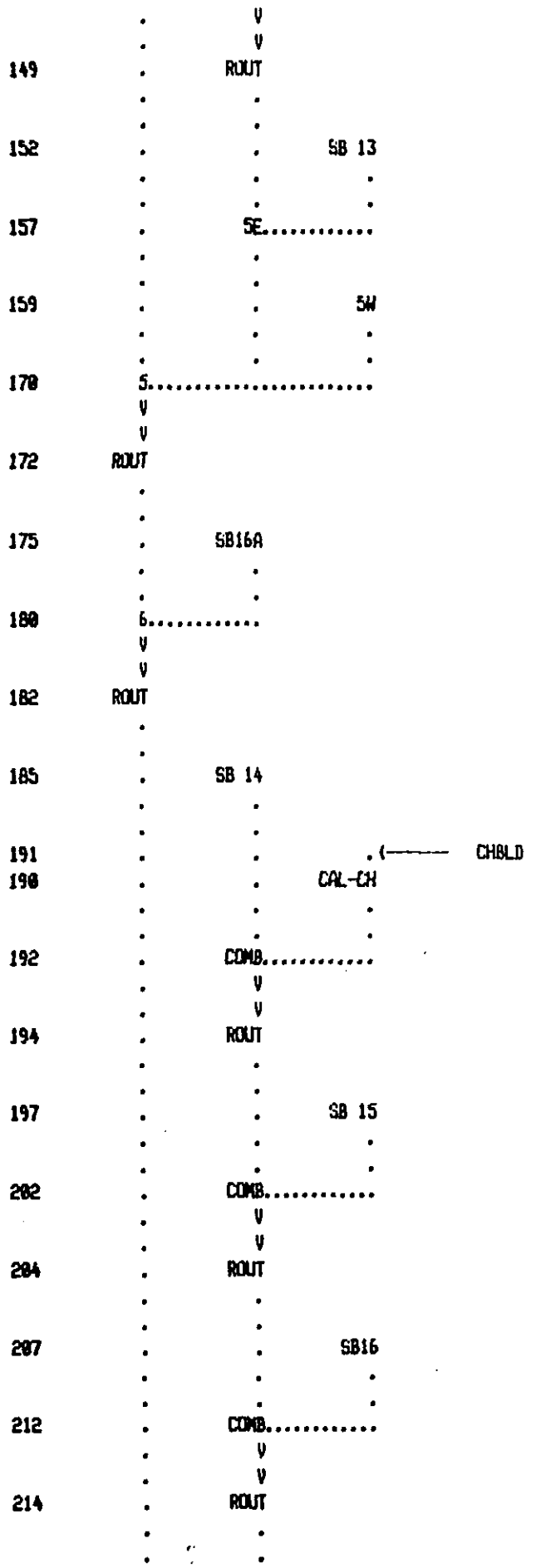
89 COMB
91 ROUT
94 SB 8
99 COMB
101 ROUT
104 SB 88
109 4E
111 4
113 ROUT
116 ROUT
119 SB 10
124 ROUT
127 SB 11
132 COMB
136 CHBLD
134 DIVERT
139 ROUT
142 SB 12
147 COMB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159 SW
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175 SB16A
180 S
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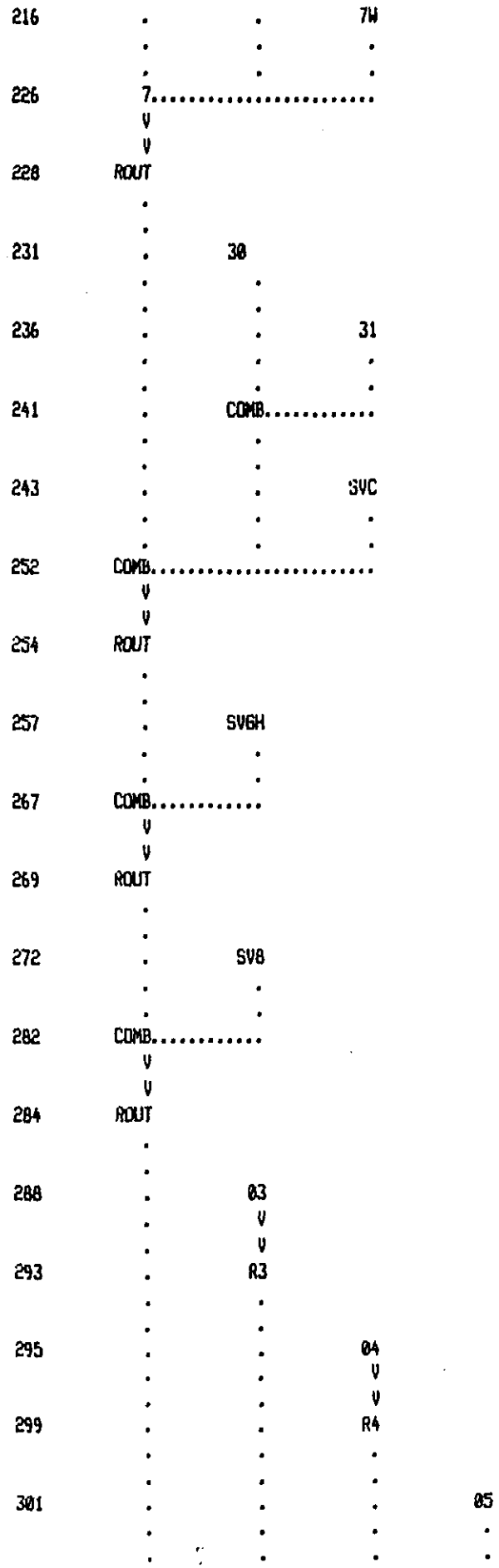
194 ROUT
197 SB 15
202 COMB
204 ROUT
207 SB16
212 COMB
214 ROUT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267
COMB
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R4
301
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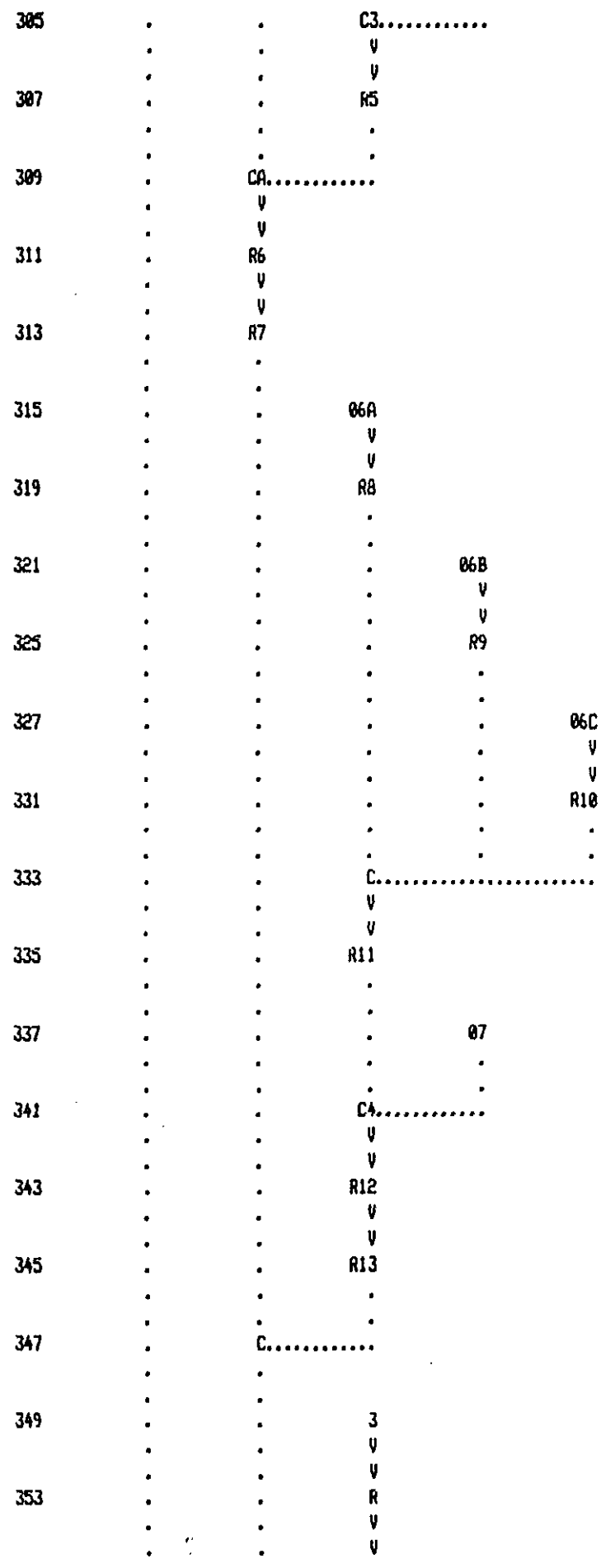
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06C
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R10
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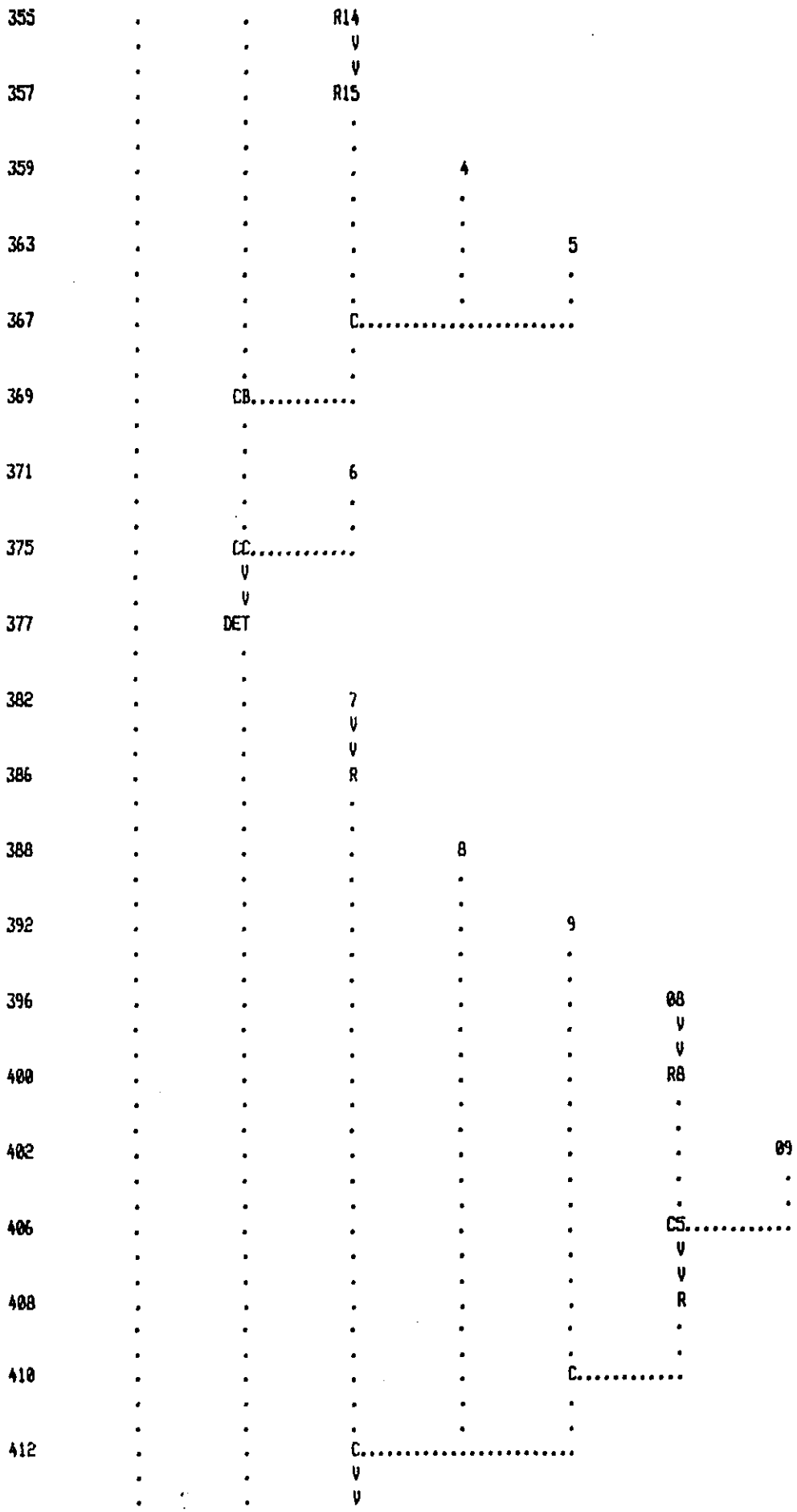
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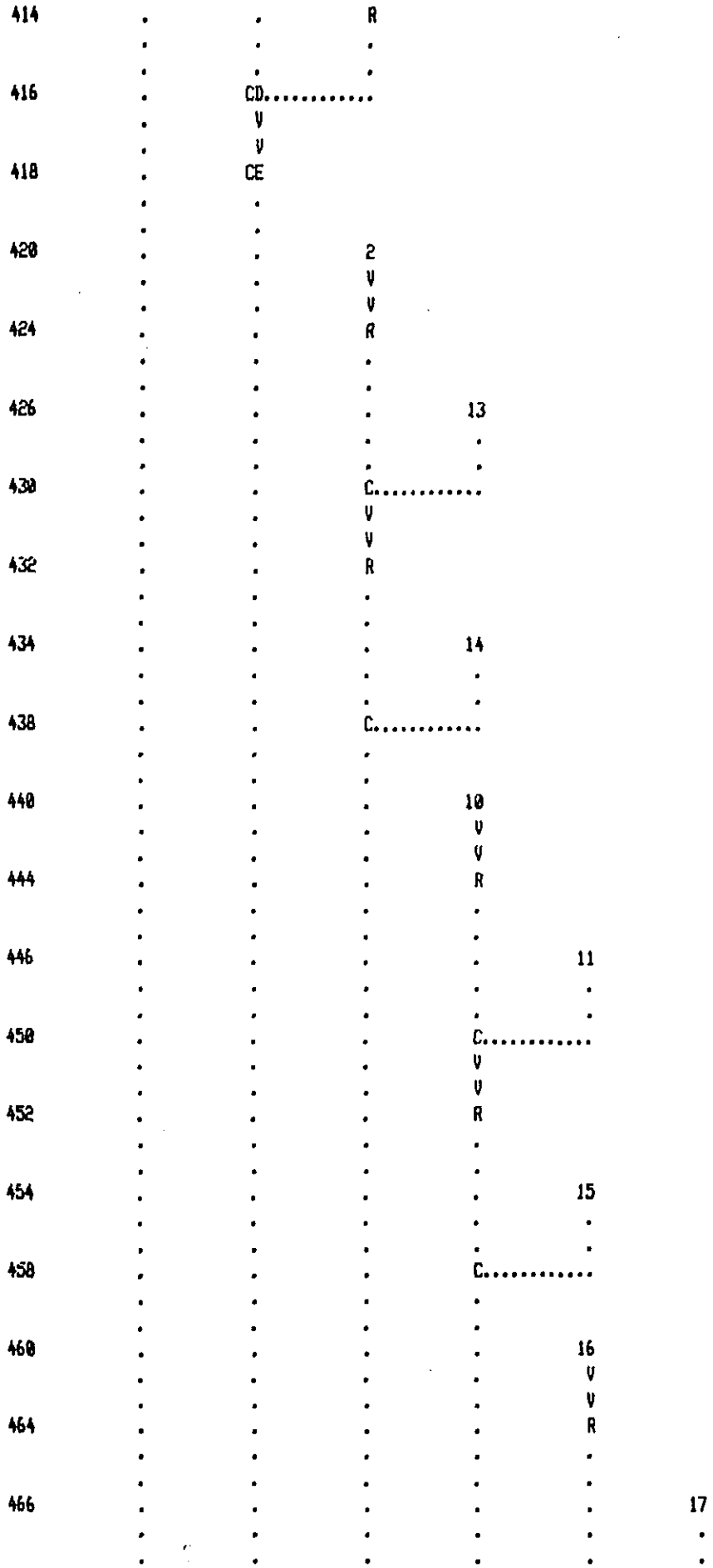
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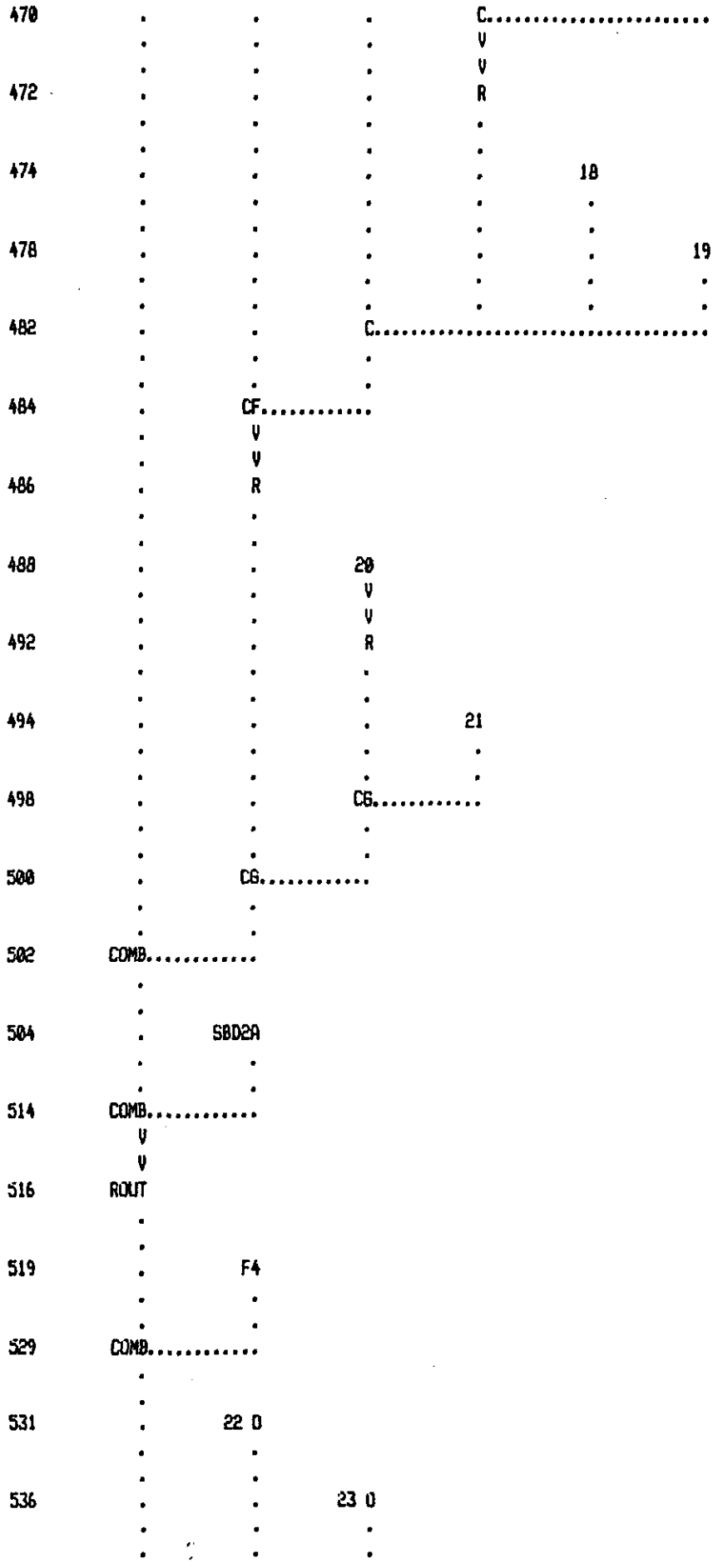
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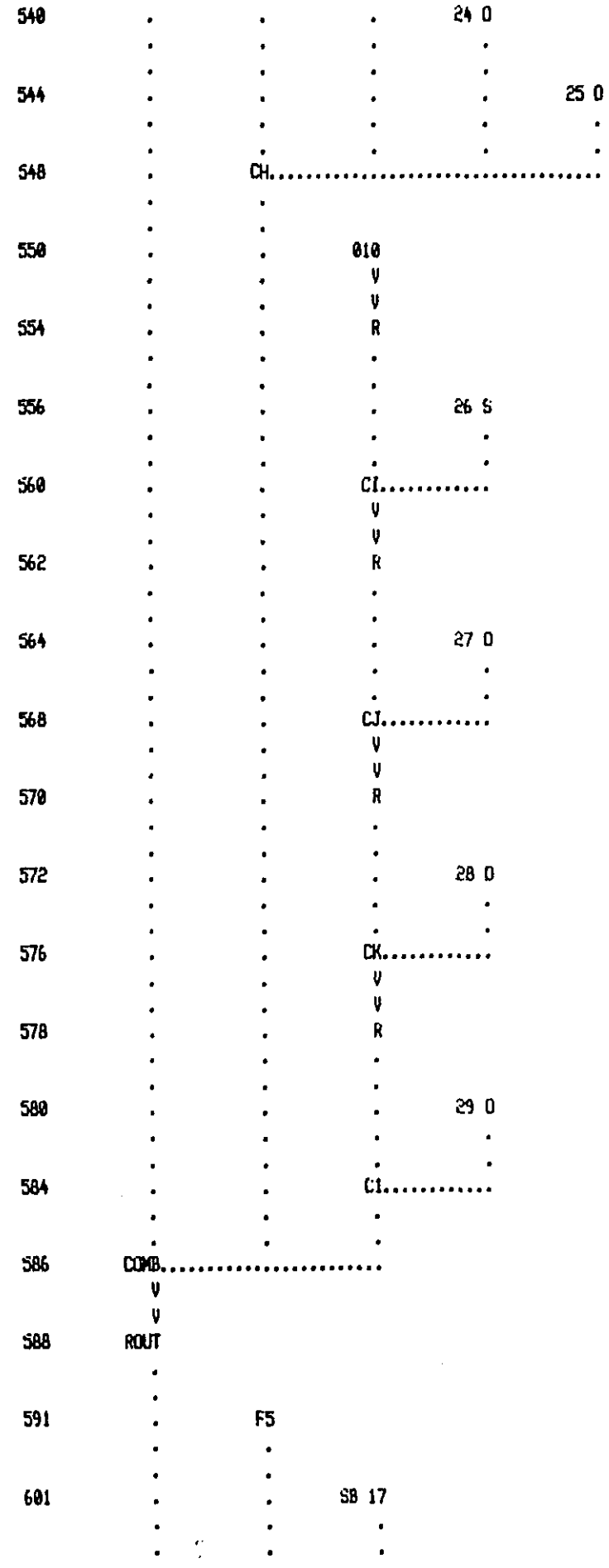
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29 0
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COMB
588
ROUT
591
F5
601
SB 17

606 9CH .....

(###) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
                    *         UNDER ULTIMATE DEVELOPMENT CONDITION           *
                     ****                                                    ****
                    * TIRBUTRY BASINS TO SLOAN CHANNEL BETWEEN OWENS AND LVWASH CONFL. *
                    * 6-HOUR RAIN FALL ,5 Min. TIME INC. - FILE:SLOAN.H1 *
                    * POINT RAINF ALL(100-YR. STORM)     10-YR. FREQUANCY   3-29-93

 7 IO         OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                    NMIN          3  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME       0000  STARTING TIME
                      NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                  NQDATE      1   0  ENDING DATE
                  NQTIME       1457  ENDING TIME

               COMPUTATION INTERVAL     .05 HOURS
                  TOTAL TIME BASE   14.95 HOURS

       ENGLISH UNITS

   JP          MULTI-PLAN OPTION
                    NPLAN          1  NUMBER OF PLANS

   JR          MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                  .57      .56
                  .53      .51
                  .50

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG


    UNIT HYDROGRAPH TRUNCATED FROM 162 TO 150 INT   ERVALS

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

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WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .57	RATIO 2 .56	RATIO 3 .53	RATIO 4 .51	RATIO 5 .50
HYDROGRAPH AT	SB 5	.12	1	FLOW	31.	30.	26.	23.	22.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	.12	1	FLOW	31.	30.	26.	23.	22.
				TIME	3.85	3.80	3.80	3.80	3.85
HYDROGRAPH AT	SB 1	.64	1	FLOW	445.	432.	393.	367.	354.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.64	1	FLOW	437.	424.	387.	362.	350.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SB 2	.21	1	FLOW	27.	26.	21.	17.	16.
				TIME	3.75	3.75	3.80	3.80	3.80
2 COMBINED AT	COMB	.85	1	FLOW	460.	446.	403.	375.	362.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUT	.85	1	FLOW	455.	441.	398.	369.	355.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SB 3	.27	1	FLOW	46.	43.	36.	31.	29.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	COMB	1.12	1	FLOW	493.	476.	426.	393.	377.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUTE	1.12	1	FLOW	489.	472.	424.	392.	376.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 4	.13	1	FLOW	35.	33.	29.	26.	24.
				TIME	3.75	3.75	3.75	3.80	3.80
2 COMBINED AT	2E	1.26	1	FLOW	523.	505.	452.	418.	401.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	2	1.37	1	FLOW	554.	535.	477.	439.	421.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	1.37	1	FLOW	549.	530.	474.	438.	420.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	3E	.11	1	FLOW	5.	5.	3.	3.	3.
				TIME	3.95	3.95	5.00	5.00	5.00
2 COMBINED AT	3	1.48	1	FLOW	553.	534.	477.	439.	421.
				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	ROUT	1.48	1	FLOW	547.	527.	469.	434.	416.

				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	SB 6	.58	1	FLOW	447.	434.	395.	369.	356.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	ROUT	.58	1	FLOW	433.	421.	384.	359.	347.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 7	.24	1	FLOW	31.	29.	24.	20.	18.
				TIME	3.75	3.75	3.80	3.80	3.80
2 COMBINED AT	COMB	.82	1	FLOW	454.	440.	398.	371.	357.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.82	1	FLOW	440.	426.	386.	359.	345.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SB 8	.36	1	FLOW	48.	46.	38.	33.	31.
				TIME	3.95	3.95	3.95	4.00	4.00
2 COMBINED AT	COMB	1.18	1	FLOW	462.	447.	402.	372.	357.
				TIME	3.65	3.65	3.65	3.65	3.65
ROUTED TO	ROUT	1.18	1	FLOW	454.	438.	400.	371.	357.
				TIME	3.65	3.65	3.70	3.70	3.70
HYDROGRAPH AT	SB 8B	.05	1	FLOW	12.	11.	10.	9.	8.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	4E	1.23	1	FLOW	465.	449.	410.	380.	365.
				TIME	3.65	3.65	3.70	3.70	3.70
2 COMBINED AT	4	2.72	1	FLOW	929.	893.	839.	770.	737.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	ROUT	2.72	1	FLOW	925.	893.	829.	762.	730.
				TIME	3.80	3.80	3.75	3.80	3.80
ROUTED TO	ROUT	2.72	1	FLOW	924.	889.	828.	760.	726.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	SB 10	.28	1	FLOW	221.	214.	195.	182.	176.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	ROUT	.28	1	FLOW	213.	206.	187.	175.	169.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	SB 11	.33	1	FLOW	58.	55.	46.	40.	37.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	COMB	.61	1	FLOW	248.	240.	214.	197.	188.
				TIME	3.60	3.60	3.60	3.60	3.60
DIVERSION TO	CHBLD	.61	1	FLOW	124.	120.	107.	98.	94.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	DIVERT	.61	1	FLOW	124.	120.	107.	98.	94.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.61	1	FLOW	108.	103.	91.	82.	78.

				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	SB 12	.36	1	FLOW	32.	29.	23.	20.	18.
				TIME	3.95	3.95	4.00	4.00	4.00
2 COMBINED AT	COMB	.97	1	FLOW	130.	124.	107.	96.	91.
				TIME	3.75	3.75	3.80	3.80	3.80
ROUTED TO	ROUT	.97	1	FLOW	129.	123.	106.	95.	90.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	SB 13	.18	1	FLOW	57.	55.	48.	44.	42.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	5E	1.15	1	FLOW	187.	178.	154.	139.	132.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	5W	2.70	1	FLOW	204.	195.	169.	153.	145.
				TIME	5.55	5.55	5.60	5.60	5.65
3 COMBINED AT	5	6.56	1	FLOW	1129.	1085.	994.	908.	868.
				TIME	3.80	3.80	3.80	3.80	3.85
ROUTED TO	ROUT	6.56	1	FLOW	1127.	1084.	993.	907.	865.
				TIME	3.85	3.85	3.85	3.85	3.90
HYDROGRAPH AT	SB16A	.16	1	FLOW	44.	42.	37.	33.	32.
				TIME	3.80	3.80	3.80	3.80	3.80
2 COMBINED AT	6	6.72	1	FLOW	1170.	1125.	1029.	940.	896.
				TIME	3.85	3.85	3.85	3.85	3.85
ROUTED TO	ROUT	6.72	1	FLOW	1167.	1121.	1022.	935.	895.
				TIME	3.85	3.85	3.85	3.90	3.90
HYDROGRAPH AT	SB 14	.09	1	FLOW	19.	18.	15.	13.	12.
				TIME	3.70	3.70	3.70	3.75	3.75
HYDROGRAPH AT	CAL-CH	.00	1	FLOW	124.	120.	107.	98.	94.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.09	1	FLOW	140.	134.	119.	108.	103.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	ROUT	.09	1	FLOW	135.	129.	112.	100.	95.
				TIME	3.70	3.70	3.70	3.75	3.75
HYDROGRAPH AT	SB 15	.24	1	FLOW	35.	34.	28.	24.	23.
				TIME	3.90	3.90	3.90	3.90	3.90
2 COMBINED AT	COMB	.33	1	FLOW	162.	154.	133.	120.	114.
				TIME	3.70	3.70	3.75	3.75	3.75
ROUTED TO	ROUT	.33	1	FLOW	161.	154.	132.	119.	113.
				TIME	3.75	3.75	3.75	3.80	3.80
HYDROGRAPH AT	SB16	.13	1	FLOW	2.	2.	1.	1.	1.
				TIME	5.00	5.00	5.05	5.05	5.05
2 COMBINED AT	COMB	.46	1	FLOW	161.	154.	132.	119.	113.

				TIME	3.75	3.75	3.75	3.80	3.80
ROUTED TO	ROUT	.46	1	FLOW	159.	150.	131.	118.	111.
				TIME	3.80	3.80	3.85	3.85	3.85
HYDROGRAPH AT	7W	.19	1	FLOW	57.	56.	50.	46.	44.
				TIME	3.90	3.90	3.90	3.95	3.95
3 COMBINED AT	7	7.37	1	FLOW	1377.	1326.	1201.	1097.	1049.
				TIME	3.85	3.85	3.85	3.90	3.90
ROUTED TO	ROUT	7.37	1	FLOW	1368.	1320.	1198.	1096.	1045.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	30	.03	1	FLOW	16.	16.	15.	14.	13.
				TIME	3.70	3.70	3.70	3.70	3.70
HYDROGRAPH AT	31	.02	1	FLOW	11.	11.	10.	9.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	.04	1	FLOW	26.	26.	23.	22.	21.
				TIME	3.65	3.65	3.65	3.65	3.65
HYDROGRAPH AT	SVC	.04	1	FLOW	33.	32.	29.	28.	27.
				TIME	3.60	3.60	3.60	3.60	3.60
3 COMBINED AT	COMB	7.46	1	FLOW	1402.	1352.	1228.	1124.	1073.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	ROUT	7.46	1	FLOW	1401.	1349.	1217.	1114.	1065.
				TIME	3.90	3.90	3.90	3.95	3.95
HYDROGRAPH AT	SVGH	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.50	1	FLOW	1416.	1363.	1231.	1125.	1076.
				TIME	3.90	3.90	3.90	3.95	3.95
ROUTED TO	ROUT	7.50	1	FLOW	1403.	1354.	1227.	1124.	1072.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	SVB	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	COMB	7.54	1	FLOW	1420.	1368.	1240.	1136.	1084.
				TIME	3.90	3.95	3.95	3.95	3.95
ROUTED TO	ROUT	7.54	1	FLOW	1418.	1367.	1237.	1132.	1080.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	03	.21	1	FLOW	49.	47.	41.	37.	35.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R3	.21	1	FLOW	49.	47.	41.	37.	35.
				TIME	4.05	4.05	4.05	4.10	4.10
HYDROGRAPH AT	04	.42	1	FLOW	219.	213.	193.	180.	174.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R4	.42	1	FLOW	163.	159.	144.	134.	130.

				TIME	4.70	4.70	4.70	4.70	4.70
HYDROGRAPH AT	05	.41	1	FLOW	60.	57.	49.	43.	41.
				TIME	4.10	4.15	4.15	4.15	4.15
2 COMBINED AT	C3	.83	1	FLOW	200.	193.	174.	162.	155.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R5	.83	1	FLOW	200.	193.	174.	161.	155.
				TIME	4.65	4.65	4.65	4.70	4.70
2 COMBINED AT	CA	1.04	1	FLOW	224.	217.	195.	181.	174.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R6	1.04	1	FLOW	224.	217.	195.	181.	174.
				TIME	4.65	4.65	4.65	4.65	4.65
ROUTED TO	R7	1.04	1	FLOW	224.	216.	195.	180.	173.
				TIME	4.65	4.65	4.65	4.70	4.70
HYDROGRAPH AT	06A	.26	1	FLOW	192.	187.	170.	158.	153.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R8	.26	1	FLOW	145.	141.	128.	119.	115.
				TIME	3.95	3.95	3.95	3.95	3.95
HYDROGRAPH AT	06B	.16	1	FLOW	118.	114.	104.	97.	94.
				TIME	3.55	3.55	3.60	3.60	3.60
ROUTED TO	R9	.16	1	FLOW	84.	81.	74.	69.	66.
				TIME	4.10	4.10	4.10	4.10	4.10
HYDROGRAPH AT	06C	.17	1	FLOW	113.	110.	100.	93.	90.
				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R10	.17	1	FLOW	78.	75.	68.	64.	62.
				TIME	4.25	4.25	4.25	4.25	4.25
3 COMBINED AT	C	.60	1	FLOW	280.	272.	247.	230.	222.
				TIME	4.05	4.05	4.05	4.05	4.05
ROUTED TO	R11	.60	1	FLOW	222.	215.	195.	182.	176.
				TIME	4.95	4.95	4.95	5.00	5.00
HYDROGRAPH AT	07	.60	1	FLOW	76.	72.	62.	55.	51.
				TIME	4.30	4.30	4.30	4.30	4.35
2 COMBINED AT	C4	1.20	1	FLOW	275.	266.	240.	223.	214.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	R12	1.20	1	FLOW	275.	266.	239.	222.	214.
				TIME	4.95	4.95	5.00	5.00	5.00
ROUTED TO	R13	1.20	1	FLOW	274.	265.	239.	222.	214.
				TIME	4.95	4.95	5.00	5.00	5.00
2 COMBINED AT	C	2.24	1	FLOW	474.	459.	414.	384.	369.
				TIME	4.85	4.85	4.85	4.90	4.90
HYDROGRAPH AT	13	.01	1	FLOW	2.	1.	1.	1.	1.

				TIME	3.60	3.60	3.60	3.60	3.60
ROUTED TO	R	.01	1	FLOW	1.	1.	1.	1.	1.
				TIME	3.75	3.75	3.80	3.85	3.80
ROUTED TO	R14	.01	1	FLOW	1.	1.	1.	1.	1.
				TIME	3.80	3.85	3.90	3.90	3.95
ROUTED TO	R15	.01	1	FLOW	1.	1.	1.	1.	1.
				TIME	4.05	4.05	4.10	4.20	4.20
HYDROGRAPH AT	4	.08	1	FLOW	14.	13.	11.	10.	9.
				TIME	3.75	3.75	3.80	3.80	3.80
HYDROGRAPH AT	5	.03	1	FLOW	5.	4.	4.	3.	3.
				TIME	3.75	3.75	3.80	3.80	3.80
3 COMBINED AT	C	.11	1	FLOW	19.	18.	15.	13.	12.
				TIME	3.75	3.75	3.80	3.80	3.80
2 COMBINED AT	CB	2.36	1	FLOW	483.	467.	421.	391.	376.
				TIME	4.85	4.85	4.85	4.90	4.90
HYDROGRAPH AT	6	.02	1	FLOW	0.	0.	0.	0.	0.
				TIME	5.05	5.05	5.05	5.05	5.10
2 COMBINED AT	CC	2.38	1	FLOW	483.	468.	421.	391.	376.
				TIME	4.85	4.85	4.85	4.90	4.90
ROUTED TO	DET	2.38	1	FLOW	479.	464.	418.	388.	373.
				TIME	4.95	4.95	4.95	4.95	4.95
				** PEAK STAGES IN FEET **					
			1	STAGE	11.95	11.92	11.82	11.75	11.72
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	7	.03	1	FLOW	7.	6.	5.	4.	4.
				TIME	3.65	3.65	3.70	3.70	3.70
ROUTED TO	R	.03	1	FLOW	7.	6.	5.	4.	4.
				TIME	3.70	3.70	3.75	3.75	3.80
HYDROGRAPH AT	8	.02	1	FLOW	14.	14.	12.	11.	11.
				TIME	3.60	3.60	3.60	3.60	3.60
HYDROGRAPH AT	9	.02	1	FLOW	0.	0.	0.	0.	0.
				TIME	5.20	5.20	5.20	5.20	5.25
HYDROGRAPH AT	08	.02	1	FLOW	15.	14.	13.	12.	12.
				TIME	3.55	3.55	3.55	3.60	3.60
ROUTED TO	R8	.02	1	FLOW	9.	8.	8.	7.	7.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	09	.29	1	FLOW	34.	32.	28.	24.	23.
				TIME	4.40	4.40	4.40	4.40	4.45
2 COMBINED AT	C5	.31	1	FLOW	39.	37.	32.	29.	28.
				TIME	4.55	4.60	4.60	4.60	4.60

ROUTED TO	R	.31	1	FLOW	39.	37.	32.	29.	28.
				TIME	4.60	4.60	4.65	4.65	4.70
2 COMBINED AT	C	.33	1	FLOW	39.	38.	32.	29.	28.
				TIME	4.60	4.60	4.65	4.65	4.70
3 COMBINED AT	C	.38	1	FLOW	45.	43.	37.	34.	32.
				TIME	4.65	4.65	4.65	4.70	4.70
ROUTED TO	R	.38	1	FLOW	45.	43.	37.	34.	32.
				TIME	4.70	4.70	4.70	4.70	4.75
2 COMBINED AT	CD	2.76	1	FLOW	521.	503.	453.	420.	404.
				TIME	4.90	4.95	4.95	4.95	4.95
ROUTED TO	CE	2.76	1	FLOW	521.	503.	452.	419.	403.
				TIME	4.95	4.95	4.95	4.95	4.95
HYDROGRAPH AT	2	.01	1	FLOW	3.	3.	3.	2.	2.
				TIME	3.55	3.55	3.55	3.60	3.60
ROUTED TO	R	.01	1	FLOW	3.	3.	2.	2.	2.
				TIME	3.60	3.60	3.65	3.65	3.65
HYDROGRAPH AT	13	.01	1	FLOW	3.	3.	3.	2.	2.
				TIME	3.50	3.50	3.50	3.50	3.50
2 COMBINED AT	C	.02	1	FLOW	6.	5.	4.	4.	3.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.02	1	FLOW	5.	5.	5.	4.	3.
				TIME	3.80	3.80	3.80	3.85	3.90
HYDROGRAPH AT	14	.02	1	FLOW	2.	2.	2.	1.	1.
				TIME	3.80	3.80	3.80	3.80	3.85
2 COMBINED AT	C	.04	1	FLOW	7.	7.	6.	5.	4.
				TIME	3.80	3.80	3.80	3.85	3.90
HYDROGRAPH AT	10	.00	1	FLOW	5.	5.	5.	4.	4.
				TIME	3.55	3.55	3.55	3.55	3.55
ROUTED TO	R	.00	1	FLOW	4.	4.	4.	3.	3.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	11	.03	1	FLOW	4.	4.	3.	3.	2.
				TIME	4.00	4.00	4.00	4.05	4.05
2 COMBINED AT	C	.04	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.90	3.90	3.90	3.90	3.90
ROUTED TO	R	.04	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.95	4.00	4.00	4.00	4.00
HYDROGRAPH AT	15	.01	1	FLOW	0.	0.	0.	0.	0.
				TIME	.05	.05	.05	.05	.05
2 COMBINED AT	C	.05	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.95	4.00	4.00	4.00	4.00

HYDROGRAPH AT	16	.04	1	FLOW	14.	13.	12.	11.	11.
				TIME	3.80	3.80	3.80	3.80	3.80
ROUTED TO	R	.04	1	FLOW	14.	13.	12.	11.	11.
				TIME	3.85	3.85	3.90	3.85	3.85
HYDROGRAPH AT	17	.01	1	FLOW	7.	7.	6.	6.	5.
				TIME	3.65	3.65	3.65	3.65	3.65
3 COMBINED AT	C	.10	1	FLOW	25.	23.	21.	19.	19.
				TIME	3.85	3.90	3.85	3.85	3.85
ROUTED TO	R	.10	1	FLOW	25.	23.	21.	19.	18.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	18	.05	1	FLOW	15.	15.	13.	12.	11.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	19	.04	1	FLOW	20.	19.	17.	16.	15.
				TIME	3.75	3.75	3.75	3.75	3.75
4 COMBINED AT	C	.23	1	FLOW	61.	58.	51.	46.	43.
				TIME	3.85	3.85	3.90	3.90	3.90
2 COMBINED AT	CF	2.99	1	FLOW	542.	524.	471.	437.	420.
				TIME	4.95	4.95	4.95	4.95	4.95
ROUTED TO	R	2.99	1	FLOW	542.	523.	471.	437.	420.
				TIME	5.00	5.00	5.00	5.00	5.00
HYDROGRAPH AT	20	.04	1	FLOW	22.	22.	19.	18.	17.
				TIME	3.75	3.75	3.75	3.75	3.75
ROUTED TO	R	.04	1	FLOW	22.	21.	19.	18.	17.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	21	.02	1	FLOW	11.	11.	10.	9.	9.
				TIME	3.65	3.65	3.70	3.70	3.70
2 COMBINED AT	CG	.06	1	FLOW	33.	31.	28.	26.	25.
				TIME	3.75	3.75	3.75	3.75	3.80
2 COMBINED AT	CG	3.05	1	FLOW	551.	532.	479.	444.	427.
				TIME	5.00	5.00	5.00	5.00	5.00
2 COMBINED AT	COMB	10.59	1	FLOW	1618.	1550.	1374.	1251.	1193.
				TIME	3.95	4.00	4.00	3.95	4.00
HYDROGRAPH AT	5BD2A	.02	1	FLOW	10.	10.	9.	8.	8.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	COMB	10.61	1	FLOW	1621.	1553.	1377.	1254.	1196.
				TIME	3.95	4.00	3.95	3.95	3.95
ROUTED TO	ROUT	10.61	1	FLOW	1619.	1553.	1377.	1253.	1195.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	F4	.04	1	FLOW	20.	20.	18.	17.	16.
				TIME	3.65	3.65	3.65	3.65	3.65

2 COMBINED AT	COMB	10.64	1	FLOW	1628.	1562.	1385.	1261.	1203.
				TIME	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	22 D	.04	1	FLOW	13.	12.	11.	10.	9.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	23 D	.02	1	FLOW	8.	8.	7.	7.	6.
				TIME	3.80	3.80	3.80	3.80	3.80
HYDROGRAPH AT	24 D	.05	1	FLOW	19.	18.	17.	15.	15.
				TIME	3.90	3.90	3.90	3.90	3.90
HYDROGRAPH AT	25 D	.01	1	FLOW	8.	7.	7.	6.	6.
				TIME	3.65	3.65	3.65	3.65	3.65
4 COMBINED AT	CH	.12	1	FLOW	45.	44.	39.	36.	35.
				TIME	3.85	3.85	3.85	3.85	3.85
HYDROGRAPH AT	010	.10	1	FLOW	18.	17.	15.	13.	12.
				TIME	3.95	3.95	3.95	3.95	3.95
ROUTED TO	R	.10	1	FLOW	18.	17.	14.	13.	12.
				TIME	4.00	4.00	4.05	4.00	4.00
HYDROGRAPH AT	26 S	.05	1	FLOW	24.	24.	22.	20.	20.
				TIME	3.85	3.85	3.85	3.85	3.85
2 COMBINED AT	CI	.14	1	FLOW	40.	39.	35.	32.	31.
				TIME	3.90	3.85	3.90	3.90	3.90
ROUTED TO	R	.14	1	FLOW	40.	39.	35.	32.	31.
				TIME	4.00	3.95	4.00	4.00	4.00
HYDROGRAPH AT	27 D	.03	1	FLOW	15.	14.	13.	12.	12.
				TIME	3.70	3.70	3.70	3.70	3.70
2 COMBINED AT	CJ	.17	1	FLOW	49.	48.	42.	39.	37.
				TIME	3.90	3.90	3.95	3.95	3.95
ROUTED TO	R	.17	1	FLOW	49.	47.	42.	39.	37.
				TIME	3.95	3.95	4.00	4.00	4.00
HYDROGRAPH AT	28 D	.01	1	FLOW	11.	11.	10.	10.	9.
				TIME	3.60	3.60	3.60	3.60	3.60
2 COMBINED AT	CK	.19	1	FLOW	53.	51.	45.	41.	40.
				TIME	3.95	3.95	3.95	4.00	4.00
ROUTED TO	R	.19	1	FLOW	52.	51.	45.	41.	39.
				TIME	4.00	4.00	4.05	4.05	4.05
HYDROGRAPH AT	29 D	.01	1	FLOW	10.	10.	9.	8.	8.
				TIME	3.65	3.65	3.65	3.65	3.65
2 COMBINED AT	C1	.20	1	FLOW	57.	55.	49.	45.	43.
				TIME	4.00	4.00	4.00	3.95	3.95
3 COMBINED AT	COMB	10.96	1	FLOW	1725.	1655.	1469.	1338.	1277.
				TIME	4.00	4.00	4.00	4.00	4.00

Hydraulic Analysis

The water surface profile for the Sloan Channel was computed for supercritical and subcritical flow conditions beginning with critical flow depth approximately 137 feet downstream from the Owens Avenue RCB culvert. The channel stationing starts at 1+37.48 per the 1986 channel design drawing Boyle provided by Clark County Public Works.

The cross section locations are taken from the above mentioned design drawing. The cross section numbers in the HEC-2 model correspond to the channel stationing. Cross sections were taken at 300 foot intervals through the length of the channel. Additional sections were taken at grade breaks, transitions and culvert crossings. The channel cross section geometry and channel flow line were matched as closely as possible to the Boyle design mentioned above.

The design flows to be used in the HEC-2 model were established by the contract as 3,300 cfs and 6,000 cfs.

To evaluate the existing culverts and bridges, the special bridge routine was selected.

The computed water surface elevations and hydraulic characteristics of the channel 3,300 cfs and 6,000 cfs are shown in Table C1 and Table C2. A printout of each HEC-2 model run is also contained in this Appendix.

Channel Capacity

Per existing design drawings from Station 0+00 to Station 105+74, and from Station 125+30 to end of channel, the channel bottom width is 60 feet, the side slopes are 1.5:1 (H:V), and the depth varies from 6 feet to 7.5 feet. From Station 108+30 to Station 124+30 the channel bottom width is 70 feet, the side slopes are 1.5:1 (H:V), and the depth varies from 5.3 feet to 7.5 feet. The analysis shows the design flow of 3,300 cfs is contained in the typical channel section and meets the CCRFCD freeboard requirements. The invert slope of the channel is sufficient to maintain supercritical flow for both design

flows. The existing bridges and culverts will cause a backwater effect immediately upstream from these structures. The backwater effect will cause the flow to pass from supercritical to subcritical for a short distance upstream from the structures. The channel flows do not have sufficient energy to sustain a strong hydraulic jump. An undular jump (Fr = $1 < x < 1.7$) can be expected upstream from the bridges and culverts.

The super-elevation of the water surface for both design flows caused by the reverse curve in the channel alignment located south of Charleston Boulevard was calculated per Equation 730 of the Manual. The calculated super-elevations in the reverse curve for 3,300 cfs and 6,000 cfs is on the order of 0.6 feet and 1.0 feet, respectively.

The design flow of 6,000 cfs is contained within a typical section of the Sloan Channel without freeboard.

Bridge and Culvert Capacity

To evaluate the bridge and culvert capacities, the special bridge routine was used in the HEC-2 analysis. The design flow of 3,300 cfs passes through the Washington and Charleston bridges as Class B low flow, and passes through the Bonanza Road and Stewart Avenue culverts as pressure flow.

The design flow of 6,000 cfs passes through and overflows the above mentioned bridges and culverts as pressure and weir flow. The restriction of flow at the bridges and culverts will cause a backwater upstream from these structures, and will cause overflow from the channel onto adjacent properties and streets.

A summary of bridge information and ponding depth is shown in Table C3 and Table C4 for the 3,300 cfs and the 6,000 cfs design flows.

TABLE B2
LOCAL INFLOW INTO SLOAN CHANNEL
EXISTING CONDITION

Point Location*	Cross Street	INFLOW (cfs) East 10-Year	East 100-Year	West 10-Year	West 100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	505	1339		
3	Harris Ave.	5	39		
4	Bonanza Road	449	1232		
5	Stewart Ave.	178	665	169	579
6	Sunrise Ave.	44	133		
7	Charleston Blvd.	161	470	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

TABLE B3
LOCAL INFLOW INTO SLOAN CHANNEL
ULTIMATE DEVELOPMENT CONDITION

Point Location*	Cross Street	INFLOW (cfs) East 10-Year	East 100-Year	West 10-Year	West 100-Year
1	Monroe Ave.	31	99		
2	Washington Ave.	177	449		
3	Harris Ave.	5	39		
4	Bonanza Road	77	356		
5	Stewart Ave.	169	579	169	579
6	Sunrise Ave	44	133		
7	Charleston Blvd.	46	233	57	146
8	--	11	59	33	64
9	--	532	1206	10	22
10	Sahara Ave.	57	164	20	45
11	--	101	208	28	63

TABLE C1

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

DESIGN FLOW (Q = 3300 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH
137.48	3300	4.54	771.47	776.01	778.77	778.77	11.37	1.47	6.0	7.3
437.48	3300	3.86	770.31	774.17	777.61	777.61	13.67	1.54	5.4	7.3
737.48	3300	3.85	769.16	773.01	776.46	776.46	13.67	1.54	5.4	7.3
1037.50	3300	3.85	768.00	771.86	775.30	775.30	13.68	1.54	5.4	7.3
1337.50	3300	3.85	766.85	770.70	774.15	774.15	13.66	1.54	5.4	7.3
1637.50	3300	3.85	765.69	769.55	772.99	772.99	13.67	1.54	5.4	7.3
1937.50	3300	3.85	764.54	768.39	771.84	771.84	13.66	1.54	5.4	7.3
2237.50	3300	3.85	763.38	767.24	770.68	770.68	13.67	1.54	5.4	7.3
2532.20	3300	3.86	762.25	766.11	769.55	769.55	13.66	1.54	5.4	7.3
2572.70	3300	5.54	762.10	767.64	769.40	769.40	12.98	1.57	7.1	7.3
2652.70	3300	3.61	761.80	765.41	768.70	768.70	14.10	1.54	5.2	6.9
2712.20	3300	4.48	761.36	765.84	768.33	768.33	11.53	1.48	6.0	6.97
3012.20	3300	3.60	759.83	763.43	766.80	766.80	14.75	1.57	5.2	6.97
3312.20	3300	3.57	758.30	761.88	765.27	765.27	14.90	1.57	5.1	6.97
3612.20	3300	3.56	756.77	760.33	763.74	763.74	14.94	1.57	5.1	6.97
3912.20	3300	3.56	755.24	758.80	762.21	762.21	14.95	1.57	5.1	6.97
4121.00	3300	3.56	754.17	757.73	761.14	761.14	14.95	1.57	5.1	6.97
4222.00	3300	3.56	753.66	757.22	760.63	760.63	14.95	1.57	5.1	6.97
4512.20	3300	3.54	752.13	755.66	759.10	759.10	15.07	1.57	5.1	6.97
4812.20	3300	3.57	750.60	754.16	757.57	757.57	14.93	1.57	5.1	6.97

TABLE C1 Continue

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

SUPERCRITICAL FLOW (Q = 3300 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH
5100.00	3300	3.56	749.13	752.69	756.10	756.10	14.96	1.57	5.1	6.97
5147.30	3300	3.81	748.94	752.75	755.90	755.91	13.87	1.54	5.4	6.97
5168.30	3300	6.30	747.50	753.80	754.46	754.47	13.20	1.61	7.9	6.97
5268.30	3300	7.37	746.80	754.17	754.00	754.00	8.62	1.42	8.8	7.2
5290.10	3300	3.02	746.86	749.88	753.79	753.79	17.98	1.65	4.7	6.93
5484.00	3300	3.15	745.40	748.56	752.34	752.34	17.18	1.63	4.8	6.94
5590.10	3300	3.15	744.61	747.78	751.55	751.55	17.09	1.63	4.8	6.94
5890.10	3300	3.20	742.36	745.55	749.30	749.30	16.89	1.62	4.8	6.94
6190.10	3300	3.20	740.11	743.30	747.05	747.05	16.91	1.62	4.8	6.94
6208.70	3300	3.17	739.93	743.11	746.87	746.87	17.01	1.62	4.8	6.94
6508.70	3300	3.59	738.46	742.06	745.40	745.40	14.79	1.57	5.2	6.94
6808.70	3300	3.59	736.99	740.59	743.93	743.93	14.77	1.57	5.2	6.94
7108.70	3300	3.59	735.52	739.12	742.46	742.46	14.76	1.57	5.2	6.94
7480.00	3300	3.60	733.70	737.31	740.64	740.64	14.75	1.57	5.2	6.94
7584.70	3300	3.60	733.19	736.80	740.13	740.13	14.75	1.57	5.2	6.94
7662.60	3300	4.31	732.80	737.11	739.10	739.10	11.94	1.49	5.8	6.3
7747.50	3300	4.79	732.19	736.98	738.49	738.49	11.79	1.50	6.3	6.3
7847.50	3300	6.81	731.30	738.11	737.68	737.68	7.03	1.33	8.1	6.3
8049.30	3300	3.11	730.45	733.56	736.75	736.75	17.34	1.63	4.7	6.3
8156.70	3300	3.39	730.00	733.39	736.30	736.70	15.73	1.59	5.0	6.7

TABLE C1 Continue

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

SUPERCRITICAL FLOW (Q = 3300 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	
8349.30	3300	3.70	729.19	732.89	735.49	735.89	14.23	1.55	5.3	6.7
8649.30	3300	3.75	727.92	731.67	734.22	734.62	14.00	1.54	5.3	6.7
8949.30	3300	3.75	726.65	730.40	732.95	733.35	14.02	1.54	5.3	6.7
9249.30	3300	3.75	725.39	729.14	731.69	732.09	14.02	1.54	5.3	6.7
9549.30	3300	3.75	724.12	727.87	730.42	730.82	14.03	1.54	5.3	6.7
9849.30	3300	3.75	722.86	726.60	729.16	729.56	14.03	1.54	5.3	6.7
10149.00	3300	3.89	721.70	725.58	728.00	728.40	13.41	1.53	5.4	6.7
10423.00	3300	3.79	720.43	724.22	728.08	728.13	14.09	1.55	5.3	7.7
10574.00	3300	3.79	719.00	723.59	726.54	727.84	14.09	1.55	5.3	8.04
10623.00	3300	3.40	719.55	722.95	727.70	727.70	14.86	1.56	5.0	8.15
10624.00	3300	5.46	719.54	725.00	727.69	727.69	14.81	1.65	7.1	8.15
10724.00	3300	3.59	719.04	722.63	727.70	727.70	14.35	1.55	5.1	8.66
10725.00	3300	3.05	717.90	720.95	726.56	726.56	17.21	1.62	4.7	8.66
10830.00	3300	4.20	717.80	722.02	723.15	728.10	12.03	1.49	5.7	10.3
10900.00	3300	3.19	717.52	720.71	723.82	723.82	14.57	1.54	4.7	6.3
11191.00	3300	3.65	716.35	720.00	723.85	723.85	12.65	1.49	5.1	7.5
11491.00	3300	3.44	714.99	718.43	722.49	722.49	13.56	1.51	5.0	7.5
11791.00	3300	3.40	713.63	717.04	721.13	721.13	13.70	1.52	4.9	7.5
12091.00	3300	3.40	712.27	715.67	719.77	719.77	13.72	1.52	4.9	7.5
12430.00	3300	3.40	710.74	714.14	718.24	718.24	13.72	1.52	4.9	7.5

channelization

TABLE C2

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

DESIGN FLOW (Q = 6000 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH	
137.48	6000	6.55	771.47	778.02	778.77	778.77	13.54	1.63	8.2	7.3	6.6
437.48	6000	5.64	770.31	775.96	777.61	777.61	16.12	1.72	7.4	7.3	5.6
737.48	6000	5.51	769.16	774.67	776.46	776.46	16.54	1.73	7.2	7.3	
1037.50	6000	5.47	768.00	773.47	775.30	775.30	16.70	1.74	7.2	7.3	
1337.50	6000	5.45	766.85	772.30	774.15	774.15	16.78	1.74	7.2	7.3	
1637.50	6000	5.44	765.69	771.13	772.99	772.99	16.81	1.74	7.2	7.3	
1937.50	6000	5.43	764.54	769.97	771.84	771.84	16.83	1.74	7.2	7.3	
2237.50	6000	5.43	763.38	768.81	770.68	770.68	16.84	1.74	7.2	7.3	
2532.20	6000	5.42	762.25	767.67	769.55	769.55	16.85	1.74	7.2	7.3	
2572.70	6000	8.01	762.10	770.11	769.40	769.40	13.01	1.65	9.7	7.3	8.0
2652.70	6000	8.34	761.80	770.14	768.70	768.70	9.87	1.50	9.8	6.9	8.3
2712.20	6000	5.62	761.36	766.98	768.33	768.33	16.19	1.72	7.3	6.97	5.6
3012.20	6000	5.25	759.83	765.08	766.80	766.80	17.51	1.76	7.0	6.97	
3312.20	6000	5.12	758.30	763.42	765.27	765.27	18.01	1.78	6.9	6.97	
3612.20	6000	5.06	756.77	761.85	763.74	763.74	18.24	1.78	6.8	6.97	
3912.20	6000	5.04	755.24	760.28	762.21	762.21	18.32	1.79	6.8	6.97	
4121.00	6000	5.03	754.17	759.20	761.14	761.14	18.38	1.79	6.8	6.97	
4222.00	6000	5.03	753.66	758.69	760.63	760.63	18.39	1.79	6.8	6.97	
4512.20	6000	4.99	752.13	757.12	759.10	759.10	18.53	1.79	6.8	6.97	
4812.20	6000	4.99	750.60	755.59	757.57	757.57	18.50	1.79	6.8	6.97	

TABLE C2 CONTINUE

HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS

DESIGN FLOW (Q = 6000 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH	
5100.00	6000	5.00	749.13	754.13	756.10	756.10	18.48	1.79	6.8	6.97	
5147.30	6000	9.32	748.94	758.26	755.90	755.91	9.03	1.48	10.8	6.97	9.3
5168.30	6000	9.39	747.50	754.52	756.89	754.47	15.73	1.83	11.2	6.97	9.4
5268.30	6000	7.37	746.80	757.65	754.00	754.00	17.30	1.84	9.2	7.2	7.4
5290.10	6000	4.26	746.86	751.12	753.79	753.79	28.30	1.82	6.1	6.93	
5484.00	6000	4.38	745.46	749.78	752.34	752.34	20.52	1.84	6.2	6.94	
5590.10	6000	4.42	744.61	749.02	751.55	751.55	20.60	1.85	6.3	6.94	
5890.10	6000	4.47	742.36	746.82	749.30	749.30	20.77	1.86	6.3	6.94	
6190.10	6000	4.48	740.11	744.58	747.05	747.05	20.86	1.86	6.3	6.94	
6208.78	6000	4.47	739.93	744.40	746.87	746.87	20.93	1.86	6.3	6.94	
6508.78	6000	4.88	738.46	743.35	745.48	745.48	18.96	1.80	6.7	6.94	
6808.78	6000	5.02	736.99	742.01	743.93	743.93	18.34	1.79	6.8	6.94	
7108.78	6000	5.07	735.52	740.60	742.46	742.46	18.24	1.78	6.9	6.94	
7480.00	6000	5.06	733.70	738.77	740.64	740.64	18.24	1.78	6.8	6.94	
7584.78	6000	5.06	733.19	738.26	740.13	740.13	18.23	1.78	6.8	6.94	
7662.60	6000	8.29	732.80	741.09	739.10	739.10	10.21	1.52	9.8	6.3	8.3
7747.50	6000	7.14	732.19	739.33	738.49	738.49	15.34	1.74	8.9	6.3	7.1
7847.50	6000	10.24	731.30	741.54	737.60	737.60	8.07	1.44	11.7	6.3	10.2
8049.30	6000	4.44	730.45	734.89	736.75	736.75	21.01	1.86	6.3	6.3	
8156.78	6000	4.69	730.00	734.69	736.30	736.70	19.78	1.83	6.5	6.7	

TABLE C2 CONTINUE
HYDRAULIC CHARACTERISTICS OF SLOAN CHANNEL/EXISTING DESIGN DRAWINGS
DESIGN FLOW (Q = 6000 cfs)

STATION	FLOW	DEPTH	INV.ELV	CWSEL	LB.ELV	LB.ELV	VCH	FB	FB+DEPTH	CH.DEPTH	
8349.30	6000	5.00	729.19	734.43	735.49	735.89	17.34	1.74	6.7	6.7	
8649.30	6000	5.23	727.92	733.18	734.22	734.62	17.28	1.75	7.0	6.7	
8949.30	6000	5.26	726.65	731.93	732.95	733.35	17.26	1.75	7.0	6.7	
9249.30	6000	5.27	725.39	730.66	731.69	732.09	17.27	1.75	7.0	6.7	
9549.30	6000	5.27	724.12	729.39	730.42	730.82	17.27	1.75	7.0	6.7	
9849.30	6000	5.27	722.86	728.13	729.16	729.56	17.28	1.75	7.0	6.7	
10149.00	6000	5.41	721.70	727.10	728.00	728.40	16.78	1.74	7.1	6.7	
10423.00	6000	5.44	720.43	725.87	728.88	728.13	17.08	1.75	7.2	7.7	
10574.00	6000	5.44	719.80	725.24	728.54	727.84	17.13	1.75	7.2	8.04	
10623.00	6000	6.31	719.55	725.86	727.70	727.70	13.58	1.63	7.9	8.15	
10624.00	6000	7.90	719.54	727.44	727.69	727.69	12.77	1.64	9.5	8.15	7.9
10724.00	6000	8.59	719.04	727.63	727.70	727.70	9.68	1.58	10.1	8.66	8.6
10725.00	6000	4.78	717.90	722.68	726.56	726.56	18.94	1.88	6.6	8.66	
10830.00	6000	5.96	717.80	723.76	723.15	728.10	15.15	1.69	7.6	10.3	
10900.00	6000	4.53	717.52	722.05	723.82	723.82	17.74	1.73	6.3	6.3	
11191.00	6000	5.01	716.35	721.36	723.85	723.85	16.06	1.69	6.7	7.5	
11491.00	6000	4.88	714.99	719.87	722.49	722.49	16.59	1.70	6.6	7.5	
11791.00	6000	4.81	713.63	718.44	721.13	721.13	16.85	1.71	6.5	7.5	
12091.00	6000	4.78	712.27	717.06	719.77	719.77	16.94	1.71	6.5	7.5	
12430.00	6000	4.77	710.74	715.51	718.24	718.24	16.98	1.71	6.5	7.5	

TABLE C3

BRIDGE INFORMATION DESIGN Q=3300 CFS.

STATION		BRIDGE ID.	UPSTREAM INFO DEPTH (FT.)	UPSTREAM INFO VELOCITY (FPS)	BRIDGE INFO B.AREA (SQFT)	BRIDGE INFO PONDING DEPTH (FT.)	Q.THRU (CFS)	WIER Q (CFS)
11937	*		3.86	13.66				
12532		WSHINGTON	3.86	13.66				
12572		BRIDGE			437	5.54	3300	0
12652								
13312	*							
13312	*		3.57	14.92				
15147		BANANZA	3.81	13.87				
15168		5(10'X5')			250	6.3	3300	0
		PCB.						
15268								
[illegible]80								
15898	*							
16888	*		3.59	14.77				
17662		STEWART	4.31	11.94				
17747		8(10'X3.5			280	4.79	3300	0
		RCB.						
17847								
18049								
18349	*							
110149	*		3.89	13.47				
110574		CHARESTON	3.8	14.08				
110623		BRIDGE	3.4	14.86				
110624					437	5.46	3300	0
110724								
110725								
110838								
111791	*							

* CHANNEL TYPICAL CROSS SECTIONS

TABLE C4

BRIDGE INFORMATION DESIGN Q=6000 CFS.

STATION		BRIDGE ID.	UPSTREAM INFO DEPTH (FT.)	UPSTREAM INFO VELOCITY (FPS)	BRIDGE INFO B.AREA (SQFT)	BRIDGE INFO PONDING DEPTH (FT.)	BRIDGE INFO Q.THRU (CFS)	BRIDGE INFO WIER Q (CFS)	DOWNSTREAM INFO. DEPTH (FT.)	DOWNSTREAM INFO. VELOCITY (FPS)
11937	*		5.43	16.83						
12532		WSHINGTON	5.42	16.85						
12572		BRIDGE			437	8.81	5683	319		
12652									8.34	9.87
12712									5.62	16.19
13312	*								5.06	18.24
13312	*		5.06	18.24						
15147		BANANZA	9.32	9.03						
15168		5(10'X5')			250	9.39	3932	2074		
		RCB.								
15268									10.85	10.6
15290									4.26	22.19
15890	*								4.47	21.04
16808	*		5.02	18.37						
17662		STEWART	8.29	10.21						
17747		8(10'X3.5			280	7.14	4296	1727		
		RCB.								
17847									10.24	8.07
18049									4.44	21.01
18349	*								5	18.36
110149	*		5.41	16.78						
110574		CHARESTON	5.44	17.13						
110623		BRIDGE	6.31	13.58						
110624					437	7.9	5580	419		
110724									8.59	9.68
110725									4.78	18.94
110830									4.36	11.91
111791	*								5.01	16.86

* CHANNEL TYPICAL CROSS SECTIONS

DATE _____

CLIENT CCPW JOB NO 500.710 CALC BY NGL

DESCRIPTION SLOAN CHANNEL - SUPERELEVATION CHECKED BY _____

SUPERELEVATION FOR REVERSE CURVES SOUTH OF CHARLESTON

EQ. 730 FROM THE CCRFCD MANUAL

$S_e = \frac{V^2 T_W}{g r}$ WHERE: S_e = SUPERELEVATION (ft)

T_W = TOP WIDTH OF FLOW (ft)

g = ACCEL. OF GRAVITY (ft/sec^2)

r = RADIUS OF CURVE (ft)

*CURVE 1 (STA 107+75.83 TO STA 111+91.30)

$r = 853.02$ ft

3300 cfs (X-SECT 10900)

$V = 14.57$ fps

$T_W = 80.97$ ft

$S_e = \frac{(14.57)^2 (80.97)}{(32.17)(853.02)} = 0.62$ ft

6000 cfs

$V = 17.74$ fps

$T_W = 86.14$ ft

$S_e = \frac{(17.74)^2 (86.14)}{(32.17)(853.02)} = 0.99$ ft

(CON'T.)

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

DATE

CLIENT CCPW JOB NO. CALC BY NCL

DESCRIPTION SLOAN CHANNEL - SUPERELEVATION CHECKED BY

*CURVE 2 (STA 1164 00.30 TO 120+30.43)

r = 800 ft

3300 cfs (X-SECT 11791.00)

V = 13.70 ft

TW = 79.62 ft

$$S_e = \frac{(13.70)^2(79.62)}{(32.17)(800)} = \boxed{0.58 \text{ ft}}$$

6000 cfs

V = 16.85 fps

TW = 84.05 ft

$$S_e = \frac{(16.85)^2(84.05)}{(32.17)(800)} = \boxed{0.93 \text{ ft}}$$

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

SUPERCRITICAL FLOW

```
**********************************************
*  HEC-2 WATER SURFACE PROFILES              *
*                                            *
*  Version  4.6.2:  May 1991                 *
*                                            *
*  RUN DATE    05APR93    TIME   10:03:59     *
**********************************************
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**************************************
*  U.S. ARMY CORPS OF ENGINEERS      *
*  HYDROLOGIC ENGINEERING CENTER     *
*  609 SECOND STREET, SUITE D        *
*  DAVIS, CALIFORNIA 95616-4687      *
*          (916) 756-1104            *
**************************************
```


```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

THIS RUN EXECUTED 05APR93 10:04:00

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2: May 1991
****

T1 SLOAN CHANNEL HYDRAULICS.
T2 FROM OWNES AVENUE TO LAS VEGAS WASH CONFLUENCE.
T3 SUPERCRITICAL FLOW.

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	1	-1	0	0	0	0	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	0	0	-1	0	0	0	-1			

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	38	43	3	42	1	53	54	55	26	56
QT	2	3300	6000							
NC	.015	.015	.015	.1	.3					
X1	137.48	5	0	81	300	300	300			
GR	778.77	0	771.77	10.5	771.47	40.5	771.77	70.5	778.77	81
X1	437.48	0	0	0	300	300	300		-1.155	
X1	737.48	0	0	0	300	300	300		-1.155	
X1	1037.5	0	0	0	300	300	300		-1.155	
X1	1337.5	0	0	0	300	300	300		-1.155	
X1	1637.5	0	0	0	300	300	300		-1.155	
X1	1937.5	0	0	0	300	300	300		-1.155	
X1	2237.5	0	0	0	295	295	295		-1.155	
NC	.015	.015	.015	.2	.4					
X1	2532.2	5	0	81	40.5	40.5	40.5			
GR	769.55	0	762.55	10.5	762.25	40.5	762.55	70.5	769.55	81
X1	2572.7	0	0	0	80	80	80		-.153	
X3	10							770.5	770.5	0

SB	.30	1.27	3	0	62	4	437	1.5	762.1	761.82
X1	2652.7	7	0	81	60	60	60			
X2	0	0	1	768.88	770.13	0	0	1.33	0	0
X3	10							770.5	770.5	0
BT	7	0	770.13	0	6.5	772.8	0	8.5	770.2	0
BT	40	769.68	0	71.5	770.2	0	73.5	772.8	0	80
BT	770.13	0								
GR	768.7	0	767.8	.1	762.2	8	761.8	40	762.2	72
GR	767.8	80.9	768.7	81						
X1	2712.2	5	0	80	300	300	300			
GR	768.33	0	761.66	10	761.36	40	761.66	70	768.33	80
NC	.015	.015	.015	.1	.3					
X1	3012.2	0	0	0	300	300	300		-1.53	
X1	3312.2	0	0	0	300	300	300		-1.53	
X1	3612.2	0	0	0	300	300	300		-1.53	
X1	3912.2	0	0	0	209	209	209		-1.53	
X1	4121.0	0	0	0	101	101	101		-1.066	
X1	4222.0	0	0	0	290	290	290		-0.515	
X1	4512.2	0	0	0	300	300	300		-1.53	
X1	4812.2	0	0	0	288	288	288		-1.53	
X1	5100.0	0	0	0	47.3	47.3	47.3		-1.469	
NC	.015	.015	.015	.3	.5					
X1	5147.3	5	0	30	21	21	21			
GR	755.5	0	749.24	10	748.94	40	749.24	70	755.91	80
X1	5168.3	5	0	52.7	100	100	100			
X3	10							755.5	755.5	0
GR	752.5	0	747.5	.1	747.3	26	747.5	52.6	752.5	52.7
SB	.30	1.27	3	0	52.7	2.7	250	0	747.3	746.8
X1	5268.3	0	0	0	21.8	21.8	21.8		-.5	
X2	0	0	1	752.5	755.5	0	0	1.33	0	0
X3	10							755.4	755.4	0
BT	5	0	756.14	0	20	755.66	0	46	755.52	0
BT	76	755.62	0	96	755.72	0				
NC	.015	.015	.015	.1	.3					
X1	5290.1	5	0	80	194	194	194			
GR	753.79	0	747.16	10	746.86	40	747.16	70	753.79	80

X1	5484	5	0	80	106	106	106			
GR	752.34	0	745.7	10	745.4	40	745.7	70	752.34	80
X1	5590.1	0	0	0	300	300	300		-0.795	
X1	5890.1	0	0	0	300	300	300		-2.25	
X1	6190.1	0	0	0	18	18	18		-2.25	
X1	6208.7	0	0	0	300	300	300		-0.1714	
X1	6508.7	0	0	0	300	300	300		-1.47	
X1	6808.7	0	0	0	300	300	300		-1.47	
X1	7108.7	0	0	0	371	371	371		-1.47	
X1	7480.0	0	0	0	104.7	104.7	104.7		-1.819	
X1	7584.7	0	0	0	77.9	77.9	77.9		-.5120	
NC	.015	.015	.015	.3	.5					
X1	7662.6	5	0	80	83.9	95.2	89.5			
GR	739.1	0	733.1	10	732.80	40	733.1	70	739.1	80
X1	7747.5	0	0	0	100	100	100		-.61	
X3	10							739.17	739.17	0
SB	.90	1.27	3	0	87	6.8	280	0	732.2	731.31
X1	7847.5	0	0	0	201.8	199	200		-.69	
X2	0	0	1	735.5	739.17	0	0	1.33	0	0
X3	10							739.17	739.17	0
BT	3	0	739.1	0	45	739.1	0	90	739.1	0
NC	.015	.015	.015	.1	.3					
X1	8049.3	5	0	80	107	107	107			
GR	736.75	0	730.75	10	730.45	40	730.75	70	736.75	80
X1	8156.7	5	0	80	153	153	153			
GR	736.3	0	730.3	10	730.0	40	730.3	70	736.7	80
X1	8349.3	0	0	0	300	300	300		-0.8145	
X1	8649.3	0	0	0	300	300	300		-1.266	
X1	8949.3	0	0	0	300	300	300		-1.266	
X1	9249.3	0	0	0	300	300	300		-1.266	

X1	9549.3	0	0	0	300	300	300		-1.266	
X1	9849.3	0	0	0	300	300	300		-1.266	
X1	10149	0	0	0	274	274	274		-1.159	
X1	10423	5	0	80	151	151	151			
GR	728.88	0	720.73	10	720.43	40	720.73	70	728.13	80
NC	.015	.015	.015	.2	.4					
X1	10574	5	0	80	50	50	50			
GR	728.54	0	720.1	10	719.80	40	720.1	70	727.84	80
X1	10623	5	0	85	1	1	1			
GR	727.7	0	719.8	13	719.55	45	719.55	75	727.7	85
X1	10624	0	0	0	100	100	100		-.01	
X3	10							727.4	727.4	0
SB	.90	1.27	3	0	62	4	437	1.5	719.55	719.04
X1	10724	5	0	85	1	1	1			
X2	0	0	1	726.15	727.4	0	0	1.33	0	0
X3	10							727.3	727.3	0
BT	7	0	727.4	0	6.5	730	0	6.5	727.6	0
BT	40	727.4	0	71.5	727.4	0	73.5	730	0	80
BT	727.4	0								
GR	727.7	0	719.3	13	719.04	45	719.3	75	727.7	85
X1	10725	0	0	0	105	105	105		-1.14	
X1	10830	5	0	80	70	70	70			
GR	723.15	0	718.1	10	717.6	40	718.1	70	728.10	80
NC	.015	.015	.015	.1	.3					
X1	10900	5	0	93	291	291	291			
GR	723.82	0	717.87	10	717.52	45	717.87	80	723.82	93
X1	11191	5	0	92.5	300	300	300			
GR	723.85	0	716.70	11.25	716.35	46.25	716.70	81.25	723.85	92.5
X1	11491	0	0	0	300	300	300		-1.359	
X1	11791	0	0	0	300	300	300		-1.359	
X1	12091	0	0	0	339	339	339		-1.359	
X1	12430	0	0	0	100	100	100		-1.5357	

X1	12530	5	0	82.5	200	200	200			
GR	717.81	0	710.61	11.25	710.31	41.25	710.61	71.25	717.81	82.5
X1	12730	0	0	0	300	300	300		-.86	
X1	13030	0	0	0	300	300	300		-1.29	
X1	13330	0	0	0	300	300	300		-1.29	
X1	13630	0	0	0	300	300	300		-1.29	
X1	13930	0	0	0	300	300	300		-1.29	
X1	14230	0	0	0	270	270	270		-1.29	
X1	14500	0	0	0	400	400	400		-1.161	
X1	14900	0	0	0	230	230	230		-1.72	
X1	15130	0	0	0	300	300	300		-.989	
X1	15430	0	0	0	300	300	300		-1.29	
X1	15730	0	0	0	300	300	300		-1.29	
X1	16030	0	0	0	300	300	300		-1.29	
X1	16330	0	0	0	300	300	300		-1.29	
X1	16630	0	0	0	300	300	300		-1.29	
X1	16930	0	0	0	300	300	300		-1.29	
X1	17230	0	0	0	180	180	180		-1.29	
X1	17410	0	0	0	0	0	0		-.774	

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300
*SECNO 137.480
2096 WSEL NOT GIVEN, AVG OF MAX, MIN USED
3720 CRITICAL DEPTH ASSUMED

137.480	4.53	775.00	776.00	.00	778.02	2.02	.00	.00	778.77
3300.0	.0	3300.0	.0	.0	289.5	.0	.0	.0	778.77
.00	.00	11.40	.00	.000	.015	.000	.000	771.47	4.16
.002196	0.	0.	0.	0	10	0	.00	72.68	76.84

*SECNO 437.480

3301 HV CHANGED MORE THAN HVINS

437.480	3.85	774.17	774.35	.00	777.07	2.90	.85	.09	777.61
3300.0	.0	3300.0	.0	.0	241.6	.0	1.8	.5	777.61
.01	.00	13.65	.00	.000	.015	.000	.000	770.31	5.16
.003845	300.	300.	300.	6	5	0	.00	70.68	75.84

*SECNO 737.480

737.480	3.85	773.02	773.71	.00	775.92	2.90	1.15	.00	775.46
3300.0	.0	3300.0	.0	.0	241.4	.0	3.5	1.0	776.46
.01	.00	13.67	.00	.000	.015	.000	.000	769.16	5.17
.003854	300.	300.	300.	6	8	0	.00	70.67	75.83

*SECNO 1037.500

1037.500	3.85	771.86	772.55	.00	774.76	2.91	1.16	.00	775.30
3300.0	.0	3300.0	.0	.0	241.3	.0	5.2	1.5	775.30
.02	.00	13.68	.00	.000	.015	.000	.000	768.00	5.17
.003860	300.	300.	300.	5	8	0	.00	70.66	75.83

*SECNO 1337.500

1337.500	3.86	770.71	771.40	.00	773.60	2.90	1.16	.00	774.15
3300.0	.0	3300.0	.0	.0	241.6	.0	6.8	2.0	774.15
.02	.00	13.66	.00	.000	.015	.000	.000	766.85	5.16
.003844	300.	300.	300.	5	8	0	.00	70.68	75.84

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1637.500

1637.500	3.85	769.54	770.24	.00	772.45	2.91	1.16	.00	772.59
3300.0	.0	3300.0	.0	.0	241.2	.0	8.5	2.4	772.39
.03	.00	13.68	.00	.000	.015	.000	.000	765.69	5.17
.003860	300.	300.	300.	5	8	0	.00	70.66	75.83

*SECNO 1937.500

1937.500	3.86	768.40	769.09	.00	771.29	2.89	1.15	.00	771.84
3300.0	.0	3300.0	.0	.0	241.8	.0	10.1	2.9	771.84
.04	.00	13.65	.00	.000	.015	.000	.000	764.54	5.16
.003831	300.	300.	300.	5	8	0	.00	70.69	75.84

*SECNO 2237.500

2237.500	3.85	767.24	767.93	.00	770.14	2.90	1.15	.00	770.68
3300.0	.0	3300.0	.0	.0	241.5	.0	11.8	3.4	770.68
.04	.00	13.67	.00	.000	.015	.000	.000	763.38	5.16
.003848	300.	300.	300.	5	8	0	.00	70.67	75.84

CCHV= .200 CEHV= .400

*SECNO 2532.200

2532.200	3.86	766.11	766.50	.00	769.00	2.89	1.13	.00	769.55
3300.0	.0	3300.0	.0	.0	241.8	.0	13.4	3.9	769.55
.05	.00	13.65	.00	.000	.015	.000	.000	762.25	5.16
.003834	295.	295.	295.	7	8	0	.00	70.69	75.84

*SECNO 2572.700

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 770.50 ELREA= 770.50

2572.700	4.03	766.13	766.64	.00	768.75	2.62	.14	.11	769.40
3300.0	.0	3300.0	.0	.0	254.2	.0	13.7	4.0	769.40
.05	.00	12.98	.00	.000	.015	.000	.000	762.10	4.89
.003283	41.	41.	41.	2	8	0	.00	71.21	76.11

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
3012.200	3.60	763.43	764.37	.00	766.81	3.38	.96	.13	766.80
3300.0	.0	3300.0	.0	.0	223.7	.0	16.2	4.7	766.80
.06	.00	14.75	.00	.000	.015	.000	.000	759.83	5.05
.004886	300.	300.	300.	6	5	0	.00	69.91	74.95
*SECNO 3312.200									
3312.200	3.57	761.87	762.83	.00	765.32	3.45	1.49	.01	765.27
3300.0	.0	3300.0	.0	.0	221.5	.0	17.8	5.2	765.27
.06	.00	14.50	.00	.000	.015	.000	.000	758.30	5.09
.005034	300.	300.	300.	6	11	0	.00	69.82	74.91
*SECNO 3612.200									
3612.200	3.56	760.33	761.30	.00	763.80	3.47	1.52	.00	763.74
3300.0	.0	3300.0	.0	.0	220.9	.0	19.3	5.6	763.74
.07	.00	14.54	.00	.000	.015	.000	.000	756.77	5.10
.005079	300.	300.	300.	6	11	0	.00	69.79	74.90
*SECNO 3912.200									
3912.200	3.56	758.80	759.77	.00	762.27	3.47	1.53	.00	762.21
3300.0	.0	3300.0	.0	.0	220.7	.0	20.8	6.1	762.21
.07	.00	14.95	.00	.000	.015	.000	.000	755.24	5.11
.005093	300.	300.	300.	6	11	0	.00	69.78	74.89
*SECNO 4121.000									
4121.000	3.56	757.73	758.70	.00	761.21	3.47	1.06	.00	761.14
3300.0	.0	3300.0	.0	.0	220.6	.0	21.9	6.5	761.14
.08	.00	14.96	.00	.000	.015	.000	.000	754.17	5.11
.005097	209.	209.	209.	6	11	0	.00	69.78	74.89
*SECNO 4222.000									
4222.000	3.56	757.22	758.19	.00	760.69	3.47	.51	.00	760.63
3300.0	.0	3300.0	.0	.0	220.7	.0	22.4	6.6	760.63
.08	.00	14.95	.00	.000	.015	.000	.000	753.66	5.11
.005090	101.	101.	101.	11	11	0	.00	69.78	74.89
*SECNO 4512.200									
4512.200	3.54	755.66	756.66	.00	759.19	3.53	1.49	.01	759.10
3300.0	.0	3300.0	.0	.0	219.0	.0	23.8	7.1	759.10
.09	.00	15.07	.00	.000	.015	.000	.000	752.13	5.15
.005218	290.	290.	290.	6	11	0	.00	69.71	74.85

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 4812.200

4812.200	3.57	754.16	755.13	.00	757.63	3.46	1.54	.02	757.57
3300.0	.0	3300.0	.0	.0	221.0	.0	25.4	7.6	757.57
.09	.00	14.93	.00	.000	.015	.000	.000	750.60	5.10
.005075	300.	300.	300.	7	11	0	.00	69.79	74.90

*SECNO 5100.000

5100.000	3.56	752.69	753.66	.00	756.16	3.47	1.46	.00	756.10
3300.0	.0	3300.0	.0	.0	220.6	.0	26.8	8.0	756.10
.10	.00	14.96	.00	.000	.015	.000	.000	745.13	5.11
.005099	286.	286.	286.	6	11	0	.00	69.78	74.89

CCHV= .300 CEHV= .500
*SECNO 5147.300
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

5147.300	3.81	752.75	753.47	.00	755.73	2.99	.21	.21	755.90
3300.0	.0	3300.0	.0	.0	238.0	.0	27.1	8.1	755.91
.10	.00	13.87	.00	.000	.015	.000	.000	748.94	4.73
.004026	47.	47.	47.	20	11	0	.00	70.53	75.26

*SECNO 5168.300

3301 HV CHANGED MORE THAN HVINS

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.50 ELREA= 755.50

5168.300	4.00	751.30	752.35	.00	755.33	4.03	.10	.31	752.50
3300.0	.0	3300.0	.0	.0	204.5	.0	27.2	8.1	752.50
.10	.00	16.11	.00	.000	.015	.000	.000	747.30	.02
.005154	21.	21.	21.	13	11	0	.00	52.65	52.68

SPECIAL BRIDGE

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

5290 UPSTREAM ELEV IS 753.60 ,NOT 751.30 NEW BACKWATER REQUIRED

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.27	3.00	.00	52.70	2.70	250.00	.00	747.30	746.80

*SECNO 5268.300
6180 SUPERCRITICAL FLOW, PRESSURE FLOW
6110 EGLWC OF 754.73 LESS THAN XEG OF 755.33
3280 CROSS SECTION 5268.30 EXTENDED 2.17 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .37

PRESSURE FLOW

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
754.73	754.68	.00	0.	3300.	250.	260.	752.50	753.50	0.

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.40 ELREA= 755.40

5268.300	7.37	754.17	.00	.00	755.33	1.15	.00	.00	752.00
3300.0	.0	3300.0	.0	.0	382.7	.0	27.9	8.3	752.00
.10	.00	8.62	.00	.000	.015	.000	.000	746.80	.00
.000708	100.	100.	100.	3	0	0	.00	52.70	52.70

CCHV= .100 CEHV= .300
*SECNO 5290.100

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.58

5290.100	3.02	749.88	751.39	.00	754.90	5.02	.04	.39	753.79
3300.0	.0	3300.0	.0	.0	183.6	.0	28.0	8.3	753.79
.10	.00	17.98	.00	.000	.015	.000	.000	746.86	5.89
.009080	22.	22.	22.	7	14	0	.00	66.21	74.11

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 5464.000									
5464.000	3.15	748.55	749.95	.00	753.13	4.58	1.64	.13	752.34
3300.0	.0	3300.0	.0	.0	192.1	.0	28.8	8.6	752.34
.11	.00	17.18	.00	.000	.015	.000	.000	745.40	5.71
.007666	194.	194.	194.	6	11	0	.00	68.58	74.29
*SECNO 5590.100									
5590.100	3.15	747.76	749.15	.00	752.25	4.53	.83	.01	751.55
3300.0	.0	3300.0	.0	.0	193.1	.0	29.3	8.8	751.55
.11	.00	17.09	.00	.000	.015	.000	.000	744.61	5.69
.007738	106.	106.	106.	7	11	0	.00	68.62	74.31
*SECNO 5890.100									
5890.100	3.20	745.55	746.90	.00	749.58	4.43	2.28	.03	749.30
3300.0	.0	3300.0	.0	.0	195.4	.0	30.6	9.2	749.30
.11	.00	16.89	.00	.000	.015	.000	.000	742.36	5.64
.007480	300.	300.	300.	6	11	0	.00	68.72	74.36
*SECNO 6190.100									
6190.100	3.15	743.30	744.64	.00	747.74	4.44	2.24	.00	747.05
3300.0	.0	3300.0	.0	.0	195.2	.0	32.0	9.7	747.05
.12	.00	16.91	.00	.000	.015	.000	.000	740.11	5.64
.007486	300.	300.	300.	7	11	0	.00	68.71	74.36
*SECNO 6208.700									
6208.700	3.17	743.11	744.47	.00	747.60	4.49	.14	.01	746.87
3300.0	.0	3300.0	.0	.0	194.1	.0	32.1	9.7	746.87
.12	.00	17.00	.00	.000	.015	.000	.000	739.93	5.67
.007623	18.	18.	18.	8	11	0	.00	68.66	74.33
*SECNO 6508.700									
3301 HV CHANGED MORE THAN HVINS									
6508.700	3.59	742.05	743.00	.00	745.45	3.40	1.82	.33	745.40
3300.0	.0	3300.0	.0	.0	223.1	.0	33.5	10.2	745.40
.12	.00	14.79	.00	.000	.015	.000	.000	738.46	5.04
.004839	300.	300.	300.	6	11	0	.00	69.93	74.96

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 6808.700									
6808.700	3.59	740.58	741.52	.00	743.97	3.39	1.48	.00	743.93
3300.0	.0	3300.0	.0	.0	223.4	.0	35.0	10.7	743.93
.13	.00	14.77	.00	.000	.015	.000	.000	736.99	5.03
.004908	300.	300.	300.	6	11	0	.00	69.94	74.97
*SECNO 7108.700									
7108.700	3.60	739.12	740.05	.00	742.50	3.38	1.47	.00	742.46
3300.0	.0	3300.0	.0	.0	223.6	.0	36.6	11.2	742.46
.13	.00	14.76	.00	.000	.015	.000	.000	735.52	5.03
.004894	300.	300.	300.	6	11	0	.00	69.95	74.97
*SECNO 7480.000									
7480.000	3.60	737.31	738.23	.00	740.69	3.38	1.81	.00	740.64
3300.0	.0	3300.0	.0	.0	223.7	.0	38.5	11.8	740.64
.14	.00	14.75	.00	.000	.015	.000	.000	733.70	5.02
.004886	371.	371.	371.	6	11	0	.00	69.95	74.98
*SECNO 7584.700									
7584.700	3.60	736.80	737.72	.00	740.17	3.38	.51	.00	740.13
3300.0	.0	3300.0	.0	.0	223.7	.0	39.0	11.9	740.13
.14	.00	14.75	.00	.000	.015	.000	.000	733.19	5.02
.004884	105.	105.	105.	11	11	0	.00	69.95	74.98

CCHV= .300 CEHV= .500
*SECNO 7662.600

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY									
7662.600	4.31	737.11	737.31	.00	739.32	2.21	.27	.58	739.10
3300.0	.0	3300.0	.0	.0	276.4	.0	39.5	12.1	739.10
.14	.00	11.94	.00	.000	.015	.000	.000	732.80	3.32
.002578	78.	78.	78.	2	11	0	.00	73.37	76.68

*SECNO 7747.500

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 739.17 ELREA= 739.17

7747.500	3.89	736.08	736.70	.00	738.87	2.79	.27	.17	738.49
3300.0	.0	3300.0	.0	.0	246.0	.0	40.0	12.2	738.49
.15	.00	13.41	.00	.000	.015	.000	.000	732.19	4.01
.003693	84.	90.	95.	10	8	0	.00	71.97	75.59

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 736.98 ,NOT 736.08 NEW BACKWATER REQUIRED

SB XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
.50	1.27	3.00	.00	87.00	6.60	280.00	.00	732.20	731.31

*SECNO 7847.500
PRESS FLOW BECAUSE EGLWC OF 739.74 EXCEEDS 1.5 DEPTH
6180 SUPERCRITICAL FLOW, PRESSURE FLOW
6110 EGLWC OF 738.82 LESS THAN XEG OF 738.87
3280 CROSS SECTION 7847.50 EXTENDED .51 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .37

PRESSURE FLOW

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
738.82	739.74	.00	0.	3300.	280.	265.	735.50	739.17	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 739.17 ELREA= 739.17

7847.500	6.81	738.11	.00	.00	738.87	.77	.00	.00	737.60
3300.0	.0	3300.0	.0	.0	469.7	.0	40.8	12.4	737.60
.15	.00	7.03	.00	.000	.015	.000	.000	731.30	.00
.000505	100.	100.	100.	3	0	0	.00	80.00	80.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 8049.300

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 4.03

8049.300	3.11	733.56	734.97	.00	738.22	4.67	.26	.39	736.75
3300.0	.0	3300.0	.0	.0	190.4	.0	42.3	12.7	736.75
.15	.00	17.34	.00	.000	.015	.000	.000	730.45	5.33
.006206	202.	200.	199.	6	14	0	.00	69.35	74.67

*SECNO 8156.700

3301 HV CHANGED MORE THAN HVINS

8156.700	3.39	733.39	734.53	.00	737.23	3.84	.75	.25	736.30
3300.0	.0	3300.0	.0	.0	209.7	.0	42.6	12.9	736.70
.16	.00	15.73	.00	.000	.015	.000	.000	730.00	4.85
.006034	107.	107.	107.	6	11	0	.00	69.97	74.83

*SECNO 8349.300

3301 HV CHANGED MORE THAN HVINS

8349.300	3.70	732.89	733.71	.00	736.03	3.14	.39	.21	735.49
3300.0	.0	3300.0	.0	.0	231.9	.0	43.8	13.2	735.89
.16	.00	14.23	.00	.000	.015	.000	.000	729.19	4.33
.004412	193.	193.	193.	7	11	0	.00	70.99	75.32

*SECNO 8649.300

8649.300	3.75	731.67	732.44	.00	734.71	3.04	1.29	.03	734.22
3300.0	.0	3300.0	.0	.0	235.8	.0	45.4	13.7	734.62
.17	.00	14.00	.00	.000	.015	.000	.000	727.92	4.24
.004191	300.	300.	300.	4	11	0	.00	71.17	75.40

*SECNO 8949.300

8949.300	3.76	730.41	731.17	.00	733.45	3.04	1.26	.00	732.95
3300.0	.0	3300.0	.0	.0	235.7	.0	47.0	14.2	733.35
.17	.00	14.00	.00	.000	.015	.000	.000	726.65	4.24
.004194	300.	300.	300.	6	11	0	.00	71.16	75.40

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 9249.300									
9249.300	3.75	729.13	729.91	.00	732.19	3.06	1.26	.00	731.69
3300.0	.0	3300.0	.0	.0	235.3	.0	48.7	14.7	732.09
.18	.00	14.03	.00	.000	.015	.000	.000	725.39	4.25
.004219	300.	300.	300.	6	11	0	.00	71.14	75.39
*SECNO 9549.300									
9545.300	3.75	727.87	728.64	.00	730.92	3.05	1.27	.00	730.42
3300.0	.0	3300.0	.0	.0	235.4	.0	50.3	15.2	730.82
.18	.00	14.02	.00	.000	.015	.000	.000	724.12	4.25
.004214	300.	300.	300.	6	11	0	.00	71.15	75.39
*SECNO 9849.300									
9849.300	3.75	726.60	727.37	.00	729.66	3.05	1.26	.00	729.16
3300.0	.0	3300.0	.0	.0	235.3	.0	51.9	15.7	725.56
.19	.00	14.02	.00	.000	.015	.000	.000	722.66	4.25
.004217	300.	300.	300.	6	11	0	.00	71.14	75.39
*SECNO 10145.000									
10145.000	3.85	725.58	726.21	.00	728.40	2.82	1.19	.07	728.00
3300.0	.0	3300.0	.0	.0	245.0	.0	53.6	16.2	726.40
.20	.00	13.47	.00	.000	.015	.000	.000	721.70	4.02
.003719	300.	300.	300.	8	11	0	.00	71.59	75.61
*SECNO 10423.000									
10423.000	3.75	724.22	725.00	.00	727.30	3.08	1.07	.03	728.88
3300.0	.0	3300.0	.0	.0	234.5	.0	55.1	16.6	726.13
.20	.00	14.07	.00	.000	.015	.000	.000	720.43	5.71
.004134	274.	274.	274.	7	8	0	.00	69.01	74.72
CCHV= .200 CEHV= .400									
*SECNO 10574.000									
10574.000	3.80	723.60	724.35	.00	726.68	3.08	.62	.00	728.54
3300.0	.0	3300.0	.0	.0	234.3	.0	55.9	16.8	727.84
.20	.00	14.08	.00	.000	.015	.000	.000	715.80	5.85
.004123	151.	151.	151.	14	11	0	.00	68.68	74.53

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10623.000

10623.000	3.40	722.95	723.92	.00	726.38	3.43	.23	.07	727.70
3300.0	.0	3300.0	.0	.0	222.0	.0	56.1	16.9	727.70
.20	.00	14.86	.00	.000	.015	.000	.000	719.55	7.82
.005149	50.	50.	50.	19	8	0	.00	71.35	79.17

*SECNO 10624.000
7185 MINIMUM SPECIFIC ENERGY

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.40 ELREA= 727.40

10624.000	3.42	722.95	723.90	.00	726.33	3.41	.01	.01	727.69
3300.0	.0	3300.0	.0	.0	222.3	.0	56.1	16.9	727.69
.20	.00	14.81	.00	.000	.015	.000	.000	719.54	7.80
.005092	1.	1.	1.	0	11	0	.00	71.39	79.18

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 725.00 ,NOT 722.56 NEW BACKWATER REQUIRED

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.27	3.00	.00	62.00	4.00	437.00	1.50	719.55	719.04

*SECNO 10724.000
CLASS B LOW FLOW

3420 BRIDGE W.S.= 723.76 BRIDGE VELOCITY= 11.42 CALCULATED CHANNEL AREA= 271.

EGPRS	EGLWC	HS	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	725.83	.00	0.	3300.	437.	448.	726.15	727.40	0.

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.30 ELREA= 727.30

10724.000	3.59	722.63	.00	.00	725.83	3.20	.53	.00	727.70
3300.0	.0	3300.0	.0	.0	230.0	.0	56.7	17.1	727.70
.21	.00	14.35	.00	.000	.015	.000	.000	719.04	7.84
.004568	100.	100.	100.	0	0	0	.00	71.13	78.97

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10725.000

3301 HV CHANGED MORE THAN HVINS

10725.000	3.05	720.95	722.33	.00	725.54	4.60	.01	.28	726.56
3300.0	.0	3300.0	.0	.0	191.7	.0	56.7	17.1	726.56
.21	.00	17.21	.00	.000	.015	.000	.000	717.50	8.68
.008097	1.	1.	1.	19	11	0	.00	69.64	78.32

*SECNO 10830.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

10830.000	4.32	722.12	722.35	.00	724.37	2.25	.44	.55	723.15
3300.0	.0	3300.0	.0	.0	274.3	.0	57.2	17.3	728.10
.21	.00	12.03	.00	.000	.015	.000	.000	717.80	3.04
.002598	105.	105.	105.	20	11	0	.00	71.98	74.02

CCHV= .100 CEHV= .300
*SECNO 10900.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.47

10900.000	3.19	720.71	721.67	.00	724.00	3.30	.26	.11	723.82
3300.0	.0	3300.0	.0	.0	226.4	.0	57.6	17.4	723.82
.21	.00	14.57	.00	.000	.015	.000	.000	717.52	3.23
.005620	70.	70.	70.	14	8	0	.00	80.57	86.20

*SECNO 11191.000

3301 HV CHANGED MORE THAN HVINS

11191.000	3.65	720.00	720.51	.00	722.49	2.49	1.27	.24	723.85
3300.0	.0	3300.0	.0	.0	260.8	.0	59.3	17.9	723.85
.22	.00	12.55	.00	.000	.015	.000	.000	716.35	6.05
.003506	291.	291.	291.	5	11	0	.00	80.40	86.45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 11491.000									
11491.000	3.44	718.43	719.16	.00	721.28	2.85	1.17	.04	722.49
3300.0	.0	3300.0	.0	.0	243.5	.0	61.0	18.5	722.49
.22	.00	13.56	.00	.000	.015	.000	.000	714.99	6.39
.004353	300.	300.	300.	7	8	0	.00	79.72	86.11
*SECNO 11791.000									
11791.000	3.40	717.03	717.79	.00	719.95	2.92	1.33	.01	721.13
3300.0	.0	3300.0	.0	.0	240.8	.0	62.7	19.0	721.13
.23	.00	13.70	.00	.000	.015	.000	.000	713.63	6.44
.004504	300.	300.	300.	6	11	0	.00	79.62	86.06
*SECNO 12091.000									
12091.000	3.40	715.68	716.43	.00	718.59	2.92	1.35	.00	719.77
3300.0	.0	3300.0	.0	.0	240.7	.0	64.3	19.6	719.77
.23	.00	13.71	.00	.000	.015	.000	.000	712.27	6.45
.004513	300.	300.	300.	5	11	0	.00	79.61	86.05
*SECNO 12430.000									
12430.000	3.40	714.13	714.89	.00	717.05	2.93	1.53	.00	718.24
3300.0	.0	3300.0	.0	.0	240.3	.0	66.2	20.2	718.24
.24	.00	13.73	.00	.000	.015	.000	.000	710.74	6.45
.004533	339.	339.	339.	8	11	0	.00	79.60	86.05

*SECNO 12530.000

3301 HV CHANGED MORE THAN HVINS

3585 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12530.000	4.53	714.84	714.84	.00	716.84	2.00	.30	.23	717.81
3300.0	.0	3300.0	.0	.0	290.5	.0	66.8	20.4	717.81
.24	.00	11.36	.00	.000	.015	.000	.000	710.31	4.65
.002189	100.	100.	100.	20	11	0	.00	73.21	77.85

*SECNO 12730.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	GLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

12730.000	3.87	713.32	713.58	.00	716.19	2.87	.57	.09	716.95
3300.0	.0	3300.0	.0	.0	242.7	.0	68.0	20.7	716.95
.25	.00	13.60	.00	.000	.015	.000	.000	709.45	5.68
.003813	200.	200.	200.	6	5	0	.00	71.14	76.82

*SECNO 13030.000

13030.000	3.76	711.92	712.70	.00	714.97	3.05	1.20	.02	715.66
3300.0	.0	3300.0	.0	.0	235.5	.0	69.7	21.2	715.66
.25	.00	14.01	.00	.000	.015	.000	.000	708.16	5.54
.004185	300.	300.	300.	7	8	0	.00	70.82	76.66

*SECNO 13330.000

13330.000	3.74	710.61	711.39	.00	713.70	3.09	1.27	.00	714.37
3300.0	.0	3300.0	.0	.0	234.0	.0	71.3	21.7	714.37
.25	.00	14.10	.00	.000	.015	.000	.000	706.87	5.37
.004269	300.	300.	300.	7	11	0	.00	70.76	76.63

*SECNO 13630.000

13630.000	3.74	709.32	710.10	.00	712.41	3.10	1.28	.00	713.08
3300.0	.0	3300.0	.0	.0	233.6	.0	72.9	22.2	713.08
.27	.00	14.13	.00	.000	.015	.000	.000	705.53	5.38
.004291	300.	300.	300.	7	11	0	.00	70.74	76.62

*SECNO 13930.000

13930.000	3.73	708.02	708.81	.00	711.13	3.10	1.29	.00	711.79
3300.0	.0	3300.0	.0	.0	233.5	.0	74.5	22.6	711.79
.27	.00	14.13	.00	.000	.015	.000	.000	704.29	5.38
.004297	300.	300.	300.	7	11	0	.00	70.73	76.62

*SECNO 14230.000

14230.000	3.72	706.72	707.52	.00	709.83	3.11	1.29	.00	710.50
3300.0	.0	3300.0	.0	.0	233.1	.0	76.1	23.1	710.50
.28	.00	14.16	.00	.000	.015	.000	.000	703.00	5.39
.004320	300.	300.	300.	6	11	0	.00	70.72	76.61

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 14500.000									
14500.000	3.73	705.57	706.36	.00	708.67	3.10	1.16	.00	709.34
3300.0	.0	3300.0	.0	.0	233.7	.0	77.6	23.6	709.34
.28	.00	14.12	.00	.000	.015	.000	.000	701.84	5.88
.004286	270.	270.	270.	7	11	0	.00	70.74	76.62
*SECNO 14900.000									
14900.000	3.73	703.65	704.64	.00	706.95	3.10	1.72	.00	707.62
3300.0	.0	3300.0	.0	.0	233.6	.0	79.7	24.2	707.62
.25	.00	14.12	.00	.000	.015	.000	.000	700.12	5.88
.004290	400.	400.	400.	8	11	0	.00	70.74	76.62
*SECNO 15130.000									
15130.000	3.74	702.87	703.65	.00	705.96	3.10	.99	.00	706.63
3300.0	.0	3300.0	.0	.0	233.6	.0	80.9	24.6	706.63
.30	.00	14.12	.00	.000	.015	.000	.000	699.13	5.88
.004290	230.	230.	230.	7	11	0	.00	70.74	76.62
*SECNO 15430.000									
15430.000	3.73	701.57	702.36	.00	704.68	3.10	1.29	.00	705.34
3300.0	.0	3300.0	.0	.0	233.5	.0	82.6	25.1	705.34
.30	.00	14.13	.00	.000	.015	.000	.000	697.34	5.88
.004296	300.	300.	300.	7	11	0	.00	70.73	76.62
*SECNO 15730.000									
15730.000	3.72	700.27	701.07	.00	703.38	3.11	1.29	.00	704.05
3300.0	.0	3300.0	.0	.0	233.1	.0	84.2	25.6	704.05
.31	.00	14.16	.00	.000	.015	.000	.000	696.55	5.89
.004320	300.	300.	300.	6	11	0	.00	70.72	76.61
*SECNO 16030.000									
16030.000	3.73	698.99	699.78	.00	702.09	3.10	1.29	.00	702.76
3300.0	.0	3300.0	.0	.0	233.6	.0	85.8	26.1	702.76
.31	.00	14.13	.00	.000	.015	.000	.000	695.26	5.88
.004291	300.	300.	300.	6	11	0	.00	70.74	76.62

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 16330.000									
16330.000	3.73	697.70	698.49	.00	700.80	3.10	1.29	.00	701.47
3300.0	.0	3300.0	.0	.0	233.7	.0	87.4	26.5	701.47
.32	.00	14.12	.00	.000	.015	.000	.000	693.97	5.88
.004288	300.	300.	300.	5	11	0	.00	70.74	76.62
*SECNO 16630.000									
16630.000	3.73	696.41	697.20	.00	699.51	3.10	1.29	.00	700.18
3300.0	.0	3300.0	.0	.0	233.4	.0	89.0	27.0	700.18
.33	.00	14.14	.00	.000	.015	.000	.000	692.68	5.89
.004304	300.	300.	300.	6	11	0	.00	70.73	76.61
*SECNO 16930.000									
16930.000	3.73	695.12	695.91	.00	698.22	3.10	1.29	.00	698.89
3300.0	.0	3300.0	.0	.0	233.6	.0	90.6	27.5	698.89
.33	.00	14.13	.00	.000	.015	.000	.000	691.39	5.88
.004293	300.	300.	300.	6	11	0	.00	70.74	76.62
*SECNO 17230.000									
17230.000	3.72	693.82	694.62	.00	696.93	3.10	1.29	.00	697.60
3300.0	.0	3300.0	.0	.0	233.4	.0	92.2	28.0	697.60
.34	.00	14.14	.00	.000	.015	.000	.000	690.10	5.89
.004303	300.	300.	300.	6	11	0	.00	70.73	76.61
*SECNO 17410.000									
17410.000	3.73	693.06	693.85	.00	696.15	3.09	.77	.00	696.83
3300.0	.0	3300.0	.0	.0	233.8	.0	93.2	28.3	696.83
.34	.00	14.11	.00	.000	.015	.000	.000	689.33	5.88
.004279	180.	180.	180.	8	11	0	.00	70.75	76.62

T1 SLOAN CHANNEL HYDRAULICS.
T2 FROM OWNES AVENUE TO LAS VEGAS WASH CONFLUENCE.
T3 SUPERCRITICAL FLOW.

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	3	0	1	-1	0	0	0	0	0
J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15	0	-1	0	0	0	-1			

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 2

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300
*SECNO 137.480
2096 WSEL NOT GIVEN, AVG OF MAX, MIN USED
3720 CRITICAL DEPTH ASSUMED

137.480	6.56	778.03	778.03	.00	780.87	2.84	.00	.00	778.77
6000.0	.0	6000.0	.0	.0	443.6	.0	.0	.0	778.77
.00	.00	13.53	.00	.000	.015	.000	.000	771.47	1.11
.001961	0.	0.	0.	0	13	0	.00	78.79	79.89

*SECNO 437.480

3301 HV CHANGED MORE THAN HVINS

437.480	5.54	775.96	776.88	.00	779.99	4.04	.76	.12	777.51
6000.0	.0	6000.0	.0	.0	372.1	.0	2.8	.5	777.61
.01	.00	16.12	.00	.000	.015	.000	.000	770.31	2.49
.003368	300.	300.	300.	6	5	0	.00	76.02	76.51

*SECNO 737.480

737.480	5.51	774.67	775.74	.00	778.92	4.25	1.05	.02	776.46
6000.0	.0	6000.0	.0	.0	362.8	.0	5.3	1.1	776.46
.01	.00	16.54	.00	.000	.015	.000	.000	769.15	2.68
.003640	300.	300.	300.	8	8	0	.00	75.65	76.32

*SECNO 1037.500

1037.500	5.47	773.47	774.56	.00	777.80	4.33	1.11	.01	775.30
6000.0	.0	6000.0	.0	.0	359.2	.0	7.8	1.6	775.30
.02	.00	16.70	.00	.000	.015	.000	.000	768.00	2.75
.003751	300.	300.	300.	8	11	0	.00	75.51	78.25

*SECNO 1337.500

1337.500	5.45	772.30	773.41	.00	776.67	4.37	1.13	.00	774.15
6000.0	.0	6000.0	.0	.0	357.6	.0	10.3	2.1	774.15
.02	.00	16.78	.00	.000	.015	.000	.000	766.85	2.78
.003803	300.	300.	300.	8	11	0	.00	75.44	78.22

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1637.500

1637.500	5.44	771.13	772.25	.00	775.52	4.39	1.14	.00	772.99
6000.0	.0	6000.0	.0	.0	356.8	.0	12.8	2.6	772.99
.03	.00	16.81	.00	.000	.015	.000	.000	765.69	2.79
.003827	300.	300.	300.	7	11	0	.00	75.41	78.21

*SECNO 1937.500

1937.500	5.43	765.97	771.10	.00	774.37	4.40	1.15	.00	771.84
6000.0	.0	6000.0	.0	.0	356.5	.0	15.2	3.1	771.84
.03	.00	16.83	.00	.000	.015	.000	.000	764.54	2.80
.003839	300.	300.	300.	7	11	0	.00	75.40	78.20

*SECNO 2237.500

2237.500	5.43	768.81	769.94	.00	773.22	4.40	1.15	.00	770.68
6000.0	.0	6000.0	.0	.0	356.3	.0	17.7	3.7	770.68
.04	.00	16.84	.00	.000	.015	.000	.000	763.33	2.80
.003845	300.	300.	300.	7	11	0	.00	75.39	78.20

CCHV= .200 CEHV= .400

*SECNO 2532.200

2532.200	5.42	767.67	768.81	.00	772.06	4.41	1.13	.00	769.55
6000.0	.0	6000.0	.0	.0	356.1	.0	20.1	4.2	769.55
.04	.00	16.85	.00	.000	.015	.000	.000	762.25	2.81
.003850	295.	295.	295.	11	11	0	.00	75.38	78.19

*SECNO 2572.700

3301 HV CHANGED MORE THAN HVINS

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 770.50 ELREA= 770.50

2572.700	5.69	767.98	768.65	.00	771.65	3.67	.13	.30	769.40
6000.0	.0	6000.0	.0	.0	390.5	.0	20.4	4.2	769.40
.04	.00	15.37	.00	.000	.015	.000	.000	762.10	2.13
.002911	41.	41.	41.	4	11	0	.00	76.74	78.87

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 770.11 ,NOT 767.98 NEW BACKWATER REQUIRED

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.27	3.00	.00	62.00	4.00	437.00	1.50	762.10	761.62

*SECNO 2652.700
6180 SUPERCRITICAL FLOW, PRESSURE FLOW
6870 D.S. ENERGY OF 771.65 IS HIGHER THAN COMPUTED ENERGY OF 771.33
3260 CROSS SECTION 2652.70 EXTENDED 1.44 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, XRATIO = .51

PRESSURE AND WEIR FLOW. Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
771.70	771.33	.00	319.	5689.	437.	462.	768.88	770.13	71.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 770.50 ELREA= 770.50

2652.700	5.34	770.14	.00	.00	771.65	1.51	.00	.00	768.70
6000.0	.0	6000.0	.0	.0	607.8	.0	21.3	4.4	768.70
.04	.00	9.87	.00	.000	.015	.000	.000	761.80	.00
.000745	80.	80.	80.	3	0	2	.00	81.00	81.00

*SECNO 2712.200

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, XRATIO = 2.13

2712.200	5.62	766.98	767.92	.00	771.06	4.07	.08	.51	768.33
6000.0	.0	6000.0	.0	.0	370.6	.0	22.0	4.5	768.33
.04	.00	16.19	.00	.000	.015	.000	.000	761.36	2.03
.003412	60.	60.	60.	5	15	0	.00	75.95	77.97

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 3012.200

3301 HV CHANGED MORE THAN HVINS

3012.200	5.25	765.08	766.41	.00	769.84	4.76	1.15	.07	766.80
6000.0	.0	6000.0	.0	.0	342.7	.0	24.5	5.0	766.80
.05	.00	17.51	.00	.000	.015	.000	.000	759.83	2.58
.004327	300.	300.	300.	8	8	0	.00	74.84	77.42

*SECNO 3312.200

3312.200	5.12	763.42	764.86	.00	768.46	5.04	1.36	.03	755.27
6000.0	.0	6000.0	.0	.0	333.1	.0	26.8	5.5	765.27
.05	.00	16.01	.00	.000	.015	.000	.000	758.30	2.77
.004720	300.	300.	300.	5	11	0	.00	74.46	77.23

*SECNO 3612.200

3612.200	5.06	761.33	763.33	.00	767.00	5.17	1.44	.01	753.74
6000.0	.0	6000.0	.0	.0	329.3	.0	29.1	5.0	763.74
.06	.00	18.24	.00	.000	.015	.000	.000	756.77	2.36
.004905	300.	300.	300.	6	11	0	.00	74.29	77.14

*SECNO 3912.200

3912.200	5.04	760.28	761.80	.00	765.51	5.23	1.49	.01	752.21
6000.0	.0	6000.0	.0	.0	326.9	.0	31.3	6.5	762.21
.06	.00	18.35	.00	.000	.015	.000	.000	755.24	2.30
.005000	300.	300.	300.	5	11	0	.00	74.21	77.19

*SECNO 4121.000

4121.000	5.02	759.20	760.74	.00	764.46	5.26	1.05	.00	761.14
6000.0	.0	6000.0	.0	.0	326.0	.0	32.9	6.9	761.14
.07	.00	18.40	.00	.000	.015	.000	.000	754.17	2.93
.005041	209.	209.	209.	8	11	0	.00	74.17	77.08

*SECNO 4222.000

4222.000	5.02	758.58	760.22	.00	763.95	5.25	.51	.00	750.63
6000.0	.0	6000.0	.0	.0	325.9	.0	33.7	7.1	760.63
.07	.00	18.41	.00	.000	.015	.000	.000	753.66	2.92
.005046	101.	101.	101.	15	11	0	.00	74.17	77.08

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 4512.200

4512.200	4.99	757.12	756.69	.00	762.46	5.34	1.48	.01	759.10
6000.0	.0	6000.0	.0	.0	323.6	.0	35.8	7.6	759.10
.07	.00	16.54	.00	.000	.015	.000	.000	752.13	2.96
.005156	290.	290.	290.	6	11	0	.00	74.07	77.04

*SECNO 4812.200

4812.200	4.99	755.59	757.16	.00	760.91	5.32	1.54	.01	757.57
6000.0	.0	6000.0	.0	.0	324.2	.0	38.1	8.1	757.57
.08	.00	16.51	.00	.000	.015	.000	.000	750.60	2.95
.005128	300.	300.	300.	6	11	0	.00	74.10	77.05

*SECNO 5100.000

5100.000	5.00	754.13	755.69	.00	759.43	5.30	1.47	.01	756.10
6000.0	.0	6000.0	.0	.0	324.7	.0	40.2	8.6	756.10
.08	.00	16.48	.00	.000	.015	.000	.000	749.13	2.94
.005104	288.	288.	288.	6	11	0	.00	74.12	77.06

CCHV= .300 CEHV= .500
*SECNO 5147.300

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY

5147.300	5.43	754.37	755.50	.00	758.77	4.40	.21	.45	755.50
6000.0	.0	6000.0	.0	.0	356.5	.0	40.6	8.6	755.91
.08	.00	16.83	.00	.000	.015	.000	.000	748.54	2.25
.003840	47.	47.	47.	0	11	0	.00	75.40	77.69

*SECNO 5168.300
3280 CROSS SECTION 5168.30 EXTENDED 2.02 FEET

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.50 ELREA= 755.50

5168.300	7.22	754.52	754.77	.00	758.50	3.99	.06	.21	752.50
6000.0	.0	6000.0	.0	.0	374.5	.0	40.7	8.7	752.50
.08	.00	16.02	.00	.000	.015	.000	.000	747.30	.00
.002507	21.	21.	21.	2	11	0	.00	52.70	52.70

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 756.69 ,NOT 754.52 NEW BACKWATER REQUIRED

SE	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.50	1.37	3.00	.00	52.70	2.70	250.00	.00	747.30	746.80

*SECNO 5268.300
5160 SUPERCRITICAL FLOW, PRESSURE FLOW
3280 CROSS SECTION 5268.30 EXTENDED 5.65 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .52

PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
765.87	758.44	.00	2074.	3932.	250.	260.	752.50	755.50	96.

5268.300	10.85	757.65	.00	.00	759.39	1.74	.89	.00	752.00
6000.0	.0	6000.0	.0	.0	566.1	.0	41.8	8.8	752.00
.06	.00	10.60	.00	.000	.015	.000	.000	746.80	.00
.000680	100.	100.	100.	3	0	3	.00	52.70	52.70

CCHV= .100 CEHV= .300
*SECNO 5230.100

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.63

5230.100	4.26	751.12	753.42	.00	758.77	7.64	.04	.59	753.79
6000.0	.0	6000.0	.0	.0	270.5	.0	42.0	8.8	753.79
.08	.00	22.19	.00	.000	.015	.000	.000	746.86	4.02
.008963	22.	22.	22.	7	14	0	.00	71.95	75.98

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 5484.000									
5484.000	4.38	749.78	751.96	.00	756.97	7.19	1.66	.13	752.34
6000.0	.0	6000.0	.0	.0	276.7	.0	43.3	9.2	752.34
.09	.00	21.52	.00	.000	.015	.000	.000	745.40	3.36
.008163	194.	194.	194.	7	14	0	.00	72.28	76.14
*SECNO 5590.100									
5590.100	4.42	749.02	751.19	.00	756.08	7.06	.85	.04	751.55
6000.0	.0	6000.0	.0	.0	281.4	.0	43.9	9.3	751.55
.09	.00	21.32	.00	.000	.015	.000	.000	744.51	3.30
.007926	106.	106.	106.	12	11	0	.00	72.40	76.20
*SECNO 5890.100									
5890.100	4.47	746.82	748.93	.00	753.70	6.87	2.33	.06	749.30
6000.0	.0	6000.0	.0	.0	285.2	.0	45.9	9.8	749.30
.09	.00	21.04	.00	.000	.015	.000	.000	743.36	3.72
.007607	300.	300.	300.	7	11	0	.00	72.55	76.28
*SECNO 6190.100									
6190.100	4.46	744.59	746.68	.00	751.41	6.83	2.27	.01	747.05
6000.0	.0	6000.0	.0	.0	288.2	.0	47.5	10.3	747.05
.10	.00	20.97	.00	.000	.015	.000	.000	740.11	3.70
.007526	300.	300.	300.	8	11	0	.00	72.59	76.30
*SECNO 6208.700									
6208.700	4.47	744.40	746.51	.00	751.27	6.87	.14	.00	745.87
6000.0	.0	6000.0	.0	.0	283.3	.0	48.0	10.4	746.87
.10	.00	21.03	.00	.000	.015	.000	.000	739.93	3.72
.007600	18.	18.	18.	7	11	0	.00	72.56	76.28
*SECNO 6508.700									
3301 HV CHANGED MORE THAN HVINS									
6508.700	4.88	743.35	745.04	.00	748.93	5.61	1.94	.38	745.40
6000.0	.0	6000.0	.0	.0	315.8	.0	50.0	10.9	745.40
.10	.00	19.00	.00	.000	.015	.000	.000	738.46	3.09
.005563	300.	300.	300.	5	11	0	.00	73.81	76.91

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 6608.700									
6808.700	5.02	742.02	743.56	.00	747.26	5.24	1.58	.11	743.93
6000.0	.0	6000.0	.0	.0	326.6	.0	52.3	11.4	743.93
.11	.00	18.37	.00	.000	.015	.000	.000	736.99	2.88
.005019	300.	300.	300.	6	11	0	.00	74.25	77.12
*SECNO 7108.700									
7108.700	5.07	740.39	742.09	.00	745.75	5.16	1.49	.03	742.46
6000.0	.0	6000.0	.0	.0	329.2	.0	54.5	11.9	742.46
.11	.00	18.22	.00	.000	.015	.000	.000	735.52	2.82
.004695	300.	300.	300.	7	11	0	.00	74.36	77.18
*SECNO 7480.000									
7480.000	5.06	738.77	740.27	.00	743.93	5.16	1.62	.00	740.64
6000.0	.0	6000.0	.0	.0	329.1	.0	57.3	12.5	740.64
.12	.00	18.23	.00	.000	.015	.000	.000	733.70	2.82
.004902	371.	371.	371.	5	11	0	.00	74.35	77.18
*SECNO 7584.700									
7584.700	5.06	738.26	739.75	.00	743.42	5.16	.51	.00	740.13
6000.0	.0	6000.0	.0	.0	329.2	.0	58.1	12.7	740.13
.12	.00	18.23	.00	.000	.015	.000	.000	733.19	2.82
.004898	105.	105.	105.	15	11	0	.00	74.36	77.18

CCHV= .300 CEHV= .500
*SECNO 7662.600

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .70

7662.600	6.19	738.99	739.30	.00	742.17	3.18	.26	.99	739.10
6000.0	.0	6000.0	.0	.0	419.6	.0	58.8	12.6	739.10
.12	.00	14.30	.00	.000	.015	.000	.000	732.80	.20
.002397	78.	78.	78.	3	11	0	.00	79.61	79.80

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 7747.500

3301 HV CHANGED MORE THAN HVINS

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 739.17 ELREA= 739.17

7747.500	5.71	737.90	738.69	.00	741.73	3.82	.25	.19	738.49
6000.0	.0	6000.0	.0	.0	382.4	.0	59.6	13.0	738.49
.12	.00	15.69	.00	.000	.015	.000	.000	732.19	.98
.003170	84.	50.	95.	3	3	0	.00	78.03	79.02

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 739.33 .NOT 737.90 NEW BACKWATER REQUIRED

SB XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
.50	1.27	3.00	.00	67.00	6.80	280.00	.00	732.20	731.31

*SECNO 7847.300
6180 SUPERCRITICAL FLOW, PRESSURE FLOW
3280 CROSS SECTION 7847.50 EXTENDED 3.94 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .36

PRESSURE AND WEIR FLOW. Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
746.96	743.05	.00	1727.	4296.	280.	265.	735.50	739.17	90.

7847.500	10.24	741.54	.00	.00	742.55	1.01	.82	.00	737.60
6000.0	.0	6000.0	.0	.0	743.9	.0	60.9	13.2	737.60
.12	.00	8.07	.00	.000	.015	.000	.000	731.30	.00
.000404	100.	100.	100.	3	0	2	.00	80.00	80.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 8049.300

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 4.37

8049.300	4.44	734.89	736.93	.00	741.75	6.85	.21	.58	736.75
6000.0	.0	6000.0	.0	.0	285.6	.0	63.3	13.5	736.75
.13	.00	21.01	.00	.000	.013	.000	.000	730.45	3.11
.007708	202.	200.	199.	6	14	0	.00	73.78	76.89

*SECNO 8156.700

3301 HV CHANGED MORE THAN HVINS

8156.700	4.69	734.65	736.54	.00	740.77	6.08	.75	.23	736.30
6000.0	.0	6000.0	.0	.0	303.3	.0	64.0	13.7	736.70
.13	.00	19.75	.00	.000	.015	.000	.000	730.00	2.69
.006375	107.	107.	107.	7	11	0	.00	74.17	76.85

*SECNO 8345.300

3301 HV CHANGED MORE THAN HVINS

8345.300	5.30	734.18	735.72	.00	739.42	5.23	1.09	.25	735.49
6000.0	.0	6000.0	.0	.0	326.8	.0	65.4	14.0	735.89
.13	.00	18.36	.00	.000	.015	.000	.000	729.15	2.16
.005074	193.	193.	193.	7	11	0	.00	75.18	77.33

*SECNO 8649.300

3301 HV CHANGED MORE THAN HVINS

8649.300	5.23	733.15	734.44	.00	737.86	4.70	1.40	.16	734.22
6000.0	.0	6000.0	.0	.0	344.7	.0	67.7	14.6	734.62
.14	.00	17.41	.00	.000	.015	.000	.000	727.92	1.77
.004312	300.	300.	300.	7	11	0	.00	75.95	77.72

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 8949.300									
8949.300	5.26	731.91	733.18	.00	736.56	4.65	1.28	.02	732.95
6000.0	.0	6000.0	.0	.0	346.7	.0	70.1	15.1	733.35
.14	.00	17.31	.00	.000	.015	.000	.000	726.65	1.73
.004239	300.	300.	300.	7	11	0	.00	76.03	77.76
*SECNO 9249.300									
9249.300	5.27	730.65	731.91	.00	735.29	4.63	1.27	.01	731.69
6000.0	.0	6000.0	.0	.0	347.4	.0	72.5	15.6	732.09
.15	.00	17.27	.00	.000	.015	.000	.000	725.39	1.71
.004212	300.	300.	300.	7	11	0	.00	76.06	77.77
*SECNO 9549.300									
9549.300	5.27	729.40	730.64	.00	734.02	4.63	1.26	.00	730.42
6000.0	.0	6000.0	.0	.0	347.6	.0	74.9	16.1	730.82
.15	.00	17.26	.00	.000	.015	.000	.000	724.12	1.71
.004205	300.	300.	300.	7	11	0	.00	76.07	77.78
*SECNO 9849.300									
9849.300	5.27	728.13	729.38	.00	732.76	4.63	1.26	.00	729.15
6000.0	.0	6000.0	.0	.0	347.5	.0	77.2	16.7	729.56
.15	.00	17.27	.00	.000	.015	.000	.000	722.86	1.71
.004209	300.	300.	300.	7	11	0	.00	76.06	77.77
*SECNO 10149.000									
10149.000	5.41	727.10	728.22	.00	731.47	4.37	1.21	.08	728.00
6000.0	.0	6000.0	.0	.0	357.7	.0	79.7	17.2	728.40
.16	.00	16.78	.00	.000	.015	.000	.000	721.70	1.49
.003858	300.	300.	300.	8	11	0	.00	76.50	77.98
*SECNO 10423.000									
10423.000	5.44	725.87	727.03	.00	730.40	4.53	1.06	.02	728.88
6000.0	.0	6000.0	.0	.0	351.4	.0	81.9	17.7	728.13
.16	.00	17.08	.00	.000	.015	.000	.000	720.43	3.69
.003909	274.	274.	274.	8	11	0	.00	73.25	76.94

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .200 CEHV= .400
*SECNO 10574.000

10574.000	5.44	725.24	726.41	.00	729.50	4.56	.59	.01	728.54
6000.0	.0	6000.0	.0	.0	350.3	.0	83.1	17.9	727.84
.17	.00	17.13	.00	.000	.015	.000	.000	719.80	3.91
.003924	151.	151.	151.	18	11	0	.00	72.74	76.64

*SECNO 10623.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

10623.000	6.31	725.86	725.92	.00	728.72	2.86	.14	.19	727.70
6000.0	.0	6000.0	.0	.0	441.9	.0	83.6	18.0	727.70
.17	.00	13.56	.00	.000	.015	.000	.000	719.55	3.03
.002042	50.	50.	50.	20	8	0	.00	79.72	82.74

*SECNO 10624.000
7185 MINIMUM SPECIFIC ENERGY

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.40 ELREA= 727.40

10624.000	6.33	725.87	725.90	.00	728.72	2.85	.00	.00	727.69
6000.0	.0	6000.0	.0	.0	442.9	.0	83.6	18.0	727.69
.17	.00	13.55	.00	.000	.015	.000	.000	719.54	3.01
.002028	1.	1.	1.	0	5	0	.00	79.73	82.76

SPECIAL BRIDGE

5290 UPSTREAM ELEV IS 727.44 ,NOT 725.87 NEW BACKWATER REQUIRED

SB XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
.90	1.27	3.00	.00	62.00	4.00	437.00	1.50	719.55	719.04

*SECNO 10724.000
5160 SUPERCRITICAL FLOW, PRESSURE FLOW

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	COPAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .60

PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
729.58	728.76	.00	419.	5580.	437.	448.	726.15	727.40	74.

10724.000	6.59	727.53	.00	.00	729.08	1.46	.36	.00	727.70
6000.0	.0	6000.0	.0	.0	619.6	.0	84.8	18.2	727.70
.17	.00	5.53	.00	.000	.015	.000	.000	719.04	.11
.000733	100.	100.	100.	3	0	2	.00	84.81	84.92

*SECNO 10725.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, XRATIO = 2.76

10725.000	4.78	722.58	724.34	.00	726.26	3.67	.00	.82	726.56
6000.0	.0	6000.0	.0	.0	316.7	.0	84.8	18.2	726.56
.17	.00	16.34	.00	.000	.015	.000	.000	717.90	3.59
.005583	1.	1.	1.	5	15	0	.00	74.39	80.39

*SECNO 10830.000
3280 CROSS SECTION 10830.00 EXTENDED .51 FEET

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

10830.000	5.96	723.76	724.32	.00	727.32	3.56	.40	.97	723.15
6000.0	.0	6000.0	.0	.0	396.1	.0	85.7	18.4	728.10
.17	.00	15.15	.00	.000	.015	.000	.000	717.50	.00
.002763	105.	105.	105.	30	11	0	.00	75.66	75.66

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .100 CEHV= .300
*SECNO 10900.000

3301 HV CHANGED MORE THAN HVINS

10900.000	4.53	722.05	723.49	.00	726.93	4.89	.26	.13	723.82
6000.0	.0	6000.0	.0	.0	338.3	.0	86.3	18.5	723.82
.17	.00	17.74	.00	.000	.015	.000	.000	717.52	2.58
.005340	70.	70.	70.	14	5	0	.00	86.14	89.12

*SECNO 11191.000

3301 HV CHANGED MORE THAN HVINS

11191.000	5.01	721.35	722.37	.00	725.37	4.01	1.30	.26	723.85
6000.0	.0	6000.0	.0	.0	373.8	.0	88.6	19.1	723.85
.18	.00	16.06	.00	.000	.015	.000	.000	715.35	3.90
.003790	291.	291.	291.	7	11	0	.00	84.70	86.60

*SECNO 11491.000

11491.000	4.88	719.57	721.01	.00	724.15	4.28	1.19	.03	722.45
6000.0	.0	6000.0	.0	.0	351.6	.0	91.2	19.6	722.49
.18	.00	16.59	.00	.000	.015	.000	.000	714.53	4.12
.004191	300.	300.	300.	7	11	0	.00	84.25	86.38

*SECNO 11791.000

11791.000	4.81	718.44	719.65	.00	722.85	4.41	1.25	.01	721.13
6000.0	.0	6000.0	.0	.0	356.1	.0	93.6	20.2	721.13
.19	.00	16.85	.00	.000	.015	.000	.000	713.53	4.23
.004392	300.	300.	300.	6	11	0	.00	84.05	86.27

*SECNO 12091.000

12091.000	4.79	717.06	718.29	.00	721.51	4.45	1.33	.00	719.77
6000.0	.0	6000.0	.0	.0	354.3	.0	96.1	20.8	719.77
.19	.00	16.94	.00	.000	.015	.000	.000	712.27	4.26
.004465	300.	300.	300.	6	11	0	.00	83.96	86.24

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12430.000

12430.000	4.77	715.51	716.75	.00	719.99	4.48	1.52	.00	718.24
6000.0	.0	6000.0	.0	.0	353.3	.0	98.8	21.5	718.24
.20	.00	16.98	.00	.000	.015	.000	.000	710.74	4.28
.004502	339.	339.	339.	6	11	0	.00	83.94	88.22

*SECNO 12530.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3730 CRITICAL DEPTH ASSUMED

12530.000	6.55	716.86	716.86	.00	719.68	2.82	.29	.40	717.81
6000.0	.0	6000.0	.0	.0	445.1	.0	99.6	21.6	717.81
.20	.00	13.46	.00	.000	.015	.000	.000	710.31	1.48
.001979	100.	100.	100.	20	11	0	.00	79.33	81.02

*SECNO 12730.000

3301 HV CHANGED MORE THAN HVINS

12730.000	5.67	715.12	716.00	.00	719.07	3.94	.30	.11	716.95
6000.0	.0	6000.0	.0	.0	376.5	.0	101.6	22.0	716.95
.20	.00	15.94	.00	.000	.015	.000	.000	709.45	2.85
.003278	200.	200.	200.	6	5	0	.00	76.79	79.65

*SECNO 13030.000

13030.000	5.42	713.58	714.72	.00	717.96	4.38	1.06	.04	715.66
6000.0	.0	6000.0	.0	.0	357.1	.0	104.2	22.5	715.65
.21	.00	16.80	.00	.000	.015	.000	.000	708.16	3.25
.003843	300.	300.	300.	9	8	0	.00	76.00	79.25

*SECNO 13330.000

13330.000	5.33	712.20	713.41	.00	716.76	4.56	1.19	.02	714.37
6000.0	.0	6000.0	.0	.0	350.3	.0	106.6	23.1	714.37
.21	.00	17.13	.00	.000	.015	.000	.000	705.87	3.39
.004081	300.	300.	300.	7	11	0	.00	75.72	79.11

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 13630.000									
13630.000	5.25	710.87	712.12	.00	715.51	4.64	1.24	.01	713.08
6000.0	.0	6000.0	.0	.0	347.2	.0	109.0	23.6	713.08
.22	.00	17.26	.00	.000	.015	.000	.000	705.58	3.46
.004193	300.	300.	300.	7	11	0	.00	75.59	79.04
*SECNO 13930.000									
13930.000	5.27	709.56	710.83	.00	714.24	4.68	1.27	.00	711.79
6000.0	.0	6000.0	.0	.0	345.7	.0	111.4	24.1	711.79
.22	.00	17.35	.00	.000	.015	.000	.000	704.29	3.49
.004247	300.	300.	300.	7	11	0	.00	75.53	79.01
*SECNO 14230.000									
14230.000	5.26	708.26	709.54	.00	712.96	4.70	1.28	.00	710.50
6000.0	.0	6000.0	.0	.0	345.0	.0	113.8	24.6	710.50
.23	.00	17.39	.00	.000	.015	.000	.000	703.00	3.50
.004274	300.	300.	300.	7	11	0	.00	75.50	79.00
*SECNO 14500.000									
14500.000	5.25	707.09	708.33	.00	711.80	4.71	1.16	.00	709.34
6000.0	.0	6000.0	.0	.0	344.7	.0	115.9	25.1	709.34
.23	.00	17.41	.00	.000	.015	.000	.000	701.84	3.51
.004286	270.	270.	270.	8	11	0	.00	75.48	78.99
*SECNO 14900.000									
14900.000	5.24	705.36	706.66	.00	710.08	4.72	1.72	.00	707.62
6000.0	.0	6000.0	.0	.0	344.1	.0	119.1	25.8	707.62
.24	.00	17.44	.00	.000	.015	.000	.000	700.12	3.52
.004309	400.	400.	400.	6	11	0	.00	75.46	78.98
*SECNO 15130.000									
15130.000	5.25	704.38	705.67	.00	709.09	4.71	.99	.00	706.63
6000.0	.0	6000.0	.0	.0	344.6	.0	120.9	26.2	706.63
.24	.00	17.41	.00	.000	.015	.000	.000	699.13	3.51
.004289	230.	230.	230.	9	11	0	.00	75.48	78.99

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 15430.000									
15430.000	5.25	703.09	704.38	.00	707.80	4.70	1.29	.00	705.34
6000.0	.0	6000.0	.0	.0	344.7	.0	123.3	26.7	705.34
.25	.00	17.41	.00	.000	.015	.000	.000	697.84	3.51
.004284	300.	300.	300.	7	11	0	.00	75.49	78.99
*SECNO 15730.000									
15730.000	5.25	701.80	703.09	.00	706.51	4.71	1.29	.00	704.05
6000.0	.0	6000.0	.0	.0	344.6	.0	125.6	27.2	704.05
.25	.00	17.41	.00	.000	.015	.000	.000	696.55	3.51
.004290	300.	300.	300.	7	11	0	.00	75.48	78.99
*SECNO 16030.000									
16030.000	5.25	700.51	701.80	.00	705.22	4.71	1.29	.00	702.76
6000.0	.0	6000.0	.0	.0	344.4	.0	128.0	27.7	702.76
.26	.00	17.42	.00	.000	.015	.000	.000	695.26	3.51
.004295	300.	300.	300.	7	11	0	.00	75.48	78.99
*SECNO 16330.000									
16330.000	5.25	699.22	700.51	.00	703.93	4.71	1.29	.00	701.47
6000.0	.0	6000.0	.0	.0	344.4	.0	130.4	28.3	701.47
.26	.00	17.42	.00	.000	.015	.000	.000	693.97	3.51
.004297	300.	300.	300.	7	11	0	.00	75.47	78.99
*SECNO 16630.000									
16630.000	5.25	697.93	699.22	.00	702.65	4.71	1.29	.00	700.18
6000.0	.0	6000.0	.0	.0	344.3	.0	132.8	28.8	700.18
.27	.00	17.42	.00	.000	.015	.000	.000	692.68	3.51
.004299	300.	300.	300.	7	11	0	.00	75.47	78.99
*SECNO 16930.000									
16930.000	5.25	696.64	697.93	.00	701.36	4.72	1.29	.00	698.89
6000.0	.0	6000.0	.0	.0	344.3	.0	135.1	29.3	698.89
.27	.00	17.43	.00	.000	.015	.000	.000	691.33	3.51
.004299	300.	300.	300.	7	11	0	.00	75.47	78.99

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 17230.000									
17230.000	5.25	695.35	696.64	.00	700.07	4.72	1.29	.00	697.60
6000.0	.0	6000.0	.0	.0	344.3	.0	137.5	29.8	697.60
.25	.00	17.43	.00	.000	.015	.000	.000	690.10	3.52
.004300	300.	300.	300.	7	11	0	.00	75.47	78.98
*SECNO 17410.000									
17410.000	5.25	694.57	695.87	.00	699.29	4.72	.77	.00	696.83
6000.0	.0	6000.0	.0	.0	344.3	.0	138.5	30.1	696.83
.28	.00	17.43	.00	.000	.015	.000	.000	689.33	3.52
.004301	180.	180.	180.	10	11	0	.00	75.47	78.98

THIS RUN EXECUTED 05APR93 10:21:14

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HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUPERCRITICAL FLOW.

SUMMARY PRINTOUT

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
•	137.480	3300.00	4.53	771.47	776.00	4.16	76.84	.00	11.40	.00
*	137.480	6000.00	6.56	771.47	778.03	1.11	75.89	.00	13.53	.00
	437.480	3300.00	3.86	770.31	774.17	5.16	75.84	.00	13.66	.00
	437.480	6000.00	5.54	770.31	775.86	2.49	78.51	.00	16.12	.00
	737.480	3300.00	3.86	769.16	773.02	5.17	75.83	.00	13.67	.00
	737.480	6000.00	5.51	769.16	774.67	2.68	78.32	.00	16.54	.00
	1037.500	3300.00	3.85	768.00	771.86	5.17	75.83	.00	13.68	.00
	1037.500	6000.00	5.47	768.00	773.47	2.75	78.25	.00	16.70	.00
	1337.500	3300.00	3.86	766.85	770.71	5.16	75.84	.00	13.66	.00
	1337.500	6000.00	5.45	766.85	772.30	2.78	78.22	.00	16.78	.00
	1637.500	3300.00	3.85	765.69	769.54	5.17	75.83	.00	13.68	.00
	1637.500	6000.00	5.44	765.69	771.13	2.79	78.21	.00	16.81	.00
	1937.500	3300.00	3.86	764.54	768.40	5.16	75.84	.00	13.65	.00
	1937.500	6000.00	5.43	764.54	769.97	2.80	78.20	.00	16.83	.00
	2237.500	3300.00	3.85	763.38	767.24	5.16	75.84	.00	13.67	.00
	2237.500	6000.00	5.43	763.38	768.81	2.80	78.20	.00	16.84	.00
	2532.200	3300.00	3.86	762.25	766.11	5.16	75.84	.00	13.65	.00
	2532.200	6000.00	5.42	762.25	767.67	2.81	78.19	.00	16.85	.00
	2572.700	3300.00	4.03	762.10	766.13	4.89	76.11	.00	12.98	.00
	2572.700	6000.00	5.89	762.10	767.98	2.13	78.87	.00	15.37	.00
•	2652.700	3300.00	3.61	761.60	765.41	3.47	77.11	.00	14.10	.00
*	2652.700	6000.00	8.34	761.60	770.14	.00	81.00	.00	9.87	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
	2712.200	3300.00	4.48	761.36	765.84	3.73	76.27	.00	11.53	.00
*	2712.200	6000.00	5.62	761.36	766.98	2.03	77.97	.00	16.19	.00
*	3012.200	3300.00	3.60	759.83	763.43	5.05	74.95	.00	14.75	.00
	3012.200	6000.00	5.25	759.83	765.08	2.58	77.42	.00	17.51	.00
	3312.200	3300.00	3.57	758.30	761.87	5.09	74.91	.00	14.90	.00
	3312.200	6000.00	5.12	758.30	763.42	2.77	77.23	.00	18.01	.00
	3612.200	3300.00	3.56	756.77	760.33	5.10	74.90	.00	14.94	.00
	3612.200	6000.00	5.06	756.77	761.83	2.86	77.14	.00	18.24	.00
	3912.200	3300.00	3.56	755.24	758.80	5.11	74.89	.00	14.95	.00
	3912.200	6000.00	5.04	755.24	760.28	2.90	77.10	.00	18.35	.00
	4121.000	3300.00	3.56	754.17	757.73	5.11	74.89	.00	14.96	.00
	4121.000	6000.00	5.02	754.17	759.20	2.92	77.08	.00	18.40	.00
	4222.000	3300.00	3.56	753.66	757.22	5.11	74.89	.00	14.95	.00
	4222.000	6000.00	5.02	753.66	758.68	2.92	77.08	.00	18.41	.00
	4512.200	3300.00	3.54	752.13	755.66	5.15	74.85	.00	15.07	.00
	4512.200	6000.00	4.99	752.13	757.12	2.96	77.04	.00	18.54	.00
	4812.200	3300.00	3.57	750.60	754.16	5.10	74.90	.00	14.93	.00
	4812.200	6000.00	4.99	750.60	755.59	2.95	77.05	.00	18.51	.00
	5100.000	3300.00	3.56	749.13	752.69	5.11	74.89	.00	14.96	.00
	5100.000	6000.00	5.00	749.13	754.13	2.94	77.06	.00	18.48	.00
*	5147.300	3300.00	3.81	748.94	752.75	4.73	75.26	.00	13.37	.00
*	5147.300	6000.00	5.43	748.94	754.37	2.29	77.69	.00	16.83	.00
	5158.300	3300.00	4.00	747.30	751.30	.02	52.68	.00	16.11	.00
	5158.300	6000.00	7.22	747.30	754.52	.00	52.70	.00	15.02	.00
*	5268.300	3300.00	7.37	746.80	754.17	.00	52.70	.00	8.62	.00
*	5268.300	6000.00	10.85	746.80	757.65	.00	52.70	.00	10.60	.00
*	5290.100	3300.00	3.02	746.86	749.88	5.89	74.11	.00	17.98	.00
*	5290.100	6000.00	4.26	746.86	751.12	4.02	75.98	.00	22.19	.00
	5484.000	3300.00	3.15	745.40	748.55	5.71	74.29	.00	17.18	.00
	5484.000	6000.00	4.38	745.40	749.78	3.86	75.14	.00	21.52	.00
	5590.100	3300.00	3.15	744.61	747.76	5.69	74.31	.00	17.09	.00
	5590.100	6000.00	4.42	744.61	749.02	3.80	76.20	.00	21.32	.00
	5890.100	3300.00	3.20	742.36	745.55	5.64	74.36	.00	16.89	.00
	5890.100	6000.00	4.47	742.36	746.82	3.72	75.28	.00	21.04	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
	6190.100	3300.00	3.19	740.11	743.30	5.64	74.36	.00	16.91	.00
	6190.100	6000.00	4.48	740.11	744.59	3.70	76.30	.00	20.97	.00
	6208.700	3300.00	3.17	739.93	743.11	5.67	74.33	.00	17.00	.00
	6208.700	6000.00	4.47	739.93	744.40	3.72	76.28	.00	21.03	.00
	6508.700	3300.00	3.59	738.46	742.05	5.04	74.96	.00	14.79	.00
	6508.700	6000.00	4.88	738.46	743.35	3.09	76.91	.00	19.00	.00
	6808.700	3300.00	3.59	736.99	740.58	5.03	74.97	.00	14.77	.00
	6808.700	6000.00	5.02	736.99	742.02	2.88	77.12	.00	18.37	.00
	7108.700	3300.00	3.60	735.52	739.12	5.03	74.97	.00	14.76	.00
	7108.700	6000.00	5.07	735.52	740.59	2.82	77.18	.00	18.22	.00
	7480.000	3300.00	3.60	733.70	737.31	5.02	74.98	.00	14.75	.00
	7480.000	6000.00	5.06	733.70	738.77	2.82	77.18	.00	18.23	.00
	7584.700	3300.00	3.60	733.19	736.80	5.02	74.98	.00	14.75	.00
	7584.700	6000.00	5.06	733.19	738.26	2.82	77.18	.00	18.23	.00
*	7662.600	3300.00	4.31	732.80	737.11	3.32	76.68	.00	11.94	.00
*	7662.600	6000.00	6.19	732.80	738.99	.20	79.80	.00	14.30	.00
	7747.500	3300.00	3.89	732.19	736.08	4.01	75.99	.00	13.41	.00
	7747.500	6000.00	5.71	732.19	737.90	.98	79.02	.00	15.65	.00
*	7847.500	3300.00	6.81	731.30	738.11	.00	80.00	.00	7.03	.00
*	7847.500	6000.00	10.24	731.30	741.54	.00	80.00	.00	8.07	.00
*	8049.300	3300.00	3.11	730.45	733.56	5.33	74.67	.00	17.34	.00
*	8049.300	6000.00	4.44	730.45	734.89	3.11	76.89	.00	21.01	.00
	8156.700	3300.00	3.39	730.00	733.39	4.85	74.83	.00	15.73	.00
	8156.700	6000.00	4.69	730.00	734.69	2.69	76.85	.00	19.76	.00
	8349.300	3300.00	3.70	729.19	732.89	4.33	75.32	.00	14.23	.00
	8349.300	6000.00	5.00	729.19	734.18	2.16	77.35	.00	18.36	.00
	8649.300	3300.00	3.75	727.92	731.67	4.24	75.40	.00	14.00	.00
	8649.300	6000.00	5.23	727.92	733.15	1.77	77.72	.00	17.41	.00
	8949.300	3300.00	3.76	726.65	730.41	4.24	75.40	.00	14.00	.00
	8949.300	6000.00	5.26	726.65	731.91	1.73	77.76	.00	17.31	.00
	9249.300	3300.00	3.75	725.39	729.13	4.25	75.39	.00	14.03	.00
	9249.300	6000.00	5.27	725.39	730.65	1.71	77.77	.00	17.27	.00
	9549.300	3300.00	3.75	724.12	727.87	4.25	75.39	.00	14.02	.00
	9549.300	6000.00	5.27	724.12	729.40	1.71	77.78	.00	17.25	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
	9849.300	3300.00	3.75	722.86	726.60	4.25	75.39	.00	14.02	.00
	9849.300	6000.00	5.27	722.86	728.13	1.71	77.77	.00	17.27	.00
	10149.000	3300.00	3.89	721.70	725.58	4.02	75.61	.00	13.47	.00
	10149.000	6000.00	5.41	721.70	727.10	1.49	77.98	.00	16.76	.00
	10423.000	3300.00	3.79	720.43	724.22	5.71	74.72	.00	14.07	.00
	10423.000	6000.00	5.44	720.43	725.87	3.69	76.94	.00	17.08	.00
	10574.000	3300.00	3.80	719.80	723.60	5.85	74.53	.00	14.06	.00
	10574.000	6000.00	5.44	719.80	725.24	3.91	76.64	.00	17.13	.00
	10623.000	3300.00	3.40	719.55	722.95	7.82	79.17	.00	14.86	.00
*	10623.000	6000.00	6.31	719.55	725.86	3.03	82.74	.00	13.58	.00
*	10624.000	3300.00	3.42	719.54	722.96	7.80	79.18	.00	14.81	.00
*	10624.000	6000.00	6.33	719.54	725.87	3.01	82.76	.00	13.55	.00
*	10724.000	3300.00	3.39	719.04	722.63	7.84	78.97	.00	14.35	.00
*	10724.000	6000.00	8.59	719.04	727.63	.11	84.92	.00	9.68	.00
	10725.000	3300.00	3.03	717.90	720.93	8.68	78.32	.00	17.21	.00
*	10725.000	6000.00	4.78	717.90	722.68	5.99	80.39	.00	16.94	.00
*	10830.000	3300.00	4.32	717.80	722.12	2.04	74.32	.00	12.03	.00
*	10830.000	6000.00	5.96	717.80	723.76	.00	75.66	.00	15.15	.00
*	10900.000	3300.00	3.19	717.52	720.71	5.23	86.20	.00	14.57	.00
	10900.000	6000.00	4.53	717.52	722.05	2.58	89.12	.00	17.74	.00
	11191.000	3300.00	3.65	716.35	720.00	6.05	86.45	.00	12.65	.00
	11191.000	6000.00	5.01	716.35	721.36	3.90	88.60	.00	16.06	.00
	11491.000	3300.00	3.44	714.99	718.43	6.39	86.11	.00	13.56	.00
	11491.000	6000.00	4.88	714.99	719.87	4.12	53.38	.00	16.59	.00
	11791.000	3300.00	3.40	713.63	717.03	6.44	86.06	.00	13.70	.00
	11791.000	6000.00	4.81	713.63	718.44	4.23	88.27	.00	16.85	.00
	12091.000	3300.00	3.40	712.27	715.68	6.45	86.05	.00	13.71	.00
	12091.000	6000.00	4.79	712.27	717.06	4.26	88.24	.00	16.94	.00
	12430.000	3300.00	3.40	710.74	714.13	6.45	86.05	.00	13.73	.00
	12430.000	6000.00	4.77	710.74	715.51	4.26	88.22	.00	16.96	.00
*	12530.000	3300.00	4.53	710.31	714.84	4.65	77.83	.00	11.36	.00
*	12530.000	6000.00	6.55	710.31	716.86	1.48	81.02	.00	13.48	.00
	12730.000	3300.00	3.87	709.45	713.32	5.68	76.82	.00	13.60	.00
	12730.000	6000.00	5.67	709.45	715.12	2.85	79.65	.00	15.94	.00

SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
13030.000	3300.00	3.76	708.16	711.92	5.84	76.66	.00	14.01	.00
13030.000	6000.00	5.42	708.16	713.58	3.25	79.25	.00	16.80	.00
13330.000	3300.00	3.74	706.87	710.61	5.87	76.63	.00	14.10	.00
13330.000	6000.00	5.33	706.87	712.20	3.39	79.11	.00	17.13	.00
13630.000	3300.00	3.74	705.58	709.32	5.88	76.62	.00	14.13	.00
13630.000	6000.00	5.29	705.58	710.87	3.46	79.04	.00	17.28	.00
13930.000	3300.00	3.73	704.29	708.02	5.88	76.62	.00	14.13	.00
13930.000	6000.00	5.27	704.29	709.56	3.49	79.01	.00	17.36	.00
14230.000	3300.00	3.72	703.00	706.72	5.89	76.61	.00	14.16	.00
14230.000	6000.00	5.26	703.00	708.26	3.50	79.00	.00	17.39	.00
14500.000	3300.00	3.73	701.84	705.57	5.88	76.62	.00	14.12	.00
14500.000	6000.00	5.25	701.84	707.09	3.51	78.99	.00	17.41	.00
14900.000	3300.00	3.73	700.12	703.85	5.83	76.62	.00	14.12	.00
14900.000	6000.00	5.24	700.12	705.36	3.52	78.98	.00	17.44	.00
15130.000	3300.00	3.74	699.13	702.87	5.88	76.62	.00	14.12	.00
15130.000	6000.00	5.25	699.13	704.38	3.51	78.99	.00	17.41	.00
15430.000	3300.00	3.73	697.84	701.57	5.88	76.62	.00	14.12	.00
15430.000	6000.00	5.25	697.84	703.09	3.51	78.99	.00	17.41	.00
15730.000	3300.00	3.72	696.55	700.27	5.89	76.61	.00	14.16	.00
15730.000	6000.00	5.25	696.55	701.80	3.51	78.98	.00	17.41	.00
16030.000	3300.00	3.73	695.26	698.99	5.88	76.62	.00	14.13	.00
16030.000	6000.00	5.25	695.26	700.51	3.51	78.99	.00	17.42	.00
16330.000	3300.00	3.73	693.97	697.70	5.88	76.62	.00	14.12	.00
16330.000	6000.00	5.25	693.97	699.22	3.51	78.99	.00	17.42	.00
16630.000	3300.00	3.73	692.68	696.41	5.89	76.61	.00	14.14	.00
16630.000	6000.00	5.25	692.68	697.93	3.51	78.99	.00	17.42	.00
16930.000	3300.00	3.73	691.39	695.12	5.88	76.62	.00	14.13	.00
16930.000	6000.00	5.25	691.39	696.64	3.51	78.99	.00	17.43	.00
17230.000	3300.00	3.72	690.10	693.82	5.89	76.61	.00	14.14	.00
17230.000	6000.00	5.25	690.10	695.35	3.52	78.98	.00	17.43	.00
17410.000	3300.00	3.73	689.33	693.06	5.88	76.62	.00	14.11	.00
17410.000	6000.00	5.25	689.33	694.57	3.52	78.98	.00	17.43	.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 137.480 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 137.480 PROFILE= 2 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 2652.700 PROFILE= 1 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
CAUTION SECNO= 2652.700 PROFILE= 2 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
WARNING SECNO= 2652.700 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 2712.200 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 3012.200 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 5147.300 PROFILE= 1 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 5147.300 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 5147.300 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 5268.300 PROFILE= 1 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
WARNING SECNO= 5268.300 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 5268.300 PROFILE= 2 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
WARNING SECNO= 5268.300 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 5290.100 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 5290.100 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 7662.600 PROFILE= 1 MINIMUM SPECIFIC ENERGY
WARNING SECNO= 7662.600 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 7847.500 PROFILE= 1 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
WARNING SECNO= 7847.500 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 7847.500 PROFILE= 2 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
WARNING SECNO= 7847.500 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 8049.300 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 8049.300 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 10623.000 PROFILE= 2 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 10623.000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 10624.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 10624.000 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 10724.000 PROFILE= 1 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED
CAUTION SECNO= 10724.000 PROFILE= 2 BRIDGE DROWNS U.S. PROFILE
NEW BACKWATER REQUIRED

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CAUTION SECNO=  10830.000  PROFILE=  1  WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO=  10830.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=  10830.000  PROFILE=  2  WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO=  10830.000  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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WARNING SECNO=  10900.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=  12530.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  12530.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=  12530.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=  12530.000  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=  12530.000  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=  12530.000  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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SUBCRITICAL FLOW

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**********************************************
*  HEC-2 WATER SURFACE PROFILES              *
*                                            *
*  Version  4.6.2;  May 1991                 *
*                                            *
*  RUN DATE   08APR93    TIME   10:27:13     *
**********************************************
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**************************************
*  U.S. ARMY CORPS OF ENGINEERS      *
*  HYDROLOGIC ENGINEERING CENTER     *
*  609 SECOND STREET, SUITE D        *
*  DAVIS, CALIFORNIA 95616-4687      *
*         (916) 756-1104             *
**************************************
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X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
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THIS RUN EXECUTED 05APR93 10:27:18

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

T1 SLOAN CHANNEL HYDRAULICS
T2 FROM OWNES AVENUE TO LAS VEGAS WASH CONF
T3 SUBCRITICAL RUN FILE:SLCH.SUB

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	-1	0	0	0	732	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	0	0	-1	0	0	0	-1	0	0	0

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

	38	43	3	42	1	53	54	55	39	56
NC	.015	.015	.015	.1	.3					
QT	2	3300	6000							
X1	17410	5	0	32.5	0	0	0			
GR	696.83	0	686.68	11.25	688.33	41.25	686.68	71.25	686.83	82.5
X1	17230	0	0	0	180	180	180		.77	
X1	16930	0	0	0	300	300	300		1.29	
X1	16630	0	0	0	300	300	300		1.29	
X1	16330	0	0	0	300	300	300		1.29	
X1	16030	0	0	0	300	300	300		1.29	
X1	15730	0	0	0	300	300	300		1.29	
X1	15430	0	0	0	300	300	300		1.29	
X1	15130	0	0	0	300	300	300		1.29	
X1	14900	0	0	0	230	230	230		.99	
X1	14500	0	0	0	400	400	400		1.72	

X1	14230	0	0	0	270	270	270		1.161	
X1	13930	0	0	0	300	300	300		1.29	
X1	13630	0	0	0	300	300	300		1.29	
X1	13330	0	0	0	300	300	300		1.29	
X1	13030	0	0	0	300	300	300		1.29	
X1	12730	0	0	0	300	300	300		1.29	
X1	12430	0	0	0	300	300	300		1.29	
X1	12091	0	0	0	339	339	339		1.5357	
X1	11791	0	0	0	300	300	300		1.359	
X1	11491	0	0	0	300	300	300		1.359	
X1	11191	5	0	92.5	300	300	300			
GR	723.85	0	716.70	11.25	716.35	46.25	716.70	31.25	723.85	92.5
X1	10900	5	0	93	291	291	291			
GR	723.83	0	717.87	10	717.52	45	717.87	50	723.83	93
X1	10830	5		80	0	0	0			
GR	723.15		718.1	10	717.8	40	718.1	70	728.10	80
X1	10725	0	0	85	105	105	105		.1	
X1	10724	5	0	85	1	1	1			
X3	10							727.3	727.3	
GR	727.7		719.3	13	719.04	45	719.3	75	727.7	85
NC	.015	.015	.015	.3	.4					
SB	.90	1.27	3		62	4	437	1.5	719.55	719.04
X1	10624	0		0	100	100	100		.31	
X2			1	726.15	727.4			1.33		
X3	10							727.4	727.4	
BT	7		727.4		6.5	730		8.5	727.6	
BT	40	727.4		71.5	727.4		73.5	730		80
BT	727.4									
X1	10574	5	0	80	49	49	49			
GR	726.54	0	720.1	10	719.80	40	720.1	70	728.54	80
NC	.015	.015	.015	.1	.3					
X1	10423	5		80	151	151	151			
GR	728.88		720.73	10	720.43	40	720.73	70	728.13	80

X1	10143	0	0	0	274	274	274		1.27	
X1	9849.3			80	300	300	300		1.16	
X1	9549.3			80	300	300	300		1.26	
X1	9249.3			80	300	300	300		1.27	
X1	8949.3			80	300	300	300		1.26	
X1	8649.3			80	300	300	300		1.27	
X1	8349.3			80	300	300	300		1.27	
X1	8156.7	5		80	193	193	193			
GR	736.3		730.3	10	730.6	40	730.3	70	736.7	80
X1	8049.3	5		80	107	107	107			
GR	735.75		730.75	10	730.45	40	730.75	70	736.75	80
X1	7847.5	0	0	0	201.8	199	200		.85	
X3	10							739.07	739.07	
NC	.015	.015	.015	.3	.5					
SB	.50	1.27	3		87	6.8	260		732.2	731.31
X1	7747.5	0	0	0	100	100	100		.90	
X2			1	735.5	739.17			1.33		
X3	10							739.17	739.17	
BT	3		739.1		45	739.1		90	739.1	
X1	7662.6	5		80	83.9	95.2	86.5			
GR	739.1		733.1	10	732.80	40	733.1	70	739.1	80
NC	.015	.015	.015	.1	.3					
X1	7584.7	5		80	77.9	77.9	77.9			
GR	740.03		733.39	10	733.19	40	733.39	70	740.03	80
X1	7480.0	0		80	104.7	104.7	104.7		.5	
X1	7108.7			80	371	371	371		1.82	
X1	6808.7			80	300	300	300		1.47	
X1	6508.7			80	300	300	300		1.47	
X1	6205.7			80	300	300	300		1.47	
X1	6190.1			80	18	18	18		.18	

X1	5890.1			80	300	300	300		2.25	
X1	5590.1			80	300	300	300		2.25	
X1	5484	5		80	106	106	106			
GR	752.34		745.7	10	745.4	40	745.7	70	752.34	80
NC	.015	.015	.015	.2	.4					
X1	5290.1	5		80	194	194	194			
GR	753.79		747.16	10	746.86	40	747.16	70	753.79	80
X1	5268.3	5	0	52.7	21.8	21.8	21.8			
X3	10							755.4	755.4	
GR	754.0		747.0	.1	746.8	25	747.0	52.6	754.0	52.7
NC	.015	.015	.015	.3	.4					
SB	.50	1.27	3		52.7	2.7	350		747.3	746.6
X1	5168.3	0		0	100	100	100		.7	
X2			1	752.6	755.5			1.33		
X3	10							755.5	755.5	
BT	5		756.14		20	755.66		46	755.52	
BT	76	755.62		96	755.72					
X1	5147.3	5		80	20	20	20			
GR	755.5		748.24	10	748.94	40	748.24	70	755.91	80
NC	.015	.015	.015	.2	.4					
X1	5100.0	0	0	0	47.3	47.3	47.3		.19	
X1	4812.2			50	288	288	288		1.47	
X1	4512.2			80	300	300	300		1.53	
X1	4222.0			80	290	290	290		1.53	
X1	4121.0			80	101	101	101		.51	
X1	3912.2			80	209	209	209		1.07	
X1	3612.2			80	300	300	300		1.53	
X1	3312.2			80	300	300	300		1.53	
X1	3012.2			80	300	300	300		1.53	
X1	2712.2	5		80	300	300	300			
GR	768.33		761.66	10	761.36	40	761.66	70	768.33	80

X1	2652.7	7		81	60	60	60			
X3	10							770.4	770.4	
GR	768.7		767.8	.1	762.2	8	761.8	40	762.2	72
GR	767.8	80.9	768.7	81						
SB	.90	1.27	3		62	4	437	1.5	762.1	761.82
X1	2572.7	5		81	80	80	80			
X2			1	758.66	770.13			1.33		
X3	10							770.5	770.5	
BT	7		770.13		6.5	772.8		8.5	770.2	
BT	40	769.68		71.5	770.2		73.5	772.8		80
BT	770.13									
GR	769.4		762.4	10.5	762.1	40.5	762.4	70.5	769.4	81
X1	2532.2	5		81	40.5	40.5	40.5			
GR	769.55		762.55	10.5	762.25	40.5	762.55	70.5	769.55	81
X1	2237.5	5		81	295	295	295			
GR	770.68		763.68	10.5	763.38	40.5	763.68	70.5	770.68	81
X1	1937.5			81	300	300	300		1.155	
X1	1637.5	0	0	0	300	300	300		1.155	
X1	1337.5	0	0	0	300	300	300		1.155	
X1	1037.5	0	0	0	300	300	300		1.155	
X1	737.46	0	0	0	300	300	300		1.155	
X1	437.48	0	0	0	300	300	300		1.155	
X1	137.46	5	0	81	300	300	300			
GR	778.77	0	771.77	10.5	771.47	40.5	771.77	70.5	778.77	81

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300
*SECNO 17410.000
3720 CRITICAL DEPTH ASSUMED

17410.000	4.56	693.89	693.89	732.00	695.89	1.99	.00	.00	696.83
3300.0	.0	3300.0	.0	.0	291.1	.0	.0	.0	696.83
.00	.00	11.33	.00	.000	.015	.000	.000	669.33	4.52
.002173	0.	0.	0.	0	19	0	.00	73.23	77.88

*SECNO 17230.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

17230.000	4.55	694.55	694.65	.00	696.66	2.00	.39	.00	697.60
3300.0	.0	3300.0	.0	.0	290.5	.0	1.2	.3	697.60
.00	.00	11.35	.00	.000	.015	.000	.000	650.10	4.64
.002186	180.	180.	180.	0	5	0	.00	73.23	77.86

*SECNO 16930.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16930.000	4.55	695.95	695.95	.00	697.95	2.00	.66	.00	698.89
3300.0	.0	3300.0	.0	.0	290.6	.0	3.2	.6	698.89
.01	.00	11.35	.00	.000	.015	.000	.000	631.39	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

*SECNO 16630.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16630.000	4.55	697.23	697.23	.00	699.24	2.00	.66	.00	700.18
3300.0	.0	3300.0	.0	.0	290.5	.0	5.2	1.3	700.18
.02	.00	11.36	.00	.000	.015	.000	.000	652.68	4.64
.002187	300.	300.	300.	0	5	0	.00	73.23	77.86

*SECNO 16330.000
7185 MINIMUM SPECIFIC ENERGY

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
3720 CRITICAL DEPTH ASSUMED									
16330.000	4.55	698.52	698.52	.00	700.53	2.00	.66	.00	701.47
3300.0	.0	3300.0	.0	.0	290.6	.0	7.2	1.8	701.47
.03	.00	11.35	.00	.000	.015	.000	.000	693.97	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87
*SECNO 16030.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
16030.000	4.55	699.51	699.51	.00	701.82	2.00	.65	.00	702.76
3300.0	.0	3300.0	.0	.0	290.5	.0	9.2	2.3	702.76
.03	.00	11.35	.00	.000	.015	.000	.000	695.26	4.64
.002187	300.	300.	300.	0	5	0	.00	73.23	77.86
*SECNO 15730.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
15730.000	4.55	701.10	701.10	.00	703.11	2.00	.66	.00	704.05
3300.0	.0	3300.0	.0	.0	290.6	.0	11.2	2.8	704.05
.04	.00	11.35	.00	.000	.015	.000	.000	696.53	4.63
.002183	300.	300.	300.	0	5	0	.00	73.23	77.87
*SECNO 15430.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
15430.000	4.55	702.39	702.39	.00	704.40	2.00	.66	.00	705.34
3300.0	.0	3300.0	.0	.0	290.5	.0	13.2	3.3	705.34
.05	.00	11.35	.00	.000	.015	.000	.000	697.84	4.64
.002187	300.	300.	300.	0	5	0	.00	73.23	77.86
*SECNO 15130.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
15130.000	4.55	703.68	703.68	.00	705.69	2.00	.66	.00	706.63
3300.0	.0	3300.0	.0	.0	290.6	.0	15.2	3.8	706.63
.06	.00	11.36	.00	.000	.015	.000	.000	699.13	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	OLOB	OCH	OROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 14900.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14900.000	4.55	704.67	704.67	.00	706.68	2.00	.50	.00	707.62
3300.0	.0	3300.0	.0	.0	290.5	.0	16.7	4.2	707.62
.06	.00	11.36	.00	.000	.015	.000	.000	700.12	4.64
.002167	230.	230.	230.	0	5	0	.00	73.23	77.86

*SECNO 14500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14500.000	4.55	706.39	706.39	.00	708.40	2.00	.37	.00	709.34
3300.0	.0	3300.0	.0	.0	290.6	.0	19.4	4.9	709.34
.07	.00	11.35	.00	.000	.015	.000	.000	701.84	4.63
.002185	400.	400.	400.	0	5	0	.00	73.23	77.87

*SECNO 14230.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14230.000	4.55	707.55	707.55	.00	709.56	2.00	.55	.00	710.50
3300.0	.0	3300.0	.0	.0	290.5	.0	21.2	5.3	710.50
.06	.00	11.36	.00	.000	.015	.000	.000	703.00	4.64
.002187	270.	270.	270.	0	5	0	.00	73.23	77.86

*SECNO 13930.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13930.000	4.55	708.84	708.84	.00	710.85	2.00	.66	.00	711.79
3300.0	.0	3300.0	.0	.0	290.6	.0	23.2	5.9	711.79
.09	.00	11.36	.00	.000	.015	.000	.000	704.29	4.64
.002186	300.	300.	300.	0	5	0	.00	73.23	77.86

*SECNO 13630.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13630.000	4.55	710.14	710.14	.00	712.14	2.00	.66	.00	713.08
3300.0	.0	3300.0	.0	.0	290.6	.0	25.2	6.4	713.08
.09	.00	11.35	.00	.000	.015	.000	.000	705.58	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 13330.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13330.000	4.55	711.42	711.42	.00	713.43	2.00	.66	.00	714.37
3300.0	.0	3300.0	.0	.0	290.5	.0	27.2	6.9	714.37
.10	.00	11.36	.00	.000	.015	.000	.000	706.87	4.64
.002187	300.	300.	300.	0	5	0	.00	73.23	77.86

*SECNO 13030.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13030.000	4.55	712.72	712.72	.00	714.72	2.00	.66	.00	715.66
3300.0	.0	3300.0	.0	.0	290.6	.0	29.2	7.4	715.66
.11	.00	11.35	.00	.000	.015	.000	.000	708.15	4.53
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

*SECNO 12730.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12730.000	4.55	714.00	714.00	.00	716.01	2.00	.66	.00	716.95
3300.0	.0	3300.0	.0	.0	290.5	.0	31.2	7.9	716.95
.11	.00	11.36	.00	.000	.015	.000	.000	709.45	4.64
.002187	300.	300.	300.	0	5	0	.00	73.23	77.86

*SECNO 12430.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12430.000	4.55	715.30	715.30	.00	717.30	2.00	.66	.00	718.24
3300.0	.0	3300.0	.0	.0	290.6	.0	33.2	8.4	718.24
.12	.00	11.35	.00	.000	.015	.000	.000	710.74	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

*SECNO 12091.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12091.000	4.55	716.83	716.83	.00	718.83	2.00	.74	.00	719.76
3300.0	.0	3300.0	.0	.0	290.5	.0	35.5	8.9	719.76
.13	.00	11.36	.00	.000	.015	.000	.000	712.23	4.64
.002187	339.	339.	339.	0	5	0	.00	73.23	77.86

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOS	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 11791.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11791.000	4.55	718.19	718.19	.00	720.19	2.00	.66	.00	721.14
3300.0	.0	3300.0	.0	.0	290.6	.0	37.5	9.4	721.14
.14	.00	11.35	.00	.000	.015	.000	.000	713.64	4.64
.002186	300.	300.	300.	0	5	0	.00	73.23	77.86

*SECNO 11491.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11491.000	4.55	719.55	719.55	.00	721.55	2.00	.66	.00	722.49
3300.0	.0	3300.0	.0	.0	290.6	.0	35.5	10.0	722.49
.14	.00	11.35	.00	.000	.015	.000	.000	714.99	4.63
.002185	300.	300.	300.	0	5	0	.00	73.23	77.87

*SECNO 11191.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11191.000	4.18	720.51	720.51	.00	722.37	1.86	.65	.01	723.65
3300.0	.0	3300.0	.0	.0	301.4	.0	41.5	10.5	723.35
.15	.00	10.95	.00	.000	.015	.000	.000	715.35	5.26
.002220	300.	300.	300.	0	11	0	.00	81.97	87.24

*SECNO 10900.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10900.000	4.13	721.65	721.65	.00	723.47	1.82	.65	.00	723.82
3300.0	.0	3300.0	.0	.0	304.5	.0	43.5	11.0	723.82
.16	.00	10.64	.00	.000	.015	.000	.000	717.52	3.65
.002234	291.	291.	291.	0	3	0	.00	84.61	88.26

*SECNO 10830.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10830.000	4.53	722.33	722.33	.00	724.35	2.01	.00	.06	723.15
3300.0	.0	3300.0	.0	.0	288.7	.0	43.5	11.0	723.10
.16	.00	11.39	.00	.000	.015	.000	.000	717.80	1.52
.002195	0.	0.	0.	0	8	0	.00	72.62	74.23

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10725.000

3301 HV CHANGED MORE THAN HVINS

10725.000	5.23	723.13	722.43	.00	724.58	1.45	.16	.06	723.25
3300.0	.0	3300.0	.0	.0	341.1	.0	44.3	11.2	728.20
.16	.00	9.68	.00	.000	.015	.000	.000	717.90	.24
.001332	105.	105.	105.	5	5	0	.00	74.69	74.93

*SECNO 10724.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.30 ELREA= 727.30

10724.000	4.44	723.48	723.48	.00	725.47	1.99	.00	.16	727.70
3300.0	.0	3300.0	.0	.0	291.5	.0	44.3	11.2	727.70
.16	.00	11.32	.00	.000	.015	.000	.000	719.04	5.52
.002184	1.	1.	1.	0	11	0	.00	73.45	79.58

CCHV= .200 CEHV= .400

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 728.63 , NOT 723.46 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SE	XK	XKOR	COFQ	RDLEN	BWC	BWP	FAREA	ES	ELCHU	ELCHD
	.50	1.27	3.00	.00	52.00	4.00	437.00	1.50	719.55	715.04

*SECNO 10624.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.46

CLASS B LOW FLOW

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3420 BRIDGE W.S.= 723.76 BRIDGE VELOCITY= 11.42 CALCULATED CHANNEL AREA= 271.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
724.61	726.30	.00	0.	3300.	437.	448.	726.15	727.40	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.40 ELREA= 727.40

10624.000	5.54	725.09	.00	.00	726.30	1.21	.83	.00	728.21
3300.0	.0	3300.0	.0	.0	373.4	.0	45.1	11.4	728.21
.17	.00	8.84	.00	.000	.015	.000	.000	719.35	4.83
.001019	100.	100.	100.	0	0	0	.00	76.45	31.28

*SECNO 10574.000

10574.000	5.12	724.92	724.35	.00	726.51	1.59	.06	.15	728.54
3300.0	.0	3300.0	.0	.0	326.0	.0	45.5	11.5	728.54
.17	.00	10.13	.00	.000	.015	.000	.000	719.30	4.26
.001471	49.	49.	49.	2	13	0	.00	71.43	75.72

CCHV= .100 CEHV= .300
*SECNO 10423.000
7135 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10423.000	4.55	724.98	724.98	.00	727.03	2.05	.27	.14	728.58
3300.0	.0	3300.0	.0	.0	287.3	.0	46.5	11.7	728.13
.17	.00	11.49	.00	.000	.015	.000	.000	720.43	4.78
.002197	151.	151.	151.	0	11	0	.00	70.96	75.74

*SECNO 10149.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10149.000	4.56	726.26	726.26	.00	728.30	2.04	.60	.00	730.15
3300.0	.0	3300.0	.0	.0	287.6	.0	48.3	12.2	729.40
.18	.00	11.47	.00	.000	.015	.000	.000	721.70	4.78
.002190	274.	274.	274.	0	5	0	.00	70.97	75.75

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 8349.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8349.300	4.55	733.74	733.74	.00	735.79	2.04	.66	.00	737.64
3300.0	.0	3300.0	.0	.0	287.6	.0	60.2	15.1	736.89
.22	.00	11.46	.00	.000	.015	.000	.000	729.19	4.76
.002192	300.	300.	300.	0	5	0	.00	70.97	75.75

*SECNO 8156.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8156.700	4.51	734.51	734.51	.00	736.52	2.00	.42	.00	736.30
3300.0	.0	3300.0	.0	.0	290.6	.0	61.5	15.4	736.70
.23	.00	11.36	.00	.000	.015	.000	.000	730.00	2.95
.002198	193.	193.	193.	0	5	0	.00	73.61	76.53

*SECNO 8049.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8049.300	4.52	734.97	734.97	.00	736.95	1.99	.23	.00	735.75
3300.0	.0	3300.0	.0	.0	291.7	.0	62.2	15.6	736.75
.23	.00	11.31	.00	.000	.015	.000	.000	730.45	2.97
.002185	107.	107.	107.	0	5	0	.00	74.06	77.03

*SECNO 7847.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 735.07 ELREA= 736.07

7847.500	4.52	735.82	735.82	.00	737.80	1.99	.44	.00	737.60
3300.0	.0	3300.0	.0	.0	291.7	.0	63.5	15.9	737.60
.23	.00	11.31	.00	.000	.015	.000	.000	731.30	2.97
.002186	202.	200.	199.	0	5	0	.00	74.06	77.03

CCHV= .300 CEHV= .500

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 734.17 , NOT 735.82 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.50	1.27	3.00	.00	87.00	6.50	280.00	.00	732.20	731.31

*SECNO 7747.500
PRESS FLOW BECAUSE EGLWC OF 738.73 EXCEEDS 1.5 DEPTH
PRESSURE FLOW

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
738.56	738.73	.00	0.	3300.	280.	265.	735.50	739.17	0.

3585 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF
3653 PROBABLE MINIMUM SPECIFIC ENERGY

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 739.17 ELREA= 739.17

7747.500	4.52	736.72	736.72	.00	738.70	1.98	.22	.03	738.50
3300.0	.0	3300.0	.0	.0	292.1	.0	64.2	16.1	738.50
.24	.00	11.30	.00	.000	.015	.000	.000	732.20	2.96
.002176	100.	100.	100.	30	5	0	.00	74.06	77.04

*SECNO 7662.600
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7562.500	4.52	737.32	737.32	.00	739.30	1.99	.20	.00	739.10
3300.0	.0	3300.0	.0	.0	291.6	.0	64.8	16.3	739.10
.24	.00	11.32	.00	.000	.015	.000	.000	732.60	2.97
.002188	84.	90.	95.	0	3	0	.00	74.05	77.03

CCHV= .100 CEHV= .300
*SECNO 7584.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7584.700	4.47	737.66	737.66	.00	739.68	2.02	.17	.01	740.03
3300.0	.0	3300.0	.0	.0	289.5	.0	65.3	16.4	740.03
.24	.00	11.40	.00	.000	.015	.000	.000	733.19	3.57
.002204	78.	78.	78.	0	5	0	.00	72.85	76.43

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 6190.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6190.100	4.46	744.58	744.58	.00	746.59	2.01	.04	.00	746.94
3300.0	.0	3300.0	.0	.0	390.1	.0	74.6	18.7	746.94
.27	.00	11.38	.00	.000	.015	.000	.000	740.10	3.56
.002150	18.	18.	18.	0	5	0	.00	72.88	76.44

*SECNO 5890.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5890.100	4.46	746.63	746.63	.00	748.64	2.01	.55	.00	749.19
3300.0	.0	3300.0	.0	.0	390.2	.0	76.6	19.2	749.19
.28	.00	11.37	.00	.000	.015	.000	.000	742.35	3.56
.002168	300.	300.	300.	0	5	0	.00	72.88	76.44

*SECNO 5590.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5590.100	4.46	749.08	749.08	.00	751.09	2.01	.66	.00	751.44
3300.0	.0	3300.0	.0	.0	390.1	.0	78.6	19.7	751.44
.25	.00	11.38	.00	.000	.015	.000	.000	744.60	3.56
.002190	300.	300.	300.	0	5	0	.00	72.88	76.44

*SECNO 5464.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5464.000	4.54	749.94	749.94	.00	751.94	2.00	.23	.00	752.34
3300.0	.0	3300.0	.0	.0	390.7	.0	79.3	19.9	752.34
.29	.00	11.35	.00	.000	.015	.000	.000	745.40	3.61
.002170	106.	106.	106.	0	5	0	.00	72.78	76.39

CCHV= .200 CEHV= .400
*SECNO 5290.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5290.100	4.83	751.33	751.33	.00	753.40	2.01	.42	.01	753.79
3300.0	.0	3300.0	.0	.0	385.7	.0	80.6	20.2	753.79
.30	.00	11.39	.00	.000	.015	.000	.000	746.86	3.62
.002192	194.	194.	194.	0	5	0	.00	72.76	76.38

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 5268.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.40 ELREA= 755.40

5268.300	5.06	751.86	751.86	.00	754.35	2.49	.05	.19	754.00
3300.0	.0	3300.0	.0	.0	260.5	.0	60.8	20.3	754.00
.30	.00	18.67	.00	.000	.015	.000	.000	746.80	.03
.002422	22.	22.	22.	0	3	0	.00	52.64	52.67

CCHV= .200 CEHV= .400

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 750.95 , NOT 751.86 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XR	XKOR	CDFG	RDLEN	BWC	BWF	BAREA	SS	ELCHU	ELCHD
	.30	1.27	3.00	.00	52.70	2.70	250.00	.00	747.30	746.30

*SECNO 5168.300
PRESS FLOW BECAUSE EGLWC OF 755.30 EXCEEDS 1.5 DEPTH

3301 HV CHANGED MORE THAN HVINS

PRESSURE FLOW

EGPRS	EGLWC	HS	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLO	ELTRD	WEIRLN
755.29	755.30	.00	0.	3300.	250.	260.	752.50	755.30	0.

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.50 ELREA= 755.50

5168.300	6.09	753.59	.00	.00	755.29	1.71	.94	.00	754.70
3300.0	.0	3300.0	.0	.0	314.9	.0	81.4	20.4	754.70
.30	.00	10.46	.00	.000	.013	.000	.000	747.50	.02
.001345	100.	100.	100.	4	0	0	.00	52.57	52.53

*SECNO 5147.300
7185 MINIMUM SPECIFIC ENERGY

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	%OL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
3720 CRITICAL DEPTH ASSUMED									
5147.300	4.53	753.47	753.47	.00	755.49	2.01	.03	.12	755.90
3300.0	.0	3300.0	.0	.0	289.8	.0	81.6	20.4	755.91
.30	.00	11.39	.00	.000	.015	.000	.000	748.54	3.64
.002188	20.	20.	20.	0	15	0	.00	72.70	76.35
CCHV= .200 CEHV= .400									
*SECNO 5100.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
5100.000	4.53	753.66	753.66	.00	755.68	2.01	.10	.00	756.09
3300.0	.0	3300.0	.0	.0	289.9	.0	81.9	20.5	756.10
.30	.00	11.38	.00	.000	.015	.000	.000	748.13	3.64
.002187	47.	47.	47.	0	5	0	.00	72.70	76.35
*SECNO 4812.200									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
4812.200	4.53	755.13	755.13	.00	757.15	2.01	.63	.00	757.56
3300.0	.0	3300.0	.0	.0	289.3	.0	83.8	21.0	757.57
.31	.00	11.38	.00	.000	.015	.000	.000	750.59	3.64
.002187	288.	288.	288.	0	5	0	.00	72.70	76.35
*SECNO 4512.200									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
4512.200	4.53	756.66	756.66	.00	758.68	2.01	.66	.00	759.09
3300.0	.0	3300.0	.0	.0	289.9	.0	85.8	21.5	759.10
.32	.00	11.38	.00	.000	.015	.000	.000	752.13	3.64
.002187	300.	300.	300.	0	5	0	.00	72.70	76.35
*SECNO 4222.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
4222.000	4.33	758.19	758.19	.00	760.21	2.01	.63	.00	760.62
3300.0	.0	3300.0	.0	.0	289.9	.0	87.7	22.0	760.63
.32	.00	11.38	.00	.000	.015	.000	.000	753.66	3.64
.002187	290.	290.	290.	0	5	0	.00	72.70	76.35

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

+SECNO 4121.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4121.000	4.53	758.70	758.70	.00	760.72	2.01	.22	.00	761.13
3300.0	.0	3300.0	.0	.0	289.9	.0	88.4	22.1	761.14
.32	.00	11.38	.00	.000	.015	.000	.000	754.17	3.64
.002187	101.	101.	101.	0	5	0	.00	72.70	76.35

+SECNO 3912.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3912.200	4.53	759.77	759.77	.00	761.75	2.01	.46	.00	762.20
3300.0	.0	3300.0	.0	.0	289.9	.0	89.6	22.5	762.21
.33	.00	11.38	.00	.000	.015	.000	.000	755.24	3.64
.002187	203.	203.	203.	0	5	0	.00	72.70	76.35

+SECNO 3612.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3612.200	4.53	761.30	761.30	.00	763.32	2.01	.66	.00	763.73
3300.0	.0	3300.0	.0	.0	289.9	.0	91.6	23.0	763.74
.34	.00	11.38	.00	.000	.015	.000	.000	756.77	3.64
.002187	300.	300.	300.	0	5	0	.00	72.70	76.35

+SECNO 3312.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3312.200	4.53	762.83	762.83	.00	764.85	2.01	.65	.00	765.28
3300.0	.0	3300.0	.0	.0	289.9	.0	93.8	23.5	765.27
.34	.00	11.38	.00	.000	.015	.000	.000	758.30	3.64
.002187	300.	300.	300.	0	5	0	.00	72.70	76.35

+SECNO 3012.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3012.200	4.53	764.36	764.36	.00	766.38	2.01	.65	.00	766.79
3300.0	.0	3300.0	.0	.0	289.9	.0	95.8	24.0	766.80
.33	.00	11.38	.00	.000	.015	.000	.000	759.83	3.64
.002187	300.	300.	300.	0	5	0	.00	72.70	76.35

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

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*SECNO 2712.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  2712.200      4.53    765.89    765.89       .00    767.91      2.01       .66       .00    766.33
    3300.0        .0    3300.0        .0        .0     283.9        .0      97.8      24.5    768.33
       .35       .00     11.38       .00      .000      .015      .000      .000    761.36      3.65
   .002187      300.      300.      300.         0         5         0       .00     72.69     76.35


*SECNO 2652.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      770.40 ELREA=      770.40

  2652.700      4.43    766.23    766.23       .00    768.17      1.95       .13       .01    768.70
    3300.0        .0    3300.0        .0        .0     284.7        .0      38.2      24.6    768.70
       .35       .00     11.20       .00      .000      .015      .000      .000    761.80      2.32
   .002189       60.       60.       60.         0         6         0       .00     76.08     76.40


SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS     765.41 , NOT     765.83 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB  XK        XKOR      COFC      RDLEN     BWC       BWF       BAREA     SS        ELCHU     ELCHD
      .50      1.37      3.00       .00     82.00      4.00    437.00      1.50    762.11    761.82

*SECNO 2573.700

3301 HV CHANGED MORE THAN HVINS

CLASS B LOW FLOW

3420 BRIDGE W.S.=     766.43 BRIDGE VELOCITY=      11.42     CALCULATED CHANNEL AREA=      273.

 EGPRS      EGLWC       H3        QWEIR     QLOW      BAREA     TRAPEZOID AREA     ELLC      ELTRD     WEIRLN
       .00    768.87       .00         0.     3300.      437.      462.      768.88    770.13         0.


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      770.50 ELREA=      770.50
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
2572.700	5.45	767.55	.00	.00	768.87	1.32	.70	.00	765.40
3300.0	.0	3300.0	.0	.0	357.8	.0	98.8	24.7	765.40
.36	.00	5.22	.00	.000	.015	.000	.000	762.10	2.77
.001148	80.	80.	80.	0	0	0	.00	75.45	78.23
*SECNO 2532.300									
2532.200	5.29	767.54	766.78	.00	768.96	1.41	.05	.04	765.35
3300.0	.0	3300.0	.0	.0	346.2	.0	99.1	24.8	765.35
.36	.00	5.53	.00	.000	.015	.000	.000	762.25	3.01
.001270	41.	41.	41.	2	15	0	.00	74.55	77.36
*SECNO 2237.500									
3301 HV CHANGED MORE THAN HVINS									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
2237.500	4.54	767.92	767.92	.00	769.93	2.01	.48	.34	770.68
3300.0	.0	3300.0	.0	.0	350.4	.0	101.3	25.3	770.68
.37	.00	11.37	.00	.000	.015	.000	.000	753.38	4.14
.002176	295.	295.	295.	0	11	0	.00	72.72	76.86
*SECNO 1937.500									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
1937.500	4.53	769.07	769.07	.00	771.08	2.01	.55	.00	771.84
3300.0	.0	3300.0	.0	.0	289.8	.0	103.3	25.8	771.84
.38	.00	11.38	.00	.000	.015	.000	.000	764.54	4.15
.002190	300.	300.	300.	0	5	0	.00	72.70	76.85
*SECNO 1637.500									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
1637.500	4.53	770.22	770.22	.00	772.24	2.01	.66	.00	772.99
3300.0	.0	3300.0	.0	.0	289.9	.0	105.2	26.3	772.99
.39	.00	11.38	.00	.000	.015	.000	.000	765.69	4.15
.002187	300.	300.	300.	0	5	0	.00	72.70	76.85

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1337.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1337.500	4.53	771.38	771.38	.00	773.39	2.01	.56	.00	774.15
3300.0	.0	3300.0	.0	.0	289.9	.0	107.2	26.3	774.15
.39	.00	11.38	.00	.000	.015	.000	.000	765.65	4.15
.002187	300.	300.	300.	0	5	0	.00	72.70	76.85

*SECNO 1037.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1037.500	4.53	772.53	772.53	.00	774.55	2.01	.56	.00	775.30
3300.0	.0	3300.0	.0	.0	289.9	.0	109.2	27.3	775.30
.40	.00	11.38	.00	.000	.015	.000	.000	768.00	4.15
.002188	300.	300.	300.	0	5	0	.00	72.70	76.85

*SECNO 737.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

737.480	4.53	773.69	773.69	.00	775.70	2.01	.56	.00	776.46
3300.0	.0	3300.0	.0	.0	289.8	.0	111.2	27.8	776.46
.41	.00	11.39	.00	.000	.015	.000	.000	769.16	4.15
.002188	300.	300.	300.	0	5	0	.00	72.70	76.85

*SECNO 437.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

437.480	4.53	774.84	774.84	.00	776.85	2.01	.56	.00	777.61
3300.0	.0	3300.0	.0	.0	289.9	.0	113.2	28.3	777.61
.42	.00	11.38	.00	.000	.015	.000	.000	770.31	4.15
.002187	300.	300.	300.	0	5	0	.00	72.70	76.85

*SECNO 137.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

137.480	4.53	775.00	776.00	.00	778.02	2.01	.56	.00	778.77
3300.0	.0	3300.0	.0	.0	289.9	.0	115.2	28.8	778.77
.42	.00	11.38	.00	.000	.015	.000	.000	771.47	4.15
.002187	300.	300.	300.	0	5	0	.00	72.70	76.85

```
T1      SLOAN CHANNEL HYDRAULICS
T2      FROM OWNES AVENUE TO LAS VEGAS WASH CONF
T3      SUBCRITICAL RUN                 FILE:SLSUB.H3

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    AVINS     Q         WSEL      FQ

                3                   0        -1                            0         0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLOC     IBW       CHNIM     ITRACE

     15                  -1                                      -1
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 2

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV= .100 CEHV= .300
*SECNO 17410.000
2096 WSEL NOT GIVEN, AVG OF MAX, MIN USED
3720 CRITICAL DEPTH ASSUMED

17410.000	6.57	695.90	695.90	.00	698.73	2.83	.00	.00	696.83
6000.0	.0	6000.0	.0	.0	444.8	.0	.0	.0	696.83
.00	.00	13.45	.00	.000	.015	.000	.000	689.33	1.46
.001383	0.	0.	0.	0	13	0	.00	79.58	81.04

*SECNO 17230.000
7135 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

17230.000	6.58	696.68	696.68	.00	699.50	2.82	.35	.00	697.60
6000.0	.0	6000.0	.0	.0	445.1	.0	1.8	.3	697.60
.00	.00	13.46	.00	.000	.015	.000	.000	690.10	1.45
.001980	180.	180.	180.	0	5	0	.00	79.59	81.05

*SECNO 16930.000
7135 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16930.000	6.58	697.97	697.97	.00	700.79	2.82	.55	.00	698.89
6000.0	.0	6000.0	.0	.0	445.0	.0	4.9	.9	698.89
.01	.00	13.46	.00	.000	.015	.000	.000	691.39	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 16630.000
7135 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16630.000	6.58	699.26	699.26	.00	702.08	2.82	.59	.00	700.18
6000.0	.0	6000.0	.0	.0	445.0	.0	8.0	1.4	700.18
.02	.00	13.46	.00	.000	.015	.000	.000	692.68	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 16330.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16330.000	6.58	700.55	700.55	.00	703.37	2.82	.59	.00	701.47
6000.0	.0	6000.0	.0	.0	445.0	.0	11.0	2.0	701.47
.02	.00	13.48	.00	.000	.015	.000	.000	593.97	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 16030.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

16030.000	6.58	701.84	701.84	.00	704.66	2.82	.59	.00	702.76
6000.0	.0	6000.0	.0	.0	445.0	.0	14.1	2.5	702.76
.03	.00	13.48	.00	.000	.015	.000	.000	595.26	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 15730.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15730.000	6.58	703.13	703.13	.00	705.95	2.82	.59	.00	704.05
6000.0	.0	6000.0	.0	.0	445.0	.0	17.2	3.1	704.05
.03	.00	13.48	.00	.000	.015	.000	.000	596.55	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 15430.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15430.000	6.58	704.42	704.42	.00	707.24	2.82	.59	.00	705.34
6000.0	.0	6000.0	.0	.0	445.0	.0	20.3	3.6	705.34
.04	.00	13.48	.00	.000	.015	.000	.000	597.34	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 15130.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

15130.000	6.58	705.71	705.71	.00	708.53	2.82	.59	.00	706.63
6000.0	.0	6000.0	.0	.0	445.0	.0	23.3	4.2	706.63
.05	.00	13.48	.00	.000	.015	.000	.000	598.13	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 14900.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14900.000	6.58	706.70	706.70	.00	709.52	2.82	.46	.00	707.62
6000.0	.0	6000.0	.0	.0	445.0	.0	25.6	4.6	707.62
.05	.00	13.48	.00	.000	.015	.000	.000	700.12	1.45
.001980	230.	230.	230.	0	5	0	.00	79.59	81.05

*SECNO 14500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14500.000	6.58	706.42	706.42	.00	711.24	2.82	.79	.00	709.34
6000.0	.0	6000.0	.0	.0	445.0	.0	29.7	5.3	709.34
.05	.00	13.48	.00	.000	.015	.000	.000	701.84	1.45
.001980	400.	400.	400.	0	5	0	.00	79.59	81.05

*SECNO 14230.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

14230.000	6.58	709.58	709.58	.00	712.40	2.82	.53	.00	710.50
6000.0	.0	6000.0	.0	.0	445.0	.0	32.5	5.8	710.50
.07	.00	13.48	.00	.000	.015	.000	.000	703.00	1.45
.001980	270.	270.	270.	0	5	0	.00	79.59	81.05

*SECNO 13930.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13930.000	6.58	710.87	710.87	.00	713.69	2.82	.59	.00	711.79
6000.0	.0	6000.0	.0	.0	445.0	.0	35.6	6.4	711.79
.07	.00	13.48	.00	.000	.015	.000	.000	704.29	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 13630.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13630.000	6.58	712.16	712.16	.00	714.98	2.82	.59	.00	713.08
6000.0	.0	6000.0	.0	.0	445.0	.0	38.6	6.9	713.08
.08	.00	13.48	.00	.000	.015	.000	.000	705.53	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 13330.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13330.000	6.58	713.45	713.45	.00	716.27	2.82	.59	.00	714.37
6000.0	.0	6000.0	.0	.0	445.0	.0	41.7	7.5	714.37
.03	.00	13.48	.00	.000	.015	.000	.000	706.87	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.03

*SECNO 13030.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13330.000	6.58	714.74	714.74	.00	717.56	2.82	.59	.00	715.66
6000.0	.0	6000.0	.0	.0	445.0	.0	44.7	8.0	715.66
.03	.00	13.48	.00	.000	.015	.000	.000	708.18	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.03

*SECNO 12730.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12730.000	6.58	716.03	716.03	.00	718.85	2.82	.59	.00	715.99
6000.0	.0	6000.0	.0	.0	445.0	.0	47.8	8.6	716.99
.10	.00	13.48	.00	.000	.015	.000	.000	709.45	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.03

*SECNO 12430.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12430.000	6.58	717.32	717.32	.00	720.14	2.82	.59	.00	716.24
6000.0	.0	6000.0	.0	.0	445.0	.0	50.3	9.1	716.24
.10	.00	13.48	.00	.000	.015	.000	.000	710.74	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.03

*SECNO 12091.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12091.000	6.58	716.85	716.85	.00	721.67	2.82	.67	.00	715.78
6000.0	.0	6000.0	.0	.0	445.0	.0	54.3	9.7	715.78
.11	.00	13.48	.00	.000	.015	.000	.000	713.25	1.45
.001980	339.	339.	339.	0	5	0	.00	79.59	81.03

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 11791.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11791.000	6.58	720.21	720.21	.00	723.03	2.32	.59	.00	721.14
6000.0	.0	6000.0	.0	.0	445.0	.0	57.4	10.3	721.14
.12	.00	13.48	.00	.000	.015	.000	.000	713.54	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 11491.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11491.000	6.58	721.57	721.57	.00	724.39	2.82	.59	.00	722.49
6000.0	.0	6000.0	.0	.0	445.0	.0	60.5	10.8	722.49
.12	.00	13.48	.00	.000	.015	.000	.000	714.55	1.45
.001980	300.	300.	300.	0	5	0	.00	79.59	81.05

*SECNO 11191.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11191.000	6.02	722.37	722.37	.00	725.01	2.65	.50	.02	723.35
6000.0	.0	6000.0	.0	.0	456.4	.0	53.6	11.4	723.35
.13	.00	13.35	.00	.000	.015	.000	.000	715.35	2.33
.008011	300.	300.	300.	0	11	0	.00	87.83	90.17

*SECNO 10500.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10500.000	3.35	723.48	723.48	.00	726.78	3.57	.56	.01	723.62
6000.0	.0	6000.0	.0	.0	465.2	.0	66.7	12.0	723.62
.13	.00	12.87	.00	.000	.015	.000	.000	717.52	.56
.002068	291.	291.	291.	3	5	0	.00	91.70	92.27

*SECNO 10830.000
3280 CROSS SECTION 10830.00 EXTENDED 1.17 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10830.000	6.32	724.32	724.32	.00	727.23	2.91	.00	.10	723.15
6000.0	.0	6000.0	.0	.0	433.5	.0	66.7	12.0	728.10
.13	.00	13.53	.00	.000	.015	.000	.000	717.80	.00
.000812	0.	0.	0.	0	8	0	.00	76.23	76.23

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10725.000
3280 CROSS SECTION 10725.00 EXTENDED 1.58 FEET

3301 HV CHANGED MORE THAN HVINS

10725.000	7.33	725.23	724.48	.00	727.47	2.23	.17	.07	723.25
6000.0	.0	6000.0	.0	.0	500.4	.0	67.8	12.2	728.20
.14	.00	11.99	.00	.000	.015	.000	.000	717.90	.00
.001338	105.	105.	105.	5	5	0	.00	77.03	77.03

*SECNO 10724.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.30 ELREA= 727.30

10724.000	8.44	725.48	725.48	.00	728.32	3.34	.00	.13	727.76
6000.0	.0	6000.0	.0	.0	443.7	.0	67.8	12.2	727.79
.14	.00	13.32	.00	.000	.015	.000	.000	719.04	3.43
.001393	1.	1.	1.	0	11	0	.00	78.53	82.33

CCHV= .200 CEHV= .400

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 724.35 , NOT 725.48 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XK	XKOR	COFQ	ADLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.27	3.00	.00	62.00	4.00	437.00	1.50	719.55	719.04

*SECNO 10624.000
PRESS FLOW BECAUSE EGLWC OF 730.40 EXCEEDS 1.5 DEPTH
PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
729.20	730.40	.00	317.	5680.	437.	448.	726.15	727.40	72.

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF
3693 PROBABLE MINIMUM SPECIFIC ENERGY

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 727.40 ELREA= 727.40

10624.000	6.52	728.07	725.99	.00	728.83	2.76	.20	.30	728.31
6000.0	.0	6000.0	.0	.0	450.1	.0	66.8	12.4	728.21
.14	.00	13.33	.00	.000	.015	.000	.000	719.55	3.31
.001905	100.	100.	100.	20	5	2	.00	75.15	82.46

+SECNO 10574.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10574.000	6.65	726.45	726.45	.00	729.37	3.92	.10	.06	726.54
6000.0	.0	6000.0	.0	.0	437.7	.0	68.3	12.4	728.54
.14	.00	13.71	.00	.000	.015	.000	.000	719.80	2.48
.001975	49.	49.	49.	0	5	0	.00	75.05	77.52

CCHV= .100 CEHV= .300
+SECNO 10423.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10423.000	6.60	727.03	727.03	.00	729.54	2.51	.30	.03	728.38
6000.0	.0	6000.0	.0	.0	438.0	.0	70.5	12.7	728.13
.14	.00	13.70	.00	.000	.015	.000	.000	720.43	2.27
.001999	151.	151.	151.	0	5	0	.00	76.24	78.51

+SECNO 10149.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10149.000	5.61	728.31	728.31	.00	731.21	2.90	.55	.00	730.15
6000.0	.0	6000.0	.0	.0	438.9	.0	73.6	13.2	729.40
.15	.00	13.67	.00	.000	.015	.000	.000	721.70	2.26
.001987	274.	274.	274.	0	5	0	.00	76.27	78.53

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	AV	AL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 9349.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9349.300	6.61	729.47	729.47	.00	732.37	2.90	.60	.00	731.31
6000.0	.0	6000.0	.0	.0	438.8	.0	76.6	13.7	730.56
.15	.00	13.68	.00	.000	.015	.000	.000	732.86	2.26
.001989	300.	300.	300.	0	5	0	.00	76.26	78.52

*SECNO 9549.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9549.300	6.61	730.73	730.73	.00	733.63	2.90	.61	.00	732.57
6000.0	.0	6000.0	.0	.0	438.8	.0	75.7	14.2	731.82
.16	.00	13.68	.00	.000	.015	.000	.000	734.13	2.35
.001989	300.	300.	300.	0	5	0	.00	76.26	78.52

*SECNO 9649.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9649.300	6.61	732.38	732.38	.00	735.28	2.90	.60	.00	734.24
6000.0	.0	6000.0	.0	.0	438.8	.0	82.7	14.8	733.09
.17	.00	13.68	.00	.000	.015	.000	.000	735.39	2.25
.001989	300.	300.	300.	0	5	0	.00	76.26	78.52

*SECNO 9749.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9749.300	6.61	733.35	733.35	.00	736.15	2.90	.60	.00	735.10
6000.0	.0	6000.0	.0	.0	438.8	.0	85.7	15.3	734.35
.17	.00	13.68	.00	.000	.015	.000	.000	736.65	2.25
.001989	300.	300.	300.	0	5	0	.00	76.26	78.52

*SECNO 9849.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9849.300	6.61	734.53	734.53	.00	737.43	2.90	.60	.00	736.37
6000.0	.0	6000.0	.0	.0	438.8	.0	88.7	15.8	735.62
.18	.00	13.68	.00	.000	.015	.000	.000	737.92	2.25
.001989	300.	300.	300.	0	5	0	.00	76.26	78.52

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

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*SECNO 8349.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  8349.300      6.61    735.80    735.80       .00    738.70      2.30       .60       .00    737.64
  6000.0          .0    6000.0        .0        .0    438.3         .0      91.8      16.3    736.83
     .19         .00     13.68       .00      .000     .015       .000      .000    729.15      2.26
  .001985       300.      300.      300.         0        5          0       .00     76.26     76.52


*SECNO 8156.700
3280 CROSS SECTION   8156.70 EXTENDED       .21 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  8156.700      6.51    735.51    735.51       .00    739.35      3.84       .35       .01    735.50
  6000.0          .0    6000.0        .0        .0    443.9         .0      93.7      16.7    736.70
     .19         .00     13.52       .00      .000     .015       .000      .000    730.00       .00
  .002003       193.      193.      193.         0        5          0       .00     79.79     79.79


*SECNO 8049.300
3280 CROSS SECTION   8049.30 EXTENDED       .21 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  8049.300      6.51    735.56    735.56       .00    739.77      3.82       .21       .00    735.75
  6000.0          .0    6000.0        .0        .0    445.5         .0      94.3      16.9    736.75
     .19         .00     13.47       .00      .000     .015       .000      .000    730.45       .00
  .001930       107.      107.      107.         0        5          0       .00     80.00     80.00


*SECNO 7847.500
3280 CROSS SECTION   7847.50 EXTENDED       .21 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      739.07 ELREA=      739.07

  7847.500      6.51    737.81    737.81       .00    740.62      2.82       .40       .00    737.50
  6000.0          .0    6000.0        .0        .0    445.6         .0      96.3      17.2    737.60
     .20         .00     13.47       .00      .000     .015       .000      .000    731.35       .00
  .001982       202.      200.      199.         0        5          0       .00     80.00     80.00
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .300 CEHV= .500

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 735.57 , NOT 737.81 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SS	XK	XKOR	COFQ	RDLEN	EWC	BWP	BAREA	SS	ELCHU	ELCHD
	.50	1.27	3.00	.00	37.00	6.60	250.00	.00	732.20	731.31

*SECNO 7747.500
3280 CROSS SECTION 7747.50 EXTENDED 2.65 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.76

PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	HS	QWEIR	QFR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
746.86	742.14	.00	1700.	4323.	280.	255.	735.50	739.17	90.

7747.500	8.35	741.15	.00	.00	742.51	1.36	1.89	.00	738.50
6000.0	.0	6000.0	.0	.0	641.2	.0	98.1	17.4	738.50
.20	.00	9.36	.00	.000	.015	.000	.000	732.20	.00
.000833	100.	100.	100.	3	0	2	.00	80.00	80.00

*SECNO 7662.600
3280 CROSS SECTION 7662.60 EXTENDED 1.99 FEET

7662.600	8.29	741.03	739.32	.00	742.70	1.62	.06	.13	739.10
6000.0	.0	6000.0	.0	.0	587.9	.0	99.4	17.6	739.10
.20	.00	10.21	.00	.000	.015	.000	.000	732.80	.00
.000834	84.	90.	95.	2	15	0	.00	80.00	80.00

CCHV= .100 CEHV= .300
*SECNO 7584.700
3280 CROSS SECTION 7584.70 EXTENDED .35 FEET

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
7584.700	7.79	740.98	739.69	.00	742.85	1.87	.07	.08	740.03
6000.0	.0	6000.0	.0	.0	547.1	.0	100.4	17.7	740.03
.20	.00	10.97	.00	.000	.015	.000	.000	733.19	.00
.001033	78.	78.	78.	2	15	0	.00	80.00	80.00

*SECNO 7480.000
3280 CROSS SECTION 7480.00 EXTENDED .29 FEET

7480.000	7.13	740.81	740.19	.00	743.10	2.29	.13	.13	740.53
6000.0	.0	6000.0	.0	.0	453.8	.0	101.6	17.5	740.53
.21	.00	12.13	.00	.000	.015	.000	.000	733.68	.00
.001431	105.	105.	105.	2	15	0	.00	80.00	80.00

*SECNO 7108.700

3301 HV CHANGED MORE THAN HVINS

7183 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7108.700	5.50	742.01	742.01	.00	744.85	2.84	.62	.16	742.33
6000.0	.0	6000.0	.0	.0	443.9	.0	103.5	18.6	742.33
.21	.00	13.52	.00	.000	.015	.000	.000	735.51	.51
.001983	371.	371.	371.	0	11	0	.00	78.58	79.49

*SECNO 6608.700
7183 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6608.700	5.51	743.49	743.49	.00	746.32	2.83	.59	.00	743.82
6000.0	.0	6000.0	.0	.0	444.3	.0	108.7	19.2	743.82
.22	.00	13.51	.00	.000	.015	.000	.000	736.56	.50
.001978	300.	300.	300.	0	5	0	.00	78.95	79.50

*SECNO 6506.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6508.700	5.51	744.96	744.96	.00	747.79	2.83	.59	.00	745.29
6000.0	.0	6000.0	.0	.0	444.3	.0	111.7	19.7	745.29
.23	.00	13.50	.00	.000	.015	.000	.000	738.45	.50
.001978	300.	300.	300.	0	5	0	.00	79.00	79.50

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 6208.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6208.700	5.51	746.43	746.43	.00	749.26	2.83	.59	.00	746.75
6000.0	.0	6000.0	.0	.0	444.3	.0	114.8	80.2	746.76
.23	.00	13.50	.00	.000	.015	.000	.000	739.52	.50
.001978	300.	300.	300.	0	5	0	.00	75.00	75.50

*SECNO 6190.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6190.100	6.51	746.51	746.51	.00	749.44	2.93	.74	.00	746.84
6000.0	.0	6000.0	.0	.0	444.3	.0	115.0	80.2	746.84
.23	.00	13.50	.00	.000	.015	.000	.000	740.10	.50
.001978	18.	18.	18.	0	5	0	.00	75.00	75.50

*SECNO 5890.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5890.100	6.51	748.66	748.38	.00	751.69	3.33	.59	.00	749.15
6000.0	.0	6000.0	.0	.0	444.3	.0	118.1	80.8	749.19
.24	.00	13.50	.00	.000	.015	.000	.000	742.35	.50
.001978	300.	300.	300.	0	5	0	.00	75.00	75.50

*SECNO 5590.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5590.100	6.51	751.11	751.11	.00	753.94	3.33	.59	.00	751.44
6000.0	.0	6000.0	.0	.0	444.3	.0	121.1	81.4	751.44
.24	.00	13.50	.00	.000	.015	.000	.000	744.58	.50
.001978	300.	300.	300.	0	5	0	.00	75.00	75.50

*SECNO 5484.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5484.000	5.57	751.97	751.97	.00	754.80	2.83	.21	.00	752.34
6000.0	.0	6000.0	.0	.0	444.6	.0	122.2	81.6	752.34
.25	.00	13.50	.00	.000	.015	.000	.000	745.40	.55
.001970	106.	106.	106.	0	5	0	.00	75.89	75.45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .200 CEHV= .400
*SECNO 5290.100
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

5290.100	6.56	753.42	753.42	.00	756.26	2.84	.38	.00	753.79
6000.0	.0	6000.0	.0	.0	443.9	.0	124.2	21.9	753.79
.25	.00	13.52	.00	.000	.015	.000	.000	746.86	.55
.001980	154.	154.	154.	0	3	0	.00	76.89	79.45

*SECNO 5268.300
3280 CROSS SECTION 5268.30 EXTENDED .25 FEET

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 755.40 ELREA= 755.40

5268.300	7.49	754.29	754.29	.00	757.99	3.70	.03	.35	754.11
5000.0	.0	5000.0	.0	.0	333.6	.0	124.4	21.3	754.03
.25	.00	15.44	.00	.000	.015	.000	.000	746.80	.90
.003321	22.	22.	22.	0	3	0	.00	52.70	53.70

CCHV= .200 CEHV= .400

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 753.98 , NOT 754.29 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB XK	XKOR	CDFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
.90	1.27	3.00	.00	52.70	2.70	250.00	.00	747.30	746.30

*SECNO 5168.300
3280 CROSS SECTION 5168.30 EXTENDED 2.37 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
765.83	760.39	.00	3012.	3993.	250.	260.	752.50	755.50	36.
5168.300	5.37	757.07	.00	.00	759.32	2.25	1.33	.00	754.70
6000.0	.0	6000.0	.0	.0	496.2	.0	125.4	22.1	754.70
.25	.00	12.04	.00	.000	.015	.000	.000	747.50	.00
.001105	100.	100.	100.	4	0	3	.00	52.70	52.70

*SECNO 5147.300
3280 CROSS SECTION 5147.30 EXTENDED 2.36 FEET

3301 HV CHANGED MORE THAN HVINS

5147.300	3.32	758.25	755.51	.00	759.53	1.37	.02	.20	755.30
6000.0	.0	6000.0	.0	.0	664.3	.0	125.6	22.1	755.91
.25	.00	3.03	.00	.000	.015	.000	.000	746.94	.00
.000588	20.	20.	20.	4	14	3	.00	80.00	80.00

QLHV= .300 QRHV= .400
*SECNO 5100.000
3280 CROSS SECTION 5100.00 EXTENDED 2.15 FEET

5100.000	3.12	758.25	755.69	.00	759.58	1.33	.03	.03	756.09
6000.0	.0	6000.0	.0	.0	548.3	.0	126.4	22.2	756.10
.25	.00	3.25	.00	.000	.015	.000	.000	745.13	.00
.000512	47.	47.	47.	3	13	0	.00	80.00	80.00

*SECNO 4812.200
3280 CROSS SECTION 4812.20 EXTENDED .47 FEET

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	CLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .69

4812.200	7.42	758.02	757.16	.00	760.15	2.13	.25	.32	757.56
6000.0	.0	6000.0	.0	.0	512.8	.0	130.2	22.7	757.57
.26	.00	11.70	.00	.000	.015	.000	.000	750.60	.00
.001270	288.	288.	288.	2	15	0	.00	60.00	80.00

*SECNO 4512.200

3301 HV CHANGED MORE THAN .4VINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4512.200	5.56	759.69	759.69	.00	761.53	2.84	.47	.29	759.09
6000.0	.0	6000.0	.0	.0	443.6	.0	133.3	23.3	759.10
.27	.00	13.52	.00	.000	.015	.000	.000	753.13	.60
.001962	300.	300.	300.	0	11	0	.00	78.79	79.39

*SECNO 4222.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4222.000	5.56	760.32	760.32	.00	763.05	2.84	.57	.00	760.62
6000.0	.0	6000.0	.0	.0	443.8	.0	135.4	23.8	760.63
.27	.00	13.52	.00	.000	.015	.000	.000	753.66	.59
.001979	290.	290.	290.	0	5	0	.00	78.80	79.39

*SECNO 4121.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4121.000	5.56	760.73	760.73	.00	763.57	2.84	.20	.00	761.13
6000.0	.0	6000.0	.0	.0	443.8	.0	137.3	24.0	761.14
.28	.00	13.52	.00	.000	.015	.000	.000	754.17	.59
.001979	101.	101.	101.	0	5	0	.00	78.80	79.39

*SECNO 3912.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3912.200	6.56	761.80	761.80	.00	764.64	2.84	.41	.00	762.20
6000.0	.0	6000.0	.0	.0	443.8	.0	139.6	24.3	762.21
.28	.00	13.52	.00	.000	.015	.000	.000	755.24	.59
.001979	209.	209.	209.	0	5	0	.00	78.80	79.39

SECNO	DEPTH	CWSEL	CRIWS	WSELR	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 3612.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3612.200	6.56	763.33	763.33	.00	765.17	2.84	.59	.00	763.73
6000.0	.0	6000.0	.0	.0	443.7	.0	142.7	24.9	763.74
.29	.00	13.53	.00	.000	.015	.000	.000	755.77	.59
.001980	300.	300.	300.	0	5	0	.00	78.80	79.39

*SECNO 3312.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3312.200	6.57	764.37	764.37	.00	767.70	3.34	.59	.00	757.80
6000.0	.0	6000.0	.0	.0	443.6	.0	145.7	23.4	765.27
.29	.00	13.53	.00	.000	.015	.000	.000	753.30	.59
.001979	300.	300.	300.	0	5	0	.00	78.80	79.39

*SECNO 3012.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3012.200	6.55	765.39	765.39	.00	769.23	3.84	.59	.00	758.79
6000.0	.0	6000.0	.0	.0	443.7	.0	148.8	26.0	765.80
.30	.00	13.52	.00	.000	.015	.000	.000	759.53	.59
.001980	300.	300.	300.	0	5	0	.00	78.80	79.39

*SECNO 2712.200
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2712.200	6.55	767.92	767.92	.00	770.75	2.84	.59	.00	768.33
6000.0	.0	6000.0	.0	.0	443.7	.0	151.8	28.8	768.33
.31	.00	13.52	.00	.000	.015	.000	.000	761.35	.61
.001979	300.	300.	300.	0	5	0	.00	78.78	79.39

*SECNO 2652.700
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3455 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 770.40 ELREA= 770.40

2652.700	6.37	768.17	768.17	.00	770.35	2.78	.12	.01	768.70
6000.0	.0	6000.0	.0	.0	448.3	.0	152.4	25.6	768.70
.31	.00	13.35	.00	.000	.015	.000	.000	761.80	.05
.001936	60.	60.	60.	0	3	0	.00	80.85	80.54

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

SPECIAL BRIDGE

3237 DOWNSTREAM ELEV IS 767.13 , NOT 768.17 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XK	XKOR	COFQ	RDLEN	EWC	EWP	BAREA	BS	ELCHU	ELCHD
	.30	1.27	3.00	.00	62.00	4.00	437.00	1.50	762.10	761.82

*SECNO 2572.700
PRESSURE AND WEIR FLOW, Weir Submergence Based on TRAPEZOIDAL Shape

ESPRS	EELWC	HS	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
771.29	771.84	.00	364.	5634.	437.	462.	768.66	770.13	71.

3665 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF
3693 PROBABLE MINIMUM SPECIFIC ENERGY

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 770.50 ELREA= 770.50

2572.700	6.63	768.73	768.66	.00	771.50	2.77	.16	.34	769.40
6000.0	.0	6000.0	.0	.0	443.1	.0	153.3	25.6	769.40
.31	.00	13.36	.00	.000	.015	.000	.000	762.10	1.00
.001910	80.	80.	80.	20	8	2	.00	79.00	80.00

*SECNO 2532.300
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2532.300	6.54	768.79	768.79	.00	771.65	2.86	.08	.03	769.35
6000.0	.0	6000.0	.0	.0	442.2	.0	153.7	26.6	769.35
.31	.00	13.57	.00	.000	.015	.000	.000	762.25	1.13
.002601	41.	41.	41.	0	5	0	.00	78.73	79.87

*SECNO 2237.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2237.500	6.56	769.94	769.94	.00	772.78	2.84	.55	.00	770.68
6000.0	.0	6000.0	.0	.0	443.8	.0	156.7	27.4	770.68
.31	.00	13.52	.00	.000	.015	.000	.000	763.38	1.10
.001979	295.	295.	295.	0	5	0	.00	78.79	79.99

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SGTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1937.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1937.500	6.56	771.10	771.10	.00	773.54	2.84	.59	.00	771.54
6000.0	.0	6000.0	.0	.0	443.3	.0	159.7	27.9	771.84
.32	.00	13.53	.00	.000	.015	.000	.000	764.54	1.11
.001983	300.	300.	300.	0	3	0	.00	78.78	79.89

*SECNO 1637.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1637.500	6.56	772.85	772.85	.00	775.03	2.84	.59	.00	773.39
6000.0	.0	6000.0	.0	.0	443.3	.0	162.8	28.5	773.39
.33	.00	13.53	.00	.000	.015	.000	.000	765.89	1.11
.001981	300.	300.	300.	0	3	0	.00	78.79	79.89

*SECNO 1337.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1337.500	6.56	773.41	773.41	.00	775.25	2.84	.59	.00	774.13
6000.0	.0	6000.0	.0	.0	443.3	.0	165.8	29.3	774.13
.33	.00	13.53	.00	.000	.015	.000	.000	766.83	1.11
.001983	300.	300.	300.	0	3	0	.00	78.78	79.89

*SECNO 1037.500
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1037.500	6.56	774.56	774.56	.00	777.40	2.84	.59	.00	775.30
6000.0	.0	6000.0	.0	.0	443.3	.0	168.9	29.5	775.30
.34	.00	13.53	.00	.000	.015	.000	.000	767.00	1.11
.001982	300.	300.	300.	0	3	0	.00	78.79	79.89

*SECNO 737.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

737.480	6.56	775.72	775.72	.00	778.56	2.84	.59	.00	776.46
6000.0	.0	6000.0	.0	.0	443.3	.0	172.0	30.1	776.46
.35	.00	13.53	.00	.000	.015	.000	.000	769.15	1.11
.001983	300.	300.	300.	0	3	0	.00	78.78	79.33

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 437.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

437.480	6.56	776.87	776.87	.00	779.71	2.84	.59	.00	777.61
6000.0	.0	6000.0	.0	.0	443.6	.0	175.0	30.8	777.61
.35	.00	13.53	.00	.000	.015	.000	.000	770.31	1.11
.001982	300.	300.	300.	0	5	0	.00	78.79	79.83

*SECNO 137.480
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

137.480	6.56	773.03	776.03	.00	780.87	3.84	.59	.00	773.77
6000.0	.0	6000.0	.0	.0	443.5	.0	173.1	31.2	778.77
.36	.00	13.53	.00	.000	.015	.000	.000	771.47	1.11
.001982	300.	300.	300.	0	5	0	.00	78.79	79.85

THIS RUN EXECUTED 05APR93 10:45:33

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUBCRITICAL RUN

SUMMARY PRINTOUT

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
*	17410.000	3300.00	4.56	685.33	693.85	4.63	77.88	.00	11.33	.00
*	17410.000	6000.00	6.57	688.33	695.90	1.46	81.04	.00	13.49	.00
*	17230.000	3300.00	4.55	690.10	694.65	4.64	77.86	.00	11.36	.00
*	17230.000	6000.00	6.53	690.10	696.66	1.45	81.05	.00	13.48	.00
*	16930.000	3300.00	4.55	691.39	695.95	4.63	77.87	.00	11.35	.00
*	16930.000	6000.00	6.53	691.39	697.97	1.45	81.05	.00	13.48	.00
*	16630.000	3300.00	4.53	692.68	697.23	4.64	77.86	.00	11.36	.00
*	16630.000	6000.00	6.53	692.68	699.26	1.45	81.05	.00	13.48	.00
*	16330.000	3300.00	4.53	693.97	698.52	4.63	77.87	.00	11.36	.00
*	16330.000	6000.00	6.53	693.97	700.55	1.45	81.05	.00	13.48	.00
*	16030.000	3300.00	4.55	695.26	699.81	4.64	77.86	.00	11.36	.00
*	16030.000	6000.00	6.58	695.26	701.34	1.45	81.05	.00	13.48	.00
*	15730.000	3300.00	4.55	696.55	701.10	4.63	77.87	.00	11.35	.00
*	15730.000	6000.00	6.58	696.55	703.13	1.45	81.05	.00	13.48	.00
*	15430.000	3300.00	4.55	697.84	702.39	4.64	77.86	.00	11.36	.00
*	15430.000	6000.00	6.58	697.84	704.42	1.45	81.05	.00	13.48	.00
*	15130.000	3300.00	4.55	699.13	703.68	4.63	77.87	.00	11.36	.00
*	15130.000	6000.00	6.58	699.13	705.71	1.45	81.05	.00	13.48	.00
*	14900.000	3300.00	4.55	700.12	704.67	4.64	77.86	.00	11.36	.00
*	14900.000	6000.00	6.58	700.12	706.70	1.45	81.05	.00	13.48	.00
*	14630.000	3300.00	4.55	701.84	706.39	4.63	77.87	.00	11.35	.00
*	14630.000	6000.00	6.58	701.84	708.42	1.45	81.05	.00	13.48	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
*	14230.000	3300.00	4.55	703.00	707.55	4.64	77.86	.00	11.36	.00
*	14230.000	6000.00	6.58	703.00	709.58	1.45	81.05	.00	13.48	.00
*	13930.000	3300.00	4.55	704.29	708.84	4.64	77.86	.00	11.36	.00
*	13930.000	6000.00	6.58	704.29	710.87	1.45	81.05	.00	13.48	.00
*	13630.000	3300.00	4.55	705.58	710.14	4.63	77.87	.00	11.36	.00
*	13630.000	6000.00	6.58	705.58	712.16	1.45	81.05	.00	13.48	.00
*	13330.000	3300.00	4.55	706.87	711.42	4.64	77.86	.00	11.36	.00
*	13330.000	6000.00	6.58	706.87	713.45	1.45	81.05	.00	13.48	.00
*	13030.000	3300.00	4.55	708.16	712.72	4.63	77.87	.00	11.35	.00
*	13030.000	6000.00	6.58	708.16	714.74	1.45	81.05	.00	13.48	.00
*	12730.000	3300.00	4.55	709.45	714.00	4.64	77.86	.00	11.35	.00
*	12730.000	6000.00	6.58	709.45	716.03	1.45	81.05	.00	13.48	.00
*	12430.000	3300.00	4.55	710.74	715.30	4.63	77.87	.00	11.35	.00
*	12430.000	6000.00	6.58	710.74	717.32	1.45	81.05	.00	13.48	.00
*	12091.000	3300.00	4.55	712.26	716.83	4.64	77.86	.00	11.36	.00
*	12091.000	6000.00	6.58	712.28	718.85	1.45	81.05	.00	13.48	.00
*	11791.000	3300.00	4.55	713.54	718.10	4.64	77.86	.00	11.36	.00
*	11791.000	6000.00	6.58	713.54	720.31	1.45	81.05	.00	13.48	.00
*	11491.000	3300.00	4.55	714.99	719.55	4.63	77.87	.00	11.36	.00
*	11491.000	6000.00	6.58	714.99	721.57	1.45	81.05	.00	13.48	.00
*	11191.000	3300.00	4.16	716.35	720.51	5.26	87.24	.00	10.95	.00
*	11191.000	6000.00	6.02	716.35	722.37	2.33	90.17	.00	13.06	.00
*	10900.000	3300.00	4.13	717.52	721.65	3.65	88.26	.00	10.84	.00
*	10900.000	6000.00	5.95	717.52	723.48	.36	92.27	.00	12.87	.00
*	10630.000	3300.00	4.53	717.80	722.33	1.62	74.23	.00	11.39	.00
*	10630.000	6000.00	6.52	717.80	724.32	.00	76.32	.00	13.55	.00
	10725.000	3300.00	5.23	717.90	723.13	.24	74.93	.00	9.68	.00
	10725.000	6000.00	7.33	717.90	725.23	.00	77.03	.00	11.99	.00
*	10724.000	3300.00	4.44	719.04	723.48	6.52	79.96	.00	11.32	.00
*	10724.000	6000.00	6.44	719.04	725.48	3.43	82.35	.00	13.52	.00
*	10624.000	3300.00	5.54	719.53	725.09	4.83	81.38	.00	8.84	.00
*	10624.000	6000.00	6.52	719.55	726.07	3.31	82.46	.00	13.33	.00
	10574.000	3300.00	5.12	719.80	724.92	4.88	75.72	.00	10.12	.00
*	10574.000	6000.00	6.65	719.80	726.45	2.46	77.52	.00	13.71	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
*	10423.000	3300.00	4.55	720.43	724.98	4.78	75.74	.00	11.45	.00
*	10423.000	6000.00	5.60	720.43	727.03	2.27	78.51	.00	13.70	.00
*	10149.000	3300.00	4.56	721.70	726.26	4.78	75.75	.00	11.47	.00
*	10149.000	6000.00	5.61	721.70	728.31	2.26	78.53	.00	13.67	.00
*	9849.300	3300.00	4.55	722.86	727.41	4.78	75.75	.00	11.46	.00
*	9849.300	6000.00	5.61	722.86	729.47	2.26	78.52	.00	13.63	.00
*	9549.300	3300.00	4.55	724.12	728.67	4.78	75.75	.00	11.46	.00
*	9549.300	6000.00	5.61	724.12	730.73	2.25	78.52	.00	13.68	.00
*	9249.300	3300.00	4.55	725.39	729.94	4.78	75.75	.00	11.46	.00
*	9249.300	6000.00	5.61	725.39	732.00	2.26	78.52	.00	13.65	.00
*	8949.300	3300.00	4.55	726.65	731.20	4.78	75.75	.00	11.46	.00
*	8949.300	6000.00	5.61	726.65	733.26	2.25	78.52	.00	13.63	.00
*	8649.300	3300.00	4.55	727.92	732.47	4.78	75.75	.00	11.46	.00
*	8649.300	6000.00	5.61	727.92	734.53	2.26	78.52	.00	13.63	.00
*	8349.300	3300.00	4.55	729.19	733.74	4.78	75.75	.00	11.46	.00
*	8349.300	6000.00	5.61	729.19	735.80	2.26	78.52	.00	13.63	.00
*	8156.700	3300.00	4.51	730.00	734.51	3.38	76.39	.00	11.38	.00
*	8156.700	6000.00	5.51	730.00	736.51	.00	79.70	.00	13.52	.00
*	8049.300	3300.00	4.52	730.45	734.97	3.97	77.03	.00	11.31	.00
*	8049.300	6000.00	5.51	730.45	736.96	.00	80.00	.00	13.47	.00
*	7847.500	3300.00	4.52	731.30	735.82	3.97	77.03	.00	11.31	.00
*	7847.500	6000.00	5.51	731.30	737.81	.00	80.00	.00	13.47	.00
*	7747.500	3300.00	4.52	732.20	736.72	2.96	77.04	.00	11.30	.00
*	7747.500	6000.00	5.55	732.20	741.15	.00	80.00	.00	9.35	.00
*	7662.600	3300.00	4.52	732.80	737.32	3.97	77.03	.00	11.32	.00
	7662.600	6000.00	5.25	732.80	741.09	.00	80.00	.00	10.21	.00
*	7584.700	3300.00	4.47	733.19	737.66	3.57	76.43	.00	11.40	.00
	7584.700	6000.00	7.75	733.19	740.98	.00	80.00	.00	10.97	.00
*	7480.000	3300.00	4.48	733.69	738.17	3.56	76.44	.00	11.37	.00
	7480.000	6000.00	7.12	733.69	740.81	.00	80.00	.00	12.15	.00
*	7108.700	3300.00	4.48	735.51	739.99	3.56	76.44	.00	11.37	.00
*	7108.700	6000.00	5.50	735.51	742.01	.51	79.49	.00	13.52	.00
*	6808.700	3300.00	4.48	736.98	741.46	3.56	76.44	.00	11.37	.00
*	6808.700	6000.00	5.51	736.98	743.49	.50	79.50	.00	13.51	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
*	6508.700	3300.00	4.48	738.45	742.93	3.56	76.44	.00	11.38	.00
*	6508.700	6000.00	6.51	738.45	744.96	.50	79.50	.00	13.50	.00
*	6208.700	3300.00	4.48	739.92	744.40	3.56	76.44	.00	11.37	.00
*	6208.700	6000.00	6.51	739.92	746.43	.50	79.50	.00	13.50	.00
*	6190.100	3300.00	4.48	740.10	744.58	3.56	76.44	.00	11.38	.00
*	6190.100	6000.00	6.51	740.10	746.61	.50	79.50	.00	13.50	.00
*	5890.100	3300.00	4.48	742.35	746.83	3.56	76.44	.00	11.37	.00
*	5890.100	6000.00	6.51	742.35	748.86	.50	79.50	.00	13.50	.00
*	5590.100	3300.00	4.48	744.60	749.08	3.56	76.44	.00	11.38	.00
*	5590.100	6000.00	6.51	744.60	751.11	.50	79.50	.00	13.50	.00
*	5484.000	3300.00	4.34	745.40	749.74	3.61	76.39	.00	11.35	.00
*	5484.000	6000.00	5.57	745.40	751.37	.55	79.45	.00	13.50	.00
*	5290.100	3300.00	4.33	746.86	751.35	3.52	76.38	.00	11.39	.00
*	5290.100	6000.00	5.56	746.86	753.42	.55	79.45	.00	13.52	.00
*	5268.300	3300.00	5.06	746.80	751.86	.03	82.67	.00	12.67	.00
*	5268.300	6000.00	7.45	746.80	754.25	.00	82.70	.00	15.44	.00
*	5168.300	3300.00	5.03	747.50	752.53	.12	82.88	.00	12.48	.00
*	5168.300	6000.00	5.57	747.50	757.07	.00	82.70	.00	13.04	.00
*	5147.300	3300.00	4.53	748.34	752.87	3.64	76.35	.00	11.33	.00
	5147.300	6000.00	5.32	748.34	753.66	.00	80.00	.00	5.33	.00
*	5100.000	3300.00	4.53	749.13	753.66	3.64	76.35	.00	11.38	.00
	5100.000	6000.00	5.12	749.13	754.25	.00	80.00	.00	5.25	.00
*	4812.200	3300.00	4.53	750.60	755.13	3.64	76.35	.00	11.38	.00
*	4812.200	6000.00	7.42	750.60	758.02	.00	80.00	.00	11.79	.00
*	4512.200	3300.00	4.53	752.13	756.66	3.64	76.35	.00	11.38	.00
*	4512.200	6000.00	5.56	752.13	758.69	.60	79.39	.00	13.53	.00
*	4222.000	3300.00	4.53	753.66	758.19	3.64	76.35	.00	11.38	.00
*	4222.000	6000.00	6.56	753.66	760.22	.59	79.39	.00	13.52	.00
*	4121.000	3300.00	4.53	754.17	758.70	3.64	76.35	.00	11.38	.00
*	4121.000	6000.00	5.55	754.17	760.73	.59	79.39	.00	13.52	.00
*	3912.200	3300.00	4.53	755.24	759.77	3.64	76.35	.00	11.38	.00
*	3912.200	6000.00	6.56	755.24	761.80	.59	79.39	.00	13.52	.00
*	3812.200	3300.00	4.53	756.77	761.30	3.64	76.35	.00	11.38	.00
*	3812.200	6000.00	5.56	756.77	763.33	.59	79.39	.00	13.53	.00

	SECNO	Q	DEPTH	ELMIN	CWSEL	SSTA	ENDST	VLOB	VCH	VROB
*	3312.200	3300.00	4.53	758.30	762.83	3.64	76.35	.00	11.38	.00
*	3312.200	6000.00	6.57	758.30	764.87	.59	79.35	.00	13.52	.00
*	3012.200	3300.00	4.53	759.83	764.36	3.64	76.35	.00	11.38	.00
*	3012.200	6000.00	6.56	759.83	766.39	.59	79.39	.00	13.52	.00
*	2712.200	3300.00	4.53	761.36	765.89	3.65	76.35	.00	11.38	.00
*	2712.200	6000.00	6.56	761.36	767.92	.61	79.39	.00	13.52	.00
*	2652.700	3300.00	4.43	761.80	766.23	2.32	78.40	.00	11.20	.00
*	2652.700	6000.00	6.37	761.80	768.17	.06	80.94	.00	13.38	.00
*	2572.700	3300.00	5.45	762.10	767.55	2.77	78.23	.00	9.22	.00
*	2572.700	6000.00	6.83	762.10	768.93	1.00	80.00	.00	13.35	.00
	2532.200	3300.00	5.29	762.28	767.54	3.01	77.99	.00	9.53	.00
*	2532.200	6000.00	6.54	762.28	768.79	1.13	79.87	.00	13.57	.00
*	2237.500	3300.00	4.54	763.38	767.92	4.14	76.86	.00	11.37	.00
*	2237.500	6000.00	6.56	763.38	769.94	1.10	79.90	.00	13.52	.00
*	1937.500	3300.00	4.53	764.84	769.37	4.13	76.85	.00	11.36	.00
*	1937.500	6000.00	6.56	764.84	771.40	1.11	79.89	.00	13.53	.00
*	1637.500	3300.00	4.53	765.83	770.36	4.15	76.85	.00	11.36	.00
*	1637.500	6000.00	6.56	765.83	772.39	1.11	79.89	.00	13.52	.00
*	1337.500	3300.00	4.53	766.85	771.38	4.15	76.85	.00	11.36	.00
*	1337.500	6000.00	6.56	766.85	773.41	1.11	79.89	.00	13.53	.00
*	1037.500	3300.00	4.53	768.00	772.53	4.15	76.85	.00	11.36	.00
*	1037.500	6000.00	6.56	768.00	774.56	1.11	79.89	.00	13.53	.00
*	737.480	3300.00	4.53	769.16	773.69	4.15	76.85	.00	11.36	.00
*	737.480	6000.00	6.56	769.16	775.72	1.11	79.89	.00	13.53	.00
*	437.480	3300.00	4.53	770.31	774.84	4.15	76.85	.00	11.36	.00
*	437.480	6000.00	6.56	770.31	776.87	1.11	79.89	.00	13.53	.00
*	137.480	3300.00	4.53	771.47	776.00	4.15	76.85	.00	11.38	.00
*	137.480	6000.00	6.56	771.47	778.03	1.11	79.89	.00	13.53	.00

SUMMARY OF ERRORS AND SPECIAL NOTES

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CAUTION SECNO= 737.460 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 737.460 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 437.460 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 437.460 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 437.460 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 437.460 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 137.460 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 137.460 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 137.460 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 137.460 PROFILE= 2 MINIMUM SPECIFIC ENERGY

5.5.2 Cibola Drainage Study

DRAINAGE

NAME:

CIBOLA

SECTION / TOWNSHIP/ RANGE:

SEC 33 T20S R62E

CROSS STREETS:

STEWART / SLOAN

ASSESSOR'S PARCEL NUMBER:

NEW ASSESSOR'S PARCEL NUMBERS:

140-33-701-001, 002
003

ACREAGE:

± 12.7AC

SUBMITTAL DATE:

11/14/94

C L A R K C O U N T Y
REGIONAL FLOOD CONTROL DISTRICT

MAR 2 8 1995

Gale Wm. Fraser, II, P.E.
General Manager / Chief Engineer

BOARD OF DIRECTORS

Iris Bletsch
Chairman
City of Boulder City

Larry Scheffler
Vice-Chairman
City of Henderson

Ken Brass
City of Las Vegas

Ken Carter
City of Mesquite

Yvonne Atkinson Gates
Clark County

Theron Goynes
City of North Las Vegas

Jan Laverty Jones
City of Las Vegas

Bruce L. Woodbury
Clark County

March 27, 1995

Robert Thompson, P.E.
Clark County Department of Public Works
401 South Fourth Street
Las Vegas, NV 89101

DISTRICT CONCURRENCE: CIBOLA (HTE 94-25236)

Dear Mr. Thompson:

The District has reviewed the Technical Drainage Study dated November 19, 1994, Addendum No. 1 dated December 30, 1994, Addendum No. 2 dated January 15, 1995, and Addendum No. 3 dated February 6, 1995, for the above captioned project as submitted by Ray Novatney, P.E. In addition the District is in receipt of the Conditional Letter of Acceptance from Clark County Public Works dated February 24, 1995.

The District concurs with the acceptance of this Technical Drainage Study by Clark County Public Works. As noted in the Conditional Letter of Acceptance from the County, the Clark County Public Works Design Division must concur with the proposed connection to the Sloan Channel.

The District's review of this project was limited to issues of Regional Flood Control Significance as defined in the Uniform Regulations for the Control of Drainage. As noted in the study the site resides in a Special Flood Hazard Area (SFHA) designated as "Zone A" per the effective Flood Insurance Rate Map (FIRM). Therefore the consultant should be advised that this acceptance does not serve to amend the FIRM or remove the SFHA designation.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, the information submitted by Ray Novatney, P.E. may be superseded. Compliance with the regulatory elements and design standards specified in the Uniform Regulations for the Control of Drainage does not imply a guarantee that

301 E. Clark Avenue, Suite 301 • Las Vegas, Nevada 89101
(702) 455-3139 • FAX: (702) 455-3870

properties will be free from flooding or flood damage. No liability is assumed by the District, its officials, or employees for the information, data or conclusions presented by the consulting engineer. We therefore make no warranties, either expressed or implied, in conducting this review.

GALE WM. FRASER II, P.E.
General Manager/Chief Engineer

BY: _____
Kevin L. Eubanks, P.E.
Assistant General Manager

CC: Ray Novatney, P.E.

KLE:SEC:mak

File: 20-62-33.nov

Clark County

Department of Public Works

M. J. MANNING
DIRECTOR

6855 WEST SAHARA AVENUE
BUILDING C-204
LAS VEGAS, NEVADA 89102
(702) 455-7760
FAX: (702) 455-7764

Progress As Promised

February 24, 1995

URBAN C. LIVENGOOD, JR.
Deputy Director
455-7755

NALLIAH T. RAJAH
Manager
Administration & Programs
455-7760

DENIS CEDERBURG
Manager
Design Engineering
455-7766

LESLIE R. HENLEY
Manager
Construction Management
455-7788

BRETT N. LANE
County Surveyor
455-7728

RICHARD T. ROMER
Manager
Traffic Management
455-7790

OTHER OFFICES

JOHN N. MURDOCH
Manager
Maintenance Management
5825 East Flamingo Road
Las Vegas, Nevada 89122
455-7540

CHARLES R. JENNER
Manager
Environmental Control
4900 West Dewey Drive
Las Vegas, Nevada 89118
455-7712

CARLA J. PEARSON
Manager
Community Development
401 South Fourth Street, 2nd Floor
P.O. Box 554130
Las Vegas, Nevada 89155-4130
455-4600

Ray Novatney, P.E.
4782 South Mojave Road
Las Vegas, Nevada 89121

Dear Sirs:

Re: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study *for Cibola aka Magnolia Estates* **(1530)**
Study Dated: November 19, 1994
First Addendum Dated: December 30, 1994
Second Addendum Dated: January 15, 1995
Third Addendum Dated: February 6, 1995
Location: Southwest corner of Stewart Avenue and Sloan Channel (Sec. 33, T. 20 S., R. 62 E.)
H.T.E.# 94-25236

The referenced **Technical Drainage Study** has been reviewed and is accepted as complying with minimum improvement standards. As set forth in the subject drainage study, the following measures will be taken to mitigate flood hazards:

1. The site shall be graded with respect to drainage as shown on "Grading Plan for Magnolia Estates," signed and sealed by Ray Novatney, P.E., on November 18, 1994;

2. The following drainage facilities shall be constructed:

   a. A concrete lined channel located on the south side of Stewart Avenue. The channel will begin at the Battle Mountain Drive intersection and will extend east to the project entrance. The channel will include a steel post metal beam guardrail at the west channel flume, and a 12 foot chainlink gate for access at the extreme west end. The street side of the channel will include a traffic barrier wall with chainlink fence a minimum of 6 feet tall. The property side of the channel will include a minimum 6-foot-tall block screen wall. The channel will be vertical concrete lined, 3.4-foot-deep, 8-foot-wide, located within a 9-foot-wide public drainage easement

COMMISSIONERS
Jay Bingham, Chairman • Don Schlesinger, Vice-Chairman
Paul J. Christensen, Thalia M. Dondero, Yvonne Atkinson Gates, Karen Hayes, Bruce L. Woodbury
Donald L. "Pat" Shalmy, County Manager

b. A box culvert extending from the east end of the channel to the Sloan Channel. The box culvert will be 187 feet long, 8 feet wide by 3.5 feet tall, located within a 9-foot-wide underground public drainage easement

c. A connection of the proposed 8-foot-wide x 3.5-foot-tall RCB to the existing Slogan Channel

d. A 20-foot-long Type A drop inlet located east of the site entrance, connected to the 8-foot-wide x 3.5-foot-high RCB with 2 LF of 30-inch RCP

e. An onsite drainage system at the south side of the project within a 10-foot-wide private drainage easement, with the following facilities:

6.5-foot-long Type A drop inlet #1 at Maple Court
233 LF of 18-inch RCP from DI#1 to DI#2
2-foot-long Type A drop inlet #2 at Banyon Court
239 LF of 18-inch RCP from DI#2 to DI#3
4.5-foot-long Type A drop inlet #3 at Cherry Blossom Drive
135 LF of 21-inch RCP from DI#3 to Sloan Channel
Flared end section and 10-foot-wide x 10-foot-long rip-rap pad, 1.5 feet thick of d_{50} = 0.75 or 25 lb. stone

f. 8-foot-wide valley gutter located at the project entrance and the west side of Maple Court at Mulberry Court, the west side of Cherry Blossom Drive at Apple Blossom Drive, and the east side of Maple Court at Apple Blossom Drive

3. A bond estimate must be submitted to Clark County Public Works for the stormwater management facilities noted in 2 above;

4. The minimum finish floor elevations for the proposed structures with the designated base flood elevations (BFE's) shall be constructed as shown on the above-referenced grading plan;

5. As a condition of approval, Clark County Public Works Design Division must concur with the proposed connection to the Sloan Channel;

6. The subject site is located within Zone A, as shown on FIRM Community-Panel Number 320003 1250B, revised September 29, 1989. Zone A is a special flood hazard area determined to be within the 100-year flood plain. No base flood elevations have been determined by FEMA;

7. Clark County Regional Flood Control District concurrence is required since the site is located within Flood Zone A and adjacent to regional facility. As a condition of final approval, the applicant must submit a copy of the drainage study and any addenda to the Clark County Regional Flood Control District. The final map will not be approved by the Board of County Commissioners until concurrence is obtained from the Clark County Regional Flood Control District;

8. *Right-of-way dedication must be verified;*

9. Mylars of the grading plan must be submitted to the Clark County Plan Check department for approval signatures prior to map recordation;

10. At the request of Clark County Public Works, we have reviewed the Grading plans in reference to section 34.030, Uniform Regulations for the Control of Drainage, Nov 12, 1990 for compliance to permitting requirements. **As a condition of final approval the grading plans submitted for this project require the following modifications to meet the minimum standards outlined in the above regulation.**

    - Revise the drainage easement where the box culvert is located to be a public underground drainage easement

    - Rename roads in storm drain profile

No liability is assumed by the County for information, data, and conclusions of the consulting engineer.

Yours truly,

Robert Thompson, P.E.
Civil Engineer III

RT/li

cc: Barbara Ginoulias
John Sara

03226/project/1530-1

WILLDAN ASSOCIATES ❑ ENGINEERS & PLANNERS

Professional Consulting Services Since 1964

MEMORANDUM

TO: Ralph M. Gabriel, P.E.
Isabel Pennington

FROM: Stephen L. Weatherman, P.E.

OFFICE: Las Vegas

DATE: November 30, 1994

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Cibola **(1530)**
Study Dated: November 19, 1994
Location: Southwest corner of Stewart Avenue and Sloan Channel
(Sec. 33, T. 20 S., R. 62 E.)
H.T.E. 94-25236
Prepared by Ray Novatney

We have completed our initial review of the above-referenced **Technical Drainage Study**, and have the following comments:

1. The design of the proposed storm drain on the south side of Stewart Avenue must be revised. The purpose of the storm drain is to collect flows within Stewart Avenue, but the proposed pipe is located outside of the right-of-way within a 10-foot-wide easement behind a block wall. The access and maintenance of the pipe would require access to the backyard of 14 lots. The pipe must be relocated into the Stewart Avenue right-of-way. The present design includes Y connections from the proposed drop inlets to the mainline pipe which does not meet current criteria. The storm drain connections must be with manholes. Alternately, the storm drain pipe may be run from drop inlet to drop inlet. Appropriate plan and profile must be provided for the storm drain design;

2. The submitted calculations and grading plan indicates the BFE's are above the channel bank. The finished floors are above the BFE's and apparently a retaining wall is to be placed on the Sloan Channel property line. This wall must be designed as a flood wall to include appropriate cutoff walls to prevent undercutting by the Sloan Channel. Appropriate calculations and designs are required;

3. The Sloan Channel is currently under design and the applicant must coordinate all improvements with the Clark County Public Works Design section;

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4. The current scale of 1-inch = 60 feet may not be legible when the required tc, road centerline elevations, and finished contours are added. If the plan cannot be legible to microfilm, the scale must be changed;

5. The grading plan will be reviewed by the building department to ensure compliance with the handicap access requirements (see attached letter). Revisions to the grading plan may be required if the site accessibility design does not comply with the requirements set forth in the Accessibility Chapter of the Clark County Building Code;

6. Clark County Regional Flood Control District concurrence is required since the site is located within Flood Zone A and adjacent to a regional facility. As a condition of final approval, the applicant must submit a copy of the drainage study and any addenda to the Clark County Regional Flood Control District. The final map will not be approved by the Board of County Commissioners until concurrence is obtained from the Clark County Regional Flood Control District;

7. At the request of Clark County Public Works, grading plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **The plans submitted do not meet the minimum requirements and must be revised prior to Drainage Study approval, to address the following:**

   a. Existing pavement, show sawcut and replace areas, pavement transitions

   b. Typical road sections

   c. Profile, HGL for proposed storm drains

   d. Proposed contours

   e. Crown elevations at lot lines and extension of lot lines

   f. Details at property lines, fences, and berms

   g. Details of flood walls and retaining walls

   h. Detail of proposed or future block wall opening with flowline elevation

The grading plan has been red-lined and is being returned to the engineer. The red-lined grading plan must be resubmitted with the revised drawings. Failure to resubmit the red-lined grading plan will prevent further review of the project.

All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log- in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature _____ Date 12/2/94

COMMENTS:

Item 3 - This study must be reviewed and commented by the CCPW Design Division regarding the storm drain on Stewart and the Sloan Channel. It is the engineer's responsibility to forward a copy of this study and all addenda to the CCPW Design. No approval shall be given until after the approval by the CCPW Design -

DL 12-2-94

cc: John Sara

03226/0717-1530 025
MH129942.rg 03226

WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS

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MEMORANDUM

TO: Ralph M. Gabriel, P.E.
Isabel Pennington

FROM: Stephen L. Weatherman, P.E.

OFFICE: Las Vegas

DATE: January 11, 1995

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Cibola **(1530)**
Study Dated: November 19, 1994
First Addendum Dated: December 30, 1994
Location: Southwest corner of Stewart Avenue and Sloan Channel
(Sec. 33, T. 20 S., R. 62 E.)
H.T.E.# 94-25236
Prepared by Ray Novatney

We have completed our second review of the above-referenced **Technical Drainage Study**, and have the following comments:

1. A *fax memo which listed the following items had been requested by the project* engineer initially. Due to a schedule change, a response to the fax memo within five days is not possible and the engineer has requested a standard review memo. The drainage facility plans were provided to the engineer with the fax memo and are not included with this review;

2. The width of the drainage channel on the south side of Stewart Avenue is shown as 8 feet wide. The minimum width required to allow maintenance is 10 feet. The channel must be ~~widened to 10 feet;~~ 8' OK RJ.

3. *The public drainage easement cannot include the project side channel wall.* The public drainage easement must be revised to begin on the north side of the south wall;

4. A traffic barrier is required on the north side of the channel. The proposed wall must be designed to resist traffic impacts or a guiderail may be used. The spillway entrance also requires a traffic barrier. This can be a wall with openings or a guiderail. This barrier must extend from the gate to the beginning of the proposed wall. The 12-foot-wide chainlink gate is acceptable;

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5. At the request of Clark County Public Works, grading plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **The plans submitted do not meet the minimum requirements and must be revised prior to Drainage Study approval, to address the following:**

   a. Revise channel width

   b. Revise easement to begin on the north side of the south channel wall

   c. Revise chainlink fence to be traffic barrier

   d. Revise north channel wall to be traffic barrier

The grading plan has been red-lined and is being returned to the engineer. The red-lined grading plan must be resubmitted with the revised drawings. Failure to resubmit the red-lined grading plan will prevent further review of the project.

All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log- in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature _____ Date 1/13/95

COMMENTS: _____

cc: John Sara

03226/0717-1530/073
M0109952.rg4/03226

WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS

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FAX MEMORANDUM

TO: Ray Navatney, P.E.

FROM: Stephen L. Weatherman, P.E.

DATE: January 5, 1995

SUBJECT: **Technical Drainage Study** for Cibola (1530)
H.T.E. 94-25236

This memo is being faxed in lieu of a typical mailed memorandum in order to expedite the review process. The following items are required in order to produce an approval memorandum for the above referenced **Technical Drainage Study:**

Drainage Study

1.) The width of the drainage channel on the south side of Stewart Avenue is shown as 8-foot-wide. The minimum width required to allow maintenance is 10 feet. The channel must be widened to 10 feet; 2). The public drainage easement cannot include the project side channel wall. The public drainage easement must be revised to begin on the north side of the south wall; 3.) A traffic barrier is required on the north side of the channel. The proposed wall can be designed to resist traffic impacts or a guiderail may be used. The spillway entrance also requires a traffic barrier. This can be a wall with openings or a guiderail. This barrier must extend from the gate to the beginning of the proposed wall. The 12-foot-wide chainlink gate is acceptable;

Grading Plan

1. Revise channel width; 2.) Revise easement to begin on the north side of the south channel wall; 3.) Revise chainlink fence to be traffic barrier; 4.) Revise north channel wall to be traffic barrier;

The supplemental information must be submitted directly to Willdan Associates.

The items listed herein must be thoroughly addressed and submitted for review within 5 days of the above date.

cc: Phu Simpson, CCPW
John Sara

c:\03226\fax12

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WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS

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MEMORANDUM

TO: Ralph M. Gabriel, P.E.
Isabel Pennington

FROM: Stephen L. Weatherman, P.E.

OFFICE: Las Vegas

DATE: January 23, 1995

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Cibola **(1530)**
Study Dated: November 19, 1994
First Addendum Dated: December 30, 1994
Second Addendum Dated: January 15, 1995
Located: Southwest corner of Stewart Avenue and Sloan Channel
(Sec. 33, T. 20 S., R. 62 E.)
H.T.E.# 94-25236
Prepared by Ray Novatney

We have completed our third review of the above-referenced **Technical Drainage Study**, and have the following comments:

1. The following comments refer to the structural calculations for the traffic barrier wall:

   a. Calculation sheet S-1 for the horizonal masonry beam spreading the impact load utilizes an allowable bending stress of 500 PSI. Per UBC 2406(c), this value must be reduced by one-half if special inspection is not provided. If full stress is to be used, the drawings must be revised to note that special inspection is required. Ref. UBC/UAC 302(c)1;

   b. Calculation sheet S-3 shows the value of 2kj is determined by using n=40. The value of n is based on the definition given in UBC 2401 using Em=750 x f'm from UBC 2406(f)B. The value of Em is not reduced for half-stress purposes. This resulted in a value of n=26. A revaluation of the masonry stress shows it exceeds the allowable value of 250 PSI;

   The structural calculations and structural details must be revised to incorporate these comments.

2. The NDOT Details of the Steel Post Metal Beam Guardrail are not County standards and must be shown on the plans;

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All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log- in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature _____ Date 1/24/95

COMMENTS: Item 1. Portable precast concrete barrier rail [NDOT's standard dwg. R-8.3.3. (502)] may be used in lieu of the structurally designed traffic barrier wall. In either case, chain link fence is to be installed on top of the conc. barrier for a total wall height of 6'.

* There is a 2' drop between the channel invert and the ~~box~~ flow line elev. of the box culvert under Magenta Wy. While the channel slope is only 0.16% the engineer is requested to look into increasing the channel slope to reduce future maintenance work on the channel

PS 1-24-95

cc: John Sara

03226/0717-1530/073
M0120952..rg2/03226

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: EBOLA Date: 11/14/94

Location of Development: a) Descriptive SW COR. STEWART & SLOAN CHANNEL
b) Sect. [illegible] Twn. 20 Rng. -62

Name of Owner: JOHN SARA Assessors Parcel No: 25-04-03, 04, 805

Contact Person-Name: RAY NOVATNEY Telephone No: 456-6734

Firm: CONSULTING ENGR.

Address: 4782 S. MOJAVE RD., LAS VEGAS, NV 89121

1530

NOV 2 3 1994

Type of Land Development/Land Disturbance Process:

- ☐ Rezoning
- ☐ Parcel Map
- ☐ Large Parcel Map
- ☒ Subdivision Map
- ☐ Planned Unit Development
- ☐ Building Permit
- ☐ Clearing and Grading Only
- ☐ Other (Please specify below)

1. Total Owned Land Area: At Site: 12.7 AC Being Developed/Disturbed: 12.7 AC
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES* NO
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES* NO
4. Proposed type of development (Residential, Commercial, Etc.)? RESIDENTIAL
5. Approximate upstream land area which drains to the subject site? FOR. 1.9 MI²
6. Has the site drainage been evaluated in the past? YES NO. If yes, please identify documentation: UNKNOWN
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: N/A
8. Briefly describe your proposed schedule for the subject project: UNKNOWN

REGISTERED PROFESSIONAL ENGINEER — RAY NOVATNEY — CIVIL — No. 4028 — STATE OF NEVADA

Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

* Review and concurrence of the Clark County Regional Flood Control District is required.

Revision	Date

Local Entity File No.

REFERENCE: H.T.E. 94-25236

STANDARD FORM 1

Record of: **Meeting**

Date: January 9, 1996 - 3:00 PM

Location: City of Las Vegas

Project: 1996 Las Vegas Valley Master Plan Update
PBS&J Reference No. 51876.00

Subject: Discuss Detailed Work Plans

Prepared by: Virginia Valentine PBS&J

Attendees:

Kevin Eubanks	CCRFCD
Charlie Kajkowski	CLV
Randy Fultz	CLV
Chip Paulson	MW
Ken Gilbreth	VTN
Don Davis	PBS&J
Mark Sorensen	PBS&J
Virginia Valentine	PBS&J

Distribution:

Attendees	
Gale Fraser	CCRFCD
Project File - 51876	Meeting Minutes File

PURPOSE OF STUDY

THE SITE IS BORDERED ON THE EAST BY THE SLOAN FLOOD CONTROL CHANNEL AND ON THE NORTH BY STEWART STREET WHICH WOULD RECEIVE CONSIDERABLE RUNOFF FROM THE NORTH DURING A 100-YEAR STORM. THIS STUDY IS TO EVALUATE THE IMPACT THAT A 100-YEAR STORM RUNOFF WILL HAVE ON THE SITE.

THE SITE IS LOCATED IN ZONE "A", AN AREA DETERMINED TO BE WITHIN A 100-YEAR FLOOD PLAIN WITH NO BASE FLOOD ELEVATIONS DETERMINED, ACCORDING TO "FIRM" PANEL 320003-1250-B. A COPY OF THE PERTINENT AREA OF THIS PANEL IS SHOWN ON PAGE A-2.

SITE CHARACTERISTICS

THE SITE IS LOCATED IN THE NORTHEAST QUARTER OF THE SOUTHEAST QUARTER OF SECTION 33, T20S, R62E, MDM IN CLARK COUNTY. IT IS BORDERED ON THE NORTH BY STEWART STREET AND ON THE EAST BY THE SLOAN CHANNEL. IT IS ABUTTED ON THE WEST AND SOUTH SIDES BY EXISTING RESIDENTIAL DEVELOPMENT. THE SITE CONTAINS 12.7 ACRES AND INCLUDES ASSESSORS PARCEL NUMBERS 25-04-03, 25-04-04, AND 25-04-05. THE ASSESSORS PARCEL MAP IS SHOWN ON PAGE A-1.

THERE IS AN EXISTING WASH TRAVERSING DIAGONALLY ACROSS THE SITE FROM ITS NORTHWEST TO SOUTHEAST CORNERS. THE WASH DOES NOT APPEAR TO BE IN ITS NATURAL POSITION, BUT HAS MIGRATED EASTERLY DUE TO DEVELOPMENT ON THE NORTH, EAST, AND SOUTH SIDES OF THE SITE. THIS WASH CARRIES A SUBSTANTIAL AMOUNT OF RUNOFF FROM BATTLE MOUNTAIN DRIVE AT ITS INTERSECTION WITH STEWART TOGETHER WITH FLOW FROM THE WEST ON STEWART. BATTLE MOUNTAIN INTERSECTS STEWART AT ABOUT THE WEST QUARTER POINT OF THE SITE. THE ORIGIONAL AND PRESENT LOCATION OF THE WASH IS SHOWN ON EXHIBIT "A" IN THIS REPORT. OTHER THAN THE WASH, ONSITE GRADES ARE ON A RELATIVELY LEVEL PLANE.

THE SITE IS PROPOSED TO BE A RESIDENTIAL SUBDIVISION WITH ONSITE PRIVATE STREETS AND WILL BE ACCESSED FROM STEWART STREET.

SLOAN CHANNEL

A PREDESIGN DRAINAGE ANALYSIS AND IMPROVEMENT PLANS FOR THE SLOAN CHANNEL FROM OWENS AVENUE TO LAS VEGAS WASH HAVE BEEN COMPLETED BY G.C.WALLACE, INC. AND APPROVED BY CLARK COUNTY. UPON COMPLETION OF THE CHANNEL IMPROVEMENTS, THE 100-YEAR FLOW IN THE CHANNEL WILL BE 3300 CFS AT STEWART.

PRESENTLY, THE "FIS" RATES CHANNEL FLOW FOR A 100-YEAR STORM FROM 5200 CFS AT OWENS AVENUE TO 6000 CFS AT VEGAS VALLEY DRIVE. A LINEAR ADJUSTMENT WAS MADE ON PAGE B-3 TO OBTAIN A CHANNEL FLOW OF 5500 CFS AT STEWART.

A WATER SURFACE PROFILE FOR THE CHANNEL WAS DONE ON PAGES B-1 TO B-23 FOR THE 5500 CFS AND 3300 CFS FLOWS WITH SECTION 8 BEING THE SOUTH RIGHT OF WAY OF STEWART AND SECTION 2 BEING NEAR THE SOUTH-EAST CORNER OF THE SITE. STATION LOCATIONS ARE SHOWN ON PAGE B-1 AND BASE FLOOD ELEVATIONS ARE AS FOLLOWS FOR THE TWO FLOWS:

SECNO	5500 CFS	3300 CFS
1	1738.2	1735.8
2	1738.7	1737.1
3	1738.8	1737.0
4	1740.1	1738.3
5	1740.5	1738.5
6	1740.5	1738.3
7	1741.9	1739.8
8	1741.9	1739.8
9	1741.8	1739.8
10	1741.1	1739.2

GRADING PLAN ELEVATIONS WILL BE PRESENTLY BASED ON THE BFE'S FOR THE 5500 CFS. HOWEVER, IF CHANNEL CONSTRUCTION IS COMPLETED NORTH OF STEWART PRIOR TO THE DEVELOPMENT OF THE SITE, GRADES ALONG THE CHANNEL MAY BE LOWERED TO CONFORM TO THE BFE'S FOR 3300 CFS.

OFFSITE DRAINAGE AREAS

THE OFFSITE DRAINAGE AREAS, DA 1, DA 2, DA 3, DA 4, AND DA 5 ARE SHOWN ON PAGE C-1. CALCULATIONS FOR THE PEAK RAINFALL RUNOFF FROM A 100-YEAR STORM ARE MADE AN PAGES C-2 THROUGH C-16. SPLIT FLOWS FOR THE INTERSECTIONS OF STEWART/CHRISTY, STEWART/UNGER, STEWART/LINN, AND BATTLE MOUNTAIN/LINN TOGETHER WITH THE FLOOD ROUTING OF DA 3/DA 4 AND DA 3/DA 4/DA 5 ARE MADE ON PAGES C-17 TO C-55 WITH A FLOW SUMMARY DEPICTED ON PAGE C56.

THE PARAMETERS OF DA 1 AND DA 2 ARE AS FOLLOWS:

DA	AREA	CN	Q	T	PEAK RUNOFF
1	4.8 AC	72	0.81"	0.27 HR	4 CFS
2	70.9 AC	72	0.81"	0.50 HR	41 CFS

DA 1 IS CONTAINED BY AN EXISTING STORM DRAIN SYSTEM IN LAKE MEAD DRAINING TO THE SLOAN CHANNEL AND DOES NOT IMPACT THE SITE. DA 2 IS PARTIALLY CONTAINED BY AN EXISTING STORM DRAIN SYSTEM IN LAKE MEAD AND CONTRIBUTES AN OVERFLOW OF 9 CFS TO DA 3.

THE PARAMETERS OF DA 3, DA 4, AND DA 5 ARE AS FOLLOWS:

DA	BA	LS	PB	UD	PEAK RUNOFF
2	1.27 MI^2	72	2.74"	0.94 HR	326 CFS
4	0.54 MI^2	74	2.80"	0.73 HR	193 CFS
5	0.09 MI^2	75	2.86"	0.26 HR	67 CFS

5 0.09 MI² 75 2.86" 0.26 HR 67 CFS

THE SUM OF THE DA 3, DA 4, AND DA 5 RUNOFF OF 595 CFS (UNROUTED) COMPARES FAVORABLY TO THE G.C.WALLACE PREDESIGN ANALYSIS FOR THE SLOAN CHANNEL OF 579 CFS FLOWING IN STEWART AT THE SLOAN CHANNEL FROM A 100-YEAR STORM. IN THE WALLACE REPORT, THE ENTIRE FLOW WAS ASSUMED TO REMAIN IN STEWART. IN THIS REPORT, SPLIT FLOWS DRAINING SOUTH ON STREETS INTERSECTING STEWART WAS CONSIDERED. THESE FLOW LOSSES ARE AS FOLLOWS:

SOUTH ON CHRISTY = 173 CFS
SOUTH ON UNGER = 50 CFS
SOUTH ON LINN = 65 CFS

FLOWS FROM DA 3, DA 4, AND DA 5 WERE ROUTED BY THE MUSKINGUM METHOD, SUBTRACTING THE FLOWS LOST TO INTERSECTING STREETS, TO PRODUCE THE FOLLOWING FLOWS IN STEWART ADJACENT TO THE SITE:

WEST OF BATTLE MOUNTAIN = 80 CFS
AT BATTLE MOUNTAIN = 217 CFS
AT SEARCHLIGHT = 242 CFS

A STORM DRAIN SYSTEM, SHOWN ON PAGE D-1, WAS DESIGNED ON PAGES D-2 THROUGH D-12 TO CONVEY THE ABOVE FLOWS TO THE SLOAN CHANNEL. WITH CONSIDERATION TO THE EXISTING STORM DRAIN SYSTEM AND GUTTER FLOW ON THE NORTH SIDE OF STEWART AND EXISTING DRAIN INLETS ON THE SOUTH SIDE OF STEWART AT THE SLOAN CHANNEL, THE PROPOSED SYSTEM WILL ELIMINATE RUNOFF FROM THE SOUTH SIDE OF STEWART.

GUTTER DEPTHS AND DEPTH/VELOCITY RATIOS FROM A 100-YEAR STORM IN THE SOUTH SIDE OF STEWART ARE AS FOLLOWS:

	DEPTH	d/v
WEST OF THE SITE	1.1	2.7
WEST OF BATTLE MOUNTAIN	0.9	1.7
EAST OF BATTLE MOUNTAIN	0.8	1.9

ONSITE DRAINAGE

THE ONSITE DRAINAGE AREAS ARE SHOWN ON PAGE E-1 WITH PEAK RUNOFF VALUES FOR 10-, 25-, AND 100-YEAR STORMS DETERMINED ON PAGES E-2 THROUGH E-6. GUTTER FLOW DEPTH ARE DETERMINED ON PAGES E-7 TO E-24 AND THE ONSITE PRIVATE STORM DRAIN IS OUTLINED ON E-25.

THE ONSITE STREET FLOWS AND GUTTER FLOW DEPTHS ARE AS FOLLOWS:

DA	Q-10	Q-25	Q-100
01	2.2 CFS	3.6 CFS	5.8 CFS
02	0.7 CFS	1.1 CFS	1.8 CFS
03	1.5 CFS	2.4 CFS	3.9 CFS

DA	Q-10	Q-25	Q-100
01	0.33'	0.37'	0.42'
02	0.25'	0.28'	0.31'
03	0.30'	0.34'	0.38'

ALL GUTTER DEPTH FLOWS ARE BELOW TOP OF CURB ELEVATION.

THE ONSITE PRIVATE STORM DRAIN ALONG THE SOUTH SIDE OF THE SITE IS AS FOLLOWS:

DA	SIZE TYPE "A" DI	SIZE & GRADE OF DRAIN
01	6.5' OPENING	18" RCP @ 0.3%
02	2.0' OPENING	18" RCP @ 0.5%
03	4.5' OPENING	21" RCP @ 0.5%

FUTURE CCRFCD FACILITIES

FUTURE CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT PROPOSED IMPROVEMENTS IN THE VICINITY OF THE SITE ARE SHOWN ON PAGE F-15. THEY ARE THE IMPROVEMENT OF THE SLOAN CHANNEL AND CONSTRUCTION OF THE RANGE WASH DETENTION BASIN REDUCING THE FLOW IN THE CHANNEL ADJACENT TO THE SITE TO 2030 CFS.

SOIL PERMIABILITY

THE HYDROLOGIC SOIL GROUP (HSG) USED IN THE RAINFALL RUNOFF CALCULATIONS WAS TAKEN FROM CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT VOLUME 2 UPDATE, AUGUST 1991. THE AREA OF CONCERN IS SHOWN ON PAGE H-15.

PRECIPITATION

PRECIPITATION AMOUNTS USED IN THE RAINFALL RUNOFF CALCULATIONS ARE VALUES TAKEN FROM NOAA ATLAS II (NEVADA) FOR A 6-HOUR OR 24-HOUR DURATION STORM.

CALCULATION METHOD

THE METHOD USED TO DETERMINE THE PEAK RAINFALL RUNOFF VALUES FOR SMALL DRAINAGE AREAS IS AS OUTLINED IN USDA, SOIL CONSEVATION SERVICE TECHNICAL RELEASE 55 DATED JUNE 1986: "URBAN HYDROLOGY FOR SMALL WATERSHEDS" USING A TYPE II RAINFALL DISTRIBUTION.

THE METHOD USED TO DETERMINE THE PEAK RAINFALL RUNOFF VALUES FOR LARGE DRAINAGE AREAS IS THE US ARMY CORPS OF ENGINEERS HEC-1 COMPUTER PROGRAM UPDATED AUGUST 1988.

THE METHOD USED TO DETERMINE THE WATER SURFACE PROFILE, MUSKINGUM ROUTING, AND SPLIT FLOWWS IS THE US ARMY CORPS OF ENGINEERS HEC-2 COMPUTER PROGRAM UPDATED SEPTEMBER 1989.

SUPPORTING DATA INDEX

ITEM	PAGE
ASSESSORS MAP	A- 1
FLOOD INSURANCE RATE MAP	A- 2
SLOAN CHANNEL SECTIONS	B- 1
SLOAN CHANNEL WATER SURFACE PROFILE, 5500 CFS	B- 2 TO B-13
SLOAN CHANNEL WATER SURFACE PROFILE, 3300 CFS	B-14 TO B-23
OFFSITE DRAINAGE AREA MAP	C- 1
OFFSITE DRAINAGE AREA RUNOFF CALCULATIONS	C- 2 TO C-16
SPLIT FLOW - STEWART TO CHRISTY AND UNGER	C-17 TO C-28
SPLIT FLOW - AT BATTLE MOUNTAIN AND LINN	C-29 TO C-37
MUSKINGUM ROUTE DA 3/DA 4	C-38 TO C-41
SPLIT FLOW - STEWART TO LINN	C-42 TO C-50
MUSKINGUM ROUTE DA 3/DA 4/DA 5	C-51 TO C-55
SPLIT FLOW AND ROUTING SUMMARY	C-56
STORM DRAIN MAP	D- 1
STORM DRAIN AND GUTTER FLOW CALCULATIONS	D- 2 TO D-12
ONSITE DRAINAGE AREA MAP	E- 1
ONSITE DRAINAGE AREA RUNOFF CALCULATIONS	E- 2 TO E- 6
ONSITE GUTTER DEPTH CALCULATIONS	E- 7 TO E-24
ONSITE PRIVATE STORM DRAIN CALCULATIONS	E-25
PROPOSED CCRFCD FACILITIES	F-15
CCRFCD HYDROLOGIC SOILS GROUPS	H-15

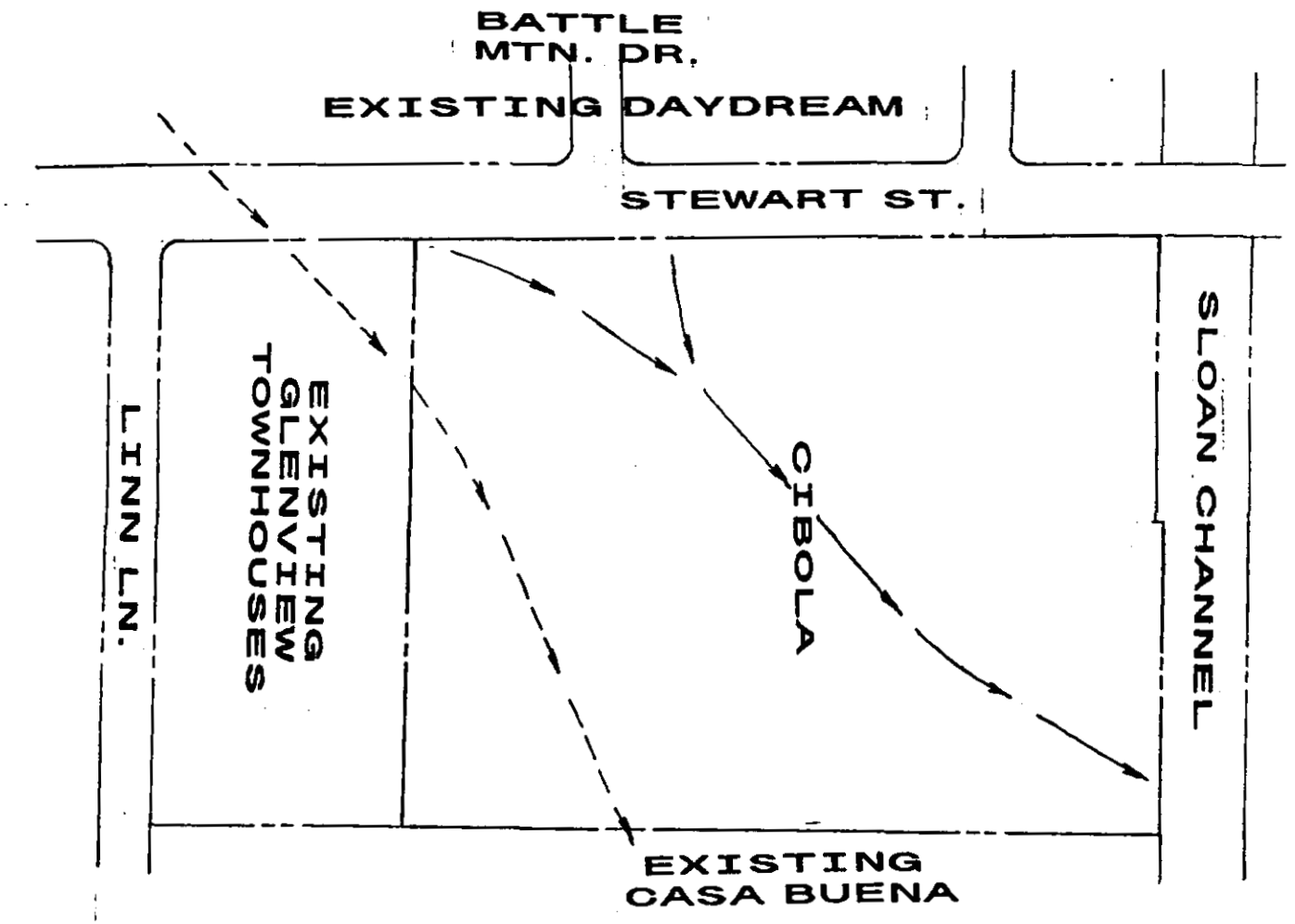


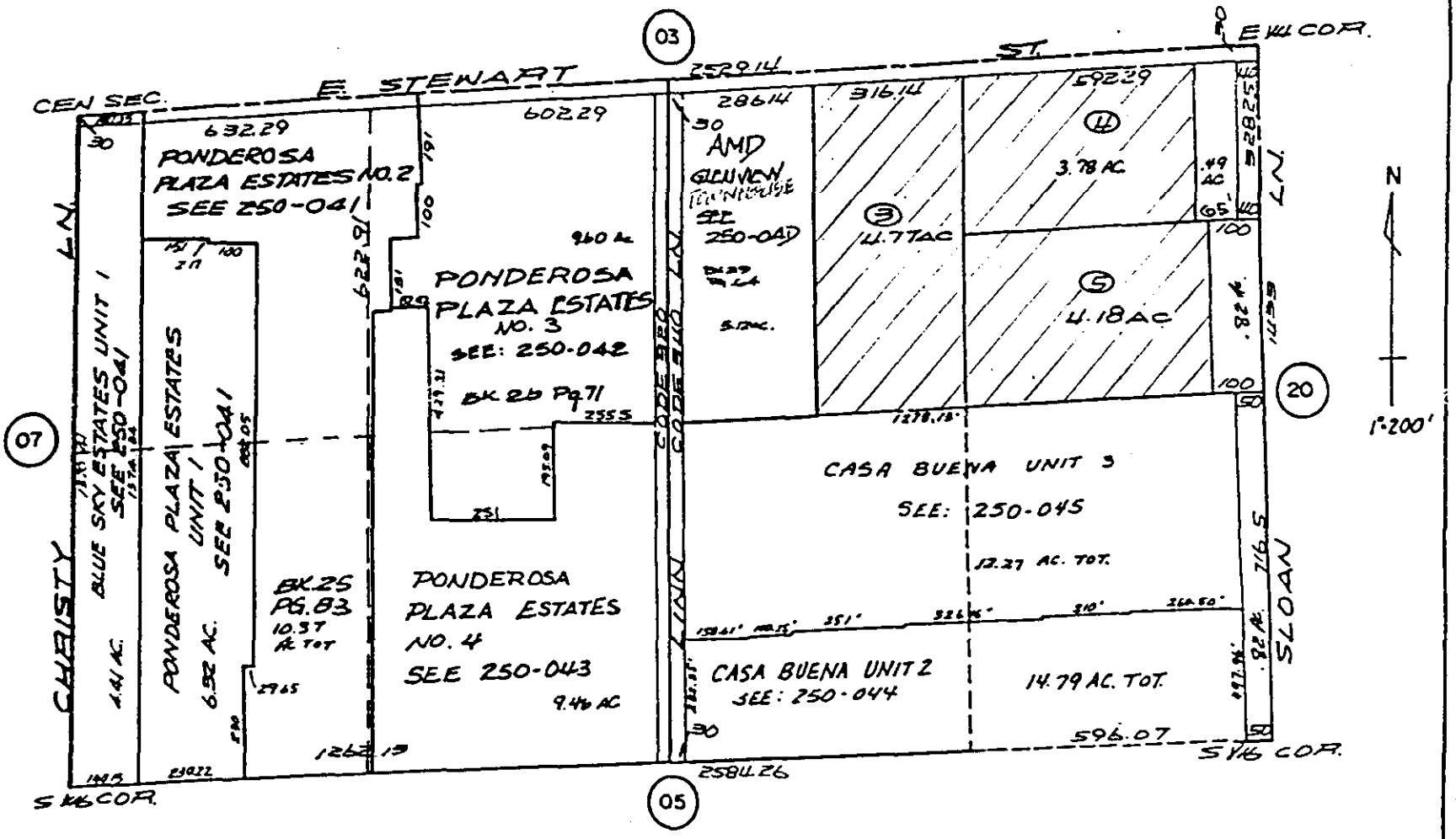
EXHIBIT 'A'

① NATURAL CHANNEL LOCATION ON USGS "LAS VEGAS NE, NEV" QUADRANGLE, 1967 PHOTOREVISED 1973.

② NATURAL CHANNEL LOCATION ON MONTGOMERY TOPOGRAPHY FOR "EASTERN RANGE WASH" 1984.

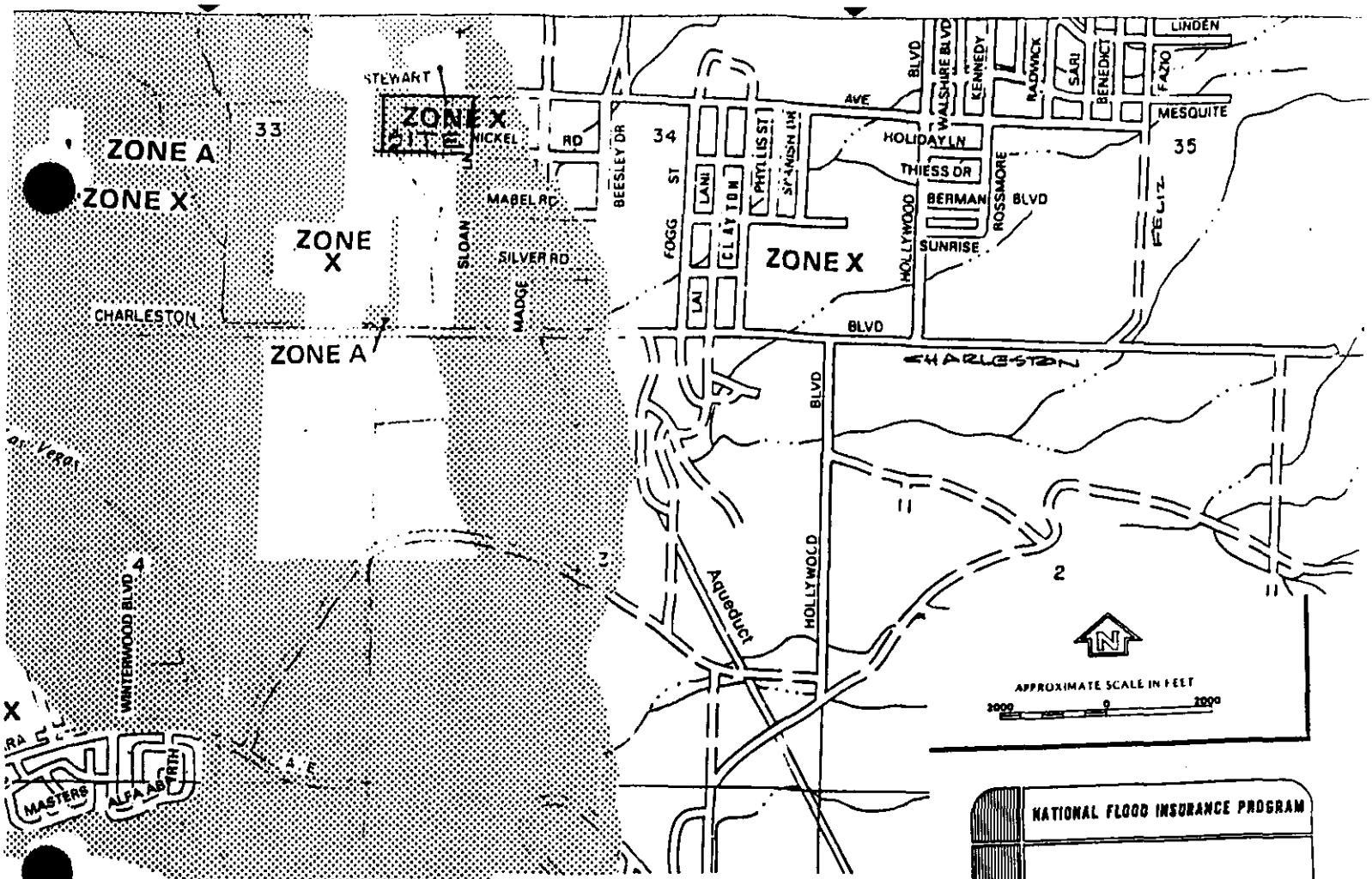
N2 SE4 SEC. 33 T-20S R-62E

25-04



340

A-1



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** — No base flood elevations determined.
- **ZONE AE** — Base flood elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** — To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
- **ZONE V** — Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** — Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** — Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside 500-year flood plain.
- **ZONE D** — Areas in which flood hazards are undetermined.

- Flood Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones
- 513 — Base Flood Elevation Line; Elevation in Feet*
- D — D — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone*
- RM7x — Elevation Reference Mark

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA
(UNINCORPORATED AREAS)

PANEL 1250 OF 2035
(SEE MAP INDEX FOR PANELS NOT PRINTED)

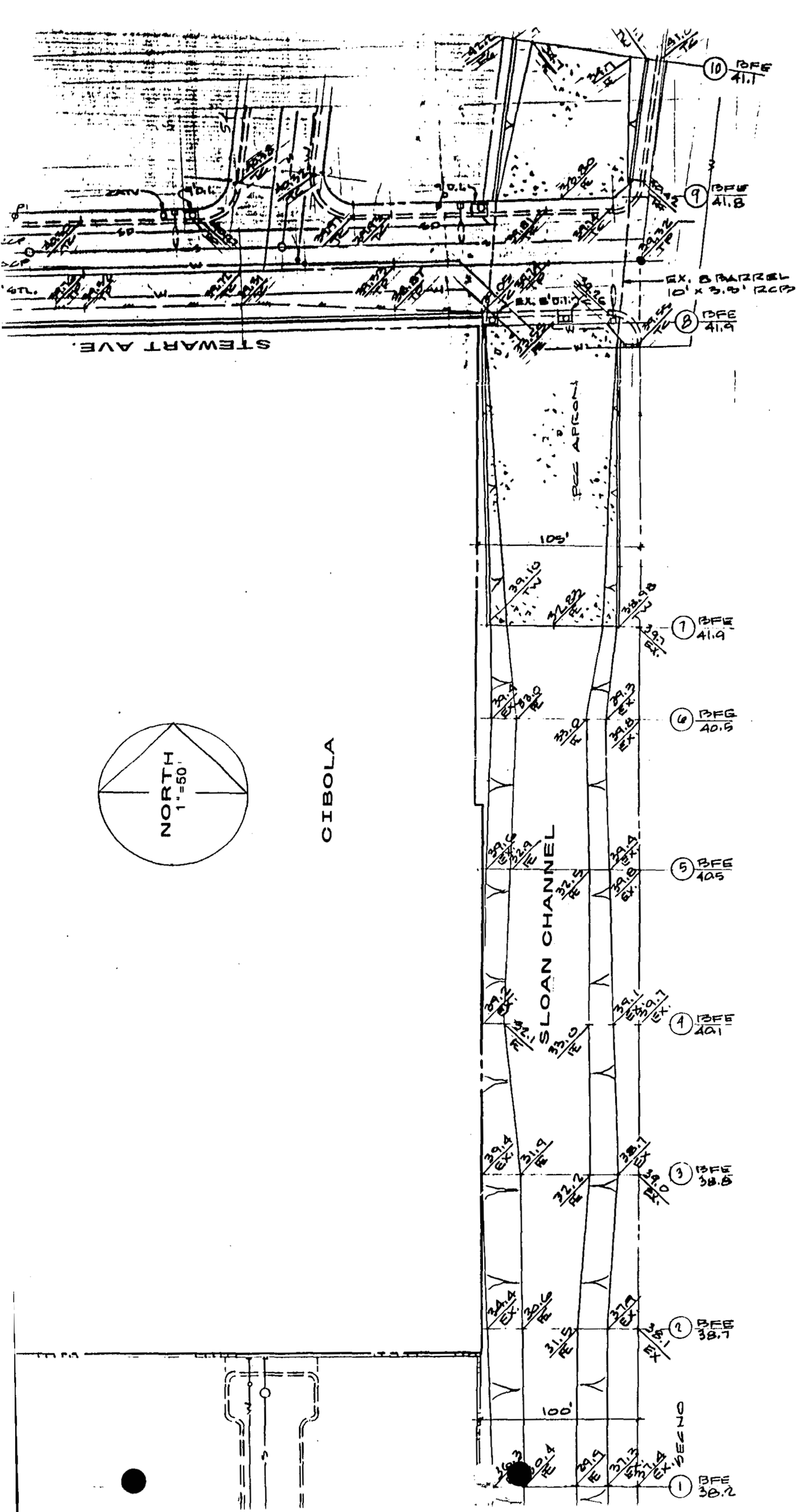
PANEL LOCATION

COMMUNITY-PANEL NUMBER
320003 1250 B

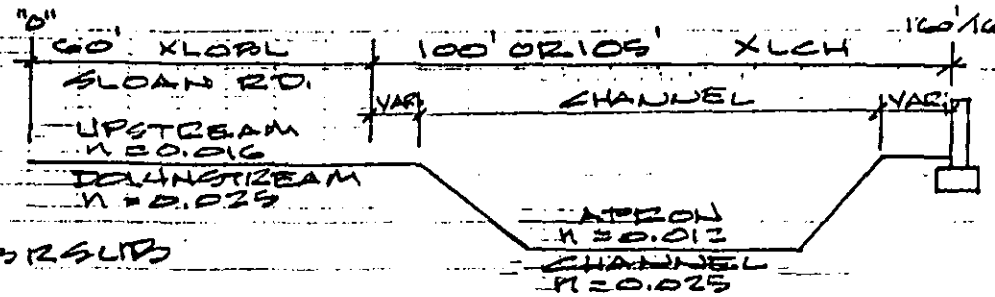
EFFECTIVE DATE:
SEPTEMBER 29, 1989

Federal Emergency Management Agency

A-2


SLOAN CHANNEL SECTIONS
B-1
STEWART AVE.
CIBOLA
SLOAN CHANNEL
NORTH
1"=50'
EX. 8 BARREL
10' x 5.5' RCB
RCC APRON
105'
100'
10 BFE 41.1
9 BFE 41.8
8 BFE 41.9
7 BFE 41.9
6 BFE 40.5
5 BFE 40.5
4 BFE 40.1
3 BFE 38.8
2 BFE 38.7
1 BFE 38.2

SLOAN CHANNEL WATER SURFACE PROFILE



NC 0.025 0.025 0.025 0.1 0.3

1 37.4/0 37.4/60 (37.3/79) 29.9/100 30.4/133
(36.3/153) 36.3/160

100'

2 38.1/0 38.1/60 (37.9/78) 31.5/98 30.6/134
(34.4/156) 37.9/160

100'

3 39.0/0 39.0/60 (38.7/72) 32.2/90 31.9/134
(39.4/160)

100'

4 39.7/0 39.7/60 (39.1/76) 33.0/90 32.1/146
(39.2/160)

100'

5 39.8/0 39.8/60 (39.4/77) 32.5/92 32.9/143
(39.6/160)

100'

6 39.8/0 39.8/60 (39.3/80) 33.0/92 33.0/137
(39.4/155) 39.4/165

60'

NC 0.025 0.025 0.012 0.1 0.3

7 39.7/0 39.7/60 (39.0/72) 32.8/81 32.8/149
(39.1/158) 39.1/165

200'

8 39.4/0 39.4/60 (39.5/73) 33.5/73 33.5/157
(39.5/157) 39.5/165

X2 0 0 1 37.3 39.8 0 0 1.33 0 0

SB 0.9 1.56 2.6 165 83.5 3.5 280 0 0 0

80'

NC 0.016 0.025 0.012 0.1 0.3

9 40.0/0 40.0/60 (40.1/73) 33.8/73 33.8/157
(40.1/157) 40.1/165

100'

10 41.0/0 41.0/60 (41.1/73) 34.7/82 34.7/48
(41.1/157) 42.2/165

100-YR. PEAK FLOW

REF: FIS RANCHO WASH TABLE 2-3

NODE "S" = 5200 CFS (CHANNEL @ OWENS)
NODE "CC" = 6000 CFS (" @ VEGAS VAL.)

OWENS TO VEGAS VALLEY = 3.5 MI.
OWENS TO STEWART = 1.5 MI.

FLOW @ STEWART = $5200 + \left(\frac{1.5}{3.5} \times 800\right) = 5500$ CFS

FUTURE FLOW @ STEWART = 3300 CFS

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

```
*****************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
*****************************************************
FR
T1 SLOAN CHANNEL SOUTH OF STEWART
T2 SUBCRITICAL (UPSTREAM RUN)
T3 SCBRSUB (RN)
J1   ICHECK      INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
        0        0         0         0         0.01        0         0       5500      38.0        0
J2   NPROF      IPLOT     PRFVS     XSECV     XSECH      FN        ALLDC     IBV       CHNIM     ITRACE
       -1        0         0         0         0          0         0         0         0         0

NC    0.025     0.025     0.025      0.1       0.3
X1        1         7        79      153         0         0         0         0         0         0
GR     37.4         0      37.4       60     37.30        79      29.9       100      30.4       133
GR     36.3       153      36.3      160

X1        2         7        78      156       100       100       100         0         0         0
GR     38.1         0      38.1       60     37.9         78      31.5        98      30.6       134
GR     34.4       156      37.9      160

X1        3         6        72      160       100       100       100         0         0         0
GR     39.0         0      39.0       60     38.7         72      32.2        90      31.9       134
GR     39.4       160

X1        4         6        76      160       100       100       100         0         0         0
GR     39.7         0      39.7       60     39.1         76      33.0        90      32.1       146
GR     39.2       160

X1        5         6        77      160       100       100       100         0         0         0
GR     39.0         0      39.8       60     39.4         77      32.5        92      32.9       143
GR     39.6       160

X1        6         7        80      155        60        60        60         0         0         0
GR     39.8         0      39.8       60     39.3         80      33.0        92      33.0       137
GR     39.4       155      39.4      165

NC    0.025     0.025     0.012      0.1       0.3
X1        7         7        72      158       200       200       200         0         0         0
GR     39.7         0      39.7       60     39.0         72      32.8        81      32.8       149
GR     39.1       158      39.1      165

X1        8         7        73      157        80        80        80         0         0         0
GR     39.4         0      39.4       60     39.5         73      33.5        73      33.5       157
GR     39.5       157      39.5      165
X2        0         0         1     37.3      39.8         0         0      1.33         0         0

SB      0.9      1.56       2.6      165      83.5       3.5       280         0         0         0
X1        9         7        73      157       100       100       100         0         0         0
GR     40.0         0      40.0       60     40.1         73      33.8        73      33.8       157
GR     40.1       157      40.1      165

X1       10         7        73      157       100       100       100         0         0         0
GR     41.1         0      41.0       60     41.1         73      34.7        82      34.7       148
GR     41.1       157      42.2      165
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1.000
3280 CROSS SECTION 1.00 EXTENDED 1.90 FEET
3720 CRITICAL DEPTH ASSUMED

1.000	8.30	38.20	38.20	38.00	40.14	1.94	.00	.00	37.30
5500.	193.	5247.	60.	64.	460.	13.	0.	0.	36.30
.00	2.99	11.42	4.51	.025	.025	.025	.000	29.90	.00
.003356	0.	0.	0.	0	5	0	.00	160.00	160.00

A/T = 6.7
F_R = 0.7

*SECNO 2.000
3280 CROSS SECTION 2.00 EXTENDED .76 FEET

2.000	8.06	38.66	38.05	.00	40.47	1.81	.32	.01	37.90
5500.	104.	5351.	46.	46.	489.	10.	1.	0.	34.40
.00	2.27	10.95	4.55	.025	.025	.025	.000	30.60	.00
.003003	100.	100.	100.	4	8	0	.00	160.00	160.00

A/T = 6.3
F_R = 0.6

*SECNO 3.000
3301 HV CHANGED MORE THAN HVINS
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3.000	6.89	38.79	38.79	.00	41.23	2.44	.39	.19	38.70
5500.	0.	5500.	0.	0.	439.	0.	2.	1.	39.40
.00	.54	12.53	.00	.025	.025	.000	.000	31.90	68.42
.005214	100.	100.	100.	4	9	0	.00	89.47	157.88

A/T = 5.0
F_R = 1.0

*SECNO 4.000
3280 CROSS SECTION 4.00 EXTENDED .95 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.46

4.000	8.05	40.15	.00	.00	41.66	1.51	.34	.09	39.10
5500.	76.	5424.	0.	39.	546.	0.	4.	1.	39.20
.01	1.94	9.93	.00	.025	.025	.000	.000	32.10	.00
.002447	100.	100.	100.	3	0	0	.00	160.00	160.00

A/T = 6.5
F_R = 0.5

*SECNO 5.000
3280 CROSS SECTION 5.00 EXTENDED 1.48 FEET

5.000	7.98	40.48	.00	.00	41.91	1.44	.24	.01	39.40
5500.	234.	5266.	0.	79.	536.	0.	5.	1.	39.60
.01	2.94	9.82	.00	.025	.025	.000	.000	32.50	.00
.002402	100.	100.	100.	2	0	0	.00	160.00	160.00

A/T = 6.5
F_R = 0.5

*SECNO 6.000
3280 CROSS SECTION 6.00 EXTENDED 1.07 FEET
3301 HV CHANGED MORE THAN HVINS
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6.000	7.47	40.47	40.47	.00	42.42	1.95	.17	.15	39.30
5500.	166.	5298.	36.	59.	465.	11.	6.	2.	39.40
.01	2.83	11.40	3.38	.025	.025	.025	.000	33.00	.00
.003382	60.	60.	60.	3	11	0	.00	165.00	165.00

A/T = 6.2
F_R = 0.7

*SECNO 7.000
3280 CROSS SECTION 7.00 EXTENDED 2.76 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 3.99

7.000	9.06	41.86	.00	.00	42.64	.78	.11	.12	39.00
5500.	232.	5241.	26.	160.	723.	19.	9.	2.	39.10
.02	1.45	7.25	1.37	.025	.012	.025	.000	32.80	.00
.000212	200.	200.	200.	3	0	0	.00	165.00	165.00

A/T = 8.4
F_R = 0.2

```
*SECNO 8.000
3280 CROSS SECTION      8.00 EXTENDED      2.47 FEET
    8.000     8.37    41.87      .00      .00    42.67      .79      .02      .00    39.50
    5500.      300.    5174.     27.      179.     703.     19.      11.      3.     39.50
      .02     1.67     7.36     1.40     .025     .012     .025     .000    33.50     .00
  .000249      80.      80.      80.       2        0        0       .00    165.00   165.00

SPECIAL BRIDGE
5070, VARIABLE ELCHU OR ELCHD ON SB CARD NOT SPECIFIED
SB   XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
      .90      1.56      2.60      165.00    83.50     3.50      280.00      .00     33.50     33.50

*SECNO 9.000
3280 CROSS SECTION      9.00 EXTENDED      1.81 FEET
    9.000     8.01    41.81      .00      .00    42.73      .92      .03      .04    40.10
    5500.      198.    5284.     18.      132.     673.     14.      13.      3.     40.10
      .03     1.51     7.85     1.30     .025     .012     .025     .000    33.80     .00
  .000302      100.     100.     100.      2        0        0       .00    165.00   165.00

*SECNO 10.000
3265 DIVIDED FLOW
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =    .58
   10.000     6.36    41.06    40.43      .00    43.13     2.07      .05      .34    41.10
    5500.       0.    5500.      0.       1.     476.      0.       14.      3.     41.10
      .03      .17    11.54      .00     .025     .012     .000     .000    34.70    25.38
  .000913      100.     100.     100.      6        15       0       .00    126.00   156.94

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    30.        32.        34.        36.        38.        40.        42.        44.        46.        48.
    SECNO   CUMDIS
    1.00      0.  I          .          .          .  R    L  .W        .E         .          .          .          .          .
             10.  I          .          .          .R M    L  .CW       .E         .          .          .          .          .
             20.  .I         .          .          R    M    L .CW       . E        .          .          .          .          .
             30.  .I         .          .          R.   M    L .CW       . E        .          .          .          .          .
             40.  .I         .          .          R .    M   L .CW       . E        .          .          .          .          .
             50.  . I        .          .          R  .     M  L.C W      . E        .          .          .          .          .
             60.  . I        .          .          R  .      M L.C W      . E        .          .          .          .          .
             70.  . I        .          .          R  .       ML.C W      . E        .          .          .          .          .
             80.  .  I       .          .          R  .       ML.C W      .  E       .          .          .          .          .
             90.  .  I       .          .          R  .        MLC  W     .  E       .          .          .          .          .
    2.00    100.  .   I      .          .          R  .        LC   W     .  E       .          .          .          .          .
            110.  .   I      .          .            R .       LC   W     .  E       .          .          .          .          .
            120.  .    I     .          .              R .     .C   W     .   E      .          .          .          .          .
            130.  .    I     .          .                R     .LC  W     .   E      .          .          .          .          .
            140.  .     I    .          .                  R   . C  W     .   E      .          .          .          .          .
            150.  .      I   .          .                    R . LCW     .    E     .          .          .          .          .
            160.  .      I   .          .                      R LCW     .    E     .          .          .          .          .
            170.  .       I  .          .                        R CW     .     E    .          .          .          .          .
            180.  .        I.  .        .                         LW      .     E    .          .          .          .          .
            190.  .        I.  .        .                         VR      .     E    .          .          .          .          .
    3.00    200.  .         I  .        .                         W M R   .      E   .          .          .          .          .
            210.  .         I  .      C .                         LWMR    .      E   .          .          .          .          .
            220.  .     C   I  .        .                         L WR    .      E   .          .          .          .          .
            230.  C         I  .        .                         LWR     .       E  .          .          .          .          .
            240.  C         I  .        .                         LMW     .       E  .          .          .          .          .
            250.  C         I  .        .                         LMRW    .       E  .          .          .          .          .
            260.  C         .I .        .                         LMR W.  .       E  .          .          .          .          .
            270.  C         .I .        .                         LMR W.  .       E  .          .          .          .          .
            280.  C         .I .        .                           LR  W .       E  .          .          .          .          .
            290.  C         .I .        .                           LR  .W        E. .          .          .          .          .
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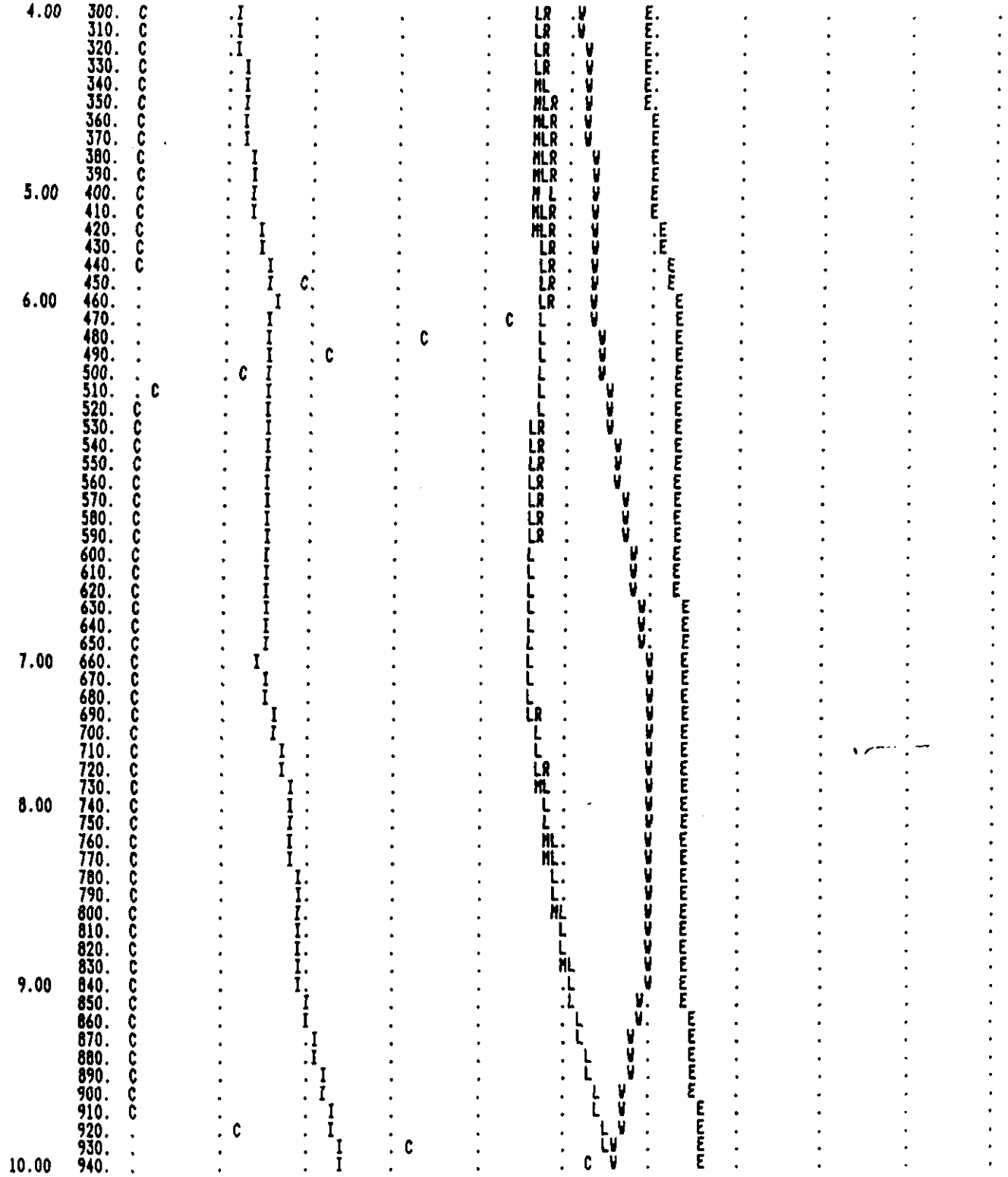
B-6



NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	29.90	5500.00	38.20	38.20	40.14	33.56	11.42	537.38	949.3
	2.000	100.00	.00	.00	30.60	5500.00	38.66	38.05	40.47	30.03	10.95	544.42	1003.7
*	3.000	100.00	.00	.00	31.90	5500.00	38.79	38.79	41.23	52.14	12.53	439.09	761.7
*	4.000	100.00	.00	.00	32.10	5500.00	40.15	.00	41.66	24.47	9.93	585.06	1111.8
	5.000	100.00	.00	.00	32.50	5500.00	40.48	.00	41.91	24.02	9.82	615.73	1122.2
*	6.000	60.00	.00	.00	33.00	5500.00	40.47	40.47	42.42	33.82	11.40	534.20	945.8
*	7.000	200.00	.00	.00	32.80	5500.00	41.86	.00	42.64	2.12	7.25	902.65	3773.3
	8.000	80.00	.00	.00	33.50	5500.00	41.87	.00	42.67	2.49	7.36	901.19	3488.4
	9.000	100.00	.00	.00	33.80	5500.00	41.81	.00	42.73	3.02	7.85	818.14	3163.7
*	10.000	100.00	.00	.00	34.70	5500.00	41.06	40.43	43.13	9.13	11.54	477.66	1820.1

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1.000	5500.00	38.20	.00	.00	.20	160.00	.00
	2.000	5500.00	38.66	.00	.45	.00	160.00	100.00
*	3.000	5500.00	38.79	.00	.13	.00	89.47	100.00
*	4.000	5500.00	40.15	.00	1.36	.00	160.00	100.00
	5.000	5500.00	40.48	.00	.32	.00	160.00	100.00
*	6.000	5500.00	40.47	.00	-.00	.00	165.00	60.00
*	7.000	5500.00	41.86	.00	1.39	.00	165.00	200.00
	8.000	5500.00	41.87	.00	.01	.00	165.00	80.00
	9.000	5500.00	41.81	.00	-.06	.00	165.00	100.00
*	10.000	5500.00	41.06	.00	-.75	.00	126.00	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
WARNING SECNO= 7.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 10.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

```
X    X  XXXXXXX   XXXXX            XXXXX
X    X  X        X     X          X     X
X    X  X        X                      X
XXXXXXX  XXXX    X          XXXXX   XXXXX
X    X  X        X                X
X    X  X        X     X          X
X    X  XXXXXXX   XXXXX            XXXXXXX
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HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
ERROR CORR - 01,02,03
MODIFICATION -

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FR
T1 SLOAN CHANNEL SOUTH OF STEWART
T2 SUPERCRITICAL (DOWNSTREAM RUN)
T3 SCBRSUP (RN)
J1   ICHECK      INQ       NINV      IDIR      STRT      METRIC     HVINS      Q         WSEL      FQ
        0          0         0         1      0.01           0         0      5500      41.0         0
J2   NPROF      IPLOT     PRFVS     XSECV     XSECH        FN      ALLDC      IBW      CHNIM     ITRACE
       -1           0         0         0         0         0          0        0          0          0

NC    0.016      0.025     0.012       0.1       0.3
X1       10          7        73       157       100       100       100         0          0          0
GR     41.0          0      41.0        60      41.1        73      34.7        82       34.7        148
GR     41.1        157      42.2       165

X1        9          7        73       157        80        80        80         0          0          0
GR     40.0          0      40.0        60      40.1        73      33.8        73       33.8        157
GR     40.1        157      40.1       165
X2        0          0         1      37.3      39.8         0         0      1.33          0          0

SB      0.9       1.56       2.6       165      83.5       3.5       280         0          0          0
NC    0.025      0.025      0.12       0.1       0.3
X1        8          7        73       157       200       200       200         0          0          0
GR     39.4          0      39.4        60      39.5        73      33.5        73       33.5        157
GR     39.5        157      39.5       165

NC    0.025      0.025     0.025       0.1       0.3
X1        7          7        72       158        60        60        60         0          0          0
GR     39.7          0      39.7        60      39.0        72      32.8        81       32.8        147
GR     39.1        158      39.1       165

X1        6          7        80       155       100       100       100         0          0          0
GR     39.8          0      39.8        60      39.3        80      33.0        92       33.0        137
GR     39.4        155      39.4       165

X1        5          6        77       160       100       100       100         0          0          0
GR     39.8          0      39.8        60      39.4        77      32.5        92       32.9        143
GR     39.6        160

X1        4          6        76       160       100       100       100         0          0          0
GR     39.7          0      39.7        60      39.1        76      33.0        90       32.1        146
GR     39.2        160

X1        3          6        72       160       100       100       100         0          0          0
GR     39.0          0      39.0        60      38.7        72      32.2        90       31.9        134
GR     39.4        160

X1        2          7        78       156       100       100       100         0          0          0
GR     38.1          0      38.1        60      37.9        78      31.5        98       30.6        134
GR     34.4        156      37.9       160

X1        1          7        79       153         0         0         0         0          0          0
GR     37.4          0      37.4        60      37.3        79      29.9       100       30.4        133
GR     36.3        153      36.3       160
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WIN       ELMIN      SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST

*SECNO 10.000
   10.000      3.13     37.83     40.47     41.00     47.52      9.69       .00       .00     41.10
    5500.        0.      5500.        0.        0.     220.        0.        0.        0.     41.10
     .00        .00     24.98       .00      .000      .012      .000      .000     34.70     77.60
 .009992         0.        0.        0.         0        10         5       .00     74.80    152.40

*SECNO 9.000
    9.000      2.58     36.38     38.89       .00     46.36      9.98      1.13       .03     40.10
    5500.        0.      5500.        0.        0.      217.        0.        1.        0.     40.10
     .00        .00     25.35       .00      .000      .012      .000      .000     33.80     73.00
 .012807        100.      100.      100.        13        14         0       .00     84.00    157.00

SPECIAL BRIDGE
5070, VARIABLE ELCHU OR ELCHD ON SB CARD NOT SPECIFIED
SB  XK        XKOR      COFQ      RDLEN     BVC       BVP       BAREA     SS        ELCHU     ELCHD
      .90      1.56      2.60    165.00      83.50      3.50    280.00       .00     33.80     33.80

*SECNO 8.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  5.22
    8.000      3.86     37.36     38.60       .00     41.82      4.47      2.89      1.65     39.50
    5500.        0.      5500.        0.        0.      324.        0.        1.        0.     39.50
     .00        .00     16.96       .00      .000      .120      .000      .000     33.50     73.00
 .348342         80.       80.       80.         2        14         0       .00     84.00    157.00

*SECNO 7.000
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    7.000      5.71     38.51     38.51       .00     41.06      2.55      3.52      3.36     39.00
    5500.        0.      5500.        0.        0.      429.        0.        3.        1.     39.10
     .01        .00     12.81       .00      .000      .025      .000      .000     32.80     72.71
 .005582         200.      200.      200.        20        11         0       .00     84.27    156.97

*SECNO 6.000
3280 CROSS SECTION      6.00 EXTENDED      1.08 FEET
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    6.000      7.48     40.48     40.48       .00     42.42      1.94       .26       .52     39.30
    5500.       167.      5296.       36.       59.      465.       11.        3.        1.     39.40
     .01        2.84     11.38      3.38      .025      .025      .025      .000     33.00       .00
 .003371         60.       60.       60.        20        15         0       .00    165.00    165.00

*SECNO 5.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.47
    5.000      6.13     38.63     39.15       .00     41.81      3.19       .48       .12     39.40
    5500.        0.      5500.        0.        0.      384.        0.        4.        1.     39.60
     .01        .00     14.33       .00      .000      .025      .000      .000     32.50     78.71
 .007332         100.      100.      100.         4         9         0       .00     78.80    157.50
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*SECNO 4.000
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    4.000     6.59    38.69    38.69      .00    41.31     2.62      .64      .16    39.10
    5500.       0.     5500.      0.       0.     424.       0.       5.       1.     39.20
      .01       .00    12.98      .00      .000   .025      .000     .000   32.10    76.94
  .005585     100.     100.     100.       20       8         0      .00   82.05   158.99

*SECNO 3.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    3.000     6.74    38.64    38.64      .00    41.23     2.58      .56      .05    38.70
    5500.       0.     5500.      0.       0.     427.       0.       6.       2.     39.40
      .01       .00    12.89      .00      .000   .025      .000     .000   31.90    72.15
  .005677     100.     100.     100.       20       11        0      .00   85.23   157.38

*SECNO 2.000
3301 HV CHANGED MORE THAN HVINS
    2.000     6.57    37.17    37.67      .00    40.50     3.33      .65      .08    37.90
    5500.       0.     5477.     23.       0.     373.       4.       7.       2.     34.40
      .02       .00    14.68     5.26      .000   .025      .025     .000   30.60    80.29
  .007433     100.     100.     100.       4        11        0      .00   78.87   159.16

*SECNO 1.000
3280 CROSS SECTION      1.00 EXTENDED      1.86 FEET
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    1.000     8.26    38.16    38.16      .00    40.14     1.98      .49      .26    37.30
    5500.     180.     5261.     59.      61.     457.      13.       8.       2.     36.30
      .02     2.93     11.52     4.52     .025    .025      .025     .000   29.90      .00
  .003448     100.     100.     100.       20       11        0      .00  160.00   160.00

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    30.        32.        34.        36.        38.        40.        42.        44.        46.        48.
    SECNO   CUMDIS
    10.00     0.
              10.
              20.
              30.
              40.
              50.
              60.
              70.
              80.
              90.
     9.00    100.
             110.
             120.
             130.
             140.
             150.
             160.
             170.
     8.00    180.
             190.
             200.
             210.
             220.
             230.
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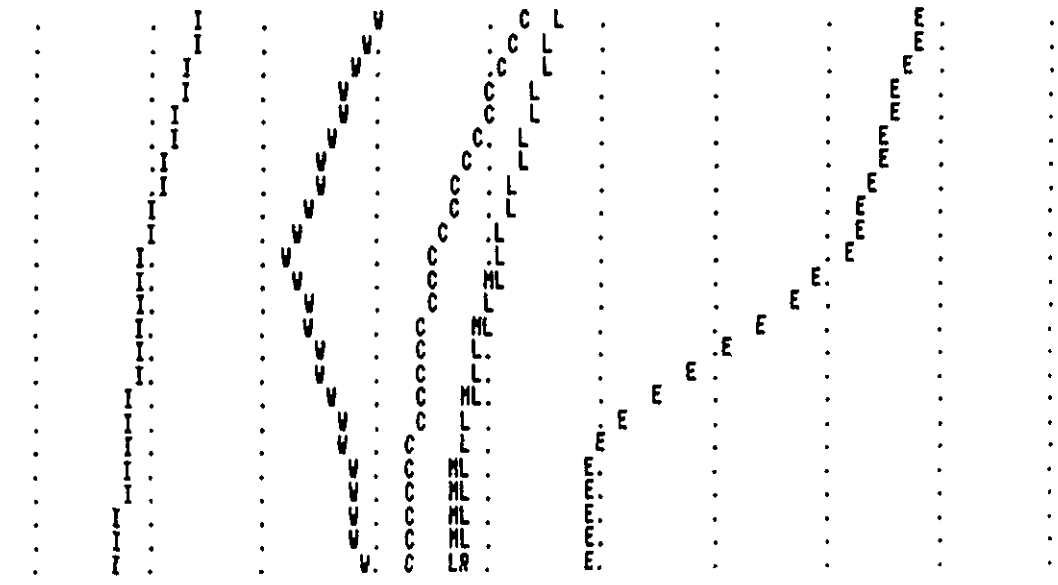

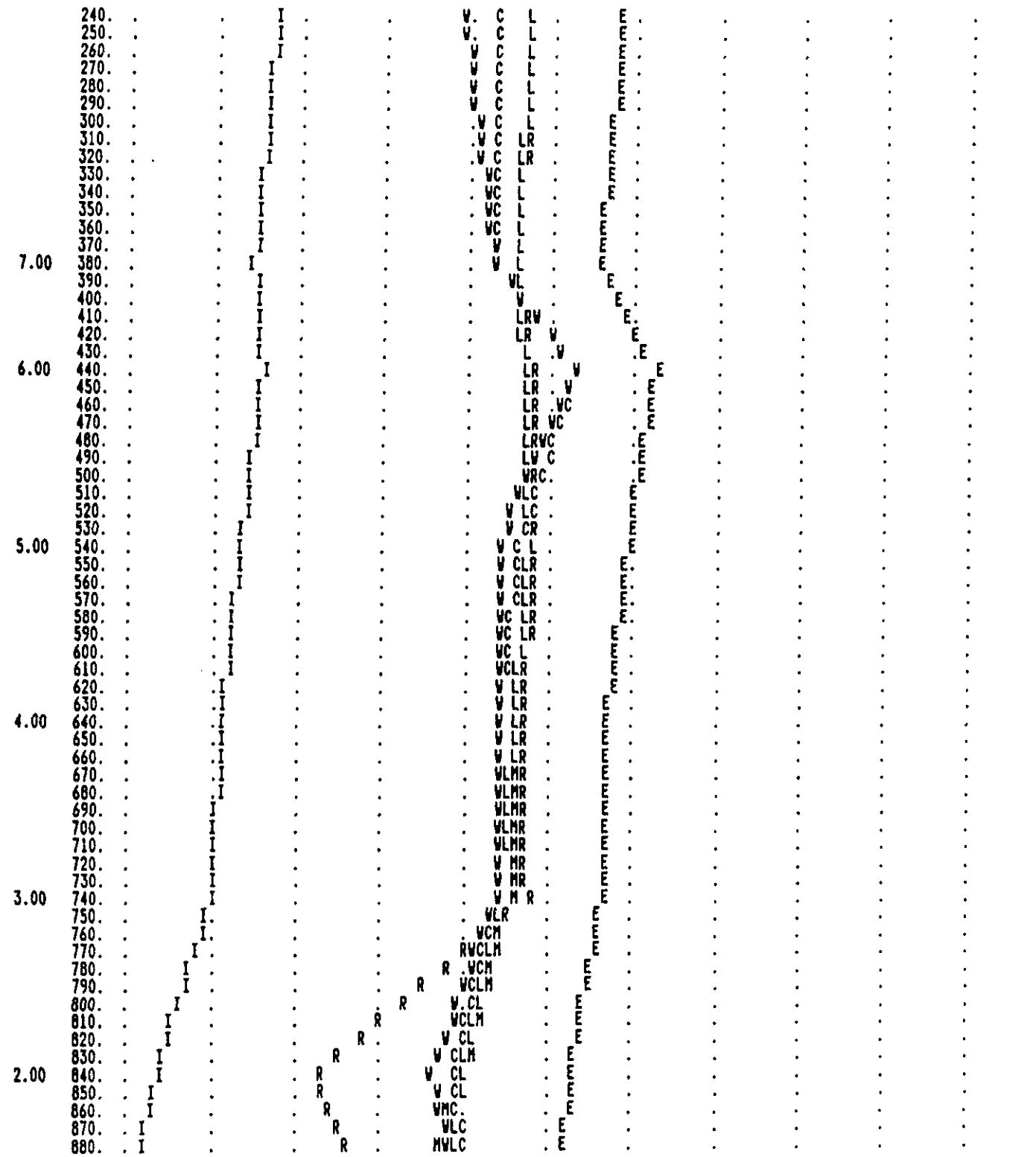

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          890.  . I        .        .      R  .      M  WC        . E        .        .        .        .        .
          900.  .I         .        .       R .      M  LWC       . E        .        .        .        .        .
          910.  .I         .        .        R.    M    L WC      . E        .        .        .        .        .
          920.  .I         .        .         R    M    L WC      . E        .        .        .        .        .
          930.  I          .        .        .R M    L   .W       .E         .        .        .        .        .
     1.00 940.  I          .        .        . R     L   .W       .E         .        .        .        .        .
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	10.000	.00	.00	.00	34.70	5500.00	37.83	40.47	47.52	99.92	24.98	220.16	550.2
	9.000	100.00	.00	.00	33.80	5500.00	36.38	38.89	46.36	128.07	25.35	216.95	486.0
*	8.000	80.00	.00	.00	33.50	5500.00	37.36	38.60	41.82	3483.42	16.96	324.26	93.1
*	7.000	200.00	.00	.00	32.80	5500.00	38.51	38.51	41.06	55.82	12.81	429.19	736.1
*	6.000	60.00	.00	.00	33.00	5500.00	40.48	40.48	42.42	33.71	11.38	535.00	947.3
*	5.000	100.00	.00	.00	32.50	5500.00	38.63	39.15	41.81	73.32	14.33	383.77	642.2
*	4.000	100.00	.00	.00	32.10	5500.00	38.69	38.69	41.31	55.85	12.98	423.69	735.9
*	3.000	100.00	.00	.00	31.90	5500.00	38.64	38.64	41.23	56.77	12.89	426.54	729.9
	2.000	100.00	.00	.00	30.60	5500.00	37.17	37.67	40.50	74.33	14.68	377.42	637.9
*	1.000	100.00	.00	.00	29.90	5500.00	38.16	38.16	40.14	34.48	11.52	530.95	936.6

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	10.000	5500.00	37.83	.00	.00	-3.17	74.80	.00
	9.000	5500.00	36.38	.00	-1.45	.00	84.00	100.00
*	8.000	5500.00	37.36	.00	.97	.00	84.00	80.00
*	7.000	5500.00	38.51	.00	1.16	.00	84.27	200.00
*	6.000	5500.00	40.48	.00	1.96	.00	165.00	60.00
*	5.000	5500.00	38.63	.00	-1.85	.00	78.80	100.00
*	4.000	5500.00	38.69	.00	.06	.00	82.05	100.00
*	3.000	5500.00	38.64	.00	-.04	.00	85.23	100.00
	2.000	5500.00	37.17	.00	-1.48	.00	78.87	100.00
*	1.000	5500.00	38.16	.00	.99	.00	160.00	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO= 8.000  PROFILE= 1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 7.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 7.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 6.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 6.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO= 5.000  PROFILE= 1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 4.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 3.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 1.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 1.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X         X     X          X     X
X     X  X         X                      X
XXXXXXX  XXXX      X          XXXXX    XXXXX
X     X  X         X                 X
X     X  X         X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX
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**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************
FR
T1 SLOAN CHANNEL SOUTH OF STEWART
T2 SUBCRITICAL (UPSTREAM RUN)
T3 SCBRSUBA (RN)
J1   ICHECK      INQ       NINV      IDIR      STRT      METRIC     HVINS      Q          WSEL       FQ
        0          0         0         0      0.01           0         0      3300       33.0        0
J2   NPROF      IPLOT     PRFVS     XSECV     XSECH      FN        ALLDC      IBW        CHNIM      ITRACE
       -1          0         0         0         0          0         0          0          0          0

NC    0.025     0.025     0.025       0.1       0.3
X1        1         7        79       153         0          0          0          0          0          0
GR     37.4         0      37.4        60     37.30         79       29.9        100       30.4        133
GR     36.3       153      36.3       160

X1        2         7        78       156       100        100        100          0          0          0
GR     38.1         0      38.1        60      37.9         78       31.5         98       30.6        134
GR     34.4       156      37.9       160

X1        3         6        72       160       100        100        100          0          0          0
GR     39.0         0      39.0        60      38.7         72       32.2         90       31.9        134
GR     39.4       160

X1        4         6        76       160       100        100        100          0          0          0
GR     39.7         0      39.7        60      39.1         76       33.0         90       32.1        146
GR     39.2       160

X1        5         6        77       160       100        100        100          0          0          0
GR     39.0         0      39.8        60      39.4         77       32.5         92       32.9        143
GR     39.6       160

X1        6         7        80       155         60         60         60          0          0          0
GR     39.8         0      39.8        60      39.3         80       33.0         92       33.0        137
GR     39.4       155      39.4       165

NC    0.025     0.025     0.012       0.1       0.3
X1        7         7        72       158       200        200        200          0          0          0
GR     39.7         0      39.7        60      39.0         72       32.8         81       32.8        149
GR     39.1       158      39.1       165

X1        8         7        73       157         80         80         80          0          0          0
GR     39.4         0      39.4        60      39.5         73       33.5         73       33.5        157
GR     39.5       157      39.5       165
X2        0         0         1      37.3      39.8          0          0       1.33          0          0

SB      0.9      1.56       2.6       165      83.5        3.5        280          0          0          0
X1        9         7        73       157       100        100        100          0          0          0
GR     40.0         0      40.0        60      40.1         73       33.8         73       33.8        157
GR     40.1       157      40.1       165

X1       10         7        73       157       100        100        100          0          0          0
GR     41.1         0      41.0        60      41.1         73       34.7         82       34.7        148
GR     41.1       157      42.2       165
```

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        QLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTH       ELMIN      SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST

*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED
    1.000     5.88     35.78     35.78     33.00     37.88      2.09       .00       .00     37.30
    3300.       0.     3300.       0.        0.      284.        0.        0.        0.      36.30
      .00       .00     11.61       .00       .000      .025       .000      .000    29.90     83.30
  .005866       0.        0.        0.         0        14         0       .00     67.94    151.25

*SECNO 2.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.47
    2.000     6.53     37.13       .00       .00     38.35      1.22       .39       .09     37.90
    3300.       0.     3286.      14.        0.      371.        4.        1.        0.      34.40
      .00       .00      8.87      3.17      .000      .025       .025      .000    30.60     80.40
  .002732     100.      100.      100.         4         0          0       .00     78.73    159.12

*SECNO 3.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .69
    3.000     5.13     37.03     36.96       .00     38.94      1.91       .38       .21     38.70
    3300.       0.     3300.       0.        0.      297.        0.        2.        0.      39.40
      .01       .00     11.10       .00       .000      .025       .000      .000    31.90     76.62
  .005732     100.      100.      100.         6        15          0       .00     75.18    151.80

*SECNO 4.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.50
    4.000     6.18     38.28       .00       .00     39.39      1.11       .37       .08     39.10
    3300.       0.     3300.       0.        0.      391.        0.        2.        1.      39.20
      .01       .00      8.45       .00       .000      .025       .000      .000    32.10     77.88
  .002554     100.      100.      100.         4         0          0       .00     80.32    158.19

*SECNO 5.000
    5.000     5.98     38.48       .00       .00     39.69      1.21       .27       .03     39.40
    3300.       0.     3300.       0.        0.      373.        0.        3.        1.      39.60
      .01       .00      8.84       .00       .000      .025       .000      .000    32.50     79.00
  .002862     100.      100.      100.         2         0          0       .00     78.17    157.16

*SECNO 6.000
3301 HV CHANGED MORE THAN HVINS
    6.000     5.25     38.25       .00       .00     40.11      1.86       .22       .20     39.30
    3300.       0.     3300.       0.        0.      301.        0.        4.        1.      39.40
      .01       .00     10.96       .00       .000      .025       .000      .000    33.00     82.00
  .005039      60.       60.       60.         3         0          0       .00     69.76    151.76

*SECNO 7.000
3280 CROSS SECTION      7.00 EXTENDED       .69 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  4.84
    7.000     6.99     39.79       .00       .00     40.36       .57       .12       .13     39.00
    3300.       4.     3293.       3.       11.      545.        5.        6.        1.      39.10
      .02       .34      6.04       .64       .025      .012       .025      .000    32.80      .00
  .000215     200.      200.      200.         3         0          0       .00    165.00    165.00

*SECNO 8.000
3280 CROSS SECTION      8.00 EXTENDED       .38 FEET
    8.000     6.29     39.79       .00       .00     40.39       .60       .02       .01     39.50
    3300.      14.     3286.       1.       27.      528.        2.        7.        2.      39.50
      .03       .50      6.23       .40       .025      .012       .025      .000    33.50      .00
  .000261      80.       80.       80.         2         0          0       .00    165.00    165.00
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SPECIAL BRIDGE
5070, VARIABLE ELCHU OR ELCHD ON SB CARD NOT SPECIFIED
SB  XK        XKOR       COFQ       RDLEN      BWC        BWP        BAREA      SS         ELCHU      ELCHD
      .90       1.56       2.60     165.00      83.50       3.50     280.00        .00      33.50      33.50

*SECNO 9.000
    9.000      5.97      39.77        .00        .00      40.44        .67        .03        .02      40.10
    3300.        0.       3300.        0.         0.       501.         0.         8.         2.       40.10
      .03        .00       6.58        .00       .000       .012       .000       .000      33.80      73.00
  .000312      100.       100.       100.          2          0          0        .00      84.00     157.00

*SECNO 10.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .53
   10.000      4.45      39.15        .00        .00      40.78       1.63        .05        .29      41.10
    3300.        0.       3300.        0.         0.       322.         0.         9.         2.       41.10
      .03        .00      10.26        .00       .000       .012       .000       .000      34.70      75.74
  .001098      100.       100.       100.          3          0          0        .00      78.52     154.26

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    30.        32.        34.        36.        38.        40.        42.        44.        46.        48.
    SECNO   CUMDIS
     1.00       0.  I          .          .          .        W. R    L  E          .          .          .          .          .          .
               10.  I          . C        .          .         WR M   L  E          .          .          .          .          .          .
               20.  CI         .          .          .         RW  M   L E          .          .          .          .          .          .
               30.  CI         .          .          .        R.W  M   L .E         .          .          .          .          .          .
               40.  CI         .          .          .      R . W  M  L .E         .          .          .          .          .          .
               50.  C I        .          .          .     R   . W  M  L.E         .          .          .          .          .          .
               60.  C I        .          .          .    R    . W   M L.E         .          .          .          .          .          .
               70.  C I        .          .          .   R     . W    ML. E         .          .          .          .          .          .
               80.  C  I       .          .          .  R      . W    ML. E         .          .          .          .          .          .
               90.  C  I       .          .          . R       . W    ML E          .          .          .          .          .          .
     2.00     100.  C   I      .          .          . R       .  W    L E          .          .          .          .          .          .
              110.  C   I      .          .          .  R      .  W    LM E         .          .          .          .          .          .
              120.  C    I     .          .          .   R     .  W    .L E         .          .          .          .          .          .
              130.  C    I     .          .          .    R    .  W    .LME         .          .          .          .          .          .
              140.  C     I    .          .          .     R   .  W    . LE         .          .          .          .          .          .
              150.  C      I   .          .          .      R  .  W    . LME        .          .          .          .          .          .
              160.  C      I   .          .          .       . W R  . LME         .          .          .          .          .          .
              170.  C       I  .          .          .       . W    R  LE         .          .          .          .          .          .
              180.  C        I.          .          .       . W    .  LME        .          .          .          .          .          .
              190.  .        I.          C          .       . W    .   LE        .          .          .          .          .          .
     3.00     200.  .        I           .          .       . CW   .   LEM R     .          .          .          .          .          .
              210.  .        I           C          .       . W    .   LEMR      .          .          .          .          .          .
              220.  C        I           .          .       .  W   .   L ER      .          .          .          .          .          .
              230.  C        I           .          .       .   W  .    LER      .          .          .          .          .          .
              240.  C        I           .          .       .   W  .    LER      .          .          .          .          .          .
              250.  C        I           .          .       .    W.     LER      .          .          .          .          .          .
              260.  C        .I          .          .       .    W.     LME      .          .          .          .          .          .
              270.  C        .I          .          .       .     W     LME      .          .          .          .          .          .
              280.  C        .I          .          .       .      W    LE       .          .          .          .          .          .
              290.  C        .I          .          .       .      W    LE       .          .          .          .          .          .
     4.00     300.  C        .I          .          .       .       W   LE       .          .          .          .          .          .
              310.  C        .I          .          .       .       W   LRE      .          .          .          .          .          .
              320.  C        .I          .          .       .       W   LRE      .          .          .          .          .          .
              330.  C        . I         .          .       .       W   LRE      .          .          .          .          .          .
              340.  C        . I         .          .       .       W   MLE      .          .          .          .          .          .
              350.  C        . I         .          .       .       W   MLE      .          .          .          .          .          .
              360.  C        . I         .          .       .       W   MLE      .          .          .          .          .          .
              370.  C        . I         .          .       .        W  MLE      .          .          .          .          .          .
              380.  C        .  I        .          .       .        W  MLRE.    .          .          .          .          .          .
              390.  C        .  I        .          .       .        W  MLRE.    .          .          .          .          .          .
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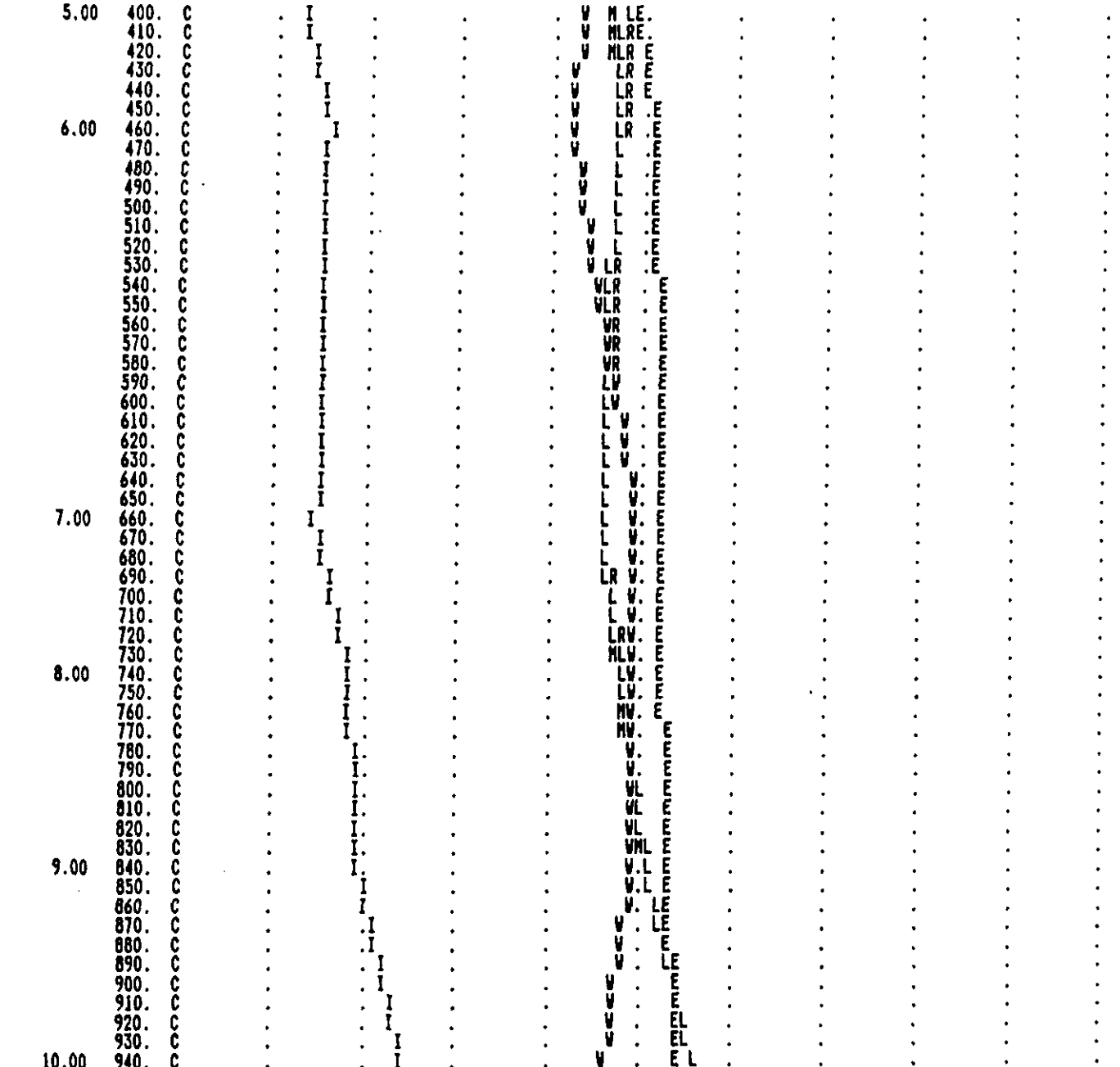

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	29.90	3300.00	35.78	35.78	37.88	58.66	11.61	284.13	430.8
*	2.000	100.00	.00	.00	30.60	3300.00	37.13	.00	38.35	27.32	8.87	374.79	631.3
*	3.000	100.00	.00	.00	31.90	3300.00	37.03	36.96	38.94	57.32	11.10	297.30	435.8
*	4.000	100.00	.00	.00	32.10	3300.00	38.28	.00	39.39	25.54	8.45	390.75	652.9
	5.000	100.00	.00	.00	32.50	3300.00	38.48	.00	39.69	28.62	8.84	373.29	616.8
	6.000	60.00	.00	.00	33.00	3300.00	38.25	.00	40.11	50.39	10.96	301.15	464.8

x	7.000	200.00	.00	.00	32.80	3300.00	39.79	.00	40.36	2.15	6.04	561.13	2250.
	8.000	80.00	.00	.00	33.50	3300.00	39.79	.00	40.39	2.61	6.23	557.14	2044.
	9.000	100.00	.00	.00	33.80	3300.00	39.77	.00	40.44	3.12	6.58	501.17	1868.
x	10.000	100.00	.00	.00	34.70	3300.00	39.15	.00	40.78	10.98	10.26	321.61	995.

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
x	1.000	3300.00	35.78	.00	.00	2.78	67.94	.00
x	2.000	3300.00	37.13	.00	1.35	.00	78.73	100.00
x	3.000	3300.00	37.03	.00	-.10	.00	75.18	100.00
x	4.000	3300.00	38.28	.00	1.25	.00	80.32	100.00
	5.000	3300.00	38.48	.00	.20	.00	78.17	100.00
	6.000	3300.00	38.25	.00	-.23	.00	69.76	60.00
x	7.000	3300.00	39.79	.00	1.55	.00	165.00	200.00
	8.000	3300.00	39.79	.00	-.01	.00	165.00	80.00
	9.000	3300.00	39.77	.00	-.02	.00	84.00	100.00
x	10.000	3300.00	39.15	.00	-.62	.00	78.52	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
WARNING SECNO= 2.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 3.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 7.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 10.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X           XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX
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**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************
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FR
T1 SLOAN CHANNEL SOUTH OF STEWART
T2 SUPERCRITICAL (DOWNSTREAM RUN)
T3 SCBRSUPA (RN)

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	0	0	1	0.01	0	0	3300	39.0	0
J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	-1	0	0	0	0	0	0	0	0	0

NC	0.016	0.025	0.012	0.1	0.3					
X1	10	7	73	157	100	100	100	0	0	0
GR	41.0	0	41.0	60	41.1	73	34.7	82	34.7	148
GR	41.1	157	42.2	165						
X1	9	7	73	157	80	80	80	0	0	0
GR	40.0	0	40.0	60	40.1	73	33.8	73	33.8	157
GR	40.1	157	40.1	165						
X2	0	0	1	37.3	39.8	0	0	1.33	0	0
SB	0.9	1.56	2.6	165	83.5	3.5	280	0	0	0
NC	0.025	0.025	0.12	0.1	0.3					
X1	8	7	73	157	200	200	200	0	0	0
GR	39.4	0	39.4	60	39.5	73	33.5	73	33.5	157
GR	39.5	157	39.5	165						
NC	0.025	0.025	0.025	0.1	0.3					
X1	7	7	72	158	60	60	60	0	0	0
GR	39.7	0	39.7	60	39.0	72	32.8	81	32.8	147
GR	39.1	158	39.1	165						
X1	6	7	80	155	100	100	100	0	0	0
GR	39.8	0	39.8	60	39.3	80	33.0	92	33.0	137
GR	39.4	155	39.4	165						
X1	5	6	77	160	100	100	100	0	0	0
GR	39.8	0	39.8	60	39.4	77	32.5	92	32.9	143
GR	39.6	160								
X1	4	6	76	160	100	100	100	0	0	0
GR	39.7	0	39.7	60	39.1	76	33.0	90	32.1	146
GR	39.2	160								
X1	3	6	72	160	100	100	100	0	0	0
GR	39.0	0	39.0	60	38.7	72	32.2	90	31.9	134
GR	39.4	160								
X1	2	7	78	156	100	100	100	0	0	0
GR	38.1	0	38.1	60	37.9	78	31.5	98	30.6	134
GR	34.4	156	37.9	160						
X1	1	7	79	153	0	0	0	0	0	0
GR	37.4	0	37.4	60	37.3	79	29.9	100	30.4	133
GR	36.3	153	36.3	160						

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TVA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 10.000

10.000	2.30	37.00	38.84	39.00	43.67	6.67	.00	.00	41.10
3300.	0.	3300.	0.	0.	159.	0.	0.	0.	41.10
.00	.00	20.72	.00	.000	.012	.000	.000	34.70	78.77
.010069	0.	0.	0.	0	8	2	.00	72.47	151.23

*SECNO 9.000

9.000	1.88	35.68	37.42	.00	42.51	6.83	1.15	.02	40.10
3300.	0.	3300.	0.	0.	157.	0.	0.	0.	40.10
.00	.00	20.97	.00	.000	.012	.000	.000	33.80	73.00
.013150	100.	100.	100.	9	14	0	.00	84.00	157.00

SPECIAL BRIDGE
5070, VARIABLE ELCHU OR ELCHD ON SB CARD NOT SPECIFIED

SB XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
.90	1.56	2.60	165.00	83.50	3.50	280.00	.00	33.80	33.80

*SECNO 8.000
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8.000	3.63	37.13	37.13	.00	38.95	1.82	2.52	1.58	39.50
3300.	0.	3300.	0.	0.	305.	0.	1.	0.	39.50
.00	.00	10.83	.00	.000	.120	.000	.000	33.50	73.00
.153308	80.	80.	80.	20	14	0	.00	84.00	157.00

*SECNO 7.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7.000	4.12	36.92	36.92	.00	38.81	1.90	3.40	2.75	39.00
3300.	0.	3300.	0.	0.	299.	0.	2.	1.	39.10
.01	.00	11.05	.00	.000	.025	.000	.000	32.80	75.03
.006118	200.	200.	200.	20	8	0	.00	79.16	154.19

*SECNO 6.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6.000	5.00	38.00	38.00	.00	40.10	2.10	.36	.28	39.30
3300.	0.	3300.	0.	0.	284.	0.	3.	1.	39.40
.01	.00	11.62	.00	.000	.025	.000	.000	33.00	82.48
.005983	60.	60.	60.	20	11	0	.00	68.59	151.06

*SECNO 5.000

5.000	4.63	37.13	37.39	.00	39.42	2.29	.66	.02	39.40
3300.	0.	3300.	0.	0.	272.	0.	3.	1.	39.60
.01	.00	12.14	.00	.000	.025	.000	.000	32.50	81.94
.007306	100.	100.	100.	5	8	0	.00	71.79	153.73

*SECNO 4.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

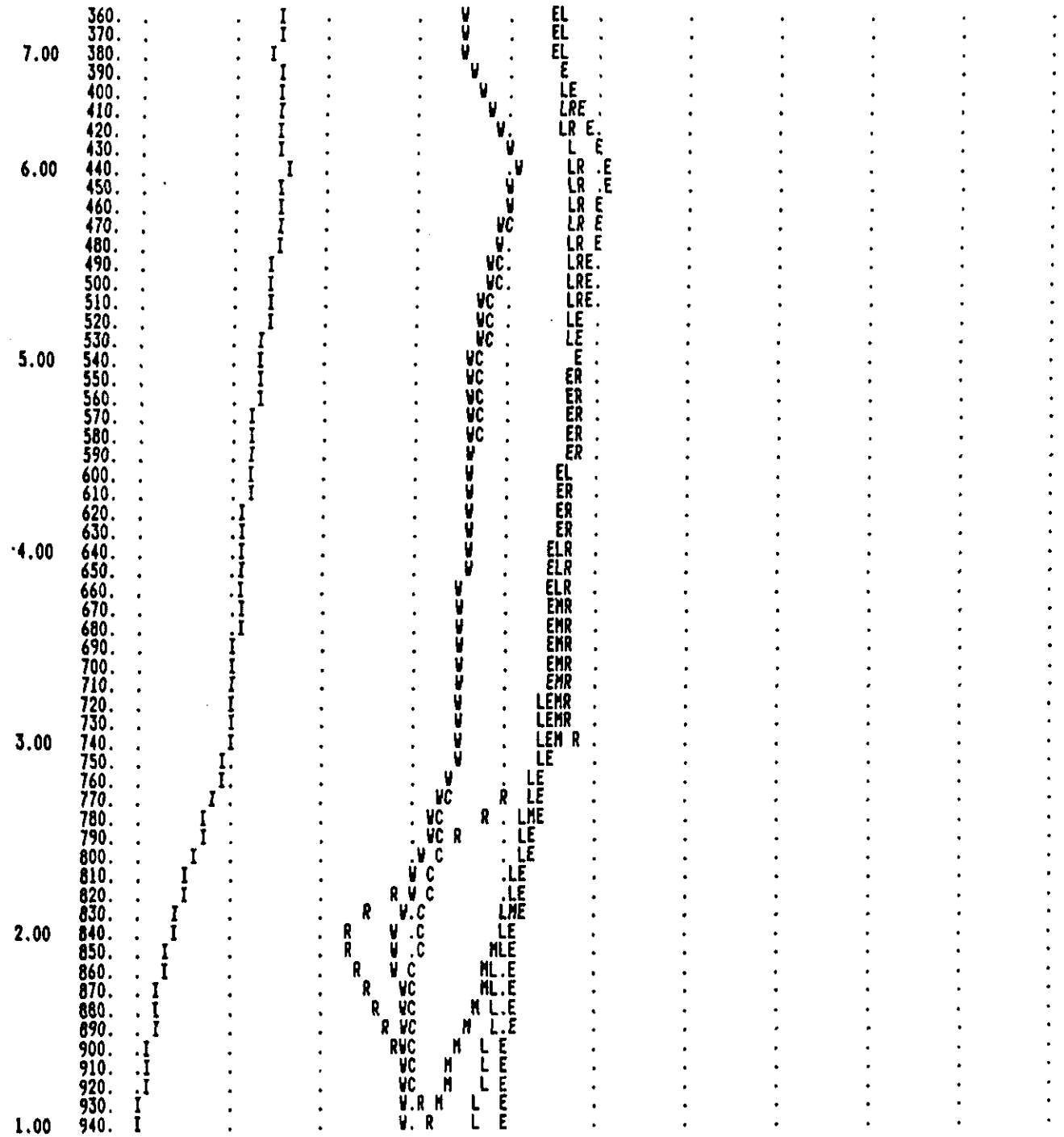
4.000	4.91	37.01	37.01	.00	38.99	1.98	.67	.08	39.10
3300.	0.	3300.	0.	0.	292.	0.	4.	1.	39.20
.01	.00	11.29	.00	.000	.025	.000	.000	32.10	80.79
.006084	100.	100.	100.	20	8	0	.00	74.90	155.69

```
*SECNO 3.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    3.000     5.06    36.96    36.96      .00    38.95     1.98      .61      .40    38.70
    3300.       0.     3300.      0.       0.     292.       0.       5.       1.     39.40
      .02      .00    11.30      .00     .000     .025     .000     .000    31.90    76.81
  .006030     100.     100.     100.       20        8        0      .00    74.75   151.56

*SECNO 2.000
3301 HV CHANGED MORE THAN HVINS
    2.000     4.95    35.55    36.03      .00    38.16     2.61      .72      .06    37.90
    3300.       0.     3298.      2.       0.     254.       1.       5.       1.     34.40
      .02      .00    12.96     3.18     .000     .025     .025     .000    30.60    85.36
  .008774     100.     100.     100.        4        8        0      .00    71.95   157.31

*SECNO 1.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    1.000     5.86    35.76    35.76      .00    37.88     2.12      .72      .45    37.30
    3300.       0.     3300.      0.       0.     283.       0.       6.       2.     36.30
      .02      .00    11.68      .00     .000     .025     .000     .000    29.90    83.37
  .005958     100.     100.     100.       20       11        0      .00    67.80   151.17

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    30.       32.       34.       36.       38.       40.       42.       44.       46.       48.
   SECNO   CUMDIS
   10.00      0.  .         .         .  I      .      W  .      C  .      L  .         E.        .         .
              10.  .         .         .  I      .     W   .     C   .     L   .        E  .         .         .
              20.  .         .         .  I      .     W   .     C   .     L   .        E  .         .         .
              30.  .         .         .  I      .     W   .     C   .     L   .       E   .         .         .
              40.  .         .         .  I      .    W    .    C    .     L   .       E   .         .         .
              50.  .         .         .  I      .    W    .   C     .    L    .     E     .         .         .
              60.  .         .         .  I      .    W    .   C     .    L    .     E     .         .         .
              70.  .         .         .  I      .   W     .   C     .   L     .    E      .         .         .
              80.  .         .         .  I      .   W     .  C      .   L     .    E      .         .         .
              90.  .         .         .  I      .   W     .  C      .  L      .   E       .         .         .
    9.00     100.  .         .         .  I.     .  W.     .  C      .  L      .   E       .         .         .
             110.  .         .         .  I.     .  W      .  C      .  ML     .  E        .         .         .
             120.  .         .         .  I.     . W       .  C      .  L      . E         .         .         .
             130.  .         .         .  I.     . W       .  C      . ML      E           .         .         .
             140.  .         .         .  I.     .  W      .  C      .  L.     E           .         .         .
             150.  .         .         .  I.     .  W      .  C      .  L. E               .         .         .
             160.  .         .         .  I      .  W      .  C      .  MLE                .         .         .
             170.  .         .         .  I      .  WC     .  W      . EL                  .         .         .
    8.00     180.  .         .         .  I      .  W      .  W      . E L                 .         .         .
             190.  .         .         .  I      .  W      .  W      . E ML                .         .         .
             200.  .         .         .  I      .  W      .  W      . E ML                .         .         .
             210.  .         .         .  I      .  W      .  W      . E ML                .         .         .
             220.  .         .         .  I      .  W      .  W      . E ML                .         .         .
             230.  .         .         .  I      .  W      .  W      . E LR                .         .         .
             240.  .         .         .  I      .  W      .  W      . E L                 .         .         .
             250.  .         .         .  I      .  W      .  W      . E L                 .         .         .
             260.  .         .         .  I      .  W      .  W      . E L                 .         .         .
             270.  .         .         I  .      .  W      .  W      . E L                 .         .         .
             280.  .         .         I  .      .  W      .  W      . E L                 .         .         .
             290.  .         .         I  .      .  W      .  W      . E L                 .         .         .
             300.  .         .         I  .      .  W      .  W      . E L                 .         .         .
             310.  .         .         I  .      .  W      .  W      . ELR                 .         .         .
             320.  .         .         I  .      .  W      .  W      . ELR                 .         .         .
             330.  .         .         I  .      .  W      .  W      . EL                  .         .         .
             340.  .         .         I  .      .  W      .  W      . EL                  .         .         .
             350.  .         .         I  .      .  W      .  W      . EL                  .         .         .
```



NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

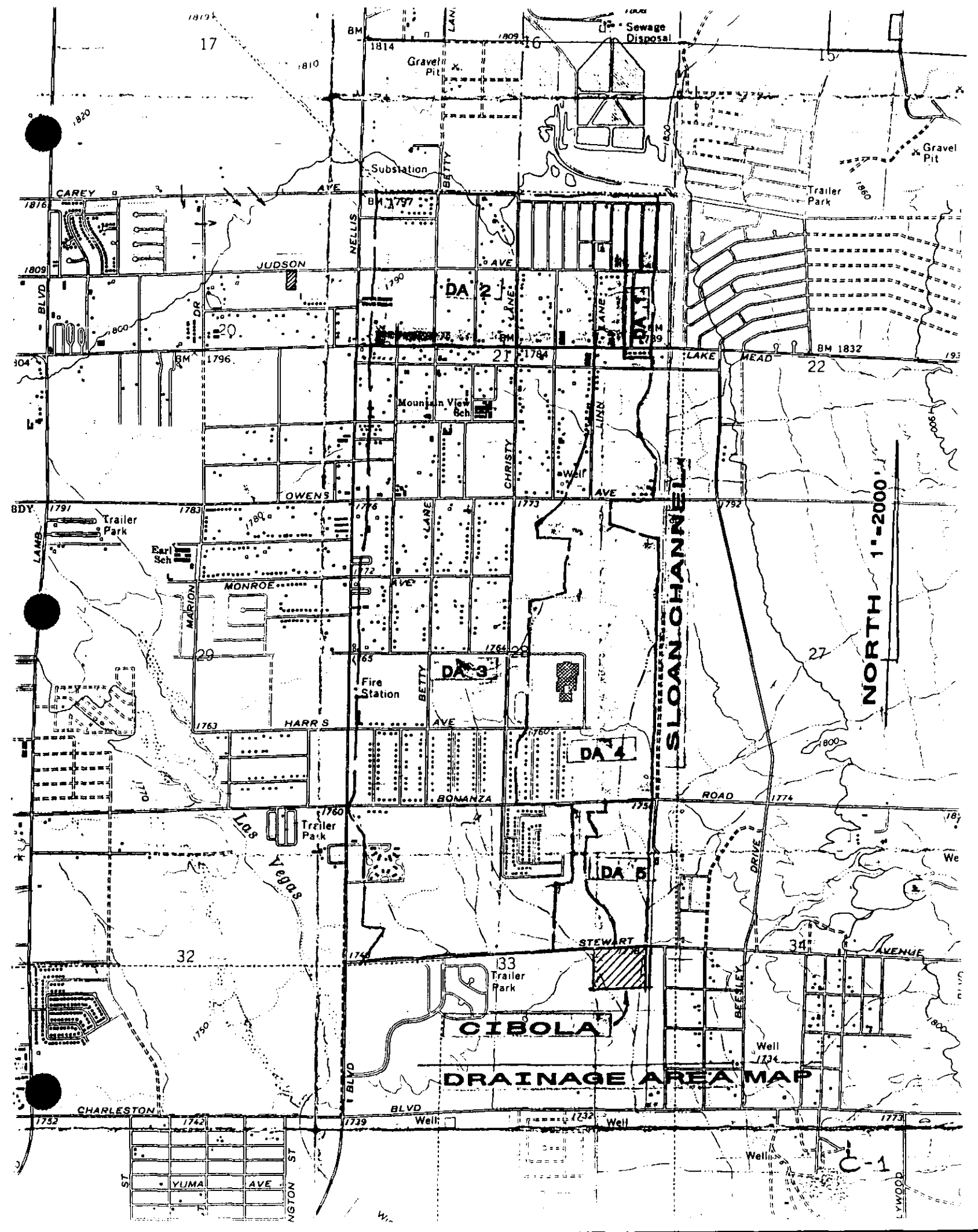
	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	10.000	.00	.00	.00	34.70	3300.00	37.00	38.84	43.67	100.69	20.72	159.24	328.8
	9.000	100.00	.00	.00	33.80	3300.00	35.68	37.42	42.51	131.50	20.97	157.41	287.7
*	8.000	80.00	.00	.00	33.50	3300.00	37.13	37.13	38.95	1533.08	10.83	304.67	84.2
*	7.000	200.00	.00	.00	32.80	3300.00	36.92	36.92	38.81	61.18	11.05	298.69	421.9
*	6.000	60.00	.00	.00	33.00	3300.00	38.00	38.00	40.10	59.83	11.62	283.99	426.6
	5.000	100.00	.00	.00	32.50	3300.00	37.13	37.39	39.42	73.06	12.14	271.85	386.0
*	4.000	100.00	.00	.00	32.10	3300.00	37.01	37.01	38.99	60.84	11.29	292.28	423.0
*	3.000	100.00	.00	.00	31.90	3300.00	36.96	36.96	38.95	60.30	11.30	292.12	424.9
	2.000	100.00	.00	.00	30.60	3300.00	35.55	36.03	38.16	87.74	12.96	255.14	352.3
*	1.000	100.00	.00	.00	29.90	3300.00	35.76	35.76	37.88	59.58	11.68	282.56	427.9

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	10.000	3300.00	37.00	.00	.00	-2.00	72.47	.00
	9.000	3300.00	35.68	.00	-1.32	.00	84.00	100.00
*	8.000	3300.00	37.13	.00	1.44	.00	84.00	80.00
*	7.000	3300.00	36.92	.00	-.21	.00	79.16	200.00
*	6.000	3300.00	38.00	.00	1.09	.00	68.59	60.00
	5.000	3300.00	37.13	.00	-.87	.00	71.79	100.00
*	4.000	3300.00	37.01	.00	-.12	.00	74.90	100.00
*	3.000	3300.00	36.96	.00	-.05	.00	74.75	100.00
	2.000	3300.00	35.55	.00	-1.41	.00	71.95	100.00
*	1.000	3300.00	35.76	.00	.21	.00	67.80	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 8.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 8.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 7.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 7.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 6.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 1.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL


DRAINAGE AREA MAP
CIBOLA
SLOAN CHANNEL
NORTH 1"=2000'
DA 1
DA 2
DA 3
DA 4
DA 5
C-1
Sewage Disposal
Gravel Pit
Substation
Trailer Park
Mountain View Sch
Earl Sch
Fire Station
Well
CAREY AVE
JUDSON AVE
OWENS AVE
MONROE AVE
HARRS AVE
BONANZA ROAD
STEWART AVENUE
CHARLESTON BLVD
YUMA AVE
LAKE MEAD
BETTY LANE
NELLIS BLVD
LAMB BLVD
MARION DR
CHRISTY LANE
BEESLEY DRIVE
Los Vegas
BM 1814
BM 1797
BM 1796
BM 1832

Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location DA 1 Checked _____ Date _____

Circle one: [Present] Developed A = 4.8 AC = 0.0075 MI^2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi^2 ☒ %	Product of CN x area
D	SEMIARID (FAIR)	77			100	
1/ Use only one CN source per line.		Totals =				

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = _____ = _____ ; Use CN = 77

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr			100
Rainfall, P (24-hour)	in			3.0
Runoff, Q (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in			0.81

Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location DA 2 Checked _____ Date _____

Circle one: [Present] Developed A = 70.9 AC. = 0.110 mi^2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐acres ☐mi^2 ☒%	Product of CN x area
B	SEMI ARID (FAIR)	72			20	1440
B	LOW DENS. RES.	70			50	3500
B	MED. DENS. RES.	75			30	2250
1/ Use only one CN source per line.				Totals =	100	7190

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = _____; Use CN = 72

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			100
Rainfall, P (24-hour) ..... in			3.0
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)			0.81

Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location DA 3 Checked _____ Date _____

Circle one: [Present] Developed DA = 815 AC = 1.27 MI²

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi² ☒ %	Product of CN x area
B	MED. DENS. RES.	75			25	1875
B	LOW DENS. RES.	70			50	3500
B	SEMI ARID (FAIR)	72			25	1800
					100	7175

1/ Use only one CN source per line. Totals =

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ——— = _____; Use CN = [72] = L4

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			100
Rainfall, P (~~24~~ 6 hour) ..... in			2.0
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)			

PRECIP. ADJ. FACTOR = 1.43
AREA RED. FACTOR = 0.96
P6 = 2.74"

C-4

Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location DA 4 Checked _____ Date _____

Circle one: [Present] Developed DA = 348 AC = 0.544 MI²

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐acres ☐mi² ☒%	Product of CN x area
B	MED. DENS. RES.	75			75	5625
B	LOW DENS. RES.	70			10	700
B	SEMI ARID (FAIR)	72			15	1080
1/ Use only one CN source per line.				Totals =	100	7405

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = _____; Use CN = [74] = LS

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			100
Rainfall, P ($\frac{6}{24}$-hour) ..... in			2.0
Runoff, Q ..... in			

(Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

PRECIP. ADJ. FACTOR = 1.43

AREA RED. FACTOR = 0.98

PP = 2.80"

Worksheet 2: Runoff curve number and runoff

Project _____ By _____ Date _____

Location DA 5 Checked _____ Date _____

Circle one: [Present] Developed DA = 55 AC = 0.0859 MI²

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi² ☒ %	Product of CN x area
B	MED. DENS. RES	75			100	

1/ Use only one CN source per line. Totals = _____ _____

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = _____ = _____; Use CN = 75 = LS

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency ..... yr			100
Rainfall, P (6-hour) ..... in			2.0
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)			

PRECIP. ADJ. FACTOR = 1.43

AREA RED. FACTOR = 1.00

PP = 2.86"

TIME OF CONCENTRATION

REFERENCE:

DEVELOPMENT _____

CACULATED BY N DATE _____

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)		FINAL t_c	REMARKS	
DESIG: DA (1)	K (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	TOTAL LENGTH Ft (11)	$t_c = (L/180)+10$ Min (12)	Min (13)	Tc (HRS)	UD TLAG (HRS)
1	0.56	4.2	240	0.5	13	760	0.4	1.4	9	1000	16	16	0.27	
2	0.56	10.9	100	0.5		3550	0.4	1.4	42	3650	30	30	0.50	
3	0.56	815	200	0.5		14900	0.4	1.4	177	15100	94	94		0.94
4	59	348	200	0.5		11200	0.4	1.4	133	11400	73	73		0.73
5	0.60	55	100	1.0		2800	0.4	1.4	33	2900	26	26		0.26

$t_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$

$K = (0.0132 \times CN) - 0.39$

$t_c = t_i + t_t$

$t_t = \frac{L}{60V}$

$T_{LAG} = 0.6\,T_c$

STANDARD FORM 4

C-7

Revision

Date

Worksheet 4: Graphical Peak Discharge method

Project _____ By N Date _____

Location DA 1 Checked _____ Date _____

Circle one: [Present] Developed _____

1. Data:

   Drainage area ..... A_m = 0.00075 mi^2 (acres/640)

   Runoff curve number .... CN = 72 (From worksheet 2)

   Time of concentration .. T_c = 0.27 hr (From worksheet 3)

   Rainfall distribution type = II (I, IA, II, III)

   Pond and swamp areas spread throughout watershed ..... = 0 percent of A_m (____ acres or mi^2 covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	10	25	100
3.	Rainfall, P (24-hour)	in			3.0
4.	Initial abstraction, I_a ..... (Use CN with table 4-1.)	in			0.778
5.	Compute I_a/P				0.26
6.	Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in			630
7.	Runoff, Q ..... (From worksheet 2).	in			0.81
8.	Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)				1.0
9.	Peak discharge, q_p ..... (where $q_p = q_u A_m Q F_p$)	cfs			4

FLOW TO "A" D.I.'s # 2-18" RCP's
2-5' D.I.'s ℄ OPENING = 10'
Y = 1.1' MAX.
D.I.'s GOOD FOR (2.4 x 10) 24 CFS > 4 OK
RCP's GOOD FOR (2 x 7) 14 CFS > 4 OK
NO FLOW FROM DA1 SOUTH OF LAKE MEAD
CULVERT FLOW IS TO SLOAN CHANNEL

Worksheet 4: Graphical Peak Discharge method

Project: _____ By N Date _____

Location DA2 Checked _____ Date _____

Circle one: Present | Developed _____

1. Data:

Drainage area ..... A_m = 0.110 mi^2 (acres/640)

Runoff curve number .... CN = 72 (From worksheet 2)

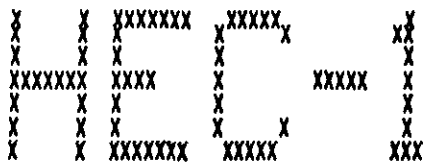
Time of concentration .. T_c = 0.50 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = 0 percent of A_m (____ acres or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	10	25	100
3. Rainfall, P (24-hour)	in			3.0
4. Initial abstraction, I_a ..... (Use CN with table 4-1.)	in			0.778
5. Compute I_a/P				0.26
6. Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in			460
7. Runoff, Q ..... (From worksheet 2).	in			0.81
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)				1.0
9. Peak discharge, q_p ..... (where $q_p = q_u A_m Q F_p$)	cfs			41

FLOW TO "A" D.I.'s & 30" RCP
11-5' D.I.'s & 2-4' D.I.'s @ OPENING = 63' IN SUMP
Y = 1.0' MAX.
D.I.'s GOOD FOR (2.3×63) 145 CFS > 41 OK
RCP GOOD FOR 32 CFS < 41
9 CFS FLOWS TO SOUTH OF LAKE MEAD FROM DA2
CULVERT FLOW IS TO NELLIS 84" RCP STORM DRAIN



THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT

```
      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

        1           ID  OFFSITE DRAINAGE AREA DA 3 TRIB TO STEWART/CHRISTY

        2           ID  CI80LA
        3           ID  100-YEAR 6-HOUR STORM
        4           ID  SDN3/C3
*** FREE ***
        5           IT    03      0       0     300
        6           IO     3      0       0
        7           KK    DA3, 100-YEAR
        8           BA   1.27
        9           PB   2.74
       10           PC      0   2.00    5.70    7.00    8.70   10.80   12.40   13.00   13.00   13.00
       11           PC  13.00   13.00   13.00   13.30   14.00   14.20   14.80   15.80   17.20   18.10
       12           PC  19.00   19.70   19.90   20.00   20.10   20.40   21.40   22.90   24.10   24.90
       13           PC  25.10   25.60   27.00   27.80   28.10   28.30   29.50   32.20   35.20   40.90
       14           PC  49.90   59.00   71.00   74.40   78.10   81.20   81.90   83.50   85.10   85.60
       15           PC  86.00   86.80   87.60   88.80   91.00   92.60   93.70   95.00   97.00   97.60
       16           PC  98.20   98.50   98.70   98.90   99.00   99.30   99.30   99.40   99.50   99.80
       17           PC  99.80   99.90  100.00
       18           LS      0      72
       19           UD   0.94
       20           ZZ
```

```
  IT        HYDROGRAPH TIME DATA
                NMIN          3  MINUTES IN COMPUTATION INTERVAL
               IDATE      1   0  STARTING DATE
               ITIME         0000  STARTING TIME
                  NQ         300  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE      1   0  ENDING DATE
              NDTIME       1457  ENDING TIME
              ICENT          19  CENTURY MARK

            COMPUTATION INTERVAL      .05 HOURS
                TOTAL TIME BASE   14.95 HOURS

 10 PI      INCREMENTAL PRECIPITATION PATTERN
              2.00    3.70    1.30    1.70    2.10    1.60     .60     .00     .00     .00
               .00     .00     .30     .70     .20     .60    1.00    1.40     .90     .90
               .70     .20     .10     .10     .30    1.00    1.50    1.20     .80     .20
               .50    1.40     .80     .30     .20    1.20    2.70    3.00    5.70    9.00
              9.10   12.00    3.40    3.70    3.10     .70    1.60    1.60     .50     .40
               .80     .80    1.20    2.20    1.60    1.10    1.30    2.00     .60     .60
               .30     .20     .20     .10     .30     .00     .10     .10     .30     .00
               .10     .10
```

UNIT HYDROGRAPH
96 END-OF-PERIOD ORDINATES

10.	21.	44.	68.	97.	129.	169.	212.	265.	321.
383.	442.	494.	539.	575.	602.	622.	632.	635.	634.
630.	614.	594.	572.	549.	523.	496.	464.	430.	391.
352.	319.	288.	265.	243.	223.	204.	188.	173.	161.
149.	137.	126.	116.	107.	97.	89.	82.	76.	69.
64.	59.	54.	49.	45.	42.	38.	35.	32.	30.
27.	25.	23.	21.	20.	18.	17.	15.	14.	13.
12.	11.	10.	9.	8.	8.	7.	7.	6.	6.
5.	5.	5.	4.	4.	4.	3.	3.	2.	2.
2.	1.	1.	1.	0.	0.				

*** *** *** *** ***

HYDROGRAPH AT STATION DA

TOTAL RAINFALL = 2.74, TOTAL LOSS = 2.08, TOTAL EXCESS = .66

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	14.95-HR
+	(CFS)	(HR)					
+	326.	3.30	(CFS)	90.	36.	36.	36.
			(INCHES)	.658	.658	.658	.658
			(AC-FT)	45.	45.	45.	45.

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
					6-HOUR	24-HOUR	72-HOUR			
+	HYDROGRAPH AT	DA	326.	3.30	90.	36.	36.	1.27		

*** NORMAL END OF HEC-1 ***

+9 (FROM DA 2)

E = 335 CFS

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID   OFFSITE DRAINAGE AREA DA 4 TRIB TO STEWART/LINN-BATTLE MTN

    2         ID   CIBOLA
    3         ID   100-YEAR 6-HOUR STORM
    4         ID   SDN3/C4
xxx FREE xxx
    5         IT     03       0       0     300
    6         IO      3       0       0
    7         KK     DA3, 100-YEAR
    8         BA   0.544
    9         PB    2.80
   10         PC      0    2.00    5.70    7.00    8.70   10.80   12.40   13.00   13.00   13.00
   11         PC  13.00   13.00   13.00   13.30   14.00   14.20   14.80   15.80   17.20   18.10
   12         PC  19.00   19.70   19.90   20.00   20.10   20.40   21.40   22.90   24.10   24.90
   13         PC  25.10   25.60   27.00   27.80   28.10   28.30   29.50   32.20   35.20   40.90
   14         PC  49.90   59.00   71.00   74.40   78.10   81.20   81.90   83.50   85.10   85.60
   15         PC  86.00   86.80   87.60   88.80   91.00   92.60   93.70   95.00   97.00   97.60
   16         PC  98.20   98.50   98.70   98.90   99.00   99.30   99.30   99.40   99.50   99.80
   17         PC  99.80   99.90  100.00
   18         LS      0      74
   19         UD   0.73
   20         ZZ
```

```
IT          HYDROGRAPH TIME DATA
                NMIN          3  MINUTES IN COMPUTATION INTERVAL
               IDATE      1   0  STARTING DATE
               ITIME         0000  STARTING TIME
                  NQ          300  NUMBER OF HYDROGRAPH ORDINATES
              NDDATE      1   0  ENDING DATE
              NDTIME         1457  ENDING TIME
               ICENT           19  CENTURY MARK

            COMPUTATION INTERVAL     .05 HOURS
                TOTAL TIME BASE   14.95 HOURS
```

```
10 PI       INCREMENTAL PRECIPITATION PATTERN
              2.00    3.70    1.30    1.70    2.10    1.60     .60     .00     .00     .00
               .00     .00     .30     .70     .20     .60    1.00    1.40     .90     .90
               .70     .20     .10     .10     .30    1.00    1.50    1.20     .80     .20
               .50    1.40     .80     .30     .20    1.20    2.70    3.00    5.70    9.00
              9.10   12.00    3.40    3.70    3.10     .70    1.60    1.60     .50     .40
               .80     .80    1.20    2.20    1.60    1.10    1.30    2.00     .60     .60
               .30     .20     .20     .10     .30     .00     .10     .10     .30     .00
               .10     .10
```

UNIT HYDROGRAPH
75 END-OF-PERIOD ORDINATES

7.	18.	34.	55.	79.	107.	143.	183.	227.	264.
296.	322.	336.	346.	348.	346.	339.	325.	310.	293.
274.	252.	227.	199.	176.	155.	139.	124.	111.	100.
91.	82.	74.	67.	60.	53.	48.	43.	38.	35.
31.	28.	25.	22.	20.	18.	16.	14.	13.	12.
11.	9.	9.	8.	7.	6.	5.	5.	4.	4.
4.	3.	3.	3.	3.	2.	2.	2.	1.	1.
1.	1.	1.	0.	0.					

*** *** *** *** ***

HYDROGRAPH AT STATION DA

TOTAL RAINFALL = 2.80, TOTAL LOSS = 2.02, TOTAL EXCESS = .78

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)				
193.	2.95		46.	18.	18.	18.
		(INCHES)	.784	.784	.784	.784
		(AC-FT)	23.	23.	23.	23.

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	DA	193.	2.95	46.	18.	18.	.54		

*** NORMAL END OF HEC-1 ***

```
X    X  XXXXXXX  XXXXX          X
X    X  X       X     X        XX
X    X  X       X              X
XXXXXXX  XXXX    X        XXXXX X
X    X  X       X              X
X    X  X       X     X        X
X    X  XXXXXXX  XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1           ID   OFFSITE DRAINAGE AREA DA 5 TRIB TO STEVART/SEARCHLIGHT
  2           ID   CIBOLA
  3           ID   100-YEAR 6-HOUR STORM
  4           ID   SDN3/C5
*** FREE ***
  5           IT     03      0      0    300
  6           ID      3      0      0
  7           KK     DA5, 100-YEAR
  8           BA  0.0859
  9           PB    2.86
 10           PC      0   2.00 . 5.70   7.00   8.70  10.80  12.40  13.00  13.00  13.00
 11           PC  13.00  13.00  13.00  13.30  14.00  14.20  14.80  15.80  17.20  18.10
 12           PC  19.00  19.70  19.90  20.00  20.10  20.40  21.40  22.90  24.10  24.90
 13           PC  25.10  25.60  27.00  27.80  28.10  28.30  29.50  32.20  35.20  40.90
 14           PC  49.90  59.00  71.00  74.40  78.10  81.20  81.90  83.50  85.10  85.60
 15           PC  86.00  86.80  87.60  88.80  91.00  92.60  93.70  95.00  97.00  97.60
 16           PC  98.20  98.50  98.70  98.90  99.00  99.30  99.30  99.40  99.50  99.80
 17           PC  99.80  99.90 100.00
 18           LS      0     75
 19           UD   0.26
 20           ZZ
```

```
IT          HYDROGRAPH TIME DATA
              NMIN          3  MINUTES IN COMPUTATION INTERVAL
             IDATE      1   0  STARTING DATE
             ITIME         0000  STARTING TIME
                NQ          300  NUMBER OF HYDROGRAPH ORDINATES
            NDDATE      1   0  ENDING DATE
            NDTIME         1457  ENDING TIME
             ICENT           19  CENTURY MARK

          COMPUTATION INTERVAL      .05 HOURS
              TOTAL TIME BASE   14.95 HOURS
```

```
10 PI       INCREMENTAL PRECIPITATION PATTERN
              2.00     3.70     1.30     1.70     2.10     1.60      .60      .00      .00      .00
               .00      .00      .30      .70      .20      .60     1.00     1.40      .90      .90
               .70      .20      .10      .10      .30     1.00     1.50     1.20      .80      .20
               .50     1.40      .80      .30      .20     1.20     2.70     3.00     5.70     9.00
              9.10    12.00     3.40     3.70     3.10      .70     1.60     1.60      .50      .40
               .80      .80     1.20     2.20     1.60     1.10     1.30     2.00      .60      .60
               .30      .20      .20      .10      .30      .00      .10      .10      .30      .00
               .10      .10
```

UNIT HYDROGRAPH
28 END-OF-PERIOD ORDINATES

12.	37.	76.	120.	142.	145.	132.	113.	85.	61.
46.	35.	27.	20.	15.	11.	8.	6.	5.	4.
3.	2.	2.	1.	1.	1.	0.	0.		

*** *** *** *** ***

HYDROGRAPH AT STATION DA

TOTAL RAINFALL = 2.86, TOTAL LOSS = 1.99, TOTAL EXCESS = .87

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)	8.	3.	3.	3.
67.	2.35	(INCHES)	.870	.870	.870	.870
		(AC-FT)	4.	4.	4.	4.

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	DA	67.	2.35	8.	3.	3.	.09		

*** NORMAL END OF HEC-1 ***

DA 3, DA 4, DA 5 SUMMARY

DA 3 = 335 CFS
DA 4 = 193 CFS
DA 5 = 67 CFS

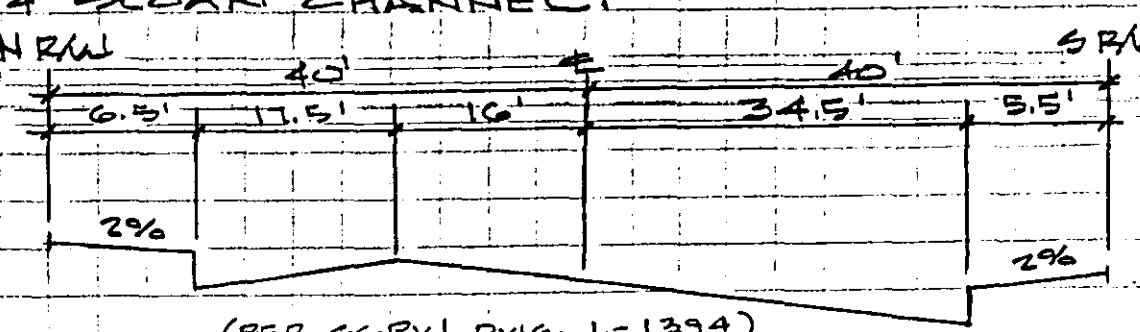
ΣQ_{100} = 595 CFS (UNROUTED)

THIS FAVORABLY CORRESPONDS TO G C WALLACE "FINAL PREDESIGN MEMORANDUM - SLOAN CHANNEL - OWENS AVENUE TO LAS VEGAS WASH" 7/9/93; Q_{100} = 579 CFS IN STEWART AT SLOAN.

IN THE WALLACE REPORT, ALL FLOW WAS ASSUMED TO REMAIN IN STEWART.

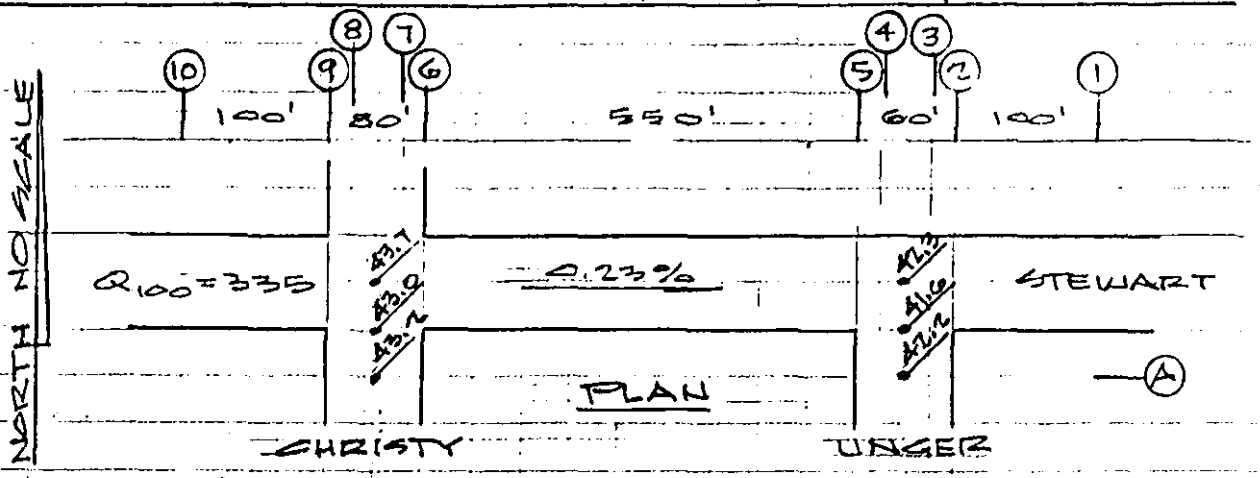
IN THIS REPORT, SPLIT FLOWS FOR INTERSECTING STREETS FLOWING SOUTH FROM STEWART WILL BE ANALYSED TO DETERMINE HOW MUCH FLOW IS LOST FROM STEWART WEST OF THE SLOAN CHANNEL.

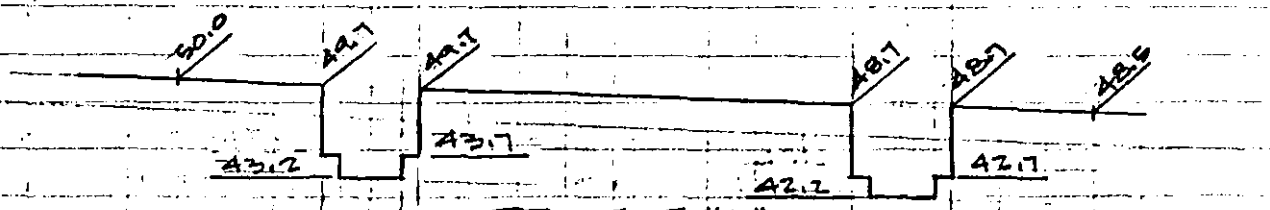
AN CROWN OFFSET TO THE NORTH SIDE OF STEWART EXISTS BETWEEN CHRISTY & SLOAN CHANNEL.

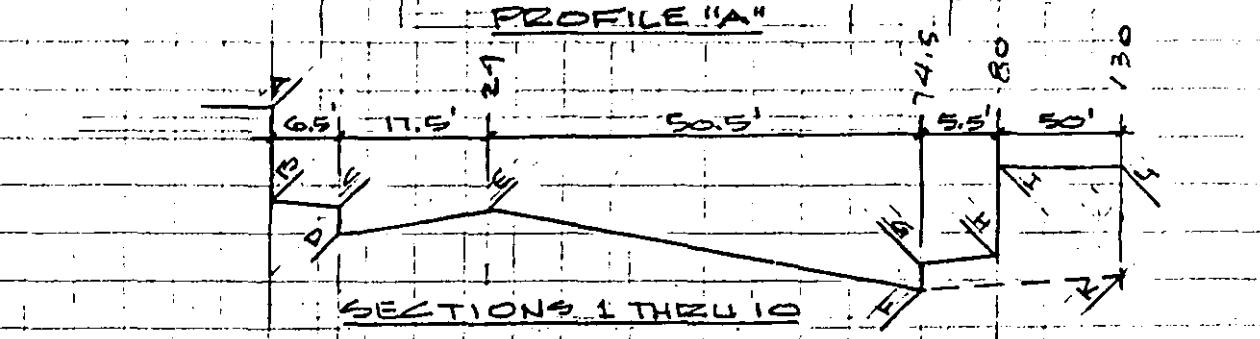


(PER CCPW DWG. L-1394)

SPLIT FLOW - STEWART TO CHRISTY & UNGER







SEC.	A	B	C	D	E	F	G	H	I	J	K
1	48.5	42.6	42.5	42.0	42.4	41.4	41.9	42.0	48.5	48.5	-
2	48.7	42.7	42.6	42.1	42.5	41.5	42.0	42.1	48.7	48.7	-
3	48.7	42.7	42.6	42.1	42.5	41.5	-	-	-	-	42.2
4	48.7	42.9	42.8	42.3	42.7	41.7	-	-	-	-	42.2
5	48.7	42.9	42.8	42.3	42.7	41.7	42.2	42.3	48.7	48.7	-
6	49.7	44.1	44.0	43.5	43.9	42.9	43.4	43.5	49.7	49.7	-
7	49.7	44.1	44.0	43.5	43.9	42.9	-	-	-	-	43.2
8	49.7	44.3	44.2	43.7	44.1	43.1	-	-	-	-	43.2
9	49.7	44.3	44.2	43.7	44.1	43.1	43.6	43.7	49.7	49.7	-
10	50.0	44.5	44.4	43.9	44.3	43.3	43.8	43.9	50.0	50.0	-

```
X    X  XXXXXXX  XXXXX          XXXXX
X    X  X      X     X        X     X
X    X  X      X              X
XXXXXXX  XXXX   X        XXXXX  XXXXX
X    X  X      X                    X
X    X  X      X    X         X     X
X    X  XXXXXXX  XXXXX          XXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT STERART; CHRISTY & UNGER
TW FLOW ON STEWART
WS     2       1       2      -1     2.7
WC     0    48.5     100    48.7
TW FLOW SOUTH ON CHRISTY
WS     8       2       5      -1     2.7
WC     0    48.7       0    42.7     5.5    42.7     5.5    42.2      49    42.2
WC    49    42.7      60    42.7      60    48.7
TW FLOW ON STEWART
WS     2       5       6      -1     2.7
WC     0    48.7     550    49.7
TW FLOW ON STEWART
WS     2       5       6      -1     2.7
WC     0    48.7     550    49.7
TW FLOW SOUTH ON UNGER
WS     8       6       9      -1     2.7
WC     0    49.7       0    43.7     5.5    43.7     5.5    43.2      49    43.2
WC    49    43.7      60    43.7      60    49.7
TW FLOW ON STEWART
WS     2       9      10      -1     2.7
WC     0    49.7     100    50.0

T1 CIBOLA
T2 SUBCRITICAL (UPSTREAM) RUN
T3 CSF1
J1  ICHECK     INQ      NINV      IDIR      STRT     METRIC    HVINS         Q      WSEL        FQ
       0       0         0         0        -1          0        0       335      43.3         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH      FN      ALLDC     IBW      CHNIM     ITRACE
      -1         0         0         0         0         0         0       0          0          0

NC   0.013     0.013     0.015       0.1       0.3

X1       1        10       6.5      74.5         0         0         0        -0         0         0
GR    48.5         0      42.6         0      42.5       6.5      42.0       6.5      42.4        24
GR    41.4      74.5      41.9      74.5      42.0        80      48.5        80      48.5       130

X1       2        10       6.5      74.5       100       100       100         0         0         0
GR    48.7         0      42.7         0      42.6       6.5      42.1       6.5      42.5        24
GR    41.5      74.5      42.0      74.5      42.1        80      48.7        80      48.7       130

X1       3         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR    48.7         0      42.7         0      42.6       6.5      42.1       6.5      42.5        24
GR    41.5      74.5      42.2       130

X1       4         7       6.5      74.5        49        49        49         0         0         0
GR    48.7         0      42.9         0      42.8       6.5      42.3       6.5      42.7        24
GR    41.7      74.5      42.2       130
```

```
X1         5        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR      48.7         0      42.9         0      42.8       6.5      42.3       6.5      42.7        24
GR      41.7      74.5      42.2      74.5      42.3        80      48.7        80      48.7       130

X1         6        10       6.5      74.5       550       550       550         0         0         0
GR      49.7         0      44.1         0      44.0       6.5      43.5       6.5      43.9        24
GR      42.9      74.5      43.4      74.5      43.5        80      49.7        80      49.7       130

X1         7         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR      49.7         0      44.1         0      44.0       6.5      43.5       6.5      43.9        24
GR      42.9      74.5      43.2       130

X1         8         7       6.5      74.5        69        69        69         0         0         0
GR      49.7         0      44.3         0      44.2       6.5      43.7       6.5      44.1        24
GR      43.1      74.5      43.2       130

X1         9        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR      49.7         0      44.3         0      44.2       6.5      43.7       6.5      44.1        24
GR      43.1      74.5      43.6      74.5      43.7        80      49.7        80      49.7       130

X1        10        10       6.5      74.5       100       100       100         0         0         0
GR      50.0         0      44.5         0      44.4       6.5      43.9       6.5      44.3        24
GR      43.3      74.5      43.8      74.5      43.9        80      50.0        80      50.0       130

   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL       OLOSS   BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL      TVA     LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN      ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR    TOPWID    ENDST
3265 DIVIDED FLOW
3720 CRITICAL DEPTH ASSUMED
    1.000      .99     42.39     42.39     43.30     42.60       .22       .00       .00     42.50
      112.       0.      102.      10.        0.       28.        2.        0.        0.     41.90
      .00       .00      3.68     4.22      .000      .015      .013      .000     41.40      6.50
  .004519        0.        0.        0.         0        10         0       .00     72.14     80.00

*SECNO 2.000
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.05
    2.000     1.22     42.72       .00       .00     42.81       .09       .19       .01     42.60
      112.       0.      103.      10.        0.       43.        4.        0.        0.     42.00
      .01       .59      2.37     2.65      .013      .015      .013      .000     41.50       .00
  .001073      100.      100.      100.         2         0         0       .00     80.00     80.00

*SECNO 3.000
3280 CROSS SECTION      3.00 EXTENDED       .60 FEET
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.82
    3.000     1.30     42.80       .00       .00     42.82       .02       .00       .01     42.60
      112.       0.       45.      67.        1.       49.       53.        0.        0.     41.50
      .01       .37       .92     1.27      .013      .015      .013      .000     41.50       .00
  .000135        6.        6.        6.         2         0         0       .00    130.00    130.00

*SECNO 4.000
3280 CROSS SECTION      4.00 EXTENDED       .60 FEET
    4.000     1.10     42.80       .00       .00     42.83       .03       .01       .00     42.80
      112.       0.       36.      76.        0.       35.       47.        0.        0.     41.70
      .02       .00      1.02     1.62      .000      .015      .013      .000     41.70      6.50
  .000254       49.       49.       49.         2         0         0       .00    123.50    130.00

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    5.000     1.11     42.81     42.81       .00     43.08       .27       .00       .07     42.80
      162.       0.      148.      14.        0.       36.        3.        0.        0.     42.20
      .02       .00      4.12     4.68      .000      .015      .013      .000     41.70      6.16
  .004139        6.        6.        6.        20         5         0       .00     73.84     80.00
```

$F_R = 0.4$

$F_R = 0.1$

$F_R = 0.0^+$

$F_R = 0.0^+$

$F_R = 0.5$

```
*SECNO 6.000
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.70
    6.000     1.30    44.20      .00      .00    44.34      .14     1.25      .01    44.00
      162.       1.      147.      14.       1.      49.       4.       1.       1.    43.40
      .07     1.21     3.00     3.31     .013     .015     .013     .000    42.90      .00
  .001438     550.     550.     550.        5        0        0      .00    80.00    80.00

*SECNO 7.000
3280 CROSS SECTION      7.00 EXTENDED      1.13 FEET
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  3.42
    7.000     1.43    44.33      .00      .00    44.35      .03      .00      .01    44.00
      162.       1.       57.     105.       2.      58.      71.       1.       1.    42.90
      .07      .53      .98     1.47     .013     .015     .013     .000    42.90      .00
  .000123        6.       6.       6.        2        0        0      .00   130.00   130.00

*SECNO 8.000
3280 CROSS SECTION      8.00 EXTENDED      1.13 FEET
    8.000     1.23    44.33      .00      .00    44.37      .04      .01      .00    44.20
      162.       0.       46.     116.       1.      44.      65.       1.       2.    43.10
      .09      .30     1.04     1.77     .013     .015     .013     .000    43.10      .00
  .000198       69.      69.      69.        2        0        0      .00   130.00   130.00

*SECNO 9.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    9.000     1.44    44.54    44.54      .00    44.95      .42      .00      .11    44.20
      335.       5.      302.      27.       2.      58.       5.       1.       2.    43.60
      .09     2.83     5.18     5.61     .013     .015     .013     .000    43.10      .00
  .003418        6.       6.       6.       20       11        0      .00    80.00    80.00

*SECNO 10.000
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.41
   10.000     1.63    44.93      .00      .00    45.20      .27      .23      .01    44.40
      335.       9.      300.      26.       3.      72.       6.       1.       2.    43.80
      .09     2.77     4.20     4.43     .013     .015     .013     .000    43.30      .00
  .001710      100.     100.     100.        3        0        0      .00    80.00    80.00

TW FLOW ON STEVART
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
      .00       .00       .00       .00       .00       .00         7   42.386    42.720     1.000     2.000
TW FLOW SOUTH ON CHRISTY
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
    49.91     50.00       .19     49.91     50.00       .19         7   42.720    42.805     2.000     5.000
TW FLOW ON STEVART
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
      .00       .00       .00     49.91     50.00       .19         7   42.805    44.200     5.000     6.000
TW FLOW ON STEVART
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
      .00       .00       .00     49.91     50.00       .19         7   42.805    44.200     5.000     6.000
TW FLOW SOUTH ON UNGER
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
   172.67    172.46       .12    222.57    222.47       .05         7   44.200    44.536     6.000     9.000
TW FLOW ON STEVART
    ASQ      QCOMP     ERRAC     TASQ      TCQ      TABER     NITER     DSWS      USWS     DSSNO     USSNO
      .00       .00       .00    222.57    222.47       .05         7   44.536    44.931     9.000    10.000

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    41.       42.       43.       44.       45.       46.       47.       48.       49.       50.
   SECNO   CUMDIS
    1.00       0.  I    R    WLE       .         .         .         .         .        .M         .         .         .
              10.  I    R    WLE       .         .         .         .         .        .M         .         .         .
              20.  I    R    .WE       .         .         .         .         .        .M         .         .         .
              30.  I    R    .W E      .         .         .         .         .        . M        .         .         .
```

$F_{IR} = 0.2$

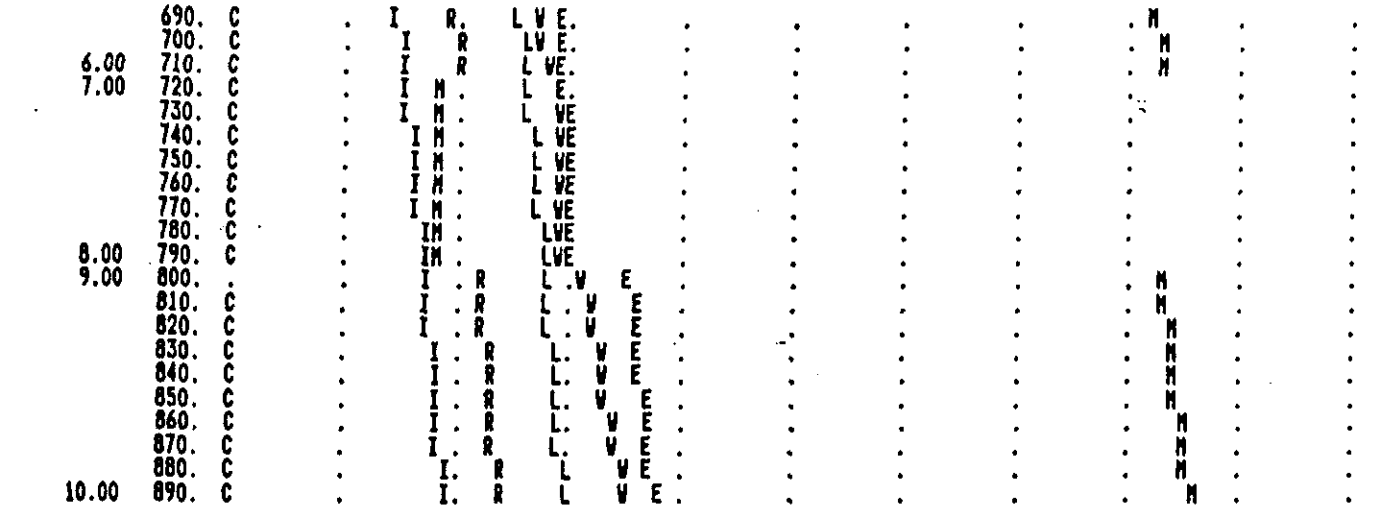
$F_R = 0.0+$

$F_R = 0.0+$

$F_{IR} = 0.6$

$F_R = 0.3$

C-21



NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	41.40	112.43	42.39	42.39	42.60	45.19	3.68	30.18	16.7
*	2.000	100.00	.00	.00	41.50	112.43	42.72	.00	42.81	10.73	2.37	47.24	34.3
*	3.000	5.50	.00	.00	41.50	112.43	42.80	.00	42.82	1.35	.92	102.53	96.6
	4.000	49.00	.00	.00	41.70	112.43	42.80	.00	42.83	2.54	1.02	82.50	70.4
*	5.000	5.50	.00	.00	41.70	162.33	42.81	42.81	43.08	41.39	4.12	38.96	25.2
*	6.000	550.00	.00	.00	42.90	162.33	44.20	.00	44.34	14.38	3.00	54.31	42.8
*	7.000	5.50	.00	.00	42.90	162.33	44.33	.00	44.35	1.23	.98	130.64	146.3
	8.000	69.00	.00	.00	43.10	162.33	44.33	.00	44.37	1.98	1.04	110.38	115.4
*	9.000	5.50	.00	.00	43.10	335.00	44.54	44.54	44.95	34.18	5.18	65.11	57.3
*	10.000	100.00	.00	.00	43.30	335.00	44.93	.00	45.20	17.10	4.20	80.57	81.0

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1.000	112.43	42.39	.00	.00	-.91	72.14	.00
*	2.000	112.43	42.72	.00	.33	.00	80.00	100.00
*	3.000	112.43	42.80	.00	.08	.00	130.00	5.50
	4.000	112.43	42.80	.00	.00	.00	123.50	49.00
*	5.000	162.33	42.81	.00	.01	.00	73.84	5.50
*	6.000	162.33	44.20	.00	1.39	.00	80.00	550.00
*	7.000	162.33	44.33	.00	.13	.00	130.00	5.50
	8.000	162.33	44.33	.00	.00	.00	130.00	69.00
*	9.000	335.00	44.54	.00	.21	.00	80.00	5.50
*	10.000	335.00	44.93	.00	.40	.00	80.00	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION	SECNO= 1.000	PROFILE= 1	CRITICAL DEPTH ASSUMED
WARNING	SECNO= 2.000	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING	SECNO= 3.000	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION	SECNO= 5.000	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO= 5.000	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO= 5.000	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING	SECNO= 6.000	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING	SECNO= 7.000	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION	SECNO= 9.000	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO= 9.000	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO= 9.000	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING	SECNO= 10.000	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

$F_R = \frac{V^2}{gy} < 1$ ∴ SUBCRITICAL FLOW

Q_{100} = 173 CFS SOUTH ON CHRISTY

Q_{100} = 50 CFS SOUTH ON UNGER

Q_{100} = 112 CFS EAST ON STEWART

```
X     X  XXXXXXX  XXXXX              XXXXX
X     X  X       X     X            X     X
X     X  X       X                        X
XXXXXXX  XXXX    X          XXXXX    XXXXX
X     X  X       X                   X
X     X  X       X     X             X
X     X  XXXXXXX  XXXXX              XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT STERART; CHRISTY & UNGER
TW FLOW ON STEWART
WS     2       1       2      -1     2.7
WC     0    48.5     100    48.7
TW FLOW SOUTH ON CHRISTY
WS     8       2       5      -1     2.7
WC     0    48.7       0    42.7     5.5    42.7     5.5    42.2      49    42.2
WC    49    42.7      60    42.7      60    48.7
TW FLOW ON STEWART
WS     2       5       6      -1     2.7
WC     0    48.7     550    49.7
TW FLOW ON STEWART
WS     2       5       6      -1     2.7
WC     0    48.7     550    49.7
TW FLOW SOUTH ON UNGER
WS     8       6       9      -1     2.7
WC     0    49.7       0    43.7     5.5    43.7     5.5    43.2      49    43.2
WC    49    43.7      60    43.7      60    49.7
TW FLOW ON STEWART
WS     2       9      10      -1     2.7
WC     0    49.7     100    50.0

T1 CIBOLA
T2 SUPERCRITICAL (DOWNSTREAM) RUN.
T3 CSF1A
J1   ICHECK     INQ      NINV      IDIR      STRT     METRIC    HVINS         Q      WSEL        FQ
        0         0         0         1        -1          0        0       335      43.3         0
J2   NPROF     IPLOT     PRFVS     XSECV     XSECH      FN      ALLDC      IBW     CHNIM     ITRACE
        -1         0         0         0         0         0         0         0         0         0

NC    0.013     0.013     0.015       0.1       0.3

X1       10        10       6.5      74.5       100       100       100         0         0         0
GR     50.0         0      44.5         0      44.4       6.5      43.9       6.5      44.3        24
GR     43.3      74.5      43.8      74.5      43.9        80      50.0        80      50.0       130

X1        9        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     49.7         0      44.3         0      44.2       6.5      43.7       6.5      44.1        24
GR     43.1      74.5      43.6      74.5      43.7        80      49.7        80      49.7       130

X1        8         7       6.5      74.5        69        69        69         0         0         0
GR     49.7         0      44.3         0      44.2       6.5      43.7       6.5      44.1        24
GR     43.1      74.5      43.2       130

X1        7         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     49.7         0      44.1         0      44.0       6.5      43.5       6.5      43.9        24
GR     42.9      74.5      43.2       130
```

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X1         6        10       6.5      74.5       550       550       550         0         0         0
GR      49.7         0      44.1         0      44.0       6.5      43.5       6.5      43.9        24
GR      42.9      74.5      43.4      74.5      43.5        80      49.7        80      49.7       130

X1         5        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR      48.7         0      42.9         0      42.8       6.5      42.3       6.5      42.7        24
GR      41.7      74.5      42.2      74.5      42.3        80      48.7        80      48.7       130

X1         4        .7       6.5      74.5        49        49        49         0         0         0
GR      48.7         0      42.9         0      42.8       6.5      42.3       6.5      42.7        24
GR      41.7      74.5      42.2       130

X1         3         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR      48.7         0      42.7         0      42.6       6.5      42.1       6.5      42.5        24
GR      41.5      74.5      42.2       130

X1         2        10       6.5      74.5       100       100       100         0         0         0
GR      48.7         0      42.7         0      42.6       6.5      42.1       6.5      42.5        24
GR      41.5      74.5      42.0      74.5      42.1        80      48.7        80      48.7       130

X1         1        10       6.5      74.5         0         0         0         0         0         0
GR      48.5         0      42.6         0      42.5       6.5      42.0       6.5      42.4        24
GR      41.4      74.5      41.9      74.5      42.0        80      48.5        80      48.5       130

   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        QLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST

*SECNO 10.000
3720 CRITICAL DEPTH ASSUMED
   10.000      1.44     44.74     44.74     43.30     45.15       .42       .00       .00     44.40
      335.        5.       302.       27.        2.       58.        5.        0.        0.     43.80
      .00      2.83      5.18 -     5.61      .013      .015      .013      .000     43.30       .00
  .003424        0.        0.        0.         0        15         0       .00     80.00     80.00

*SECNO 9.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    9.000      1.44     44.54     44.54       .00     44.95       .41       .34       .26     44.20
      335.        5.       302.       27.        2.       59.        5.        0.        0.     43.60
       .01      2.83      5.15      5.57      .013      .015      .013      .000     43.10       .00
  .003358       100.      100.      100.        20         5         0       .00     80.00     80.00

*SECNO 8.000
3280 CROSS SECTION      8.00 EXTENDED       .25 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  6.13
    8.000       .35     43.45     43.77       .00     44.83      1.37       .03       .10     44.20
      180.        0.       18.      162.        0.        3.       17.        0.        0.     43.10
       .01       .00      5.90      9.72      .000      .015      .013      .000     43.10     56.86
  .036356         6.        6.        6.        16        14         0       .00     73.14    130.00

*SECNO 7.000
3265 DIVIDED FLOW
3280 CROSS SECTION      7.00 EXTENDED       .40 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .32

    7.000       .70     43.60     43.64       .00     43.90       .30       .60       .32     44.00
      180.        0.       36.      144.        0.       13.       30.        0.        0.     42.90
       .01       .00      2.84      4.72      .000      .015      .013      .000     42.90      6.50
  .003830        69.       69.       69.        11        17         0       .00     95.17    130.00
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*SECNO 6.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   6.000     1.15    44.05    44.05      .00    44.33      .28      .02      .02    44.00
     180.       0.     164.      16.       0.      39.       3.       0.       0.    43.40
     .01      .07     4.22     4.76     .013     .015     .013     .000    42.90     3.32
 .003902       6.       6.       6.       20       14        0      .00    76.68    80.00

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   5.000     1.14    42.84    42.84      .00    43.13      .29     2.18     1.68    42.80
     180.       0.     164.      16.       0.      38.       3.       1.       1.    42.20
     .05      .07     4.26     4.81     .013     .015     .013     .000    41.70     3.69
 .004033      550.     550.     550.       20        5        0      .00    76.31    80.00

*SECNO 4.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  3.55
   4.000      .48    42.18    42.41      .00    43.03      .85      .04      .06    42.80
     139.       0.      39.      99.       0.       6.      13.       1.       1.    41.70
     .05      .00     6.67     7.69     .000     .015     .013     .000    41.70    50.14
 .030164       6.       6.       6.       10       14        0      .00    77.91   128.05

*SECNO 3.000
3265 DIVIDED FLOW
3280 CROSS SECTION      3.00 EXTENDED       .07 FEET
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   3.000      .77    42.27    42.27      .00    42.48      .21      .41      .41    42.60
     139.       0.      46.      92.       0.      16.      23.       1.       1.    41.50
     .05      .00     2.97     3.98     .000     .015     .013     .000    41.50     6.50
 .003870       49.      49.      49.       20       14        0      .00   101.69   130.00

*SECNO 2.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   2.000     1.06    42.56    42.56      .00    42.80      .24      .02      .04    42.60
     139.       0.     126.      12.       0.      33.       3.       1.       1.    42.00
     .05      .00     3.88     4.45     .000     .015     .013     .000    41.50     6.50
 .004184       6.       6.       6.       20       11        0      .00    73.50    80.00

*SECNO 1.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   1.000     1.05    42.45    42.45      .00    42.70      .25      .43      .01    42.50
     139.       0.     126.      12.       0.      32.       3.       1.       2.    41.90
     .06      .00     3.94     4.52     .000     .015     .013     .000    41.40     6.50
 .004406      100.     100.     100.       20        5        0      .00    73.50    80.00

 TW FLOW ON STEVART
    ASQ      QCOMP      ERRAC      TASQ       TCQ      TABER     NITER      DSWS      USWS     DSSNO     USSNO
      .00       .00        .00        .00       .00        .00         7    42.448    42.555     1.000     2.000
 TW FLOW SOUTH ON CHRISTY
    ASQ      QCOMP      ERRAC      TASQ       TCQ      TABER     NITER      DSWS      USWS     DSSNO     USSNO
    41.22     41.22        .00     41.22     41.22        .00         7    42.555    42.843     2.000     5.000
 TW FLOW ON STEVART
    ASQ      QCOMP      ERRAC      TASQ       TCQ      TABER     NITER      DSWS      USWS     DSSNO     USSNO
      .00       .00        .00     41.22     41.22        .00         7    42.843    44.049     5.000     6.000
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TW FLOW ON STEVART

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.00	.00	.00	41.22	41.22	.00	7	42.843	44.049	5.000	6.000

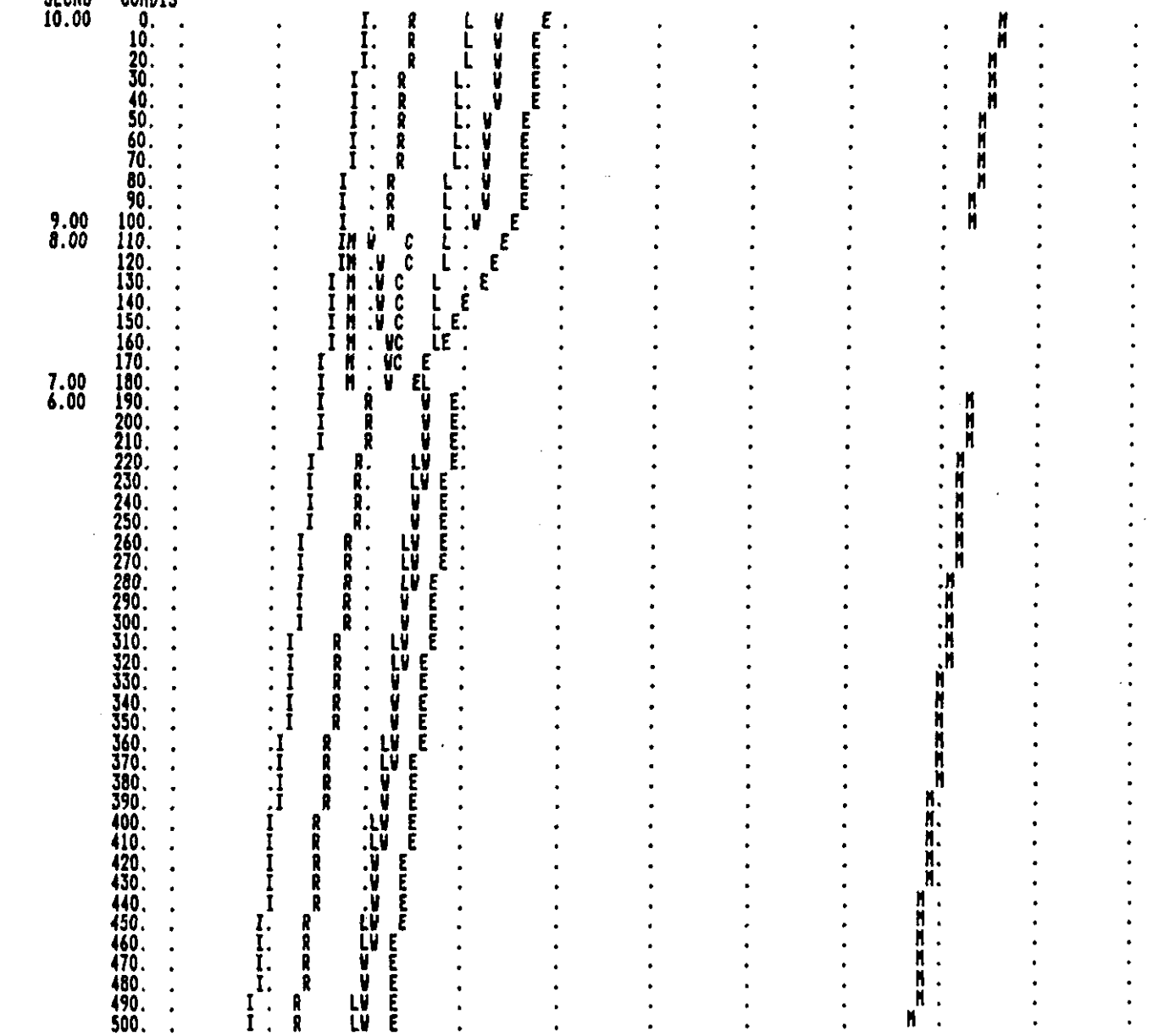
TW FLOW SOUTH ON UNGER

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
155.24	155.24	.00	196.46	196.46	.00	7	44.049	44.540	6.000	9.000

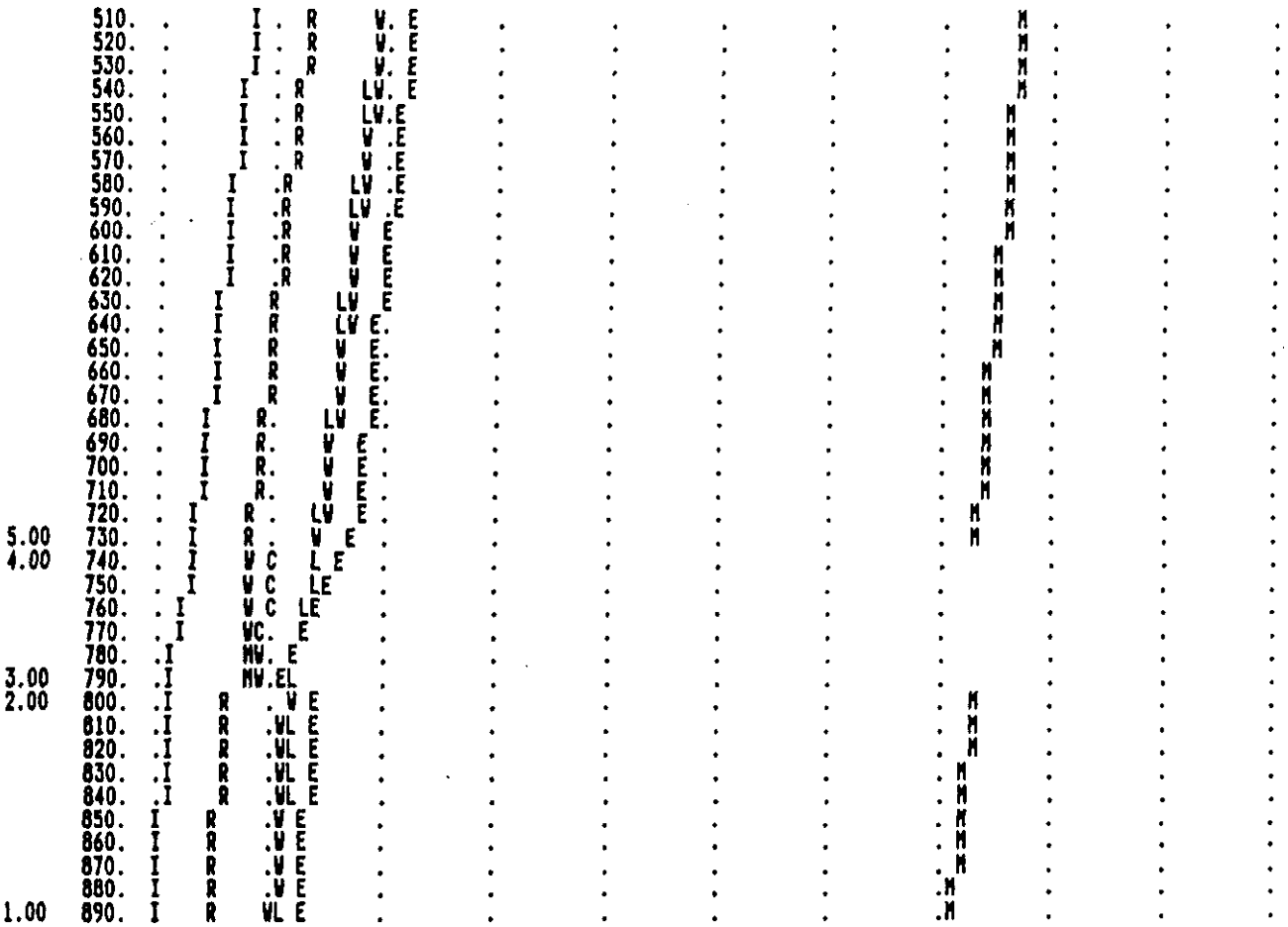
TW FLOW ON STEVART

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.00	.00	.00	196.46	196.46	.00	7	44.540	44.735	9.000	10.000

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA



C-26



NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	10.000	.00	.00	.00	43.30	335.00	44.74	44.74	45.15	34.24	5.18	65.07	57.25
*	9.000	100.00	.00	.00	43.10	335.00	44.54	44.54	44.95	33.58	5.15	65.46	57.81
*	8.000	5.50	.00	.00	43.10	179.76	43.45	43.77	44.83	363.56	5.90	19.70	9.42
*	7.000	69.00	.00	.00	42.90	179.76	43.60	43.64	43.90	38.30	2.84	43.06	29.05
*	6.000	5.50	.00	.00	42.90	179.76	44.05	44.05	44.33	39.02	4.22	42.25	28.78
*	5.000	550.00	.00	.00	41.70	179.76	42.84	42.84	43.13	40.33	4.26	41.81	28.30
*	4.000	5.50	.00	.00	41.70	138.54	42.18	42.41	43.03	301.64	6.67	18.79	7.98
*	3.000	49.00	.00	.00	41.50	138.54	42.27	42.27	42.48	38.70	2.97	38.77	22.27
*	2.000	5.50	.00	.00	41.50	138.54	42.56	42.56	42.80	41.84	3.88	35.29	21.42
*	1.000	100.00	.00	.00	41.40	138.54	42.45	42.45	42.70	44.06	3.94	34.74	20.87

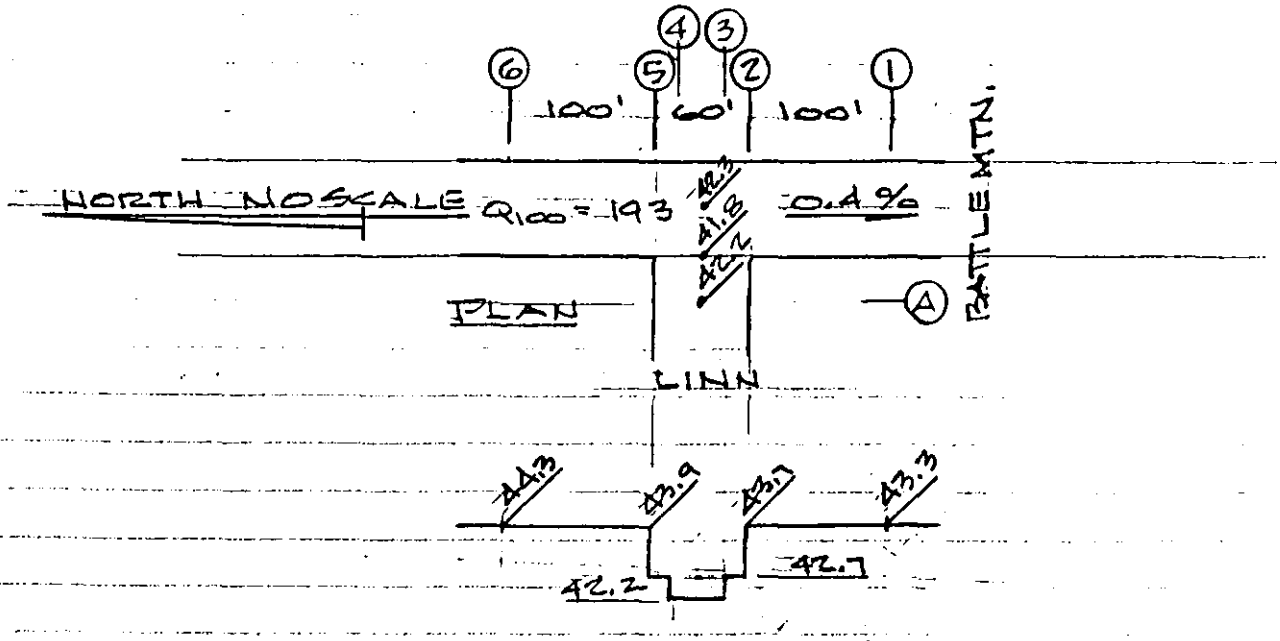
SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
x	10.000	335.00	44.74	.00	.00	1.44	80.00	.00
x	9.000	335.00	44.54	.00	-.20	.00	80.00	100.00
x	8.000	179.76	43.45	.00	-1.09	.00	73.14	5.50
x	7.000	179.76	43.60	.00	.15	.00	95.17	69.00
x	6.000	179.76	44.05	.00	.45	.00	76.68	5.50
x	5.000	179.76	42.84	.00	-1.21	.00	76.31	550.00
x	4.000	138.54	42.18	.00	-.66	.00	77.91	5.50
x	3.000	138.54	42.27	.00	.09	.00	101.69	49.00
x	2.000	138.54	42.56	.00	.29	.00	73.50	5.50
x	1.000	138.54	42.45	.00	-.11	.00	73.50	100.00

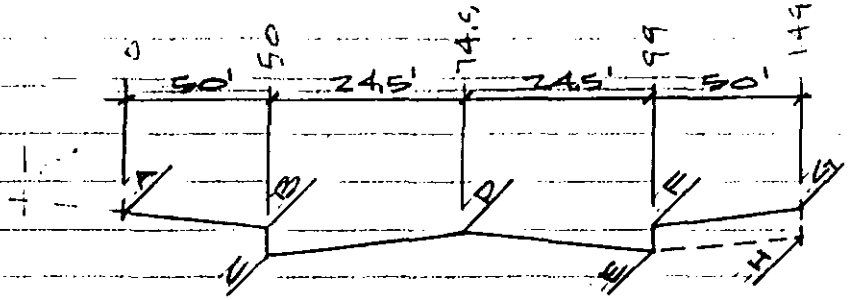
SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 10.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 9.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 9.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 9.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO= 8.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 7.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 6.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 1.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

SPLIT FLOW - BATTLE MTN./LINN



PROFILE "A"



SECTIONS 1 THRU 6

SEC.	A	B	C	D	E	F	G	H
1	43.3	41.8	41.3	41.8	41.3	41.8	43.3	–
2	43.7	42.2	41.7	42.2	41.7	42.2	43.7	–
3	43.7	42.2	41.7	42.2	41.7	–	–	42.2
4	43.9	42.4	41.9	42.4	41.9	–	–	42.2
5	43.9	42.4	41.9	42.4	41.9	42.4	43.9	–
6	44.3	42.8	42.3	42.8	42.3	42.8	44.3	–

```
X     X  XXXXXXX  XXXXX            XXXXX
X     X  X       X     X          X     X
X     X  X       X                      X
XXXXXXX  XXXX    X          XXXXX   XXXXX
X     X  X       X                X
X     X  X       X     X          X
X     X  XXXXXXX  XXXXX           XXXXXXX
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**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT BATTLE MTN & LINN
TW FLOW ON BATTLE MTN
WS      2       1       2      -1     2.7
WC      0    43.3     100    43.7
TW FLOW WEST ON LINN
WS      8       2       5      -1     2.7
WC      0    43.7       0    42.7     5.5    42.7     5.5    42.2    54.5    42.2
WC   54.5    42.7      60    42.7      60    43.9
TW FLOW ON BATTLE MTN
WS      2       5       6      -1     2.7
WC      0    43.1     100    43.5

TI CIBOLA
T2 SUBCRITICAL (UPSTREAM) RUN
T3 CSF2
J1   ICHECK     INQ      NINV     IDIR     STRT     METRIC    HVINS     Q        WSEL     FQ
        0         0         0        0       -1          0        0      193      42.1      0
J2   NPROF     IPLOT     PRFVS    XSECV    XSECH     FN      ALLDC     IBW      CHNIM    ITRACE
       -1         0         0        0        0        0         0        0         0        0

NC    0.020     0.020     0.015      0.1      0.3

X1        1         7        50       99        0         0         0         0         0         0
GR     43.3         0      41.8       50     41.3        50      41.8      74.5      41.3        99
GR     41.8        99      43.3      149

NC    0.020     0.012     0.015      0.1      0.3

X1        2         7        50       99      100       100       100         0         0         0
GR     43.7         0      42.2       50     41.7        50      42.2      74.5      41.7        99
GR     42.2        99      43.7      149

NC    0.020     0.015     0.015      0.1      0.3

X1        3         6        50       99      5.5       5.5       5.5         0         0         0
GR     43.7         0      42.2       50     41.7        50      42.2      74.5      41.7        99
GR     42.2       149

NC    0.020     0.012     0.015      0.1      0.3

X1        4         6        50       99       49        49        49         0         0         0
GR     43.9         0      42.4       50     41.9        50      42.4      74.5      41.9        99
GR     42.2       149

NC    0.020     0.020     0.015      0.1      0.3

X1        5         7        50       99      5.5       5.5       5.5         0         0         0
GR     43.9         0      42.4       50     41.9        50      42.4      74.5      41.9        99
GR     42.4        99      43.9      149
```

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X1          6          7         50         99        100        100        100          0          0          0
GR       44.3          0       42.8         50       42.3         50       42.8       74.5       42.3         99
GR       42.8         99       44.3        149

   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        ML        QLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TVA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST

*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED
    1.000       .88     42.18     42.18     42.10     42.44       .27       .00       .00     41.80
      137.        3.      130.        3.        2.       31.        2.        0.        0.     41.80
       .00      1.44      4.23      1.44      .020      .015      .020      .000     41.30     37.44
  .003502        0.        0.        0.         0         7         0       .00     74.11    111.56

*SECNO 2.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    2.000       .88     42.58     42.58       .00     42.83       .26       .34       .00     42.20
      137.        3.      128.        6.        2.       31.        2.        0.        0.     42.20
       .01      1.42      4.17      2.37      .020      .015      .012      .000     41.70     37.46
  .003399      100.      100.      100.         2         5         0       .00     74.07    111.54

*SECNO 3.000
3280 CROSS SECTION      3.00 EXTENDED       .62 FEET
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  3.40
    3.000      1.12     42.82       .00       .00     42.86       .04       .00       .02     42.20
      137.        4.       66.       67.        6.       43.       44.        0.        0.     41.70
       .01       .59      1.54      1.54      .020      .015      .015      .000     41.70     29.25
  .000295        6.        6.        6.         3         0         0       .00    119.75    149.00

*SECNO 4.000
3280 CROSS SECTION      4.00 EXTENDED       .63 FEET
    4.000       .92     42.82       .00       .00     42.88       .06       .02       .01     42.40
      137.        2.       52.       83.        3.       33.       39.        0.        0.     41.90
       .02       .55      1.57      2.14      .020      .015      .012      .000     41.90     35.78
  .000427       49.       49.       49.         2         0         0       .00    113.22    149.00

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    5.000      1.03     42.93     42.93       .00     43.24       .31       .01       .08     42.40
      193.        8.      177.        8.        5.       38.        5.        0.        0.     42.40
       .02      1.72      4.65      1.72      .020      .015      .020      .000     41.90     32.42
  .003164        6.        6.        6.        20         8         0       .00     84.17    116.58

*SECNO 6.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    6.000      1.03     43.33     43.33       .00     43.64       .31       .32       .00     42.80
      193.        8.      177.        8.        5.       38.        5.        0.        1.     42.80
       .02      1.72      4.66      1.72      .020      .015      .020      .000     42.30     32.45
  .003181      100.      100.      100.         2         5         0       .00     84.09    116.55

 TW FLOW ON BATTLE MTN
    ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSWS      USWS      DSSNO     USSNO
       .00       .00       .00       .00       .00       .00         5   42.177    42.576      1.000     2.000
 TW FLOW WEST ON LINN
    ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSWS      USWS      DSSNO     USSNO
     56.13     56.13       .01     56.13     56.13       .01         5   42.576    42.928      2.000     5.000
 TW FLOW ON BATTLE MTN
    ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSWS      USWS      DSSNO     USSNO
       .00       .00       .00     56.13     56.13       .01         5   42.928    43.326      5.000     6.000
```
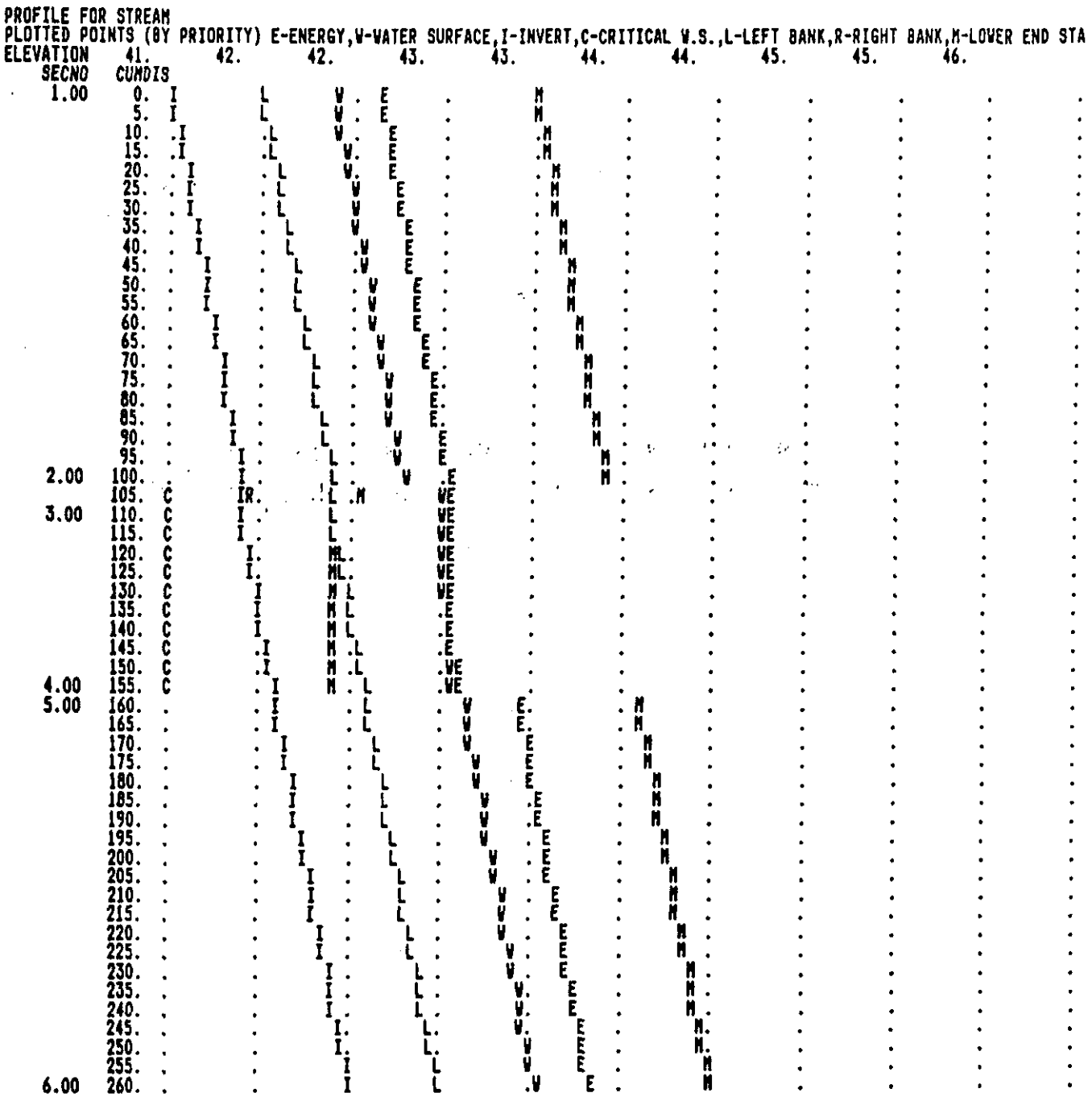

FR = 0.6

FR = 0.6

FR = 0.6

FR = 0.6


PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION 41. 42. 42. 43. 43. 44. 44. 45. 45. 46.
SECNO CUMDIS
1.00 0.
2.00
3.00
4.00
5.00
6.00

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	41.30	136.87	42.18	42.18	42.44	35.02	4.23	35.44	23.1
*	2.000	100.00	.00	.00	41.70	136.87	42.58	42.58	42.83	33.99	4.17	35.39	23.4
*	3.000	5.50	.00	.00	41.70	136.87	42.82	.00	42.86	2.95	1.54	92.83	79.7
	4.000	49.00	.00	.00	41.90	136.87	42.82	.00	42.88	4.27	1.57	75.00	66.2
*	5.000	5.50	.00	.00	41.90	193.00	42.93	42.93	43.24	31.64	4.65	47.37	34.3
*	6.000	100.00	.00	.00	42.30	193.00	43.33	43.33	43.64	31.81	4.66	47.28	34.2

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1.000	136.87	42.18	.00	.00	.08	74.11	.00
*	2.000	136.87	42.58	.00	.40	.00	74.07	100.00
*	3.000	136.87	42.82	.00	.25	.00	119.75	5.50
	4.000	136.87	42.82	.00	.00	.00	113.22	49.00
*	5.000	193.00	42.93	.00	.10	.00	84.17	5.50
*	6.000	193.00	43.33	.00	.40	.00	84.09	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
WARNING SECNO= 3.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

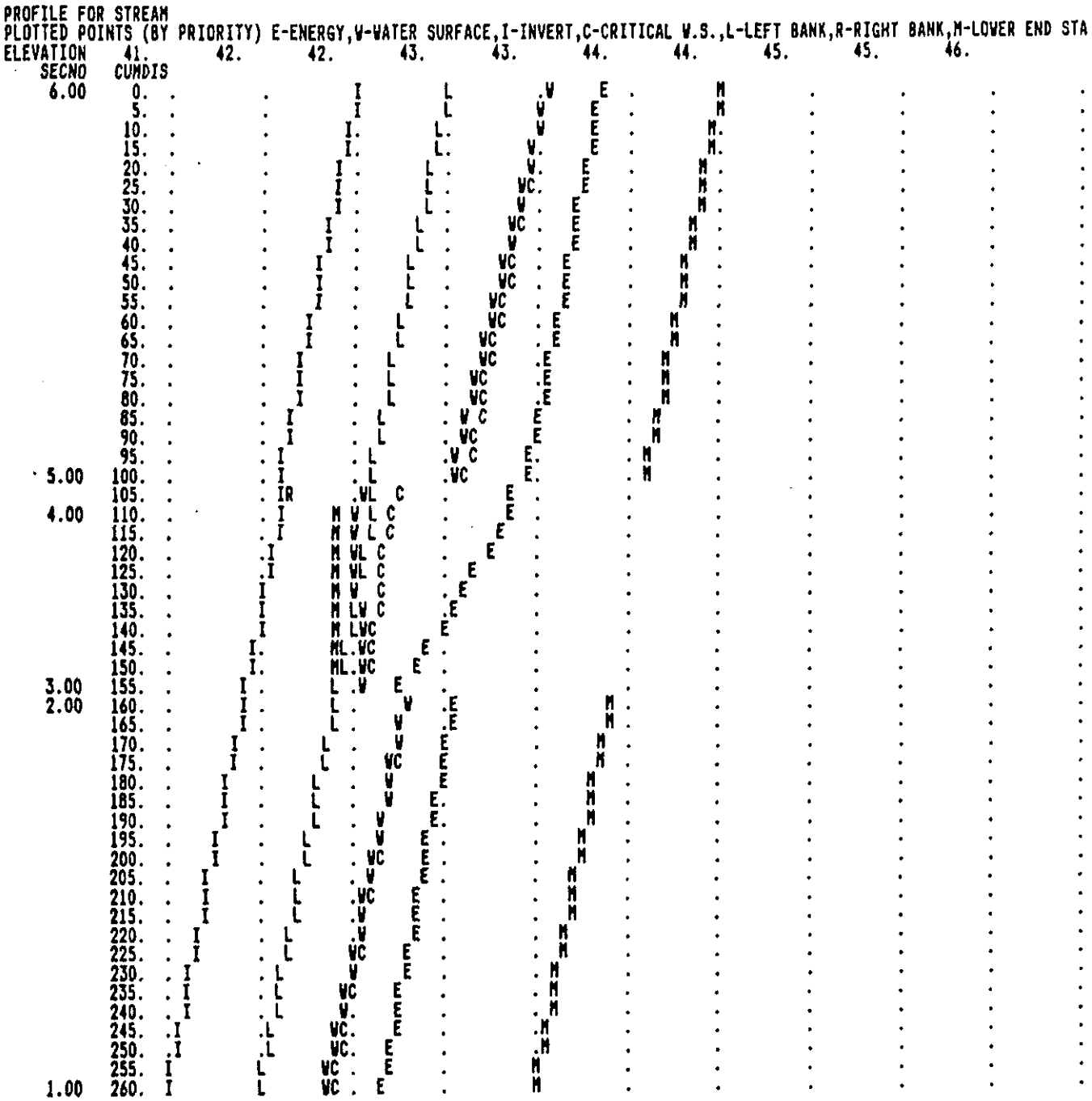
$F_R = \frac{V^2}{gA} < 1$ ∴ SUBCRITICAL FLOW

Q_{100} = 137 CFS SOUTH ON BATTLE MTN.

Q_{100} = 50 CFS WEST ON LINN

```
X    X  XXXXXXX   XXXXX            XXXXX
X    X  X       X     X          X     X
X    X  X       X                      X
XXXXXXX  XXXX    X          XXXXX   XXXXX
X    X  X       X                  X
X    X  X       X     X            X
X    X  XXXXXXX  XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT BATTLE MTN & LINN
TW FLOW ON BATTLE MTN
WS     2       1       2      -1     2.7
WC     0    43.3     100    43.7
TW FLOW WEST ON LINN
WS     8       2       5      -1     2.7
WC     0    43.7       0    42.7     5.5    42.7     5.5    42.2    54.5    42.2
WC  54.5    42.7      60    42.7      60    43.9
TW FLOW ON BATTLE MTN
WS     2       5       6      -1     2.7
WC     0    43.1     100    43.5

T1 CIBOLA
T2 SUPERCRITICAL (DOWNSTREAM) RUN
T3 CSF2A
J1  ICHECK     INQ      NINV     IDIR     STRT     METRIC    HVINS     Q        WSEL     FQ
       0         0         0        1       -1          0        0       193     42.1        0
J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN        ALLDC    IBW      CHNIM    ITRACE
      -1         0         0        0        0         0        0        0        0        0

NC    0.020     0.020     0.015     0.1      0.3

X1        6         7        50       99      100       100       100         0         0         0
GR     44.3         0      42.8       50     42.3        50      42.8      74.5      42.3        99
GR     42.8        99      44.3      149

NC    0.020     0.012     0.015     0.1      0.3

X1        5         7        50       99      5.5       5.5       5.5         0         0         0
GR     43.9         0      42.4       50     41.9        50      42.4      74.5      41.9        99
GR     42.4        99      43.9      149

NC    0.020     0.015     0.015     0.1      0.3

X1        4         6        50       99       49        49        49         0         0         0
GR     43.9         0      42.4       50     41.9        50      42.4      74.5      41.9        99
GR     42.2       149

NC    0.020     0.012     0.015     0.1      0.3

X1        3         6        50       99      5.5       5.5       5.5         0         0         0
GR     43.7         0      42.2       50     41.7        50      42.2      74.5      41.7        99
GR     42.2       149

NC    0.020     0.020     0.015     0.1      0.3

X1        2         7        50       99      100       100       100         0         0         0
GR     43.7         0      42.2       50     41.7        50      42.2      74.5      41.7        99
GR     42.2        99      43.7      149
```

```
X1          1          7         50         99          0          0          0          0          0          0
GR       43.3          0       41.8         50       41.3         50       41.8       74.5       41.3         99
GR       41.8         99       43.3        149

   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS    BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA    LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST

*SECNO 6.000
3720 CRITICAL DEPTH ASSUMED
    6.000      1.03     43.33     43.33     42.10     43.64       .31       .00       .00     42.80
      193.        8.       177.        8.        5.       38.        5.        0.        0.     42.80
      .00      1.71      4.63      1.71      .020      .015      .020      .000     42.30     32.35
  .003133        0.        0.        0.         0        12         0       .00     84.30    116.65

*SECNO 5.000
    5.000       .94     42.84     42.92       .00     43.25       .40       .38       .01     42.40
      193.        6.       177.       10.        3.       34.        3.        0.        0.     42.40
      .01      1.86      5.25      3.10      .020      .015      .012      .000     41.90     35.40
  .004759       100.      100.      100.         3         5         0       .00     78.20    113.60

*SECNO 4.000
3265 DIVIDED FLOW
3280 CROSS SECTION      4.00 EXTENDED       .09 FEET
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  4.04
    4.000       .39     42.29     42.50       .00     43.15       .86       .05       .05     42.40
      142.        0.        50.       93.        0.        7.       12.        0.        0.     41.90
      .01       .00      6.77      7.80      .000      .015      .015      .000     41.90     50.00
  .042211         6.        6.        6.        10        14         0       .00     87.98    149.00

*SECNO 3.000
3280 CROSS SECTION      3.00 EXTENDED       .16 FEET
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .28
7185 MINIMUM SPECIFIC ENERGY
    3.000       .65     42.35     42.36       .00     42.55       .20       .40       .20     42.20
      142.        0.        62.       80.        0.       20.       20.        0.        0.     41.70
      .01       .79      3.12      3.92      .020      .015      .012      .000     41.70     44.77
  .003346        49.       49.       49.        10        14         0       .00    104.23    149.00

*SECNO 2.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    2.000       .89     42.59     42.59       .00     42.86       .27       .02       .03     42.20
      142.        4.       135.        4.        3.       32.        3.        0.        0.     42.20
      .01      1.47      4.27      1.47      .020      .015      .020      .000     41.70     36.84
  .003420         6.        6.        6.        20        11         0       .00     75.32    112.16

*SECNO 1.000
    1.000       .84     42.14     42.19       .00     42.47       .33       .39       .01     41.80
      142.        3.       136.        3.        2.       29.        2.        0.        0.     41.80
      .02      1.55      4.67      1.55      .020      .015      .020      .000     41.30     38.47
  .004550       100.      100.      100.         2         5         0       .00     72.05    110.53

 TW FLOW ON BATTLE MTN
    ASQ       QCOMP      ERRAC      TASQ       TCQ       TABER      NITER     DSWS      USWS      DSSNO     USSNO
       .00        .00        .00        .00        .00        .00          5   42.141    42.595     1.000     2.000
 TW FLOW WEST ON LINN
    ASQ       QCOMP      ERRAC      TASQ       TCQ       TABER      NITER     DSWS      USWS      DSSNO     USSNO
     50.56      50.56        .00      50.56      50.56        .00          5   42.595    42.845     2.000     5.000
 TW FLOW ON BATTLE MTN
    ASQ       QCOMP      ERRAC      TASQ       TCQ       TABER      NITER     DSWS      USWS      DSSNO     USSNO
       .00        .00        .00      50.56      50.56        .00          5   42.845    43.330     5.000     6.000
```


PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION
SECNO
CUMDIS
41.
42.
42.
43.
43.
44.
44.
45.
45.
46.
6.00
5.00
4.00
3.00
2.00
1.00

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	6.000	.00	.00	.00	42.30	193.00	43.33	43.33	43.64	31.33	4.63	47.54	34.4
	5.000	100.00	.00	.00	41.90	193.00	42.84	42.92	43.25	47.59	5.25	40.11	27.9
*	4.000	5.50	.00	.00	41.90	142.44	42.29	42.50	43.15	422.11	6.77	19.24	6.9
*	3.000	49.00	.00	.00	41.70	142.44	42.35	42.36	42.55	33.46	3.12	40.69	24.6
*	2.000	5.50	.00	.00	41.70	142.44	42.59	42.59	42.86	34.20	4.27	36.79	24.3
	1.000	100.00	.00	.00	41.30	142.44	42.14	42.19	42.47	45.50	4.67	33.18	21.1

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	6.000	193.00	43.33	.00	.00	1.23	84.30	.00
	5.000	193.00	42.84	.00	-.48	.00	78.20	100.00
*	4.000	142.44	42.29	.00	-.56	.00	87.98	5.50
*	3.000	142.44	42.35	.00	.06	.00	104.23	49.00
*	2.000	142.44	42.59	.00	.24	.00	75.32	5.50
	1.000	142.44	42.14	.00	-.45	.00	72.05	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 3.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
WARNING SECNO= 3.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

ROUTE DA 3 TO DA 4

MUSKINGUM METHOD

"x" = 0.1

L = 10000'

S = 0.2%

V = 4 FPS

"K" = L/3600 V = 0.07

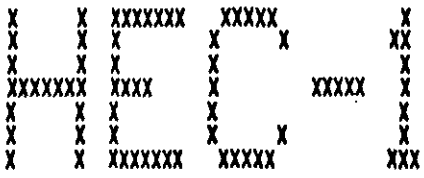
"T" = S/60 = 0.083

NSTPS = 2

$$\frac{1}{2(1-X)} \leq \frac{K}{NSTPS \times T} \leq \frac{1}{2X}$$

$$\frac{1}{1.8} < \frac{0.7}{0.17} < \frac{1}{0.2}$$

$$0.6 < 4.1 < 5.0$$



THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1D8, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT

```
      LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

        1           ID   OFFSITE DRAINAGE AREA DA3 + DA4 MUSKINGUM ROUTE

        2           ID   CIBOLA
        3           ID   100-YEAR 6-HOUR STORM
        4           ID   SDN3/C34
*** FREE ***
        5           IT     03       0       0     300
        6           IO      3       0       0
        7           KK    SUB1    SUB-BASIN 3 HYDROGRAPH
        8           KM            SCS RUNOFF COMPUTATION, SUB-1
        9           BA   1.27
       10           PB   2.74
       11           PC      0    2.00    5.70    7.00    8.70   10.80   12.40   13.00   13.00   13.00
       12           PC  13.00   13.00   13.00   13.30   14.00   14.20   14.80   15.80   17.20   18.10
       13           PC  19.00   19.70   19.90   20.00   20.10   20.40   21.40   22.90   24.10   24.90
       14           PC  25.10   25.60   27.00   27.80   28.10   28.30   29.50   32.20   35.20   40.90
       15           PC  49.90   59.00   71.00   74.40   78.10   81.20   81.90   83.50   85.10   85.60
       16           PC  86.00   86.80   87.60   88.80   91.00   92.60   93.70   95.00   97.00   97.60
       17           PC  98.20   98.50   98.70   98.90   99.00   99.30   99.30   99.40   99.50   99.80
       18           PC  99.80   99.90  100.00
       19           LS      0      72
       20           UD   0.94
       21           KK   NODE8   ROUTE FLOW TO NODE 8
       22           RM      2    0.07     0.1
       23           KK    SUB2    SUB-BASIN 4 HYDROGRAPH
       24           KM            SCS RUNOFF COMPUTATION, SUB-2
       25           BA  0.544
       26           PB   2.80
       27           LS      0      74
       28           UD   0.73
       29           KK   NODE8   COMBINE FLOW AT NODE 8
       30           HC      2
       31           ZZ
```

```
  IT          HYDROGRAPH TIME DATA
                   NMIN          3  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME         0000  STARTING TIME
                     NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      1   0  ENDING DATE
                 NDTIME         1457  ENDING TIME
                  ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL     .05 HOURS
                   TOTAL TIME BASE   14.95 HOURS
```

SUB-BASIN 3 HYDROGRAPH
SCS RUNOFF COMPUTATION, SUB-1

11 PI INCREMENTAL PRECIPITATION PATTERN

2.00	3.70	1.30	1.70	2.10	1.60	.60	.00	.00	.00
.00	.00	.30	.70	.20	.60	1.00	1.40	.90	.90
.70	.20	.10	.10	.30	1.00	1.50	1.20	.80	.20
.50	1.40	.80	.30	.20	1.20	2.70	3.00	5.70	9.00
9.10	12.00	3.40	3.70	3.10	.70	1.60	1.60	.50	.40
.80	.80	1.20	2.20	1.60	1.10	1.30	2.00	.60	.60
.30	.20	.20	.10	.30	.00	.10	.10	.30	.00
.10	.10								

UNIT HYDROGRAPH
96 END-OF-PERIOD ORDINATES

10.	21.	44.	68.	97.	129.	169.	212.	265.	321.
383.	442.	494.	539.	575.	602.	622.	632.	635.	634.
630.	614.	594.	572.	549.	523.	496.	464.	430.	391.
352.	319.	288.	265.	243.	223.	204.	188.	173.	161.
149.	137.	126.	116.	107.	97.	89.	82.	76.	69.
64.	59.	54.	49.	45.	42.	38.	35.	32.	30.
27.	25.	23.	21.	20.	18.	17.	15.	14.	13.
12.	11.	10.	9.	8.	8.	7.	7.	6.	6.
5.	5.	5.	4.	4.	4.	3.	3.	2.	2.
2.	1.	1.	1.	0.	0.				

HYDROGRAPH AT STATION SUB

TOTAL RAINFALL = 2.74, TOTAL LOSS = 2.08, TOTAL EXCESS = .66

	PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
+	(CFS)	(HR)	(CFS)			
+	326.	3.30	90.	36.	36.	36.
			(INCHES) .658	.658	.658	.658
			(AC-FT) 45.	45.	45.	45.

ROUTE FLOW TO NODE 8
HYDROGRAPH ROUTING DATA

22 RM MUSKINGUM ROUTING

NSTPS	2 NUMBER OF SUBREACHES
AMSKK	.07 MUSKINGUM K
X	.10 MUSKINGUM X

HYDROGRAPH AT STATION NODE

	PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
+	(CFS)	(HR)	(CFS)			
+	325.	3.35	90.	36.	36.	36.
			(INCHES) .658	.658	.658	.658
			(AC-FT) 45.	45.	45.	45.

SUB-BASIN 4 HYDROGRAPH
SCS RUNOFF COMPUTATION, SUB-2

11 PI INCREMENTAL PRECIPITATION PATTERN

2.00	3.70	1.30	1.70	2.10	1.60	.60	.00	.00	.00
.00	.00	.30	.70	.20	.60	1.00	1.40	.90	.90
.70	.20	.10	.10	.30	1.00	1.50	1.20	.80	.20
.50	1.40	.80	.30	.20	1.20	2.70	3.00	5.70	9.00
9.10	12.00	3.40	3.70	3.10	.70	1.60	1.60	.50	.40
.80	.80	1.20	2.20	1.60	1.10	1.30	2.00	.60	.60
.30	.20	.20	.10	.30	.00	.10	.10	.30	.00
.10	.10								

UNIT HYDROGRAPH
75 END-OF-PERIOD ORDINATES

7.	18.	34.	55.	79.	107.	143.	183.	227.	264.
296.	322.	336.	346.	348.	346.	339.	325.	310.	293.
274.	252.	227.	199.	176.	155.	139.	124.	111.	100.
91.	82.	74.	67.	60.	53.	48.	43.	38.	35.
31.	28.	25.	22.	20.	18.	16.	14.	13.	12.
11.	9.	9.	8.	7.	6.	5.	5.	4.	4.
4.	3.	3.	3.	3.	2.	2.	2.	1.	1.
1.	1.	1.	0.	0.					

HYDROGRAPH AT STATION SUB

TOTAL RAINFALL = 2.80, TOTAL LOSS = 2.02, TOTAL EXCESS = .78

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)				
193.	2.95		46.	18.	18.	18.
		(INCHES)	.784	.784	.784	.784
		(AC-FT)	23.	23.	23.	23.

COMBINE FLOW AT NODE B

HYDROGRAPH AT STATION NODE

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)				
496.	3.20		136.	54.	54.	54.
		(INCHES)	.696	.696	.696	.696
		(AC-FT)	67.	67.	67.	67.

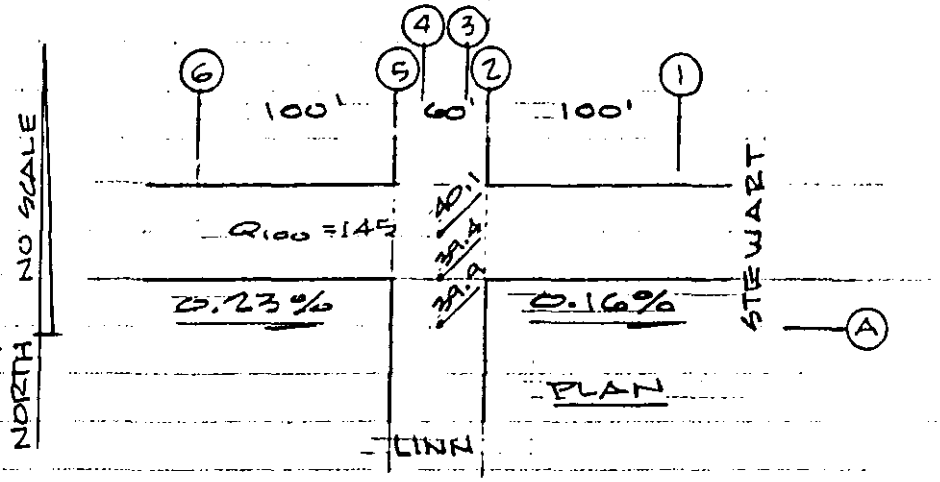
RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

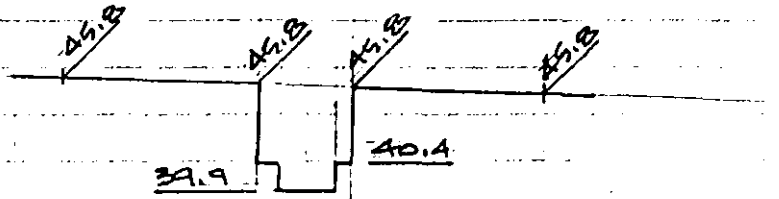
OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	SUB	326.	3.30	90.	36.	36.	1.27		
ROUTED TO	NODE	325.	3.35	90.	36.	36.	1.27		
HYDROGRAPH AT	SUB	193.	2.95	46.	18.	18.	.54		
2 COMBINED AT	NODE	496.	3.20	136.	54.	54.	1.81		

*** NORMAL END OF HEC-1 ***

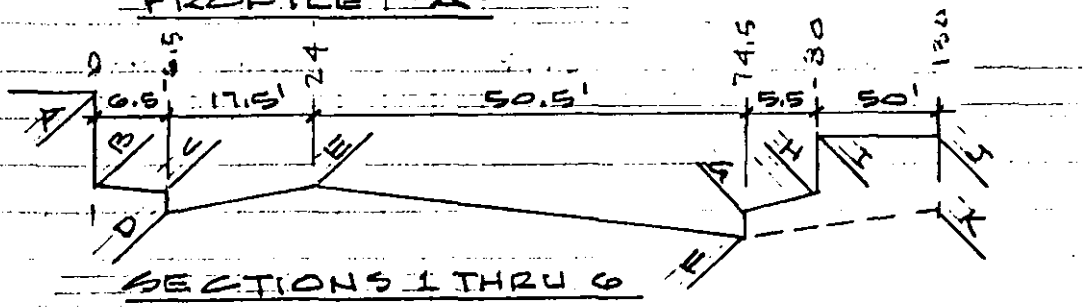
EQ100 DA 3+DA 4 = 496
FROM DA 2 = + 9
SOUTH ON CHRISTY = - 173
SOUTH ON UNGER = - 50
SOUTH ON BATTLEMT = - 137
TO STEWART/LINN = 145 CFS

SPLIT FLOW - STEWART TO LINN





PROFILE "A"



SECTIONS 1 THRU 6

SEC.	A	B	C	D	E	F	G	H	I	J	K
1	46.5	40.5	40.4	39.9	40.2	39.2	39.7	39.8	45.8	45.8	-
2	46.5	40.7	40.6	40.1	40.4	39.4	39.9	40.0	45.8	45.8	-
3	46.5	40.7	40.6	40.1	40.4	39.4	-	-	-	-	39.9
4	46.5	40.8	40.7	40.2	40.5	39.5	-	-	-	-	39.9
5	46.5	40.8	40.7	40.2	40.5	39.5	40.0	40.1	45.8	45.8	-
6	46.5	41.0	40.9	40.4	40.7	39.7	40.2	40.3	45.8	45.8	-

```
X    X  XXXXXXX  XXXXX          XXXXX
X    X  X       X    X        X     X
X    X  X       X              X
XXXXXXX  XXXX    X       XXXXX   XXXXX
X    X  X       X                  X
X    X  X       X    X             X
X    X  XXXXXXX  XXXXX          XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT STEWART & LINN
TW FLOW ON STEWART
WS     2       1       2      -1     2.7
WC     0    45.8     100    45.8
TW FLOW WEST ON LINN
WS     8       2       5      -1     2.7
WC     0    45.8       0    40.4     5.5    40.4     5.5    39.9    54.5    39.9
WC  54.5    40.4      60    40.4      60    45.8
TW FLOW ON STEWART
WS     2       5       6      -1     2.7
WC     0    45.8     100    45.8

T1 CIBOLA
T2 SUBCRITICAL (UPSTREAM) RUN
T3 CSF3
J1   ICHECK      INQ      NINV      IDIR      STRT     METRIC     HVINS         Q      WSEL        FQ
        0        0         0         0        -1          0         0       145      41.1         0
J2   NPROF     IPLOT     PRFVS     XSECV     XSECH        FN    ALLDC      IBW     CHNIM     ITRACE
       -1         0         0         0         0         0         0         0         0         0

NC    0.013     0.013     0.015       0.1       0.3

X1        1        10       6.5      74.5         0         0         0         0         0         0
GR     46.5         0      40.5         0      40.4       6.5      39.9       6.5      40.2        24
GR     39.2      74.5      39.7      74.5      39.8        80      45.8        80      45.8       130

X1        2        10       6.5      74.5       100       100       100         0         0         0
GR     46.5         0      40.7         0      40.6       6.5      40.1       6.5      40.4        24
GR     39.4      74.5      39.9      74.5      40.0        80      45.8        80      45.8       130

X1        3         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     46.5         0      40.7         0      40.6       6.5      40.1       6.5      40.4        24
GR     39.4      74.5      39.9       130

X1        4         7       6.5      74.5        49        49        49         0         0         0
GR     46.5         0      40.8         0      40.7       6.5      40.2       6.5      40.5        24
GR     39.5      74.5      39.9       130

X1        5        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     46.5         0      40.8         0      40.7       6.5      40.2       6.5      40.5        24
GR     39.5      74.5      40.0      74.5      40.1        80      45.8        80      45.8       130

X1        6        10       6.5      74.5       100       100       100         0         0         0
GR     46.5         0      41.0         0      40.9       6.5      40.4       6.5      40.7        24
GR     39.7      74.5      40.2      74.5      40.3        80      45.8        80      45.8       130
```

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        QLOSS     BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA     LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*SECNO 1.000
3265 DIVIDED FLOW
3720 CRITICAL DEPTH ASSUMED
    1.000      .89     40.09     40.09     41.10     40.28      .19       .00       .00     40.40
      80.       0.       73.       7.        0.       21.       2.        0.        0.      39.70
      .00       .00     3.52      3.68      .000      .015      .013      .000     39.20     6.50
  .004754       0.       0.        0.        0         13        0        .00      61.12    80.00

*SECNO 2.000
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.79
    2.000     1.05     40.45      .00       .00      40.54      .08       .24       .01     40.60
      80.       0.       73.       7.        0.       32.       3.        0.        0.      39.90
      .01       .00     2.29      2.66      .000      .015      .013      .000     39.40     6.50
  .001489      100.     100.      100.        2         0         0        .00      73.50    80.00

*SECNO 3.000
3280 CROSS SECTION      3.00 EXTENDED       .63 FEET
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  3.60
    3.000     1.13     40.53      .00       .00      40.54      .02       .00       .01     40.60
      80.       0.       26.       54.       0.       37.       49.       0.        0.      39.40
      .01       .00      .70      1.12      .000      .015      .013      .000     39.40     6.50
  .000115       6.       6.        6.        2         0         0        .00     123.50    130.00

*SECNO 4.000
3280 CROSS SECTION      4.00 EXTENDED       .63 FEET
    4.000     1.03     40.53      .00       .00      40.55      .02       .01       .00     40.70
      80.       0.       22.       58.       0.       30.       46.       0.        0.      39.50
      .03       .00      .72      1.27      .000      .015      .013      .000     39.50     6.50
  .000159      49.      49.       49.        2         0         0        .00     123.50    130.00

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    5.000     1.07     40.57     40.57      .00      40.83      .26       .00       .07     40.70
      145.      0.       132.      13.       0.       33.       3.        0.        0.      40.00
      .03       .00     4.01      4.65      .000      .015      .013      .000     39.50     6.50
  .004389       6.       6.        6.        20        8         0        .00      73.50    80.00

*SECNO 6.000
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.67
    6.000     1.25     40.95      .00       .00      41.09      .14       .25       .01     40.90
      145.      0.       132.      13.       0.       45.       4.        0.        0.      40.20
      .04       .05     2.95      3.32      .013      .015      .013      .000     39.70     3.31
  .001577      100.     100.      100.        2         0         0        .00      76.69    80.00

TW FLOW ON STEWART
   ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSVS      USVS      DSSNO     USSNO
      .00       .00       .00       .00       .00       .00         5    40.086    40.452     1.000     2.000
TW FLOW WEST ON LINN
   ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSVS      USVS      DSSNO     USSNO
    64.81     64.74       .11     64.81     64.74       .11         5    40.452    40.573     2.000     5.000
TW FLOW ON STEWART
   ASQ       QCOMP     ERRAC     TASQ      TCQ       TABER     NITER     DSVS      USVS      DSSNO     USSNO
      .00       .00       .00     64.81     64.74       .11         5    40.573    40.951     5.000     6.000
```

$F_R = 0.4$

$F_R = 0.2$

```
PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    39.      40.      41.      42.      43.      44.      45.      46.      47.      48.
    SECNO   CUMDIS
     1.00       0.  I   R  W.EL                                                M
                5.  I   R  W.EL                                                M
               10.  I   R  W.EL                                                M
               15.  I   R  W.EL                                                M
               20.  I   R   WEL                                                M
               25.  CI  R   WE L                                               M
               30.  CI  R   W EL                                               M
               35.  CI  R   W EL                                               M
               40.  CI  R   W EL                                               M
               45.  CI  R  .WEL                                                M
               50.  CI  R  .WEL                                                M
               55.  CI  R  .WEL                                                M
               60.  CI  R  .WEL                                                M
               65.  CI  R  .WEL                                                M
               70.  CI  R  .W E                                                M
               75.  C I   R  . WE                                              M
               80.  C I   R  . WEL                                             M
               85.  C I   R  . WEL                                             M
               90.  C I   R  . WEL                                             M
               95.  C I   R  . WEL                                             M
     2.00     100.  C I   R  .  EL                                              M
              105.  C I      . MEL
     3.00     110.  C I   M  .  EL
              115.  C I   M  .  EL
              120.  C I   M  .  EL
              125.  C I   M  .  EL
              130.  C I   M  .  EL
              135.  C  I  M  .  E L
              140.  C  I  M  .  E L
              145.  C  I  M  .  E L
              150.  C  I  M  .  E L
     4.00     155.  C  I  M  .  E L
     5.00     160.  .  I   R .   WLE                                                M
              165.  C  I   R .   WLE                                                M
              170.  C  I   R .   WL E                                               M
              175.  C  I   R .   WL E                                               M
              180.  C  I   R .   WL E                                               M
              185.  C  I   R .    WLE                                               M
              190.  C    I   R.    WLE                                               M
              195.  C    I   R.    WLE                                               M
              200.  C    I   R.    WLE                                               M
              205.  C    I   R.    WLE                                               M
              210.  C    I   R.     W E                                              M
              215.  C    I   R.     W E                                              M
              220.  C    I   R.     W E                                              M
              225.  C    I   R.     W E                                              M
              230.  C    I   R.     W E                                              M
              235.  C    I   R.      WE                                              M
              240.  C    I     R      WE                                             M
              245.  C    I     R      W E                                            M
              250.  C    I     R      W E                                            M
              255.  C    I     R      W E                                            M
     6.00     260.  C    I     R      LWE                                            M
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01X
*	1.000	.00	.00	.00	39.20	80.19	40.09	40.09	40.28	47.54	3.52	22.69	11.6
*	2.000	100.00	.00	.00	39.40	80.19	40.45	.00	40.54	14.89	2.29	34.63	20.7
*	3.000	5.50	.00	.00	39.40	80.19	40.53	.00	40.54	1.15	.70	85.47	74.7
	4.000	49.00	.00	.00	39.50	80.19	40.53	.00	40.55	1.59	.72	76.25	63.5
*	5.000	5.50	.00	.00	39.50	145.00	40.57	40.57	40.83	43.89	4.01	35.73	21.8
*	6.000	100.00	.00	.00	39.70	145.00	40.95	.00	41.09	15.77	2.95	48.74	36.5

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1.000	80.19	40.09	.00	.00	-1.01	61.12	.00
*	2.000	80.19	40.45	.00	.37	.00	73.50	100.00
*	3.000	80.19	40.53	.00	.08	.00	123.50	5.50
	4.000	80.19	40.53	.00	.00	.00	123.50	49.00
*	5.000	145.00	40.57	.00	.04	.00	73.50	5.50
*	6.000	145.00	40.95	.00	.38	.00	76.69	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
WARNING SECNO= 2.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 3.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO= 6.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

$F_R = \frac{V^2}{gy} < 1 \therefore$ SUBCRITICAL FLOW

$Q_{100} = 80$ CFS EAST ON STEWART

$Q_{100} = 65$ CFS SOUTH ON LINN

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X           XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
SPLIT FLOW BEING PERFORMED
SF SPLIT FLOW AT STEWART & LINN
TW FLOW ON STEWART
WS      2       1       2      -1     2.7
WC      0    45.8     100    45.8
TW FLOW WEST ON LINN
WS      8       2       5      -1     2.7
WC      0    45.8       0    40.4     5.5    40.4     5.5    39.9    54.5    39.9
WC   54.5    40.4      60    40.4      60    45.8
TW FLOW ON STEWART
WS      2       5       6      -1     2.7
WC      0    45.8     100    45.8

T1 CIBOLA
T2 SUPERCRITICAL (DOWNSTREAM) RUN
T3 CSF3A
J1   ICHECK     INQ      NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
        0         0         0         1        -1           0        0       145      41.1         0
J2   NPROF     IPLOT     PRFVS     XSECV     XSECH        FN    ALLDC     IBW      CHNIM     ITRACE
        -1         0         0         0         0         0        0         0         0         0

NC    0.013     0.013     0.015       0.1       0.3

X1        6        10       6.5      74.5       100       100       100         0         0         0
GR     46.5         0      41.0         0      40.9       6.5      40.4       6.5      40.7        24
GR     39.7      74.5      40.2      74.5      40.3        80      45.8        80      45.8       130

X1        5        10       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     46.5         0      40.8         0      40.7       6.5      40.2       6.5      40.5        24
GR     39.5      74.5      40.0      74.5      40.1        80      45.8        80      45.8       130

X1        4         7       6.5      74.5        49        49        49         0         0         0
GR     46.5         0      40.8         0      40.7       6.5      40.2       6.5      40.5        24
GR     39.5      74.5      39.9       130

X1        3         7       6.5      74.5       5.5       5.5       5.5         0         0         0
GR     46.5         0      40.7         0      40.6       6.5      40.1       6.5      40.4        24
GR     39.4      74.5      39.9       130

X1        2        10       6.5      74.5       100       100       100         0         0         0
GR     46.5         0      40.7         0      40.6       6.5      40.1       6.5      40.4        24
GR     39.4      74.5      39.9      74.5      40.0        80      45.8        80      45.8       130

X1        1        10       6.5      74.5         0         0         0         0         0         0
GR     46.5         0      40.5         0      40.4       6.5      39.9       6.5      40.2        24
GR     39.2      74.5      39.7      74.5      39.8        80      45.8        80      45.8       130
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TVA     LEFT/RIGHT
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN       SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID      ENDST

*SECNO 6.000
3720 CRITICAL DEPTH ASSUMED
    6.000     1.10     40.80     40.80     41.10     41.03      .24       .00       .00      40.90
      145.       0.      132.       13.       0.        34.       3.        0.        0.       40.20
      .00       .00      3.83      4.43      .000      .015      .013      .000     39.70      6.50
  .003790        0.        0.        0.         0        13         0       .00     73.50     80.00

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    5.000     1.09     40.59     40.59       .00     40.83      .24       .39       .03      40.70
      145.       0.      132.       13.       0.        34.       3.        0.        0.       40.00
      .01       .00      3.90      4.51      .000      .015      .013      .000     39.50      6.50
  .003996      100.      100.      100.        20         6         0       .00     73.50     80.00

*SECNO 4.000
3301 HV CHANGED MORE THAN HVINS
3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  5.46
    4.000      .36      39.86     40.06       .00     40.73      .86       .04       .06      40.70
      89.       0.       21.       68.        0.        3.       9.        0.        0.       39.50
      .01       .00      6.66      7.69      .000      .015      .013      .000     39.50     56.50
  .045076        6.        6.        6.         11         8         0       .00     67.46    123.96

*SECNO 3.000
3280 CROSS SECTION      3.00 EXTENDED       .09 FEET
3301 HV CHANGED MORE THAN HVINS
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    3.000      .59      39.99     39.99       .00     40.16      .17       .47       .52      40.60
      89.       0.       24.       65.        0.        9.      19.        0.        0.       39.40
      .01       .00      2.76      3.49      .000      .015      .013      .000     39.40     44.90
  .004000       49.       49.       49.         20        14         0       .00     85.10    130.00

*SECNO 2.000
3265 DIVIDED FLOW
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    2.000      .92      40.32     40.32       .00     40.52      .20       .02       .03      40.60
      89.       0.       81.        8.        0.       23.       2.        0.        0.       39.90
      .01       .00      3.56      3.89      .000      .015      .013      .000     39.40      6.50
  .004699        6.        6.        6.         20        14         0       .00     64.84     80.00

*SECNO 1.000
3265 DIVIDED FLOW
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    1.000      .92      40.12     40.12       .00     40.32      .20       .47       .34      40.40
      89.       0.       81.        8.        0.       23.       2.        0.        0.       39.70
      .02       .00      3.54      3.88      .000      .015      .013      .000     39.20      6.50
  .004645      100.      100.      100.         20         5         0       .00     65.03     80.00

 TW FLOW ON STEWART
    ASQ       QCOMP      ERRAC      TASQ       TCQ       TABER      NITER      DSWS      USWS      DSSNO     USSNO
       .00        .00        .00        .00        .00        .00          5    40.122    40.320     1.000     2.000
```

```
 TW FLOW WEST ON LINN
    ASQ      QCOMP      ERRAC      TASQ       TCQ       TABER     NITER     DSWS      USWS      DSSNO     USSNO
    55.87     55.87        .00      55.87      55.87       .00         5    40.320    40.587     2.000     5.000
 TW FLOW ON STEWART
    ASQ      QCOMP      ERRAC      TASQ       TCQ       TABER     NITER     DSWS      USWS      DSSNO     USSNO
     .00       .00        .00      55.87      55.87       .00         5    40.587    40.795     5.000     6.000

PROFILE FOR STREAM
PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA
ELEVATION    39.        40.        41.        42.        43.        44.        45.        46.        47.        48.
    SECNO   CUMDIS
     6.00       0.  .    I    R     WLE  .          .          .          .          .    M     .          .          .          .
                5.  .    I    R     WLE  .          .          .          .          .    M     .          .          .          .
               10.  .    I    R     WLE  .          .          .          .          .    M     .          .          .          .
               15.  .    I    R     WLE  .          .          .          .          .    M     .          .          .          .
               20.  .    I    R     WLE  .          .          .          .          .    M     .          .          .          .
               25.  .  I      R.    W LE  .          .          .          .          .    M     .          .          .          .
               30.  .  I      R.    WL E  .          .          .          .          .    M     .          .          .          .
               35.  .  I      R.    WL E  .          .          .          .          .    M     .          .          .          .
               40.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               45.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               50.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               55.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               60.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               65.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               70.  .  I      R.    WLE   .          .          .          .          .    M     .          .          .          .
               75.  .  I    R .    W LE  .          .          .          .          .    M     .          .          .          .
               80.  .  I    R .    WL E  .          .          .          .          .    M     .          .          .          .
               85.  .  I    R .    WL E  .          .          .          .          .    M     .          .          .          .
               90.  .  I    R .    WL E  .          .          .          .          .    M     .          .          .          .
               95.  .  I    R .    WLE   .          .          .          .          .    M     .          .          .          .
     5.00     100.  .  I    R .    WLE   .          .          .          .          .    M     .          .          .          .
              105.  .  I    W C. M  E    .          .          .          .          .          .          .          .          .
     4.00     110.  .  I    W C.    E    .          .          .          .          .          .          .          .          .
              115.  .  I    W C.    E    .          .          .          .          .          .          .          .          .
              120.  .  I    WC .    EL   .          .          .          .          .          .          .          .          .
              125.  .  I    WC .    EL   .          .          .          .          .          .          .          .          .
              130.  .  I    WC .   E L   .          .          .          .          .          .          .          .          .
              135.  . I     WC . E L     .          .          .          .          .          .          .          .          .
              140.  . I     WC . E L     .          .          .          .          .          .          .          .          .
              145.  . I     MW .E  L     .          .          .          .          .          .          .          .          .
              150.  . I     MW .E  L     .          .          .          .          .          .          .          .          .
     3.00     155.  . I     MW E   L     .          .          .          .          .          .          .          .          .
     2.00     160.  . I     R  .W EL     .          .          .          .          .    M     .          .          .          .
              165.  . I     R  .W EL     .          .          .          .          .    M     .          .          .          .
              170.  . I     R  .W EL     .          .          .          .          .    M     .          .          .          .
              175.  . I     R  .W EL     .          .          .          .          .    M     .          .          .          .
              180.  . I     R  .W EL     .          .          .          .          .    M     .          .          .          .
              185.  . I     R  .W E      .          .          .          .          .    M     .          .          .          .
              190.  .I      R  .W E      .          .          .          .          .    M     .          .          .          .
              195.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              200.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              205.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              210.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              215.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              220.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              225.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              230.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              235.  .I      R  W EL      .          .          .          .          .    M     .          .          .          .
              240.  I     R    W E      .          .          .          .          .    M     .          .          .          .
              245.  I     R   W.EL      .          .          .          .          .    M     .          .          .          .
              250.  I     R   W.EL      .          .          .          .          .    M     .          .          .          .
              255.  I     R   W.EL      .          .          .          .          .    M     .          .          .          .
     1.00     260.  I     R   W.EL      .          .          .          .          .    M     .          .          .          .
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	6.000	.00	.00	.00	39.70	145.00	40.80	40.80	41.03	37.90	3.83	37.35	23.5
*	5.000	100.00	.00	.00	39.50	145.00	40.59	40.59	40.83	39.96	3.90	36.76	22.9
*	4.000	5.50	.00	.00	39.50	89.13	39.86	40.06	40.73	450.76	6.66	12.02	4.2
*	3.000	49.00	.00	.00	39.40	89.13	39.99	39.99	40.16	40.00	2.76	27.33	14.0
*	2.000	5.50	.00	.00	39.40	89.13	40.32	40.32	40.52	46.99	3.56	24.84	13.0
*	1.000	100.00	.00	.00	39.20	89.13	40.12	40.12	40.32	46.45	3.54	24.96	13.0

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	6.000	145.00	40.80	.00	.00	-.30	73.50	.00
*	5.000	145.00	40.59	.00	-.21	.00	73.50	100.00
*	4.000	89.13	39.86	.00	-.72	.00	67.46	5.50
*	3.000	89.13	39.99	.00	.12	.00	85.10	49.00
*	2.000	89.13	40.32	.00	.33	.00	64.84	5.50
*	1.000	89.13	40.12	.00	-.20	.00	65.03	100.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO= 4.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 1.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

ROUTE DA3 → DA4 → DA5

SEE PAGE C-38 FOR DA3 → DA4

MUSKINGUM METHOD

"X" = 0.1
L = 5560'
S = 0.16%
V = 4 FPS
"K" = 0.04
"T" = 0.083
NSTPS = 3

$$\frac{1}{2(1-X)} \leq \frac{K}{NSTPS \times T} \leq \frac{1}{2X}$$

$$\frac{1}{1.8} < \frac{0.04}{0.25} < \frac{1}{0.2}$$

$$0.6 < 1.6 < 5.0$$

```
X     X  XXXXXXX   XXXXX          X
X     X  X         X     X       XX
X     X  X         X             X
XXXXXXX  XXXX      X       XXXXX X
X     X  X         X             X
X     X  X         X     X       X
X     X  XXXXXXX    XXXXX        XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID   OFFSITE DRAINAGE AREA DA3 + DA4 + DA5 MUSKINGUM ROUTE

    2         ID   CIBOLA
    3         ID   100-YEAR 6-HOUR STORM
    4         ID   SDN3/C345
*** FREE ***
    5         IT      03       0       0     300
    6         IO       3       0       0
    7         KK     SUB1    SUB-BASIN 3 HYDROGRAPH
    8         KM             SCS RUNOFF COMPUTATION, SUB-1
    9         BA    1.27
   10         PB    2.74
   11         PC       0    2.00    5.70    7.00    8.70   10.80   12.40   13.00   13.00   13.00
   12         PC   13.00   13.00   13.00   13.30   14.00   14.20   14.80   15.80   17.20   18.10
   13         PC   19.00   19.70   19.90   20.00   20.10   20.40   21.40   22.90   24.10   24.90
   14         PC   25.10   25.60   27.00   27.80   28.10   28.30   29.50   32.20   35.20   40.90
   15         PC   49.90   59.00   71.00   74.40   78.10   81.20   81.90   83.50   85.10   85.60
   16         PC   86.00   86.80   87.60   88.80   91.00   92.60   93.70   95.00   97.00   97.60
   17         PC   98.20   98.50   98.70   98.90   99.00   99.30   99.30   99.40   99.50   99.80
   18         PC   99.80   99.90  100.00
   19         LS       0      72
   20         UD    0.94
   21         KK    NODEB   ROUTE FLOW TO NODE B
   22         RM        2    0.07     0.1
   23         KK     SUB2    SUB-BASIN 4 HYDROGRAPH
   24         KM             SCS RUNOFF COMPUTATION, SUB-2
   25         BA   0.544
   26         PB    2.80
   27         LS       0      74
   28         UD    0.73
   29         KK    NODEC   ROUTE FLOW TO NODE C
   30         RM        3    0.04     0.1
   31         KK     SUB3    SUB-BASIN 5 HYDROGRAPH
   32         KM             SCS RUNOFF COMPUTATION, SUB-3
   33         BA  0.0859
   34         PB    2.86
   35         LS       0      75
   36         UD    0.26
   37         KK    NODEC   COMBINE FLOW AT NODE C
   38         HC        3
   39         ZZ
```

```
 IT          HYDROGRAPH TIME DATA
                 NMIN          3  MINUTES IN COMPUTATION INTERVAL
                IDATE      1   0  STARTING DATE
                ITIME         0000  STARTING TIME
                   NQ          300  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE      1   0  ENDING DATE
               NDTIME         1457  ENDING TIME
               ICENT           19  CENTURY MARK

              COMPUTATION INTERVAL     .05 HOURS
                  TOTAL TIME BASE   14.95 HOURS

 SUB-BASIN 3 HYDROGRAPH
 SCS RUNOFF COMPUTATION, SUB-1
 11 PI          INCREMENTAL PRECIPITATION PATTERN
                  2.00     3.70     1.30     1.70     2.10     1.60      .60      .00      .00      .00
                   .00      .00      .30      .70      .20      .60     1.00     1.40      .90      .90
                   .70      .20      .10      .10      .30     1.00     1.50     1.20      .80      .20
                   .50     1.40      .80      .30      .20     1.20     2.70     3.00     5.70     9.00
                  9.10    12.00     3.40     3.70     3.10      .70     1.60     1.60      .50      .40
                   .80      .80     1.20     2.20     1.60     1.10     1.30     2.00      .60      .60
                   .30      .20      .20      .10      .30      .00      .10      .10      .30      .00
                   .10      .10

                                                UNIT HYDROGRAPH
                                          96 END-OF-PERIOD ORDINATES
                  10.      21.      44.      68.      97.     129.     169.     212.     265.     321.
                 383.     442.     494.     539.     575.     602.     622.     632.     635.     634.
                 630.     614.     594.     572.     549.     523.     496.     464.     430.     391.
                 352.     319.     288.     265.     243.     223.     204.     188.     173.     161.
                 149.     137.     126.     116.     107.      97.      89.      82.      76.      69.
                  64.      59.      54.      49.      45.      42.      38.      35.      32.      30.
                  27.      25.      23.      21.      20.      18.      17.      15.      14.      13.
                  12.      11.      10.       9.       8.       8.       7.       7.       6.       6.
                   5.       5.       5.       4.       4.       4.       3.       3.       2.       2.
                   2.       1.       1.       1.       0.       0.

                          HYDROGRAPH AT STATION      SUB

   TOTAL RAINFALL =    2.74, TOTAL LOSS =    2.08, TOTAL EXCESS =     .66
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     14.95-HR
+   (CFS)       (HR)
                  (CFS)
+    326.       3.30                  90.         36.         36.         36.
                (INCHES)              .658        .658        .658        .658
                 (AC-FT)              45.         45.         45.         45.

   ROUTE FLOW TO NODE 8
   HYDROGRAPH ROUTING DATA
 22 RM          MUSKINGUM ROUTING
                NSTPS          2 NUMBER OF SUBREACHES
                AMSKK        .07 MUSKINGUM K
                   X         .10 MUSKINGUM X

                          HYDROGRAPH AT STATION      NODE

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     14.95-HR
+   (CFS)       (HR)
                  (CFS)
+    325.       3.35                  90.         36.         36.         36.
                (INCHES)              .658        .658        .658        .658
                 (AC-FT)              45.         45.         45.         45.
```

SUB-BASIN 4 HYDROGRAPH
SCS RUNOFF COMPUTATION, SUB-2

11 PI INCREMENTAL PRECIPITATION PATTERN

2.00	3.70	1.30	1.70	2.10	1.60	.60	.00	.00	.00
.00	.00	.30	.70	.20	.60	1.00	1.40	.90	.90
.70	.20	.10	.10	.30	1.00	1.50	1.20	.80	.20
.50	1.40	.80	.30	.20	1.20	2.70	3.00	5.70	9.00
9.10	12.00	3.40	3.70	3.10	.70	1.60	1.60	.50	.40
.80	.80	1.20	2.20	1.60	1.10	1.30	2.00	.60	.60
.30	.20	.20	.10	.30	.00	.10	.10	.30	.00
.10	.10								

UNIT HYDROGRAPH
75 END-OF-PERIOD ORDINATES

7.	18.	34.	55.	79.	107.	143.	183.	227.	264.
296.	322.	336.	346.	348.	346.	339.	325.	310.	293.
274.	252.	227.	199.	176.	155.	139.	124.	111.	100.
91.	82.	74.	67.	60.	53.	48.	43.	38.	35.
31.	28.	25.	22.	20.	18.	16.	14.	13.	12.
11.	9.	9.	8.	7.	6.	5.	5.	4.	4.
4.	3.	3.	3.	3.	2.	2.	2.	1.	1.
1.	1.	1.	0.	0.					

HYDROGRAPH AT STATION SUB

TOTAL RAINFALL = 2.80, TOTAL LOSS = 2.02, TOTAL EXCESS = .78

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	14.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 193.	2.95		46.	18.	18.	18.
		(INCHES)	.784	.784	.784	.784
		(AC-FT)	23.	23.	23.	23.

ROUTE FLOW TO NODE C
HYDROGRAPH ROUTING DATA

30 RM MUSKINGUM ROUTING

NSTPS	3	NUMBER OF SUBREACHES
AMSKK	.04	MUSKINGUM K
X	.10	MUSKINGUM X

HYDROGRAPH AT STATION NODE

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	14.95-HR
+ (CFS)	(HR)					
		(CFS)				
+ 192.	3.00		46.	18.	18.	18.
		(INCHES)	.784	.784	.784	.784
		(AC-FT)	23.	23.	23.	23.

SUB-BASIN 5 HYDROGRAPH
SCS RUNOFF COMPUTATION, SUB-3

11 PI INCREMENTAL PRECIPITATION PATTERN

2.00	3.70	1.30	1.70	2.10	1.60	.60	.00	.00	.00
.00	.00	.30	.70	.20	.60	1.00	1.40	.90	.90
.70	.20	.10	.10	.30	1.00	1.50	1.20	.80	.20
.50	1.40	.80	.30	.20	1.20	2.70	3.00	5.70	9.00
9.10	12.00	3.40	3.70	3.10	.70	1.60	1.60	.50	.40
.80	.80	1.20	2.20	1.60	1.10	1.30	2.00	.60	.60
.30	.20	.20	.10	.30	.00	.10	.10	.30	.00
.10	.10								

UNIT HYDROGRAPH
28 END-OF-PERIOD ORDINATES

12.	37.	76.	120.	142.	145.	132.	113.	85.	61.
46.	35.	27.	20.	15.	11.	8.	6.	5.	4.
3.	2.	2.	1.	1.	1.	0.	0.		

HYDROGRAPH AT STATION SUB

TOTAL RAINFALL = 2.86, TOTAL LOSS = 1.99, TOTAL EXCESS = .87

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)				
67.	2.35		8.	3.	3.	3.
		(INCHES)	.870	.870	.870	.870
		(AC-FT)	4.	4.	4.	4.

COMBINE FLOW AT NODE C

HYDROGRAPH AT STATION NODE

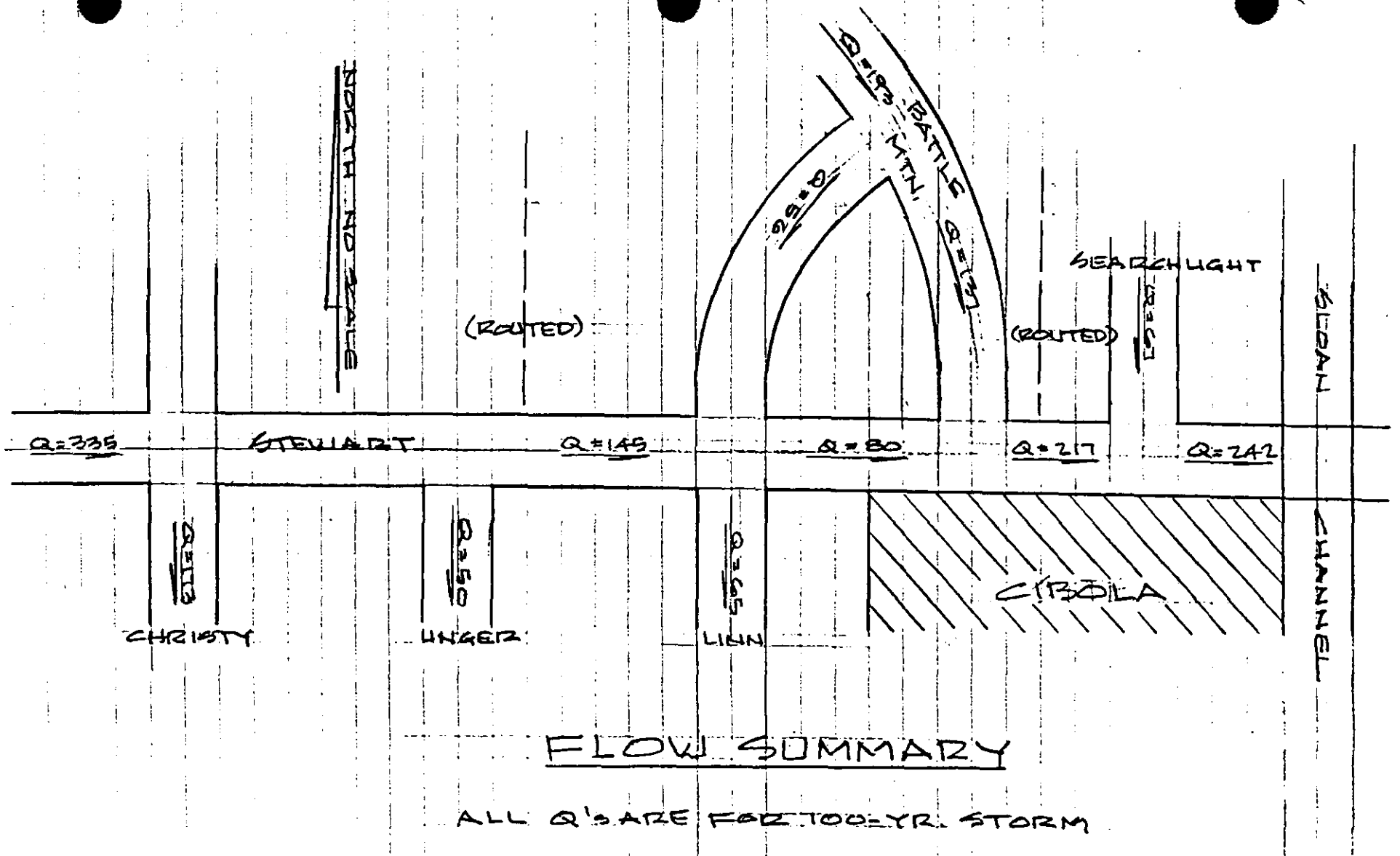
PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	14.95-HR
(CFS)	(HR)	(CFS)				
521.	3.15		144.	58.	58.	58.
		(INCHES)	.704	.704	.704	.704
		(AC-FT)	71.	71.	71.	71.

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
HYDROGRAPH AT	SUB	326.	3.30	90.	36.	36.	1.27		
ROUTED TO	NODE	325.	3.35	90.	36.	36.	1.27		
HYDROGRAPH AT	SUB	193.	2.95	46.	18.	18.	.54		
ROUTED TO	NODE	192.	3.00	46.	18.	18.	.54		
HYDROGRAPH AT	SUB	67.	2.35	8.	3.	3.	.09		
3 COMBINED AT	NODE	521.	3.15	144.	58.	58.	1.90		

*** NORMAL END OF HEC-1 ***

Q_{100} DA3 + DA4 + DA5 = 521
FROM DA 2 = + 9
SOUTH ON CHRISTY = - 173
SOUTH ON UNGER = - 50
SOUTH ON LINN = - 65
TO STEWART/SEARCHLIGHT = 242 CFS



FLOW SUMMARY

ALL Q's ARE FOR 100-YR. STORM

NORTH
1"=60'

0 50 100 200
SCALE IN FEET

BATTLE MTN. DR.

SEARCHLIGHT DR.

EX. DAYDREAM (UNITS 1 & 7)

STEWART AVE.

PCC APRON

EX. 8-10'x3.5' RCB

EX. 8'D.I.

27"x42" RCP (124 LF)

48"x76" RCP (90LF)

53"x83" RCP (586 LF)

= 20' TYPE "A" D.I. W/ 27"x42" RCP LATERAL

CIBOLA

10' DRAINAGE EASEMENT

SLOAN CHANNEL

PCC APRON

105'

STORM DRAIN MAP

D-1

EX. D.I. CAPACITY - NORTH SIDE STEWART

2-7' TYPE "A" @ BATTLE MTN. (SUMP)
2-9' TYPE "A" @ SEARCHLIGHT (SUMP)

Σ OPENING WIDTH = 32'

"Y" = 0.4'

CAPACITY D.I.'s = 0.6 x 32 = 19 CFS (USE)

CAPACITY 30" RCP @ 0.2% = 20 CFS

EX. D.I. CAPACITY - SOUTH SIDE STEWART

2-8' TYPE "A" @ SLOAN CHANNEL (SUMP)

Σ OPENING WIDTH = 16'

"Y" = 0.7'

CAPACITY D.I.'s = 1.6 x 16 = 26 CFS (USE)

D.I.'s DRAIN DIRECTLY INTO SLOAN CHANNEL

NEW TYPE "A" D.I. CAPACITY

SUMP CONDITION

"Y" = 0.8', CAPACITY = 2.0 CFS/FT OPENING

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************
```

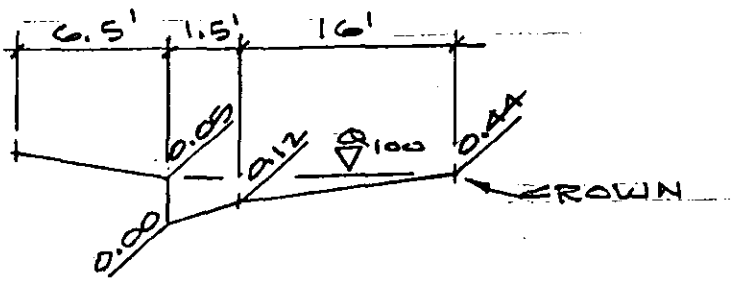
```
FR
T1 NORTH SIDE OF STEWART
T2 SUBCRITICAL FLOW Q=5 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         0    0.0016         0         0         5       0.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
    -10       -10

NC    0.012     0.016     0.015

X1        1         4         0      17.5         0         0         0
GR     0.50         0      0.00         0      0.12       1.5      0.44      17.5
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT

Q	DEPTH	10*KS	QLOB	QCH	QROB	VLOB	VCH	VROB
5.001	.47	16.21	.00	5.00	.00	.00	1.37	.00

SUMMARY OF ERRORS AND SPECIAL NOTES



SECTION

Q_{100} NORTH OF CROWN ..... = 5 CFS

Q_{100} SOUTH OF CROWN (80-5) = 75 CFS

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 NORTH SIDE OF STEWART
T2 SUPERCRITICAL FLOW Q=5 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1    0.0016         0         0         5       0.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.012     0.016     0.015

X1        1         4         0      17.5         0         0         0
GR     0.50         0      0.00         0      0.12       1.5      0.44      17.5

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*     5.001        .38     66.84      .00      5.00       .00        .00      2.26       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     5.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

FLOW TRANSMISSION ANALYSIS

A. STEWART - WEST OF CIBOLA

NORTH GUTTER FLOW = 5 CFS

SOUTH GUTTER FLOW (80-5) = 75 CFS

B. STEWART - WEST OF BATTLE MTN.

NEW 20' D.I. (20 x 2.0) = 40 CFS

SOUTH GUTTER FLOW (75 - 40) = 35 CFS

C. STEWART - AT BATTLE MTN.

NEW 4-20' D.I.'s (80 x 1.6) = 128 CFS

EX. 2-7' D.I.'s (14 x 0.6) = 8 CFS

NORTH CURB FLOW = 5 CFS

SOUTH GUTTER FLOW (217 - 128 - 8 - 5 - 40) = 36 CFS

D. STEWART - AT SEARCHLIGHT

NEW 20' D.I. (20 x 2.0) = 40 CFS

EX. 2-7' & 2-9' D.I.'s (32 x 0.6) = 19 CFS

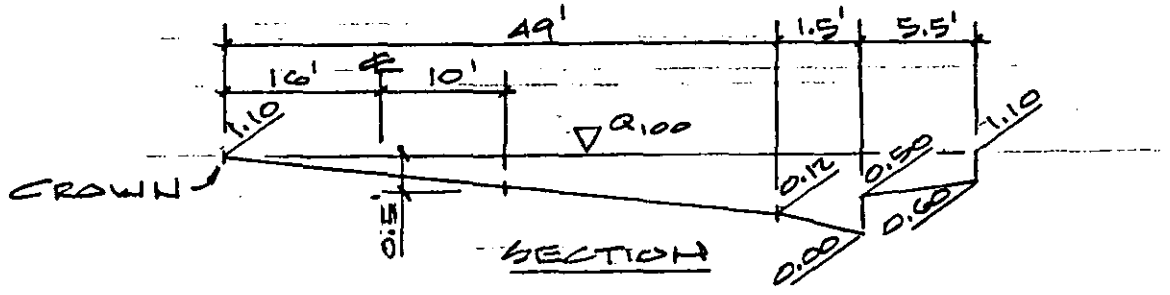
NORTH CURB FLOW = 5CFS

SOUTH GUTTER FLOW (242 - 40 - 128 - 40 - 19 - 5)
= 10 CFS

EX. 2-8' D.I.'s @ SLOAN CHANNEL = 26 CFS
> 10 OK

```
X     X  XXXXXXX  XXXXX            XXXXX
X     X  X       X    X          X     X
X     X  X       X                     X
XXXXXXX  XXXX    X         XXXXX   XXXXX
X     X  X       X                X
X     X  X       X    X           X
X     X  XXXXXXX  XXXXX            XXXXXXX
```

```
**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 SOUTH SIDE OF STEWART WEST CIBOLA
T2 SUBCRITICAL FLOW Q=75 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         0    0.0016         0         0        75       1.1         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
    -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR     1.10         0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR     1.10        56

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS      QLOB       QCH      QROB      VLOB       VCH      VROB
   75.001        1.12     16.00       .00     64.80     10.20       .00      2.42      3.23

SUMMARY OF ERRORS AND SPECIAL NOTES
```



GUTTER DEPTH = 1.1' < 2' OK
d N = 1.12 x 2.42 = 2.7 < 8 OK
TRAFFIC DEPTH = 0.5' < 1' OK

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 SOUTH SIDE OF STEWART WEST OF CIBOLA
T2 SUPERCRITICAL FLOW Q=75 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         1    0.0016         0         0        75       1.1         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
    -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR     1.10         0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR     1.10        56

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS      QLOB      QCH       QROB      VLOB      VCH       VROB
*     75.001       .93     50.50       .00     65.63      9.37       .00      3.69      4.46

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     75.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************
```

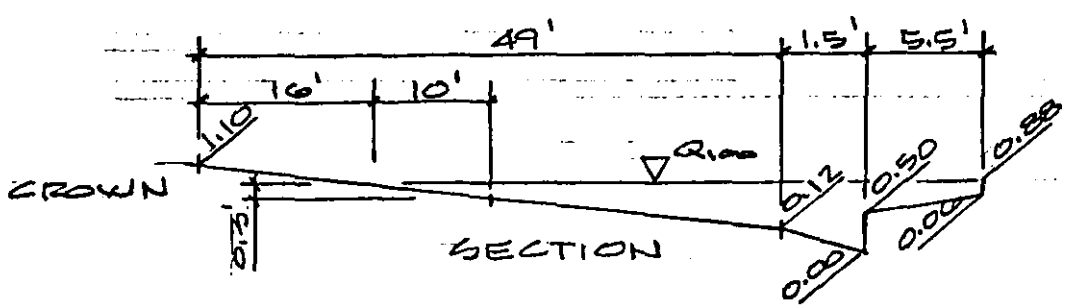
```
FR
T1 SOUTH SIDE OF STEWART WEST OF BATTLE MTN
T2 SUBCRITICAL FLOW Q=35 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0    0.0016         0         0        35       0.8         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
       43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
      -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR     1.10         0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR     1.10        56
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT

Q	DEPTH	10*KS	QLOB	QCH	QROB	VLOB	VCH	VROB
35.001	.88	15.74	.00	30.89	4.11	.00	1.97	2.27

SUMMARY OF ERRORS AND SPECIAL NOTES



GUTTER DEPTH = 0.9' < 2' OK

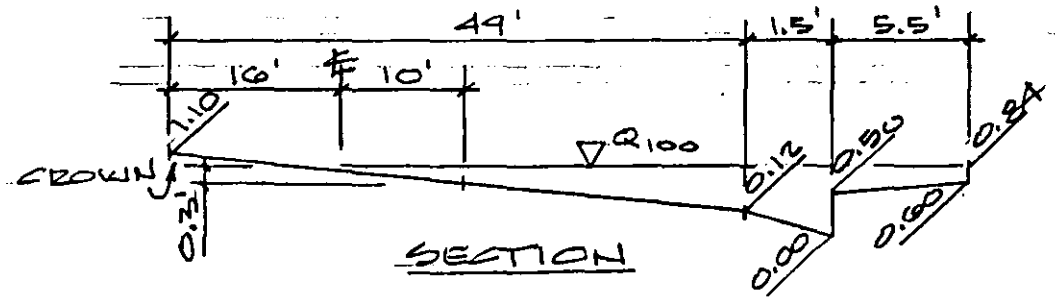
d V = 0.88 x 1.97 = 1.7 < 8 OK

TRAFFIC DEPTH = 0.3' < 1' OK

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X           XXXXX   XXXXX
X     X  X        X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
I1 SOUTH SIDE OF STEWART WEST OF BATTLE MTN
I2 SUPERCRITICAL FLOW Q=35 CFS
I3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         1    0.0016         0         0        35       0.8         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
    -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR     1.10         0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR     1.10        56

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*XS      QLOB      QCH       QROB      VLOB      VCH       VROB
*     35.001       .72     54.91       .00     32.28      2.72       .00      3.18      2.83

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     35.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                X     X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 SOUTH SIDE OF STEWART EAST OF BATTLE MTN
T2 SUBCRITICAL FLOW Q=36 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0    0.0022         0         0        36       0.8         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR     1.10         0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR     1.10        56

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH      10*KS      QLOB       QCH      QROB      VLOB       VCH      VROB
    36.001         .84      21.88       .00     32.01      3.99       .00      2.25      2.48

SUMMARY OF ERRORS AND SPECIAL NOTES
```



GUTTER DEPTH = 0.8' < 2' OK

$d_V = 0.84 \times 2.25 = 1.9 < 8$ OK

TRAFFIC DEPTH = 0.3' < 1' OK

```
X    X  XXXXXXX   XXXXX            XXXXX
X    X  X       X     X          X     X
X    X  X       X                      X
XXXXXXX  XXXX    X         XXXXX    XXXXX
X    X  X       X                  X
X    X  X       X     X            X
X    X  XXXXXXX   XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 SOUTH SIDE OF STEWART EAST OF BATTLE MTN
T2 SUPERCRITICAL FLOW Q=36 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1    0.0022         0         0        36       0.8        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.016     0.012     0.016

X1        1         6         0      50.5         0         0         0
GR      1.10        0      0.12        49      0.00      50.5      0.50      50.5      0.60        56
GR      1.10       56

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH      QROB      VLOB      VCH      VROB
*     36.001        .73     54.83      .00     33.12      2.86       .00      3.20      2.89

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     36.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

CONDUIT DATA					HYDRAULIC DATA			COMMENTS
STATION		SIZE / TYPE	INVERTS		TRANSITION			
FROM	TO		D/S ELEV.	U/S ELEV.	LEL	U/S HGL ELEV.	PRESS. FLOW ?	OTHER
					1	39.0		
0+00	0+62	53"x83"	33.55	33.71			YES	USE S = 0.0029
0+62	5+86	53"x83"	33.71	35.02			YES	USE S = 0.0026
5+86	6+76	48"x76"	35.02	35.25			YES	USE S = 0.0025
6+76	8+00	27"x42"	35.25	35.56			YES	USE S = 0.0039

$$S_f = \frac{\Sigma H_v}{R^{1.33}}$$

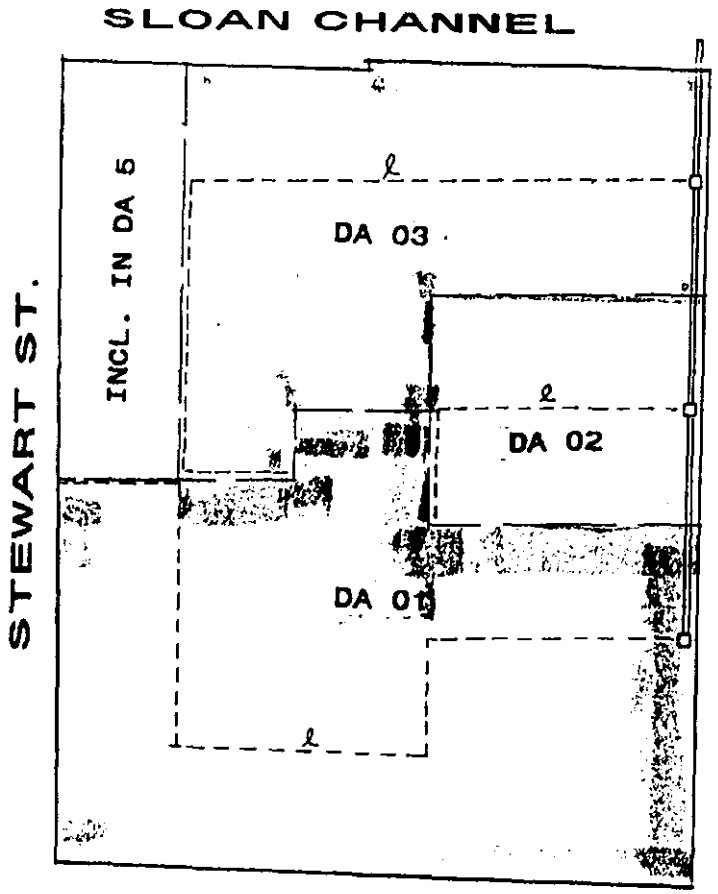
Revision	Date

WRC ENGINEERING, INC. | REFEREN

D-12

STANDARD FORM 6

NORTH (1"=200')



ONSITE DRAINAGE AREAS

Worksheet 2: *Runoff curve number and runoff*

Project _____ By _____ Date _____

Location ONSITE DA's Checked _____ Date _____

Circle one: Present | Developed | _____

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area ☐ acres ☐ mi² ☒ %	Product of CN x area
B	MED. DENS. RES.	75			100	
	Totals =					

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = _____; Use CN = 75

2. *Runoff*

	Storm #1	Storm #2	Storm #3
Frequency ..... yr	10	25	100
Rainfall, P (24-hour) ..... in	2.0	2.4	3.0
Runoff, Q ..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	0.38	0.60	0.96

TIME OF CONCENTRATION

REFERENCE:

DEVELOPMENT CIBOLA

CACULATED BY N DATE

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)		FINAL t_c	REMARKS	
DESIG: DA (1)	K (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	TOTAL LENGTH Ft (11)	$t_c = (L/180)+10$ Min (12)	Min (13)	T_C (HRS)	UD T_{LAG} (HRS)
01	0.60	6.0	100	1%	7	970	0.4	1.2	13	1070	16	16	0.27	
02	0.60	1.6	100	1%	7	300	0.4	1.2	4	400	12	11	0.18	
03	0.60	3.9	100	1%	7	880	0.4	1.2	12	980	15	15	0.25	

$t_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$

$K = (0.0132 \times CN) - 0.39$

$t_c = t_i + t_t$

$t_t = \frac{L}{60V}$

$T_{LAG} = 0.6\,T_c$

E-3

STANDARD FORM 4

Revision

Date

Worksheet 4: Graphical Peak Discharge method

Project: EIBOLA By: N Date: _____

Location: EDA 10 Checked: _____ Date: _____

Circle one: Present | Developed A = 6.10 AC

1. Data:

Drainage area ..... A_m = 0.00094 mi^2 (acres/640)

Runoff curve number .... CN = 75 (From worksheet 2)

Time of concentration .. T_c = 0.27 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = 0 percent of A_m (____ acres or mi^2 covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	10	25	100
3.	Rainfall, P (24-hour)	in	2.0	2.4	3.0
4.	Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.667	0.667	0.667
5.	Compute I_a/P		0.33	0.28	0.22
6.	Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in	615	630	645
7.	Runoff, Q ..... (From worksheet 2).	in	0.38	0.60	0.96
8.	Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0	1.0	1.0
9.	Peak discharge, q_p ..... (Where $q_p = q_u A_m Q F_p$)	cfs	2.2	3.6	5.8

Worksheet 4: Graphical Peak Discharge method

Project: EIBOLA By: N Date: _____

Location: DA 02 Checked: _____ Date: _____

Circle one: Present | Developed A = 1.6 AC

1. Data:

   Drainage area ..... A_m = 0.0025 mi^2 (acres/640)

   Runoff curve number .... CN = 75 (From worksheet 2)

   Time of concentration .. T_c = 0.18 hr (From worksheet 3)

   Rainfall distribution type = II (I, IA, II, III)

   Pond and swamp areas spread throughout watershed ..... = 0 percent of A_m (____ acres or mi^2 covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	10	25	100
3.	Rainfall, P (24-hour)	in	2.0	2.4	3.0
4.	Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.6667	0.6667	0.6667
5.	Compute I_a/P		0.33	0.28	0.22
6.	Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in	700	730	760
7.	Runoff, Q ..... (From worksheet 2).	in	0.38	0.60	0.96
8.	Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0	1.0	1.0
9.	Peak discharge, q_p ..... (where $q_p = q_u A_m Q F_p$)	cfs	0.7	1.1	1.8

Worksheet 4: Graphical Peak Discharge method

Project: CIRCLA By: N Date: _____

Location: DA-03 Checked: _____ Date: _____

Circle one: Present | Developed | A = 3.9 AC

1. Data:

Drainage area ..... A_m = 0.00061 mi^2 (acres/640)

Runoff curve number .... CN = 75 (From worksheet 2)

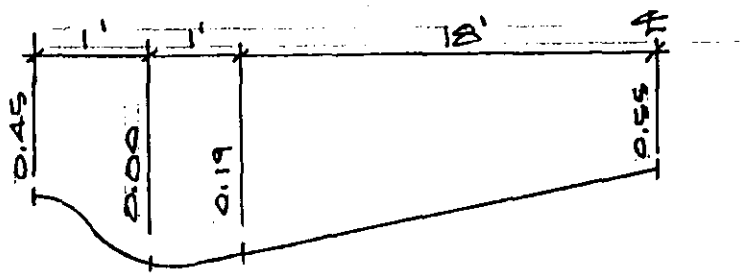
Time of concentration .. T_c = 0.25 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ..... = 0 percent of A_m (____ acres or mi^2 covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	10	25	100
3.	Rainfall, P (24-hour)	in	2.0	2.4	3.0
4.	Initial abstraction, I_a ..... (Use CN with table 4-1.)	in	0.667	0.667	0.667
5.	Compute I_a/P		0.33	0.28	0.22
6.	Unit peak discharge, q_u ..... (Use T_c and I_a/P with exhibit 4-II)	csm/in	650	660	670
7.	Runoff, Q ..... (From worksheet 2).	in	0.38	0.60	0.96
8.	Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		1.0	1.0	1.0
9.	Peak discharge, q_p ..... (where $q_p = q_u A_m Q F_p$)	cfs	1.5	2.4	3.9

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 01
T2 SUBCRITICAL FLOW Q=2.2 CFS
T3 STSU6

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0     0.004          0        0       1.1       0.2        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.025     0.025     0.015

XI        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
     1.101         .33     40.16      .00      1.10       .00        .00      1.31       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```



TYP. SECTION DA 01, DA 02, & DA 03

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 01
T2 SUPERCRITICAL FLOW Q=2.2 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1     0.004          0        0       1.1       0.2         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
      -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     GLOB      QCH       QROB      VLOB      VCH       VROB
*      1.101       .30     82.73      .00      1.10       .00        .00      1.74       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     1.101  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X    X  XXXXXXX   XXXXX            XXXXX
X    X  X        X     X          X     X
X    X  X        X                      X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X    X  X        X                 X
X    X  X        X     X           X
X    X  XXXXXXX   XXXXX            XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 01
T2 SUBCRITICAL FLOW Q=3.6 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0     0.004          0         0       1.8       0.4          0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS      GLOB      GCH       GROB      VLOB      VCH       VROB
    1.801         .37     39.92       .00      1.80       .00        .00      1.46       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA 01
T2 SUPERCRITICAL FLOW Q=3.6 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1     0.004          0        0       1.8       0.4        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*      1.801       .34     77.97      .00      1.80       .00       .00      1.89       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     1.801  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX          XXXXX
X     X  X        X     X        X     X
X     X  X        X              X     X
XXXXXXX  XXXX     X        XXXXX   XXXXX
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX          XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA 01
T2 SUBCRITICAL FLOW Q=5.8 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         VSEL      FQ
       0        0         0         0     0.004        0         0       2.9       0.5         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    **********REQUESTED SECTION NUMBERS**********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH      QROB      VLOB      VCH      VROB
     2.901         .42     39.52      .00      2.90       .00       .00      1.63       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 01
T2 SUPERCRITICAL FLOW Q=5.8 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1     0.004          0        0       2.9       0.5         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS      QLOB       QCH      QROB      VLOB       VCH      VROB
*     2.901         .39     61.39       .00      2.90       .00       .00      1.93       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=      2.901  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 02
T2 SUBCRITICAL FLOW Q=0.7 CFS
T3 STSU8

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         0     0.004        0         0      0.35       0.2         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     IO*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
       .351       .25     40.45      .00       .35       .00       .00      1.06       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X    X  XXXXXXX   XXXXX            XXXXX
X    X  X        X     X          X     X
X    X  X        X                      X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X    X  X        X                  X
X    X  X        X     X            X
X    X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 02
T2 SUPERCRITICAL FLOW Q=0.7 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         1     0.004        0         0      0.35       0.2         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT    NUMSEC                    ********REQUESTED SECTION NUMBERS********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
          Q       DEPTH     10*KS      QLOB       QCH       QROB      VLOB       VCH       VROB
*        .351       .23     86.57       .00       .35        .00       .00      1.49        .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=       .351  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X       X     X          X     X
X     X  X       X                      X
XXXXXXX  XXXX    X          XXXXX    XXXXX
X     X  X       X                 X
X     X  X       X     X           X
X     X  XXXXXXX  XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 02
T2 SUBCRITICAL FLOW Q=1.1 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0     0.004          0        0      0.55       0.3        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH      10*KS      QLOB       QCH       QROB      VLOB       VCH       VROB
     .551         .28      39.86       .00       .55        .00       .00      1.13        .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

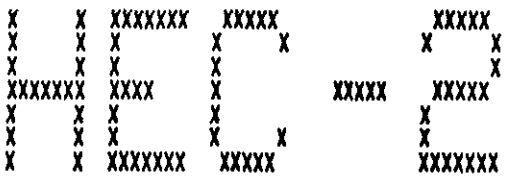
```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA 02
T2 SUPERCRITICAL FLOW Q=1.1 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         1     0.004          0         0      0.55       0.3          0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*       .551      .26     87.32      .00       .55        .00       .00      1.57       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=      .551  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA Q2
T2 SUBCRITICAL FLOW Q=1.8 CFS
T3 ST9UB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         0     0.004        0         0       0.9       0.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
      .901        .31     39.79      .00       .90        .00       .00      1.25       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA 02
T2 SUPERCRITICAL FLOW Q=1.8 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         1     0.004         0         0       0.9       0.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5         13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
          Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*        .901       .29     80.35       .00       .90        .00       .00      1.65        .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=       .901  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X           XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 03
T2 SUBCRITICAL FLOW Q=1.5 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
      0         0         0         0       0.004       0         0       0.75      0.3         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
       .751       .30     39.98      .00       .75       .00       .00      1.21       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 03
T2 SUPERCRITICAL FLOW Q=1.5 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         VSEL      FQ
      0         0         0         1       0.004       0         0       0.75      0.3         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*       .751       .28     73.34       .00       .75       .00       .00      1.54       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=       .751  PROFILE=  1  CRITICAL DEPTH ASSUMED
```



```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 03
T2 SUBCRITICAL FLOW Q=2.4 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0         0         0         0     0.004          0         0       1.2       0.4          0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
     1.201         .34     39.97      .00      1.20       .00       .00      1.33       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX            XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA 03
T2 SUPERCRITICAL FLOW Q=2.4 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1     0.004          0        0       1.2       0.4        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1         0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43         8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*      1.201       .32     69.33      .00      1.20       .00        .00      1.66       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     1.201  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

```
X    X  XXXXXXX  XXXXX            XXXXX
X    X  X       X     X          X     X
X    X  X       X                      X
XXXXXXX  XXXX    X         XXXXX   XXXXX
X    X  X       X                X
X    X  X       X     X          X
X    X  XXXXXXX  XXXXX           XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 ONSITE STREET DA Q3
T2 SUBCRITICAL FLOW Q=3.9 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0     0.004        0         0      1.95       0.4        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
     -1        0         -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
     43        8         5         13        14        15        55        26        56
J5  LPRNT     NUMSEC                    *********REQUESTED SECTION NUMBERS*********
    -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
      1.951       .38     39.29      .00      1.95       .00        .00      1.48       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

```
X     X  XXXXXXX   XXXXX            XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX

**********************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**********************************************************

FR
T1 ONSITE STREET DA 03
T2 SUPERCRITICAL FLOW Q=3.9 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1     0.004          0        0      1.95       0.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.025     0.025     0.015

X1        1         4         0        20         0         0         0
GR     0.45         0      0.00         1      0.19         2      0.55        20

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
        Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*     1.951       .35     66.90      .00      1.95       .00        .00      1.82       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     1.951  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

ONSITE STORM DRAIN

USE "Y" = 0.5' (0.9 CFS/FT D.I. OPENING)

DA 01: Q_{100} = 5.8 CFS

USE 6.5' TYPE "A" D.I. IN SUMP

DA 02: Q_{100} = 1.8 CFS

USE 2' TYPE "A" D.I. IN SUMP

DA 03: Q_{100} = 3.9 CFS

USE 4.5' TYPE "A" D.I. IN SUMP

RCP

USE 18" @ 0.3% MIN. DA 01 → DA 02

USE 18" @ 0.5% MIN. DA 02 → DA 03

USE 21" @ 0.5% MIN. DA 03 → CHAN.

REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL UNSTUDIED FACILITIES
- PROPOSED MASTER PLAN FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

0 1500 4500

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE : 10

James M. Montgomery Consulting Engineers, Inc.

Reno, Nevada

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
	25	26	

DATE: 06 FEBRUARY 1995

SLW
1530

FEB 0 9 1995

TO: CLARK COUNTY
DEPARTMENT OF PUBLIC WORKS
401 SOUTH 4th STREET
LAS VEGAS, NV 89101

FROM: RAY NOVATNEY, PE
4782 SOUTH MOJAVE RD.
LAS VEGAS, NV 89121
PHONE: 456-6734

RE: ADDENDUM TO DRAINAGE STUDY FOR CIBOLA
HTE 94-25236

SUBJECT: WILLDAN ASSOCIATES MEMORANDUM DATED 01/23/95.

A COPY OF THE MEMORANDUM IS ATTACHED AND THE ENGINEERS COMMENTS ARE AS FOLLOWS:

ITEM 1. A SPECIAL INSPECTION NOTE HAS BEEN ADDED TO THE GRADING PLAN FOR THE NORTH WALL OF THE DRAIN AND A CHAIN LINK FENCE IS ADDED TO THE TOP OF THIS WALL FOR A TOTAL HEIGHT OF 6 FEET. PAGE S-3 HAS BEEN REVISED.

ITEM 2. DETAILS HAVE BEEN ADDED TO SHEET 2 OF THE GRADING PLAN FOR THE GUARDRAIL (AND THE BOX CULVERT). IN REFERENCE TO A TELEPHONE CONVERSATION WITH ROBERT THOMPSON, PE, CCPW ON 01/31/95, IT WAS DETERMINED THAT SELF ADHESIVE COPIES OF NDOT STANDARDS WERE SUFFICIENT.

END OF COMMENTS

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
RAY NOVATNEY
CIVIL
No. 4028

2/6/95

To: Willdan & Associates for Review
From: Clark County Public Works, 401 S. Fourth Street
Addendum # 1 Original
By R.A.E. Date 2-8-95.

WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS

Professional Consulting Services Since 1964

MEMORANDUM

TO: Ralph M. Gabriel, P.E.
Isabel Pennington

FROM: Stephen L. Weatherman, P.E.

OFFICE: Las Vegas

DATE: January 23, 1995

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Cibola (1530)
Study Dated: November 19, 1994
First Addendum Dated: December 30, 1994
Second Addendum Dated: January 15, 1995
Located: Southwest corner of Stewart Avenue and Sloan Channel
(Sec. 33, T. 20 S., R. 62 E.)
H.T.E.# 94-25236
Prepared by Ray Novatney

We have completed our third review of the above-referenced **Technical Drainage Study**, and have the following comments:

1. The following comments refer to the structural calculations for the traffic barrier wall:

   a. Calculation sheet S-1 for the horizonal masonry beam spreading the impact load utilizes an allowable bending stress of 500 PSI. Per UBC 2406(c), this value must be reduced by one-half if special inspection is not provided. If full stress is to be used, the drawings must be revised to note that special inspection is required. Ref. UBC/UAC 302(c)1;

   b. Calculation sheet S-3 shows the value of 2kj is determined by using n=40. The value of n is based on the definition given in UBC 2401 using Em=750 x f'm from UBC 2406(f)B. The value of Em is not reduced for half-stress purposes. This resulted in a value of n=26. A revaluation of the masonry stress shows it exceeds the allowable value of 250 PSI;

   The structural calculations and structural details must be revised to incorporate these comments.

2. The NDOT Details of the Steel Post Metal Beam Guardrail are not County standards and must be shown on the plans;
   SELF-ADHESIVE COPIES OF NDOT STDS. SUFFICIENT PER T.P. CONV. W/ ROBT. THOMPSON 1/31/95.

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All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log- in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

John Hannon — 1/24/95

Signature — Date

COMMENTS: Item 1. Portable precast concrete barrier rail [NDOT's standard dwg. R-8.3.3. (502)] may be used in lieu of the structurally designed traffic barrier wall. In either case, chain link fence is to be installed on top of the conc barrier for a total wall height of 6'.

* There is a 2' drop between the channel invert and the ~~box~~ flow line elev. of the box culvert under Magenta Wy. While the channel slope is only 0.16% the engineer is requested to look into increasing the channel slope to reduce future maintenance work on the channe

PS 1-24-95

CHANNEL GRADE IS SET AT STREET GRADE FOR A UNIFORM WALL HEIGHT TO ENHANCE ITS APPEARANCE - WILL INCREASE LENGTH OF DROP AREA

cc: John Sara

03226/0717-1530/073
M0120952..rg2/03226

FTG. REINF:

$V = \frac{700 \times 3.36}{2} = 1176^{\#}$

$d = 8 - (2.5 + \frac{.962}{2}) = 5.18''$

$v = \frac{1176}{12 \times 7/8 \times 5.18} = 22 PSI < 54$ OK

$M = \frac{700 \times 3.36^2}{2 \times 3} = 1317 FT^{\#}$

$A_s = \frac{1.317 \times 12}{20 \times 7/8 \times 5.18} = 0.17 IN^2 <$ #5 @ 16

TEMP $A_s = 0.0012 \times 8 \times 6.67 \times 12 = 0.77 IN^2 <$ 4-#4

STEM REINF:

$V = (\frac{102 \times 3.4}{2}) + 962 = 1135^{\#}$

$d = 10''$

$v = \frac{1136}{12 \times 7/8 \times 10} = 11 PSI < 17$ OK

$M = (\frac{102 \times 3.4^2}{2 \times 6}) + (962 \times 4.4) = 4429 FT^{\#}$

$A_s = \frac{4.429 \times 12}{20 \times 7/8 \times 10} = 0.30 IN^2 <$ #6 @ 16

$\Sigma A_s = 0.33 IN^2/FT$

$p = \frac{0.33}{12 \times 10} = 0.0028$

$np = 20 \times 0.0028 = 0.073$

$\frac{z}{jk} = 7.2$

$f_m = \frac{4429 \times 12 \times 7.2}{12 \times 10^2} = 319 PSI < 500$

DATE: 15 JANUARY 1995

TO: CLARK COUNTY
DEPARTMENT OF PUBLIC WORKS
401 SOUTH 4th STREET
LAS VEGAS, NV 89101

To: Willdan & Associates for Review
From: Clark County Public Works, 401 S. Fourth Street
Addendum # 2 Original
By SCJ Date 01/17/95

FROM: RAY NOVATNEY, PE
4782 SOUTH MOJAVE RD.
LAS VEGAS, NV 89121
PHONE: 456-6734

RE: ADDENDUM TO DRAINAGE STUDY FOR CIBOLA
HTE 94-25236

SUBJECT: WILLDAN ASSOCIATES MEMORANDUM DATED 01/11/95.

A COPY OF THE MEMORANDUM IS ATTACHED AND THE ENGINEERS COMMENTS ARE AS FOLLOWS:

ITEM 1. BOTH SHEETS OF THE GRADING PLAN CHECK PRINTS ARE BEING RETURNED,

ITEM 2. AN 8-FOOT WIDE CHANNEL IS SUFFICIENT FOLLOWING A MEETING ON THIS PROJECT BETWEEN THE OWNER AND ROBERT THOMPSON, PE, CCPW ON THE 11th OF JANUARY, 1995.

ITEM 3. THE PUBLIC DRAINAGE EASEMENT HAS BEEN ADJUSTED.

ITEM 4. THE WALL HAS BEEN DESIGNED TO RESIST TRAFFIC IMPACT.

ITEM 5. GRADING PLAN REVISIONS HAVE BEEN MADE.

END OF COMMENTS

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
RAY NOVATNEY
CIVIL
No. 4028

01/15/95

SLW
1530
JAN 1 1995

5. At the request of Clark County Public Works, grading plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **The plans submitted do not meet the minimum requirements and must be revised prior to Drainage Study approval, to address the following:**

8' OK PER ITEM #2

a. Revise channel width

b. Revise easement to begin on the north side of the south channel wall

c. Revise chainlink fence to be traffic barrier

d. Revise north channel wall to be traffic barrier

The grading plan has been red-lined and is being returned to the engineer. The red-lined grading plan must be resubmitted with the revised drawings. Failure to resubmit the red-lined grading plan will prevent further review of the project.

All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log- in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature _____ Date 1/13/95

COMMENTS: _____

cc: John Sara

03226/0717-1530/073
M0109952.rg4/03226

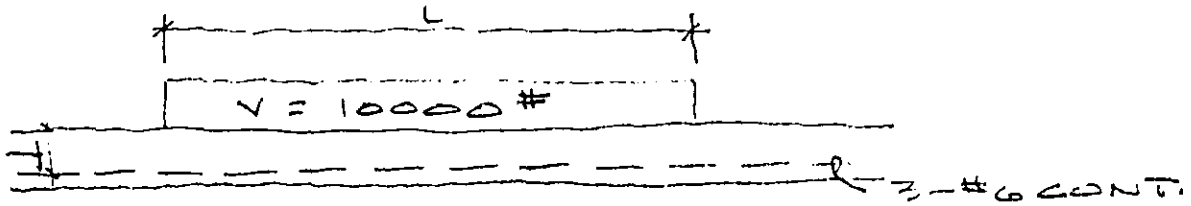
RETAINING WALL
STRUCTURAL CALCULATIONS

(REVISED FOR TRAFFIC BARRIER)

REF: STRUCT. ENGR. HANDBOOK, GAYLORD, FISHER

VEHICULAR F (AASHTO) TO BARRIER = 10000 #

CHECK SPREAD ALONG 12" CMU WALL
USE MAX. STRESS FOR IMPACT LOADING



$d = 11.62 - \left(1.25 + \frac{0.75}{2}\right) = 10"$

$\Sigma A_s = 3 \times 0.44 = 1.32 \text{ IN}^2$

$p = \frac{1.32}{12 \times 10} = 0.011$

$np = 20 \times 0.011 = 0.22$

$\frac{z}{jk} = 4.8$

$f_m = 600 = \frac{M \times 12 \times 48}{12 \times 10^2}$

$M = 10417 \text{ FT}^{\#} = \frac{10000}{10} L$

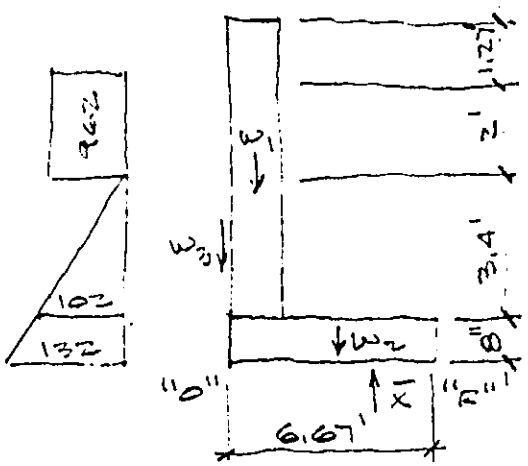
$L = 10.4'$

$V = \frac{10000}{10.4} = 962 \#/\text{FT}$

UBC 2406(c)1
$F_b = \frac{1500}{3 \times 2}$ w/o S.I.

Special INSP. reqd

3.4' HIGH WALL & TRAFFIC BARRIER



EFP = 30 PSF

$W_1 = 6.167 \times 1.04 = 6.94$

$W_2 = 6.167 \times 0.167 \times 150 = 670$

$W_3 = 3.4^2 \times 30 \times \frac{1}{2 \times 3} = 58$

$\Sigma W = 1422\ ^{\#}/_{FT}$

$M_o = \left(\frac{13.2 \times 4.4^2}{2 \times 3}\right) + (5.4 \times 962) = 5621\ FT^{\#}$

$M_R = (6.17 \times 694) + (3.33 \times 670) + (6.67 \times 58) = 6900\ FT^{\#}$

OVERTURN RATIO = $\frac{6900}{5621} = 1.2$ OK FOR IMPACT

NET $M = 6900 - 5621 = 1279\ FT^{\#}$

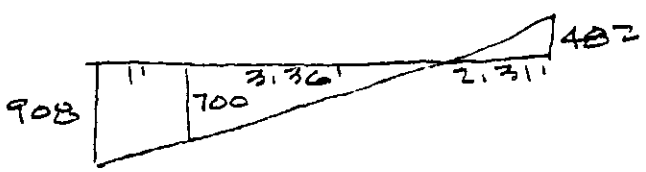
$\bar{x} = \frac{1279}{1422} = 0.90'$

$e = \frac{6.67}{2} - 0.90 = 2.43'$

$M_e = 1422 \times 2.43 = 3455\ FT^{\#}$

$S_{FTG} = \frac{0.67 \times 6.67^2}{6} = 4.97\ FT^3$

$SBP = \frac{1422}{6.67} \pm \frac{3455}{4.97} = 908\ PSF \text{ & } -482\ PSF$



FTG. REINF:

$V = \frac{700 \times 3.36}{2} = 1176^{\#}$

$d = 8 - (2.5 + \frac{.962}{2}) = 5.18''$

$v = \frac{1176}{12 \times 7/8 \times 5.18} = 22 PSI < 54$ OK

$M = \frac{700 \times 3.36^2}{2 \times 3} = 1317 FT^{\#}$

$A_s = \frac{1.317 \times 12}{20 \times 7/8 \times 5.18} = 0.17 IN^2 <$ #5 @ 16

TEMP $A_s = 0.0012 \times 8 \times 6.67 \times 12 = 0.77 IN^2 <$ 4-#4

STEM REINF:

$V = (\frac{102 \times 3.4}{2}) + 962 = 1135^{\#}$

$d = 10''$

$v = \frac{1135}{12 \times 7/8 \times 10} = 11 PSI < 17$ OK

$M = (\frac{102 \times 3.4^2}{2 \times 6}) + (962 \times 4.4) = 4429 FT^{\#}$

$A_s = \frac{4.429 \times 12}{20 \times 7/8 \times 10} = 0.30 IN^2 <$ #6 @ 16

$\Sigma A_s = 0.33 IN^2/FT$

$p = \frac{0.33}{12 \times 10} = 0.0028$

$n_p = 40 \times 0.0028 = 0.112$

See UBC 2401(C) & UBC 2406(4)B

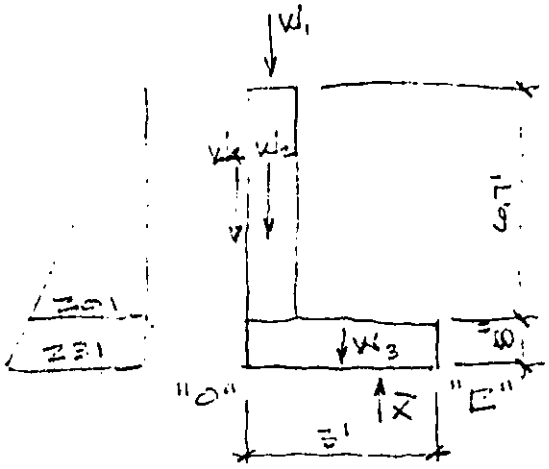
$\frac{z}{JK} = 6.0$

$f_m = \frac{4429 \times 12 \times 6.0}{12 \times 10^2} = 266$ PSI < 500 @ full stress

7.11 → 315.2

$315.2 < 250$ OK FOR IMPACT NG

6.7' HIGH WALL



EFP = 30 PCF

W_1 = 2 x 1.5 = 270
W_2 = 6.7 x 84 = 583
W_3 = 0.67 x 3 x 150 = 302
W_4 = $6.7^2 \times 30 \times \frac{1}{2} \times 3$ = 224

ΣW = 1379 #/FT

$M_O = \frac{231 \times 7.7^2}{3 \times 3} = 2283$ FT#

$M_R = (2.75 \times 270) + (2.67 \times 583) + (1.5 \times 302) + (3 \times 224)$
$= 3424$ FT#

OVERTURN RATIO = $\frac{3424}{2283} = 1.5$ OK

NET M = 3424 − 2283 = 1141 FT#

$\bar{X} = \frac{1141}{1379} = 0.83'$

$e = \frac{3}{2} - 0.83 = 0.67'$

$M_e = 1141 \times 0.67 = 764$ FT#

$S_{FTG} = \frac{0.67 \times 3^2}{6} = 1.01$ FT³

$\sigma = \frac{1379}{3} \pm \frac{764}{1.01} = 1217$ PSF & −297 PSF

FTG. REINF:

$V = \frac{712 \times 1.78}{2} = 634\#$

$d = 5.18"$

$v = \frac{634}{12 \times 7/8 \times 5.18} = 12 \text{ PSI} < 54 \text{ OK}$

$M = \frac{634 \times 1.78^2}{2 \times 3} = 335 \text{ FT}\#$

$A_s = \frac{0.335 \times 12}{20 \times 7/8 \times 5.18} = 0.04 \text{ IN}^2 < \#5 @ 16$

TEMP $A_s = 0.0012 \times 8 \times 3 \times 12 = 0.35 \text{ IN}^2 <$ 2 - #4

STEM REINF:

$V = \frac{201 \times 6.7}{2} = 673\#$

$M = \frac{673 \times 6.7}{3} = 1503 \text{ FT}\#$

$d = 7.62 - \left(1.25 + \frac{0.62}{2}\right) = 6.06"$

$v = \frac{673}{12 \times 7/8 \times 6.06} = 11 \text{ PSI} < 17 \quad \text{OK}$

$A_s = \frac{1.503 \times 12}{20 \times 7/8 \times 6.06} = 0.17 \text{ IN}^2 < \#5 @ 16$

$\Sigma A_s = 0.233 \text{ IN}^2/\text{FT}$

$p = \frac{0.233}{12 \times 6.06} = 0.0032$

$np = 40 \times 0.0032 = 0.128$

$\frac{z}{jk} = 5.77$

$f_m = \frac{1.503 \times 12 \times 5.77}{12 \times 6.06^2} = 236 \text{ PSI} < 250 \quad \text{OK}$

DATE: 30 DECEMBER 1994

TO: CLARK COUNTY
DEPARTMENT OF PUBLIC WORKS
401 SOUTH 4th STREET
LAS VEGAS, NV 89101

FROM: RAY NOVATNEY, PE
4782 SOUTH MOJAVE RD.
LAS VEGAS, NV 89121
PHONE: 456-6734

SLW
1 S 30
JAN 04 1995

RE: ADDENDUM TO DRAINAGE STUDY FOR CIBOLA
HTE 94-25236

SUBJECT: WILLDAN ASSOCIATES MEMORANDUM DATED 11/30/94.

A COPY OF THE MEMORANDUM IS ATTACHED AND THE ENGINEERS COMMENTS ARE AS FOLLOWS:

ITEM 1. THE STEWART AVENUE STORM DRAIN HAS BEEN REDESIGNED. HYDRAULIC AND STRUCTURAL CALCULATIONS, AND REVISED GRADING PLAN ARE HEREIN INCLUDED.

ITEM 2. WALL SECTIONS HAVE BEEN INCLUDED ON THE GRADING PLAN. REFERING TO THE SLOAN CHANNEL HEC 11 WATER SURFACE PROFILE, RIGHT (SITE SIDE) OVERBANK VELOCITIES VARY FROM 0 TO 3.4 FPS WHICH IS LOWER THAN THE ALLOWABLE VELOCITY OF 3.75 FPS FOR ONSITE SOILS OF SILT-LOAM-COBBLE.

ITEM 3. A COPY OF THE DRAINAGE STUDY AND GRADING PLAN WERE SUBMITTED TO CCPW DESIGN SECTION ON 12/08/94. A COPY OF THIS ADDENDUM WILL BE SUBMITTED TO THEM.

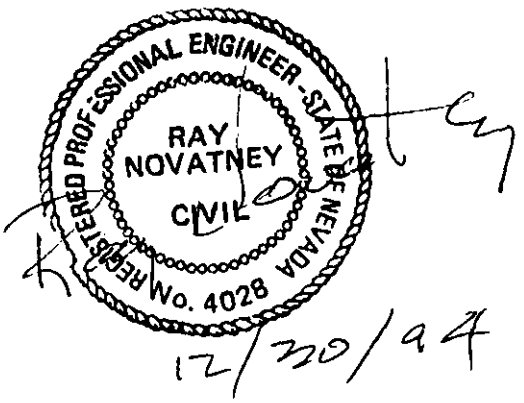
ITEM 4. REQUIRED ADDITIONAL INFORMATION HAS BEEN ADDED TO THE PLAN AND IT IS LEGIBLE.

ITEM 5. HANDICAP FACILITIES ARE SHOWN ON THE GRADING PLAN.

ITEM 6. A COPY OF THE DRAINAGE STUDY AND GRADING PLAN WERE SUBMITTED TO CCRFCD AND A COPY OF THIS ADDENDUM WILL BE SUBMITTED TO THEM.

ITEM 7. THE NOTED ITEMS, WHEN APPLICABLE, HAVE BEEN INCORPORATED ON THE GRADING PLAN.

END OF COMMENTS



12/30/94

WILLDAN ASSOCIATES ☐ ENGINEERS & PLANNERS

Professional Consulting Services Since 1964

MEMORANDUM

TO: Ralph M. Gabriel, P.E.
Isabel Pennington

FROM: Stephen L. Weatherman, P.E.

OFFICE: Las Vegas

DATE: November 30, 1994

SUBJECT: Willdan/Clark County Public Works Plan Review Contract
Technical Drainage Study for Cibola **(1530)**
Study Dated: November 19, 1994
Location: Southwest corner of Stewart Avenue and Sloan Channel (Sec. 33, T. 20 S., R. 62 E.)
H.T.E. 94-25236
Prepared by Ray Novatney

We have completed our initial review of the above-referenced **Technical Drainage Study**, and have the following comments:

X 1. The design of the proposed storm drain on the south side of Stewart Avenue must be revised. The purpose of the storm drain is to collect flows within Stewart Avenue, but the proposed pipe is located outside of the right-of-way within a 10-foot-wide easement behind a block wall. The access and maintenance of the pipe would require access to the backyard of 14 lots. The pipe must be relocated into the Stewart Avenue right-of-way. The present design includes Y connections from the proposed drop inlets to the mainline pipe which does not meet current criteria. The storm drain connections must be with manholes. Alternately, the storm drain pipe may be run from drop inlet to drop inlet. Appropriate plan and profile must be provided for the storm drain design;

REDESIGNED, THE FIFE IS 7' WIDE - CAN'T RUN FROM D.I. TO D.I. 4 CAN'T MAINTAIN 10' CLEAR FROM EX. 42" WATER, ALSO NO COVER ON FIFE IN R/W.

✓ 2. The submitted calculations and grading plan indicates the BFE's are above the channel bank. The finished floors are above the BFE's and apparently a retaining wall is to be placed on the Sloan Channel property line. This wall must be designed as a flood wall to include appropriate cutoff walls to prevent undercutting by the Sloan Channel. Appropriate calculations and designs are required; "GLENDALE" SILT-LOAM-COBBLES GOOD FOR 2.75 FPS

SECNO	VPROP
2	4.6
3	0.0
4	0.0
5	0.0
6	3.4
7	1.4
8	1.4

SEE HEC II

✓ 3. The Sloan Channel is currently under design and the applicant must coordinate all improvements with the Clark County Public Works Design section;

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X 4. The current scale of 1-inch = 60 feet may not be legible when the required tc, road centerline elevations, and finished contours are added. If the plan cannot be legible to microfilm, the scale must be changed;

✓ 5. The grading plan will be reviewed by the building department to ensure compliance with the handicap access requirements (see attached letter). Revisions to the grading plan may be required if the site accessibility design does not comply with the requirements set forth in the Accessibility Chapter of the Clark County Building Code;

✓ 6. Clark County Regional Flood Control District concurrence is required since the site is located within Flood Zone A and adjacent to a regional facility. As a condition of final approval, the applicant must submit a copy of the drainage study and any addenda to the Clark County Regional Flood Control District. The final map will not be approved by the Board of County Commissioners until concurrence is obtained from the Clark County Regional Flood Control District:

HAS BEEN SUBMITTED

✓ 7. At the request of Clark County Public Works, grading plans for the proposed development have been reviewed for compliance to permitting requirements according to Section 34.030 of the "Uniform Regulations for the Control of Drainage," revised November 12, 1990. **The plans submitted do not meet the minimum requirements and must be revised prior to Drainage Study approval, to address the following:**

- ✓ a. Existing pavement, show sawcut and replace areas, pavement transitions
- ✓ b. Typical road sections
- ✓ c. Profile, HGL for proposed storm drains
- ✓ d. Proposed contours
- ✓ e. Crown elevations at lot lines and extension of lot lines
- ✓ f. Details at property lines, fences, and berms
- ✓ g. Details of flood walls and retaining walls
- X h. Detail of proposed or future block wall opening with flowline elevation

THERE ARE NO OPENINGS.

The grading plan has been red-lined and is being returned to the engineer. The red-lined grading plan must be resubmitted with the revised drawings. Failure to resubmit the red-lined grading plan will prevent further review of the project.

All addenda must be submitted directly to Clark County. Any drainage studies or addenda submitted directly to Willdan will be returned to Clark County for the necessary log-in procedures.

The items listed herein must be thoroughly addressed and submitted for review prior to acceptance of this study.

A study review workshop with Willdan Associates may be scheduled if there are questions concerning the above listed comments.

CONCURRENCE BY CLARK COUNTY PUBLIC WORKS:

Signature _____ Date 12/2/94

COMMENTS:

Item 3 - This study must be reviewed and commented by the CCPW Design Division regarding the storm drain on Stewart and the Sloan Channel. It is the engineer's responsibility to forward a copy of this study and all addenda to the CCPW Design. No approval shall be given until after the approval by the CCPW Design.

PL 12-2-94

SUBMITTED 12/05/94

cc: John Sara

032260717-1530.023
MH129942 ip/032226

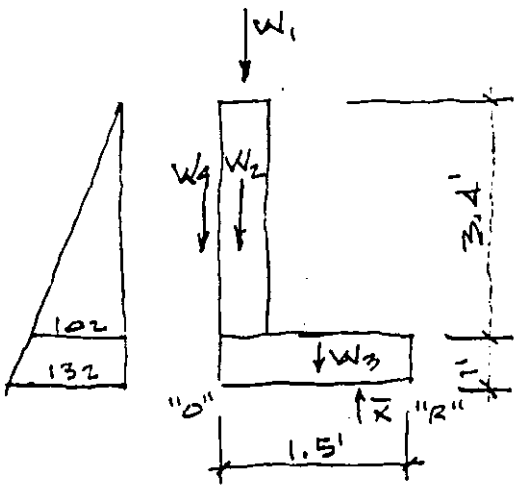
RETAINING WALL
STRUCTURAL CALCULATIONS

MATERIALS:
1. PCC = 2500 PSI @ 28 DAYS
2. PC = TYPE V OR EQUAL
3. MORTAR = TYPE "S" 1500 PSI
4. GROUT = 2000 PSI
5. CMU = GRADE "N" 1500 PSI NORMAL WEIGHT
6. REINF. STL. = AGIS DEF. BILLET GRADE 40
7. NO SPECIAL INSPECTION

WHEEL LOAD

MIN. WHEEL LOAD DIST. FROM WALL = 6'
MAX. WALL HGT. AFFECTED = 5.3'
∴ NO WHEEL SURCHARGE APPLIED

3.4' HIGH WALL



EFP = 30 PCF

$W_1 = 4 \times 45$	=	180
$W_2 = 3.4 \times 84$	=	285
$W_3 = 1.5 \times 150$	=	225
$W_4 = 3.4^2 \times 30 \times \frac{1}{2} \times \frac{1}{3}$	=	58
ΣW	=	748 #/FT

$$M_O = \frac{132 \times 4.4^2}{2 \times 3} = 426 \text{ FT\#}$$

$$M_R = (1.25 \times 180) + (1.17 \times 285) + (0.75 \times 225) + (1.5 \times 58)$$
$$= 814 \text{ FT\#}$$

OVERTURN RATIO = $\frac{814}{426} = 1.9 > 1.5$ OK

NET M = 814 − 426 = 388 FT#

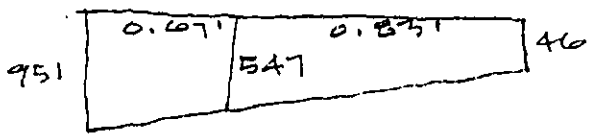
$\bar{x} = \frac{388}{748} = 0.52'$ (WITHIN MID 3RD)

$e = \frac{1.5}{2} - 0.52 = 0.23'$

$M_e = 748 \times 0.23 = 172$ FT#

$S_{FTG} = \frac{1 \times 1.5^2}{6} = 0.38$ FT^3

$SBP = \frac{748}{1.5} \pm \frac{172}{0.38} = 951$ PSF & 46 PSF



FTG. REINF.:

$V = \left(\frac{547 + 46}{2}\right) \times 0.83 = 246$#

$d = 12 - \left(3 + \frac{0.5}{2}\right) = 8.75$"

$v = \frac{246}{12 \times 7/8 \times 8.75} = 3$ PSI < 54 OK

$M = \left(\frac{46 \times 0.83^2}{2}\right) + \left(\frac{501 \times 0.83^2}{2 \times 3}\right) = 73$ FT#

$A_s = \frac{0.073 \times 12}{20 \times 7/8 \times 8.75} = 0.01$ IN^2 < #4 @ 16

TEMP $A_s = 0.0012 \times 12 \times 1.5 \times 12 = 0.26$ IN^2 < 2-#4

STEM REINF.:

$V = \frac{102 \times 3.4}{2} = 173$#

$M = \frac{173 \times 3.4}{3} = 196$ FT#

$d = 7.62' - \left(1.25 + \frac{0.5}{2}\right) = 6.12$"

$$v = \frac{173}{12 \times 7/8 \times 6.12} = 3 \text{ PSI} < 17 \text{ OK}$$

$$A_s = \frac{0.196 \times 12}{20 \times 7/8 \times 6.12} = 0.021 \text{ IN}^2 < \#4 @ 16$$

$$\Sigma A_s = 0.15 \text{ IN}^2/\text{FT}$$

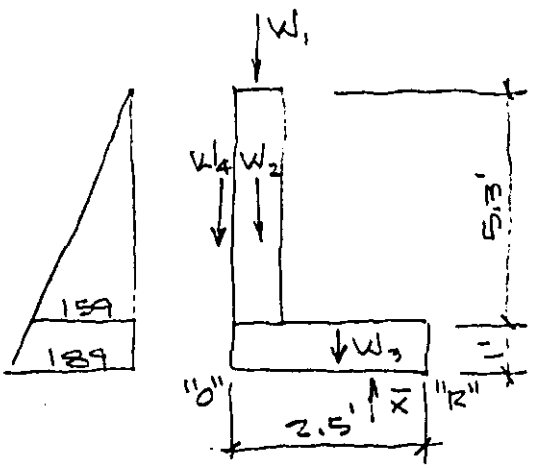
$$p = \frac{0.15}{12 \times 6.12} = 0.0020$$

$$np = 40 \times 0.0020 = 0.08$$

$$\frac{z}{jk} = 17.7$$

$$f_m = \frac{196 \times 12 \times 17.7}{12 \times 6.12^2} = 93 \text{ PSI} < 250 \text{ OK}$$

5.3' HIGH WALL



EFP = 30 PCF

W_1	=	4×45	= 180
W_2	=	5.3×84	= 445
W_3	=	2.5×150	= 375
W_4	=	$5.3^2 \times 30 \times \frac{1}{2 \times 3}$	= 140
ΣW			= 1140 #/FT

$$M_o = \frac{189 \times 6.3^2}{2 \times 3} = 1250 \text{ FT}^\#$$

$$M_R = (2.25 \times 180) + (2.17 \times 445) + (1.25 \times 375) + (2.5 \times 140)$$
$$= 2189 \text{ FT}^\#$$

$$\text{OVERTURN RATIO} = \frac{2189}{1250} = 1.8 > 1.5 \text{ OK}$$

$$\text{NET } M = 2189 - 1250 = 939 \text{ FT}^\#$$

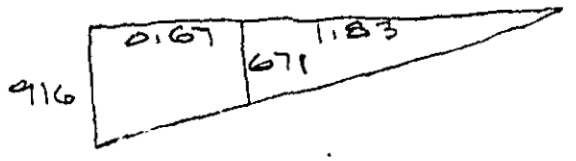
$$\bar{x} = \frac{939}{1140} = 0.83' \text{ (@ 3RD POINT)}$$

$e = \frac{2.5}{2} - 0.83 = 0.42$

$M_e = 1140 \times 0.42 = 479 \text{ FT}^{\#}$

$S_{FTG} = \frac{1 \times 2.5^2}{6} = 1.04 \text{ FT}^3$

$S_{BP} = \frac{1140}{2.5} \pm \frac{479}{1.04} = 916 \text{ PSF} \; \& \; 0 \text{ PSF}$



FTG. REINF.:

$V = \frac{671 \times 1.83}{2} = 614^{\#}$

$d = 8.75''$

$v = \frac{614}{12 \times 7/8 \times 8.75} = 7 \text{ PSI} < 54 \text{ OK}$

$M = \frac{671 \times 1.83^2}{2 \times 3} = 375 \text{ FT}^{\#}$

$A_s = \frac{0.375 \times 12}{20 \times 7/8 \times 8.75} = 0.031 \text{ IN}^2 < \#4 @ 16$

TEMP. $A_s = 0.0012 \times 12 \times 2.5 \times 12 = 0.432 \text{ IN}^2 = 2\text{-}\#$.

STEM REINF.:

$V = \frac{159 \times 5.3}{2} = 421^{\#}$

$M = \frac{421 \times 5.3}{3} = 744 \text{ FT}^{\#}$

$d = 7.62 - (1.25 + \frac{0.62}{2}) = 6.06''$

$v = \frac{421}{12 \times 7/8 \times 6.06} = 7 \text{ PSI} < 17 \text{ OK}$

$A_s = \frac{0.744 \times 12}{20 \times 7/8 \times 6.06} = 0.08 \text{ IN}^2 < \#5 @ 16$

$\Sigma A_s = 0.233 \text{ IN}^2/\text{FT}$

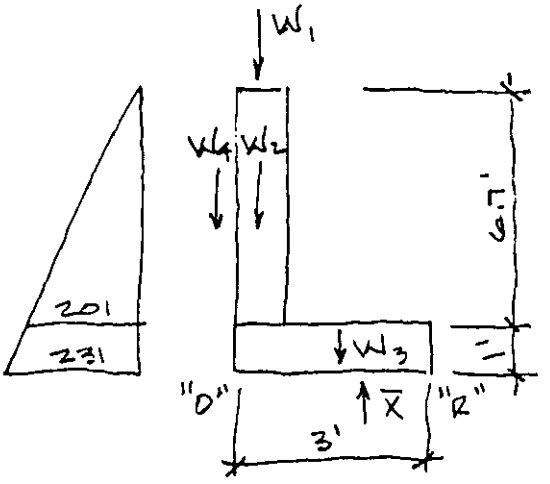
$$p = \frac{0.233}{12 \times 6.106} = 0.00032$$

$$np = 40 \times 0.00032 = 0.128$$

$$\frac{z}{jk} = 5.77$$

$$f_m = \frac{744 \times 12 \times 5.77}{12 \times 6.106^2} = 117 \text{ PSI} < 250 \quad \text{OK}$$

6.7' HIGH WALL



EFP = 30 PCF

$W_1 = 6 \times 45$	=	270
$W_2 = 6.7 \times 84$	=	583
$W_3 = 3 \times 150$	=	450
$W_4 = 6.7^2 \times 30 \times \frac{1}{2 \times 3}$	=	224
$= W$	=	1527 #/FT

$$M_o = \frac{231 \times 7.7^2}{2 \times 3} = 2283 \text{ FT}^\#$$

$$M_R = (2.75 \times 270) + (2.67 \times 583) + (1.50 \times 450) + (3 \times 224)$$
$$= 3646 \text{ FT}^\#$$

$$\text{OVERTURN RATIO} = \frac{3646}{2283} = 1.6 > 1.5 \quad \text{OK}$$

$$\text{NET } M = 3646 - 2283 = 1363 \text{ FT}^\#$$

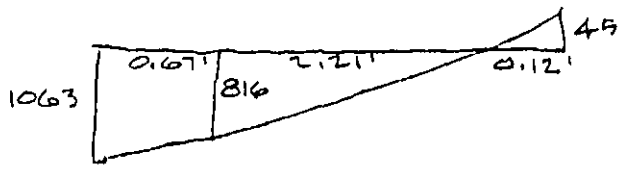
$$\bar{X} = \frac{1363}{1527} = 0.891' \quad (\text{OUTSIDE MID } 3\text{FT})$$

$$e = \frac{3}{2} - 0.89 = 0.61'$$

$$M_e = 1363 \times 0.61 = 831 \text{ FT}^\#$$

$$S_{FTG} = \frac{1 \times 3^2}{6} = 1.50 \text{ FT}^3$$

$$SBP = \frac{1527}{3} \pm \frac{831}{1.50} = 1063 \text{ PSF} \;\&\; -45 \text{ PSF}$$



FTG. REINF.

$$V = \frac{816 \times 2.21}{2} = 902\#$$

$$d = 12 - \left(3 + \frac{0.62}{2}\right) = 8.69''$$

$$v = \frac{902}{12 \times .75 \times 8.69} = 10 \text{ PSI} < 54 \quad \text{OK}$$

$$M = \frac{902 \times 2.21^2}{2 \times 3} = 734 \text{ FT}\#$$

$$A_s = \frac{0.734 \times 12}{20 \times .75 \times 8.69} = 0.061 \text{ IN}^2 < \#4 @ 16$$

TEMP. $A_s = 0.0012 \times 12 \times 3 \times 12 = 0.52 \text{ IN}^2 < 3\text{-}\#4$

STEM REINF.

$$V = \frac{201 \times 6.7}{2} = 673\#$$

$$M = \frac{673 \times 6.7}{3} = 1503 \text{ FT}\#$$

$$d = 6.06''$$

$$v = \frac{673}{12 \times .75 \times 6.06} = 11 \text{ PSI} < 17 \quad \text{OK}$$

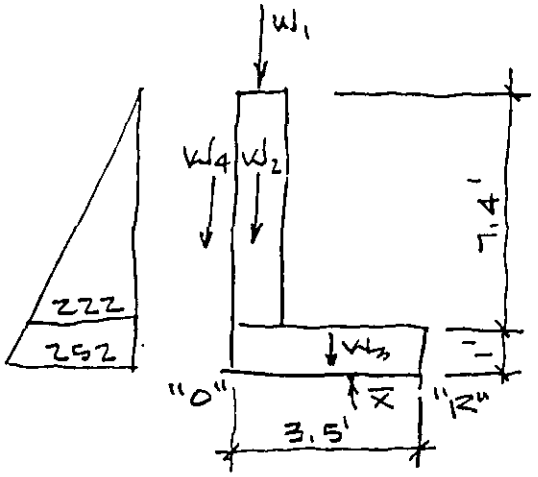
$$A_s = \frac{1.503 \times 12}{20 \times .75 \times 6.06} = 0.17 \text{ IN}^2 < \#5 @ 16$$

$$\Sigma A_s = 0.233 \text{ IN}^2/\text{FT}$$

$$p = 0.0032 \qquad np = 0.128 \qquad \frac{z}{jk} = 5.77$$

$$f_m = \frac{1503 \times 12 \times 5.77}{12 \times 6.06^2} = 236 \text{ PSI} < 250 \quad \text{OK}$$

7.4' HIGH WALL



EFP = 30 PCF

W_1	$= 6 \times 45$	$= 270$
W_2	$= 7.4 \times 84$	$= 622$
W_3	$= 3.5 \times 150$	$= 525$
W_4	$= 7.4^2 \times 30 \times \frac{1}{2 \times 3}$	$= 274$
ΣW		$= 1691$ #/FT

$$M_o = \frac{252 \times 7.4^2}{2 \times 3} = 2300 \text{ FT}^{\#}$$

$$M_{12} = (3.25 \times 270) + (3.17 \times 622) + (1.75 \times 525) + (3.5 \times 274)$$
$$= 4727 \text{ FT}^{\#}$$

$$\text{OVERTURN RATIO} = \frac{4727}{2300} = 2.1 > 1.5 \text{ OK}$$

$$\text{NET } M = 4727 - 2300 = 2427 \text{ FT}^{\#}$$

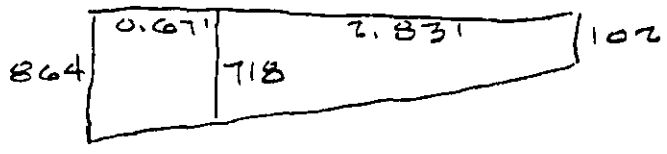
$$\bar{x} = \frac{2427}{1691} = 1.43' \quad (\text{INSIDE MID } 3^{RD})$$

$$e = \frac{3.5}{2} - 1.43 = 0.32'$$

$$M_e = 2427 \times 0.32 = 777 \text{ FT}^{\#}$$

$$S_{FTG} = \frac{1 \times 3.5^2}{6} = 2.04 \text{ FT}^3$$

$$SFP = \frac{1691}{3.5} \pm \frac{777}{2.04} = 864 \text{ PSF} \; \& \; 102 \text{ PSF}$$



FTG. REINF.:

$V = \left(\frac{718 + 102}{2}\right) \times 2.83 = 1160^{\#}$

$d = 8.69''$

$v = \frac{1160}{12 \times 7/8 \times 8.69} = 13 \text{ PSI} < 54 \quad \text{OK}$

$M = \frac{1160 \times 2.83^2}{2 \times 3} = 1548 \text{ FT}^{\#}$

$A_s = \frac{1,548 \times 12}{20 \times 7/8 \times 8.69} = 0.12 \text{ IN}^2 < \#4 @ 16$

TEMP. $A_s = 0.0012 \times 12 \times 3.5 \times 12 = 0.60 \text{ IN}^2 = 3\text{-}\#4$

STEM REINF.

$V = \frac{222 \times 7.4}{2} = 821^{\#}$

$M = \frac{821 \times 7.4}{3} = 2025 \text{ FT}^{\#}$

$d = 6.06''$

$v = \frac{821}{12 \times 7/8 \times 6.06} = 13 \text{ PSI} < 17 \quad \text{OK}$

$A_s = \frac{2,025 \times 12}{20 \times 7/8 \times 6.06} = 0.23 \text{ IN}^2 = \#5 @ 16$

USE $2\text{-}\#5 @ 16$

$\Sigma A_s = 0.47 \text{ IN}^2/\text{FT}$

$p = \frac{0.47}{12 \times 6.06} = 0.0065$

$np = 40 \times 0.0065 = 0.259$

$\frac{z}{jk} = 4.80$

$f_M = \frac{2025 \times 12 \times 4.80}{12 \times 6.06^2} = 265 \leq 250 \quad \text{OK}$

```
X    X  XXXXXXX  XXXXX           XXXXX
X    X  X       X    X              X
X    X  X       X                   X
XXXXXXX  XXXX    X         XXXXX   XXXXX
X    X  X       X                   X
X    X  X       X    X              X
X    X  XXXXXXX  XXXXX           XXXXXXX
```

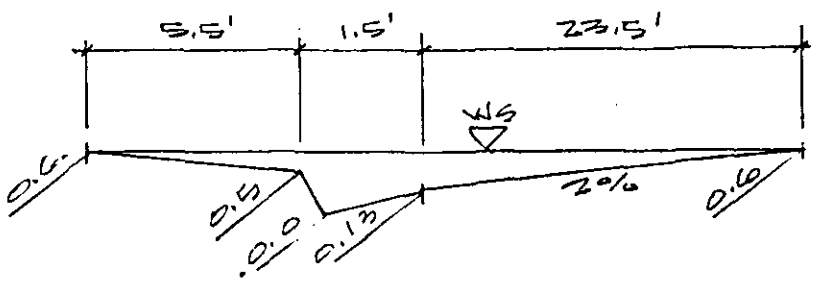
```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 SOUTH SIDE STEWART
T2 SUBCRITICAL FLOW Q=13 CFS
T3 STSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0          0         0    0.0016         0         0        13       0.6         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0         -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8          5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.016     0.012     0.012

X1        1         5       5.5         7         0         0         0
GR      0.6         0       0.5       5.5       0.0       5.6      0.13         7       0.6      30.5
```

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT

Q	DEPTH	10*KS	QLOB	QCH	QROB	VLOB	VCH	VROB
13.001	.60	16.00	.16	2.16	10.68	.53	2.74	1.90

SUMMARY OF ERRORS AND SPECIAL NOTES



$S = 0.0016$

$Q = 13$ CFS

$V_{ch} = 2.74 \times 0.6 < 6$ OK

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X          X     X
X     X  X        X                      X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX            XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 SOUTH SIDE STEWART
T2 SUPERCRITICAL FLOW Q=13 CFS
T3 STSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1    0.0016         0         0        13       0.6         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      *********REQUESTED SECTION NUMBERS*********
     -10       -10

NC    0.016     0.012     0.012

X1        1         5       5.5         7         0         0         0
GR      0.6         0       0.5       5.5       0.0       5.6      0.13         7       0.6      30.5

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH      QROB      VLOB      VCH      VROB
*     13.001        .55     29.78      .00      2.47     10.53       .05      3.48     2.39

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=     13.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

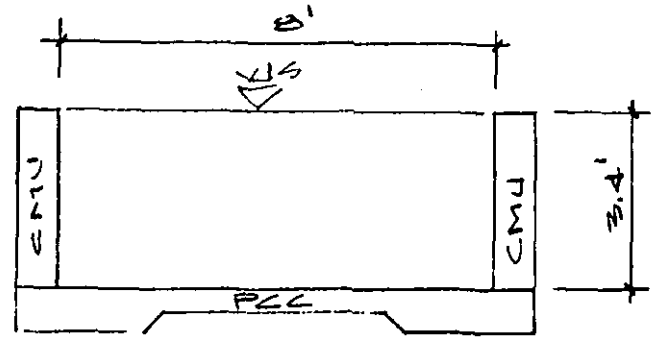
E-2

```
X    X  XXXXXXX  XXXXX          XXXXX
X    X  X       X    X        X     X
X    X  X       X              X
XXXXXXX XXXX    X        XXXXX  XXXXX
X    X  X       X              X
X    X  X       X    X         X
X    X  XXXXXXX  XXXXX          XXXXXXX
```

```
**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************
```

```
FR
T1 STEWART DRAIN WEST OF KAYENTA: CMU VERT SIDES & PCC BOTT
T2 SUBCRITICAL FLOW Q-100=(217-13) = 204 CFS
T3 RN CHSUB

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         0    0.0016         0         0       204       3.4         0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                      ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.012     0.012     0.012

X1        1         4         0         8         0         0         0
GR      3.4         0         0         0         0         8       3.4         8

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH      10*KS      QLOB       QCH      QROB      VLOB       VCH      VROB
   204.001        3.40      16.29       .00    204.00       .00       .00      7.50       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
```

$F_R = 0.5$



$S = 0.0016$

CURB OPENING:

$Q = CLH^{3/2} = 204 = 2.9\ L\ 0.6^{1.5}$

$L = 204 / 2.9 \times 0.6^{1.5} = 152'$

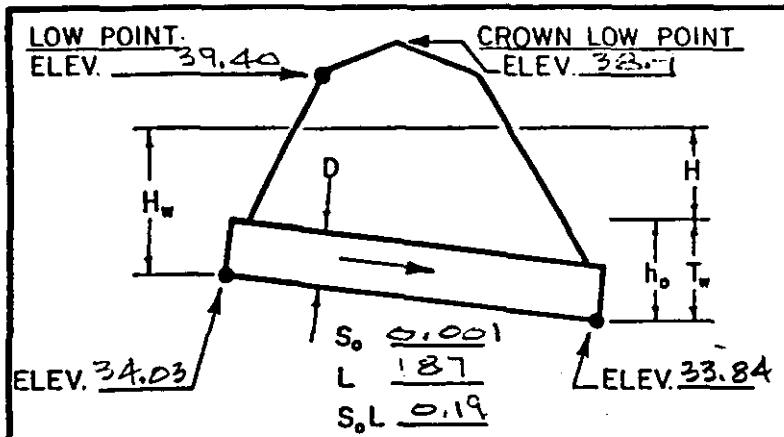
R-3

```
X     X  XXXXXXX   XXXXX             XXXXX
X     X  X        X     X           X     X
X     X  X        X                 X     X
XXXXXXX  XXXX     X          XXXXX   XXXXX
X     X  X        X                 X
X     X  X        X     X           X
X     X  XXXXXXX   XXXXX             XXXXXXX

**************************************************
  HEC2 RELEASE DATED SEP 88 UPDATED SEPT 1989
  ERROR CORR -  01,02,03
  MODIFICATION -
**************************************************

FR
T1 STEWART DRAIN WEST OF KAYENTA: CMU VERT SIDES & PCC BOTT
T2 SUPERCRITICAL FLOW Q-100=(217-13) = 204 CFS
T3 RN CHSUP

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0        0         0         1    0.0016         0         0       204       3.4        0
J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      -1        0        -1
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
      43        8         5        13        14        15        55        26        56
J5  LPRNT     NUMSEC                    ********REQUESTED SECTION NUMBERS********
     -10       -10

NC    0.012     0.012     0.012

X1        1         4         0         8         0         0         0
GR      3.4         0         0         0         0         8       3.4         8

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUMMARY PRINTOUT
         Q       DEPTH     10*KS     QLOB      QCH       QROB      VLOB      VCH       VROB
*    204.001      2.71     30.36       .00    204.00       .00       .00      9.40       .00

SUMMARY OF ERRORS AND SPECIAL NOTES
CAUTION SECNO=    204.001  PROFILE=  1  CRITICAL DEPTH ASSUMED
```

CULVERT RATING

REFERENCE:

PROJECT: _____ LOCATION: _____ STATION: _____



CULVERT DATA

TYPE: 8'x 3.5' RCB n: 0.012
INLET: _____ Q_{FULL}: 204
K_e: 0.2 V_{FULL}: 8.5

OUTLET CONTROL EQUATIONS

(1) $H_w = H + h_o - LS_o$

(2) For $T_w < D$; $h_o = \frac{d_c + D}{2}$ or T_w (whichever is greater)

$T_w \geq D$; $h_o = T_w$

(3) For Box Culvert: $d_c = 0.315(Q/B)^{2/3} \leq D$

Q	STORM EVENT	INLET CONTROL		OUTLET CONTROL						TYPE OF CONTROL	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY
		$\frac{H_w}{D}$	H_w	H	T_w	$T_w < D$ d_c	$T_w < D$ $\frac{d_c + D}{2} = h$	$T_w \geq D$ h_o	H_w			
1	2	3	4	5	6	7	8	9	10	11	12	13
229	100 YR	1.53	5.37	1.98	3.58			3.58	5.37	INLET		

$Q_{100} = TAZ-13 = 229$ CFS

USE 8'x3.5' RCB PER NDOT STD. B-20.13 FOR 2' MAX. COVER

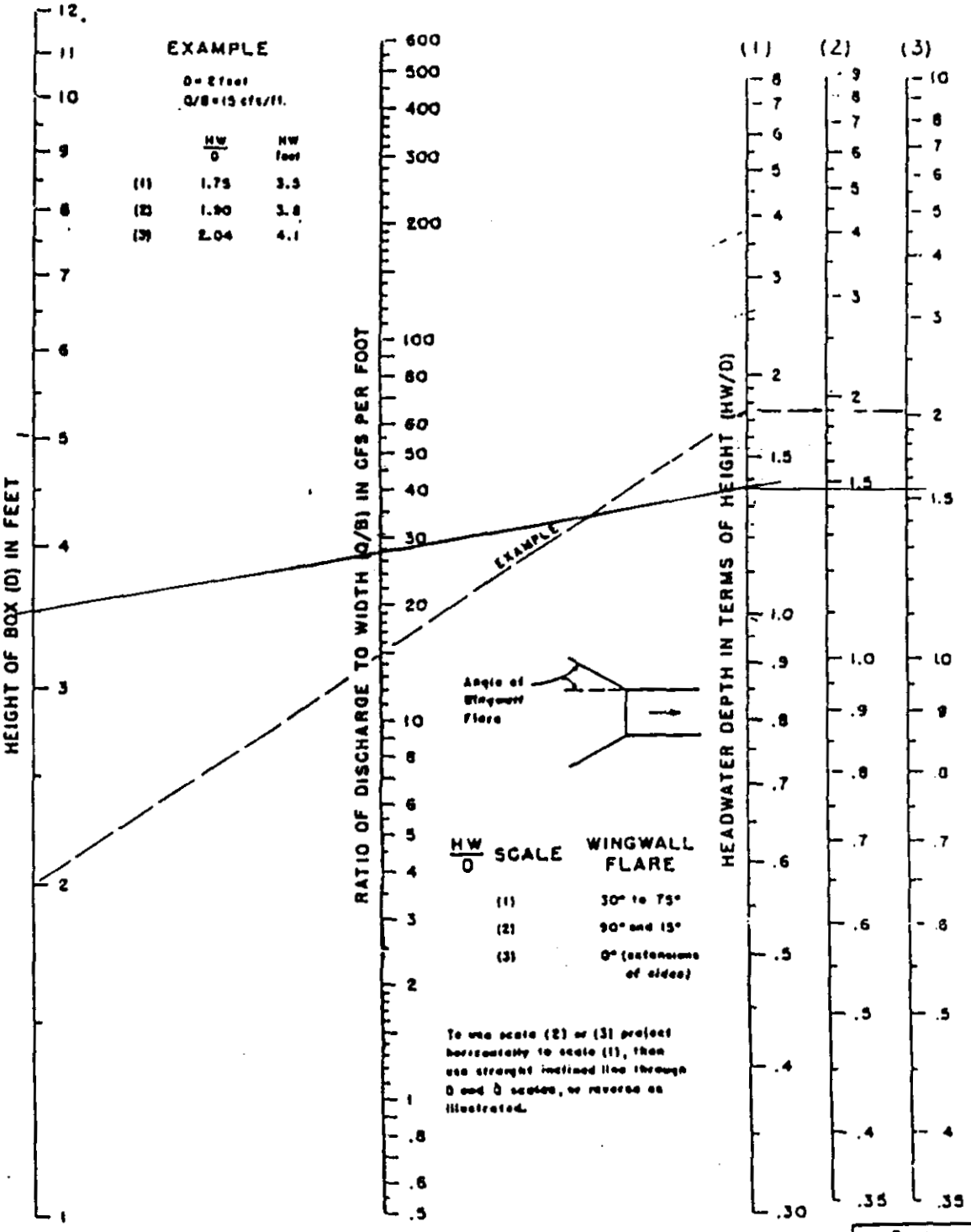
R-5

STANDARD FORM 7

Revision

Date

NOMOGRAPH - INLET CONTROL BOX CULVERT



Revision	Date

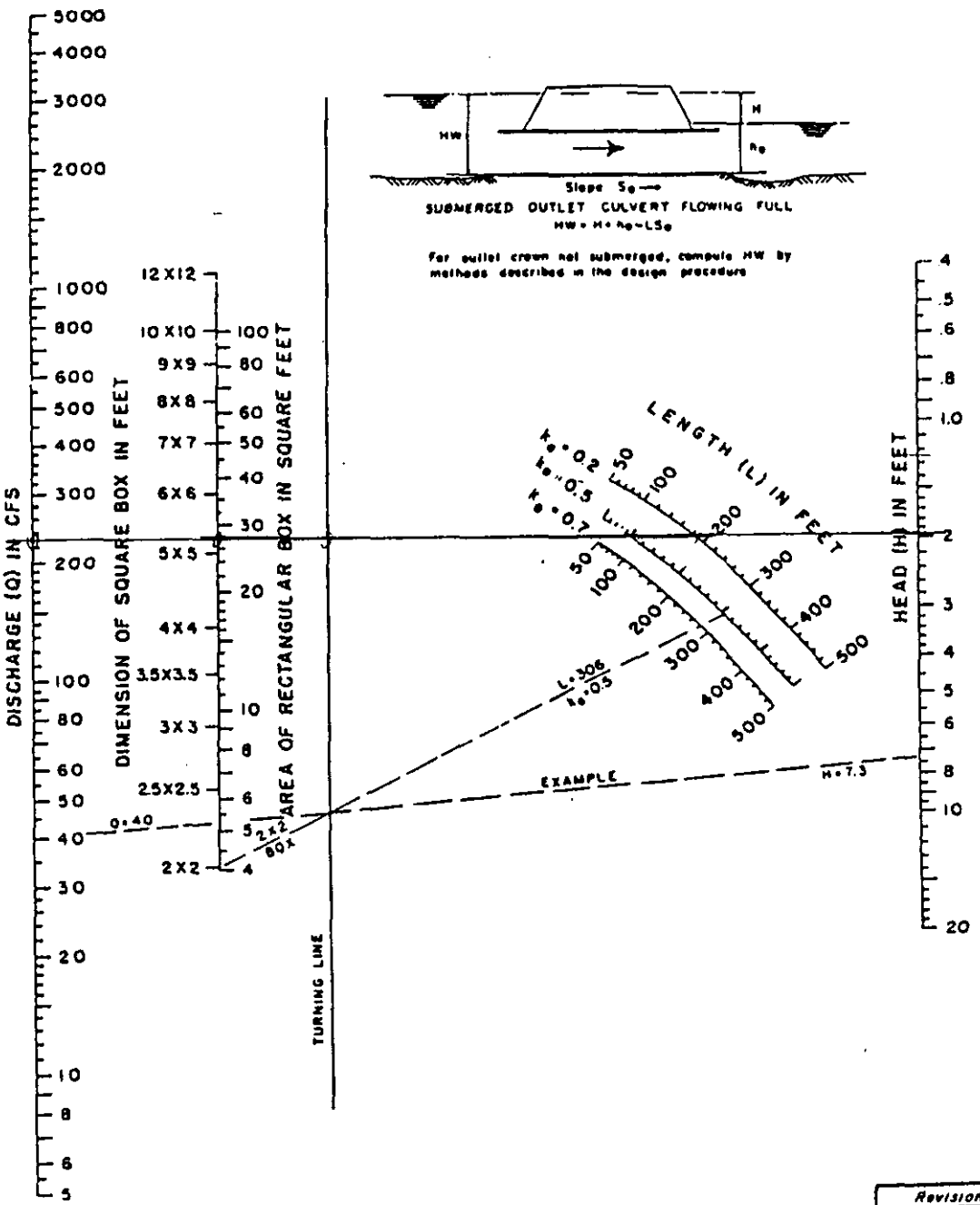
WRC ENGINEERING

REFERENCE:
USDOT, FHWA, HDS No.5, 1985 R-6

FIGURE 1004

NOMOGRAPH - OUTLET CONTROL BOX CULVERT

(n=0.012)



Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS No. 5, 1985 R-7	FIGURE 1008

STORM SEWER HYDRAULIC CALCULATIONS

CONDUIT DATA						FLOW DATA							ENERGY LOSS DATA							ENERGY AND HYDRAULIC DATA				COMMENTS	
STATION		SIZE / TYPE	INVERTS		LENGTH	A (FT^2)	I	Q (CFS)	V (FPS)	$H_v = V^2/2g$ (FT)	S_f (FT/FT)	AVE. S_f (FT/FT)	PIPE	TRANSITIONS						PIPE		TRANSITION		PRESS. FLOW ?	OTHER
FROM	TO		D/S ELEV.	U/S ELEV.									H_f (FT)	H_f (FT)	H_j (FT)	H_m (FT)	$H_{_}$ (FT)	$H_{_}$ (FT)	TOTAL (FT)	U/S EGL ELEV.	U/S HGL ELEV.	U/S EGL ELEV.	U/S HGL ELEV.		
													Enter Starting EGL and HGL Here →							32.10	32.35	←			
		21" RCP	30.60	31.44	135'	2.41	0.0041	11.5	4.77	0.35	0.0044	0.0044	0.59							33.29	32.94			N	
		18" RCP	31.69	33.12	239'	1.77	0.0042	7.6	4.29	0.29	0.0045	0.0044	1.05				0.01	0.01	0.02	34.36	34.07			N	$K_e = 0.15$ $K_m = 0.02$
		18" RCP	33.12	34.52	233'	1.77	0.0042	5.8	3.28	0.17	0.0026	0.0035	0.82				0.01		001	35.18	35.01				$K_m = 0.02$

$$S_f = \frac{I H_v}{R^{1.33}} \qquad I = \frac{2g(n^2)}{2.21}$$

Revision	Date

WRC ENGINEERING, INC.	REFERENCE:		R-8 STANDARD FORM 6

5.5.3 Cibola (Magnolia Estates) Grading Plans

5.5.4 Collins Business Park Hydrology Study

ONSITE HYDROLOGY STUDY
FOR
COLLINS BUSINESS PARK, PHASE II
& CHANNEL DESIGN FOR CCRFCD
FACILITY # RWWE 0027

WO# 755 - B165

August 18, 1995

Prepared by:

Engineers and Surveyors, Inc.
7548 W. Sahara Ave
Las Vegas, Nevada 89117

CLARK COUNTY PUBLIC WORKS DEPARTMENT
COMMUNITY DEVELOPMENT DIVISION
OFF-SITE DEVELOPMENT SUBMITTAL SHEET

(Each set of plans and/or studies must have a separate submittal sheet and a separate check.)

DATE 09-19-1995 TELEPHONE NUMBER (702) 248-6415

PROJECT NAME Collins Business Park, Phase II

ENGINEER Engineers and Surveyors Inc. (ESI)

ADDRESS 7548 W. Sahara Ave., Las Vegas, Nv. 89117

PUBLIC WORKS HTE # _____

TYPE OF SUBMITTAL (check only one type)

- [XX] NEW (never submitted before)
  (new improvement plans require Drainage Study HTE #_____ and Traffic Study HTE #_____.)
- [ ] CORRECTIONS (requested changes have been made to improvement plans) ⇒ HTE number is required.
- [ ] ADDENDUM (requested changes have been made to a study) ⇒ HTE number is required.
- [ ] TRAFFIC PRINTS ONLY (these are changes to the Traffic prints of the improvement plans.) ⇒ HTE number is required.
- [ ] AMENDMENT (these are changes to a study previously approved.)
- [ ] *UPDATE to a previously approved study.*

PROJECT TYPE (check only one type)

- [XX] DRAINAGE STUDY
- [ ] TRAFFIC STUDY
- [ ] COMMERCIAL IMPROVEMENT PLANS (☐Gravel ☐Paving ☐Full Offsites)
- [ ] SUBDIVISION IMPROVEMENT PLANS (☐Gravel ☐Paving ☐Full Offsites)
- [ ] PARCEL MAP IMPROVEMENT PLANS (☐ Gravel ☐Paving ☐Full Offsites)

(Please continue for NEW, AMENDMENT, and UPDATE submittals only.)

ASSESSOR'S PARCEL NUMBER (APN)

1. 260-560-015 2. 260-570-001 3. 260-580-005

RANGE 62E TOWNSHIP 22S SECTION 05 QUARTER _____

STREET LOCATION

1. EAST/WEST Craig Road 2. NORTH/SOUTH Lamb Boulevard

ZONING ACTIONS

1. _____ 3. _____ 5. _____ 7. _____
2. _____ 4. _____ 6. _____ 8. _____

OWNER E.A. Collins ADDRESS 7448 W. Sahara Ave. Sweet #101

DEVELOPER E.A. Collins ADDRESS Las Vegas, Nv. 89117

COMMENTS _____

(Revised 11/30/94)

DRAINAGE STUDY INFORMATION FORM

Name of Development: Collins Business Park, Phase II Date: 09-18-1995

Location of Development: a) Southeast corner of Craig Road and Lamb Boulevard

b) Sect. 05 Twn. 22S Rng. 62E 260-560-015, 260-570-001

Name of Owner: E.A. Collins Assessors Parcel No: 260-580-005

Contact Person-Name: Dan Le Telephone No: (702) 248-6415

Firm: Engineers and Surveyors (ESI)

Address: 7548 W. Sahara Ave.

Las Vegas, Nevada 89117

Type of Development/Land Disturbance Process:

- ☐ Rezoning
- ☐ Parcel Map
- ☐ Large Parcel Map
- ☐ Subdivision Map
- ☒ Planned Unit Development
- ☐ Building Permit
- ☐ Clearing and Grading Only
- ☐ Other (Please specify below)

1. Total Owned Land Area: At Site: Approx. 91 Ac Being Developed/Disturbed: Approx. 43 Ac
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? (YES*) NO
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? (YES*) NO
4. Proposed type of development (Residential, Commercial, Etc.) ? Industrial Park
5. Approximate upstream land area which drains to the subject site? 46.8 Sq. mi.
6. Has the site drainage been evaluated in the past? (YES) NO If yes, please identify documentation: Conceptual Drainage Study for Craig and Lamb, ESI Jan. 1994
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: ~~Existing natural channel at the southeast corner of the site~~
8. Briefly describe your proposed schedule for the subject project: A.S.A.P.

REGISTERED PROFESSIONAL ENGINEER-STATE OF NEVADA BYRON J. GLENN No. 11016 CIVIL

9-18-95

Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

* Review and concurrence of the Clark County Regional Flood Control District is required.

REVISION	DATE

Local Enity File No.

REFERENCE:

STANDARD FORM 1

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APPENDICES

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B. HEC-1 Analysis: Existing Conditions
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2. Interim Onsite HEC-1 Drainage Basin Map
3. Interim Onsite Rough Grading Plans and Drainage Details
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SECTION I: INTRODUCTION

INTRODUCTION

The purpose of this report is to present a drainage study for the Collins Business Park, Phase II development (formerly entitled Craig and Lamb). This report will also present the analysis and design of the regional flood control facility #RWWE 0027. This facility intersects the southwest corner of the site. Collins Business Park is a proposed industrial development, located at the southeast corner of Craig Road and Lamb Boulevard in an unincorporated area of Clark County (Figure 1).

The Developer will divide the proposed development into two phases. Phase II is located immediately north of Alexander Road and approximately 1200-feet south of Craig Road. Phase I lies immediately north of Phase II. The Phase I hydrology study, entitled, "*Onsite Hydrology Study of the Interim Condition for Collins Business Park, Phase I,*" has been submitted to the Clark County Department of Public Works in April, 1995 by Engineers and Surveyors Inc. (ESI). This study is currently in the approval process. Since flow from the Collins Business Park, Phase I development directly impacts the Phase II boundary, flows from the Phase I Hydrology Study will be referenced throughout this report (See Figure 1 for the location of each Phase).

A conceptual hydrology study for Collins Business Park was completed by Engineers and Surveyors Inc. in January, 1994. This report was entitled *Conceptual Drainage Study for Craig and Lamb*. The conceptual study was approved by Clark County on March 7, 1994. A review of this report proved to contain an accurate assessment of offsite flows. This previous study has addressed all offsite flows impacting the proposed Collins Business Park development, and will be referenced throughout this report.

This report will identify any natural washes, as well as any existing drainage facilities that contribute runoff to the proposed development during a 100-year, 6-hour storm event. Recommendations on making improvements necessary to control stormwater generated by the 100-year, 6-hour storm event will be provided to the design engineer, the developer, and the Clark County Public Works Department. This study was conducted in accordance with the criteria set forth by the *1991 Clark County Regional Flood Control District (CCRFCD) Hydraulic Criteria and Design Manual.*

LEGAL DESCRIPTION

The site is located within a portion of the southwest quarter (SW 1/4) of Section 05, of Township 22 South, Range 62 East, M.D.M., Clark County, Nevada.

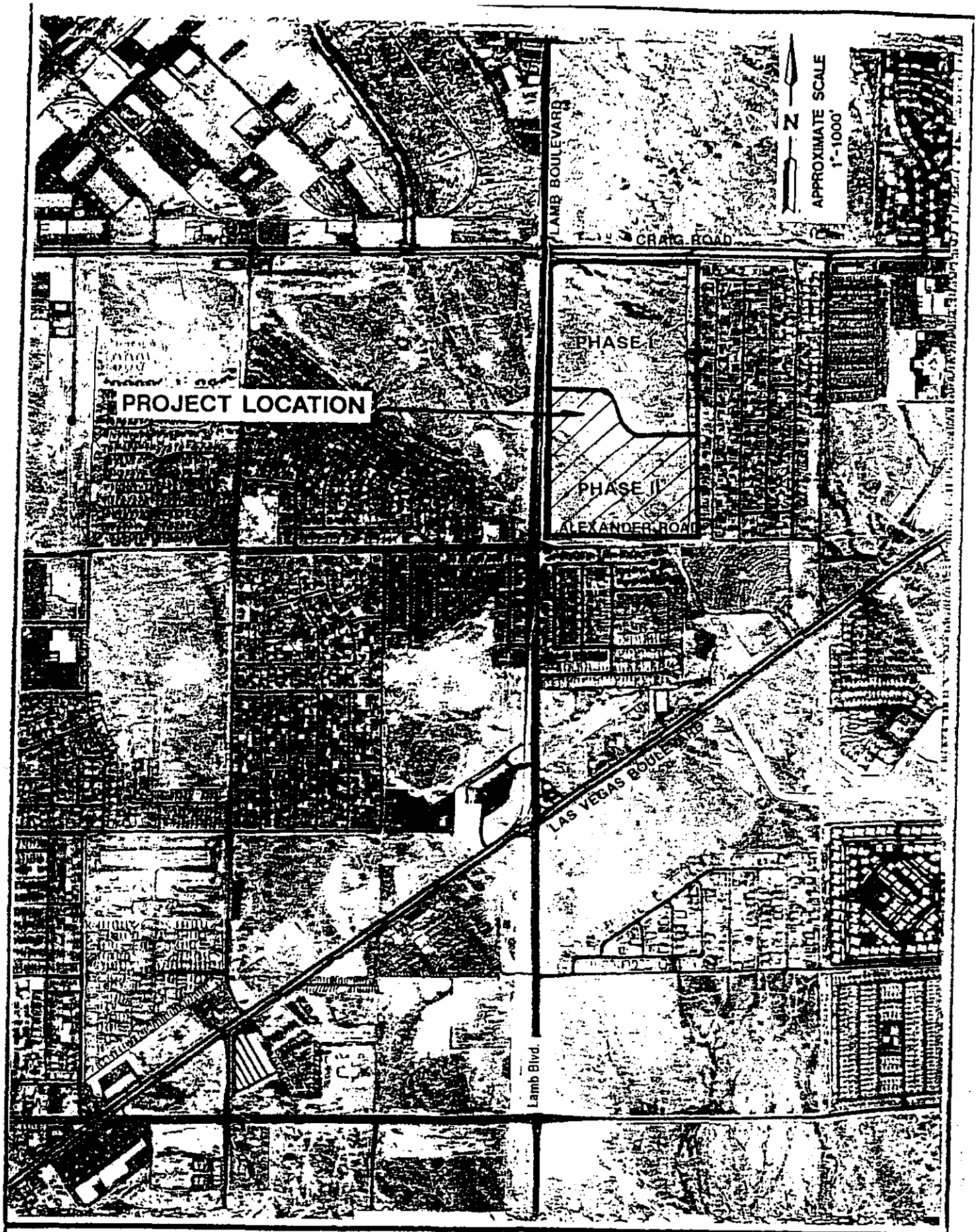

FIGURE 1

VICINITY MAP

STORMWATER MANAGEMENT DEPT.

ESI ENGINEERS AND SURVEYORS INC.

PLANNERS · CIVIL ENGINEERS · SURVEYORS

7546 WEST CHARLESTON AVENUE · LAS VEGAS, NEVADA 89117 · (702) 384-4115

FLOOD HAZARD ZONE

A review of the *Flood Insurance Rate Map (FIRM)*, Community Panel Number 320003 1025 B, effective September 29, 1989, indicates a finger of Zone A (approximately 11 acres) traverses the southwestern portion of the site. Zone A is an area of 100-year flood hazards, with base flood elevations and flood hazard factors not determined. The remaining area of the project (approximately 32.2 acres), lies within Zone X; an area determined to be outside 500-year flood plain. Figure 2 shows the project location depicted on the FIRM.

FLOOD CONTROL FACILITIES

According to the *1991 Flood Control Master Plan Update for the Las Vegas Valley*, the planned regional facility (RWWE 0027) crosses the southwestern portion of the development. This planned facility will convey flows from the Western Finger of the Western Tributary of Range Wash. According to the *Master Plan Update*, the channel will be concrete lined, approximately 20-feet wide and 6-feet deep with 2:1 side slopes. The proposed discharge for this channel is approximately 2,200 cubic feet per second (cfs). Figure 3 shows the project location on the Master Plan Update.

PREVIOUS DRAINAGE STUDIES

The following drainage study was utilized in the preparation of this study:

Conceptual Drainage Study for Craig and Lamb, Engineers and Surveyors Inc. submitted January 5, 1994.

Onsite Hydrology Study for Interim Conditions of Collins Business Park, Phase I, Engineers and Surveyors Inc., submitted April 11, 1995.

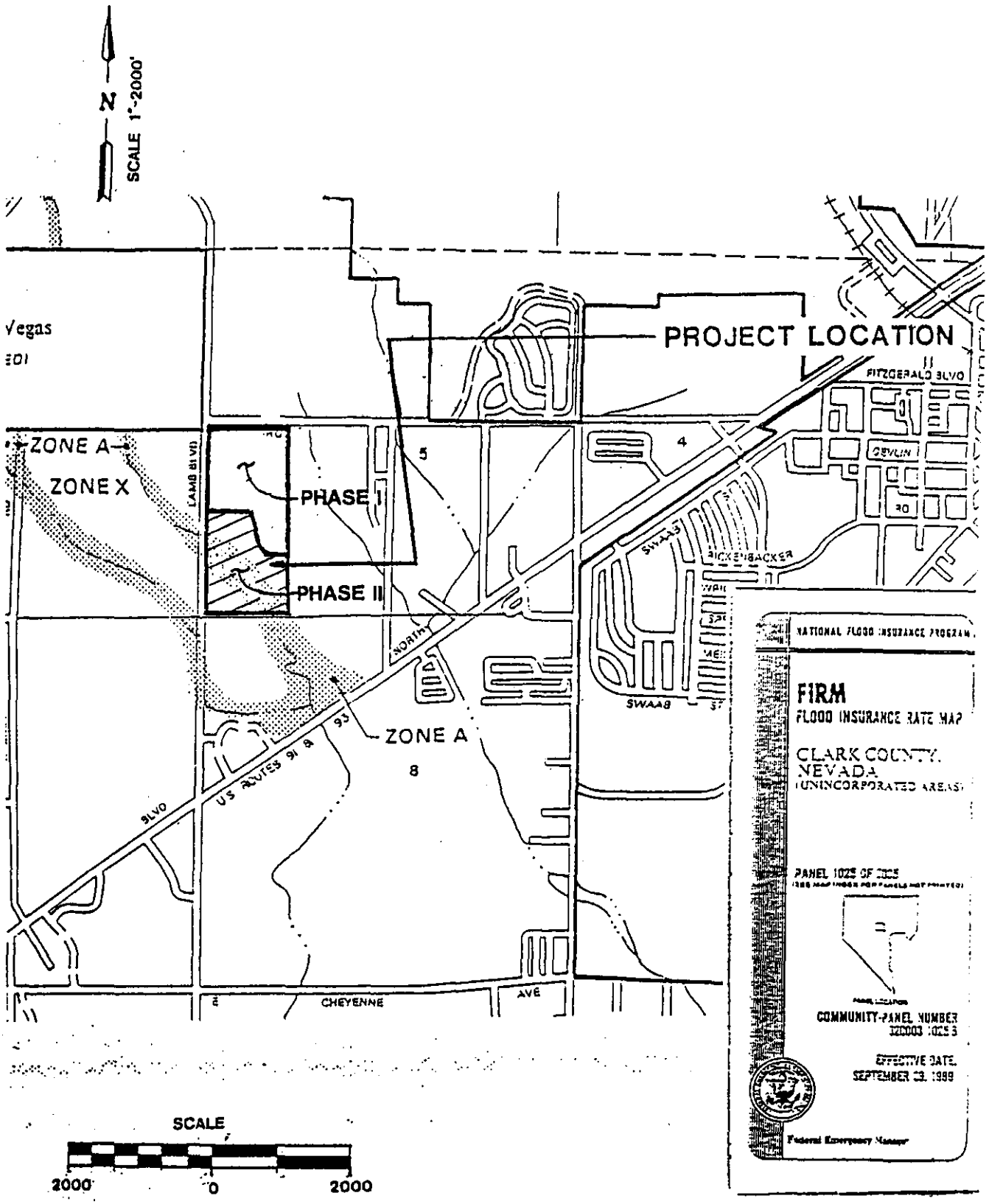

FIGURE 2

FEMA FLOOD INSURANCE RATE MAP

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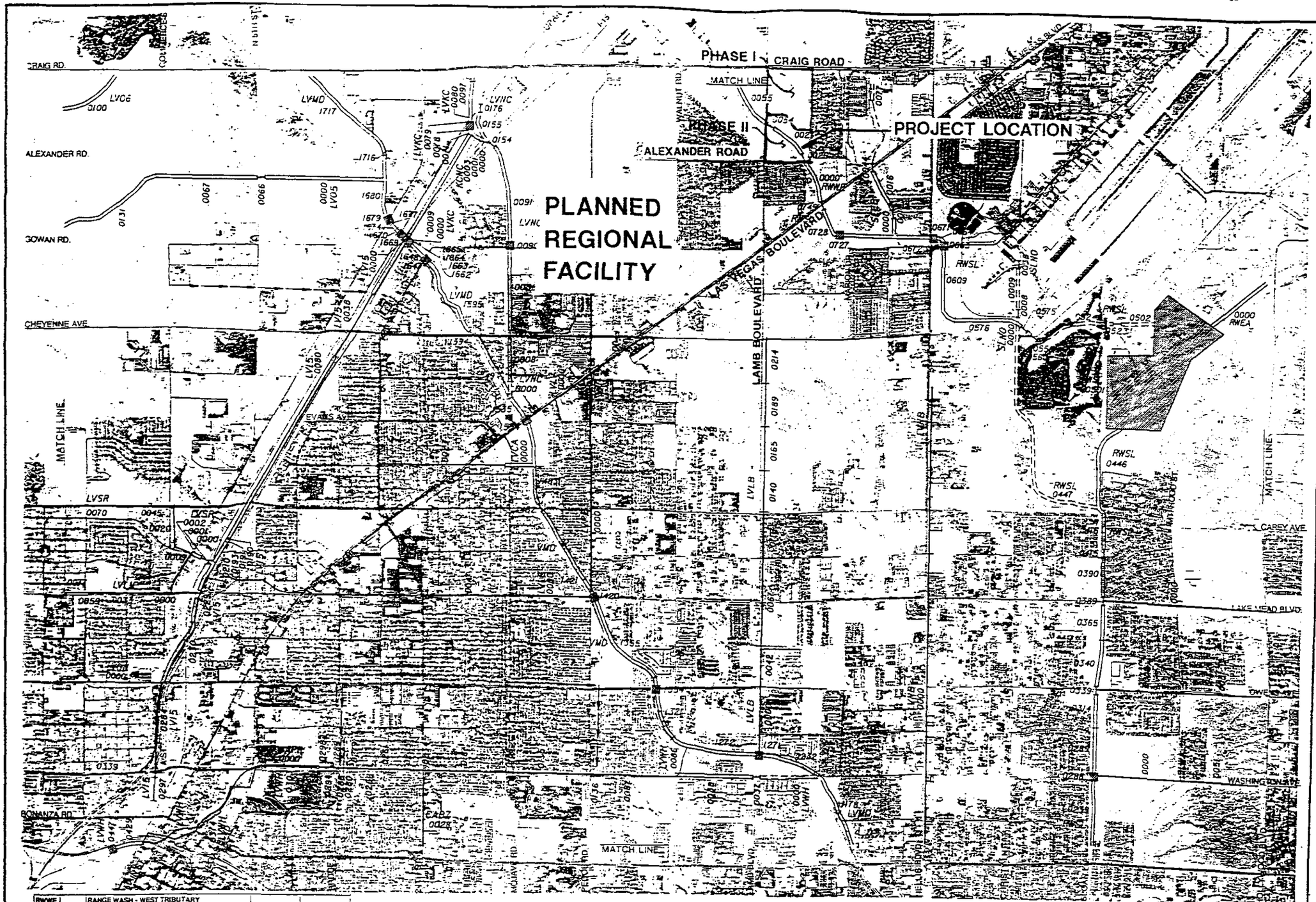

RWWE		RANGE WASH - WEST TRIBUTARY		
0000	P3	Conc Chnl 6'D 25'W 2:1 SS	1,565	2,225
0026	E	3: 12' X 10' RCB Culverts @ Alexander		4,680
0027	P3	Conc Chnl 6'D 22'W 2:1 SS	1,650	2,200
0054	E	~~6'x4' RCB culverts~~ 3: 6'x4' Culv		~~1,987~~
0054	P3	Acq 1~~6'x4' RCB culverts~~ 6'x4' Culv	50	2,200
0055	P3	Conc Chnl 6'D 22'W 2:1 SS	2,050	2,200

REGIONAL FLOOD CONTROL DISTRICT

1991 FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY

LEGEND

- EXISTING MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- PROPOSED MASTER PLAN FACILITIES
- BRIDGE
- CULVERT
- DEBRIS BASIN
- DETENTION BASIN
- DIKE / LEVEE
- PIPELINE
- NATURAL WASH
- FLOODWAY
- UNLINED IMPROVED CHANNEL
- LINED CHANNEL
- DROP STRUCTURE
- SECONDARY FACILITY
- ENVIRONMENTAL AREAS

N

0 1500 3000 4500

(APPROXIMATE)

FLOOD CONTROL FACILITIES AND ENVIRONMENTAL AREAS

FIGURE F-11

JMM James M. Montgomery Consulting Engineers, Inc.

Las Vegas, Nevada

FIGURE 3

CCRFCD MASTER PLANNED FACILITIES, 1991

STORMWATER MANAGEMENT DEPT.

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SECTION II: SITE DESCRIPTION

EXISTING SITE DESCRIPTION

Collins Business Park, Phase II, encompasses approximately 43.2 acres and currently consists of undeveloped desert. The ground cover is poor with sparse desert shrub. The site slopes from the northwest to the southeast at approximately 0.65 percent. Washes of various sizes traverse the site in a southeast direction. The Western Finger Wash traverses across the site from the western boundary to the southeastern corner of the site. The site is bordered by existing residential homes to the east and a newly graded area (Collins Business Park, Phase I) to the north. Alexander Road lies south of the site and Lamb Boulevard lies to the west. Lamb Boulevard is paved and fully improved. Alexander Road is an improved half street and will be fully improved with the construction of this project.

The primary soil located in the portion of the proposed Phase II development is listed in the *Soil Conservation Service (SCS), Soil Survey of the Las Vegas Valley* as Casage (Unit #140). This soil is formed in mixed alluvium, derived dominantly from limestone and gypsiferious sediment. Casage (hydrologic soil group C) is a well drained soil that can be found on erosional fan remmants. The secondary soil in the area is listed in the *SCS Soil Survey* as Arizo (Unit #117). Arizo (hydrologic soil group A) is a very gravelly fine sandy loam formed in alluvium derived from various kinds of rock. Arizo is an excessively drained soil that can be found on alluvial fans and inset fans. A small portion of the soil onsite is classified as Pits, gravel (Unit #610). Pits, gravel (hydrologic soil group D), consists of open excavations from which soil material and gravel have been removed, exposing rock, a hardpan, or other material. Figure 4 shows the project location depicted on the SCS Soil Survey.

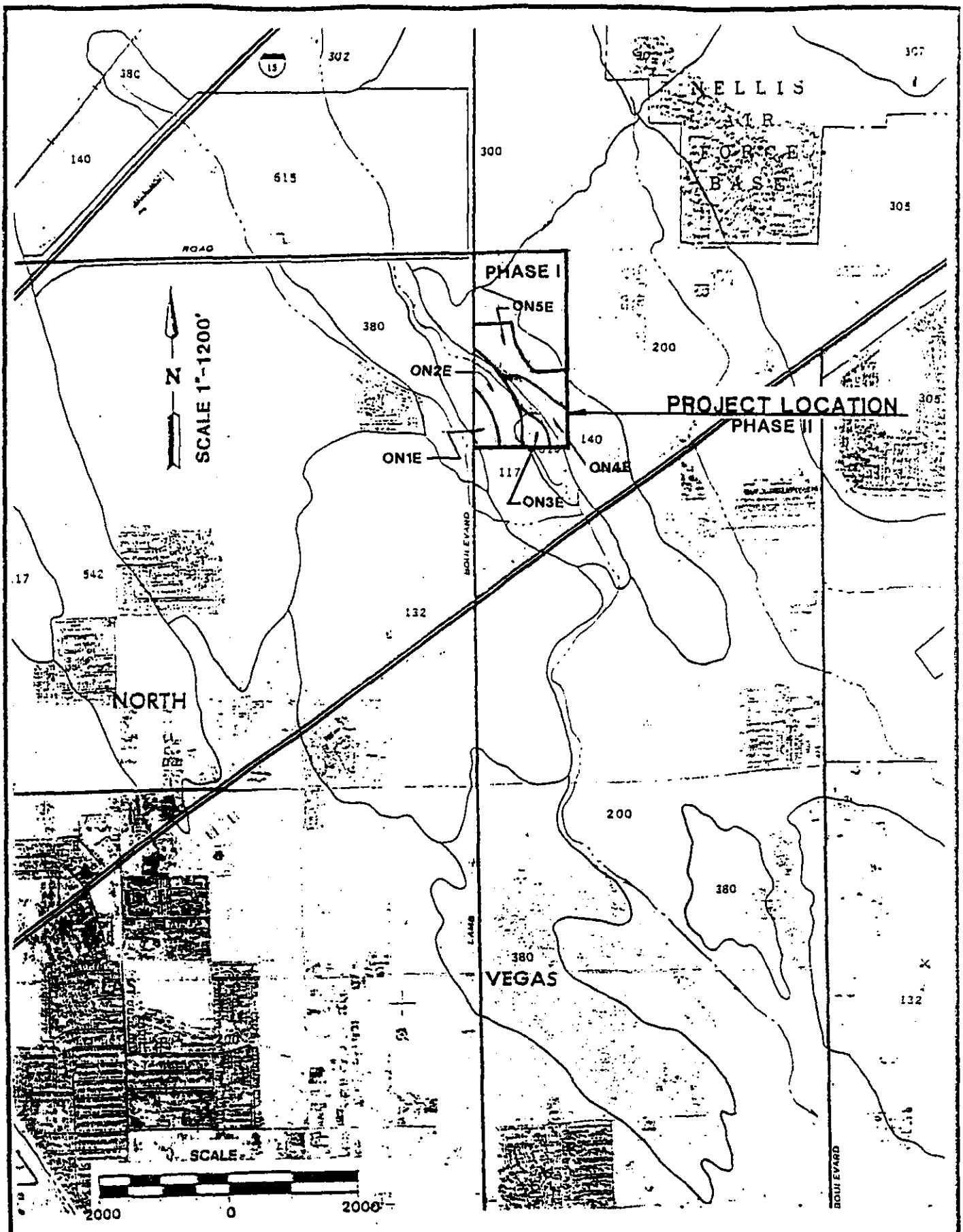

FIGURE 5

SCS Soil Survey Map for Las Vegas Valley
EXISTING CONDITIONS

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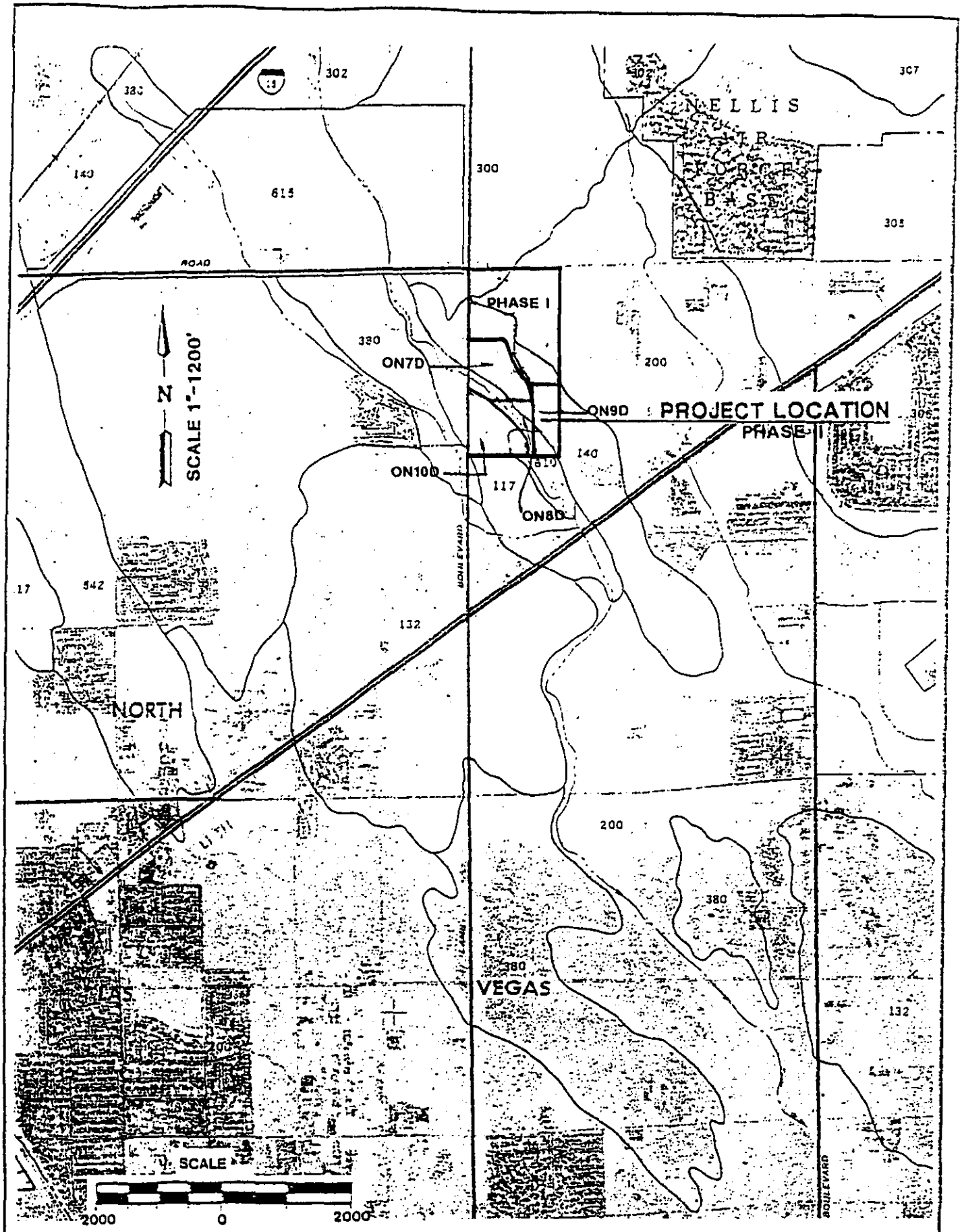

FIGURE 6

SCS Soil Survey Map for Las Vegas Valley
PROPOSED CONDITIONS

STORMWATER MANAGEMENT DEPT.
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EXISTING DRAINAGE DESCRIPTION

The proposed site is located within the southern end of the Western Finger of the Western Tributary of Range Wash Watershed. This watershed originates within the Las Vegas Mountain Range and terminates at Alexander Road, east of Lamb Boulevard. The Western Finger Wash intersects the site in a natural channel from the west. This channel conveys flow southeast from the existing triple, 9-ft. X 6-ft. reinforced concrete box culverts (RCBC) under Lamb Boulevard to four, 12-ft. X 7-ft. RCBCs under Alexander Road.

The existing drainage calculations within the *Conceptual Drainage Study for Craig and Lamb* (ESI, January 1994) show utilizing Inlet Control Charts that the existing, triple 9-ft. X 6-ft. RCBC under Lamb Boulevard is not capable of intercepting the total flow of 2140 cfs from the Western Finger Wash. In the 100-year, 6-hour storm event, approximately 1809 cfs of the 2140 cfs is intercepted by the triple RCBC. Therefore, approximately 331 cfs appears to over-top the natural wash, flowing into Lamb Boulevard. A portion of this flow may impact the southwestern boundary of the site.

The existing drainage swale located just north of Alexander Road along the southern boundary of the site, confluences with the Western Finger Wash at the four RCBCs. The swale is approximately five feet deep and drains an existing 48-inch reinforced concrete pipe (RCP). This RCP is located at the northeast corner of Lamb Boulevard and Alexander Road. Current survey information shows that the existing stormdrain system at the corner of Lamb Boulevard and Alexander Road appears to drain to the west, parallel with the existing street grade. This study assumes that the existing 48-inch RCP at the swale will convey the flow from the eastern inlet at the corner of Lamb Boulevard and Alexander Road to the existing swale (approximately 12 cfs).

Rainfall impacting the site is currently conveyed by shallow sheet flow and concentrated flow within one of various washes towards the southeast. Offsite runoff from the north currently flows toward the site from the Phase I development. This runoff impacts Phase II at two locations. The first location consists of an earthen channel located along the eastern boundary of the development. The second location is Flossmoor Street. This street will extend south through the site to Alexander Road. Flows from these areas are currently being intercepted by the four existing RCBCs at Alexander Road.

INTERIM SITE DESCRIPTION

The interim condition of Collins Business Park, Phase II, will consist of three sheet graded areas. The first area will be located east of Flossmoor Street (Pad A). Pad A will encompass approximately 4.4 acres and will slope from the northwest to the southeast at approximately 0.5 percent. The second area (Pad B) will encompass approximately 18.2 acres and will be located between Flossmoor Street and the proposed drainage channel. Pad B will slope from the west to the east at one percent. The third area (Pad C) will be located west of the proposed drainage channel. Pad C will encompass approximately 12.9 acres and will slope from the west to the east at approximately 0.41 percent (See the Proposed Onsite Drainage Basin Map). Approximately 1500-ft. of concrete lined channel will be constructed along the same alignment as the large existing wash. This proposed channel will extend from the existing triple RCBCs under Lamb Boulevard, to the four existing RCBCs under Alexander Road.

Flossmoor Street will consist of a 60-ft right-of-way. Full street improvements will be constructed for all the interior streets. Access to the site will be provided from Alexander Road and Lamb Boulevard.

INTERIM DRAINAGE DESCRIPTION

The site will be graded such that onsite runoff will follow similar flow paths to the pre-developed conditions. Rainfall impacting Pad B will be conveyed within Flossmoor Street to the south, where it will be intercepted by drop inlets and will discharge into the proposed channel. Pad A will be graded so that runoff will be conveyed within the earthen channel, located along the eastern boundary of the site. This channel is the continuation of the earthen channel described in the Phase I report. It will discharge runoff into three proposed 54-inch RCPs, located just north of Alexander Road and east of Flossmoor Street. Runoff from Pad C will be intercepted by the proposed fully improved channel. With the improvements of Alexander Road, the proposed 48-inch RCP will be extended to the four RCBCs. In order to intercept runoff impacting Alexander Road, a modified 20-foot type"C" drop-inlet with four grates will be placed along the northern half of Alexander Road at the four RCBCs. Because of the existing drainage problems at the southeast corner of the site, this project will intercept most of the offsite flows prior to reaching the low point. Please note that the proposed site will not add any flow to this proposed 48-inch RCP.

SECTION III: HYDROLOGIC ANALYSIS

HYDROLOGIC METHODOLOGY AND CRITERIA

The *U.S. Army Corps of Engineers HEC-1 Flood Hydrograph Package* was used to determine the peak runoff generated by the 100-year, 6-hour storm event. The HEC-1 computer model has the ability to simulate the surface runoff response of a given basin to rainfall. The HEC-1 program represents the basin as an interconnected system of hydraulic components. Each component models an aspect of the rainfall runoff process within a portion of the entire basin. This smaller basin portion is referred to as a sub-basin. The computed hydrographs from each sub-basin are then combined at appropriate locations, from which a final discharge is obtained. HEC-1 parameter calculations are included in Appendix A.

Basin Area

The existing onsite areas were determined from the existing 100-scale topographic map. The onsite areas of the interim conditions were determined from the proposed 100-scale interim grading plan. These areas were delineated in order to determine the discharge resulting from the 100-year, 6-hour storm event at various points throughout the project. The HEC-1 drainage basin maps can be found in the map pockets at the end of this report.

Precipitation

The project site is located within the McCarran Airport Rainfall Area. A point depth precipitation of 2.77 inches was obtained from the Depth-Duration-Frequency Values for the 100-year, 6-hour storm event within the McCarran Airport Rainfall Area. The site encompasses less than ten square miles therefore the Storm Distribution Number of three was used for the HEC-1 model.

Hydrologic Abstractions

The SCS curve number method was used to determine the infiltration rates for the project. The soil groups for the project site were determined using the *SCS Soil Survey of the Las Vegas Valley Area.* Curve numbers for this area were calculated using Table 602, "Runoff Curve Number: Urban Areas" and Table 602, "Runoff Curve Numbers: Semiarid Rangelands". Composite curve number calculations for the existing and proposed conditions have been included in Appendix A.

SCS Lag-Time with Time of Concentration

Lag-time, T_L, is defined as the time measured from the centroid of effective rainfall to the peak of the outflow hydrograph. It is a measure of the watershed's response time and is a coherent property to basin length, slope, roughness characteristics, and land use.

Lag-times for the study were estimated by calculating the basins time of concentration, T_c. The time of concentration consists of two component of time, t_i, and the gutter or channel flow time, t_t. The equation for the time of concentration is: $T_c = t_i + t_t$

Lag-times can be found by the following equation: $T_L = 0.6T_c$

Drainage Patterns

Precipitation in the Las Vegas Valley is characterized typically by long duration, low intensity winter storms and by short duration, high intensity summer storms. The winter storms, in general, do not produce major flooding events, whereas the summer storms can and do produce major flash flooding hazards in the Las Vegas Valley Area.

Due to the phenomenon of the storm centering, two HEC-1 analyses were completed. The first HEC-1 analysis modeled the flows which directly impact the site. Therefore, the storm was assumed to be centered directly over the site. Flows that are conveyed to the existing lo-hed culverts were calculated with this analysis.

Flows in the second HEC-1 analysis were used for the design of the proposed regional facility that crosses the site. The storm was assumed to be centered over the entire watershed that contributes flows to the channel. Flows for the second HEC-1 analysis were determined in the previous study entitled, *"Conceptual Drainage Study for Craig and Lamb"* ESI, January, 1994.

SECTION IV: HYDROLOGIC RESULTS

EXISTING DRAINAGE ANALYSIS

Runoff from the northern offsite areas (Phase I and the northerly offsite areas) discharge approximately 390 cfs into the graded earth channel located at the northeast corner of the site. This flow, and the flow from Basins ON3E-ON5E, contribute approximately 418 cfs to the four RCBCs located under Alexander Road. Approximately 88 cfs (Basins ON1E, ON2E, and spill over from Lamb Boulevard) is intercepted by the existing drainage swale, located along the southern boundary of the site. This swale confluences with the Western Finger Wash at the four RCBCs. The total 100-year runoff impacting the southeast corner of the Collins Business Park, Phase II, is approximately 506 cfs. The Western Finger Wash contributes a total of 2140 cfs to the four, existing RCBCs located under Alexander Road. The onsite drainage basin map of the existing conditions is included in Map Pocket 1. Table 1 shows the existing drainage conditions for the individual basins.

TABLE 1
100-YEAR FLOWS
EXISTING CONDITIONS

BASIN	AREA (acres)	FLOW (cfs)
ON1E	6.15	2
ON2E	8.45	3
ON3E	2.85	2
ON4E	7.90	11
ON5E	13.50	16
LAMB	5.58	13
Flow impacting from Phase I	N/A	390
Flow impacting site from Lamb	N/A	83
Flow in Western Finger Wash	N/A	1809
Total flow @ four Ex. RCBs	N/A	2140

INTERIM DRAINAGE ANALYSIS

The HEC-1 analysis calculated a proposed 100-year, 6-hour storm discharge of approximately 31 cfs for Basins ON7D, and ON8D. This flow, and the flow within Flossmoor Street from Phase I (approximately 77 cfs) will be intercepted by two proposed 20-ft. Type "C" drop-inlets with double grates, within Flossmoor Street, just north of Alexander Road (See Appendix E for inlet capacity calculations.)

Flow impacting the site from Lamb Boulevard (approximately 83 cfs), and flow from Basin ON10D (approximately 14 cfs) contribute approximately 97 cfs to the flow within the proposed channel, which crosses the site. Flow from the eastern half of Lamb Boulevard and Basin ALEX (approximately 81 cfs) will be intercepted by the proposed 20-ft. Type "C" drop-inlets with four grates, located along the north side of Alexander Road.

A portion of the existing residential development located at the southeast corner of the site contributes approximately 3 cfs to the low point on the north side of Alexander Road. This flow will be collected at the proposed sidewalk opening and will ultimately discharge into the proposed earthen channel. Because of grading constraints within this area of the site, the proposed hydraulic grade line (HGL) within the earthen channel will be above the top-of-curb elevation at this point in Alexander Road. To alleviate flooding in this area, the 18-inch outlet pipe will be equipped with a flap gate to prevent flows within the channel from inundating Alexander Road and increasing the flooding problem.

The earthen channel along the eastern boundary of Phase I will continue to be built with the development of Phase II. This channel will be constructed along the eastern boundary of the site and outlet flow into a proposed triple 54-inch RCP culvert underneath Flossmoor Street. The earthen channel is capable of conveying the 100-year storm of approximately 400 cfs. The proposed triple, 54-inch RCPs will allow flow from the proposed earthen channel to discharge into the proposed Western Finger Channel at the southeast corner of the site (See Map Pocket 2 for cross section of the earthen channel and the location of the triple RCP culverts.) Inlet Control Chart was used to determine the allowable flow at the entrance to the triple, 54-inch RCP culverts.

For the 10-year event, a 32-foot dry lane will exist in each travelling directions on Alexander Road. Lamb Boulevard will provide approximately 31-feet of dry-lane for emergency vehicles in each direction (See Appendix D for calculations.)

The drainage analysis for Basins ON1D-ON6D can be found in the Phase I study. Table 1 shows the proposed drainage conditions for the individual basins. The onsite drainage basin map of the interim conditions is located in Map pocket 2. The HEC-1 analysis for the interim conditions can be found in Appendix C. Street and channel capacity calculations can be found in Appendix D.

TABLE 5
100-YEAR FLOWS
INTERIM CONDITIONS

BASIN	AREA (acres)	FLOW (cfs)
ON1D	5.38	13
ON2D	5.45	12
ON3D	6.72	15
ON4D	1.11	3
ON5D	14.41	23
ON6D	14.69	24
ON7D	10.88	21
ON8D	7.38	10
ON9D	4.38	9
ON10D	12.90	14
ON11D	1.76	5
ALEX.	3.21	9
Total outlet of earthen channel	N/A	400
Total outlet of Western Finger Wash Channel	N/A	2140
Total flow at Lamb Blvd.	N/A	178
Total flow at Alexander	N/A	81
Total flow at Flossmoor	N/A	77

SECTION V: HYDRAULIC METHODOLOGY AND CRITERIA

HYDRAULIC METHODOLOGY AND CRITERIA

The *U.S. Army Corp of Engineers' HEC-2 Water Surface Profile* computer model was utilized in the design of the proposed concrete channel through the development. The HEC-2 computer program has the capability of calculating water surface profiles for steady gradually varied flow in natural streams, rivers and improved flood control channels. The effects of structures such as bridges, culverts, weirs and other structures within the floodplain may be considered in the calculations.

The computational procedure is based on solving the one-dimensional energy equation with energy loss due to friction evaluated with Manning's Equation. This procedure of calculating water surface profiles is known as the "Standard Step Method." The HEC-2 model can analyze both sub-critical and super-critical flow profiles.

Input parameters for the HEC-2 model include the channel cross section, roughness characteristics, starting water surface elevation, design storm discharge and reach lengths between consecutive cross sections.

The channel cross sections were input into the HEC-2 program as a templet, with slopes and ground elevations the only parameters which changed for a given reach within the improved portion of the channel. Culverts were input as a rectangular channel with piers. The X2 card was utilized to define the culverts top of box and bottom of roadway.

The roughness coefficient for the box culverts was estimated to be 0.013. The roughness values for the improved channel was estimated at 0.015. The roughness value utilized for the natural wash upstream and downstream of the project was estimated to be 0.025.

The starting water surface elevation was obtained by a trial and error procedure, as outlined in the HEC-2 Users Manual. A starting water surface elevation was estimated and the slope of the energy grade line was adjusted until a 25 convergence was reached.

The design storm discharge is the current 100-year, 6-hour flow rate, determined in the approved *"Conceptual Hydrology Study for Craig and Lamb."* A 100-year, 6-hour discharge of 2,140 cfs was utilized for the design. The HEC-2 analysis is located in Appendix F.

The HEC-2 analysis began approximately 500-ft. downstream of Alexander Road. This section is an existing, unimproved earthen channel with varying width and depth. Engineers and Surveyors, Inc. (ESI) obtained cross sectional survey information of the wash for this analysis. This section of the Western Finger of Ranch Wash discharges into an existing, improved concrete lined channel at Las Vegas Boulevard North.

The HEC-2 analysis terminates approximately 300-ft. upstream of Lamb Boulevard. Due to the submergence of the existing triple box culvert under Lamb Boulevard, the special bridge method was used for this crossing.

SECTION VI: HYDRAULIC RESULTS

HYDRAULIC RESULTS

The results of the HEC-2 analysis indicate that the existing triple 9-ft. X 6-ft. RCBC upstream of Lamb Boulevard does not have adequate capacity to convey the 100-year discharge of 2140 cfs under Lamb Boulevard. Approximately 331 cfs will spill out of the channel at this location and flow south within Lamb Boulevard. It appears that the existing RCBCs crossing under Lamb Boulevard was undersized for the construction of Lamb Boulevard, as it does not correlate with the recommendations in the *1991 Master Plan Update*.

The street right-of-way is capable of conveying approximately 178 cfs to the top of crown. The remaining flow (approximately 83 cfs) will be conveyed within the existing undeveloped areas along both sides of Lamb Boulevard to Alexander Road.

CHANNEL DESIGN

Proposed channel improvements will originate at the eastern side of Lamb Boulevard and terminate at the northern boundary of Alexander Road. The channel will be 1500-ft. long, and will transition in top-width from 59-ft. at Lamb Boulevard to 71-ft. at Alexander Road. The increase in width is due to the higher flow depths at the entrance of the four, 12-ft. X 7-ft. RCBCs. The channel will have a constant longitudinal bed slope of 0.78% and a transverse slope of 2% to the channel flow line.

The channel is trapezoidal in shape, with a 32-ft. bottom width, 2:1 side slopes and a total depth varying from 6.5-ft. to 9.0-ft. This depth includes an average of 1.5-ft. of freeboard. Table 6 shows the stations, channel water surface elevations, and velocities.

A ramp will be provided at the eastern side of Lamb boulevard for access to the channel bottom for the required routine maintenance. A ramp will not be provided downstream at Alexander Road due to potential flow "run-up" problems. The channel has been designed with an adequate bottom width to provide for "U-turns". A six foot high chain link fence will be constructed around the perimeter of the proposed channel to inhibit unauthorized personnel from entering the facility.

Inlet Control Charts were used to determined the allowable flows for the three existing 6-ft. x 9-ft. RCBCs under Lamb Boulevard, the four existing 7-ft. x 12-ft. RCBCs under Alexander Road, and the proposed triple 54-inch RCPs at the corner of Flossmoor Street and Alexander Road. The three RCBCs, four RCBCs, and the triple 54-inch RCPs are capable of intercepting approximately 1809 cfs, 3840 cfs, and 480 cfs respectively. These Inlets Control Charts and calculations are included in Appendix E.

TABLE *6*
HEC-2 ANALYSIS
PROPOSED CONCRETE CHANNEL - SUB CRITICAL RUN

SECTION	WATER SURFACE ELEVATION (ft)	VELOCITY (fps)	DEPTH (ft)
1.0	57.11	8.39	2.88
2.0	57.62	9.11	3.39
3.0	58.24	9.95	4.01
4.0	59.53	10.75	5.30
5.0	60.01	8.75	5.78
6.0	60.16	8.94	5.93
7.0	60.02	10.13	5.79
8.0	60.10	11.68	5.87
9.0	61.43	8.54	7.20
10.0	61.20	9.91	6.97
11.0	62.29	5.31	8.06
12.0	62.28	5.37	8.05
12.5	62.19	6.36	7.96
13.0	62.24	6.36	7.82
13.5	62.48	5.36	8.06
14.0	62.39	6.85	7.86
15.0	62.35	7.32	7.43
16.0	62.31	7.88	7.00
17.0	62.25	8.59	6.54
18.0	62.17	9.42	6.07
19.0	62.05	10.49	5.55
20.0	61.87	11.94	4.98

21.0	62.24	12.00	4.96
22.0	63.00	11.99	4.97
23.0	63.74	11.99	4.96
24.0	64.50	11.99	4.97
25.0	65.25	11.99	4.97
26.0	66.00	11.99	4.97
27.0	66.75	11.99	4.97
28.0	67.50	11.99	4.97
29.0	68.25	11.99	4.97
30.0	69.00	11.99	4.97
31.0	69.75	11.99	4.97
32.0	70.90	9.35	6.11
33.0	70.79	10.39	5.60
34.0	70.61	11.79	5.03
35.0	70.93	12.04	4.95
36.0	71.34	11.98	4.97
38.0	75.41	3.54	7.41
39.0	75.38	4.43	7.38
40.0	75.35	5.10	7.35
41.0	75.37	5.45	7.37
42.0	75.35	6.04	6.35
43.0	75.38	6.09	6.38
44.0	75.37	6.83	6.37
45.0	75.33	8.25	5.33
46.0	75.35	9.35	5.35

SECTION VII: SUMMARY

RECOMMENDATIONS

The following recommendations are provided to facilitate safety, both public and private, for the proposed industrial development.

1. The site should be graded as shown on the enclosed grading plan to insure flood protection from the 100-year, 6-hour storm event for the fully developed conditions. In the future, finished floors will be placed a minimum of 18-inches above the 100-year water surface elevations.

2. Construct the flood control facilities as shown on the Improvement Plans to safely direct onsite and offsite flows through the development to the four RCBCs, located at the southeast corner of the site.

3. Regular maintenance of the proposed flood control facilities to insure proper efficiency.

CONCLUSION

Collins Business Park, Phase II, is a proposed industrial development, planned to be constructed in Clark County. The site will be designed to convey existing offsite flows north of Craig Road and west of Lamb Boulevard to the four existing RCBCs, located at the southeast corner of the site. Approximately 2140 cfs is conveyed through the site and discharges to the southeast in a proposed concrete channel. The proposed earthen channel located along the eastern boundary of the site will convey offsite flow north of Lamb Boulevard and most of the onsite flow (approximately 400 cfs) to the proposed triple, 54-inch RCPs, which will be confluence with the four RCBCs at the corner of Flossmoor Street and Alexander Road.

It is the opinion of this firm that this report is complete in its entirety and all hazards have been investigated and dealt with individually and completely.

REFERENCES

CCRFCD Hydrologic Criteria and Drainage Design Manual. Prepared by WRC Engineering Inc. for Clark County Regional Flood Control District, Las Vegas, Nevada.

CCRFCD Volume II The Master Plan Update for the Las Vegas Valley, James M. Montgomery, Consulting Engineers, Inc., August 1991.

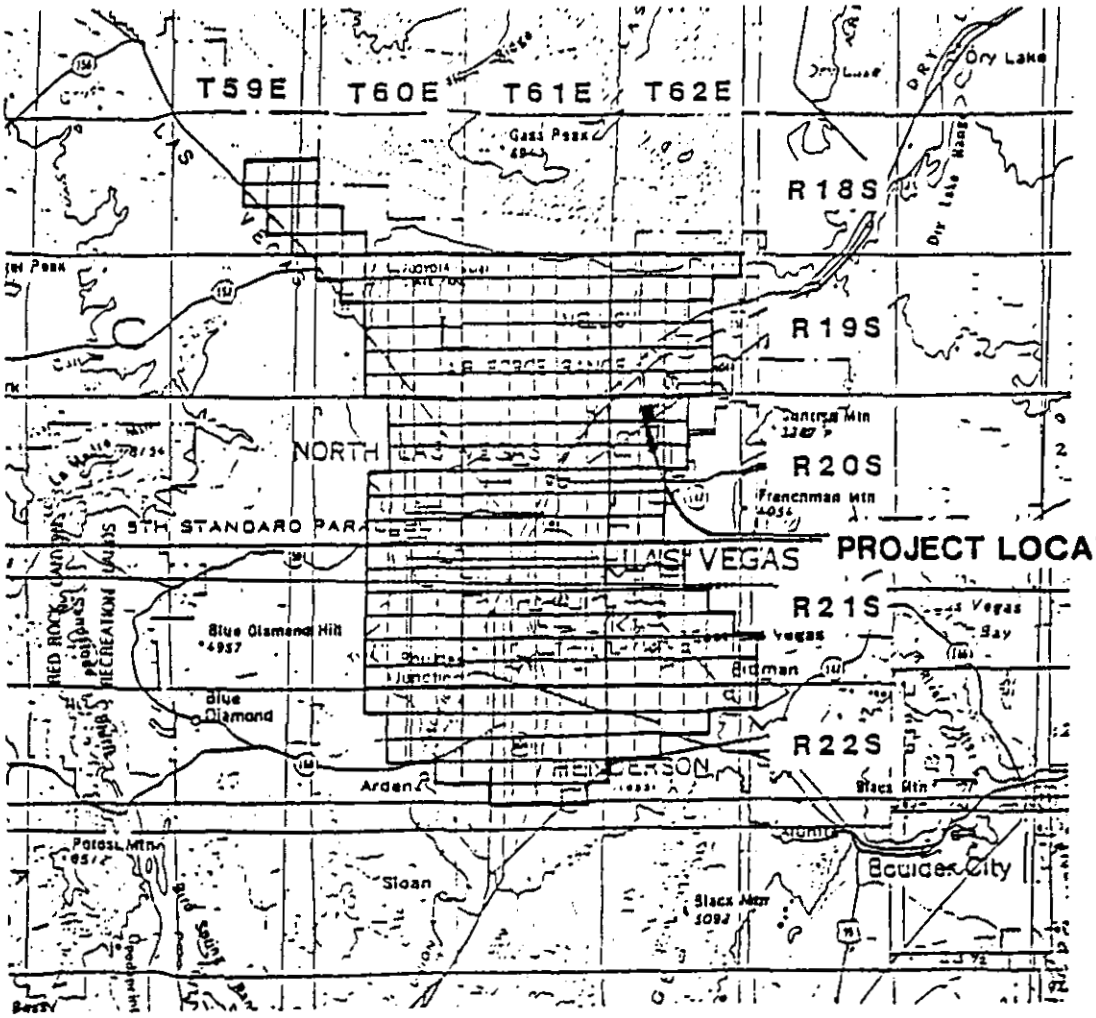
HEC-1 and HEC-2 Flood Hydrograph Package Users Manual. U.S. Army Corps of Engineers, Revised September 1990.

Soil Survey of the Las Vegas Valley Area, Nevada, Department of Agriculture, Soil Conservation Service, July 1985.

APPENDIX A

HEC-1 Parameter Calculations

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36
18 South	60 East	30-32
19 South	60 East	1-6,8-16,21-28,33-36
19 South	61 East	ALL SECTIONS
19 South	62 East	2-11,14-23,27-34
20 South	60 East	1-3,10-15,21-28,33-36
20 South	61 East	ALL SECTIONS
20 South	62 East	4-9,16-20,29-32
21 South	60 East	1-4,9-16,21-28,33-36
21 South	61 East	ALL SECTIONS
21 South	62 East	4-9,15-23, 25-36
22 South	60 East	1-4,10-15,24
22 South	61 East	1-24,26-29
22 South	62 East	1-10,17-18

Notes:
1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

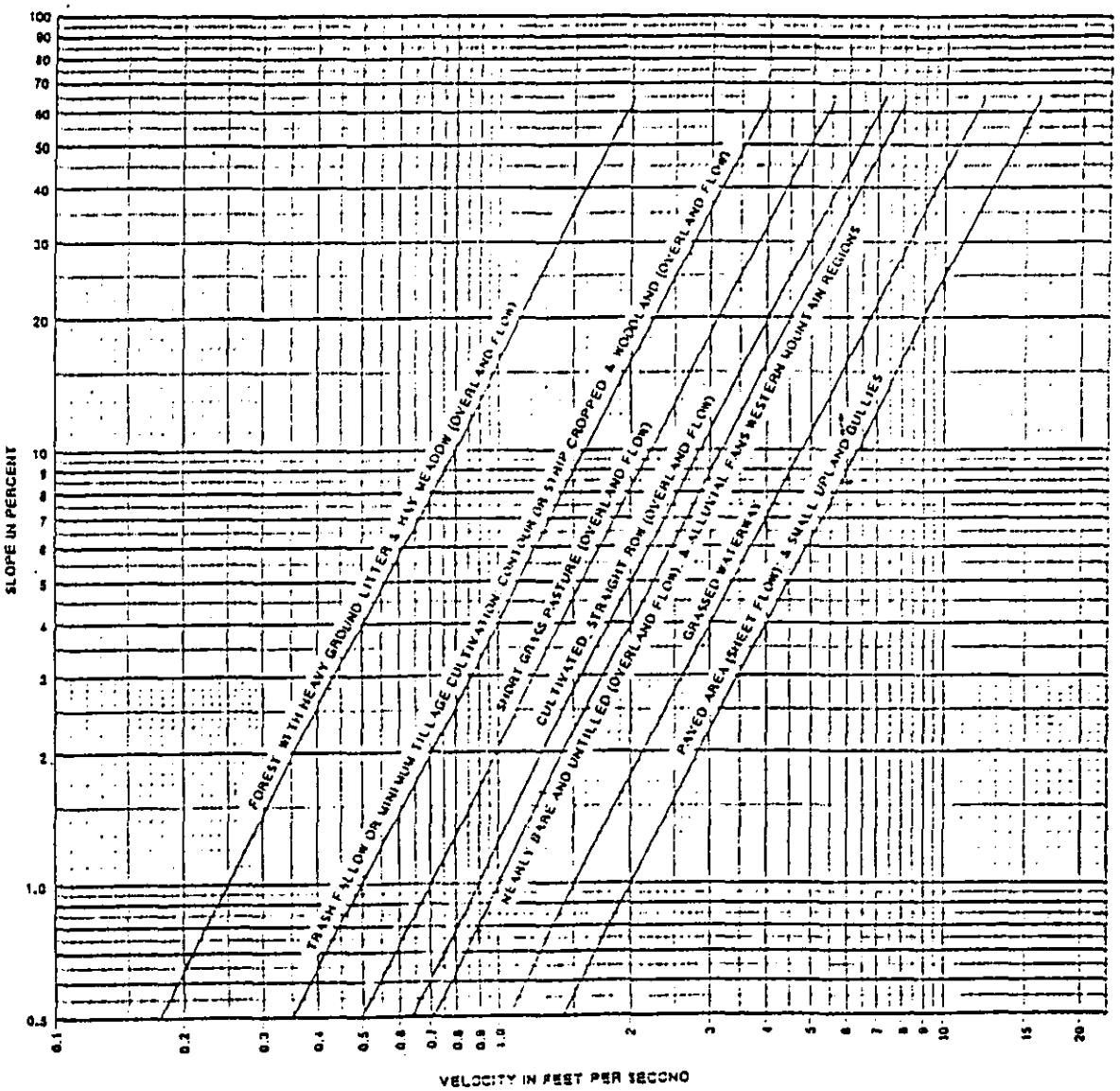
Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

TRAVEL TIME VELOCITY



Revision	Date

WRC ENGINEERING

REFERENCE: SCS National Engineering Handbook Section 4, Hydrology, March, 1985

FIGURE 602

RUNOFF CURVE NUMBERS
(URBAN AREAS[1])

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 603
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figure 603 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 603 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

RUNOFF CURVE NUMBERS
(SEMIARID RANGELANDS[1])

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

Revision	Date

COMPOSITE CURVE NUMBER CALCULATIONS

	Soil Type	Existing CN	Interim CN
Onsite Development	A	63	77
	B	77	86
	C	85	91
	D	88	94
Paved Area	A	63	98
	B	77	98
	C	85	98
	D	88	98

Soil Unit	Composite	Hydrologic Group	Total
#117 (Arizo)	90% Arizo	A	90% A
	5% Aztec	B	5% B
	5% Pittman	C	5% C
#140 (Casaga)	90% Casaga	C	90% C
	5% Arizo	A	5% A
	5% Caliza	B	5% B
#610 (Pitts)	100% Pitts	D	100% D

Composite Curve Numbers For Individual Soil Units

Existing

Natural ground

$$CN(\#117) = (0.90)*(63) + (0.05)*(77) + (0.05)*(85) = 64.80$$

$$CN(\#140) = (0.90)*(85) + (0.05)*(63) + (0.05)*(77) = 83.50$$

$$CN(\#610) = (1.0)*(88) = 88.00$$

Proposed

Newly Graded

$$CN(\#117) = (0.90)*(77) + (0.05)*(86) + (0.05)*(91) = 78.15$$

$$CN(\#140) = (0.90)*(91) + (0.05)*(77) + (0.05)*(86) = 90.05$$

$$CN(\#610) = (1.00)*(94) = 94.00$$

Paved Area

$$CN = (0.85)*(98) + (0.10)*(98) + (0.05)*(98) = 98.00$$

COMPOSITE CURVE NUMBER FOR HEC-1 BASINS

Existing Conditions:

ON1E - 100% Soil Unit #117
CN = 64.80

ON2E - 93% Soil Unit #117, 7% Soil Unit #610
CN = (0.93)*(64.80) + (0.07)*(88.00) = 66.42

ON3E - 67% Soil Unit #140, 14% Soil Unit #610, 9% Soil Unit #117
CN = (0.67)*(83.5) + (0.14)*(88.0) + (0.09)*(64.8)
CN = 74.10

ON4E - 100% Soil Unit #140
CN = 83.30

ON5E - 100% Soil Unit #140
CN = 83.30

LAMB - Paved Road
CN = 98.0

Interim Conditions:

ON7D - Graded Pad
95% Soil Unit #140, 5% Soil Unit #117
CN = (0.95)*(90.05) + (0.05)*(78.15) = 89.45

ON8D - Graded Pad
74% Soil Unit #140, 21% Soil Unit #117, 5% Soil Unit #610
CN = (0.74)*(90.05) + (0.21)*(78.15) + (0.05)*(94.0)
CN = 87.75

ON9D - Graded Pad
100% Soil Unit #140
CN = 90.05

ON10D - Graded Pad
93% Soil Unit #117, 7% Soil Unit #610
CN = (0.93)*(78.15) + (0.07)*(94.0) = 79.26

ON11D - Paved Road
100% Soil Unit #140
CN = 98.0

ALEX - Paved Road
CN = 98.00

EXISTING BASIN CONDITIONS

DEVELOPMENT CRAIG & LAMB, PHASE II

CACULATED BY DL DATE 06-30-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)		FINAL t_c	REMARKS
DESIG (1)	K (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	TOTAL LENGTH Ft (11)	$t_c = (L/180)+10$ Min (12)	Min (13)	CN
ONE	0.4654	6.15	140	1.4	12.08	710	0.85	0.91	13.0	850	N/A	25.09	64.80
ONE	0.4867	8.45	40	20	2.57	1400	0.64	0.80	29.17	1480	N/A	31.74	66.42
ONE	0.5881	2.85	500	0.80	25.75	0	N/A	N/A	N/A	500	N/A	25.75	74.10
ONE	0.7096	7.90	100	2.0	5.58	1050	0.67	0.81	21.61	1150	N/A	27.18	83.30
ONE	0.7096	13.50	150	2.6	6.26	1450	0.62	0.79	30.59	1600	N/A	36.85	83.30
LMB	0.904	5.58	44	2.0	1.96	2700	0.85	1.85	24.32	2744	25.24	25.24	98.0

$t_t = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$

$K = 0.0132(CN) - 0.39$

$t_c = t_i + t_t$

$t_t = L/(60V)$

REFERENCE:

STANDARD FORM 4

TIME OF CONCENTRATION

Revision	Date

INTERIM BASIN CONDITIONS

DEVELOPMENT COLLINS BUSINESS PARK, PHASE II

CACULATED BY DL DATE 06-30-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (t_i)			TRAVEL TIME (t_t)				t_c CHECK (URBANIZED BASINS)		FINAL t_c	REMARKS
DESIGN (1)	K (2)	AREA Ac (3)	LENGTH Ft (4)	SLOPE % (5)	t_i Min (6)	LENGTH Ft (7)	SLOPE % (8)	VEL. FPS (9)	t_t Min (10)	TOTAL LENGTH Ft (11)	$t_c = (1./180)+10$ Min (12)	Min (13)	CN
ON7D	.791	10.28	500	1.0	12.44	830	.5%	1.4	9.88	1330	NOT YET URBANIZED	22.32	89.45
ON8D	.768	5.62	500	1.0	13.36	730	.4%	1.4	8.69	1230	NOT YET URBANIZED	22.05	87.75
ON9D	.799	4.38	450	0.9	11.90	700	.5%	1.4	8.33	1150	NOT YET URBANIZED	20.23	90.05
ON10D	.656	12.90	500	0.75	19.67	950	.8%	1.8	8.8	1450	NOT YET URBANIZED	28.47	79.26
ON11D	0.904	1.76	25	2.0	1.40	850	0.5%	1.4	10.12	890	14.94	11.52	98.0
ALEX	0.904	3.21	45	2.0	1.88	1400	0.5%	1.4	16.67	1445	18.03	18.55	98.0

$t_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$

$K = 0.0132(CN) - 0.39$

$t_c = t_i + t_t$

$t_t = L/(60V)$

TIME OF CONCENTRATION

REFERENCE:

STANDARD FORM 4

Revision 1 2 etc

APPENDIX B

HEC-1 Analysis: Existing Conditions

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         SEPTEMBER 1990                *
*          VERSION 4.0                  *
*                                       *
*  RUN DATE  07/01/1995  TIME  09:04:01 *
*                                       *
*****************************************
```


U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104


```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
   1      ID
   2      ID
   3      ID
   4      ID                          COLLINS BUSINESS PARK II
   5      ID                            HYDROLOGICAL MODEL
   6      ID
   7      ID                          ONSITE EXISTING CONDITIONS
   8      ID
   9      ID
  10      ID                          ENGINEERS & SURVEYORS, INC.
  11      ID
  12      ID
  13      ID
  14      ID        RATIO 1=100 YR.
  15      ID        RATIO 2=10 YR.
  16      ID
  17      ID        STORM DISTRIBUTION #3
  18      ID
  19      ID        INPUT FILE:  COLLIN2.DAT
  20      ID
          *DIAGRAM
  21      IT       5                    185
  22      IO       5
  23      JR    PREC     1.0     .57

  24      KK    ON1E
  25      KM    RUNOFF FROM ONSITE BASIN ON1E
  26      BA   .0096
  27      PB  2.762
  28      PC       0   .0200   .0570   .0700   .0870   .1080   .1240   .1300   .1300   .1300
  29      PC   .1300   .1300   .1300   .1330   .1400   .1420   .1480   .1580   .1720   .1810
  30      PC   .1900   .1970   .1990   .2000   .2010   .2040   .2140   .2290   .2410   .2490
  31      PC   .2510   .2560   .2700   .2780   .2810   .2830   .2950   .3220   .3520   .4090
  32      PC   .4990   .5900   .7100   .7440   .7810   .8120   .8190   .8350   .8510   .8560
  33      PC   .8600   .8680   .8760   .8880   .9100   .9260   .9370   .9500   .9700   .9760
  34      PC   .9820   .9850   .9870   .9890   .9900   .9930   .9930   .9940   .9950   .9980
  35      PC   .9980   .9990  1.000
  36      LS       0    64.8
  37      UD    .251

  38      KK    RT1E
  39      KM    ROUTE BASIN ON1E THROUGH BASIN ON2E TO THE EXISTING RCB'S AT ALEXANDER ROAD
  40      RT     600    .005    .017            TRAP       5       4

  41      KK    ON2E
  42      KM    RUNOFF FROM ONSITE BASIN ON2E
  43      BA   .0132
  44      LS       0    66.4
  45      UD    .317
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  46      KK    RT2E
  47      KM    ROUTE BASIN ON2E TO THE EXISTING RCB'S AT ALEXANDER ROAD
  48      RT     250    .005    .017            TRAP       5       4

  49      KK    ON3E
  50      KM    RUNOFF FROM ONSITE BASIN ON3E
  51      BA    .0045
  52      LS       0    74.1
  53      UD    .258

  54      KK    COMB1
  55      KM    COMBINE ONSITE BASINS ON1D, ON2D, ON3D AT THE EXISTING RCB'S AT ALEXANDER RD
  56      HC       3

  57      KK    ON4E
  58      KM    RUNOFF FROM ONSITE BASIN ON4E
  59      BA    .0123
  60      LS       0    83.3
  61      UD    .272

  62      KK    ON5E
  63      KM    RUNOFF FROM ONSITE BASIN ON5E
  64      BA    .0211
  65      LS       0    83.3
  66      UD    .369

  67      KK    COMB2
  68      KM    COMBINE ONSITE BASINS ON4E AND ON5E
  69      HC       2

  70      KK    LAMB
  71      KM    RUNOFF FROM LAMB BLVD.
  72      BA    .0087
  73      LS       0    98.0
  74      UD    .252
  75      ZZ
```

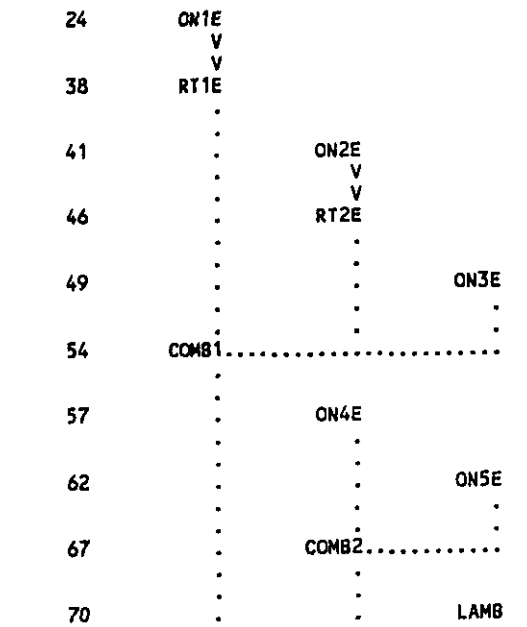
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

OUTLINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *
*        SEPTEMBER 1990                 *
*         VERSION 4.0                   *
*                                       *
*  RUN DATE  07/01/1995  TIME  09:04:01 *
*                                       *
*****************************************
```

```
**************************************** ****
*                                          *
*    U.S. ARMY CORPS OF ENGINEERS          *
*    HYDROLOGIC ENGINEERING CENTER         *
*         609 SECOND STREET                *
*       DAVIS, CALIFORNIA 95616            *
*           (916) 756-1104                 *
*                                          *
**************************************** ****
```

COLLINS BUSINESS PARK II
HYDROLOGICAL MODEL

ONSITE EXISTING CONDITIONS

ENGINEERS & SURVEYORS, INC.

RATIO 1=100 YR.
RATIO 2=10 YR.

STORM DISTRIBUTION #3

INPUT FILE: COLLIN2.DAT

```
22 IO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT        HYDROGRAPH TIME DATA
                   NMIN           5  MINUTES IN COMPUTATION INTERVAL
                   IDATE      1   0  STARTING DATE
                   ITIME        0000  STARTING TIME
                     NQ         185  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE      1   0  ENDING DATE
                  NDTIME       1520  ENDING TIME
                  ICENT          19  CENTURY MARK

             COMPUTATION INTERVAL     .08 HOURS
                  TOTAL TIME BASE   15.33 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT

   JP        MULTI-PLAN OPTION
                   NPLAN          1  NUMBER OF PLANS

   JR        MULTI-RATIO OPTION
               RATIOS OF PRECIPITATION
              1.00       .57
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION	
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2
					1.00	.57
HYDROGRAPH AT						
+	ON1E	.01	1	FLOW	2.	0.
				TIME	3.75	4.92
ROUTED TO						
+	RT1E	.01	1	FLOW	2.	0.
				TIME	3.75	4.92
HYDROGRAPH AT						
+	ON2E	.01	1	FLOW	3.	0.
				TIME	3.83	5.00
ROUTED TO						
+	RT2E	.01	1	FLOW	3.	0.
				TIME	3.83	5.00
HYDROGRAPH AT						
+	ON3E	.00	1	FLOW	2.	0.
				TIME	3.75	3.83
3 COMBINED AT						
+	COMB1	.03	1	FLOW	8.	1.
				TIME	3.75	5.00
HYDROGRAPH AT						
+	ON4E	.01	1	FLOW	11.	4.
				TIME	3.67	3.75
HYDROGRAPH AT						
+	ON5E	.02	1	FLOW	16.	5.
				TIME	3.83	3.83
2 COMBINED AT						
+	COMB2	.03	1	FLOW	26.	9.
				TIME	3.75	3.83
HYDROGRAPH AT						
+	LAMB	.01	1	FLOW	13.	7.
				TIME	3.67	3.67

*** NORMAL END OF HEC-1 ***

APPENDIX C

HEC-1 Analysis: Interim Conditions

```
*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*         SEPTEMBER 1990                *
*          VERSION 4.0                  *
*                                       *
*  RUN DATE  08/20/1995  TIME  09:18:14 *
*                                       *
*****************************************
```


U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104


```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

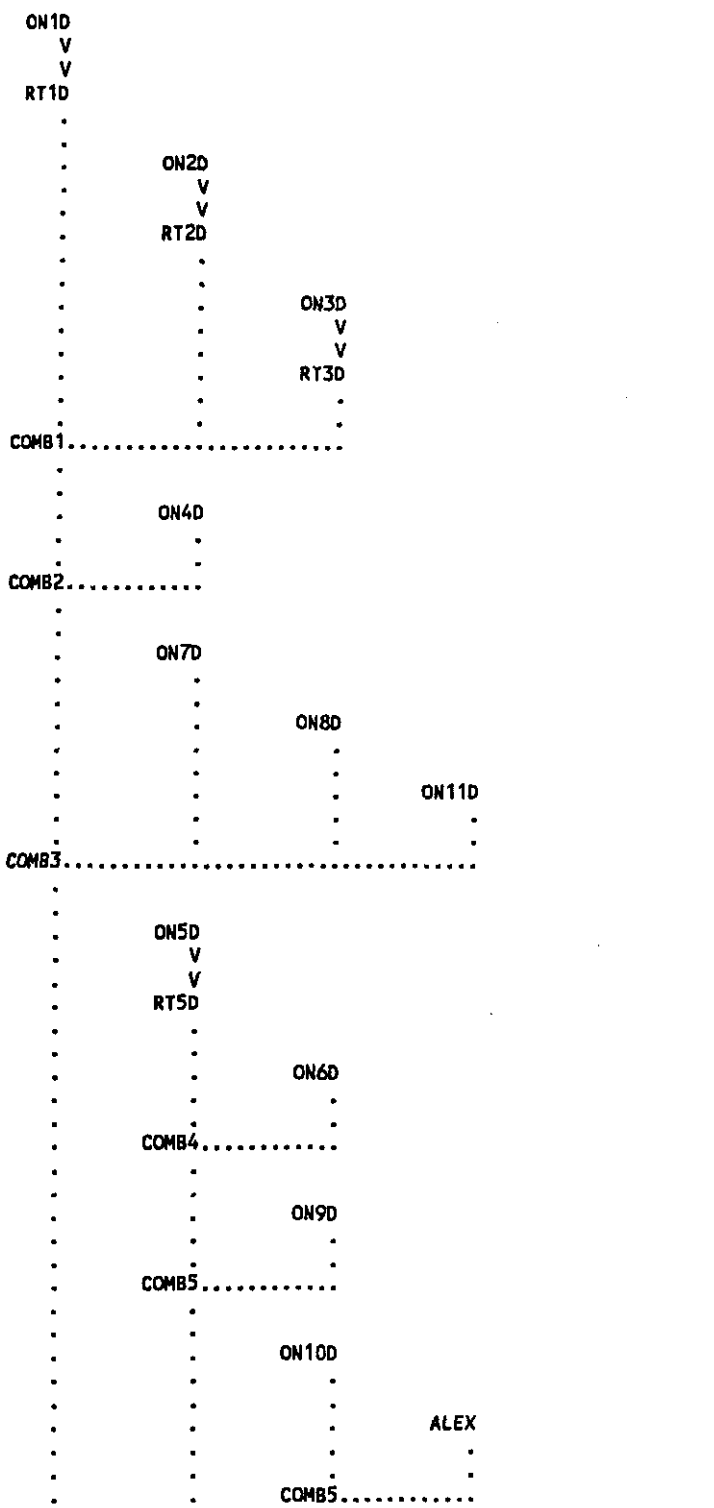
```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  46      KK   RT2D
  47      KM   ROUTE ONSITE BASIN ON2D THROUGH BASINS ON3D AND ON4D TO PHASE BOUNDARY LINE
  48      RT    1608    .005    .017            TRAP      60       0

  49      KK   ON3D
  50      KM   RUNOFF FROM ONSITE BASIN ON3D
  51      BA   .0105
  52      LS      0    90.1
  53      UD    .167

  54      KK   RT3D
  55      KM   ROUTE ONSITE BASIN ON3D THROUGH BASIN ON4D TO PHASE BOUNDARY LINE
  56      RT     808    .005    .017            TRAP      60       0

  57      KK   COMB1
  58      KM   COMBINE ONSITE BASINS ON1E, ON2E, AND ON3E ON FLOSSMOOR AT THE PHASE BOUNDARY
  59      HC      3

  60      KK   ON4D
  61      KM   RUNOFF FROM ONSITE BASIN ON4D
  62      BA   .0017
  63      LS      0    90.1
  64      UD    .120

  65      KK   COMB2
  66      KM   COMBINE COMBINATION COMB1 AND BASIN ON4D ON FLOSSMOOR AT THE PHASE BOUNDARY
  67      HC      2

  68      KK   ON7D
  69      KM   RUNOFF FROM ONSITE BASIN ON7D
  70      BA   .0170
  71      LS      0   89.45
  72      UD    .223

  73      KK   ON8D
  74      KM   RUNOFF FROM ONSITE BASIN ON8D
  75      BA   .0088
  76      LS      0   87.75
  77      UD    .221

  78      KK   ON11D
  79      KM   RUNOFF FROM ONSITE BASIN ON11D
  80      BA   .0027
  81      LS      0      98
  82      UD    .115

  83      KK   COMB3
  84      KM   COMBINE COMB2, ON7D, ON8D, AND ON11D ON FLOSSMOOR AT THE SE CORNER OF THE SIT
  85      HC      4
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  86      KK   ON5D
  87      KM   RUNOFF FROM ONSITE BASIN ON5D
  88      BA   .0225
  89      LS      0    85.7
  90      UD   .239

  91      KK   RT5D
  92      KM   ROUTE ONSITE BASIN ON5D THROUGH ONSITE BASIN ON6D TO COMBINATION 3
  93      RK    700    .003    .017            TRAP      20       2

  94      KK   ON6D
  95      KM   RUNOFF FROM ONSITE BASIN ON6D
  96      BA   .0230
  97      LS      0    87.5
  98      UD   .266

  99      KK   COMB4
 100      KM   COMBINE ONSITE BASINS ON5D AND ON6D AT THE SOUTHWEST CORNER OF PHASE BOUNDARY
 101      HC      2

 102      KK   ON9D
 103      KM   RUNOFF FROM ONSITE BASIN ON9D
 104      BA   .0068
 105      LS      0   90.05
 106      UD   .202

 107      KK   COMB5
 108      KM   COMBINE ONSITE BASINS ON5D, ON6D, ON9D AT THE SOUTH WEST CORNER OF THE SITE
 109      HC      2

 110      KK   ON10D
 111      KM   RUNOFF FROM ONSITE BASIN ON10D
 112      BA   .0200
 113      LS      0   79.26
 114      UD   .285

 115      KK   ALEX
 116      KM   RUNOFF FROM ALEXANDER RD.
 117      BA   .005
 118      LS      0      98
 119      UD   .186

 120      KK   COMB5
 121      KM   COMBINE BASINS ON10D AND ALEX ON ALEXANDER RD @ THE SE CORNER OF THE SITE
 122      HC      2
 123      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (.) CONNECTOR (---->) DIVERSION OR PUMP FLOW (<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
**********************************************
*                                            *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)        *
*          SEPTEMBER 1990                    *
*           VERSION 4.0                      *
*                                            *
*  RUN DATE  08/20/1995  TIME  09:18:14      *
*                                            *
**********************************************
```


```
**********************************************
*                                            *
*     U.S. ARMY CORPS OF ENGINEERS           *
*     HYDROLOGIC ENGINEERING CENTER          *
*          609 SECOND STREET                 *
*        DAVIS, CALIFORNIA 95616             *
*           (916) 756-1104                   *
*                                            *
**********************************************
```


COLLINS BUSINESS PARK, PHASE II
HYDROLOGICAL MODEL

ONSITE INTERIM CONDITIONS

ENGINEERS & SURVEYORS, INC.

RATIO 1=100 YR.
RATIO 2=10 YR.

STORM DISTRIBUTION #3

INPUT FILE: COL2DEV.DAT

```
22 IO        OUTPUT CONTROL VARIABLES
                  IPRNT          5  PRINT CONTROL
                  IPLOT          0  PLOT CONTROL
                  QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                  NMIN           5  MINUTES IN COMPUTATION INTERVAL
                  IDATE      1   0  STARTING DATE
                  ITIME        0000  STARTING TIME
                    NQ         185  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE      1   0  ENDING DATE
                 NDTIME       1520  ENDING TIME
                 ICENT          19  CENTURY MARK

               COMPUTATION INTERVAL     .08 HOURS
                   TOTAL TIME BASE   15.33 HOURS

     ENGLISH UNITS
          DRAINAGE AREA          SQUARE MILES
          PRECIPITATION DEPTH    INCHES
          LENGTH, ELEVATION      FEET
          FLOW                   CUBIC FEET PER SECOND
          STORAGE VOLUME         ACRE-FEET
          SURFACE AREA           ACRES
          TEMPERATURE            DEGREES FAHRENHEIT

   JP         MULTI-PLAN OPTION
                 NPLAN           1  NUMBER OF PLANS

   JR         MULTI-RATIO OPTION
                 RATIOS OF PRECIPITATION
               1.00       .57
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 .57
HYDROGRAPH AT						
+	ON1D	.01	1	FLOW	13.	6.
				TIME	3.50	3.58
ROUTED TO						
+	RT1D	.01	1	FLOW	13.	6.
				TIME	3.50	3.58
HYDROGRAPH AT						
+	ON2D	.01	1	FLOW	12.	5.
				TIME	3.58	3.58
ROUTED TO						
+	RT2D	.01	1	FLOW	12.	5.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON3D	.01	1	FLOW	15.	7.
				TIME	3.58	3.58
ROUTED TO						
+	RT3D	.01	1	FLOW	15.	7.
				TIME	3.58	3.58
3 COMBINED AT						
	COMB1	.03	1	FLOW	40.	17.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON4D	.00	1	FLOW	3.	1.
				TIME	3.58	3.58
2 COMBINED AT						
+	COMB2	.03	1	FLOW	42.	19.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON7D	.02	1	FLOW	21.	9.
				TIME	3.67	3.67
HYDROGRAPH AT						
+	ON8D	.01	1	FLOW	10.	4.
				TIME	3.67	3.67
HYDROGRAPH AT						
+	ON11D	.00	1	FLOW	5.	3.
				TIME	3.50	3.50
4 COMBINED AT						
+	COMB3	.06	1	FLOW	77.	33.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	ON5D	.02	1	FLOW	23.	9.
				TIME	3.67	3.67
ROUTED TO						
+	RT5D	.02	1	FLOW	22.	8.
				TIME	3.67	3.75
HYDROGRAPH AT						

+	ON6D	.02	1	FLOW	24.	10.
				TIME	3.67	3.75
2 COMBINED AT						
+	COMB4	.05	1	FLOW	47.	18.
				TIME	3.67	3.75
HYDROGRAPH AT						
+	ON9D	.01	1	FLOW	9.	4.
				TIME	3.58	3.67
2 COMBINED AT						
+	COMB5	.05	1	FLOW	55.	21.
				TIME	3.67	3.75
HYDROGRAPH AT						
+	ON10D	.02	1	FLOW	14.	4.
				TIME	3.75	3.75
HYDROGRAPH AT						
+	ALEX	.00	1	FLOW	9.	5.
				TIME	3.58	3.58
2 COMBINED AT						
+	COMB5	.02	1	FLOW	21.	8.
				TIME	3.67	3.67

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
RT5D	MANE	1.03	22.98	221.81	1.44	5.00	22.32	220.00	1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1727E+01 EXCESS= .0000E+00 OUTFLOW= .1729E+01 BASIN STORAGE= .2822E-05 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .57									
RT5D	MANE	1.50	8.49	223.25	.53	5.00	8.39	225.00	.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6349E+00 EXCESS= .0000E+00 OUTFLOW= .6355E+00 BASIN STORAGE= .2694E-05 PERCENT ERROR= -.1

*** NORMAL END OF HEC-1 ***

APPENDIX D

Street Capacity Calculations

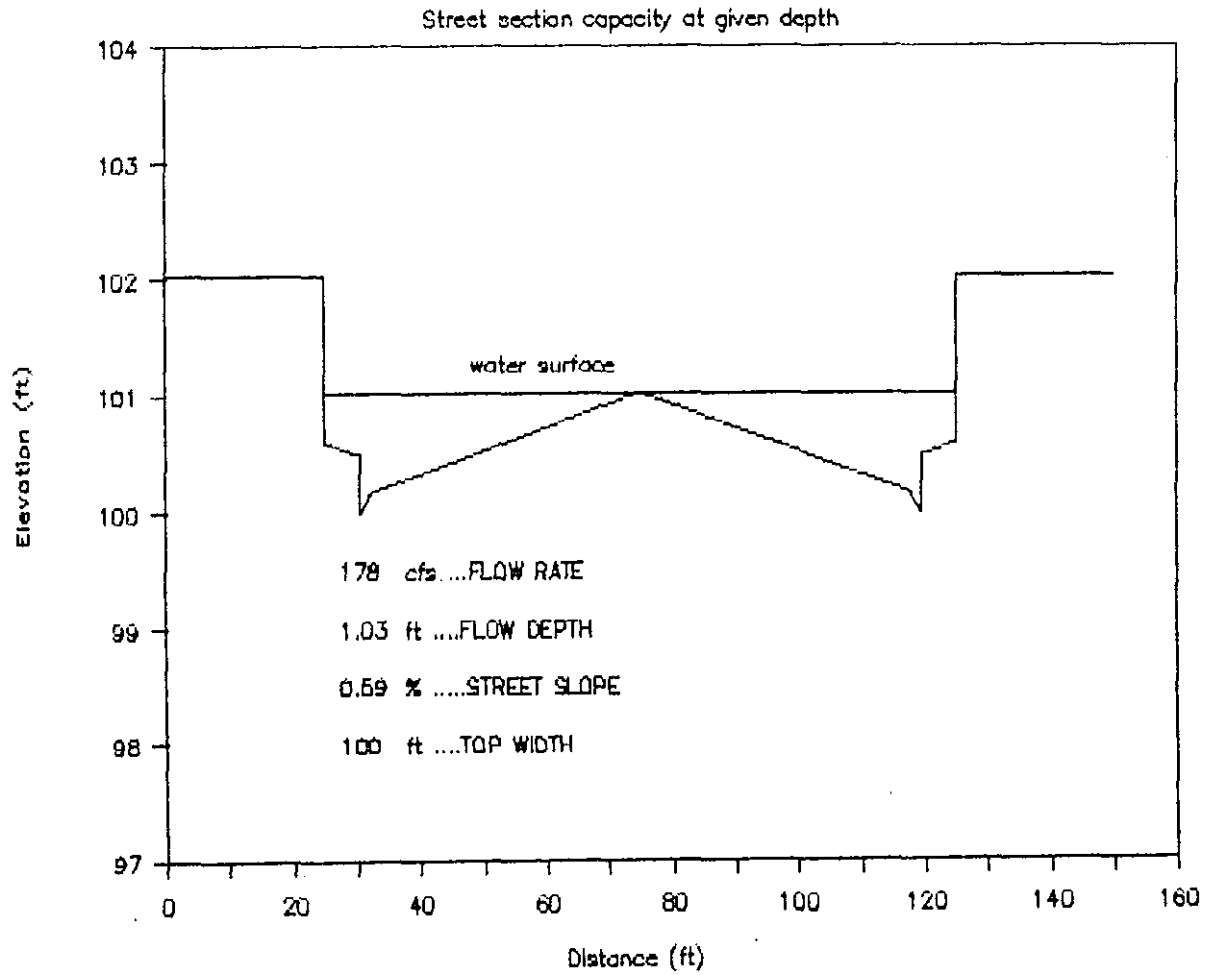
S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Street Capacity (Lamb Blvd.)

Input variables:		Output variables:	
Flow depth, d	1.030 ft	Capacity at d	178.44 cfs
Road width	90.0 ft	Velocity	3.9 fps
Crown height	1.03 ft	Top width	100.0 ft
Street slope	0.590 %	VD Product	4.1
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	14.8 cfs
Median width	0.0 ft	@ back of walk	26.4 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

Street Capacity (Lamb Blvd.) @ CROWN



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7546 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4615

S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Lamb Blvd. Q100=344 cfs

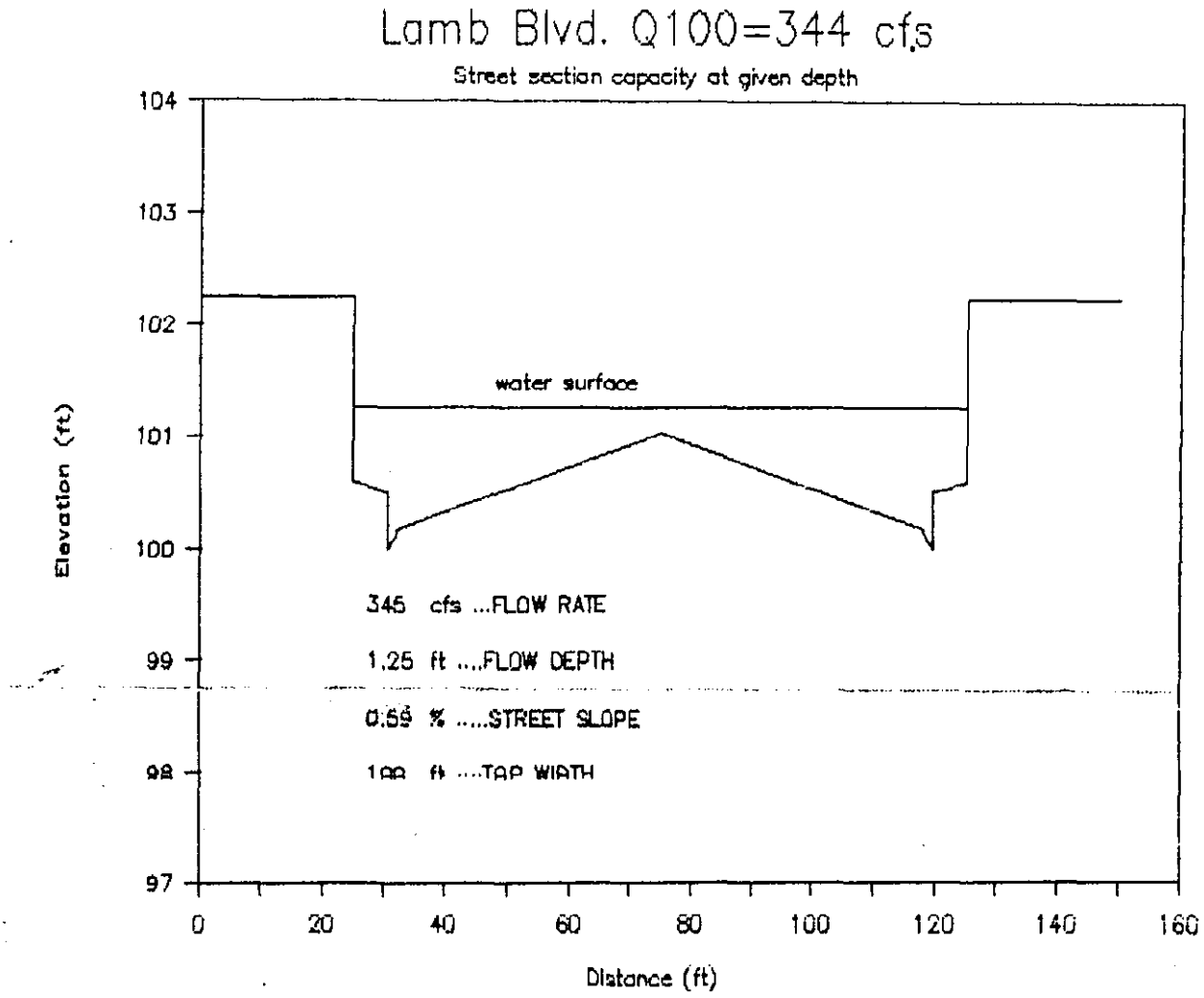
Input variables:		Output variables:	
Flow depth, d	1.250 ft	Capacity at d	344.94 cfs
Road width	90.0 ft	Velocity	5.1 fps
Crown height	1.03 ft	Top width	100.0 ft
Street slope	0.590 %	VD Product	6.4
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	14.8 cfs
Median width	0.0 ft	@ back of walk	26.4 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

331 from spill over
+ 13 from street runoff
344 cfs

SINCE LAMB BLVD. CAN ONLY HOLD 178 cfs (CAPACITY @ CROWN)

$344 - 178 = \frac{166}{2} = 83$ cfs

WILL SPILL OVER ON EACH SIDE OF LAMB BLVD.



STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7236 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4415

S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

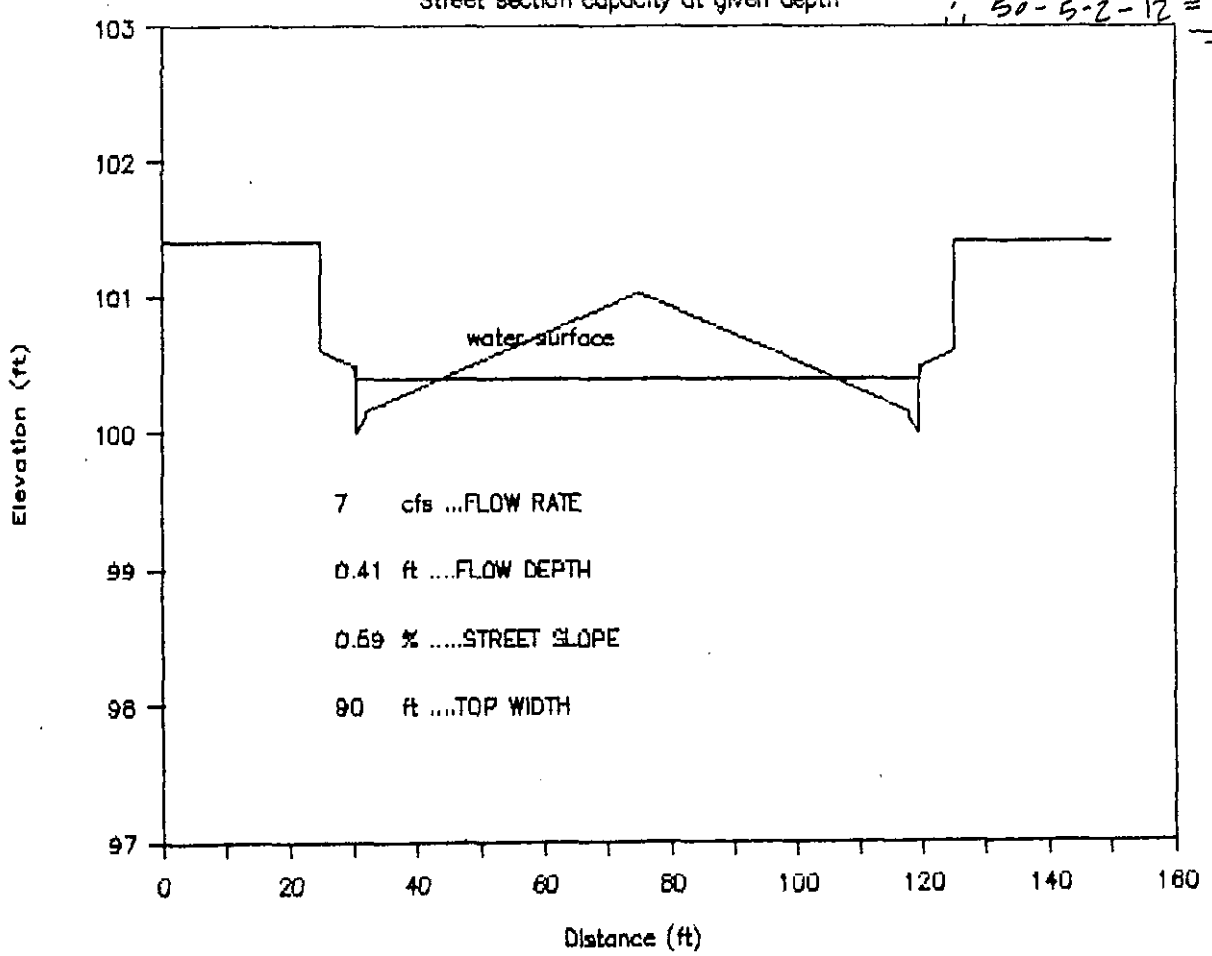
Lamb Blvd. Q10=7 cfs

Input variables:		Output variables:	
Flow depth, d	0.410 ft	Capacity at d	7.28 cfs
Road width	90.0 ft	Velocity	1.8 fps
Crown height	1.03 ft	Top width	90.0 ft
Street slope	0.590 %	VD Product	0.7
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	14.8 cfs
Median width	0.0 ft	@ back of walk	26.4 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

FOR THE 10 YEAR STORM, THE RCB CULVERTS UNDER LAMB ARE CAPABLE OF INTERCEPTING FLOW FROM THE WESTERN FINGER WASH. THEREFORE, NO SPILL OVER IN LAMB, THE 10-YEAR FLOW IN LAMB IS 7 c/s (STREET-RUNOFF)

DRY LANE CALC.

0.41
-0.17
0.24' + .02 = 12'
∴ 50 - 5 - 2 - 12 = 31'



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7548 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4415

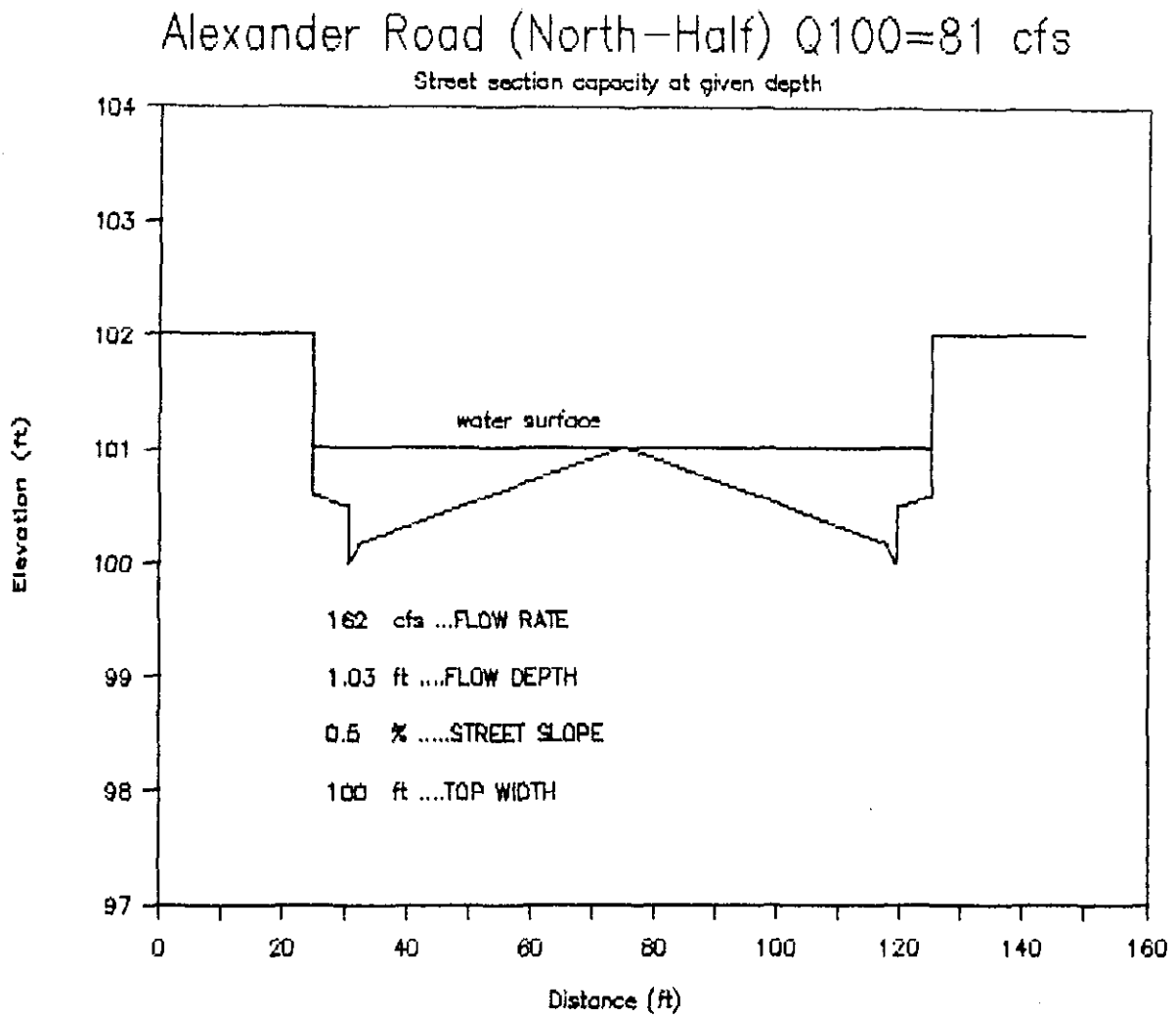
S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Alexander Road (North-Half) Q100=81 cfs

Input variables:		Output variables:	
Flow depth, d	1.026 ft	Capacity at d	162.29 cfs
Road width	90.0 ft	Velocity	3.6 fps
Crown height	1.03 ft	Top width	100.0 ft
Street slope	0.500 %	VD Product	3.7
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	13.7 cfs
Median width	0.0 ft	@ back of walk	24.3 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

HALF-STREET CALC.



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7548 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4415

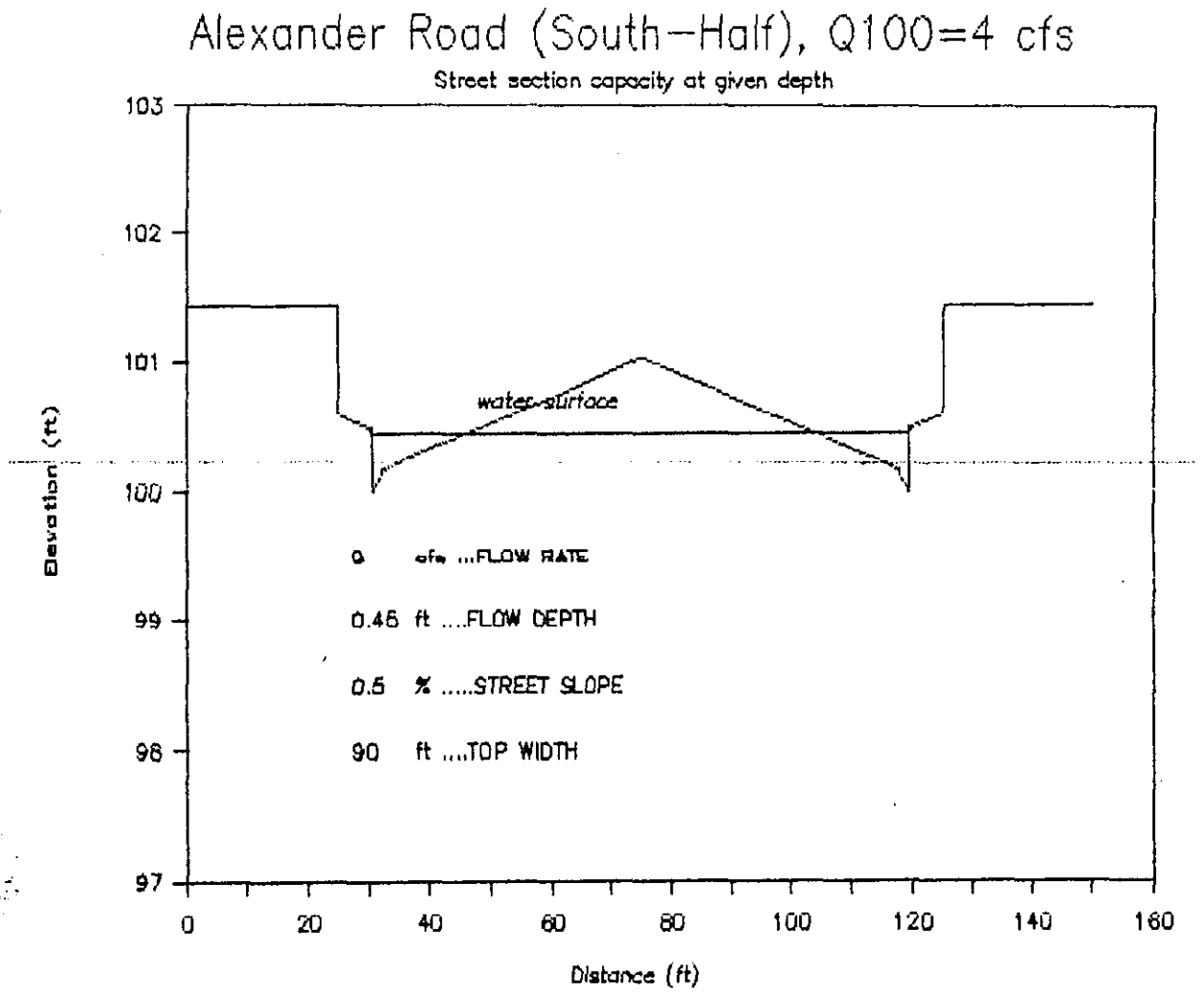
S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Alexander Road (South-Half), Q100=4 cfs

Input variables:		Output variables:	
Flow depth, d	0.445 ft	Capacity at d	9.04 cfs
Road width	90.0 ft	Velocity	1.8 fps
Crown height	1.03 ft	Top width	90.0 ft
Street slope	0.500 %	VD Product	0.8
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	13.7 cfs
Median width	0.0 ft	@ back of walk	24.3 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

HALF-STREET



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7546 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4415

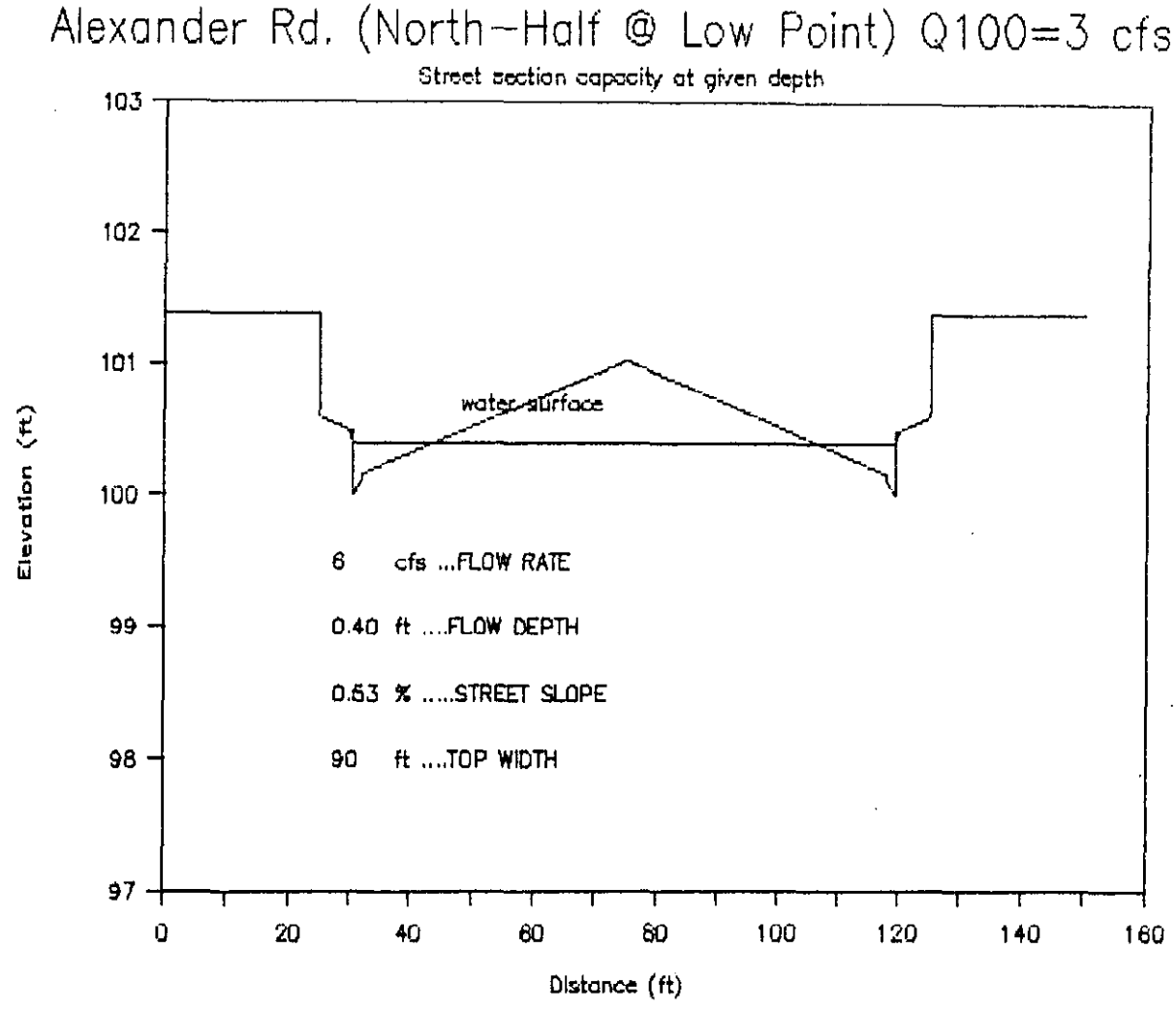
S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Alexander Rd. (North-Half @ Low Point) Q100=3 cfs

Input variables:		Output variables:	
Flow depth, d	0.395 ft	Capacity at d	6.02 cfs
Road width	90.0 ft	Velocity	1.7 fps
Crown height	1.03 ft	Top width	90.0 ft
Street slope	0.530 %	VD Product	0.7
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	14.1 cfs
Median width	0.0 ft	@ back of walk	25.0 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

HALF-STREET CALC.



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC.
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STREET FLOWS

Manning's Equation for flow capacity in a street section.
Alexander Rd. Q10=5 cfs

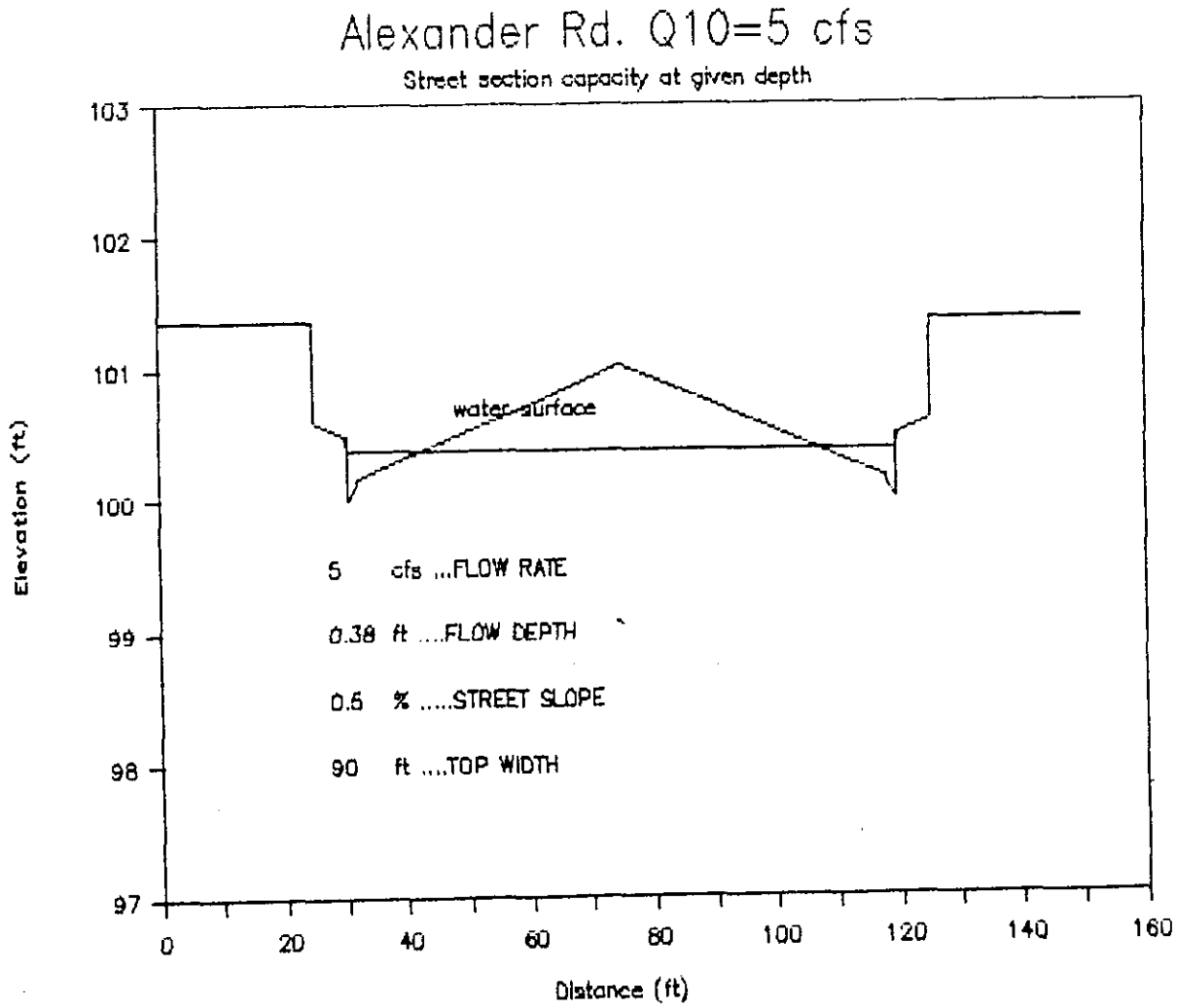
Input variables:		Output variables:	
Flow depth, d	0.380 ft	Capacity at d	5.06 cfs
Road width	90.0 ft	Velocity	1.6 fps
Crown height	1.03 ft	Top width	90.0 ft
Street slope	0.500 %	VD Product	0.6
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	13.7 cfs
Median width	0.0 ft	@ back of walk	24.3 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017

RET LANE CALC.

0.38' depth of flow
0.17' Gutter depth.
0.21'

0.21 ÷ 0.02 = 10.5'

50' - 5' - 2' - 10.5'
= 32.5' ℄ lane



APPENDIX D

STREET CAPACITY CALCULATIONS

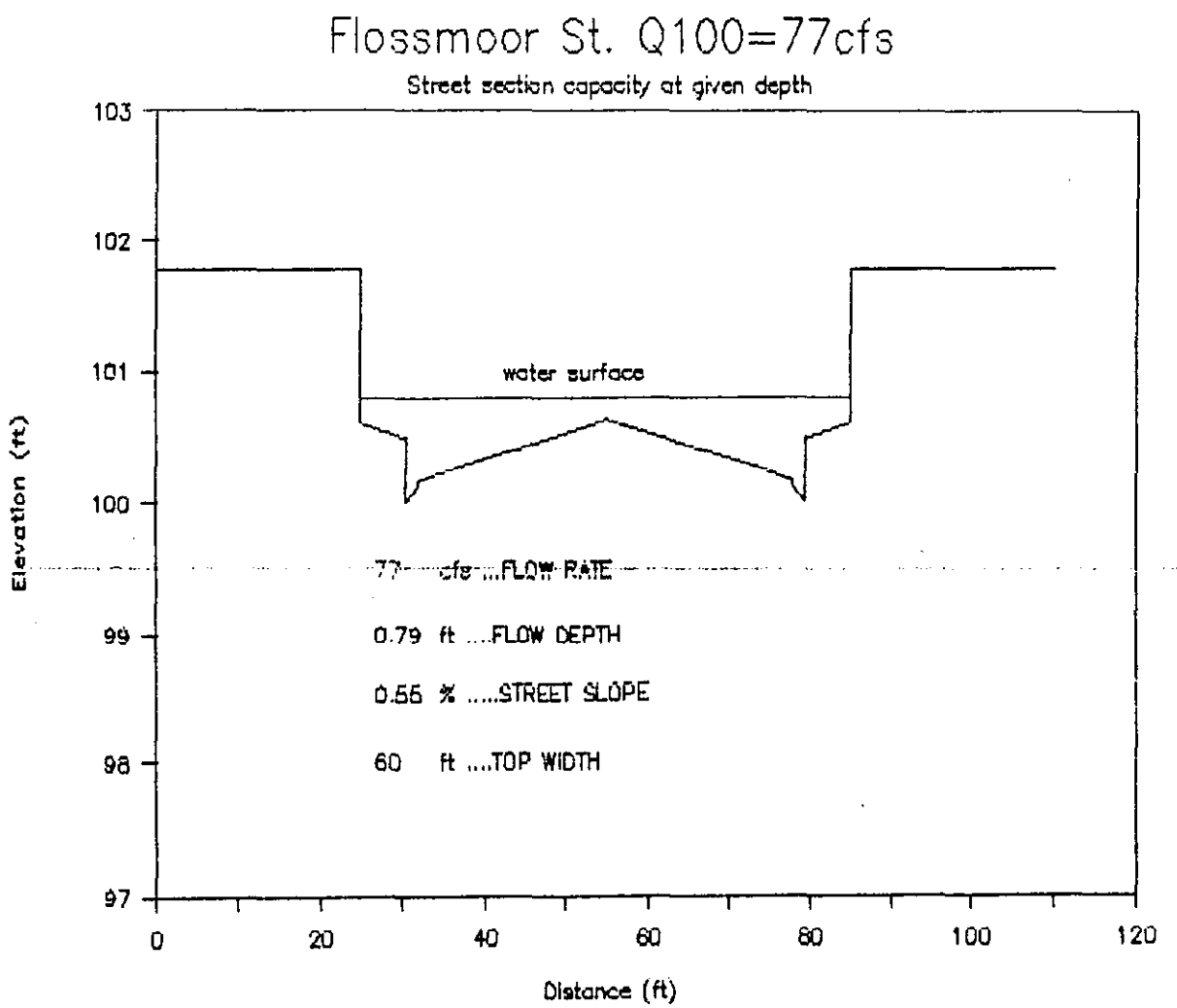
STORMWATER MANAGEMENT DEPT.
ESI ENGINEERS AND SURVEYORS INC
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7540 WEST SAHARA AVENUE • LAS VEGAS, NEVADA 89117 • (702) 240-4615

S T R E E T F L O W S

Manning's Equation for flow capacity in a street section.

Flossmoor St. Q100=77cfs

Input variables:		Output variables:	
Flow depth, d	0.790 ft	Capacity at d	77.11 cfs
Road width	50.0 ft	Velocity	3.4 fps
Crown height	0.63 ft	Top width	60.0 ft
Street slope	0.550 %	VD Product	2.7
Sidewalk width	5.0 ft	CAPACITY:	
Curb height	6 in	@ top of curb	14.3 cfs
Median width	0.0 ft	@ back of walk	25.4 cfs
Rt back of walk	100.0 %		
Lt back of walk	100.0 %	Manning's n	0.017



APPENDIX D

STREET CAPACITY CALCULATIONS

STORMWATER MANAGEMENT DEPT.
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APPENDIX E

Pipe, Culvert, and Inlet Capacity Calculations

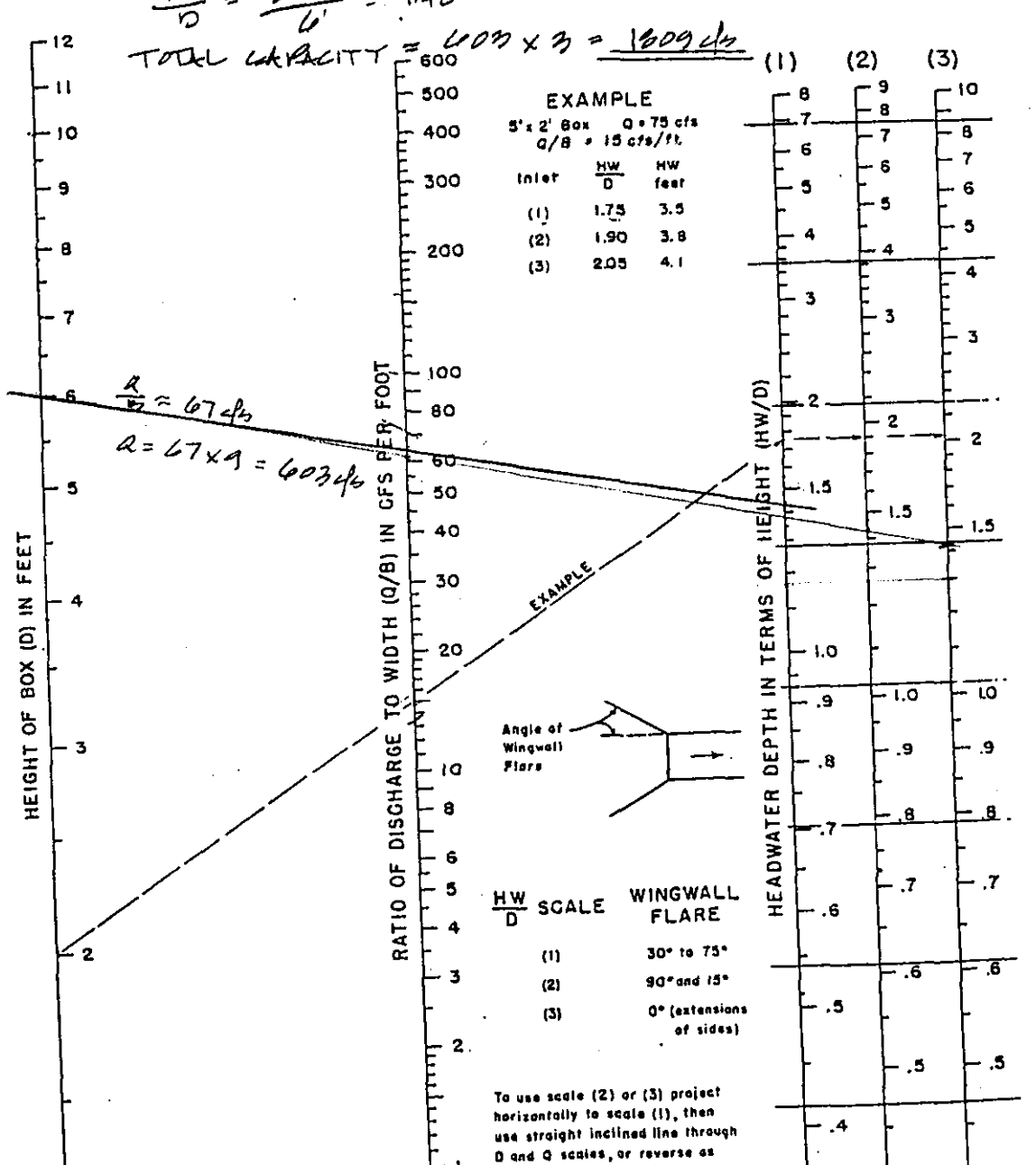
LANDS BLVD. 3 - 6'x9' RCBLs

AVAILABLE HEAD = 8.5'

$\frac{H_W}{D} = \frac{8.5'}{6'} = 1.42'$ 7.81 1.320

TOTAL CAPACITY = 603 x 3 = 1809 cfs

CHART I



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

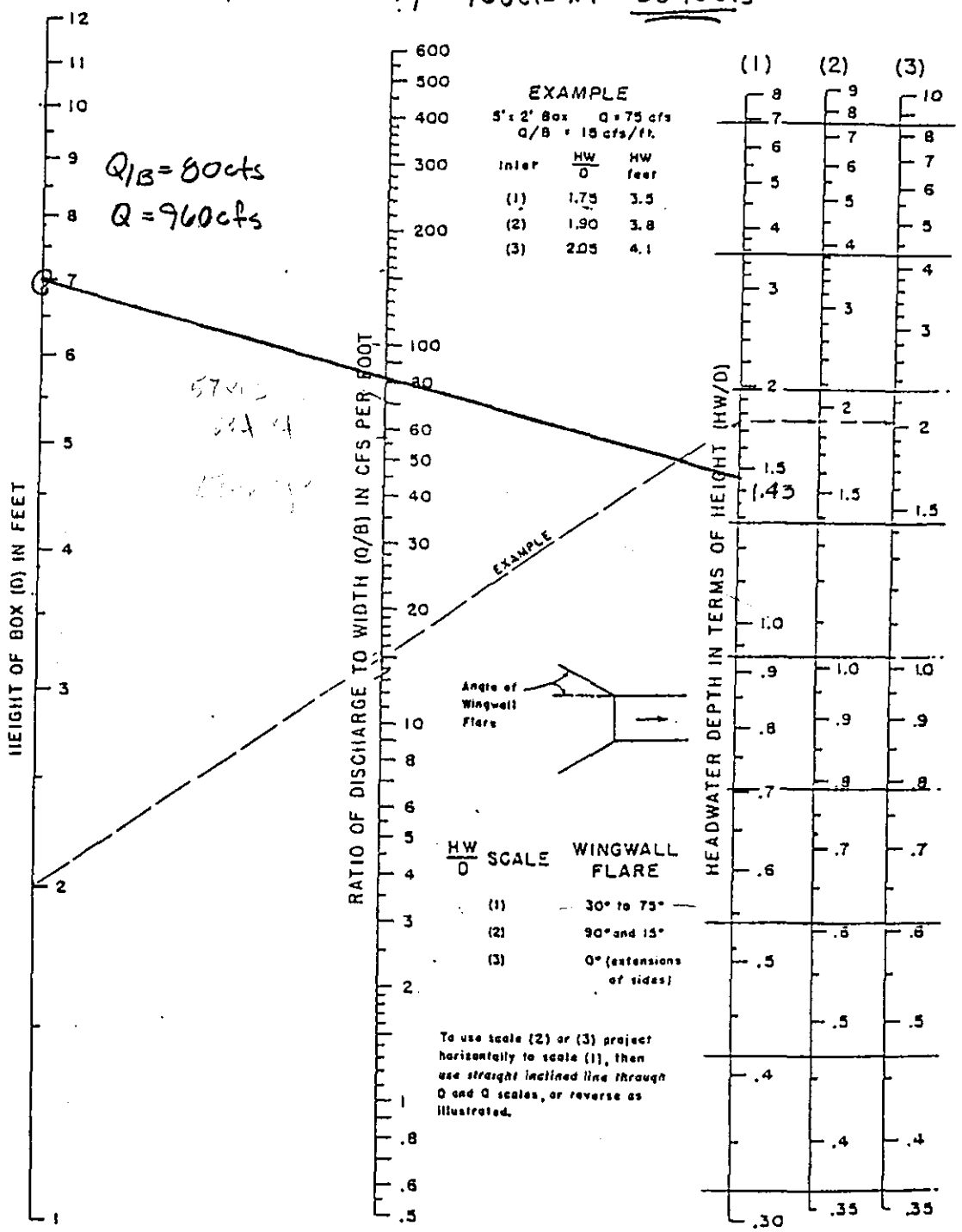
BUREAU OF PUBLIC ROADS JAN. 1963

ALEXANDER ROAD - 4 - 7'x12' RCB's WITH WINGWALLS

AVAILABLE HEAD = 10' $\frac{Hw}{D}$ = 1.43'

TOTAL CAPACITY = 960cfs x4 = 3840cfs

CHART 1 $\frac{7.39}{7}$ = 1.06'



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

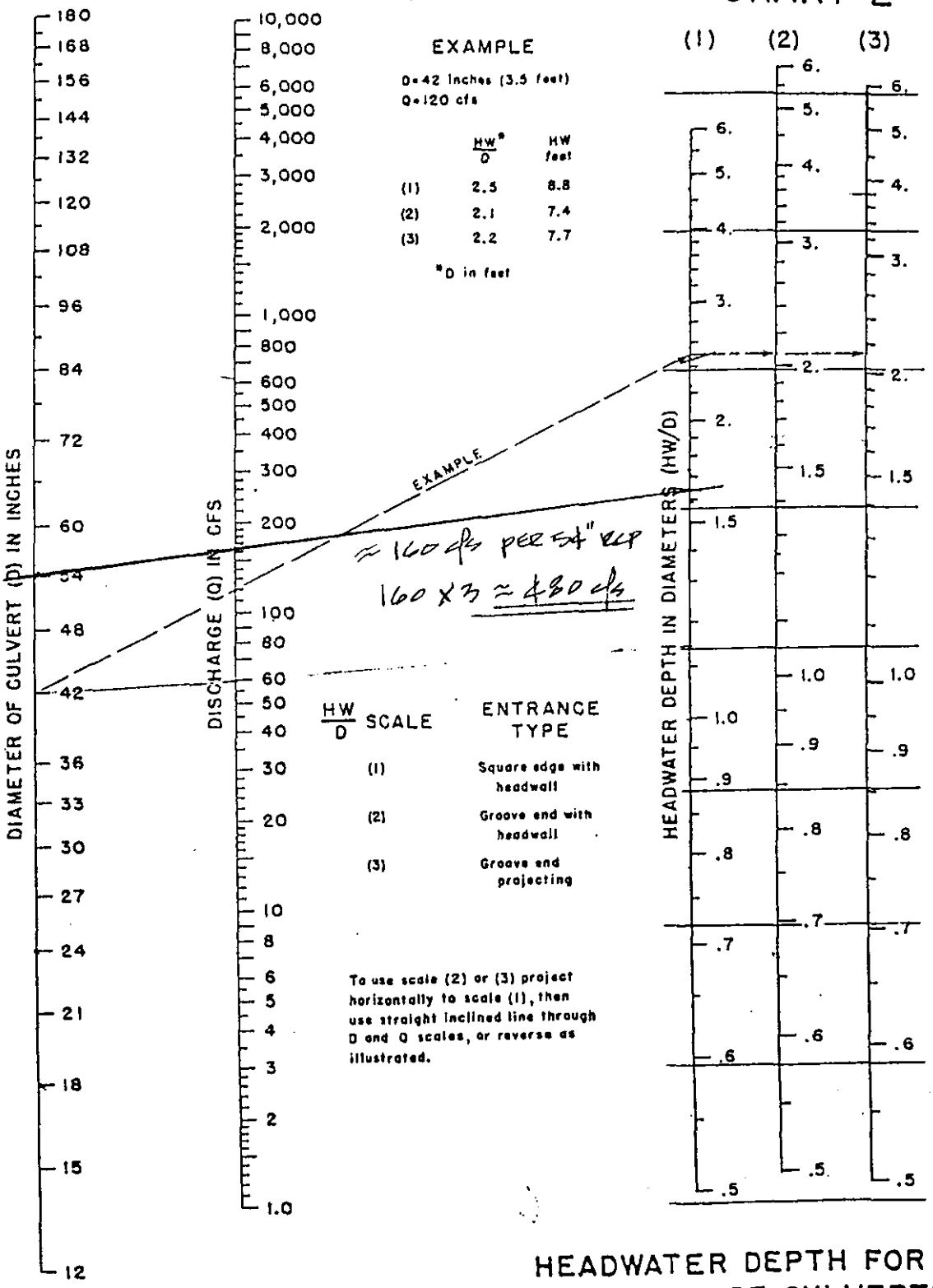
BUREAU OF PUBLIC ROADS JAN. 1963

For Proposed
Triple, 54" RCP

$HW = 7.39'$

$\frac{HW}{D} = \frac{7.39'}{54''} = 1.64$

CHART 2



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 283
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

DROP-INLET CAPACITY CALC.

FLOSSMOOR ST.

PROPOSED MODIFIED 20' TYPE "C" DI W/ DOUBLE GRATES

Q_{100} = 77 cfs ——— DEPTH OF FLOW = 0.79

20' CONTINUOUS GRADE, TYPE "A" CHART ——— Q = 23 cfs

DOUBLE TYPE "C" GRATE ——— Q ≈ 10.5 × 2 = 21 cfs

ALLOWABLE CAPACITY — 44 cfs

× 2

TOTAL ALLOWABLE INLET CAPACITY (BOTH SIDES OF STREET) 88 cfs

LAMB BLVD.

EXIST. 3' TYPE "B" DI

Q_{100} = 178 cfs ——— DEPTH OF FLOW = 1.03'

CONTINUOUS GRADE, TYPE "B" CHART ——— Q = 12 cfs

× 2

BOTH SIDES OF STREET 24 cfs

FLOW IN LAMB BLVD. = 178 cfs − 24 cfs = $\frac{154 \text{ cfs}}{2}$ = 77 cfs (ON EACH SIDE OF STREET)

77 cfs ON (EAST-HALF) LAMB BLVD. WILL FOLLOW STREET GRADE TO TURN ON ALEXANDER

ALEXANDER RD.

NORTHSIDE ——— 77 cfs + 4 cfs (STREET RUNOFF) = 81 cfs

Q_{100} = 81 cfs ——— DEPTH OF FLOW = 1.026'

PROPOSED MODIFIED 20' TYPE "C" W/ 4 GRATE

20' CONTINUOUS GRADE, TYPE "A" CHART ——— Q = 33 cfs

4 TYPE "C" GRATE ——— Q = 4 × 12 cfs = 48 cfs

81 cfs

SOUTHSIDE ——— STREET RUNOFF Q = 4 cfs

Q_{100} = 4 cfs ——— DEPTH OF FLOW = 0.445'

EXIST. 2' TYPE "B" DI (RIGHT AMONG EAST. RCBCs)

CAPABLE OF INTERCEPTING ≈ 5 cfs

ALEXANDER RD.

NORTHBOUND @ LOW POINT

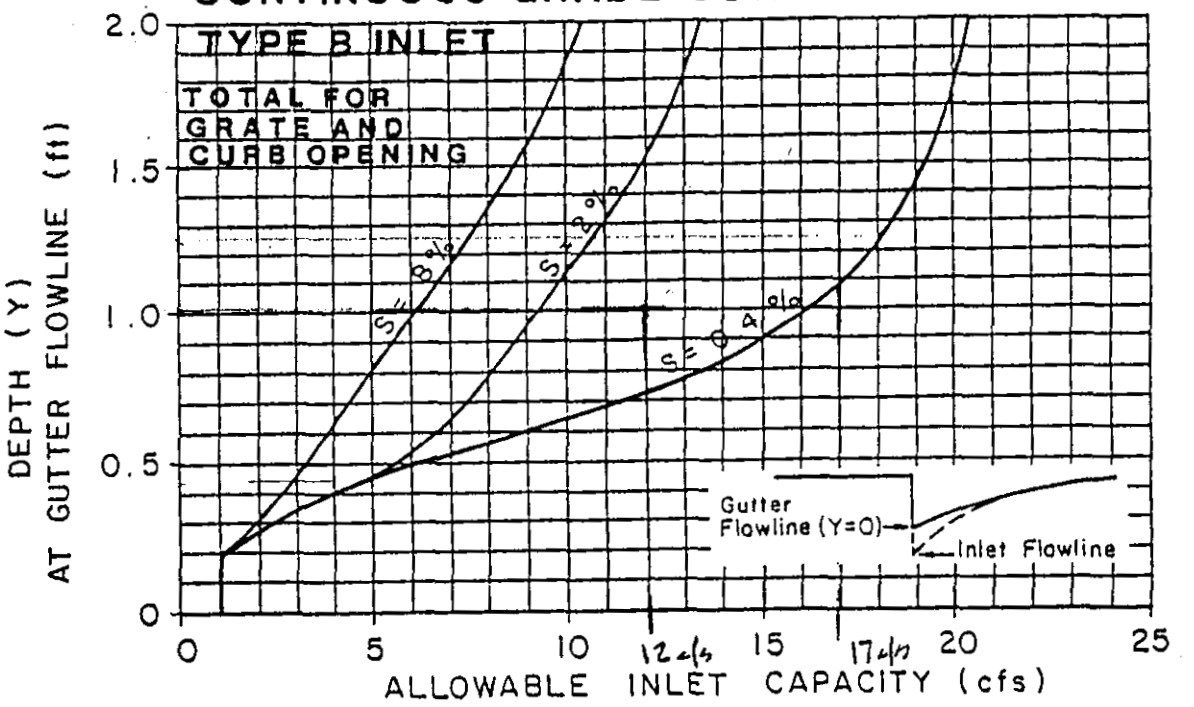
$Q = 3$ cfs ——— DEPTH OF FLOW = 0.395'

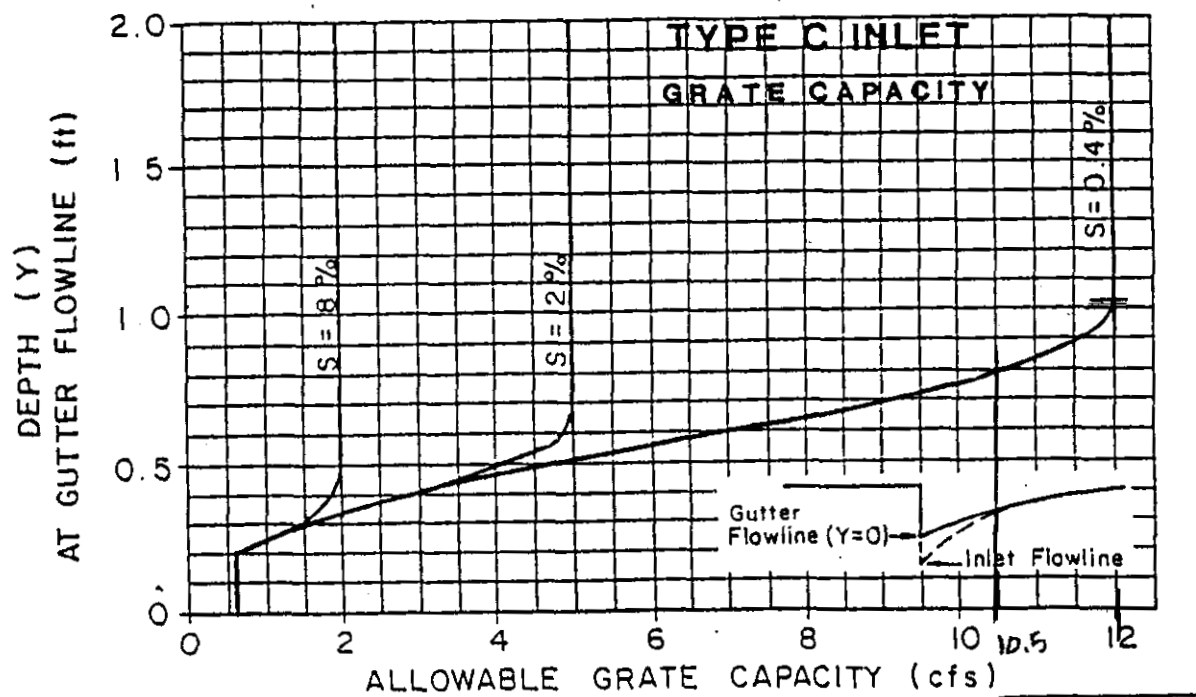
PROPOSED MODIFIED 4' TYPE "B" DI (SUMP CONDITION)

CAPABLE OF INTERCEPTING ≈ 6 cfs

ALLOWABLE INLET CAPACITY

CONTINUOUS GRADE CONDITION





NOTES: 1. Type C Inlet: Add the grate capacity from this graph to curb opening capacity from Type A Inlet-Continuous Grade graphs to obtain Total Inlet Capacity.
2. Type C Inlet: Grate Capacity includes a reduction factor of 0.70.
3. Type B Inlet: Capacity includes a reduction factor of 0.70 applied to grate capacity and 0.80 applied to curb opening capacity.

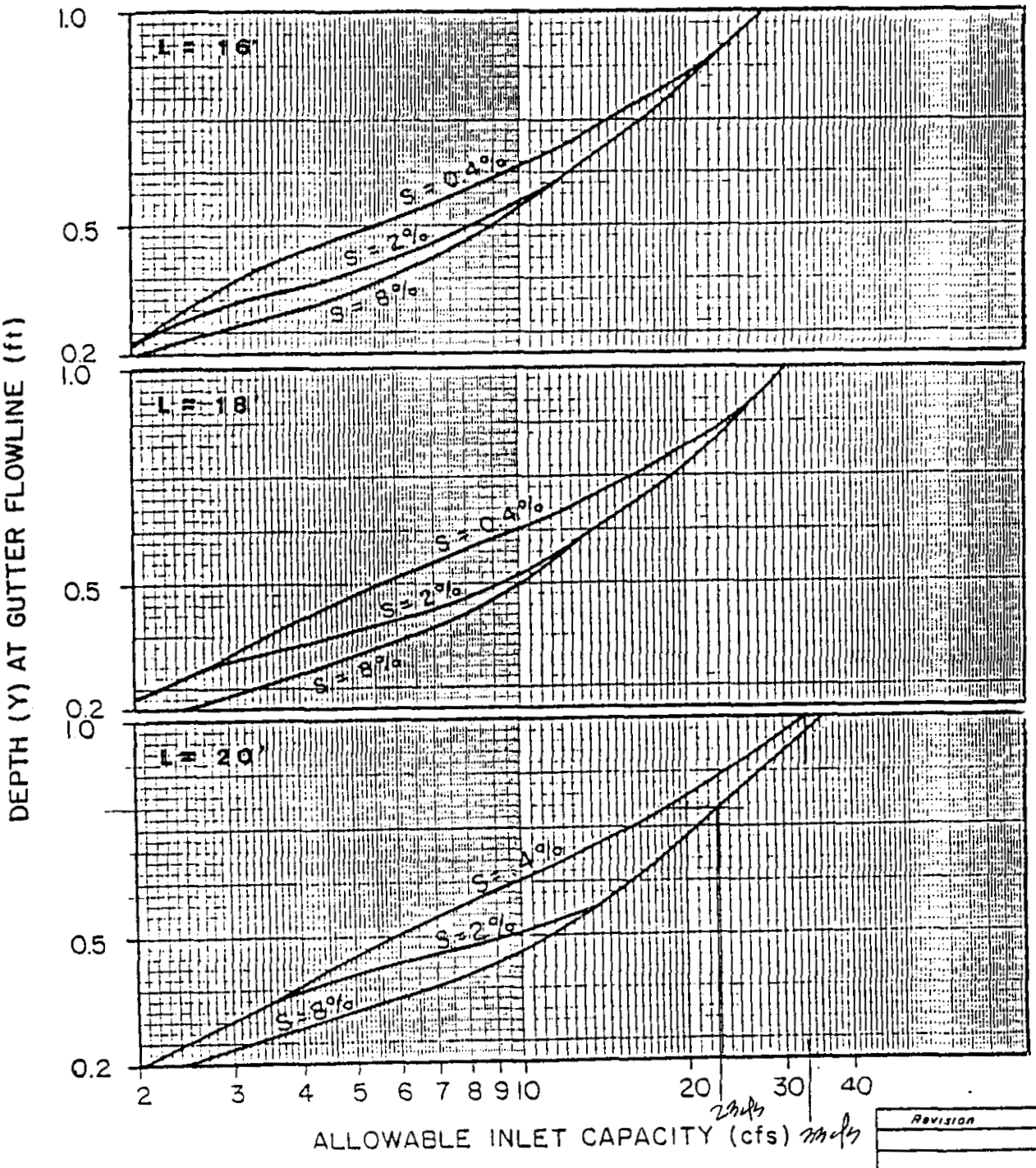
Revision	Date

WRC ENGINEERING

REFERENCE:

FIGURE 806

ALLOWABLE INLET CAPACITY
CONTINUOUS GRADE CONDITION
TYPE A INLET - Y ≤ 1 FOOT

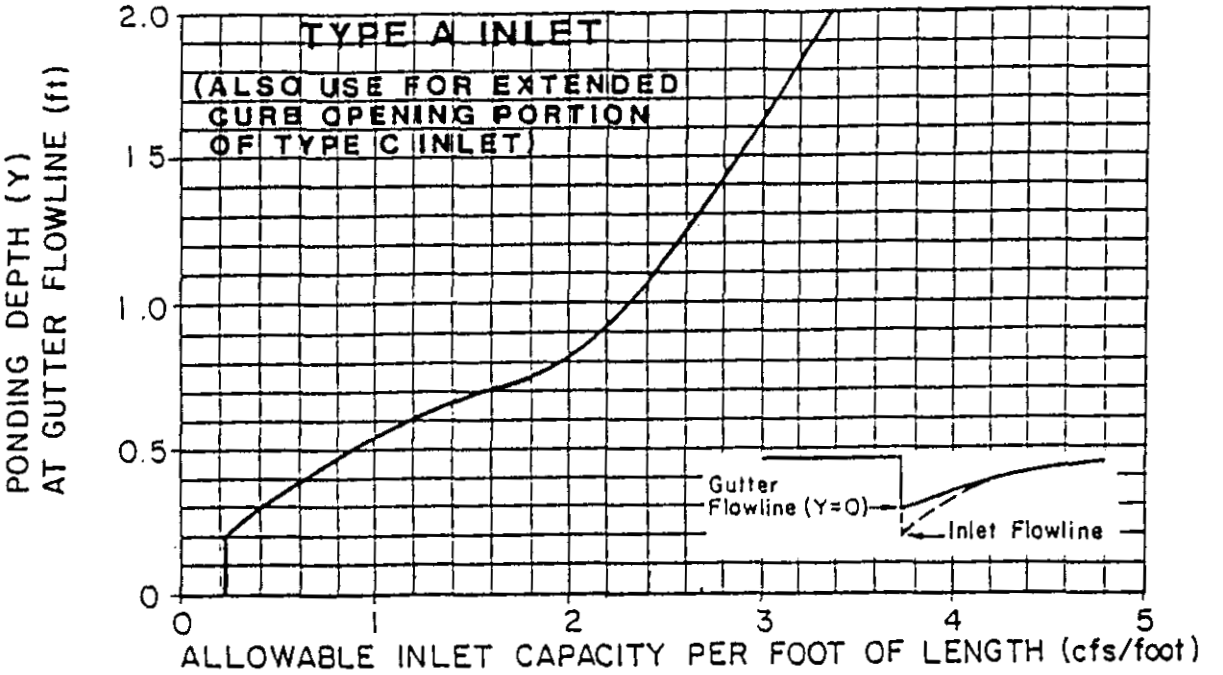


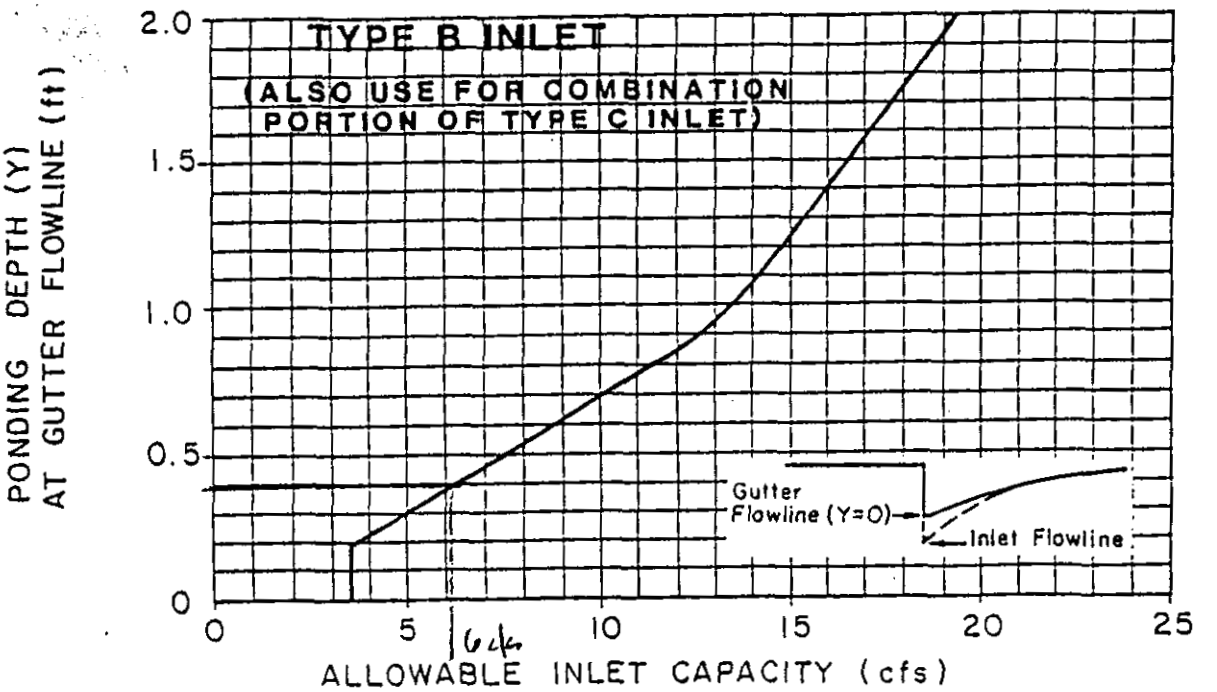
Revision	Date

WRC ENGINEERING	REFERENCE:	FIGURE 804 3 OF 3

ALLOWABLE INLET CAPACITY

SUMP CONDITION





NOTES: 1. Includes capacity reduction factor of 0.80 for Type A Inlet.
2. Includes capacity reduction factor of 0.65 for Type B Inlet.

Revision	Date

WRC ENGINEERING

REFERENCE:

FIGURE 807

ESI ENGINEERS AND SURVEYORS INC.
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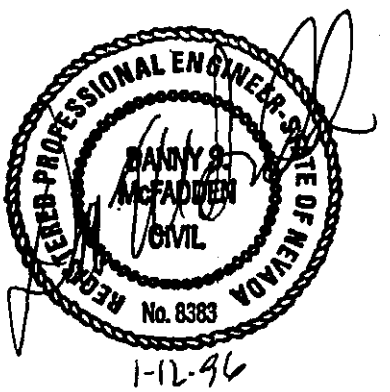
SECOND ADDENDUM TO THE ONSITE HYDROLOGY STUDY FOR COLLINS BUSINESS PARK, PHASE II & CHANNEL DESIGN FOR CCRFCD FACILITY # RWWE 0027

WO # 755 - B165
January 12, 1996



Prepared by:

Engineers and Surveyors, Inc.
7548 W. Sahara Avenue
Las Vegas, Nevada 89117

ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS

January 12, 1996
WO# 755-B165

Clark County Public Works Dept.
500 S. Grand Central Parkway
Las Vegas, Nevada 89155

ATT: **Robert Thompson, P.E.**

RE: Onsite Hydrology Study for Collins Business Park, Phase II & Channel Design for CCRFCD Facility # RWWE 0027
H.T.E.# 95-12569
Willdan #1814

Dear Mr. Thompson,

This letter is in response to the Clark County Regional Flood Control District comments, dated January 10, 1996, in regards to the above referenced project.

Comment 1: **The consultant quantified a Q100 of 265 cfs crossing subbasin ON1E in the existing condition. It must be demonstrated that diverting this 265 cfs, through placement of the proposed berm along the westerly property line, does not create an adverse impact to Lamb Blvd. or properties on the westerly side of Lamb.**

Response 1: The hydrology study is intended to analyze the hydrologic and hydraulic conditions of the site in interim conditions. The interim site will be graded to allow the 265 cfs to sheet flow across the site ultimately discharging into the proposed channel. In the future, when a site plan is prepared for the area bounded by the channel to the north and east and by Lamb Boulevard and Alexander Road to the west and south, a technical drainage study will be submitted. Drainage conveyance systems and finish floor elevations will be designed in accordance with Clark County Public Works (CCPW) drainage criteria. A revised grading plan for the interim condition has been included in map pocket 1.

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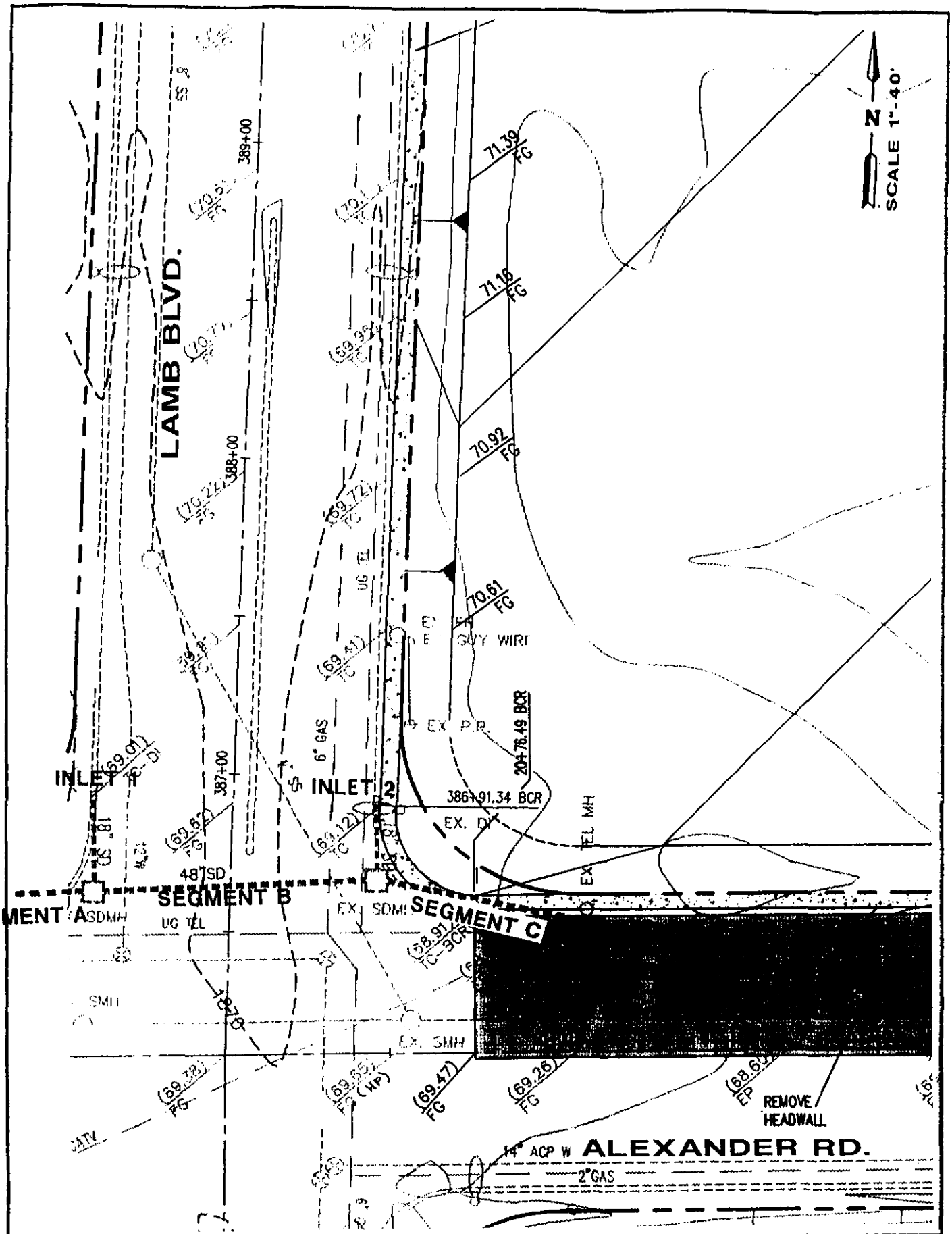

FIGURE 1

EXISTING 48" PIPE LAMB BLVD. & ALEXANDER RD.

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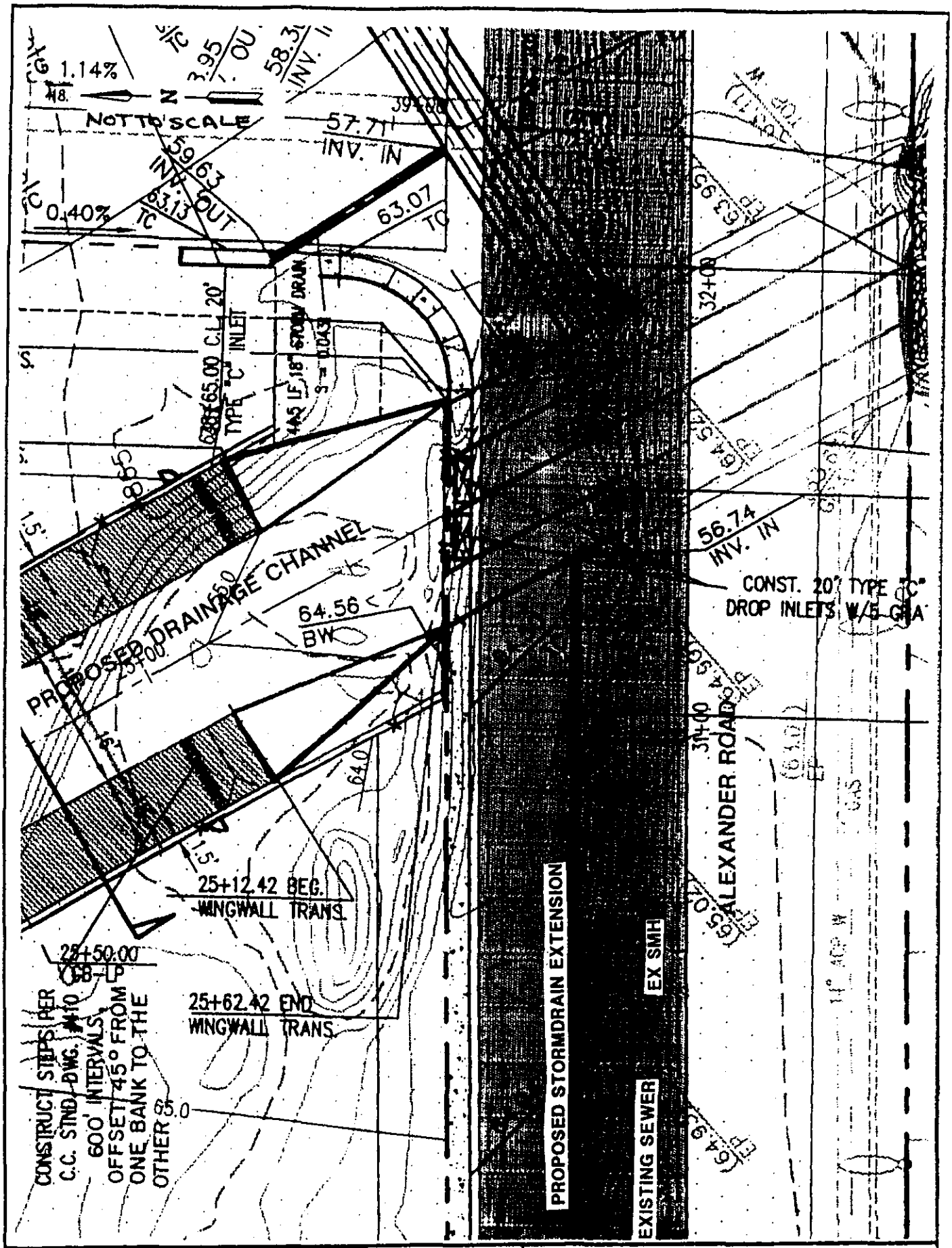

FIGURE 2

UTILITY MAP

STORMWATER MANAGEMENT DEPT.
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Comment 2: **The consultant must be directed to provide hydrologic and hydraulic calculations, along with a detailed plan and profile, for the proposed 960' extension of the existing 48" RCP in Alexander Road. If this storm drain is operating under pressure in the existing condition, the extension and new tail water could have a significant impact on the system's capacity. Storm sewer design must be in conformance with the requirements outlined in Section 800 of the District's Hydrologic Criteria and Drainage Design Manual (HC&DDM). The angle of entry to the 12' by 7' RCBC should be at a maximum of 45 degrees. In addition, please advice the consultant to provide a trench detail.**

Response 2: The 48-inch RCP in Alexander Road currently conveys minimal flows. A profile of the RCP has been included in map pocket 2 for your review. As can be seen (Figure 1) the pipe (Segment B) connecting the inlets slopes to the west. The existing 3-foot type B inlets located on Lamb Boulevard contribute a total flow of approximately 24 cfs to the existing pipe system. The flow intercepted by inlet 2 (maximum: 12 cfs) splits at the confluence of segments B and C. Although the maximum flow within segment C, assuming no split, is approximately 12 cfs, a calculation was completed using the Mannings equation, assuming the pipe was at capacity, to demonstrate the total amount of flow the pipe could convey. This amounted to approximately 90 cfs.

Due to existing utilities (Figure 2) the angle of entry for the 48-inch RCP cannot be modified to be 45 degrees. The trench detail has been added to the plans.

Comment 3: **The Manning's roughness coefficient of .013 utilized in the HEC-2 analysis does not coincide with the statement by the engineer in the original submittal that a roughness value of .015 was estimated for the improved channel. If the channel is to be constructed with a trowel finish ("n" = .013), then please advice the engineer to specify a trowel finish on the typical channel sections.**

Response 3: The HEC-2 analyses have been revised to reflect the more accurate Manning's roughness coefficient of 0.015 for the concrete channel. See Appendix A for the revised HEC-2 analyses.

Comment 4: **The HEC-2 analysis submitted for the proposed condition indicates a significant amount of overbank flow is present on each cross section. Please refer the consultant to the U.S. Army Corps of Engineers HEC-2 Water Surface Profiles "User's Manual", Section 3.6, which present an overview on cross section geometry. As noted in this section of the "User's Manual", the X1 card is used to define the left and right stations separating the channel from the overbank area. Overbank stations should be set at the top, not the toe, of the channel being modeled. In addition, the consultant has indicated the "west" channel will be designed to convey a flow of 2140 cfs, yet a Q100 of 1431 cfs has been used in the subcritical model. A revised HEC-2 analysis must be submitted for each flow regime, using the total design flow of 2140 cfs and the correct bank stations in the X1 card. Design flow must be contained within the banks of the channel, with adequate freeboard, depending on the flow regime, as outlined in section 706.1.3 and/or Section 706.2.4 of the HC&DDM. Freeboard calculations must be submitted for each particular reach. As noted in the HC&DDM all channel design submittal must include a calculated Froude number for each unique reach to check the flow state and compliance with the HC&DDM Section 702.2.**

Response 4: The revised HEC-2 analysis was completed using 2140 cfs throughout the channel. Overbank stations have been set at the top of the channel and freeboard calculations are included in Appendix B. The HEC-2 analyses include the Froude number in their output. From the Froude number it was determined that the channel is flowing in a supercritical state. The Froude numbers from the supercritical analysis were checked to verify that the main channel did not fall within the critical limits as outlined in the HC&DDM.

Comment 5: **The typical channel sections must be revised to incorporate the following:**

a) **Reinforcing bar size shall be increase or spacing decreased to conform to the requirements specified in Section 705.7.1.5 of the HC&DDM;**

b) **Channel bedding must be in conformance with section 705.7.1.6 and the geotechnical report;**

c) **A trowel finish must be specified, if appropriate, as previously noted.**

Response 5:

a) The longitudinal and transverse reinforcement has been revised to conform to the requirements specified in the HC&DDM. The longitudinal bars have been increased to #5 bars and the transverse reinforcement has remained the same. As the bar size increased the spacing has remained the same (12-inches on center) per the CCRFCD requirements. See channel plans for revised notes.

b) The channel bedding has been noted on the plans and is in conformance with the HC&DDM and the geotechnical report.

c) A trowel finish is no longer required for the proposed channel.

Comment 6: **Please advice the consultant to provide Improvement plans, profile construction details and hydraulic calculations for the confluence of the (3) 54" RCP and the proposed 12' by 7' RCBC under Alexander Road. It must be demonstrated through the appropriate hydraulic analysis that the proposed RCBC has adequate capacity to convey the additional 390 cfs from the 54" RCP.**

Response 6: The approved hydrology study for this project demonstrated that the three 54" RCP and the RCBC at Alexander Road are well capable of intercepting all onsite and offsite flow for the 100-year flow. See Appendix C for capacity calculations. In addition, the peaking time for the western finger wash is approximately 2.5 hours greater than the peaking time of the localized offsite and onsite flows.

Comment 7: **Concrete cut-off wall locations should be indicated on the channel improvement plans. A concrete cut-off wall should be placed at the upstream end of the proposed improvements, along with a detail of the connection to the existing RCBC structure under Lamb Blvd.**

Response 7: Concrete cut-off wall details and locations have been shown on the revised channel plans. A detail showing the connection to the existing structure under Lamb Boulevard has been added to the plans.

Comment 8 **Ladder type steps shall be placed on each side of the channel at 600' centers, offset at 45 degrees from one bank to the other, to facilitate swift water rescue.**

Response 8: See the attached channel plans for the revised locations of the ladder steps.

Comment 9: **Please advice the consultant to revise the expansion joint shown in SEC H-H, to accommodate movement of the channel lining.**

Response 9: The expansion joint detail has been revised and is shown on the plans.

If you have any further questions or comments, please call me at 248-6415.

Sincerely,
Engineers and Surveyors, Inc.

Dan Le, E.I.T.
Stormwater Management Division

Danny S. McFadden, P.E.
Project Manager

APPENDIX A

Revised HEC-2 Analysis
(Subcritical)

```
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*  Version   4.6.2:  May 1991           *
*                                       *
*  RUN DATE    28DEC95    TIME   13:37:10 *
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*  HYDROLOGIC ENGINEERING CENTER        *
*  609 SECOND STREET, SUITE D           *
*  DAVIS, CALIFORNIA 95616-4687         *
*       (916) 756-1104                  *
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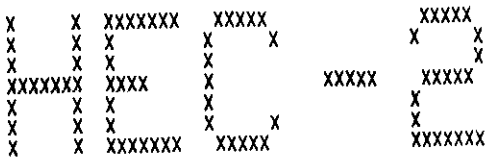

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HEC-2 WATER SURFACE PROFILES

Version  4.6.2:  May 1991
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T1      ENGINEERS & SURVEYORS, INC.   (filename:CBPSUB.DAT)
T2      COLLINS BUSINESS PARK II: PROPOSED CHANNEL
T3      SUB CRITICAL FLOW (11-15-95)

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
        0         2         0         0        -1                                    57

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
       -1                                                       -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

       68       150

NC    0.025     0.025     0.025       .1        .3
QT        1      2140
X1        1         9        20       105         0         0         0
GR       59         0        58         1        57         6        56        13        55        20
GR    54.23      62.5        55       105        56       130        57       145

X1        2        11        24        82        51        56        52
GR       60         0        59         3        58         6        57         8        56        12
GR       55        24     54.23        53        55        82        56        98        57       117
GR       58       131

X1        3        14        13        50        50        56        51
GR       60         0        59         2        58         8        57        11        56        12
GR       55        13     54.23      31.5        55        50        56        58        56        64
GR       56        88        57        96        58       106        59       114

X1        4        13        28        49        54        51        52
GR       60         0        59         3        58         6        57        10        56        18
GR       55        28     54.23      38.5        55        49        56        52        57        57
GR       58        63        59        90        60       104

X1        5        15         9        37        54        52        51
GR       60         0        59         3        58         6        57         7        56         8
GR       55         9     54.23        23        55        37        56        57        57        58
GR       58        59        59        60        60        65        60        70        60        79
```

X1	6	14	16	44	50	50	50			
GR	60	0	59	5	58	7	57	9	56	12
GR	55	16	54.23	30	55	44	57	53	58	64
GR	59	71	60	76	61	82	62	87		
X1	7	17	20	49	53	53	53			
GR	60	0	59	4	58	7	57	11	56	15
GR	55	20	54.23	34.5	55	49	56	52	57	53
GR	58	54	59	55	60	56	61	59	62	70
GR	63	77	64	82						
X1	8	20	20	56	52	52	50			
GR	64	0	63	8	62	9	61	10	60	13
GR	59	15	58	17	57	19	56	20	55	54
GR	54.23	55	56	56	57	58	58	60	59	62
GR	60	64	61	69	62	72	63	86	64	91
X1	9	21	31	50	53	53	50			
GR	64	0	63	9	62	12	61	13	60	15
GR	59	18	58	21	57	24	56	27	55	31
GR	54.23	40.5	55	50	56	55	57	60	58	65
GR	59	70	60	75	61	80	62	85	63	91
GR	64	100								
X1	10	21	30	55	52	54	53			
GR	64	0	63	5	62	18	61	19	60	20
GR	59	22	58	24	57	26	56	28	55	30
GR	54.23	42.5	55	55	56	57	57	59	58	61
GR	59	63	60	65	61	66	62	73	63	82
GR	64	93								
X1	11	18	14	54	52	53	51			
GR	61	0	60	2	59	5	58	8	57	10
GR	56	12	55	14	54.23	34	55	54	56	57
GR	57	60	58	63	59	66	60	70	61	73
GR	62	76	63	80	64	87				
NC	.015	.015	.015	.3	.5					
X1	12	4	.1	49.7	57	84	70			
GR	64.23	0	54.23	.1	54.23	49.6	64.23	49.7		
X1	12.5	16	.1	49.7	1	1	1			
X2				61.23	66.3					
GR	61.23	0	54.23	.1	54.23	11.8	61.23	11.9	61.23	12.3
GR	54.23	12.4	54.23	24.6	61.23	24.7	61.23	25.1	54.23	25.2
GR	54.23	37.1	61.23	37.2	61.23	37.6	54.23	37.7	54.23	49.6
GR	61.23	49.7								

X1	13	16	.1	49.7	50	50	50			
X2				61.42	66.61					
GR	61.42	0	54.42	.1	54.42	11.8	61.42	11.9	61.42	12.3
GR	54.42	12.4	54.42	24.6	61.42	24.7	61.42	25.1	54.42	25.2
GR	54.42	37.1	61.42	37.2	61.42	37.6	54.42	37.7	54.42	49.6
GR	61.42	49.7								
X1	13.5	4	.1	49.7	1	1	1			
GR	64.42	0	54.42	.1	54.42	49.6	64.42	49.7		
NC	.015	.015	.015	.1	.3					
X1	14	5	0	64	35	9	24			
GR	62.97	0	54.97	16	54.65	32	54.97	48	62.97	64
X1	15	5	0	64	54	54	50			
GR	63.37	0	55.37	16	55.04	32	55.37	48	63.37	64
X1	16	5	0	64	50	50	50			
GR	61.75	0	55.75	16	55.43	32	55.75	48	63.75	64
X1	17	5	0	64	51	50	49			
GR	64.15	0	56.15	16	55.83	32	56.15	48	64.15	64
X1	18	5	0	64	50	50	50			
GR	64.54	0	56.54	16	56.22	32	56.54	48	64.54	64
X1	19	5	0	64	51	50	49			
GR	64.94	0	56.94	16	56.62	32	56.94	48	64.94	64
X1	20	5	0	64	50	50	50			
GR	65.43	0	57.43	16	57.01	32	57.43	48	65.43	64
X1	21	0	0	0	50	50	50	0	.39	
X1	22	0	0	0	100	100	100	0	.75	
X1	23	0	0	0	100	100	100	0	.75	
X1	24	0	0	0	100	100	100	0	.75	
X1	25	0	0	0	100	100	100	0	.75	
X1	26	0	0	0	100	100	100	0	.75	
X1	27	0	0	0	100	100	100	0	.75	
X1	28	0	0	0	100	100	100	0	.75	

X1	29	0	0	0	100	100	100	0	.75	
X1	30	0	0	0	100	100	100	0	.75	
X1	31	0	0	0	100	100	100	0	.75	
X1	32	5	0	64	100	100	100			
GR	73.23	0	65.23	16	64.91	32	65.23	48	73.23	64
X1	33	5	0	64	50	50	50			
GR	73.63	0	65.63	16	65.31	32	65.63	48	73.63	64
X1	34	5	0	64	52	50	48			
GR	74.02	0	66.02	16	65.70	32	66.02	48	74.02	64
X1	35	5	0	64	50	50	50			
GR	74.42	0	66.42	16	66.1	32	66.42	48	74.42	64
X1	36	5	0	64	50	45	32			
GR	74.81	0	66.81	16	66.49	32	66.81	48	74.81	64
NC	.015	.015	.015	.3	.5					
X1	36.5	4	.1	31.1	40	10	25			
GR	72.52	0	66.52	.1	66.52	31	72.52	31.1		
X1	37	12	.1	31.1	1	1	1			
X2				72.52	76.22					
GR	72.41	0	66.41	.1	66.41	9	72.41	9.1	72.52	11
GR	66.52	11.1	66.52	20	72.52	20.1	72.51	22	66.51	22.1
GR	66.51	31	72.51	31.1						
X1	37.3	12	.1	31.1	98	98	98			
X2				73.6	76.5					
GR	73.59	0	67.59	.1	67.59	9	73.59	9.1	73.60	11
GR	67.60	11.1	67.60	20	73.60	20.1	73.77	22	67.77	22.1
GR	67.77	31	73.77	31.1						
X1	37.6	4	.1	31.1	1	1	1			
GR	73.59	0	67.59	.1	67.59	31	73.59	31.1		
NC	.025	.025	.025	.1	.3					
X1	38	14	20	61	130	130	130			
GR	74	0	73	2	72	5	71	9	70	12
GR	69	16	68	20	68	61	69	66	70	85
GR	71	96	72	110	73	120	74	130		
X1	39	14	19	60	50	50	50			
GR	74	0	73	3	72	6	71	9	70	13
GR	69	15	68	19	68	60	69	63	70	68
GR	71	72	72	80	73	94	74	118		

X1	40	13	20	58	50	50	50			
GR	74	0	73	2	72	7	71	10	70	13
GR	69	16	68	20	68	58	69	61	70	66
GR	71	70	72	74	73	79				
X1	41	12	16	36	50	55	52			
GR	73	0	72	4	71	7	70	11	69	14
GR	68	16	68	36	69	57	70	62	71	65
GR	72	70	73	75						
X1	42	11	15	54	50	55	52			
GR	73	0	72	3	71	8	70	11	69	15
GR	69	54	70	58	71	62	72	66	73	70
GR	74	73								
X1	43	11	15	56	50	50	50			
GR	73	0	72	4	71	8	70	12	69	15
GR	69	56	70	58	71	61	72	65	73	68
GR	74	73								
X1	44	13	16	57	50	53	51			
GR	74	0	73	4	72	9	71	13	70	16
GR	69	41	69	56	70	57	71	61	72	63
GR	73	65	74	69	75	75				
X1	45	13	25	58	51	53	52			
GR	75	0	74	4	73	11	72	16	71	21
GR	70	25	70	58	71	60	72	63	73	70
GR	74	73	75	79	76	83				
X1	46	14	34	60	51	51	50			
GR	75	0	74	10	73	16	72	21	71	29
GR	70	34	70	60	71	61	72	64	73	69
GR	74	71	75	80	76	86	77	92		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS
0

CCHV= .100 CEHV= .300
*SECNO 1.000
3280 CROSS SECTION 1.00 EXTENDED .10 FEET

3720 CRITICAL DEPTH ASSUMED

1.000	2.87	57.10	57.10	57.00	58.10	1.00	.00	.00	55.00
2140.0	83.4	1776.6	280.0	15.4	211.3	49.0	.0	.0	55.00
.00	5.41	8.41	5.71	.025	.025	.025	.000	54.23	5.50
.005947	0.	0.	0.	0	7	0	.00	139.50	145.00

*SECNO 2.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2.000	3.39	57.62	57.62	.00	58.73	1.12	.30	.04	55.00
2140.0	204.3	1586.2	349.5	30.3	174.1	57.8	.3	.2	55.00
.00	6.75	9.11	6.05	.025	.025	.025	.000	54.23	6.77
.005426	51.	52.	56.	0	11	0	.00	118.87	125.64

*SECNO 3.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3.000	4.01	58.24	58.24	.00	59.47	1.24	.27	.04	55.00
2140.0	33.8	1332.7	773.5	6.8	134.0	110.4	.6	.3	55.00
.00	4.94	9.95	7.01	.025	.025	.025	.000	54.23	6.59
.005043	50.	51.	56.	0	11	0	.00	101.30	107.89

*SECNO 4.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4.000	5.30	59.53	59.53	.00	60.86	1.34	.23	.03	55.00
2140.0	625.4	1108.4	406.1	76.1	103.1	69.0	.9	.4	55.00
.00	8.22	10.75	5.89	.025	.025	.025	.000	54.23	1.42
.003931	54.	52.	51.	0	11	0	.00	95.94	97.36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 5.000
3280 CROSS SECTION 5.00 EXTENDED .02 FEET

5.000	5.78	60.01	58.94	.00	61.05	1.04	.15	.03	55.00
2140.0	76.1	1323.7	740.2	16.7	151.4	100.9	1.2	.5	55.00
.01	4.56	8.75	7.34	.025	.025	.025	.000	54.23	.00
.002286	54.	51.	52.	2	12	0	.00	79.00	79.00

*SECNO 6.000
3280 CROSS SECTION 6.00 EXTENDED .17 FEET

6.000	5.93	60.16	59.38	.00	61.16	1.01	.11	.00	55.00
2140.0	264.4	1389.0	486.7	41.7	155.4	81.9	1.6	.6	55.00
.01	6.34	8.94	5.94	.025	.025	.025	.000	54.23	.00
.002303	50.	50.	50.	0	11	0	.00	77.00	77.00

*SECNO 7.000
3280 CROSS SECTION 7.00 EXTENDED .03 FEET

7.000	5.79	60.02	59.42	.00	61.42	1.40	.14	.12	55.00
2140.0	391.1	1590.9	158.0	53.6	157.0	21.7	1.9	.7	55.00
.01	7.30	10.13	7.28	.025	.025	.025	.000	54.23	.00
.003060	53.	53.	53.	2	11	0	.00	56.09	56.09

*SECNO 8.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8.000	5.87	60.10	60.10	.00	62.04	1.94	.20	.16	56.00
2140.0	87.9	1926.0	126.1	13.2	166.8	16.8	2.1	.7	56.00
.01	6.66	11.55	7.50	.025	.025	.025	.000	54.23	12.71
.005124	52.	50.	52.	0	5	0	.00	51.78	64.49

*SECNO 9.000

3301 HV CHANGED MORE THAN HVINS

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.78

9.000	7.18	61.41	60.04	.00	62.28	.87	.14	.11	55.00
2140.0	411.2	1104.7	624.1	66.3	129.0	102.5	2.4	.8	55.00
.01	6.20	8.56	6.09	.025	.025	.025	.000	54.23	12.60
.001622	53.	50.	53.	4	5	0	.00	69.42	82.02

*SECNO 10.000

10.000	6.96	61.19	60.10	.00	62.52	1.33	.10	.14	55.00
2140.0	252.7	1634.6	252.8	37.7	164.5	37.8	2.7	.9	55.00
.01	6.71	9.93	6.69	.025	.025	.025	.000	54.23	18.80
.002270	52.	53.	54.	2	15	0	.00	48.57	67.38

*SECNO 11.000
3280 CROSS SECTION 11.00 EXTENDED 1.29 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.07

11.000	8.06	62.29	58.83	.00	62.67	.38	.05	.10	55.00
2140.0	206.7	1630.4	302.9	58.0	306.8	82.4	3.1	1.0	55.00
.02	3.56	5.31	3.68	.025	.025	.025	.000	54.23	.00
.000529	52.	51.	53.	3	14	0	.00	77.14	77.14

CCHV= .300 CEHV= .500
*SECNO 12.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.54

12.000	8.05	62.28	58.10	.00	62.72	.45	.02	.03	54.23
2140.0	.1	2139.9	.0	.3	398.6	.0	3.8	1.1	64.23
.02	.17	5.37	.00	.015	.015	.000	.000	54.23	.02
.000222	57.	70.	84.	2	11	0	.00	49.66	49.68

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12.500
3280 CROSS SECTION 12.50 EXTENDED .96 FEET

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .41

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 66.30 MAX ELLC= 61.23

12.500	7.96	62.19	58.18	.00	62.81	.63	.00	.09	54.23
2140.0	.2	2139.8	.0	.4	336.4	.0	3.8	1.1	61.23
.02	.49	6.36	.00	.015	.015	.000	.000	54.23	.00
.001344	1.	1.	1.	2	15	0	-47.53	49.70	49.70

*SECNO 13.000
3280 CROSS SECTION 13.00 EXTENDED .83 FEET

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 66.61 MAX ELLC= 61.42

13.000	7.83	62.25	58.37	.00	62.88	.63	.07	.00	54.42
2140.0	.2	2139.8	.0	.3	336.4	.0	4.2	1.1	61.42
.02	.49	6.36	.00	.015	.015	.000	.000	54.42	.00
.001344	50.	50.	50.	2	15	0	-41.43	49.70	49.70

*SECNO 13.500

02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.47

13.500	8.07	62.49	58.27	.00	62.94	.44	.00	.06	54.42
2140.0	.1	2139.9	.0	.3	400.0	.0	4.2	1.1	64.42
.02	.17	5.35	.00	.015	.015	.000	.000	54.42	.02
.000220	1.	1.	1.	2	8	0	.00	49.66	49.68

CCHV= .100 CEHV= .300
*SECNO 14.000

14.000	7.76	62.41	59.51	.00	62.98	.57	.01	.04	62.97
2140.0	.0	2140.0	.0	.0	354.2	.0	4.4	1.2	62.97
.02	.00	6.04	.00	.000	.015	.000	.000	54.65	1.11
.000390	35.	24.	9.	2	14	0	.00	61.78	62.89

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 15.000									
15.000	7.33	62.37	59.91	.00	63.03	.66	.02	.03	63.37
2140.0	.0	2140.0	.0	.0	327.2	.0	4.8	1.2	63.37
.03	.00	6.54	.00	.000	.015	.000	.000	55.04	2.00
.000488	54.	50.	54.	2	14	0	.00	59.99	62.00
*SECNO 16.000									
3280 CROSS SECTION		16.00 EXTENDED		.62 FEET					
16.000	6.94	62.37	60.23	.00	63.07	.70	.03	.01	61.75
2140.0	.0	2140.0	.0	.0	318.6	.0	5.2	1.3	63.75
.03	.00	6.72	.00	.000	.015	.000	.000	55.43	.00
.000547	50.	50.	50.	2	14	0	.00	61.24	61.24
*SECNO 17.000									
17.000	6.40	62.23	60.69	.00	63.18	.95	.03	.08	64.15
2140.0	.0	2140.0	.0	.0	273.4	.0	5.5	1.4	64.15
.03	.00	7.83	.00	.000	.015	.000	.000	55.83	3.85
.000811	51.	49.	50.	2	19	0	.00	56.31	60.15
*SECNO 18.000									
18.000	5.89	62.11	61.08	.00	63.29	1.18	.05	.07	64.54
2140.0	.0	2140.0	.0	.0	245.7	.0	5.8	1.4	64.54
.03	.00	8.71	.00	.000	.015	.000	.000	56.22	4.85
.001101	50.	50.	50.	2	15	0	.00	54.30	59.15
*SECNO 19.000									
19.000	5.30	61.92	61.48	.00	63.47	1.55	.06	.11	64.94
2140.0	.0	2140.0	.0	.0	214.4	.0	6.1	1.5	64.94
.03	.00	9.98	.00	.000	.015	.000	.000	56.62	6.03
.001627	51.	49.	50.	2	15	0	.00	51.94	57.97
*SECNO 20.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
20.000	4.92	61.93	61.93	.00	63.87	1.94	.10	.12	65.43
2140.0	.0	2140.0	.0	.0	191.4	.0	6.3	1.5	65.43
.03	.00	11.18	.00	.000	.015	.000	.000	57.01	6.99
.002249	50.	50.	50.	0	11	0	.00	50.02	57.01

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 21.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
21.000	4.93	62.33	62.33	.00	64.26	1.93	.11	.00	65.82
2140.0	.0	2140.0	.0	.0	191.7	.0	6.5	1.6	65.82
.04	.00	11.16	.00	.000	.015	.000	.000	57.40	6.98
.002239	50.	50.	50.	0	5	0	.00	50.04	57.02
*SECNO 22.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
22.000	4.93	63.08	63.08	.00	65.01	1.94	.22	.00	66.57
2140.0	.0	2140.0	.0	.0	191.7	.0	7.0	1.7	66.57
.04	.00	11.17	.00	.000	.015	.000	.000	58.15	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02
*SECNO 23.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
23.000	4.93	63.83	63.83	.00	65.76	1.94	.22	.00	67.32
2140.0	.0	2140.0	.0	.0	191.7	.0	7.4	1.8	67.32
.04	.00	11.16	.00	.000	.015	.000	.000	58.90	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02
*SECNO 24.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
24.000	4.93	64.58	64.58	.00	66.51	1.94	.22	.00	68.07
2140.0	.0	2140.0	.0	.0	191.7	.0	7.9	1.9	68.07
.04	.00	11.16	.00	.000	.015	.000	.000	59.65	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02
*SECNO 25.000									
7185 MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
25.000	4.93	65.33	65.33	.00	67.26	1.94	.22	.00	68.82
2140.0	.0	2140.0	.0	.0	191.7	.0	8.3	2.1	68.82
.05	.00	11.16	.00	.000	.015	.000	.000	60.40	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 26.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

26.000	4.93	66.08	66.08	.00	68.01	1.94	.22	.00	69.57
2140.0	.0	2140.0	.0	.0	191.7	.0	8.7	2.2	69.57
.05	.00	11.16	.00	.000	.015	.000	.000	61.15	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

*SECNO 27.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

27.000	4.93	66.83	66.83	.00	68.76	1.94	.22	.00	70.32
2140.0	.0	2140.0	.0	.0	191.7	.0	9.2	2.3	70.32
.05	.00	11.16	.00	.000	.015	.000	.000	61.90	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

*SECNO 28.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

28.000	4.93	67.58	67.58	.00	69.51	1.94	.22	.00	71.07
2140.0	.0	2140.0	.0	.0	191.7	.0	9.6	2.4	71.07
.05	.00	11.16	.00	.000	.015	.000	.000	62.65	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

*SECNO 29.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

29.000	4.93	68.33	68.33	.00	70.26	1.94	.22	.00	71.82
2140.0	.0	2140.0	.0	.0	191.7	.0	10.1	2.5	71.82
.06	.00	11.16	.00	.000	.015	.000	.000	63.40	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

*SECNO 30.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

30.000	4.93	69.08	69.08	.00	71.01	1.94	.22	.00	72.57
2140.0	.0	2140.0	.0	.0	191.7	.0	10.5	2.6	72.57
.06	.00	11.16	.00	.000	.015	.000	.000	64.15	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 31.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

31.000	4.93	69.83	69.83	.00	71.76	1.94	.22	.00	73.32
2140.0	.0	2140.0	.0	.0	191.7	.0	10.9	2.8	73.32
.06	.00	11.16	.00	.000	.015	.000	.000	64.90	6.98
.002241	100.	100.	100.	0	5	0	.00	50.04	57.02

*SECNO 32.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE. KRATIO = 1.43

32.000	5.90	70.81	69.76	.00	71.99	1.18	.15	.08	73.23
2140.0	.0	2140.0	.0	.0	245.7	.0	11.4	2.9	73.23
.06	.00	8.71	.00	.000	.015	.000	.000	64.91	4.85
.001100	100.	100.	100.	4	5	0	.00	54.30	59.15

*SECNO 33.000

33.000	5.33	70.64	70.17	.00	72.16	1.53	.07	.10	73.63
2140.0	.0	2140.0	.0	.0	215.8	.0	11.7	2.9	73.63
.07	.00	9.92	.00	.000	.015	.000	.000	65.31	5.97
.001597	50.	50.	50.	2	15	0	.00	52.05	58.03

*SECNO 34.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

34.000	4.86	70.56	70.56	.00	72.50	1.94	.09	.12	74.02
2140.0	.0	2140.0	.0	.0	191.6	.0	11.9	3.0	74.02
.07	.00	11.17	.00	.000	.015	.000	.000	65.70	6.92
.002251	52.	48.	50.	0	11	0	.00	50.16	57.08

*SECNO 35.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

35.000	4.87	70.97	70.97	.00	72.90	1.93	.11	.00	74.42
2140.0	.0	2140.0	.0	.0	191.9	.0	12.2	3.0	74.42
.07	.00	11.15	.00	.000	.015	.000	.000	66.10	6.91
.002240	50.	50.	50.	0	5	0	.00	50.18	57.09

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 36.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

36.000	4.86	71.35	71.35	.00	73.29	1.93	.07	.00	74.81
2140.0	.0	2140.0	.0	.0	191.9	.0	12.3	3.1	74.81
.07	.00	11.15	.00	.000	.015	.000	.000	66.49	6.91
.002242	50.	32.	45.	0	5	0	.00	50.18	57.09

CCHV= .300 CEHV= .500
*SECNO 36.500

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

36.500	5.28	71.80	71.80	.00	74.46	2.66	.06	.36	66.52
2140.0	.1	2139.9	.0	.2	163.4	.0	12.4	3.1	72.52
.07	.60	13.09	.00	.015	.015	.000	.000	66.52	.01
.002339	40.	25.	10.	0	8	0	.00	31.08	31.09

*SECNO 37.000

3265 DIVIDED FLOW

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 76.22 MAX ELLC= 72.52

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37.000	5.92	72.33	72.33	.00	75.19	2.86	.00	.10	66.41
2140.0	.3	2139.7	.0	.3	157.7	.0	12.4	3.1	72.51
.07	.91	13.57	.00	.015	.015	.000	.000	66.41	.00
.004709	1.	1.	1.	0	18	0	.00	27.29	31.10

*SECNO 37.300

3265 DIVIDED FLOW

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 76.50 MAX ELLC= 73.60

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37.300	5.79	73.38	73.38	.00	76.37	2.99	.48	.07	67.59
2140.0	.3	2139.7	.0	.3	154.2	.0	12.7	3.2	73.77
.07	.93	13.88	.00	.015	.015	.000	.000	67.59	.00
.004997	98.	98.	98.	0	18	0	.00	27.27	31.09

*SECNO 37.600
3280 CROSS SECTION 37.60 EXTENDED 2.27 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.93

37.600	8.26	75.85	72.87	.00	76.94	1.09	.00	.57	67.59
2140.0	.2	2139.8	.0	.5	255.9	.0	12.8	3.2	73.59
.07	.38	8.36	.00	.015	.015	.000	.000	67.59	.00
.000583	1.	1.	1.	5	11	0	.00	31.10	31.10

CCHV= .100 CEHV= .300
SECNO 38.000
3280 CROSS SECTION 38.00 EXTENDED 2.98 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.28

38.000	8.98	76.98	71.64	.00	77.07	.09	.03	.10	68.00
2140.0	267.6	999.1	873.3	125.6	368.1	412.1	14.5	3.4	68.00
.09	2.13	2.71	2.12	.025	.025	.025	.000	68.00	.00
.000112	130.	130.	130.	2	14	0	.00	130.00	130.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 39.000
3280 CROSS SECTION 39.00 EXTENDED 2.95 FEET

39.000	8.95	76.95	71.96	.00	77.09	.14	.01	.01	68.00
2140.0	291.2	1224.1	624.6	114.6	367.1	277.3	15.4	3.6	68.00
.09	2.54	3.34	2.25	.025	.025	.025	.000	68.00	.00
.000169	50.	50.	50.	2	14	0	.00	118.00	118.00

*SECNO 40.000
3280 CROSS SECTION 40.00 EXTENDED 3.91 FEET

40.000	8.91	76.91	72.07	.00	77.12	.21	.01	.02	68.00
2140.0	371.9	1363.5	404.6	120.2	338.5	131.6	16.2	3.7	68.00
.09	3.10	4.03	3.08	.025	.025	.025	.000	68.00	.00
.000249	50.	50.	50.	2	14	0	.00	79.00	79.00

*SECNO 41.000
3280 CROSS SECTION 41.00 EXTENDED 3.91 FEET

41.000	8.91	76.91	72.32	.00	77.14	.23	.01	.01	68.00
2140.0	312.1	768.7	1059.2	98.6	178.3	282.1	16.9	3.8	68.00
.10	3.17	4.31	3.75	.025	.025	.025	.000	68.00	.00
.000285	50.	52.	55.	1	11	0	.00	75.00	75.00

*SECNO 42.000
3280 CROSS SECTION 42.00 EXTENDED 3.88 FEET

42.000	7.88	76.88	72.98	.00	77.18	.30	.02	.02	69.00
2140.0	324.3	1436.9	378.7	88.7	307.4	104.3	17.6	3.8	69.00
.10	3.66	4.67	3.63	.025	.025	.025	.000	69.00	.00
.000394	50.	52.	55.	2	14	0	.00	73.00	73.00

*SECNO 43.000
3280 CROSS SECTION 43.00 EXTENDED 3.90 FEET

43.000	7.90	76.90	73.03	.00	77.20	.30	.02	.00	69.00
2140.0	313.9	1535.1	291.0	87.0	323.9	85.8	18.1	3.9	69.00
.11	3.61	4.74	3.39	.025	.025	.025	.000	69.00	.00
.000404	50.	50.	50.	0	8	0	.00	73.00	73.00

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 44.000
3280 CROSS SECTION 44.00 EXTENDED 2.88 FEET

44.000	7.88	76.88	73.50	.00	77.24	.36	.02	.02	70.00
2140.0	280.0	1604.0	256.0	76.1	310.0	72.8	18.7	4.0	70.00
.11	3.68	5.17	3.52	.025	.025	.025	.000	69.00	.00
.000518	50.	51.	53.	2	11	0	.00	75.00	75.00

*SECNO 45.000
3280 CROSS SECTION 45.00 EXTENDED 1.86 FEET

45.000	6.86	76.86	74.38	.00	77.29	.43	.03	.02	70.00
2140.0	466.2	1316.8	357.0	107.1	226.5	89.1	19.2	4.1	70.00
.11	4.35	5.81	4.01	.025	.025	.025	.000	70.00	.00
.000733	51.	52.	53.	2	11	0	.00	83.00	83.00

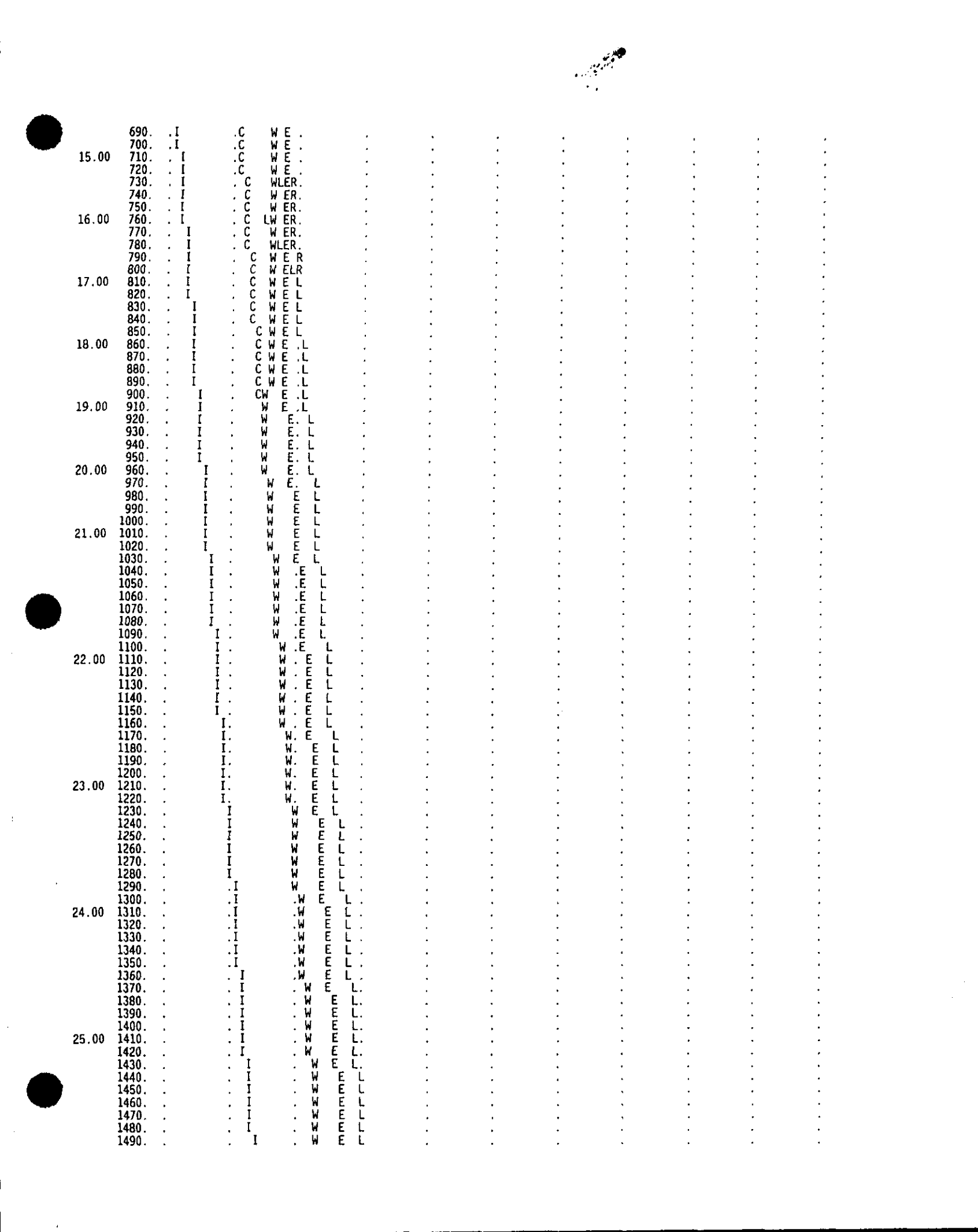
*SECNO 46.000
3280 CROSS SECTION 46.00 EXTENDED 1.86 FEET

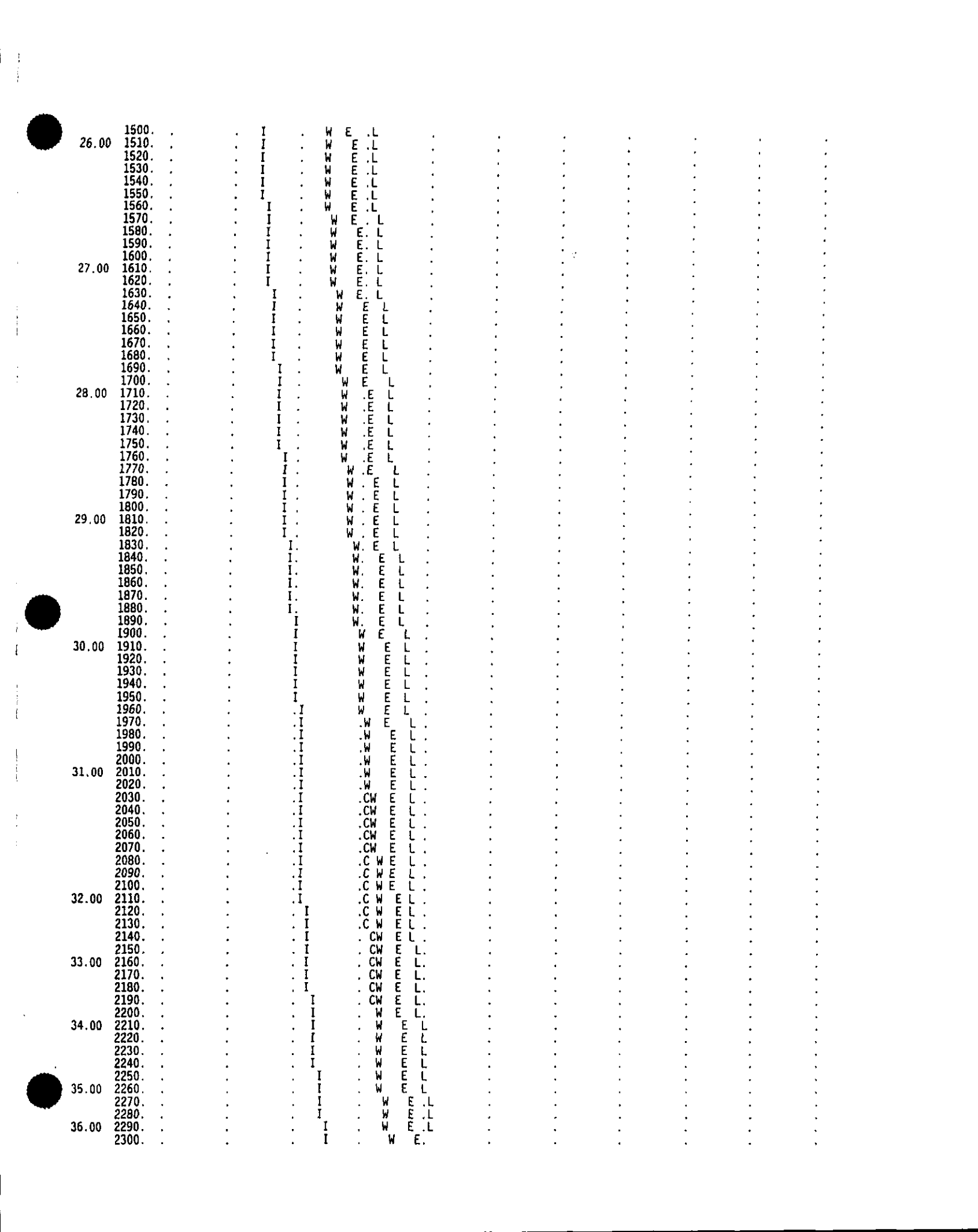
46.000	6.86	76.86	74.78	.00	77.35	.49	.04	.02	70.00
2140.0	670.2	1141.6	328.2	140.4	178.5	82.7	19.7	4.2	70.00
.11	4.77	6.40	3.97	.025	.025	.025	.000	70.00	.00
.000888	51.	50.	51.	2	19	0	.00	91.18	91.18

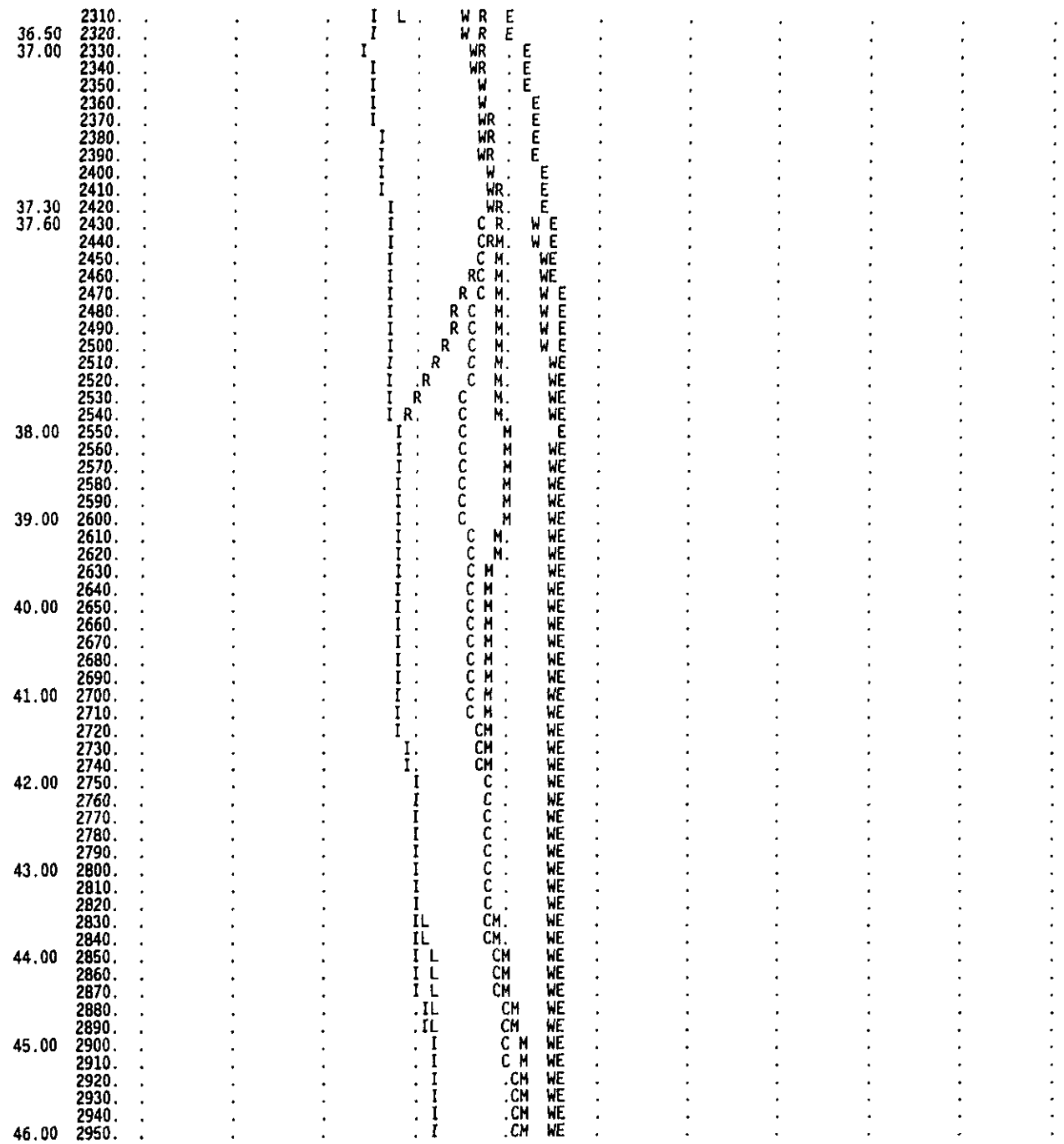
PROFILE FOR STREAM SUB CRITICAL FLOW (11-15

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION SECNO	CUMDIS	54. 59. 64. 69. 74. 79. 84. 89. 94. 99.
1.00	0.	I L W E .
	10.	I L W E .
	20.	I L W E .
	30.	I L WME .
	40.	I L W E.
	50.	I L W E.
2.00	60.	I L WME.
	70.	I L WME.
	80.	I L WM E
	90.	I L WME
	100.	I L WME
3.00	110.	I L W E
	120.	I L WME
	130.	I L WM E
	140.	I L WME
	150.	I L WM E
4.00	160.	I L .WME
	170.	I L CWME
	180.	I L CWME
	190.	I L CWME
	200.	I L CWM E
5.00	210.	I L C. W E
	220.	I L C W E
	230.	I L C W E
	240.	I L C W E
	250.	I L C W E
6.00	260.	I L C W E
	270.	I L C W E
	280.	I L C W E
	290.	I L C W E
	300.	I L C W E
7.00	310.	I L C W E
	320.	I L .CWM E
	330.	I L .CW E
	340.	I L .CW EM
	350.	I L .CW E M
8.00	360.	I L . W E M
	370.	I L . W E M
	380.	I L . CW E M
	390.	I L . CW E M
	400.	I L . C W E M
9.00	410.	I L . C W E M
	420.	I L . C W E M
	430.	I L . C W E M
	440.	I L . C W E M
	450.	I L . C W E M
	460.	I L . C W E M
10.00	470.	I L . C W E M
	480.	I L .C W EM
	490.	I L .C W E
	500.	I L C WME
	510.	I L C MWE
11.00	520.	I L C. M WE
	530.	IL R C. M WE
	540.	IL R C. MWE
	550.	IL C. WE
	560.	IL C . R WE
	570.	I C . RWEM
	580.	I C . WE M.
12.00	590.	I C . WE R
12.50	600.	I C . R WE
	610.	I C . R WE
	620.	I C . R WE
	630.	I C . R WE
13.00	640.	I C . R WE
13.50	650.	I C . E R
14.00	660.	.I .C WLE
	670.	.I .C W E
	680.	.I .C W E







THIS RUN EXECUTED 28DEC95 13:37:18

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HEC-2 WATER SURFACE PROFILES

Version 4.6.2: May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUB CRITICAL FLOW (11-15

SUMMARY PRINTOUT

	FRCH
•	.940
•	.927
*	.921
•	.855
	.663
	.668
	.767
	.945
•	.579
	.682
•	.338
•	.334
*	.431
	.431
•	.332
	.445
	.494

	FRCH
	.519
	.626
	.722
	.866
•	1.007
•	1.005
*	1.005
•	1.005
*	1.005
*	1.005
*	1.005
*	1.005
•	1.005
*	1.005
*	1.005
*	1.005
	.722
	.858
*	1.007
•	1.005
*	1.005
*	1.005
•	1.060
•	1.097
*	.513
*	.160

FRCH

.196

.238

.255

.293

.297

.332

.391

.430

SUB CRITICAL FLOW (11-15

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	1.000	.00	.00	.00	54.23	2140.00	57.10	57.10	58.10	59.47	8.41	275.70	277.51
*	2.000	52.00	.00	.00	54.23	2140.00	57.62	57.62	58.73	54.26	9.11	262.14	290.53
*	3.000	51.00	.00	.00	54.23	2140.00	58.24	58.24	59.47	50.43	9.95	251.23	301.34
*	4.000	52.00	.00	.00	54.23	2140.00	59.53	59.53	60.86	39.31	10.75	248.17	341.32
	5.000	51.00	.00	.00	54.23	2140.00	60.01	58.94	61.05	22.86	8.75	268.91	447.58
	6.000	50.00	.00	.00	54.23	2140.00	60.16	59.38	61.16	23.03	8.94	279.03	445.92
	7.000	53.00	.00	.00	54.23	2140.00	60.02	59.42	61.42	30.60	10.13	232.35	386.85
*	8.000	50.00	.00	.00	54.23	2140.00	60.10	60.10	62.04	51.24	11.55	196.80	298.97
*	9.000	50.00	.00	.00	54.23	2140.00	61.41	60.04	62.28	16.22	8.56	297.86	531.38
	10.000	53.00	.00	.00	54.23	2140.00	61.19	60.10	62.52	22.70	9.93	240.03	449.19
*	11.000	51.00	.00	.00	54.23	2140.00	62.29	58.83	62.67	5.29	5.31	447.22	930.55
*	12.000	70.00	.00	.00	54.23	2140.00	62.28	58.10	62.72	2.22	5.37	398.94	1435.11
*	12.500	1.00	66.30	61.23	54.23	2140.00	62.19	58.18	62.81	13.44	6.36	336.70	583.68
	13.000	50.00	66.61	61.42	54.42	2140.00	62.25	58.37	62.88	13.44	6.36	336.70	583.68
	13.500	1.00	.00	.00	54.42	2140.00	62.49	58.27	62.94	2.20	5.35	400.32	1442.91
	14.000	24.00	.00	.00	54.65	2140.00	62.41	59.51	62.98	3.90	6.04	354.19	1083.27
	15.000	50.00	.00	.00	55.04	2140.00	62.37	59.91	63.03	4.88	6.54	327.16	968.87
	16.000	50.00	.00	.00	55.43	2140.00	62.37	60.23	63.07	5.47	6.72	318.60	915.40
	17.000	49.00	.00	.00	55.83	2140.00	62.23	60.69	63.18	8.11	7.83	273.41	751.36
	18.000	50.00	.00	.00	56.22	2140.00	62.11	61.08	63.29	11.01	8.71	245.65	645.01
	19.000	49.00	.00	.00	56.62	2140.00	61.92	61.48	63.47	16.27	9.98	214.39	530.56
*	20.000	50.00	.00	.00	57.01	2140.00	61.93	61.93	63.87	22.49	11.18	191.41	451.20
*	21.000	50.00	.00	.00	57.40	2140.00	62.33	62.33	64.26	22.39	11.16	191.73	452.29
*	22.000	100.00	.00	.00	58.15	2140.00	63.08	63.08	65.01	22.41	11.17	191.66	452.05

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	23.000	100.00	.00	.00	58.90	2140.00	63.83	63.83	65.76	22.41	11.16	191.67	452.10
*	24.000	100.00	.00	.00	59.65	2140.00	64.58	64.58	66.51	22.41	11.16	191.67	452.09
*	25.000	100.00	.00	.00	60.40	2140.00	65.33	65.33	67.26	22.41	11.16	191.67	452.09
*	26.000	100.00	.00	.00	61.15	2140.00	66.08	66.08	68.01	22.41	11.16	191.67	452.09
*	27.000	100.00	.00	.00	61.90	2140.00	66.83	66.83	68.76	22.41	11.16	191.67	452.09
•	28.000	100.00	.00	.00	62.65	2140.00	67.58	67.58	69.51	22.41	11.16	191.67	452.09
*	29.000	100.00	.00	.00	63.40	2140.00	68.33	68.33	70.26	22.41	11.16	191.67	452.09
*	30.000	100.00	.00	.00	64.15	2140.00	69.08	69.08	71.01	22.41	11.16	191.67	452.09
*	31.000	100.00	.00	.00	64.90	2140.00	69.83	69.83	71.76	22.41	11.16	191.67	452.09
*	32.000	100.00	.00	.00	64.91	2140.00	70.81	69.76	71.99	11.00	8.71	245.71	645.22
	33.000	50.00	.00	.00	65.31	2140.00	70.64	70.17	72.16	15.97	9.92	215.77	535.49
•	34.000	48.00	.00	.00	65.70	2140.00	70.56	70.56	72.50	22.51	11.17	191.60	451.05
•	35.000	50.00	.00	.00	66.10	2140.00	70.97	70.97	72.90	22.40	11.15	191.92	452.16
*	36.000	32.00	.00	.00	66.49	2140.00	71.35	71.35	73.29	22.42	11.15	191.85	451.92
*	36.500	25.00	.00	.00	66.52	2140.00	71.80	71.80	74.46	23.39	13.09	163.67	442.47
*	37.000	1.00	76.22	72.52	66.41	2140.00	72.33	72.33	75.19	47.09	13.57	157.95	311.87
	37.300	98.00	76.50	73.60	67.59	2140.00	73.38	73.38	76.37	49.97	13.88	154.45	302.74
*	37.600	1.00	.00	.00	67.59	2140.00	75.85	72.87	76.94	5.83	8.36	256.46	886.32
*	38.000	130.00	.00	.00	68.00	2140.00	76.98	71.64	77.07	1.12	2.71	905.77	2025.00
	39.000	50.00	.00	.00	68.00	2140.00	76.95	71.96	77.09	1.69	3.34	758.91	1644.61
	40.000	50.00	.00	.00	68.00	2140.00	76.91	72.07	77.12	2.49	4.03	590.21	1357.06
	41.000	52.00	.00	.00	68.00	2140.00	76.91	72.32	77.14	2.85	4.31	558.98	1268.19
	42.000	52.00	.00	.00	69.00	2140.00	76.88	72.98	77.18	3.94	4.67	500.41	1077.90
	43.000	50.00	.00	.00	69.00	2140.00	76.90	73.03	77.20	4.04	4.74	496.65	1064.50
	44.000	51.00	.00	.00	69.00	2140.00	76.88	73.50	77.24	5.18	5.17	458.93	940.70
	45.000	52.00	.00	.00	70.00	2140.00	76.86	74.38	77.29	7.33	5.81	422.73	790.39

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
46.000	50.00	.00	.00	70.00	2140.00	76.86	74.78	77.35	8.88	6.40	401.51	718.18

SUB CRITICAL FLOW (11-15

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
•	1.000	2140.00	57.10	.00	.00	.10	139.50	.00
•	2.000	2140.00	57.62	.00	.52	.00	118.87	52.00
*	3.000	2140.00	58.24	.00	.62	.00	101.30	51.00
•	4.000	2140.00	59.53	.00	1.29	.00	95.94	52.00
	5.000	2140.00	60.01	.00	.49	.00	79.00	51.00
	6.000	2140.00	60.16	.00	.15	.00	77.00	50.00
	7.000	2140.00	60.02	.00	-.13	.00	56.09	53.00
•	8.000	2140.00	60.10	.00	.07	.00	51.78	50.00
*	9.000	2140.00	61.41	.00	1.32	.00	69.42	50.00
	10.000	2140.00	61.19	.00	-.22	.00	48.57	53.00
*	11.000	2140.00	62.29	.00	1.10	.00	77.14	51.00
*	12.000	2140.00	62.28	.00	-.01	.00	49.66	70.00
*	12.500	2140.00	62.19	.00	-.09	.00	49.70	1.00
	13.000	2140.00	62.25	.00	.07	.00	49.70	50.00
	13.500	2140.00	62.49	.00	.24	.00	49.66	1.00
	14.000	2140.00	62.41	.00	-.08	.00	61.78	24.00
	15.000	2140.00	62.37	.00	-.05	.00	59.99	50.00
	16.000	2140.00	62.37	.00	.00	.00	61.24	50.00
	17.000	2140.00	62.23	.00	-.14	.00	56.31	49.00
	18.000	2140.00	62.11	.00	-.11	.00	54.30	50.00
	19.000	2140.00	61.92	.00	-.19	.00	51.94	49.00
*	20.000	2140.00	61.93	.00	.01	.00	50.02	50.00
*	21.000	2140.00	62.33	.00	.40	.00	50.04	50.00
*	22.000	2140.00	63.08	.00	.75	.00	50.04	100.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	23.000	2140.00	63.83	.00	.75	.00	50.04	100.00
*	24.000	2140.00	64.58	.00	.75	.00	50.04	100.00
*	25.000	2140.00	65.33	.00	.75	.00	50.04	100.00
*	26.000	2140.00	66.08	.00	.75	.00	50.04	100.00
*	27.000	2140.00	66.83	.00	.75	.00	50.04	100.00
*	28.000	2140.00	67.58	.00	.75	.00	50.04	100.00
*	29.000	2140.00	68.33	.00	.75	.00	50.04	100.00
*	30.000	2140.00	69.08	.00	.75	.00	50.04	100.00
*	31.000	2140.00	69.83	.00	.75	.00	50.04	100.00
*	32.000	2140.00	70.81	.00	.99	.00	54.30	100.00
	33.000	2140.00	70.64	.00	-.18	.00	52.05	50.00
*	34.000	2140.00	70.56	.00	-.08	.00	50.16	48.00
*	35.000	2140.00	70.97	.00	.41	.00	50.18	50.00
*	36.000	2140.00	71.35	.00	.39	.00	50.18	32.00
*	36.500	2140.00	71.80	.00	.45	.00	31.08	25.00
*	37.000	2140.00	72.33	.00	.53	.00	27.29	1.00
	37.300	2140.00	73.38	.00	1.04	.00	27.27	98.00
*	37.600	2140.00	75.85	.00	2.48	.00	31.10	1.00
*	38.000	2140.00	76.98	.00	1.12	.00	130.00	130.00
	39.000	2140.00	76.95	.00	-.02	.00	118.00	50.00
	40.000	2140.00	76.91	.00	-.04	.00	79.00	50.00
	41.000	2140.00	76.91	.00	.00	.00	75.00	52.00
	42.000	2140.00	76.88	.00	-.02	.00	73.00	52.00
	43.000	2140.00	76.90	.00	.01	.00	73.00	50.00
	44.000	2140.00	76.88	.00	-.02	.00	75.00	51.00
	45.000	2140.00	76.86	.00	-.01	.00	83.00	52.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
46.000	2140.00	76.86	.00	.00	.00	91.18	50.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 8.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

WARNING SECNO= 9.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 11.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 12.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 12.500 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO= 13.500 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 20.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 20.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 21.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 21.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 22.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 22.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 23.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 23.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 24.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 24.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 25.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 25.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 26.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 26.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 27.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 27.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 28.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 28.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY

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CAUTION SECNO=    29.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    29.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    30.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    30.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    31.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    31.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=    32.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    34.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    34.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    35.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    35.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    36.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    36.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    36.500  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    36.500  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    37.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    37.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    37.300  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    37.300  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=    37.600  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=    38.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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Revised HEC-2 Analysis
(Supercritical)

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*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    28DEC95    TIME   10:59:25  *
*******************************************
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*******************************************
*  U.S. ARMY CORPS OF ENGINEERS           *
*  HYDROLOGIC ENGINEERING CENTER          *
*  609 SECOND STREET, SUITE D             *
*  DAVIS, CALIFORNIA 95616-4687           *
*           (916) 756-1104                *
*******************************************
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X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X           X     X
X     X  X        X                       X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                   X
X     X  X        X     X             X
X     X  XXXXXXX   XXXXX              XXXXXXX
```

THIS RUN EXECUTED 28DEC95 10:59:25

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**************************************
 HEC-2 WATER SURFACE PROFILES

 Version  4.6.2;  May 1991
**************************************

T1      ENGINEERS & SURVEYORS, INC.   (filename:CBPSU.DAT)
T2      COLLINS BUSINESS PARK II: PROPOSED CHANNEL
T3        SUPER CRITICAL FLOW (11-15-95)

J1  ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

        0         2         0         1        -1                                     74.78

J2  NPROF      IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      -1                                                          -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

       68       150

NC    0.025     0.025     0.025      .1        .3
QT        1      2140
X1       46        14        34        60        51        51        50
GR       75         0        74        10        73        16        72        21        71        29
GR       70        34        70        60        71        61        72        64        73        69
GR       74        71        75        80        76        86        77        92

          45        13        25        58        51        53        52
          75         0        74         4        73        11        72        16        71        21
GR        70        25        70        58        71        60        72        63        73        70
GR        74        73        75        79        76        83

X1        44        13        16        57        50        53        51
GR        74         0        73         4        72         9        71        13        70        16
GR        69        41        69        56        70        57        71        61        72        63
GR        73        65        74        69        75        75

X1        43        11        15        56        50        50        50
GR        73         0        72         4        71         8        70        12        69        15
GR        69        56        70        58        71        61        72        65        73        68
GR        74        73

X1        42        11        15        54        50        55        52
GR        73         0        72         3        71         8        70        11        69        15
GR        69        54        70        58        71        62        72        66        73        70
GR        74        73
```

X1	41	12	16	36	50	55	52			
GR	73	0	72	4	71	7	70	11	69	14
GR	68	16	68	36	69	57	70	62	71	65
GR	72	70	73	75						
X1	40	13	20	58	50	50	50			
GR	74	0	73	2	72	7	71	10	70	13
GR	69	16	68	20	68	58	69	61	70	66
GR	71	70	72	74	73	79				
X1	39	14	19	60	50	50	50			
GR	74	0	73	3	72	6	71	9	70	13
GR	69	15	68	19	68	60	69	63	70	68
GR	71	72	72	80	73	94	74	118		
X1	38	14	20	61	5	25	15			
GR	74	0	73	2	72	5	71	9	70	12
GR	69	16	68	20	68	61	69	66	70	85
GR	71	96	72	110	73	120	74	130		
NC	.015	.015	.015	.3	.5					
X1	37.6	4	.1	31.1	1	1	1			
GR	73.59	0	67.59	.1	67.59	31	73.59	31.1		
X1	37.3	12	.1	31.1	98	98	98			
X2				73.6	76.5					
GR	73.59	0	67.59	.1	67.59	9	73.59	9.1	73.60	11
GR	67.60	11.1	67.60	20	73.60	20.1	73.77	22	67.77	22.1
GR	67.77	31	73.77	31.1						
X1	37	12	.1	31.1	1	1	1			
X2				72.52	76.22					
GR	72.41	0	66.41	.1	66.41	9	72.41	9.1	72.52	11
	66.52	11.1	66.52	20	72.52	20.1	72.51	22	66.51	22.1
	66.51	31	72.51	31.1						
X1	36.5	4	.1	31.1	40	10	25			
GR	72.52	0	66.52	.1	66.52	31	72.52	31.1		
NC	.015	.015	.015	.1	.3					
X1	36	5	0	64	50	45	32			
GR	74.81	0	66.81	16	66.49	32	66.81	48	74.81	64
X1	35	5	0	64	50	50	50			
GR	74.42	0	66.42	16	66.1	32	66.42	48	74.42	64
X1	34	5	0	64	52	50	48			
GR	74.02	0	66.02	16	65.70	32	66.02	48	74.02	64

X1	33	5	0	64	50	50	50			
GR	73.63	0	65.63	16	65.31	32	65.63	48	73.63	64
X1	32	5	0	64	100	100	100			
GR	73.23	0	65.23	16	64.91	32	65.23	48	73.23	64
X1	31	0	0	0	100	100	100	0	-.75	
X1	30	0	0	0	100	100	100	0	-.75	
X1	29	0	0	0	100	100	100	0	-.75	
X1	28	0	0	0	100	100	100	0	-.75	
X1	27	0	0	0	100	100	100	0	-.75	
X1	26	0	0	0	100	100	100	0	-.75	
X1	25	0	0	0	100	100	100	0	-.75	
X1	24	0	0	0	100	100	100	0	-.75	
X1	23	0	0	0	100	100	100	0	-.75	
X1	22	0	0	0	100	100	100	0	-.75	
X1	21	0	0	0	50	50	50	0	-.39	
X1	20	5	0	64	50	50	50			
GR	65.43	0	57.43	16	57.01	32	57.43	48	65.43	64
X1	19	5	0	64	51	50	49			
GR	64.94	0	56.94	16	56.62	32	56.94	48	64.94	64
X1	18	5	0	64	50	50	50			
GR	64.54	0	56.54	16	56.22	32	56.54	48	64.54	64
X1	17	5	0	64	50	50	50			
GR	64.15	0	56.15	16	55.83	32	56.15	48	64.15	64
X1	16	5	0	64	50	50	50			
GR	63.75	0	55.75	16	55.43	32	55.75	48	63.75	64
X1	15	5	0	64	54	54	50			
GR	63.37	0	55.37	16	55.04	32	55.37	48	63.37	64
X1	14	5	0	64	35	9	24			
GR	62.97	0	54.97	16	54.65	32	54.97	48	62.97	64

NC	.015	.015	.015	.3	.5					
X1	13.5	4	.1	49.7	1	1	1			
GR	64.42	0	54.42	.1	54.42	49.6	64.42	49.7		
X1	13	16	.1	49.7	50	50	50			
X2				61.42	66.61					
GR	61.42	0	54.42	.1	54.42	11.8	61.42	11.9	61.42	12.3
GR	54.42	12.4	54.42	24.6	61.42	24.7	61.42	25.1	54.42	25.2
GR	54.42	37.1	61.42	37.2	61.42	37.6	54.42	37.7	54.42	49.6
GR	61.42	49.7								
X1	12.5	16	.1	49.7	1	1	1			
X2				61.23	66.3					
GR	61.23	0	54.23	.1	54.23	11.8	61.23	11.9	61.23	12.3
GR	54.23	12.4	54.23	24.6	61.23	24.7	61.23	25.1	54.23	25.2
GR	54.23	37.1	61.23	37.2	61.23	37.6	54.23	37.7	54.23	49.6
GR	61.23	49.7								
X1	12	4	.1	49.7	57	84	70			
GR	64.23	0	54.23	.1	54.23	49.6	64.23	49.7		
NC	.025	.025	.025	.1	.3					
X1	11	18	14	54	52	53	51			
GR	61	0	60	2	59	5	58	8	57	10
GR	56	12	55	14	54.23	34	55	54	56	57
GR	57	60	58	63	59	66	60	70	61	73
GR	62	76	63	80	64	87				
X1	10	21	30	55	52	54	53			
GR	64	0	63	5	62	18	61	19	60	20
GR	59	22	58	24	57	26	56	28	55	30
GR	54.23	52.5	55	55	56	57	57	59	58	61
	59	63	60	65	61	66	62	73	63	82
	64	93								
X1	9	21	31	50	53	53	50			
GR	64	0	63	9	62	12	61	13	60	15
GR	59	18	58	21	57	24	56	27	55	31
GR	54.23	40.5	55	50	56	55	57	60	58	65
GR	59	70	60	75	61	80	62	85	63	91
GR	64	100								
X1	8	20	20	56	52	52	50			
GR	64	0	63	8	62	9	61	10	60	13
GR	59	15	58	17	57	19	56	20	55	54
GR	54.23	55	56	56	57	58	58	60	59	62
GR	60	64	61	69	62	72	63	86	64	91

X1	7	17	20	49	53	53	53			
GR	60	0	59	4	58	7	57	11	56	15
GR	55	20	54.23	34.5	55	49	56	52	57	53
GR	58	54	59	55	60	56	61	59	62	70
GR	63	77	64	82						
X1	6	14	16	44	50	50	50			
GR	60	0	59	5	58	7	57	9	56	12
GR	55	16	54.23	30	55	44	57	53	58	64
GR	59	71	60	76	61	82	62	87		
X1	5	15	9	37	54	52	51			
GR	60	0	59	3	58	6	57	7	56	8
GR	55	9	54.23	23	55	37	56	57	57	58
GR	58	59	59	60	60	65	60	70	60	79
X1	4	13	28	49	54	51	52			
GR	60	0	59	3	58	6	57	10	56	18
GR	55	28	54.23	38.5	55	49	56	52	57	57
GR	58	63	59	90	60	104				
X1	3	14	13	50	50	56	51			
GR	60	0	59	2	58	8	57	11	56	12
GR	55	13	54.23	31.5	55	50	56	58	56	64
GR	56	88	57	96	58	106	59	114		
X1	2	11	24	82	51	56	52			
GR	60	0	59	3	58	6	57	8	56	12
GR	55	24	54.23	53	55	82	56	98	57	117
GR	58	131								
X1	1	9	20	105	0	0	0			
GR	59	0	58	1	57	6	56	13	55	20
GR	54.23	62.5	55	105	56	130	57	145		

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS
0

CCHV= .100 CEHV= .300
*SECNO 46.000
3720 CRITICAL DEPTH ASSUMED

46.000	4.78	74.78	74.78	74.78	76.32	1.55	.00	.00	70.00
2140.0	557.9	1373.4	208.7	69.6	124.2	30.7	.0	.0	70.00
.00	8.01	11.06	6.79	.025	.025	.025	.000	70.00	2.24
.004304	0.	0.	0.	0	4	0	.00	75.74	77.98

*SECNO 45.000

45.000	4.01	74.01	74.37	.00	76.01	2.00	.27	.05	70.00
2140.0	320.9	1611.2	207.8	37.5	132.0	26.5	.2	.1	70.00
.00	8.56	12.20	7.84	.025	.025	.025	.000	70.00	4.00
.006638	51.	50.	51.	4	11	0	.00	69.01	73.00

*SECNO 44.000

3301 HV CHANGED MORE THAN HVINS

44.000	3.71	72.71	73.50	.00	75.50	2.79	.43	.08	70.00
2140.0	104.6	1927.1	108.3	12.8	139.4	11.8	.5	.2	70.00
.00	8.17	13.83	9.17	.025	.025	.025	.000	69.00	5.42
.010736	51.	52.	53.	11	8	0	.00	59.01	64.43

*SECNO 43.000

43.000	3.33	72.33	73.02	.00	74.90	2.57	.53	.07	69.00
2140.0	180.9	1830.5	128.5	19.4	136.6	14.7	.7	.2	69.00
.00	9.34	13.40	8.77	.025	.025	.025	.000	69.00	2.67
.010211	50.	51.	53.	10	8	0	.00	63.32	66.00

*SECNO 42.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST

3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

42.000	3.98	72.98	72.98	.00	74.57	1.58	.35	.21	69.00
2140.0	233.7	1659.8	246.5	30.2	155.3	31.7	.9	.3	69.00
.00	7.73	10.68	7.77	.025	.025	.025	.000	69.00	.05
.005117	50.	50.	50.	20	11	0	.00	69.88	69.93

*SECNO 41.000

3301 HV CHANGED MORE THAN HVINS

41.000	3.69	71.69	72.31	.00	74.12	2.44	.36	.09	68.00
2140.0	166.5	1011.8	961.7	18.3	73.6	82.4	1.1	.4	68.00
.01	9.09	13.75	11.68	.025	.025	.025	.000	68.00	4.96
.009417	50.	52.	55.	6	8	0	.00	63.44	68.40

*SECNO 40.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

40.000	4.07	72.07	72.07	.00	73.69	1.61	.35	.18	68.00
2140.0	228.2	1667.3	244.6	28.4	154.7	32.2	1.3	.5	68.00
.01	8.02	10.78	7.60	.025	.025	.025	.000	68.00	6.64
.005054	50.	52.	55.	20	8	0	.00	67.72	74.36

*SECNO 39.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

39.000	3.96	71.96	71.96	.00	73.51	1.54	.25	.02	68.00
2140.0	200.2	1709.5	230.3	26.0	162.5	32.3	1.6	.5	68.00
.01	7.69	10.52	7.13	.025	.025	.025	.000	68.00	6.11
.004989	50.	50.	50.	20	8	0	.00	73.61	79.72

*SECNO 38.000

38.000	3.08	71.08	71.64	.00	73.12	2.04	.34	.05	68.00
2140.0	167.8	1566.5	405.7	18.5	126.5	49.5	1.8	.6	68.00
.01	9.10	12.38	8.19	.025	.025	.025	.000	68.00	8.66
.009665	50.	50.	50.	11	11	0	.00	88.53	97.19

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

CCHV= .300 CEHV= .500
*SECNO 37.600

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37.600	5.28	72.87	72.87	.00	75.53	2.66	.07	.55	67.59
2140.0	.1	2139.9	.0	.2	163.4	.0	1.9	.7	73.59
.01	.60	13.10	.00	.015	.015	.000	.000	67.59	.01
.002342	5.	15.	25.	20	14	0	.00	31.08	31.09

*SECNO 37.300

3265 DIVIDED FLOW

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 76.50 MAX ELLC= 73.60

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

37.300	5.79	73.38	73.38	.00	76.37	2.99	.00	.58	67.59
2140.0	.3	2139.7	.0	.3	154.2	.0	1.9	.7	73.77
.01	.93	13.88	.00	.015	.015	.000	.000	67.59	.00
.004997	1.	1.	1.	20	18	0	.00	27.27	31.09

*SECNO 37.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 76.22 MAX ELLC= 72.52

37.000	5.00	71.41	72.33	.00	75.46	4.05	.59	.32	66.41
2140.0	.2	2139.8	.0	.2	132.6	.0	2.2	.7	72.51
.01	1.03	16.14	.00	.015	.015	.000	.000	66.41	.02
.007481	98.	98.	98.	7	18	0	.00	27.19	31.08

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 36.500

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

36.500	5.23	71.75	71.80	.00	74.46	2.72	.00	.01	66.52
2140.0	.1	2139.9	.0	.2	161.7	.0	2.2	.7	72.52
.01	.60	13.23	.00	.015	.015	.000	.000	66.52	.01
.002418	1.	1.	1.	20	8	0	.00	31.07	31.09

CCHV= .100 CEHV= .300
SECNO 36.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.69

36.000	3.57	70.06	71.35	.00	74.22	4.17	.10	.14	74.81
2140.0	.0	2140.0	.0	.0	130.7	.0	2.3	.8	74.81
.01	.00	16.38	.00	.000	.015	.000	.000	66.49	9.48
.006909	40.	25.	10.	14	11	0	.00	45.04	54.52

*SECNO 35.000

35.000	3.51	69.61	70.97	.00	73.98	4.37	.23	.02	74.42
2140.0	.0	2140.0	.0	.0	127.6	.0	2.4	.8	74.42
.01	.00	16.77	.00	.000	.015	.000	.000	66.10	9.62
.007411	50.	32.	45.	6	11	0	.00	44.76	54.38

*SECNO 34.000

34.000	3.49	69.19	70.57	.00	73.60	4.41	.37	.00	74.02
2140.0	.0	2140.0	.0	.0	127.0	.0	2.6	.8	74.02
.01	.00	16.85	.00	.000	.015	.000	.000	65.70	9.64
.007515	50.	50.	50.	5	11	0	.00	44.71	54.36

*SECNO 33.000

33.000	3.48	68.79	70.18	.00	73.23	4.44	.36	.00	73.63
2140.0	.0	2140.0	.0	.0	126.5	.0	2.7	.9	73.63
.01	.00	16.91	.00	.000	.015	.000	.000	65.31	9.67
.007602	52.	48.	50.	5	11	0	.00	44.67	54.33

SECNO / Q / TIME / SLOPE	DEPTH / QLOB / VLOB / XLOBL	CWSEL / QCH / VCH / XLCH	CRIWS / QROB / VROB / XLOBR	WSELK / ALOB / XNL / ITRIAL	EG / ACH / XNCH / IDC	HV / AROB / XNR / ICONT	HL / VOL / WTN / CORAR	OLOSS / TWA / ELMIN / TOPWID	L-BANK ELEV / R-BANK ELEV / SSTA / ENDST
*SECNO 32.000									
32.000	3.48	68.39	69.78	.00	72.85	4.46	.38	.00	73.23
2140.0	.0	2140.0	.0	.0	126.2	.0	2.8	.9	73.23
.02	.00	16.95	.00	.000	.015	.000	.000	64.91	9.68
.007654	50.	50.	50.	5	11	0	.00	44.64	54.32
*SECNO 31.000									
31.000	3.48	67.64	69.03	.00	72.08	4.44	.76	.01	72.48
2140.0	.0	2140.0	.0	.0	126.5	.0	3.1	1.0	72.48
.02	.00	16.91	.00	.000	.015	.000	.000	64.16	9.67
.007598	100.	100.	100.	8	11	0	.00	44.67	54.33
*SECNO 30.000									
30.000	3.49	66.90	68.28	.00	71.32	4.42	.76	.01	71.73
2140.0	.0	2140.0	.0	.0	126.8	.0	3.4	1.1	71.73
.02	.00	16.87	.00	.000	.015	.000	.000	63.41	9.65
.007547	100.	100.	100.	8	11	0	.00	44.70	54.35
*SECNO 29.000									
29.000	3.49	66.15	67.53	.00	70.56	4.41	.75	.00	70.98
2140.0	.0	2140.0	.0	.0	127.0	.0	3.7	1.2	70.98
.02	.00	16.85	.00	.000	.015	.000	.000	62.66	9.64
.007512	100.	100.	100.	8	11	0	.00	44.71	54.36
*SECNO 28.000									
28.000	3.50	65.41	66.78	.00	69.81	4.40	.75	.00	70.23
2140.0	.0	2140.0	.0	.0	127.1	.0	4.0	1.3	70.23
.02	.00	16.83	.00	.000	.015	.000	.000	61.91	9.64
.007493	100.	100.	100.	8	11	0	.00	44.72	54.36
*SECNO 27.000									
27.000	3.50	64.66	66.03	.00	69.06	4.40	.75	.00	69.48
2140.0	.0	2140.0	.0	.0	127.2	.0	4.3	1.4	69.48
.02	.00	16.83	.00	.000	.015	.000	.000	61.16	9.64
.007487	100.	100.	100.	8	11	0	.00	44.73	54.36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IOC	ICONT	CORAR	TOPWID	ENDST
*SECNO 26.000									
26.000	3.50	63.91	65.28	.00	68.31	4.40	.75	.00	68.73
2140.0	.0	2140.0	.0	.0	127.2	.0	4.6	1.6	68.73
.03	.00	16.83	.00	.000	.015	.000	.000	60.41	9.64
.007488	100.	100.	100.	8	11	0	.00	44.73	54.36
*SECNO 25.000									
25.000	3.50	63.16	64.53	.00	67.56	4.40	.75	.00	67.98
2140.0	.0	2140.0	.0	.0	127.1	.0	4.9	1.7	67.98
.03	.00	16.83	.00	.000	.015	.000	.000	59.66	9.64
.007491	100.	100.	100.	8	11	0	.00	44.72	54.36
*SECNO 24.000									
24.000	3.50	62.41	63.78	.00	66.81	4.40	.75	.00	67.23
2140.0	.0	2140.0	.0	.0	127.1	.0	5.2	1.8	67.23
.03	.00	16.83	.00	.000	.015	.000	.000	58.91	9.64
.007494	100.	100.	100.	8	11	0	.00	44.72	54.36
*SECNO 23.000									
23.000	3.50	61.66	63.03	.00	66.06	4.40	.75	.00	66.48
2140.0	.0	2140.0	.0	.0	127.1	.0	5.5	1.9	66.48
.03	.00	16.83	.00	.000	.015	.000	.000	58.16	9.64
.007495	100.	100.	100.	8	11	0	.00	44.72	54.36
*SECNO 22.000									
22.000	3.50	60.91	62.28	.00	65.31	4.40	.75	.00	65.73
2140.0	.0	2140.0	.0	.0	127.1	.0	5.8	2.0	65.73
.03	.00	16.84	.00	.000	.015	.000	.000	57.41	9.64
.007497	100.	100.	100.	8	11	0	.00	44.72	54.36
*SECNO 21.000									
3301 HV CHANGED MORE THAN HVINS									
21.000	3.78	60.80	61.89	.00	64.43	3.63	.65	.23	65.34
2140.0	.0	2140.0	.0	.0	140.0	.0	6.1	2.1	65.34
.03	.00	15.29	.00	.000	.015	.000	.000	57.02	9.07
.005637	100.	100.	100.	12	11	0	.00	45.86	54.93

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 20.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

20.000	4.61	61.62	61.94	.00	63.92	2.30	.20	.44	65.43
2140.0	.0	2140.0	.0	.0	175.8	.0	6.2	2.1	65.43
.03	.00	12.17	.00	.000	.015	.000	.000	57.01	7.62
.002880	50.	50.	50.	20	11	0	.00	48.75	56.38

*SECNO 19.000

3301 HV CHANGED MORE THAN HVINS

19.000	4.13	60.75	61.48	.00	63.68	2.93	.17	.06	64.94
2140.0	.0	2140.0	.0	.0	155.7	.0	6.4	2.2	64.94
.04	.00	13.75	.00	.000	.015	.000	.000	56.62	8.40
.004122	50.	50.	50.	9	8	0	.00	47.21	55.60

*SECNO 18.000

18.000	3.94	60.16	61.10	.00	63.43	3.27	.22	.03	64.54
2140.0	.0	2140.0	.0	.0	147.4	.0	6.6	2.2	64.54
.04	.00	14.52	.00	.000	.015	.000	.000	56.22	8.75
.004838	51.	49.	50.	16	8	0	.00	46.50	55.25

*SECNO 17.000

17.000	3.85	59.68	60.69	.00	63.16	3.48	.25	.02	64.15
2140.0	.0	2140.0	.0	.0	142.9	.0	6.8	2.3	64.15
.04	.00	14.98	.00	.000	.015	.000	.000	55.83	8.94
.005303	50.	50.	50.	15	11	0	.00	46.11	55.06

*SECNO 16.000

16.000	3.77	59.20	60.29	.00	62.86	3.67	.28	.02	63.75
2140.0	.0	2140.0	.0	.0	139.3	.0	6.9	2.3	63.75
.04	.00	15.37	.00	.000	.015	.000	.000	55.43	9.10
.005722	50.	50.	50.	15	11	0	.00	45.79	54.90

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 15.000									
15.000	3.71	58.75	59.91	.00	62.56	3.80	.29	.01	63.37
2140.0	.0	2140.0	.0	.0	136.8	.0	7.1	2.4	63.37
.04	.00	15.65	.00	.000	.015	.000	.000	55.04	9.22
.006035	50.	50.	50.	6	11	0	.00	45.56	54.78
*SECNO 14.000									
14.000	3.66	58.31	59.51	.00	62.24	3.92	.31	.01	62.97
2140.0	.0	2140.0	.0	.0	134.7	.0	7.2	2.4	62.97
.04	.00	15.89	.00	.000	.015	.000	.000	54.65	9.30
.006319	54.	50.	54.	6	11	0	.00	45.39	54.70

CCHV= .300 CEHV= .500
*SECNO 13.500

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

13.500	3.82	58.24	58.28	.00	60.23	1.99	.09	.52	54.42
2140.0	.0	2140.0	.0	.1	189.1	.0	7.3	2.5	64.42
.04	.05	11.32	.00	.015	.015	.000	.000	54.42	.06
.002413	35.	24.	9.	20	8	0	.00	49.58	49.64

*SECNO 13.000

35 DIVIDED FLOW

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 66.61 MAX ELLC= 61.42

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

13.000	3.95	58.37	58.37	.00	60.36	1.99	.00	.04	54.42
2140.0	.1	2139.9	.0	.1	189.1	.0	7.3	2.5	61.42
.04	.57	11.32	.00	.015	.015	.000	.000	54.42	.04
.003824	1.	1.	1.	20	15	0	.00	48.15	49.66

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12.500

3265 DIVIDED FLOW

3370 NORMAL BRIDGE, NRD= 0 MIN ELTRD= 66.30 MAX ELLC= 61.23

7185 MINIMUM SPECIFIC ENERGY

12.500	3.94	58.17	58.18	.00	60.16	1.99	.19	.00	54.23
2140.0	.1	2139.9	.0	.1	189.0	.0	7.6	2.5	61.23
.04	.57	11.32	.00	.015	.015	.000	.000	54.23	.04
.003829	50.	50.	50.	3	15	0	.00	48.15	49.66

*SECNO 12.000

12.000	3.57	57.80	58.09	.00	60.07	2.28	.00	.09	54.23
2140.0	.0	2140.0	.0	.1	176.7	.0	7.6	2.5	64.23
.04	.05	12.11	.00	.015	.015	.000	.000	54.23	.06
.003008	1.	1.	1.	5	8	0	.00	49.57	49.64

CCHV= .100 CEHV= .300
*SECNO 11.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11.000	4.60	58.83	58.83	.00	60.60	1.77	.27	.35	55.00
2140.0	106.0	1869.9	164.1	15.0	168.6	22.0	7.9	2.6	55.00
.04	7.06	11.09	7.46	.025	.025	.025	.000	54.23	5.51
.005115	57.	70.	84.	20	11	0	.00	59.98	65.49

*SECNO 10.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10.000	5.87	60.10	60.10	.00	62.24	2.15	.25	.31	55.00
2140.0	214.4	1711.2	214.4	26.0	137.0	26.0	8.1	2.7	55.00
.05	8.26	12.49	8.26	.025	.025	.025	.000	54.23	19.90
.004600	52.	51.	53.	20	11	0	.00	45.19	65.10

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 9.000

9.000	5.33	59.56	60.04	.00	61.93	2.38	.29	.02	55.00
2140.0	343.5	1297.0	499.4	35.1	93.8	51.8	8.3	2.7	55.00
.05	9.79	13.83	9.65	.025	.025	.025	.000	54.23	16.35
.006474	52.	53.	54.	9	5	0	.00	56.40	72.75

*SECNO 8.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8.000	5.86	60.09	60.09	.00	62.04	1.95	.29	.06	56.00
2140.0	87.6	1926.7	125.8	13.1	166.4	16.7	8.6	2.8	56.00
.05	6.68	11.58	7.52	.025	.025	.025	.000	54.23	12.74
.005169	53.	50.	53.	20	8	0	.00	51.69	64.43

*SECNO 7.000

3301 HV CHANGED MORE THAN HVINS

7.000	4.42	58.65	59.41	.00	61.60	2.95	.34	.10	55.00
2140.0	302.7	1702.1	135.2	29.6	117.1	13.0	8.8	2.9	55.00
.05	10.23	14.54	10.42	.025	.025	.025	.000	54.23	5.05
.009328	52.	50.	52.	7	11	0	.00	49.61	54.65

*SECNO 6.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3710 WSEL ASSUMED BASED ON MIN DIFF

6.000	5.02	59.25	59.40	.00	60.99	1.75	.35	.33	55.00
2140.0	237.8	1504.5	397.6	28.4	129.7	53.8	9.0	2.9	55.00
.05	8.39	11.60	7.39	.025	.025	.025	.000	54.23	3.77
.004945	53.	53.	53.	20	8	0	.00	68.46	72.23

*SECNO 5.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
5.000	4.69	58.92	58.92	.00	60.74	1.82	.26	.16	55.00
2140.0	51.4	1389.9	698.8	8.5	120.5	72.7	9.2	3.0	55.00
.05	6.02	11.53	9.62	.025	.025	.025	.000	54.23	3.24
.005385	50.	50.	50.	20	11	0	.00	56.68	59.92

*SECNO 4.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

4.000	5.31	59.54	59.54	.00	60.86	1.33	.24	.08	55.00
2140.0	625.6	1106.5	408.0	76.4	103.4	69.6	9.5	3.1	55.00
.05	8.19	10.70	5.86	.025	.025	.025	.000	54.23	1.39
.003886	54.	51.	52.	20	8	0	.00	96.14	97.53

*SECNO 3.000

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.13

3.000	3.08	57.31	58.24	.00	60.32	3.01	.38	.17	55.00
2140.0	21.7	1529.4	588.9	2.8	99.8	60.9	9.7	3.2	55.00
.05	7.82	15.32	9.67	.025	.025	.025	.000	54.23	10.06
.017707	54.	52.	51.	7	19	0	.00	89.07	99.13

CNO 2.000

3301 HV CHANGED MORE THAN HVINS

2.000	2.66	56.89	57.62	.00	59.25	2.35	.87	.20	55.00
2140.0	165.0	1730.2	244.8	18.4	132.6	30.1	9.9	3.3	55.00
.06	8.95	13.05	8.13	.025	.025	.025	.000	54.23	8.40
.016024	50.	51.	56.	6	8	0	.00	106.71	115.11

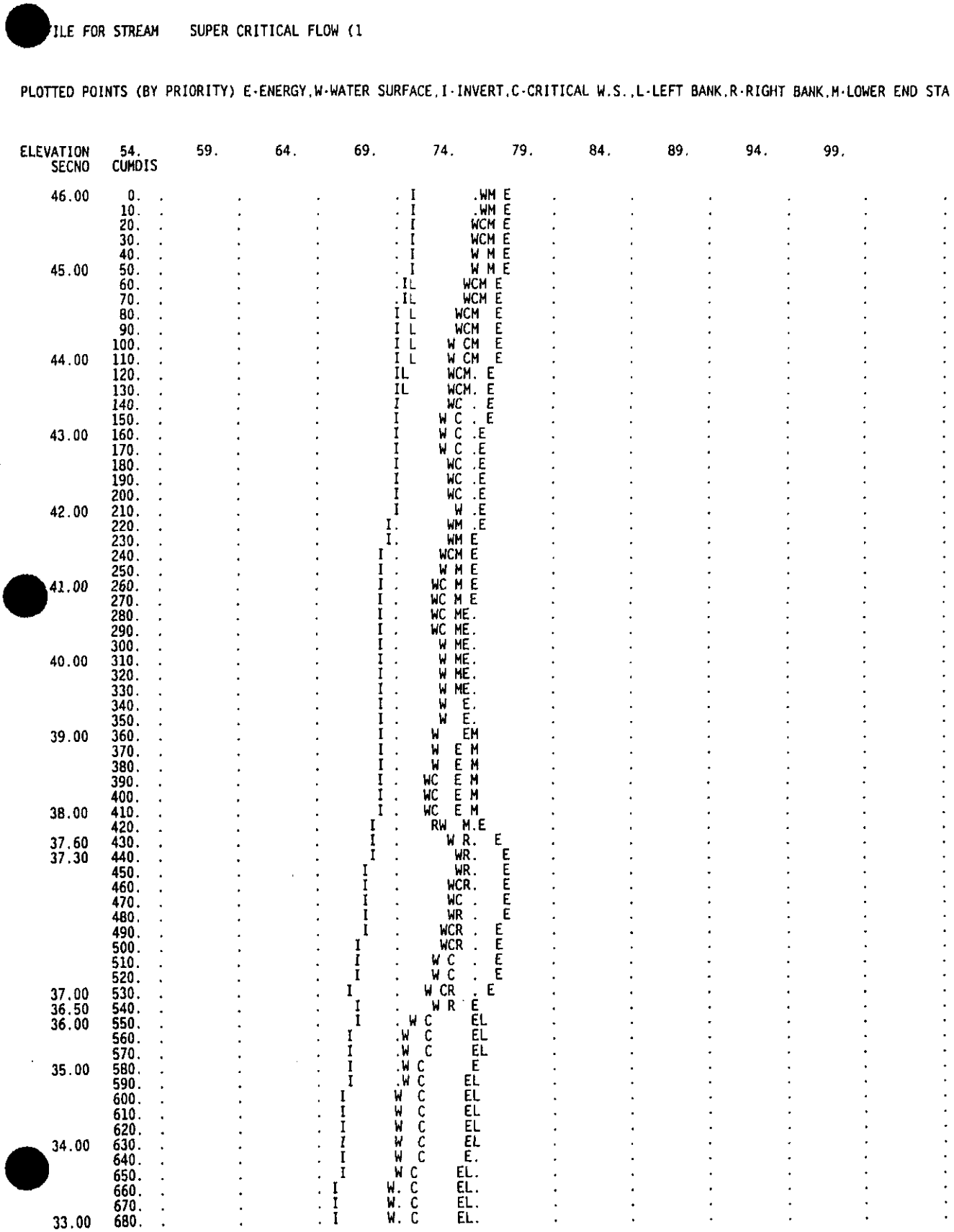
*SECNO 1.000

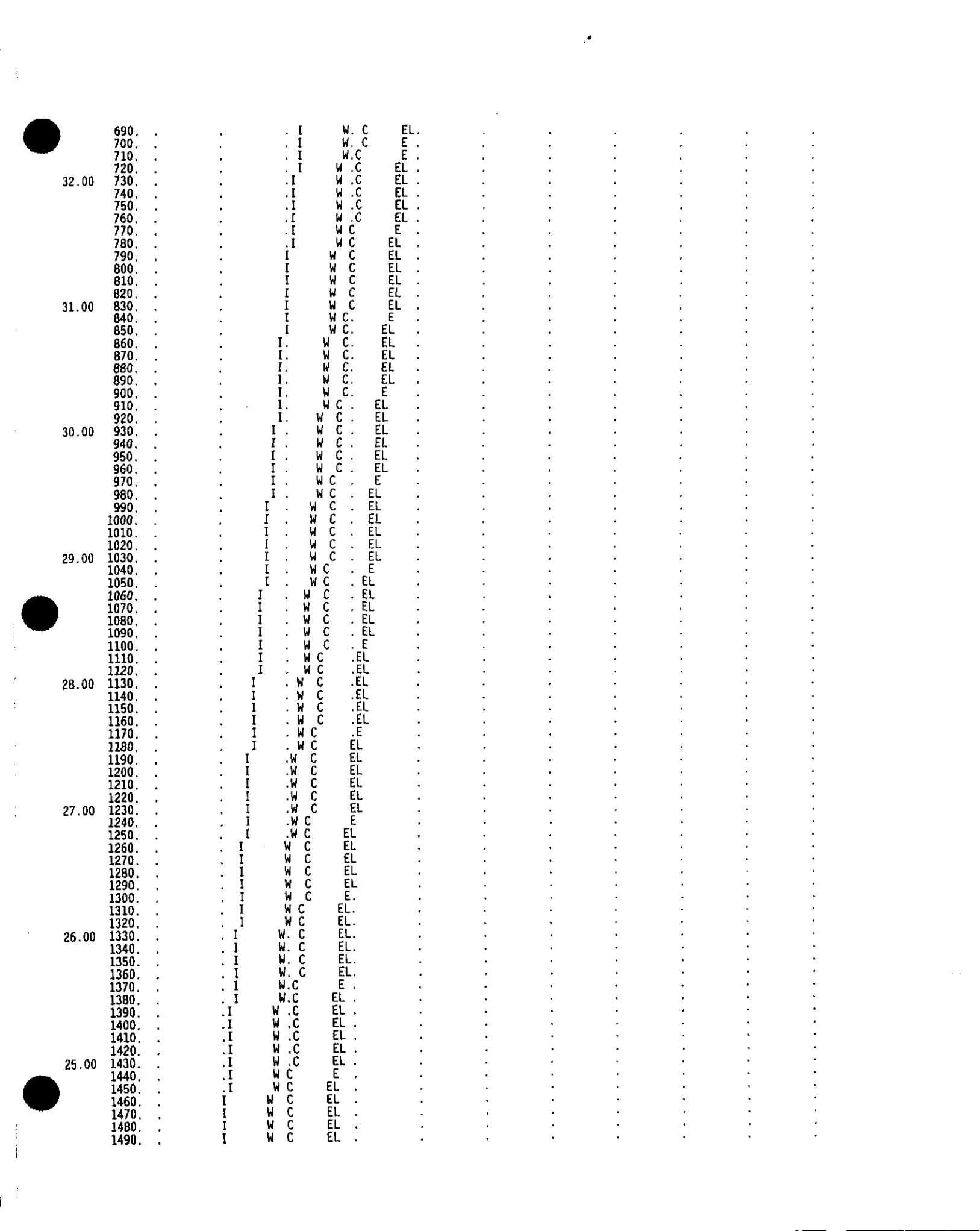
3301 HV CHANGED MORE THAN HVINS

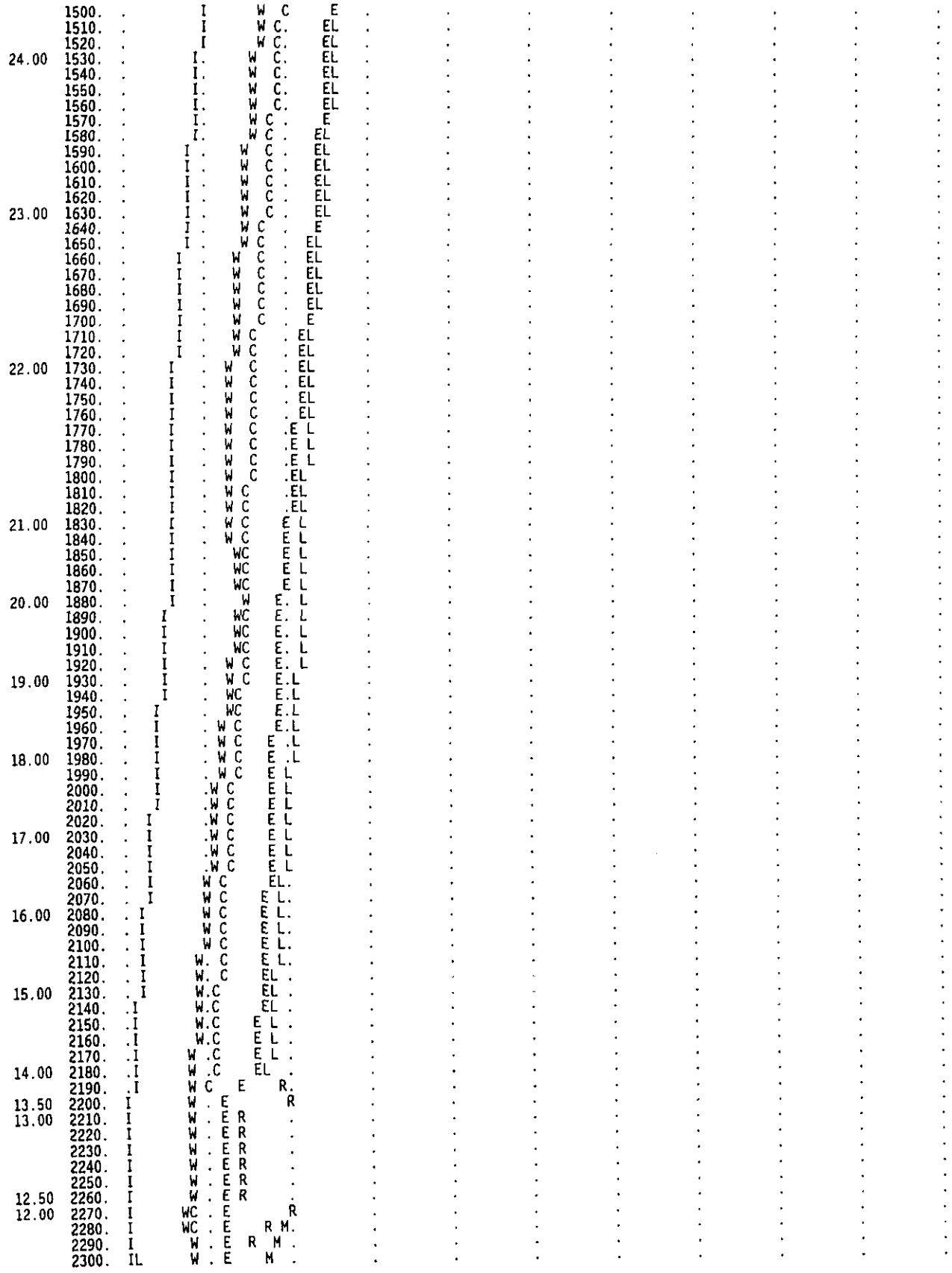
SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
1.000	2.43	56.66	57.10	.00	58.29	1.63	.74	.22	55.00
2140.0	63.6	1854.7	221.7	9.6	173.5	32.1	10.2	3.5	55.00
.06	6.62	10.69	6.90	.025	.025	.025	.000	54.23	8.40
.012485	51.	52.	56.	7	8	0	.00	131.45	139.85

ILE FOR STREAM SUPER CRITICAL FLOW (1

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA






1500. I W C E
1510. I W C. EL
1520. I W C. EL
24.00 1530. I. W C. EL
1540. I. W C. EL
1550. I. W C. EL
1560. I. W C. EL
1570. I. W C . E
1580. I. W C . EL
1590. I . W C . EL
1600. I . W C . EL
1610. I . W C . EL
1620. I . W C . EL
23.00 1630. I . W C . EL
1640. I . W C . E
1650. I . W C . EL
1660. I . W C . EL
1670. I . W C . EL
1680. I . W C . EL
1690. I . W C . EL
1700. I . W C . E
1710. I . W C . EL
1720. I . W C . EL
22.00 1730. I . W C . EL
1740. I . W C . EL
1750. I . W C . EL
1760. I . W C . EL
1770. I . W C .E L
1780. I . W C .E L
1790. I . W C .E L
1800. I . W C .EL
1810. I . W C .EL
1820. I . W C .EL
21.00 1830. I . W C E L
1840. I . W C E L
1850. I . WC E L
1860. I . WC E L
1870. I . WC E L
20.00 1880. I . W E. L
1890. I . WC E. L
1900. I . WC E. L
1910. I . WC E. L
1920. I . W C E. L
19.00 1930. I . W C E.L
1940. I . WC E.L
1950. I . WC E.L
1960. I . W C E.L
1970. I . W C E .L
18.00 1980. I . W C E .L
1990. I . W C E L
2000. I .W C E L
2010. I .W C E L
2020. I .W C E L
17.00 2030. I .W C E L
2040. I .W C E L
2050. I .W C E L
2060. I W C EL.
2070. I W C E L.
16.00 2080. I W C E L.
2090. I W C E L.
2100. I W C E L.
2110. I W. C E L.
2120. I W. C EL .
15.00 2130. I W.C EL .
2140. I W.C EL .
2150. I W.C E L .
2160. I W.C E L .
2170. I W .C E L .
14.00 2180. I W .C EL .
2190. I W C E R.
13.50 2200. I W . E R
13.00 2210. I W . E R .
2220. I W . E R .
2230. I W . E R .
2240. I W . E R .
2250. I W . E R .
12.50 2260. I W . E R .
12.00 2270. I WC . E R
2280. I WC . E R M.
2290. I W . E R M .
2300. IL W . E M .

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       2310.  IL      WC. E   M   .  .  .  .  .  .  .  .  .
       2320.  IL     R W. E   M   .  .  .  .  .  .  .  .  .
11.00  2330.  I L      W.  EM     .  .  .  .  .  .  .  .  .
       2340.  I L       W  E M   .  .  .  .  .  .  .  .  .
       2350.  I L       W   E M  .  .  .  .  .  .  .  .  .
       2360.  I L       .W   E M .  .  .  .  .  .  .  .  .
       2370.  I L       .W   E  M.  .  .  .  .  .  .  .  .
10.00  2380.  I L       . W   E   M  .  .  .  .  .  .  .  .
       2390.  I L       . W   E   M  .  .  .  .  .  .  .  .
       2400.  I L       .WC   E   M  .  .  .  .  .  .  .  .
       2410.  I L       .WC   E   M  .  .  .  .  .  .  .  .
       2420.  I L       .WC   E   M  .  .  .  .  .  .  .  .
 9.00  2430.  I L       .WC  E    M  .  .  .  .  .  .  .  .
       2440.  I L       .WC  E    M  .  .  .  .  .  .  .  .
       2450.  I L       .WC  E    M  .  .  .  .  .  .  .  .
       2460.  I  L      .WC   E   M  .  .  .  .  .  .  .  .
       2470.  I  L      . W   E   M  .  .  .  .  .  .  .  .
 8.00  2480.  I   L     . W   E   M  .  .  .  .  .  .  .  .
       2490.  I  L      .W   E  M .  .  .  .  .  .  .  .  .
       2500.  I  L      .W   EM    .  .  .  .  .  .  .  .  .
       2510.  I L       WC   E     .  .  .  .  .  .  .  .  .
       2520.  I L      W.C M E     .  .  .  .  .  .  .  .  .
 7.00  2530.  I L      WC M  E     .  .  .  .  .  .  .  .  .
       2540.  I L      WC M  E     .  .  .  .  .  .  .  .  .
       2550.  I L      WC M E      .  .  .  .  .  .  .  .  .
       2560.  I L       W M E      .  .  .  .  .  .  .  .  .
       2570.  I L       W M E      .  .  .  .  .  .  .  .  .
 6.00  2580.  I L       W M E      .  .  .  .  .  .  .  .  .
       2590.  I L       W ME       .  .  .  .  .  .  .  .  .
       2600.  I L       W ME       .  .  .  .  .  .  .  .  .
       2610.  I L       W ME       .  .  .  .  .  .  .  .  .
       2620.  I L       W ME       .  .  .  .  .  .  .  .  .
 5.00  2630.  I L      W. ME       .  .  .  .  .  .  .  .  .
       2640.  I L       W ME       .  .  .  .  .  .  .  .  .
       2650.  I L       W ME       .  .  .  .  .  .  .  .  .
       2660.  I L       W ME       .  .  .  .  .  .  .  .  .
       2670.  I L       W ME       .  .  .  .  .  .  .  .  .
 4.00  2680.  I L       .WME       .  .  .  .  .  .  .  .  .
       2690.  I L       WM E       .  .  .  .  .  .  .  .  .
       2700.  I L      WCM E       .  .  .  .  .  .  .  .  .
       2710.  I L     WCM  E       .  .  .  .  .  .  .  .  .
       2720.  I L    W CM E        .  .  .  .  .  .  .  .  .
       2730.  I L   W C M E        .  .  .  .  .  .  .  .  .
 3.00  2740.  I L   W C M E        .  .  .  .  .  .  .  .  .
       2750.  I L   W CM. E        .  .  .  .  .  .  .  .  .
       2760.  I L   W CM.E         .  .  .  .  .  .  .  .  .
       2770.  I L   WCM .E         .  .  .  .  .  .  .  .  .
       2780.  I L   WCM .E         .  .  .  .  .  .  .  .  .
 2.00  2790.  I L  W CM E          .  .  .  .  .  .  .  .  .
       2800.  I L  W C  E          .  .  .  .  .  .  .  .  .
       2810.  I L  WCM E.          .  .  .  .  .  .  .  .  .
       2820.  I L  WC  E.          .  .  .  .  .  .  .  .  .
       2830.  I L  WC  E.          .  .  .  .  .  .  .  .  .
 1.00  2840.  I L  WC E .          .  .  .  .  .  .  .  .  .
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HEC-2 WATER SURFACE PROFILES
Version 4.6.2: May 1991
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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SUPER CRITICAL FLOW (1

SUMMARY PRINTOUT

	FRCH
*	.892
	1.075
	1.322
	1.294
*	.943
	1.263
*	.941
*	.931
	1.243
	1.005
*	1.097
	1.375
*	1.021
*	1.695
	1.750
	1.762
	1.771

	FRCH
	1.777
	1.771
	1.765
	1.761
	1.759
	1.759
	1.759
	1.759
	1.759
	1.760
	1.760
	1.542
*	1.130
	1.334
	1.437
	1.499
	1.553
	1.592
	1.626
*	1.021
*	1.021
*	1.021
	1.130
*	.952
*	.940
	1.097

FRCH

* .949

1.275

* .950

* .979

* .850

* 1.644

1.522

1.318

SUPER CRITICAL FLOW (1

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	46.000	.00	.00	.00	70.00	2140.00	74.78	74.78	76.32	43.04	11.06	224.56	326.19
	45.000	50.00	.00	.00	70.00	2140.00	74.01	74.37	76.01	66.38	12.20	196.04	262.66
	44.000	52.00	.00	.00	69.00	2140.00	72.71	73.50	75.50	107.36	13.83	163.98	206.54
	43.000	51.00	.00	.00	69.00	2140.00	72.33	73.02	74.90	102.11	13.40	170.63	211.77
*	42.000	50.00	.00	.00	69.00	2140.00	72.98	72.98	74.57	51.17	10.68	217.33	299.17
	41.000	52.00	.00	.00	68.00	2140.00	71.69	72.31	74.12	94.17	13.75	174.27	220.53
*	40.000	52.00	.00	.00	68.00	2140.00	72.07	72.07	73.69	50.54	10.78	215.34	301.03
*	39.000	50.00	.00	.00	68.00	2140.00	71.96	71.96	73.51	49.89	10.52	220.89	302.98
	38.000	50.00	.00	.00	68.00	2140.00	71.08	71.64	73.12	96.65	12.38	194.47	217.68
*	37.600	15.00	.00	.00	67.59	2140.00	72.87	72.87	75.53	23.42	13.10	163.60	442.20
*	37.300	1.00	76.50	73.60	67.59	2140.00	73.38	73.38	76.37	49.97	13.88	154.45	302.74
	37.000	98.00	76.22	72.52	66.41	2140.00	71.41	72.33	75.46	74.81	16.14	132.77	247.41
*	36.500	1.00	.00	.00	66.52	2140.00	71.75	71.80	74.46	24.18	13.23	161.94	435.18
	36.000	25.00	.00	.00	66.49	2140.00	70.06	71.35	74.22	69.09	16.38	130.66	257.45
	35.000	32.00	.00	.00	66.10	2140.00	69.61	70.97	73.98	74.11	16.77	127.61	248.59
	34.000	50.00	.00	.00	65.70	2140.00	69.19	70.57	73.60	75.15	16.85	127.01	246.86
	33.000	48.00	.00	.00	65.31	2140.00	68.79	70.18	73.23	76.02	16.91	126.52	245.45
	32.000	50.00	.00	.00	64.91	2140.00	68.39	69.78	72.85	76.54	16.95	126.22	244.60
	31.000	100.00	.00	.00	64.16	2140.00	67.64	69.03	72.08	75.98	16.91	126.54	245.51
	30.000	100.00	.00	.00	63.41	2140.00	66.90	68.28	71.32	75.47	16.87	126.83	246.34
	29.000	100.00	.00	.00	62.66	2140.00	66.15	67.53	70.56	75.12	16.85	127.03	246.91
	28.000	100.00	.00	.00	61.91	2140.00	65.41	66.78	69.81	74.93	16.83	127.13	247.22
	27.000	100.00	.00	.00	61.16	2140.00	64.66	66.03	69.06	74.87	16.83	127.17	247.32
	26.000	100.00	.00	.00	60.41	2140.00	63.91	65.28	68.31	74.88	16.83	127.16	247.30

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	25.000	100.00	.00	.00	59.66	2140.00	63.16	64.53	67.56	74.91	16.83	127.14	247.25
	24.000	100.00	.00	.00	58.91	2140.00	62.41	63.78	66.81	74.94	16.83	127.13	247.21
	23.000	100.00	.00	.00	58.16	2140.00	61.66	63.03	66.06	74.95	16.83	127.12	247.18
	22.000	100.00	.00	.00	57.41	2140.00	60.91	62.28	65.31	74.97	16.84	127.11	247.16
	21.000	100.00	.00	.00	57.02	2140.00	60.80	61.89	64.43	56.37	15.29	139.97	285.03
•	20.000	50.00	.00	.00	57.01	2140.00	61.62	61.94	63.92	28.80	12.17	175.79	398.77
	19.000	50.00	.00	.00	56.62	2140.00	60.75	61.48	63.68	41.22	13.75	155.69	333.32
	18.000	49.00	.00	.00	56.22	2140.00	60.16	61.10	63.43	48.38	14.52	147.42	307.66
	17.000	50.00	.00	.00	55.83	2140.00	59.68	60.69	63.16	53.03	14.98	142.90	293.88
	16.000	50.00	.00	.00	55.43	2140.00	59.20	60.29	62.86	57.22	15.37	139.26	282.91
	15.000	50.00	.00	.00	55.04	2140.00	58.75	59.91	62.56	60.35	15.65	136.76	275.48
	14.000	50.00	.00	.00	54.65	2140.00	58.31	59.51	62.24	63.19	15.89	134.66	269.21
*	13.500	24.00	.00	.00	54.42	2140.00	58.24	58.28	60.23	24.13	11.32	189.16	435.66
*	13.000	1.00	66.61	61.42	54.42	2140.00	58.37	58.37	60.36	38.24	11.32	189.23	346.06
*	12.500	50.00	66.30	61.23	54.23	2140.00	58.17	58.18	60.16	38.29	11.32	189.14	345.83
	12.000	1.00	.00	.00	54.23	2140.00	57.80	58.09	60.07	30.08	12.11	176.73	390.21
	11.000	70.00	.00	.00	54.23	2140.00	58.83	58.83	60.60	51.15	11.09	205.66	299.23
*	10.000	51.00	.00	.00	54.23	2140.00	60.10	60.10	62.24	46.00	12.49	188.94	315.54
	9.000	53.00	.00	.00	54.23	2140.00	59.56	60.04	61.93	64.74	13.83	180.62	265.96
*	8.000	50.00	.00	.00	54.23	2140.00	60.09	60.09	62.04	51.69	11.58	196.23	297.67
	7.000	50.00	.00	.00	54.23	2140.00	58.65	59.41	61.60	93.28	14.54	159.63	221.58
*	6.000	53.00	.00	.00	54.23	2140.00	59.25	59.40	60.99	49.45	11.60	211.84	304.33
*	5.000	50.00	.00	.00	54.23	2140.00	58.92	58.92	60.74	53.85	11.53	201.72	291.63
*	4.000	51.00	.00	.00	54.23	2140.00	59.54	59.54	60.86	38.86	10.70	249.30	343.30
•	3.000	52.00	.00	.00	54.23	2140.00	57.31	58.24	60.32	177.07	15.32	163.48	160.82
	2.000	51.00	.00	.00	54.23	2140.00	56.89	57.62	59.25	160.24	13.05	181.10	169.06

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
1.000	52.00	.00	.00	54.23	2140.00	56.66	57.10	58.29	124.85	10.69	215.29	191.52

SUPER CRITICAL FLOW (1

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
•	46.000	2140.00	74.78	.00	.00	.00	75.74	.00
	45.000	2140.00	74.01	.00	-.77	.00	69.01	50.00
	44.000	2140.00	72.71	.00	-1.30	.00	59.01	52.00
	43.000	2140.00	72.33	.00	-.38	.00	63.32	51.00
*	42.000	2140.00	72.98	.00	.65	.00	69.88	50.00
	41.000	2140.00	71.69	.00	-1.30	.00	63.44	52.00
*	40.000	2140.00	72.07	.00	.39	.00	67.72	52.00
*	39.000	2140.00	71.96	.00	-.11	.00	73.61	50.00
	38.000	2140.00	71.08	.00	-.89	.00	88.53	50.00
*	37.600	2140.00	72.87	.00	1.79	.00	31.08	15.00
*	37.300	2140.00	73.38	.00	.51	.00	27.27	1.00
	37.000	2140.00	71.41	.00	-1.96	.00	27.19	98.00
*	36.500	2140.00	71.75	.00	.33	.00	31.07	1.00
*	36.000	2140.00	70.06	.00	-1.69	.00	45.04	25.00
	35.000	2140.00	69.61	.00	-.45	.00	44.76	32.00
	34.000	2140.00	69.19	.00	-.42	.00	44.71	50.00
	33.000	2140.00	68.79	.00	-.40	.00	44.67	48.00
	32.000	2140.00	68.39	.00	-.40	.00	44.64	50.00
	31.000	2140.00	67.64	.00	-.75	.00	44.67	100.00
	30.000	2140.00	66.90	.00	-.74	.00	44.70	100.00
	29.000	2140.00	66.15	.00	-.74	.00	44.71	100.00
	28.000	2140.00	65.41	.00	-.75	.00	44.72	100.00
	27.000	2140.00	64.66	.00	-.75	.00	44.73	100.00
	26.000	2140.00	63.91	.00	-.75	.00	44.73	100.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	25.000	2140.00	63.16	.00	-.75	.00	44.72	100.00
	24.000	2140.00	62.41	.00	-.75	.00	44.72	100.00
	23.000	2140.00	61.66	.00	-.75	.00	44.72	100.00
	22.000	2140.00	60.91	.00	-.75	.00	44.72	100.00
	21.000	2140.00	60.80	.00	-.11	.00	45.86	100.00
*	20.000	2140.00	61.62	.00	.82	.00	48.75	50.00
	19.000	2140.00	60.75	.00	-.87	.00	47.21	50.00
	18.000	2140.00	60.16	.00	-.59	.00	46.50	49.00
	17.000	2140.00	59.68	.00	-.48	.00	46.11	50.00
	16.000	2140.00	59.20	.00	-.48	.00	45.79	50.00
	15.000	2140.00	58.75	.00	-.44	.00	45.56	50.00
	14.000	2140.00	58.31	.00	-.44	.00	45.39	50.00
*	13.500	2140.00	58.24	.00	-.08	.00	49.58	24.00
*	13.000	2140.00	58.37	.00	.13	.00	48.15	1.00
•	12.500	2140.00	58.17	.00	-.19	.00	48.15	50.00
	12.000	2140.00	57.80	.00	-.38	.00	49.57	1.00
	11.000	2140.00	58.83	.00	1.03	.00	59.98	70.00
	10.000	2140.00	60.10	.00	1.26	.00	45.19	51.00
	9.000	2140.00	59.56	.00	-.54	.00	56.40	53.00
*	8.000	2140.00	60.09	.00	.53	.00	51.69	50.00
	7.000	2140.00	58.65	.00	-1.43	.00	49.61	50.00
*	6.000	2140.00	59.25	.00	.59	.00	68.46	53.00
*	5.000	2140.00	58.92	.00	-.33	.00	56.68	50.00
*	4.000	2140.00	59.54	.00	.62	.00	96.14	51.00
*	3.000	2140.00	57.31	.00	-2.23	.00	89.07	52.00
	2.000	2140.00	56.89	.00	-.41	.00	106.71	51.00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
1.000	2140.00	56.66	.00	-.24	.00	131.45	52.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 46.000 PROFILE= 1 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 42.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 42.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 42.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 40.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 40.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 40.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 39.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 39.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 39.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 37.600 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 37.600 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 37.600 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 37.300 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 37.300 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 37.300 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 36.500 PROFILE= 1 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 36.500 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO= 36.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 20.000 PROFILE= 1 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 20.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 13.500 PROFILE= 1 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 13.500 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 13.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 13.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 13.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 12.500 PROFILE= 1 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 11.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 11.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 11.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 10.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 10.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 10.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 8.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 8.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 6.000 PROFILE= 1 WSEL ASSUMED BASED ON MIN DIFF
CAUTION SECNO= 6.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO= 3.000 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

APPENDIX B

Revised Superelevation and Freeboard Calculations

22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
AMPAD

REGIONAL FACILITY

SUPERELEVATION CALCULATIONS

$$S_o = \frac{V^2 T_N}{GR}$$

$$= \frac{(13.75)^2 (64)}{(32.2)(370)}$$

SUPERCRITICAL FLOW REGIME

$$S_o = 1.02'$$

FREEBOARD CALCULATIONS

$$F_b = 1 + 0.025 V (d)^{1/3}$$

$$= 1 + 0.025 (13.75)(4.31)^{1/3}$$

$$F_b = 1.56'$$

$d + S_o + F_b \Rightarrow 4.31 + 1.02 + 1.56 = 6.89'$ TOTAL DEPTH

CHANNEL BANK $8' > 6.89'$ $\therefore$ O.K.

SUPERELEVATION CALCULATIONS

$$S_o = \frac{V^2 T_N}{GR}$$

$$= \frac{(7.33)^2 (64)}{(32.2)(370)}$$

SUBCRITICAL FLOW REGIME

$$S_o = 0.33'$$

FREEBOARD CALCULATIONS

$$F_b = 1 + 0.025 V (d)^{1/3}$$

$$= 1 + 0.025 (7.33)(6.4)^{1/3}$$

$$F_b = 1.36'$$

$d + S_o + F_b \Rightarrow 6.4' + 0.33' + 1.36' = 8.09'$

CHANNEL BANK $9' > 8.09'$ $\therefore$ O.K

APPENDIX C

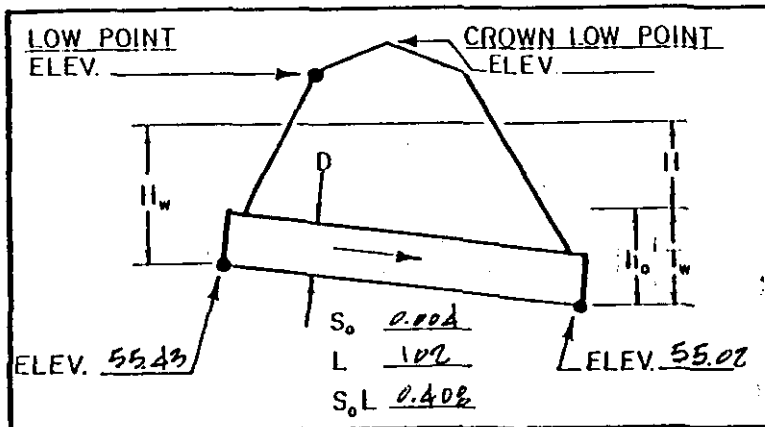
Revised Pipe and Box Culvert Capacity Calculations

CULVERT RATING

REFERENCE:

STANDARD FORM 7

PROJECT: COLLINS BUSINESS PARK LOCATION: NE CORNER OF ALEX. & LAMB STATION: TRIPLE 54" RCP



CULVERT DATA

TYPE: _____ n: _____

INLET: _____ Q_{FULL}: _____

K_e: _____ V_{FULL}: _____

OUTLET CONTROL EQUATIONS

(1) $H_w = H + h_o - LS_o$

(2) For $T_w < D$; $h_o = \frac{d_c + D}{2}$ or T_w (whichever is greater)

$T_w \geq D$; $h_o = T_w$

(3) For Box Culvert: $d_c = 0.315(Q/B)^{2/3} \leq D$

Q	STORM EVENT	INLET CONTROL		OUTLET CONTROL						TYPE OF CONTROL	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY
						$T_w < D$		$T_w \geq D$				
		$\frac{H_w}{D}$	H_w	H	T_w	d_c	$\frac{d_c + D}{2} = h$	h_o	H_w			
1	2	3	4	5	6	7	8	9	10	11	12	13
133	100	1.37	6.16	3.41	3.16	3.58	4.04		7.04	OUTLET		
133	100	0.91	3.66	0.905	3.16	3.55	4.04		4.04	OUTLET		

SINCE

∴ THE DESIGN IS OKAY.

Revision	Date

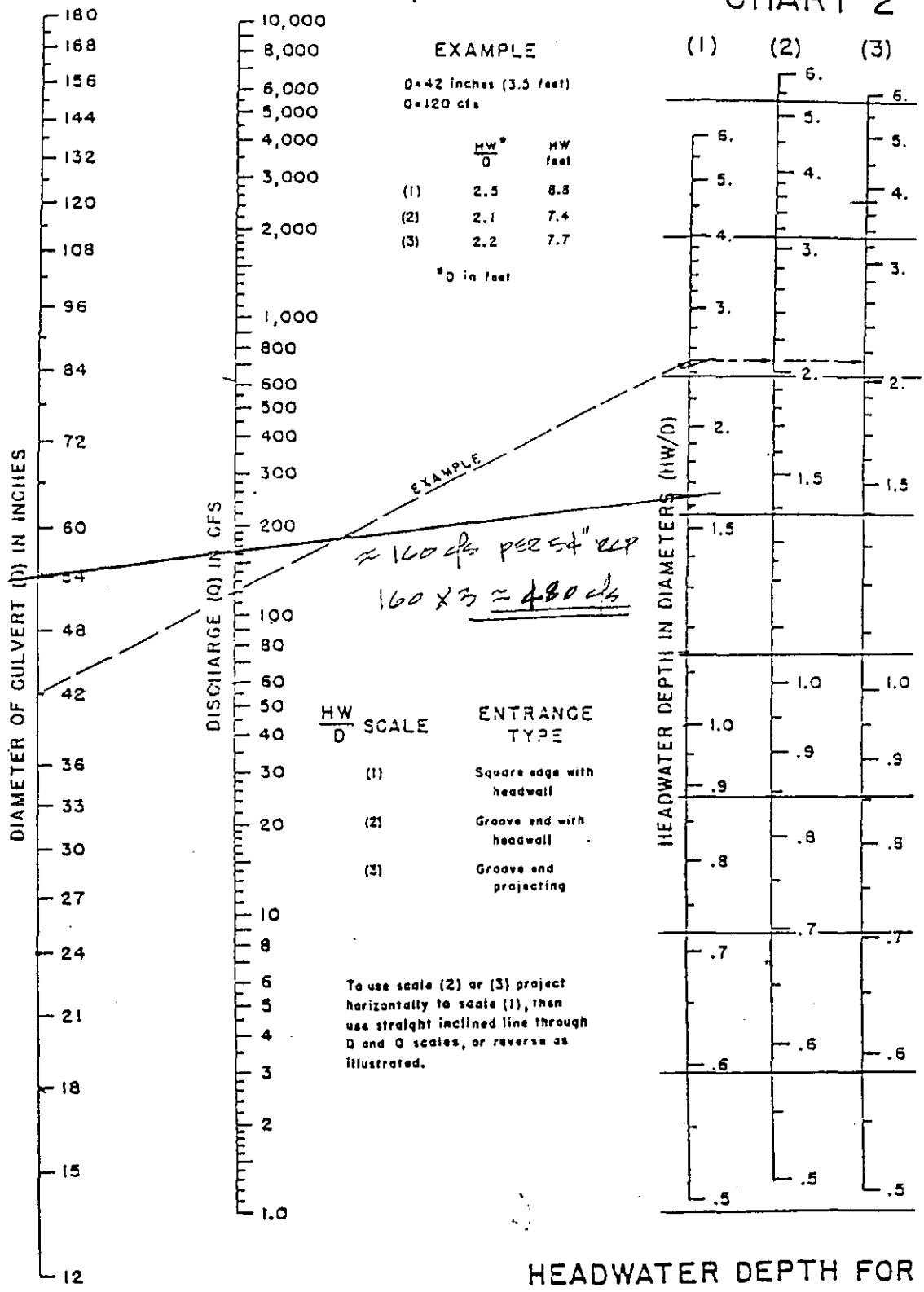
FOR PROPOSED TRIPLE, 54" RCP

$HW = 7.39'$

$\frac{HW}{D} = \frac{7.39'}{54"} = 1.64$

ALLOWABLE INLET CAPACITY.

CHART 2



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 283
REVISED MAY 1964

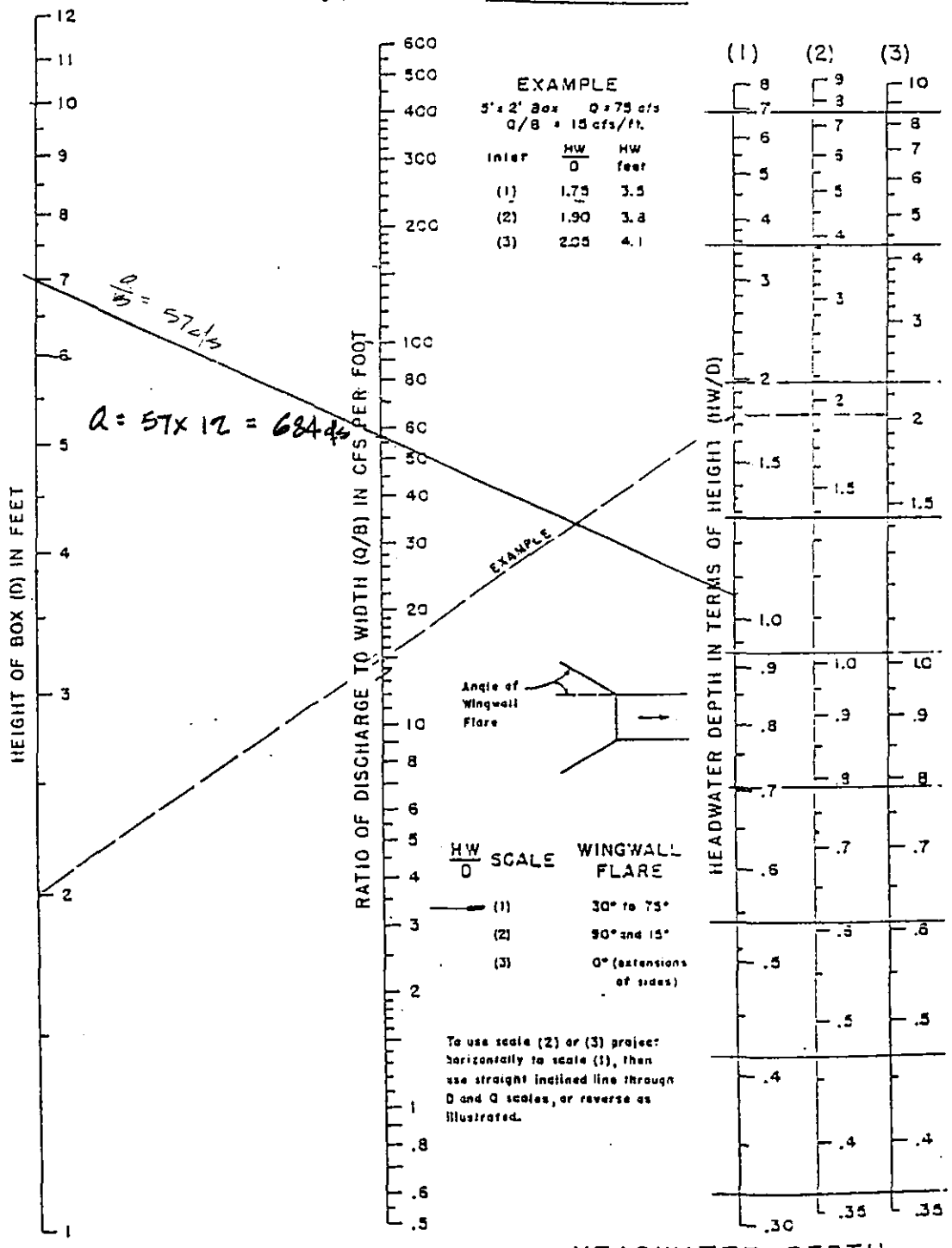
BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER EL = 4 - 7'x12' BOXES WITH WING WALLS

ALL LINES STOP = 7.34' (SOME SLOPE) $\frac{HW}{D} = \frac{7.34}{7} = 1.04$

TOTAL CAPACITY = 684 cfs/box x 4 boxes = 2736 cfs

CHART I



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

APPENDIX D

Miscellaneous Details

P A R T I A L L Y F U L L P I P E

Manning's Equation for flow capacity in a circular pipe.

Capacity of Proposed 48" (Assume full flow)

Input variables:		Output variables:	
		Capacity at d	90.85 cfs
Normal depth, d	48 in	Normal velocity	7.23 fps
Pipe slope	0.0040 ft/ft	Critical depth	36.26 in
Pipe diameter	48 in	Critical velocity	8.20 fps
Manning's n	0.013	Critical slope	0.004 ft/ft

NORTH
1"=60'

SCALE IN FEET

BATTLE MTN. DR.

SEARCHLIGHT DR.

EX. DAYDREAM (UNITS 1 & 7)

STEWART AVE. (PUBLIC)

EX. 8-10'x3.5' RCB

EX. 8 BARREL 10'x3.5' (2CP)

PCC APRON

PUBLIC DRAINAGE EMT. (SEE SHT. 4 FOR DETAIL "SD-1")

SLOAN LN.

DANA RODGERS DR.

HEATHER MARIE DR.

EX. GLENVIEW TOWNHOUSES

EGBERT WAY

KATHRYN MARIE CT.

JUDITH ANN CT.

AMELIA MARIE DR.

KRISTEN LEE CT.

SLOAN CHANNEL

UNDEVELOPED

10' PRIVATE DRAINAGE EASEMENT

EX. CASA BUENA (UNIT 3)

LYRA LN.

PROVIDE DRAIN OPENING IN CMU WALL (SEE SHT. 4 FOR DET. "SD-2")

10'x10'x1.5' THICK 25# ROCK RIPRAP

LEGEND

- EX. CMU WALL
- EX. 'L' CURB
- EDGE EX. AC
- EX. STORM DRAIN
- EX. SEWER & MH
- EX. WATER & GV
- EX. DRAIN INLET
- EX. TELEPHONE MH
- EX. CABLE TV BOX
- EX. OH UTILITY POLE
- EX. STREET LIGHT
- EX. GROUND CONTOUR
- FINISH GRADE CONTOUR
- NEW 'L' CURB
- NEW ROLL CURB
- NEW SIDEWALK
- NEW AC PAVING
- DRAINAGE SWALE
- NEW CMU WALL
- STREET R/W LINE
- SITE BOUNDARY

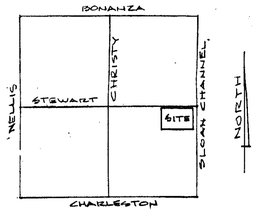
ABBREVIATIONS

AC	ASPHALT CONCRETE
ADD	ADDENDUM
BOC	BACK OF CURB
BFE	BASE FLOOD ELEVATION
BIT	BITUMINOUS
CURB	CURB
COMM	COMMERCIAL
CMU	CONCRETE MASONRY UNIT
CONC	CONCRETE
CTR	CENTER
DET	DETAIL
DI	DRAIN/CURB INLET
DWY	DRIVEWAY
ELEV	ELEVATION
EASEMENT	EASEMENT
EXISTING	EXISTING
FFE	FINISH FLOOR ELEVATION
FGE	FINISH GRADE ELEVATION
FH	FIRE HYDRANT
FL	FLOWLINE
GB	GRADE BREAK
HORIZ	HORIZONTAL
PAVING	PAVING
PCC	PORTLAND CEMENT CONCRETE
PERIMETER	PERIMETER GRADE ELEVATION
PROPERTY	PROPERTY LINE
PUE	PUBLIC UTILITY EASEMENT
PUP	PUBLIC UTILITY POLE
RADIAL	RADIAL
RECT	RECTANGULAR
ROW	RIGHT OF WAY
SECT	SECTION
STLT	STREET LIGHT
SW	SIDEWALK
TOC	TOP OF CURB ELEVATION
TOP	TOP OF PAVING ELEVATION
TOW	TOP OF WALK ELEVATION
TYP	TYPICAL
UNDERGROUND	UNDERGROUND
VERT	VERTICAL
VG	VALLEY/GROSS GUTTER
WSE	WATER SURFACE ELEVATION

LEGAL DESCRIPTION

APN 260-040-003
THE E2 OF THE NW4 OF THE NE4 OF THE SE4 OF SEC. 33, T20S, R62E, MDM
EXCEPT THE NORTH 30'.
TOGETHER WITH
APN 260-040-004
THE N2 OF THE NE4 OF THE NE4 OF THE SE4 OF SEC. 33, T20S, R62E, MDM
EXCEPT THE NORTH 30' AND THE EAST 105'.
TOGETHER WITH
APN 260-040-005
THE S2 OF THE NE4 OF THE NE4 OF THE SE4 OF SEC. 33, T20S, R62E, MDM
EXCEPT THE EAST 100'.

NEW APN: 140-33-701-001, -002, & -003



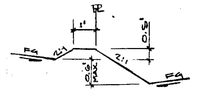
SEC 33, T20S, R62E, MDM
LOCATION MAP
NO SCALE

RETAINING WALL NOTE

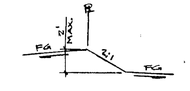
ALL NEW CMU WALLS SHOWN ON THE PLAN ARE RETAINING WALLS AND ARE A STANDARD CLARK COUNTY RETAINING WALL DESIGN. A CLARK COUNTY BUILDING DEPARTMENT WALL CONSTRUCTION PERMIT MUST BE OBTAINED PRIOR TO WALL CONSTRUCTION.

ALL ONSITE STREETS ARE PRIVATE

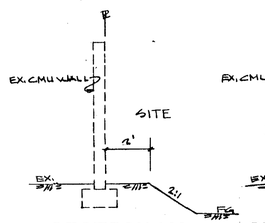
TYPICAL LOT SECTION
NO SCALE



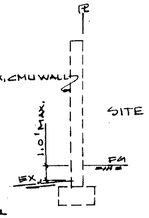
TYP. SIDE YARD SLOPE BANK
NO SCALE



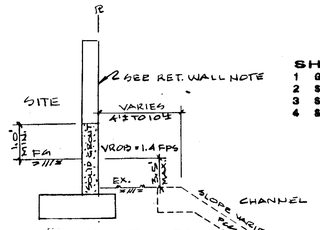
TYP. REAR YARD SLOPE BANK
NO SCALE



SECTION 'A'
NO SCALE



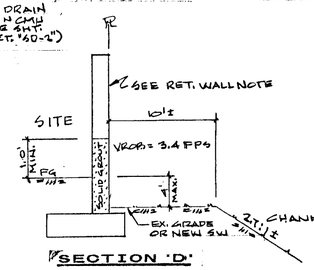
SECTION 'B'
NO SCALE



SECTION 'C'
NO SCALE

SHEET INDEX

1 GRADING PLAN
2 SEWER & WATER PLANS
3 STREET PLAN & PROFILE
4 STREET LIGHT & SIGNING



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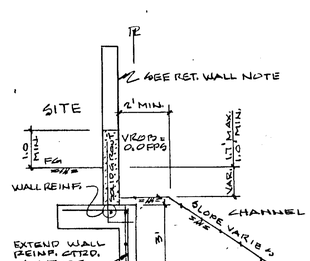

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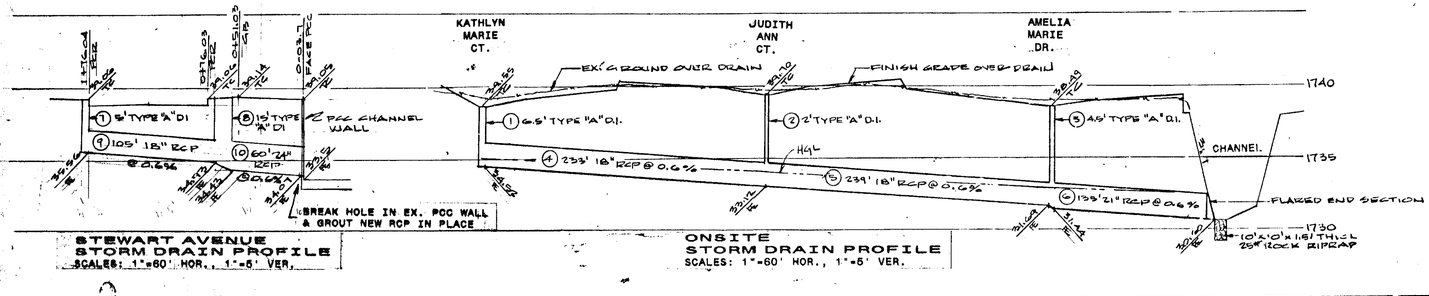


STEWART AVENUE STORM DRAIN PROFILE
SCALES: 1"=60' HOR., 1"=6' VER.

ONSITE STORM DRAIN PROFILE
SCALES: 1"=60' HOR., 1"=6' VER.

REVISIONS

1 EN 6/15/95 REVISED ALIGNMENT, STORM DRAIN & FLOW GRADE

BASIS OF BEARING

NORTH LINE OF THE NE4 OF SEC. 33, T20S, R62E, MDM PER BK 25, PG 27 OF RECORDED PLATS
IE; S89°42'56"W

BENCHMARK

NEW 70 DISTRICT
ELEV - 1758.37

ENGINEER

RYAN NOVAK
4782 SOUTH NELLIS BLVD.
LAS VEGAS, NV 89121
PHONE: 456-6734

GRADING PLAN

MAGNOLIA ESTATES

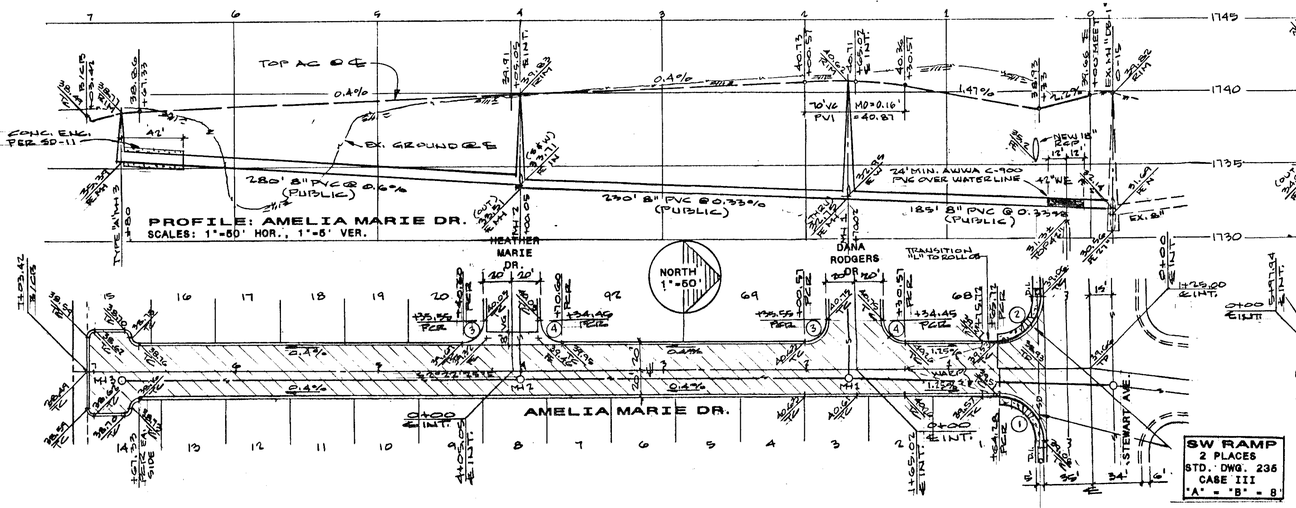
(AKA CIBOLA)
CLARK COUNTY, NEVADA

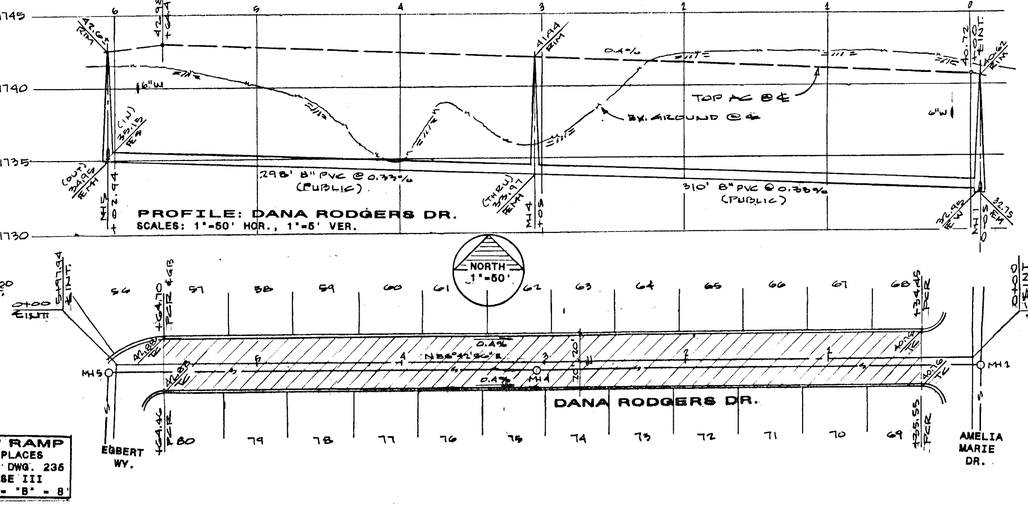
SHEET 1 OF 4

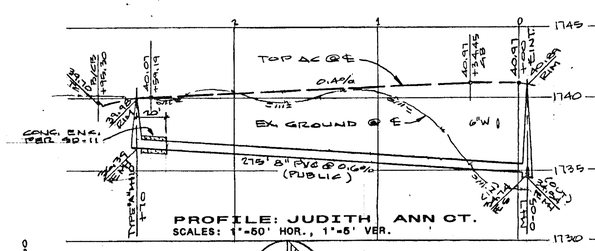
H.T.E. 95-21150

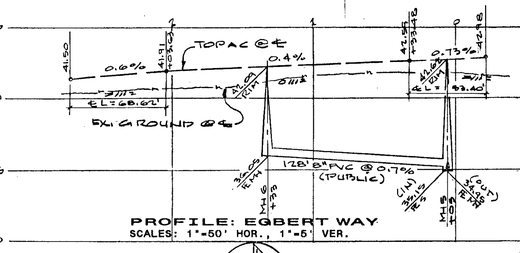
HTE DESIG. DS = 94-26236
AMEND. DS = 95-11726
IMP. PLS. = 95-21150

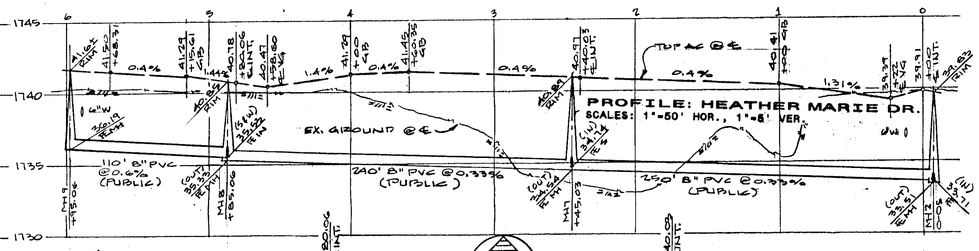
SCALE IN FEET 0 50 100 200

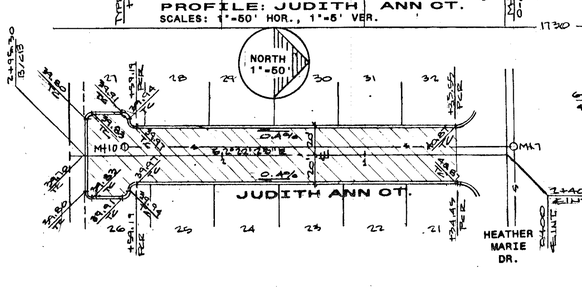


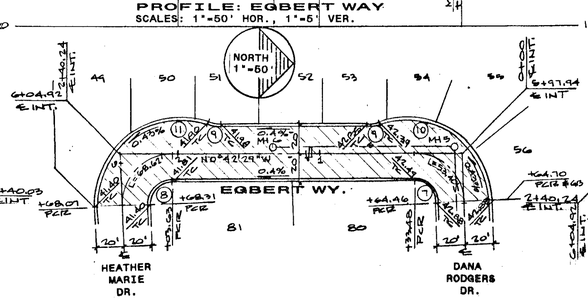


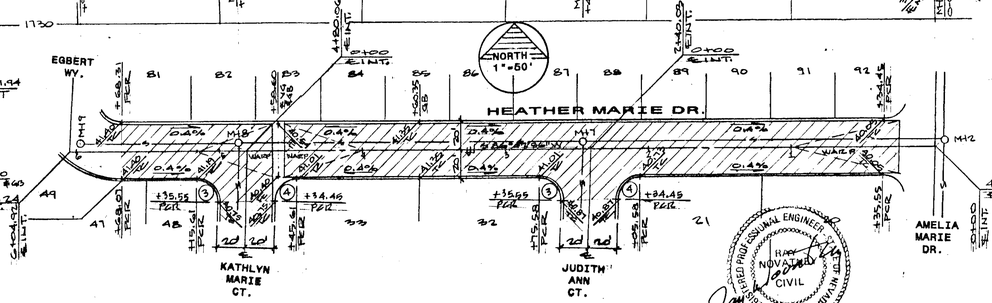


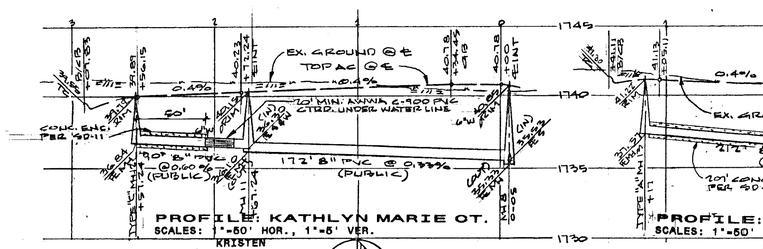


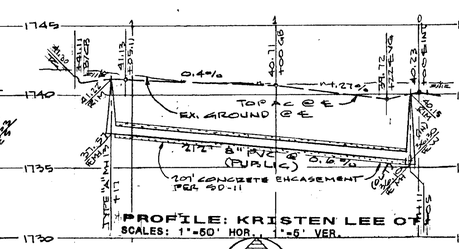


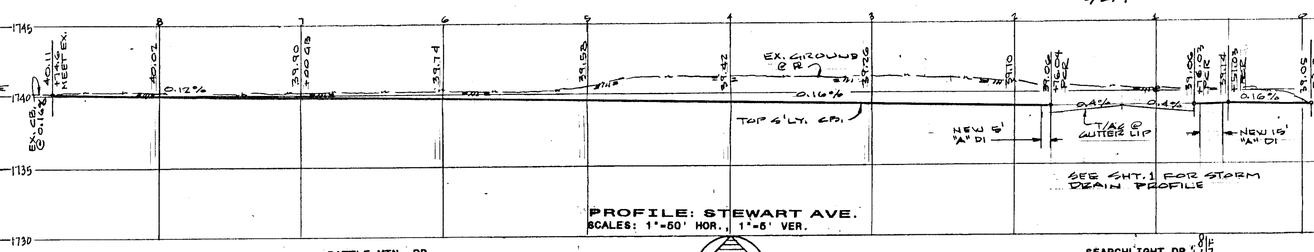










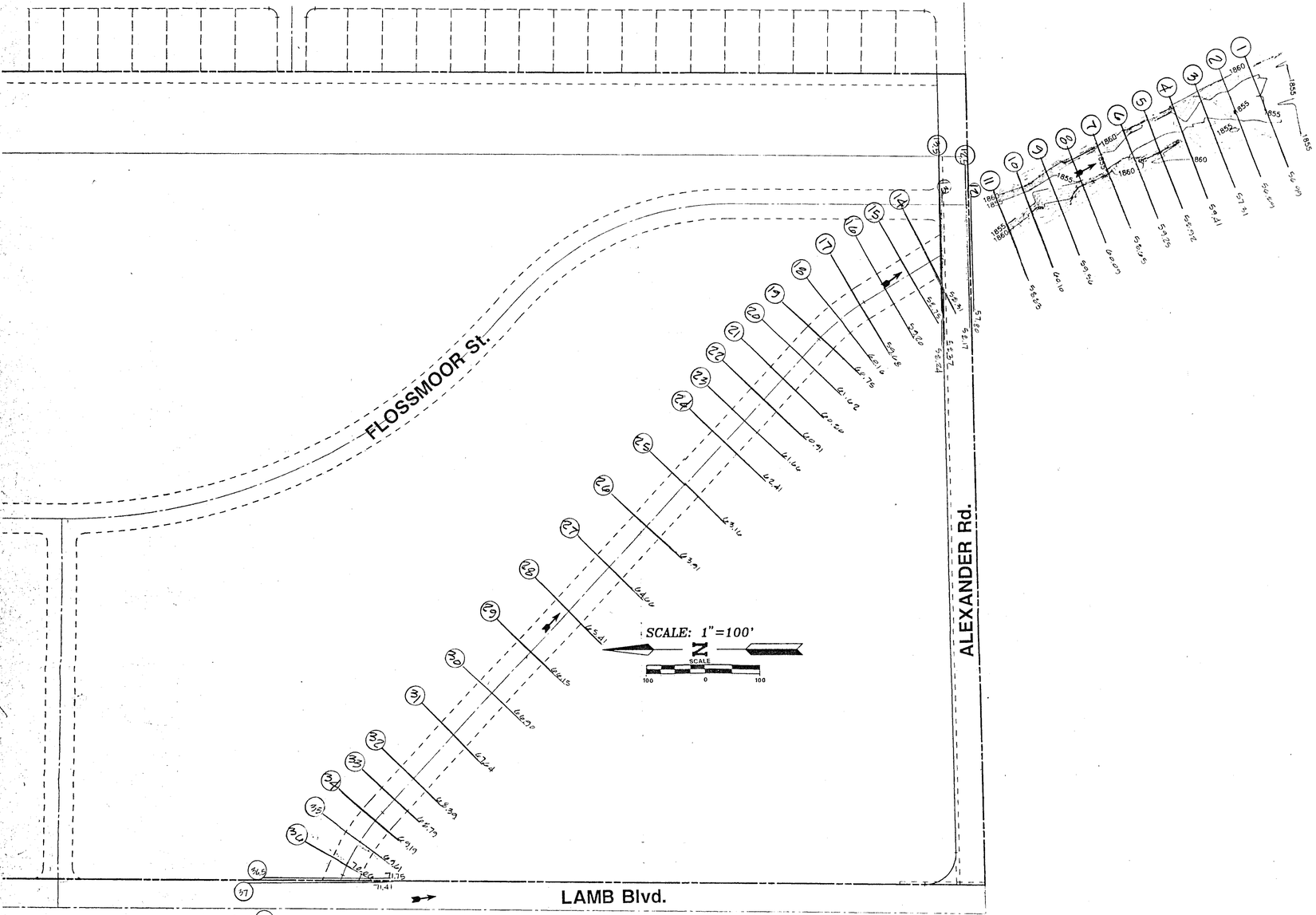


REVISIONS
NO. BY DATE REVISION

BENCHMARK
CCBM 7502273WS
ELEV - 1758.57

ENGINEER
RAY NOVATNEY, PE
4210 SOUTH NELLIS BLVD.
LAS VEGAS, NV 89121
PHONE: 456-6734

SHEET 3 OF 4
STREET PLAN & PROFILE
MAGNOLIA ESTATES
(AKA CIBOLA)
CLARK COUNTY, NEVADA



LEGEND

56.17 CWSE (Supercritical flow)

(12) HEC-2 SECTION

PROPOSED HEC-2 SECTION MAP
COLLINS BUSINESS PARK PHASE II

ESI ENGINEERS AND SURVEYORS INC.
PLANNERS • CONSULTING ENGINEERS • SURVEYORS
7548 W. SAHARA AVE. • LAS VEGAS, NEVADA 89117 • (702) 248-6415

01-12-96 - REV'D CHNGS PER CCRFD

VOLUME 6

SECTION 5

REFERENCE MATERIALS

EXHIBITS A - E

Design & Layout: Louis Jones

TECHNICAL SUPPORT DATA NOTEBOOK

FOR

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

INCLUDING:

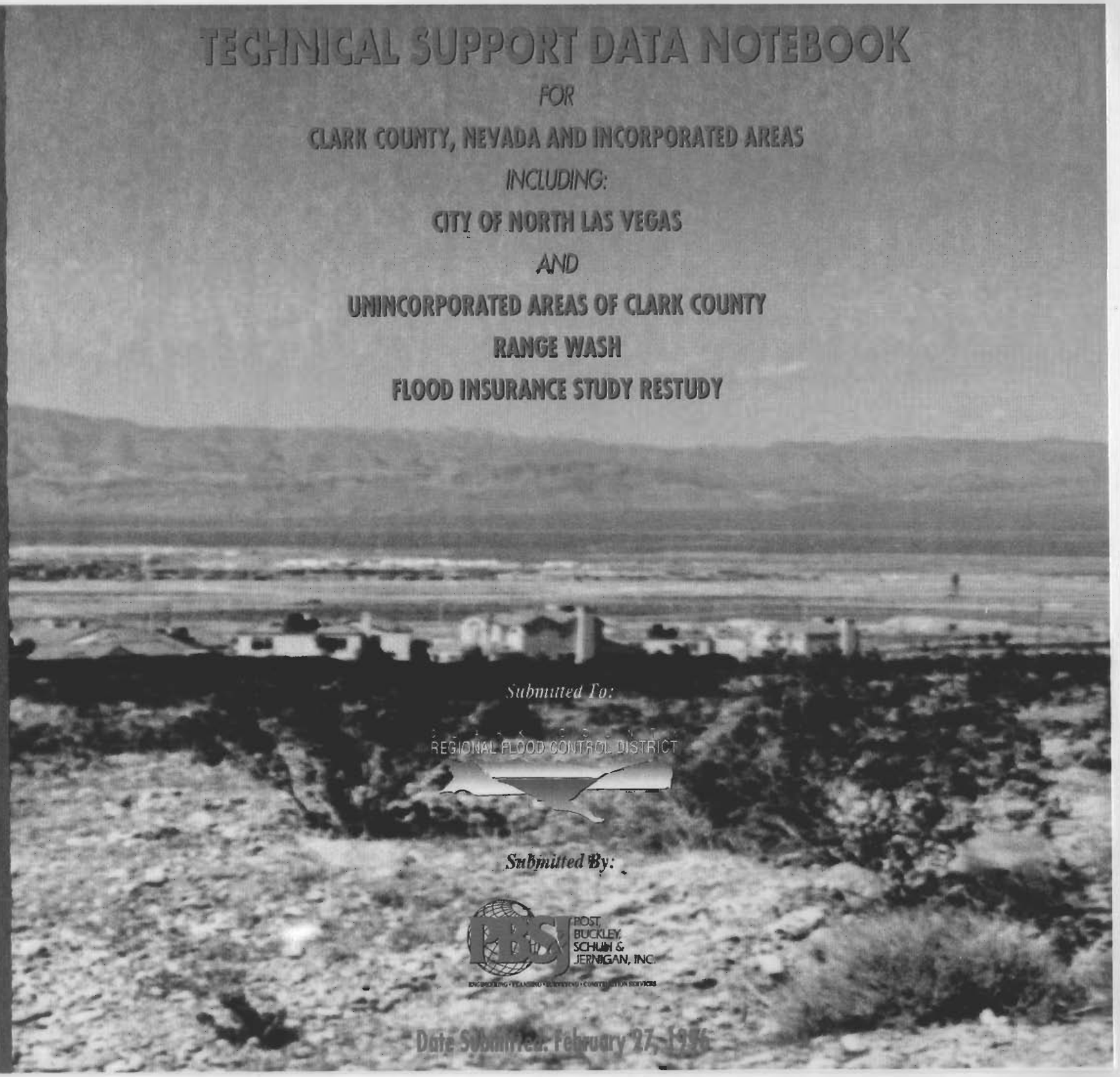
CITY OF NORTH LAS VEGAS

AND

UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH

FLOOD INSURANCE STUDY RESTUDY



Submitted To:

REGIONAL FLOOD CONTROL DISTRICT

Submitted By:

PBS POST, BUCKLEY, SCHUH & JERNIGAN, INC.

ENGINEERING • PLANNING • SURVEYING • CONSTRUCTION SERVICES

Date Submitted: February 27, 1996

TECHNICAL SUPPORT DATA NOTEBOOK

for

CLARK COUNTY, NEVADA AND INCORPORATED AREAS
INCLUDING:
CITY OF NORTH LAS VEGAS
AND
UNINCORPORATED AREAS OF CLARK COUNTY

RANGE WASH
FLOOD INSURANCE STUDY RESTUDY

VOLUME 6

SECTION 5 REFERENCE MATERIALS
EXHIBITS A-E

Submitted by:	**Clark County Regional Flood Control District**
Study Contractor:	**Post, Buckley, Schuh & Jernigan, Inc.**
Date Submitted:	**February 27, 1996**

TABLE OF CONTENTS
(Continued)

VOLUME 6

SECTION 5 MISCELLANEOUS REFERENCE MATERIALS

5.6 EXHIBITS A-E

EXHIBIT

A — West Range Wash Diversion Dike
As-Built Drawings

B — Range Wash/Sloan Channel Phase 1
Nellis Air Force Base (NAFB) Channel
As-Built Drawings

C — Range Wash/Sloan Channel
Confluence Detention Basin and
Sloan Diversion Channel Modification
Construction Drawings

D — Sloan Channel
Owens Avenue to Stewart Avenue
As-Built Drawings

E — Collins Business Park Phase II Improvement Plans

EXHIBIT A

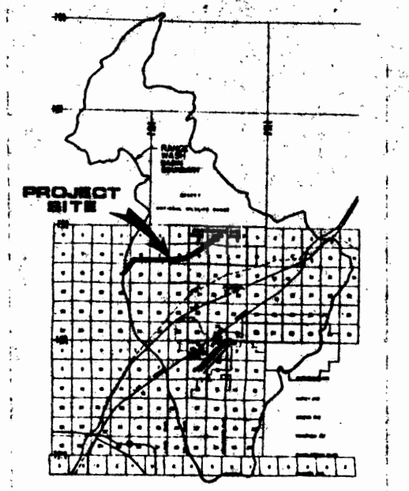
West Range Wash Diversion Dike
As-Built Drawings

CITY OF NORTH LAS VEGAS, NEVADA

DEPARTMENT OF PUBLIC WORKS

WEST RANGE WASH DIVERSION DIKE

FUNDED BY: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT



VICINITY MAP
NO SCALE

LIST OF DRAWINGS

DWG NO	TITLE			
1	COVER SHEET			
2	KEY MAP, QUANTITIES, LEGEND, ABBREVIATIONS, GENERAL NOTES			
G-1	GEOMETRY PLAN	0+00.00	TO	170+00.00
G-2	GEOMETRY PLAN	170+00.00	TO	320+00.00
F-1	FLOODWAY PLAN AND PROFILE	1+00.00	TO	30+00.00
F-2	FLOODWAY PLAN AND PROFILE	30+00.00	TO	55+00.00
D-1	DIKE PLAN AND PROFILE	55+00.00	TO	84+00.00
D-2	DIKE PLAN AND PROFILE	84+00.00	TO	113+00.00
D-3	DIKE PLAN AND PROFILE	113+00.00	TO	142+00.00
D-4	DIKE PLAN AND PROFILE	142+00.00	TO	171+00.00
D-5	DIKE PLAN AND PROFILE	171+00.00	TO	200+00.00
D-6	DIKE PLAN AND PROFILE	200+00.00	TO	229+00.00
D-7	DIKE PLAN AND PROFILE	229+00.00	TO	258+00.00
D-8	DIKE PLAN AND PROFILE	258+00.00	TO	287+00.00
D-9	DIKE PLAN AND PROFILE	287+00.00	TO	305+00.00
D-10	DIKE PLAN AND PROFILE	305+00.00	TO	320+00.00
C-1	ROADWAY CROSSING PLAN AND PROFILE			
DT-1	CHANNEL AND FLOODWAY SECTIONS			
DT-2	ROADWAY SECTIONS AND DETAILS			
DT-3	ROADWAY CROSSING SIGNAGE PLAN AND DETAILS			

VERTICAL DATUM

CITY OF NORTH LAS VEGAS MONUMENTATION BASED ON BENCHMARK № 514-115 AND BENCHMARK № 6-17-134.

PLANS REVIEWED BY:

6-9-92
NLV OFFICE ENGINEER — DATE

6-8-92
NLV RIGHT-OF-WAY — DATE

3-17-93
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT — DATE

6/9/92
NLV TRAFFIC ENGINEER — DATE

CITY OF NORTH LAS VEGAS

MAYOR
JAMES K. SEASTRAND

COUNCIL
THERON H. GOYNES
MARY J. KINCAID
WILLIAM E. ROBINSON
W. BRENT HARDY

APPROVALS

3.15.93
GARY W. HOLLER, R.P.E. #1920 — DATE
DIRECTOR OF PUBLIC WORKS

MARCH 12, 1993
JAMES A. BELL, R.P.E. #4524 — DATE
CITY ENGINEER

3-15-93

3-25-93

SHEET 1 OF 20 SHEETS

PROJECT: WEST RANGE WASH DIVERSION DIKE | BID NO.: 872 | BID DATE MAY 19, 1993 | NO. 180 DAYS

ESTIMATED QUANTITIES

DESCRIPTION OF ITEM	QUANTITY	UNIT
MOBILIZATION	1	LS
STRIPPING	85	ACRES
CLEARING AND GRUBBING	85	ACRES
FLOODWAY AND DIP SECTION EXCAVATION (STA 0+00 TO 55+00)	93,000	CY
CHANNEL EXCAVATION (STA 55+00 TO 320+00)	930,000	CY
DIKE FILL (STA 0+00 TO 55+00	35,000	CY
DIKE FILL (STA 55+00 TO 320+00	810,000	CY
SOIL CEMENT (STA 0+00 TO 55+00)	13,000	CY
BULK CEMENT	1095	TON
RIP-RAP WITH FILTER BLANKET	360	CY
SOIL CEMENT SUBGRADE	33,000	SY
CONSTRUCTION WATER MOBILIZATION	1	LS
CONSTRUCTION WATER QUANTITY	90,000	1000 GAL
MISCELLANEOUS SIGNAGE, FENCING AND TRAFFIC CONTROL	1	LS
GRAVEL ROADWAY RELOCATION	1	LS
SEDIMENTATION MONUMENT	31	EA
CONSTRUCTION CONFLICTS	70,000	$

NOTE:

THE CUT AND FILL VOLUMES SHOWN IN TABLE "A" ARE THOSE VOLUMES BETWEEN ORIGINAL GROUND CONTOURS AND NEAT LINES OF EMBANKMENT FILLS AND EXCAVATION CUTS. NO ALLOWANCE HAS BEEN MADE FOR SHRINKAGE, MATERIAL LOSSES DURING CLEARING, GRUBBING, AND STRIPPING OR WASTE. THE CONTRACTOR SHALL TRANSPORT EXCAVATED MATERIAL AS REQUIRED TO COMPLETE FILL EMBANKMENTS SHOULD STATION LIMITS CHANGE BE ENCOUNTERED.

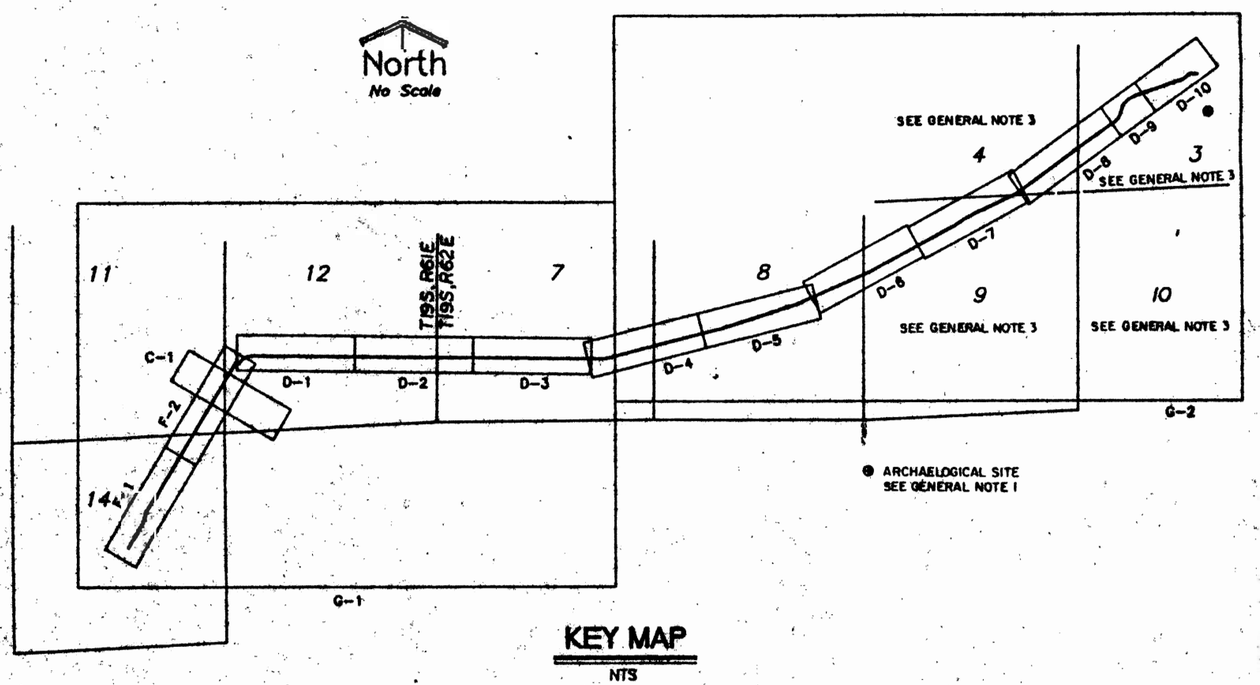
TABLE "A"

DIKE AND CHANNEL EARTHWORK VOLUMES
STA 55+00 to 320+00

STA FT	CUT CU YD	FILL CU YD	SUM CUT CU YD	SUM FILL CU YD	EXTRA CU YD
55+00	0	0	0	0	0
60+00	19501	11211	48617	18650	87967
70+00	18547	14658	67166	31260	31906
75+00	14958	14983	82123	45243	32782
80+00	14543	14544	96666	59795	32871
85+00	13218	14269	109884	74064	33375
90+00	14898	14530	124782	88594	33682
95+00	15147	14638	139929	103232	33961
100+00	18503	13472	158432	116704	39871
105+00	16314	14929	174746	131633	40458
110+00	17264	13879	192010	145512	44148
115+00	16435	13857	208445	159369	50810
120+00	17988	13587	226433	172956	54924
125+00	17576	14363	244009	187319	57936
130+00	19856	12852	263865	200171	64940
135+00	18347	13817	283212	213988	70071
140+00	18014	14423	301362	227900	73662
145+00	14936	15833	316298	243734	72364
150+00	15901	15098	331999	258833	73166
155+00	11546	11654	343544	270487	69294
160+00	16781	14029	360326	284499	69574
165+00	16239	13288	376565	297711	70891
170+00	13517	13575	390082	311286	71133
175+00	13068	13099	403150	324385	70723
180+00	16963	13358	420113	341844	70307
185+00	15813	14875	435926	356719	70945
190+00	19197	14368	455123	371087	71977
195+00	17818	14298	472941	385376	72693
200+00	19493	12387	492434	397763	73908
205+00	20266	12174	512700	409937	72099
210+00	14856	15615	527556	425554	72398
215+00	14621	15249	542177	440803	72502
220+00	17733	13628	559910	454431	72810
225+00	17006	13867	576916	468298	73158
230+00	18986	12821	595902	481119	73579
235+00	17411	13621	613313	494740	73789
240+00	20092	11997	633405	506737	74090
245+00	19886	12751	653291	519488	73419
250+00	16427	13798	669718	533286	73604
255+00	18931	13121	688649	546407	73044
260+00	13748	15441	702397	561848	73341
265+00	19078	14681	721475	576529	73709
270+00	20423	13976	741898	590505	73175
275+00	17488	14195	759386	604700	73469
280+00	16060	14588	775446	619288	73933
285+00	17775	13781	793221	633069	73973
290+00	17594	13949	810815	647018	73979
295+00	16913	13784	827728	660802	73207
300+00	21996	12092	849724	672894	73609
305+00	18508	13215	868232	686110	73678
310+00	15989	14911	884221	700992	73551
315+00	16945	13113	901166	714104	73384
320+00	8887	17279	910053	728435	73091

FLOODWAY EARTHWORK VOLUMES
STA 0+00 TO 55+00

STA FT	CUT CU YD	FILL CU YD	SUM CUT CU YD	SUM FILL CU YD	EXTRA CU YD
0+00	0	0	0	0	0
5+00	6773	157	6773	157	3679
10+00	10967	3896	17740	4054	12886
15+00	5615	2414	23355	7268	16087
20+00	4707	3142	28062	11809	17053
25+00	3206	3964	31268	14933	16295
30+00	2849	4250	34118	19223	14894
35+00	3582	3549	37619	22769	14851
40+00	4179	3972	41798	26741	15057
45+00	7931	2982	49729	29724	20006
50+00	10195	884	59925	30608	37317
55+00	24495	877	92620	31485	61135



KEY MAP

NTS

LEGEND

- SURVEY LINE
- CENTER LINE
- RIGHT-OF-WAY
- CONSTRUCTION EASEMENT
- NELLIS AFB BOUNDARY
- BLM BOUNDARY
- SECTION LINE
- APPROXIMATE BORING LOCATION
- APPROXIMATE TRENCH LOCATION
- FOR SEDIMENT TRANSPORT ANALYSIS
- CHANNEL SEDIMENTATION MONUMENT
- EXISTING FENCE
- EXISTING UTILITY POLE
- EXISTING POST
- EXISTING SURVEY MONUMENT (HV-31, 1814.64)
- EXISTING STRUCTURE
- EXISTING EDGE OF PAVEMENT
- SAWCUT
- RIP RAP
- SOIL CEMENT

GENERAL NOTES

1. CONTRACTOR SHALL KEEP CONSTRUCTION ACTIVITIES AND WORKERS AWAY FROM ARCHAEOLOGICAL SITE AT EAST END OF PROJECT SITE. IF HISTORICAL OR ARCHAEOLOGICAL REMAINS ARE ENCOUNTERED CONSTRUCTION SHALL BE TEMPORARILY HALTED AND ENGINEER NOTIFIED. SEE SPECIAL PROVISIONS.
2. CONTRACTOR'S WORKERS SHALL UNDERGO DESERT TORTOISE TRAINING AND THEREAFTER COMPLY WITH ALL REGULATIONS AND INSTRUCTIONS PROVIDED BY QUALIFIED DESERT TORTOISE BIOLOGIST. SEE SPECIAL PROVISIONS.
3. ACCESS TO SECTIONS 3,4,9, AND 10 IS CONTROLLED BY NELLIS AIR FORCE BASE (NAFB). ACTIVE SMALL ARMS RANGE IS LOCATED IN SECTION 9. CONTRACTOR SHALL COORDINATE CLOSELY WITH NAFB TO SCHEDULE ACCESS AND CONSTRUCTION ACTIVITIES. NAFB SAFETY PERSONNEL HAVE CONDUCTED A PRELIMINARY "SWEEP" ALONG PROPOSED DIKE ALIGNMENT FOR POSSIBLE UNEXPLODED ORDNANCE. FOLLOWING CONSTRUCTION STAKING, CONTRACTOR SHALL NOTIFY ENGINEER FOR COORDINATION OF POSSIBLE ADDITIONAL ORDNANCE "SWEEP" BY NAFB. IF MEMORIAL OBJECTS ARE DETECTED DURING CONSTRUCTION, CONTRACTOR SHALL TEMPORARILY HALT WORK AND NOTIFY ENGINEER. SEE SPECIAL PROVISIONS.
4. TEMPORARY GATES SHALL BE CONSTRUCTED ACROSS HAUL ROADS WHERE THEY ENTER/EXIT NAFB. THESE GATES SHALL BE OF THE SAME QUALITY AND MATERIAL AS FENCE WHICH IS TEMPORARILY REMOVED.
5. CONSTRUCTION SHALL BEGIN FROM THE DOWNSTREAM END CONTINUING UPSTREAM TO PROVIDE PROTECTION FROM FLOOD WATERS. CONTRACTOR SHALL DIVERT ALL DRAINAGE FROM CHANNELS PRIOR TO EXCAVATION AND BE RESPONSIBLE FOR CONTROL OF ALL STORM WATERS DURING CONSTRUCTION.
6. WHERE THICKNESS OF SOIL CEMENT, RIP-RAP, STRIPPING, PAVEMENT AND SIMILAR DIMENSIONS OF IMPROVEMENTS ARE INDICATED, THEY SHALL BE THE MINIMUM THICKNESS AND DIMENSIONS OF MATERIALS AND IMPROVEMENTS PROVIDED.
7. PHONE REFERENCES NELLIS AIRFORCE BASE:
   1. NELLIS AFB SAFETY — 652-4049
   2. COMBAT TRAINING SQUADRON — 652-9521
   3. NELLIS REAL ESTATE — 652-3302

ABBREVIATIONS

@	AT	PC	POINT OF CURVATURE
A/C, AC	ASPHALTIC CONCRETE	PI	POINT OF INTERSECTION
BVC	BEGIN VERTICAL CURVE	PT	POINT OF TANGENCY
℄	CENTERLINE	PVI	PT OF VERT CURVE INTERSECTION
DET	DETAIL	PVMT	PAVEMENT
DWG	DRAWING	R	RADIUS
E	EAST	RD	ROAD
EA	EACH	R/W, ROW	RIGHT-OF-WAY
EG	EXISTING GRADE	RT	RIGHT
EL, ELEV	ELEVATION	S	SOUTH
EVC	END VERTICAL CURVE	SHT	SHEET
EXIST, EX	EXISTING	STA	STATION
FG	FINISHED GRADE	STD	STANDARD
FL	FLOW LINE	TRANS	TRANSITION
FT	FOOT, FEET	TYP	TYPICAL
GB	GRADE BREAK	VC	VERTICAL CURVE
HORIZ	HORIZONTAL	VERT	VERTICAL
LF	LINEAL FEET	W	WEST
MAX	MAXIMUM	W/	WITH
MIN	MINIMUM	W/O	WITHOUT
N	NORTH		
NO	NUMBER		
NTS	NOT TO SCALE		
OC	ON CENTER		
OHP	OVERHEAD POWER		

NO	DATE	BY	REVISION

DESIGNED: WGH
DRAWN: DM
CHECKED: WGH

PROJECT ENGINEER — DATE 2-23-92
PROJECT MANAGER — DATE 2-24-92

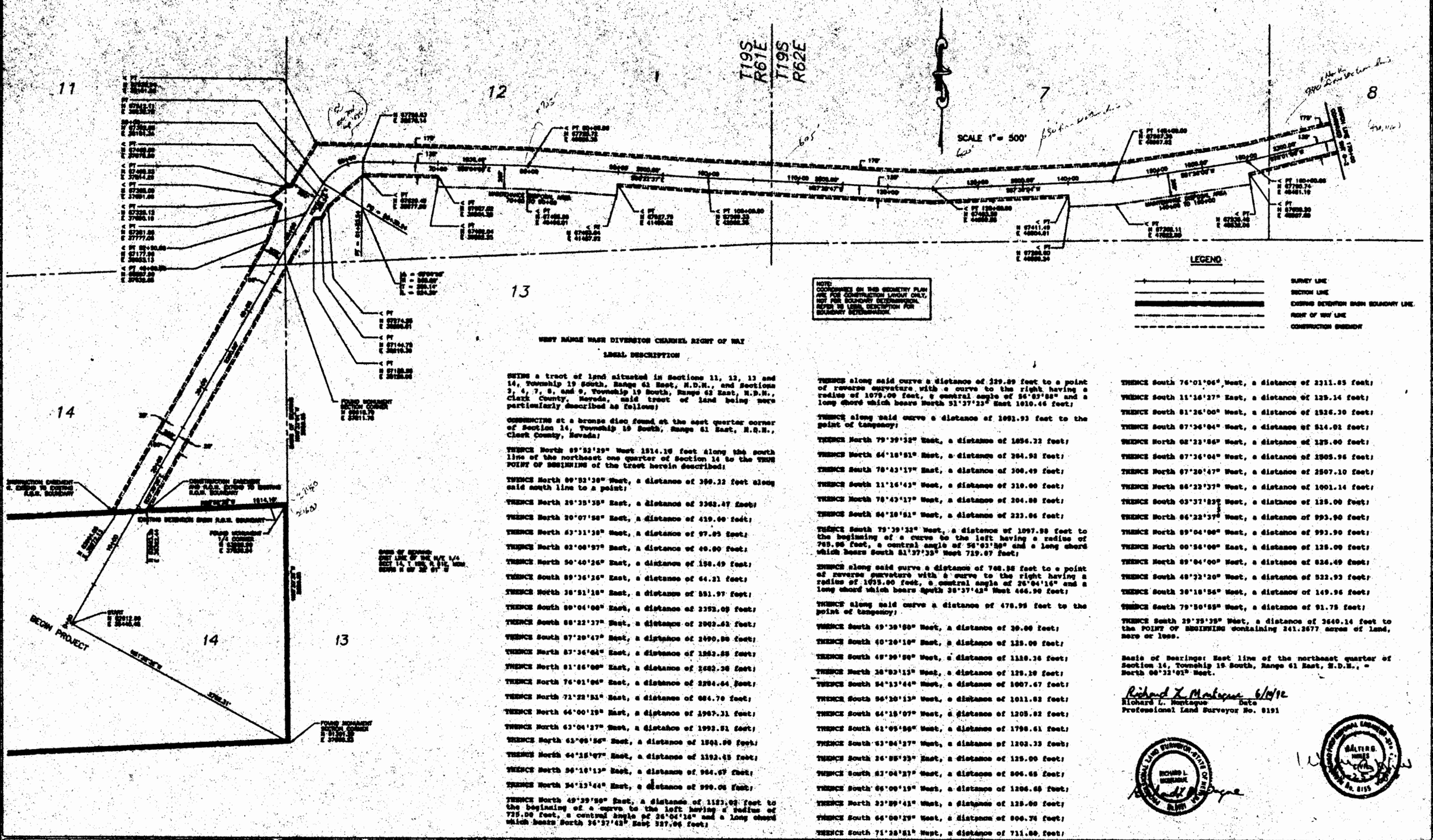
Boyle Engineering Corporation
consulting engineers
1785 E. Sahara Ave., Las Vegas, NV 89104 (702) 731-9511

CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

WEST RANGE WASH DIVERSION DIKE

KEY MAP, QUANTITIES, LEGEND, ABBREVIATIONS, GENERAL NOTES

DRAWING 2
2 OF 20



WEST RANGE WASH DIVERSION CHANNEL RIGHT OF WAY

LEGAL DESCRIPTION

BEING a tract of land situated in Sections 11, 12, 13 and 14, Township 19 South, Range 61 East, M.D.M., and Sections 3, 4, 7, 8, and 9, Township 19 South, Range 62 East, M.D.M., Clark County, Nevada, said tract of land being more particularly described as follows:

COMMENCING at a bronze disc found at the east quarter corner of Section 14, Township 19 South, Range 61 East, M.D.M., Clark County, Nevada;

THENCE North 89°32'29" West 1514.10 feet along the south line of the northeast one quarter of Section 14 to the TRUE POINT OF BEGINNING of the tract herein described;

THENCE North 89°32'30" West, a distance of 300.22 feet along said south line to a point;

THENCE North 29°35'38" East, a distance of 3368.47 feet;

THENCE North 20°07'58" East, a distance of 419.00 feet;

THENCE North 69°31'38" West, a distance of 97.05 feet;

THENCE North 02°08'57" East, a distance of 40.00 feet;

THENCE North 50°40'26" East, a distance of 158.49 feet;

THENCE South 89°36'26" East, a distance of 64.21 feet;

THENCE North 38°51'18" East, a distance of 851.97 feet;

THENCE South 89°04'00" East, a distance of 2392.09 feet;

THENCE South 88°22'37" East, a distance of 2063.62 feet;

THENCE South 87°20'47" East, a distance of 2490.98 feet;

THENCE North 87°36'04" East, a distance of 1863.85 feet;

THENCE North 81°36'00" East, a distance of 2682.36 feet;

THENCE North 76°01'06" East, a distance of 2284.64 feet;

THENCE North 71°23'51" East, a distance of 684.79 feet;

THENCE North 64°00'19" East, a distance of 1967.31 feet;

THENCE North 63°04'27" East, a distance of 1993.51 feet;

THENCE North 61°05'56" East, a distance of 1564.90 feet;

THENCE North 64°15'47" East, a distance of 1192.45 feet;

THENCE North 56°10'13" East, a distance of 964.67 feet;

THENCE North 54°13'44" East, a distance of 990.06 feet;

THENCE North 49°39'59" East, a distance of 1123.03 feet to the beginning of a curve to the left having a radius of 725.00 feet, a central angle of 26°04'16" and a long chord which bears North 36°37'42" East 327.06 feet;

THENCE along said curve a distance of 329.89 feet to a point of reverse curvature with a curve to the right having a radius of 1079.00 feet, a central angle of 54°03'58" and a long chord which bears North 51°37'23" East 1010.46 feet;

THENCE along said curve a distance of 1091.93 feet to the point of tangency;

THENCE North 79°39'32" East, a distance of 1056.22 feet;

THENCE North 64°18'51" East, a distance of 204.91 feet;

THENCE South 70°43'17" East, a distance of 306.49 feet;

THENCE South 11°16'43" West, a distance of 310.00 feet;

THENCE North 70°43'17" West, a distance of 204.88 feet;

THENCE South 64°18'51" West, a distance of 223.06 feet;

THENCE South 79°39'32" West, a distance of 1097.98 feet to the beginning of a curve to the left having a radius of 765.00 feet, a central angle of 56°03'58" and a long chord which bears South 51°37'33" West 719.07 feet;

THENCE along said curve a distance of 748.58 feet to a point of reverse curvature with a curve to the right having a radius of 1035.00 feet, a central angle of 26°04'16" and a long chord which bears South 36°37'42" West 466.90 feet;

THENCE along said curve a distance of 470.98 feet to the point of tangency;

THENCE South 49°39'59" West, a distance of 30.00 feet;

THENCE South 40°20'10" East, a distance of 125.00 feet;

THENCE South 49°39'59" West, a distance of 1118.36 feet;

THENCE North 36°03'13" West, a distance of 129.10 feet;

THENCE South 54°13'44" West, a distance of 1007.67 feet;

THENCE South 56°10'13" West, a distance of 1011.82 feet;

THENCE South 64°15'07" West, a distance of 1205.82 feet;

THENCE South 61°05'56" West, a distance of 1798.61 feet;

THENCE South 63°04'27" West, a distance of 1203.33 feet;

THENCE South 26°55'33" East, a distance of 125.00 feet;

THENCE South 63°04'27" West, a distance of 806.65 feet;

THENCE South 66°00'19" West, a distance of 1206.65 feet;

THENCE North 23°59'41" West, a distance of 125.00 feet;

THENCE South 66°00'19" West, a distance of 806.76 feet;

THENCE South 71°23'51" West, a distance of 711.80 feet;

THENCE South 76°01'06" West, a distance of 2311.85 feet;

THENCE South 11°16'27" East, a distance of 125.14 feet;

THENCE South 81°36'00" West, a distance of 1526.30 feet;

THENCE South 87°36'04" West, a distance of 514.01 feet;

THENCE North 02°23'56" West, a distance of 125.00 feet;

THENCE South 87°36'04" West, a distance of 1965.96 feet;

THENCE North 87°20'47" West, a distance of 2507.10 feet;

THENCE North 88°22'37" West, a distance of 1001.14 feet;

THENCE South 03°37'23" West, a distance of 125.00 feet;

THENCE North 86°22'37" West, a distance of 993.90 feet;

THENCE North 89°04'00" West, a distance of 993.90 feet;

THENCE North 00°56'00" East, a distance of 125.00 feet;

THENCE North 89°04'00" West, a distance of 826.49 feet;

THENCE South 48°32'20" West, a distance of 522.93 feet;

THENCE South 30°18'56" West, a distance of 149.96 feet;

THENCE South 79°50'55" West, a distance of 91.75 feet;

THENCE South 29°35'38" West, a distance of 3640.14 feet to the POINT OF BEGINNING containing 241.3677 acres of land, more or less.

Basis of Bearings: East line of the northeast quarter of Section 14, Township 19 South, Range 61 East, M.D.M., = North 00°32'01" West.

Richard L. Montague 6/8/12
Richard L. Montague Date
Professional Land Surveyor No. 8191

RICHARD L. MONTAGUE — STATE OF NEVADA — No. 8191

WALTER G. HINES — No. 6155

MARK	DATE	BY	REVISION

DESIGNED: WJH
DRAWN: WJH
CHECKED: WGH

PROJECT ENGINEER — DATE
PROJECT MANAGER — 1-25-11 DATE

Boyle Engineering Corporation
consulting engineers / surveyors
1795 E. Sahara Ave., Ste. 300, Las Vegas, NV 89104 (702) 731-3581

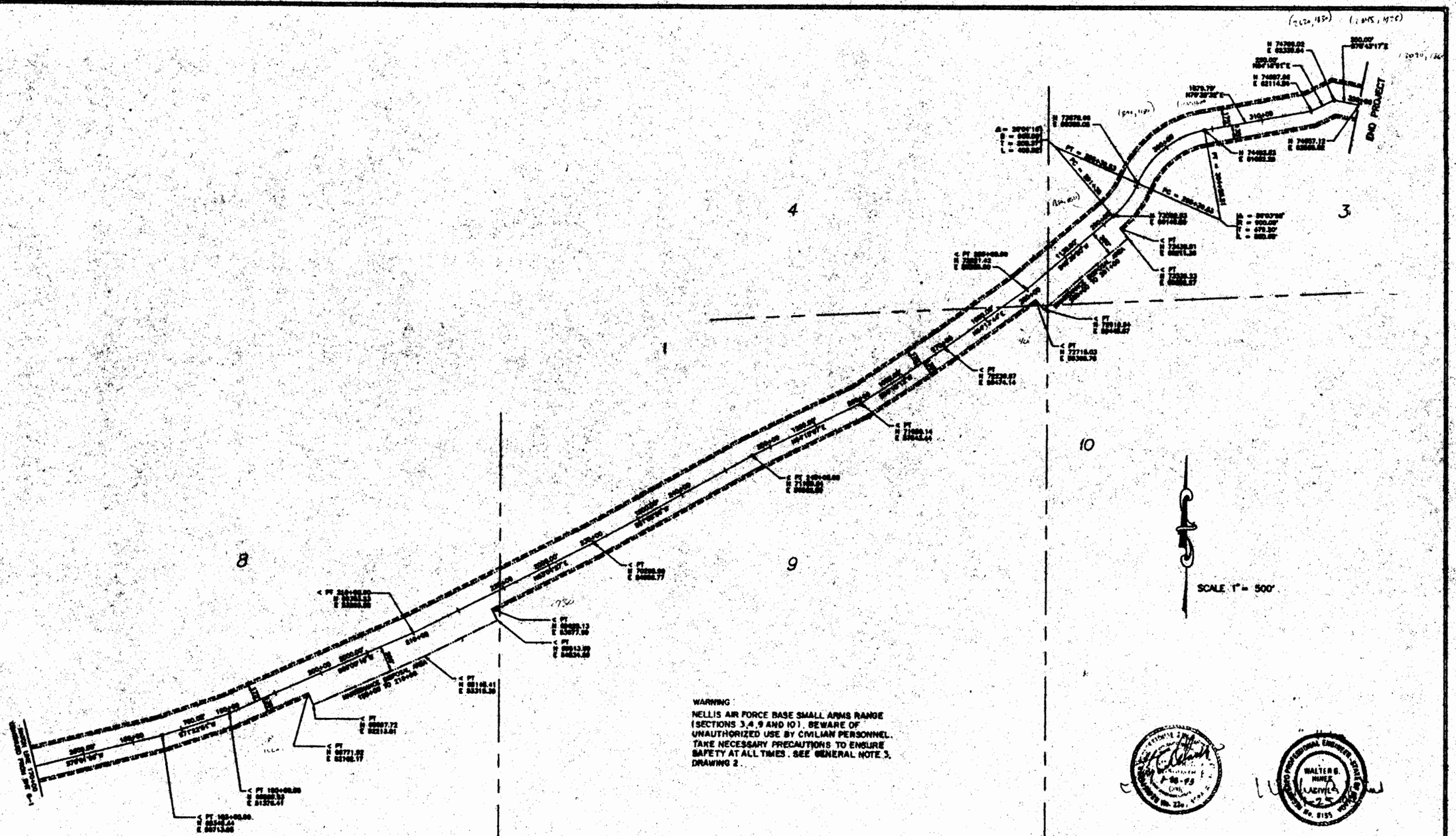
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

KEY MAP

WEST RANGE WASH DIVERSION DIKE

GEOMETRY PLAN
0+00 TO 170+00

DRAWING G-1
3 OF 20
geometry1.dwg



WARNING:
NELLIS AIR FORCE BASE SMALL ARMS RANGE (SECTIONS 3,4,9 AND 10). BEWARE OF UNAUTHORIZED USE BY CIVILIAN PERSONNEL. TAKE NECESSARY PRECAUTIONS TO ENSURE SAFETY AT ALL TIMES. SEE GENERAL NOTE 3, DRAWING 2.

LEGEND

- SURVEY LINE
- RECORD LINE
- EXISTING DETENTION BASIN BOUNDARY LINE
- RIGHT OF WAY LINE
- CONSTRUCTION EASEMENT

DESIGNED: WJH		Boyle Engineering Corporation	CITY OF NORTH LAS VEGAS	KEY MAP	WEST RANGE WASH DIVERSION DIKE
DRAWN: WJH			DEPARTMENT OF PUBLIC WORKS		GEOMETRY PLAN 170+00 TO 320+00
CHECKED: WJH					DRAWING G-2 4 OF 20
MARK DATE BY REVISION					

TIE INTO 5' BELOW GRADE SOIL CEMENT SIDE SLOPE

G DT-1

STA 2+50

STA 8+50

SOIL CEMENT CUT-OFF WALL

SOIL CEMENT CUT-OFF TRENCH TO EXTEND UP CHANNEL SIDES TO LIMIT OF EXCAVATION

CONSTRUCTION EASEMENT AND ROW EXTEND TO EXISTING DETENTION BASIN ROW BOUNDARY

B DT-1

A DT-1

BEGIN SOIL CEMENT LINING 1+00

TIE INTO 5' BELOW GRADE SOIL CEMENT SIDE SLOPE DETAIL B DT-1

STA 4+00

CHANNEL SEDIMENTATION MONUMENT (TYP)

SURVEY LINE

N29°35'38"E

5250.00'

SOIL CEMENT LINING EACH SIDE

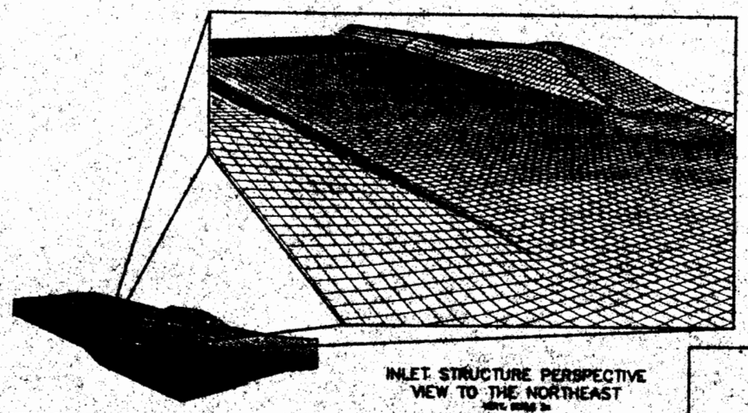
10+00

30+00

Match Line STA 30+00 - See Sheet F-2

CONSTRUCTION EASEMENT AND ROW EXTEND TO EXISTING DETENTION BASIN ROW BOUNDARY

SCALE: HORIZ. 1"= 100'
VERT. 1"= 10'



INLET STRUCTURE PERSPECTIVE VIEW TO THE NORTHEAST

TOP OF BERM

APPROXIMATE EXISTING GROUND ABOVE SURVEY LINE

FLOWLINE

8 FT BERM

3600 L.F. S = +0.0083

644 L.F. S = +0.0083

MATCH EXISTING GRADE

370 L.F. S = +0.0050

6+50 6' DEEP SOIL CEMENT CUT-OFF TRENCH

4' DEEP SOIL CEMENT CUT-OFF TRENCH

2190
2180
2170
2160
2150
2140
2130
2120
2110
2100

2+00 4+00 6+00 8+00 10+00 12+00 14+00 16+00 18+00 20+00 22+00 24+00 26+00 28+00 30+00

DESIGNED: MJH	
DRAWN: MJH	
CHECKED: MJH	

MARK DATE BY REVISION

Boyle Engineering Corporation
consulting engineers / surveyors
1700 S. Jones Blvd. Suite 300
Las Vegas, NV 89146
(702) 731-3311

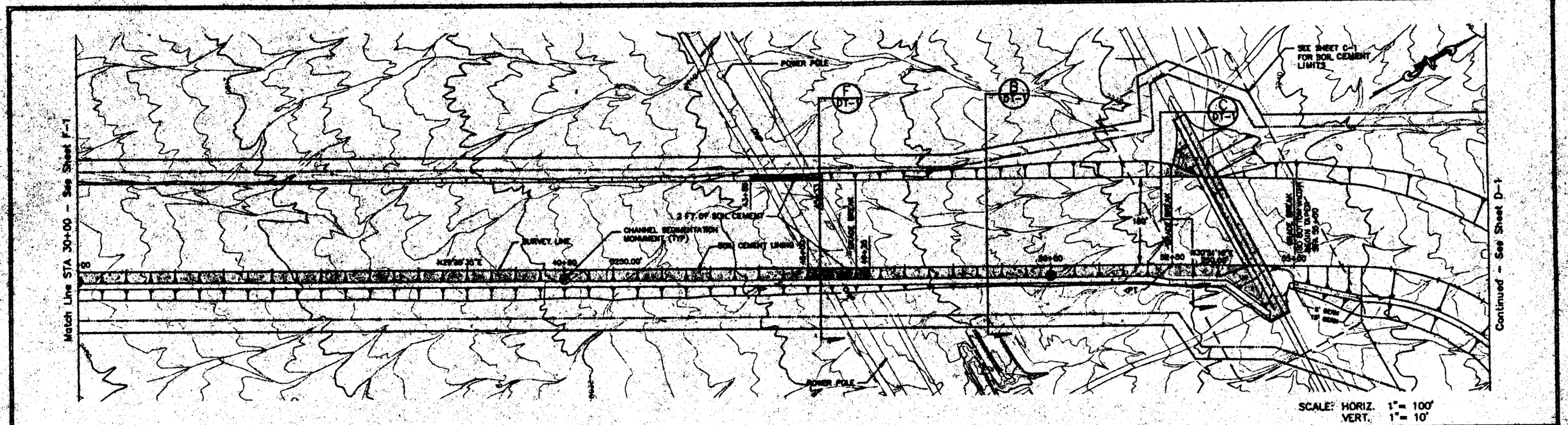
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

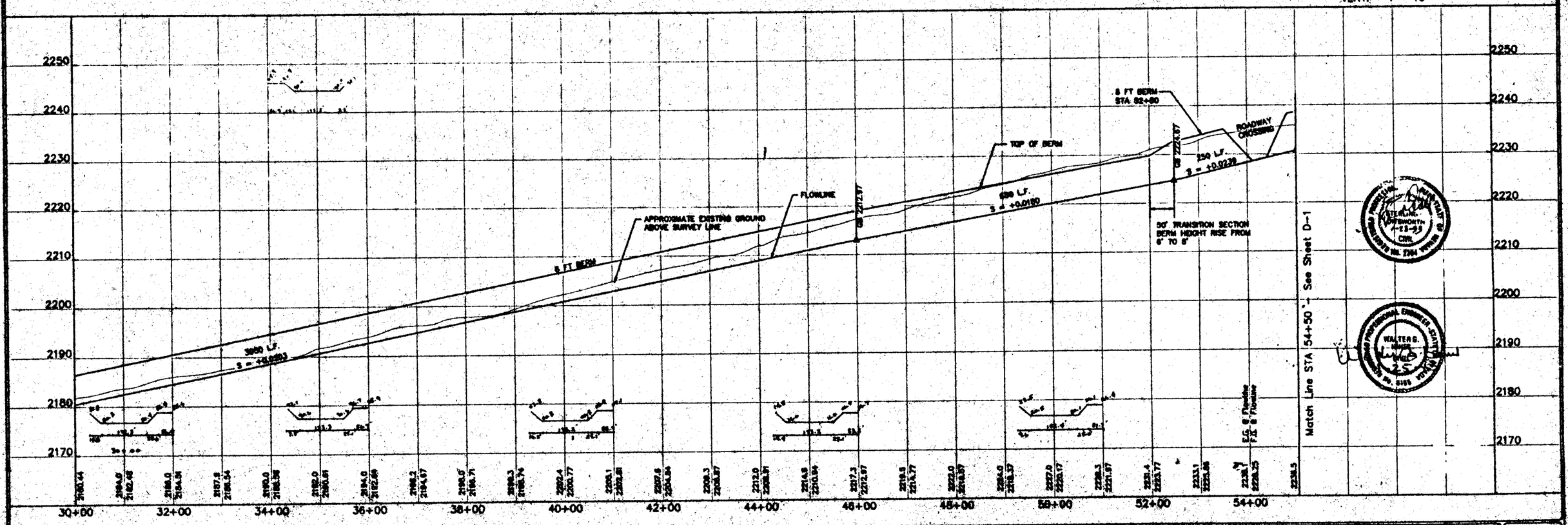
KEY MAP

WEST RANGE WASH DIVERSION DIKE

FLOODWAY PLAN AND PROFILE
1+00.00 TO 30+00.00

DRAWING F-1
5 OF 20
rwfp05.dwg





DESIGNED:	WJH
DRAWN:	WJH
CHECKED:	WDH

Boyle Engineering Corporation
consulting engineers

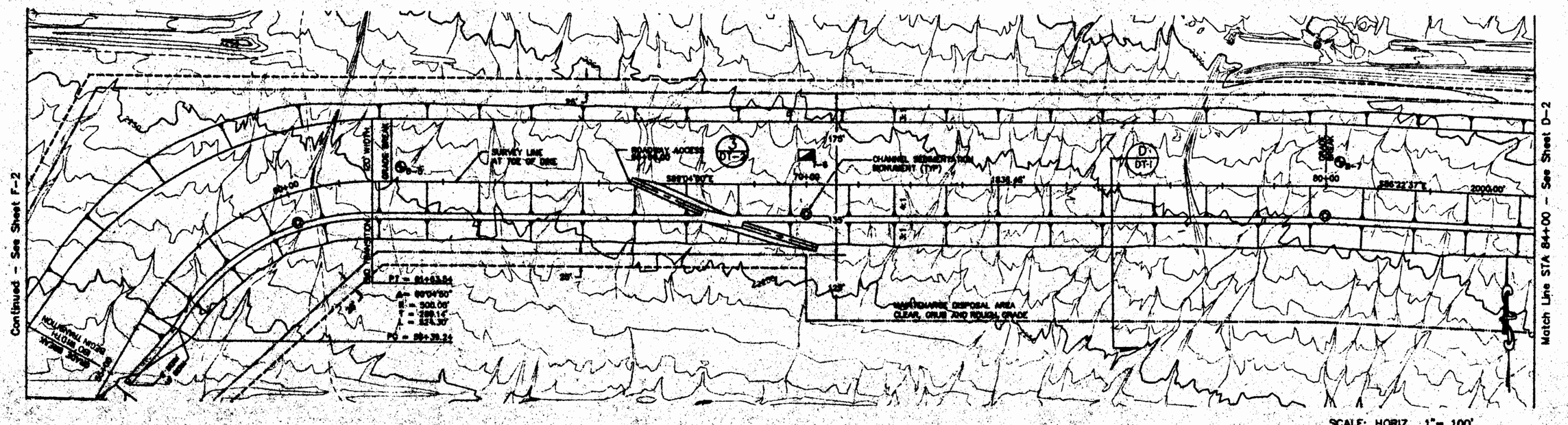
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

KEY MAP

WEST RANGE WASH DIVERSION DIKE

FLOODWAY PLAN AND PROFILE
30+00.00 TO 55+00.00

DRAWING
F-2
9 OF 20



SCALE: HORIZ. 1"= 100'
VERT. 1"= 10'

MARK	DATE	BY	REVISION

DESIGNED: W.H
DRAWN: W.H
CHECKED: W.H

PROJECT ENGINEER — DATE
PROJECT MANAGER — DATE 1-15-93

Boyle Engineering Corporation
consulting engineers
1973 E. Sahara Ave. Suite 202
Las Vegas, NV 89104
(702) 731-3611

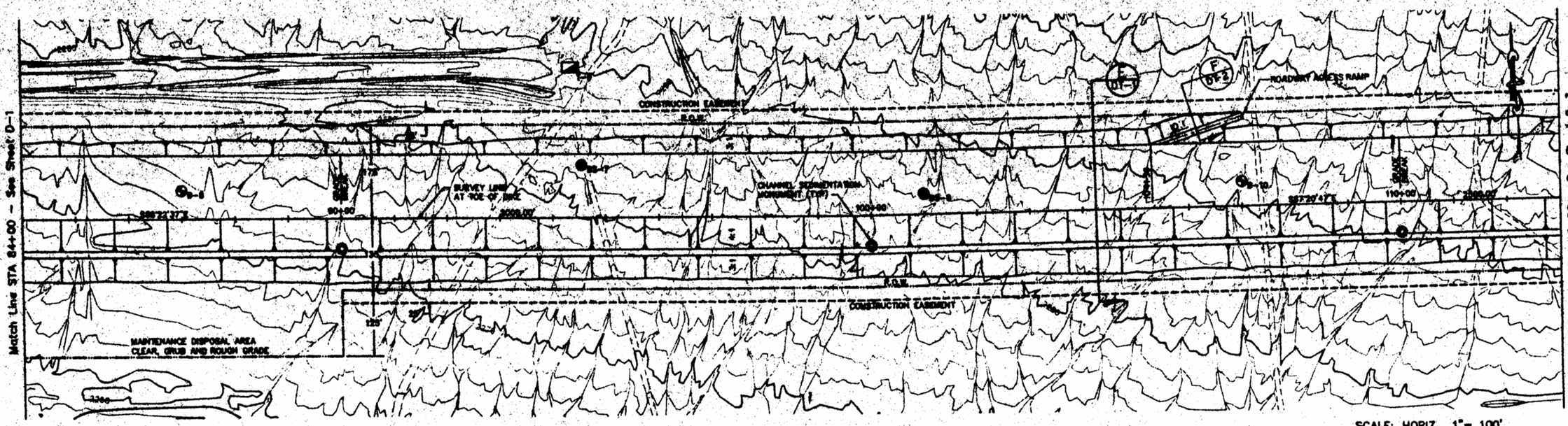
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

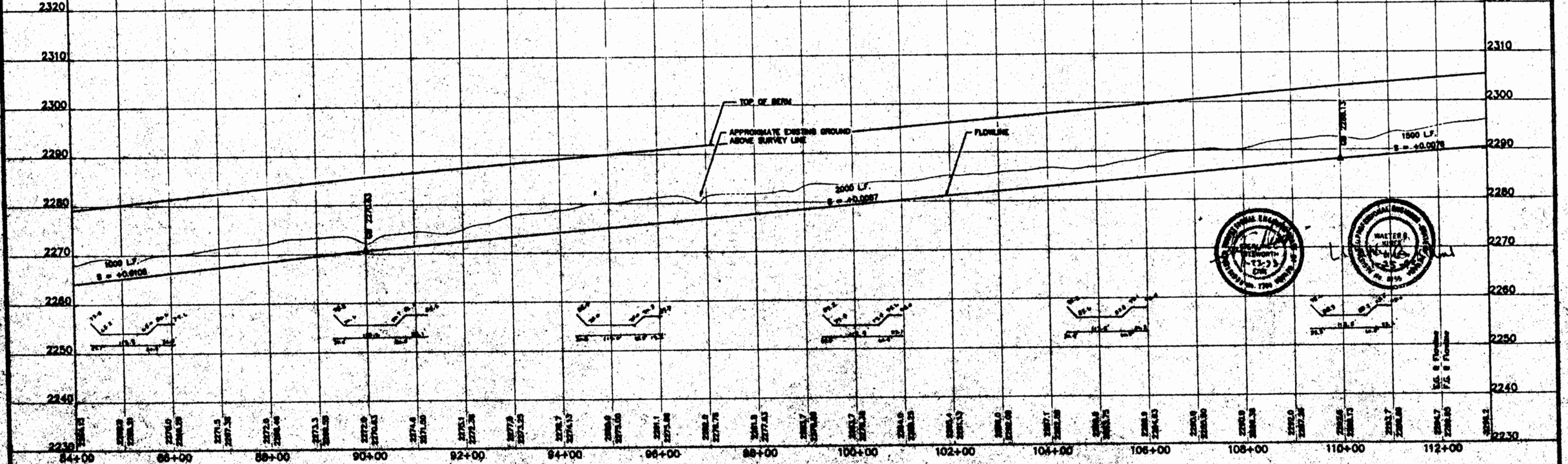
KEY MAP

WEST RANGE WASH DIVERSION DIKE

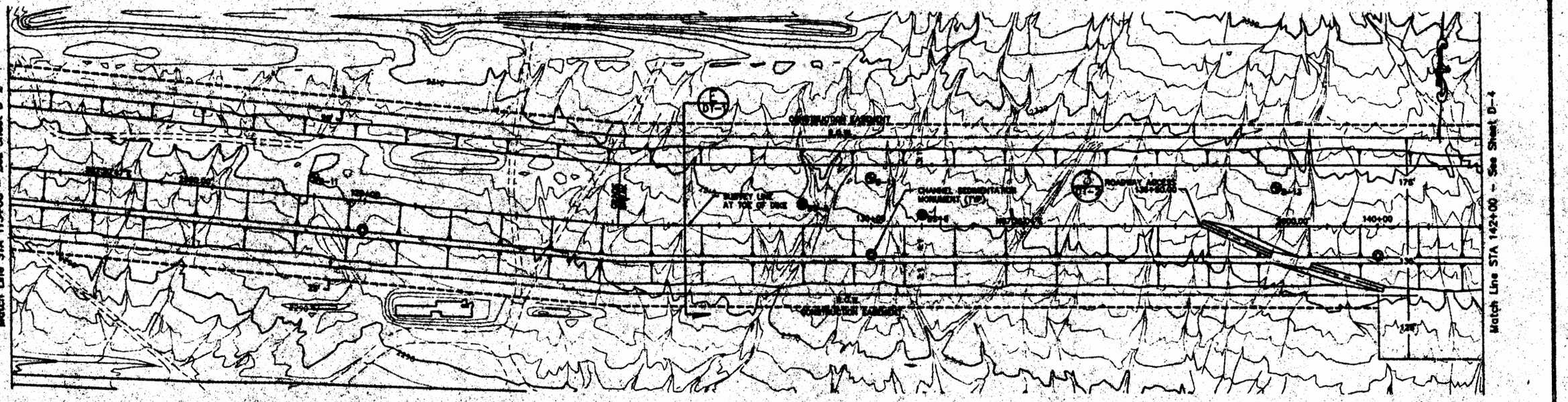
DIKE PLAN AND PROFILE
55+00.00 TO 84+00.00

DRAWING
D-1
7 OF 20
rwdp01.dwg

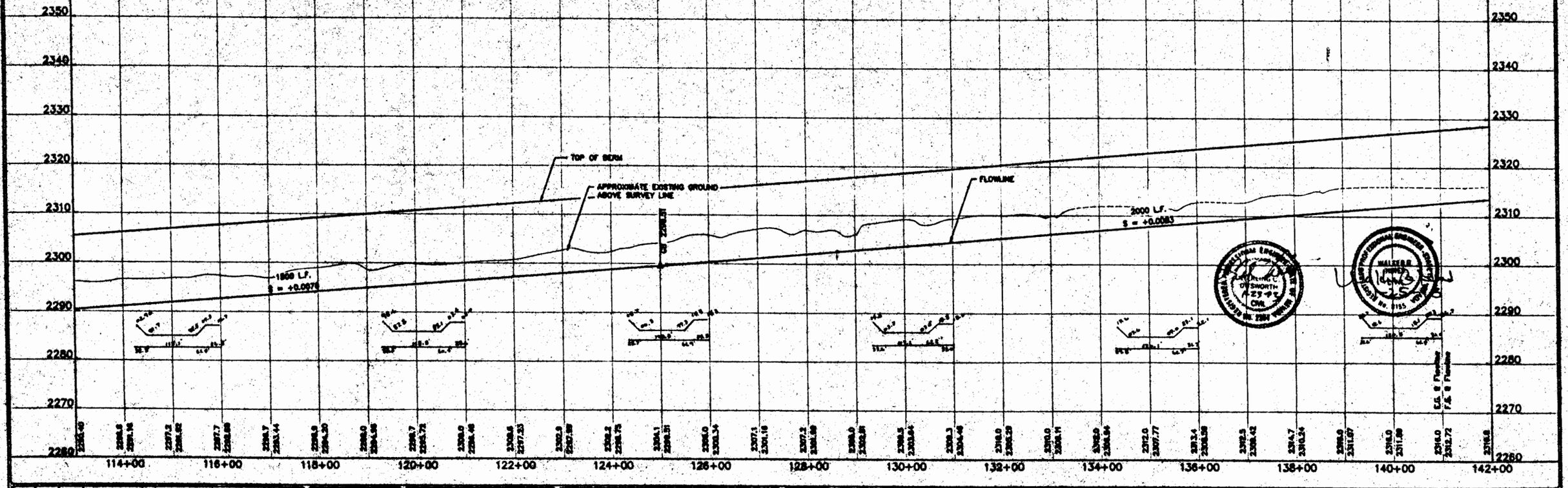




DESIGNED WJH	State Engineering Corporation	CITY OF NORTH LAS VEGAS DEPARTMENT OF PUBLIC WORKS	KEY MAP	WEST RANGE WASH DIVERSION DIKE	DRAWING D-2
DRAWN WJH				DIKE PLAN AND PROFILE 84+00.00 TO 113+00.00	8 OF 20
CHECKED WJH					nwp02.dwg



SCALE: HORIZ. 1"= 100'
VERT. 1"= 10'



MARK	DATE	BY	REVISION

DESIGNED: WJH
DRAWN: WJH
CHECKED: WGH

PROJECT ENGINEER — DATE
PROJECT MANAGER — DATE

Boyle Engineering Corporation
consulting engineers
1960 E. Grand Ave., Suite 200
El Segundo, CA 90245
(562) 727-1501

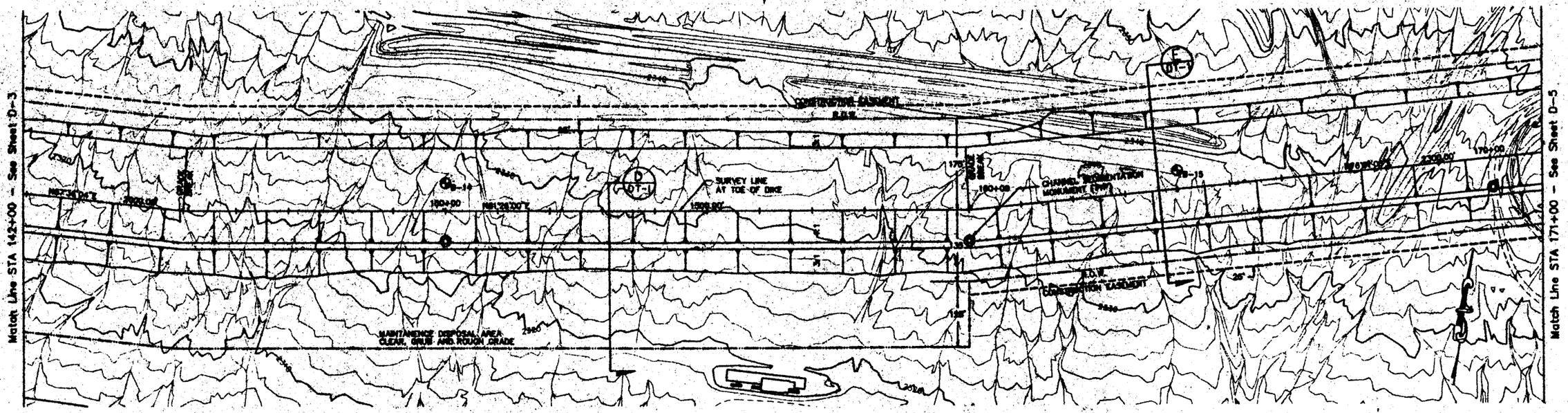
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

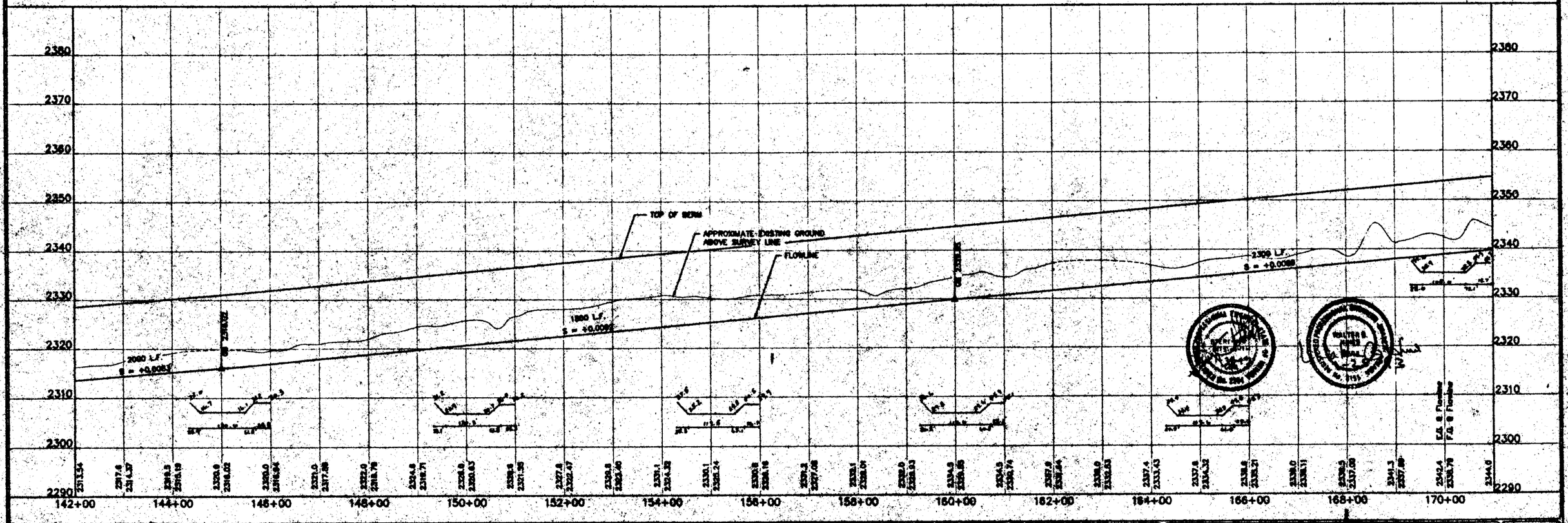
KEY MAP

WEST RANGE WASH DIVERSION DIKE

DIKE PLAN AND PROFILE
113+00.00 TO 142+00.00

DRAWING
D-3
9 OF 20





DESIGNED: WJH
DRAWN: WJH
CHECKED: WJH

PROJECT ENGINEER — DATE 2-4-04
DATE 4-26-04

Engineering Corporation
consulting engineers

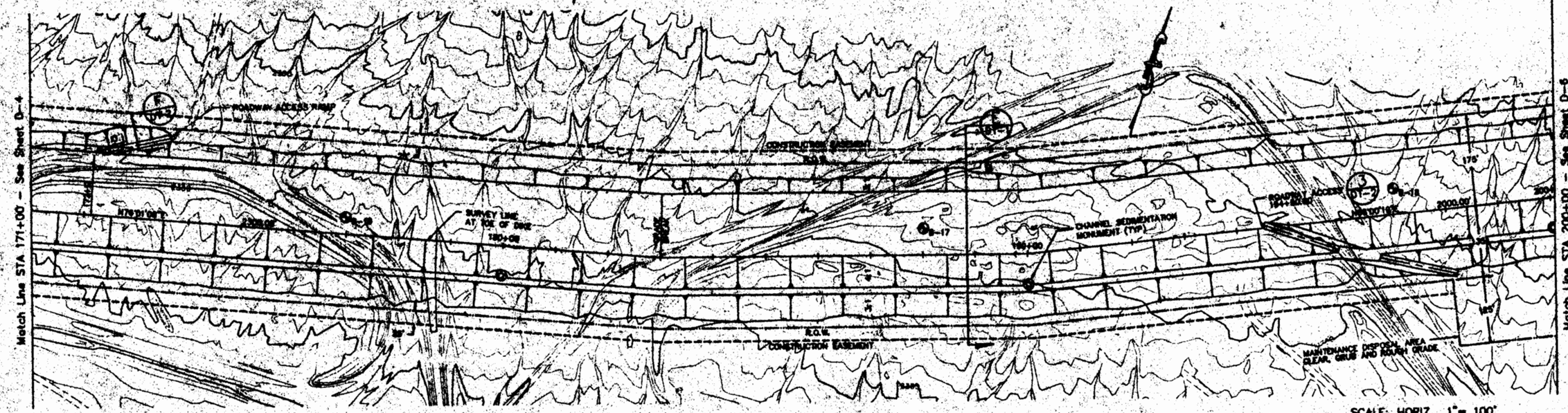
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

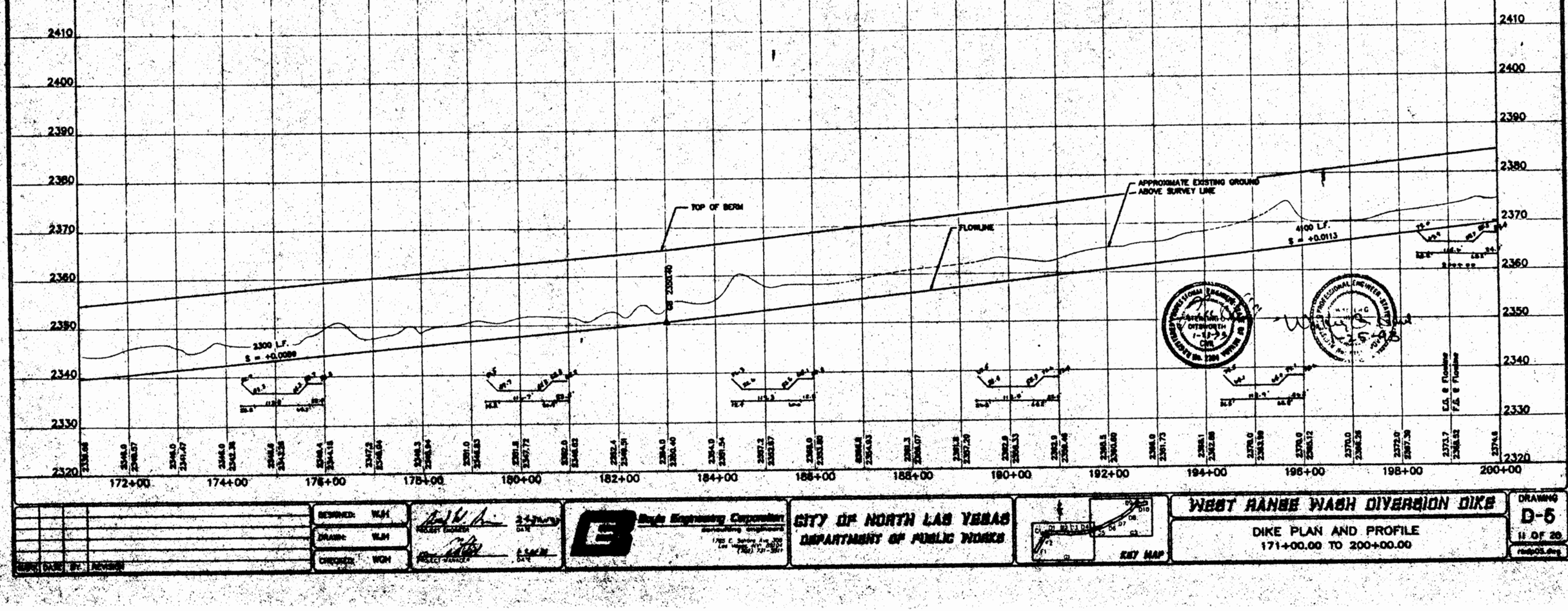
KEY MAP

WEST RANGE WASH DIVERSION DIKE

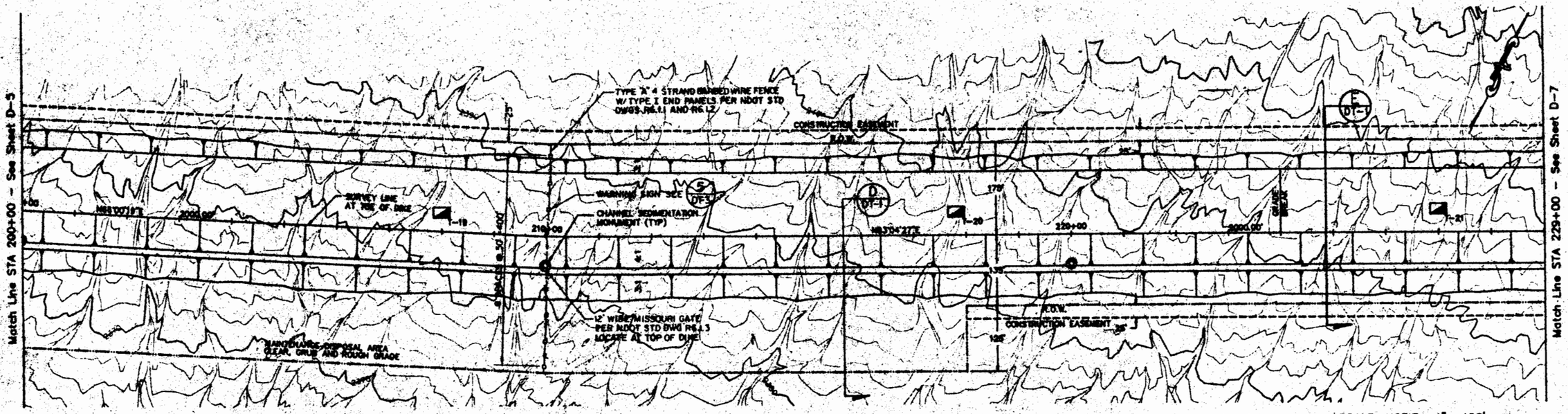
DIKE PLAN AND PROFILE
142+00.00 TO 171+00.00

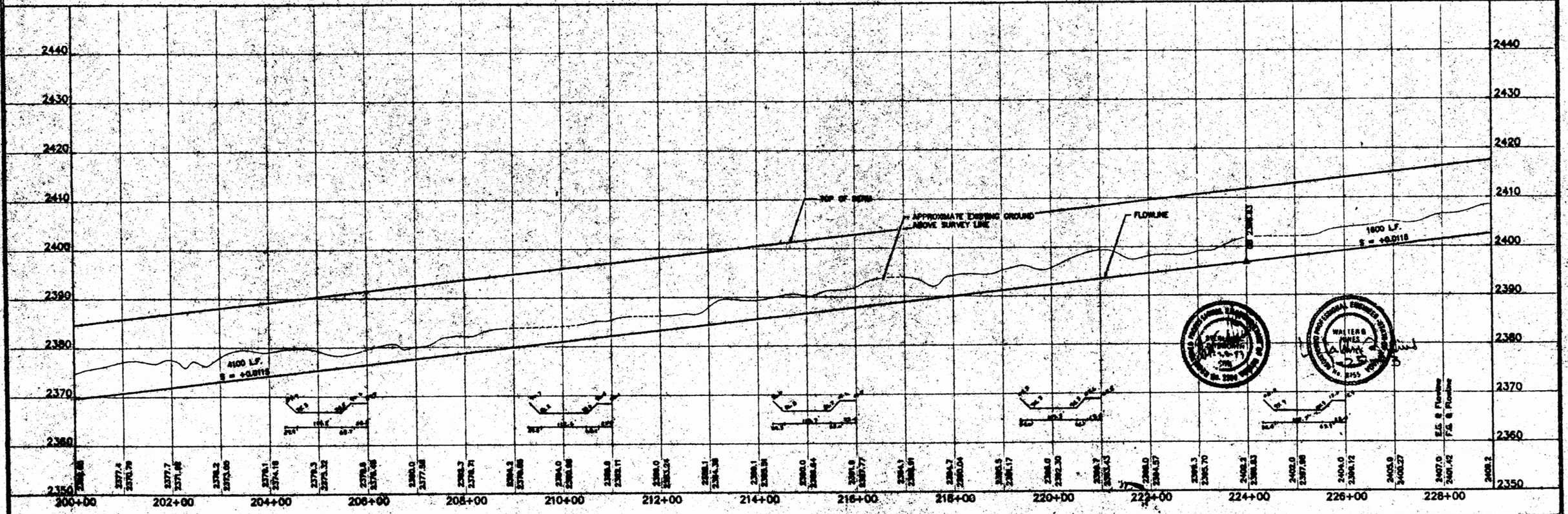
DRAWING D-4
10 OF 20





	DESIGNED: WJH		Boyle Engineering Corporation	CITY OF NORTH LAS VEGAS DEPARTMENT OF PUBLIC WORKS	WEST RANGE WASH DIVERSION DIKE
	DRAWN: WJH				DIKE PLAN AND PROFILE 171+00.00 TO 200+00.00
	CHECKED: WGH			KEY MAP	DRAWING D-5 11 OF 20
NO.	DATE	BY	REVISION		





MARK	DATE	BY	REVISION

DESIGNED: WJH
DRAWN: WJH
CHECKED: WJH

PROJECT ENGINEER — DATE

Boyle Engineering Corporation
Consulting Engineers

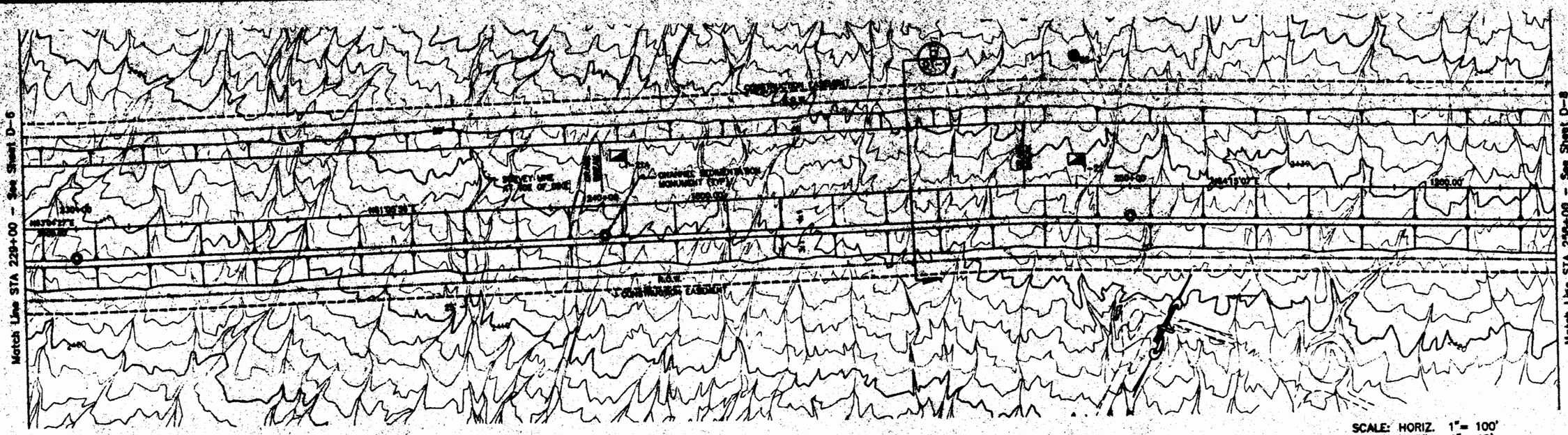
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

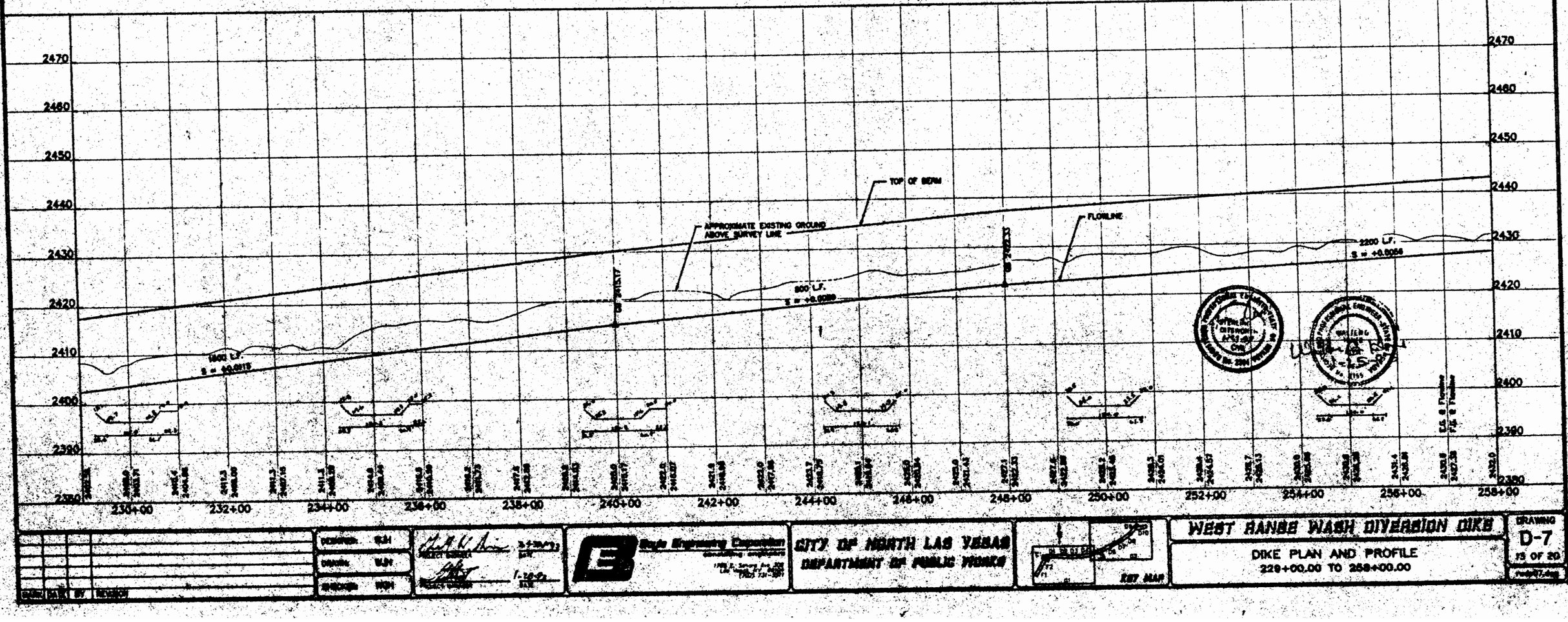
KEY MAP

WEST RANGE WASH DIVERSION DIKE

DIKE PLAN AND PROFILE
200+00.00 TO 229+00.00

DRAWING D-6
12 OF 20


Match Line STA 229+00 - See Sheet D-6
Match Line STA 256+00 - See Sheet D-8
SCALE: HORIZ. 1"= 100'
VERT. 1"= 10'


TOP OF BERM
APPROXIMATE EXISTING GROUND ABOVE SURVEY LINE
FLOWLINE
1600 L.F. S = +0.0015
800 L.F. S = +0.0050
2200 L.F. S = +0.0056
2470
2460
2450
2440
2430
2420
2410
2400
2390
2380
230+00
232+00
234+00
236+00
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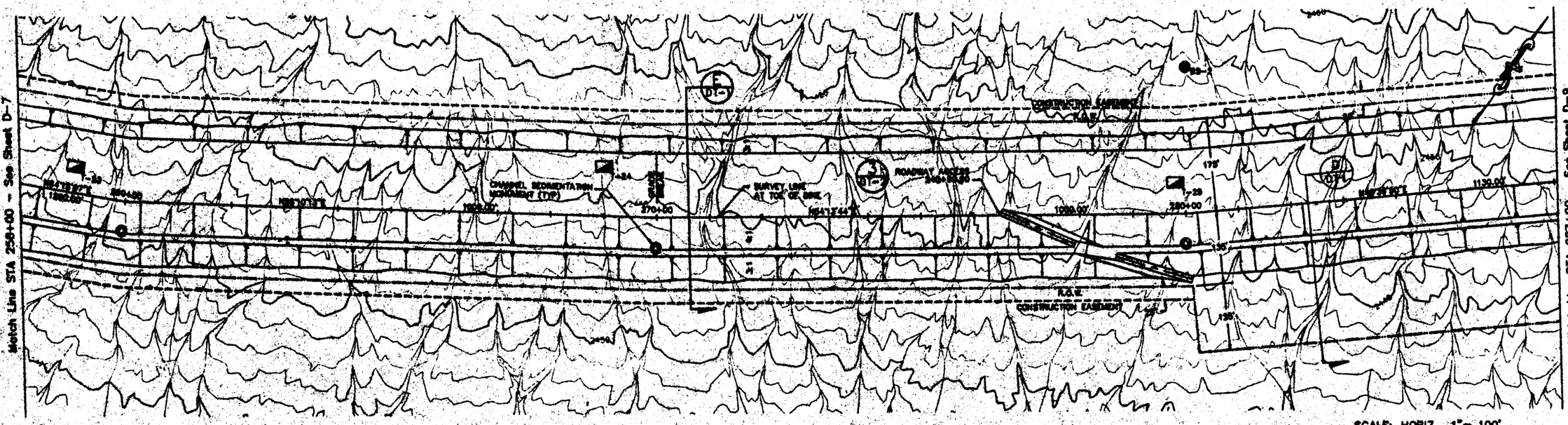
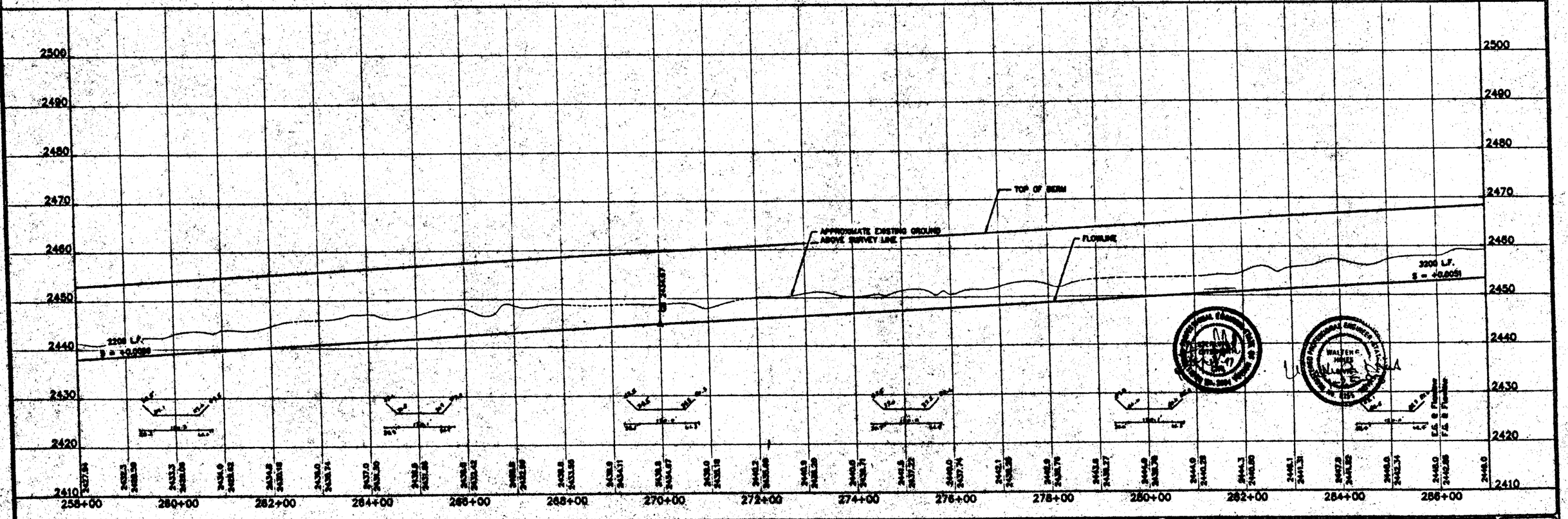
254+00
256+00
258+00





DESIGNED	WJH
DRAWN	WJH
CHECKED	WJH

Eagle Engineering Corporation
Consulting Engineers

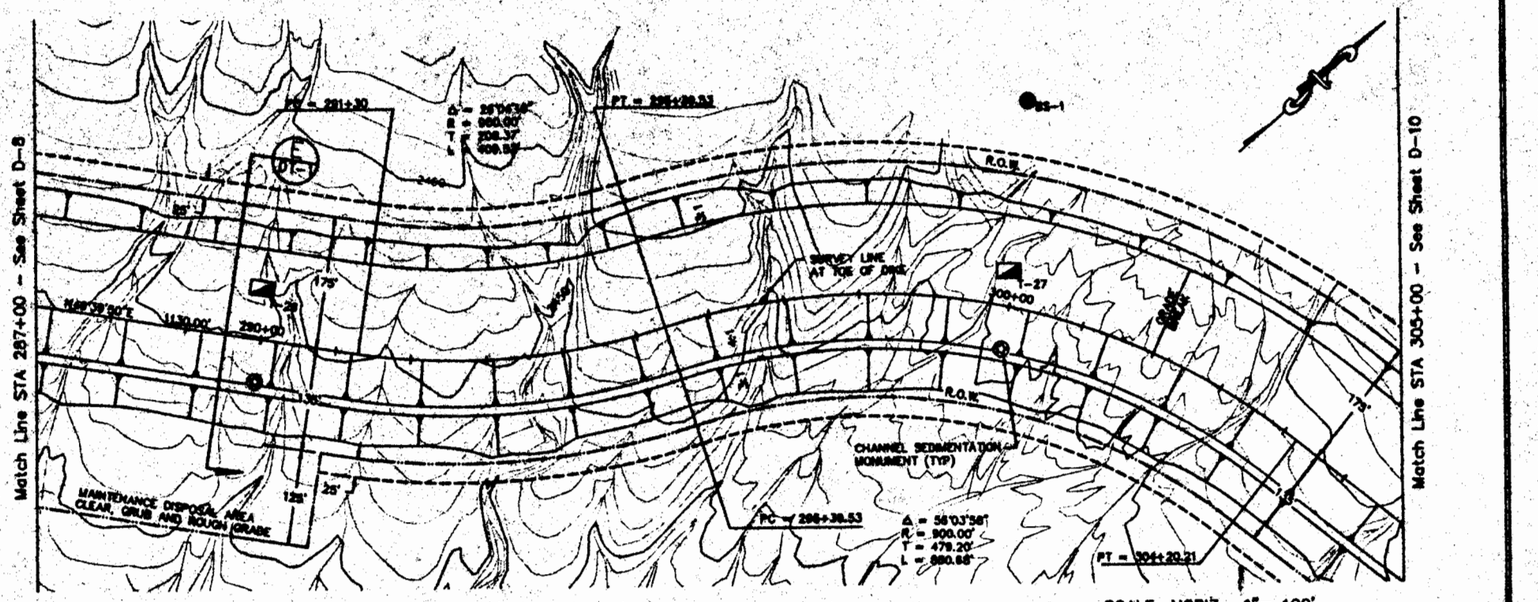
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

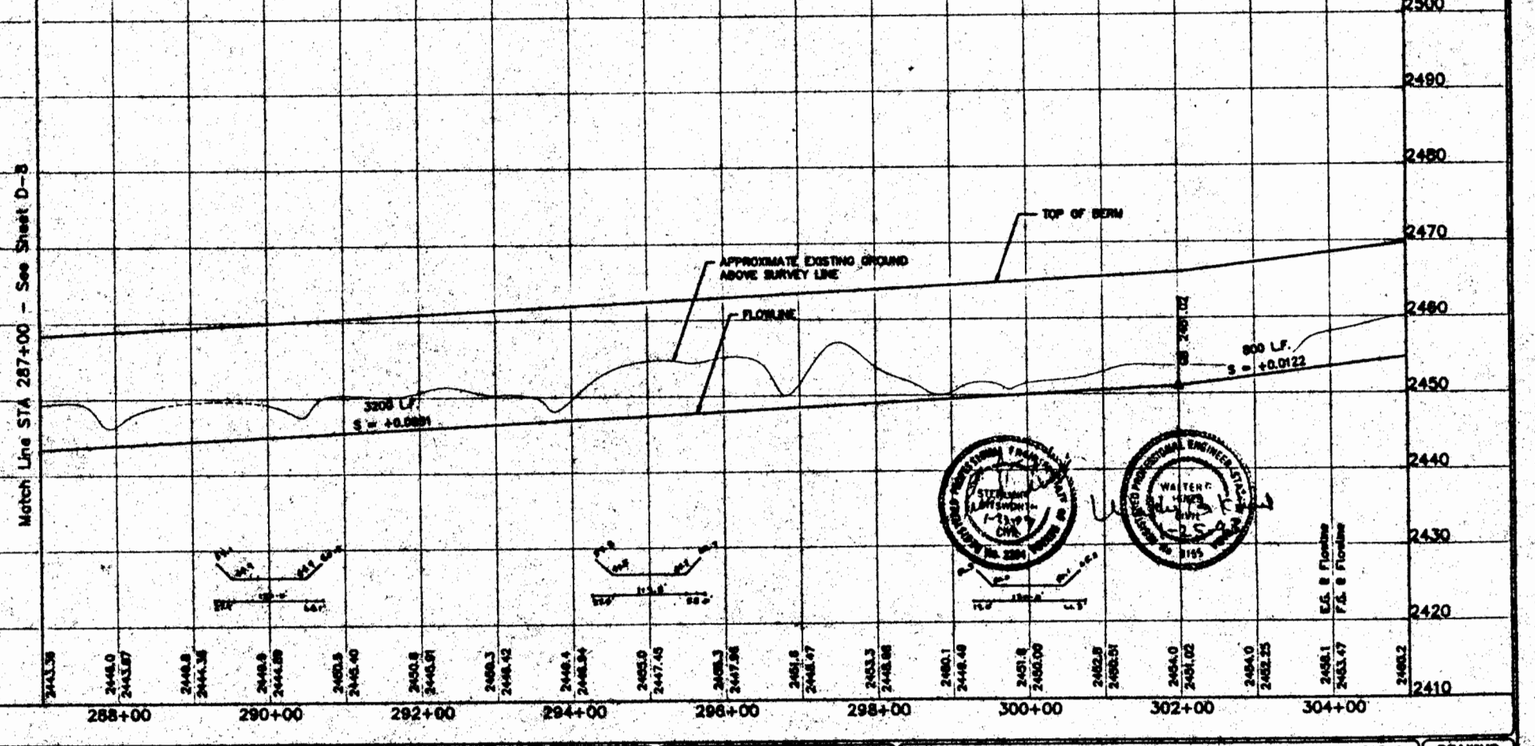
KEY MAP

WEST RANGE WASH DIVERSION DIKE

DIKE PLAN AND PROFILE
256+00.00 TO 287+00.00

DRAWING D-8
14 OF 20





MARK	DATE	BY	REVISION

DESIGNED: W.H
DRAWN: W.H
CHECKED: W.H

PROJECT ENGINEER — DATE

PROJECT MANAGER — DATE

Boyle Engineering Corporation
Consulting engineers
1111 E. Sahara Ave., Suite 300
Las Vegas, NV 89104
(702) 731-3311

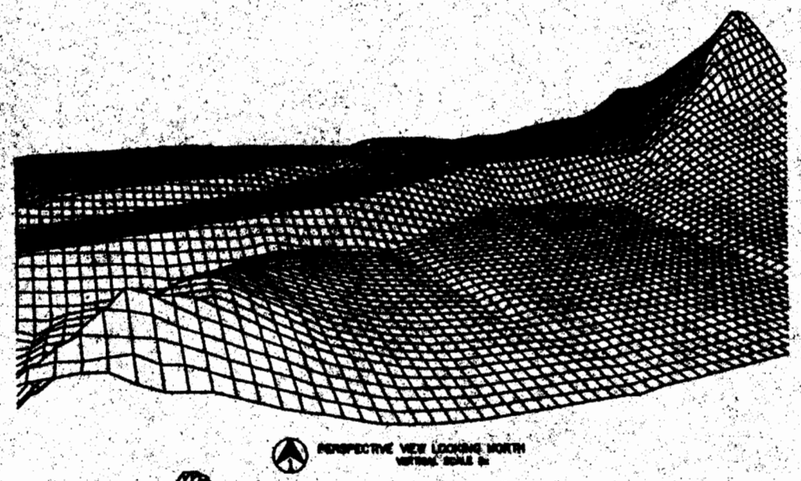
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

KEY MAP

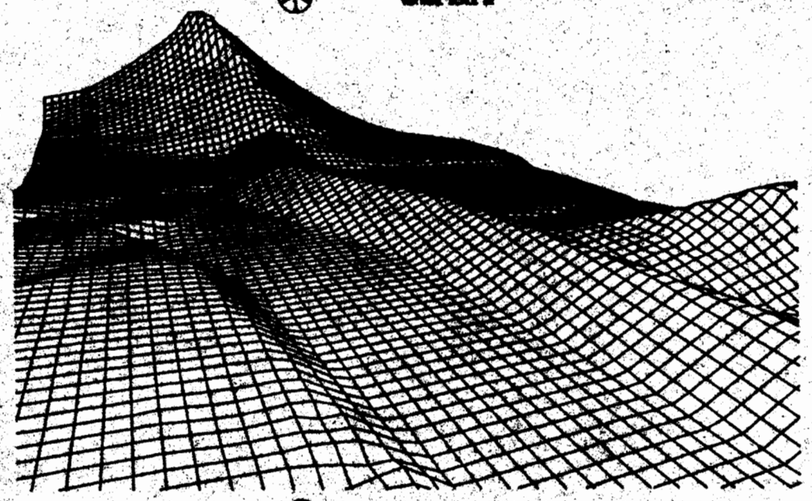
WEST RANGE WASH DIVERSION DIKE

DIKE PLAN AND PROFILE
287+00.00 TO 305+00.00

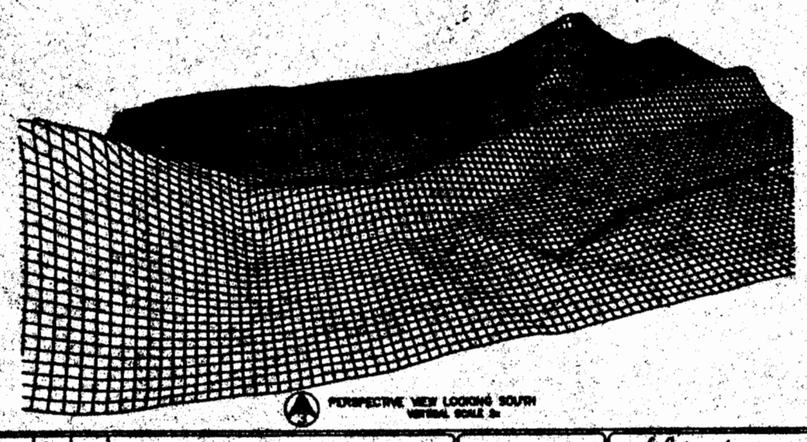
DRAWING D-9
19 OF 20
rw609.dwg



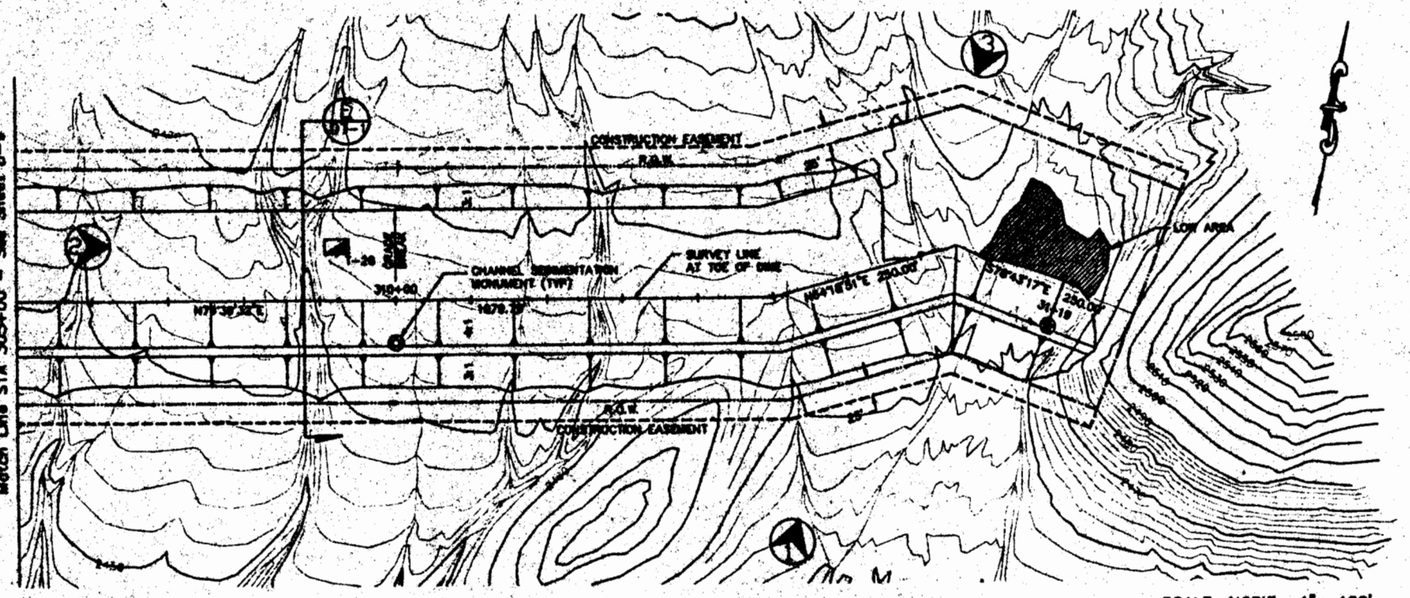
PERSPECTIVE VIEW LOOKING NORTH
VERTICAL SCALE 2x

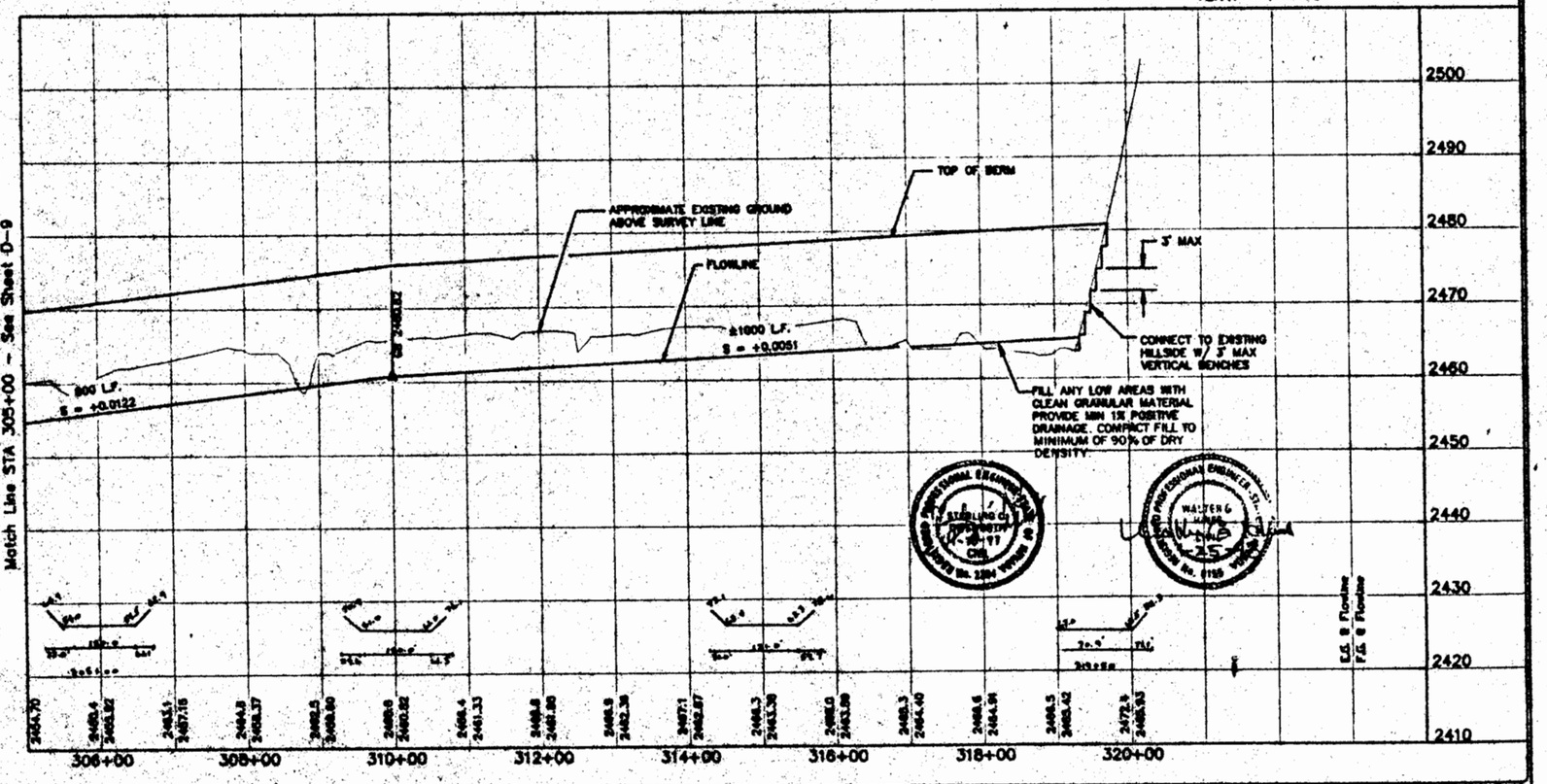


PERSPECTIVE VIEW LOOKING EAST
VERTICAL SCALE 2x



PERSPECTIVE VIEW LOOKING SOUTH
VERTICAL SCALE 2x





DESIGNED: WJH
DRAWN: WJH
CHECKED: WJH

MARK | DATE | BY | REVISION

PROJECT ENGINEER — DATE

PROJECT MANAGER — DATE

Boyle Engineering Corporation
consulting engineers / surveyors
1501 E. Warm Springs, Ste. 200
Las Vegas, NV 89119
(702) 731-3311

CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

KEY MAP

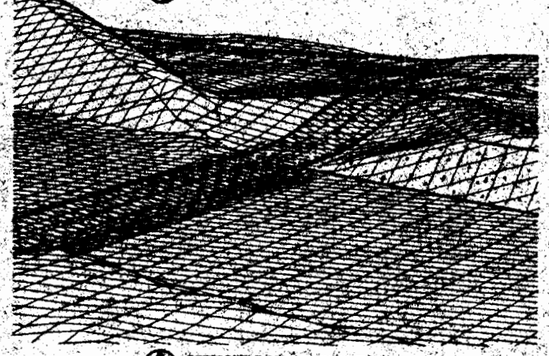
WEST RANGE WASH DIVERSION DIKE

DIKE PLAN AND PROFILE
305+00.00 TO 320+00.00

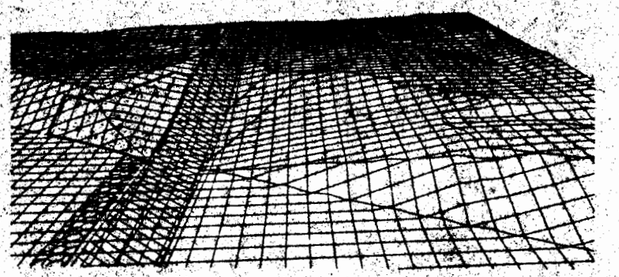
DRAWING
D-10
16 OF 20
rwdp10.dwg

KEY NOTES			
No.	Elevation	Station	Description
1	2229.21	54+40.00	North Side Road, East Bank
2	2228.52	54+11.14	South Side Road, East Bank
3	2226.86	53+41.61	North Side Road, West Bank
4	2226.18	53+13.29	South Side Road, West Bank
5	2235.09	53+51.31	Top of Berm
6	2237.84	54+66.47	Top of Berm

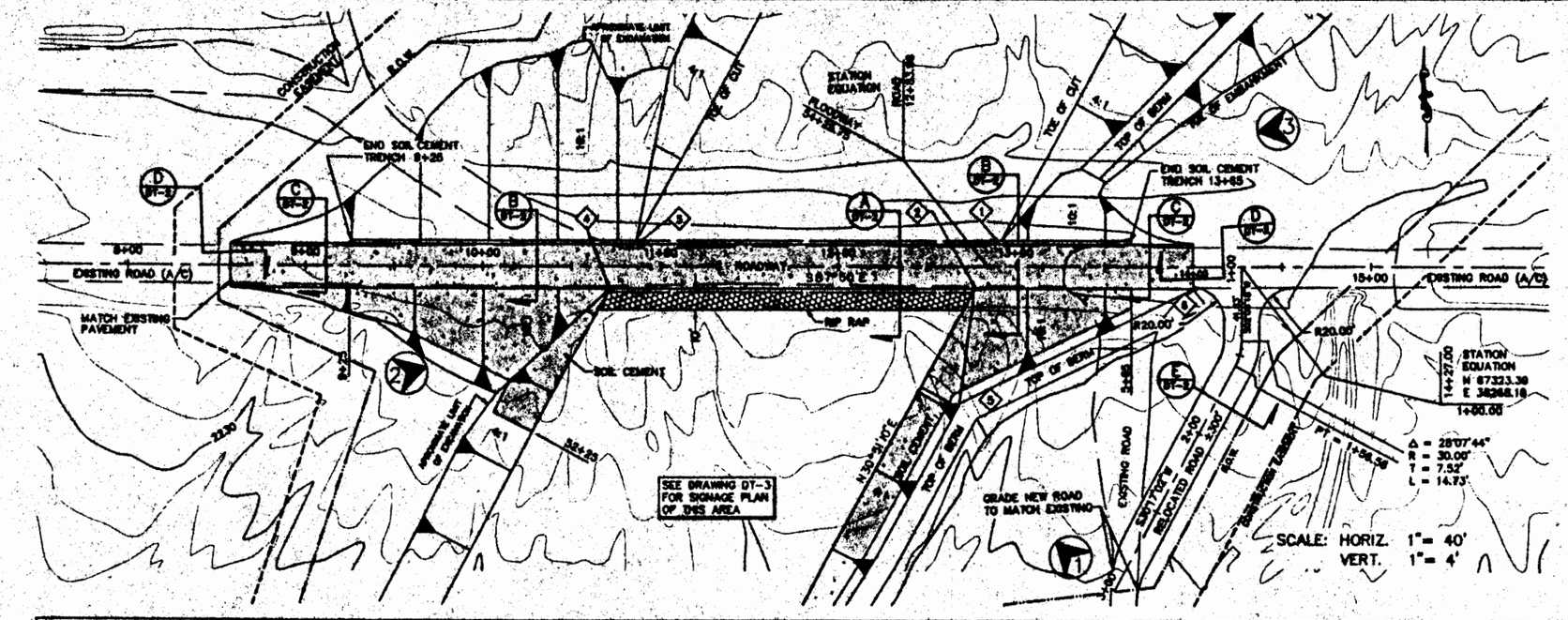
PERSPECTIVE VIEW LOOKING NORTH WEST
VERTICAL SCALE 2x

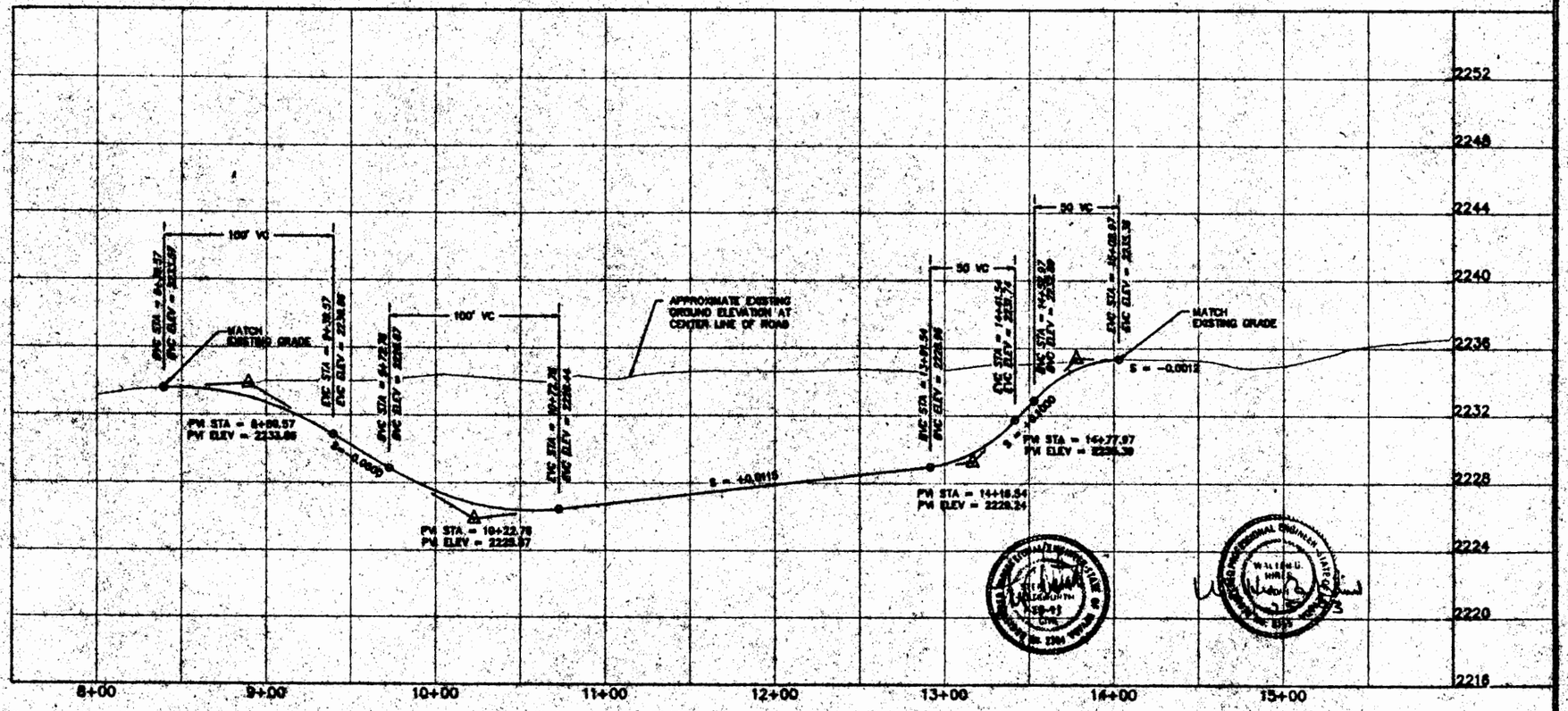


PERSPECTIVE VIEW LOOKING EAST
VERTICAL SCALE 2x



PERSPECTIVE VIEW LOOKING WEST
VERTICAL SCALE 2x





DESIGNED: WJH						
DRAWN: WJH						
CHECKED: WJH						
QUAN. CK'D BY:						

Engineering Corporation
Consulting Engineers / Surveyors

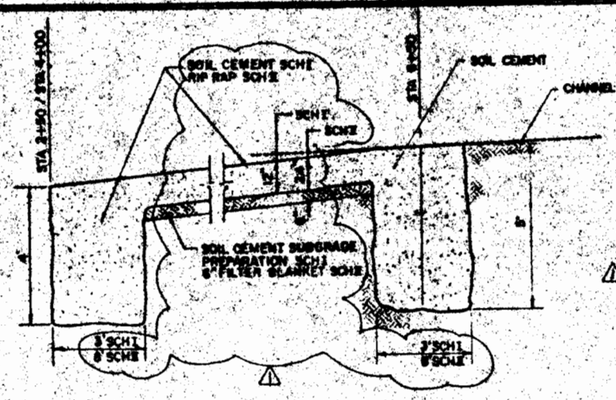
CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

KEY MAP

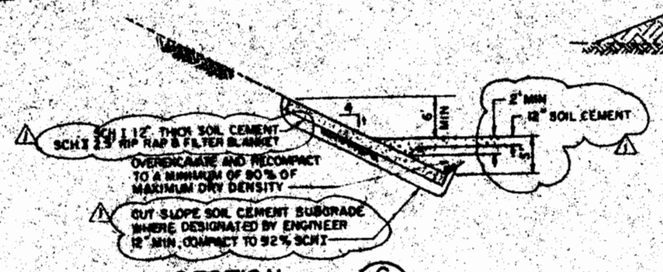
WEST RANGE WASH DIVERSION DIKE

ROADWAY CROSSING PLAN AND PROFILE

DRAWING C-1
17 OF 20



SECTION A
NOT TO SCALE
F-1



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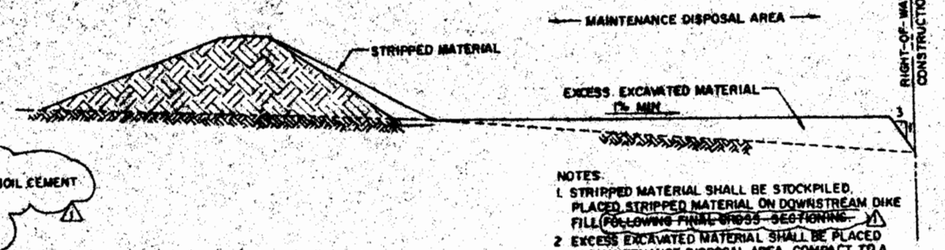
F-1



SECTION D
NOT TO SCALE
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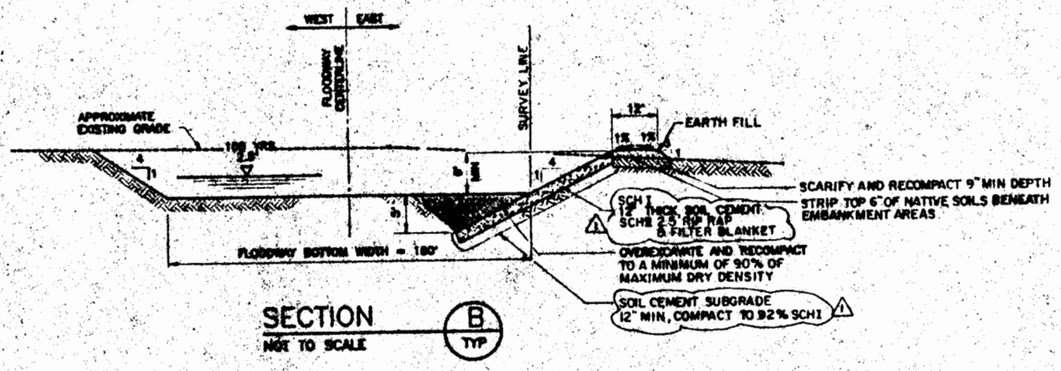
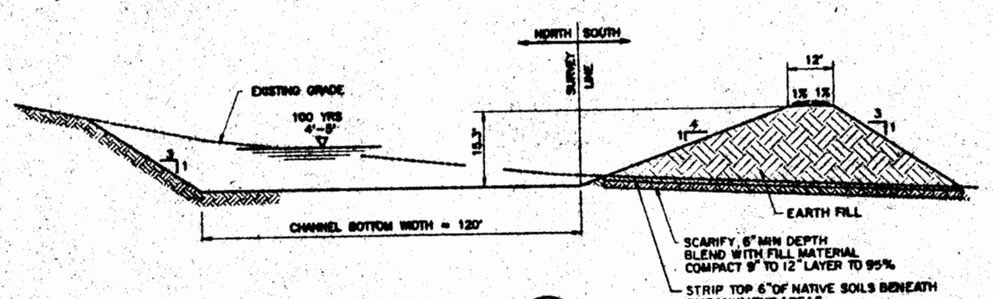


SECTION B
NOT TO SCALE
TYP



SECTION E
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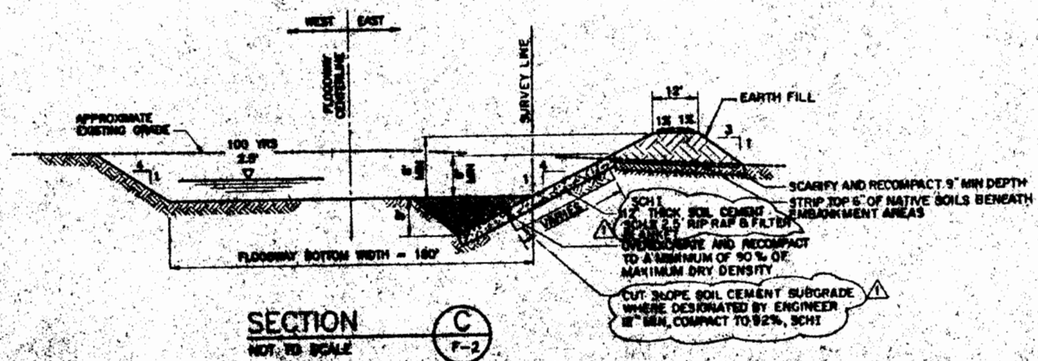
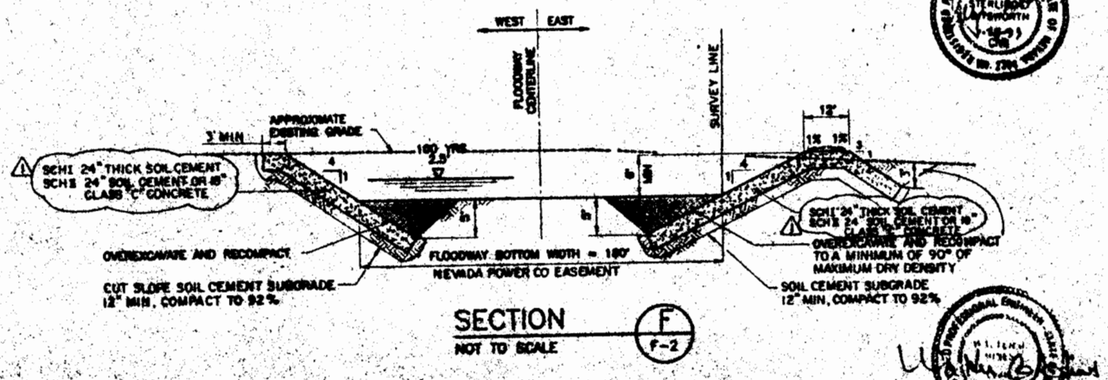
TYP

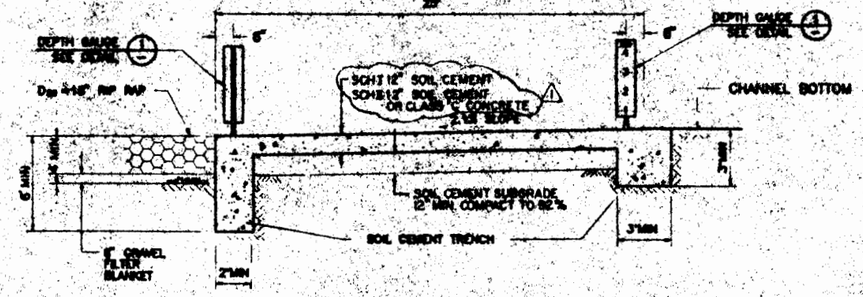


SECTION C
NOT TO SCALE
F-2



SECTION F
NOT TO SCALE
F-2

A	3-24-92	TDP	ADDITIONAL INFO SCH I SOIL CEMENT, SCH II RIP RAP	DESIGNED	WAH	Boyle Engineering Corporation consulting engineers 1705 E. Sahara Ave. Ste 300 Las Vegas, NV 89104 (702) 735-5511	CITY OF NORTH LAS VEGAS DEPARTMENT OF PUBLIC WORKS	WEST RANGE WASH DIVERSION DIKE CHANNEL AND FLOODWAY SECTIONS	DRAWING DT-1 18 OF 20
MARK	DATE	BY	REVISION	DRAWN	WH				
				CHECKED	WAH				



SECTION A / C-1
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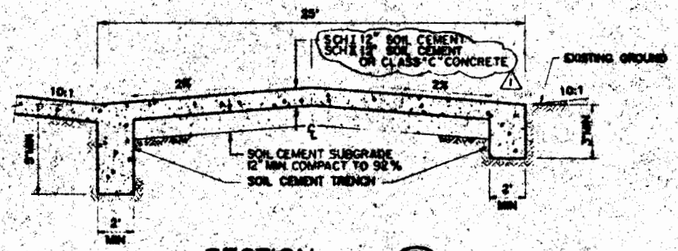

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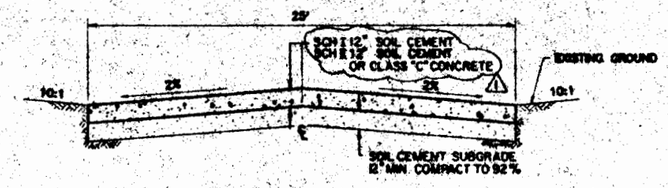
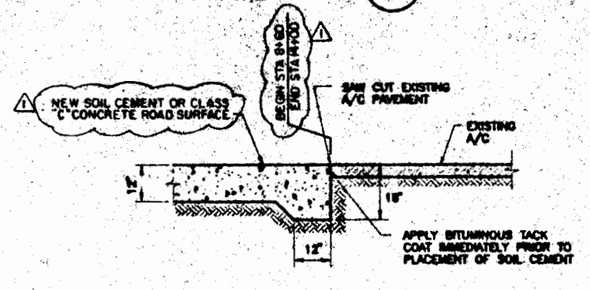


SECTION C / C-1
NOT TO SCALE



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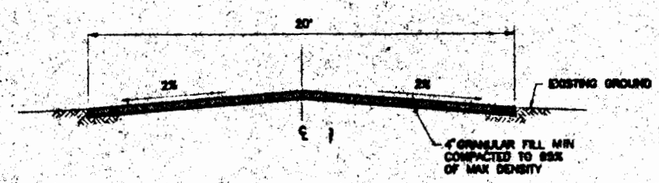
NOT TO SCALE



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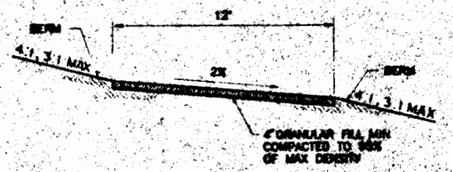
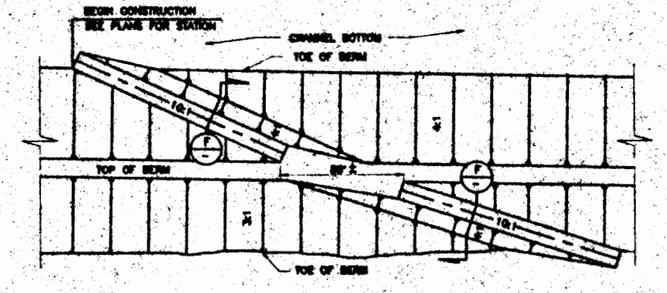
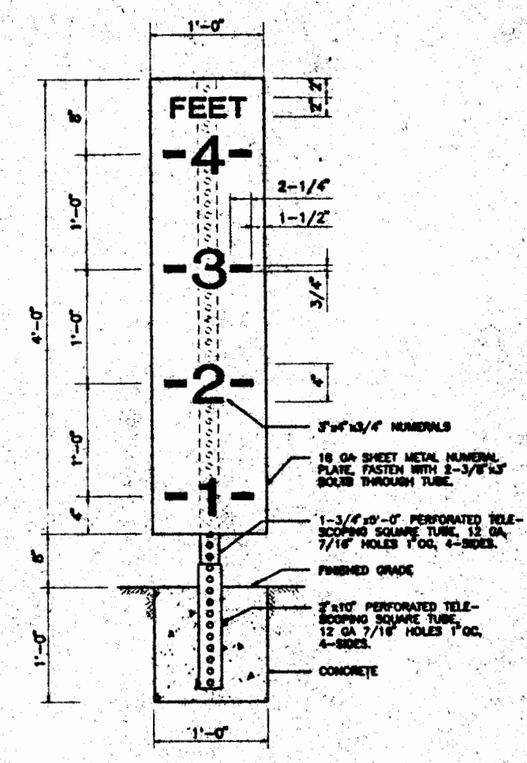


SECTION F / -
NOT TO SCALE



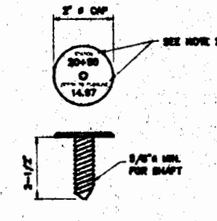
DETAIL 3 / TYP
NOT TO SCALE

NOTES:
DEPTH GAUGE TUBING SHALL BE PROTECTED AGAINST CONCRETE ENTERING THROUGH BOTTOM OR PERFORATIONS.
DEPTH GAUGE TUBING AND BOTH SIDES OF NUMERAL PLATE SHALL BE PAINTED 2-COATS WHITE ENAMEL. NUMERALS AND MARKERS SHALL BE 1-COAT GLOSS BLACK ENAMEL.

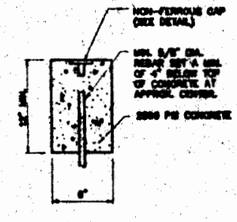


DEPTH GAUGE 1 / C-1
NOT TO SCALE

NOTES:
1. NON-FERROUS CAP TO BE MADE FROM CAST BRASS METAL IN ONE PIECE, FREE FROM CASTING IMPERFECTIONS, WITH CORRUGATED SHAFT.
2. THE WORDS "STATION" AND "DEPTH TO FLOWLINE" SHALL BE STAMPED ON EACH SEDIMENTATION MONUMENT AS SHOWN.
3. THE STATION OF EACH MONUMENT SHALL BE STAMPED ON THE CAP. STATION TO THE NEAREST ONE FOOT WITH A "+" SYMBOL BETWEEN THE HUNDREDS AND TENS OF FEET.
4. DEPTH TO FLOWLINE SHALL BE STAMPED ON THE CAP TO THE NEAREST HUNDREDTH FOOT.
5. CAP SHALL BE LOCATED ON TOP OF BERM 1' FROM EDGE CLOSEST TO CHANNEL.



STANDARD CAP



MONUMENT

SEDIMENTATION MONUMENT 2 / TYP
NOT TO SCALE

MARK	DATE	BY	REVISION
1	5-14-98	BCD	ADDENDUM No 1: SCH I SOIL CEMENT, SCH II RIP RAP

DESIGNED: WJH
DRAWN: GM
CHECKED: WGH

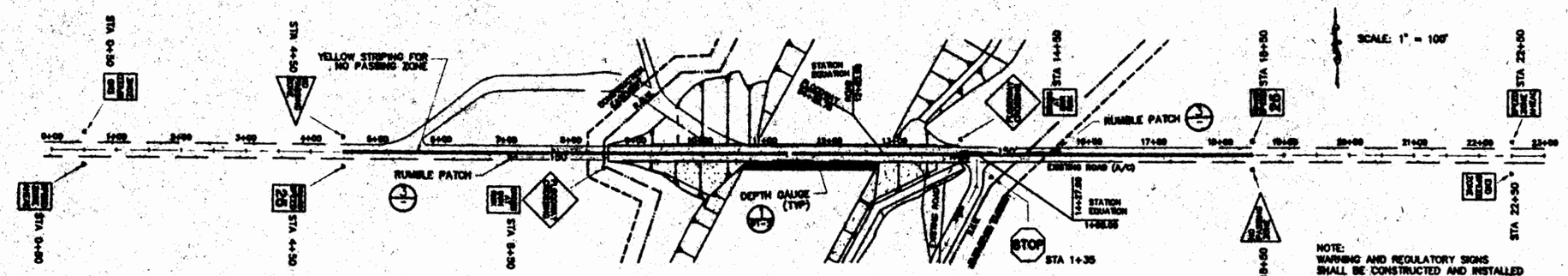
PROJECT ENGINEER — DATE 5-14-98
PROJECT MANAGER — DATE 5-14-98

Boyle Engineering Corporation
consulting engineers
1785 E. Sahara Ave. 300
Las Vegas, NV. 89104
(702) 731-5511

CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

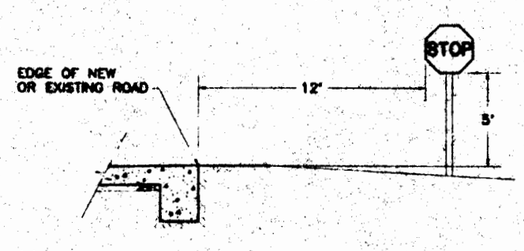
WEST RANGE WASH DIVERSION DIKE
ROADWAY SECTIONS AND DETAILS

DRAWING
DT-2
19 OF 20



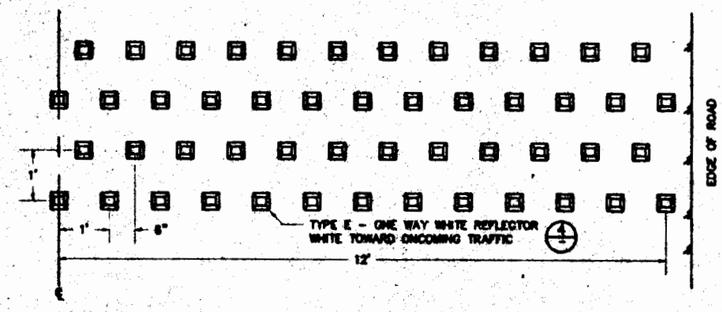
SIGNAGE PLAN

SCALE: 1" = 100'



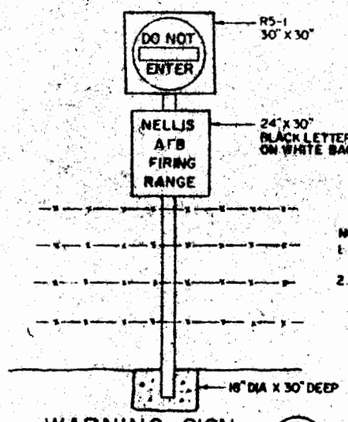
TYPICAL ROADSIDE SIGN (1)

NOT TO SCALE



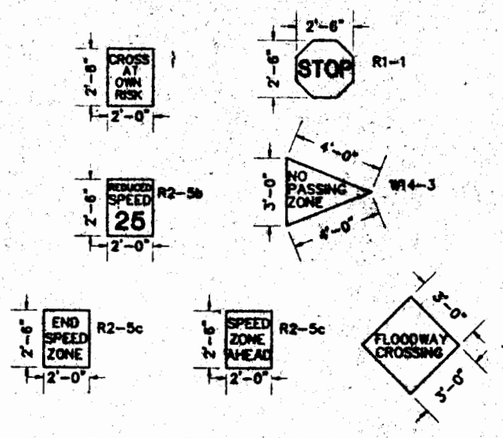
RUMBLE PATCH (3)

SCALE: 1" = 1'-0"



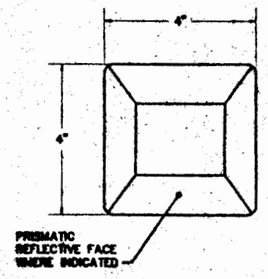
WARNING SIGN (5) D-6

NOT TO SCALE



ROADSIDE SIGN DIMENSIONS (2)

NOT TO SCALE



TYPE E REFLECTOR (4)

SCALE: 1" = 2"

MARK	DATE	BY	REVISION	DESIGNED: WJH			
				DRAWN: WJH			
				CHECKED: WGH			

PROJECT ENGINEER — DATE 24 JAN 92

PROJECT MANAGER — DATE 1-29-92

Boyle Engineering Corporation
consulting engineers
1785 E. Sahara Ave. 300
Las Vegas, NV 89104
(702) 731-3511

CITY OF NORTH LAS VEGAS
DEPARTMENT OF PUBLIC WORKS

WEST RANGE WASH DIVERSION DIKE

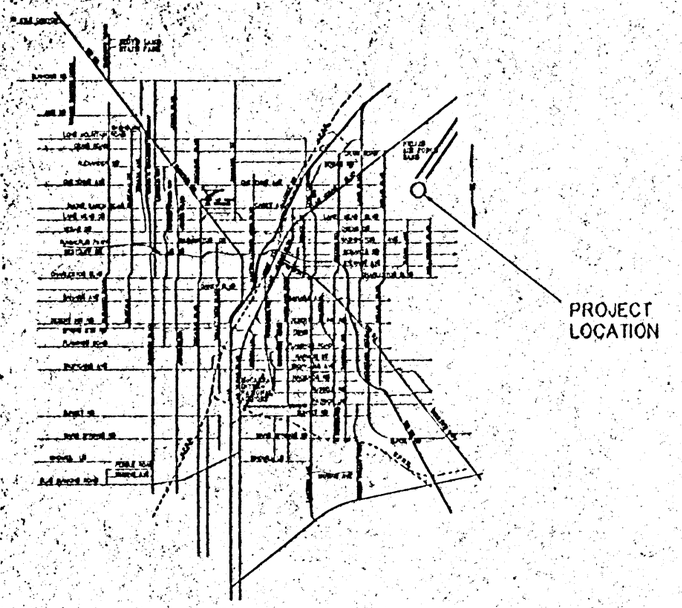
ROADWAY CROSSING
SIGNAGE PLAN AND DETAILS

DRAWING DT-3
20 OF 20
rwdsh03.dwg

EXHIBIT B

Range Wash/Sloan Channel Phase 1
Nellis Air Force Base (NAFB) Channel
As-Built Drawings

DEPARTMENT OF PUBLIC WORKS



Vicinity Map

NOT TO SCALE

CLARK COUNTY NEVADA

Index of Sheets

(See Drawing G-3)

AS-BUILT

By: _____

(Date)

Clark County Regional Flood Control District

Acting General Manager / Chief Engineer

Approved:

Gale W. Fraser II

GALE Wm. FRASER, II, P.E.

"PROGRESS AS PROMISED"

1993

IMPROVEMENT PLANS FOR

RANGE WASH / SLOAN CHANNEL

PHASE 1

NELLIS AIR FORCE BASE, (NAFB) CHANNEL

FUNDED BY

REGIONAL FLOOD CONTROL DISTRICT

County Commissioners

Jay Bingham, Chairman
Don Schlesinger, Vice Chairman
Paul J. Christensen
Thalia M. Dondero
Yvonne Atkinson Gates
Karen Hayes
Bruce L. Woodbury

County Manager

Donald L. Shalmy

Director of Public Works

Approved:

M.J. Manning R.P.E. 7299

DONALD W. DAVIS CIVIL — No. 6281 — STATE OF NEVADA — PROFESSIONAL ENGINEER

11/20/93

AGENCY	PLANS REVIEWED BY	DATE
SPRINT CENTRAL TELEPHONE NEVADA	Ngh Smith	9-15-93
SOUTHWEST GAS COMPANY	[illegible]	9/15/93
NEVADA POWER COMPANY	[illegible]	9/15/93
CLARK COUNTY SANITATION DISTRICT	Bud Fuller	9/15/93
COMMUNITY CABLE T.V.	[illegible]	9/16/93
NELLIS AIR FORCE BASE	[illegible]	9-24-93
CITY OF NORTH LAS VEGAS		

DEPARTMENT OF PUBLIC WORKS	PLANS REVIEWED BY	DATE OF APPROVAL
DEPUTY DIRECTOR FOR PROFESSIONAL SERVICES		
DEPUTY DIRECTOR FOR FIELD OPERATIONS		
COMMUNITY DEVELOPMENT DIVISION	Carla J. Lawson	9-22-93
CONSTRUCTION MANAGEMENT DIVISION		
DESIGN ENGINEERING DIVISION	[illegible]	9-21-93
MAINTENANCE MANAGEMENT DIVISION		
TRAFFIC MANAGEMENT DIVISION	[illegible]	9-21-93
COUNTY SURVEYOR'S OFFICE	Brett A. Allen	9/21/93

REVISIONS

REVISION No.	DESCRIPTION	BY	DATE	APPROVAL	DATE

Boyle Engineering Corp.

COVER SHEET

L - 1420

QUANTITIES

ITEM	TITLE	APPROX. QUANTITY	UNIT
109.01	CONSTRUCTION CONFLICTS & ADDITIONAL WORK	1	LS
200.01	MOBILIZATION	1	LS
201.01	CLEARING, GRUBBING & STRIPPING	12	ACRE
202.01	REMOVE CONCRETE CURB & GUTTER	1,440	LF
202.02	REMOVE ASPHALTIC PAVEMENT	4,930	SY
203.01	GOLF COURSE CHANNEL EXCAVATION	100,400	CY
203.02	GOLF COURSE CHANNEL EMBANKMENT	220	CY
203.03	GOLF COURSE CHANNEL SURPLUS EXCAVATED MATERIAL	66,400	CY
203.04	SUBGRADE PREPARATION FILL AREAS	20,000	SY
203.05	GOLF COURSE CHANNEL FOUNDATION & SURFACE COMPACTION	34,700	CY
203.06	ROADWAY SUBGRADE COMPACTION	4,690	CY
209.01	DRAIN ROCK	2,290	CY
212.01	SOD	45,000	SF
212.02	RELOCATE TREE OR SCHRUB	22	EA
213.01	RELOCATION AND MAINTENANCE OF IRRIGATION SYSTEM	1	LS
213.02	4-INCH IRRIGATION MAIN RELOCATION	1,600	LF
213.03	6-INCH IRRIGATION MAIN RELOCATION	190	LF
213.04	8-INCH IRRIGATION MAIN RELOCATION	150	LF
216.01	GEOTEXTILE FABRIC	8,010	SY
302.01	TYPE II AGGREGATE BASE	1,510	CY
402.01	PLANTMIX BITUMINOUS SURFACE	985	TON
406.01	PRIME COAT (MC-70)	7,410	SY
407.01	SEAL COAT (SS-III)	7,410	SY
502.01	PRECAST CONC. ARCH BRIDGE FOOTINGS	67	CY
502.02	PRECAST CONC. ARCH BRIDGE WING WALLS	44	CY
502.03	PREFABRICATED STEEL BRIDGE ABUTMENTS	45	CY
506.01	PREFABRICATED STEEL TRUSS BRIDGE 120-FOOT SPAN	1	LS
506.02	PREFABRICATED STEEL TRUSS BRIDGE 60-FOOT SPAN	1	LS
605.01	PRECAST CONCRETE ARCH BRIDGE	1	LS
813.01	24-INCH 2" TYPE CURB AND GUTIER	1,402	LF
813.02	VALLEY GUTIER	608	SF
623.01	2-INCH PVC ELEC CONDUIT	340	LF
623.02	3-INCH PVC ELEC CONDUIT	1,810	LF
623.03	4-INCH PVC ELEC CONDUIT	4,340	LF
623.04	#2 XLEP Cu	17.6	CLF
623.05	#2/0 15KV Cu	15.8	CLF
623.06	#4/0 AWG, THW. Cu	30	CLF
623.07	#1/0 AWG, THW. Cu	4.2	CLF
623.08	#6 AWG, THW. Cu	16.4	CLF
623.09	ELEC MANHOLE	3	EA
623.10	INTERSET ELEC MANHOLE	8	EA
623.11	COMMUNICATIONS MANHOLE	7	EA
623.12	ELEC TRENCHING & BACKFILL	1,905	LF
623.13	ELEC CONDUIT CONCRETE ENCASEMENT	40	CY
623.14	TEMPORARY ELEC FACILITIES AND TELEPHONE SUPPORTS	1	LS
622.01	PERMANENT SIGNS	1	EA
629.02	WATER MAIN RELOCATION - 10-INCH	610	LF
629.03	WATER MAIN RELOCATION - 8-INCH	495	LF
629.04	WATER MAIN RELOCATION - 6-INCH	140	LF
629.05	WATER MAIN RELOCATION - 4-INCH	330	LF
638.01	DUST CONTROL SOIL STABALIZER	10	AC
640.01	TELEPHONE SYSTEM OUTSIDE PLANT	1	LS
661.01	GABION RETAINING WALL	910	CY
661.02	GABION CHANNEL PROTECTION	570	CY

GENERAL NOTES

1. THE INTENT OF THIS PROJECT IS TO CONSTRUCT VARIOUS FLOOD CONTROL IMPROVEMENTS WITHIN CLARK COUNTY. PHASE I IMPROVEMENTS INCLUDE A CHANNEL THROUGH NAFB GOLF COURSE TO DIVERT MAJOR FLOWS TO THE DETENTION BASIN, UTILITY LOCATION, BRIDGES AND ROADWAY IMPROVEMENTS. PHASE II IMPROVEMENTS CONSIST OF A DIVERSION STRUCTURE; A DETENTION BASIN WITH OUTLET AND SPILLWAY STRUCTURES; AND AN OUTFALL CHANNEL FROM THE DETENTION BASIN.
2. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "IMPROVEMENT STANDARDS", MAY 1990, AS REVISED, AND "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION", 1986, CLARK COUNTY, NEVADA, UNLESS OTHERWISE SPECIFIED BY NOTE ON PLANS AND SPECIAL PROVISIONS OR AS DIRECTED BY THE ENGINEER. THE CONTRACTOR SHALL MAINTAIN A SET OF THESE STANDARDS AT THE JOBSITE AT ALL TIMES.
3. ALL UTILITY COMPANIES SHALL BE NOTIFIED AT LEAST 48 HOURS PRIOR TO BEGINNING CONSTRUCTION.
4. THE EXISTENCE AND LOCATION OF UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON PLANS FOR CONTRACTOR'S CONVENIENCE WERE OBTAINED BY A SEARCH OF AVAILABLE RECORDS. THE OWNER ASSUMES NO RESPONSIBILITY FOR UTILITIES OR STRUCTURES NOT OF RECORD, OR NOT IN THE LOCATION OF RECORD. THE CONTRACTOR'S LIABILITY REGARDING ANY DAMAGED UTILITY IS SET FORTH IN SECTION 105 OF THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS.
5. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL OVERHEAD INTERFERENCES WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD OR UNDERGROUND POWER, GAS AND/OR OTHER UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COSTS AND LIABILITY IN CONNECTION THEREWITH.
6. THE CONTRACTOR IS REQUIRED TO TAKE PRECAUTIONARY MEASURES TO PROTECT ALL EXISTING IMPROVEMENTS REMAINING IN PLACE, AND ANY IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED OR RECONSTRUCTED AT THE EXPENSE OF THE CONTRACTOR.
7. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS, ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED, AT THE EXPENSE OF THE CONTRACTOR, PER AVAILABLE RECORDS IN ACCORDANCE WITH NEVADA REVISED STATUTE NUMBER 625.550.
8. ALL BARRICADING AND TEMPORARY TRAFFIC CONTROL DEVISES OR METHODS TO BE USED DURING CONSTRUCTION SHALL BE DONE IN ACCORDANCE WITH THE STATE OF NEVADA "TRAFFIC CONTROL MANUAL", LATEST EDITION, AND WITH THE "U.S. MANUAL ON UNIFORM TRAFFIC CONTROL DEVISES", LATEST EDITION, 1988.
9. CONSTRUCTION SCHEDULING SHALL MINIMIZE DISTURBANCE TO THE NORMAL PLAY ON THE GOLF COURSE. THE PLAY FOR HOLE NUMBER 2 SHALL NOT BE CLOSED. A TEMPORARY NEW TEE SHALL BE ESTABLISHED BY OTHERS ON THE LEFT SIDE OF THE CHANNEL CONSTRUCTION, TEMPORARILY REDUCING THE LENGTH OF THE FAIRWAY. HOLE NUMBER 3 SHALL BE TEMPORARILY CLOSED DUE TO CHANNEL CONSTRUCTION. ALL OTHER HOLES TO REMAIN OPEN FOR NORMAL PLAY.
10. PRIOR TO CHANNEL EXCAVATION, IRRIGATION AND OTHER AFFECTED UTILITIES IN THE GOLF COURSE, SHALL BE THOROUGHLY INVESTIGATED BY A NONDESTRUCTIVE MEANS OF EXCAVATION. ALL UTILITIES, OTHER THAN FOR IRRIGATION, SHALL BE RELOCATED, TO NOT INTERFERE WITH CHANNEL CONSTRUCTION, PRIOR TO BEGINNING CHANNEL EXCAVATION.
11. IRRIGATION FACILITIES SHALL BE RELOCATED TO NOT INTERFERE WITH CHANNEL CONSTRUCTION PRIOR TO BEGINNING CHANNEL EXCAVATION, IF REASONABLE TO DO SO. IF IRRIGATION FACILITIES CANNOT REASONABLY BE COMPLETELY RELOCATED, TEMPORARY FACILITIES SHALL BE PROVIDED AND MAINTAINED TO PROVIDE CONTINUED OPERATION EACH SIDE OF THE CONSTRUCTION AREA THROUGHOUT THE CONSTRUCTION PERIOD.
12. THE EXISTING ACCESS ROAD TO THE GOLF COURSE SHALL REMAIN UNTIL THE PRECAST CONCRETE ARCH BRIDGE HAS BEEN COMPLETED AND MAY BE USED TO REROUTE THE TRAFFIC. THE CONTRACTOR'S SCHEDULE SHALL INCLUDE TIME FRAMES FOR THE CONSTRUCTION OF THE BRIDGE, AND FOR THE CONSTRUCTION OF THE DIVERSION STRUCTURE AFTER COMPLETION OF THE BRIDGE.
13. UTILITY COORDINATION ON NELLIS AIR FORCE BASE CALL 652-4246.

REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — DAVID W. DAVIS — CIVIL — 1/20/93

Avoid cutting underground utility lines. It's costly.

Call before you Dig

1-800-227-2600

UNDERGROUND SERVICE (USA)

REFERENCE DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — DATE 1/10/93

PROJECT MANAGER — DATE 1/20/93

Doyle Engineering Corporation
consulting engineers

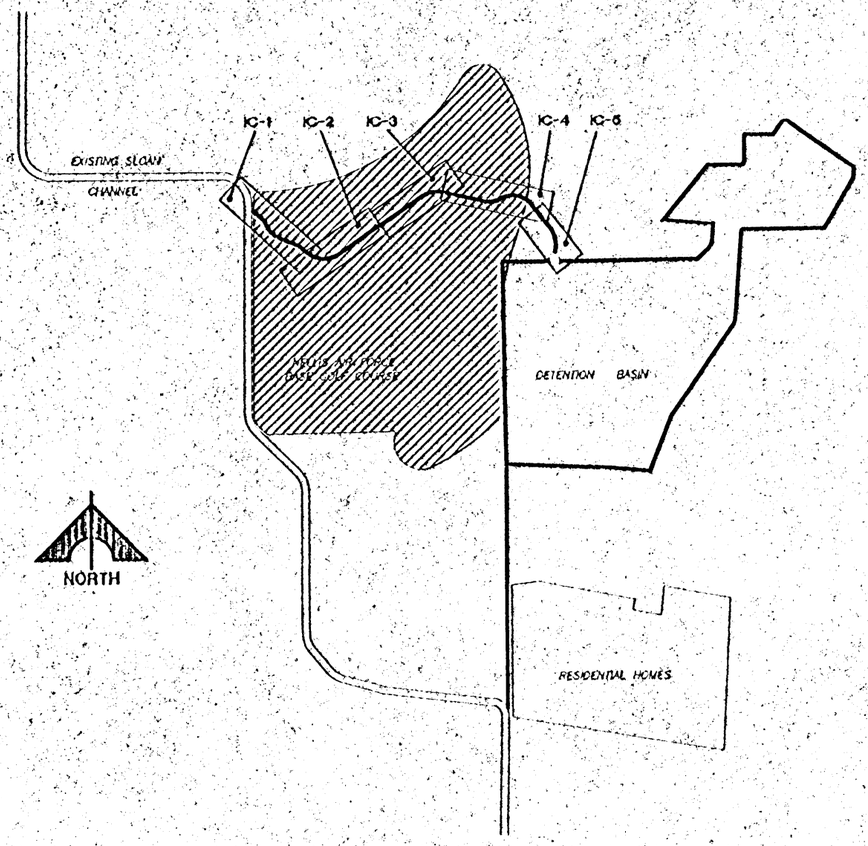
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE 1 - NAFB CHANNEL

QUANTITIES AND GENERAL NOTES

DRAWING G-2
2 OF 26
G1-2

PLOT DATE: 9-21-93



KEY MAP

NOT TO SCALE

LEGEND

- HV-31 1914.64 — EXISTING SURVEY MONUMENT
- EXISTING RIGHT-OF-WAY
- S — EXISTING SANITARY SEWER W/ MANHOLE
- W — EXISTING WATER MAIN W/ VALVE
- G — EXISTING GAS MAIN
- T — EXISTING TELEPHONE CABLE(S)
- E — EXISTING ELECTRICAL
- IRR — EXISTING IRRIGATION LINE W/SPRINKLER HEAD
- EXISTING STREET SIGN
- EXISTING UTILITY POLE
- EXISTING POST
- W — NEW WATER MAIN
- IRR — NEW IRRIGATION MAIN
- NEW OR RELOCATED SPRINKLER HEAD
- EXISTING FIRE HYDRANT
- EXISTING STREET LIGHT
- EXISTING TRAFFIC SIGNAL W/ STREET LIGHT
- EXISTING BUILDING
- EXISTING FENCE
- EXISTING PAVED ROAD
- EXISTING SHRUB OR TREE
- EXISTING CHANNEL SIDESLOPE
- SAWCUT
- NEW CHANNEL SIDESLOPE
- NEW PAVED ROAD
- EXISTING IRRIGATION VALVE BOX
- SWALE

ABBREVIATIONS

@	AT	FL	FLOW LINE	RD	ROAD
A/C, AC	ASPHALTIC CONCRETE	FT	FOOT, FEET	R/W	RIGHT-OF-WAY
AVE	AVENUE	G	GAS	RT	RIGHT
AWG	AMERICAN WIRE GAUGE	HORIZ	HORIZONTAL	S	SANITARY SEWER
BC	BACK OF CURB	INT	INTERSECTION	S	SOUTH
	BEGIN CURVE	IRR	IRRIGATION	SD	STORM DRAIN
BCR	BEGIN CURB RADIUS, BEGIN CURB RETURN	LF	LINEAR FEET	SHT	SHEET
		LN	LANE	SL	STREET LIGHT
BVC	BEGIN VERTICAL CURVE	MAX	MAXIMUM	ST	STREET
℄	CENTERLINE	MH	MANHOLE	STA	STATION
CONC	CONCRETE	MIN	MINIMUM	STD	STANDARD
CLF	FUNGFED LINEAR FEET	N	NORTH	T, TEL	TELEPHONE
CU	COPPER	NO	NUMBER	TC	TOP OF CURB
DET	DETAIL	NTS	NOT TO SCALE	THW	INSULATED STRAND WIRE
DIA	DIAMETER	OC	ON CENTER	TRANS	TRANSITION
DWG	DRAWING	PC	POINT OF CURVATURE	TYP	TYPICAL
E	EAST	PI	POINT OF INTERSECTION	VC	VERTICAL CURVE
EA	EACH	PT	POINT OF TANGENCY	VERT	VERTICAL
EC	END CURVE	PVC	POLY VINYL CHLORIDE	W	WATER
ECR	END OF CURB RADIUS, END OF CURB RETURN	PVI	POINT OF VERTICAL CURVE		WEST
		PVMT	PAVEMENT	W/	WITH
EL, ELEV	ELEVATION	R	RADIUS	W/O	WITHOUT
ELEC, E	ELECTRIC			XLPE	CROSS-LINKED POLYETHYLENE WIRE
EVC	END VERTICAL CURVE				
EXIST, EX	EXISTING				
FG	FINISHED GRADE				

LIST OF DRAWINGS

DRAWING	TITLE
G-1	COVER SHEET
G-2	QUANTITIES AND GENERAL NOTES
G-3	VICINITY MAP, KEY MAP, LEGEND, ABBREVIATIONS AND DRAWING INDEX
G-4	CHANNEL EASEMENT AND GEOMETRY PLAN
G-5	SURVEY DATA
IC-1	GOLF COURSE CHANNEL STA 0+00 TO STA 11+00
IC-2	GOLF COURSE CHANNEL STA 11+00 TO STA 20+00
IC-3	GOLF COURSE CHANNEL STA 20+00 TO STA 28+00
IC-4	GOLF COURSE CHANNEL STA 28+00 TO STA 39+00
IC-5	GOLF COURSE CHANNEL STA 39+00 TO STA 44+50
R-1	ACCESS ROAD
R-2	MAINTENANCE ROAD
R-3	ROADWAY DETAILS
D-1	GOLF COURSE CHANNEL SECTIONS
D-2	PRECAST CONCRETE ARCH BRIDGE
D-3	PRECAST CONCRETE ARCH BRIDGE DETAILS
D-4	PREFABRICATED STEEL BRIDGE (120' SPAN)
D-5	PREFABRICATED STEEL BRIDGE (60' SPAN)
D-6	CONCRETE REINFORCEMENT DETAILS
D-7	WATER RELOCATION DETAILS
D-8	WATER MAIN RELOCATIONS
E-1	ELECTRICAL PLAN
E-2	ELECTRICAL PLANS
E-3	ELECTRICAL PLANS
E-4	ELECTRICAL DETAILS
E-5	ELECTRICAL SECTIONS

DONALD W. DAVIS CIVIL — REGISTERED PROFESSIONAL ENGINEER — No. 8111 — STATE OF NEVADA — 9/21/93

XREF or BOOK DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — DATE 9/16/93
PROJECT MANAGER — DATE 9/21/93

Doyle Engineering Corporation
consulting engineers
7465 West Sahara Avenue
Las Vegas, Nevada 89117

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

KEY MAP, LEGEND, ABBREVIATIONS, AND LIST OF DRAWINGS

DRAWING G-3
3 OF 26
GT-3

PLOT DATE: 9-21-93

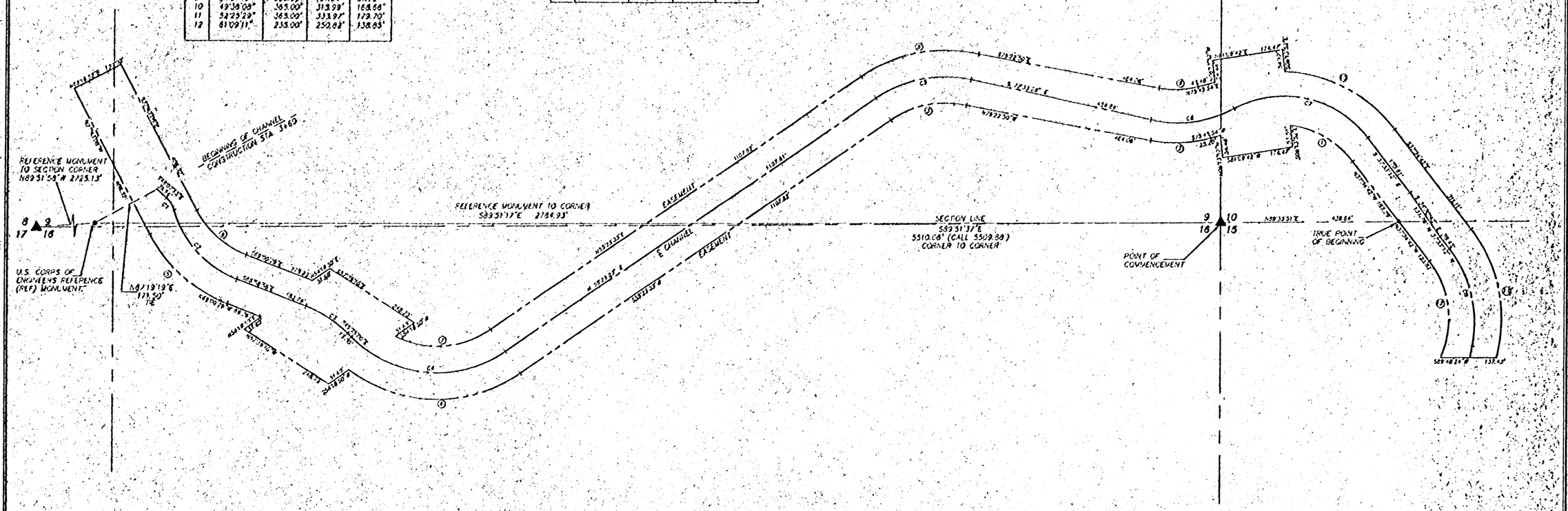
CHANNEL EASEMENT BOUNDARY CURVE DATA

NO	DELTA	RADIUS	LENGTH	TANGENT
1	44°30'39"	235.00'	182.58'	96.17'
2	24°58'18"	365.00'	158.33'	80.43'
3	45°14'09"	235.00'	185.53'	97.91'
4	70°54'07"	365.00'	451.68'	259.68'
5	41°37'21"	365.00'	265.03'	137.52'
6	41°37'21"	235.00'	170.75'	88.54'
7	60°11'39"	235.00'	246.91'	136.22'
8	45°16'07"	365.00'	288.17'	152.01'
9	24°51'18"	235.00'	101.94'	51.79'
10	49°38'09"	365.00'	315.99'	166.66'
11	52°25'29"	365.00'	333.97'	179.70'
12	81°09'11"	235.00'	250.83'	138.85'

CENTERLINE CHANNEL CURVE DATA

NO	DELTA	RADIUS	LENGTH	TANGENT
C1	32°14'39"	82.81'	35.35'	18.16'
C2	53°07'56"	260.00'	241.11'	130.01'
C3	23°28'30"	300.00'	122.76'	62.24'
C4	79°02'58"	300.00'	413.90'	247.52'
C5	47°03'29"	300.00'	246.40'	130.62'
C6	40°25'15"	300.00'	211.64'	110.44'
C7	80°24'00"	261.91'	367.53'	221.33'
C8	49°25'37"	300.00'	258.58'	136.91'

NORTH
NOT TO SCALE



REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — No. 8087 — DOUGLAS W. DAVIS — CIVIL

XReference DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER _____ DATE 9/20/93
PROJECT MANAGER _____ DATE 9/20/93

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

CHANNEL EASEMENT AND GEOMETRY PLAN

DRAWING G-4
4 OF 26
01-4

PLOT DATE: 9-21-93

NORTH
Scale: 1" = 400'

NOT IN CONTRACT

U.S. CORPS OF ENG.
FND CONC MONUMENT
W/BRASS DISC
MC 293-58
PLS 1871
@ 0.35' NORTH &
29.90' WEST OF COR.

FND BRASS DISC
PLS 3803
8 | 9 / 16 | 17 — 19275.0177 N / 9129.4837 E
SECT COR

DIVERSION AREA PHASE II

APPROXIMATE LOCATION OF PROPOSED CUL/SPAN STRUCTURE

19368.3013 N / 11884.5078 E — 9 / 16 — 1/4 COR

PROPOSED BRIDGE LOCATION

LINED INLET CHANNEL

FND BRASS DISC
PLS 3803
19361.5361 N / 14839.5319 E — 9 | 10 / 16 | 15
SECT COR

BASIS OF BEARING
THE NORTH LINE OF SECTION 15, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M. BEARS N89°33'51"E AS SHOWN ON RECORDS OF SURVEY (FILE 1, PAGE 9).

BENCHMARK
CLARK COUNTY VERTICAL DATUM
COUNTY BM STA 6002-9SW3
2" BRASS DISC
NE COR NELLIS BLVD. & CHEYENNE AVE.
ELEV. 1828.63

EXISTING SLOAN CHANNEL

WEST SPILLWAY EMBANKMENT

FND 2" IRON PIPE W/CAP (TOP DAMAGED)
17230.1238 N / 14826.5830 E — 16 | 15 — 1/4 COR

17293.0582 N / 11685.5330 E
U.S. CORPS OF ENG.
2" PIPE W/DISC
CEN 1/4 COR SECT 16
N.A.F.B.

PROPOSED CONCRETE LINED OUTLET CHANNEL

FND BRASS DISC
14820.6845 N / 11887.4888 E — 16 / 21
1/4 COR
PLS 3803

FND. BRASS CAP
14825.5295 N / 14813.7877 E — 16 | 15 / 21 | 22
SECT COR
PLS 1799

TOWNE AVE.

14653.3582 N / 14870.5246 E
FND 1" BRASS DISC
@ 28.75' NORTH & 54.80' EAST OF SECT COR

CHEYENNE AVE.

DETENTION BASIN CONSTRUCTION IN PHASE II CONTRACT

LIMIT OF BASIN CONSTRUCTION

LIMIT OF GRADING

ALTO DR.

BLUEHILL

CASA LOMA

SHENANDOAH

ROCKY MOUNTAIN

CASA LOMA EST. No. 1 PRIVATE

N.A.F.B. AIR FIELD

19371.7865 N / 15979.6893 E
FND U.S. CORPS OF ENGINEERS 2" IRON PIPE 1/16 COR

19381.9742 N / 17319.7572 E
5/8" IRON ROD W/ALUM DISC
10 | 15 — 1/4 COR
PLS 8191

19392.1683 N / 18659.8683 E
CALCED 1/16 COR
FND IRON ROD W/CAP PLS 6625 @ 0.59' SOUTH & 0.10' EAST OF 1/16 COR.
SEC 15 T20S R62E

18660.5551 N / 17315.0590 E
FND 5/8" IRON ROD W/TAG PLS 6142

17212.0943 N / 11110.3576 E
FND 5/8" IRON ROD
CEN 1/4 COR (NO CAP)

FND 1" IRON PIPE
@ 1.8' NORTH
& 13.0' WEST (NO CAP)
FND 1/2" IRON ROD
@ 7.2' NORTH
& 28.55' WEST (NO CAP)
OF COR

14253.6165 N / 16865.6030 E — 15 / 22 — 1/4 COR

DEPT. OF INT.
FND. BRASS CAP
PLS 5088
10 | 11 / 15 | 14 — 20002.3523 N / 19999.9828 E
SECT COR

DEPT. OF INT.
FND BRASS DISC
15 | 14 — 17142.7938 N / 19778.3680 E
1/4 COR

DEPT. OF INT.
FND. BRASS CAP
15 | 14 / 22 | 23 — 14283.5132 N / 19557.0350 E
SECT COR

FORMER COUNTY GRAVEL PIT
AVAILABLE SURPLUS
MATERIAL DISPOSAL SITE

26-81-1 U.S.A.
26-81-5 USA
26-81-8 U.S.A.
26-81-23 PRIVATE
26-81-24 PRIVATE
26-81-6 USA
26-81-2 U.S.A.
26-81-9
26-81-17 PRIVATE
26-81-7 USA
26-81-19 PRIVATE
26-47-1 U.S.A.
26-81-3 U.S.A.
26-29-1 U.S.A.
26-29-23
26-29-5 PRIVATE
26-29-21 PRIVATE
26-29-18 PRIVATE
26-29-8 PRIVATE
26-29-24
26-29-2
26-29-6 PRIVATE
26-29-25
26-29-22
26-24-1 U.S.A.
26-29-13
26-29-3
26-29-26 PRIVATE
26-29-19 PRIVATE
26-29-20 PRIVATE
26-29-9
26-29-10
26-29-4 PRIVATE
26-29-12 PRIVATE
26-29-16 PRIVATE
26-29-14 PRIVATE
26-29-15 PRIVATE
26-29-11 CLARK CO.
26-29-17
26-29-7 PRIVATE
26-23-1 U.S.A.
26-30-33 PRIVATE
26-30-1 PRIVATE
26-21-1 U.S.A.

XREF reference DRAWINGS

MARK	DATE	BY	REVISION

PLOT DATE: 9-21-93

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — DATE 9/20/93
PROJECT MANAGER — DATE 9/20/93

Doyle Engineering Corporation
consulting engineers

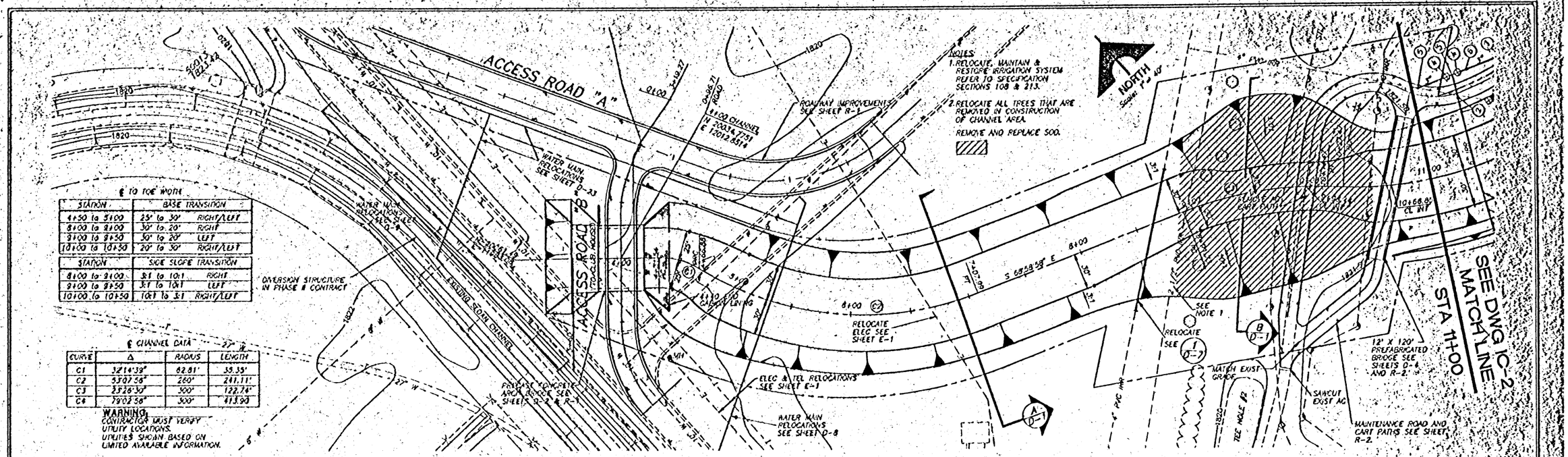
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE 1 - NAFB CHANNEL

SURVEY DATA SHEET
REFERENCE COORDINATES, BENCHMARK

DRAWING G-5
5 OF 26
ASSESSOR

DONALD W. DOYLE CIVIL — No. 6087 — REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — 9/20/93



XREF drawings
IC-DES
IC-TOPO
IC-CNF
NEWROAD

MARK	DATE	BY	REVISION
1	4-4-93	KH	ADD UTILITY NOTES

PLOT DATE: 9-21-93

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 9/21/93
PROJECT MANAGER — DATE 9/21/93

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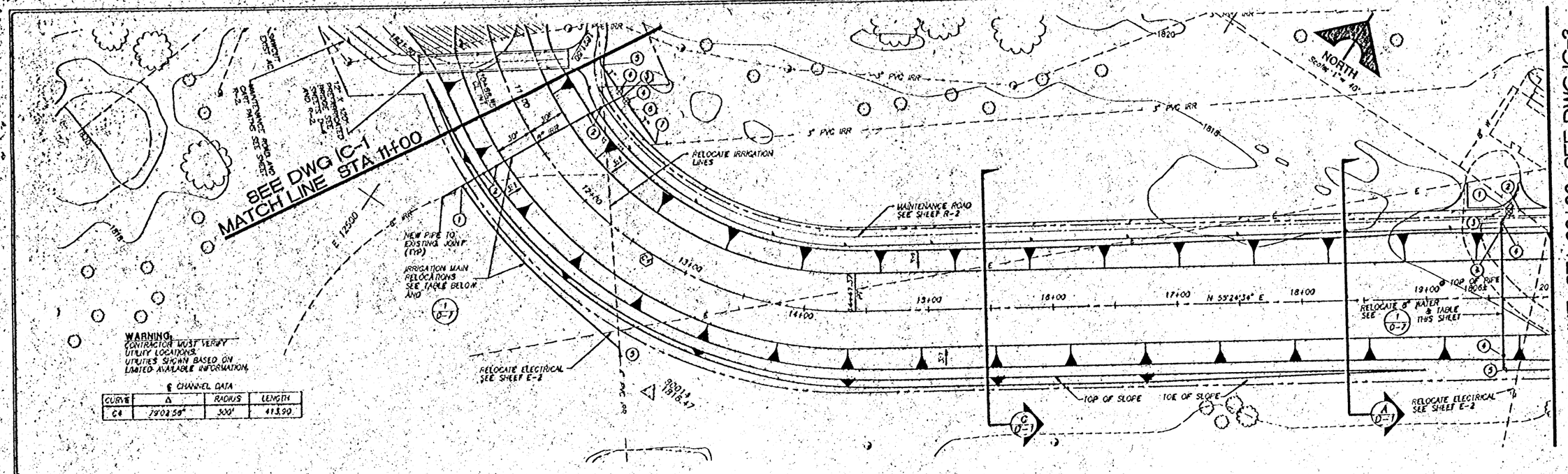
Las Vegas, Nevada

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
STA 0+00 TO STA 11+00

DRAWING IC-1
6 OF 26
IC1+1:



IRRIGATION MAIN RELOCATIONS

	LIST OF MATERIALS	APPROXIMATE QUANTITIES THIS SHEET
1	6" X 6" X 4" TEE W/THRUST BLOCK	1 EA
2	6" 45° ELBOW W/THRUST BLOCK	4 EA
3	4" X 4" X 3" TEE W/THRUST BLOCK	1 EA
4	4" GATE VALVE W/BOX & ANCHOR	2 EA
5	4" 45° ELBOW W/THRUST BLOCK	2 EA
6	4" X 3" REDUCER W/ANCHOR	1 EA
7	3" 45° ELBOW	1 EA
	6" PVC PIPE	190 LF
	4" PVC PIPE	250 LF
	3" PVC PIPE	50 LF

8" WATER RELOCATION

	LIST OF MATERIALS	APPROXIMATE QUANTITIES THIS SHEET
1	8" WET TAP W/VALVE BOX	1 EA
2	8" CAP W/THRUST BLOCK	1 EA
3	8" 45° HORIZ. ELBOW W/THRUST BLOCK	1 EA
4	8" 45° VERT. ELBOW W/THRUST BLOCK	3 EA
5	8" 90° ELBOW W/THRUST BLOCK	1 EA
	8" PVC PIPE	150 LF

XREFerence DRAWINGS
IC-DES
IC-TOPO
IC-CNT
NEWROAD

MARK	DATE	BY	REVISION
1	6-6-95	RJL	ADD UTILITY NOTE

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/21/93
PROJECT MANAGER — DATE 7/21/93

Boyle Engineering Corporation
consulting engineers
Las Vegas, Nevada 89128

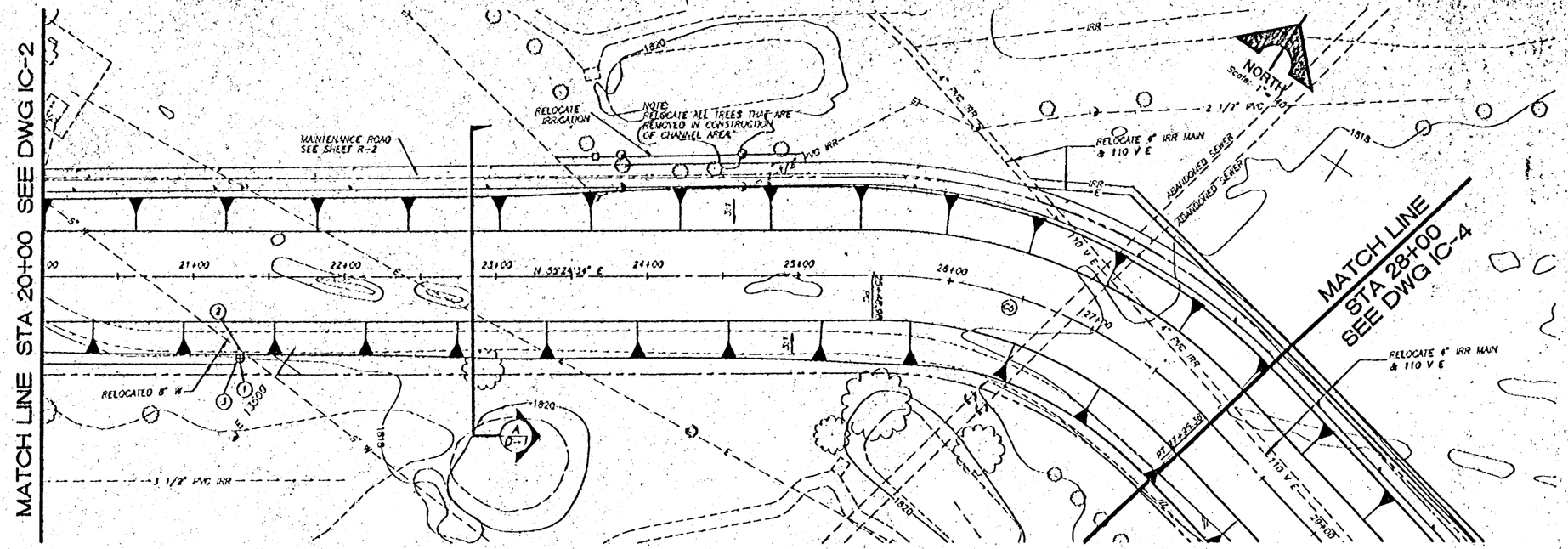
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

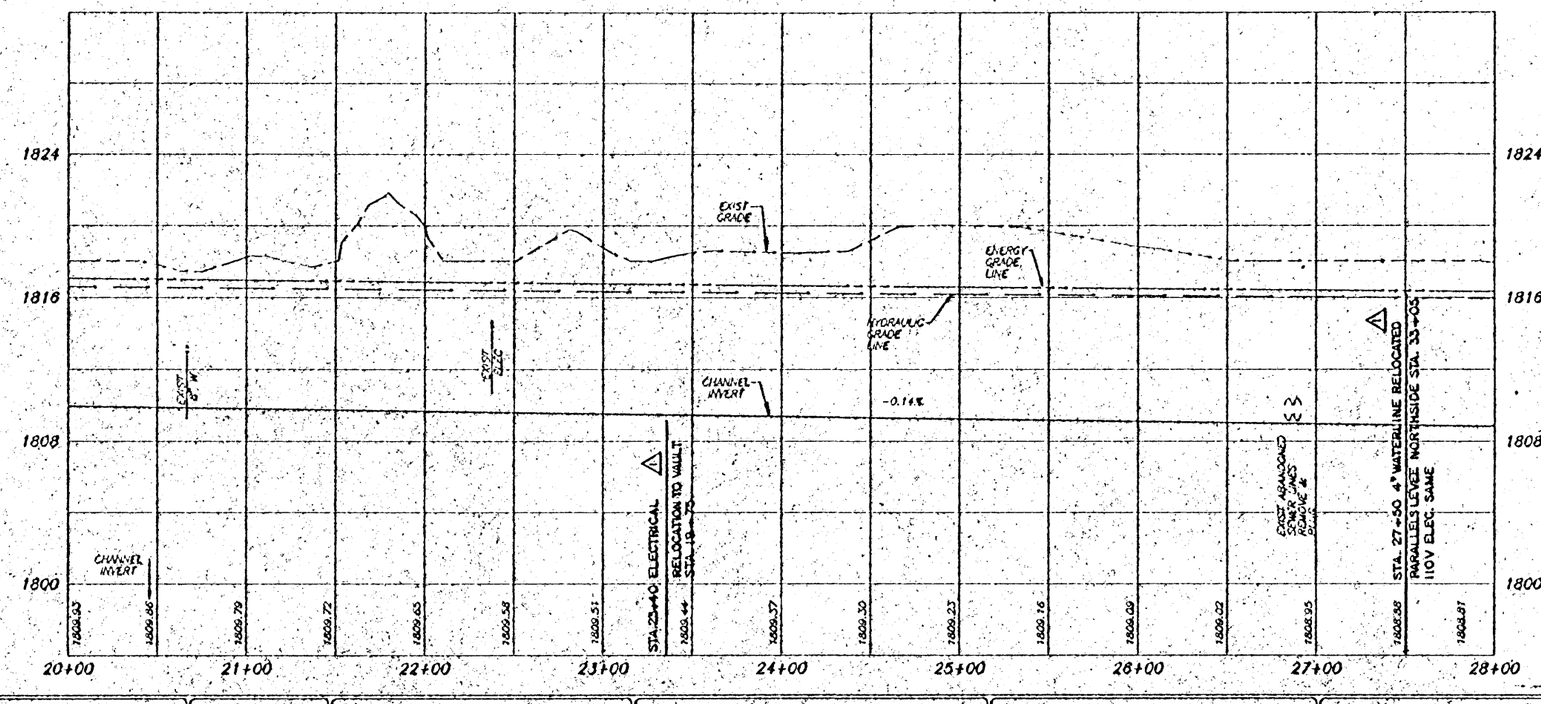
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
STA 11+00 TO STA 20+00

DRAWING IC-2
7 OF 26
IC1-2

PLOT DATE: 9-21-93





WARNING!
CONTRACTOR MUST VERIFY UTILITY LOCATIONS. UTILITIES SHOWN BASED ON LIMITED AVAILABLE INFORMATION.

℄ CHANNEL DATA

CURVE	Δ	RADIUS	LENGTH
C3	47°05'29"	300'	246.40'

8" WATER RELOCATION

LIST OF MATERIALS — APPROXIMATE QUANTITIES THIS SHEET

①	8" WET TAP W/VALVE BOX	1 EA
②	8" CAP W/THRUST BLOCK	1 EA
③	8" 45° HORIZ. ELBOW W/THRUST BLOCK	1 EA
	8" PVC PIPE	140 LF

DONALD W. COLLINS — REGISTERED PROFESSIONAL ENGINEER — CIVIL — No. 8097 — STATE OF NEVADA

XREF Reference DRAWINGS
IC-DES
IC-TOPO
IC-CNT
NEWROAD

MARK	DATE	BY	REVISION
1	4-19-93		ADD UTILITY NOTES

PLOT DATE: 9-21-93

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 9/21/93
PROJECT MANAGER — DATE 9/21/93

Boyle Engineering Corporation
consulting engineers
2501 East Sahara Avenue
Las Vegas, Nevada 89158

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

FLANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
STA 20+00 TO STA 28+00

DRAWING IC-3
8 OF 26
IC1-3

MATCH LINE STA 28+00 SEE DWG IC-3

WARNING:
CONTRACTOR MUST VERIFY UTILITY LOCATIONS. UTILITIES SHOWN BASED ON LIMITED AVAILABLE INFORMATION.

NORTH

NOTES:
1. RELOCATE, MAINTAIN & RESTORE IRRIGATION SYSTEM PER SPECIFICATION SECTIONS 108 & 217.
2. RELOCATE ALL TREES AND SCRUBS THAT ARE REMOVED IN CONSTRUCTION OF CHANNEL AREA.
REMOVE AND REPLACE SOD

STATION	SIDE SLOPE TRANSITION	
34+20 to 35+00	3:1 to 10:1	RIGHT/LEFT
35+50 to 36+00	10:1 to 3:1	RIGHT/LEFT

STATION	BASE TRANSITION	
31+00 to 31+60	30' to 25'	RIGHT/LEFT
35+50 to 36+00	25' to 30'	RIGHT/LEFT

℄ CHANNEL DATA

CURVE	Δ	RADIUS	LENGTH
C6	10°25'13"	300'	211.64'
C7	80°24'00"	281.91'	387.53'

MATCH LINE STA 39+00 SEE DWG IC-5

RELOCATE 8" PVC IRRIGATION MAIN SEE L/D-7

RELOCATE 8" PVC IRRIGATION MAIN SEE L/D-7

12' X 60' PREFABRICATED BRIDGE SEE SHEET D-3 AND SHEET R-2.

RELOCATE TEL SEE SHEET E-3

MAINTENANCE ROAD SEE SHEET R-2

PATH SEE SHEET R-2

POND

EAST GRADE

HYDRAULIC GRADE LINE

CHANNEL INVERT

ENERGY GRADE LINE

CHANNEL INVERT

1824
1816
1808
1800

28+00 29+00 30+00 31+00 32+00 33+00 34+00 35+00 36+00 37+00 38+00 39+00

XREFerence DRAWINGS
IC-DES
IC-TOPO
IC-CNS
NEWROAD

MARK	DATE	BY	REVISION
1	9-21-93	LBL	ADDED UTILITY NOTES

PLOT DATE: 9-21-93

DESIGNED DWD
DRAWN LBL
CHECKED DWD

PROJECT ENGINEER — DATE 9/20/93
PROJECT MANAGER — DATE 9/23/93

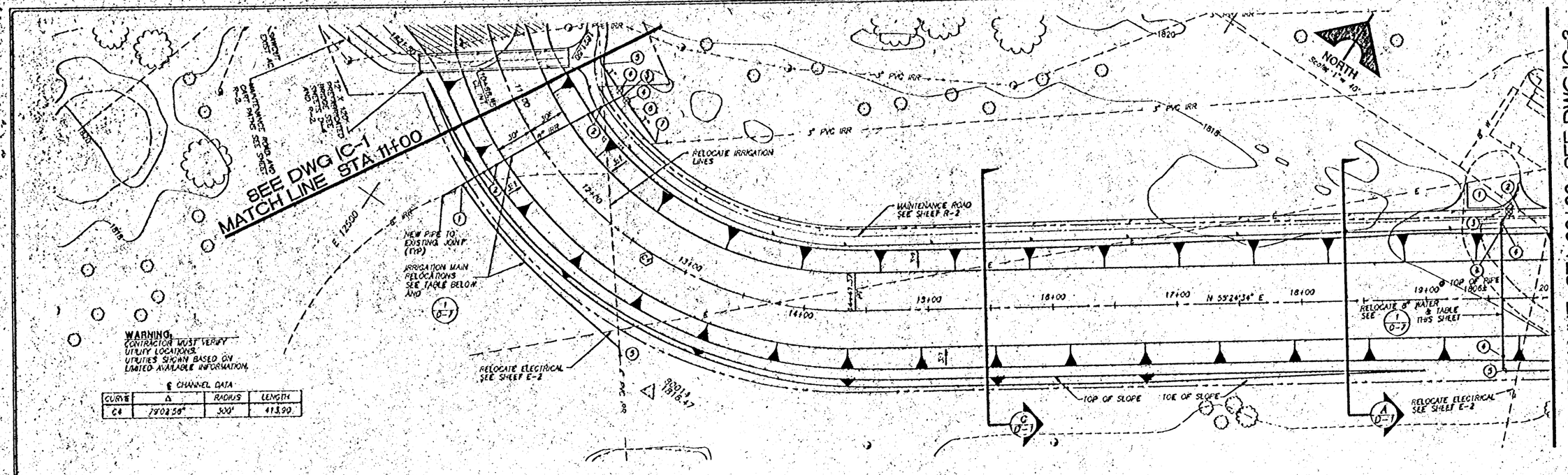
Ecker Engineering Corporation
Consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
STA 28+00 TO 39+00

DRAWING IC-4
9 OF 26
IC1-4



℄ CHANNEL DATA

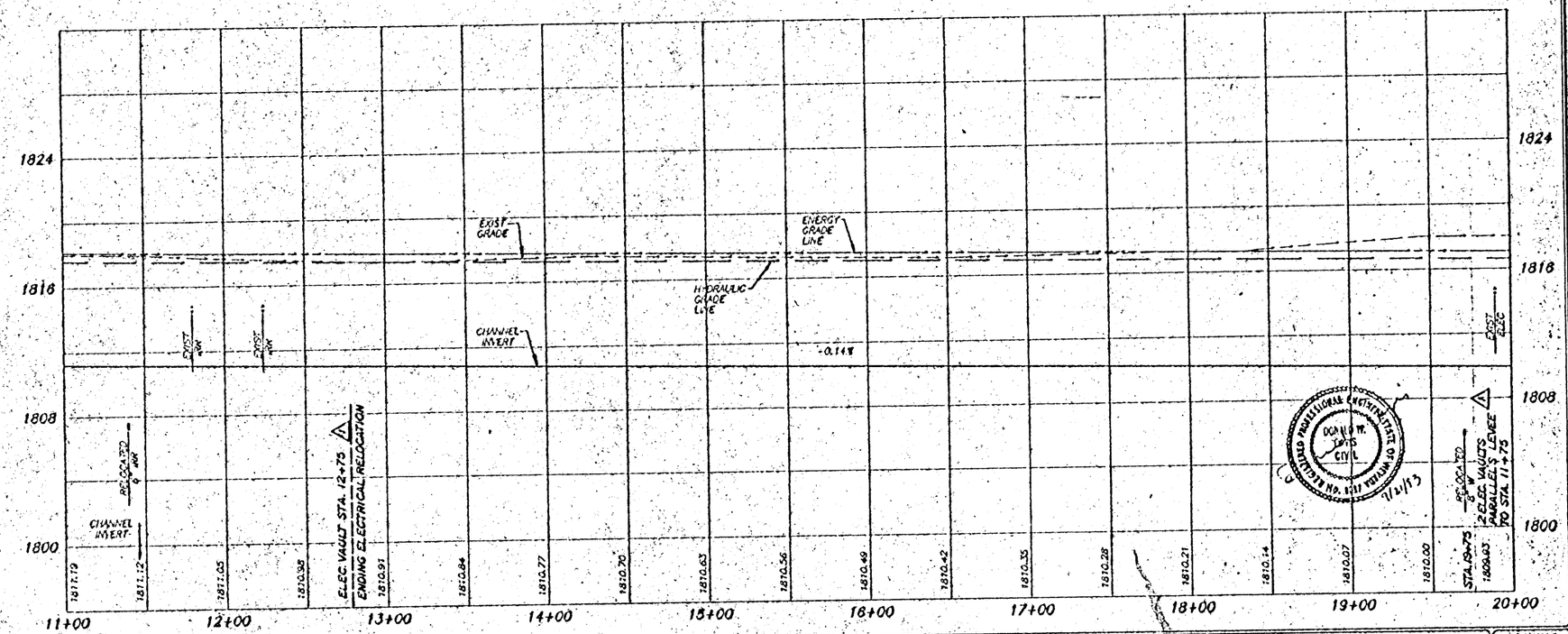
CURVE	Δ	RADIUS	LENGTH
C4	190°28'58"	500'	413.99

IRRIGATION MAIN RELOCATIONS

	LIST OF MATERIALS	APPROXIMATE QUANTITIES THIS SHEET
1	6" X 6" X 4" TEE W/THRUST BLOCK	1 EA
2	6" 45° ELBOW W/THRUST BLOCK	4 EA
3	6" X 4" X 6" TEE W/THRUST BLOCK	1 EA
4	4" GATE VALVE W/BOX & ANCHOR	2 EA
5	4" 45° ELBOW W/THRUST BLOCK	2 EA
6	4" X 3" REDUCER W/ANCHOR	1 EA
7	3" 45° ELBOW	1 EA
	6" PVC PIPE	190 LF
	4" PVC PIPE	250 LF
	3" PVC PIPE	50 LF

8" WATER RELOCATION

	LIST OF MATERIALS	APPROXIMATE QUANTITIES THIS SHEET
1	8" WET TAP W/VALVE BOX	1 EA
2	8" CAP W/THRUST BLOCK	1 EA
3	8" 45° HORIZ. ELBOW W/THRUST BLOCK	1 EA
4	8" 45° VERT. ELBOW W/THRUST BLOCK	3 EA
5	8" 90° ELBOW W/THRUST BLOCK	1 EA
	8" PVC PIPE	150 LF



DONALD W. LEWIS CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — No. 8317 — 7/21/93

XREference DRAWINGS
IC-DES
IC-TOPO
IC-CNT
NEWROAD

MARK	DATE	BY	REVISION
1	6-8-93	RJL	ADD UTILITY NOTE

DESIGNED: DWO
DRAWN: LBL
CHECKED: DWO

PROJECT ENGINEER — 7/21/93 DATE
PROJECT MANAGER — 7/21/93 DATE

Doyle Engineering Corporation consulting engineers

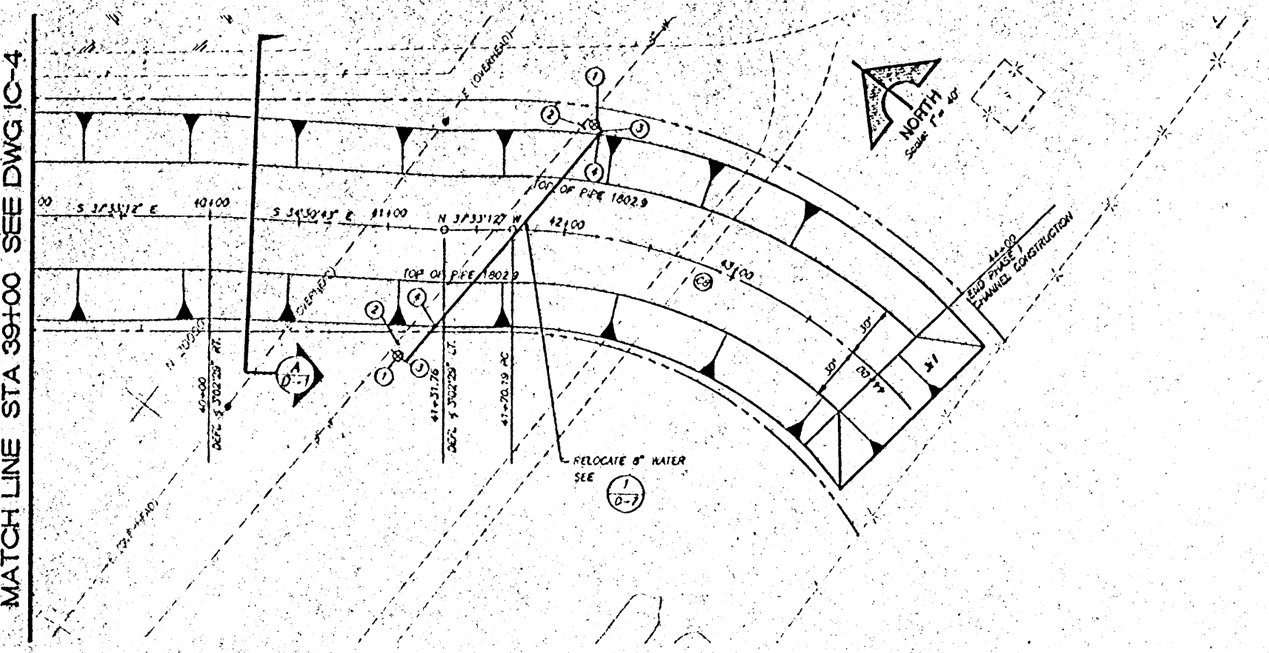
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

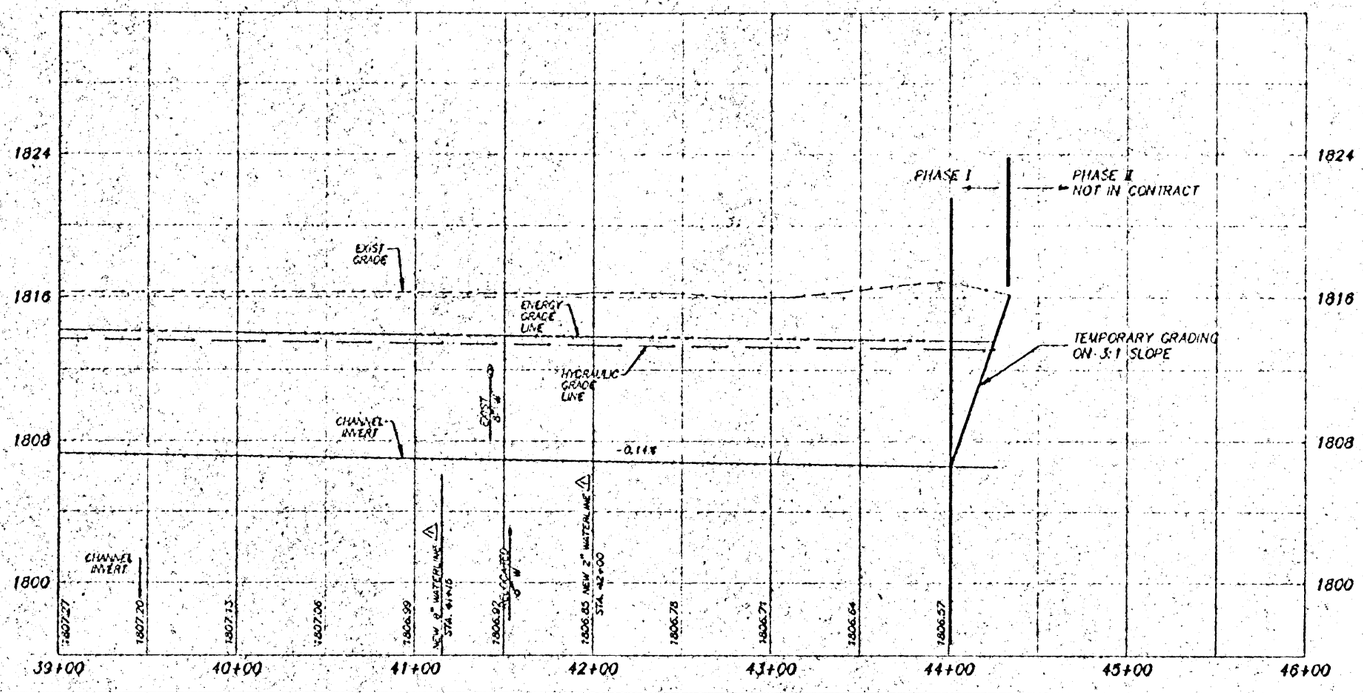
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
STA 11+00 TO STA 20+00

DRAWING IC-2
7 OF 28
IC1-2

PLOT DATE: 9-21-93





XREFerence DRAWINGS
IC-GES
IC-TOPO
CB-GES
IC-CNT

MARK	DATE	BY	REVISION
1	4-6-12	RW	ADDED UTILITY NOTES

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

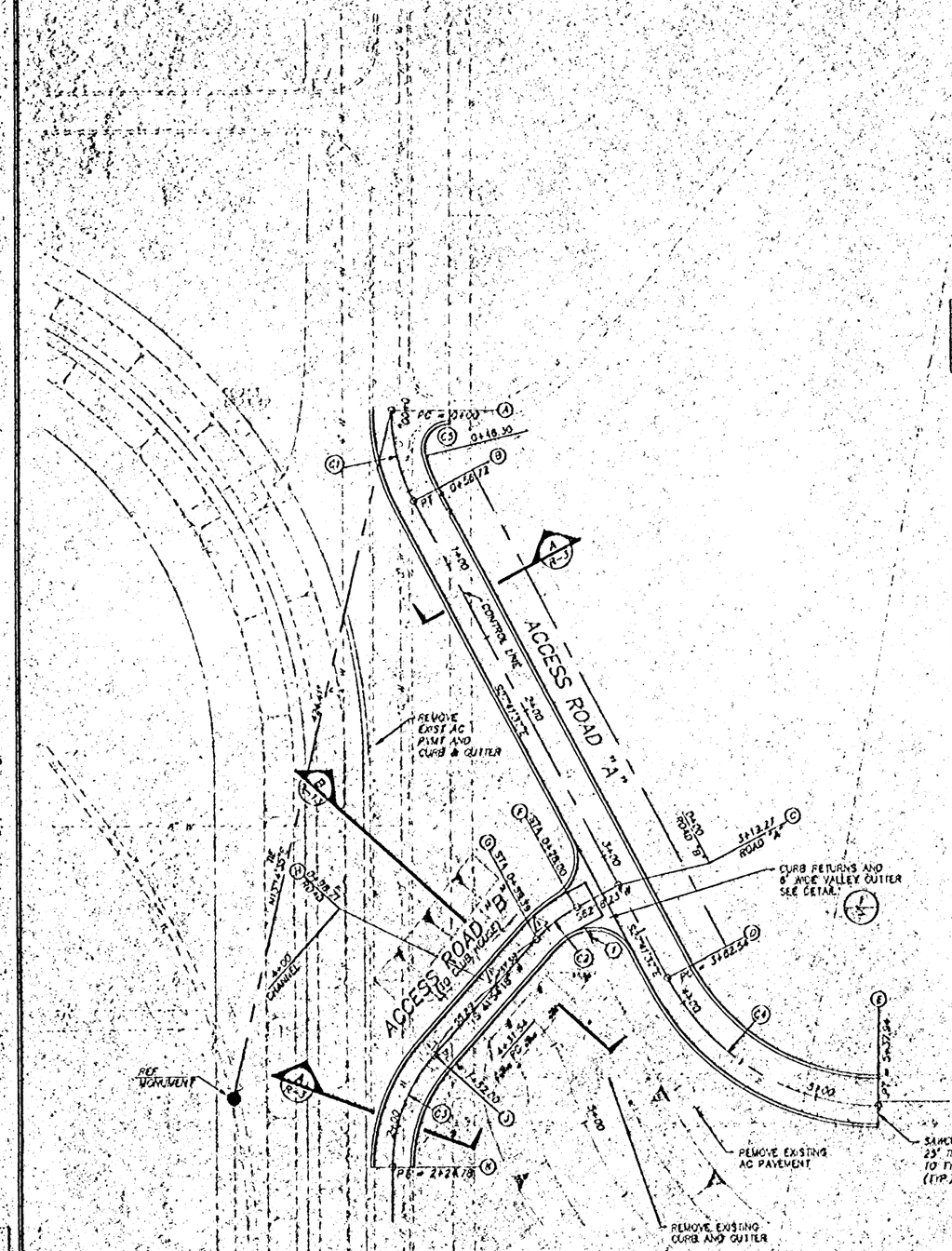
PROJECT ENGINEER — DATE 3/20/12
PROJECT MANAGER — DATE 3/20/12

Lewis Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
GOLF COURSE CHANNEL
STA 39+00 TO STA 44+50

DRAWING IC-5
10 OF 26
IC1-5

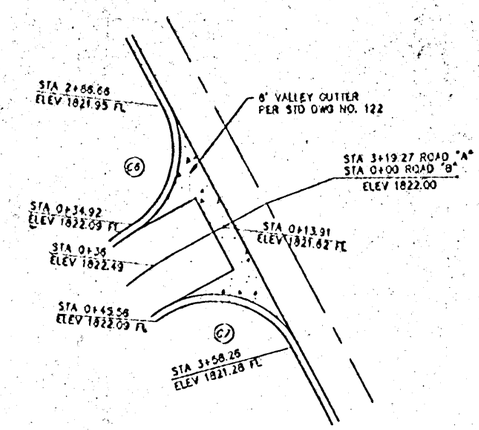


BACK OF CURB DATA				
NO	DELTA	RADIUS	LENGTH	TANGENT
C5	105°54'21"	15.00'	27.73'	19.07'
C6	85°29'18"	25.00'	37.30'	23.11'
C7	101°25'59"	25.00'	44.26'	30.58'

℄ CURVE DATA				
NO	DELTA	RADIUS	LENGTH	TANGENT
C1	27°52'21"	118.59	58.72	29.93
C2	20°24'05"	88.00	31.33	15.83
C3	41°42'06"	100.00	72.78	38.03
C4	81°36'41"	144.59	155.40	88.18

CONTROL POINT DATA				
POINT	NORTHING	EASTING	ELEV △	DESC
A	20391.7782	11951.8350	1824.61	EG
B	20327.2292	11955.1903	1824.09	FG
C	20034.7553	12087.2091	1821.10	FG
D	20038.7224	12118.6158	1821.13	FG
E	19961.3185	12242.8039	1819.70	EG
F	20031.7429	12082.4174	1821.71	FG
G	20062.5088	12037.8268	1822.55	FG
H	20034.7751	12012.8514	1823.55	FG/EG
J	19993.8331	11975.9301	1823.33	FG
K	19927.1902	11950.3559	1823.09	EG

(1) INSTALL 30"x30" STOP SIGN (R1-1 - 3030)



CURB RETURNS AND VALLEY CUTTER (1)

NORTH
Scale: 1" = 40'

REFERENCE DRAWINGS
IC-TOPO

MARK	DATE	BY	REVISION
A	6-8-93	DJK	CORRECTED ELEVATION
B	6-8-93	DJK	ADDED CONTROL LINE & STATIONS

PLOT DATE 8-21-93

DESIGNED: DMD
DRAWN: LBL
CHECKED: DMD

PROJECT ENGINEER — DATE 9/20/93
PROJECT MANAGER — DATE 9/20/93

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

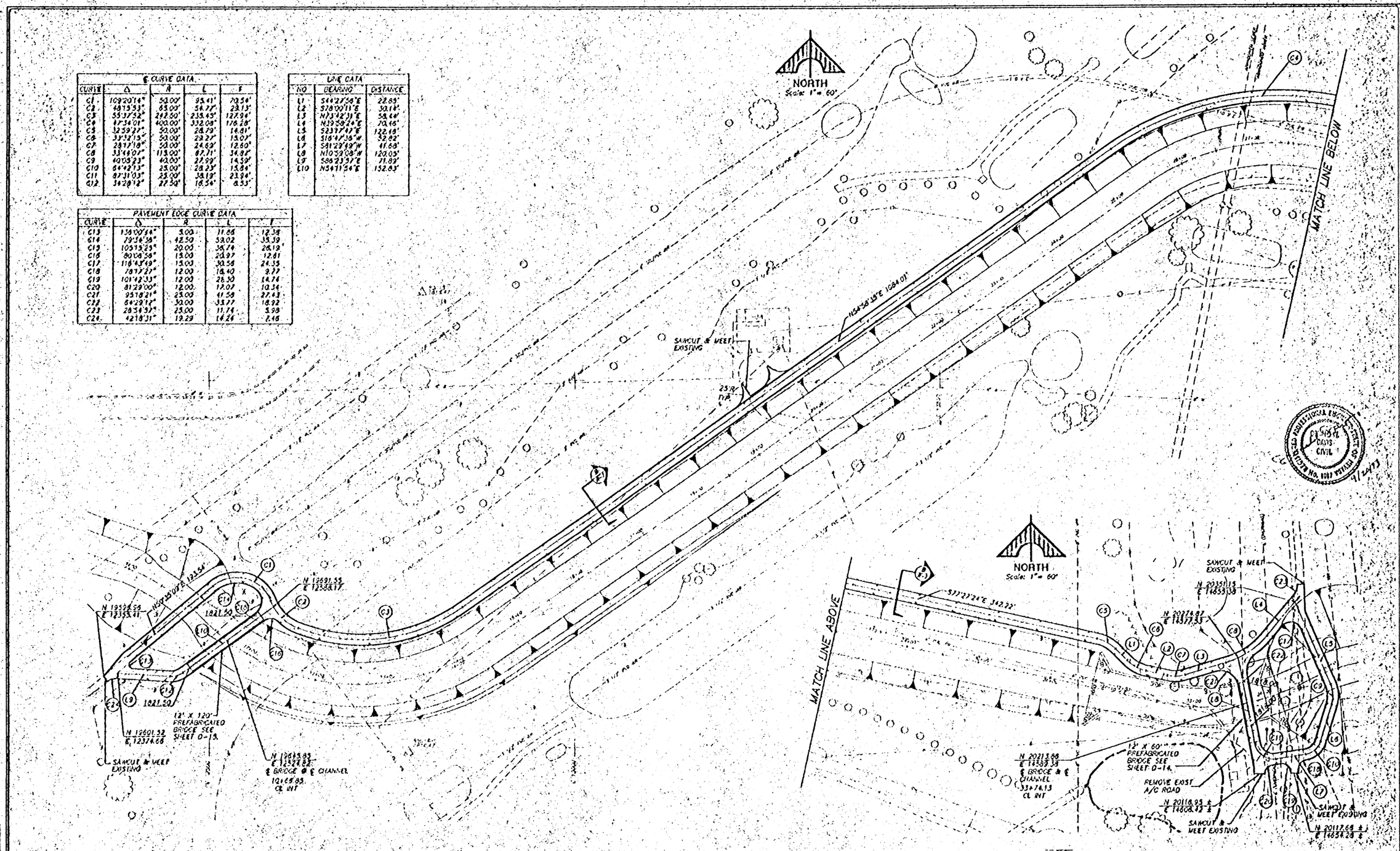
ACCESS ROADS

DRAWING R-1
11 OF 26
R1-1.

℄ CURVE DATA				
CURVE	Δ	R	L	T
C1	109°20'16"	50.00'	95.41'	70.56'
C2	49°19'53"	65.00'	56.77'	29.13'
C3	55°37'52"	292.50'	235.45'	127.94'
C4	97°34'01"	400.00'	332.08'	176.28'
C5	32°59'21"	50.00'	28.79'	14.81'
C6	33°52'15"	50.00'	29.57'	15.07'
C7	28°17'18"	50.00'	24.69'	12.60'
C8	33°46'07"	115.00'	67.77'	34.82'
C9	40°05'23"	40.00'	27.99'	14.59'
C10	64°42'13"	25.00'	28.23'	15.86'
C11	87°31'03"	25.00'	38.19'	23.94'
C12	36°28'12"	27.50'	16.56'	8.53'

LINE DATA		
NO	BEARING	DISTANCE
L1	S44°27'56"E	22.89'
L2	S78°00'11"E	30.16'
L3	N73°42'31"E	58.46'
L4	N39°58'24"E	70.46'
L5	S23°17'43"E	122.16'
L6	S16°47'58"W	52.62'
L7	S81°29'49"W	41.68'
L8	N10°59'08"W	120.05'
L9	S86°23'57"E	71.82'
L10	N54°11'54"E	152.63'

PAVEMENT EDGE CURVE DATA				
CURVE	Δ	R	L	T
C13	139°00'46"	5.00	11.86	12.38
C14	79°34'38"	42.50	59.02	35.39
C15	105°15'25"	20.00	36.74	26.19
C16	80°06'58"	15.00	20.97	12.81
C17	116°43'49"	15.00	30.56	24.35
C18	19°17'27"	12.00	16.40	9.27
C19	101°12'33"	12.00	28.30	24.74
C20	81°29'00"	12.00	17.07	10.34
C21	95°18'21"	25.00	41.58	27.43
C22	64°29'12"	30.00	33.77	18.92
C23	28°54'52"	23.00	11.74	5.98
C24	42°18'31"	19.29	14.24	7.46



XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — DATE 1/20/93
PROJECT MANAGER — DATE 1/20/93

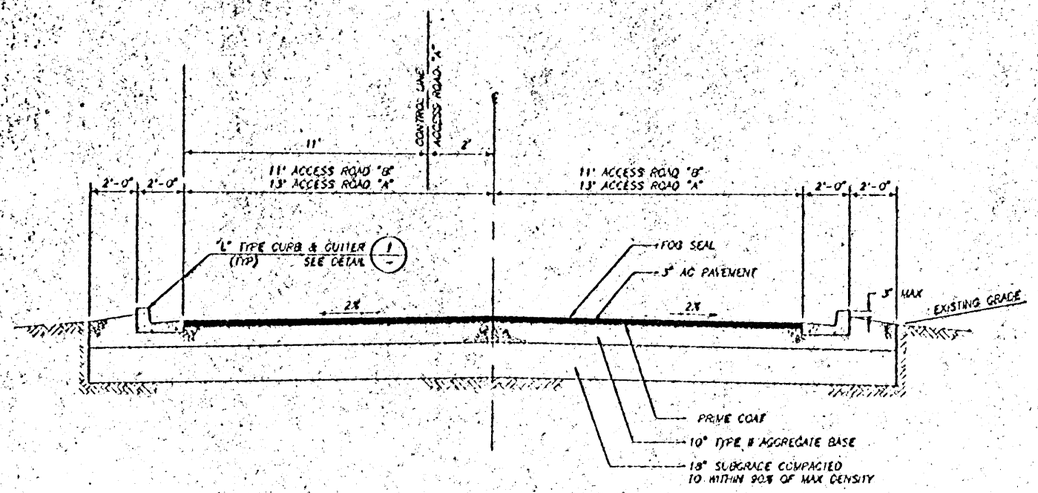
Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

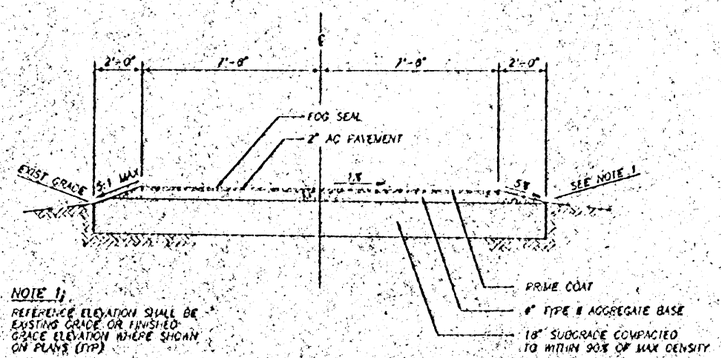
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
MAINTENANCE ROAD

DRAWING R-2
12 OF 26
A1-2

PLOT DATE: 8-21-93

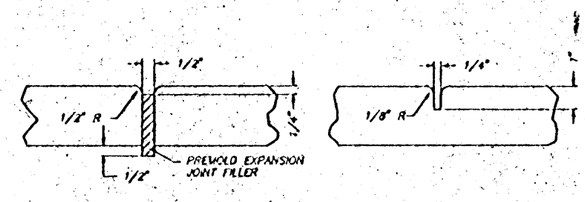


ACCESS ROADWAY SECTION (A)
SCALE: 1" = 3'-0"

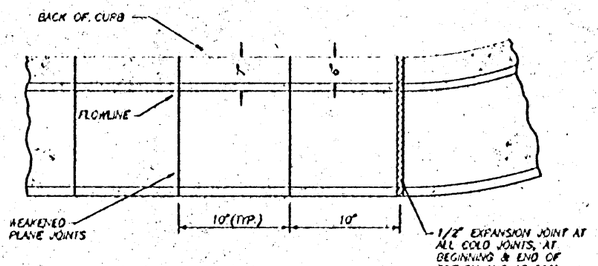


NOTE 1:
REFERENCE ELEVATION SHALL BE EXISTING GRADE OR FINISHED GRADE ELEVATION WHERE SHOWN ON PLANS (TYP)

MAINTENANCE ROAD SECTION (B)
SCALE: 1" = 3'-0"

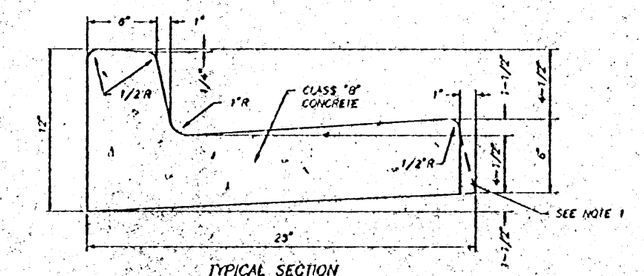


EXPANSION JOINT — WEAKENED PLANE JOINT



PLAN

NOTES:
1. 1" BATTER ON GUTTER FACE OPTIONAL.
2. WHERE LONGITUDINAL SLOPE IS LESS THAN 0.4% THE FLOW LINE SHALL BE WATER TESTED.



TYPICAL SECTION

"L" TYPE CURB & GUTTER (1)
NO SCALE

XREFerence DRAWINGS

MARK	DATE	BY	REVISION

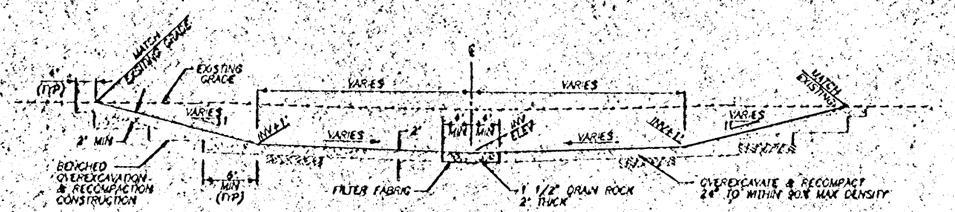
DESIGNED: DWD
DRAWN: GM
CHECKED: DWD
PROJECT ENGINEER — DATE 1/20/23
PROJECT MANAGER — DATE 1/20/23

Doyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
ROADWAY DETAILS

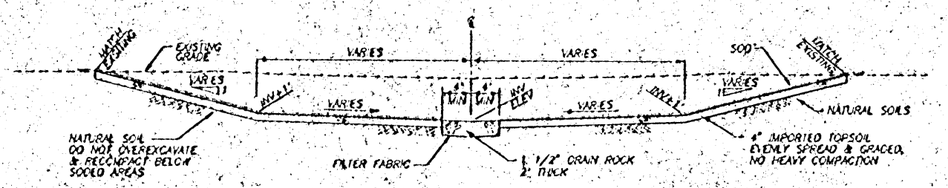
DRAWING R-3
13 OF 26
R1-3



CHANNEL SECTION (A)

STA 4+40 TO 9+00
STA 19+00 TO 31+60
STA 35+60 TO 44+03
NOT TO SCALE

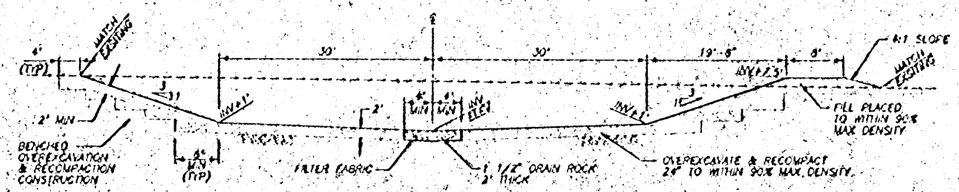
NOTE:
SIDE SLOPE IS TYPICALLY 3:1 EXCEPT AT TRANSITIONS TO SECTION B (AT FAIRWAYS) WHERE SHOWN ON PLANS



CHANNEL SECTION (B)

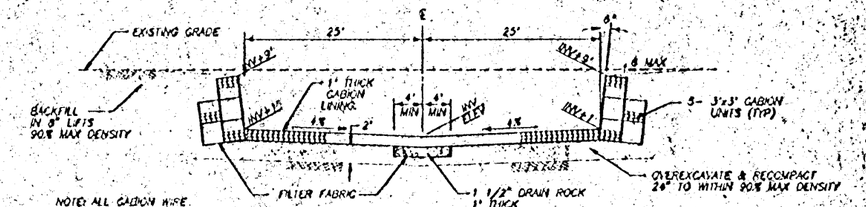
STA 9+00 TO 10+50
STA 34+20 TO 35+60
NOT TO SCALE

NOTE:
SIDE SLOPE VARIES 3:1 TO 10:1



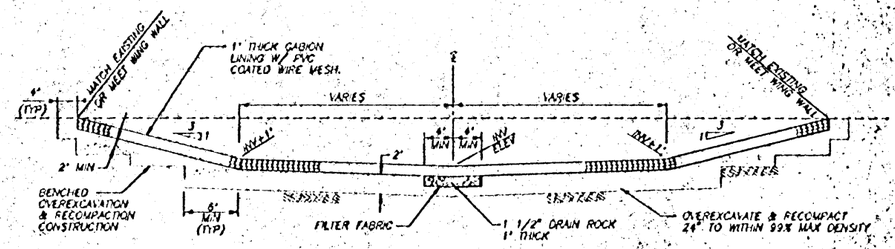
CHANNEL SECTION (C)

STA 10+50 TO 19+00
NOT TO SCALE



CHANNEL SECTION (D)

STA 31+80 TO 34+00
NOT TO SCALE



GABION LINED TRANSITION SECTION (E)

STA 4+20 TO 4+40
STA 31+60 TO 31+80
STA 34+00 TO 34+20
NOT TO SCALE

XREF'D/IMAGE DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWO
DRAWN: GM
CHECKED: DWO
PROJECT ENGINEER — DATE 1/21/93
PROJECT MANAGER — DATE 1/21/93

Boyle Engineering Corporation
consulting engineers

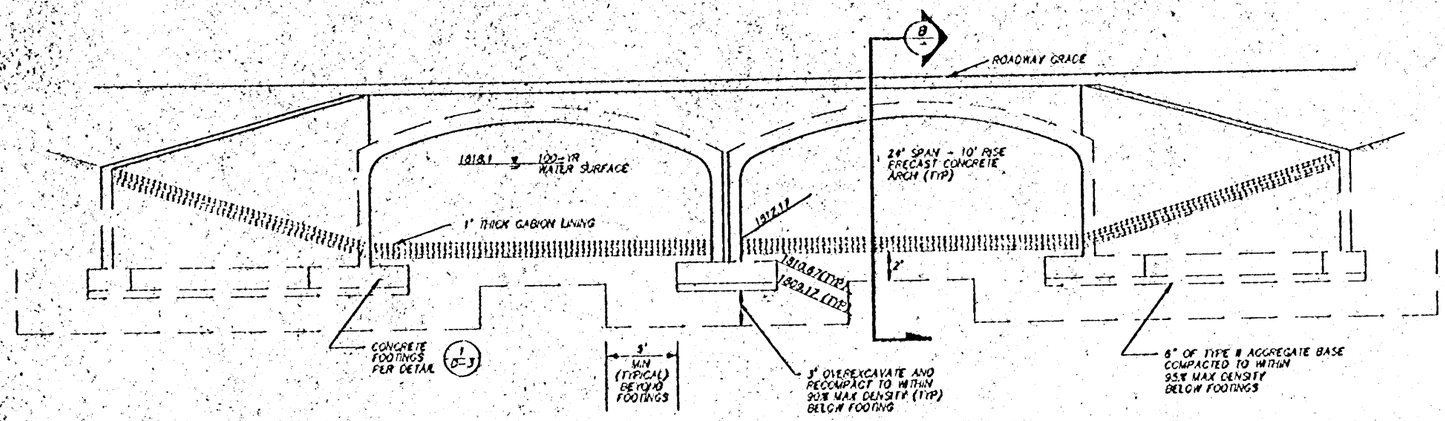
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

GOLF COURSE CHANNEL
SECTIONS + DETAILS

DRAWING D-1
14 OF 20
D1-3

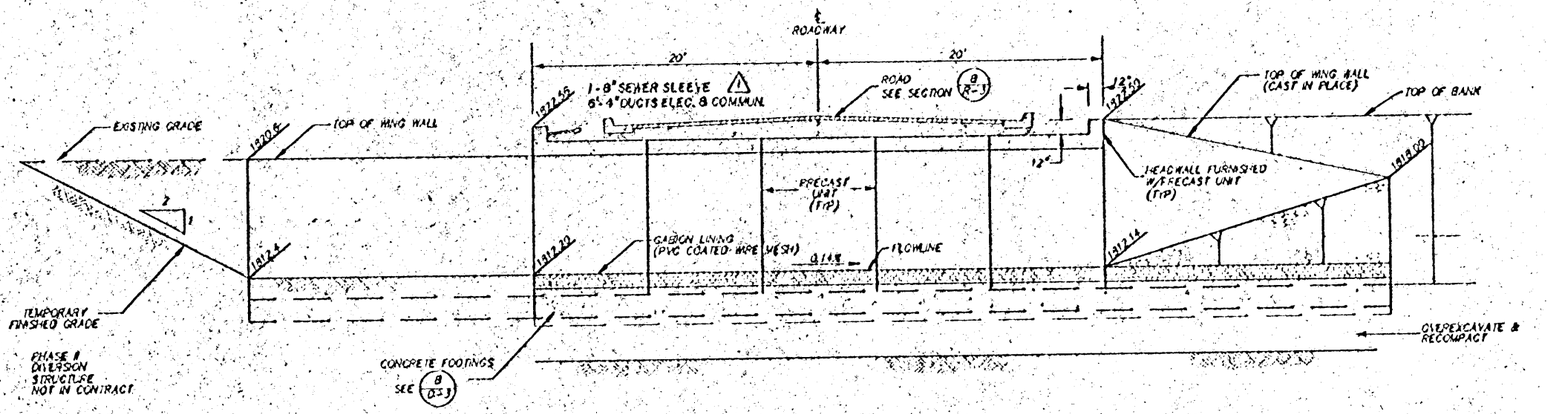
PLOT DATE: 8-21-93



NOTE: INDICATED ELEVATIONS ARE @ ℄ ROADWAY.

PRECAST CONCRETE ARCH BRIDGE ELEVATION (A)

SCALE 1" = 5'



PRECAST CONCRETE ARCH BRIDGE SECTION (B)

SCALE 1" = 5'

XREF or ce DRAWINGS

MARK	DATE	BY	REVISION
			ADDED UTILITY NOTES

PLOT DATE: 9-21-99

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 2/20/03
PROJECT MANAGER — DATE 1/20/03

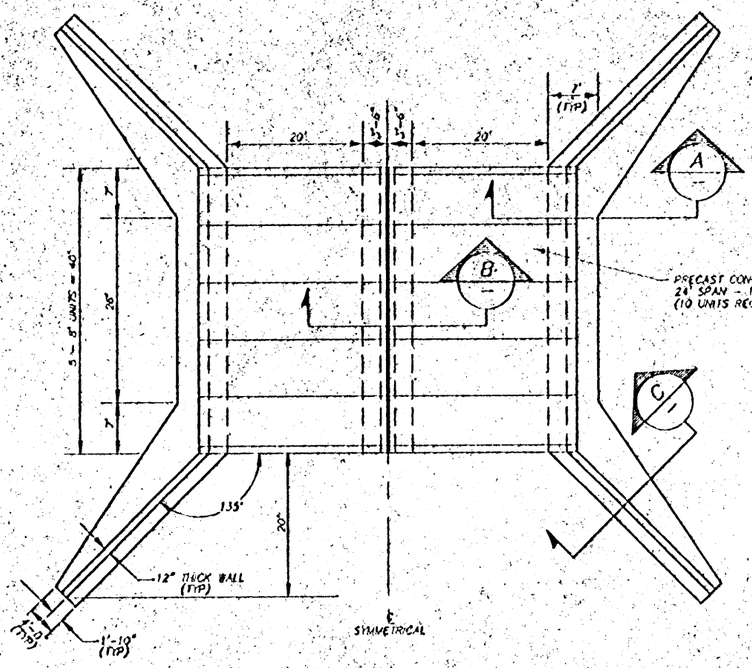
Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

PRECAST CONCRETE ARCH BRIDGE

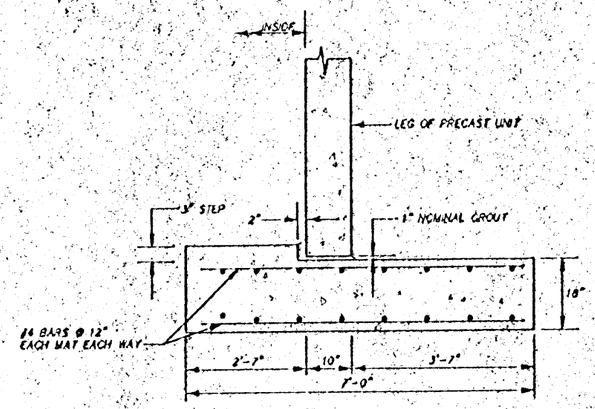
DRAWING D-2
15 OF 20
01-14



BRIDGE & WING WALL FOUNDATION PLAN

NOT TO SCALE

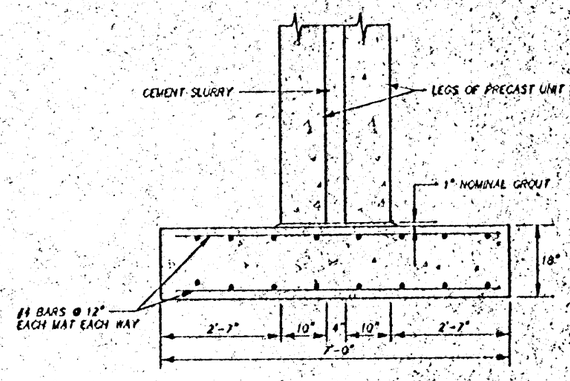
(1 / D-3)



EXTERIOR FOOTING SECTION

NOT TO SCALE

(A / —)

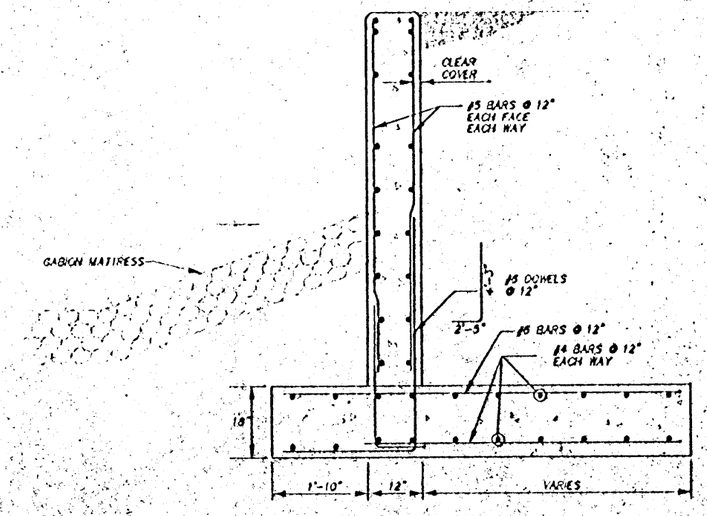


INTERIOR FOOTING SECTION

NOT TO SCALE

(B / —)

NOTE:
SEE SHEET D-8 FOR GENERAL REINFORCING NOTES AND DETAILS.



WING WALL SECTION

NOT TO SCALE

(C / —)

REFERENCE DRAWINGS

MARK	DATE	BY	REVISION

PLOT DATE: 9-21-93

DESIGNED	DWD
DRAWN	LBL
CHECKED	DWD
PROJECT ENGINEER	DATE
PROJECT MANAGER	DATE 9/20/93

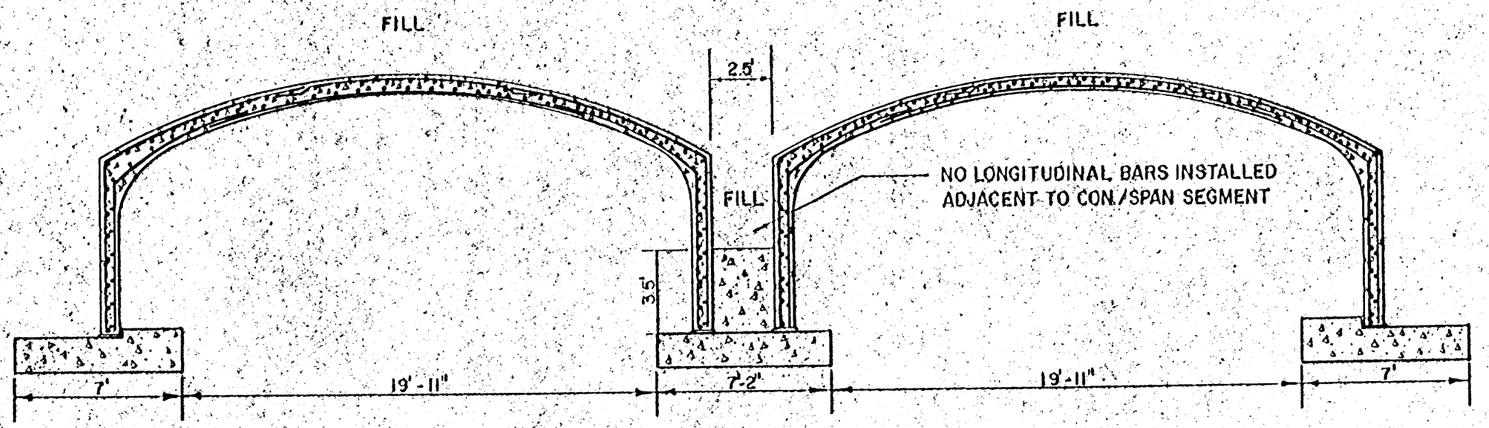
Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

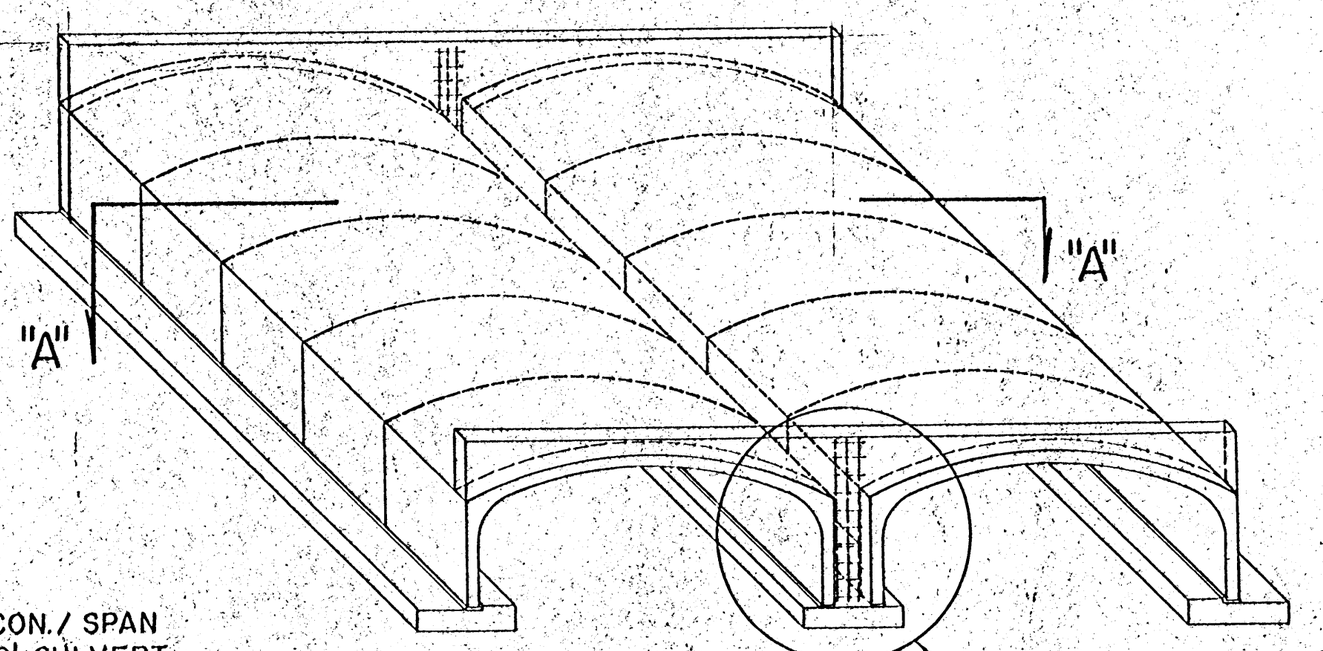
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

BRIDGE DETAILS

DRAWING D-3
16 OF 20
01-15

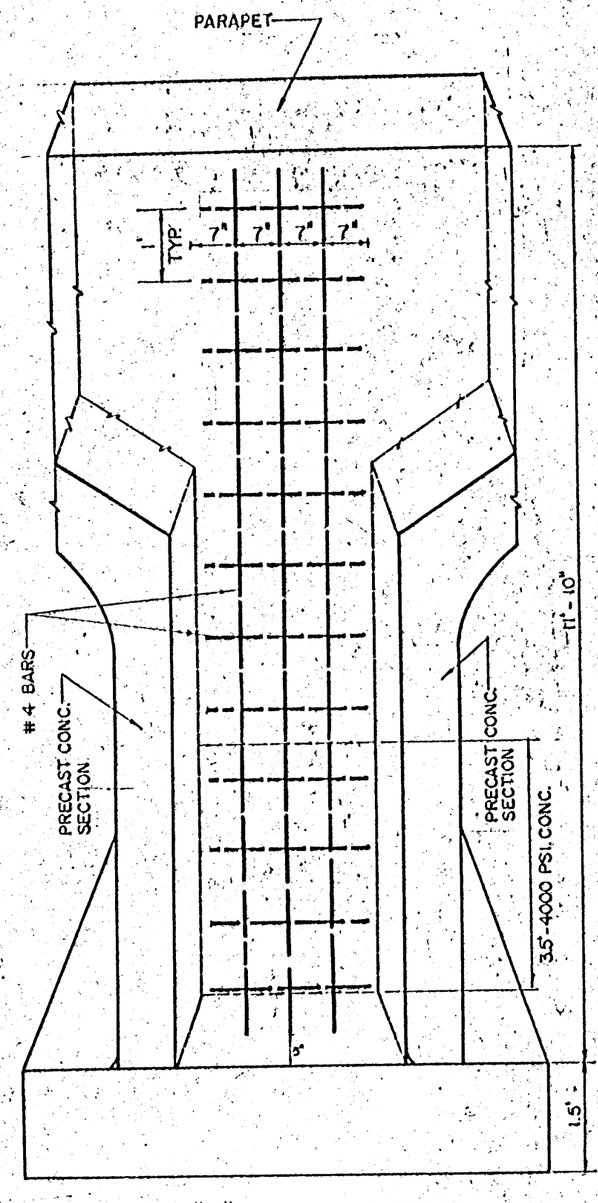


SECTION "A" – "A"
SCALE: 1" = 3'



TWIN CON./ SPAN
24' x 10' CULVERT
SCALE: 1" = 5'

DETAIL "B"
(FRONT VIEW OF BOTH ENDS)



DETAIL "B" - PROSPECTIVE VIEW
(TYPICAL, BOTH ENDS)

PROFESSIONAL ENGINEER STATE OF NEVADA
WILLIAM O. BRANDT
CIVIL
No. 8523
07/20/94

REV NO	DATE	DESCRIPTION	APPROVED

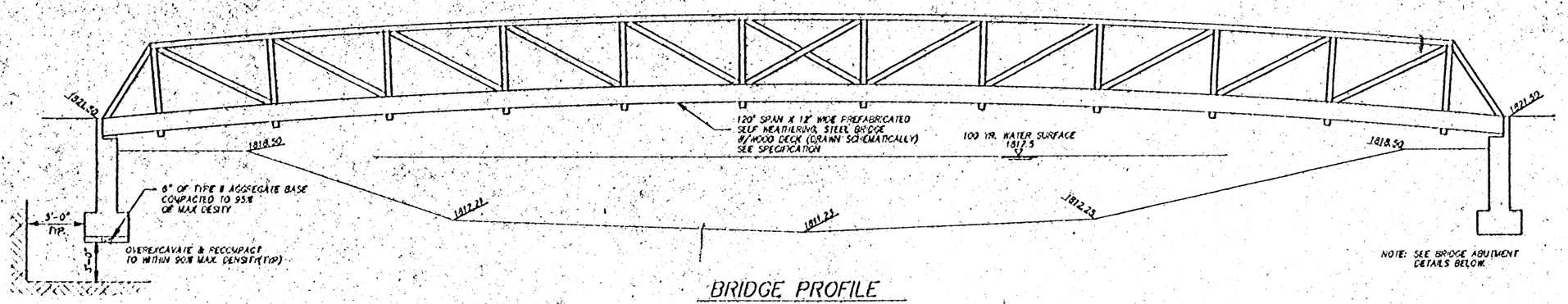
DESIGNED BY:
DRAWN BY: HIKO O
CHECKED BY: BILL B.

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH/SLOAN CHANNEL
PHASE I - N. A. F. B. CHANNEL

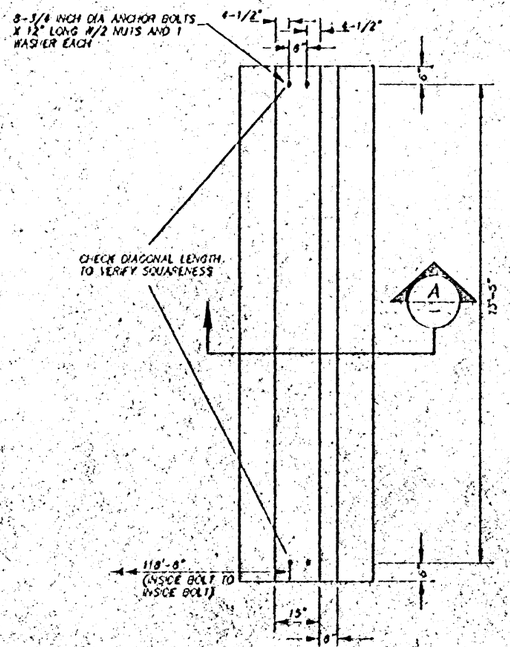
SCALE: HORZ.: VERT.:
PROJECT NO.: F910619
FIELD BOOK

DRAWING NO. D-3A
SHT. 16A OF 26



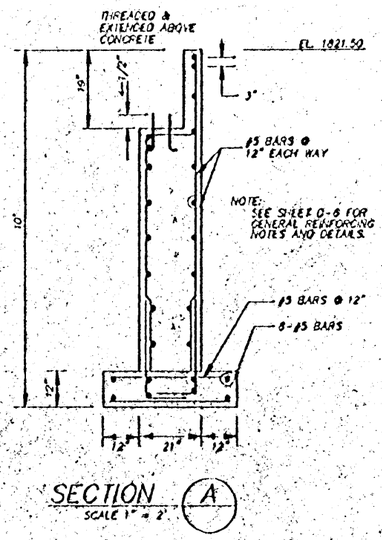
BRIDGE PROFILE

SCALE 1" = 5'



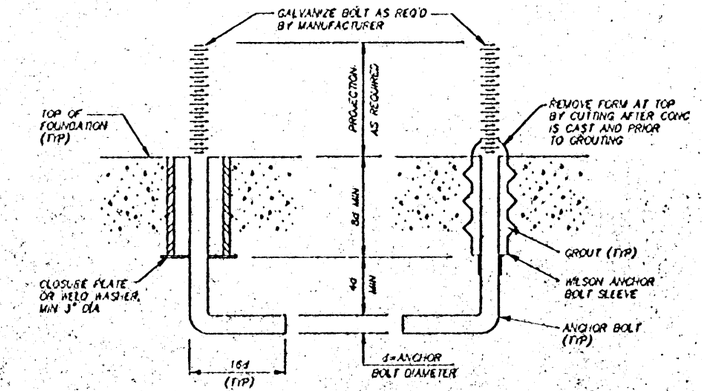
BRIDGE ABUTMENT PLAN

SCALE 1" = 2'



SECTION (A)

SCALE 1" = 2'



NOTES:

1. THE SIZE, NUMBER, TYPE, LOCATION, AND THREAD PROJECTION OF THE ANCHOR BOLTS SHALL BE DETERMINED BY THE EQUIPMENT MANUFACTURER. HOLD CONCRETE ANCHOR BOLTS IN POSITION WITH A TEMPLATE WHILE PAD IS BEING PLACED.
2. USE PIPE SLEEVES TO PROVIDE THE ANCHOR BOLT A MINIMUM MOVEMENT OF 1/2" IN ALL DIRECTIONS. THE MINIMUM SLEEVE LENGTH SHALL BE 8 TIMES THE BOLT DIAMETER. SLEEVES SHALL BE FILLED WITH NON-SHRINK GROUT.
3. PIPE SLEEVES SHALL HAVE A MINIMUM INTERNAL DIAMETER 1" GREATER AND A MAXIMUM INTERNAL DIAMETER 3" GREATER THAN ANCHOR BOLT DIAMETER. SLEEVES SHALL BE FILLED WITH NON-SHRINK GROUT.

ANCHOR BOLT DETAILS (1)

NOT TO SCALE

XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD
PROJECT ENGINEER — DATE 9/20/93
PROJECT MANAGER — DATE 9/20/93

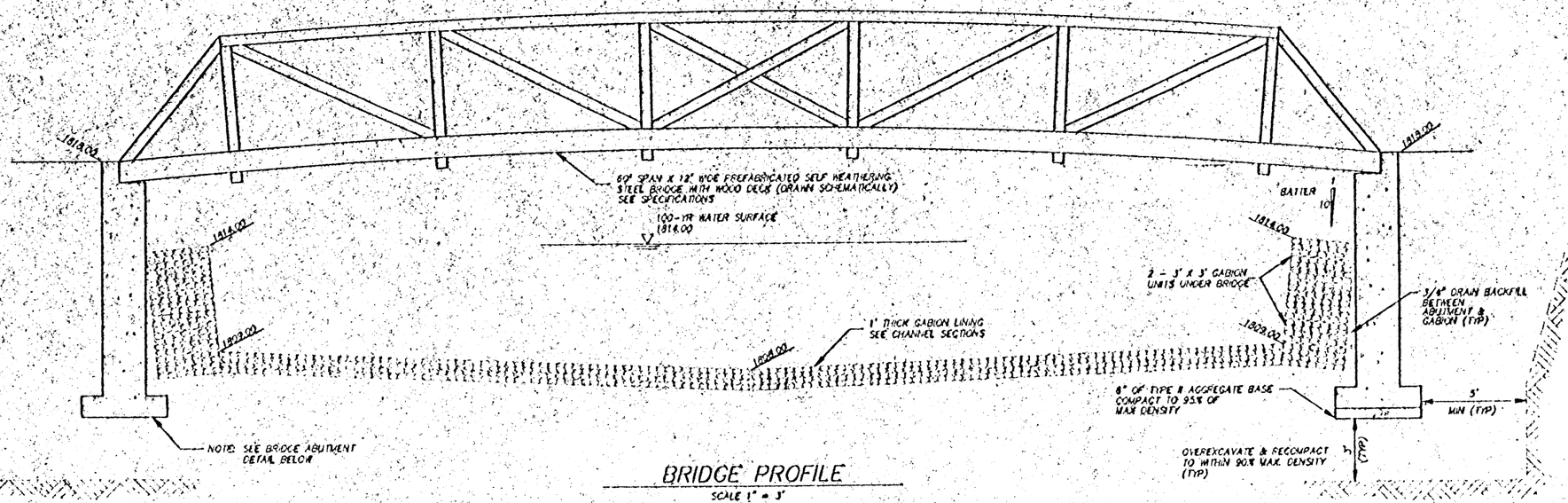
Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

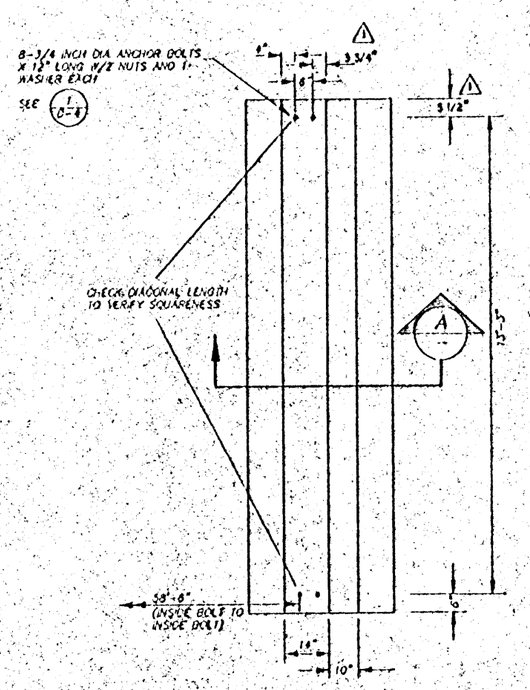
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
PREFABRICATED STEEL BRIDGE
120' SPAN

DRAWING D-4
17 OF 26
01-17

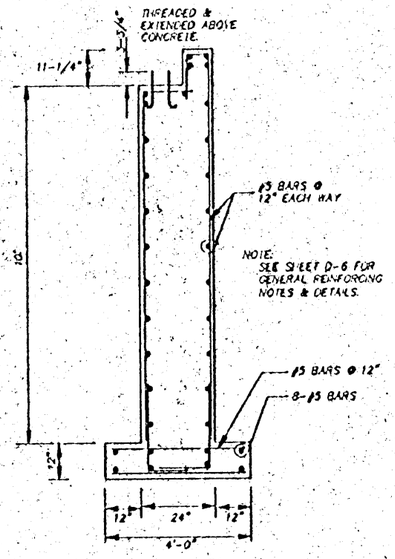
PLOT DATE: 9-21-93



BRIDGE PROFILE
SCALE 1" = 5'



BRIDGE ABUTMENT PLAN
SCALE 1" = 2'



SECTION (A)
SCALE 1" = 2'

REGISTERED PROFESSIONAL ENGINEER — DONALD W. DOYLE — No. 6367 — STATE OF NEVADA — CIVIL — 7/14/93

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	4-4-95	WW	CHANGE DIMENSIONS

PLOT DATE: 3-21-95

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD
PROJECT ENGINEER — DATE 7/20/93
PROJECT MANAGER — DATE 7/20/93

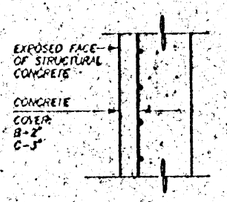
Doyle Engineering Corporation
consulting engineers
[illegible]

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

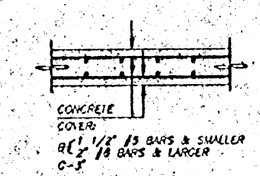
RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

PREFABRICATED STEEL BRIDGE
60' SPAN

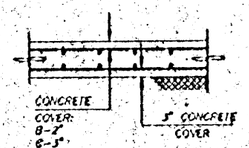
DRAWING D-5
18 OF 20
01-16



WALLS



SLABS



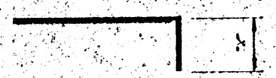
FOOTINGS

A. NO EXPOSURE TO GROUND, WEATHER OR WATER AFTER FORM REMOVAL
B. EXPOSURE TO GROUND: WEATHER OR WATER AFTER FORM REMOVAL.
C. CONCRETE PLACED AGAINST SOIL

CONCRETE COVER OVER REINFORCING STEEL (1)

NOT TO SCALE

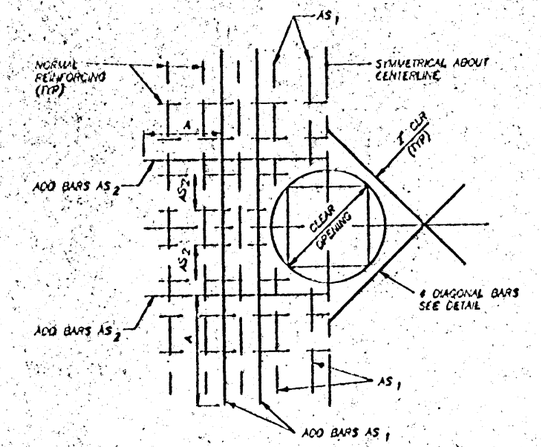
BAR SIZE	90° HOOK "X"	BAR SIZE	90° HOOK "X"
#3	6"	#9	16"
#4	8"	#9	19"
#5	10"	#10	22"
#6	12"	#11	24"
#7	14"		



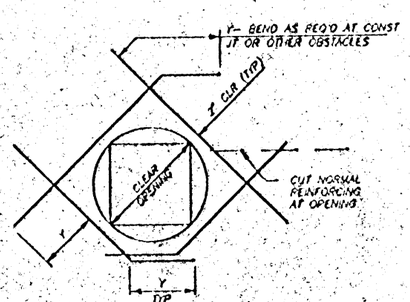
NOTE:
UNLESS NOTED OTHERWISE ON DRAWINGS, ALL LENGTHS OF BAR HOOKS IN FOOTINGS, COLUMNS, WALLS AND SLABS SHALL BE AS GIVEN IN TABLE ABOVE. HOOK LENGTH "X" IS STANDARD 90° BAR HOOK LENGTH.

STANDARD 90° BAR HOOK (2)

NOT TO SCALE



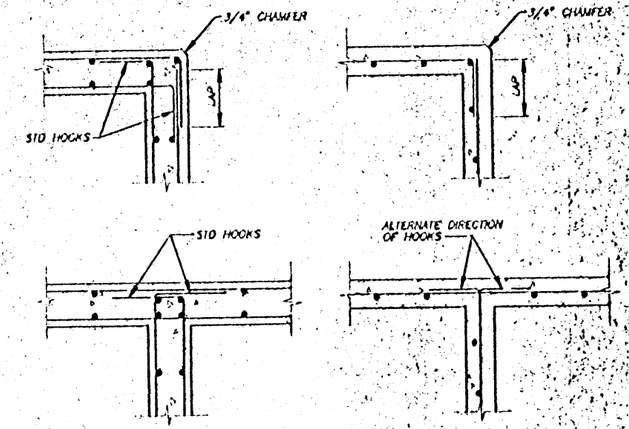
BAR SIZE	X	Y
4	15"	12"
5	18"	15"
6	18"	18"
7	21"	21"



NOTES:
1. CIRCULAR OPENINGS 8" THROUGH 11" REQUIRE DIAGONAL REINFORCING ONLY. CIRCULAR OPENINGS 12" AND LARGER REQUIRE BOTH DIAGONAL AND ADDITIONAL (AS_1 AND AS_2) REINFORCING BARS.
2. NORMAL REINFORCEMENT CUT AT OPENING:
   a. AS_1 AND AS_2 = 1/2 AREA OF CUT BARS TO BE ADDED ON EACH SIDE OF OPENING.
3. ADDITIONAL REINFORCEMENT AS_1, AS_2 AND DIAGONAL BARS TO BE PLACED:
   a. AT ℄ OF WALLS OR SLABS WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED.
   b. AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
4. LOCATE ADDITIONAL BARS (AS_1 AND AS_2) AT ℄ BETWEEN CONTINUOUS BARS THAT ARE NOT CUT.
5. UNLESS OTHERWISE NOTED, SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST REINFORCING CUT.
6. USE THIS DETAIL FOR ALL OPENINGS UNLESS OTHERWISE NOTED ON THE STRUCTURAL DRAWINGS.
7. DO NOT HELD REINFORCING TO PIPE WALL COLLARS OR EMBEDDED PIPES.

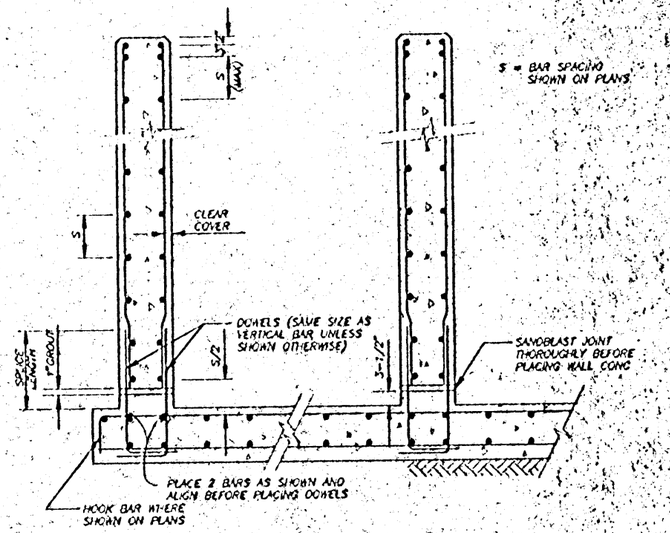
ADDITIONAL REINFORCING AT OPENINGS (3)

NOT TO SCALE



NOTE: MINIMUM LAP SPLICE LENGTHS

BAR	#4	#5	#6	#7	#8
LAP LENGTH	14	17	22	30	39



REINFORCING AT CORNERS AND JUNCTIONS (4)

NOT TO SCALE

DONALD W. DOYLE CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA (NO. 6032) — 9/20/93

XREF reference DRAWINGS

MARK	DATE	BY	REVISION

PLOT DATE 9-21-93

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 9/20/93
PROJECT MANAGER — DATE 9/20/93

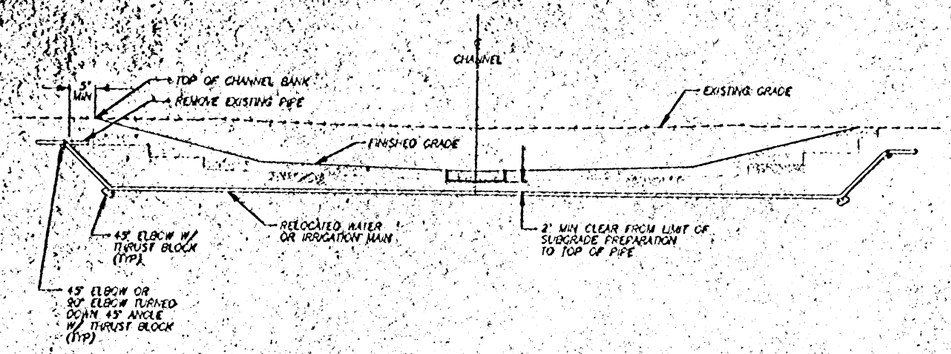
Doyle Engineering Corporation
Consulting Engineers
[illegible] Las Vegas, Nevada 89[illegible]

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

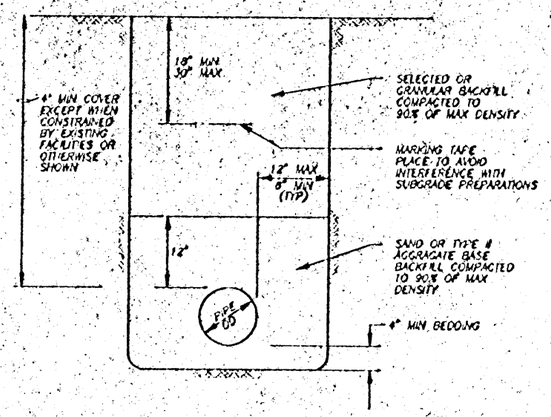
STEEL REINFORCEMENT DETAILS

DRAWING D-6
19 OF 26
01-26



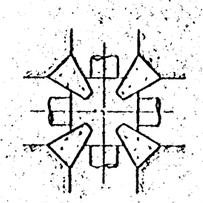
WATER/IRRIGATION MAIN CHANNEL CROSSING (1)

NOT TO SCALE

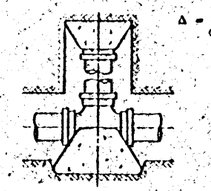


TRENCH SECTION (2)

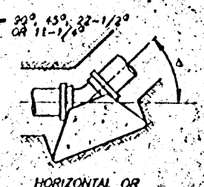
WATER OR IRRIGATION MAIN
NOT TO SCALE



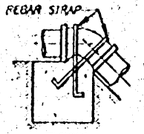
CROSS
FIGURE 1



TEE OR PLUG
FIGURE 2



HORIZONTAL OR VERTICAL ELBOW
FIGURE 3



ELBOW
FIGURE 4

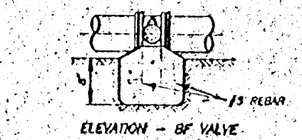
NOTES:

1. ALL FITTINGS AND EXPOSED REBAR TO BE COATED WITH EC 244 AND WRAPPED WITH TWO LAYERS OF 8 MIL POLYETHYLENE
2. ALL CONCRETE SHALL BE CLASS C MINIMUM 28 DAYS STRENGTH
3. TABLE BELOW DENOTES MINIMUM BEARING AREA OR VOLUME OF THRUST BLOCK. SPECIAL DESIGN FOR EACH INSTALLATION IS REQUIRED IF ALLOWABLE SOIL BEARING CAPACITY IS LESS THAN 3000 PSI.
4. PLACE CONCRETE AGAINST UNDISTURBED EARTH
5. VERTICAL SURFACES NOT BEARING AGAINST UNDISTURBED EARTH SHALL BE FORMED

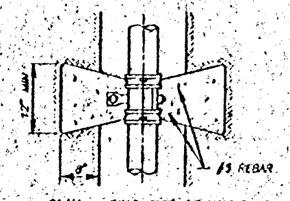
SIZE OF PIPE	MIN BEARING AREA IN SQUARE FEET						CUBIC YARDS OF CONCRETE		
	FIG 1	FIG 2	FIG 3				FIG 4		
			90°	45°	22-1/2°	11-1/4°	45°	22-1/2°	11-1/4°
4"		2	2	1	1	1	1.0	.5	.5
6"	2	3	3	2	1	1	1.5	1.0	.5
8"	2	5	8	3	2	1	2.0	1.0	.5
10"	3	7	10	5	3	1	4.0	2.0	1.0
12"	3	10	14	8	4	2			
14"	4	14	20	10	5	3			
16"	4	20	24	12	7	4		SPECIAL DESIGN	
18"	5	24	30	16	10	5			
20"	5	28	40	20	12	6			

THRUST BLOCK DETAILS (3)

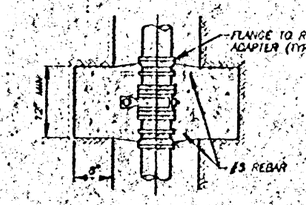
NOT TO SCALE



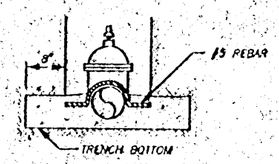
ELEVATION – BF VALVE



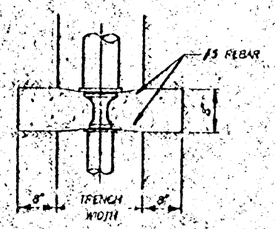
PLAN – RING-TITE BF VALVE



PLAN – FLANGE MJ BF VALVE



ELEVATION
REDUCER OR GATE VALVE

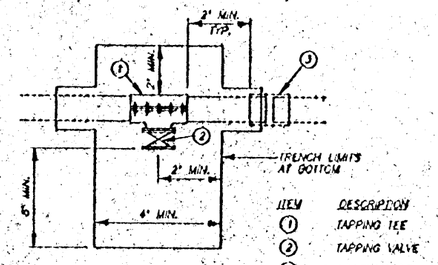


PLAN
REDUCER OR GATE VALVE

NOTES:
ALL CONCRETE SHALL BE CLASS C.
ALL VALVES TO BE PAINTED WITH E.C. 244 AND WRAPPED WITH TWO LAYERS OF 8 MIL POLYETHYLENE

ANCHOR BLOCK DETAILS (4)

REDUCER OR VALVE
NOT TO SCALE



ITEM	DESCRIPTION
1	TAPPING TEE
2	TAPPING VALVE
3	COUPLING OR COLLAR

NOTES:

A. CLEARANCE FROM A COLLAR OR PIPE JOINT SHALL BE A MINIMUM OF 2 FEET FROM THE FACE OF TAPPING SLEEVE TO COLLAR OR PIPE JOINT. THE EXISTING PIPE SHALL BE EXPOSED SUFFICIENTLY TO ENSURE THAT SUCH MINIMUM CLEARANCE IS PROVIDED.

B. TRENCH DEPTH OF 5 FEET AND OVER MUST HAVE INSIDE APPROVED SHORING AND A LADDER THAT EXTENDS A MINIMUM OF 3 FEET ABOVE THE EXISTING GROUND ELEVATION.

EXCAVATION DETAIL (5)

FOR WET TAPS
NOT TO SCALE

9/24/93

XREF WORK DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 9/24/93
PROJECT MANAGER — DATE 9/24/93

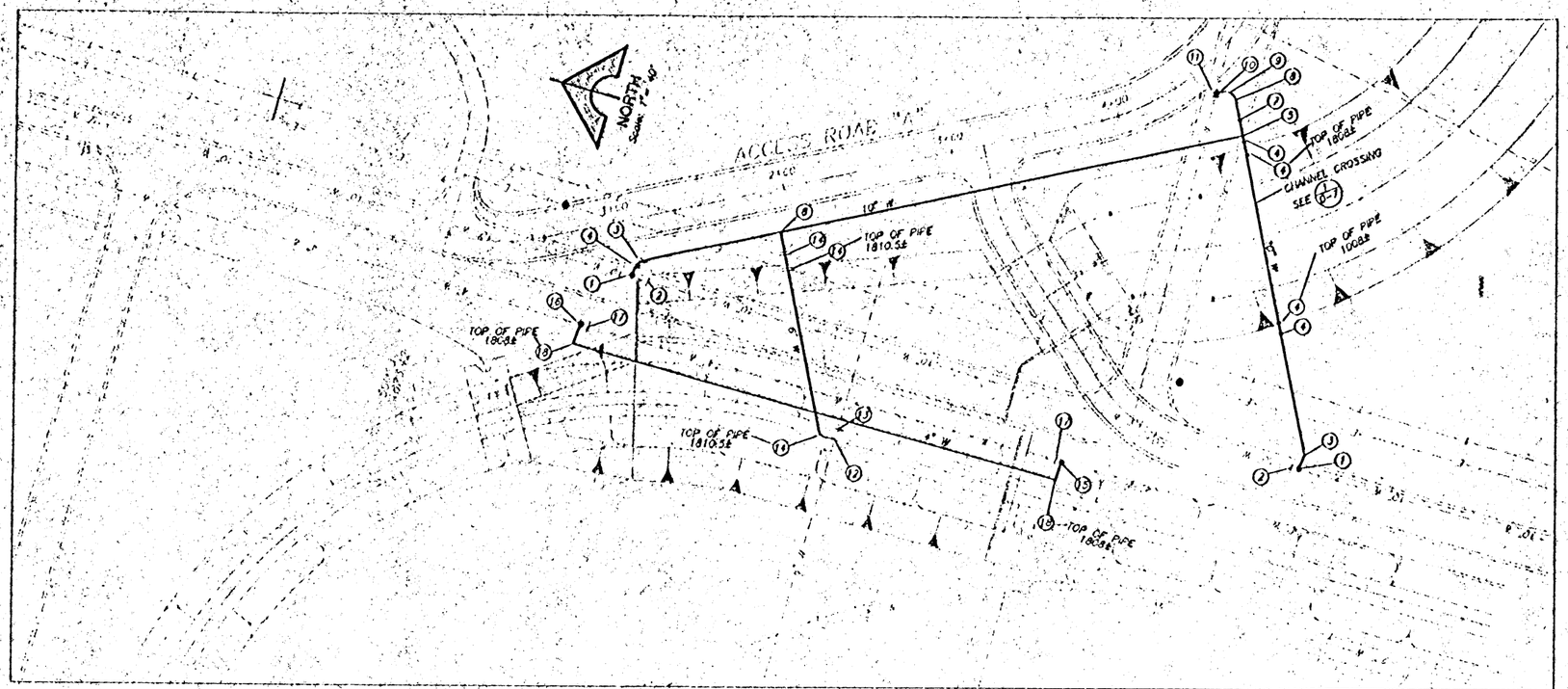
Boyle Engineering Corporation
consulting engineers
Las Vegas, Nevada

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
WATER LINE RELOCATION
DETAILS

DRAWING D-7
20 OF 26
01-22

PLOT DATE 9-21-93



WATER MAIN RELOCATIONS

MARK	LIST OF MATERIALS	APPROXIMATE QUANTITIES
①	10" WET TAP W/ VALVE BOX	2 EA
②	10" CAP W/ THRUST BLOCK	2 EA
③	10" 22.5° ELBOW W/ THRUST BLOCK	2 EA
④	10" 45° ELBOW W/ THRUST BLOCK	5 EA
⑤	10"x10"x10" TEE W/ THRUST BLOCK	1 EA
⑥	10"x10"x6" TEE W/ THRUST BLOCK	1 EA
⑦	10"x8" REDUCER W/ ANCHOR	1 EA
⑧	8" 22.5° ELBOW W/ THRUST BLOCK	1 EA
⑨	8" 45° ELBOW W/ THRUST BLOCK	1 EA
⑩	8" WET TAP W/ VALVE BOX	1 EA
⑪	8" CAP W/ THRUST BLOCK	1 EA
⑫	8" WET TAP W/ VALVE BOX	1 EA
⑬	8" CAP W/ THRUST BLOCK	3 EA
⑭	6" 45° ELBOW W/ THRUST BLOCK	1 EA
⑮	6" 22.5° ELBOW W/ THRUST BLOCK	2 EA
⑯	6" WET TAP W/ VALVE BOX	2 EA
⑰	6" CAP W/ THRUST BLOCK	2 EA
⑱	6" 90° ELBOW W/ THRUST BLOCK	1 EA
	10" PVC PIPE	810 LF
	8" PVC PIPE	15 LF
	6" PVC PIPE	130 LF
	4" PVC PIPE	330 LF

XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: SLA
CHECKED: DWD

PROJECT ENGINEER — DATE 7/20/23
PROJECT MANAGER — DATE 7/20/23

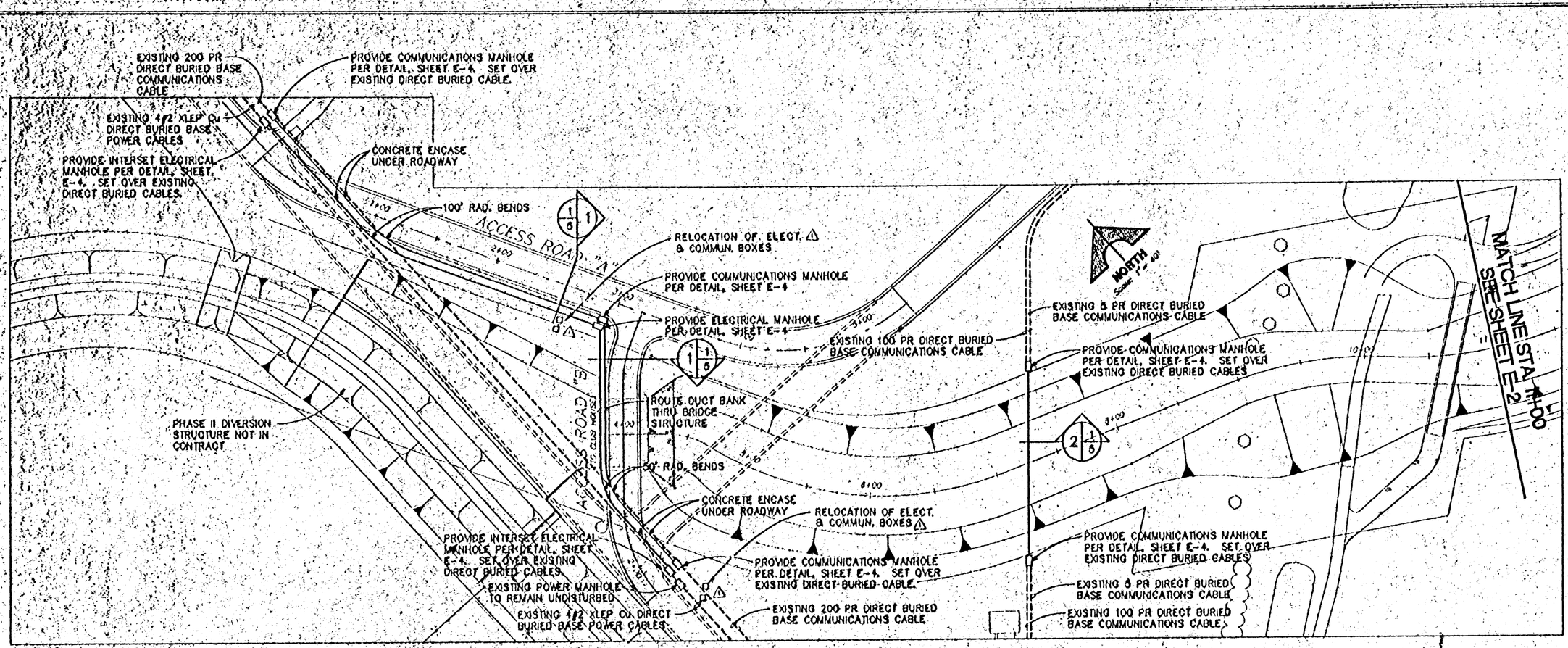
Coyle Engineering Corporation
computing engineers
Las Vegas, Nevada 89106

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
WATER MAIN RELOCATIONS

DRAWING D-8
21 OF 26
01-23

PLOT DATE: 8-21-95



ELECTRICAL LEGEND

NEW	EXISTING	
———	- - - - -	CONDUIT OR CABLE RUN AS INDICATED
▭	▭	MANHOLE
(X/X)		DUCT BANK SECTION DESIGNATOR SHEET ON WHICH SECTION IS CUT. SHEET ON WHICH SECTION IS SHOWN. DUCT BANK IDENTIFICATION NUMBER.
-o-	-o-	POWER POLE

GENERAL NOTES

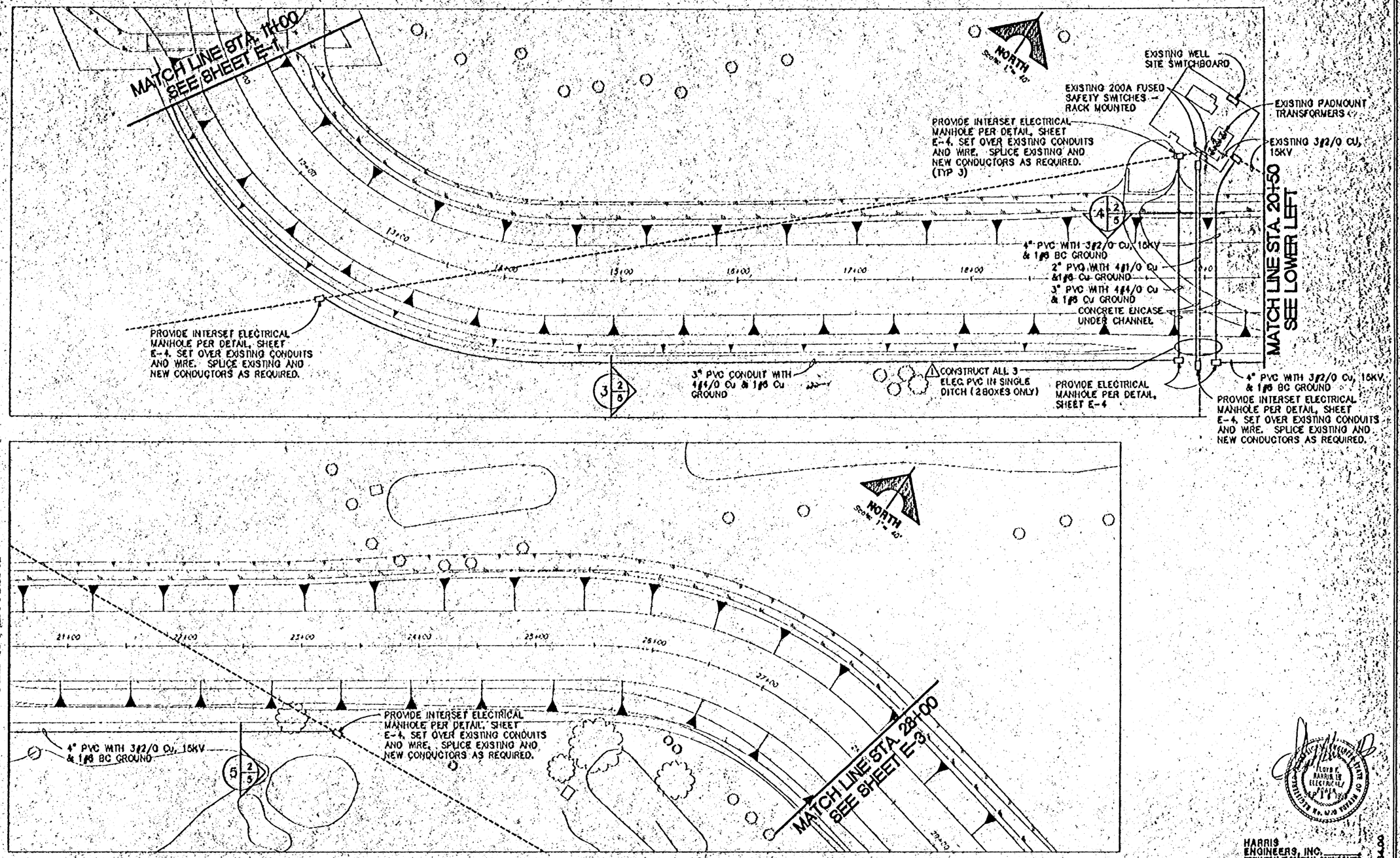
1. PRIOR TO BEGINNING EXCAVATION VERIFY LOCATIONS OF EXISTING AND NEW UNDERGROUND UTILITIES, PIPING, ETC.. PROVIDE EXCAVATION, BACKFILL, SUPPORTS, SAWCUTTING, PATCHING, PAVING AS REQUIRED. BACKFILL EXCAVATIONS TO 90% COMPACTION AND PATCH TO MATCH EXISTING CONDITIONS.
2. ELECTRICAL SYSTEM OUTAGES SHALL BE PERMITTED ONLY AT TIMES APPROVED BY NELLIS AFB REPRESENTATIVE IN WRITING. WORK WHICH MAY RESULT IN AN ACCIDENTAL OUTAGE SHALL BE PREFORMED WITH NELLIS AFB REPRESENTATIVE ADVISED OF SUCH WORK.
3. COMMUNICATIONS SYSTEMS SHALL REMAIN IN OPERATION CONTINUOUSLY DURING CONSTRUCTION. CONTRACTOR SHALL PROVIDE TEMPORARY FACILITIES AS REQUIRED TO MAINTAIN SERVICE. COORDINATE ALL SUCH WORK WITH NELLIS AFB REPRESENTATIVE.
4. ALL DIRT AND DEBRIS SHALL BE REMOVED FROM ALL MANHOLES. DISPOSE OF AS DIRECTED BY CC PUBLIC WORKS.
5. DO NOT SCALE DRAWINGS. VERIFY DIMENSIONS IN FIELD PRIOR TO BEGINNING WORK.
6. CONTRACTOR SHALL VISIT JOB SITE PRIOR TO BID AND VERIFY THAT CONDITIONS ARE AS INDICATED. CONTRACTOR SHALL INCLUDE IN HIS BID COST REQUIRED TO MAKE HIS WORK MEET EXISTING CONDITIONS.
7. CONTRACTOR SHALL BE RESPONSIBLE TO GROUND EACH CABLE SHIELD, LOAD BREAK MODULES, ETC. TO GROUND ROD IN EACH MANHOLE.

REGISTERED PROFESSIONAL ENGINEER — STATE OF NEVADA — DENISE JACOBS — ELECTRICAL POWER — No. 9418

HARRIS ENGINEERS, INC.
MECHANICAL/ELECTRICAL CONSULTANTS

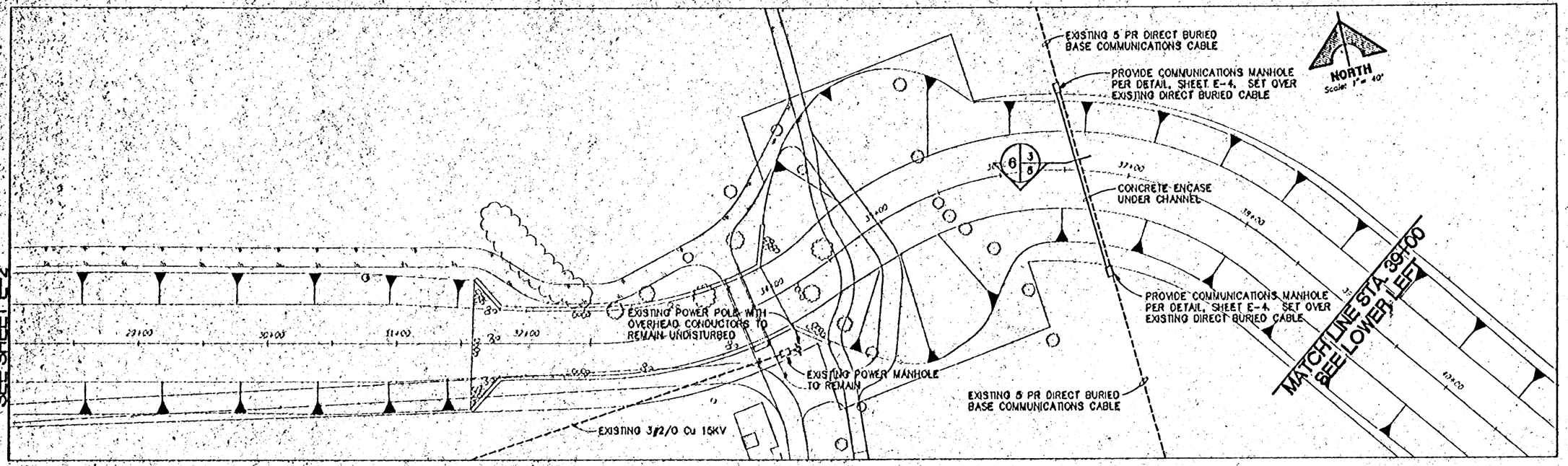
93034.00

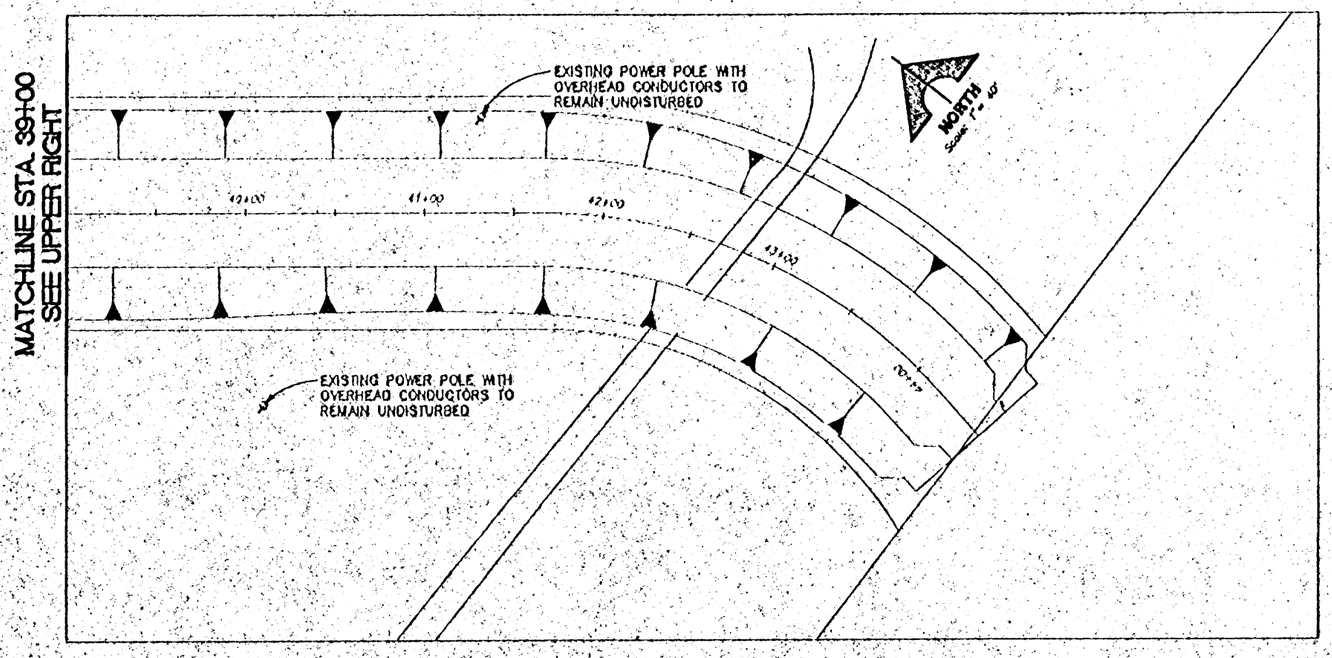
DESIGNED JAT DRAWN DEP	PROJECT ENGINEER 7/20/93 DATE	Boyle Engineering Corporation consulting engineers	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL ELECTRICAL PLAN	DRAWING E-1 22 OF 26



HARRIS ENGINEERS, INC.
MECHANICAL/ELECTRICAL CONSULTANTS

4-5-23 VAT ADD NOTE TO CONST. 3 ELEC. LINES IN ONE DITCH.	DESIGNED: JAT DRAWN: DEP CHECKED: FTH	PROJECT ENGINEER 7/20/23 DATE 7/20/23	Boyle Engineering Corporation consulting engineers	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	RANGE WASH / SLOAN CHANNEL PHASE 1 - NAFB CHANNEL ELECTRICAL PLANS	DRAWING E-2 23 OF 26





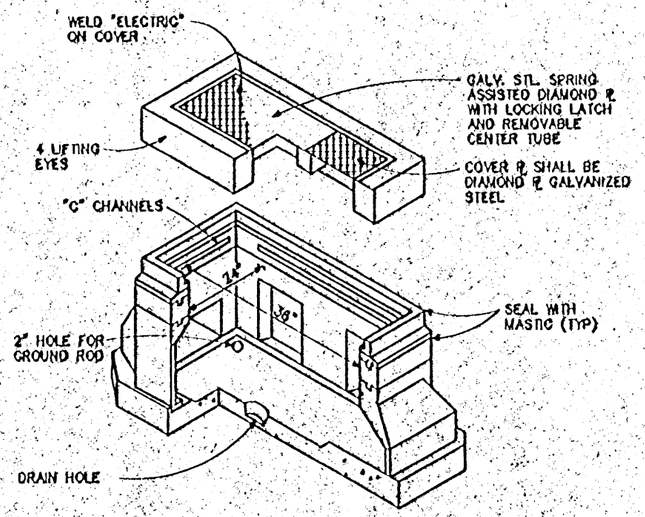
FLOYD R. HARRIS III
ELECTRICAL
No. 6719
STATE OF NEVADA
REGISTERED ENGINEER

HARRIS
ENGINEERS, INC.
MECHANICAL/ELECTRICAL CONSULTANTS
2760 East Desert Inn Road, Suite 100
Las Vegas, Nevada 89121
(702)796-9128

93034.00

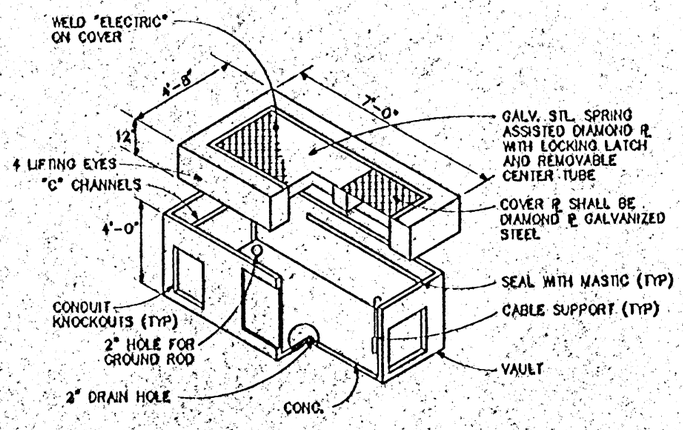
DESIGNED JAF	PROJECT ENGINEER 7/20/93 DATE	Boyle Engineering Corporation consulting engineers 3883 Howard Hughes Parkway, Suite 800 Las Vegas, Nevada 89109	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL	DRAWING E-3
DRAWN DEP	CHECKED 7/20/93 DATE			ELECTRICAL PLANS	24 OF 26
CHECKED FITH					

NOTE:
EXCAVATION FOR MANHOLES SHALL BE OVER-EXCAVATED A MINIMUM OF 12" IN DEPTH, AND 12" OF FINE AGGREGATE SHALL BE PLACED IN 2 - 6" LIFTS AND MECHANICALLY TAMPED AT OPTIMUM MOISTURE TO A COMPACTION OF 90% OF THE MAXIMUM DRY DENSITY ASTM-D1557(AASHO T-180)



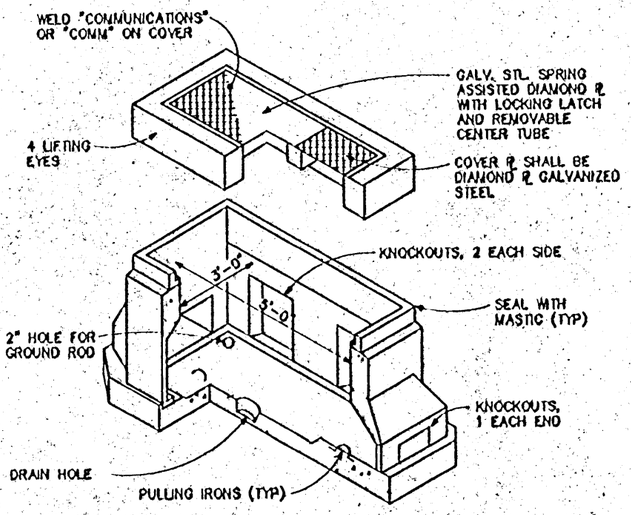
INTERSET ELECTRICAL MANHOLE DETAIL
NO SCALE

NOTE:
EXCAVATION FOR MANHOLES SHALL BE OVER-EXCAVATED A MINIMUM OF 12" IN DEPTH, AND 12" OF FINE AGGREGATE SHALL BE PLACED IN 2 - 6" LIFTS AND MECHANICALLY TAMPED AT OPTIMUM MOISTURE TO A COMPACTION OF 90% OF THE MAXIMUM DRY DENSITY ASTM-D1557(AASHO T-180)

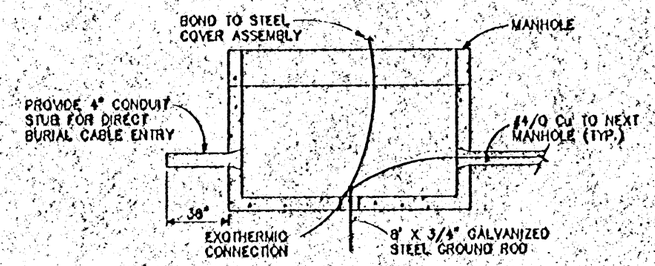


ELECTRICAL MANHOLE DETAIL
NO SCALE

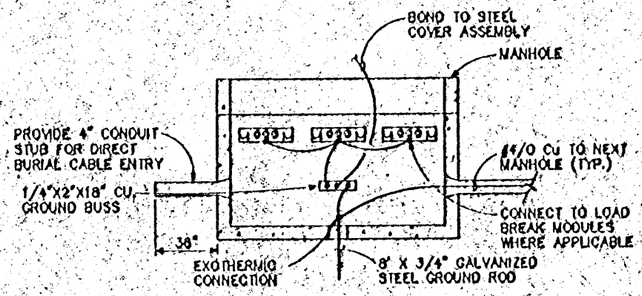
NOTE:
EXCAVATION FOR MANHOLES SHALL BE OVER-EXCAVATED A MINIMUM OF 12" IN DEPTH, AND 12" OF FINE AGGREGATE SHALL BE PLACED IN 2 - 6" LIFTS AND MECHANICALLY TAMPED AT OPTIMUM MOISTURE TO A COMPACTION OF 90% OF THE MAXIMUM DRY DENSITY ASTM-D1557(AASHO T-180)



COMMUNICATIONS MANHOLE DETAIL
NO SCALE

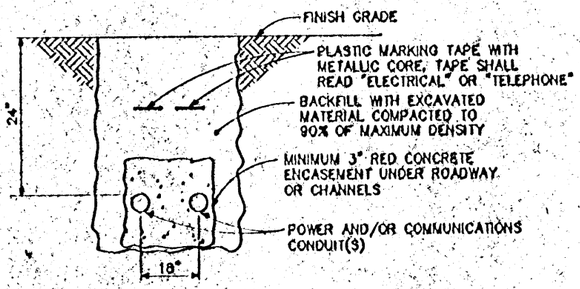


TYPICAL ELECTRICAL MANHOLE GROUNDING DETAIL
NO SCALE



NOTE:
OCCURS AT LOCATIONS WHERE 15KV CABLES TRANSITION FROM DIRECT BURIED TO CONDUIT AND NEW CABLE.

TYPICAL ELECTRICAL MANHOLE WITH LB MODULES GROUNDING DETAIL
NO SCALE



NOTE:
PRIOR TO BEGINNING TRENCHING VERIFY WITH OWNER THE EXISTENCE OF ANY UNDERGROUND UTILITIES.

TYPICAL TRENCH DETAIL
NO SCALE

HARRIS ENGINEERS, INC.
MECHANICAL ELECTRICAL CONSULTANTS

83034.00

MARK	DATE	BY	REASON

DESIGNED: JAP
DRAWN: DEF
CHECKED: RTH

PROJECT ENGINEER — DATE 7/19/93
PROJECT MANAGER — DATE 7/20/93

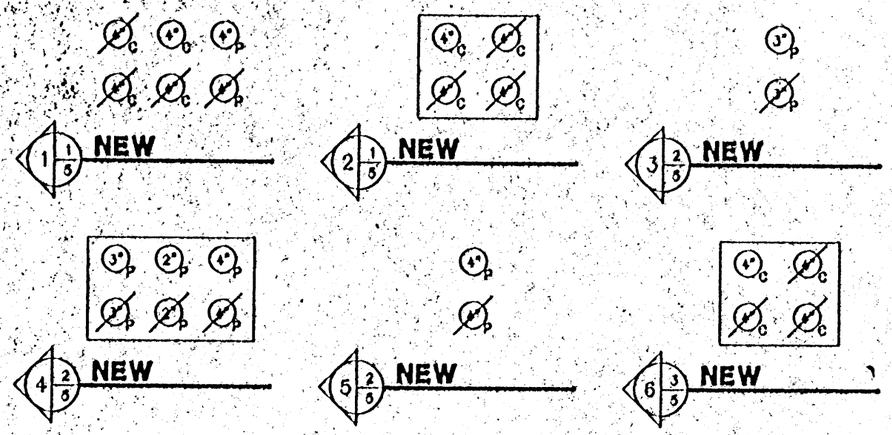
Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

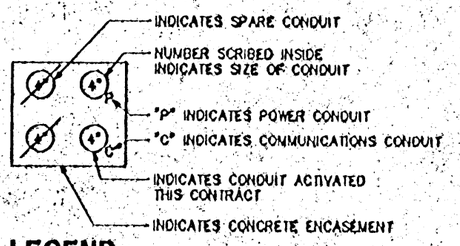
ELECTRICAL DETAILS

DRAWING E-4
25 OF 26



DUCT BANK SECTIONS

NO SCALE



LEGEND

HARRIS ENGINEERS, INC.
MECHANICAL/ELECTRICAL CONSULTANTS

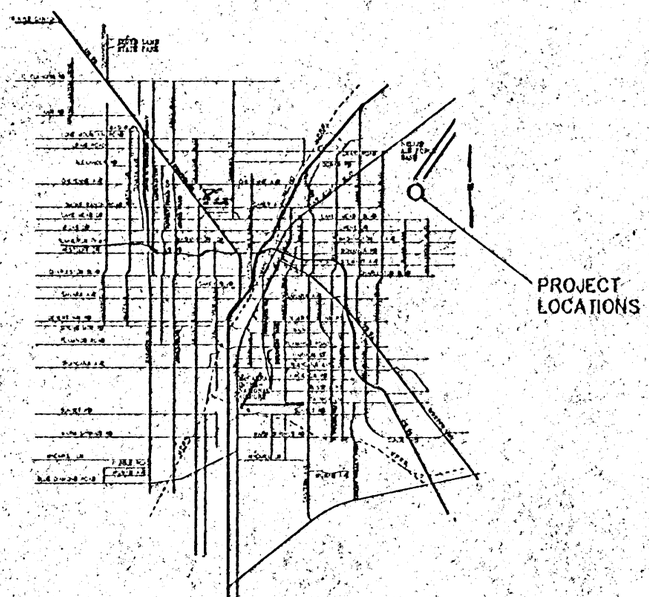
93034.00

	DESIGNED: JAT	PROJECT ENGINEER	DATE	Boyle Engineering Corporation consulting engineers	CLARK COUNTY NEVADA DEPARTMENT OF PUBLIC WORKS	RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL
	DRAWN: DEF					SECTIONS
	CHECKED: FTH	CONTRACT ENGINEER	DATE			DRAWING E-5 26 OF 26

EXHIBIT C

Range Wash/Sloan Channel
Confluence Detention Basin and
Sloan Diversion Channel Modification
Construction Drawings

DEPARTMENT OF PUBLIC WORKS



Vicinity Map
NOT TO SCALE

CLARK COUNTY NEVADA

"Progress as Promised"

Index of Sheets

(SEE DRAWING SHEET G-3)

Clark County Regional Flood Control District
General Manager / Chief Engineer
Approved:
Gale Wm. Fraser, II
GALE WM. FRASER II, PE

1995

IMPROVEMENT PLANS FOR
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN
AND
SLOAN DIVERSION CHANNEL MODIFICATION
FUNDED BY
REGIONAL FLOOD CONTROL DISTRICT

County Commissioners

Yvonne Atkinson Gates, Chair
Paul J. Christensen, Vice Chairman
Jay Bingham
Lorraine Hunt
Erin Kenny
Myrna Williams
Bruce L. Woodbury

County Manager

Donald L. "Pat" Shalmy

Director of Public Works

Approved:
M.J. Manning
M.J. Manning, R.P.E. 7299

WILLIAM O. BRYANT — REGISTERED ENGINEER — STATE OF NEVADA — No. 8583 — CIVIL
3/21/95

AGENCY	PLANS REVIEWED BY	DATE
LAS VEGAS VALLEY WATER DISTRICT		
SPRINT/CENTRAL TELEPHONE COMPANY		4-21-95
SOUTHWEST GAS COMPANY		4-21-95
NEVADA POWER COMPANY		4-25-95
CLARK COUNTY SANITATION DISTRICT		4/24/95
COMMUNITY CABLE T.V.		
NELLIS AIR FORCE BASE		4-21-95

DEPARTMENT OF PUBLIC WORKS	BY	DATE
DEPUTY DIRECTOR FOR PROFESSIONAL SERVICES		4/18-95
COMMUNITY DEVELOPMENT DIVISION		4-18-95
CONSTRUCTION MANAGEMENT DIVISION		4/18/95
DESIGN ENGINEERING DIVISION		4-18-95
MAINTENANCE MANAGEMENT DIVISION		4/19/95
TRAFFIC MANAGEMENT DIVISION		4-18-95
COUNTY SURVEYOR'S OFFICE		4-18-95

REVISIONS					
REVISION No.	DESCRIPTION	BY	DATE	APPROVAL	DATE

DESIGN ENGINEERING DIVISION

COVER SHEET

L-1478

QUANTITIES

ITEM	TITLE	APPROX. QUANTITY	UNIT
109.01	CONSTRUCTION CONFLICTS & ADDITIONAL WORK	1	LS
200.01	MOBILIZATION	1	LS
201.01	CLEARING AND GRUBBING	224	ACRE
202.01	REMOVE & SALVAGE CHAIN LINK/ BARBED WIRE FENCE	4,050	LF
202.02	REMOVE CONCRETE & SOIL CEMENT IMPROVEMENTS AT DIVERSION STRUCTURE	1	LS
202.03	REMOVE CONCRETE & SOIL CEMENT IMPROVEMENTS AT CONFLUENCE STRUCTURE	1	LS
203.02	CHANNEL EXCAVATION	13,110	CY
⚠ 203.03	DETENTION BASIN EXCAVATION	900,833	CY
203.04	DETENTION BASIN EMBANKMENT & MINIMUM FILL AREAS	387,200	CY
203.06	CHANNEL EMBANKMENT	2,160	CY
203.09	DAM EMBANKMENT FOUNDATION	77,800	CY
203.10	SUBGRADE PREPARATION FILL AREAS	305,000	SY
203.11	CONCRETE LINED CHANNEL FOUNDATION	11,580	CY
203.13	DETENTION BASIN SURFACE COMPACTION	700,500	SY
⚠ 203.14	ROADWAY SUBGRADE COMPACTION	4,690	CY
218.01	GEOTEXTILE FABRIC	1,970	SY
⚠ 302.01	TYPE II AGGREGATE BASE	1,172	CY
⚠ 304.01	PORTLAND CEMENT FOR SOIL CEMENT	2,203	TON
⚠ 304.02	SOIL CEMENT	10,877	CY
⚠ 402.01	PLANTMIX BITUMINOUS SURFACE	907	TON
⚠ 406.01	PRIME COAT	8	TON
⚠ 407.01	SEAL COAT	3	TON
502.01	OUTLET STRUCTURE	1	LS
502.02	STILLING WELL	1	LS
502.03	OUTFALL HEADWALL	38	CY
502.04	CONCRETE LINED OUTFALL CHANNEL	2,620	CY
502.05	CHANNEL ACCESS RAMP	318	CY
502.06	SIDE CHANNEL INLETS	7	CY
502.07	CONFLUENCE STRUCTURE	145	CY
502.08	DIVERSION STRUCTURE	1,275	CY
⚠ 502.12	CONCRETE CUTOFFS FOR DOWNDRAINS	23	CY
603.01	24-INCH REINF. CONC. PIPE (1350 D)	24	LF
603.02	24-INCH PRECAST END SECTION	1	EA
⚠ 605.01	REINFORCED 8' X 7' CONCRETE BOX (DOUBLE)	580	LF
607.01	WEEP DRAIN	310	EA
610.01	GABION RETAINING WALL	1,218	CY
⚠ 610.02	GABION CHANNEL PROTECTION	1,633	CY
⚠ 610.03	GABION DOWNDRAIN PROTECTION	115	CY
⚠ 613.01	24" TYPE 'L' CURB AND GUTTER	2,728	LF
⚠ 613.02	VALLEY GUTTER	484	SF
⚠ 613.03	SIDEWALK AT DOWNDRAIN "A"	560	SF
⚠ 616.01	6-FOOT CHAIN LINK FENCE	9,616	LF
616.02	RECONSTRUCT FENCE	4,055	LF
616.03	18-FOOT DOUBLE SWING GATE	2	EA
616.04	30-FOOT DOUBLE SWING GATE	2	EA
638.01	DUST CONTROL SOIL STABALIZER	215	AC

GENERAL NOTES

1. THE INTENT OF THIS PROJECT IS TO CONSTRUCT VARIOUS FLOOD CONTROL IMPROVEMENTS WITHIN CLARK COUNTY. IMPROVEMENTS CONSIST OF A DIVERSION STRUCTURE; A DETENTION BASIN WITH OUTLET AND SPILLWAY STRUCTURES; AND AN OUTFALL CHANNEL FROM THE DETENTION BASIN.
2. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "IMPROVEMENT STANDARDS", MAY 1990, AS REVISED AND "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION", 1986, CLARK COUNTY, NEVADA, UNLESS OTHERWISE SPECIFIED BY NOTE ON PLANS AND SPECIAL PROVISIONS OR AS DIRECTED BY THE ENGINEER. THE CONTRACTOR SHALL MAINTAIN A SET OF THESE STANDARDS AT THE JOBSITE AT ALL TIMES. COPIES MAY BE OBTAINED AT REGIONAL TRANSPORTATION COMMISSION. NOTE CHANGES IN CURING COMPOUND SECTION.
3. ALL UTILITY COMPANIES SHALL BE NOTIFIED AT LEAST 48 HOURS PRIOR TO BEGINNING CONSTRUCTION.
4. THE EXISTENCE AND LOCATION OF UNDERGROUND UTILITY PIPES OR STRUCTURES SHOWN ON PLANS FOR CONTRACTOR'S CONVENIENCE WERE OBTAINED BY A SEARCH OF AVAILABLE RECORDS. THE OWNER ASSUMES NO RESPONSIBILITY FOR UTILITIES OR STRUCTURES NOT OF RECORD, OR NOT IN THE LOCATION OF RECORD. THE CONTRACTOR'S LIABILITY REGARDING ANY DAMAGED UTILITY IS SET FORTH IN SECTION 105 OF THE STANDARD SPECIFICATIONS AND SPECIAL PROVISIONS. DETERMINE POSITIVE LOCATION OF ALL UTILITIES EARLY IN PROJECT.
5. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL OVERHEAD INTERFERENCES WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD OR UNDERGROUND POWER, GAS AND/OR OTHER UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COSTS AND LIABILITY IN CONNECT THEREWITH.
6. THE CONTRACTOR IS REQUIRED TO TAKE PRECAUTIONARY MEASURES TO PROTECT ALL EXISTING IMPROVEMENTS REMAINING IN PLACE, AND ANY IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED OR RECONSTRUCTED AT THE EXPENSE OF THE CONTRACTOR.
7. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED, AT THE EXPENSE OF THE CONTRACTOR, PER AVAILABLE RECORDS IN ACCORDANCE WITH NEVADA REVISED STATUTE NUMBER 625.550.
8. ALL BARRICADING AND TEMPORARY TRAFFIC CONTROL DEVISES OR METHODS TO BE USED DURING CONSTRUCTION SHALL BE DONE IN ACCORDANCE WITH THE STATE OF NEVADA "TRAFFIC CONTROL MANUAL", LATEST EDITION, AND WITH THE "U.S. MANUAL ON UNIFORM TRAFFIC CONTROL DEVISES", LATEST EDITION, 1988.

Call before you Dig. 1-800-227-2600

MARK	DATE	BY	REVISION
⚠	3-29	CDW	QUANTITIES

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD
PROJECT ENGINEER — DATE
PROJECT MANAGER — DATE

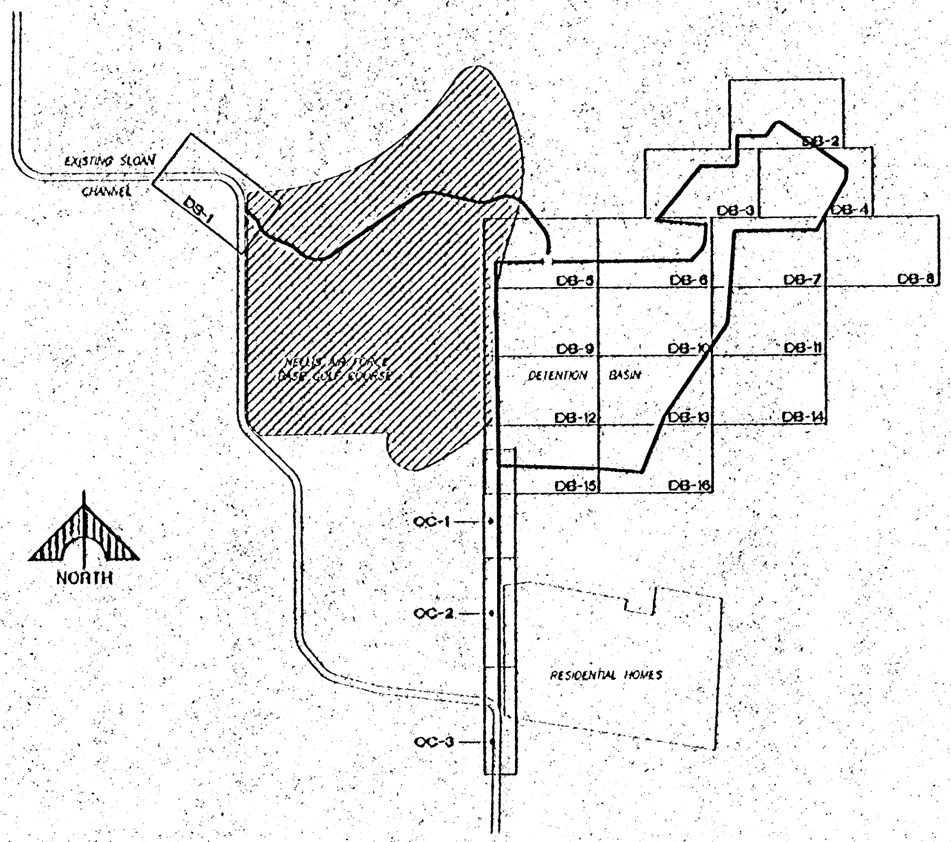
Boyle Engineering Corporation consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN
QUANTITIES AND GENERAL NOTES

DRAWING G-2
2 OF 45
G-2

PLOT DATE: 4-95



KEY MAP

NOT TO SCALE

LEGEND

- △ HV-31 1914.64 — EXISTING SURVEY MONUMENT
- EXISTING RIGHT-OF-WAY
- S — EXISTING SANITARY SEWER W/ MANHOLE
- W — EXISTING WATER MAIN W/ VALVE
- G — EXISTING GAS MAIN
- T — EXISTING TELEPHONE CABLE(S)
- E — EXISTING ELECTRICAL
- IRR — EXISTING IRRIGATION LINE W/SPRINKLER HEAD
- EXISTING STREET SIGN
- EXISTING UTILITY POLE
- EXISTING POST
- W — NEW WATER MAIN
- IRR — NEW IRRIGATION MAIN
- NEW OR RELOCATED SPRINKLER HEAD
- EXISTING FIRE HYDRANT
- EXISTING STREET LIGHT
- EXISTING TRAFFIC SIGNAL W/ STREET LIGHT
- EXISTING BUILDING
- EXISTING FENCE
- EXISTING PAVED ROAD
- EXISTING SHRUB OR TREE
- EXISTING CHANNEL SIDESLOPE
- SAWCUT
- NEW CHANNEL SIDESLOPE
- NEW PAVED ROAD
- EXISTING IRRIGATION VALVE BOX
- SWALE

ABBREVIATIONS

@	AT	FL	FLOW LINE	RD	ROAD
A/C, AC	ASPHALTIC CONCRETE	FT	FOOT, FEET	R/W	RIGHT-OF-WAY
AVE	AVENUE	G	GAS	RT	RIGHT
AWG	AMERICAN WIRE GAUGE	GB	GRADE BREAK	S	SANITARY SEWER
BC	BACK OF CURB	HORIZ	HORIZONTAL	S	SOUTH
	BEGIN CURVE	INT	INTERSECTION	SD	STORM DRAIN
BCR	BEGIN CURB RADIUS, BEGIN CURB RETURN	IRR	IRRIGATION	SHT	SHEET
		LF	LINEAR FEET	SL	STREET LIGHT
BVC	BEGIN VERTICAL CURVE	LN	LANE	ST	STREET
℄	CENTERLINE	MAX	MAXIMUM	STA	STATION
CONC	CONCRETE	MH	MANHOLE	STD	STANDARD
CLF	HUNDRED LINEAR FEET	MIN	MINIMUM	T, TEL	TELEPHONE
CU	COPPER	N	NORTH	TC	TOP OF CURB
DET	DETAIL	NO	NUMBER	THW	INSULATED STRAND WIRE
DIA	DIAMETER	NTS	NOT TO SCALE	TRANS	TRANSITION
DWG	DRAWING	OC	ON CENTER	TYP	TYPICAL
E	EAST	PC	POINT OF CURVATURE	VC	VERTICAL CURVE
EA	EACH	PI	POINT OF INTERSECTION	VERT	VERTICAL
EC	END CURVE	PT	POINT OF TANGENCY	W	WATER
ECR	END OF CURB RADIUS, END OF CURB RETURN	PVC	POLY VINYL CHLORIDE		WEST
		PVI	POINT OF VERTICAL CURVE	W/	WITH
EL, ELEV	ELEVATION	PVMT	PAVEMENT	W/O	WITHOUT
ELEC, E	ELECTRIC	R	RADIUS	XLEP	CROSS-LINKED POLYETHYLENE WIRE
EVC	END VERTICAL CURVE				
EXIST, EX	EXISTING				
FG	FINISHED GRADE				

LIST OF DRAWINGS

DRAWING	TITLE
G-1	COVER SHEET
G-2	QUANTITIES AND GENERAL NOTES
G-3	VICINITY MAP, KEY MAP, LEGEND, ABBREVIATIONS AND DRAWING INDEX
G-4	DETENTION BASIN DATA
G-5	STAGE STORAGE DISCHARGE GRAPHS
G-6	DETENTION BASIN R/W
G-7	SURVEY DATA
DB-1	DETENTION BASIN OVERALL SITE PLAN
DB-2	DETENTION BASIN PLAN
DB-3	DETENTION BASIN PLAN
DB-4	DETENTION BASIN PLAN
DB-5	DETENTION BASIN PLAN
DB-6	DETENTION BASIN PLAN
DB-7	DETENTION BASIN PLAN
DB-8	DETENTION BASIN PLAN
DB-9	DETENTION BASIN PLAN
DB-10	DETENTION BASIN PLAN
DB-11	DETENTION BASIN PLAN
DB-12	DETENTION BASIN PLAN
DB-13	DETENTION BASIN PLAN
DB-14	DETENTION BASIN PLAN
DB-15	DETENTION BASIN PLAN
DB-16	DETENTION BASIN PLAN
DS-1	DIVERSION STRUCTURE PLAN
OC-1	OUTFALL CHANNEL STA 2+90 TO STA 7+50
OC-2	OUTFALL CHANNEL STA 7+50 TO STA 19+50
OC-3	OUTFALL CHANNEL STA 19+50 TO STA 27+50

DRAWING	TITLE
D-1	DIVERSION STRUCTURE DETAILS
D-2	DIVERSION STRUCTURE DETAILS
D-3	OUTLET STRUCTURE DETAILS
D-4	OUTLET STRUCTURE DETAILS
D-5	OUTLET STRUCTURE DETAILS
D-6	SPILLING WELL DETAILS
D-7	WEST EMBANKMENT
D-8	SOUTH EMBANKMENT
D-9	DETENTION BASIN DETAILS
△ D-9A	DETENTION BASIN DETAILS
D-10	OUTFALL CHANNEL SECTIONS
D-11	SLOAN CONFLUENCE STRUCTURE DETAILS
D-12	CONCRETE REINFORCEMENT DETAILS
D-13	CHANNEL TRANSITION AND ACCESS RAMP
D-14	MISCELLANEOUS DETAILS
D-15	MISCELLANEOUS DETAILS
D-16	MISCELLANEOUS DETAILS
△ S-1	SLOAN DIVERSION CHANNEL MODIFICATION

DONALD W. DAVIS — CIVIL — No. 8081 — STATE OF NEVADA — PROFESSIONAL ENGINEER — 7/28/14

XREF or DRAWINGS

MARK	DATE	BY	REVISION
1	6-9-95	KJK	ADDITIONAL SHEET TO LIST OF DRAWINGS

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

Doyle Engineering Corporation
consulting engineers
9-33 300 Las Vegas, Nevada 89104

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

KEY MAP, LEGEND, ABBREVIATIONS, AND LIST OF DRAWINGS

DRAWING G-3
3 OF 45
G-3

PLOT DATE: 6-94

DETENTION BASIN DATA

DRAINAGE AREA: 82.4 SQUARE MILES

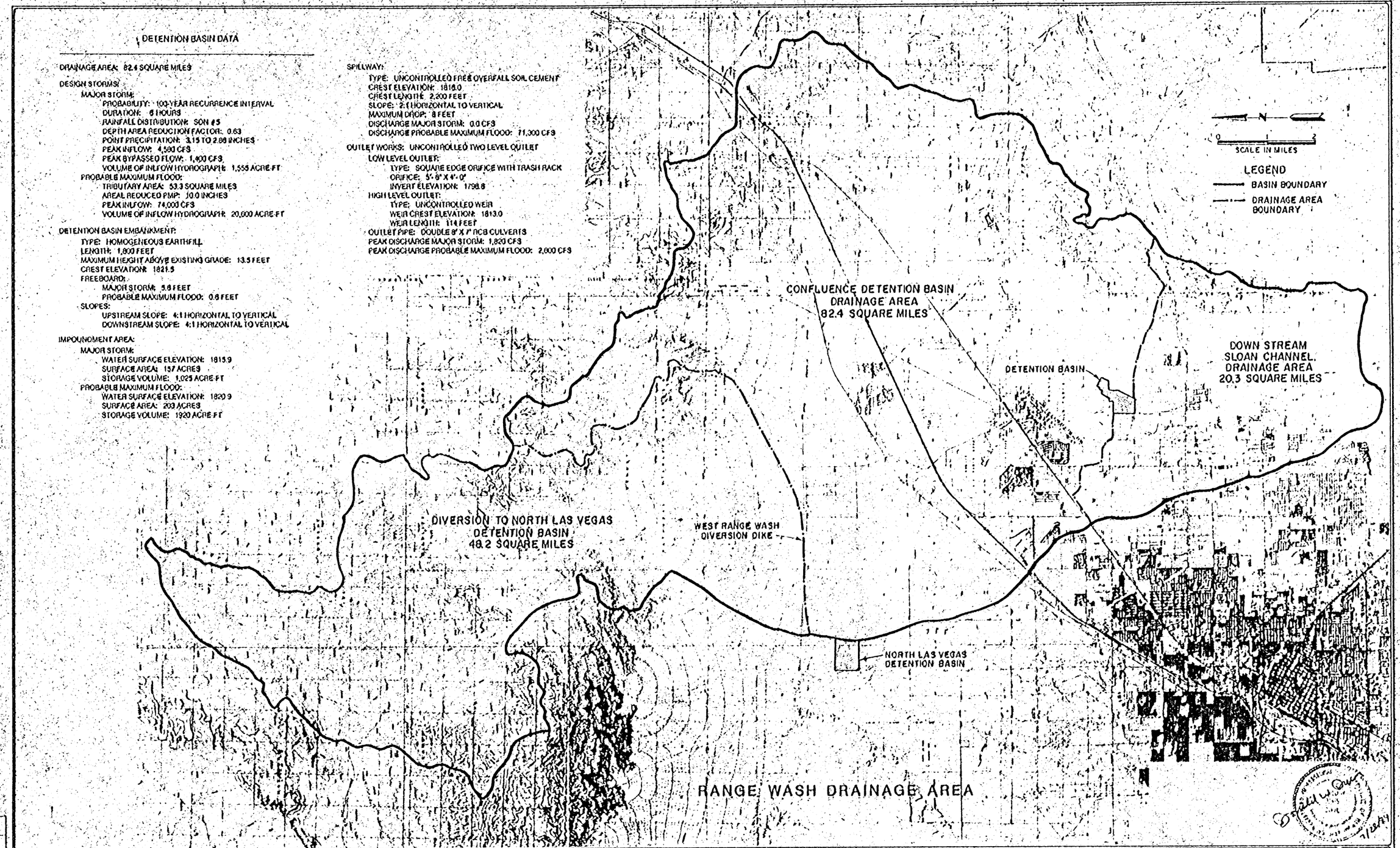
DESIGN STORMS:
- MAJOR STORM:
  - PROBABILITY: 100-YEAR RECURRENCE INTERVAL
  - DURATION: 6 HOURS
  - RAINFALL DISTRIBUTION: SCS #5
  - DEPTH AREA REDUCTION FACTOR: 0.63
  - POINT PRECIPITATION: 3.15 TO 2.86 INCHES
  - PEAK INFLOW: 4,580 CFS
  - PEAK BYPASSED FLOW: 1,400 CFS
  - VOLUME OF INFLOW HYDROGRAPH: 1,555 ACRE-FT
- PROBABLE MAXIMUM FLOOD:
  - TRIBUTARY AREA: 53.3 SQUARE MILES
  - AREAL REDUCED PMP: 10.0 INCHES
  - PEAK INFLOW: 74,000 CFS
  - VOLUME OF INFLOW HYDROGRAPH: 20,600 ACRE-FT

DETENTION BASIN EMBANKMENT:
- TYPE: HOMOGENEOUS EARTHFILL
- LENGTH: 1,800 FEET
- MAXIMUM HEIGHT ABOVE EXISTING GRADE: 13.5 FEET
- CREST ELEVATION: 1821.5
- FREEBOARD:
  - MAJOR STORM: 5.6 FEET
  - PROBABLE MAXIMUM FLOOD: 0.6 FEET
- SLOPES:
  - UPSTREAM SLOPE: 4:1 HORIZONTAL TO VERTICAL
  - DOWNSTREAM SLOPE: 4:1 HORIZONTAL TO VERTICAL

IMPOUNDMENT AREA:
- MAJOR STORM:
  - WATER SURFACE ELEVATION: 1815.9
  - SURFACE AREA: 157 ACRES
  - STORAGE VOLUME: 1,025 ACRE-FT
- PROBABLE MAXIMUM FLOOD:
  - WATER SURFACE ELEVATION: 1820.9
  - SURFACE AREA: 209 ACRES
  - STORAGE VOLUME: 1920 ACRE-FT

SPILLWAY:
- TYPE: UNCONTROLLED FREE OVERFALL SOIL CEMENT
- CREST ELEVATION: 1816.0
- CREST LENGTH: 2,200 FEET
- SLOPE: 2:1 HORIZONTAL TO VERTICAL
- MAXIMUM DROP: 8 FEET
- DISCHARGE MAJOR STORM: 0.0 CFS
- DISCHARGE PROBABLE MAXIMUM FLOOD: 71,300 CFS

OUTLET WORKS: UNCONTROLLED TWO LEVEL OUTLET
- LOW LEVEL OUTLET:
  - TYPE: SQUARE EDGE ORIFICE WITH TRASH RACK
  - ORIFICE: 5'-6" X 4'-0"
  - INVERT ELEVATION: 1798.8
- HIGH LEVEL OUTLET:
  - TYPE: UNCONTROLLED WEIR
  - WEIR CREST ELEVATION: 1813.0
  - WEIR LENGTH: 114 FEET
- OUTLET PIPE: DOUBLE 8'X 7' RCB CULVERTS
- PEAK DISCHARGE MAJOR STORM: 1,820 CFS
- PEAK DISCHARGE PROBABLE MAXIMUM FLOOD: 2,600 CFS



XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: AH
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

Boyle Engineering Corporation
consulting engineers
Las Vegas, Nevada 89118

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

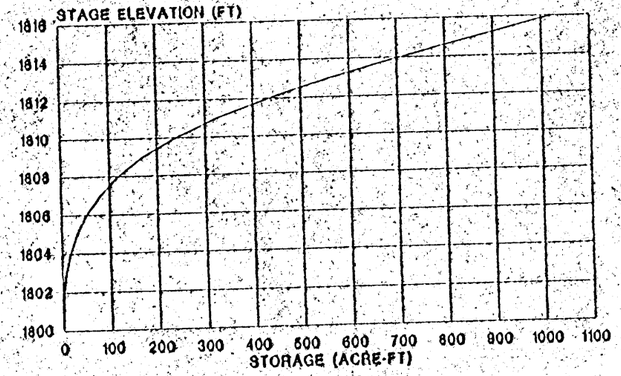
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN DATA

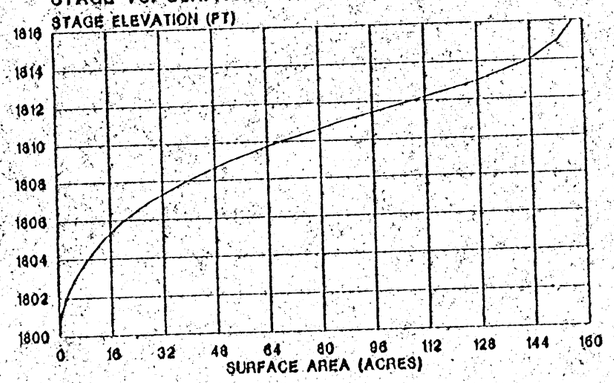
DRAWING G-4
4 OF 45
G-4

PLOT DATE: JUNE 1, 1993

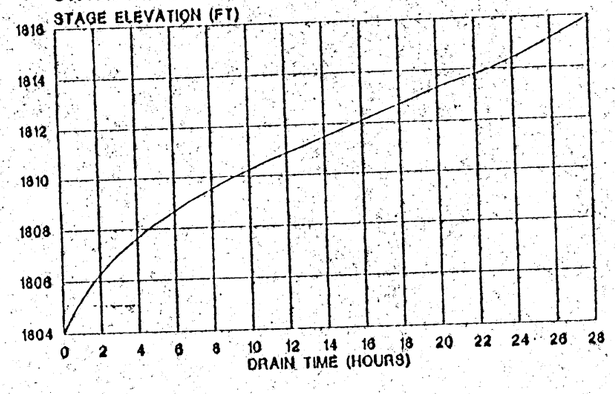
STAGE VS. STORAGE



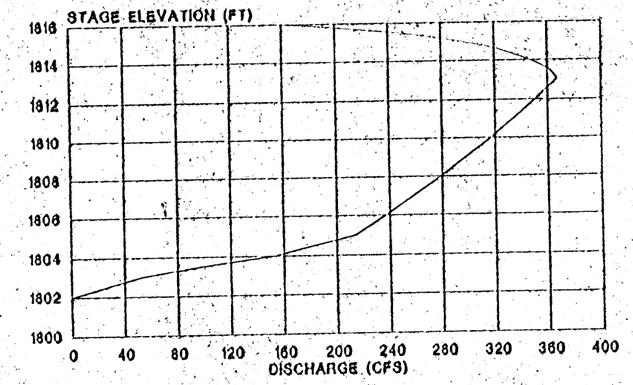
STAGE VS. SURFACE AREA



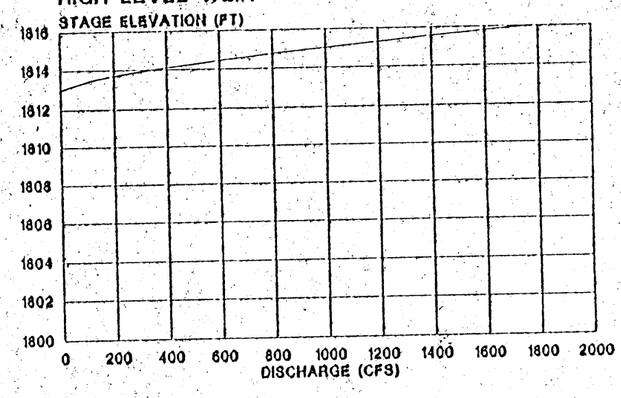
STAGE VS. DRAIN TIME



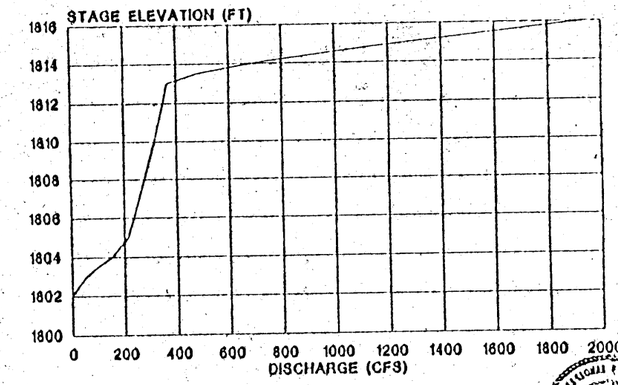
LOW LEVEL OUTLET (4'-0" x 3'-6" ORIFICE) ⚠



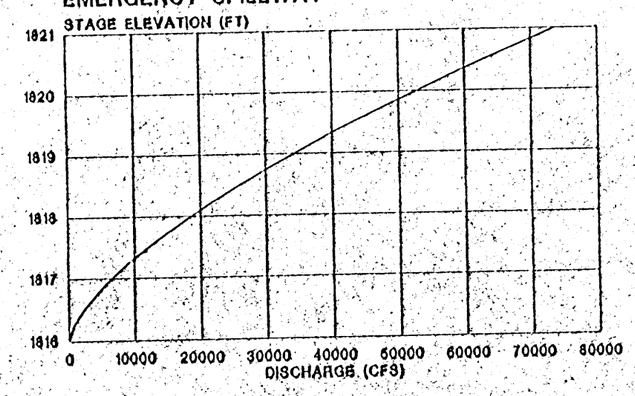
HIGH LEVEL WEIR



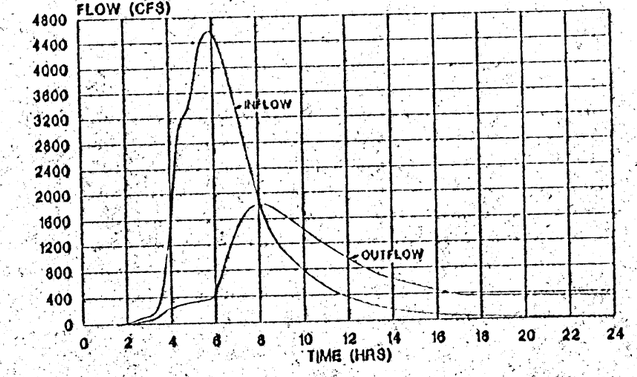
OUTLET WORKS (LOW & HIGH COMBINED)



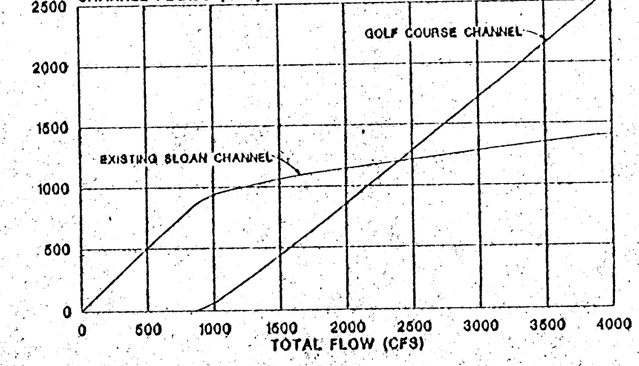
EMERGENCY SPILLWAY



INFLOW/OUTLFOW HYDROGRAPHS



DIVERSION RATING CURVE



DONALD W. DAVIS CIVIL — STATE OF NEVADA — No. 6069 — REGISTERED PROFESSIONAL ENGINEER
7/26/94

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
⚠	4-4-95	LW	4'-0" x 3'-6" ORIFICE

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN
STAGE STORAGE DISCHARGE GRAPHS

DRAWING G-5
5 OF 45
G-5

PLOT DATE: JUNE 1, 1993

LEGEND

- FOUND CORNERS
- SET SECTION CORNERS
- FOUND SECTION MONUMENTS
- CORNERS NOT FOUND
- SECTION LINE
- R.O.W. LINE
- TRACT LINE
- EASEMENT
- PROP. BASIN ROW/PROP. EASEMENTS
- BASIN RIGHT-OF-WAY
- CONSTRUCTION EASEMENT
- FLOOD CONTROL EASEMENT

BASIS OF BEARING

THE NORTH LINE OF SECTION 15, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M. BEARS N 89°33'51" E AS SHOWN ON RECORDS OF SURVEY (FILE 1, PAGE 9).

RECORD OF SURVEY REFERENCES

FILE 1, PAGE 9 (REF. DWG.)
FILE 61, PAGE 34
FILE 65, PAGE 52

PARCEL MAP REFERENCES

FILE 2, PAGE 87
FILE 9, PAGE 88
BOOK 11, PAGE 83
BOOK 12, PAGE 44
FILE 18, PAGE 5
BOOK 45, PAGE 87

I, Richard L. Montague, registered Professional Land Surveyor, do hereby certify that this map correctly delineates the results of an actual survey made by me and/or under my supervision, and is located in Section 9, 10, 15 and 16, Township 20 South, Range 62 East, M.D.M., Clark County, Nevada. This survey was performed to establish the legal rights-of-way and/or boundary limits for Sloan Channel improvements, Confluence Detention Basin and appurtenant collection and discharge facilities.

Richard L. Montague, P.L.S.
Nevada Certification No. 8191

8/17/93

7/28/94

XREference DRAWINGS

PLOT DATE:

MARK	DATE	BY	REVISION

DESIGNED: RLM
DRAWN: TGT
CHECKED: BFT

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Doyle Engineering Corporation
consulting engineers
3rd floor
1785 East Sahara Avenue
Las Vegas, Nevada 89104

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

RIGHT-OF-WAY PLAN
A PORTION OF SECTIONS 9, 10, 15 & 16
T 20 S, R 62 E, M.D.M.

DRAWING G-6
6 OF 45

NORTH
Scale: 1" = 400'

BASIS OF BEARING
THE NORTH LINE OF SECTION 15, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M. BEARS N89°33'51"E AS SHOWN ON RECORDS OF SURVEY (FILE 1, PAGE 9).

BENCHMARK
CLARK COUNTY VERTICAL DATUM
COUNTY BM STA 6C02-3SW3
2" BRASS DISC
NE COR NELLIS BLVD. & CHEYENNE AVE.
ELEV. 1828.83

FND BRASS DISC RLS 3803
13975.0177 N
9129.4837 E
SECT COR

U.S. CORPS OF ENG. FND CONC MONUMENT W/BRASS DISC NO 299-38 RLS 18711 @ 0.35' NORTH & 29.90' WEST OF COR.

APPROXIMATE LOCATION OF PROPOSED CON/SPAN STRUCTURE

DIVERSION AREA
NOT IN CONTRACT

13268.3019 N
11884.50/8 E
1/4 COR

PROPOSED BRIDGE LOCATION PHASE I NOT IN CONTRACT

UNLINED WEST CHANNEL PHASE I NOT IN CONTRACT

FND BRASS DISC RLS 3803
13961.5961 N
14639.5319 E
SECT COR

PROPOSED BRIDGE LOCATION

13971.7805 N
15979.6892 E
FND U.S. CORPS OF ENGINEERS 2" IRON PIPE 1/16 COR

CHEYENNE AVE.

DETENTION BASIN CONSTRUCTION IN PHASE II CONTRACT

MATERIAL MAY BE STOCKPILED NORTH OF CHEYENNE EAST OF NE HOOD

5/8" IRON ROD W/ALUM DISC
13931.9742 N
17319.7572 E
1/4 COR
PLS 8191

DEPT. OF INT. FND. BRASS CAP PLS 5088
20002.3623 N
19939.9826 E
SECT COR

12932.1683 N
18653.8689 E
CALCED 1/16 COR
FND IRON ROD W/CAP PLS 6625 @ 0.59' SOUTH & 0.10' EAST OF 1/16 COR

SEC 15 T20S R62E

FORMER COUNTY GRAVEL PIT SURPLUS MATERIAL DISPOSAL SITE. PLACED BY OTHERS. NOT IN CONTRACT.

18600.5551 N
17215.0590 E
FND 5/8" IRON ROD W/TAG PLS 4142

17142.7938 N
19778.3880 E
1/4 COR

17290.1236 N
14826.5830 E
FND 2" IRON PIPE W/CAP (TOP DAMAGED)
1/4 COR

17293.0583 N
11885.9990 E
U.S. CORPS OF ENG. 2" PIPE W/DISC CEN 1/4 COR SECT 16 L.V.A.F.B.

17219.0345 N
17110.3578 E
FND 5/8" IRON ROD CEN 1/4 COR (NO CAP)

FND 1" IRON PIPE @ 1.8' NORTH & 19.0' WEST (NO CAP)
FND 1/2" IRON ROD @ 7.2' NORTH & 28.65' WEST (NO CAP) OF COR

AIR FORCE STOCKPILE AREA

FND BRASS DISC
14620.6845 N
11887.4888 E
1/4 COR
RLS 3803

FND. BRASS CAP
14623.5995 N
14615.7477 E
SECT COR
RLS 1759

14652.3587 N
14970.5284 E
FND 1" BRASS DISC @ 28.75' NORTH & 54.60' EAST OF SECT COR

FND ALUM DISC
14253.6165 N
16885.6030 E
1/4 COR

DEPT. OF INT. FND. BRASS CAP
14283.5132 N
19557.0350 E
SECT COR

7/28/94

26-81-1 U.S.A.
26-81-2 U.S.A.
26-81-3 U.S.A.
26-81-5 USA
26-81-6 USA
26-81-7 USA
26-81-9
26-81-17 PRIVATE
26-81-19 PRIVATE
26-81-23 PRIVATE
26-81-24 PRIVATE
26-17-1 U.S.A.
26-29-1 U.S.A.
26-29-2
26-29-3
26-29-5 PRIVATE
26-29-6 PRIVATE
26-29-8 PRIVATE
26-29-9
26-29-10
26-29-11 CLARK CO.
26-29-12 PRIVATE
26-29-13
26-29-14 PRIVATE
26-29-15 PRIVATE
26-29-16 PRIVATE
26-29-17
26-29-18 PRIVATE
26-29-19 PRIVATE
26-29-20 PRIVATE
26-29-21 PRIVATE
26-29-22
26-29-23
26-29-24
26-29-25
26-29-26 PRIVATE
26-29-4 PRIVATE
26-29-7 PRIVATE
26-23-1 U.S.A.
26-24-1 U.S.A.
26-30-33 PRIVATE
26-30-1 PRIVATE

N.A.F.B. AIR FIELD
WEST SPILLWAY EMBANKMENT
EXISTING SLOAN CHANNEL
PROPOSED CONCRETE LINED OUTLET CHANNEL
LIMIT OF BASIN CONSTRUCTION
LIMIT OF GRADING
NE HOOD
ALTO DR.
TOWNE
BLUEHILL
CASA LOMA
SHENANDOAH
ROCKY MOUNTAIN
CASA-LOMA EST. No. 1 PRIVATE

XREF or ONCE DRAWINGS

MARK	DATE	BY	REVISION
1	4-25-94	KJE	CENTURY STOCKPILE AREA

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

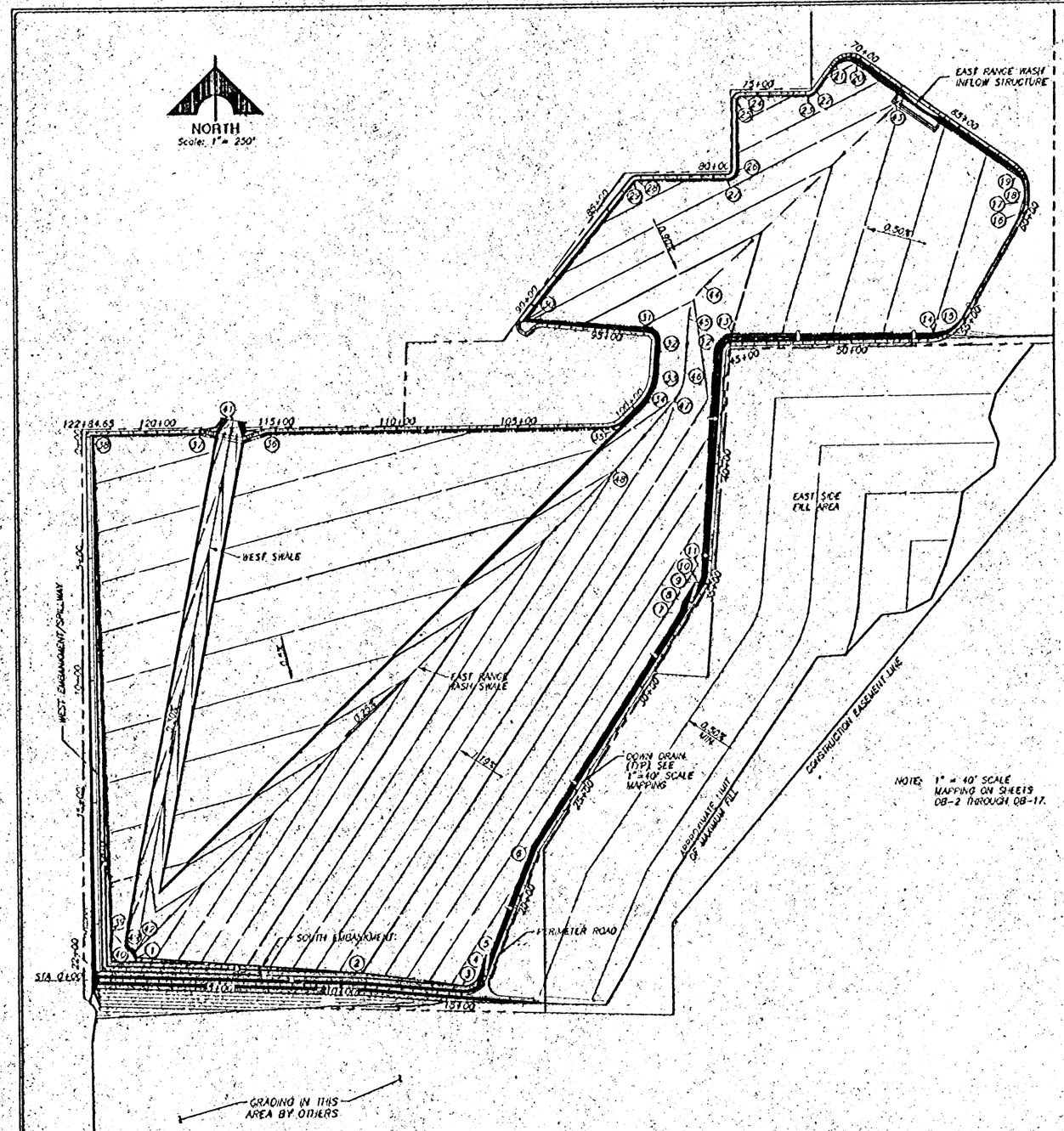
PROJECT ENGINEER: Don Davis 7/28/94 DATE
PROJECT MANAGER: Don Davis 7/28/94 DATE

Doyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE 1 - NAFB CHANNEL
SURVEY DATA SHEET
REFERENCE COORDINATES, BENCHMARK

DRAWING G-7
7 OF 45
ASSESSOR



NOTE: 1" = 40' SCALE MAPPING ON SHEETS DB-2 THROUGH DB-17.

GEOMETRY CONTROL POINTS

DETENTION BASIN INSIDE TOE CONTROL POINTS

No.	NORTHING	EASTING	ELEV
1	17454.3823	14847.4979	1800.18
2	17392.8983	15777.6660	1810.00
3	17324.7692	16191.5650	1814.49
4	17448.7718	16290.0182	1814.67
5	17448.8574	16303.8848	1814.83
6	17502.6919	16490.8771	1813.60
7	18849.8159	17098.8239	1813.31
8	18894.2782	17111.9025	1813.30
9	18925.0631	17165.2031	1813.30
10	18970.9254	17178.5258	1813.51
11	19009.8212	17192.1714	1813.39
12	19323.2299	17252.7924	1809.59
13	20048.1433	17327.5215	1810.00
14	20039.4657	18188.0890	1814.00
15	20091.1887	18303.5445	1814.48
16	20479.9907	18528.3980	1815.04
17	20523.8042	18541.6442	1815.03
18	20572.2318	18541.6806	1814.97
19	20629.1406	18513.4513	1814.75
20	21100.9184	17849.3628	1813.93
21	21101.0028	17763.9768	1814.29
22	20991.8068	17682.4921	1813.73
23	20974.2594	17687.9044	1813.73
24	20926.3124	17733.8755	1814.85
25	20955.9582	17353.4010	1814.77
26	20611.5081	17358.5588	1812.45
27	20828.8036	17311.7554	1812.27
28	20827.7154	16939.3928	1813.81
29	20821.7032	16926.5108	1813.81
30	20061.4869	16478.8426	1811.11
31	20023.7311	16974.1282	1808.91
32	19981.4039	17026.4888	1808.72
33	19830.3837	17018.0977	1808.38
34	19715.2495	16970.0290	1808.18
35	19608.3877	16848.9451	1811.28
36	19600.6987	15416.4227	1813.03
37	19599.8347	15125.2028	1813.40
38	19597.1458	14683.8221	1813.94
39	17561.3030	14745.3847	1804.00
40	17438.1388	14742.7030	1805.00
41	17507.8355	14804.7685	1800.00

PERIMETER ROAD CONTROL POINTS

STATION	NORTHING	EASTING	ELEV	DESCRIPTION
00+00.00	17364.0303	14687.7847	1821.50	BEG. PERIMETER ROAD
11+00.00	17324.5193	15788.2154	1821.50	HORIZ ANGLE POINT
15+02.91	17288.8707	16168.3830	1821.50	P.C.
16+41.25	17358.5644	16298.2843	1822.00	P.T.
22+12.93	17687.8191	16509.4009	1822.00	HORIZ ANGLE POINT
34+65.68	18953.8547	17204.7468	1822.00	P.C.
35+43.41	19007.9478	17223.0983	1822.00	P.T.
43+08.15	19963.9009	17295.4491	1822.00	P.C.
43+60.21	20002.2387	17331.0739	1822.00	P.T.
53+93.23	20008.2849	18184.0340	1822.00	P.C.
54+66.27	20085.1730	18311.9284	1818.00	P.C.C.
55+83.38	20099.5693	18321.1782	1816.00	P.T.
59+98.07	20474.4973	18537.9045	1818.00	P.C.
60+55.59	20528.4828	18552.4028	1816.00	P.T.
61+06.23	20577.1016	18552.4407	1816.00	P.C.
61+29.35	20601.9925	18549.8155	1818.58	P.T.
62+18.49	20674.8953	18502.1171	1822.00	P.T.
69+97.28	21127.0991	17868.0410	1822.00	P.C.
71+25.94	21109.1039	17753.2841	1816.00	P.T.
72+62.30	20999.7489	17671.8305	1816.00	P.C.
72+90.53	20987.6693	17641.6653	1816.00	P.T.
75+84.35	20988.8278	17373.6437	1816.00	P.C.
76+12.71	20958.0651	17342.7397	1818.00	P.T.
78+97.15	20871.6312	17340.5824	1816.00	P.C.
79+42.38	20842.8534	17311.6870	1816.00	P.C.
83+15.36	20641.2625	16938.6921	1816.00	P.C.
83+41.01	20630.5393	16918.2998	1816.00	P.T.
90+84.08	20053.6083	16447.9989	1918.00	P.C.
91+73.74	20015.9108	16437.1313	1818.00	P.R.C.
92+31.69	20038.3980	16342.4168	1816.00	P.T.
96+62.68	19995.8552	16971.4922	1816.00	P.C.
97+09.35	19963.8168	16998.5783	1816.00	P.T.
98+40.80	19832.5771	16988.1853	1818.00	P.C.
99+75.96	19713.9834	16930.2261	1818.00	P.T.
100+62.00	19654.6231	16867.9400	1818.00	P.C.
101+37.39	19627.0183	16799.8349	1818.00	P.T.
115+38.59	19618.5287	15398.5267	1818.00	HORIZ ANGLE POINT
118+16.14	19581.7288	15296.7819	1807.45	HORIZ ANGLE POINT
118+20.08	19614.4341	15123.9878	1815.40	HORIZ ANGLE POINT
122+84.65	19611.0772	14661.4123	1818.00	END PERIMETER ROAD

DETENTION BASIN SWALE CONTROL POINTS

No.	NORTHING	EASTING	ELEV	DESCRIPTION
41	19591.0838	15248.1871	1808.45	℄ INTERSECTION ROAD
42	17480.6950	14843.7995	1800.00	EAST & WEST INT.
43	20238.1433	18011.9175	1812.00	BEGIN EAST SWALE
44	20187.4702	17208.7449	1809.28	P.C. EAST SWALE
45	20055.7923	17165.2224	1808.89	PT EAST SWALE
46	19838.4928	17128.4975	1808.34	P.C. EAST SWALE
56	17098.1078	14812.5335	1813.00	BEGIN WEST SWALE
47	19720.2315	17078.2353	1807.92	PT EAST SWALE
48	19483.5908	16838.4949	1807.00	℄ PT EAST SWALE

XREF DRAWINGS
DB-DE3
DB-TOPO

MARK	DATE	BY	REVISION

DESIGNED: DWO
DRAWN: LBL
CHECKED: DWO

PROJECT ENGINEER — DATE 1/28/99
PROJECT MANAGER — DATE 1/28/99

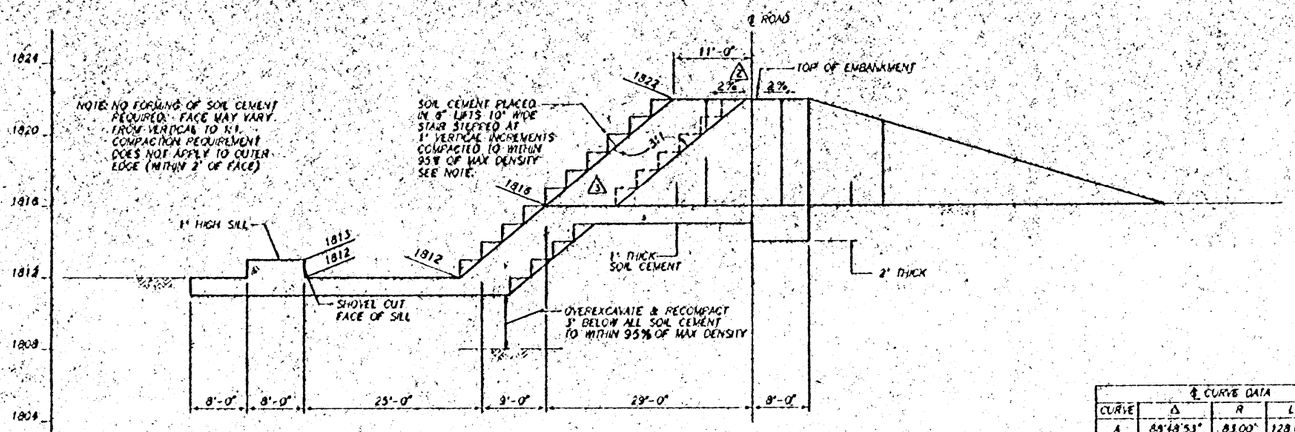
Doyle Engineering Corporation
consulting engineers
[illegible] East Sahara Ave. Suite 300
Las Vegas, Nevada 89104

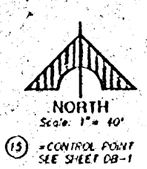
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

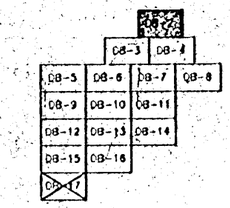
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
OVERALL SITE PLAN

DRAWING
DB-1
8 OF 45
DB-1

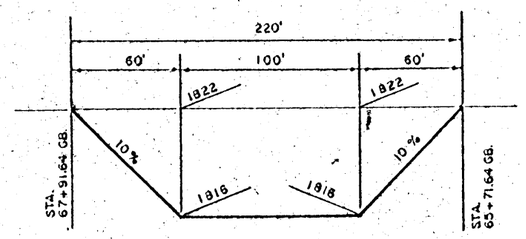


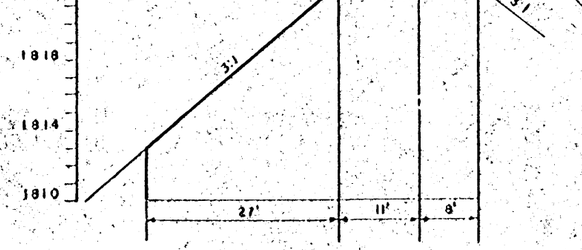




℄ CURVE DATA				
CURVE	Δ	R	L	T
A	89°48'53"	83.00'	128.66'	81.30
B	53°08'37"	30.00'	27.83'	15.00'
C	89°23'08"	31.00'	48.36'	30.87'

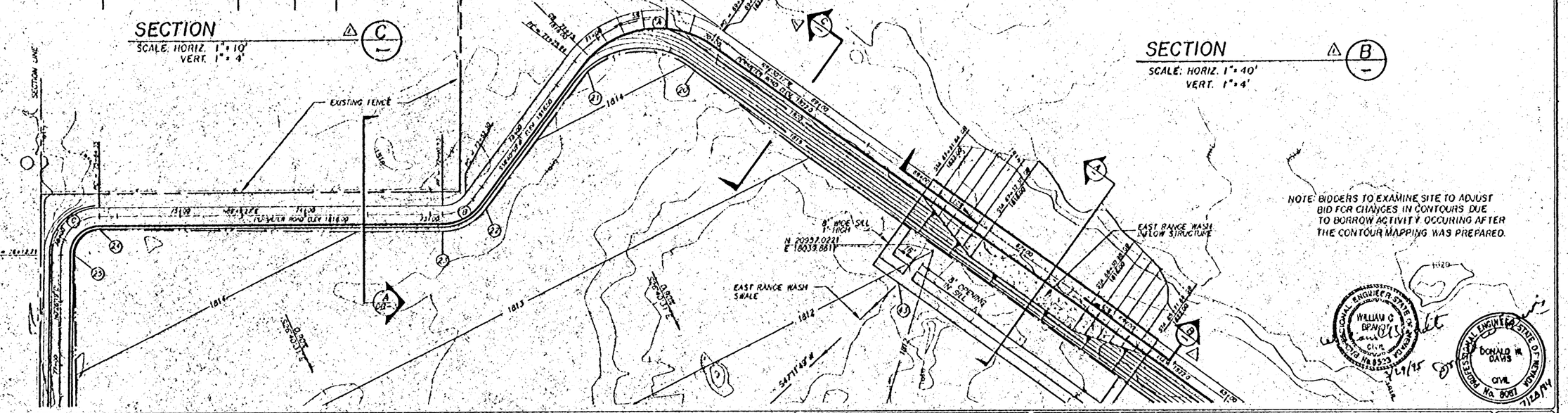
SECTION A
SCALE: HORIZ. 1" = 10'
VERT. 1" = 4'





SECTION C
SCALE: HORIZ. 1" = 10'
VERT. 1" = 4'

SECTION B
SCALE: HORIZ. 1" = 40'
VERT. 1" = 4'



NOTE: BIDDERS TO EXAMINE SITE TO ADJUST BID FOR CHANGES IN CONTOURS DUE TO BORROW ACTIVITY OCCURING AFTER THE CONTOUR MAPPING WAS PREPARED.

XREFerence DRAWINGS
DB-EG
DB-DES

MARK	DATE	BY	REVISION
1	4-95	RCD	REGRADE SOIL CEMENT STAIR 3:1
2	4-95	RCD	ADD CROWN 3% SLOPE
3	4-95	RCD	ADD SECTION B-B & C-C

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

PLOT DATE 8-94

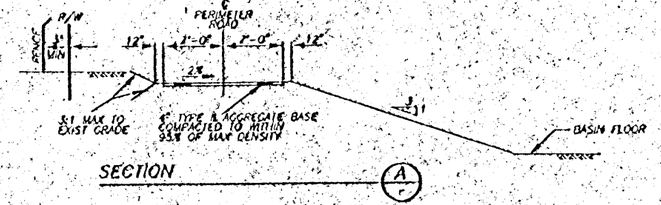
Boyle Engineering Corporation
consulting engineers
[illegible] Las Vegas, Nevada 89102

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

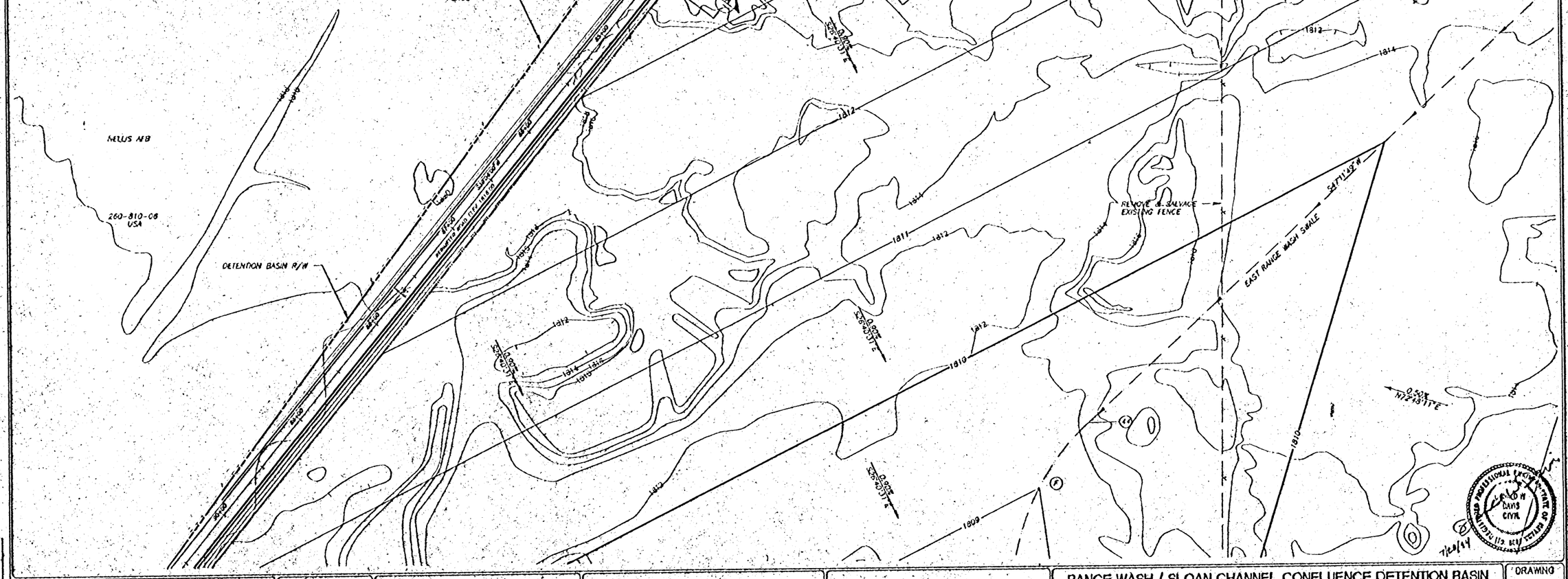
DETENTION BASIN
PLAN

DRAWING DB-2
9 OF 45
DB-2



SECTION A

CURVE DATA				
CURVE	Δ	R	L	T
D	89°19'01"	29.00'	45.21'	28.68'
E	50°41'20"	29.00'	25.66'	13.76'
F	42°50'11"	200.00'	149.53'	78.43'



XREFerence DRAWINGS
DB-EQ
DB-DES

MARK	DATE	BY	REVISION
1	4-99	BK	ADD POINTS OF CORDINATION

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

Boyle Engineering Corporation
consulting engineers
9960 West Cheyenne Avenue
Las Vegas, Nevada 89129

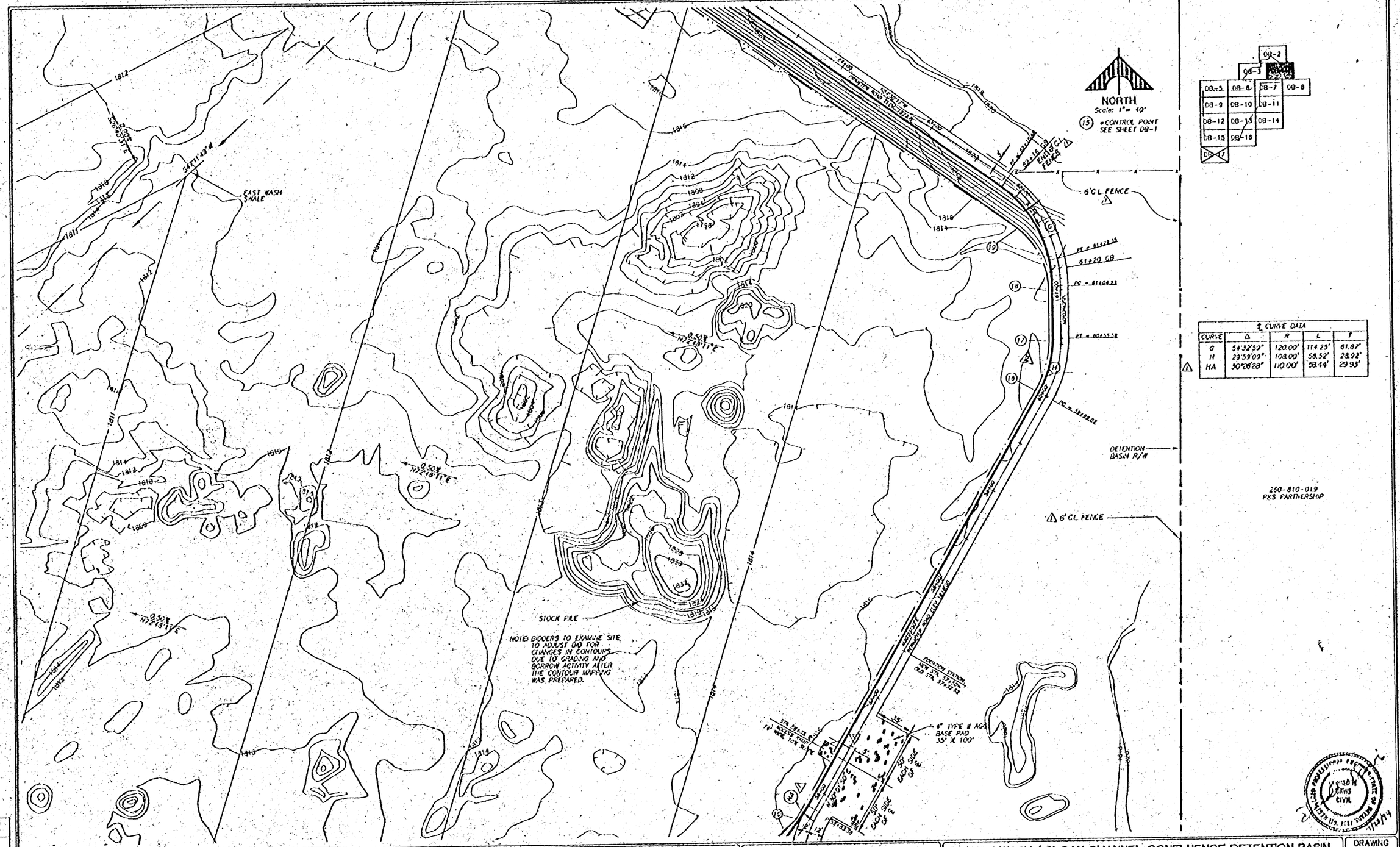
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN PLAN

DRAWING DB-3
10 OF 15
DB-3

7/28/14



℄ CURVE DATA

CURVE	Δ	R	L	T
G	54°32'59"	120.00'	114.25'	61.81'
H	29°59'09"	108.00'	56.52'	28.92'
HA	30°26'28"	110.00'	58.44'	29.93'

XREFerence DRAWINGS
DB-EG
DB-DES

MARK	DATE	BY	REVISION
1	4-4-95	MK	CORRECT R/W LINE APPROX STA 59+990F TO 60+55.58
1	4-4-95	MK	WIDEN ACCESS ROAD, ADD CURVE DATA & FENCE

DESIGNED: DWO
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/10/94

Boyle Engineering Corporation
consulting engineers

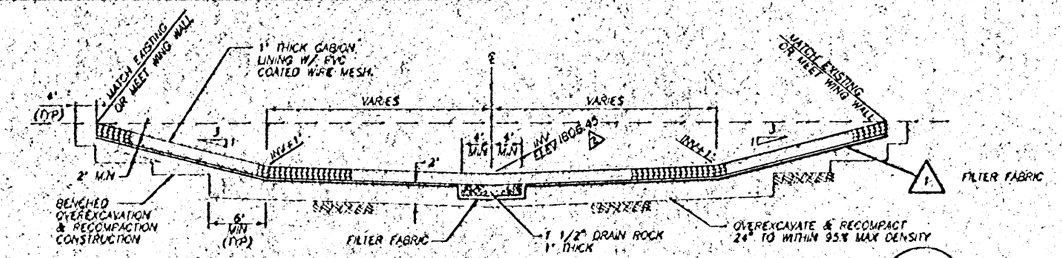
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN PLAN

DRAWING DB-4
11 OF 45
DB-4.dg

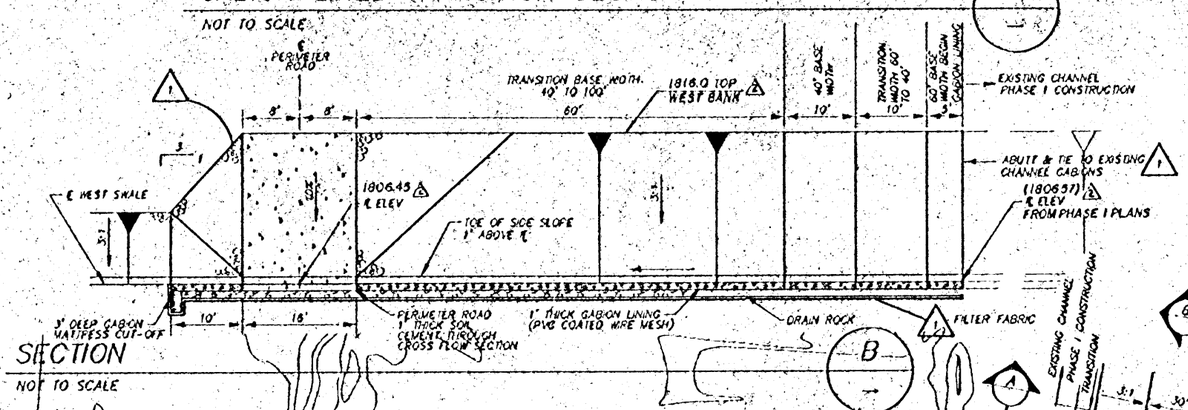
PLOT DATE: 8/94



GABION LINED TRANSITION SECTION

NOT TO SCALE

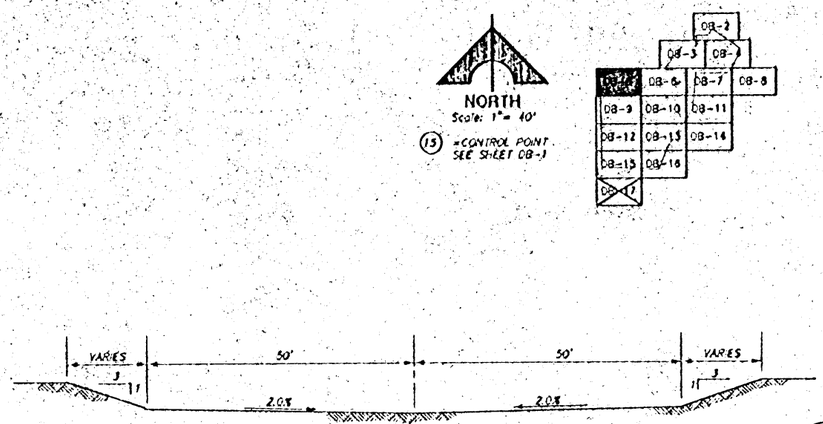
A



SECTION

NOT TO SCALE

B



WEST SWALE SECTION

NOT TO SCALE

C

⚠ NOTE: REMOVE EXISTING FENCE BETWEEN STATIONS 115+085 AND 118+82

XREFerence DRAWINGS
DB-EG1
DB-DE5

MARK	DATE	BY	REVISION
4	4-95	LBL	ADD NOTE, REMOVE EXIST FENCE
3	4-95	LBL	JOIN EXIST FENCE STA AT 115+08.50 & 118+28.50
2	4-95	GM	ADD ELEVATIONS
1	1-95	GM	NOTE ADDED, CHANNEL EXISTS (12/28/94)
			FILTER FABRIC SHOWN BENEATH GABIONS

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE
PROJECT MANAGER — DATE

Boyle Engineering Corporation
consulting engineers
Las Vegas, Nevada

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN PLAN

DRAWING DB-5
12 OF 49
DB-5

PLOT DATE: 6/24

NELLIS AFB

260-810-08
USA

RELOCATED FENCE

1997148232
1837986716

MAINTAIN EXISTING FENCE

REMOVE & SALVAGE EXISTING FENCE

DETENTION BASIN R/W

PC = 98+82.68

PT = 97+09.35

PC = 98+40.80

PT = 99+73.94

PT = 101+37.39

PC = 100+40.00

NORTH
Scale: 1" = 40'

(15) = CONTROL POINT SEE SHEET DB-1

DB-2 DB-3 DB-4 DB-5 DB-6 DB-7 DB-8 DB-9 DB-10 DB-11 DB-12 DB-13 DB-14 DB-15 DB-16 DB-17

℄ CURVE DATA

CURVE	Δ	R	L	T
I	183°12'20"	31.00'	99.12'	-
J	59°32'12"	50.00'	51.98'	28.60'
K	89°08'10"	30.00'	46.67'	29.59'
L	43°01'12"	180.00'	135.15'	70.94'
M	43°11'44"	100.00'	75.39'	39.59'

N04°10'55"E
EAST RANGE WASH SWALE

1207

S.12%
N36°33'09"W

S.12%
S74°32'25"E

S.12%
S74°32'25"E

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REFERENCE DRAWINGS
DB-EQ
DB-DES

MARK	DATE	BY	REVISION
1	4-4-99	PWK	ADD COORDINATES

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/18/94
PROJECT MANAGER — DATE 7/18/94

Boyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-6
13 OF 15
DB-6

PLOT DATE: 6/24

CURVE	Δ	R	L	T
N	59°32'05"	183.00'	190.15'	104.67'
O	85°13'46"	4000.00'	595.10'	38.80'
P	36°49'17"	200.00'	128.53'	66.57'
PA	30°26'28"	110.00'	58.44'	29.93'
PB	90°00'00"	20.00'	31.42'	20.00'

PRIVATE
APN 260-290-009

PRIVATE
APN 260-290-021

PRIVATE
APN 260-290-018

8' CL FENCE

6' CL FENCE

DETENTION BASIN R/W

NORTH
Scale: 1" = 40'

(15) = CONTROL POINT
SEE SHEET DB-1

DB-2 | DB-3 | DB-4 | DB-5 | DB-6 | DB-7 | DB-8 | DB-9 | DB-10 | DB-11 | DB-12 | DB-13 | DB-14 | DB-15 | DB-16 | DB-17

XREFerence DRAWINGS
DB-EG
DB-DES

MARK	DATE	BY	REVISION
1	8-1-96	GJK	REVISE ROADWAY & ADD CURVE DATA & FENCE

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/29/96
PROJECT MANAGER — DATE 7/29/96

Boyle Engineering Corporation
consulting engineers
1501 East Sahara Avenue
Las Vegas, Nevada 89158

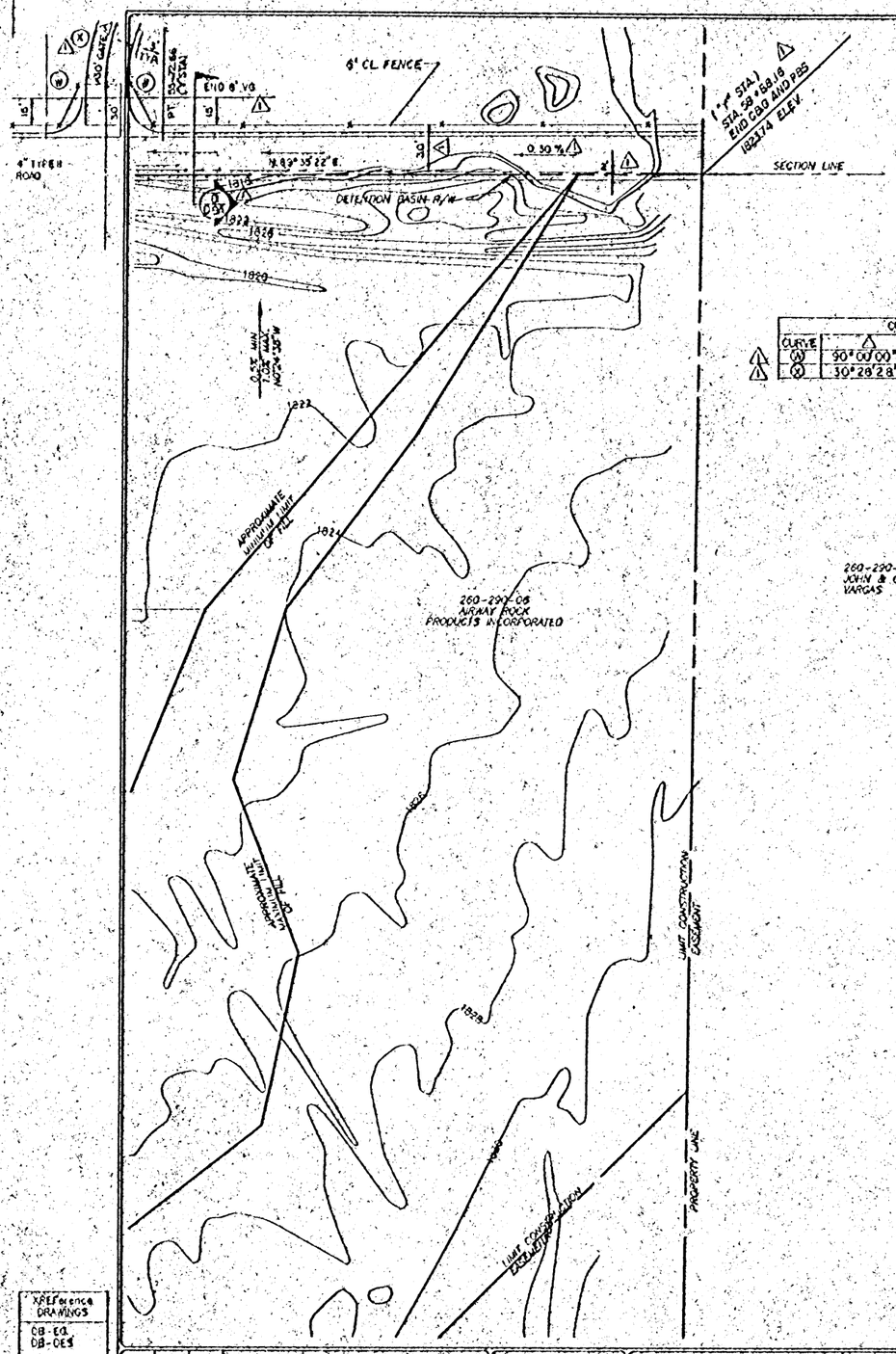
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-7
14 OF 45
DB-7

PLOT DATE: 8/96

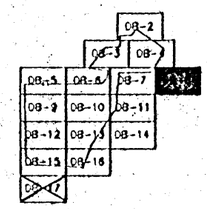


("F" STA.)
STA. 58+68.18
END CBD AND PBS
1821.74 ELEV.

CURVE DATA				
CURVE	Δ	R	L	T
Ⓦ	90°00'00"	20.00'	31.42'	20.00'
Ⓧ	30°29'28"	110.00'	58.44'	29.93'

NORTH
Scale: 1" = 40'

(13) = CONTROL POINT SEE SHEET DB-1



XREference DRAWINGS
DB-EQ
DB-DES

MARK	DATE	BY	REVISION
1	4-4-95	MK	ADD ROADWAY AND CURVE DATA & FENCE

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

Boyle Engineering Corporation
consulting engineers
9480 South Eastern Avenue
Las Vegas, Nevada 89123

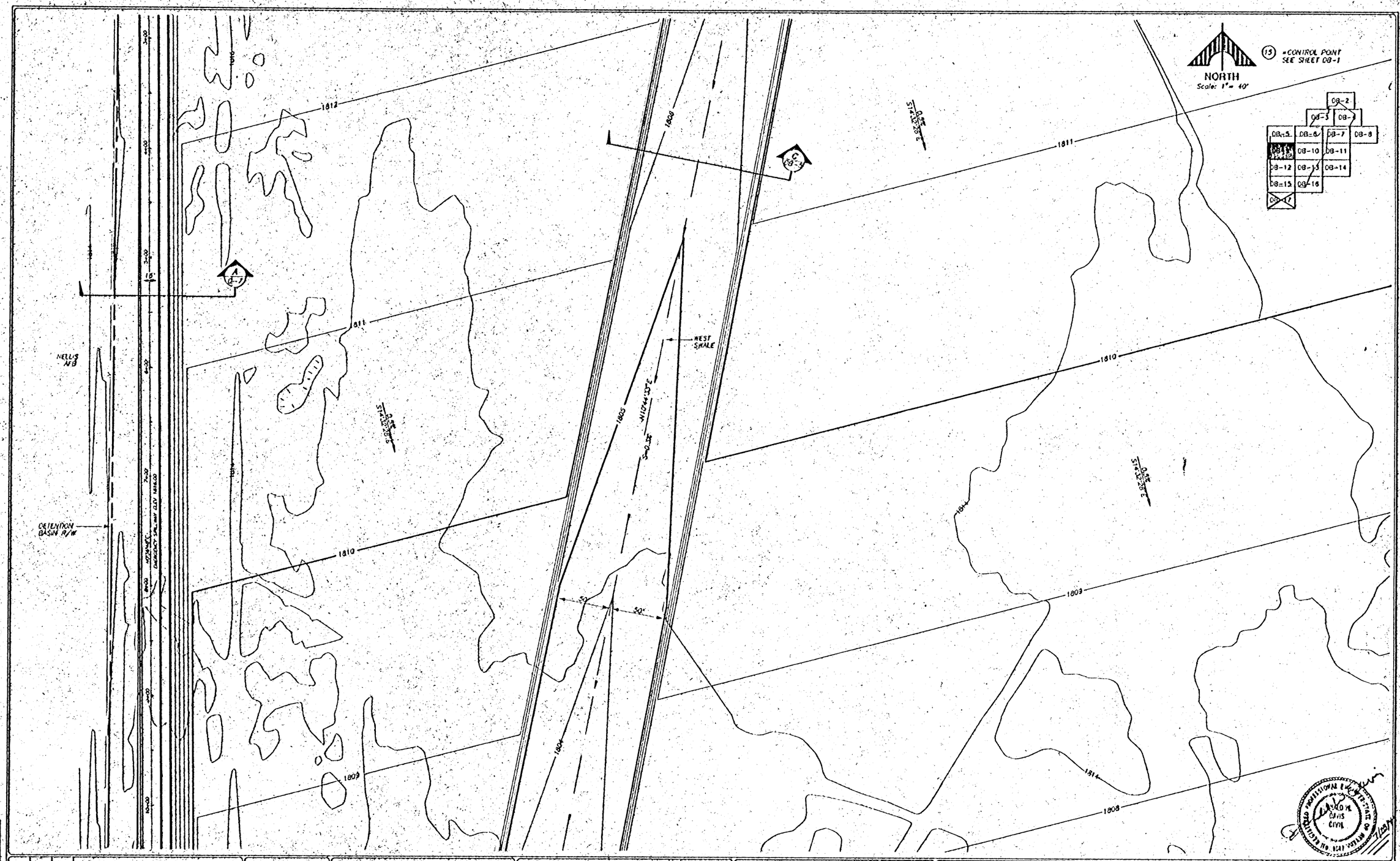
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN PLAN

DRAWING
DB-8
15 OF 45
DB-8

PLOT DATES 8/94



XREFerence DRAWINGS
DB-EQ
DB-DES

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Doyle Engineering Corporation
consulting engineers
Suite 300
1151 East Sahara Avenue
Las Vegas, Nevada 89104

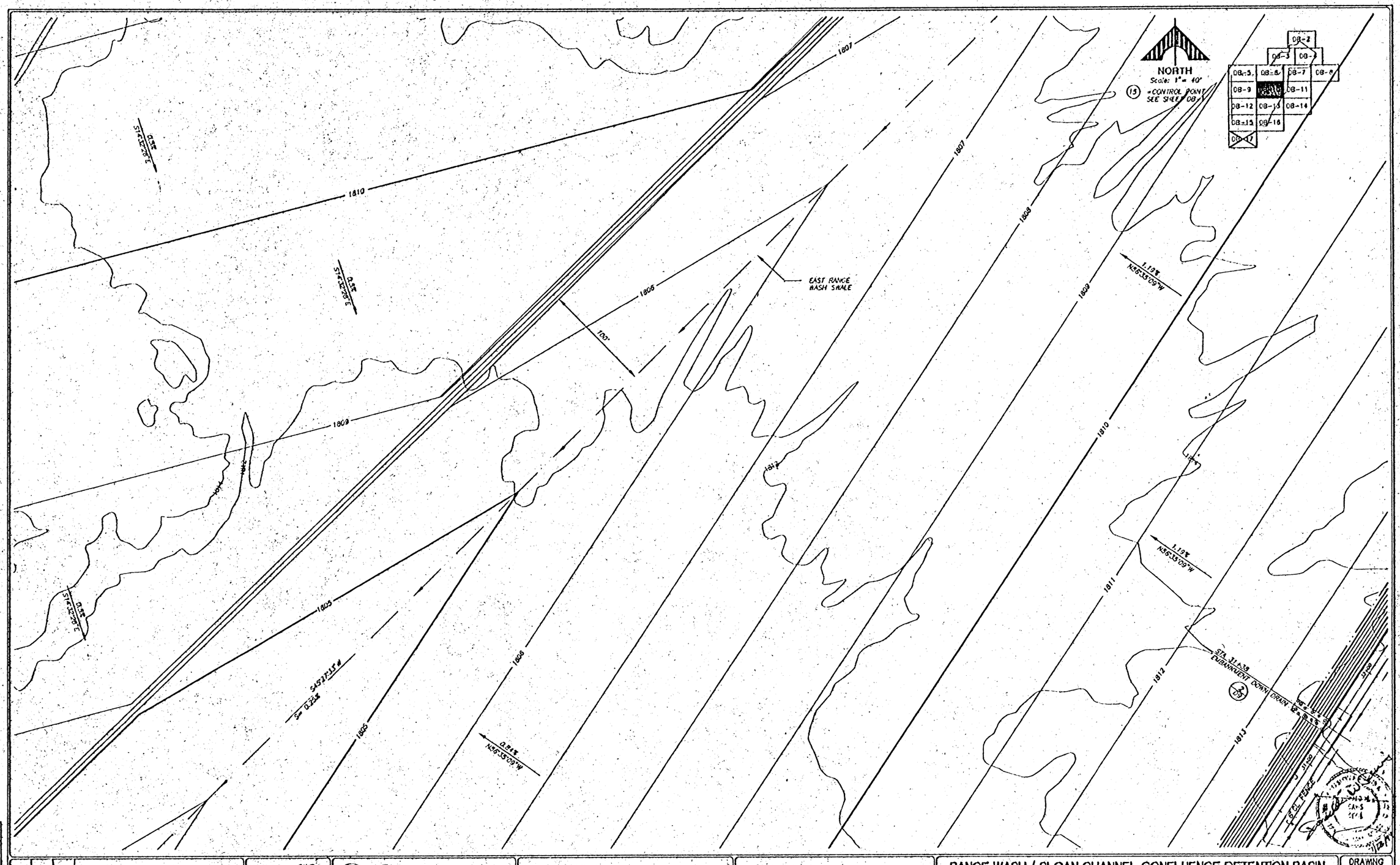
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-9
16 OF 45
DB-9

PLOT DATE: 8/94



XREFerence DRAWINGS
DB-DEST
DB-EQ

MARK	DATE	BY	REVISION
1	4-4-95	PJH	ADD FENCE

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Doyle Engineering Corporation
consulting engineers
[illegible] Las Vegas, Nevada [illegible]

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

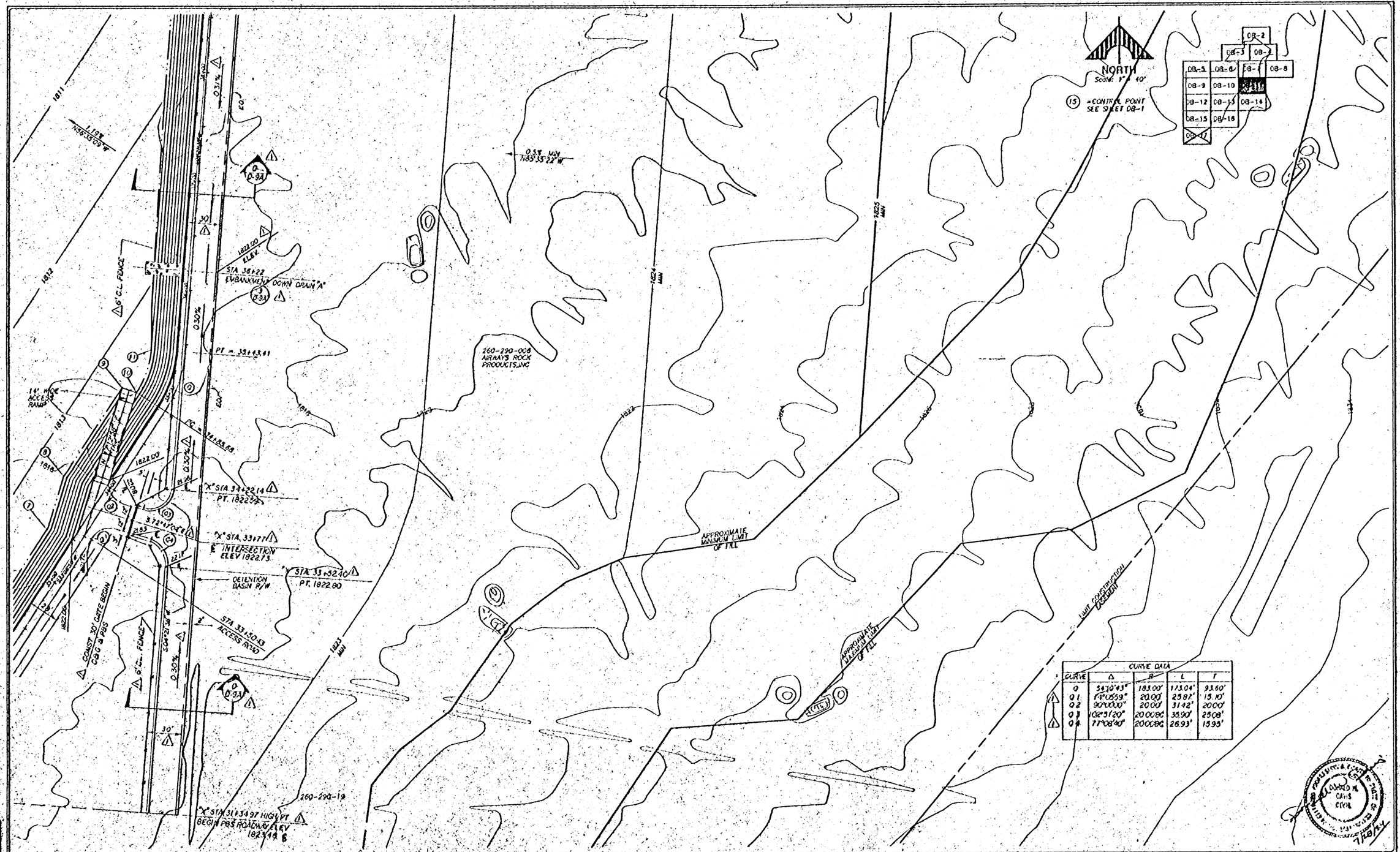
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-10
17 OF 45
DB-10

PLOT DATE: 8/94

C:\MAPLOGIN\DB-10 MON JUN 20 12:12:57 1994


NORTH
Scale: 1" = 40'
(15) = CONTROL POINT SEE SHEET DB-1
DB-2
DB-3
DB-4
DB-5
DB-6
DB-7
DB-8
DB-9
DB-10
DB-11
DB-12
DB-13
DB-14
DB-15
DB-16
DB-17
0.5% MIN N85°35'22"W
260-290-008 AIRWAYS ROCK PRODUCTS, INC
APPROXIMATE MINIMUM LIMIT OF FILL
APPROXIMATE MAXIMUM LIMIT OF FILL
LIMIT CONSTRUCTION EASEMENT
1811
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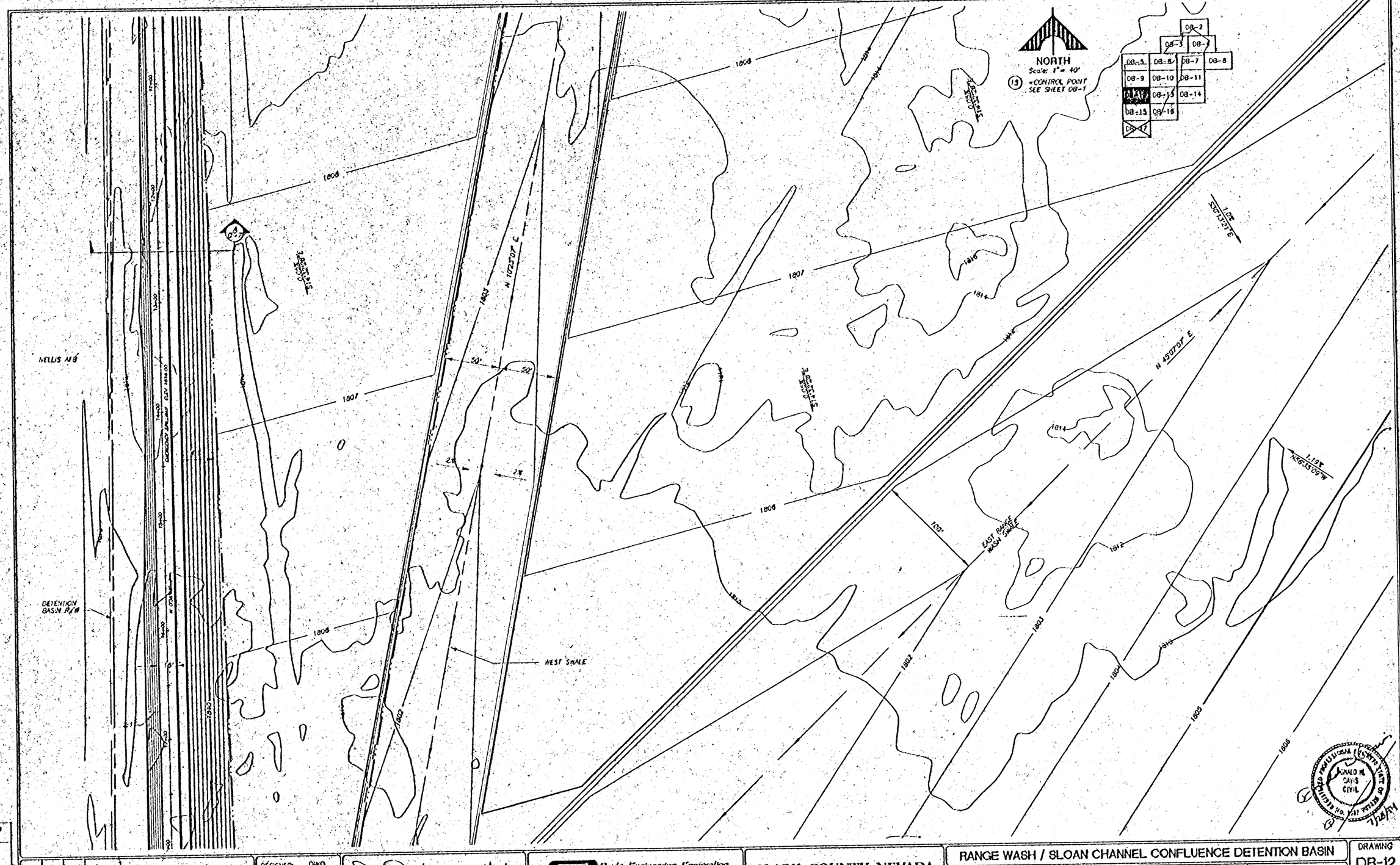


XREFerence DRAWINGS
DB-DES1
DB-EQ

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Doyle Engineering Corporation
consulting engineers
Suite 200
1758 East Sahara Avenue
Las Vegas, Nevada 89104

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

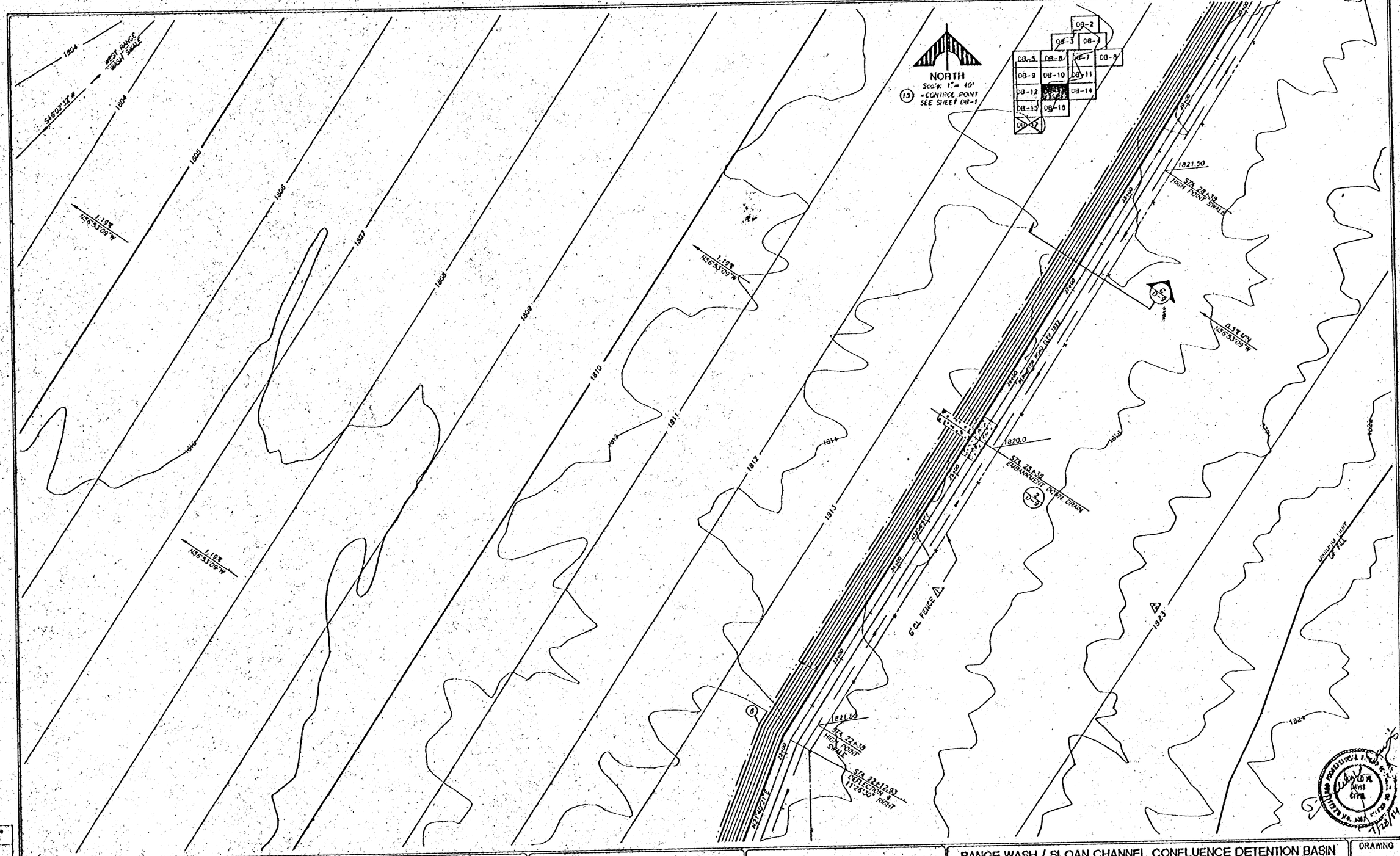
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-12
19 OF 45
DB-12

PLOT DATE: 8/24

C:\WORK\DB-12 Mon Jun 20 12:26:04 1994



MARK	DATE	BY	REVISION
4	4-99	JJK	ADD ELEV
3	4-98	JJK	ADD FENCE, ℄ℓ

XREFerence DRAWINGS
DB-DES2
DB-EQ

DESIGNED: DWD
DRAWN: SLA
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/99
PROJECT MANAGER — DATE 7/28/99

Doyle Engineering Corporation
consulting engineers
Suite 300
7398 Cora Schoen Avenue
Las Vegas, Nevada 89128

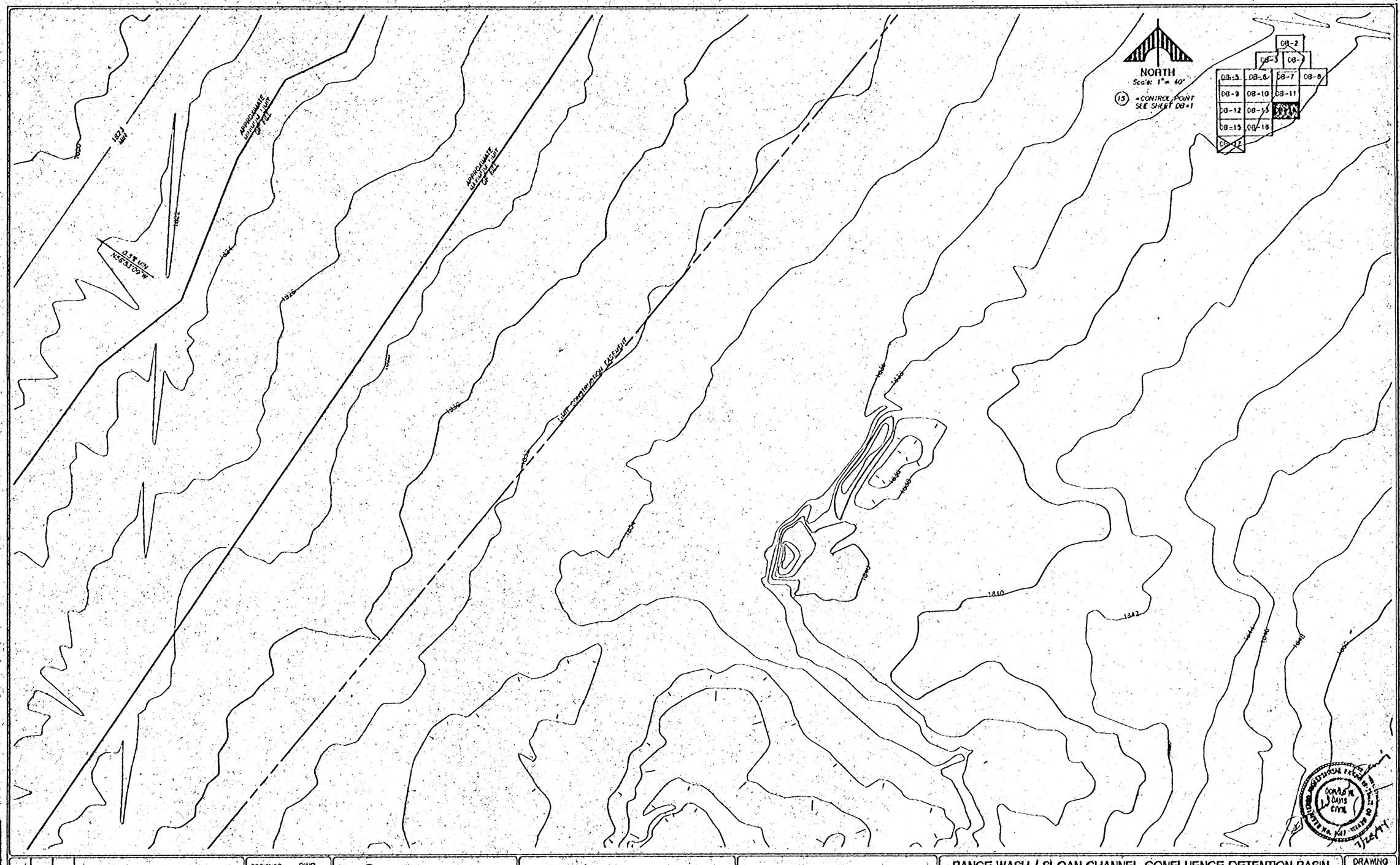
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-13
20 OF 45
DB-13

PLOT DATE: 8/24



DESIGNED:	DWD	PROJECT ENGINEER	7/16/94 DATE
DRAWN:	SLA	PROJECT MANAGER	7/20/94 DATE
CHECKED:	DWD		

MARK | DATE | BY | REVISION

Boyle Engineering Corporation
consulting engineers
2501 East Sahara Avenue
Las Vegas, Nevada 89158

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-14
21 OF 45
DB-14

XREFerence DRAWINGS
DB-DES2
DB-EG

PLOT DATE: 8/94

NORTH
Scale: 1" = 40'

(15) = CONTROL POINT
SEE SHEET DB-1

DB-2
DB-3 DB-4
DB-5 DB-6 DB-7 DB-8
DB-9 DB-10 DB-11
DB-12 DB-13 DB-14
DB-15 DB-16
DB-17

OUTLET STRUCTURE SEE 1/D-3

STA 1+37 STRUNG WELL SEE 1/D-6

NELLIS AIR FORCE BASE 230-007

SECTION LINE

STA 0+00 BY EMBANKMENT N 12380.003 E 14687.7647

C CURVE DATA Δ=51°03'25" R=60.00' L=53.47' T=28.27'

PT 2+11.20

BEGIN 6'CL FENCE & SECTION LINE

1/4 COR

MANG. STA 2+00.0 N 12375.2727 E 14611.9707

(OVERHEAD) 34' NEVADA POWER EASEMENT

POWER POLE SEE DETAIL

TWENTY

OUTLET CHANNEL SEE SHEET OG-1

1.19% N56°33'09"W

HASOTOPE WEST RANGE WASH SWALE

HASOTOPE EAST RANGE WASH SWALE

GRADE BREAK CONSTANT ELEV 1815.00

6'CL FENCE

DETENTION BASIN R/W

34' NEVADA POWER EASEMENT

STA 11+00 BEGIN 4' WIDE SWALE @ 0.50% GRADE

GRADING IN THIS AREA BY OTHERS

REFERENCE DRAWINGS
DB-DES
DB-EQ
OG-DES1

MARK	DATE	BY	REVISION
3	4-4-95		ADD OR CHANGE SECT. REF. AND STA.
2	4-4-95		CELETIE CONTOUR'S & BOUNDARY
1	4-4-95		ADD FENCE

DESIGNED: QWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

PLOT DATE: 8/94

Doyle Engineering Corporation
consulting engineers
[illegible] Las Vegas, Nevada 89104

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN
PLAN

DRAWING
DB-15
22 OF 45
DB-15

NORTH
Scale: 1" = 40'

15 = CONTROL POINT SEE SHEET DB-1

DB-1 DB-2 DB-3 DB-4 DB-5 DB-6 DB-7 DB-8 DB-9 DB-10 DB-11 DB-12 DB-13 DB-14 DB-15 DB-16 DB-17

1810 1811 1812 1813 1814 1815 1816 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828 1829 1830 1831 1832

1.13% N56°33'09"W

1820.00

STA 18+39 PERMANENT DOWN DRAIN

C 09

6' C.L. FENCE

0.5% MIN

LOT 5
260-290-004
PECCOLE DEL MAR

APPROXIMATE LIMIT OF MINIMUM FILL

APPROXIMATE LIMIT OF MINIMUM FILL

UNIT CONSTRUCTION EASEMENT

18' WIDE ACCESS RAMP

20' TOP OF EMBANKMENT WIDTH

15-22.91

PT = 18+41.25

1821.50

STA 18+08.01 ACCESS RAMP

12' WIDE GRADE BREAK TOP OF EMBANKMENT ELEV 1821.50

S86°56'48"E 14.00'

GRADE BREAK CONSTANT ELEV 1813.00

APPROXIMATE LIMIT OF FILL

6' C.L. FENCE

OVERHEAD

18+57 PP

18+22.84 PP

18+39.93 PP

14' POWER EASEMENT

DETENTION BASIN R/W

260-300-001
PSM PRT'S

GRADING IN THIS AREA BY OTHERS

& CURVE DATA

CURVE	Δ	R	L	T
R	73°23'55"	108.00'	138.34'	80.19'

XREFerence DRAWINGS
DB-DES
DB-EQ

MARK	DATE	BY	REVISION
4	4-95	WR	ADD FENCE

PLOT DATE: 6/24

DESIGNED QWD
DRAWN LBL
CHECKED GWS

PROJECT ENGINEER — DATE 7/6/94

PROJECT MANAGER — DATE 7/28/94

Boyle Engineering Corporation
consulting engineers
7398 Smoke Ranch Road
Las Vegas, Nevada 89128

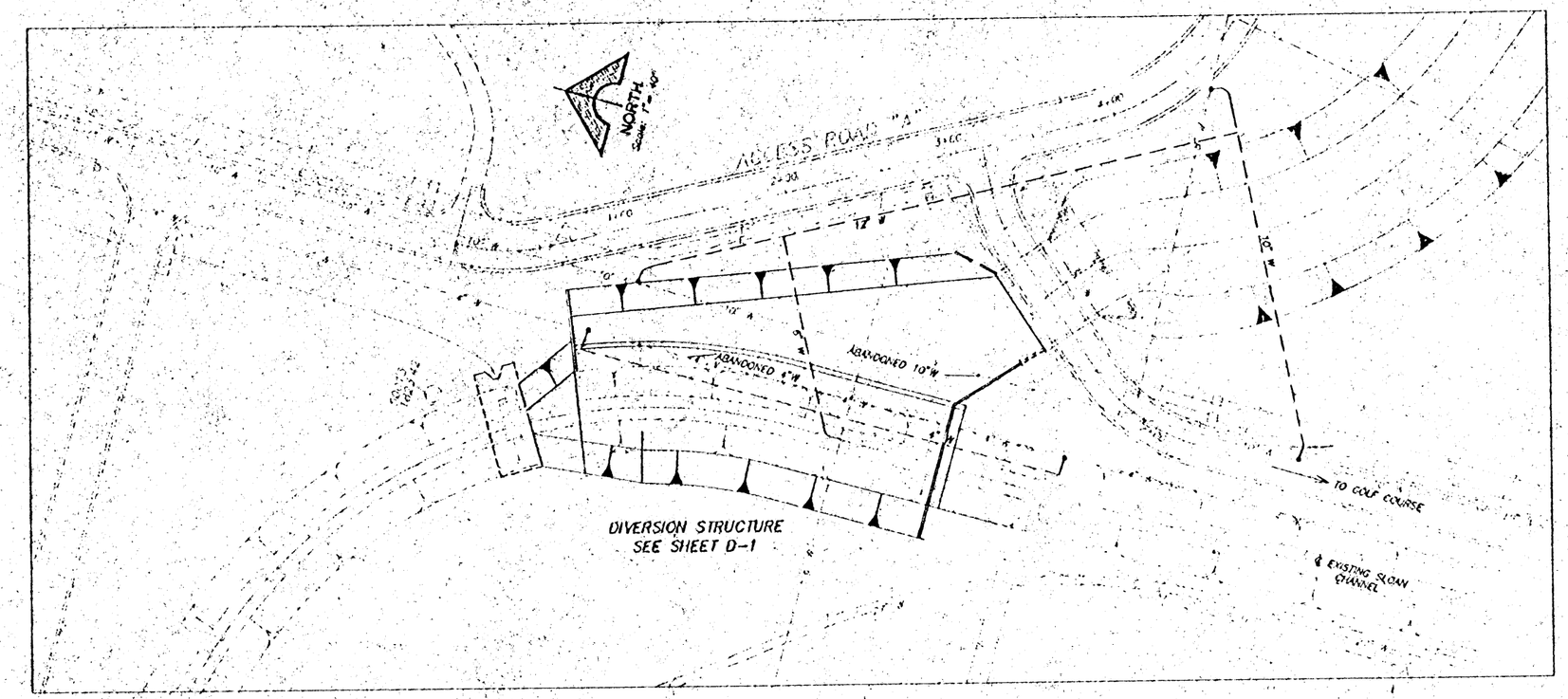
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN PLAN

DRAWING DB-16
23 OF 45
DB-16

DONALD R. DAVIS CIVIL — NEVADA No. 9081 — PROFESSIONAL ENGINEER — STATE OF NEVADA
7/28/94



XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	2-2-94	GS	SHIFT DIVERSION STRUCTURE NORTH

DESIGNED: DWD
DRAWN: LL
CHECKED: DWD

PROJECT ENGINEER — 7/28/94 DATE
PROJECT MANAGER — 7/28/94 DATE

Boyle Engineering Corporation
consulting engineers
9670 Gateway Drive, Suite 100
Reno, Nevada 89521

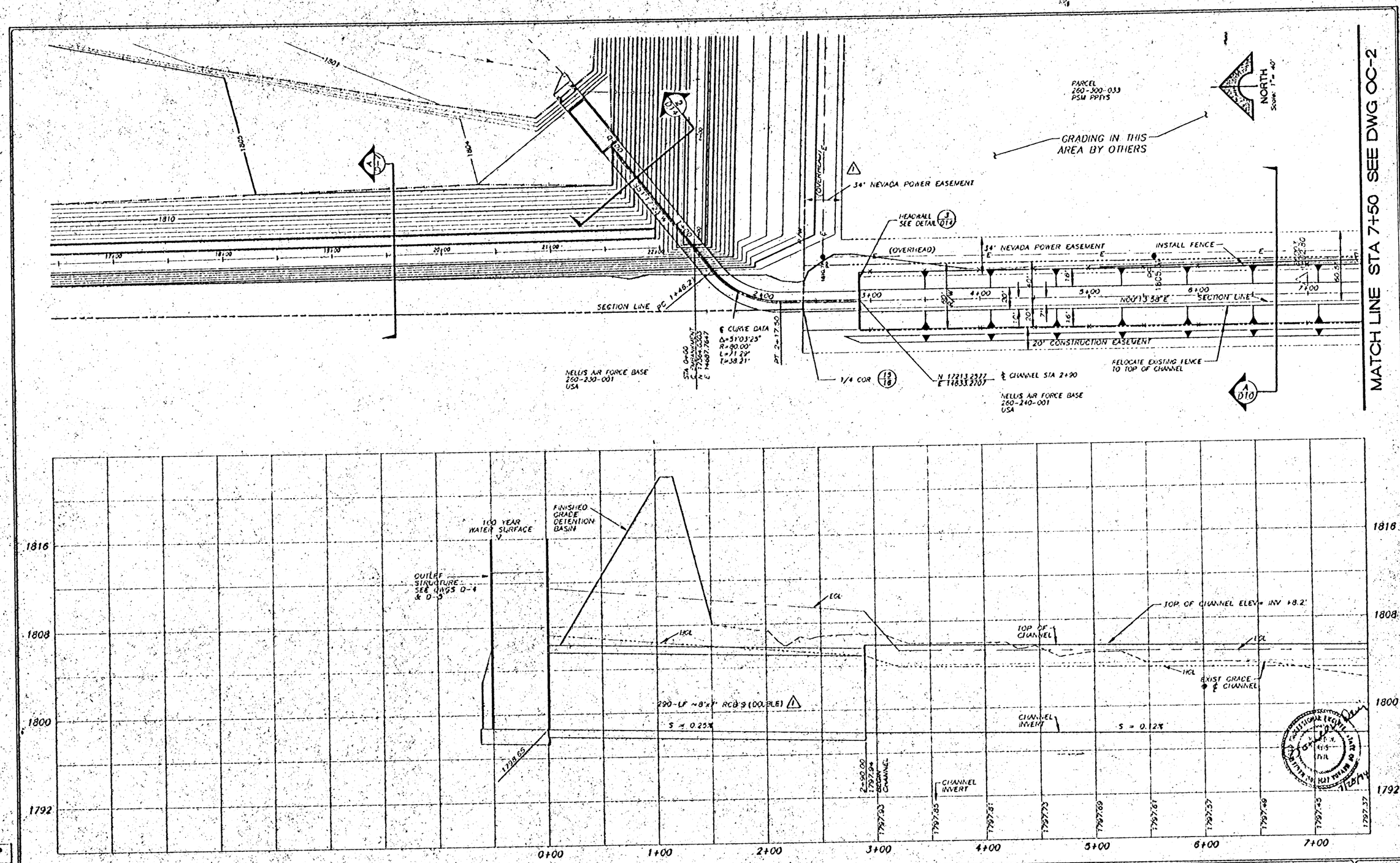
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

DIVERSION STRUCTURE PLAN

DRAWING DS-1
24 OF 45
DS-1

PLOT DATE: 7-28-94



REFERENCE DRAWINGS
OC-DES
OC-1090
CB-DES3

MARK	DATE	BY	REVISION
1	4-93	GW	CORRECT NOTE & COUNTOUR LINE

PLOT DATE: 8/94

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — DATE 7/18/94
PROJECT MANAGER — DATE 7/18/94

Doyle Engineering Corporation
consulting engineers
2608 Las Vegas Blvd. South
Las Vegas, Nevada 89109

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

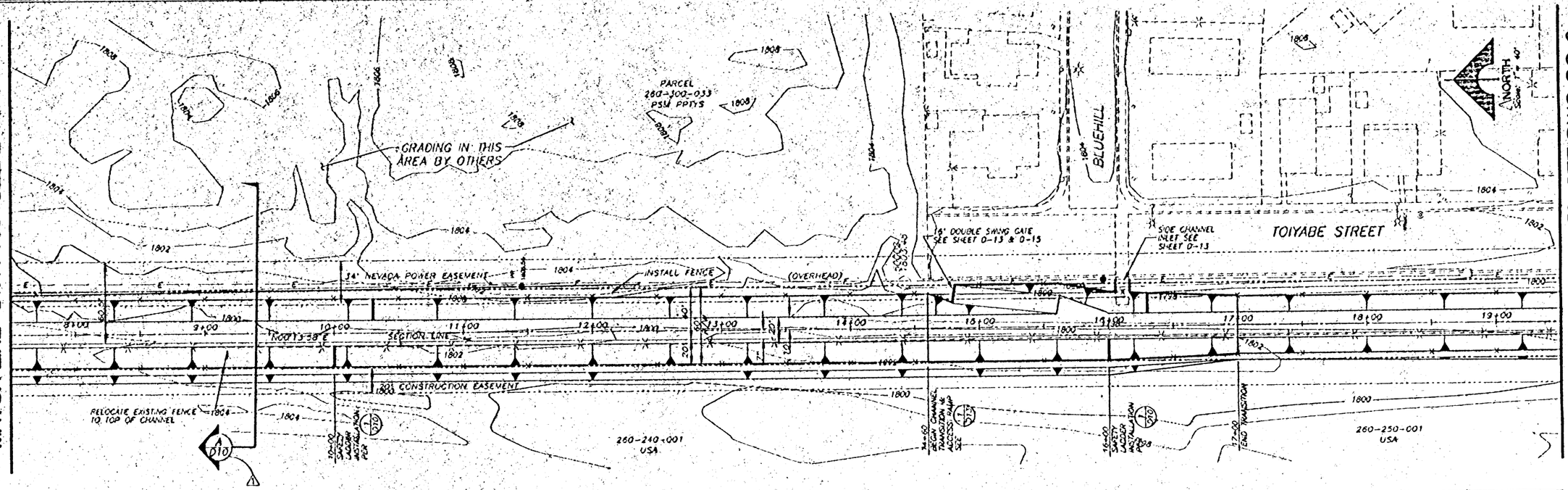
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

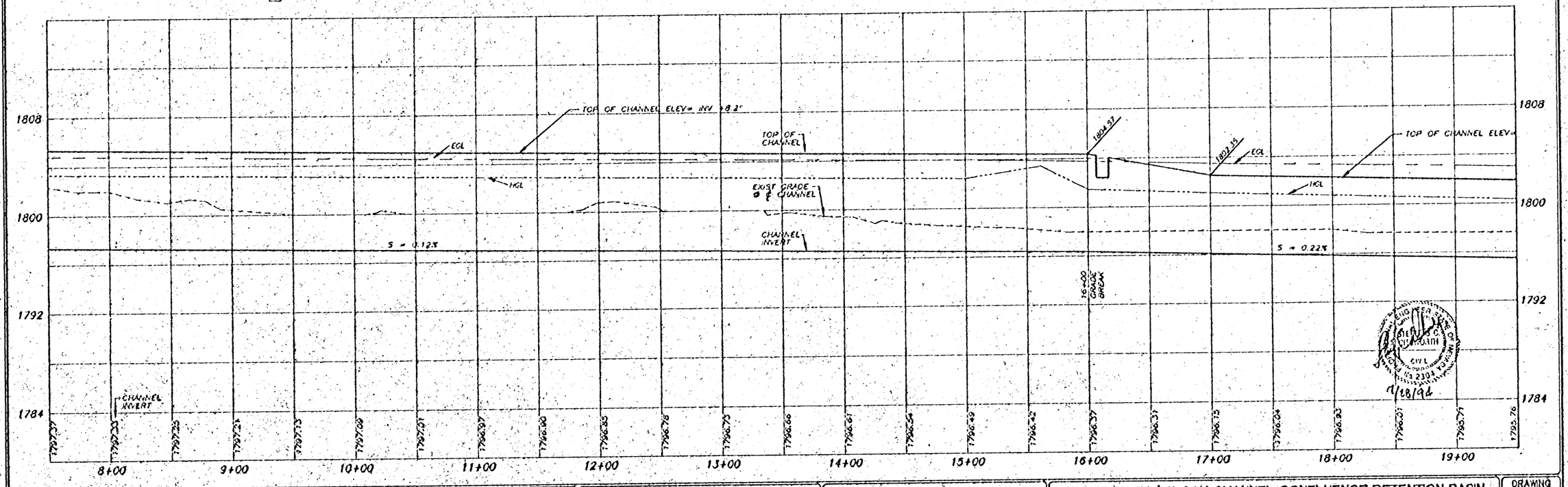
OUTLET CHANNEL
STA 2+90 TO STA 7+50

DRAWING OC-1
25 OF 45
OC-1

MATCH LINE STA 7+50 SEE DWG OC-1

MATCH LINE STA 19+50 SEE DWG OC-3





XREFERENCE DRAWINGS
OC-DES
OC-TOPO
OB-DES

MARK	DATE	BY	REVISION
	11/94	GM	DRAWING REFERENCE SECTION CUT -A/D10-

DESIGNED: DWD
DRAWN: LBL
CHECKED: CWS

PROJECT ENGINEER _____ DATE 11/28/94
PROJECT MANAGER _____ DATE 12/4/94

Boyle Engineering Corporation
consulting engineers
9950 West Cheyenne Avenue
Las Vegas, Nevada 89129

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

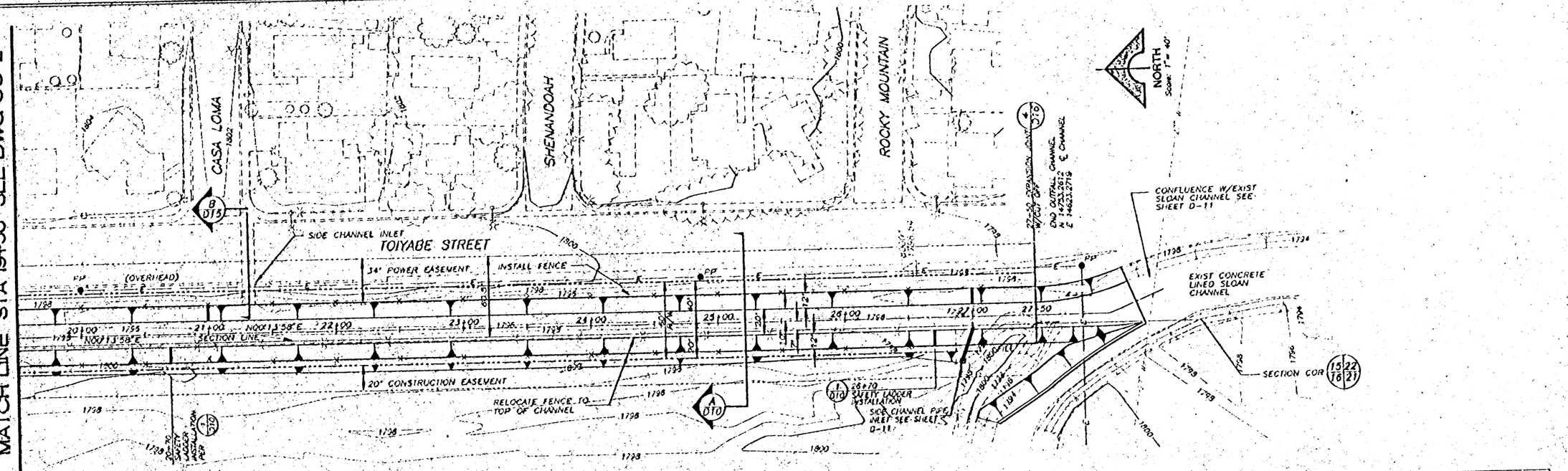
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

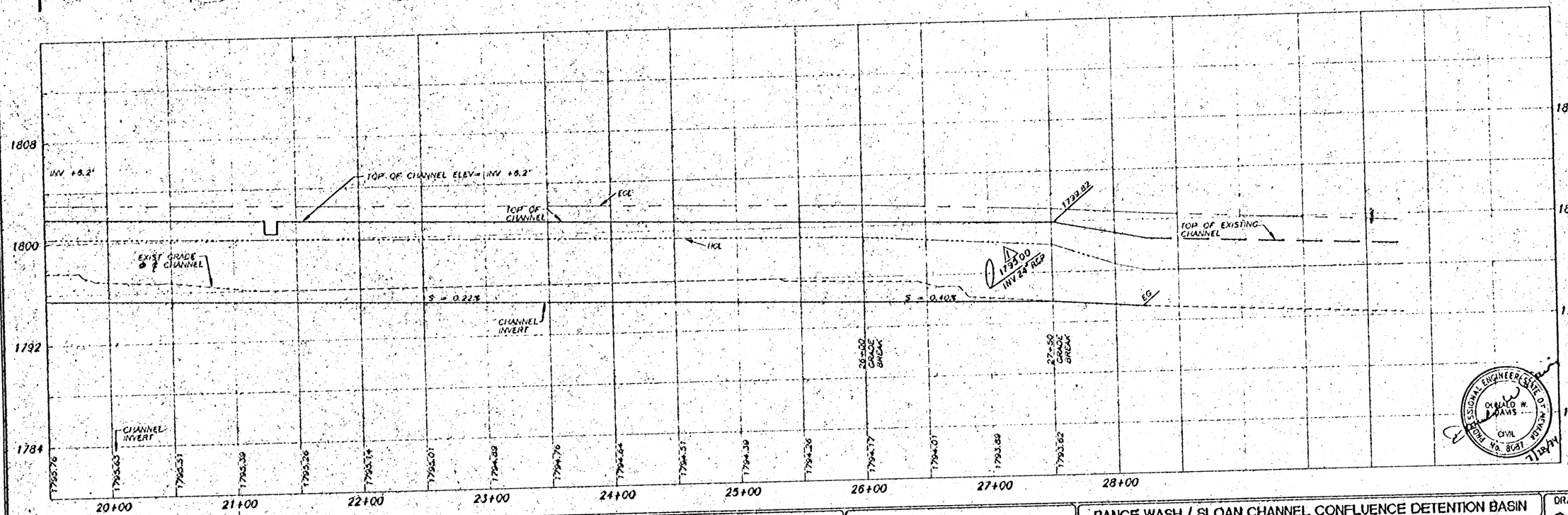
OUTLET CHANNEL
STA 7+50 TO STA 19+50

DRAWING
OC-2
26 OF 45
OC-2

PLOT DATE: 6/94

MATCH LINE STA 19+50 SEE DWG OC-2





REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
DONALD W. DAVIS
CIVIL
NO. 8087

XREFerence DRAWINGS
OC-DES
OC-TOPO

MARK	DATE	BY	REVISION
1	4-99	GK	ADD INV ELEV.

PLOT DATE: 6/96

DESIGNED: DWD
DRAWN: LBL
CHECKED: GWS

PROJECT ENGINEER — 7/28/94 DATE
PROJECT MANAGER — 7/28/94 DATE

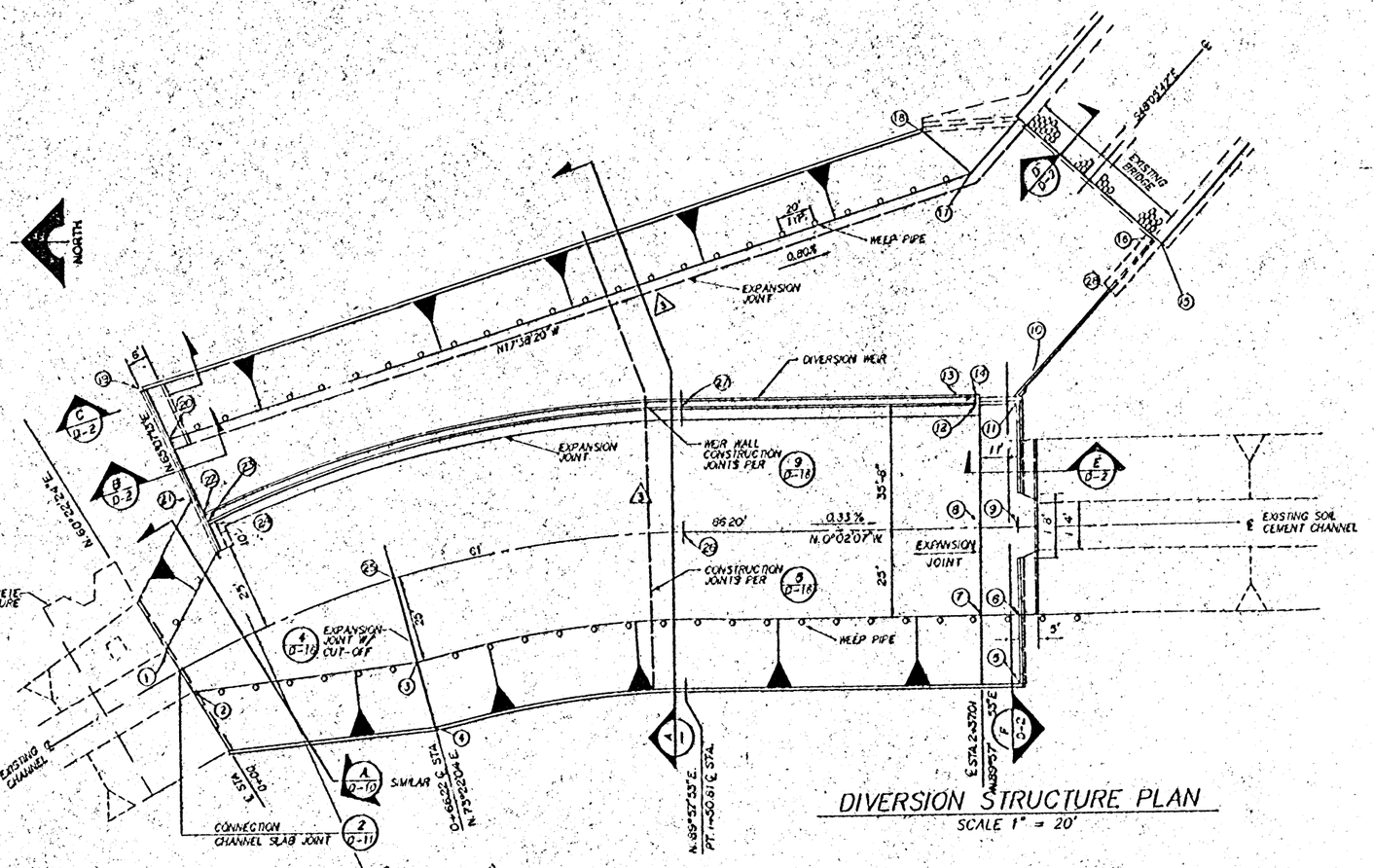
Boyle Engineering Corporation
consulting engineers
Suite 300 1501 Los Vegas, Nevada 89102

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

OUTLET CHANNEL
STA 19+50 TO STA 28+50

DRAWING OC-3
27 OF 45
OC-3



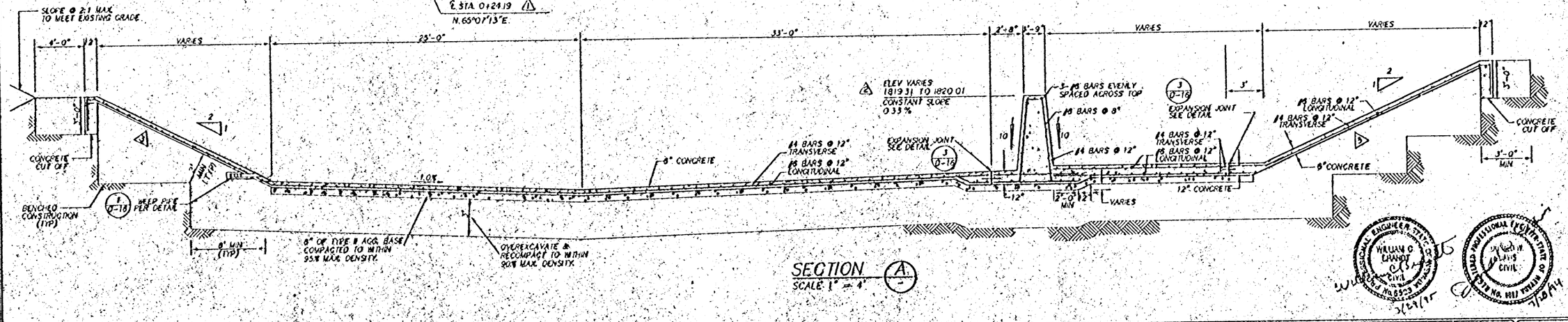
DIVERSION STRUCTURE PLAN
SCALE 1" = 20'

POINT	NORTHING	EASTING	ELEV*	DESCRIPTION
1	20313.3708	11887.2770	13.77	
2	20309.3671	11854.9816	13.62	
3	20243.9423	11863.1231	13.81	
4	20238.2999	11844.2348	23.97	
5	20070.4676	11854.3538	22.39	
6	20070.4799	11874.3538	13.14	
7	20081.4853	11874.3463	13.16	
8	20081.5007	11899.3468	12.91	
9	20070.4953	11899.3536	12.83	
10	20068.5169	11953.3704	22.39	TOP OF WALL
11	20070.5168	11934.3549	13.24	FLOOR
12	20068.5227	11934.3272	13.26	FLOOR
13	20083.5236	11935.8111	19.31	TOP WEIR
14	20082.5245	11937.3287	13.00	FLOOR
15	20028.9983	11980.3434	20.60	TOP OF WALL
16	20028.8583	11982.0131	12.3	FLOOR
17	20081.9536	12001.1926	12.3	
18	20033.8179	12013.6102	20.6	
19	20320.6003	11933.7801	22.0	
20	20513.8350	11925.1721	14.49	
21	20308.9538	11909.8903	23.62	TOP OF WALL
22	20305.4182	11907.0132	14.11	FLOOR
23	20304.6228	11905.5659	20.01	TOP WEIR
24	20304.1956	11904.3884	13.96	FLOOR
25	20231.0960	11887.0708	13.47	
26	20187.6998	11899.2938	13.19	PT
27	20187.7217	11934.9605	19.55	PT TOP WEIR
28	20039.5423	11906.3481	12.56	FLOOR

* DATUM 1800.00

CURVE DATA

CURVE	RADIUS	DELTA	LENGTH	TANGENT	CHORD
C1	292.00'	29°33'23"	150.31'	77.13'	148.74'



SECTION A
SCALE 1" = 4'

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	2-93	L.L.	DELETE TYPE H & DASH LINE
2	2-9-94	L.L.	REVISION OF POINT AND CURVE DATA
3	3-9-94	L.L.	SHIFT DIVERSION STRUCTURE NORTH

PLOT DATE: 6/94

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Boyle Engineering Corporation
consulting engineers
9320 Prototype Court, Suite 100
Reno, Nevada 89511

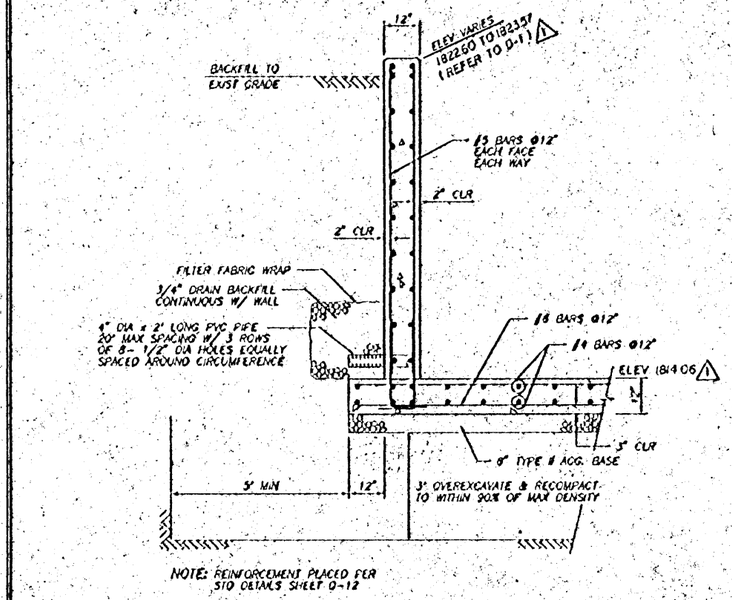
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DIVERSION STRUCTURE DETAILS

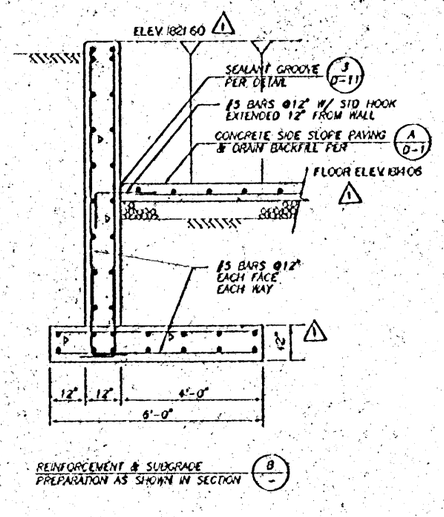
DRAWING D-1
28 OF 45
D-1

WILLIAM O. CLAWSON — NEVADA No. 6539 — CIVIL — 7/28/94
WILLIAM L. LEWIS — CIVIL — STATE OF NEVADA No. 9881 — 7/28/94



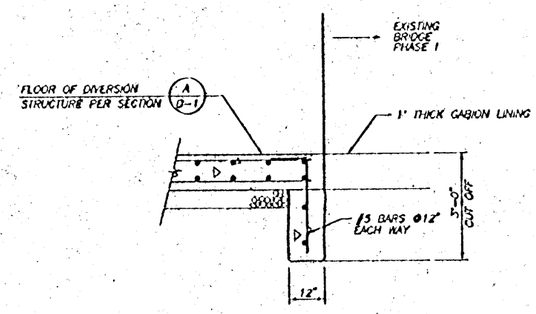
NOTE: REINFORCEMENT PLACED PER STD DETAILS SHEET D-12

SECTION (B / D-1)
SCALE: 1/2" = 1'-0"

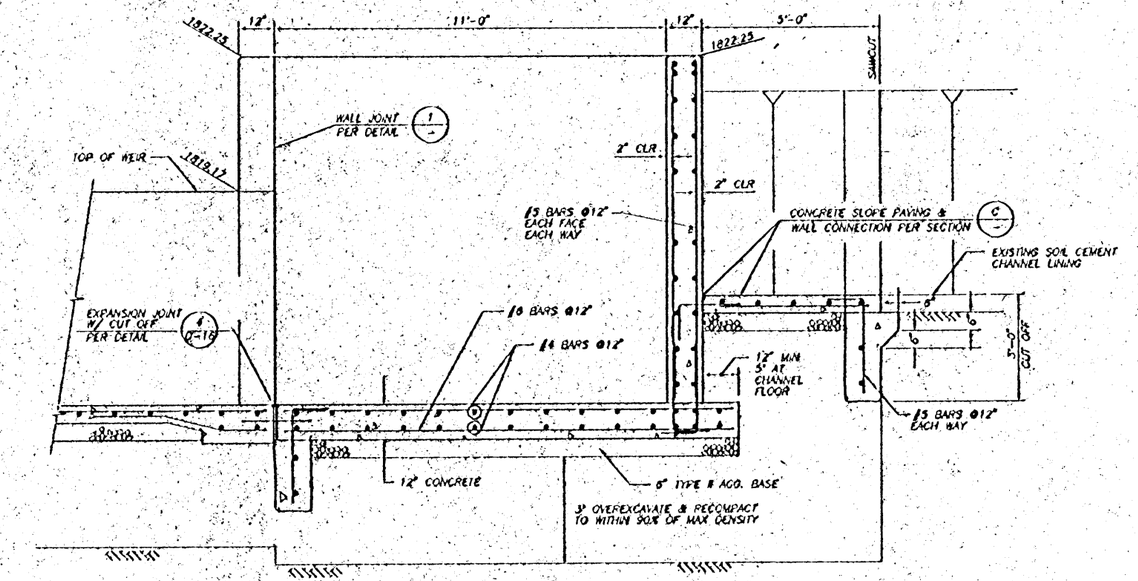


REINFORCEMENT & SUBGRADE PREPARATION AS SHOWN IN SECTION (B / -)

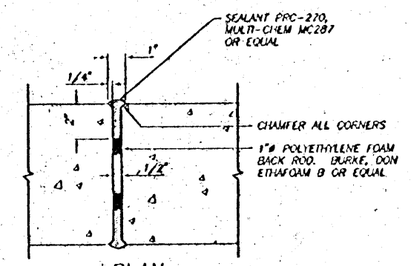
SECTION (C / D-1)
SCALE: 1/2" = 1'-0"



SECTION (D / D-1)
SCALE: 1/2" = 1'-0"

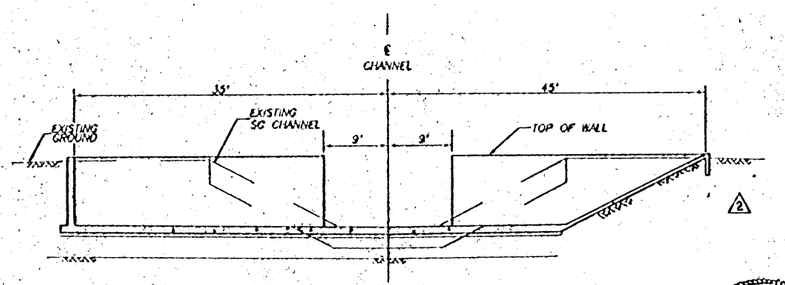


SECTION (E / D-1)
SCALE: 1/2" = 1'-0"



PLAN

WALL EXPANSION JOINT (1 / -)
SCALE: 3" = 1'-0"



ELEVATION (F / D-1)
SCALE: 1" = 10'

XREF drawings
- DRAWINGS

MARK	DATE	BY	REVISION
1	4-1-95	RWK	CORRECT INVERT SLAB
2	4-4-95	RWK	ADD ELEV. DIMENSION

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/19/94
PROJECT MANAGER — DATE 7/20/94

Doyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

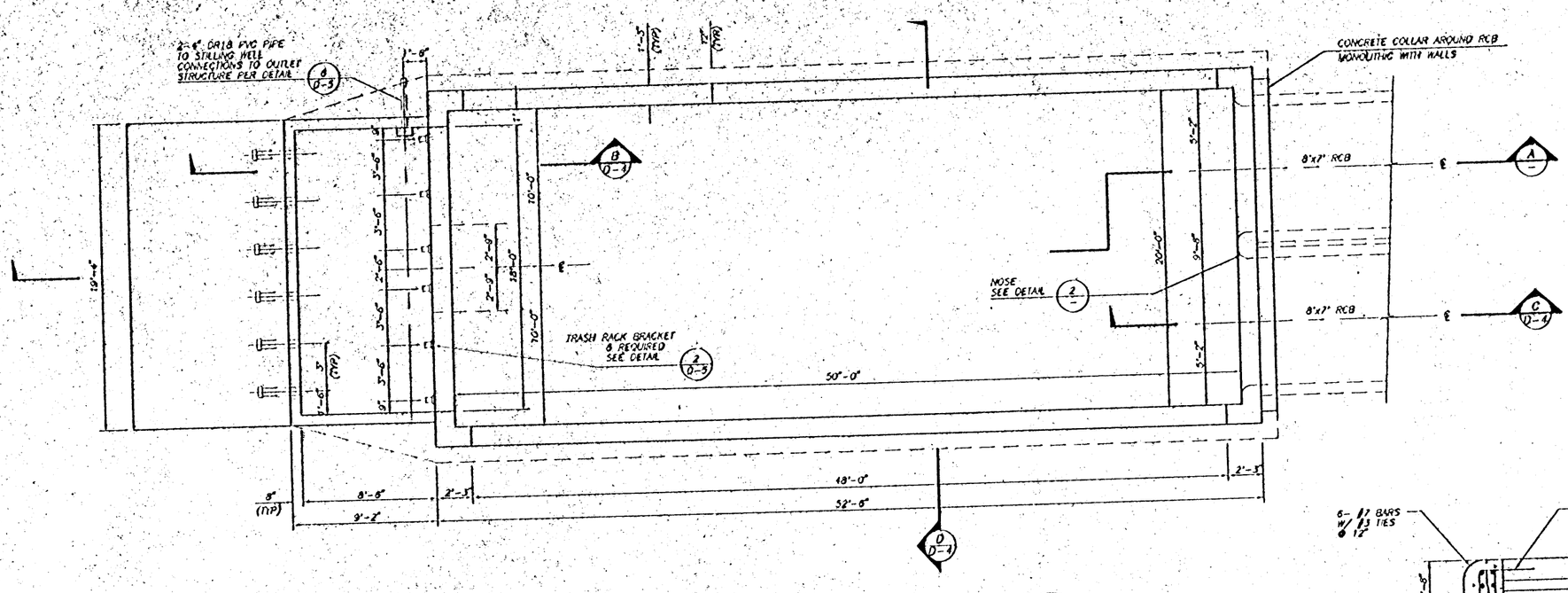
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DIVERSION STRUCTURE
SECTIONS + DETAILS

DRAWING D-2
29 OF 45
D-2

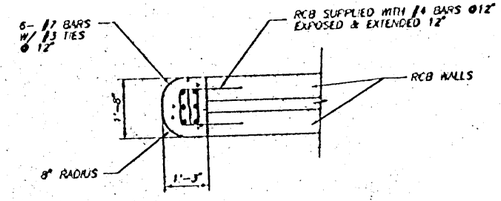
PLOT DATE: 6/24

WORKDRAWING-2 Mon Jun 20 13:34:45 1994



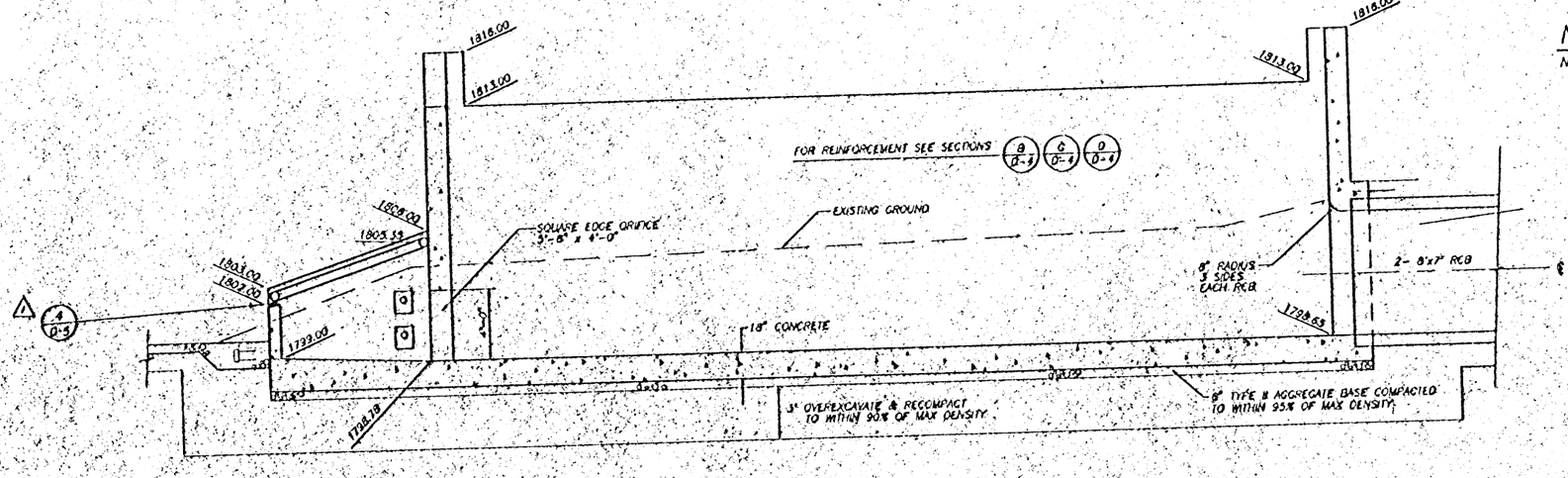
OUTLET STRUCTURE PLAN 1

SCALE: 1/4" = 1'-0"



NOSE 2

NO SCALE



SECTION A

SCALE: 1/4" = 1'-0"

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
4	4-98	MM	ADD DETAIL REFERENCE

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

PLOT DATE: 8/94

Doyle Engineering Corporation
consulting engineers
[illegible]

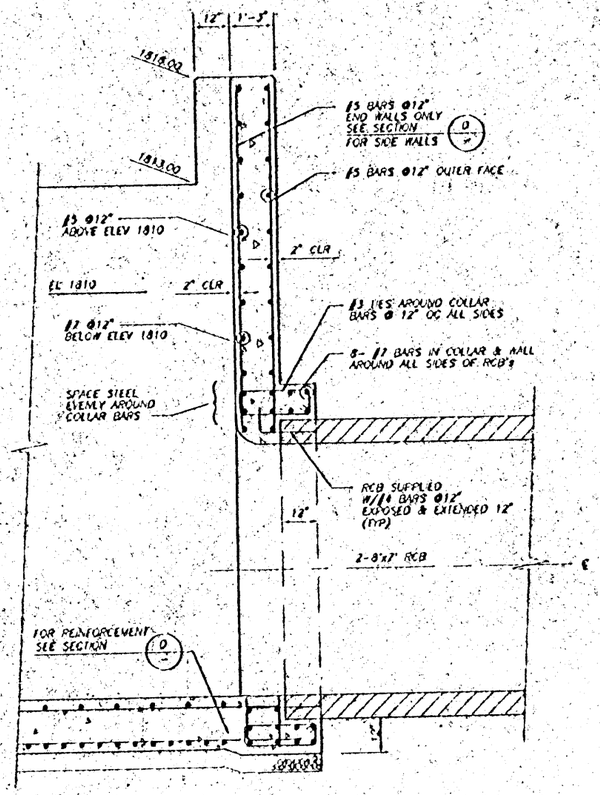
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

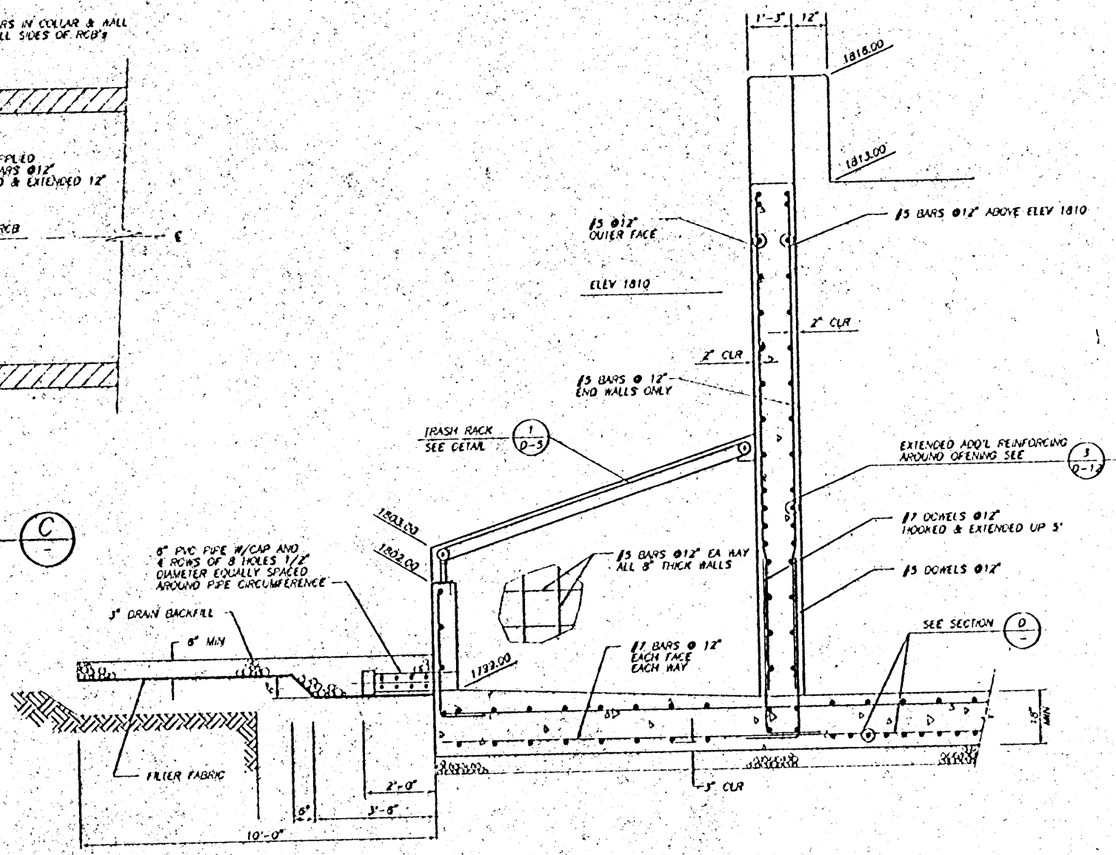
OUTLET STRUCTURE DETAILS

DRAWING D-3
30 OF 45
D-4

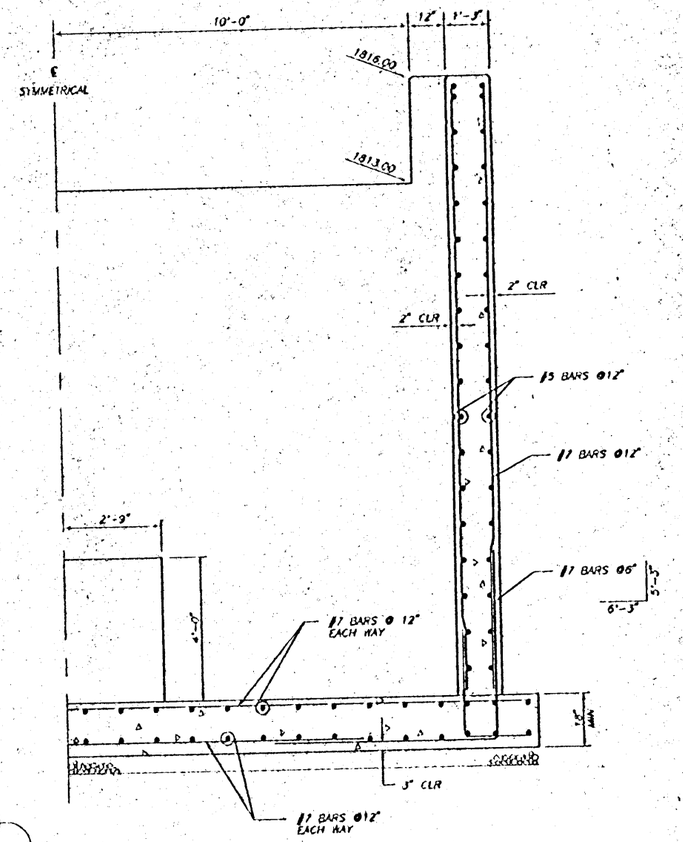
PROFESSIONAL ENGINEER — STATE OF NEVADA — No. 8089 — DAVID W. DOYLE — CIVIL — 7/28/94



SECTION C
OUTLET STRUCTURE SOUTH END WALL
SCALE: 1/2" = 1'-0"



SECTION B
OUTLET STRUCTURE NORTH END
SCALE: 1/2" = 1'-0"



SECTION D
SCALE: 1/2" = 1'-0"

NOTE:
SEE SHEET D-12 FOR GENERAL REINFORCING NOTES AND DETAILS

XREF drawings

MARK	DATE	BY	DESCRIPTION
1	6/94	SCO	SECTION SHEET CHANGE 3/2012

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 12/28/94
PROJECT MANAGER — DATE 12/28/94

Doyle Engineering Corporation
consulting engineers
[illegible]

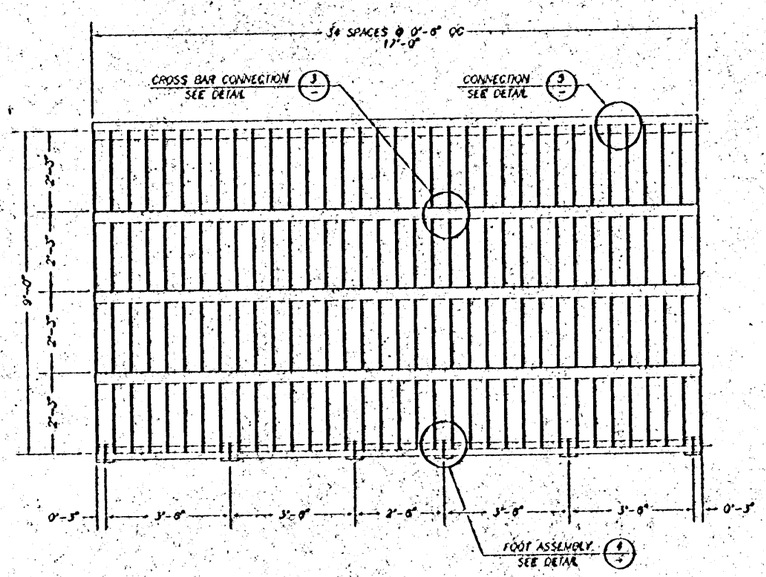
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

OUTLET STRUCTURE SECTIONS

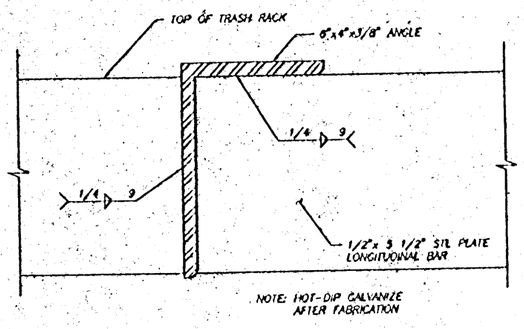
DRAWING D-4
31 OF 45
D-9

PLOT DATE: 6/94



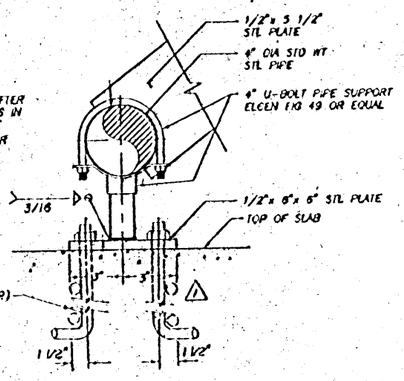
INTAKE STRUCTURE TRASH RACK 1/0-3

SCALE: 1/2" = 1'-0"

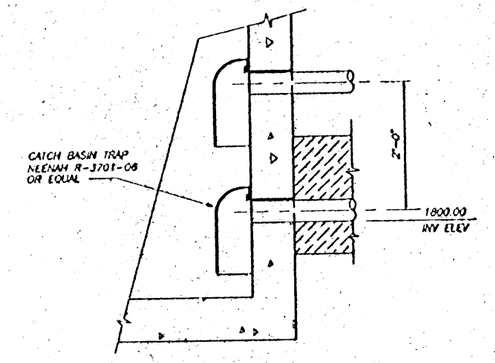


CROSS BAR CONNECTION DETAIL 3/-

SCALE: 6" = 1'-0"

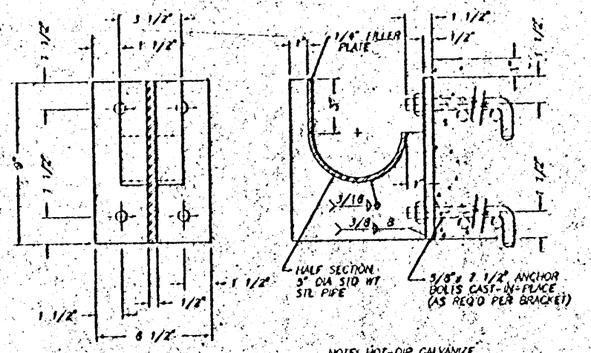


NOTES:
1. TIGHTEN U-BOLT NUTS AFTER TRASH RACK ASSEMBLY IS IN PLACE WITHIN STRUCTURE
2. HOT-DIP GALVANIZE AFTER FABRICATION



4" PVC CONNECTION 6/-

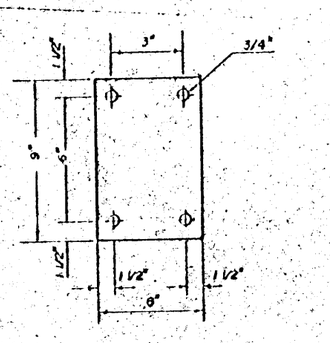
NO SCALE



NOTE: HOT-DIP GALVANIZE AFTER FABRICATION

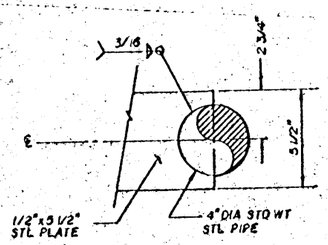
BRACKET 2/-

SCALE: 1" = 3"



FOOT ASSEMBLY 4/-

NO SCALE



NOTE: HOT-DIP GALVANIZE AFTER FABRICATION

CONNECTION 5/-

SCALE: 3"=1'-0"

WILLIAM G. BRANDT No. 8923 PROFESSIONAL ENGINEER STATE OF NEVADA CIVIL 5/12/15

DAVID W. DAVIS No. 9867 PROFESSIONAL ENGINEER STATE OF NEVADA CIVIL 7/20/14

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	4-6-95	JK	ADD ANCHOR BOLTS

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/18/14
PROJECT MANAGER — DATE 7/20/14

Doyle Engineering Corporation
consulting engineers

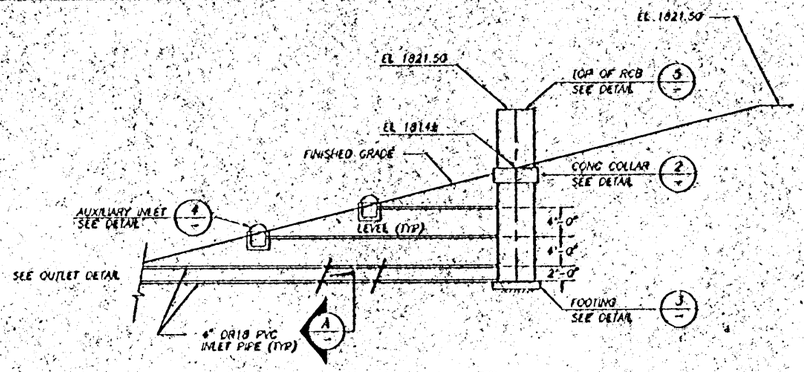
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

OUTLET STRUCTURE DETAILS

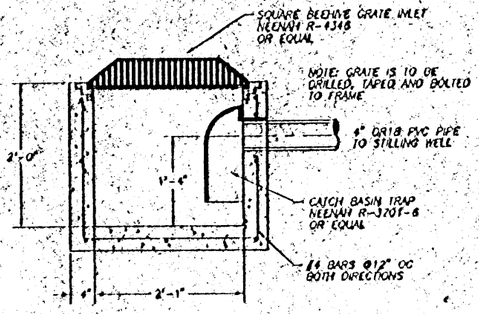
DRAWING D-5
32 OF 45
D-6

PLOT DATE: 6/24



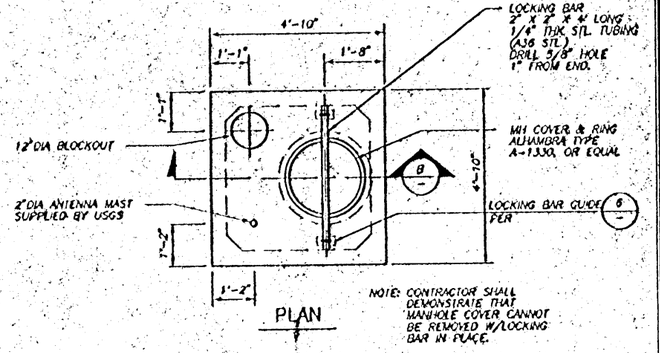
STILLING WELL 1

1" = 10' - 0"



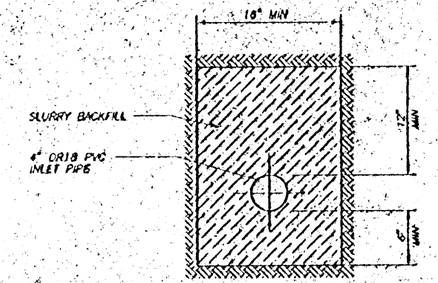
AUXILIARY INLET 4

1/2" = 1' - 0"



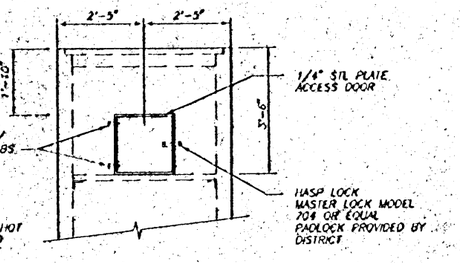
STILLING WELL 5

1/2" = 1' - 0"



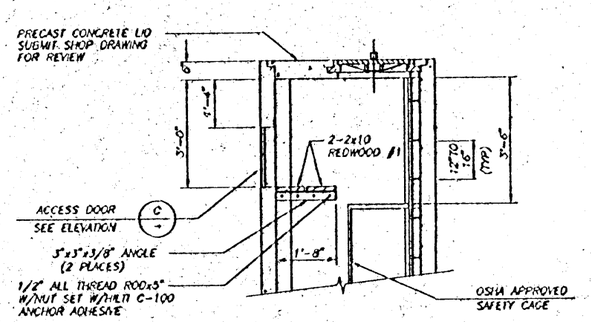
SECTION A

NTS



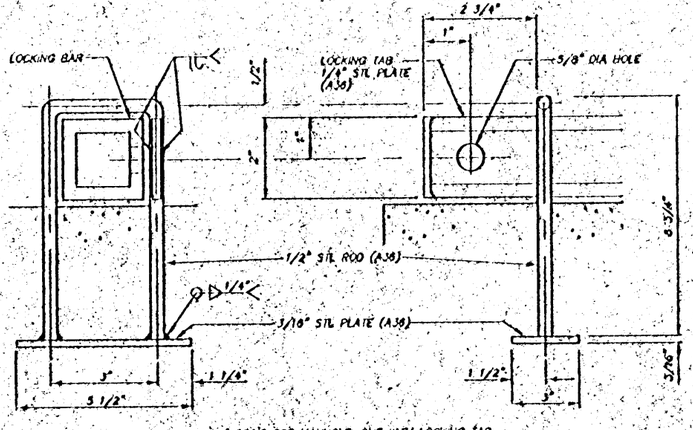
ELEVATION C

1/2" = 1' - 0"



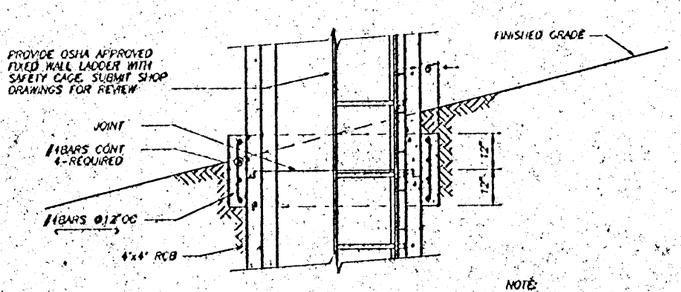
SECTION B

1/2" = 1' - 0"



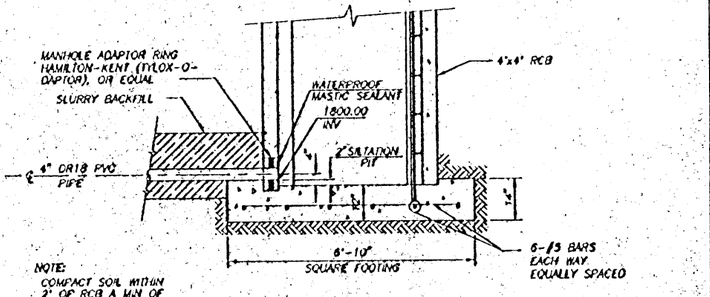
LOCKING BAR GUIDE 6

NOT TO SCALE



CONCRETE COLLAR 2

1/2" = 1' - 0"



FOOTING 3

1/2" = 1' - 0"

MARK	DATE	BY	REVISION
1	4-4-95	WR	ADD STATION

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

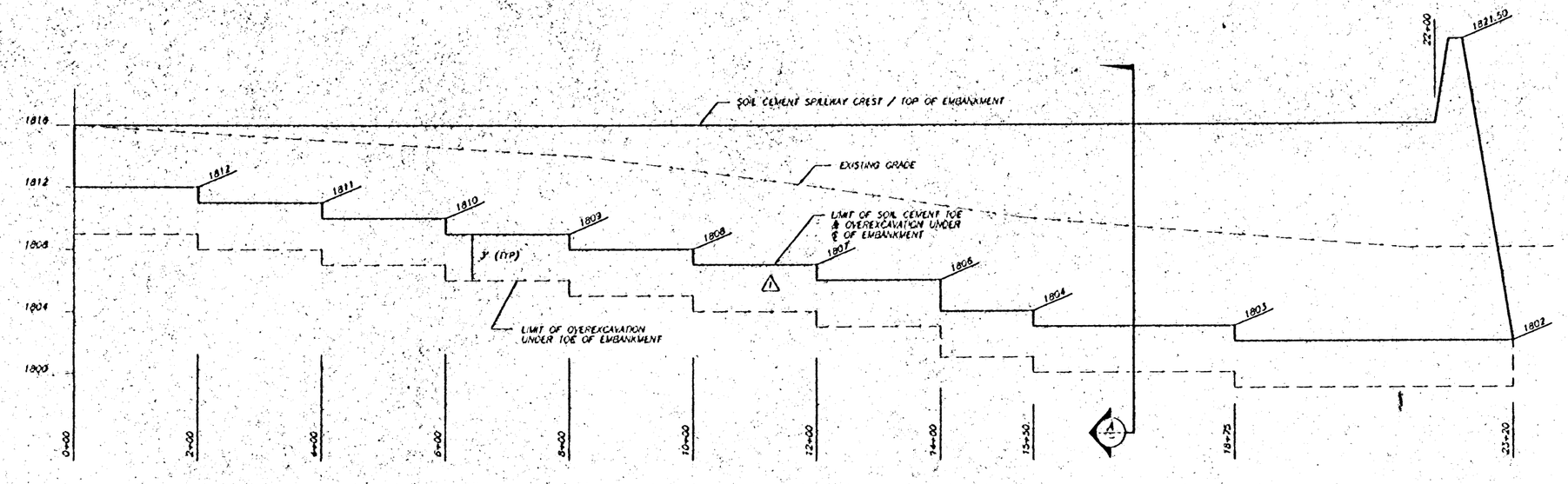
Doyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

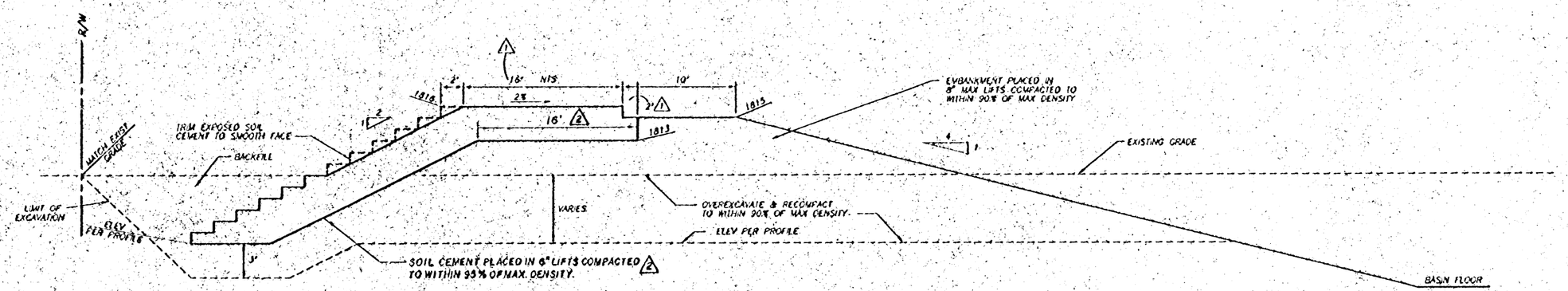
STILLING WELL DETAILS

DRAWING D-6
33 OF 45
0-7



WEST EMBANKMENT / SPILLWAY PROFILE (1/—)

SCALE: HORIZ. 1" = 100'
VERT. 1" = 4'



WEST EMBANKMENT / SPILLWAY SECTION (A/—)

SCALE: 1" = 5'

XREFerence DRAWINGS
W-PROFIL
W-SEC-A

MARK	DATE	BY	REVISION
2	4-4-95	SLD	CHANGE SOIL CEMENT PLACEMENT
1	11/14/94	SLD	SOIL CEMENT DIMENSIONS ADDED TO SEC.A

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 12/28/94
PROJECT MANAGER — DATE 12/28/94

Boyle Engineering Corporation
consulting engineers
9950 West Sahara Avenue, Las Vegas, Nevada 89134

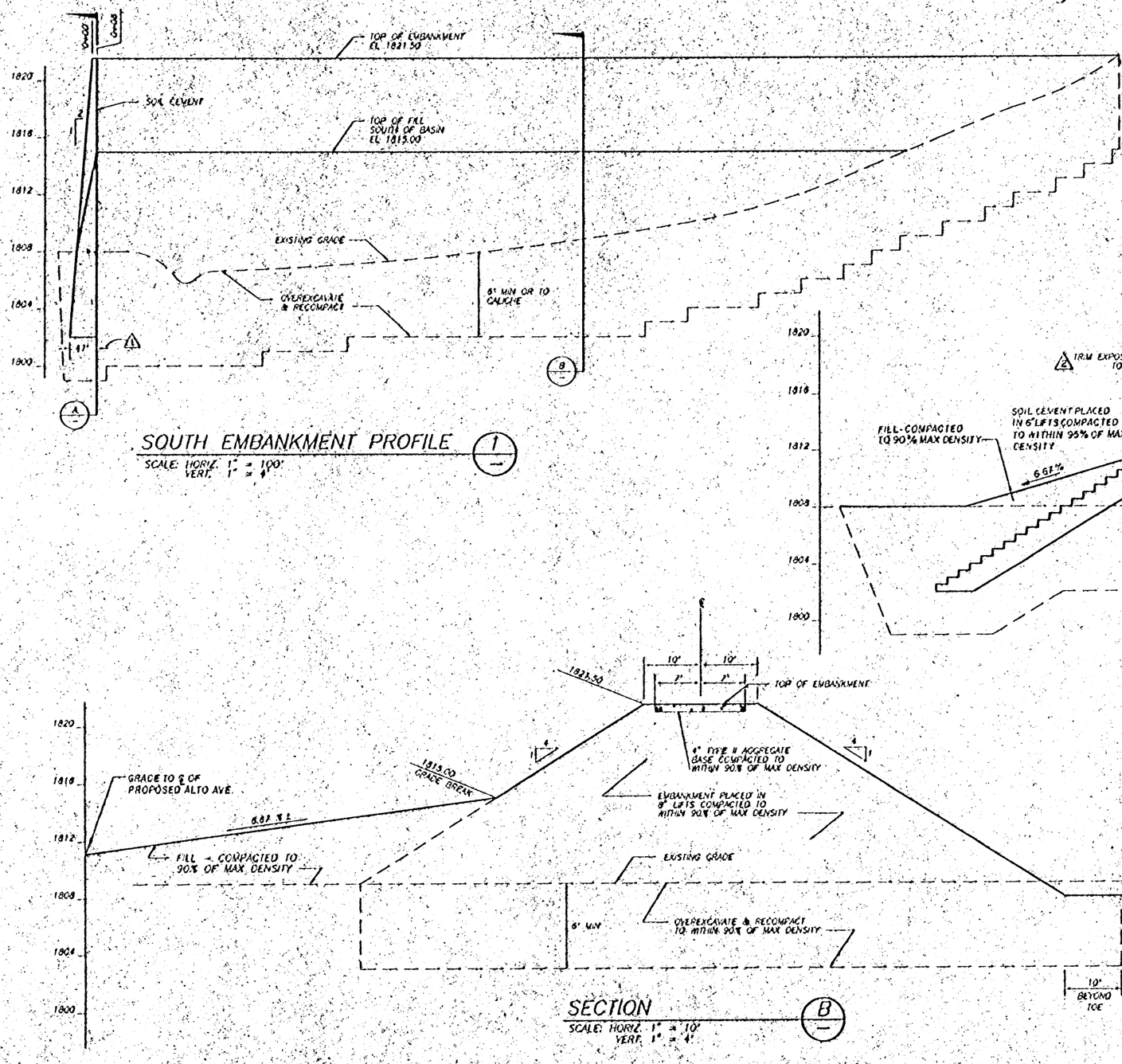
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

WEST EMBANKMENT
PROFILE + SECTION

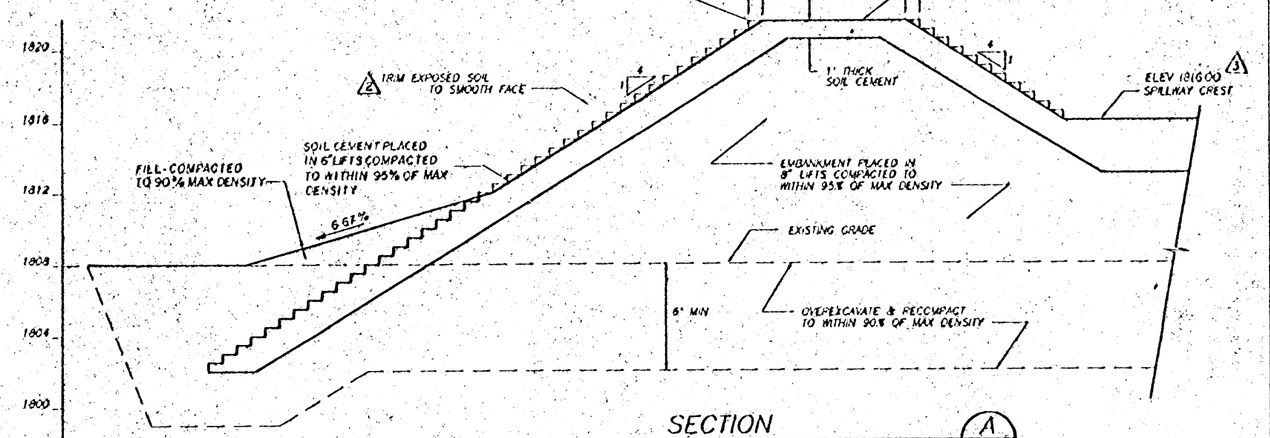
DRAWING D-7
34 OF 45
0-8

PLOT DATE: 6/94



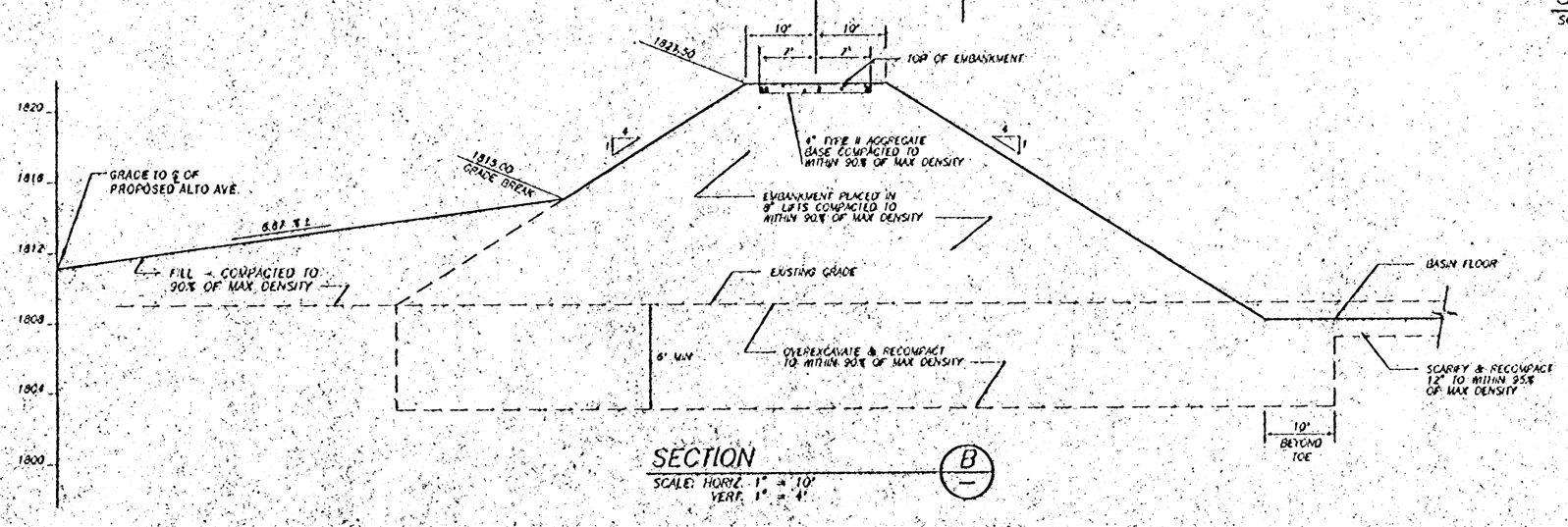
SOUTH EMBANKMENT PROFILE (1)

SCALE: HORIZ. 1" = 100'
VERT. 1" = 4'



SECTION (A)

SCALE: HORIZ. 1" = 10'
VERT. 1" = 4'



SECTION (B)

SCALE: HORIZ. 1" = 10'
VERT. 1" = 4'

WILLIAM C. BRUNO — NEVADA — CIVIL — 6523 — 5/24/95
FRANCIS O. ROYAL — NEVADA — CIVIL — 9230 — 12/28/94

XREFerence DRAWINGS
S-PROFIL
S-SEC-A
S-SEC-B

MARK	DATE	BY	REVISION
1	4-4-95	WJL	ADD ELEV.
2	4-4-95	WJL	CHANGE SOIL CEMENT PLACEMENT
3	5/24/95	SCO	DIMENSION SOIL CEMENT BASE WIDTH
			FOR SOUTH EMBANKMENT PROFILE

DESIGNED: QWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 5/24/95
PROJECT MANAGER — DATE 12/28/94

Doyle Engineering Corporation
consulting engineers
[illegible]

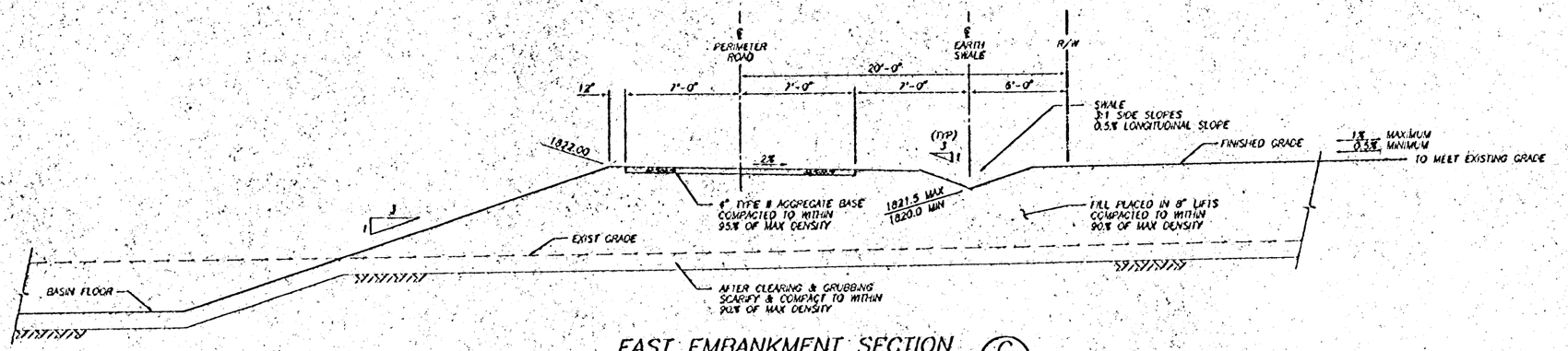
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

SOUTH EMBANKMENT
PROFILE + SECTIONS

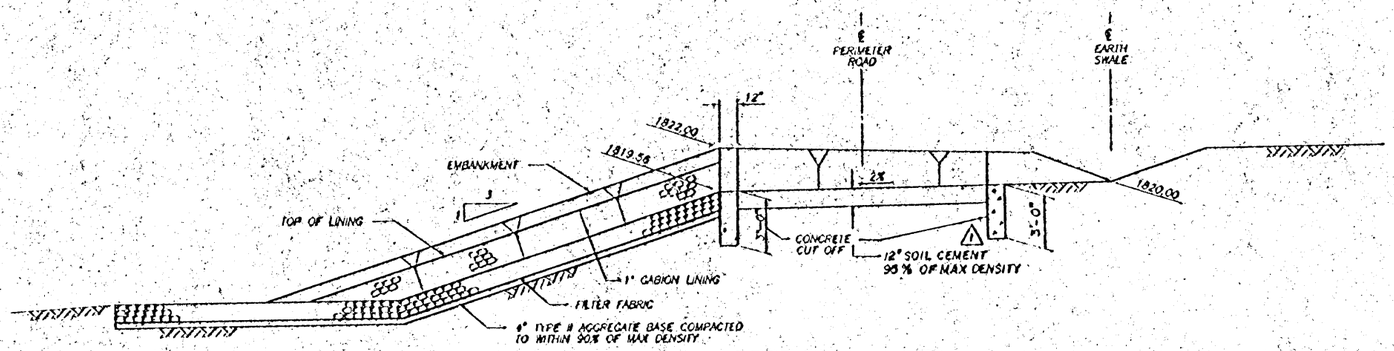
DRAWING: D-8
35 OF 45
D-9

PLOT DATE: 6/96



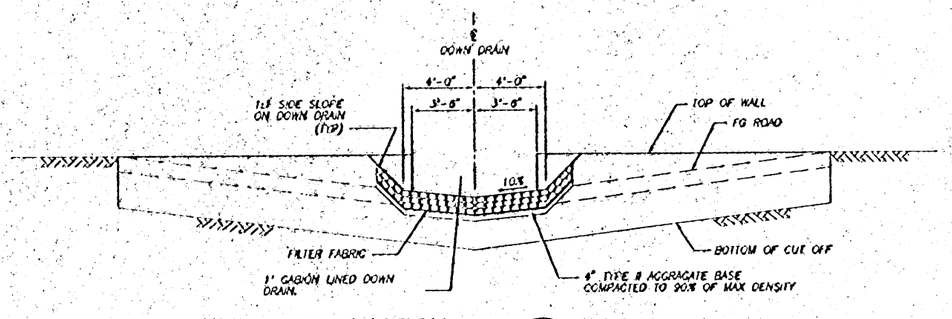
EAST EMBANKMENT SECTION (C TYP)

TYPICAL SECTION
SCALE: 1/4" = 1'-0"



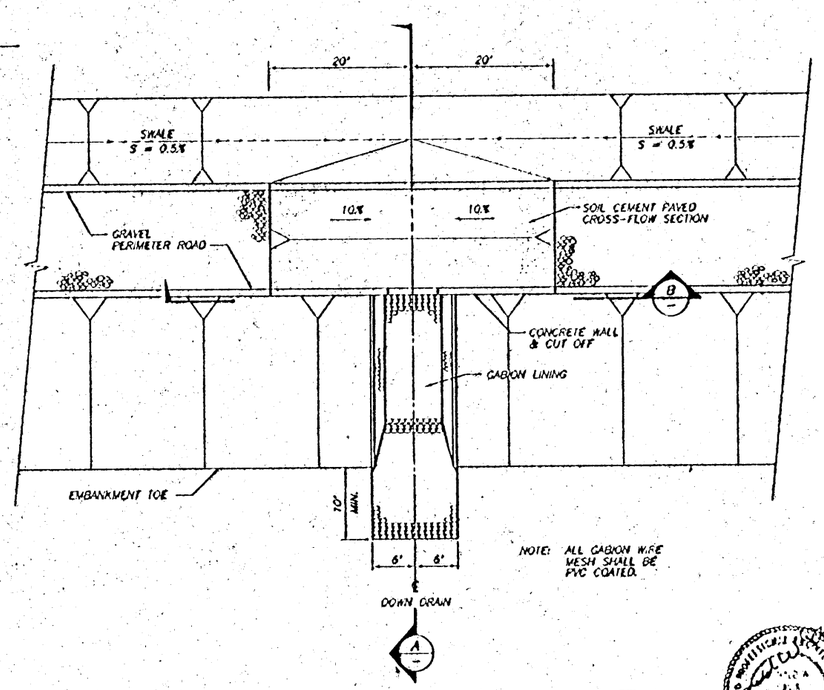
SECTION A

SCALE: 1/4" = 1'-0"



SECTION B

SCALE: 1/4" = 1'-0"



EMBANKMENT DOWN DRAIN (2)

SCALE: 1" = 10'-0"

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	4-4-95	RWM	ADD CONC. CUT-OFF

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

Boyle Engineering Corporation
consulting engineers
Las Vegas, Nevada 89108

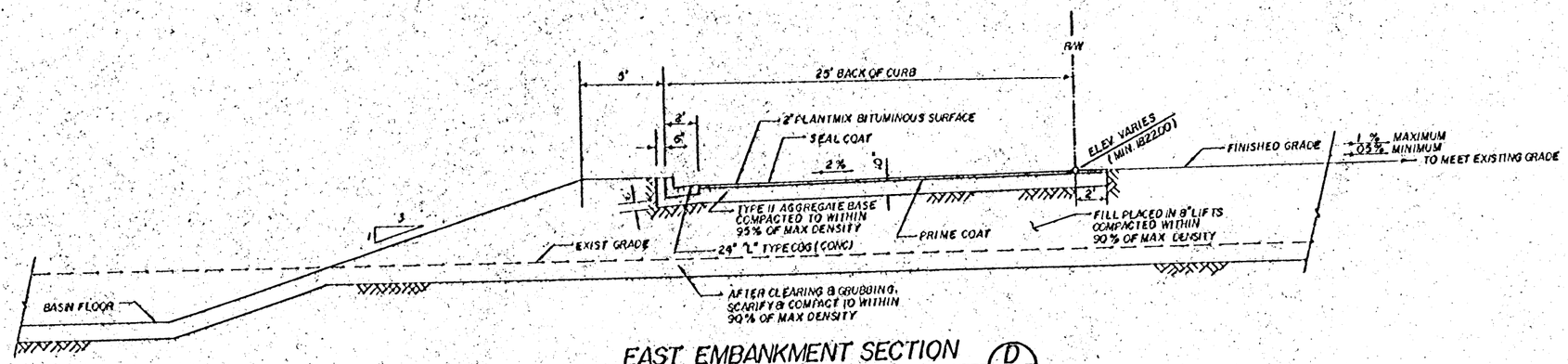
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN DETAILS

DRAWING D-9
36 OF 45
D-10

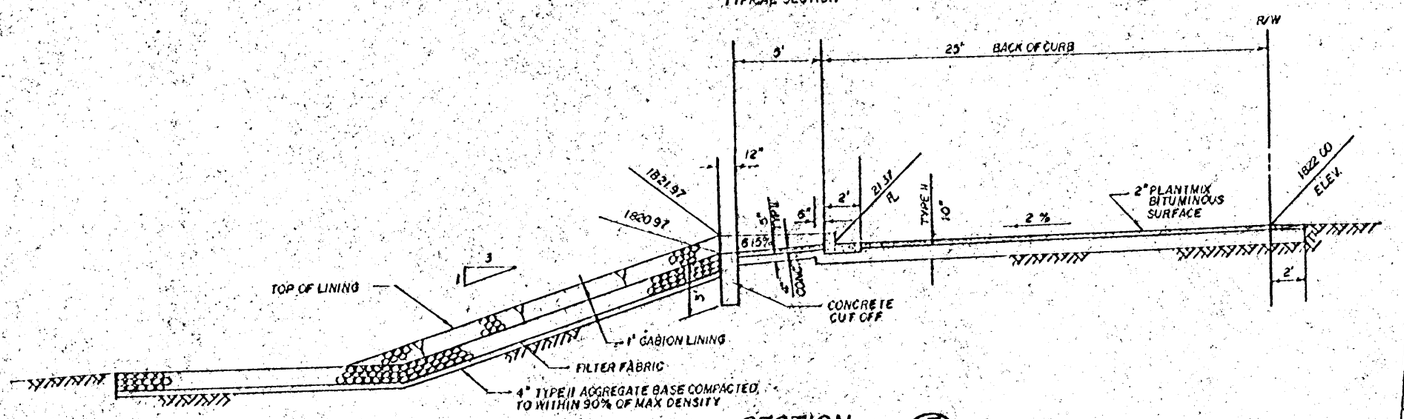
PLOT DATE: 8/94



EAST EMBANKMENT SECTION (D/TYP)

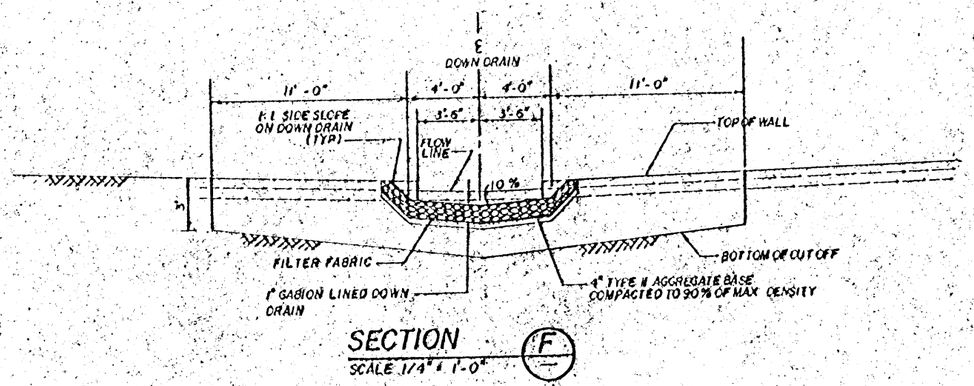
TYPICAL SECTION

SCALE: 1/4" = 1'-0"



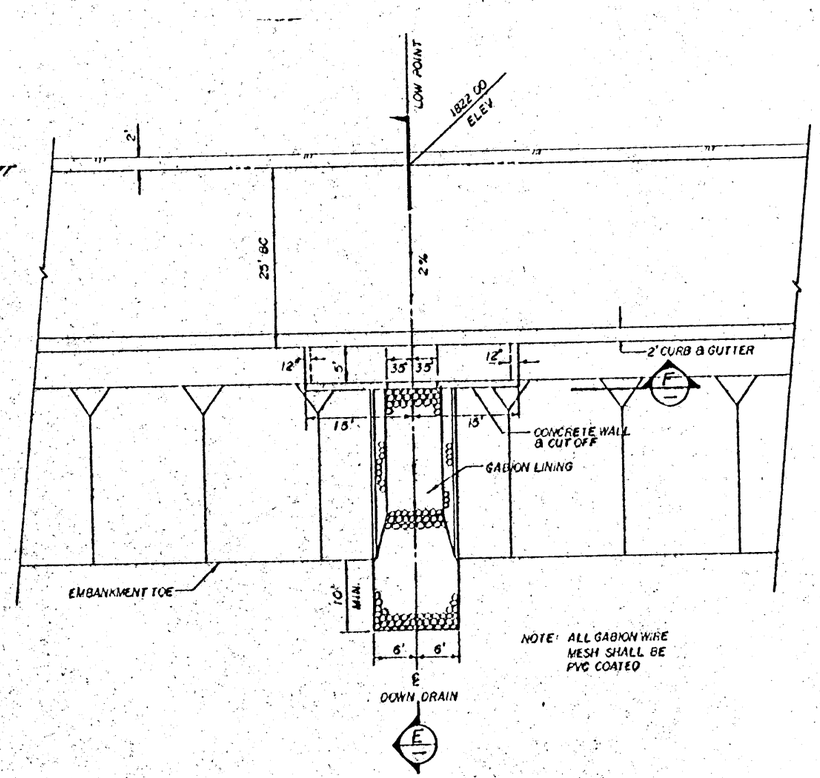
SECTION (E/—)

SCALE: 1/4" = 1'-0"



SECTION (F/—)

SCALE: 1/4" = 1'-0"



EMBANKMENT DOWN DRAIN "A" (3/—)

SCALE: 1" = 10'-0"

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

REV. NO	DATE	DESCRIPTION	APPROVED

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

DETENTION BASIN DETAILS

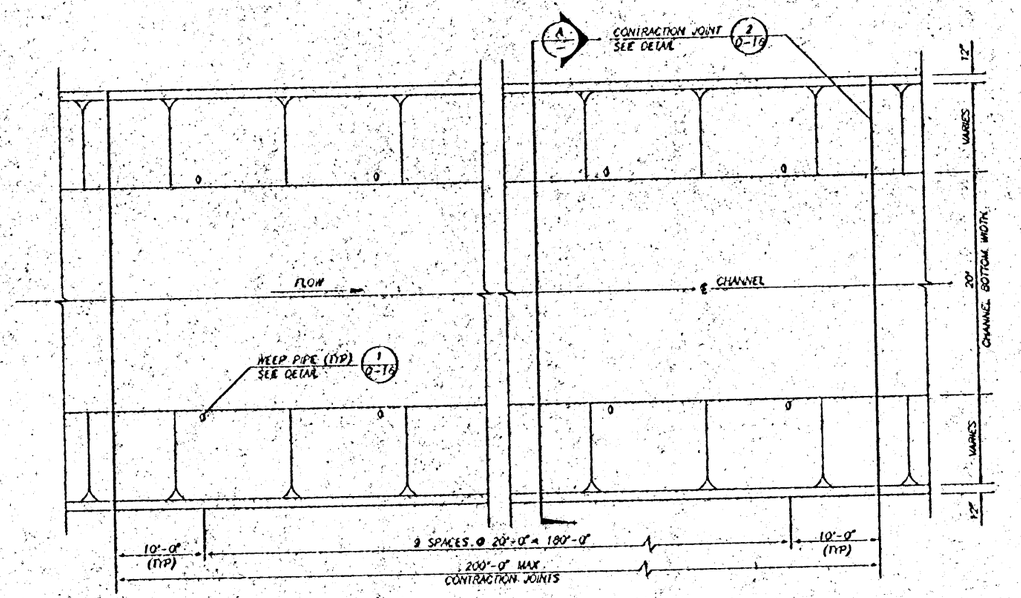
CLARK COUNTY, NEVADA, DEPARTMENT OF PUBLIC WORKS

PROJECT No:	F910619
DESIGNED BY:	MENDENHALL/BRANDT
DRAWN BY:	H. O'SULLIVAN
CHECKED BY:	
DATE:	

SCALE	
HORIZ:	AS SHOWN
VERT:	N/A
FIELD BOOK	NONE

DRAWING NO. D-9A

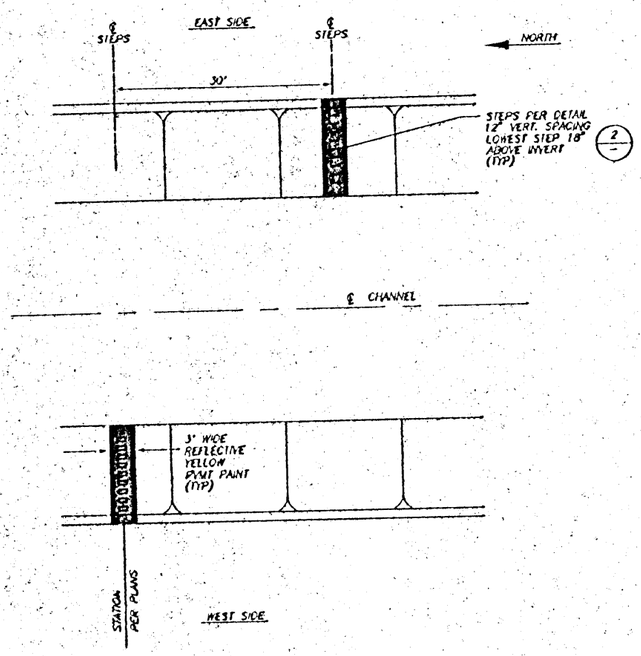
SHT. 37 OF 43



NOTES:
1. EXPANSION JOINTS WHERE INDICATED ON THE PLANS.
2. CONSTRUCTION JOINTS AT INTERRUPTIONS IN CONCRETE PLACEMENT OTHER THAN CONTRACTION OR EXPANSION JOINTS.

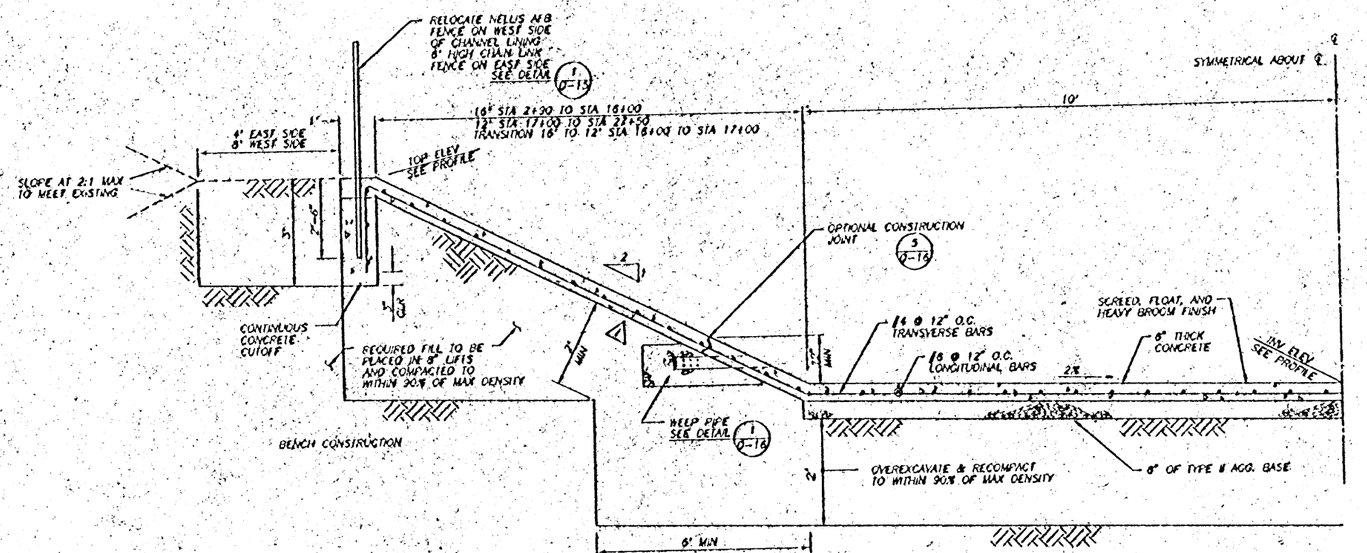
OUTFALL CHANNEL PLAN (A)

SCALE: 1/8" = 1'-0"



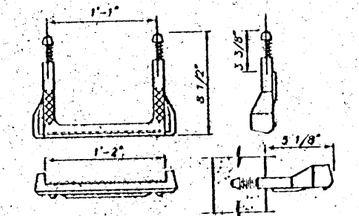
SAFETY LADDER INSTALLATION (1)

NOT TO SCALE



SECTION (A)

SCALE: 1/2" = 1'-0"



NOTES:
1. STEP SHALL CONFORM TO ASTM C-478.
2. ALUMINUM STEPS SHALL BE SOLID, MADE FROM MATERIAL IN CONFORMANCE WITH ASTM B221 (ALLOY 6005-T5)
3. REINFORCED PLASTIC STEPS SHALL BE POLYPROPELENE PLASTIC NO. 3 DEFORMED STEEL ROD (GRADE 60/ASTM A-615)
4. POLYPROPOLENE PLASTIC TO INCLUDE UV PROTECTION.

STEPS (2)

NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER — DONALD W. DAVIS — CIVIL — No. 6081 — 7/28/94

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
4	6-95	PJK	DELETE TYPE II

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — 7/28/94 DATE
PROJECT MANAGER — 7/28/94 DATE

Doyle Engineering Corporation
consulting engineers
Suite 300, 7160 East Sahara Avenue, Las Vegas, Nevada 89117

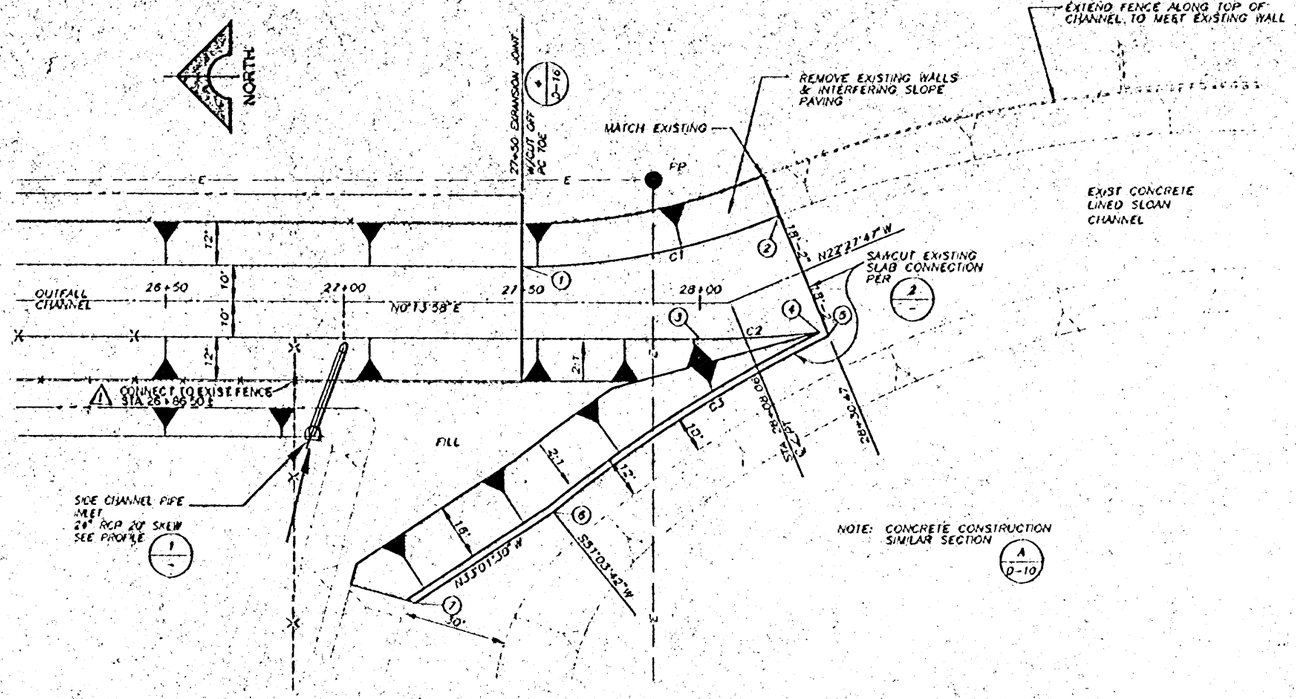
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

OUTFALL CHANNEL PLAN + SECTION

DRAWING D-10
38 OF 45
D-11

PLOT DATE: 8/94

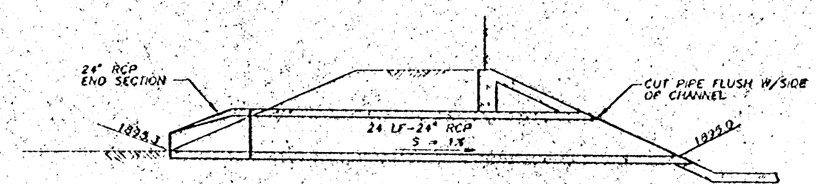


SLOAN CHANNEL CONFLUENCE STRUCTURE

SCALE 1"=20'

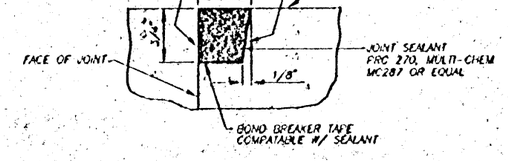
COORDINATES			
POINT	NORTHING	EASTING	DESCRIPTION
1	14753.2150	14645.2719	BC EAST TOE OUTFALL CHANNEL
2	14681.0530	14647.4590	EC EAST TOE OUTFALL CHANNEL AND SAWCUT @ EAST TOE SLOAN CHANNEL
3	14703.2962	14613.0689	BC WEST TOE SLOAN CHANNEL @ STA 28+00
4	14669.7324	14614.8443	NOSE @ TOE
5	14687.1712	14613.8842	SAWCUT & PT TOE SLOAN CHANNEL
6	14744.4908	14564.3892	SAWCUT @ EXISTING TOE SLOAN CHANNEL
7	14783.1977	14539.2284	SAWCUT @ EXISTING TOE SLOAN CHANNEL & PT & BC SLOAN CHANNEL

CURVE DATA				
CURVE	Δ	R	L	T
C1	22°41'10"	187.00	74.04	37.51
C2	06°25'21"	300.00	33.63	16.83
C3	12°37'37"	417.41	91.99	46.18



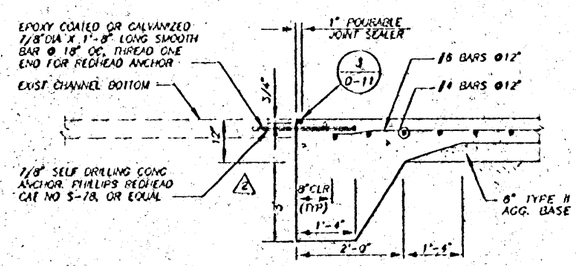
PIPE INLET PROFILE (1/-)

NOT TO SCALE



SEALANT GROOVE (3/-)

SCALE: 1" = 1"



CHANNEL SLAB JOINT (2/-)

NOT TO SCALE

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	4-95	MK	ADD CUT-OFF WALL
2	4-96	MK	ADD FENCE NOTE

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/24/94
PROJECT MANAGER — DATE 7/28/94

Doyle Engineering Corporation, consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

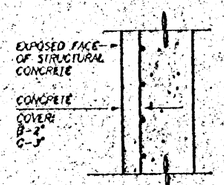
RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

SLOAN CHANNEL CONFLUENCE STRUCTURE

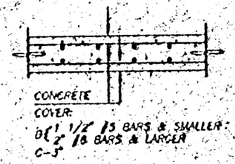
DRAWING D-11
39 OF 45
D-12

PLOT DATE: 8/96

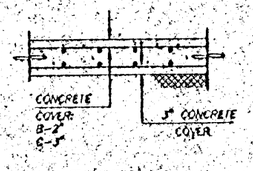
PROFESSIONAL ENGINEER — STATE OF NEVADA — DONALD W. DAVIS — CIVIL — No. 8087 — 7/28/94



WALLS



SLABS



FOOTINGS

A. NO EXPOSURE TO GROUND, WEATHER OR WATER AFTER FORM REMOVAL
B. EXPOSURE TO GROUND, WEATHER OR WATER AFTER FORM REMOVAL
C. CONCRETE PLACED AGAINST SOIL

CONCRETE COVER OVER REINFORCING STEEL (1/—)

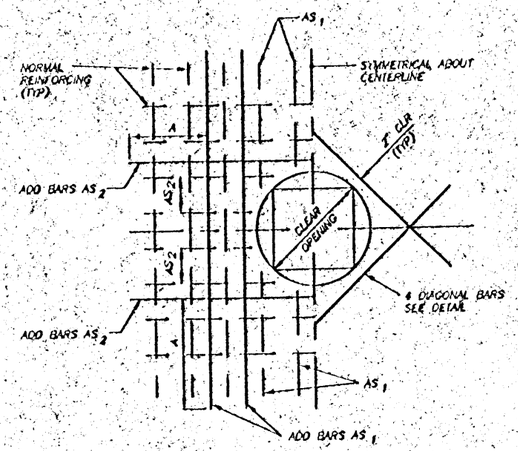
NOT TO SCALE

BAR SIZE	90° HOOK "X"	BAR SIZE	90° HOOK "X"
#3	6"	#8	16"
#4	8"	#9	19"
#5	10"	#10	22"
#6	12"	#11	24"
#7	14"		

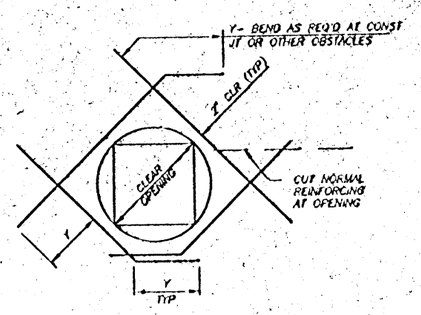
NOTE:
UNLESS NOTED OTHERWISE ON DRAWINGS, ALL LENGTHS OF BAR HOOKS IN FOOTINGS, COLUMNS, WALLS AND SLABS SHALL BE AS GIVEN IN TABLE ABOVE. HOOK LENGTH "X" IS STANDARD 90° BAR HOOK LENGTH.

STANDARD 90° BAR HOOK (2/—)

NOT TO SCALE



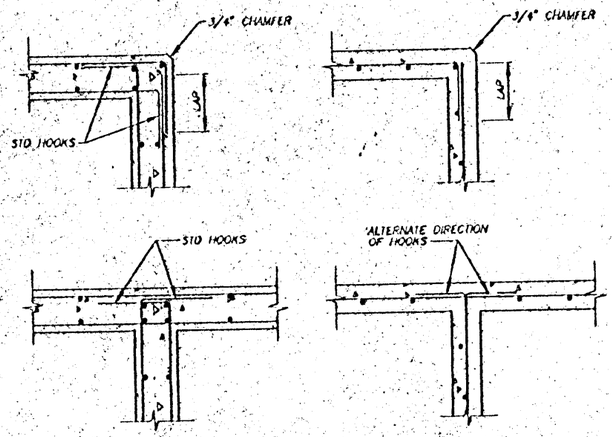
BAR SIZE	A	Y
4	15"	12"
5	18"	15"
6	18"	18"
7	21"	21"



NOTES:
1. CIRCULAR OPENINGS 8" THROUGH 11" REQUIRE DIAGONAL REINFORCING ONLY. CIRCULAR OPENINGS 12" AND LARGER REQUIRE BOTH DIAGONAL AND ADDITIONAL (AS_1 AND AS_2) REINFORCING BARS.
2. NORMAL REINFORCEMENT CUT AT OPENING:
   a: AS_1 AND AS_2 = 1/2 AREA OF CUT BARS TO BE ADDED ON EACH SIDE OF OPENING.
3. ADDITIONAL REINFORCEMENT AS_1, AS_2 AND DIAGONAL BARS TO BE PLACED:
   a: AT ℄ OF WALLS OR SLABS WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED.
   b: AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
4. LOCATE ADDITIONAL BARS (AS_1 AND AS_2) AT ℄ BETWEEN CONTINUOUS BARS THAT ARE NOT CUT.
5. UNLESS OTHERWISE NOTED, SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST REINFORCING CUT.
6. USE THIS DETAIL FOR ALL OPENINGS UNLESS OTHERWISE NOTED ON THE STRUCTURAL DRAWINGS.
7. DO NOT WELD REINFORCING TO PIPE WALL COLLARS OF EMBEDDED PIPES.

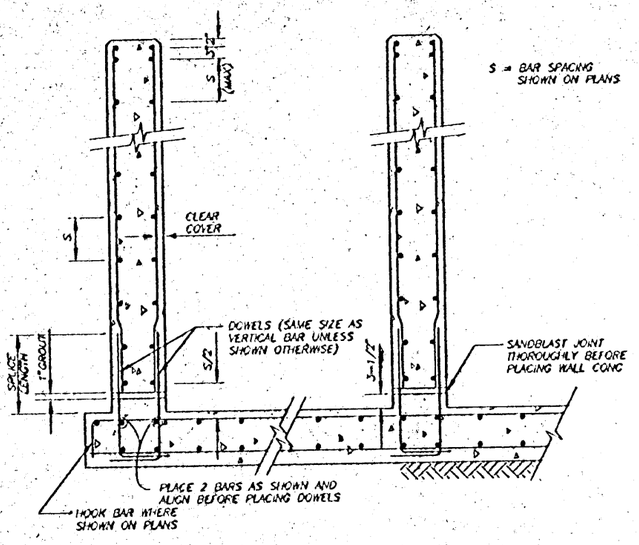
ADDITIONAL REINFORCING AT OPENINGS (3/—)

NOT TO SCALE



NOTE: MINIMUM LAP SPLICE LENGTHS

BAR	#4	#5	#6	#7	#8
LAP LENGTH	14	17	22	30	39



REINFORCING AT CORNERS AND JUNCTIONS (4/—)

NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER — RICHARD DAVIS — CIVIL — No. 10,000 — 7/18/14

XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

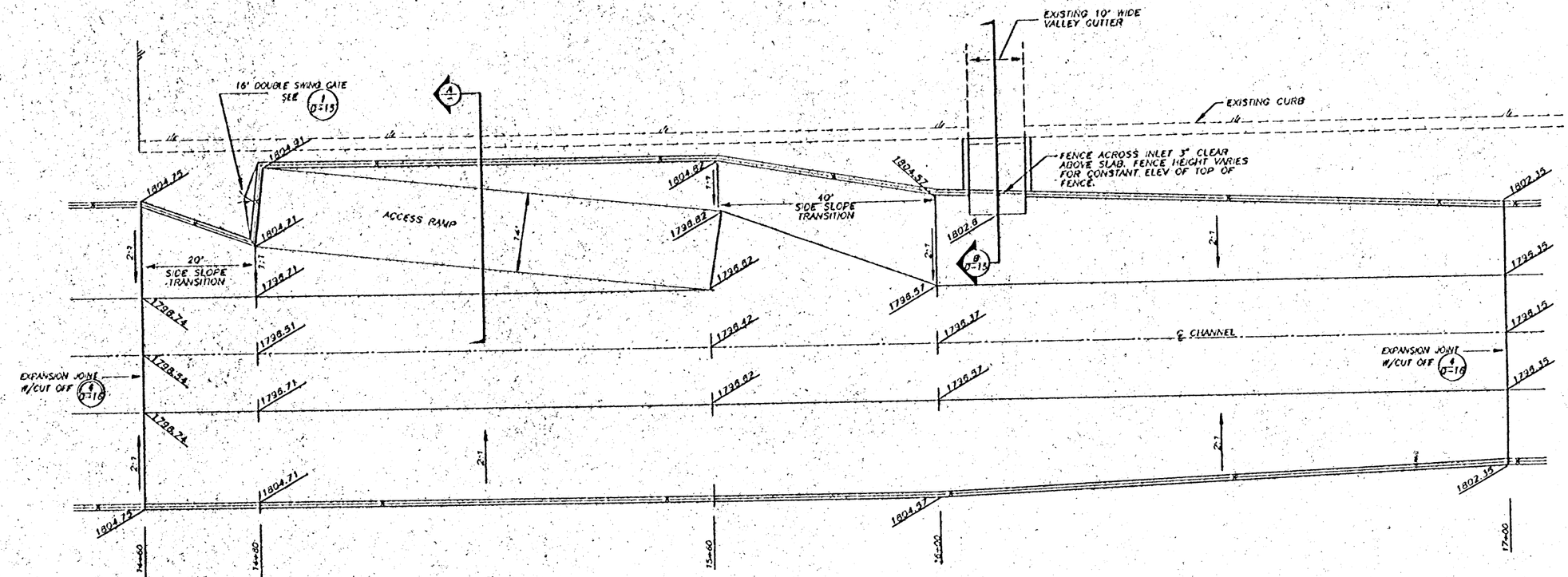
Dokja Engineering Corporation
consulting engineers
Las Vegas, Nevada 89118

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL PHASE I - NAFB CHANNEL

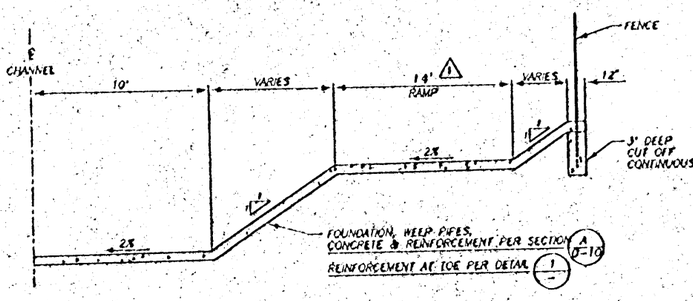
STEEL REINFORCEMENT DETAILS

DRAWING D-12
40 OF 45
D-24



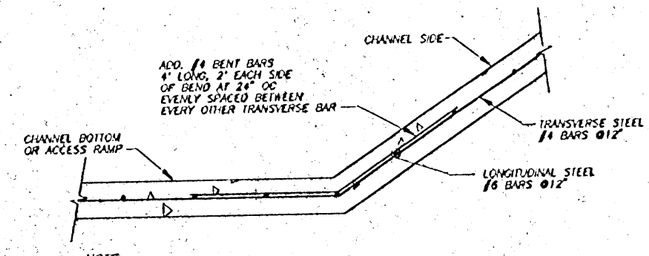
CHANNEL TRANSITION & ACCESS RAMP (1 / OC-2)

SCALE 1" = 10'



SECTION (A)

SCALE: 1/4" = 1'-0"



NOTE:
USE ADDITIONAL BARS WHEN SIDE SLOPE IS GREATER THAN 2:1
14+60 TO 18+00

ADDITIONAL TOE REINFORCEMENT (1)

SCALE: 1" = 1'-0"

7/28/94

XREFerence DRAWINGS

MARK	DATE	BY	REVISION
1	4-6-95	DWD	CHANGE DIMENSION

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/28/94
PROJECT MANAGER — DATE 7/28/94

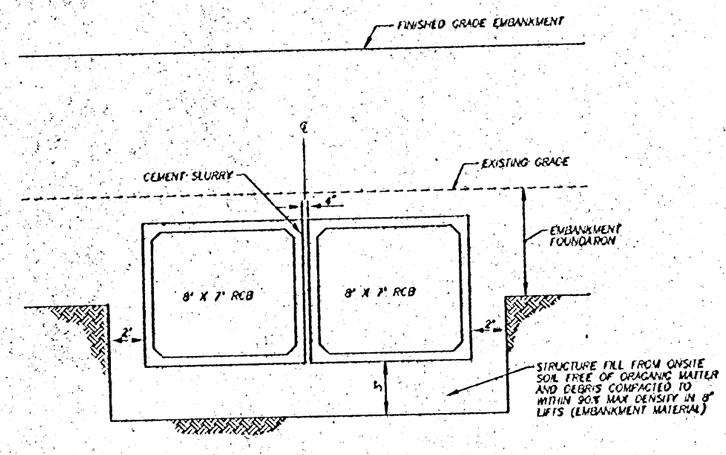
Doyle Engineering Corporation
consulting engineers
[illegible] Las Vegas, Nevada 89108

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN
CHANNEL TRANSITION + ACCESS RAMP

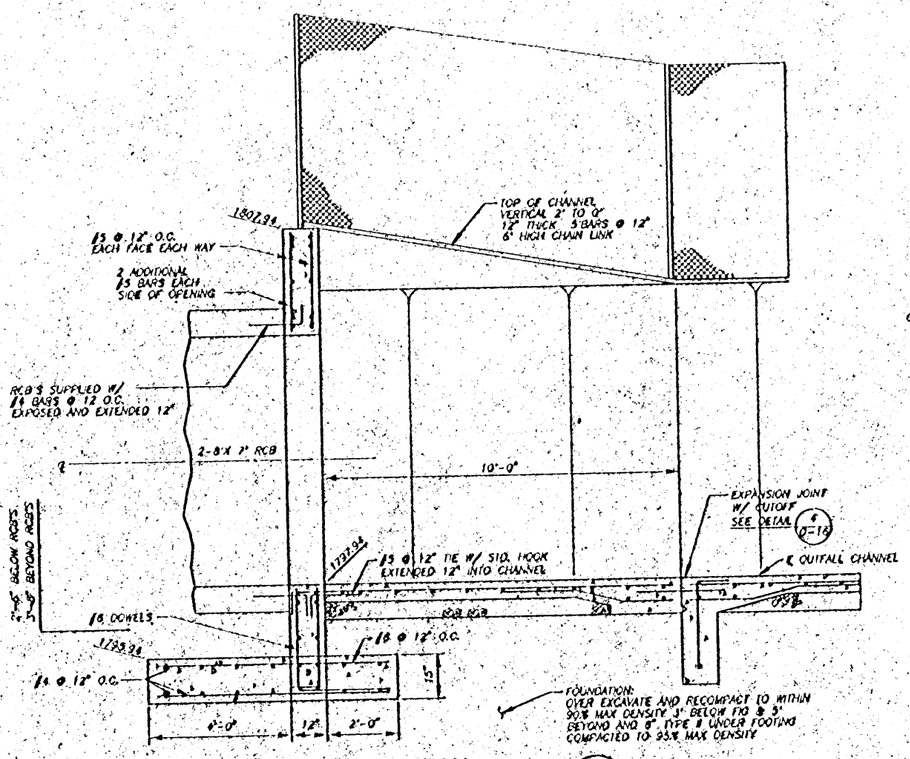
DRAWING D-13
41 OF 45
D-13

PLOT DATE: 6/94



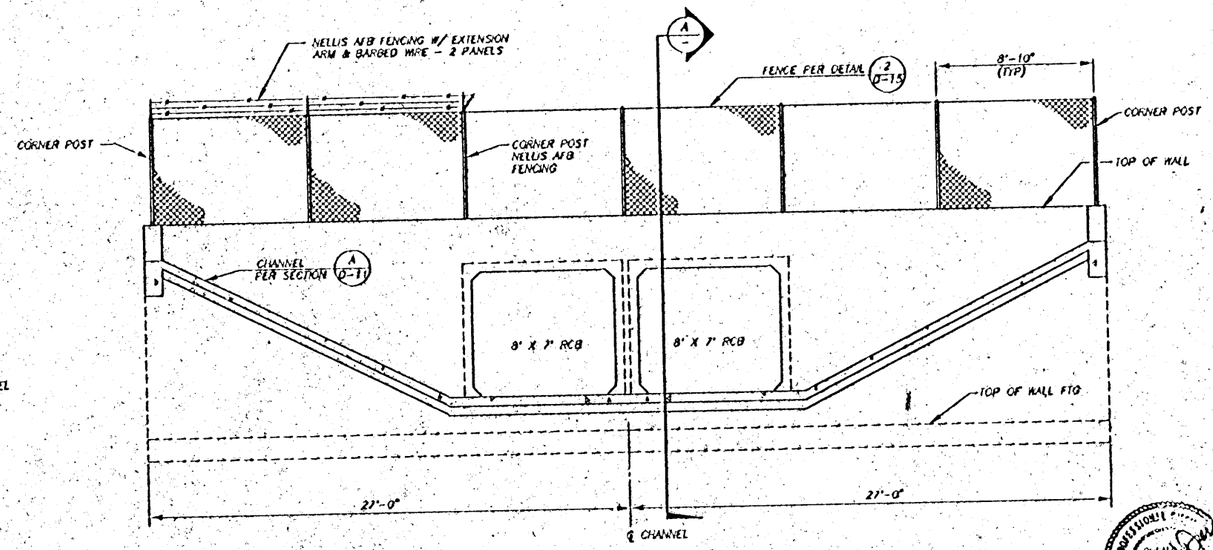
TRENCH SECTION DOUBLE RCB OUTLET (2/—)

SCALE: 1/4" = 1'-0"



SECTION (A/—)

SCALE: 1/2" = 1'-0"



OUTFALL HEADWALL (3/—)

SCALE: 1/4" = 1'-0"

XREFerence DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: LBL
CHECKED: DWD

PROJECT ENGINEER — DATE 7/18/24
PROJECT MANAGER — DATE 7/28/24

Doyle Engineering Corporation consulting engineers

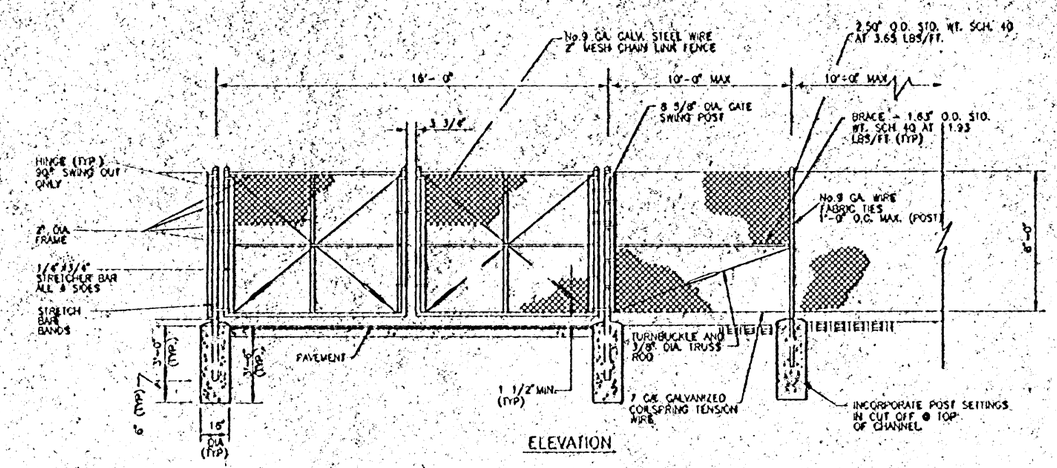
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

MISCELLANEOUS DETAILS

DRAWING: D-14
12 OF 15
D-19

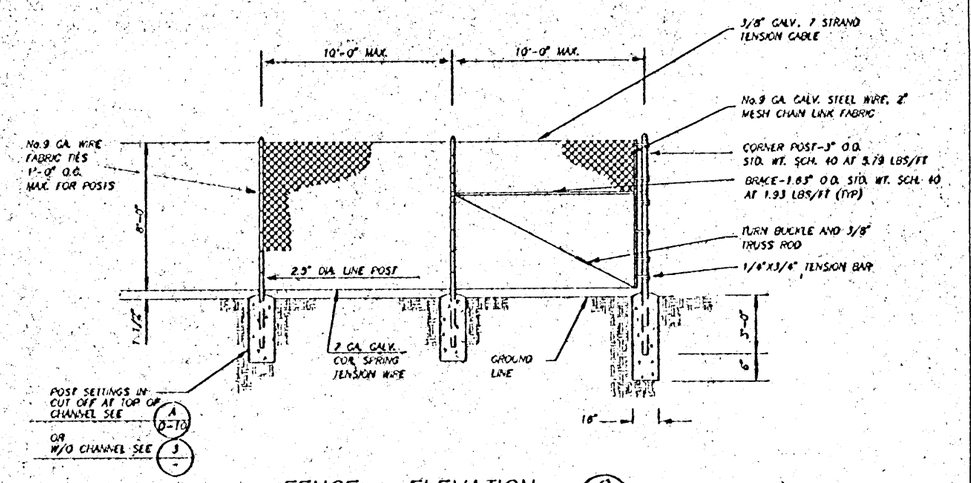
PLOT DATE: 8/24



ELEVATION

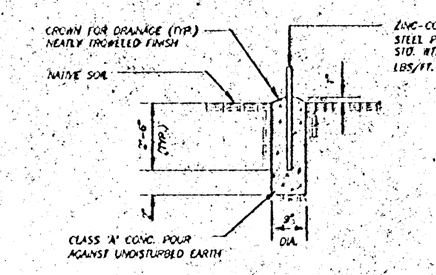
GATE DETAIL (16' DOUBLE SWING GATE) – ELEVATION (1/–)

NOT TO SCALE



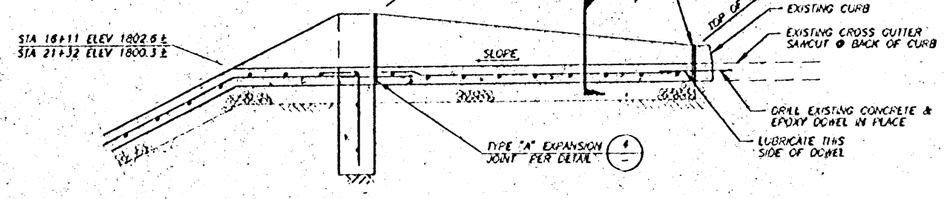
FENCE – ELEVATION (2/–)

NOT TO SCALE



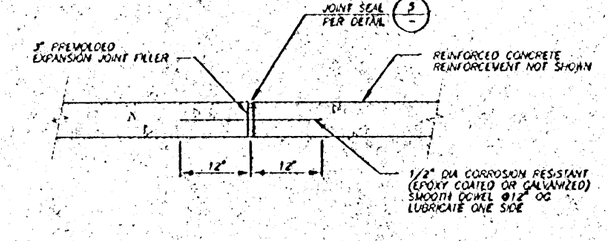
LINE POST SETTING DETAIL (3/–)

NOT TO SCALE



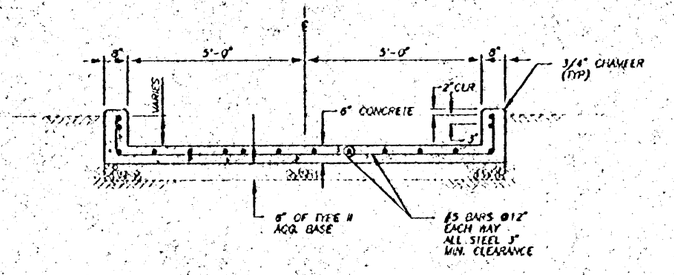
SIDE CHANNEL INLET SECTION (B/–)

SCALE: 1/2" = 1'-0"



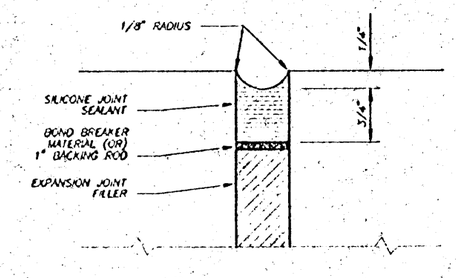
TYPE "A" EXPANSION JOINT (4/–)

SCALE: 1" = 1'-0"



SECTION (C/–)

SCALE: 1/2" = 1'-0"



TYPE "A" EXPANSION JOINT SEAL DETAIL (5/–)

NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA DONALD W. DAVIS CIVIL No. 8087 7/25/14

XREF'ed BIM DRAWINGS

MARK	DATE	BY	REVISION

DESIGNED: DWD
DRAWN: GM
CHECKED: DWD

PROJECT ENGINEER — DATE 1/29/14
PROJECT MANAGER — DATE 7/29/14

Doyle Engineering Corporation
consulting engineers
Las Vegas, Nevada 89108

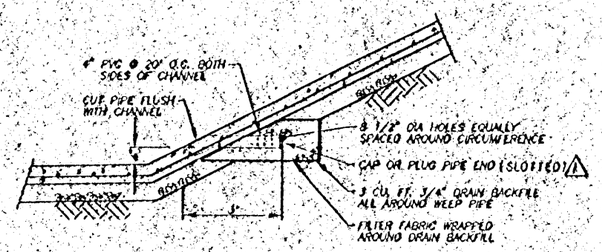
CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

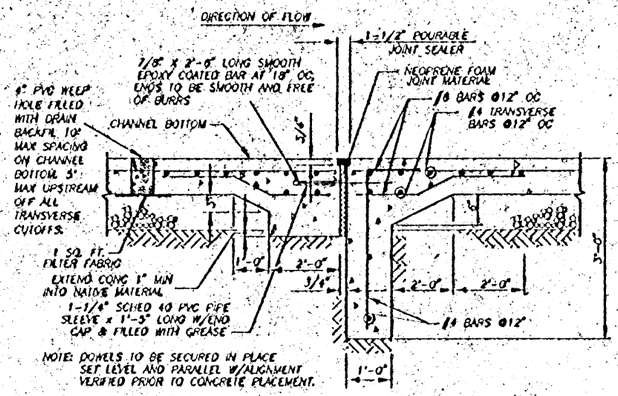
MISCELLANEOUS DETAILS

DRAWING D-15
43 OF 45
0-20

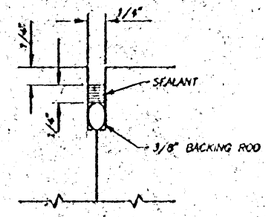
PLOT DATE: 8/24



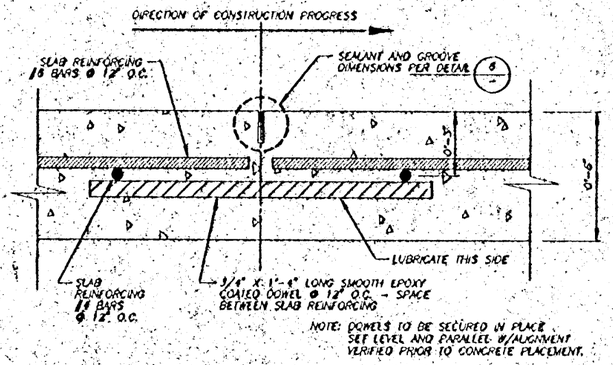
WEEP PIPE 1
NOT TO SCALE



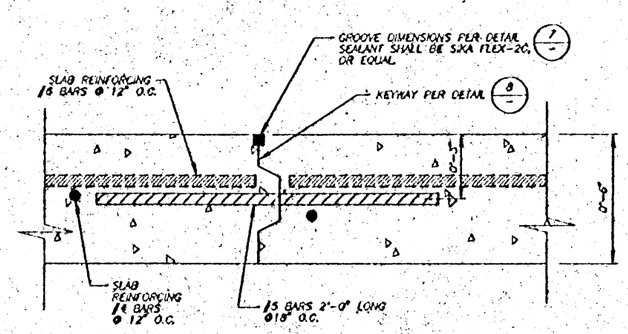
EXPANSION JOINT W/ CUTOFF 4
NOT TO SCALE



CONSTRUCTION JOINT SEAL DETAIL 7
NOT TO SCALE

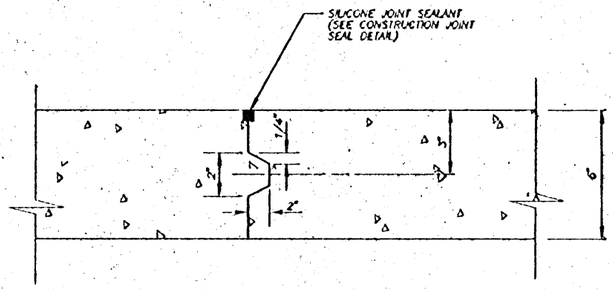


CONTRACTION JOINT 2
NOT TO SCALE

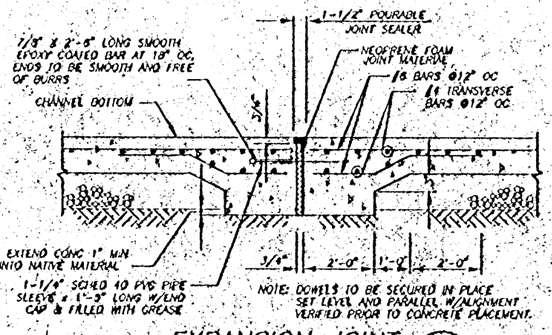


NOTES: 1. CONSTRUCTION JOINTS SHALL BE PLACED @ INTERRUPTIONS IN PLACEMENT OF CONCRETE OTHER THAN CONTRACTION OR EXPANSION JOINTS.
2. OPTIONAL LONGITUDINAL CONSTRUCTION JOINTS MUST BE PLACED IN SIDE SLOPES A MINIMUM OF 1' VERTICALLY ABOVE TOE OF SLOPE.

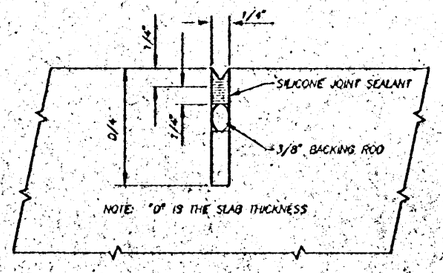
CONSTRUCTION JOINT 5
NOT TO SCALE



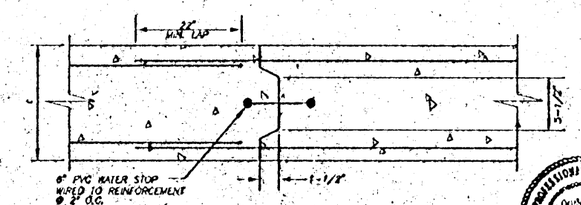
CONSTRUCTION JOINT KEYWAY 8
NOT TO SCALE



EXPANSION JOINT 3
NOT TO SCALE



TOOLED WEAKENED PLANE JOINT DETAIL 6
NOT TO SCALE



CONSTRUCTION JOINT 9
NOT TO SCALE

REGISTERED PROFESSIONAL ENGINEER — CHRISTOPHER D. DAVIS — CIVIL — NO. 11101 — STATE OF NEVADA — 7/28/14

XREFerence DRAWINGS:

MARK	DATE	BY	REVISION
1	4-15	MK	CHANGE NOTE

PLOT DATE: 8/14

DESIGNED:	DWD
DRAWN:	GM
CHECKED:	DWD

PROJECT ENGINEER — DATE 7/28/14
PROJECT MANAGER — DATE 7/28/14

Doyle Engineering Corporation
consulting engineers

CLARK COUNTY NEVADA
DEPARTMENT OF PUBLIC WORKS

RANGE WASH / SLOAN CHANNEL CONFLUENCE DETENTION BASIN

MISCELLANEOUS DETAILS

DRAWING D-16
44 OF 45
D-21

AIR FORCE BASE CHANNEL MODIFICATIONS

SCALE: 1" = 40'

CURVE DATA			
CURVE	Δ	R	L
C 8	48° 25' 37"	300.00'	253.56'

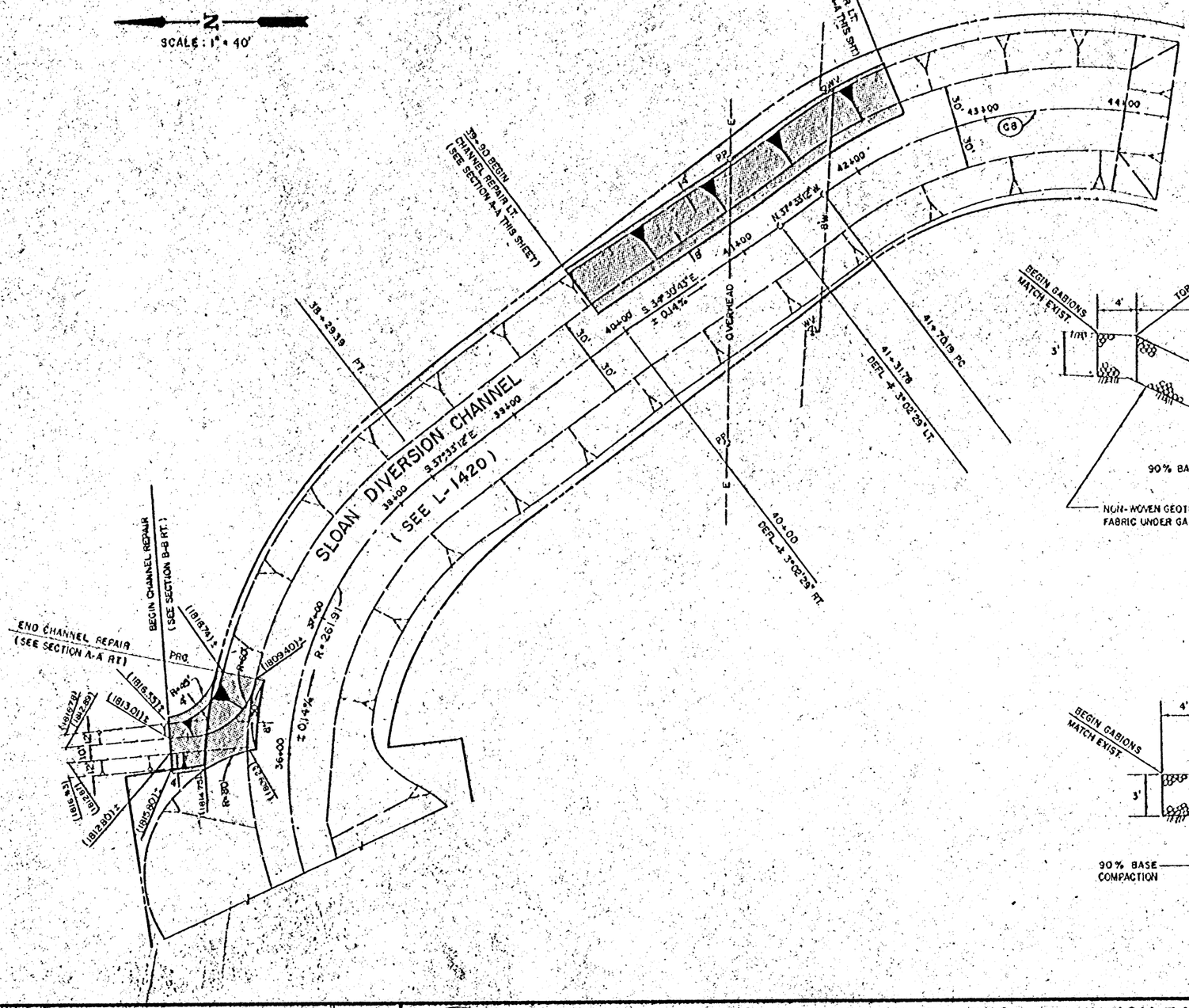
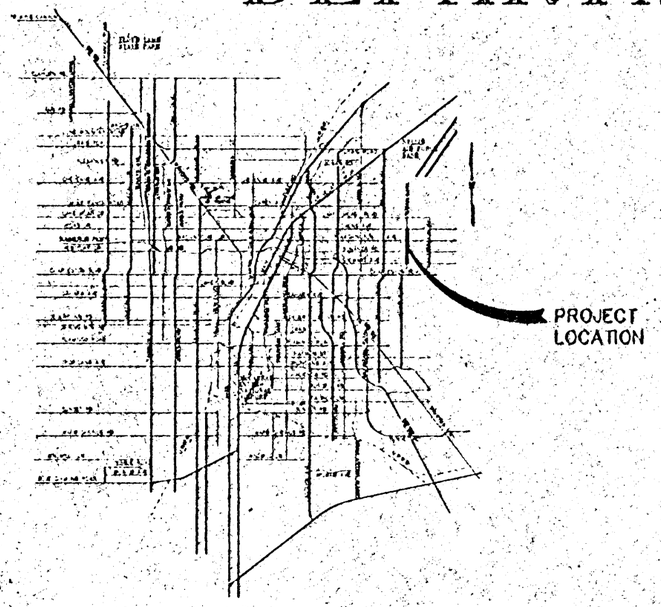

42+45 END CHANNEL REPAIR LT. (SEE SECTION A-A THIS SHT.)
38+30 BEGIN CHANNEL REPAIR LT. (SEE SECTION A-A THIS SHEET)
42+00
41+00
40+00
38+00
35+29.39 FT.
S 3° 30' 43" E
± 0.14%
N 3° 30' 43" W
OVERHEAD
41+70.19 PC
41+31.78
DEFL 4 3° 02' 29" LT.
40+00
DEFL 4 3° 02' 29" RT.
SLOAN DIVERSION CHANNEL
(SEE L-1420)
S 37° 33' 12" E
BEGIN CHANNEL REPAIR (SEE SECTION B-B RT.)
END CHANNEL REPAIR (SEE SECTION A-A RT.)
PRO.
R=30'
R=80'
R=261.91'
36+00
(1813.80)±
(1813.01)±
(1813.53)±
(1809.40)±
(1818.74)±
(1818.75)±
(1818.28)±
(1818.80)±
(1812.80)±
(1818.75)±
(1818.28)±
(1818.80)±
(1812.80)±
(1813.80)±
(1813.01)±
(1813.53)±
(1809.40)±
(1818.74

EXHIBIT D

Sloan Channel
Owens Avenue to Stewart Avenue
As-Built Drawings

CLARK COUNTY
DEPARTMENT OF PUBLIC WORKS



VICINITY MAP

"Progress as Promised"

INDEX OF SHEETS

SHEET NO.	SHEET DESCRIPTION
C-1	COVER SHEET
C-2	GENERAL NOTES
C-3	CONTROL PLAN
C-4	SLOAN CHANNEL - PLAN & PROFILE
C-5	SLOAN CHANNEL - PLAN & PROFILE
C-6	SLOAN CHANNEL - PLAN & PROFILE
C-7	SLOAN CHANNEL - PLAN & PROFILE
C-8	SLOAN CHANNEL - PLAN & PROFILE
C-9	SLOAN CHANNEL - PLAN & PROFILE
C-10	SLOAN CHANNEL - PLAN & PROFILE
C-11	CHANNEL DETAILS
C-12	CHANNEL DETAILS
C-13	CHANNEL DETAILS
C-14	CHANNEL DETAILS

SLOAN CHANNEL

OWENS AVENUE TO STEWART AVENUE

FUNDED BY
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
1994

COUNTY COMMISSIONERS

Jay Bingham, Chairman
Don Schlesinger, Vice Chairman
Paul J. Christensen
Thalia M. Dondero
Yvonne Atkinson Gates
Karen Hayes
Bruce L. Woodbury

APPROVALS

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

GENERAL MANAGER / CHIEF ENGINEER

Approved: Gale Wm. Fraser II
GALE Wm. FRASER II, P.E.
GENERAL MANAGER

COUNTY MANAGER
DONALD L. 'PAT' SHALMY

DIRECTOR OF PUBLIC WORKS

Approved: M. J. Manning
M.J. MANNING R.P.E. 7299

AGENCY	PLANS REVIEWED BY	DATE
SPRINT CENTRAL TELEPHONE COMPANY		6.1.94
LAS VEGAS VALLEY WATER DISTRICT		5/31/94
SOUTHWEST GAS COMPANY		5/31/94
NEVADA POWER COMPANY		5/26/94
CLARK COUNTY SANITATION DISTRICT		6/1/94
PRIME CABLE T.V.		5-31-94

DEPARTMENT OF PUBLIC WORKS	PLANS REVIEWED BY	DATE OF APPROVAL
DEPUTY DIRECTOR FOR PROFESSIONAL SERVICES		5/26/94
COMMUNITY DEVELOPMENT DIVISION		5-01-94
CONSTRUCTION MANAGEMENT DIVISION		5/26/94
DESIGN ENGINEERING DIVISION		5-26-94
MAINTENANCE MANAGEMENT DIVISION		5-27-94
TRAFFIC MANAGEMENT DIVISION		5-26-94
COUNTY SURVEYOR'S OFFICE		5/31/94

REVISIONS					
REVISION No.	DESCRIPTION	BY	DATE	APPROVAL	DATE

DESIGN / CONSTRUCTION DIVISION

COVER SHEET

L-1465

ABBREVIATIONS

ALT.	ALTERNATE	L.F.	LINEAR FEET
ANG.	ANGLE	LT.	LEFT
&	AND	M.H.	MANHOLE
APPROX.	APPROXIMATE	MAX.	MAXIMUM
@	AT	MIN.	MINIMUM
B.M.	BENCHMARK	MISC.	MISCELLANEOUS
℄	CENTERLINE	MOD.	MODIFIED
C.C.	CENTER TO CENTER	NO.	NUMBER
C.F.	CUBIC FEET	O.C.	ON CENTERS
C.Y.	CUBIC YARD	O.D.	OUTSIDE DIAMETER
CONC.	CONCRETE	PVMT.	PAVEMENT
CONT.	CONTINUOUS	P.P.	POWER POLE
CL.	CLEARANCE	P.	PROPERTY LINE
D	DEPTH	PVC	POLYVINYL CHLORIDE
DEG.	DEGREE	R	RADIUS
DET.	DETAIL	REINF.	REINFORCING
DIAG.	DIAGONAL	R/W	RIGHT OF WAY
DIA.	DIAMETER	RCP	REINFORCED CONC. PIPE
EA.	EACH	RCB	REINFORCED CONC. BOX
E.F.	EACH FACE	RT.	RIGHT
EL.	ELEVATION	SCH.	SCHEDULE
ESMT.	EASEMENT	SHOLR	SHOULDER
E.W.	EACH WAY	SHT.	SHEET
EQ.	EQUAL	SIM.	SIMILAR
EXIST.	EXISTING	SPECS.	SPECIFICATIONS
R/W	RIGHT OF WAY	S	SLOPE
FT.	FOOT OR FEET	SQ.	SQUARE
FTG.	FOOTING	STD.	STANDARD
F.G.	FINISH GRADE	STA.	STATION
F.L.	FLOWLINE	STL.	STEEL
G.B.	GRADEBREAK	TC	TOP OF CURB
GRD.	GROUND	TEL.	TELEPHONE
HGL.	HYDRAULIC GRADE LINE	TEMP.	TEMPORARY
HORIZ.	HORIZONTAL	TMH	TOP OF MANHOLE
INV.	INVERT	TRAP.	TRAPEZOIDAL
JT.	JOINT LENGTH	TW	TOP OF WALL
L.	LENGTH	(TYP.)	TYPICAL
		VERT.	VERTICAL
		W/	WITH

CONSTRUCTION NOTES

1. MATCH EXISTING CONCRETE CHANNEL PER DETAIL (2/C-11)
2. CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.1.1.-R(724)
3. CONSTRUCT CHANNEL SURFACE INLET FENCE (1/C-13)
4. CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.-(616)
5. PROTECT EXISTING CURB AND GUTTER, STREET LIGHTING, LANDSCAPING, AND SPRINKLER SYSTEM.
6. CONSTRUCT PIPE CONNECTION PER DETAIL (10/C-12)
7. CONSTRUCT SLOPE PAVING (9/C-11)
8. ADJUST EXISTING MANHOLE COVER AND FRAME. (STD. DWG. NO. 308)
9. CONSTRUCT CHANNEL ACCESS STEPS (3/C-12)
10. CONSTRUCT 60' COMMERCIAL DRIVEWAY PER STD. DWG. 117A
11. CONSTRUCT PERMANENT SIGN

GENERAL NOTES

1. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND OF INGRESS AND EGRESS TO SAID CONSTRUCTION, EXTENT OF TRANSITION, TO BE DETERMINED BY THE COUNTY AND AS SHOWN ON PLANS.
2. EXISTING UTILITIES ARE LOCATED ON THE PLANS FOR THE CONVENIENCE OF THE CONTRACTOR ONLY. THE CONTRACTOR SHALL BEAR FULL RESPONSIBILITY FOR THE PROTECTION OF UTILITIES AND THE ENGINEER BEARS NO RESPONSIBILITY FOR UTILITIES NOT SHOWN ON THE PLANS OR NOT IN THE LOCATION SHOWN ON THE PLANS. (CALL BEFORE YOU DIG 1-800-227-2600)
3. ALL CONSTRUCTION AND MATERIALS FOR THIS PROJECT SHALL BE IN ACCORDANCE WITH THE MOST RECENT EDITION OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA.
4. ALL UTILITY COMPANIES SHALL BE NOTIFIED BY THE CONTRACTOR AT LEAST 48 (FORTY EIGHT) HOURS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR THE VERTICAL ADJUSTMENT OF ALL EXISTING MANHOLES TO THE FINAL GRADES IN ACCORDANCE WITH SECTION 609 OF THE "STANDARD SPECIFICATIONS", UNLESS NOTIFIED OTHERWISE BY THE ENGINEER.
6. THE CONTRACTOR(S) SHALL NOT START WORK WITHIN THE ROAD RIGHTS-OF-WAY UNTIL THE CONSTRUCTION TRAFFIC PLAN SUBMITTED BY THE CONTRACTOR(S) IS APPROVED BY THE COUNTY.
7. ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS AS INDICATED IN THE STRUCTURAL NOTES FOR THIS PROJECT.
8. ALL BARRICADING AND TEMPORARY TRAFFIC CONTROL DEVICES OR METHODS USED DURING CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE "NEVADA WORK ZONE TRAFFIC CONTROL HANDBOOK, 1985", PUBLISHED BY THE STATE OF NEVADA, DEPARTMENT OF HIGHWAYS, EXCEPT AS OTHERWISE PROVIDED IN THE CONTRACT SPECIFICATIONS OR REQUIRED BY THE ENGINEER.
9. ALL STATIONS ARE CENTERLINE STATIONS UNLESS NOTED ON THE DRAWINGS.
10. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR RECONSTRUCTED SATISFACTORY TO THE COUNTY OR UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.
11. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY ALTERATIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE COUNTY.
12. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL OVERHEAD INTERFERENCES WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD OR UNDERGROUND POWER AND/OR TELEPHONE FACILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COSTS AND LIABILITY IN CONNECTION THEREWITH.
13. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.
14. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ALL MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH N.R.S. STATUTE NO. 625.550.
15. THESE PLANS SHALL BE ON THE JOBSITE AT ALL TIMES.
16. CAUTION:

    THE CONTRACTOR SHALL EXERCISE EXTREME CAUTION WHEN EXCAVATING ALONG EXISTING C.M.U. WALLS IN ORDER TO PREVENT UNDERMINING OF EXISTING WALL FOOTINGS. TOP OF FOOTING ELEVATIONS FOR THE EXISTING CMU WALLS SHOWN ON THE PLANS ARE FOR REFERENCE ONLY AND SHOULD BE VERIFIED BY THE CONTRACTOR PRIOR TO EXCAVATION NEAR EXISTING WALLS.

ESTIMATED QUANTITIES

BID ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY
203.01	CHANNEL EXCAVATION	62,780 CY
301.01	SELECT BACKFILL	27,880 CY
302.01	TYPE II AGGREGATE BASE	20,260 CY
502.01	TRAPEZOIDAL CHANNEL	69,409 SY
502.02	SURFACE INLET STRUCTURES	7 EA
502.03	MAINTENANCE ACCESS RAMP	3 EA
502.04	STORM DRAIN JUNCTION STRUCTURE	3 EA
603.01	18" RCP CLASS IV	68 LF
603.02	24" RCP CLASS IV	64 LF
603.04	48"x76" HE RCP CLASS HE II	40 LF
609.01	7-FT. DOUBLE-SIDED DROP INLET	1 EA
609.02	9-FT MODIFIED TYPE "A" INLET	1 EA
611.01	3" SLOPE PAVING	6565 SY
616.01	6-FT CHAIN LINK FENCE	7857 LF
616.02	12-FT SINGLE SWING GATE	3 EA
616.03	4-FT SWING GATE	14 EA
627.01	PERMANENT SIGN	4 EA

LEGEND

- PROPERTY OR RIGHT-OF-WAY LINE
- CENTERLINE
- HYDRAULIC GRADE LINE (HGL)
- CHANNEL EASEMENT
- EXISTING TELEPHONE CABLE
- 6' CHAIN LINK FENCE
- EXISTING SANITARY SEWER LINE
- EXISTING WATER LINE
- EXISTING GAS LINE
- EXISTING UNDERGROUND POWER
- EXISTING STORM DRAIN
- ABANDONED STORM DRAIN
- ABANDONED UNDERGROUND TELEPHONE CABLE
- EXISTING CONTOUR
- SCARP
- POWER POLE
- EXISTING ELEVATION
- NEW ELEVATION
- HORIZONTAL & VERTICAL AERIAL CONTROL POINT (PANEL # & ELEVATION)
- EXIST. STR. LT. POLE

Avoid cutting underground utility lines. It's costly.

Call before you Dig

1-800-227-2600

UNDERGROUND SERVICE ALERT (USA)

REMOVAL NOTES

1. REMOVE AND SALVAGE 6' CHAIN LINK FENCE
2. REMOVE EXIST. CURB & GUTTER
3. REMOVE EXISTING HEAVY RIPRAP ALONG WEST SIDE OF CHANNEL

BENCH MARK

CLARK COUNTY BENCHMARK STATION 7C02 21SES BEING A RIVET IN 2"x 2" ALUMINUM PLATE IN TOP CURB, NORTH SIDE OF OWENS AVENUE AND WEST OF SLOAN CHANNEL.
ELEVATION: 1780.25 FEET (NAVD 1929).

BASIS OF BEARING

NORTH 00°18'40" WEST BEING THE WEST LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 3, TOWNSHIP 21 SOUTH, RANGE 62 EAST, M.D.M. AS SHOWN BY A MAP THEREOF ON FILE IN BOOK 50, PAGE 65 OF PLATS IN THE CLARK COUNTY RECORDER'S OFFICE, CLARK COUNTY, NEVADA.

NOEL C. WALLACE — STATE OF NEVADA — REGISTERED ENGINEER — RECOMMENDED

NO.	DESCRIPTION	DATE

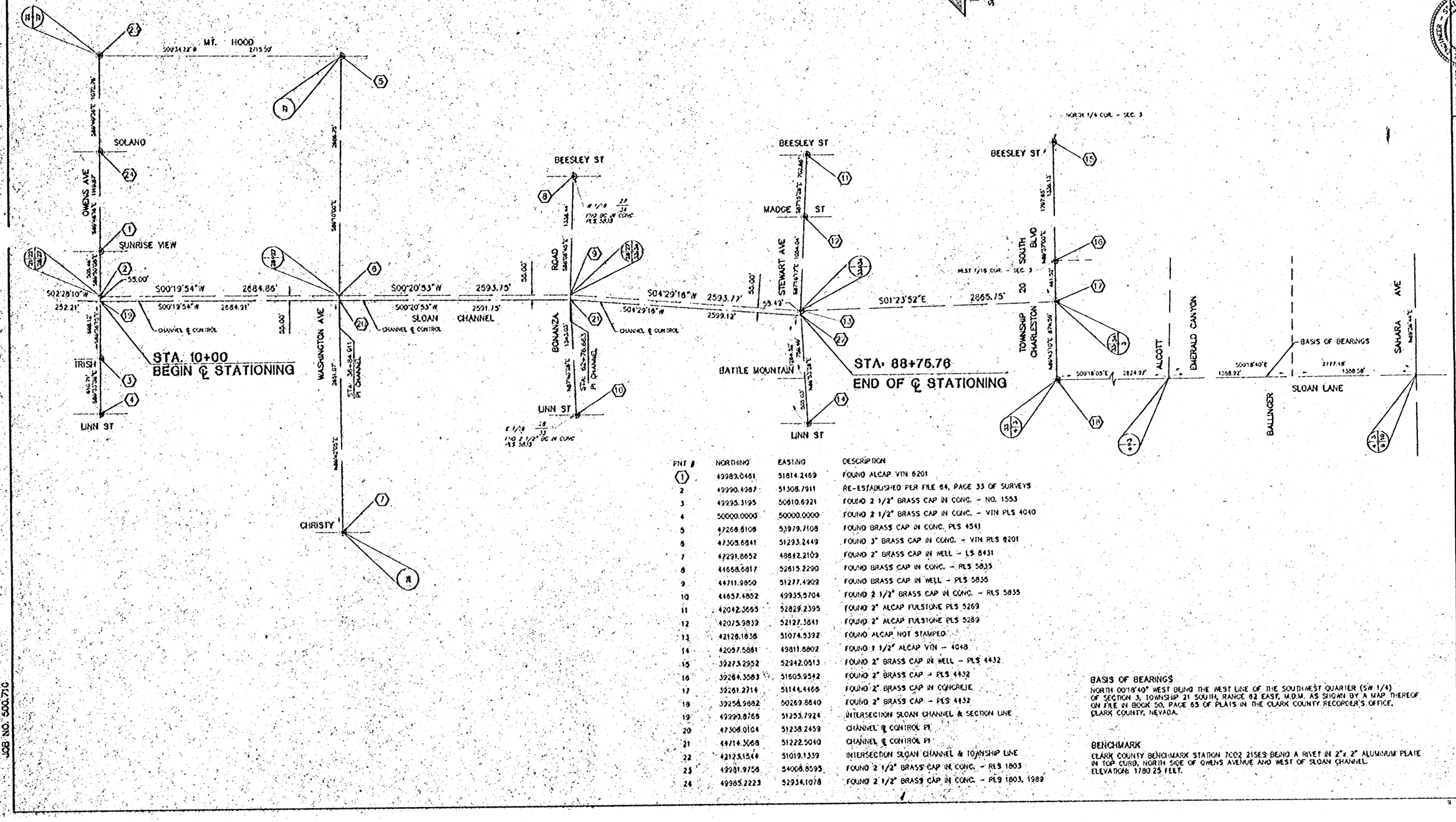
G.C. WALLACE, INC. Engineering/Architecture 1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
GENERAL NOTES
LEGEND AND ABBREVIATIONS

SHEET C-2
SHT 2 OF 14

JOB NO. 500.710-

9.0-ED1.dwg 6/02/98



PNT #	NORTHING	EASTING	DESCRIPTION
1	49983.0461	51814.2469	FOUND ALCAP VTN 8201
2	49990.4987	51308.7911	RE-ESTABLISHED PER FILE 64, PAGE 33 OF SURVEYS
3	49995.3195	50810.6321	FOUND 2 1/2" BRASS CAP IN CONC. - NO. 1553
4	50000.0000	50000.0000	FOUND 2 1/2" BRASS CAP IN CONC. - VTN PLS 4040
5	47268.6108	53979.7108	FOUND BRASS CAP IN CONC. PLS 4543
6	47303.6841	51293.2449	FOUND 3" BRASS CAP IN CONC. - VTN PLS 8201
7	42291.8652	48862.2103	FOUND 2" BRASS CAP IN WELL - LS 8431
8	44668.6817	52615.2290	FOUND BRASS CAP IN CONC. - PLS 5835
9	44711.9850	51277.4909	FOUND BRASS CAP IN WELL - PLS 5835
10	44657.4852	49935.5704	FOUND 2 1/2" BRASS CAP IN CONC. - RLS 5835
11	42042.3665	52829.2395	FOUND 2" ALCAP FULSTONE PLS 5269
12	42075.9839	52127.3841	FOUND 2" ALCAP FULSTONE PLS 5269
13	42128.1636	51074.5392	FOUND ALCAP NOT STAMPED
14	42057.5881	49811.8802	FOUND 1 1/2" ALCAP VTN - 4048
15	39273.2952	52342.0513	FOUND 2" BRASS CAP IN WELL - PLS 4432
16	39284.3583	51605.9542	FOUND 2" BRASS CAP - PLS 4432
17	39281.2714	51144.4466	FOUND 2" BRASS CAP IN CONCRETE
18	39256.9882	50269.8840	FOUND 2" BRASS CAP - PLS 4432
19	49990.8766	51253.7924	INTERSECTION SLOAN CHANNEL & SECTION LINE
20	47306.0104	51258.2459	CHANNEL ℄ CONTROL PT
21	44714.3068	51222.5040	CHANNEL ℄ CONTROL PT
22	42123.1544	51019.1339	INTERSECTION SLOAN CHANNEL & TOWNSHIP LINE
23	49981.9756	54006.8595	FOUND 2 1/2" BRASS CAP IN CONC. - RLS 1803
24	49985.2223	52934.1078	FOUND 2 1/2" BRASS CAP IN CONC. - PLS 1803, 1989

BASIS OF BEARINGS

NORTH 00°18'40" WEST BEING THE WEST LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 3, TOWNSHIP 21 SOUTH, RANGE 62 EAST, M.D.M. AS SHOWN BY A MAP THEREOF ON FILE IN BOOK 50, PAGE 65 OF PLATS IN THE CLARK COUNTY RECORDER'S OFFICE, CLARK COUNTY, NEVADA.

BENCHMARK

CLARK COUNTY BENCHMARK STATION 7C02 21SES BEING A RIVET IN 2"x 2" ALUMINUM PLATE IN TOP CURB, NORTH SIDE OF OWENS AVENUE AND WEST OF SLOAN CHANNEL.
ELEVATION: 1780.25 FEET.

RECOMMENDED — NOEL C. VAUGHAN — REG. NO. 7333 — DATE

APPROVED — REG. NO. — DATE

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
CHANNEL CONTROL PLAN

SHEET
C-3
SHT 3 OF 14

JOB NO. 500.710

SL CONTROL 8/27/84

(1) MATCH EXISTING CONCRETE CHANNEL PER DETAIL (2/C-11)
(2) CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-8.1.1.-R(724)
(3) CONSTRUCT CHANNEL SURFACE INLET FENCE (4/C-13)
(4) CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-8.3.3.-(616)
(6) CONSTRUCT PIPE CONNECTION PER DETAIL (10/C-12)
(7) CONSTRUCT SLOPE PAVING (5/C-11)
(9) CONSTRUCT CHANNEL ACCESS STEPS (3/C-12)
[3] REMOVE EXISTING HEAVY RIPRAP ALONG WEST SIDE OF EXIST. CHANNEL

NOTE 1
CONTRACTOR TO FIELD VERIFY HORIZONTAL AND VERTICAL LOCATION OF 48"x76" HE-RCP STORM DRAIN BY OTHERS. CONTRACTOR SHALL BEGIN CONSTRUCTION OF 48"x76" HE-RCP AT EXISTING STORM DRAIN AND LAY DOWN GRADE TO CHANNEL.
PROVIDE CONCRETE COLLAR PER (7/C-11) IF REQUIRED AT THE DIRECTION OF THE ENGINEER.

10+00.00 BEGIN PROJECT LIMITS
10+62.24 BEGIN CHANNEL IMPROVEMENTS
OWENS AVE.
18" SS
48"x76" HE-RCP (CLASS H3-II) 40 LF-S=0.0030
10+80.29 22' LT 72.61 INV.
(72.00) FL MATCH EXIST.
10+83.75 37.54' LT (72.73) INV.-MATCH EXISTING
11+12.24 END TRANSITION
CONNECT TO 30" PIPE BY OTHERS SEE NOTE 1
ACCESS RAMP NO. 1 (5/C-13)
CONSTRUCTION EASEMENT
R/W
45' R/W SLOAN LANE
S00°19'54"W
S=-10%
MATCH EXISTING BEGIN TRANSITION
EAST WASH
SOUTH WASH
MATCH LINE - STA 19+00.00 SEE SHEET C-5
8" SANITARY SEWER (BY OTHERS)
17+00.00 BEGIN SLOPE PAVING RT.
17+00.00, 43' RT. FENCE HORIZ. ANG. PT.
17+00.00, 50' RT. END FENCE RT. TIE TO EXIST.
3:1 TYP.
2:1
SURFACE INLET NO. 1 (1/C-13)
(1/C-11)
NORTH
SCALE: 1"=40'

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

KEY MAP
SCALE 1" = 1000'
OWENS AVE. WASHINGTON AVE. BONANZA RD. STEWART AVE.
4 5 6 7 8 9 10

PROFILE
SCALE: HORIZ. 1"=40', VERT. 1"=4'
OWENS AVENUE
3-9'x7' RCB's
3-7'x5' RCB's
TOP OF CHANNEL WALL (LT. & RT.)
EXIST. GRADE EAST R/W (55'LT.)
EXIST. GRADE WEST R/W (50'RT.)
H.G.L. (Q = 3300 cfs)
S=-0.0166
CHANNEL F.L.
EXIST. GRADE ℄ CHANNEL
S=-0.0036
D=6.83'
10+62.24 MATCH EXISTING BEGIN TRANSITION CHANNEL
11+12.24 END TRANSITION GRADE BREAK
16+75.00 SURFACE INLET NO. 1
7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00
1788 1784 1780 1776 1772 1768 1764 1760 1756 1752

JOB NO. 500.710

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE TO STEWART AVE
PLAN AND PROFILE
11+50.00 TO 19+00.00

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD./LAS VEGAS, NEVADA 89102

SHEET C-4
SHT 4 OF 14
SLOAN DWG 6/02/98

(2) CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.1.1.-R(724)

(3) CONSTRUCT CHANNEL SURFACE INLET FENCE (4/C-13)

(4) CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.-(616)

(6) CONSTRUCT PIPE CONNECTION PER DETAIL (10/C-12)

(7) CONSTRUCT SLOPE PAVING (5/C-11)

(9) CONSTRUCT CHANNEL ACCESS STEPS (3/C-12)

[3] REMOVE EXISTING HEAVY RIPRAP ALONG WEST SIDE OF CHANNEL

(1/C-13) SURFACE INLET NO. 2

(2/C-13) 23+34.00 SPECIAL INLET

MATCH LINE – STA. 19+00.00
SEE SHEET C-4

MATCH LINE – STA. 31+00.00
SEE SHEET C-6

EXIST. CONC. DRAINAGE CHANNEL

CONSTRUCTION EASEMENT

18" SANITARY SEWER (BY OTHERS)

18" SS

24" SS

DIRT ROAD

SLOAN LANE

161 L.F. – 24" RCP CLASS IV

S00°19'59"W

℄ CHANNEL

NORTH
SCALE: 1"=40'

KEY MAP
SCALE 1" = 1000'
OWENS AVE. | WASHINGTON AVE. | BONANZA RD. | STEWART AVE.

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

TOP OF CHANNEL WALL (LT. & RT.)

EXIST. GRADE EAST R/W (55' LT.)

EXIST. GRADE WEST R/W (50' RT.)

H.G.L. (Q = 3300 cfs)

24" RCP

D=8.63'

S=+0.0036

CHANNEL F.L.

EXIST. GRADE ℄ CHANNEL

22+50.00 SURFACE INLET NO. 2 Q=2.0

23+34.00 24" RCP OUTLET PIPE

PROFILE
SCALE: HORIZ. 1"=40' VERT. 1"=4'

JOB NO. 500.770

G.C. WALLACE, INC.
Engineering/Architecture

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
PLAN AND PROFILE
19+00.00 TO 31+00

SHEET
C-5

1. MATCH EXISTING CONCRETE CHANNEL PER DETAIL 2/C-11
2. CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.1.1.-R(724)
3. CONSTRUCT CHANNEL SURFACE INLET FENCE 4/C-13
4. CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.-(816)
7. CONSTRUCT SLOPE PAVING 3/C-11
9. CONSTRUCT CHANNEL ACCESS STEPS 3/C-12
11. CONSTRUCT PERMANENT SIGN
3. REMOVE EXISTING HEAVY RIPRAP ALONG WEST SIDE OF CHANNEL

MATCH LINE – STA. 31+00.00
SEE SHEET C-5

MATCH LINE – STA. 43+00.00
SEE SHEET C-7

SURFACE INLET NO. 3 1/C-13

SURFACE INLET NO. 4 1/C-13

NORTH
SCALE: 1"=40'

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

KEY MAP
SCALE 1" = 1000'

PROFILE
SCALE: HORIZ. 1"=40', VERT. 1"=4'

JOB NO. 502.710

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
PLAN AND PROFILE
31+00.00 TO 43+00.00

G.C. WALLACE, INC.
Engineering/Architecture

SHEET
C-6
SHT. 6 OF 14

(2) CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.1.1.-R(724)

(3) CONSTRUCT CHANNEL SURFACE INLET FENCE (4/C-13)

(4) CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.-(816)

(5) PROTECT EXISTING CURB AND GUTTER, STREET LIGHTING, LANDSCAPING AND SPRINKLER SYSTEM.

(6) CONSTRUCT PIPE CONNECTION PER DETAIL (10/C-12)

(7) CONSTRUCT SLOPE PAVING (5/C-11)

(8) CONSTRUCT CHANNEL ACCESS STEPS (3/C-12)

[1] REMOVE AND SALVAGE 6' CHAIN LINK FENCE

MATCH LINE – STA. 43+00.00
SEE SHEET C-6

MATCH LINE – STA. 55+00.00
SEE SHEET C-8

SURFACE INLET NO. 5 (1/C-13)

ACCESS RAMP NO. 2 (3/C-13)

DIRT ROAD

SLOAN LANE

92±60.50' 45° LT. & 45° LT. FENCE HORZ. ANG. PTS

3:1 MAX.

5%

10%

℄ CHANNEL

NORTH
SCALE 1"=40'

KEY MAP
SCALE 1" = 1000'

OWENS AVE | WASHINGTON AVE | BONANZA RD. | STEWART AVE

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

PROFILE
SCALE: HORIZ. 1"=40', VERT. 1"=4'

TOP OF CHANNEL WALL (LT. & RT.)

EXIST. GRADE EAST R/W (55' LT.)

TOP OF CHANNEL WALL LT. (LT.)

TOP OF CHANNEL WALL RT. (RT.)

EXIST. GRADE WEST R/W (50' RT.)

H.G.L. (Q = 3300 cfs)

D=8.85'

D=8.63'-RT.

D=7.63'-LT.

S=-0.0052

CHANNEL F.L.

EXIST. GRADE ℄ CHANNEL

55+00 GRADE BREAK

SURFACE INLET NO. 5 52+98.98

GRADE BREAK BEGIN EXTENDED CHANNEL LINING LEFT 53+01.00

308 NO. 530710

G.C. WALLACE, INC.
Engineering/Architecture

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE
PLAN AND PROFILE
43+00.00 TO 55+00.00

SHEET
C-7
SHT 7 OF 14

8/02/96

MATCH LINE – STA. 55+00.00
SEE SHEET C-7

1. MATCH EXISTING CONCRETE CHANNEL TRANSITION PER DETAIL 1/C-11
2. CONSTRUCT 8' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-611.1-R(724)
3. CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-613.3-(616)
4. PROTECT EXISTING CURB AND GUTTER, STREET LIGHTING, LANDSCAPING AND SPRINKLER SYSTEM.
5. CONSTRUCT SLOPE PAVING 5/C-11
6. CONSTRUCT CHANNEL ACCESS STEPS 3/C-12
7. CONSTRUCT 60' COMMERCIAL DRIVEWAY PER STD. DWG. 117A
8. CONSTRUCT PERMANENT SIGN

1. REMOVE AND SALVAGE 6' CHAIN LINK FENCE
2. REMOVE EXIST. CURB & GUTTER FROM STA. 65+77.16 TO STA. 66+48.46

SLOAN LANE
ABANDONED
℄ CHANNEL
BONANZA ROAD
ACCESS RAMP 3/C-13
BEGIN FENCE TIE TO EXIST.
S00°20'53"W
S04°29'16"W
R/W
EXIST. GRADE EAST R/W (55' LT.)
EXIST. GRADE WEST R/W (50' RT.)
EXIST. GRADE ℄ CHANNEL
CHANNEL FL.
TOP OF CHANNEL WALL (LT.)
TOP OF CHANNEL WALL (RT.)
H.G.L. (Q = 3300 c/s)
S= 0.0040
S= 0.0187
S= 0.0069
D=6.63'-RT.
D=7.03'-LT.
D=6.63'
5-10'x5' RCB'S
56.73 TW-LT.
55.73 TW-RT.
(55.08) TW-LT.
(54.08) TW-RT.
61+59.70 END TRAP. SECTION BEGIN TRANSITION
62+00 END TRANSITION MATCH EXISTING
62+76.69 HORIZ. ANG. PT.
65+46.39 BEGIN CHANNEL MATCH EXISTING
66+00.00 END TRANSITION, GRADE BREAK BEGIN TRAPZ. CHANNEL
67+00 GRADE BREAK
BEGIN SLOPE PAVING EXIST. SIDEWALK RT.
END SLOPE PAVING MATCH EXIST. SIDEWALK RT.
BEGIN TRANSITION
END TRANSITION
N 44,400
N 44,600
N 44,800
N 45,000
N 45,200

MATCH LINE – STA. 67+00.00
SEE SHEET C-9

NORTH
SCALE: 1"=40'

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

PROFILE
SCALE: HORIZ. 1"=40', VERT. 1"=4'

KEY MAP
SCALE 1" = 1000'
4 5 6 7 8 9 10

NO.	DATE	REVISE T.W. GRADE	DESCRIPTION
1	8-30-94		

RECOMMENDED FOR APPROVAL
NOEL C. LANGHAM
P.E. NO. 10165
DATE 7-11-94

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BOULEVARD, LAS VEGAS, NEVADA 89102

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
PLAN AND PROFILE
55+00.00 TO 67+00.00

SHEET
C-8
SHT 8 OF 14

JOB NO. 500.710

- (2) CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-8.1.1.-R(724)
- (3) CONSTRUCT CHANNEL SURFACE INLET FENCE (4/C-11)
- (4) CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-8.3.3.-(616)
- (5) PROTECT EXISTING CURB AND GUTTER, STREET LIGHTING, LANDSCAPING AND SPRINKLER SYSTEM.
- (6) CONSTRUCT PIPE CONNECTION PER DETAIL (10/C-12)
- (7) SLOPE PAVING (3/C-11)
- (8) ADJUST EXISTING MANHOLE & FRAME (STD. DWG. 308).
- (9) CONSTRUCT CHANNEL ACCESS STEPS (3/C-12)

MATCH LINE - STA. 67+00.00
SEE SHEET C-8

MATCH LINE - STA. 79+00.00
SEE SHEET C-10

MOD. TYPE "A" DROP INLET (C-14)

SURFACE INLET NO. 8' (1/C-13)

CONSTRUCTION EASEMENT

40' SLOAN LANE

24" RCP - 68 L.F.

SLOAN LANE 10:1

GRADE TO DRAIN

NORTH
SCALE 1"=40'

SLOAN CHANNEL
SCALE: HORIZ. 1"=40'

KEY MAP
SCALE 1" = 1000'
OWENS AVE | WASHINGTON AVE | BONANZA RD. | STEWART AVE

PROFILE
SCALE: HORIZ. 1"=10', VERT. 1"=5'

EXIST. GRADE R/W EAST (55' LT.)
EXIST. GRADE R/W WEST (50' RT.)
TOP OF CHANNEL WALL (LT. & RT.)
H.G.L. (Q = 3300 c.f.s.)
24" RCP
EXIST. GRADE ℄ CHANNEL
CHANNEL F.L.
S=-0.0053
GRADE BREAK
BEG. SLOPE PAVING RT.
END SLOPE PAVING RT.
24" RCP OUTLET PIPE
SURFACE INLET NO. 8'

JOB NO. 500.710

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE TO STEWART AVE
PLAN AND PROFILE
67+00.00 TO 79+00.00

SHEET C-9
SHT 9 OF 14

G.C. WALLACE, INC.
Engineering/Architecture
1666 SOUTH RAINBOW BLVD., LAS VEGAS, NEVADA 89102

RECOMMENDED FOR APPROVAL
NOEL C. TAYLOR, P.E.
CHIEF ENGINEER - STATE OF NEVADA
NO. 5703

NO. | DATE | DESCRIPTION

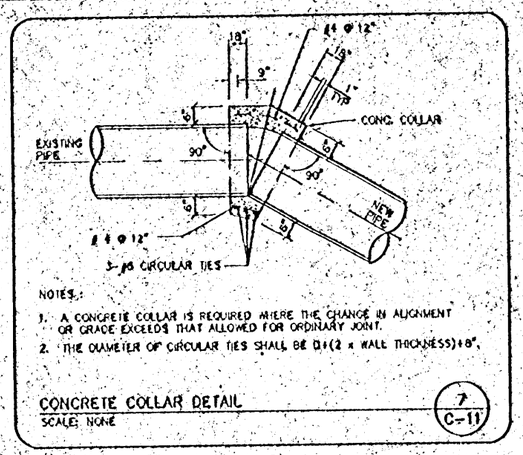
SLCH09.DWG 8/07/96

MATCH LINE - STA. 79+00.00
SEE SHEET C-9

(1) MATCH EXISTING CONCRETE CHANNEL PER DETAIL (2/C-11)
(2) CONSTRUCT 6' HIGH CHAIN LINK FENCE PER N.D.O.T. STD. DWG. NO. R-6.1.1.-R(724)
(3) CONSTRUCT CHANNEL SURFACE INLET FENCE (6/C-11)
(4) CONSTRUCT FENCE GATE PER N.D.O.T. STD. DWG. NO. R-6.3.3.-(818)
(7) CONSTRUCT SLOPE PAVING (5/C-11)
(9) CONSTRUCT CHANNEL ACCESS STEPS (5/C-11)
(11) CONSTRUCT PERMANENT SIGN

NORTH
SCALE: 1"=40'

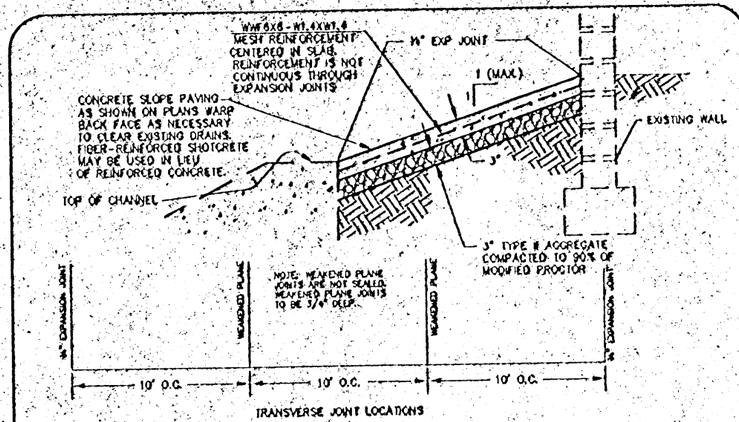
SLOAN LANE
100' R/W
GRADE TO DRAIN
DIRT ROAD
SLOAN LANE
24"
SS
42"
24"
SS
42' R/W
SLOAN LANE
R/W
LANE
℄ CHANNEL
SURFACE INLET NO. 7 (1/C-13)
87+00.00
87+26.64
END CHANNEL IMPROVEMENTS
STEWART AVE
ABANDONED
88+71.28
END OF PROJECT LIMITS
27'SS
10'
E 51,200
E 51,000
N 42,000
N 42,200
N 42,400
80+00
81+00
82+00
83+00
84+00
85+00
86+00
87+00
88+00
90+00
91+00
1735
1740
1745
2:1
30'
60.00'
RIP RAP
RIP RAP
RIP RAP



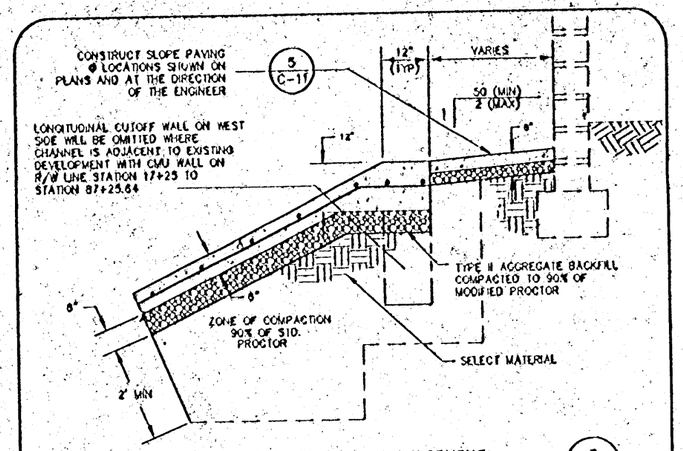
NOTES:

1. A CONCRETE COLLAR IS REQUIRED WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR ORDINARY JOINT.
2. THE DIAMETER OF CIRCULAR TIES SHALL BE D+(2 x WALL THICKNESS)+8".

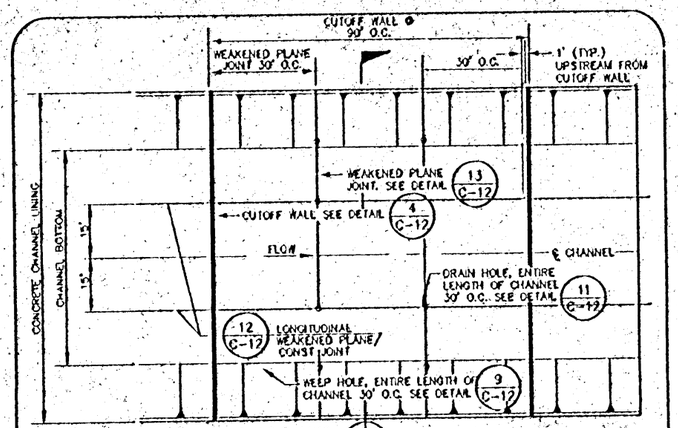
CONCRETE COLLAR DETAIL — 7 / C-11
SCALE: NONE



SLOPE PAVING DETAIL — 5 / C-11
SCALE: NONE

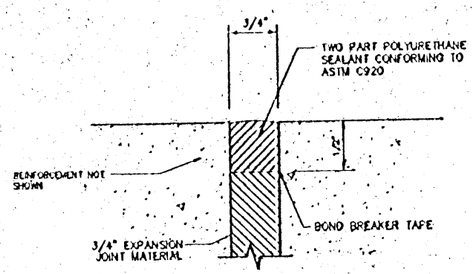


CHANNEL DETAIL-ADJACENT TO EXIST. DEVELOPMENT — 3 / C-11
SCALE: NONE

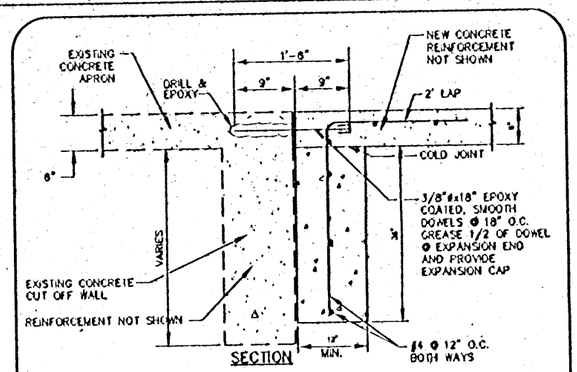


NOTE: TRANSVERSE WEAKENED PLANE JOINTS TO BE CENTER OVER WEEP HOLES (1" = 10' / C-11)

CHANNEL DETAIL — 6 / C-11
SCALE: 1" = 20'

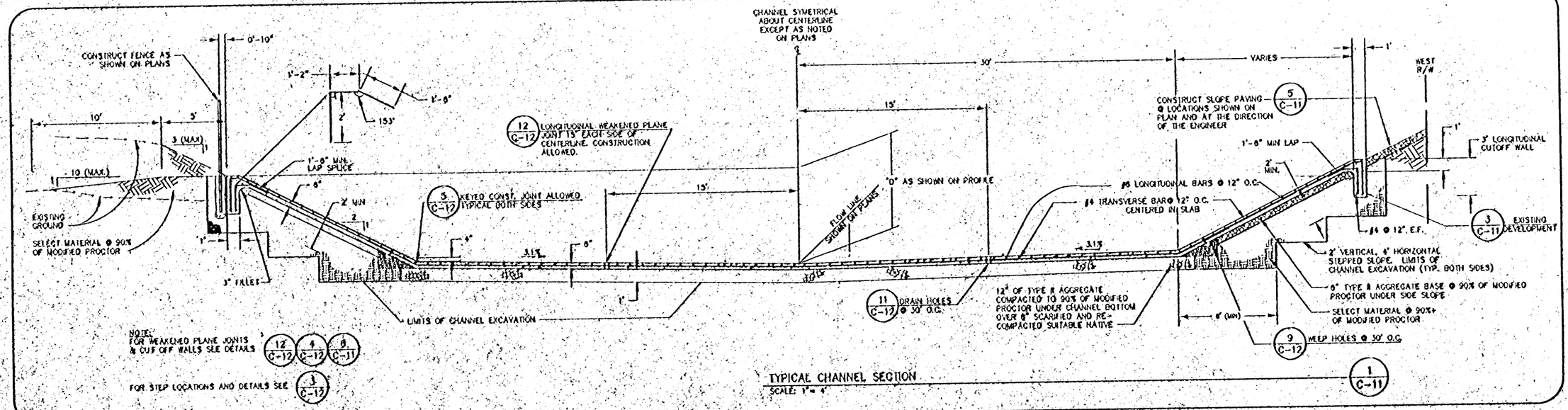


3/4" EXPANSION JOINT — 4 / C-11
SCALE: NONE



APRON ❶ OWENS AVE. R.C.B.
APRON ❷ WASHINGTON AVE. R.C.B.
APRON ❸ STEWART AVE. R.C.B.
APRON ❹ BONANZA RD. R.C.B.

SCALE: NONE — 2 / C-11



NOTE: FOR WEAKENED PLANE JOINTS & CUT OFF WALLS SEE DETAILS 12 / C-12, 4 / C-12, 6 / C-11

FOR STEP LOCATIONS AND DETAILS SEE 3 / C-12

TYPICAL CHANNEL SECTION — 1 / C-11
SCALE: 1" = 4'

JOB NO. 500.710

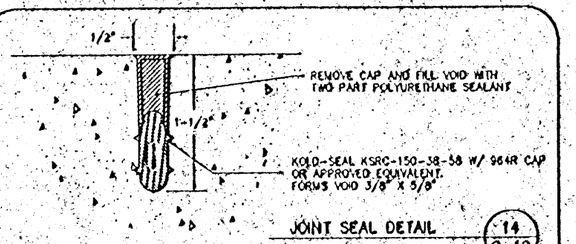
WALLACE INC. Engineering/Architecture 1555 SOUTH RAINBOW BLVD.,LAS VEGAS, NEVADA 89102

G.C. WALLACE, INC. Engineering

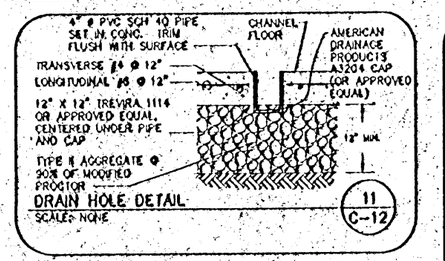
CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE
DETAIL SHEET 1

SHEET C-11
SHT 11 OF 14

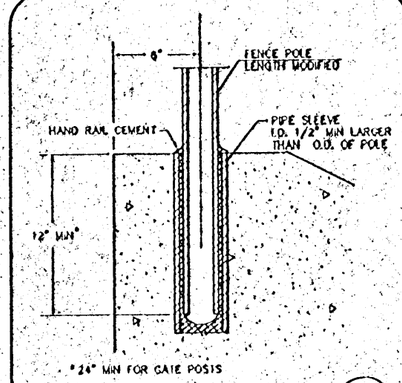
NO. DATE DESCRIPTION



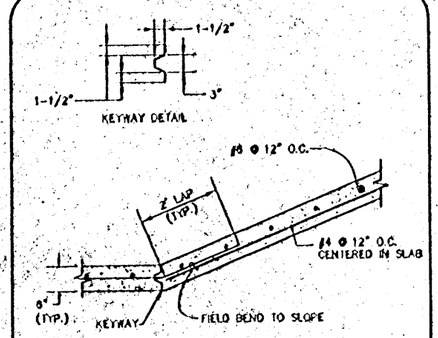
JOINT SEAL DETAIL
SCALE: NONE
14 / C-12



DRAIN HOLE DETAIL
SCALE: NONE
11 / C-12

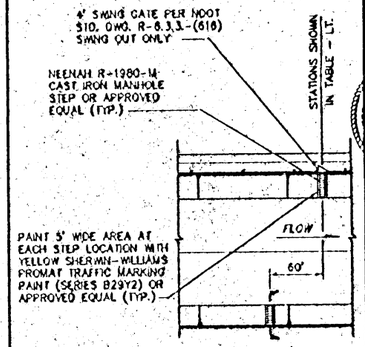


CHAIN LINK FENCE
POLE MOUNT OPT. B
SCALE: NONE
8 / C-12



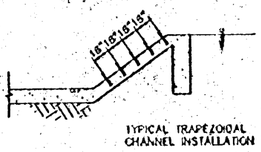
KEY JOINT DETAIL
SCALE: NONE
5 / C-12

STEP LOCATION	
STATIONS	DESCRIPTION
11+80	LT. & RT.
17+50	LT. & RT.
23+50	LT. & RT.
29+50	LT. & RT.
35+40	LT. & RT.
41+40	LT. & RT.
47+40	LT. & RT.
53+40	LT. & RT.
59+40	LT. & RT.
64+00	LT. & RT.
68+00	LT. & RT.
74+00	LT. & RT.
80+00	LT. & RT.
86+00	LT. & RT.



NOTE:
STEP LOCATIONS ON RIGHT SIDE OF CHANNEL SHALL BE OFFSET 60' UPSTREAM FROM STATIONS SHOWN IN TABLE.

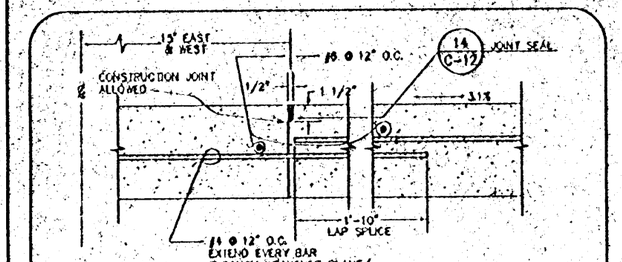
PLAN



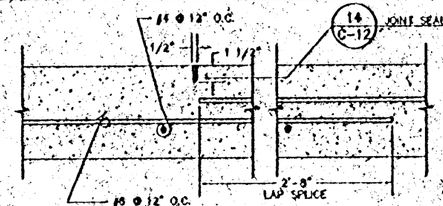
TYPICAL TRAPEZOIDAL CHANNEL INSTALLATION

SECTION

STEP LOCATION DETAIL
SCALE: NONE
3 / C-12

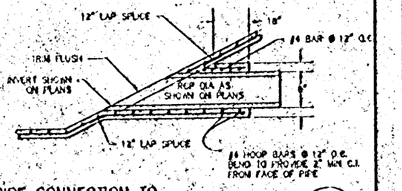


LONGITUDINAL WEAKENED PLANE JOINT
SCALE: NONE
12 / C-12

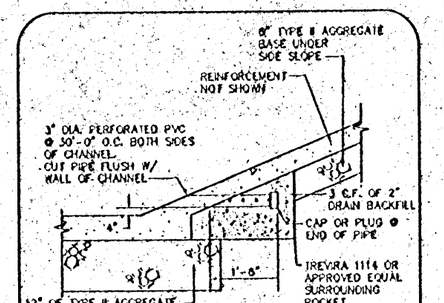


NOTE:
TRANSVERSE WEAKENED PLANE JOINTS TO BE @ 30' O.C.

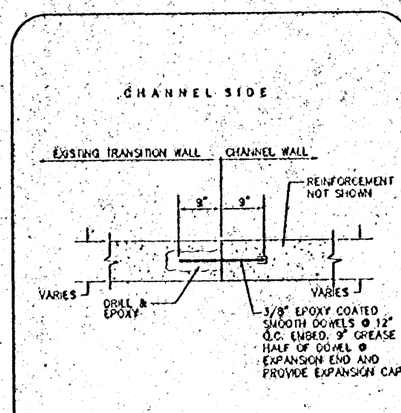
TRANSVERSE WEAKEND PLANE JOINT
SCALE: NONE
13 / C-12



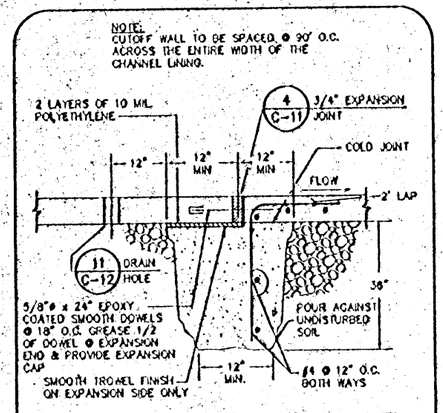
PIPE CONNECTION TO TRAPEZOIDAL CHANNEL
SCALE: NONE
10 / C-12



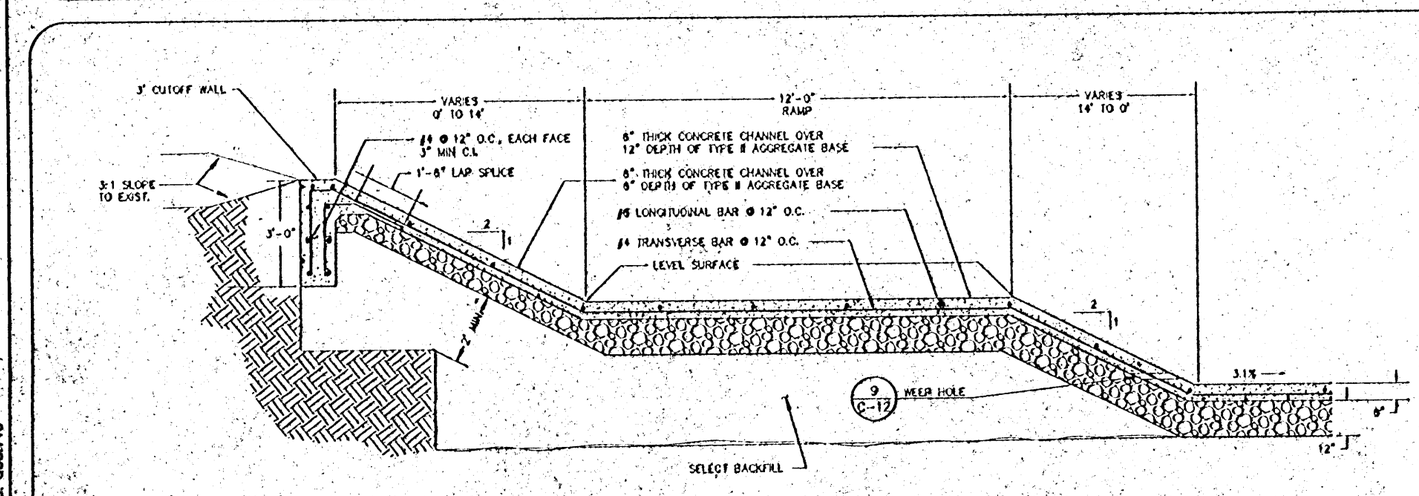
WEEP HOLE DETAIL
SCALE: NONE
9 / C-12



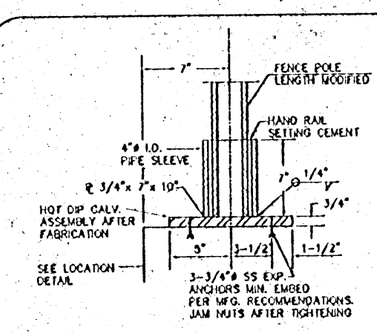
CONSTRUCTION JOINT
SCALE: NONE
7 / C-12

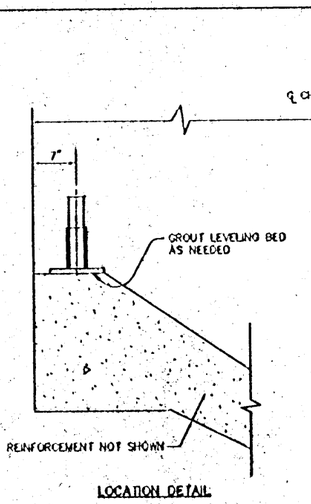


CHANNEL CUT-OFF WALL
SCALE: NONE
4 / C-12



TYPICAL ACCESS RAMP DETAIL
SCALE: 1" = 2'
6 / C-12





LOCATION DETAIL

CHAIN LINK FENCE,
POLE MOUNT OPT. A
SCALE: NONE
1 / C-12

JOB NO. 590.710

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD.,LAS VEGAS, NEVADA 89102

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE TO STEWART AVE
DETAIL SHEET 2

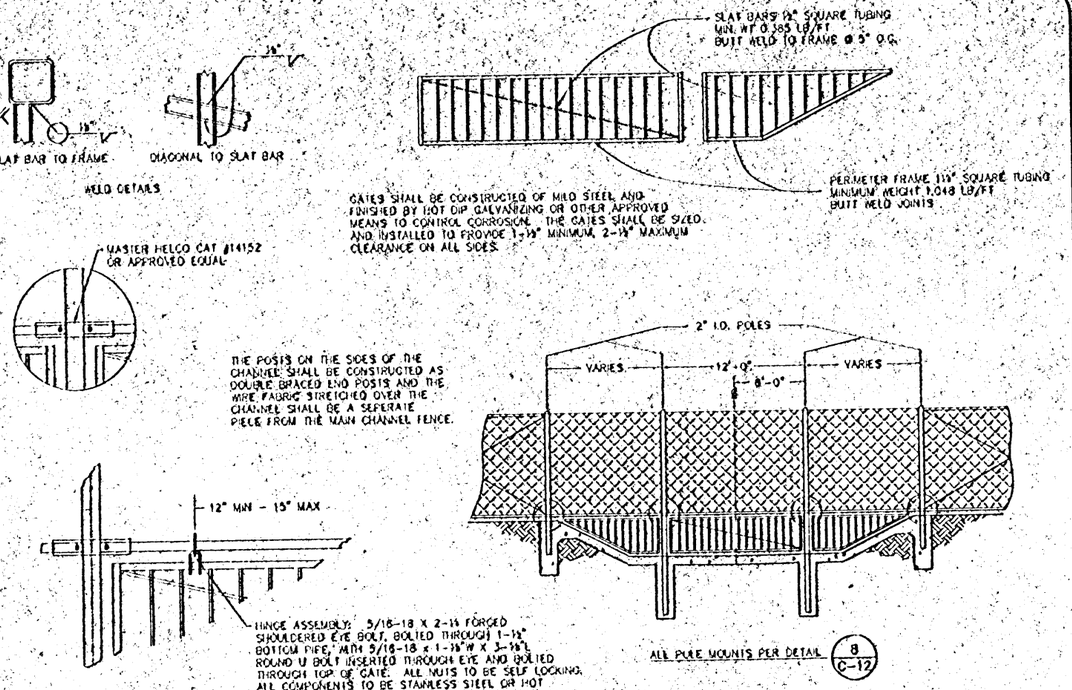
SHEET
C-12
SHT 12 OF 18

NEVADA LICENSE NO. 7676 STATE OF NEVADA NOEL C. LANGRUN REGISTERED ENGINEER CIVIL
NOEL C. LANGRUN 10/31/95 R.E.P.C. NO. DATE

NEVADA LICENSE NO. 7676 STATE OF NEVADA NOEL C. LANGRUN REGISTERED ENGINEER CIVIL
NOEL C. LANGRUN 10/31/95 R.E.P.C. NO. DATE

NO. DESCRIPTION

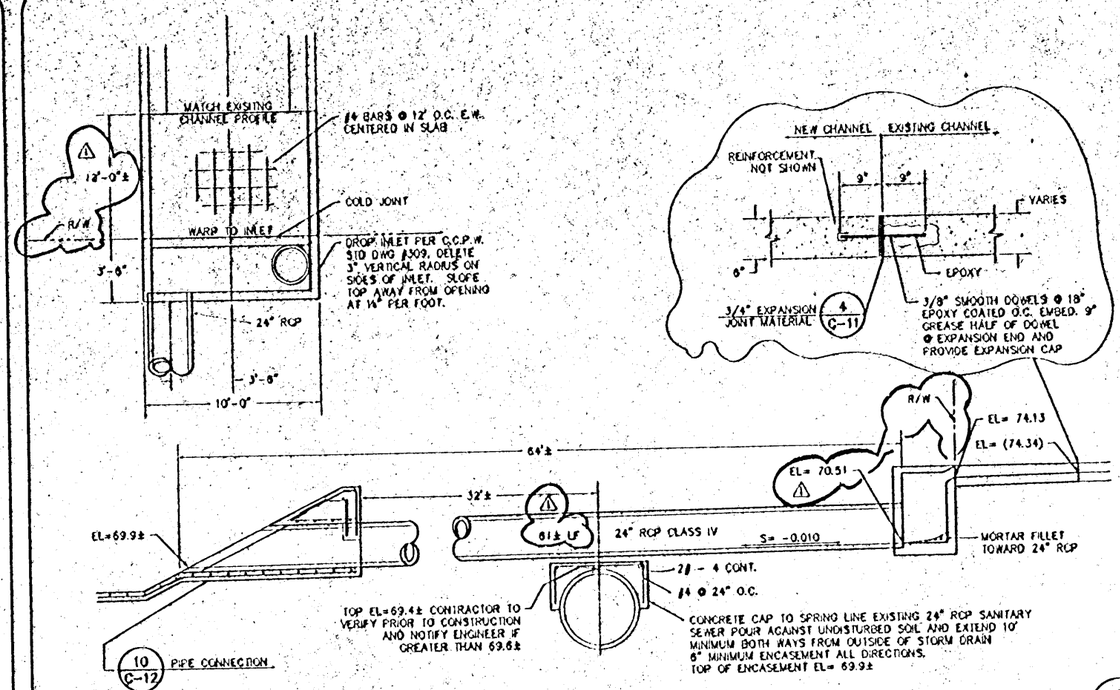
H.D.D. 8/02/96



ALL SPECIAL FENCE DETAILS FOR THE INLET STRUCTURE INCLUDING THE GATES SHALL BE INCLUDED IN THE PER EACH COST OF THE INLET STRUCTURE

SURFACE INLET FENCE DETAIL
SCALE: NONE

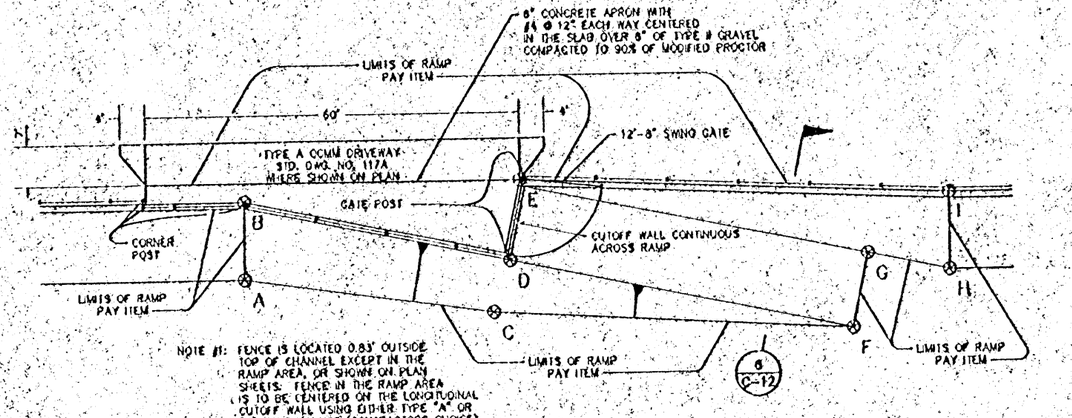
4 C-13



SPECIAL INLET DETAIL (STA. 23+34)
SCALE: NONE

2 C-13

POINT	A	B	C	D	E	F	G	H	I
RAMP 1	N/A	N/A	STA: 10+82.07±	STA: 10+61.35'	STA: 10+63.47'	STA: 11+19.48'	STA: 11+20.50'	STA: 11+49.88'	STA: 11+50.00'
			OFFSET: 23.31' R	OFFSET: 33.85' R	OFFSET: 45.64' R	OFFSET: 23.31' R	OFFSET: 35.32' R	OFFSET: 30.00' R	OFFSET: 42.40' R
			EL = (1772.17')	EL = 1777.90'	EL = 1777.90'	EL = 1771.87'	EL = 1772.13'	EL = 1771.97'	EL = 1777.87'
RAMP 2	STA: 48+03.58	STA: 48+01.22	STA: 48+45.49	STA: 48+46.22'	STA: 48+47.90'	STA: 49+01.03'	STA: 49+03.49'	STA: 49+16.61'	STA: 49+16.61'
	OFFSET: 30.00' L	OFFSET: 42.40' L	OFFSET: 24.31' L	OFFSET: 32.47' L	OFFSET: 45.40' L	OFFSET: 24.00' L	OFFSET: 32.75' L	OFFSET: 30.00' L	OFFSET: 42.40' L
	EL = 1756.26'	EL = 1761.97'	EL = 1755.87'	EL = 1761.74'	EL = 1761.73'	EL = 1755.97'	EL = 1755.77'	EL = 1755.71'	EL = 1761.41'
RAMP 3	STA: 68+00.00'	STA: 65+97.68	STA: 68+32.93	STA: 68+42.68'	STA: 68+44.35'	STA: 68+97.47'	STA: 87+00.00	STA: 87+13.05	STA: 87+13.05
	OFFSET: 30.00' L	OFFSET: 42.40' L	OFFSET: 24.31' L	OFFSET: 32.47' L	OFFSET: 45.40' L	OFFSET: 24.00' L	OFFSET: 32.73' L	OFFSET: 30.00' L	OFFSET: 42.40' L
	EL = 1745.28'	EL = 1750.98'	EL = 1744.77'	EL = 1750.63'	EL = 1750.61'	EL = 1744.27'	EL = 1744.60'	EL = 1744.46'	EL = 1750.18'

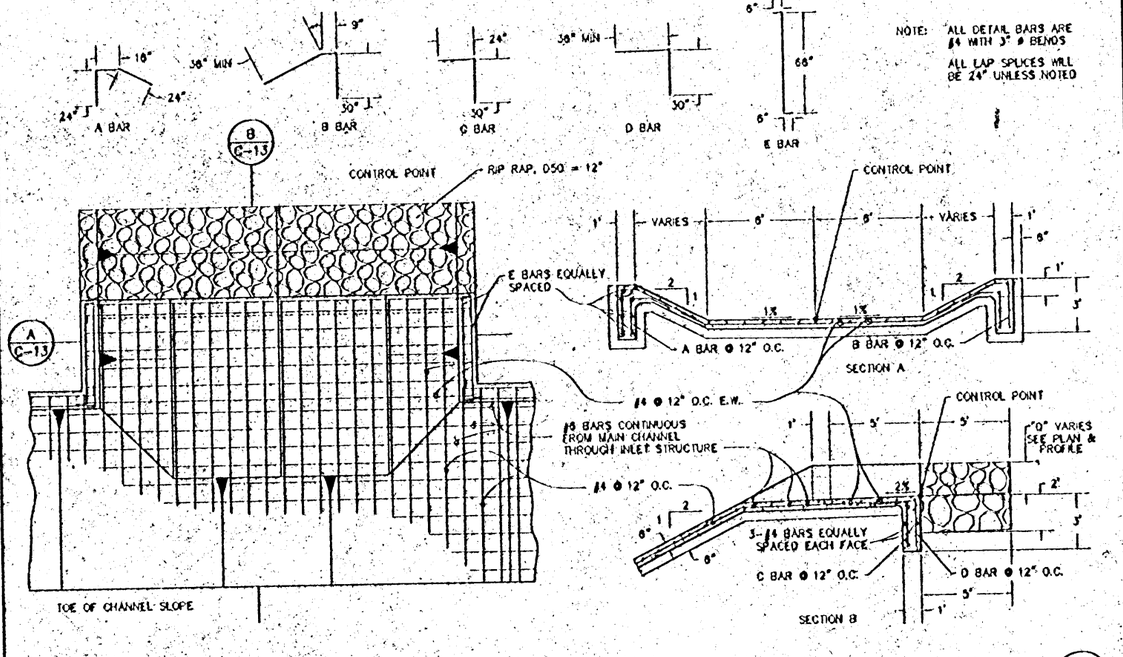


NOTE #1: FENCE IS LOCATED 0.83' OUTSIDE TOP OF CHANNEL EXCEPT IN THE RAMP AREA, OR SHOWN ON PLAN SHEETS. FENCE IN THE RAMP AREA IS TO BE CENTERED ON THE LONGITUDINAL CUTOFF WALL USING EITHER TYPE "A" OR "B" POLE MOUNTS (CONTRACTORS CHOICE). GATE POST MUST USE TYPE "B" MOUNT

NOTE #2: THE #4 LONGITUDINAL REINFORCEMENT IN THE CUTOFF WALL MUST BE CONTINUOUS THROUGH THE CORNERS. 24" MINIMUM LAP IS REQUIRED FOR ALL SPLICES MADE WITHIN 5' OF CORNERS GREATER THAN 30°.

RAMP GEOMETRIC DETAIL
SCALE: NONE

3 C-13



SURFACE INLET DETAIL
SCALE: NONE

1 C-13

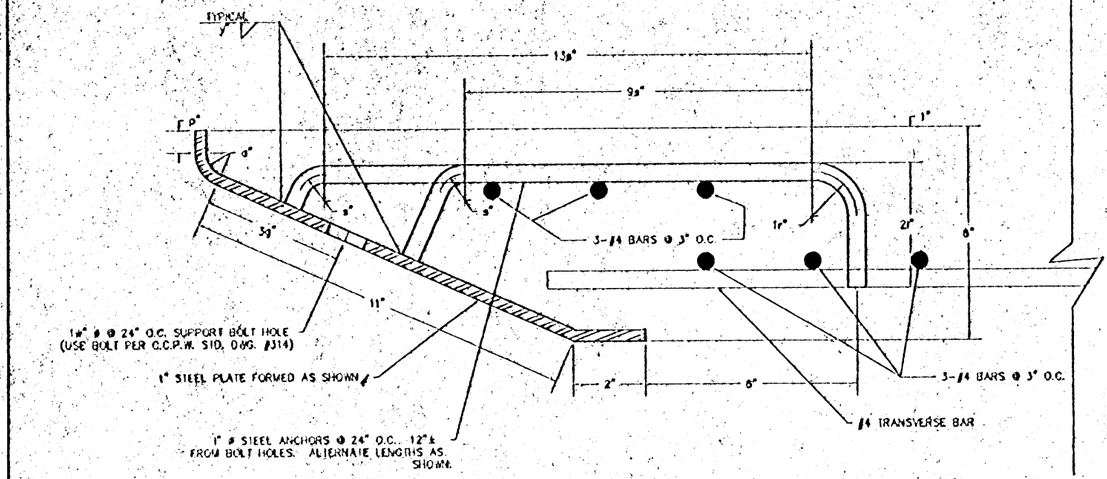
JOB NO. 500.710

G.C. WALLACE, INC.
Engineering/Architecture

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE TO STEWART AVE.
DETAIL SHEET 3

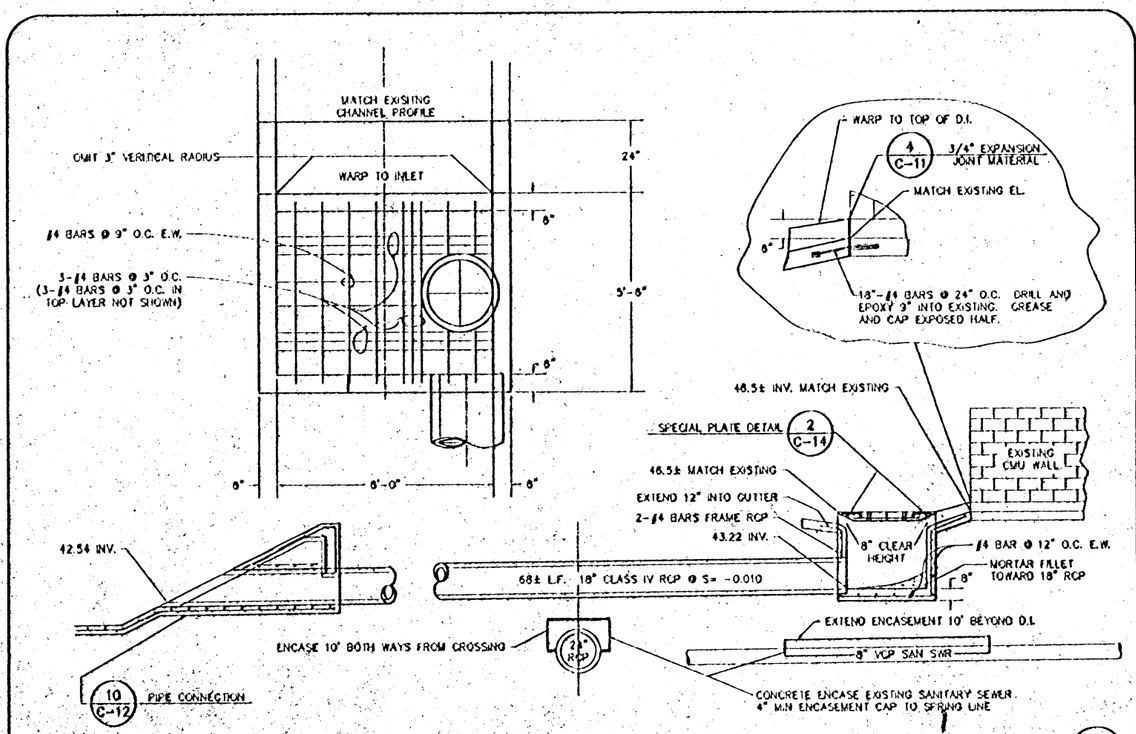
SHEET
C-13
SHT 13 OF 18

V3.0.01 8/07/14



SPECIAL PLATE DETAIL
SCALE: 1"=1'

2
C-14



MODIFIED TYPE "A" DROP INLET(C.C.P.W. TYPE A MODIFIED) (STA. 72+41.24)
AND STORM DRAIN PROFILE
SCALE: NONE

1
C-14

REVISIONS

NO.	DESCRIPTION	DATE

REGISTERED PROFESSIONAL ENGINEER
NICOLAS C. WALLACE
No. 10169
STATE OF NEVADA
CIVIL
RENEWAL DATE: 11-30-06

G.C. WALLACE, INC.
Engineering/Architecture
1555 SOUTH RAINBOW BLVD.,LAS VEGAS, NEVADA 89102

CLARK COUNTY DEPARTMENT OF PUBLIC WORKS
SLOAN CHANNEL - OWENS AVE. TO STEWART AVE.
DETAIL SHEET 4

SHEET
C-14
SHT 14 OF 14

JOB NO. 00710

W2Q 04 6/02/06

EXHIBIT E

Collins Business Park Phase II
Improvement Plans

COLLINS BUSINESS PARK - PHASE 1

GOBI SANDS AVENUE

LAMB BOULEVARD

FLOSSMOOR STREET

COLLINS BUSINESS PARK - PHASE 1

ACCESS RAMP SECTION

ZONE X

ZONE A

ZONE X

ZONE A

DRAINAGE CHANNEL "A"

CONSTRUCT CUT OFF WALL ADJACENT TO EXISTING HEADWALL, PER CONFORMANCE TO REGULATORY FLOOD CONTROL STANDARDS

CONSTRUCT CUT-OFF WALL 80' INVERALS PER DETAIL SHEET 10 (TYPICAL)

CONSTRUCT STEPS PER CCSTD DWG #416 600' INTERVALS OFFSET 45° FROM ONE BANK TO THE OTHER

CONSTRUCT SIDEWALK PER RTDD STD DWG NO. R-5112-(613)

CONSTRUCT COMMERCIAL DRIVEWAY PER CLARK COUNTY STD DWG NO. 116

15' LANDSCAPE EASEMENT

12' CHANNEL ACCESS RAMP

MATCHLINE SEE SHEET 5

GRAPHIC SCALE

PROJECT LOCATION

VICINITY MAP

LEGEND

FL	FLOW LINE
FG	FINISHED GRADE
TC	TOP OF CURB
(TC)	FUTURE TOP OF CURB
	GRADE BREAK
	2:1 SCARP
UG TEL	UG TEL
EX W	EXIST WATER
EX S / EX SWR	EXIST SEWER
	RETAINING WALL
EX GAS	EXIST GAS
	SUBDIVISION BOUNDARY
	STREET CENTERLINE
	EXIST STREET LIGHT
	PROPOSED STREET LIGHT
1'/00	EXISTING CONTOUR 5
1'/01	EXISTING CONTOUR 1
	PROPOSED CONTOUR
(98.63)	EXISTING ELEVATION
98.63	PROPOSED ELEVATION

BENCHMARK

CLARK COUNTY DATUM NO. 14 ELEV. 1894.332 SET DRIVE RIVET IN A 2"x2" ALUMINUM PLATE, IN DRILLED HOLE, WITH EPOXY GAUGE IN TOP OF CURB NORTHWEST CORNER OF CRAIG ROAD & LAMB BLVD. NEAR THE P.C. OF CRAIG ROAD

BASIS OF BEARING

THE BASIS OF BEARING FOR THIS SURVEY IS THE WESTERLY LINE OF THE S.W. 1/4 OF SEC. 5, T.19N., R.60E., M.D.M., WHICH BEARS N.00° 42' 14"E. AS SHOWN PER MAP RECORDED IN FILE 69, PAGE 87 OF SURVEYS IN THE OFFICE OF THE COUNTY RECORDER OF CLARK COUNTY, NEVADA.

NO.	BY	DATE	REVISION
1	TR	9/20/96	REVISED CHANNEL PER HYDRO. DEPT.
2	DS	11/11/96	ADDED MISC. NOTE
3	TD	11/21/96	REMOVED LANDSCAPE BERM ALONG LAMB

MASTER GRADING PLAN

COLLINS BUSINESS PARK - PHASE 2

PROFESSIONAL ENGINEER STATE OF NEVADA DANNY J. MCLAUDER No. 8352 REGISTERED PROFESSIONAL ENGINEER

ESI ENGINEERING, INC.

PLANNING · CONSULTING ENGINEERS · SURVEYORS

DRAWN BY: CP | CHECKED BY: DJM | DATE: 5-6-96

SHEET 4 OF 14 SHEETS

C:\PROJ\LAMB-BP\PHASE-2\P6356P4
5-6-1996 - 7:10

MATCHLINE SEE SHEET 4

ZONE A

ZONE X

ZONE A

ZONE X

DRAINAGE CHANNEL "A"

LAMB BOULEVARD

ALEXANDER ROAD

CONSTRUCT CUT-OFF WALL 90' INVERALS PER DETAL SHEET 10 (TYPICAL)

CONSTRUCT STEPS PER CC STND DWG #410 600' INTERVALS OFFSET 45° FROM ONE BANK TO THE OTHER

CONSTRUCT 5' SIDEWALK PER NDOT STD DWG NO R-5112-(613)

LANDSCAPE EASEMENT

1885 LF 48" STORM DRAIN @ S=0.0060

364.08 LF 48" STORM DRAIN @ S=0.0060

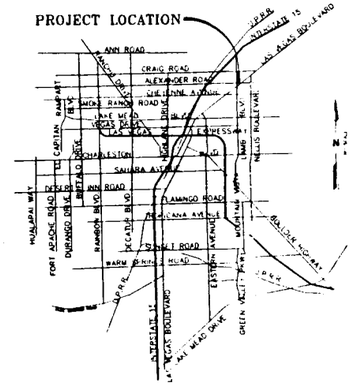
HEADWALL

MATCHLINE SEE SHEET 6

GRAPHIC SCALE

(IN FEET)
1 inch = 40 ft

PROJECT LOCATION



LEGEND

FL	FLOW LINE
FG	FINISHED GRADE
TC	TOP OF CURB
[TC]	FUTURE TOP OF CURB
	GRADE BREAK
	2:1 SLOPE
UG TEL	UG TEL
EX W	EXIST WATER
EX S	EXIST SEWER
	RETAINING WALL
EX GAS	EXIST GAS
	SUBDIVISION BOUNDARY
	STREET CENTERLINE
	EXIST STREET LIGHT
	PROPOSED STREET LIGHT
1184	EXISTING CONTOUR 5
1184	EXISTING CONTOUR 1
1180	PROPOSED CONTOUR
(98.63)	EXISTING ELEVATION
98.63	PROPOSED ELEVATION

BENCHMARK

CLARK COUNTY DATUM No. 14 ELEV. 1894.302 SET DRIVE RIVET IN A 2"x2" ALUMINUM PLATE, IN DRILLED HOLE, WITH EPOXY GLUE IN TOP OF CURB, NORTHWEST CORNER OF CRAIG ROAD & LAMB BLVD. NEAR THE PC OF CRAIG ROAD.

BASIS OF BEARING

THE BASIS OF BEARING FOR THIS SURVEY IS THE MONUMENTED LINE OF THE S.W. 1/4 OF SEC. 3, TWN. 20, RNG. 60E, M.D.M., WHICH BEARS N00°42'13"E, AS SHOWN PER MAP RECORDED IN FILE 69, PAGE 87 OF SURVEYS IN THE OFFICE OF THE COUNTY RECORDER OF CLARK COUNTY, NEVADA.

NO.	DATE	BY	DESCRIPTION
1	9/20/95	TB	REVISED CHANNEL PER HYDRO DEPT.
2	1/16/96	D.	MISC. MISC. NOTES
3	1/12/96	TB	REMOVED LANDSCAPE BERM ALONG LAMB

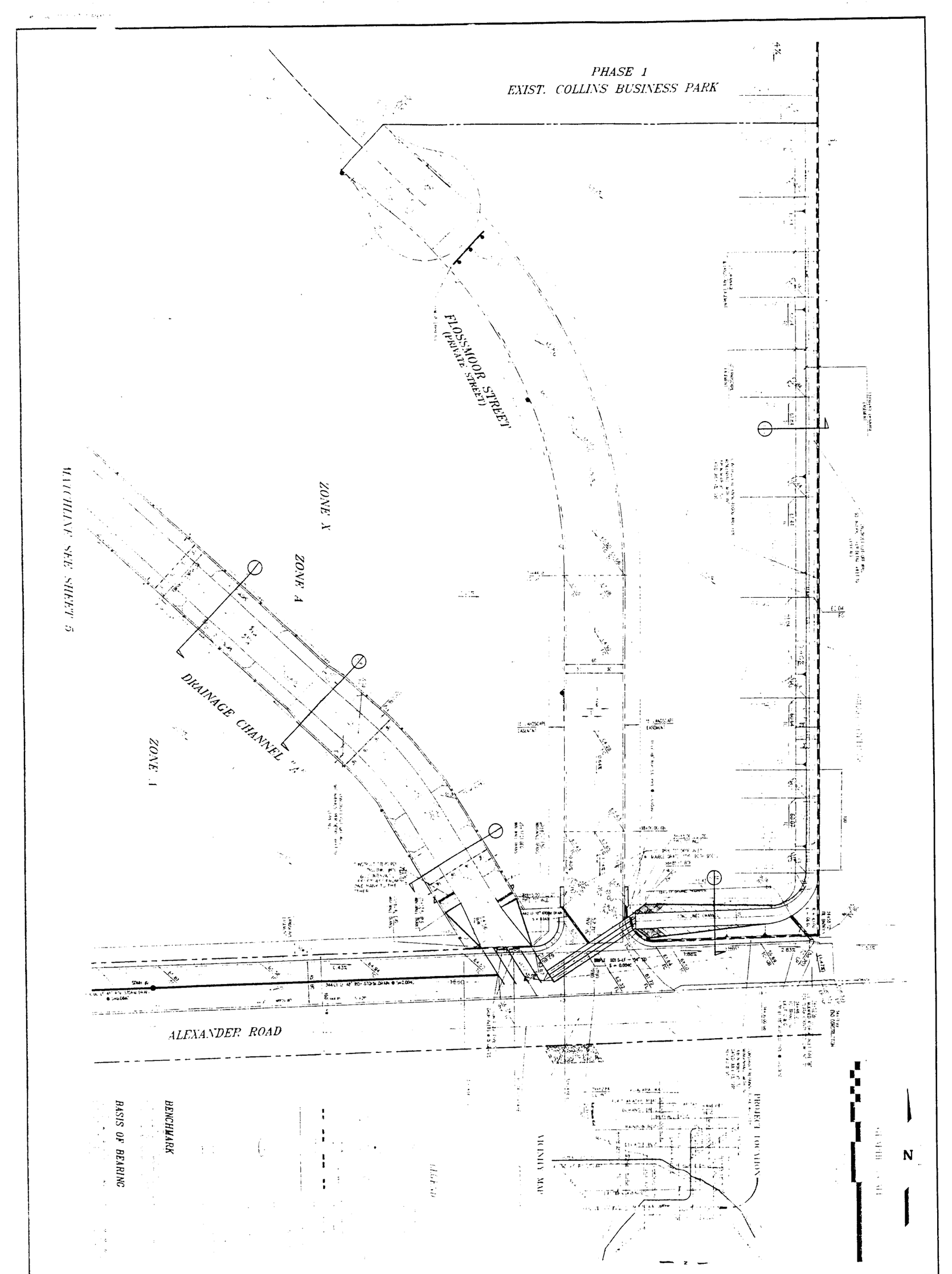
MASTER GRADING PLAN

COLLINS BUSINESS PARK - PHASE 2

PROFESSIONAL ENGINEER STATE OF NEVADA DANNY MCFADDEN No. 8582 CIVIL REGISTERED PROFESSIONAL ENGINEER

ESI

5 14



ESI

6 14

MASTER GRADING PLAN

COLLINS BUSINESS PARK - PHASE 2

1880
1870
1860
1850

LAMB BOULEVARD

EXISTING TRIPLE BOX CULVERT

ENERGY GRADE LINE

EXISTING GRADE @ CENTERLINE OF CHANNEL

FINISHED GRADE @ TOP OF CHANNEL

ENERGY GRADE LINE

HYDRAULIC GRADE LINE

BOTTOM OF CONCRETE CHANNEL

MATCHLINE STA. 20+00
SEE SHEET 13

PROFILE SCALE
VERT 1" = 4'
HORIZ 1" = 40'

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00

NOTE:

THE CHANNEL SHALL BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM. AT ALL END OF DAY CONCRETE POURS, PROVIDE 3' DEEP CUTOFF WALL. IF END OF DAY POUR IS LESS THAN 90', PROVIDE A 3' DEEP CUTOFF WALL AT A 90' MIN. SPACING

DETAIL "E" ON SHEET 10

CONSTRUCT CUT OFF WALL ADJACENT TO EXISTING HEADWALL, PER CONFORMANCE TO REGULATORY FLOOD CONTROL STANDARDS

EXIST. TRIPLE 9' x 8' REINFORCED CONCRETE BOX CULVERT

12' CHANNEL ACCESS RAMP

CONSTRUCT CUT OFF WALL 90' INTERVALS, PER DETAIL SHEET 10 (TYPICAL)

TOP OF SLOPE

2 : 1 SLOPE

MATCHLINE STA. 30-00
SEE SHEET 15

LAMB BOULEVARD

DRAINAGE CHANNEL "A"

ACCESS RAMP SECTION

NOTE
SEE DETAIL SHEET 2 FOR TYPICAL STREET SECTION

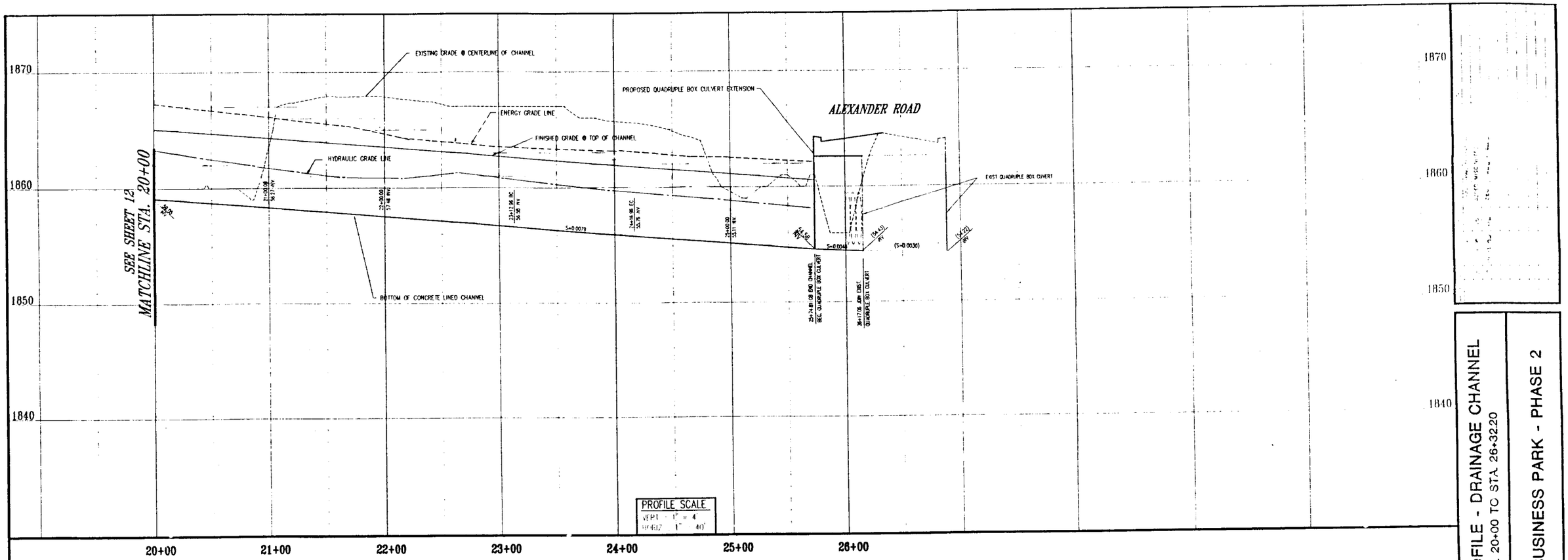
BENCHMARK

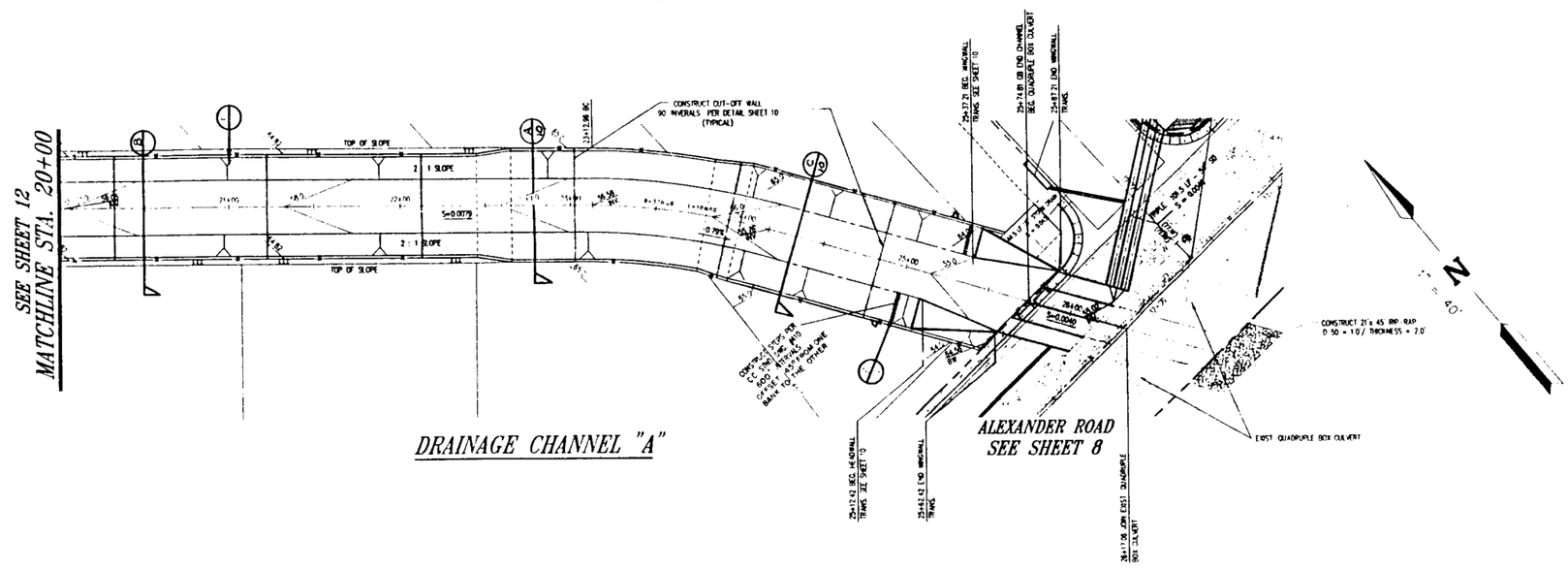
CLARK COUNTY DATUM, No. 14 ELEV. 1894.102' SET DRIVE RIVET IN A 2"x2" ALUMINUM PLATE, IN DRILLED HOLE, WITH EPOXY GLUE IN TOP OF CURB, NORTHWEST CORNER OF CRAIG ROAD & LAMB BLVD. NEAR THE PC OF CRAIG ROAD

PLAN & PROFILE DRAINAGE CHANNEL
STA. 10+00.00 TO STA. 20+00.00

COLLINS BUSINESS PARK - PHASE 2

12 14





NOTE:

THE CHANNEL SHALL BE CONSTRUCTED FROM DOWNSTREAM TO UPSTREAM AT ALL END OF DAY CONCRETE PUMP STOPS. 3' DEEP CUTOFF WALL @ END OF DAY POUR (TYP.) THAN SET, PROVIDE A 3' DEEP CUTOFF WALL AT A 90 MIN. SPACING.

DETAIL "I" ON SHEET 10

NOTE
SEE DETAIL SHEET 10 FOR TYPICAL CHANNEL SECTION

BENCHMARK

CLARK COUNTY DATUM, NO. 14 ELEV. 1894.102 SET DRIVE RIVET IN A STAT. ALUMINUM S. ATE, INSCRIBED "LCE" WITH EPOXY GLUE IN TOP OF CURB, NORTHEAST CORNER OF CRAIG ROAD & LAMB BLVD. NEAR THE PC OF CRAIG ROAD

PLAN & PROFILE - DRAINAGE CHANNEL
STA 20+00 TO STA 26+32.20

COLLINS BUSINESS PARK - PHASE 2

ESI

13 14

1-800-227-2600

RESPONSE MEMORANDUM

REGARDING FEMA CONCERNS ON WEST RANGE WASH DIVERSION DIKE

Case No. 96-09-43P

October 18, 1997

RESPONSE MEMORANDUM

REGARDING FEMA CONCERNS ON WEST RANGE WASH DIVERSION DIKE

This memorandum was prepared in response to the letter from Federal Emergency Management Agency (FEMA) dated September 5, 1996 regarding the Range Wash Flood Insurance Study Restudy, Case Number 96-09-483P. The letter expressed two areas of concern: (1) deposition where flows would impact the dike, and (2) possible erosion along the dike at the downstream end, stations 58+00 to 62+00, where there is an increase in slope and change in cross-section.

ITEM 1 DEPOSITION FROM FLOW PERPENDICULAR TO THE DIKE

The letter expresses concern that, as flows strike the dike, the velocity of flow will go to approximately zero as the flow changes direction and the accompanying sediment load will be deposited. The deposition at the dike will continue to build throughout the course of the storm hydrograph. There is concern that the sediment deposition at the dike may be high enough to allow flow to eventually overtop the dike.

Approach

An evaluation of sediment accumulation along the dike during a 100-year event was performed using a simplistic approach based on sediment loads already determined and included in the support documentation.

The previous analysis and documentation prepared by Boyle Engineering Corporation (Boyle) and included in the TSDN was reviewed. Review of topographic maps and field reconnaissance was performed to assist in making appropriate assumptions and selection of parameters. Factors to be considered for flow conditions at the dike included: type of flow regime, cumulative width of multiple channels, the spread of multiple channels, and the volume, shape, and slope of deposition accumulating as flows impact the dike.

An estimation of the deposition at the dike was determined and the conveyance along the dike was evaluated for appropriate freeboard.

Multiple Channel Flow Regime

The topography and basin boundaries tributary to the dike are shown in **Figure 1**. The topography is relevant in determining the type of flow regime. The Boyle analysis indicated that a multiple channel flow regime was expected at the location of the dike, but a single channel flow was assumed for the purpose of using a conservative approach to their analysis.

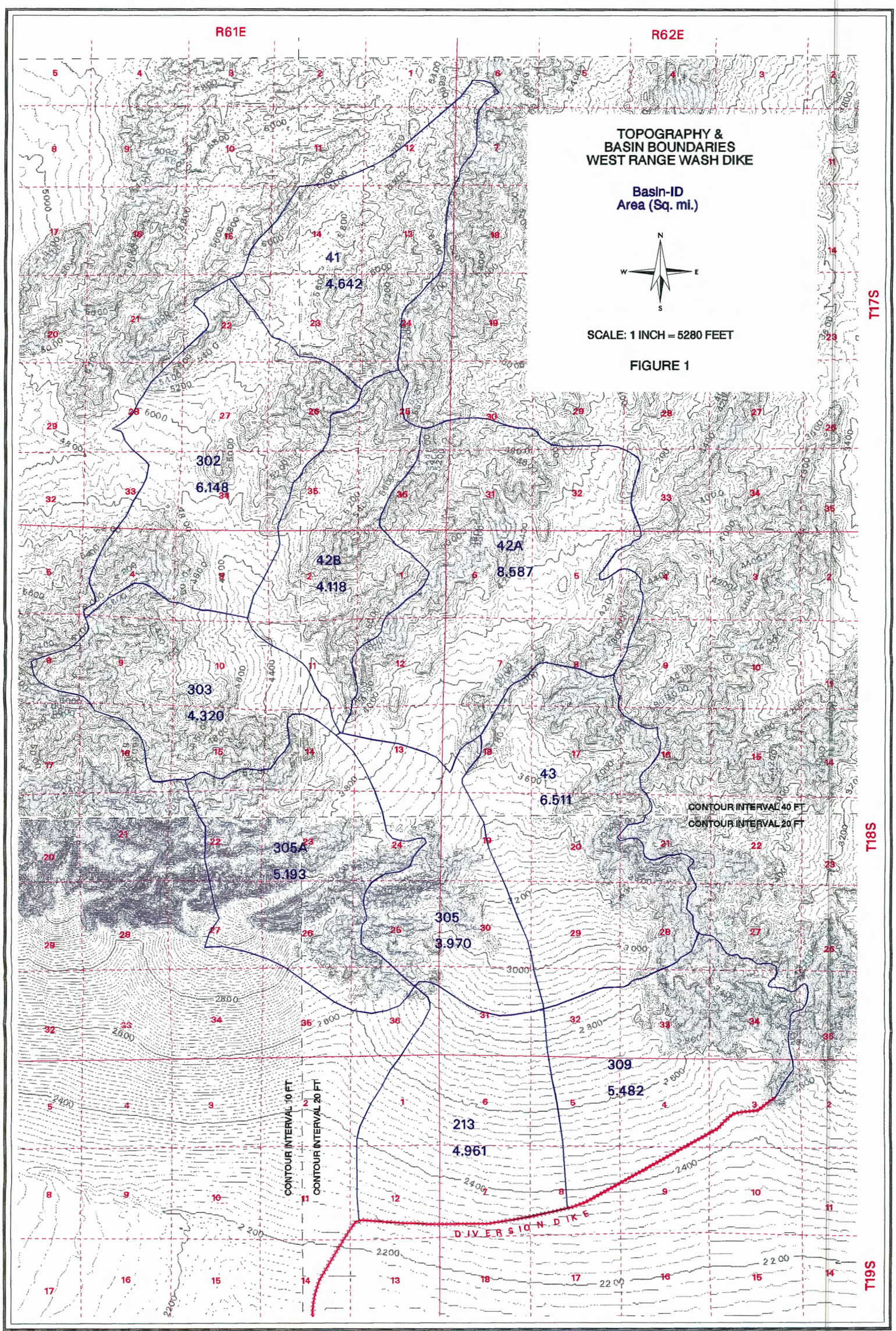
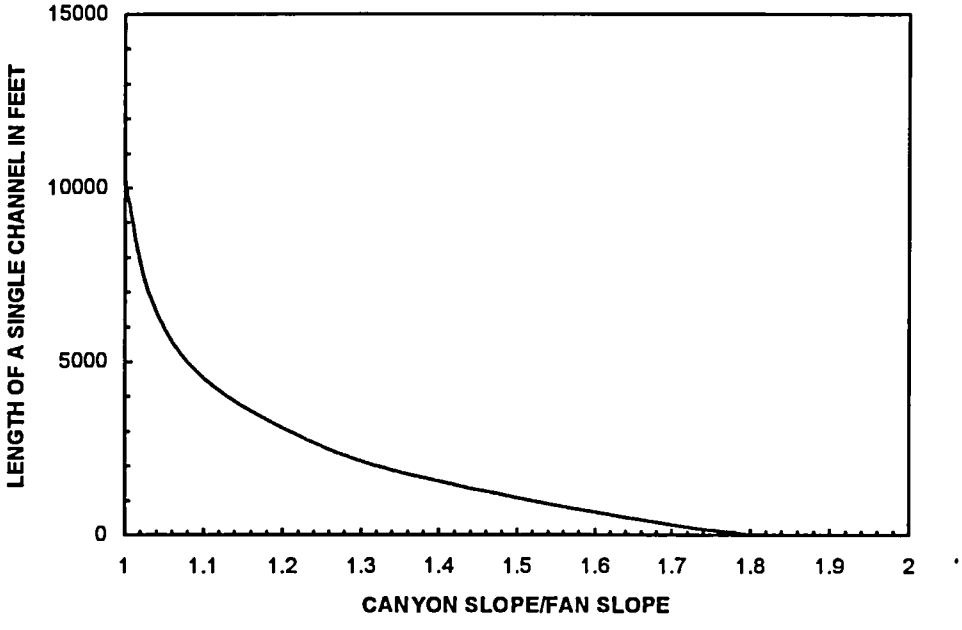

TOPOGRAPHY &
BASIN BOUNDARIES
WEST RANGE WASH DIKE
Basin-ID
Area (Sq. mi.)
SCALE: 1 INCH = 5280 FEET
FIGURE 1
R61E
R62E
T17S
T18S
T19S
41
4.642
302
6.148
42B
4.118
42A
8.587
303
4.320
43
6.511
305A
5.193
305
3.970
309
5.482
213
4.961
CONTOUR INTERVAL 40 FT
CONTOUR INTERVAL 20 FT
CONTOUR INTERVAL 10 FT
CONTOUR INTERVAL 20 FT
DIVERSION DIKE

Figure 2, from previous documentation, gives a length of a single channel regime based on the ratio of the canyon slope to the fan slope. The relationship indicates a maximum single channel length of approximately 10,000 feet.

From the topographic map it may be noted that there is not a narrow well defined canyon at the top of the West Range Wash Fan. The upper canyons are wide and filled with alluvium. Smaller fans occur upstream of the effectual apex of the West Range Fan. Several flow paths converge and form the effectual apex at the approximate location of contour 3400. This location is more than 4 miles (approximately 23,000 feet) upstream of the dike. Based on these factors it may be assumed that flows have reached a multiple channel regime upstream of the dike.

FIGURE 2
RELATIONSHIP BETWEEN LENGTH OF A SINGLE CHANNEL AND RATIO OF CANYON SLOPE TO FAN SLOPE



Canyon slope should normally be computed along the stream bed of the lower canyon to a point upstream of the canyon mouth where there is a notable change to a steeper gradient. Fan slope should normally be computed for the upper portion of the fan to a point downstream of the fan apex where there is a notable change to a flatter gradient.

Width of Flow

As included in the previous documentation the cumulative width of the multiple channel flow is estimated to be 1,254 feet. This is based on standard FEMA methodology using Dawdy's

Equations for flow regime and a 100-year peak discharge of 7,030 cfs. The width of flow is related to the quantity of flow by the following equation:

$$B = 36.1\ Q^{.4}$$

Where:

B = the cumulative width of flow in multiple channels in feet

Q = the discharge in cfs

Spread of Multiple Channels

The higher up the fan flows begin to divide, the wider the spread of flows would be at the dike. The wider the spread of flow, the more dispersed deposition along the dike would be. At the location of the dike the flow on the fan is assumed to be a multiple channel flow regime. Evidence was sought to aid in selecting a reasonable assumption for the spread of the flow reaching the dike. The width of the fan at the upstream end of the dike is approximately 5 miles wide (26,000 feet). The fan arc is very uniform with numerous small stream paths uniformly spread across the fan. The fan arc is very uniform extending up to approximate elevation 3300. At this elevation, the contours no longer follow the same arc pattern. Some incisement into the arc seems to have occurred typical of a single channel regime. A bifurcation point is therefore assumed between contours 3300 and 3200. See **Figure 3**. The bifurcation point represents a change from single channel regime to multiple channel regime.. The assumed bifurcation point, approximately 19,000 feet upstream of the dike, would support an assumption of widely spread flows reaching the dike.

A fan analysis to determine FEMA flood hazard zones was performed as an indication of the one percent probability of depths of flows reaching the dike. Flows for the 2, 5, 10, 25, 50, and 100-year recurrence intervals were used from the documentation prepared by Boyle. The analysis indicated that the dike, located at a fan width of 27,000 feet, is below the one foot depth zone. According to the analysis the 0.5 depth limit is located at a fan width of 25,805. This would also support that flows reaching the dike would likely be shallow and widely dispersed.

Field visits, analysis of topographic mapping, and aerial photos indicated that there are numerous narrow flow paths dissecting the fan. Major flooding occurred during a summer thunderstorm of July 28, 1984. In that storm 2.5 to 3.0 inches of rain fell over a large area including the Range Wash watershed. Since this storm approximated a 100-year event and had little impact on the pattern of numerous small flow paths, it is reasonable to assume the existing natural flow paths or similar new paths would occur in future flood events. The stream paths on the fan are distinct and separated by much older alluvium. Areas between recent flow paths exhibit desert pavement and desert varnish characteristics. See the included photographs.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF NEVADA
NEVADA BUREAU OF MINES AND GEOLOGY

NEVADA—CLARK CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 GASS PEAK 15' QUADRANGLE

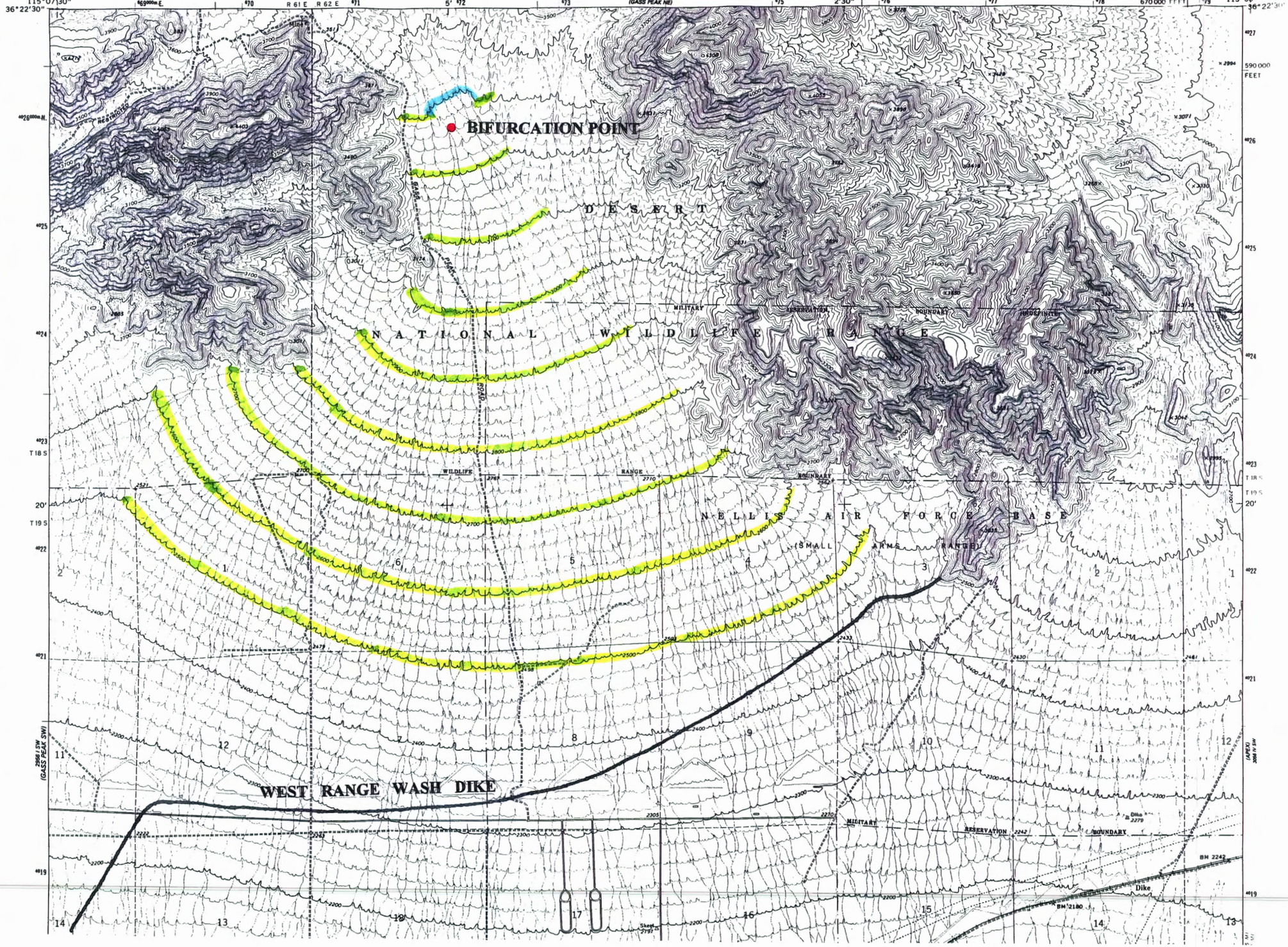


FIGURE 3

WEST RANGE FAN

Reduced Scale
1 inch = 3,000 feet

A representative reach along the dike was evaluated as an indication of the cumulative widths of flow paths related to the width of the fan at the dike. Along a 2,900 foot long reach of the dike (Plan Sheet D-7), the cumulative stream widths intercepted by the dike were estimated to total approximately 350 feet. Based on this estimate, the flow width to spread ratio along the dike would be 0.12. At this ratio, the flow would be spread in multiple channels across the fan for a width of 10,450 feet at the dike. This is approximately 40% of the total fan width at the dike. This seems reasonable based on the bifurcation point high on the fan as previously assumed. However, since these estimates were rough, and alluvial fan flows are very unpredictable, a more conservative ratio of 0.20 was assumed appropriate. At this ratio the spread of flow would be 6,270 feet, approximately 23% of the fan width at the dike. The width of the peak flow (1,254 feet) is 4.6% of the fan width at the dike.

Volume of Sediment

The previous documentation for the dike prepared by Boyle included a HEC-6 sediment transport analysis. The analysis included a determination of a stable transport capacity down the fan and a volume of sediment deposited in a transition reach from the fan to the dike. Boyle's calculations indicated 32.1 acre-ft of deposition occurred in the transition reach from fan to dike. It was estimated that 37% of the total (11.8 acre feet) was deposited at the time the peak flow occurred. The Boyle approach assumes that as deposition begins to occur at the dike, the deposition accumulation, and the dike, will cause the flow to turn and flow along the dike. Therefore a transition channel from fan to dike would form and there would not be a sudden loss of velocity and transport capacity during the peak flow.

In response to FEMA's request, this analysis will consider a complete loss of velocity and sediment transport capacity as flows meet the dike. Since the velocity is assumed to go to zero the total sand and gravel sediment load is assumed to be deposited. Since the flows will not be ponded for a long period of time, the fine materials are assumed to remain in suspension. Based on the Boyle HEC-6 analysis for fan capacity, the sediment loads, and assumed volume of deposition are given in **Table 1**.

Table 1
100-Year Event Sediment Loads and Deposition

Time (min)	Discharge (cfs)	Silt Inflow (Tons/Day)	Sand Inflow (Tons/Day)	Total Sediment Inflow (Tons/Day)	Deposition (total sand inflow) (Tons)	Cumulative Deposition (Tons)	Cumulative Deposition (Acre-ft)
145	0.0	0.0	0.0	0.0	0.0	0.0	0.0
205	261	11,262	20,656	31,918	430	430	0.2
265	2,742	383,494	417,442	800,936	9,127	9,557	4.7
325	7,028	1,573,639	1,097,033	2,670,672	31,552	41,109	20.3
385	5,897	1,209,496	852,337	2,061,833	40,612	81,721	40.3
445	2,172	270,363	221,785	492,148	22,378	104,098	51.4
505	516	31,306	30,673	61,979	5,260	109,358	54.0
565	142	4,520	3,230	7,750	706	110,064	54.3

The sediment capacity of the fan flow was based on a single channel flow regime. The multiple channel flow regime would transport less sediment to the dike. Nevertheless, the sediment capacity determined by Boyle will be used for this evaluation as a conservative approach.

The estimated sediment deposition volume would not be deposited in one place based on a multiple channel assumption. In the course of the storm event, the width, and spread, and number, of active channels reaching the dike would change. As a conservative assumption a stream path was presumed to continuously deposit sediment at one location throughout the storm event. To determine the amount of deposition possible from a continuously flowing single stream path the discharge and sediment load per unit width of flow was determined as given in **Table 2**:

Table 2
Flow and Deposition Per Unit Width of Channel

Time (min)	Discharge (cfs)	Cum. Multiple Channel Width (ft)	Unit Discharge (cfs/ft)	Deposition (Tons)	Deposition Per Channel Width (Tons/ft)
145	0	0	0	0	0
205	261	334	0.78	430	1.29
265	2,742	857	3.20	9,127	10.66
325	7,028	1,248	5.63	31,552	25.28
385	5,897	1,163	5.07	40,612	34.91
445	2,172	780	2.78	22,378	28.68
505	516	439	1.18	5,260	11.98
565	142	262	0.54	706	2.70

The existing stream paths at the dike are typically narrow, less than 10 feet wide. The largest observed active/recent flow path was approximately 30 feet wide. As a conservative assumption, a stream 50 feet wide was used for the basis of the analysis. Based on the width to spread ratio of 0.20, a flow width of 50 feet would have a spread of influence 250 feet wide. The volume of deposition would be the same, but it would be slightly more dispersed, if 5 channels 10 feet wide were considered along a 250 foot reach of the dike. The volume of sediment conveyed to the dike in a 50 foot wide channel assumed to flow continuously the entire duration of the storm is given in the **Table 3.**

Table 3
Deposition From 50 Foot Wide Channel

Time (min)	Width (ft)	Unit Discharge (cfs/ft)	Discharge (cfs)	Deposition Per Channel Width (Tons/ft)	Deposition (Tons)	Cumulative Deposition (Tons)	Cumulative Deposition (Acre-ft)
145	50	0	0	0	0	0	0
205	50	0.78	39	1.29	64	64	0.03
265	50	3.20	160	10.66	533	597	0.29
325	50	5.63	282	25.28	1,264	1,861	0.92
385	50	5.07	253	34.91	1,745	3,606	1.78
445	50	2.78	139	28.68	1,434	5,040	2.49
505	50	1.18	59	11.98	599	5,639	2.78
565	50	0.54	27	2.70	135	5,774	2.85

The channel on the upstream side of the dike has a 120 foot wide base width. The upstream slope of the dike is 4:1 horizontal to vertical. The cut slope of the channel opposite the dike embankment is at 3:1. As flows come down the fan and drop into the channel, down the 3:1 slope, some localized erosion and deposition will occur. It is assumed the drop into the channel will cause head cutting up the stream path. The materials scoured by head cutting will be deposited and form a sediment cone to build in the channel. See the included photographs for evidence of localized erosion and deposition. The sediment cone and head cutting are assumed to stop and be stabilized when the slope of the cone is equal to the slope of the fan (4%). The height of the cone for the localized condition is assumed to be five feet. **Figure 4** is a rendering of a debris cone in the channel. The radius of the cone is assumed to be 125 feet. This pattern is assumed to be repeated along the reach of the dike every 250 feet. The actual conditions would likely be less severe.

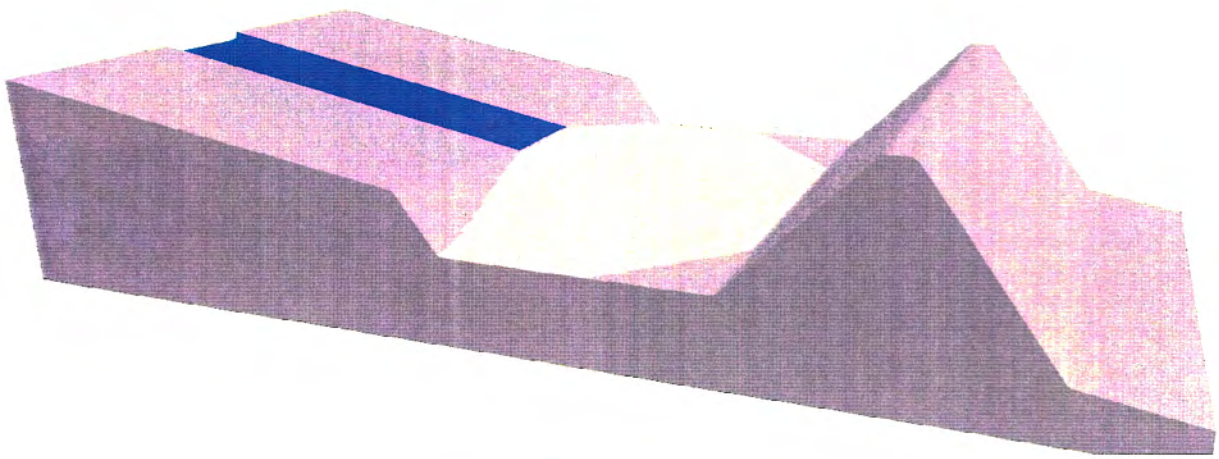


FIGURE 4 Sediment Cone From Localized Erosion

The volume of the sediment deposition from the localized condition is estimated by taking half the volume of a circular cone with a 125 foot radius and height of 5 feet. The estimated volume is 0.94 acre-feet.

The sediment cone from localized erosion would build gradually, but for simplicity this volume is added to each of the amounts of sediment estimated to be transported down the fan at different time increments in the hydrograph. Therefore, the volume of sediment deposited at the dike is assumed to be the volume of the sand transported down the fan based on the HEC-6 analysis, plus the 0.94 acre-ft estimated for local scour and deposition.

As more sediment accumulates at the dike it is assumed the slope of the cone will become flatter. The cone is assumed to eventually reach a slope of 2%. This slope is half the natural slope and is based on the assumption commonly used to estimate debris volume in a debris basin. This slope assumption is used by the U.S. Army Corps of Engineers and is prescribed in the *Los Angeles County Flood Control District Design Manual Debris Dams and Basins.* The manual states:

> The calculation for the debris volume shall be based on the assumption that the debris will be deposited in such a manner that the debris slope, sloping upstream from the spillway crest, will be equal to 50 per cent of the average slope of the original stream bed for the total length of the basin site.

The volume of sediment from a 50 foot wide channel is assumed to be deposited in a 250 foot long reach along the dike. As the sediment volume increases, it is assumed to transition from a cone with a 4% slope, to a cone with a 2% slope, to filling the channel and sloping back on a 2% slope. Trial and error solutions were performed to estimate the height and slope of deposition at different time increments of the storm. The results are shown in **Table 4** and the accompanying definition sketch.

Definition Sketch

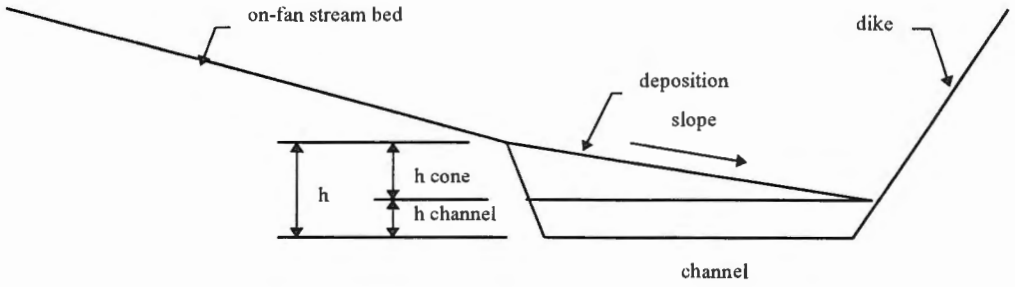


Table 4
Size and Volume of Deposition

Time (min)	Local Sediment (Acre-ft)	50-ft Channel Cumulative Deposition (Acre-ft)	Total Deposition (Acre-ft)	Assumed or Trial Slope (ft/ft)	Assumed or Trial h (ft)	h cone (ft)	h channel (ft)	Volume Cone (acre-ft)	Volume Channel (acre-ft)	Total Calculated Volume (acre-ft)
145	0.94	0.00	0.94	0.0400	5.00	5.00	0.00	0.94	0.00	0.94
205	0.94	0.03	0.97	0.0395	5.00	4.94	0.06	0.93	0.04	0.97
265	0.94	0.29	1.23	0.0354	5.00	4.42	0.58	0.83	0.40	1.23
325	0.94	0.92	1.86	0.0263	5.00	3.28	1.72	0.62	1.24	1.86
385	0.94	1.78	2.72	0.0200	5.50	2.50	3.00	0.47	2.25	2.72
445	0.94	2.49	3.43	0.0200	6.36	2.50	3.86	0.47	2.96	3.43
505	0.94	2.78	3.72	0.0200	6.71	2.50	4.21	0.47	3.25	3.72
565	0.94	2.85	3.79	0.0200	6.79	2.50	4.29	0.47	3.32	3.79

A normal depth calculation was performed based on the cross-section filled with sediment as estimated above. The channel along the dike is assumed to be filled with sediment to a level of 4.3 feet and slope back on a 2% slope. The depth of flow was 5.59 feet leaving a freeboard of 5.41 feet. The height of the dike above the energy line is 4.12 feet, thus there is more than 3 feet of freeboard as required. The conditions of the normal depth calculation are a conservative assumption since at the upstream end of the dike there would be less flow. At the downstream end of the dike, the flow would increase to the peak flow rate of 7,030 cfs, but the deposition in the channel would be less. During the peak flow the multiple channel width is 1,254 feet. This would be approximately equivalent to 25 channels 50 feet wide. If each of the channels deposited 3.79 acre-ft of sediment the total deposited would be 94.75 acre-ft. However, all the channels would not flow continuously throughout the storm hydrograph. As flows accumulate in the channel along the dike the velocity and sediment transport capacity along the dike would increase, therefore there would be less deposition at the downstream end of the dike.

ITEM 2 EROSION PROTECTION STATIONS 58+00 TO 62+00

The FEMA letter requests information about erosion protection on the left bank (looking downstream) from stations 58+00 to 62+00. This is the location where the dike turns and transitions to the floodway in to the North Las Vegas Detention Basin. The slope of the channel along the dike increased from 0.8% to 2.1%.

The embankment is presently not lined along this reach. The channel along the dike is below grade approximately 5 to 7 feet. Since the channel is below grade, and the higher energy of the channel would cause degradation of the bed, it may be argued that flows would continue to be confined even if erosion occurred. It may also be noted that the dike is on the inside of the curve. Channel bends have characteristics of scour on the outer side of a curve and deposition on the inner side of a curve. Scour on the outer side of the bend would not jeopardize the containment of flow.

A HEC-RAS water surface profile analysis was performed for this reach. It indicated depths between 4.1 and 2.4 feet and velocities between 12.7 and 17.3 fps. The shear stress for the steeper reach was compared to the shear stress along the normal channel dike reach which is assumed to be in equilibrium. Shear stress is given by the following equation:

$$\tau = \gamma y S$$

where:

τ = shear stress (lbs/ft^2)

γ = unit weight of water (62.4 lb/ft^3)

y = depth of flow (ft)

S = Slope (ft/ft)

Therefore the shear stress along the dike is:

$$\tau = (62.4)\,(4.12)\,(.008) = 2.05$$

The shear stress for the transitional area is:

$$\tau = (62.4)\,(2.89)\,(.0228) = 4.11$$

Since the shear stress approximately doubles, there is a significant difference in the channel equilibrium and scour would occur. For this reason Post, Buckley, Schuh & Jernigan, Inc. recommends that erosion protection along this reach of the dike be provided. Although the

channel is below grade, the downward gradient of the fan could cause flows to eventually escape if significant erosion of the dike occurs.

It is recommended that the dike be soil cement lined, similarly to the floodway (Section B Drawing DT-1), for the reach from station 55+00 to 62+00.

CONCLUSION

Post, Buckley, Schuh & Jernigan, Inc. recommends that the dike be accepted by FEMA based on the sediment accumulation analysis demonstrating sufficient freeboard, and on condition that the reach from 55+00 to 62+00 is lined with soil cement.

PHOTOGRAPHS

1 View Of Fan From Dike/Channel

2 Typical Stream Path

3 Typical Stream Path

4 Wide Stream Path

5 Wide Stream Path

6 Less Active Surface

7 Localized Erosion and Deposition

8 Localized Erosion and Deposition

9 Localized Erosion and Deposition

CALCULATIONS

West Range Fan

AVULSION FACTOR = 1.0000

FLOOD FREQUENCY CURVE DEFINED BY LEAST-SQUARES FIT OF DATA

RETURN INTERVAL (YEARS)	INPUT DISCHARGE (CFS)	BEST FIT DISCHARGE (CFS)
2	273	273
5	999	1020
10	1955	1911
25	3576	3574
50	5380	5230
100	7030	7253

MEAN = 2.387898
STANDARD DEVIATION = 0.725669
SKEW = -0.4

SUMMARY OF DISCHARGES:

10-YEAR DISCHARGE = 1911
50-YEAR DISCHARGE = 5230
100-YEAR DISCHARGE = 7253
500-YEAR DISCHARGE = 13461

STATISTICS AFTER TRANSFORMATION OF Y=LOG(Q) TO Z=0.7087+0.8822 LOG(Q)

MEAN OF Z = 2.815298
STANDARD DEVIATION = 0.640189
SKEW = -0.400000
TRANSFORMATION CONSTANT = 11.041702

SINGLE-CHANNEL REGION

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	5.1131 Q^0.8822	WIDTH (FT)
0.5	0.3	49	0.83021	0.95107	9880
1.5	1.0	756	0.26246	0.48689	5058
2.5	1.7	2712	0.06420	0.17071	1773
3.5	2.3	6288	0.01436	0.04850	499

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	5.1131 Q^0.8822	WIDTH (FT)
3.5	0.4	68	0.78594	0.92552	9614
4.5	0.6	238	0.53261	0.76202	7916
5.5	0.9	649	0.29447	0.52829	5488
6.5	1.3	1496	0.13902	0.30278	3145
7.5	1.7	3059	0.05187	0.14897	1548
8.5	2.2	5719	0.01726	0.05890	607

MULTIPLE-CHANNEL REGION

SLOPE = 0.0400000
N-VALUE = 0.0300000

ENERGY (FT)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	5.1131 Q^0.8822	WIDTH (FT)
0.5	0.3	395	0.41038	0.65372	25805
1.5	0.6	5285	0.01968	0.06805	2686

VELOCITY (FT/SEC)	DEPTH (FT)	DISCHARGE (CFS)	PROBABILITY OF DISCHARGE BEING EXCEEDED AT THE APEX BY: Q	5.1131 Q^0.8822	WIDTH (FT)
4.5	0.3	662	0.29031	0.52296	20644
5.5	0.4	1527	0.13572	0.29756	11746
6.5	0.5	3063	0.05174	0.14874	5871
7.5	0.7	5560	0.01813	0.06218	2442

Channel filled w/sediment & 100-yr flow
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\dike.fm2
Worksheet	West Range Dike
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.005000	ft/ft
Elevation range: 4.30 ft to 15.30 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	15.30	0.00	399.00	0.025
195.00	7.50			
355.00	4.30			
399.00	15.30			

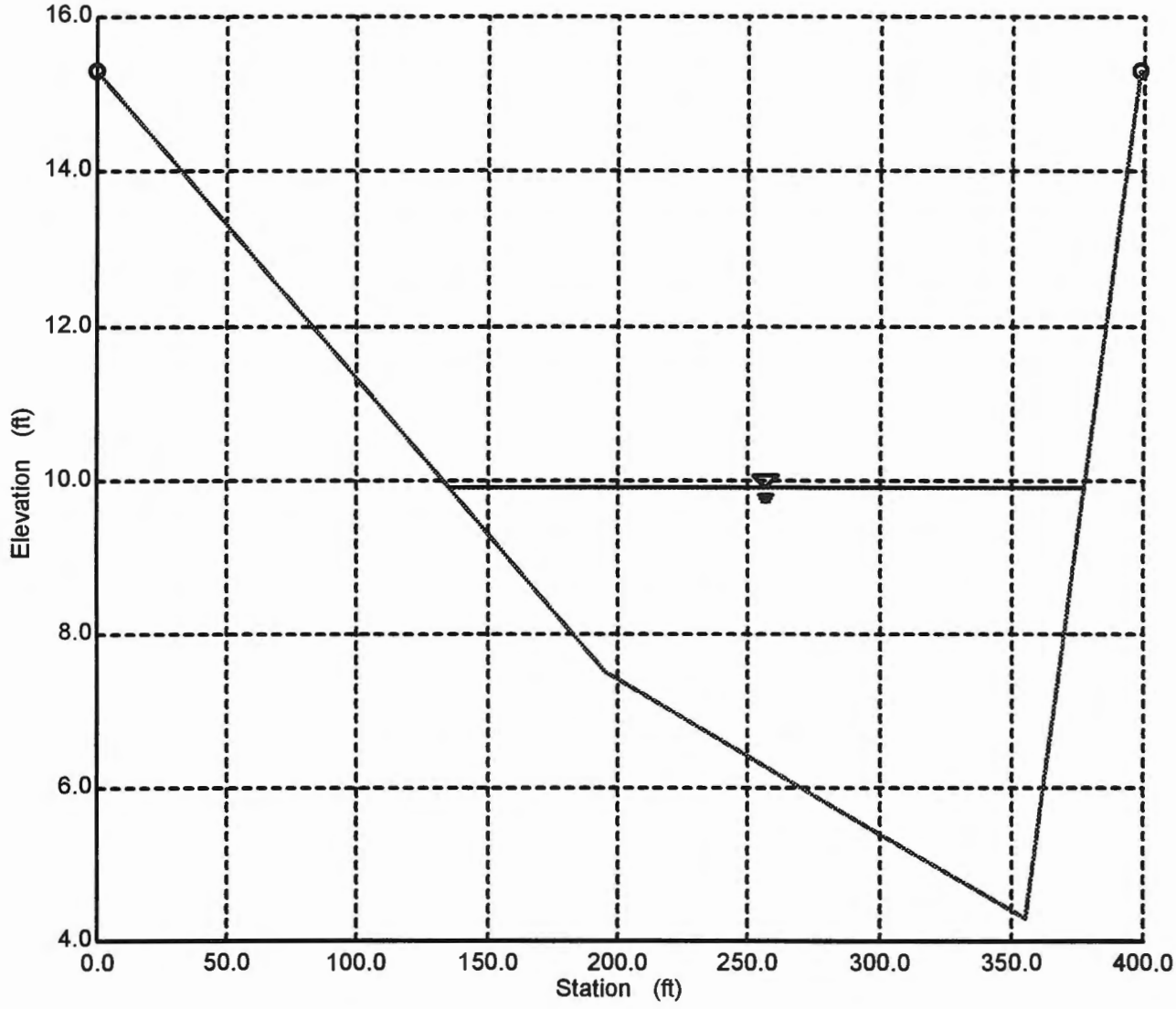
Discharge	7,030.00	cfs

Results		
Wtd. Mannings Coefficient	0.025	
Water Surface Elevation	9.89	ft
Flow Area	773.18	ft²
Wetted Perimeter	242.98	ft
Top Width	242.22	ft
Height	5.59	ft
Critical Depth	9.64	ft
Critical Slope	0.006319	ft/ft
Velocity	9.09	ft/s
Velocity Head	1.28	ft
Specific Energy	11.18	ft
Froude Number	0.90	
Flow is subcritical.		

Channel filled with sediment and peak 100-yr flow
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\dike.fm2
Worksheet	West Range Dike
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.025	
Channel Slope	0.005000	ft/ft
Water Surface Elevation	9.89	ft
Discharge	7,030.00	cfs



HEC-RAS Plan: Plan 01 Reach: West Range 10/3/96 8:40:18 AM

River Sta.	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	
6400	7030.00	2247.00	2251.51	2251.51	2253.56	0.005841	11.47	613.13	151.60	1.00	
6350.*	7030.00	2246.59	2250.78	2251.10	2253.19	0.007561	12.47	563.87	149.31	1.13	
6300.*	7030.00	2246.19	2250.35	2250.70	2252.80	0.007713	12.55	560.27	149.14	1.14	
6250.*	7030.00	2245.78	2249.91	2250.30	2252.40	0.007911	12.65	555.68	148.93	1.15	
6200	7030.00	2245.37	2249.50	2249.89	2251.99	0.007935	12.66	555.14	148.90	1.16	4.13
6150.*	7030.00	2244.32	2247.85	2248.83	2251.36	0.013535	15.04	467.43	144.72	1.47	3.53
6100.*	7030.00	2243.27	2246.60	2247.78	2250.60	0.016587	16.05	437.97	143.29	1.62	3.33
6050.*	7030.00	2242.21	2245.45	2246.73	2249.68	0.018058	16.49	426.24	142.71	1.68	3.24
6000	7030.00	2241.16	2244.35	2245.67	2248.73	0.019098	16.79	418.69	142.34	1.73	3.19
5950.*	7030.00	2240.11	2243.13	2244.53	2247.70	0.021250	17.16	409.71	146.15	1.81	3.02
5900.*	7030.00	2239.05	2241.94	2243.36	2246.61	0.022835	17.34	405.36	150.25	1.86	2.89
5850.*	7030.00	2238.00	2240.81	2242.21	2245.44	0.023388	17.27	407.11	154.68	1.88	
5800	7030.00	2236.95	2239.70	2241.08	2244.23	0.023472	17.09	411.39	159.25	1.87	
5750.*	7030.00	2235.90	2238.55	2239.89	2243.00	0.024084	16.94	415.05	166.05	1.89	
5700.*	7030.00	2234.84	2237.41	2238.71	2241.73	0.024179	16.68	421.35	172.98	1.88	
5650.*	7030.00	2233.79	2236.29	2237.55	2240.47	0.024080	16.40	428.61	180.02	1.87	
5600	7030.00	2232.74	2235.18	2236.39	2239.22	0.023915	16.12	436.13	187.10	1.86	
5550.*	7030.00	2231.69	2234.11	2235.28	2238.00	0.023263	15.82	444.26	191.95	1.83	
5500	7030.00	2230.64	2233.03	2234.16	2236.83	0.023134	15.64	449.35	196.70	1.82	2.39
5450.*	7030.00	2229.45	2231.80	2232.97	2235.72	0.020590	15.89	442.40	196.45	1.87	
5400.*	7030.00	2228.25	2230.52	2231.77	2234.74	0.017570	16.50	426.11	195.87	1.97	
5350.*	7030.00	2227.06	2229.23	2230.58	2233.86	0.016514	17.28	406.92	195.18	2.11	
5300	7030.00	2225.86	2227.92	2229.38	2233.07	0.013575	18.20	386.23	194.44	2.28	
5250.*	7030.00	2224.89	2226.90	2228.41	2232.34	0.014845	18.71	375.71	194.06	2.37	
5200.*	7030.00	2223.92	2225.90	2227.45	2231.52	0.015699	19.04	369.27	193.83	2.43	
5150.*	7030.00	2222.94	2224.89	2226.46	2230.69	0.016486	19.33	363.73	193.63	2.49	
5100	7030.00	2221.97	2223.90	2225.50	2229.82	0.017068	19.54	359.86	193.49	2.52	

$$S_e = \frac{V^2 T}{g r}$$

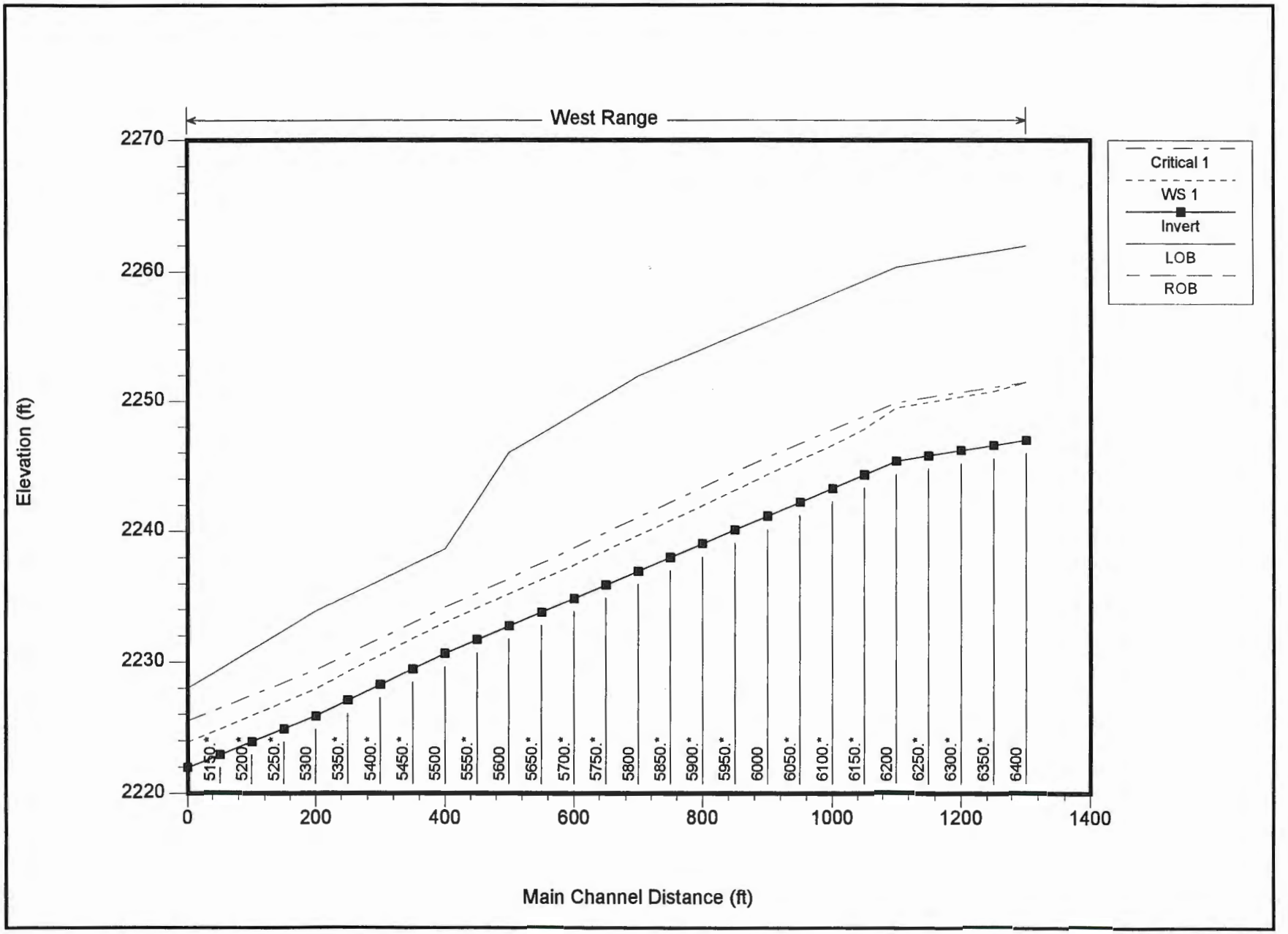
$V = 16.79$

$T = 142.34$

$g = 32.2$

$r = 560'$

$S_e = 2.22'$


West Range
Critical 1
WS 1
Invert
LOB
ROB
Elevation (ft)
2270
2260
2250
2240
2230
2220
0
200
400
600
800
1000
1200
1400
5150.*
5200.*
5250.*
5300
5350.*
5400.*
5450.*
5500
5550.*
5600
5650.*
5700.*
5750.*
5800
5850.*
5900.*
5950.*
6000
6050.*
6100.*
6150.*
6200
6250.*
6300.*
6350.*
6400
Main Channel Distance (ft)

RESPONSE MEMORANDUM

REGARDING FEMA CONCERNS ON
RANGE WASH ~~CONFLUENCE DB~~
FLOOD INSURANCE STUDY RESTUDY

484R

Case No. 96-09-~~48R~~

~~CLOMR DATED SEPT 19, 1996~~

January 22, 1997

RESPONSE MEMORANDUM

REGARDING FEMA CONCERNS ON RANGE WASH FLOOD INSURANCE STUDY RESTUDY

Introduction

This memorandum was prepared in response to the letter from Federal Emergency Management Agency (FEMA) dated September 19, 1996 regarding the Range Wash Flood Insurance Study Restudy, Case Number 96-09-484R. The restudy is based on proposed construction of the Range Wash/~~Sloan Channel~~ Confluence Detention Basin (~~Confluence Detention Basin~~) and channel modifications along the Sloan Channel.
RW CDB

West Range Wash Dike

The September 19th letter indicates issues regarding the West Range Wash Diversion Dike must be resolved. A memorandum dated November 19, 1996, was prepared in response to a letter from FEMA dated September 5, 1996 regarding the West Range Wash Diversion Dike. A LETTER OF MAP REVISION WAS SUBSEQUENTLY ISSUED ON JANUARY 28, 1997 UNDER CASE NO. 96-09-043P

Nellis Boulevard Storm Drain

The September 19th letter requested information to demonstrate that flows are intercepted by Nellis Boulevard and conveyed to the Las Vegas Wash. Additional hydrology was performed for the area contributing to the Nellis Boulevard Storm Drain System. The additional subbasins are shown in **Figure 1**. Additional soils information is show in **Figure 2**. The current land use for the added area is shown in **Figure 3.** Hydrologic calculations are included in the **Appendix A**. **Appendix B** includes hydraulic calculations for the inlets, storm drain and street capacities. **Exhibit F**, bound separately, contains the plans for the Nellis Boulevard Storm Drain. The capacities and 100-year flows are summarized in **Table 1.** According to the calculated flows and capacities, Nellis Boulevard and its storm drain system will intercept the flows and act as a basin boundary to the Range Wash Basin.

Table 1
Summary Nellis Boulevard Capacity

Location	Street Capacity (cfs)	Pipe Capacity (cfs)	Total Capacity (cfs)	Estimated 100-Year Flow (cfs)
Nellis at Carey	181	259	440	426
Nellis at Owens	95	439	534	489
Nellis at Bonanza	67	520	587	536

Confluence Detention Basin Outlet Structure Buoyancy

The letter expressed concern about the buoyant force on the outlet works of the detention basin jeopardizing its proper function. An analysis of the existing structure indicated the Factor of Safety was less than one. To increase the Factor of Safety, against the buoyant force on the outlet structure, mitigation is proposed by the installation of gabions in the structure. The proposed mitigation is shown in **Figure 4.** The gabions will add weight to the structure and have a minimal effect on the hydraulics of the outlet structure. The gabions do not obstruct the low level orifice or the 2-8'x7' Reinforced Concrete Boxes leaving the structure. The gabions increase the depth in the structure and slightly reduce the capacity of the low level orifice. At a water surface level of 1813.00, equal to the high level weir crest, the low level orifice capacity is reduced from 367 cfs to 362 cfs. The overall impact of the change in the stage-storage-discharge increased the maximum stage by 0.01 feet, from 1815.90 to 1815.91, which is still below the emergency spillway crest of 1816.00. The hydraulic calculations for the outlet structure mitigated with gabions are included in **Appendix C**. A HEC-1 output for the Confluence Detention Basin with the slightly revised stage-storage-discharge relationship is included in **Appendix D**.

Calculations for the buoyancy of the structure are included in **Appendix E**. The calculations indicate the gabions increase the Factor of Safety to 1.2.

Sloan Channel

The FEMA letter indicates concern about velocities and erosion in the unlined portion of Sloan Channel Downstream of Stewart Avenue. Since the reach of channel between Stewart Avenue and Charleston Boulevard is designed and will be constructed shortly, map changes based on a Conditional Letter of Map Revision (CLOMR) are proposed for this reach of the channel. The 95% Plans for the channel are included as a separate attachment as **Exhibit G.** Revisions to the map downstream of Charleston Boulevard will not be proposed at this time.

Additional Submittal Items

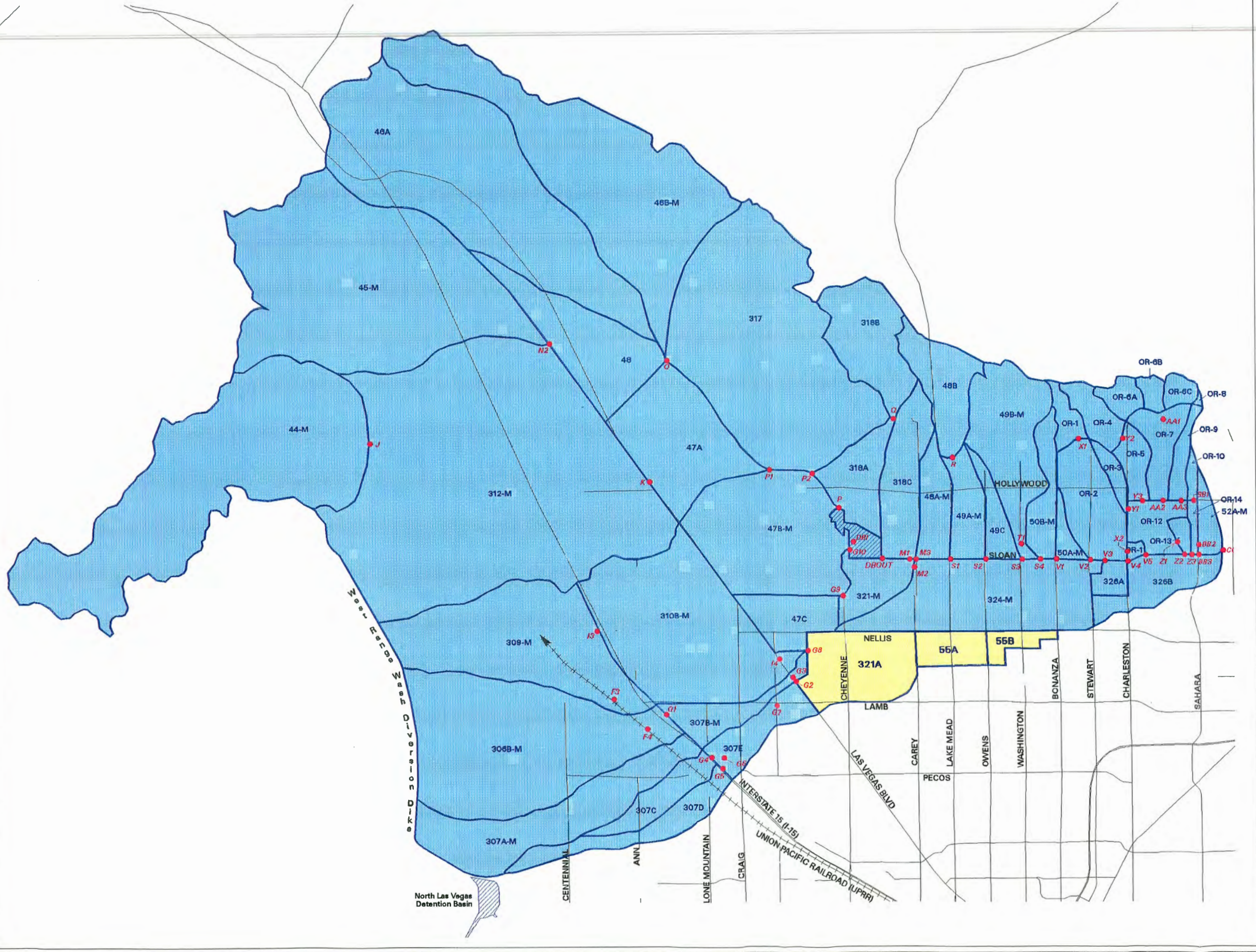
The proposed revisions to the FIRMs due to the Confluence Detention Basin and Sloan Channel Improvements are shown in **Figure 5**. When final as-built plans of the proposed Sloan Channel improvements are available they will be submitted. The following items are resubmitted as requested:

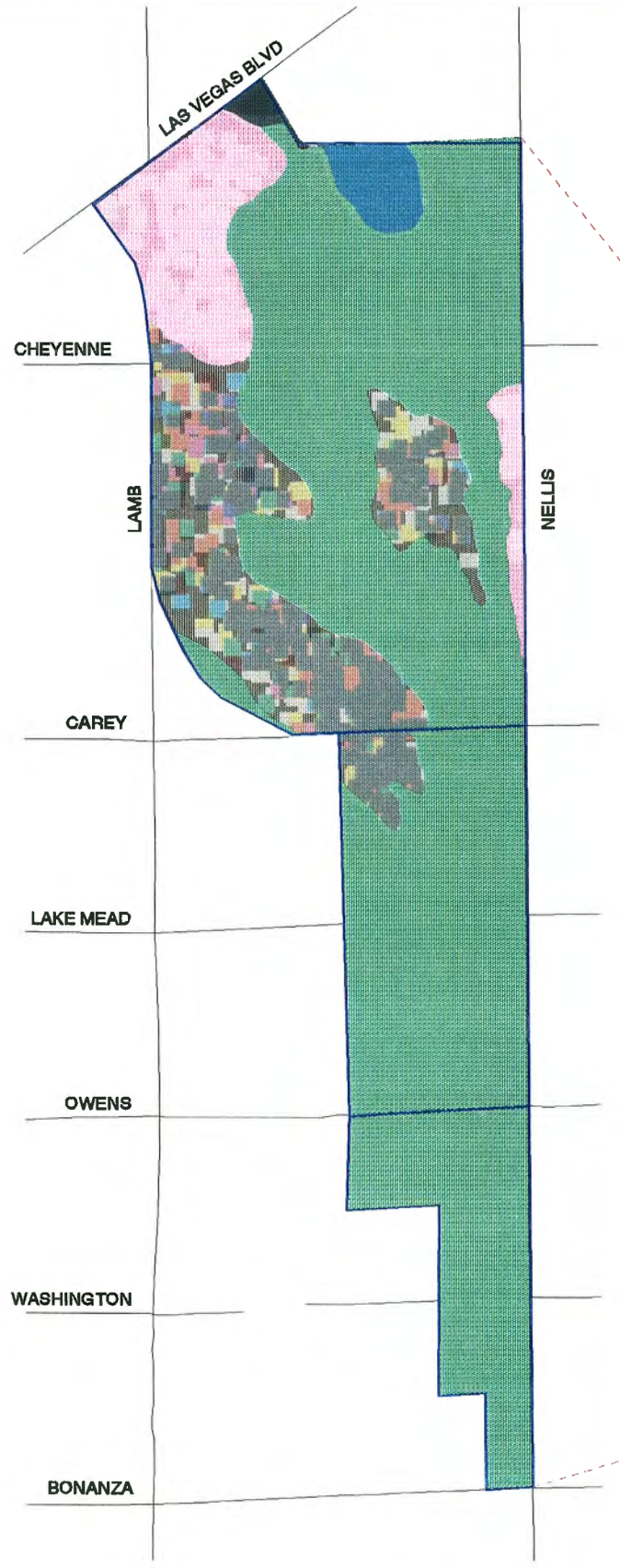
- Annotated FIRM showing the SFHA associated with Confluence Detention Basin and Sloan Channel improvements (**Figure 5**)
- FEMA Forms 1 through 7 (**Appendix F**).
- As-built plans of the Confluence Detention Basin (**Exhibit H**).
- Officially adopted maintenance and operation plan for the Confluence Detention Basin and Sloan Channel (See **Appendix G**).

Conclusion

Post, Buckley, Schuh & Jernigan, Inc. recommends that the FIRMs be modified as shown in **Figure 5**, after mitigation to the Confluence Detention Basin Outlet Structure as shown in **Figure 4**, and construction of the Sloan Channel from Stewart Avenue to Charleston Boulevard as indicated in **Exhibit G.**

FIGURES


46A
46B-M
45-M
317
316B
48
48B
49B-M
OR-6B
OR-6A
OR-6C
OR-8
OR-9
OR-7
OR-10
OR-14
52A-M
OR-12
OR-13
OR-1
OR-4
OR-5
OR-3
OR-2
44-M
47A
318A
318C
48A-M
49A-M
49C
50B-M
50A-M
HOLLYWOOD
SLOAN
326A
326B
324-M
312-M
47B-M
321-M
310B-M
47C
309-M
307B-M
306B-M
307E
307C
307D
307A-M
321A
55A
55B
NELLIS
CHEYENNE
LAMB
BONANZA
STEWART
CHARLESTON
SAHARA
CAREY
LAKE MEAD
OWENS
WASHINGTON
PECOS
LAS VEGAS BLVD
INTERSTATE 15 (I-15)
UNION PACIFIC RAILROAD (UPRR)
CENTENNIAL
ANN
LONE MOUNTAIN
CRAIG
West Recon Wash Diversion Dike
North Las Vegas Detention Basin
N2
O
J
K
P1
P2
P
DW
G10
M1
M3
M2
DROUT
S1
S2
S3
S4
V1
V2
V3
V4
V5
Z1
Z2
Z3
BB3
BB2
X2
T1
G9
G8
G3
G2
G1
G7
F4
F3
F2
G4
G5
G6
Q
R
AA1
X1
Y2
Y1
AA2
AA3
BB1
C
LEGEND
Range Wash Drainage Basins
Nellis System Drainage Basins
Detention Basins
S2 Concentration Point, ID
49A-M Basin ID
DRAINAGE BASINS
FIGURE 1
N
S
GRAPHIC SCALE
2 1.5 1 0.5 0 1 2
(IN MILES)
SCALE:1 inch = 7500 feet



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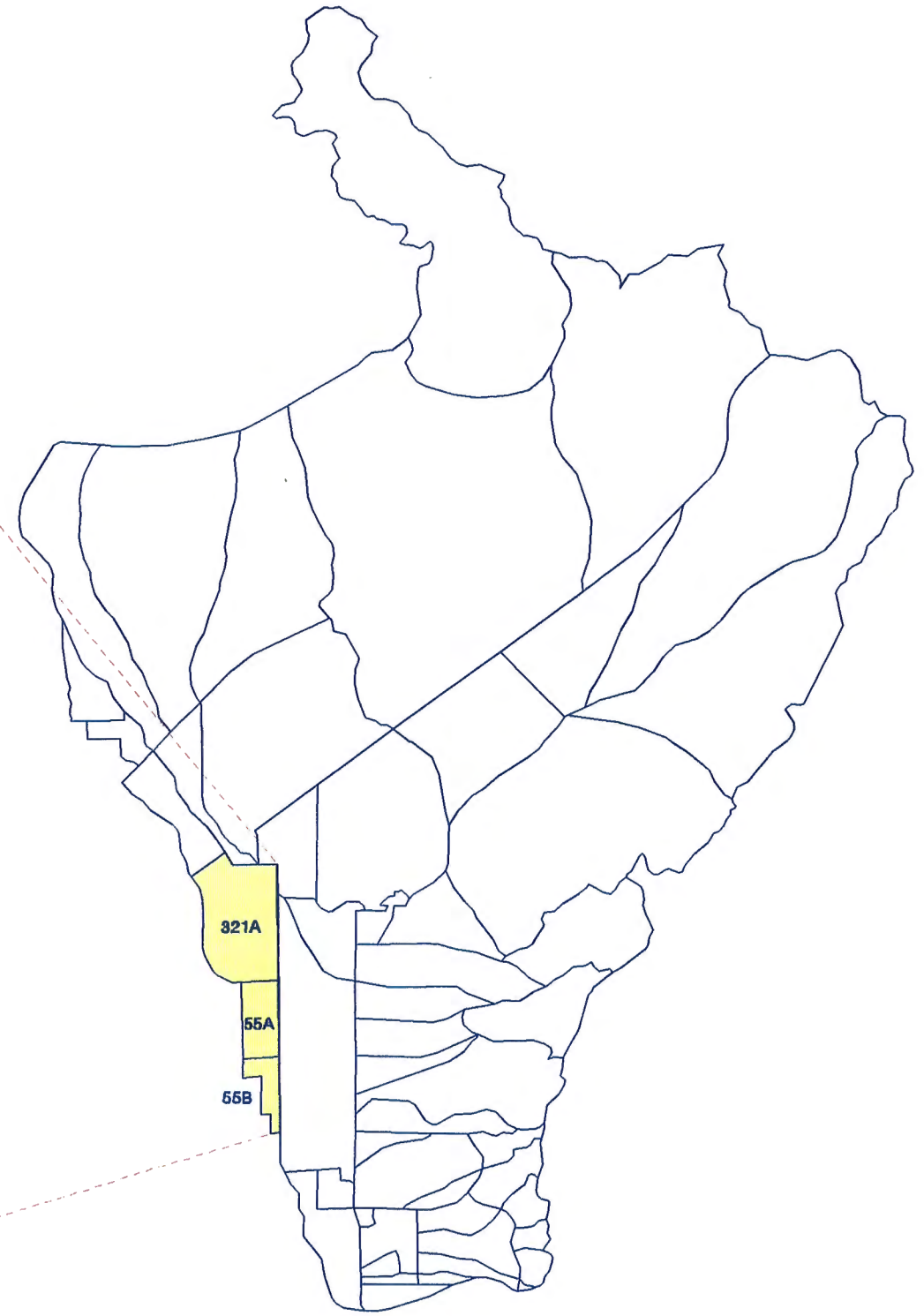


LEGEND

SOIL CLASSIFICATION

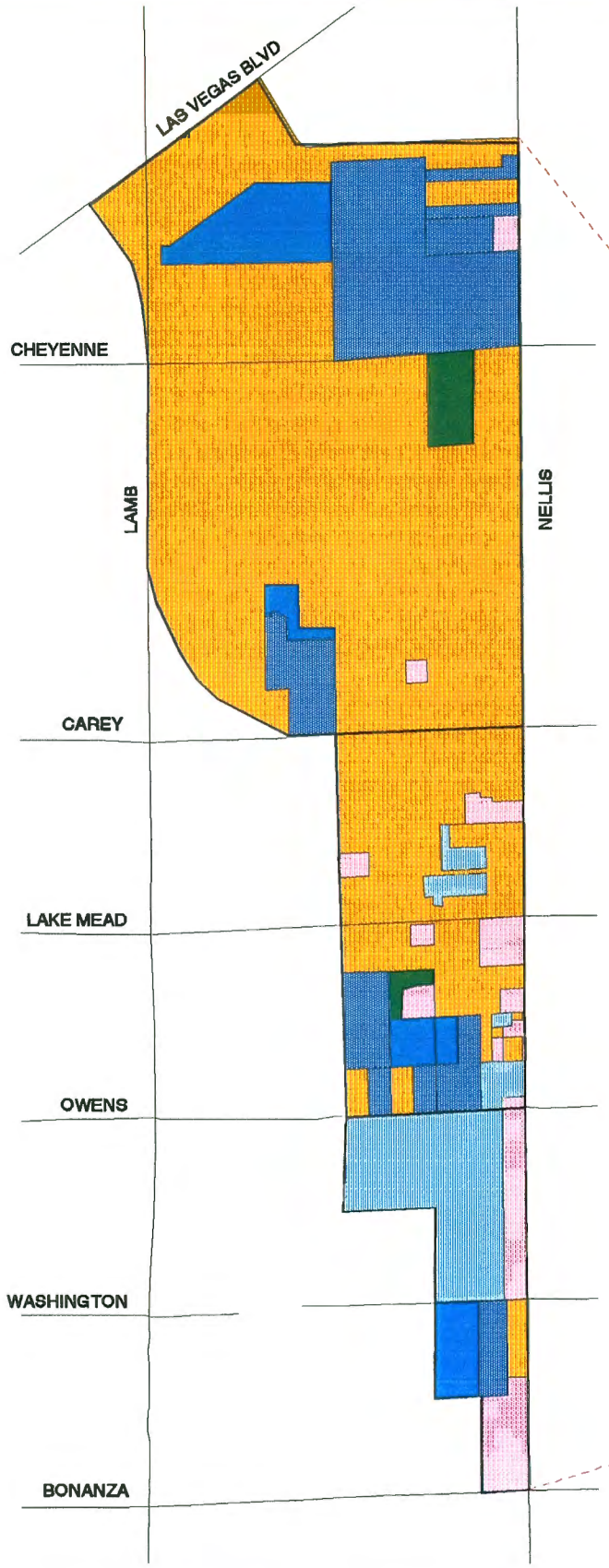
- Arizo very gravelly fine sandy loam 2 to 8 percent slopes
- Bracken very gravelly fine sandy loam 2 to 8 percent slopes
- Casaga very gravelly sandy clay loam 0 to 8 percent slopes
- Glencarb silt loam
- Skyhaven very fine sandy loam 0 to 4 percent slopes

Drainage Basins

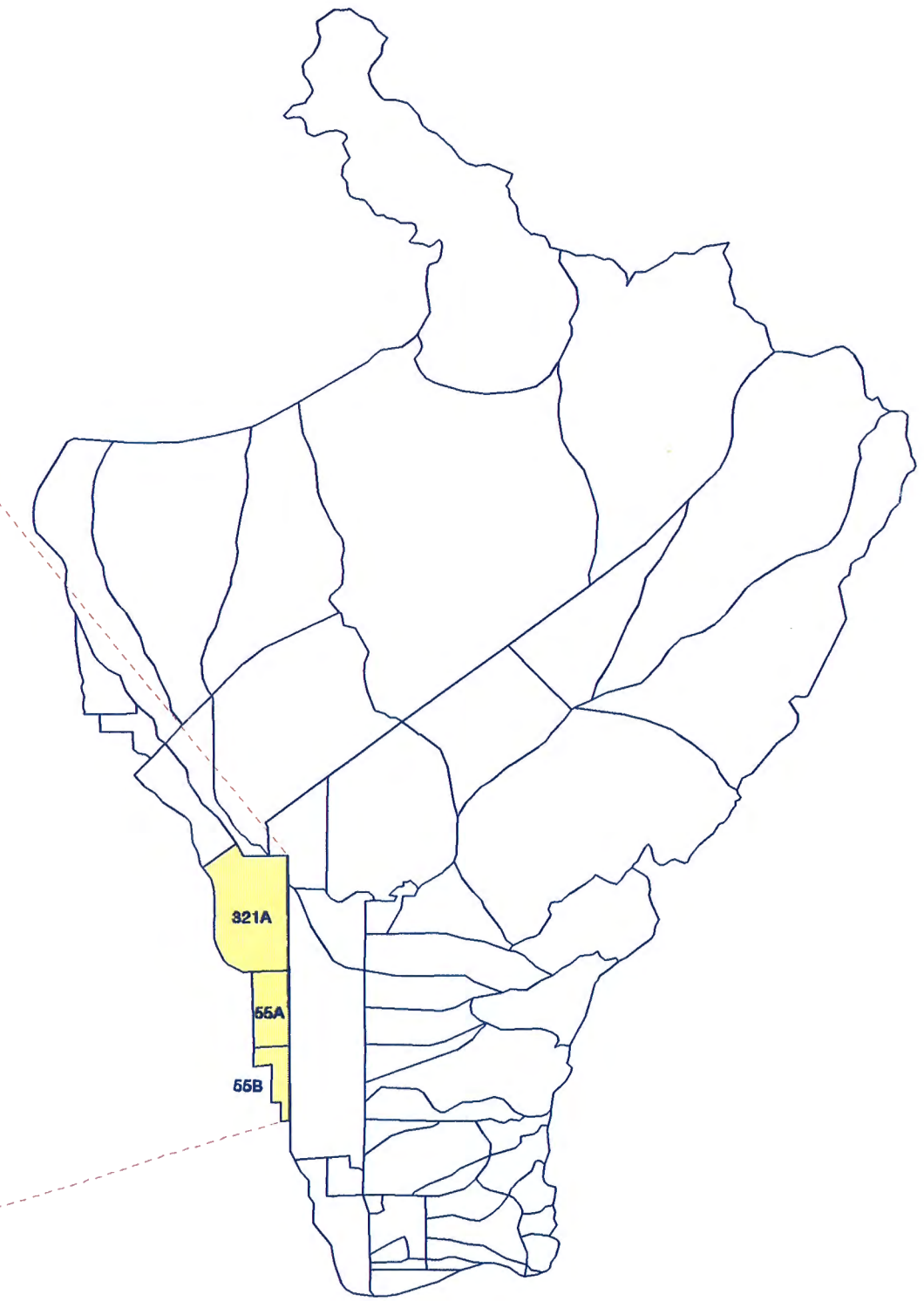
49A-M Basin ID

NELLIS AREA SOILS

FIGURE 2



1" = 2500 ft.



LEGEND

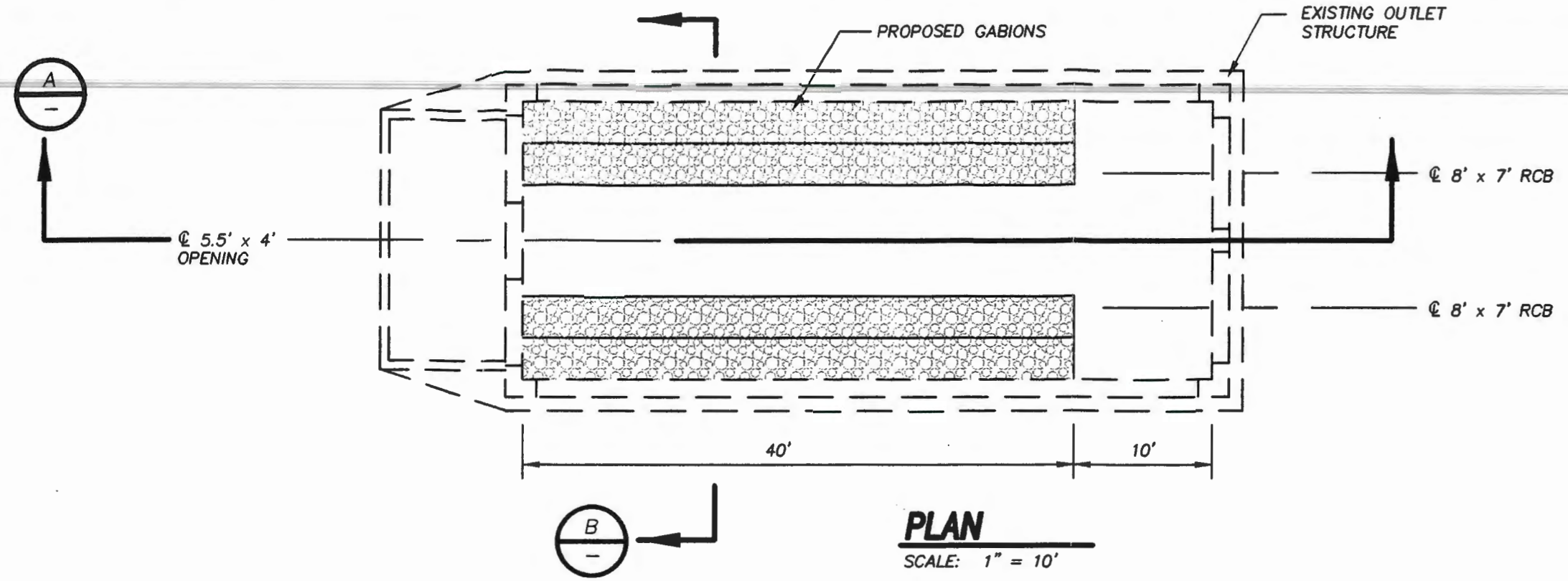
LAND USE CLASSIFICATION

- Parks/Golf Courses
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Commercial/Industrial/ Public Facility
- Open - Desert Shrubs
- Open - Heavy Brush

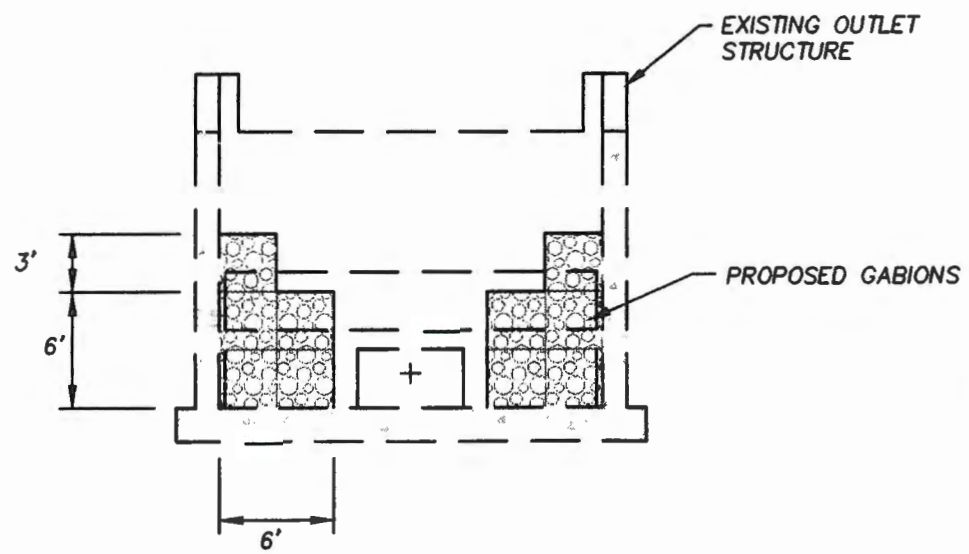
- Drainage Basins
- 49A-M Basin ID

NELLIS AREA LAND USE

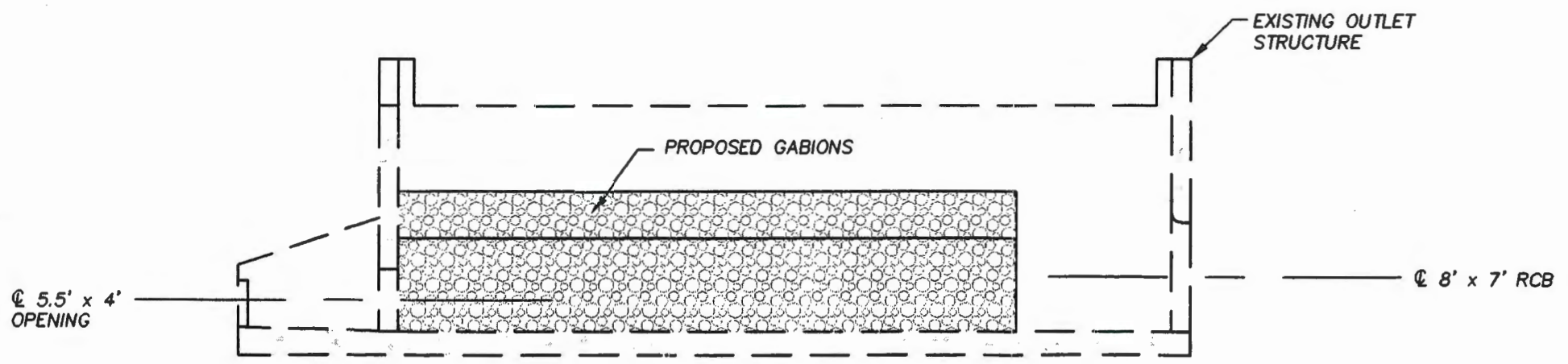
FIGURE 3



PLAN
SCALE: 1" = 10'



SECTION B
SCALE: 1" = 10'



SECTION A
SCALE: 1" = 10'

GABION MITIGATION TO OUTLET STRUCTURE
FIGURE 4

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN
ENGINEERING · PLANNING · SURVEYING · CONSTRUCTION SERVICES

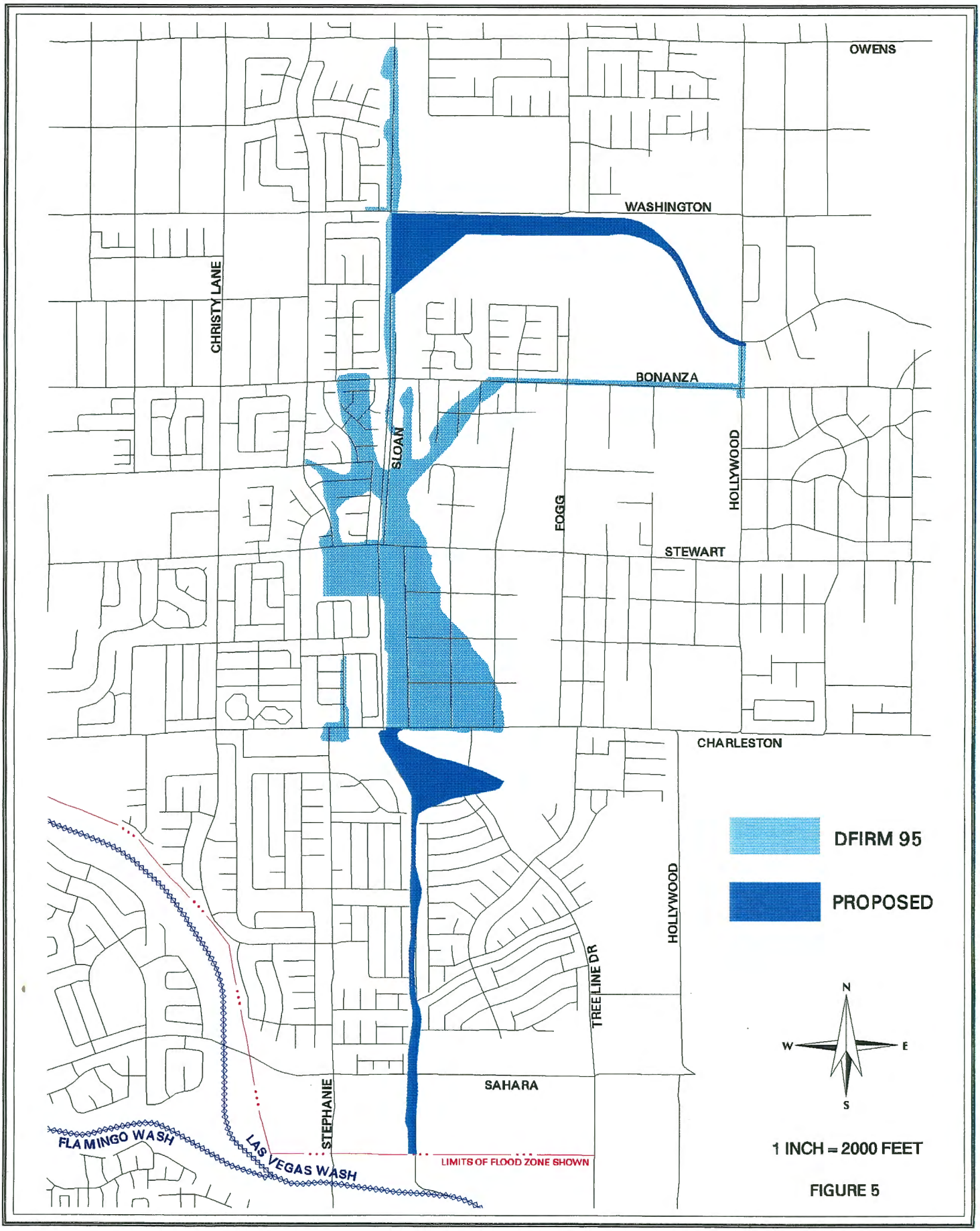

OWENS
WASHINGTON
CHRISTY LANE
BONANZA
SLOAN
FOGG
HOLLYWOOD
STEWART
CHARLESTON
HOLLYWOOD
TREE LINE DR
SAHARA
STEPHANIE
FLAMINGO WASH
LAS VEGAS WASH
LIMITS OF FLOOD ZONE SHOWN
DFIRM 95
PROPOSED
N
W
E
S
1 INCH = 2000 FEET

FIGURE 5

APPENDIX A

HYDROLOGIC CALCULATIONS
NELLIS STORM DRAIN AREA

RANGE WASH FLOOD INSURANCE RESTUDY

TABLE A6-A

DRAINAGE BASIN LAG TIME CALCULATIONS

Per CCRFCD Hydrologic Criteria and Drainage Design Manual, Section 606.3

For drainage basins with areas greater than one square mile.

$$\text{(USBR) } T_{lag} = 20*K_n(L*L_c/S^{0.5})^{0.33}$$

Basin Name	Roughness Type	Manning's Roughness (K_n)	Reach Length (L) (Feet)	Reach Length (L) (Miles)	Centroid Length (L_c) (Miles)	Average Slope (Ft/Ft)	Average Slope (S) (Feet/Mile)	(USBR) Lag Time (T_{lag}) (Hours)
321A	Mtn-Braid	0.050	11500	2.178	1.089	0.005	26	0.77

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

TABLE A5.2-A

Post, Buckley, Schuh & Jernigan, Inc.
PBS&J, Inc.
Project No. : 51804

RANGE WASH FLOOD INSURANCE RESTUDY
Existing Drainage Condition Basins

DATE: Jan-97
FILE: range\stdf4.xls
CALCULATED BY Don Davis

SUB-BASIN DATA					INITIAL / OVERLAND TIME (T_i)			TRAVEL TIME (T_t)				T_c	T_c CHECK URBANIZED BASIN		FINAL T_c	T_{lag}	REMARKS
DESIG: (1)	CN	K (2)	AREA *(acres)* (3)	AREA *(sq.mi.)*	LENGTH *(ft)* (4)	SLOPE *(%)* (5)	T_i *(min)* (6)	LENGT *(ft)* (7)	SLOPE *(%)* (8)	VELOCITY *(fps)* (9)	T_t *(min)* (10)	$T_c = T_i + T_t$ *(min)* (11)	TOTAL LENGTH *(ft)* (12)	T_c = (L/180)+10 *(min)* (13)	*(min)* (14)	T_{lag}= $0.6T_c/60$ *(hrs)*	Point Rainfall 100-yr *(inches)*
55A	77	0.620	323.0	0.505	300	1.0	15.0	7600	0.3	5.20	24.4	39.3	7900	53.9	39.3	**0.39**	2.77
									0.3								
55B	78	0.640	181.0	0.283	300	1.0	14.4	7600	0.3	4.60	27.5	41.9	7900	53.9	41.9	**0.42**	2.77

$T_c = T_i + T_t$

$T_{lag} = 0.6T_c$

$T_i = 1.8\,(1.1 - K)\,L^{1/2} / S^{1/3}$
(L in feet, S in percent)
$K = 0.0132\,(CN) - 0.39$

REFERENCE: *Hydrologic Analysis and Design*, Prentice Hall, Richard H. McCuen, 1989.

STANDARD FORM 4

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*                                       *
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*            SEPTEMBER 1990             *
*             VERSION 4.0               *
*                                       *
*  RUN DATE  01/16/1997  TIME  07:37:54 *
*                                       *
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*                                   *
*    U.S. ARMY CORPS OF ENGINEERS   *
*    HYDROLOGIC ENGINEERING CENTER  *
*         609 SECOND STREET         *
*       DAVIS, CALIFORNIA 95616     *
*           (916) 756-1104          *
*                                   *
*************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
         LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
                   *DIAGRAM
*** FREE ***
              1    ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
              2    ID               FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
              3    ID                   BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
              4    ID                                JOB. NO. 51804
              5    ID                            HEC-1 FILE: NELLIS.DAT
              6    ID                                 JANUARY 1997
              7    ID
              8    ID           EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
              9    ID                     STORM CENTERING FOR NELLIS AND BONANZA
             10    ID
             11    ID
             12    ID   ************************************************************************
             13    ID   *              FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE          *
             14    ID   *                           RANGE WASH WATERSHED                        *
             15    ID   *                JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.        *
             16    ID   *                                JANUARY 1991                           *
             17    ID   *                  PRESENT CONDITIONS, EXISTING FACILITIES              *
             18    ID   *                   BASED ON RANGE WASH FACILITIES STUDY                *
             19    ID   *                      BOYLE ENGINEERS CORP-JULY 1989                   *
             20    ID   *                                                                       *
             21    ID   *                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)              *
             22    ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
             23    ID   ************************************************************************
             24    ID   *                        100-YEAR, 6-HOUR STORM, AMC 2.0                *
             25    ID   ************************************************************************
             26    ID   *  STORM DISTRIBUTION 3 (SDN 3) FOR CONTRIBUTING AREA LESS THAN 10 SQ.MI. *
             27    ID   *     JR DARF RATIOS 1.0 FOR POINT PRECIP AND                           *
             28    ID   *     0.93 FOR NELLIS AND BONANZA (N55B)                                *
             29    ID   ************************************************************************
             30    ID
             31    IT     05       0       0     200
             32    IO      5       0       0
             33    JR   PREC    1.00    0.93

             34    KK   321A
             35    BA  1.576
             36    PB   2.77
             37    PC   .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
             38    PC   .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
             39    PC   .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
             40    PC   .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
             41    PC   .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
             42    PC   .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
             43    PC   .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
             44    PC   .998    .999   1.000
             45    LS     0      75
             46    UD  0.76
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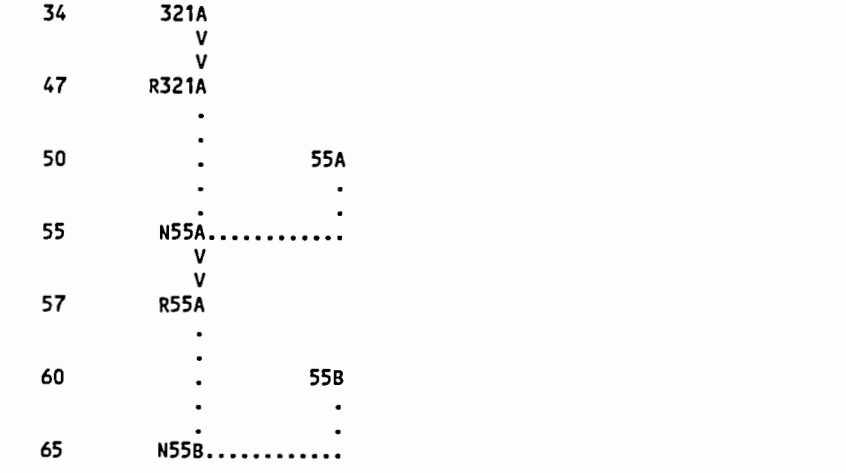
```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

   47         KK   R321A
   48         KM   ROUTE FLOW THROUGH BASIN 55A IN NELLIS.
   49         RK    5300   0.004   0.020       0    TRAP       3      50
              *
   50         KK     55A
   51         BA    .505
   52         PB    2.77
   53         LS       0    76.5
   54         UD     .39
              *
   55         KK    N55A
   56         HC       2
              *
   57         KK    R55A
   58         KM   ROUTE FLOW THROUGH BASIN 55B IN NELLIS.
   59         RK    5300   0.004   0.020       0    TRAP       3      50
              *
   60         KK     55B
   61         BA   0.283
   62         PB    2.77
   63         LS       0      78
   64         UD    0.42
              *
   65         KK    N55B
   66         KM   COMBINE FLOW AT NELLIS AND BONANZA
   67         HC       2
   68         ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING
(.) CONNECTOR
(---->) DIVERSION OR PUMP FLOW
(<----) RETURN OF DIVERTED OR PUMPED FLOW



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****************************************
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*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  01/16/1997  TIME  07:37:54 *
*                                       *
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```


RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: NELLIS.DAT
JANUARY 1997

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE
STORM CENTERING FOR NELLIS AND BONANZA

```
*****************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE              *
*                          RANGE WASH WATERSHED                             *
*                 JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.           *
*                                JANUARY 1991                               *
*                   PRESENT CONDITIONS, EXISTING FACILITIES                 *
*                    BASED ON RANGE WASH FACILITIES STUDY                   *
*                       BOYLE ENGINEERS CORP-JULY 1989                      *
*                                                                           *
*                   (CONVERTED RK TO RM IN UPLAND SUBAREAS)                 *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
*****************************************************************************
*                         100-YEAR, 6-HOUR STORM, AMC 2.0                   *
*****************************************************************************
*  STORM DISTRIBUTION 3 (SDN 3) FOR CONTRIBUTING AREA LESS THAN 10 SQ.MI.   *
*     JR DARF RATIOS 1.0 FOR POINT PRECIP AND                               *
*     0.93 FOR NELLIS AND BONANZA (N55B)                                    *
*****************************************************************************
```

```
32 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1    0  STARTING DATE
                    ITIME         0000  STARTING TIME
                       NQ         200  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1    0  ENDING DATE
                   NDTIME        1635  ENDING TIME
                    ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   16.58 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT
```

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JP          MULTI-PLAN OPTION
                NPLAN           1  NUMBER OF PLANS

JR          MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
               1.00       .93
```

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 .93	.95	
HYDROGRAPH AT								
+	321A	1.58	1	FLOW	478.	405.	426	AT CAREY
				TIME	4.25	4.33		
ROUTED TO								
+	R321A	1.58	1	FLOW	477.	403.		
				TIME	4.50	4.50		
HYDROGRAPH AT								
+	55A	.50	1	FLOW	254.	217.		
				TIME	3.83	3.83		
2 COMBINED AT								
+	N55A	2.08	1	FLOW	581.	489.		AT OWENS
				TIME	4.33	4.42		
ROUTED TO								
+	R55A	2.08	1	FLOW	577.	489.		
				TIME	4.58	4.58		
HYDROGRAPH AT								
+	55B	.28	1	FLOW	150.	129.		
				TIME	3.92	3.92		
2 COMBINED AT								
+	N55B	2.36	1	FLOW	634.	536.		AT BONANZA
				TIME	4.50	4.58		

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= 1.00									
R321A	MANE	5.00	477.02	270.76	.81	5.00	476.84	270.00	.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6840E+02 EXCESS= .0000E+00 OUTFLOW= .6840E+02 BASIN STORAGE= .6434E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .93									
R321A	MANE	5.00	404.70	267.21	.70	5.00	403.47	270.00	.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5845E+02 EXCESS= .0000E+00 OUTFLOW= .5847E+02 BASIN STORAGE= .3905E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00									
R55A	MANE	5.00	579.15	273.87	.83	5.00	577.39	275.00	.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9235E+02 EXCESS= .0000E+00 OUTFLOW= .9233E+02 BASIN STORAGE= .2229E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .93									
R55A	MANE	5.00	489.12	274.99	.71	5.00	489.11	275.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7907E+02 EXCESS= .0000E+00 OUTFLOW= .7907E+02 BASIN STORAGE= .2606E-02 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

APPENDIX B

HYDRAULIC CALCULATIONS
NELLIS STORM DRAIN & STREET CAPACITIES

SUMMARY NELLIS BOULEVARD CAPACITY

LOCATION	STREET CAPACITY (cfs)	PIPE CAPACITY (cfs)	TOTAL CAPACITY (cfs)	ESTIMATED 100-YEAR FLOW (cfs)
Nellis at Carey	181	259	440	426
Nellis at Owens	95	439	534	489
Nellis at Bonanza	67	520	587	536

NELLIS BLVD. STORM DRAIN CAPACITY

STREET - STATIONING	PIPE	ENERGY SLOPE	n	C 1.486 A $R^{2/3}$ / n	CAPACITY (cfs)
Bonanza Road					
10+63 to 30+53	96" RCP	0.003246	0.013	9,119	520
Nellis Blvd.					
225+03 to 245+00	96" RCP	0.003246	0.013	9,119	520
245+00 to 277+67	90" RCP	0.003260	0.013	7,681	439
277+67 to 307+12	84" RCP	0.003542	0.013	6,388	380
307+12 to 317+83	78" RCP	0.003529	0.013	5,242	311
317+83 to 331+67	66" RCP	0.005947	0.013	3,357	259
331+67 to 340+00	54" RCP	0.004922	0.013	1,967	138
340+00 to 344+15	42" RCP	0.005133	0.013	1,006	72
344+15 to 361+00	36" RCP	0.006825	0.013	666	55
361+00 to 372+00	30" RCP	0.006691	0.013	410	34
372+00 to 375+55	24"RCP	0.004648	0.013	226	15

NELLIS BLVD. STORM DRAIN

Pipe	To Station	Rim Elevation	Length	Ground Slope	Pipe Slope	Estimated HGL	Reach Length	Energy Slope	Pipe Reach
96" Pipe						1750.47			
96" Pipe	225+04	1759.65	1,990	N/A	0.00100				
96" Pipe	235+00	1761.46	996	0.001817	0.00307				
96" Pipe	245+00	1764.41	1,000	0.002950	0.00260	1763.41	3,986	0.003246	96" Pipe
90" Pipe	255+00	1767.41	1,000	0.003000	0.00400				
90" Pipe	264+85	1770.30	985	0.002934	0.00100				
90" Pipe	277+67	1775.56	1,282	0.004103	0.00100	1774.06	3,267	0.00326	90" Pipe
84" Pipe	291+00	1780.25	1,333	0.003518	0.00348				
84" Pipe	304+00	1785.81	1,300	0.004277	0.00340				
84" Pipe	307+12	1786.99	312	0.003782	0.00308	1784.49	2,945	0.003542	84" Pipe
78" Pipe	317+83	1790.77	1,071	0.003529	0.00327	1788.27	1,071	0.003529	78" Pipe
66" Pipe	331+67	1797.50	1,384	0.004863	0.00681	1796.50	1,384	0.005947	66" Pipe
54" Pipe	336+00	1800.00	433	0.005774	0.00307				
54" Pipe	340+00	1801.60	400	0.004000	0.00307	1800.60	833	0.004922	54" Pipe
42" Pipe	344+15	1803.73	415	0.005133	0.00641	1802.73	415	0.005133	42" Pipe
36" Pipe	349+00	1806.14	485	0.004969	0.00777				
36" Pipe	352+90	1809.68	390	0.009077	0.00844				
36" Pipe	357+00	1813.16	410	0.008488	0.00844				
36" Pipe	361+00	1816.23	400	0.007675	0.00375	1814.23	1,685	0.006825	36" Pipe
30" Pipe	365+60	1819.79	460	0.007739	0.01522				
30" Pipe	369+00	1822.90	340	0.009147	0.00300				
30" Pipe	372+00	1824.59	300	0.005633	0.03270	1821.59	1100	0.006691	30" Pipe
24" Pipe	375+55	1824.24	355	-0.000986	0.01127	1823.24	355	0.004648	24" Pipe

Nellis at Carey - Street Capactiy
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	Nellis Blvd at Carey
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.004800	ft/ft
Water Surface Elevation	1.53	ft

Elevation range: 0.50 ft to 2.00 ft.

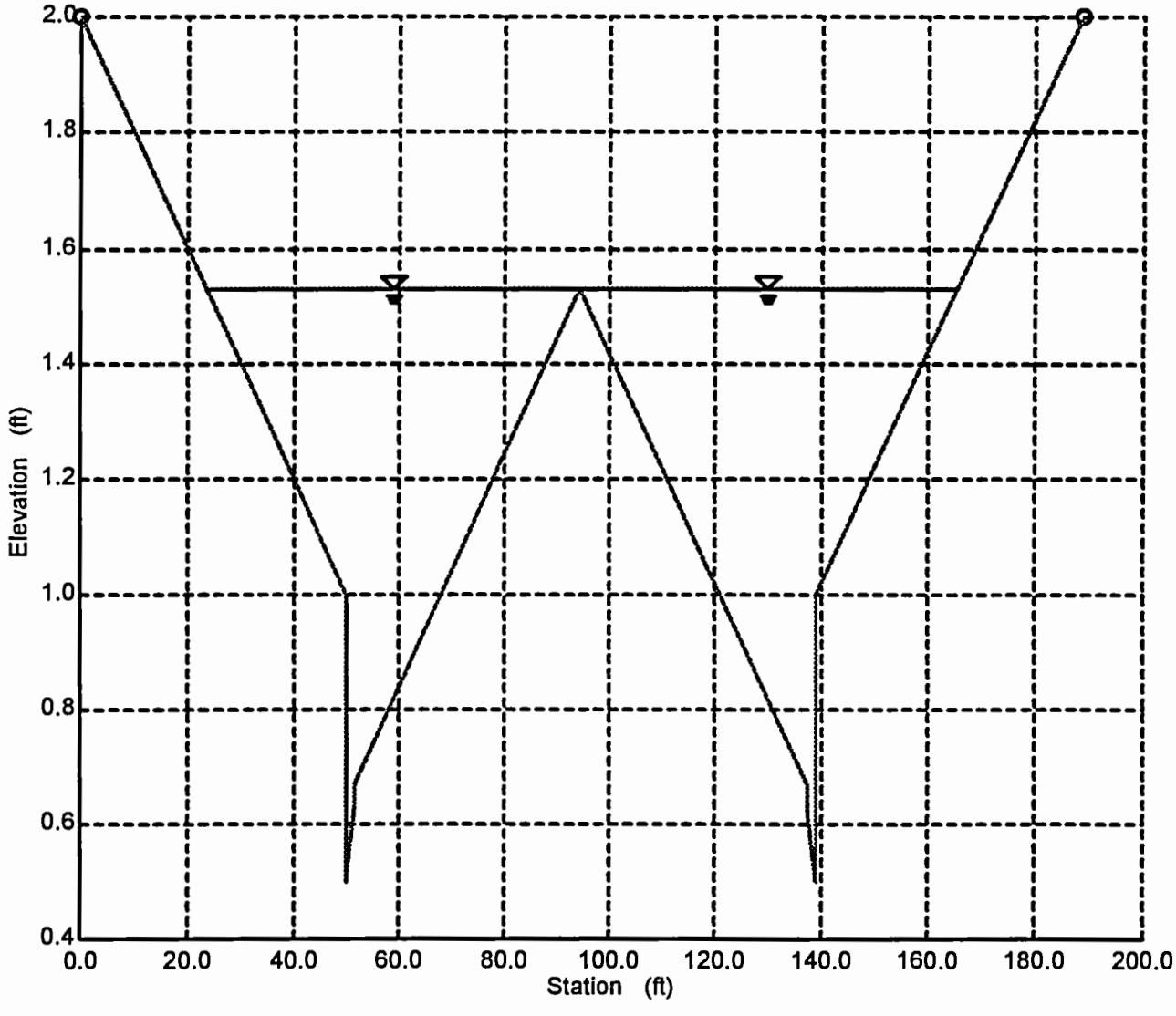
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.00	0.00	189.00	0.016
50.00	1.00			
50.00	0.50			
51.50	0.63			
51.50	0.67			
94.50	1.53			
137.50	0.67			
137.50	0.63			
139.00	0.50			
139.00	1.00			
189.00	2.00			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	180.97	cfs
Flow Area	53.92	ft²
Wetted Perimeter	143.12	ft
Top Width	142.00	ft
Height	1.03	ft
Critical Depth	1.52	ft
Critical Slope	0.005233	ft/ft
Velocity	3.36	ft/s
Velocity Head	0.18	ft
Specific Energy	1.71	ft
Froude Number	0.96	
Flow is subcritical.		
Flow is divided.		

Nellis at Carey - Street Capacity
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	Nellis Blvd at Carey
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004800	ft/ft
Water Surface Elevation	1.53	ft
Discharge	180.97	cfs



West Side of Nellis at Owens
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	West Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.004000	ft/ft
Water Surface Elevation	1.53	ft

Elevation range: 0.50 ft to 2.00 ft.

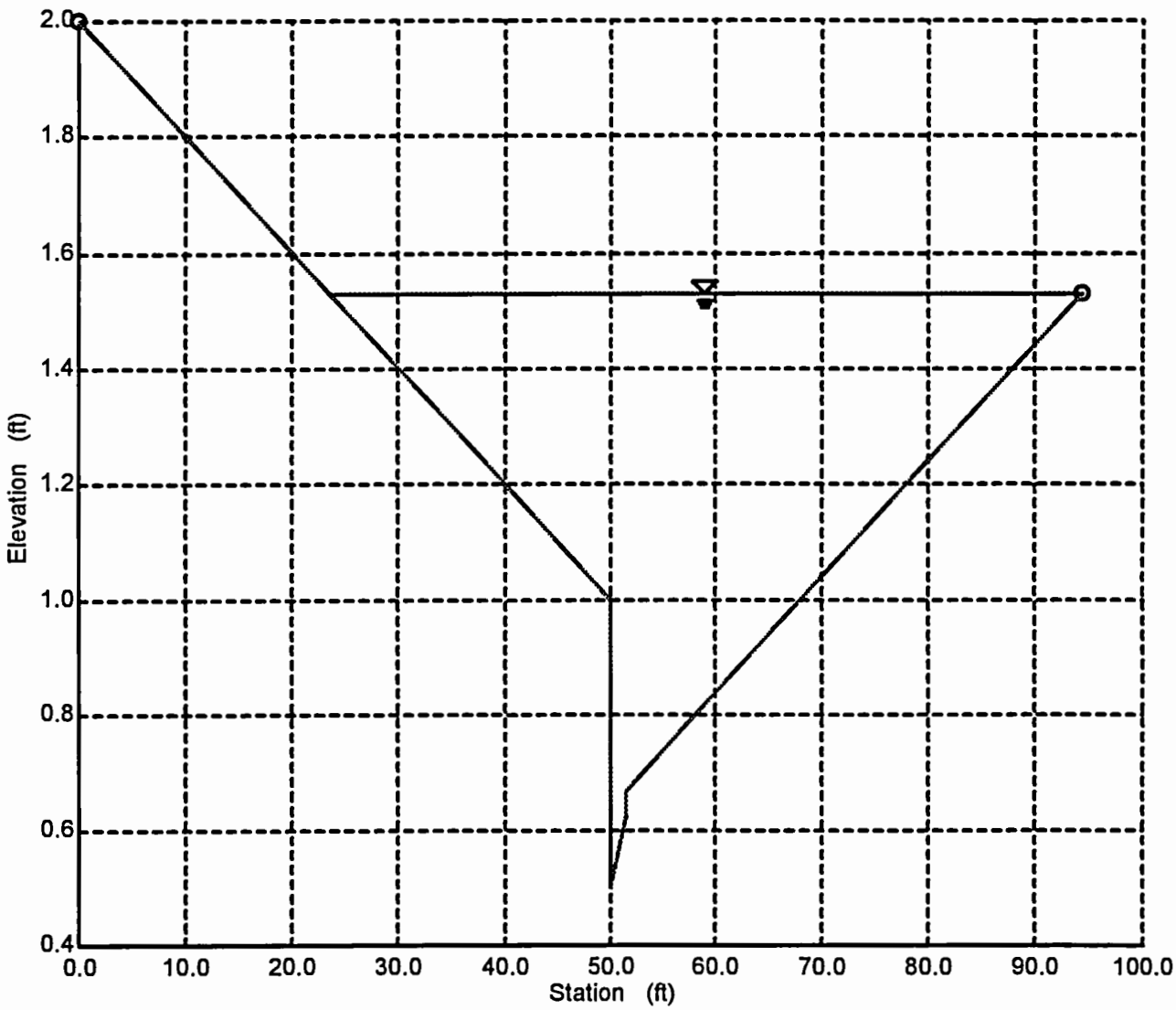
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.00	0.00	94.50	0.016
50.00	1.00			
50.00	0.50			
51.50	0.63			
51.50	0.67			
94.50	1.53			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	82.95	cfs
Flow Area	27.03	ft²
Wetted Perimeter	71.56	ft
Top Width	71.00	ft
Height	1.03	ft
Critical Depth	1.49	ft
Critical Slope	0.005291	ft/ft
Velocity	3.07	ft/s
Velocity Head	0.15	ft
Specific Energy	1.68	ft
Froude Number	0.88	
Flow is subcritical.		

West Side of Nellis at Owens
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	West Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	1.53	ft
Discharge	82.95	cfs



East Side Nellis at Owens
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	East Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.004000	ft/ft
Water Surface Elevation	1.11	ft

Elevation range: 0.50 ft to 1.53 ft.

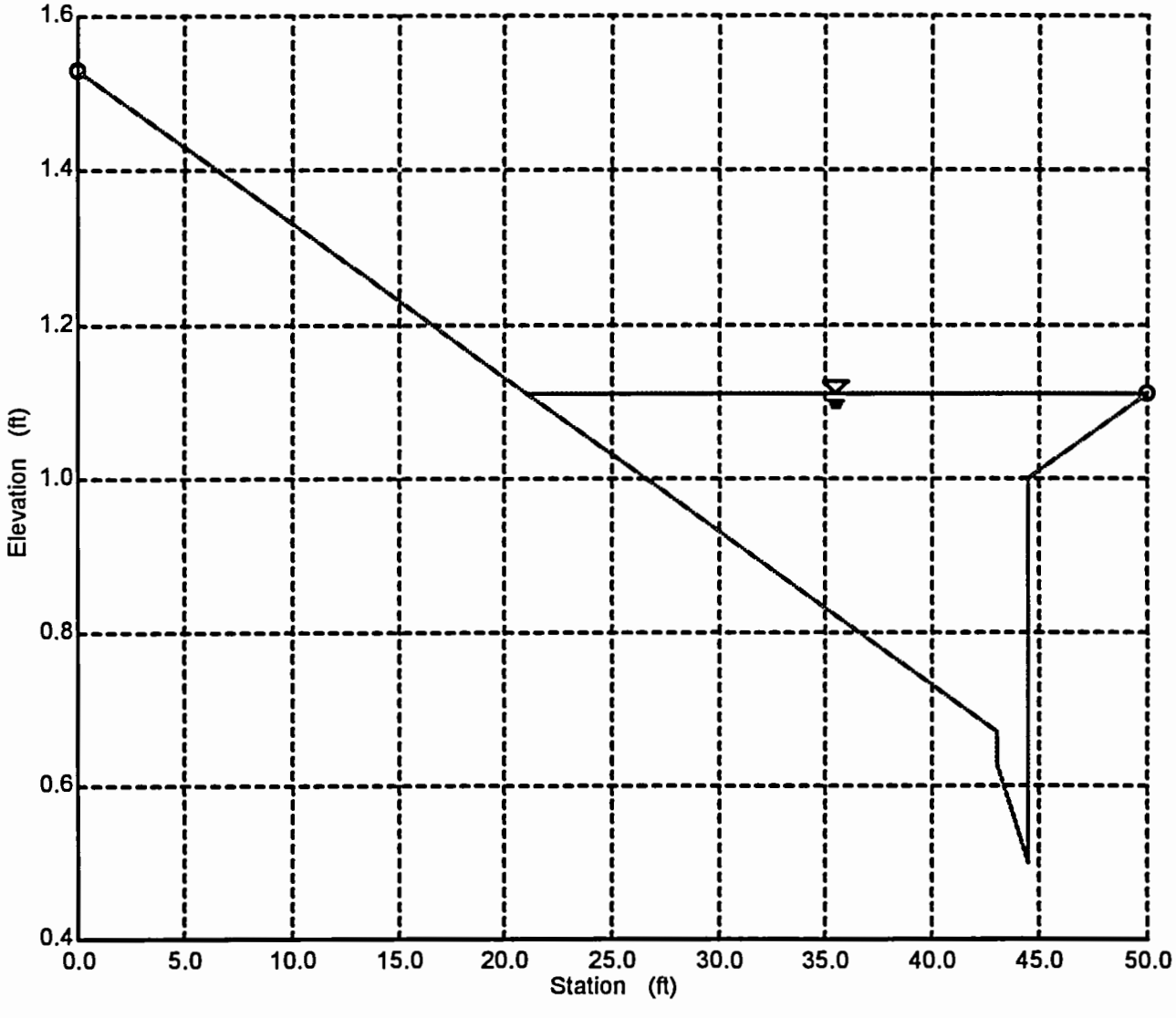
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.53	0.00	50.00	0.016
43.00	0.67			
43.00	0.63			
44.50	0.50			
44.50	1.00			
50.00	1.11			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	12.04	cfs
Flow Area	5.96	ft^2
Wetted Perimeter	29.55	ft
Top Width	29.00	ft
Height	0.61	ft
Critical Depth	1.07	ft
Critical Slope	0.006629	ft/ft
Velocity	2.02	ft/s
Velocity Head	0.06	ft
Specific Energy	1.17	ft
Froude Number	0.79	
Flow is subcritical.		

East Side Nellis at Owens
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	East Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.016	
Channel Slope	0.004000	ft/ft
Water Surface Elevation	1.11	ft
Discharge	12.04	cfs



West Side of Nellis at Bonanza
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	West Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data				
Channel Slope		0.002000 ft/ft		
Water Surface Elevation		1.53 ft		
Elevation range: 0.50 ft to 2.00 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.00	0.00	94.50	0.016
50.00	1.00			
50.00	0.50			
51.50	0.63			
51.50	0.67			
94.50	1.53			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	58.65	cfs
Flow Area	27.03	ft²
Wetted Perimeter	71.56	ft
Top Width	71.00	ft
Height	1.03	ft
Critical Depth	1.39	ft
Critical Slope	0.005532	ft/ft
Velocity	2.17	ft/s
Velocity Head	0.07	ft
Specific Energy	1.60	ft
Froude Number	0.62	
Flow is subcritical.		

East Side Nellis at Bonanza
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\nellis.fm2
Worksheet	East Side of Nellis Blvd.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.002000	ft/ft
Water Surface Elevation	1.11	ft

Elevation range: 0.50 ft to 1.53 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.53	0.00	50.00	0.016
43.00	0.67			
43.00	0.63			
44.50	0.50			
44.50	1.00			
50.00	1.11			

Results		
Wtd. Mannings Coefficient	0.016	
Discharge	8.51	cfs
Flow Area	5.96	ft²
Wetted Perimeter	29.55	ft
Top Width	29.00	ft
Height	0.61	ft
Critical Depth	1.01	ft
Critical Slope	0.006779	ft/ft
Velocity	1.43	ft/s
Velocity Head	0.03	ft
Specific Energy	1.14	ft
Froude Number	0.56	
Flow is subcritical.		

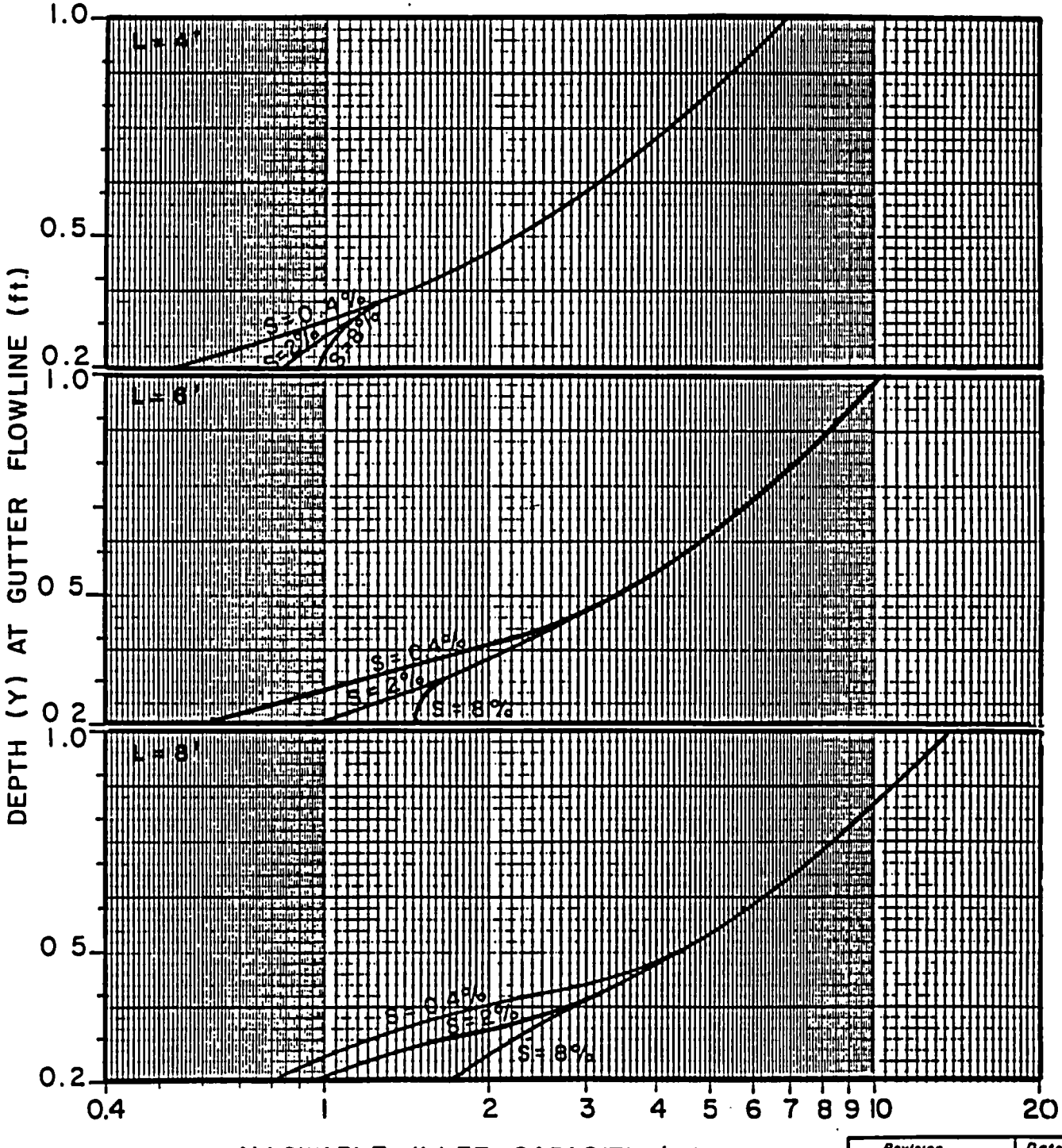
Nellis Boulevard Storm Drain Capacity
Inlets

Inlet Capactiy @ 1 ft deep	1.75 cfs/ft	Figure 804
Linear Feet of Inlets on Nellis Storm Drain =	392 ft	
Inlet Capacity = 392 x 1.75 =	686 cfs	
Capacity of Pipes Controls =	520 cfs	

ALLOWABLE INLET CAPACITY

CONTINUOUS GRADE CONDITION

TYPE A INLET Y≤1FOOT



NOTES: Includes capacity reduction factor of 0.80.

Revision	Date

WRC ENGINEERING	REFERENCE:	FIGURE 804 1 OF 3

APPENDIX C

HYDRAULIC CALCULATIONS
MODIFIED OUTLET STRUCTURE

ESTABLISH TAILWATER RATING CURVE
FOR LOW LEVEL OUTLET BY BACKWATER ANALYSIS INSIDE OUTLET STRUCTURE

Section	Flow Q cfs	Width B ft	Side Slope z	Grade So ft/ft	Rough Coef. n	Depth trial y ft	Area A sq ft	Vel. V fps	Vel. Head Vh ft	Spec. Head H ft	Wetted Perim. P ft	Hyd. Radius R ft	Energy Slope S ft/ft	Ave. Slope S ave. ft/ft	Change in Head dH ft	Length L ft
1	40	8	0	0.0025	0.025	0.92	7.35	5.44	0.46	1.38	9.84	0.747	0.012	0.017	-0.14	10
2	40	8	0	0.0025	0.025	1.28	10.3	3.9	0.24	1.52	10.57	0.971	0.004	0.007	-0.14	30
3	40	8	0	0.0025	0.025	1.48	11.9	3.37	0.18	1.66	10.97	1.083	0.003			
1	80	8	0	0.0025	0.025	1.46	11.7	6.85	0.73	2.19	10.92	1.069	0.012	0.017	-0.15	10
2	80	8	0	0.0025	0.025	1.91	15.3	5.23	0.42	2.34	11.82	1.294	0.005	0.009	-0.19	30
3	80	8	0	0.0025	0.025	2.21	17.7	4.52	0.32	2.53	12.42	1.425	0.004			
1	120	8	0	0.0025	0.025	1.91	15.3	7.85	0.96	2.87	11.82	1.294	0.012	0.018	-0.16	10
2	120	8	0	0.0025	0.025	2.44	19.5	6.16	0.59	3.02	12.87	1.514	0.006	0.01	-0.23	30
3	120	8	0	0.0025	0.025	2.81	22.5	5.34	0.44	3.25	13.62	1.651	0.004			
1	160	8	0	0.0025	0.025	2.32	18.5	8.64	1.16	3.47	12.63	1.467	0.012	0.019	-0.17	10
2	160	8	0	0.0025	0.025	2.90	23.2	6.89	0.74	3.64	13.80	1.682	0.007	0.011	-0.26	30
3	160	8	0	0.0025	0.025	3.34	26.7	5.99	0.56	3.90	14.68	1.820	0.004			
1	200	8	0	0.0025	0.025	2.69	21.5	9.3	1.34	4.03	13.37	1.607	0.013	0.02	-0.17	10
2	200	8	0	0.0025	0.025	3.33	26.6	7.51	0.88	4.20	14.66	1.817	0.007	0.012	-0.28	30
3	200	8	0	0.0025	0.025	3.82	30.6	6.54	0.66	4.49	15.65	1.955	0.005			
1	240	8	0	0.0025	0.025	3.03	24.3	9.89	1.52	4.55	14.07	1.726	0.013	0.021	-0.18	10
2	240	8	0	0.0025	0.025	3.73	29.8	8.05	1.01	4.73	15.45	1.929	0.007	0.013	-0.31	30
3	240	8	0	0.0025	0.025	4.27	34.2	7.02	0.77	5.04	16.55	2.066	0.005			
1	280	8	0	0.0025	0.025	3.36	26.9	10.4	1.68	5.04	14.73	1.827	0.013	0.021	-0.19	10
2	280	8	0	0.0025	0.025	4.10	32.8	8.53	1.13	5.23	16.21	2.026	0.008	0.013	-0.33	30
3	280	8	0	0.0025	0.025	4.70	37.6	7.45	0.86	5.56	17.40	2.161	0.006			
1	320	8	0	0.0025	0.025	3.68	29.4	10.9	1.84	5.51	15.35	1.916	0.014	0.022	-0.20	10
2	320	8	0	0.0025	0.025	4.46	35.7	8.96	1.25	5.71	16.93	2.109	0.008	0.014	-0.35	30
3	320	8	0	0.0025	0.025	5.10	40.8	7.84	0.95	6.06	18.21	2.242	0.006			
1	360	8	0	0.0025	0.025	3.98	31.8	11.3	1.99	5.97	15.95	1.994	0.014	0.023	-0.20	10
2	360	8	0	0.0025	0.025	4.81	38.5	9.36	1.36	6.17	17.61	2.183	0.009	0.015	-0.37	30
3	360	8	0	0.0025	0.025	5.49	43.9	8.2	1.04	6.53	18.98	2.314	0.006			
1	370	8	0	0.0025	0.025	4.05	32.4	11.4	2.03	6.08	16.10	2.012	0.014	0.023	-0.20	10
2	370	8	0	0.0025	0.025	4.89	39.1	9.46	1.39	6.28	17.78	2.200	0.009	0.015	-0.37	30
3	370	8	0	0.0025	0.025	5.58	44.7	8.28	1.06	6.65	19.17	2.331	0.006			

Section	Description
1	Critical at Downstream end of Gabions
2	10 feet Upstream of end of Gabions
3	Upstream end of Box Strucuture - Tailwater for Low Level Outlet

CURRENT DATE: 11-04-1996
CURRENT TIME: 12:24:18

FILE DATE: 11-04-1996
FILE NAME: OUTSS

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS / SHAPE / MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	98.78	98.77	1.25	1 RCB	5.50	4.00	.013	CONVENTIONAL
2								
3								
4								
5								
6								

FILE: OUTSS CULVERT HEADWATER ELEVATION (FT) DATE: 11-04-1996

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	98.78	0.00	0.00	0.00	0.00	0.00	113.00
37	100.69	0.00	0.00	0.00	0.00	0.00	113.22
74	101.93	0.00	0.00	0.00	0.00	0.00	113.36
111	102.72	0.00	0.00	0.00	0.00	0.00	113.47
148	103.66	0.00	0.00	0.00	0.00	0.00	113.56
185	104.73	0.00	0.00	0.00	0.00	0.00	113.65
222	105.98	0.00	0.00	0.00	0.00	0.00	113.74
259	107.47	0.00	0.00	0.00	0.00	0.00	113.82
296	109.21	0.00	0.00	0.00	0.00	0.00	113.89
333	111.24	0.00	0.00	0.00	0.00	0.00	113.97
370	113.70	0.00	0.00	0.00	0.00	0.00	114.04

CURRENT DATE: 11-04-1996 FILE DATE: 11-04-1996
CURRENT TIME: 12:24:18 FILE NAME: OUTSS

CULVERT # 1

PERFORMANCE CURVE FOR 1 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
0	98.78	98.78	0.00	0.00	0-NF	0.00	98.78	0.00	0.00
37	101.40	100.15	1.91	2.62	6-FF	0.00	0.00	0.00	4.87
74	101.93	100.88	3.00	3.15	6-FF	0.00	0.00	0.00	6.38
111	102.72	101.46	3.94	3.75	6-FF	0.00	0.00	0.00	8.92
148	103.66	101.96	4.88	4.46	6-FF	0.00	0.00	0.00	9.81
185	104.73	102.42	5.95	5.12	5-S2	0.00	0.00	0.00	10.55
222	105.98	102.85	7.20	6.45	4-FF	0.00	0.00	0.00	10.09
259	107.47	103.25	8.69	7.71	4-FF	0.00	0.00	0.00	11.77
296	109.21	103.64	10.43	9.09	4-FF	0.00	0.00	0.00	13.45
333	111.24	104.01	12.46	10.58	4-FF	0.00	0.00	0.00	15.14
370	113.70	104.36	14.92	12.19	4-FF	0.00	0.00	0.00	16.82

El. inlet face invert 98.78 ft El. outlet invert 98.77 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	98.78
OUTLET STATION (FT)	1.25
OUTLET ELEVATION (FT)	98.77
NUMBER OF BARRELS	1.00
SLOPE (V-FT/H-FT)	0.0080
CULVERT LENGTH ALONG SLOPE (FT)	1.25

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	5.50 FT
BARREL RISE	4.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.013
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 11-04-1996
CURRENT TIME: 12:24:18

FILE DATE: 11-04-1996
FILE NAME: OUTSS

TAILWATER

TAILWATER RATING CURVE

FLOW(CFS)	W.S.E.(FT)
0	98.78
37	100.15
74	100.88
111	101.46
148	101.96
185	102.42
222	102.85
259	103.25
296	103.64
333	104.01
370	104.36

ROADWAY OVERTOPPING DATA

WEIR COEFFICIENT	3.00
EMBANKMENT TOP WIDTH (FT)	1.00
CREST LENGTH (FT)	116.00
OVERTOPPING CREST ELEVATION (FT)	113.00

APPENDIX D

HYDROLOGIC ANALYSIS FOR DETENTION BASIN WITH REVISED STAGE/STORAGE/DISCHARGE

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             SEPTEMBER 1990            *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  01/17/1997  TIME  12:14:30 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
         LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                       *DIAGRAM
*** FREE ***
                   1   ID                    RANGE WASH - FLOOD INSURANCE RESTUDY
                   2   ID              FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
                   3   ID                 BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
                   4   ID                              JOB. NO. 51804
                   5   ID                         HEC-1 FILE: RFISA.DAT
                   6   ID                              JANUARY 1997
                   7   ID
                   8   ID
                   9   ID    REVISED FOR REVISIONS TO CONFLUENCE DETENTION BASIN OUTLET
                  10   ID    FILE REVISED WITH NEW STAGE STORAGE DISCHARGE RELATIONSHIP
                  11   ID    REVISED DUE TO PLACEMENT OF GABIONS IN OUTLET STRUCTURE
                  12   ID    TO IMPROVE FACTOR OF SAFETY AGAINST BUOYANCY OF STRUCTURE
                  13   ID    REVSION SLIGHTLY REDUCES LOW LEVEL DISCHARGE CAPACITY
                  14   ID    FROM 367 CFS TO 364 CFS AT CREST OF HIGH LEVEL WEIR
                  15   ID
                  16   ID
                  17   ID       EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE, AND ALSO
                  18   ID       WITH THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
                  19   ID   STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR THE CONFLUENCE DETENTION BASIN
                  20   ID
                  21   ID   ********************************************************************************
                  22   ID   *             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE             *
                  23   ID   *                          RANGE WASH WATERSHED                            *
                  24   ID   *               JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.            *
                  25   ID   *                               JANUARY 1991                               *
                  26   ID   *                 PRESENT CONDITIONS, EXISTING FACILITIES                  *
                  27   ID   *                  BASED ON RANGE WASH FACILITIES STUDY                    *
                  28   ID   *                     BOYLE ENGINEERS CORP-JULY 1989                       *
                  29   ID   *                                                                          *
                  30   ID   *                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)                 *
                  31   ID   *MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
                  32   ID   ********************************************************************************
                  33   ID   *                      100-YEAR, 6-HOUR STORM, AMC 2.0                     *
                  34   ID   ********************************************************************************
                  35   ID   * STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
                  36   ID   *    JR DARF RATIO 0.630 AT THE CONFLUENCE DETENTION BASIN, NODE DB.IN     *
                  37   ID   * JR DARF RATIO 0.601 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
                  38   ID   ********************************************************************************
                  39   ID
                  40   IT      05       0       0     200
                  41   IO       5       0       0
                  42   JR    PREC    0.60     .63

                  43   KK  306B-M
                  44   KM   BASIN 306B-M CONTRIBUTES FLOW TO NODE F3, THE BRIDGE AT THE UPRR,
                  45   KM   MPU FACILITY RWWB 0027,(2) 21'X12' BRIDGE OPENINGS.
                  46   BA   5.528
                  47   PB    2.77
                  48   PC    .000    .020    .059    .080    .110    .144    .150    .160    .168    .171
                  49   PC    .180    .182    .187    .190    .197    .202    .210    .220    .230    .241
                  50   PC    .250    .259    .265    .280    .290    .300    .305    .309    .310    .317
                  51   PC    .321    .327    .333    .346    .361    .381    .408    .430    .477    .514
                  52   PC    .561    .630    .710    .720    .731    .752    .779    .790    .795    .804
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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  53          PC    .810    .820    .826    .840    .859    .889    .910    .938    .966    .970
  54          PC    .974    .979    .981    .983    .985    .989    .990    .992    .993    .996
  55          PC    .997    .999   1.00
  56          LS       0      74
  57          UD    0.93
              *

  58          KK  307A-M
  59          KM   BASIN 307A-M CONTRIBUTES FLOW TO NODE F4, THE BOX CULVERT AT THE UPRR,
  60          KM   MPU FACILITY RWWE 0202, A 12'X8' RCB.
  61          BA   2.516
  62          PB    2.77
  63          LS       0      76
  64          UD    1.10
              *

  65          KK NODE.G1
  66          KM   COMBINE FLOW FROM F3 AND F4, NODE G1 IS THE BOX CULVERT AT INTERSTATE 15,
  67          KM   MPU FACILITY RWWE 0168, (3) 15'X10' RCBS.
  68          HC       2
              *

  69          KK   G1-G3
  70          KM   ROUTE FLOW FROM G1 THROUGH BASIN 307B-M TO G3.
  71          RM       5     .40      .3
              *

  72          KK  307B-M
  73          KM   BASIN 307B-M CONTRIBUTES FLOW TO NODE G3.
  74          BA   0.677
  75          PB    2.77
  76          LS       0      81
  77          UD    0.79
              *

  78          KK NODE.G3
  79          KM   COMBINE FLOW FROM G1 WITH FLOW FROM BASIN 307B-M.
  80          KM   NODE G3 REPRESENTS EAST TRIB TO NODE G2 AT LAS VEGAS BLVD.
  81          HC       2
              *

  82          KK    307C
  83          KM   307C MODIFIED DUE TO GOLDEN TRIANGLE INDUSTRIAL PARK
  84          KM   BASIN 307C CONTRIBUTES FLOW TO UPSTREAM OF INDUSTRIAL PARK
  85          BA    .503
  86          PB    2.77
  87          LS       0      77
  88          UD     .79
              *
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LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  89      KK    TOG4
  90      KM   ROUTE FLOW THROUGH INDUSTRIAL PARK
  91      RK    6000   0.010   0.020       0    TRAP       3      50
          *

  92      KK    307D
  93      KM   AREA OF GOLDEN TRIANGLE INDUSTRIAL PARK
  94      BA    .323
  95      PB    2.77
  96      LS       0      88
  97      UD     .30
          *

  98      KK      G4
  99      KM   NODE G4 AT WALNUT AND MITCHELL
 100      KM   ASSUMES NO STORAGE OR CULVERT CAPACTIY RESTRICTION
 101      HC       2
          *

 102      KK   G4-G2
 103      KM   ROUTE FLOW FROM NODE G4 TO NODE G2.
 104      RK    8600   0.008   0.025       0    TRAP       3      50
          *

 105      KK    307E
 106      KM   BASIN 307E CONTRIBUTES FLOW TO NODE G7.
 107      BA   0.766
 108      PB    2.77
 109      LS       0      79
 110      UD    0.60
          *

 111      KK NODE.G7
 112      KM   COMBINE FLOW FROM NODE G4 AND BASIN 307E.
 113      KM   NODE G7, LOCATED NEAR THE ALEXANDER/LAMB INTERSECTION,
 114      KM   REPRESENTS THE TOTAL FLOW IN THE WESTERN TRIBUTARY TO NODE G2.
 115      HC       2
          *

 116      KK NODE.G2
 117      KM   COMBINE FLOW FROM NODES G3 AND G7; GIVES TOTAL FLOW TO G2.
 118      KM   NODE G2 IS MPU FACILITY RWSL 0745, (7) 10'X7' RCBS AT LAS VEGAS BLVD.
 119      HC       2
          *

 120      KK   G2-G8
 121      KM   ROUTE FLOW TO NODE G8
 122      RK    2500    .003    .015       0    TRAP      20       2
          *
```

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LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  123         KK   309-M
  124         KM   BASIN 309-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
  125         KM   AND THEN CROSSING BENEATH I-15.
  126         KM   SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
  127         KM   MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0303, 0201, 0182, 0121, & 0085.
  128         KM   MPU FACILITIES AT I-15 ARE LABELED IS15 1917 AND IS15 1968.
  129         KM   NODE I3 IS LOCATED ARBITRARILY NEAR THE MIDDLE OF BASIN 309-M FOR
  130         KM   MODELING PURPOSES ONLY AND IS NOT THE ONLY CONCENTRATION POINT FOR 309-M.
  131         BA   3.976
  132         PB    2.77
  133         LS       0      75
  134         UD    0.86
              *

  135         KK   I3-I4
  136         KM   ROUTE FLOW FROM I3 THROUGH BASIN 310B-M TO I4.
  137         RM       9     .73      .2
              *

  138         KK  310B-M
  139         KM   BASIN 310B-M CONTRIBUTES FLOW TO NODE I4.
  140         BA   4.573
  141         PB    2.77
  142         LS       0      82
  143         UD     1.0
              *

  144         KK NODE.I4
  145         KM   COMBINE FLOW FROM NODE I3 AND BASIN 310B-M AT NODE I4.
  146         KM   NODE I4 IS MPU FACILITY SLEB 0044, (6) 10'X7' RCBS AT LAS VEGAS BLVD.
  147         KM   AT THE ENTRANCE TO THE CONCRETE LINED CHANNEL THAT EXTENDS THROUGH THE
  148         KM   TRAILER PARKS.
  149         HC       2
              *

  150         KK   I4-G8
  151         KM   ROUTE FLOW FROM I4 THROUGH THE CONCRETE CHANNEL TO G8.
  152         RK    2300   0.002   0.015       0    TRAP      20     1.5
              *

  153         KK NODE.G8
  154         KM   COMBINE FLOW FROM I4 AND G2 TO GIVE THE TOTAL FLOW AT NODE G8.
  155         KM   NODE G8 IS THE CONFLUENCE OF THE CONCRETE LINED CHANNELS, LABELED AS
  156         KM   MPU FACILITIES RWSL 0672 AND SLEB 0000.
  157         HC       2
              *

  158         KK   G8-G9
  159         KM   ROUTE FLOW FROM G8 THROUGH THE CONCRETE CHANNEL TO G9.
  160         RK    8400   0.003   0.015       0    TRAP      20       2
              *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  161     KK     47C
  162     KM   BASIN 47C CONTRIBUTES FLOW TO THE PORTION OF THE CONCRETE CHANNEL
  163     KM   LOCATED UPSTREAM OF THE DIVERSION STRUCTURE.
  164     BA   0.856
  165     PB    2.77
  166     LS       0      79
  167     UD     .49
          *

  168     KK NODE.G9
  169     KM   COMBINE FLOW FROM G8 WITH FLOW FROM BASIN 47C.
  170     KM   NODE G9 REPRESENTS THE TOTAL FLOW IN THE CONCRETE CHANNEL, LABELED
  171     KM   MPU FACILITY RWSL 0576, LOCATED JUST UPSTREAM OF THE DIVERSION STRUCTURE.
  172     HC       2
          *

  173     KK     DIV
  174     KM   FLOW DIVERSION STRUCTURE; SOME FLOW IS DIVERTED INTO THE CHANNEL THAT
  175     KM   EXTENDS THROUGH THE NELLIS AIR FORCE BASE GOLF COURSE.  FLOW IN THE NAFB
  176     KM   GOLF COURSE CHANNEL WILL THEN ENTER THE CONFLUENCE DETENTION BASIN.
  177     DT   RANGE
  178     DI       0     850     920    1020    1230    1440    1685    2390    3100    3900
  179     DQ       0     850     900     950    1000    1050    1100    1200    1300    1400
          *

  180     KKG9-DB.IN
  181     KM   ROUTE FLOW FROM G9 THROUGH THE GOLF COURSE CHANNEL TO THE ENTRANCE
  182     KM   OF THE CONFLUENCE DETENTION BASIN, LABELED DB.IN.
  183     RK    4000   0.002    0.03       0    TRAP      70       3
          *

  184     KK   47B-M
  185     KM   MAJORITY OF BASIN 47B-M CONTRIBUTES FLOW TO THE NAFB GOLF COURSE CHANNEL;
  186     KM   PORTION OF 47B-M CONTRIBUTES FLOW DIRECTLY TO THE CONFLUENCE DETENTION BASIN.
  187     BA   3.378
  188     PB    2.81
  189     LS       0      84
  190     UD    0.60
          *

  191     KK     G10
  192     KM   COMBINE FLOW FROM GOLF WITH FLOW FROM BASIN 47B-M.
  193     KM   GIVES TOTAL FLOW TO THE NAFB GOLF COURSE CHANNEL.
  194     HC       2
          *

  195     KK   DBINW
  196     KM   ROUTE WEST TRIBUTARY THOUGH DET BASIN AREA
  197     RM       2     .16      .3
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  198     KK    44-M
  199     KM   BASIN 44-M CONTRIBUTES FLOW TO NODE J.
  200     KM   NODE J IS LOCATED NEAR THE CENTER OF BASIN 44-M FOR MODELING PURPOSES ONLY.
  201     BA   8.164
  202     PB    2.85
  203     LS       0      84
  204     UD    1.28
          *

  205     KK     J-K
  206     KM   ROUTE FLOW FROM NODE J THROUGH BASIN 312-M TO NODE K.
  207     RM      11    0.92    0.15
          *

  208     KK   312-M
  209     KM   BASIN 312-M CONTRIBUTES FLOW TO SEVERAL CULVERTS CROSSING BENEATH THE UPRR
  210     KM   THEN CROSSING BENEATH I-15, AND THEN CROSSING BENEATH LAS VEGAS BLVD.
  211     KM   SEVERAL DIKES AT THE UPRR CONVEY FLOW TO THE UPRR CULVERT CROSSINGS.
  212     KM   MPU FACILITIES AT THE UPRR ARE LABELED RRSW 0057, 0038, 0806, 0826, ETC.
  213     KM   MPU FACILITIES AT I-15 ARE LABELED IS15 2108, 2143, 2189, 2205, ETC.
  214     KM   THE MAJORITY OF FLOW FROM BASIN 312-M CONCENTRATES AT NODE K.
  215     BA  13.457
  216     PB    2.79
  217     LS       0      75
  218     UD    1.38
          *

  219     KK  NODE.K
  220     KM   COMBINE FLOW FROM J WITH FLOW FROM BASIN 312-M AT NODE K.
  221     HC       2
          *

  222     KK    K-P1
  223     KM   ROUTE FLOW FROM NODE K THROUGH BASIN 47A TO NODE P1.
  224     RM      10     .80     .15
          *

  225     KK    45-M
  226     KM   BASIN 45-M CONTRIBUTES FLOW TO NODE N2.
  227     BA   8.207
  228     PB    2.85
  229     LS       0      78
  230     UD    1.27
          *

  231     KK    N2-O
  232     KM   ROUTE FLOW FROM N2 THROUGH BASIN 48 TO NODE O.
  233     RM       4    0.37    0.15
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  234     KK     48
  235     KM   BASIN 48 CONTRIBUTES FLOW TO NODE O.
  236     BA    2.07
  237     PB    2.85
  238     LS       0      73
  239     UD    0.99
          *

  240     KK     46A
  241     KM   BASIN 46A CONTRIBUTES FLOW TO NODE O.
  242     BA   7.278
  243     PB    2.95
  244     LS       0      76
  245     UD    1.56
          *

  246     KK   46B-M
  247     KM   BASIN 46B-M CONTRIBUTES FLOW TO NODE O.
  248     BA   6.312
  249     PB    3.00
  250     LS       0      76
  251     UD    1.64
          *

  252     KK  NODE.O
  253     KM   COMBINE FLOW FROM N2 AND BASINS 48, 46A, AND 46B-M AT NODE O.
  254     HC       4
          *

  255     KK    O-P1
  256     KM   ROUTE FLOW FROM NODE O THROUGH BASIN 47A TO NODE P1.
  257     RM      10    0.85    0.15
          *

  258     KK     47A
  259     KM   BASIN 47A CONTRIBUTES FLOW TO NODE P1.
  260     BA   2.428
  261     PB    2.95
  262     LS       0      77
  263     UD    0.84
          *

  264     KK NODE.P1
  265     KM   COMBINE FLOW FROM NODES K AND O WITH FLOW FROM BASIN 47A AT NODE P1.
  266     HC       3
          *

  267     KK   P1-P2
  268     KM   ROUTE FROM NODE P1 TO NODE P2.
  269     RM       3     .28     .15
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  270     KK     317
  271     KM   BASIN 317 CONTRIBUTES FLOW TO NODE P2.
  272     BA   7.116
  273     PB   3.075
  274     LS       0      84
  275     UD    1.22
          *

  276     KK NODE.P2
  277     KM   COMBINE FLOW FROM P1 WITH FLOW FROM BASIN 317 AT NODE P2.
  278     HC       2
          *

  279     KK    P2-P
  280     KM   ROUTE FROM NODE P2 TO NODE P.
  281     RM       3     .26    0.15
          *

  282     KK    P2DB
  283     KM   STORAGE AREA NORTH OF HOLLYWOOD CULVERTS
  284     KM   CULVERTS AT HOLLYWOOD ARE 11 8X4 RCB CELLS
  285     RS       1    ELEV    24.5
  286     SV       0    0.05    1.04     4.4    11.8    24.7    44.8    73.6
  287     SQ       0     145     434     867    1420    2090    2850    5360
  288     SE    24.5      25      26      27      28      29      30      31
          *

  289     KK    318B
  290     KM   BASIN 318B CONTRIBUTES FLOW TO NODE Q.
  291     BA   1.591
  292     PB   3.145
  293     LS       0      87
  294     UD    0.60
          *

  295     KK     Q-P
  296     KM   ROUTE FLOW FROM NODE Q THROUGH BASIN 318A TO NODE P.
  297     RM       5    0.39    0.15
          *

  298     KK    318A
  299     KM   BASIN 318A CONTRIBUTES FLOW TO NODE P.
  300     BA   0.939
  301     PB    2.93
  302     LS       0      80
  303     UD    0.69
          *

  304     KK  NODE.P
  305     KM   COMBINE FLOWS FROM NODE P2, AND BASINS 318A AND 318B AT NODE P.
  306     KM   FLOW AT NODE P ENTERS THE CONFLUENCE DETENTION BASIN.
  307     HC       3
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  308     KK     PSV
  309     KM   STORAGE AREA UPSTREAM OF BASIN INFLOW STRUCTURE
  310     RS       1    ELEV      16
  311     SV       0     1.9    7.65    17.2    30.6    45.9    61.2
  312     SQ       0     330     990    1930    3140    4610    6370
  313     SE      16      17      18      19      20      21      22
          *

  314     KK DBIN-ER
  315     KM   INFLOW TO DET BASIN FROM EAST TRIBUTARY
  316     KM   ROUTE FLOW THROUGH THE CONFLUENCE DETENTION BASIN.
  317     RM       4     .36     .15
          *

  318     KK CON-DET
  319     KM   BASIN AREA OF THE CONFLUENCE DETENTION BASIN.
  320     BA   0.249
  321     PB    2.85
  322     LS       0      80
  323     UD    0.90
          *

  324     KK    DBIN
  325     KM   COMBINE FLOW FROM NODES G10 AND P AND BASIN CON-DET.
  326     KM   GIVES TOTAL FLOW TO THE CONFLUENCE DETENTION BASIN.
  327     HC       3
  328     KO       3
          *

  329     KK  DB.OUT
  330     KM   CONFLUENCE DETENTION BASIN
  331     RS       1    ELEV       2
  332     SV       0     3.2     9.9    21.4    39.2     102     217     563     708     864
  333     SV    1025    1041    1056    1088    1119    1151
  334     SQ       0      54     153     198     222     270     310     364     688    1263
  335     SQ    1938    2147    2528    3608    5005    6661
  336     SE       2       3       4       5       6       8      10      13      14      15
  337     SE      16    16.1    16.2    16.4    16.6    16.8
  338     KO       3
          *

  339     KKDBOUT-M1
  340     KM   ROUTE DB.OUT OUTFLOW TO NODE M1.
  341     RK    2640   0.002   0.015       0    TRAP      20       2
          *

  342     KK    318C
  343     KM   BASIN 318C CONTRIBUTES FLOW TO NODE M1.
  344     BA    1.28
  345     PB    2.93
  346     LS       0      79
  347     UD    0.75
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  348     KK NODE.M1
  349     KM   COMBINE THE DETENTION BASIN OUTFLOW WITH FLOW FROM BASIN 318C.
  350     KM   NODE M1 GIVES THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
  351     KM   THE CONFLUENCE WITH THE RANGE WASH CHANNEL.
  352     HC       2
          *

  353     KK   321-M
  354     KM   BASIN 321-M CONTRIBUTES FLOW TO THE RANGE WASH CHANNEL UPSTREAM OF
  355     KM   ITS CONFLUENCE WITH THE SLOAN CHANNEL.
  356     BA   0.691
  357     PB    2.77
  358     LS       0      67
  359     UD    1.66
          *

  360     KKRNG.CHNL
  361     KM   RETRIEVE THE FLOW THAT SPLIT INTO THE RANGE WASH CHANNEL THAT EXTENDS
  362     KM   SOUTHEASTERLY THROUGH THE NAFB.
  363     DR   RANGE
          *

  364     KK NODE.M2
  365     KM   COMBINE FLOW FROM BASIN 321-M WITH RETRIEVED FLOW IN THE RANGE WASH CHANNEL.
  366     KM   GIVES TOTAL FLOW IN THE RANGE WASH CHANNEL JUST UPSTREAM OF ITS CONFLUENCE
  367     KM   WITH THE SLOAN CHANNEL.
  368     HC       2
          *

  369     KK NODE.M3
  370     KM   COMBINE FLOWS FROM M1 AND M2 AT NODE M3.
  371     KM   NODE M3 IS THE TOTAL FLOW AT THE CONFLUENCE OF THE SLOAN CHANNEL
  372     KM   AND THE RANGE WASH CHANNEL AT SLOAN AND CAREY AVENUE.
  373     HC       2
          *

  374     KK   M3-S1
  375     KM   ROUTE FLOW FROM NODE M3 THROUGH THE SLOAN CHANNEL TO NODE S1.
  376     RK    2640   0.004   0.015       0    TRAP      40       3
          *

  377     KK   48A-M
  378     KM   BASIN 48A-M CONTRIBUTES FLOW TO NODE S1.
  379     BA   0.715
  380     PB    2.93
  381     LS       0      83
  382     UD    0.44
          *
```

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  383         KK      S1
  384         KM   COMBINE FLOW FROM M3 WITH FLOW FROM BASIN 48A-M.
  385         KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT LAKE MEAD BLVD.
  386         HC       2
              *

  387         KK   S1-S2
  388         KM   ROUTE FLOW FROM S1 THROUGH THE SLOAN CHANNEL TO S2.
  389         RK    2640   0.002   0.015       0    TRAP      50       2
              *

  390         KK     48B
  391         KM   BASIN 48B CONTRIBUTES FLOW TO NODE R.
  392         BA   1.142
  393         PB    3.10
  394         LS       0      89
  395         UD    0.51
              *

  396         KK    R-S2
  397         KM   ROUTE FLOW FROM R THROUGH BASIN 49A-M TO NODE S2.
  398         RK   10500   0.022    0.02       0    TRAP      10      20
              *

  399         KK   49A-M
  400         KM   BASIN 49A-M CONTRIBUTES FLOW TO NODE S2.
  401         BA   0.693
  402         PB    2.85
  403         LS       0      79
  404         UD    0.49
              *

  405         KK NODE.S2
  406         KM   COMBINE FLOW FROM NODES S1 AND R WITH FLOW FROM BASIN 49A-M AT NODE S2.
  407         KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT OWENS AVENUE.
  408         HC       3
              *

  409         KK   S2-S3
  410         KM   ROUTE FLOW FROM S2 THROUGH THE SLOAN CHANNEL TO S3.
  411         RK    2640   0.004   0.014       0    TRAP      60       2
              *

  412         KK     49C
  413         KM   BASIN 49C CONTRIBUTES FLOW TO NODE S3.
  414         BA   0.426
  415         PB    2.85
  416         LS       0      76
  417         UD    0.53
              *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  418     KK NODE.S3
  419     KM   COMBINE FLOW FROM S2 WITH FLOW FROM BASIN 49C AT NODE S3.
  420     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT WASHINGTON AVE.
  421     HC       2
          *

  422     KK   49B-M
  423     KM   BASIN 49B-M CONTRIBUTES FLOW TO NODE T1.
  424     KM   NODE T1 REPRESENTS THE TOTAL FLOW TO THE DIVERSION CHANNEL ALONG
  425     KM   WASHINGTON AVE. JUST UPSTREAM OF THE SLOAN CHANNEL.
  426     BA   1.977
  427     PB    3.00
  428     LS       0      85
  429     UD    0.61
          *

  430     KK NODE.S4
  431     KM   COMBINE FLOW FROM S3 WITH FLOW FROM T1 AT NODE S4.
  432     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT HARRIS AVE.
  433     HC       2
          *

  434     KK   50B-M
  435     KM   BASIN 50B-M CONTRIBUTES FLOW TO NODE V1.
  436     BA   0.628
  437     PB    3.00
  438     LS       0      80
  439     UD    0.39
          *

  440     KK NODE.V1
  441     KM   COMBINE FLOW FROM S4 WITH FLOW FROM BASIN 50B-M AT NODE V1.
  442     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT BONANZA RD.
  443     HC       2
          *

  444     KK   V1-V2
  445     KM   ROUTE FLOWS FROM V1 THROUGH THE SLOAN CHANNEL TO NODE V2.
  446     RK    2640   0.008   0.014       0    TRAP      60       2
          *

  447     KK   50A-M
  448     KM   BASIN 50A-M CONTRIBUTES FLOW TO NODE V2.
  449     BA   0.207
  450     PB    2.85
  451     LS       0      73
  452     UD    0.46
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  453     KK NODE.V2
  454     KM   COMBINE FLOW FROM V1 WITH FLOW FROM BASIN 50A-M AT NODE V2.
  455     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL AT STEWART AVE.
  456     HC       2
          *

  457     KK   324-M
  458     KM   BASIN 324-M CONTRIBUTES FLOW TO NODE V3.
  459     BA   3.026
  460     PB    2.85
  461     LS       0      72
  462     UD    0.77
          *

  463     KK    STEW
  464     KM   DIVERT FLOWS WHICH CONTINUE IN CHRISTY & LINN LANES, ETC
  465     KM   FLOW IN STEWART GOES TO SLOAN CHANNEL
  466     KM   FLOW IN CHRISTY GOES TOWARD LAS VEGAS WASH
  467     DT      CL
  468     DI       0      15     600
  469     DQ       0       0     330
          *

  470     KK NODE.V3
  471     KM   COMBINE FLOW FROM V2 WITH FLOW FROM BASIN 324-M AT NODE V3.
  472     KM   GIVES TOTAL FLOW IN THE SLOAN CHANNEL
  473     KM   SOUTH OF STEWART AVE.
  474     HC       2
          *

  475     KK   V3-V4
  476     KM   ROUTE V3 THROUGH THE SLOAN CHANNEL TO V4.
  477     RK    2000   0.003    0.03       0    TRAP      80       2
          *

  478     KK     CLR
  479     KM   RETREIVE FLOW IN CHRISTY AND LINN LANES
  480     DR      CL
          *

  481     KK    LINN
  482     KM   FLOW IN LINN LANE GOES TO BASIN 326-A THEN TO SLOAN CHANNEL
  483     KM   FLOW IN CHRISTY GOES TO LAS VEGAS WASH
  484     DT   CHRIS
  485     DI       0     100     500
  486     DQ       0      78     390
          *

  487     KK   326-A
  488     KM   BASIN 326-A CONTRIBUTES FLOW TO NODE V4.
  489     KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. WEST OF SLOAN CHANNEL.
  490     BA   0.231
  491     PB    2.85
  492     LS       0      79
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
 493      UD    0.39
          *
 494      KK  326-AL
 495      KM   BASIN 326-A AND FLOW IN LINN LANE
 496      HC       2
          *
 497      KK    OR-1
 498      KM   ORCHARDS OFFSITE DRAINAGE BASIN 01; CONTRIBUTES FLOW TO NODE X1.
 499      KM   * BASINS WITH THE "OR" PREFIX ARE TAKEN FROM THE "CONCEPTUAL MASTER        *
 500      KM   * DRAINAGE STUDY FOR LEWIS HOMES - ORCHARDS," BY PENTACORE, JANUARY, 1992. *
 501      KM   * THE MAJORITY OF THE ORCHARDS SITE IS CONSTRUCTED; HOWEVER, THE PLANNED   *
 502      KM   * ORCHARDS DETENTION BASIN IS NOT CONSTRUCTED. HYDROLOGY FROM THE ORCHARDS *
 503      KM   * DRAINAGE STUDY HAS BEEN MODIFIED TO REPRESENT APPROXIMATE EXISTING       *
 504      KM   * CONDITIONS, RATHER THAN FULLY DEVELOPED CONDITIONS.                      *
 505      PB    3.00
 506      BA   0.279
 507      LS       0      89
 508      UD    0.18
          *
 509      KK   X1-X2
 510      KM   ROUTE X1 THROUGH BASIN OR-2 TO NODE X2.
 511      RK   10000   0.033    0.02       0    TRAP      20      10
          *
 512      KK    OR-2
 513      KM   ORCHARDS OFFSITE DRAINAGE BASIN 02; CONTRIBUTES FLOW TO NODE X2.
 514      BA   1.206
 515      PB    2.93
 516      LS       0      75
 517      UD    0.60
          *
 518      KK NODE.X2
 519      KM   COMBINE FLOW FROM X1 AND BASIN OR-2 AT NODE X2.
 520      KM   GIVES TOTAL FLOW IN THE SECTION OF CHARLESTON BLVD. EAST OF SLOAN CHANNEL.
 521      HC       2
          *
 522      KK NODE.V4
 523      KM   COMBINE FLOW FROM V3, X2 AND BASIN 326-A.
 524      KM   GIVES TOTAL FLOW TO THE SLOAN CHANNEL AT CHARLESTON BLVD.
 525      HC       3
          *
 526      KK   OR-11
 527      KM   ORCHARDS ONSITE BASIN OR-11 CONTRIBUTES FLOW TO NODE V5.
 528      BA  0.0428
 529      PB    2.85
 530      LS       0      75
 531      UD    0.20
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  532     KK NODE.V5
  533     KM   COMBINE FLOW FROM V4 AND BASIN OR-11.
  534     KM   TOTAL FLOW TO THE SLOAN CHANNEL APPROX. 1500 FT. SOUTH OF CHARLESTON BLVD.
  535     HC       2
          *

  536     KK   V5-Z2
  537     KM   ROUTE V5 THROUGH SLOAN CHANNEL TO THE ORCHARDS CHANNEL CONFLUENCE AT Z2.
  538     RK    2800   0.005    0.03       0    TRAP      60       2
          *

  539     KK    OR-3
  540     KM   ORCHARDS OFFSITE DRAINAGE BASIN O3.
  541     KM   GIVES FLOW TO NODE Y1, LOCATED AT CHARLESTON WEST OF HOLLYWOOD.
  542     BA   0.205
  543     PB    3.00
  544     LS       0      82
  545     UD    0.42
          *

  546     KK   Y1-Z1
  547     KM   ROUTE NODE Y1 THROUGH BASIN OR-12 TO NODE Z1.
  548     RK    5500   0.011   0.016       0    TRAP      50       1
          *

  549     KK    OR-4
  550     KM   ORCHARDS OFFSITE DRAINAGE BASIN O4.
  551     KM   CONTRIBUTES FLOW TO NODE Y2.
  552     BA   0.448
  553     PB    3.00
  554     LS       0      88
  555     UD    0.29
          *

  556     KK   Y2-Y3
  557     KM   ROUTE NODE Y2 THROUGH BASIN OR-5 TO NODE Y3.
  558     RM       4    0.33    0.15
          *

  559     KK    OR-5
  560     KM   ORCHARDS OFFSITE DRAINAGE BASIN O5.
  561     KM   CONTRIBUTES FLOW TO NODE Y3.
  562     BA   0.373
  563     PB    3.00
  564     LS       0      77
  565     UD    0.44
          *

  566     KK      Y3
  567     KM   COMBINE FLOWS FROM Y2 AND BASIN OR-5 AT HOLLYWOOD.
  568     HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  569     KK   Y3-Z1
  570     KM   ROUTE Y3 THROUGH BASIN OR-12 TO NODE Z1.
  571     RK    5000   0.012   0.016       0    TRAP      50       1
          *

  572     KK   OR-6A
  573     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6A.
  574     BA   0.264
  575     PB    3.00
  576     LS       0      88
  577     UD     .13
          *

  578     KK   OR-6B
  579     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6B,
  580     BA   0.160
  581     PB    3.00
  582     LS       0      89
  583     UD     .14
          *

  584     KK   OR-6C
  585     KM   ORCHARDS OFFSITE DRAINAGE BASIN O6C.
  586     BA   0.191
  587     PB    3.00
  588     LS       0      87
  589     UD     .18
          *

  590     KKNODE.AA1
  591     KM   COMBINE FLOWS FROM BASINS OR-6A, OR-6B & OR-6C.
  592     HC       3
          *

  593     KK AA1-AA2
  594     KM   ROUTE AA1 THROUGH BASIN OR-7 TO NODE AA2.
  595     RM       4    0.32    0.15
          *

  596     KK    OR-7
  597     KM   ORCHARDS OFFSITE DRAINAGE BASIN O7.
  598     BA   0.613
  599     PB    3.00
  600     LS       0      77
  601     UD    0.49
          *

  602     KKNODE.AA2
  603     KM   COMBINE AA1 WITH FLOW FROM BASIN OR-7 AT NODE AA2.
  604     HC       2
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  605     KK  AA2-Z1
  606     KM   ROUTE AA2 THROUGH BASIN OR-12 TO NODE Z1.
  607     RK    4500   0.013   0.016       0    TRAP      50       1
          *

  608     KK    OR-8
  609     KM   ORCHARDS OFFSITE BASIN 08; CONTRIBUTES FLOW TO NODE AA3.
  610     BA   0.017
  611     PB    3.00
  612     LS       0      77
  613     UD    0.18
          *

  614     KK  R8-AA3
  615     KM   ROUTE FLOW FROM BASIN OR-8 THROUGH BASIN OR-9 TO NODE AA3 AT HOLLYWOOD.
  616     RM      10    0.82    0.15
          *

  617     KK    OR-9
  618     KM   ORCHARDS OFFSITE DRAINAGE BASIN 09; CONTRIBUTES FLOW TO NODE AA3.
  619     BA   0.278
  620     PB    3.00
  621     LS       0      77
  622     UD    0.65
          *

  623     KKNODE.AA3
  624     KM   COMBINE FLOWS FROM BASINS OR-8 AND OR-9 AT NODE AA3.
  625     HC       2
          *

  626     KK  AA3-Z1
  627     KM   ROUTE AA3 THROUGH BASIN OR-12 TO NODE Z1.
  628     RK    4500   0.012   0.016       0    TRAP      50       1
          *

  629     KK   OR-12
  630     KM   ORCHARDS ONSITE DRAINAGE BASIN 12; CONTRIBUTES FLOW TO NODE Z1.
  631     BA   0.525
  632     PB    2.85
  633     LS       0      76
  634     UD    0.39
          *

  635     KK NODE.Z1
  636     KM   COMBINE FLOW FROM NODES Y1, Y3, AA2, AA3 AND BASIN OR-12 AT NODE Z1.
  637     KM   NODE Z1 REPRESENTS THE TOTAL FLOW IN THE CONCRETE-LINED ORCHARDS CHANNEL
  638     KM   TRIBUTARY TO THE SLOAN CHANNEL.
  639     HC       5
          *
```

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  640     KK NODE.Z2
  641     KM   COMBINE FLOW FROM NODES V5 AND Z1.
  642     KM   TOTAL FLOW IN THE SLOAN CHANNEL AT ITS CONFLUENCE WITH THE ORCHARDS CHANNEL.
  643     HC       2
          *

  644     KK   OR-13
  645     KM   ORCHARDS ONSITE DRAINAGE BASIN OR-13; CONTRIBUTES FLOW TO NODE Z3.
  646     BA   0.120
  647     PB    2.85
  648     LS       0      84
  649     UD    0.29
          *

  650     KK NODE.Z3
  651     KM   COMBINE FLOW FROM NODES Z2 AND BASIN OR-13 AT NODE Z3.
  652     KM   NODE Z3 IS THE TOTAL FLOW IN THE SLOAN CHANNEL AT APPROXIMATELY
  653     KM   450 FEET SOUTH OF THE ORCHARDS CHANNEL CONFLUENCE.
  654     HC       2
          *

  655     KK   OR-10
  656     KM   ORCHARDS OFFSITE DRAINAGE BASIN O10.
  657     KM   CONTRIBUTES FLOW TO NODE BB1, LOCATED AT THE HOLLYWOOD/SAHARA INTERSECTION.
  658     BA  0.0984
  659     PB    3.00
  660     LS       0      77
  661     UD    0.45
          *

  662     KK BB1-BB2
  663     KM   ROUTE BB1 THROUGH SAHARA AVENUE TO NODE BB2.
  664     RK    4000   0.014   0.016       0    TRAP     100       1
          *

  665     KK   OR-14
  666     KM   ORCHARDS ONSITE DRAINAGE BASIN 14; CONTRIBUTES FLOW TO NODE BB2.
  667     BA  0.0937
  668     PB    2.85
  669     LS       0      75
  670     UD    0.33
          *

  671     KKNODE.BB2
  672     KM   NODE BB2 REPRESENTS THE TOTAL FLOW IN SAHARA AVE. EAST OF THE SLOAN CHANNEL.
  673     HC       2
          *

  674     KKNODE.BB3
  675     KM   COMBINE FLOW FROM Z3 WITH FLOW FROM BB2.
  676     KM   NODE BB3 IS THE TOTAL FLOW IN SLOAN CHANNEL AT SAHARA AVE.
  677     HC       2
          *
```

```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

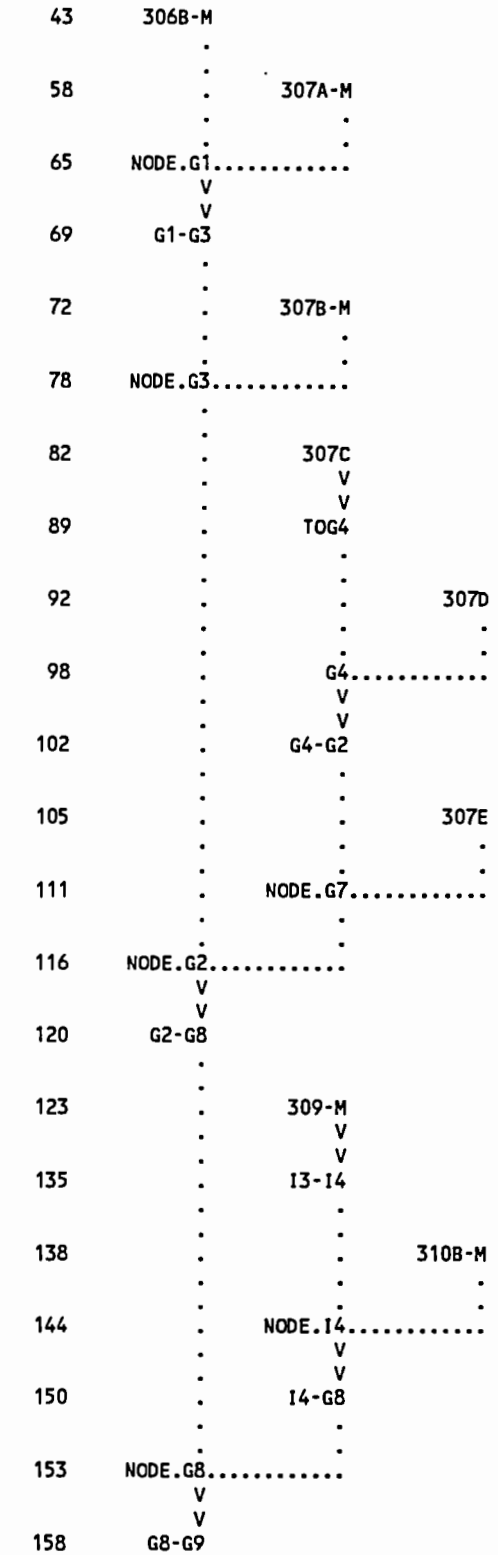
  678         KK  BB3-CC
  679         KM   ROUTE BB3 THROUGH THE SLOAN CHANNEL TO NODE CC.
  680         RK    1700   0.006   0.025       0    TRAP      80       2
              *
  681         KK   52A-M
  682         KM   BASIN 52A-M CONTRIBUTES FLOW TO NODE CC.
  683         BA   0.286
  684         PB    2.85
  685         LS       0      73
  686         UD    0.84
              *
  687         KK NODE.CC
  688         KM   COMBINE FLOW FROM  NODE BB3 WITH FLOW FROM BASINS 326-B AND 52A-M.
  689         KM   NODE CC REPRESENTS THE TOTAL FLOW IN THE SLOAN CHANNEL JUST UPSTREAM OF
  690         KM   ITS CONFLUENCE WITH THE LAS VEGAS WASH.
  691         HC       2
              *
  692         ZZ
```

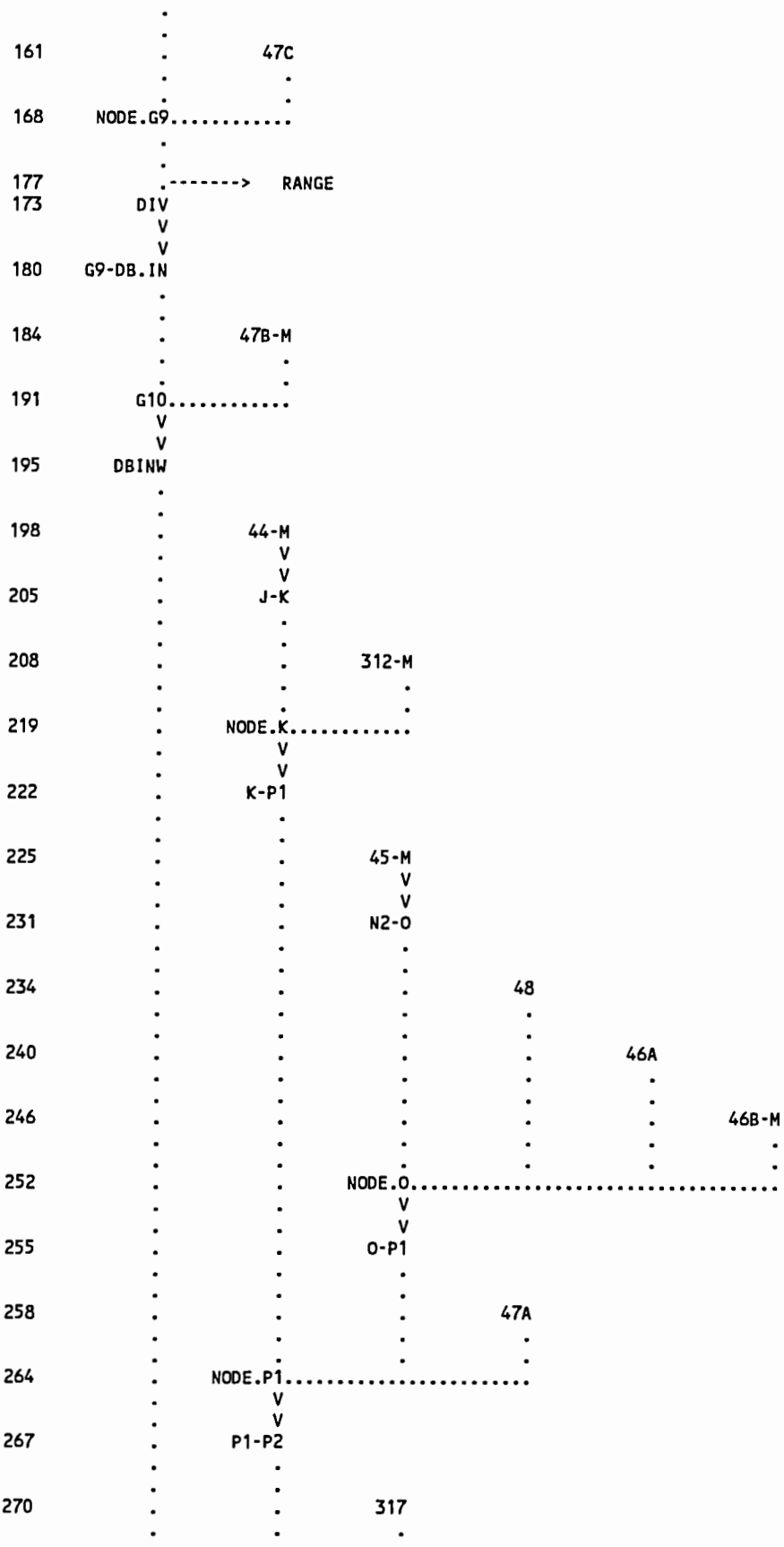
1

SCHEMATIC DIAGRAM OF STREAM NETWORK

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW

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DIV
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G10
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198
44-M
205
J-K
208
312-M
219
NODE.K
222
K-P1
225
45-M
231
N2-O
234
48
240
46A
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NODE.P1
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P1-P2
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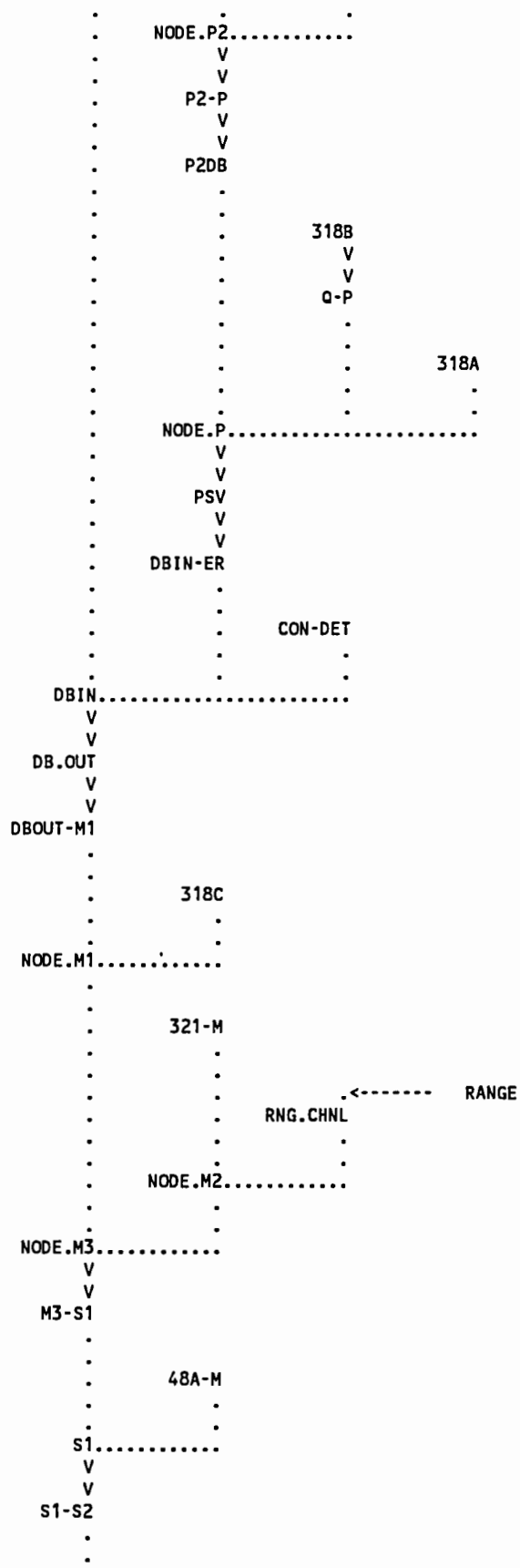
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DBIN-ER
318
CON-DET
324
DBIN
329
DB.OUT
339
DBOUT-M1
342
318C
348
NODE.M1
353
321-M
363
RANGE
360
RNG.CHNL
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NODE.M3
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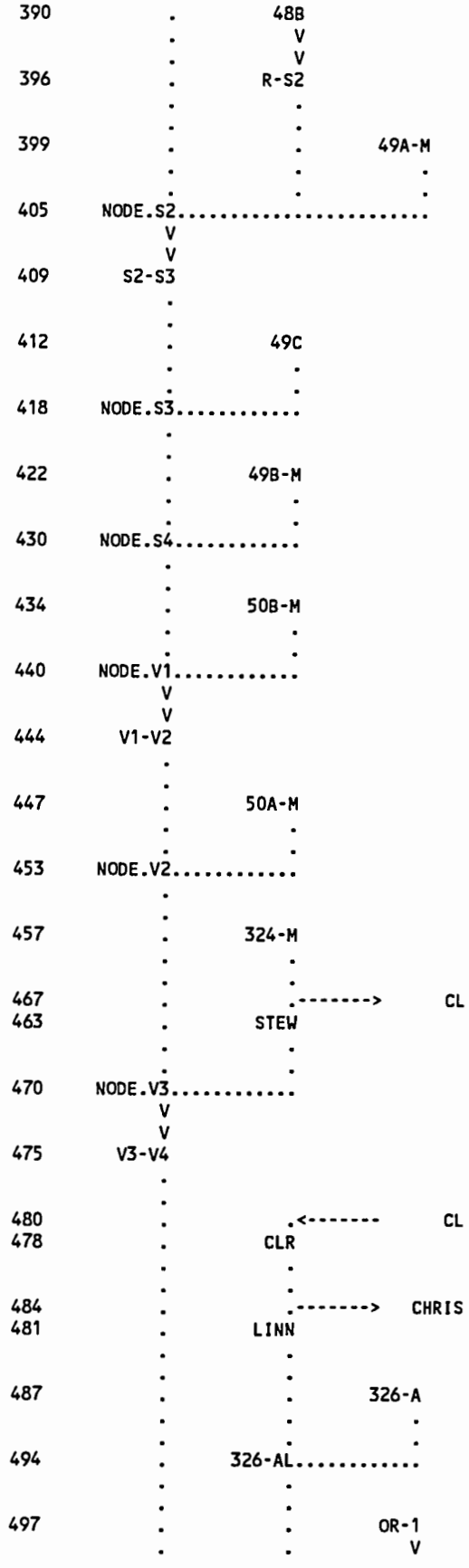
M3-S1
377
48A-M
383
S1
387
S1-S2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NODE.S4
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50B-M
440
NODE.V1
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V1-V2
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50A-M
453
NODE.V2
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NODE.V3
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326-AL
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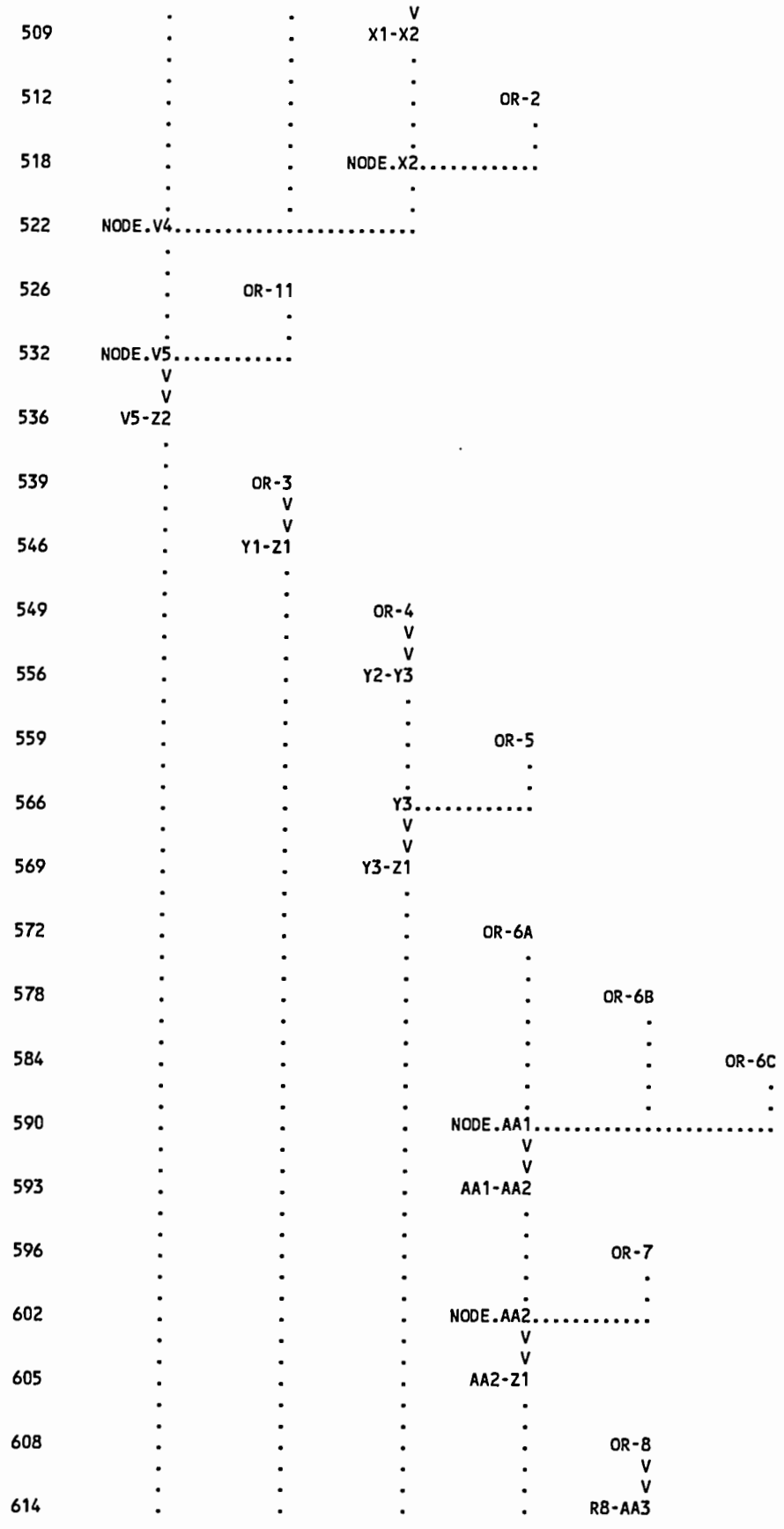
OR-1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OR-3
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Y1-Z1
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OR-4
556
Y2-Y3
559
OR-5
566
Y3
569
Y3-Z1
572
OR-6A
578
OR-6B
584
OR-6C
590
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OR-7
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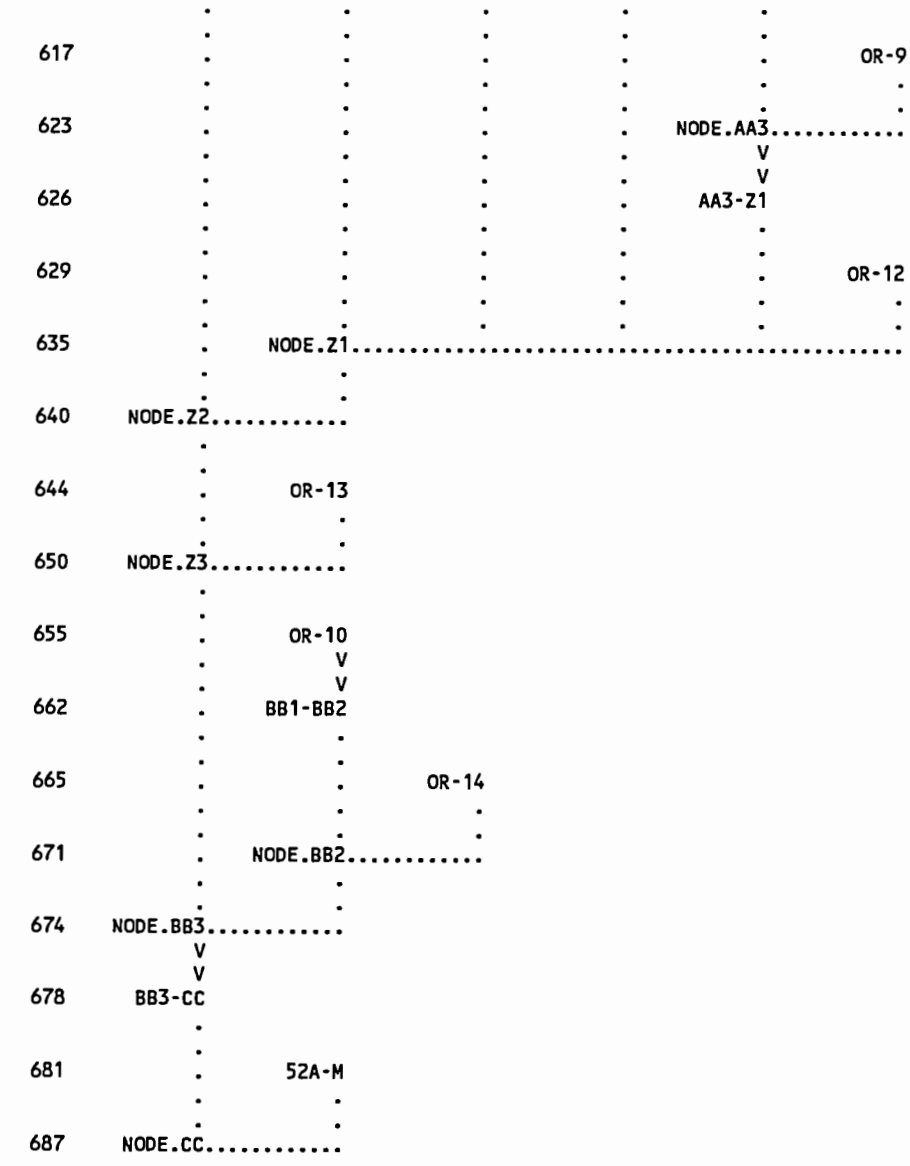
AA2-Z1
608
OR-8
614
R8-AA3



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*            SEPTEMBER 1990             *
*              VERSION 4.0              *
*                                       *
*  RUN DATE  01/17/1997  TIME  12:14:30 *
*                                       *
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*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
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RANGE WASH - FLOOD INSURANCE RESTUDY
FOR: CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT
BY: POST, BUCKLEY, SCHUH & JERNIGAN, INC.
JOB. NO. 51804
HEC-1 FILE: RFISA.DAT
JANUARY 1997

REVISED FOR REVISIONS TO CONFLUENCE DETENTION BASIN OUTLET
FILE REVISED WITH NEW STAGE STORAGE DISCHARGE RELATIONSHIP
REVISED DUE TO PLACEMENT OF GABIONS IN OUTLET STRUCTURE
TO IMPROVE FACTOR OF SAFETY AGAINST BUOYANCY OF STRUCTURE
REVSION SLIGHTLY REDUCES LOW LEVEL DISCHARGE CAPACITY
FROM 367 CFS TO 364 CFS AT CREST OF HIGH LEVEL WEIR

EXISTING CONDITIONS WITH WEST RANGE WASH DIVERSION DIKE, AND ALSO
WITH THE CONFLUENCE DETENTION BASIN, CURRENTLY UNDER CONSTRUCTION
STORM CENTERINGS FOR THE ENTIRE SYSTEM & FOR THE CONFLUENCE DETENTION BASIN

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**************************************************************************
*             FROM: CCRFCD LAS VEGAS VALLEY MASTER PLAN UPDATE           *
*                         RANGE WASH WATERSHED                           *
*               JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.          *
*                              JANUARY 1991                              *
*                 PRESENT CONDITIONS, EXISTING FACILITIES                *
*                  BASED ON RANGE WASH FACILITIES STUDY                  *
*                     BOYLE ENGINEERS CORP-JULY 1989                     *
*                                                                        *
*                  (CONVERTED RK TO RM IN UPLAND SUBAREAS)               *
*MODIFIED TO REMOVE SUBAREAS TRIBUTARY TO WEST RANGE DIVERSION DIKE (1/91)*
**************************************************************************
*                    100-YEAR, 6-HOUR STORM, AMC 2.0                     *
**************************************************************************
* STORM DISTRIBUTION 5 (SDN 5) FOR TOTAL BASIN AREA GREATER THAN 10 SQ.MI.*
*    JR DARF RATIO 0.630 AT THE CONFLUENCE DETENTION BASIN, NODE DB.IN   *
* JR DARF RATIO 0.601 AT SLOAN CHANNEL/LAS VEGAS WASH CONFLUENCE, NODE CC *
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41 IO          OUTPUT CONTROL VARIABLES
                    IPRNT          5  PRINT CONTROL
                    IPLOT          0  PLOT CONTROL
                    QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                     NMIN          5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1   0  STARTING DATE
                    ITIME       0000  STARTING TIME
                       NQ        200  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      1   0  ENDING DATE
                   NDTIME       1635  ENDING TIME
                    ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   16.58 HOURS
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          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT

     JP          MULTI-PLAN OPTION
                      NPLAN           1  NUMBER OF PLANS

     JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .60       .63

         *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


         *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT



         *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  2


         *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


         *** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT


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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 324 KK     *      DBIN  *
            *            *
            **************

 328 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

 327 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                          ***

      ***          ***             ***             ***             ***

                        HYDROGRAPH AT STATION     DBIN
                          FOR PLAN 1, RATIO =  .60

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                    6-HR       24-HR       72-HR     16.58-HR
+   (CFS)      (HR)
                         (CFS)
```

+	3715.	7.50		2477.	958.	958.	958.
			(INCHES)	.285	.304	.304	.304
			(AC-FT)	1228.	1313.	1313.	1313.

CUMULATIVE AREA = 80.91 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DBIN
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 4183.	7.50		2805.	1085.	1085.	1085.
		(INCHES)	.322	.345	.345	.345
		(AC-FT)	1391.	1488.	1488.	1488.

CUMULATIVE AREA = 80.91 SQ MI

*** *** *** *

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
923.	9.58	812.	463.	463.	463.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
15.37	9.58	14.66	10.40	10.40	10.40

CUMULATIVE AREA = 80.91 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DB.OUT
FOR PLAN 1, RATIO = .63

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	16.58-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1876.	9.42		1351.	666.	666.	666.
		(INCHES)	.155	.211	.211	.211
		(AC-FT)	670.	912.	912.	912.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (AC-FT)	(HR)				
1010.	9.42	881.	501.	501.	501.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	16.58-HR
+ (FEET)	(HR)				
15.91	9.42	15.10	10.70	10.70	10.70

CUMULATIVE AREA = 80.91 SQ MI

*** FDKRUT WARNING TIME STEP CALCULATION FAILED TO CONVERGE. STABILITY PROBLEMS MAY RESULT

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PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .60	RATIO 2 .63
HYDROGRAPH AT						
+	306B-M	5.53	1	FLOW	321.	365.
				TIME	5.42	5.42
HYDROGRAPH AT						
+	307A-M	2.52	1	FLOW	163.	184.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.G1	8.04	1	FLOW	483.	548.
				TIME	5.42	5.42
ROUTED TO						
+	G1-G3	8.04	1	FLOW	478.	542.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	307B-M	.68	1	FLOW	76.	85.
				TIME	4.33	4.25
2 COMBINED AT						
+	NODE.G3	8.72	1	FLOW	527.	597.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	307C	.50	1	FLOW	39.	44.
				TIME	5.33	5.33
ROUTED TO						
+	TOG4	.50	1	FLOW	39.	44.
				TIME	5.67	5.67
HYDROGRAPH AT						
+	307D	.32	1	FLOW	105.	114.
				TIME	3.67	3.67
2 COMBINED AT						
+	G4	.83	1	FLOW	105.	114.
				TIME	3.67	3.67
ROUTED TO						
+	G4-G2	.83	1	FLOW	101.	110.
				TIME	4.25	4.17
HYDROGRAPH AT						
+	307E	.77	1	FLOW	82.	93.
				TIME	4.08	4.08
2 COMBINED AT						
+	NODE.G7	1.59	1	FLOW	181.	202.
				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.G2	10.31	1	FLOW	663.	751.
				TIME	5.50	5.50
ROUTED TO						
+	G2-G8	10.31	1	FLOW	662.	750.
				TIME	5.58	5.50

HYDROGRAPH AT						
+	309-M	3.98	1	FLOW	258.	291.
				TIME	5.42	5.33
ROUTED TO						
+	I3-I4	3.98	1	FLOW	249.	282.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	310B-M	4.57	1	FLOW	490.	547.
				TIME	4.58	4.58
2 COMBINED AT						
+	NODE.I4	8.55	1	FLOW	690.	773.
				TIME	5.33	5.33
ROUTED TO						
+	I4-G8	8.55	1	FLOW	689.	772.
				TIME	5.42	5.33
2 COMBINED AT						
+	NODE.G8	18.86	1	FLOW	1348.	1518.
				TIME	5.50	5.50
ROUTED TO						
+	G8-G9	18.86	1	FLOW	1347.	1516.
				TIME	5.58	5.58
HYDROGRAPH AT						
+	47C	.86	1	FLOW	101.	115.
				TIME	4.00	3.92
2 COMBINED AT						
+	NODE.G9	19.72	1	FLOW	1396.	1575.
				TIME	5.50	5.50
DIVERSION TO						
+	RANGE	19.72	1	FLOW	1040.	1078.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	DIV	19.72	1	FLOW	357.	498.
				TIME	5.50	5.50
ROUTED TO						
+	G9-DB.IN	19.72	1	FLOW	357.	497.
				TIME	5.67	5.58
HYDROGRAPH AT						
+	47B-M	3.38	1	FLOW	591.	654.
				TIME	4.08	4.00
2 COMBINED AT						
+	G10	23.10	1	FLOW	736.	927.
				TIME	5.33	5.25
ROUTED TO						
+	DBINW	23.10	1	FLOW	729.	920.
				TIME	5.50	5.42
HYDROGRAPH AT						
+	44-M	8.16	1	FLOW	999.	1097.
				TIME	5.25	5.25
ROUTED TO						
+	J-K	8.16	1	FLOW	987.	1085.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	312-M	13.46	1	FLOW	748.	853.
				TIME	5.67	5.67

2 COMBINED AT						
+	NODE.K	21.62	1	FLOW	1704.	1905.
				TIME	5.83	5.83
ROUTED TO						
+	K-P1	21.62	1	FLOW	1678.	1875.
				TIME	6.67	6.67
HYDROGRAPH AT						
+	45-M	8.21	1	FLOW	642.	720.
				TIME	5.50	5.50
ROUTED TO						
+	N2-O	8.21	1	FLOW	637.	714.
				TIME	5.83	5.83
HYDROGRAPH AT						
+	48	2.07	1	FLOW	116.	132.
				TIME	5.50	5.50
HYDROGRAPH AT						
+	46A	7.28	1	FLOW	488.	552.
				TIME	5.75	5.75
HYDROGRAPH AT						
+	46B-M	6.31	1	FLOW	432.	488.
				TIME	5.83	5.83
4 COMBINED AT						
+	NODE.O	23.87	1	FLOW	1661.	1875.
				TIME	5.75	5.75
ROUTED TO						
+	O-P1	23.87	1	FLOW	1626.	1837.
				TIME	6.58	6.58
HYDROGRAPH AT						
+	47A	2.43	1	FLOW	215.	239.
				TIME	5.33	5.33
3 COMBINED AT						
+	NODE.P1	47.92	1	FLOW	3356.	3773.
				TIME	6.58	6.58
ROUTED TO						
+	P1-P2	47.92	1	FLOW	3334.	3746.
				TIME	6.92	6.83
HYDROGRAPH AT						
+	317	7.12	1	FLOW	1020.	1119.
				TIME	5.00	4.92
2 COMBINED AT						
+	NODE.P2	55.03	1	FLOW	3736.	4198.
				TIME	6.67	6.67
ROUTED TO						
+	P2-P	55.03	1	FLOW	3720.	4181.
				TIME	6.92	6.92
ROUTED TO						
+	P2DB	55.03	1	FLOW	3701.	4159.
				TIME	7.08	7.08
			** PEAK STAGES IN FEET **			
			1	STAGE	30.34	30.52
				TIME	7.08	7.08
HYDROGRAPH AT						
+	318B	1.59	1	FLOW	431.	469.

				TIME	4.00	4.00
ROUTED TO						
+	Q-P	1.59	1	FLOW	411.	447.
				TIME	4.42	4.42
HYDROGRAPH AT						
+	318A	.94	1	FLOW	119.	134.
				TIME	4.17	4.17
3 COMBINED AT						
+	NODE.P	57.56	1	FLOW	3734.	4198.
				TIME	7.08	7.00
ROUTED TO						
+	PSV	57.56	1	FLOW	3719.	4181.
				TIME	7.17	7.17
			**	PEAK STAGES IN FEET **		
			1	STAGE	20.39	20.71
				TIME	7.17	7.17
ROUTED TO						
+	DBIN-ER	57.56	1	FLOW	3695.	4158.
				TIME	7.58	7.50
HYDROGRAPH AT						
+	CON-DET	.25	1	FLOW	25.	28.
				TIME	4.42	4.42
3 COMBINED AT						
+	DBIN	80.91	1	FLOW	3715.	4183.
				TIME	7.50	7.50
ROUTED TO						
+	DB.OUT	80.91	1	FLOW	1511.	1876.
				TIME	9.58	9.42
			**	PEAK STAGES IN FEET **		
			1	STAGE	15.37	15.91
				TIME	9.58	9.42
ROUTED TO						
+	DBOUT-M1	80.91	1	FLOW	1511.	1876.
				TIME	9.58	9.50
HYDROGRAPH AT						
+	318C	1.28	1	FLOW	141.	159.
				TIME	4.25	4.25
2 COMBINED AT						
+	NODE.M1	82.19	1	FLOW	1511.	1876.
				TIME	9.58	9.50
HYDROGRAPH AT						
+	321-M	.69	1	FLOW	13.	16.
				TIME	6.17	6.17
HYDROGRAPH AT						
+	RNG.CHNL	.00	1	FLOW	1040.	1078.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M2	.69	1	FLOW	1050.	1090.
				TIME	5.50	5.50
2 COMBINED AT						
+	NODE.M3	82.88	1	FLOW	1532.	1902.
				TIME	9.50	9.42
ROUTED TO						

+	M3-S1	82.88	1	FLOW	1532.	1901.
				TIME	9.58	9.42
HYDROGRAPH AT						
+	48A-M	.71	1	FLOW	147.	163.
				TIME	3.83	3.83
2 COMBINED AT						
+	S1	83.59	1	FLOW	1539.	1901.
				TIME	5.25	9.42
ROUTED TO						
+	S1-S2	83.59	1	FLOW	1537.	1901.
				TIME	5.25	9.50
HYDROGRAPH AT						
+	48B	1.14	1	FLOW	372.	402.
				TIME	3.92	3.92
ROUTED TO						
+	R-S2	1.14	1	FLOW	369.	398.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	49A-M	.69	1	FLOW	88.	100.
				TIME	4.00	3.92
3 COMBINED AT						
+	NODE.S2	85.43	1	FLOW	1837.	1933.
				TIME	5.25	5.25
ROUTED TO						
+	S2-S3	85.43	1	FLOW	1833.	1929.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	49C	.43	1	FLOW	38.	44.
				TIME	5.17	4.08
2 COMBINED AT						
+	NODE.S3	85.85	1	FLOW	1869.	1970.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	49B-M	1.98	1	FLOW	423.	465.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.S4	87.83	1	FLOW	2174.	2299.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	50B-M	.63	1	FLOW	112.	125.
				TIME	3.83	3.83
2 COMBINED AT						
+	NODE.V1	88.46	1	FLOW	2243.	2375.
				TIME	5.25	5.17
ROUTED TO						
+	V1-V2	88.46	1	FLOW	2242.	2374.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	50A-M	.21	1	FLOW	16.	18.
				TIME	5.08	5.08
2 COMBINED AT						
+	NODE.V2	88.67	1	FLOW	2257.	2390.
				TIME	5.25	5.25

HYDROGRAPH AT						
+	324-M	3.03	1	FLOW	172.	196.
				TIME	5.33	5.33
DIVERSION TO						
+	CL	3.03	1	FLOW	89.	102.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	STEW	3.03	1	FLOW	83.	94.
				TIME	5.33	5.33
2 COMBINED AT						
+	NODE.V3	91.69	1	FLOW	2339.	2484.
				TIME	5.25	5.25
ROUTED TO						
+	V3-V4	91.69	1	FLOW	2334.	2480.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	CLR	.00	1	FLOW	89.	102.
				TIME	5.33	5.33
DIVERSION TO						
+	CHRIS	.00	1	FLOW	69.	80.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	LINN	.00	1	FLOW	19.	23.
				TIME	5.33	5.33
HYDROGRAPH AT						
+	326-A	.23	1	FLOW	33.	37.
				TIME	3.83	3.83
2 COMBINED AT						
+	326-AL	.23	1	FLOW	45.	50.
				TIME	5.08	5.08
HYDROGRAPH AT						
+	OR-1	.28	1	FLOW	138.	149.
				TIME	3.58	3.58
ROUTED TO						
+	X1-X2	.28	1	FLOW	132.	147.
				TIME	3.75	3.75
HYDROGRAPH AT						
+	OR-2	1.21	1	FLOW	102.	114.
				TIME	5.17	5.17
2 COMBINED AT						
+	NODE.X2	1.49	1	FLOW	191.	218.
				TIME	3.75	3.75
3 COMBINED AT						
+	NODE.V4	93.41	1	FLOW	2526.	2691.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-11	.04	1	FLOW	5.	6.
				TIME	3.67	3.58
2 COMBINED AT						
+	NODE.V5	93.45	1	FLOW	2527.	2692.
				TIME	5.25	5.25
ROUTED TO						
+	V5-Z2	93.45	1	FLOW	2523.	2690.
				TIME	5.25	5.25

HYDROGRAPH AT						
+	OR-3	.20	1	FLOW	42.	47.
				TIME	3.83	3.83
ROUTED TO						
+	Y1-Z1	.20	1	FLOW	42.	46.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-4	.45	1	FLOW	170.	184.
				TIME	3.67	3.67
ROUTED TO						
+	Y2-Y3	.45	1	FLOW	149.	162.
				TIME	4.00	4.00
HYDROGRAPH AT						
+	OR-5	.37	1	FLOW	47.	54.
				TIME	3.92	3.92
2 COMBINED AT						
+	Y3	.82	1	FLOW	195.	214.
				TIME	4.00	4.00
ROUTED TO						
+	Y3-Z1	.82	1	FLOW	194.	213.
				TIME	4.08	4.08
HYDROGRAPH AT						
+	OR-6A	.26	1	FLOW	131.	142.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6B	.16	1	FLOW	84.	91.
				TIME	3.58	3.58
HYDROGRAPH AT						
+	OR-6C	.19	1	FLOW	83.	91.
				TIME	3.58	3.58
3 COMBINED AT						
+	NODE.AA1	.62	1	FLOW	299.	323.
				TIME	3.58	3.58
ROUTED TO						
+	AA1-AA2	.62	1	FLOW	237.	257.
				TIME	3.83	3.83
HYDROGRAPH AT						
+	OR-7	.61	1	FLOW	73.	84.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.AA2	1.23	1	FLOW	306.	337.
				TIME	3.83	3.83
ROUTED TO						
+	AA2-Z1	1.23	1	FLOW	305.	335.
				TIME	3.92	3.92
HYDROGRAPH AT						
+	OR-8	.02	1	FLOW	3.	4.
				TIME	3.58	3.58
ROUTED TO						
+	R8-AA3	.02	1	FLOW	2.	3.
				TIME	4.50	4.42
HYDROGRAPH AT						
+	OR-9	.28	1	FLOW	29.	33.

				TIME	4.17	4.17
2 COMBINED AT						
+	NODE.AA3	.29	1	FLOW	30.	35.
				TIME	4.17	4.17
ROUTED TO						
+	AA3-Z1	.29	1	FLOW	30.	35.
				TIME	4.33	4.33
HYDROGRAPH AT						
+	OR-12	.52	1	FLOW	53.	62.
				TIME	3.83	3.83
5 COMBINED AT						
+	NODE.Z1	3.07	1	FLOW	595.	660.
				TIME	4.00	4.00
2 COMBINED AT						
+	NODE.Z2	96.52	1	FLOW	2945.	3149.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-13	.12	1	FLOW	31.	34.
				TIME	3.67	3.67
2 COMBINED AT						
+	NODE.Z3	96.64	1	FLOW	2956.	3161.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	OR-10	.10	1	FLOW	12.	14.
				TIME	3.92	3.92
ROUTED TO						
+	BB1-BB2	.10	1	FLOW	12.	14.
				TIME	4.17	4.17
HYDROGRAPH AT						
+	OR-14	.09	1	FLOW	9.	11.
				TIME	5.00	3.75
2 COMBINED AT						
+	NODE.BB2	.19	1	FLOW	18.	21.
				TIME	4.17	4.08
2 COMBINED AT						
+	NODE.BB3	96.84	1	FLOW	2973.	3179.
				TIME	5.25	5.25
ROUTED TO						
+	BB3-CC	96.84	1	FLOW	2967.	3175.
				TIME	5.25	5.25
HYDROGRAPH AT						
+	52A-M	.29	1	FLOW	17.	19.
				TIME	5.42	5.33
2 COMBINED AT						
+	NODE.CC	97.12	1	FLOW	2984.	3194.
				TIME	5.25	5.25

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .60									
TOG4	MANE	5.00	39.19	336.64	.28	5.00	39.16	340.00	.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7504E+01 EXCESS= .0000E+00 OUTFLOW= .7511E+01 BASIN STORAGE= .2096E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .63									
TOG4	MANE	4.96	43.86	339.89	.32	5.00	43.85	340.00	.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8546E+01 EXCESS= .0000E+00 OUTFLOW= .8554E+01 BASIN STORAGE= .1587E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .60									
G4-G2	MANE	5.00	102.75	254.14	.45	5.00	101.45	255.00	.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1959E+02 EXCESS= .0000E+00 OUTFLOW= .1962E+02 BASIN STORAGE= .4971E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .63									
G4-G2	MANE	5.00	112.20	252.97	.49	5.00	109.66	250.00	.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2172E+02 EXCESS= .0000E+00 OUTFLOW= .2178E+02 BASIN STORAGE= .4302E-02 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .60									
G2-G8	MANE	1.15	663.03	332.26	.26	5.00	662.09	335.00	.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1426E+03 EXCESS= .0000E+00 OUTFLOW= .1426E+03 BASIN STORAGE= .3231E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63									
G2-G8	MANE	1.07	750.21	332.30	.30	5.00	749.63	330.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1628E+03 EXCESS= .0000E+00 OUTFLOW= .1628E+03 BASIN STORAGE= .3475E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
I4-G8	MANE	1.18	689.46	322.92	.34	5.00	689.31	325.00	.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1553E+03 EXCESS= .0000E+00 OUTFLOW= .1553E+03 BASIN STORAGE= .2674E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .63									
I4-G8	MANE	1.07	773.18	321.85	.38	5.00	772.15	320.00	.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1747E+03 EXCESS= .0000E+00 OUTFLOW= .1748E+03 BASIN STORAGE= .2894E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .60									
G8-G9	MANE	2.85	1346.94	336.85	.30	5.00	1346.73	335.00	.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2979E+03 EXCESS= .0000E+00 OUTFLOW= .2979E+03 BASIN STORAGE= .2175E-01 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .63
             G8-G9  MANE          2.77   1517.09    334.45       .34      5.00   1516.42    335.00         .34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3376E+03 EXCESS= .0000E+00 OUTFLOW= .3376E+03 BASIN STORAGE= .2165E-01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
          G9-DB.IN  MANE          4.97    356.69    339.96       .04      5.00    356.67    340.00         .04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4038E+02 EXCESS= .0000E+00 OUTFLOW= .4082E+02 BASIN STORAGE= .1135E-01 PERCENT ERROR=  -1.1

          FOR PLAN = 1  RATIO=  .63
          G9-DB.IN  MANE          4.54    497.45    335.00       .06      5.00    497.45    335.00         .06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6315E+02 EXCESS= .0000E+00 OUTFLOW= .6361E+02 BASIN STORAGE= .9550E-02 PERCENT ERROR=   -.8

          FOR PLAN = 1  RATIO=  .60
          DBOUT-M1  MANE          1.00   1510.86    577.05       .17      5.00   1510.70    575.00         .17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7542E+03 EXCESS= .0000E+00 OUTFLOW= .7525E+03 BASIN STORAGE= .2124E+01 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .63
          DBOUT-M1  MANE          .91   1875.84    567.47       .21      5.00   1875.63    570.00         .21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9121E+03 EXCESS= .0000E+00 OUTFLOW= .9097E+03 BASIN STORAGE= .2243E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
             M3-S1  MANE          .92   1531.63    572.69       .24      5.00   1531.60    575.00         .24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1054E+04 EXCESS= .0000E+00 OUTFLOW= .1052E+04 BASIN STORAGE= .2079E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .63
             M3-S1  MANE          .86   1902.01    566.48       .28      5.00   1901.42    565.00         .28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1235E+04 EXCESS= .0000E+00 OUTFLOW= .1233E+04 BASIN STORAGE= .2202E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
             S1-S2  MANE          1.20   1538.50    316.96       .24      5.00   1537.45    315.00         .24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1072E+04 EXCESS= .0000E+00 OUTFLOW= .1069E+04 BASIN STORAGE= .2736E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .63
             S1-S2  MANE          1.09   1901.40    567.49       .28      5.00   1901.24    570.00         .28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1255E+04 EXCESS= .0000E+00 OUTFLOW= .1252E+04 BASIN STORAGE= .2901E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
              R-S2  MANE          4.98    370.33    242.91       .91      5.00    368.68    245.00         .91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5561E+02 EXCESS= .0000E+00 OUTFLOW= .5572E+02 BASIN STORAGE= .2862E-03 PERCENT ERROR=   -.2
```

```
          FOR PLAN = 1  RATIO=  .63
             R-S2  MANE         5.00    400.29    243.38       .99      5.00    398.23    245.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6024E+02 EXCESS= .0000E+00 OUTFLOW= .6034E+02 BASIN STORAGE= .2707E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .60
             S2-S3  MANE          .88   1836.17    316.51       .25      5.00   1832.77    315.00         .25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1139E+04 EXCESS= .0000E+00 OUTFLOW= .1136E+04 BASIN STORAGE= .2245E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .63
             S2-S3  MANE          .85   1932.19    316.42       .29      5.00   1929.37    315.00         .29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1327E+04 EXCESS= .0000E+00 OUTFLOW= .1325E+04 BASIN STORAGE= .2383E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
             V1-V2  MANE          .69   2242.47    315.45       .26      5.00   2242.33    315.00         .26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1226E+04 EXCESS= .0000E+00 OUTFLOW= .1224E+04 BASIN STORAGE= .1813E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .63
             V1-V2  MANE          .74   2375.18    311.64       .30      5.00   2374.29    315.00         .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1424E+04 EXCESS= .0000E+00 OUTFLOW= .1422E+04 BASIN STORAGE= .1927E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
             V3-V4  MANE         1.08   2337.94    316.62       .25      5.00   2334.30    315.00         .25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1242E+04 EXCESS= .0000E+00 OUTFLOW= .1239E+04 BASIN STORAGE= .3337E+01 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .63
             V3-V4  MANE         1.11   2482.22    316.48       .29      5.00   2479.99    315.00         .29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1442E+04 EXCESS= .0000E+00 OUTFLOW= .1439E+04 BASIN STORAGE= .3559E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .60
             X1-X2  MANE         4.80    135.30    223.85       .87      5.00    132.35    225.00         .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1287E+02 EXCESS= .0000E+00 OUTFLOW= .1297E+02 BASIN STORAGE= .1748E-03 PERCENT ERROR=   -.8

          FOR PLAN = 1  RATIO=  .63
             X1-X2  MANE         4.67    147.61    224.76       .94      5.00    146.65    225.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1395E+02 EXCESS= .0000E+00 OUTFLOW= .1405E+02 BASIN STORAGE= .1863E-03 PERCENT ERROR=   -.7

          FOR PLAN = 1  RATIO=  .60
             V5-Z2  MANE         1.23   2525.54    316.42       .26      5.00   2523.20    315.00         .26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1277E+04 EXCESS= .0000E+00 OUTFLOW= .1273E+04 BASIN STORAGE= .3656E+01 PERCENT ERROR=    .0
```

```
          FOR PLAN = 1  RATIO=  .63
            V5-Z2  MANE         1.14   2692.28    317.17       .30      5.00   2690.26    315.00         .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1482E+04 EXCESS= .0000E+00 OUTFLOW= .1478E+04 BASIN STORAGE= .3887E+01 PERCENT ERROR=     .0

          FOR PLAN = 1  RATIO=  .60
            Y1-Z1  MANE         5.00     42.04    240.20       .52      5.00     41.95    240.00         .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5695E+01 EXCESS= .0000E+00 OUTFLOW= .5712E+01 BASIN STORAGE= .2231E-02 PERCENT ERROR=    -.3

          FOR PLAN = 1  RATIO=  .63
            Y1-Z1  MANE         4.94     46.31    241.60       .58      5.00     46.17    240.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6313E+01 EXCESS= .0000E+00 OUTFLOW= .6325E+01 BASIN STORAGE= .1720E-02 PERCENT ERROR=    -.2

          FOR PLAN = 1  RATIO=  .60
            Y3-Z1  MANE         2.62    194.07    244.59       .60      5.00    193.84    245.00         .60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2615E+02 EXCESS= .0000E+00 OUTFLOW= .2620E+02 BASIN STORAGE= .1252E-02 PERCENT ERROR=    -.2

          FOR PLAN = 1  RATIO=  .63
            Y3-Z1  MANE         2.53    213.14    244.38       .66      5.00    212.72    245.00         .66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2873E+02 EXCESS= .0000E+00 OUTFLOW= .2878E+02 BASIN STORAGE= .1784E-02 PERCENT ERROR=    -.2

          FOR PLAN = 1  RATIO=  .60
            AA2-Z1  MANE        1.98    305.27    234.44       .58      5.00    304.82    235.00         .58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3769E+02 EXCESS= .0000E+00 OUTFLOW= .3774E+02 BASIN STORAGE= .1153E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=  .63
            AA2-Z1  MANE        1.92    336.39    233.90       .63      5.00    335.30    235.00         .63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4148E+02 EXCESS= .0000E+00 OUTFLOW= .4156E+02 BASIN STORAGE= .1253E-02 PERCENT ERROR=    -.2

          FOR PLAN = 1  RATIO=  .60
            AA3-Z1  MANE        4.75     30.35    259.60       .35      5.00     30.34    260.00         .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5431E+01 EXCESS= .0000E+00 OUTFLOW= .5446E+01 BASIN STORAGE= .1301E-02 PERCENT ERROR=    -.3

          FOR PLAN = 1  RATIO=  .63
            AA3-Z1  MANE        4.49     34.70    258.30       .39      5.00     34.66    260.00         .39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6142E+01 EXCESS= .0000E+00 OUTFLOW= .6150E+01 BASIN STORAGE= .1459E-02 PERCENT ERROR=    -.1

          FOR PLAN = 1  RATIO=  .60
            BB1-BB2  MANE       5.00     12.24    251.72       .35      5.00     12.15    250.00         .35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1812E+01 EXCESS= .0000E+00 OUTFLOW= .1827E+01 BASIN STORAGE= .1888E-02 PERCENT ERROR=    -.9

          FOR PLAN = 1  RATIO=  .63
```

```
          BB1-BB2  MANE        5.00     14.00    251.15       .39      5.00     13.92    250.00         .39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2049E+01 EXCESS= .0000E+00 OUTFLOW= .2061E+01 BASIN STORAGE= .1768E-02 PERCENT ERROR=   -.7

          FOR PLAN = 1  RATIO=  .60
            BB3-CC  MANE         .73   2970.67    316.46       .26      5.00   2967.02    315.00         .26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1362E+04 EXCESS= .0000E+00 OUTFLOW= .1360E+04 BASIN STORAGE= .2072E+01 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .63
            BB3-CC  MANE         .61   3178.14    315.99       .30      5.00   3175.14    315.00         .30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1576E+04 EXCESS= .0000E+00 OUTFLOW= .1574E+04 BASIN STORAGE= .2205E+01 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
```

APPENDIX E

OUTLET STRUCTURE
BUOYANCY ANALYSIS

CONFLUENCE DETENTION BASIN OUTLET STRUCTURE
BUOYANCY ANALYSIS

***** Existing Structure *****

ELEVATIONS

Critical condition when water surface is at weir crest

Water surface at weir crest elevation = 1813.00

Average flowline elevation in structure = 1798.71

Average water surface in structure = 1802.81

Based on flow of 367 cfs through low level outlet

Average depth in structure = 4.1 ft

VOLUME & WEIGHT OF CONCRETE

Volume & Weight of Concrete Below Water Surface (1813)

Slab Volume

$[(53.5)(24.5) + 1/2(24.5+19.33)(9.17)] (1.5) =$ 2267 ft^3

Main Walls Volume

$(14.29)(1.25)[(52.5)(2)+(2)(20)]-[(5)(4)+(2)(8)(7)](1.25) =$ 2425 ft^3

Low Level Walls Volume

$(18)(3)(.67)+(2)(4.5)(9.17)(.67) =$ 91.5 ft^3

Volume of Concrete Below Water Surface = 4783.5 ft^3

Buoyant Weight of Concrete

$(4783.5)(150-62.4) =$ **419,035 lbs**

Volume & Weight of Concrete Above Water Surface

Volume

$(3)[(4)(2.25)(1.25)+(2)(1.25)(1)+(20)(1.25)] =$ 116 ft^3

Weight

$(116)(150) =$ **17,400 lbs**

VOLUME & WEIGHT OF TRASH RACK

Bars

(35)[(5.5")(.5")(9')/(144)] = 6.02 ft^3

Ls

(3)[(6"+4")(3/8")(17')/(144)] = 1.33 ft^3

Std Wt Pipe

(2)(.022sf)(17') = 0.75 ft^3

Volume of Trash Rack Steel = 8.1 ft^3

Buoyant Weight of Trash Rack

(8.1)(490-62.4) = **3,464 lbs**

VOLUME & WEIGHT OF SOIL

Assuming no friction resistance

Soil on Footing Average Height 5.85 feet on 2 sides

Unit Weight = 120 pcf

Volume

(2)(62)(5.85)(1) = 725.4 ft^3

Buoyant Weight of Soil

(725.4)(120-62.4) = **41,783 lbs**

REACTION FROM RCB CULVERTS

Assume 1/2 weight of 6' length with 1ft of cover

Volume

Concrete (22.67 SF)(6) = 136.02 ft^3

Cover (8)(6)(1) = 48 ft^3

Reaction on Box = 1/2 buoyant weight of 2 RCBs

(2)(1/2) [(136)(150-62.4)+(48)(120-62.4)] = 14,680 lbs

Depth in RCB = 2.85 = 41% full

Upward Buoyant Force

(2)(1/2)(59%) (55.11)(6)(62.4) = 12,174 lbs

Net Reaction

14,680 - 12174 = **2,507 lbs**

TOTAL WEIGHT - DOWNWARD FORCE

Concrete below W.S. =	419,035	lbs
Concrete above W.S. =	17400	lbs
Trash rack =	3464	lbs
Soil =	41783	lbs
RCB Reaction =	2507	lbs
	484,188	**lbs**

UPWARD FORCE

Depth Displaced

1813-1802.81 = 10.19

Volume of Water Displaced

Excluding displacement for Structural Items where buoyant weight was calculated

(10.19)(20)(50) = 10190 ft^3

Buoyant Force

(62.4)(10190) = **635,856 lbs**

FACTOR OF SAFETY

FS = (484188/635856) = **0.76** **< 1 N.G.**

CONFLUENCE DETENTION BASIN OUTLET STRUCTURE
BUOYANCY ANALYSIS

***** After Mitigation with Gabions *****

ELEVATIONS

Critical condition when water surface is at weir crest

Water surface at weir crest elevation = 1813.00

Average flowline elevation in structure = 1798.71

Average water surface in structure = 1803.46

Based on flow of 360 cfs through low level outlet

	station	depth y	average y_{ave}	Length L	y_{ave} * L
u/s end	0 ft	5.49			
	30 ft	4.81	5.15	30	154.5
	40 ft	3.98	4.395	10	43.95
d/s end	50 ft	3.83	3.905	10	39.05
				50	237.5

Average depth in structure = 4.75 ft

VOLUME & WEIGHT OF CONCRETE

Volume & Weight of Concrete Below Water Surface

Slab Volume
[(53.5)(24.5) + 1/2(24.5+19.33)(9.17)] (1.5) = 2267 ft^3

Main Walls Volume
(14.29)(1.25)[(52.5)(2)+(2)(20)]-[(5)(4)+(2)(8)(7)](1.25) = 2425 ft^3

Low Level Walls Volume
(18)(3)(.67)+(2)(4.5)(9.17)(.67) = 91.5 ft^3

Volume of Concrete Below Water Surface = 4783.5 ft^3

Buoyant Weight of Concrete
(4783.5)(150-62.4) = **419,035 lbs**

Volume & Weight of Concrete Above Water Surface

Volume
(3)[(4)(2.25)(1.25)+(2)(1.25)(1)+(20)(1.25)] = 116 ft^3

Weight
(116)(150) = **17,400 lbs**

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Co./Dept. CDPW | Co. RFED
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Fax # 435-4720 | Fax #

VOLUME & WEIGHT OF TRASH RACK

Bars

(35)[(5.5")(.5")(9')/(144)] = 6.02 ft^3

Ls

(3)[(6"+4")(3/8")(17')/(144)] = 1.33 ft^3

Std Wt Pipe

(2)(.022sf)(17') = 0.75 ft^3

Volume of Trash Rack Steel = 8.1 ft^3

Buoyant Weight of Trash Rack

(8.1)(490-62.4) = **3,464 lbs**

VOLUME & WEIGHT OF GABIONS

Unit Weight Stones = 160 pcf

Porosity = 0.35

Unit Weight Gabions = 104 pcf

Volume & Weight of Gabions Below Water Surface

Volume

(2)(4.75)(6)(40) = 2280 ft^3

Buoyant Weight of Gabions

(2280)(104-62.4) = **94,848 lbs**

Volume & Weight of Gabions Above Water Surface

Volume

(2)[(3)(3)(40)+(6)(1.25)(40)] = 1320 ft^3

Weight

(104)(1020) = **137,280 lbs**

VOLUME & WEIGHT OF SOIL

Assuming no friction resistance

Soil on Footing Average Height 5.85 feet on 2 sides

Unit Weight = 120 pcf

Volume

(2)(62)(5.85)(1) = 725.4 ft^3

Buoyant Weight of Soil

(725.4)(120-62.4) = **41,783 lbs**

REACTION FROM RCB CULVERTS

Assume 1/2 weight of 6' length with 1ft of cover

Volume

Concrete	(22.67 SF)(6) =	136.02	ft^3
Cover	(8)(6)(1) =	48	ft^3

Reaction on Box = 1/2 buoyant weight of 2 RCBs

(2)(1/2) [(136)(150-62.4)+(48)(120-62.4)] = 14,680 lbs

Depth in RCB = 2.85 = 41% full

Upward Buoyant Force

(2)(1/2)(59%) (55.11)(6)(62.4) = 12,174 lbs

Net Reaction

14,680 - 12174 = **2,507 lbs**

TOTAL WEIGHT - DOWNWARD FORCE

Concrete below W.S. =	419,035	lbs
Concrete above W.S. =	17400	lbs
Trash rack =	3464	lbs
Gabions below W.S. =	94848	lbs
Gabions above W.S. =	137280	lbs
Soil =	41783	lbs
RCB Reaction =	2507	lbs
	716,316	**lbs**

UPWARD FORCE

Depth Displaced

1813-1803.46 = 9.54

Volume of Water Displaced

Excluding displacement for Structural Items where buoyant weight was calculated

(9.54)(20)(50) = 9540 ft^3

Buoyant Force

(62.4)(9540) = **595,296 lbs**

FACTOR OF SAFETY

FS = (716316/595296) = **1.20** **OK**

APPENDIX F

FEMA FORMS

FEDERAL EMERGENCY MANAGEMENT AGENCY **REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☒ Physical change
     - ☒ Existing
     - ☒ Proposed
   - ☐ Improved methodology
   - ☐ Improved data
   - ☐ Floodway revision
   - ☐ Other _____

   Explain _____
2. Flooding Source: **Range Wash**
3. Project Name/Identifier: **West Range Wash Dike, Range Wash/Sloan Channel Confluence Detention Basin, Sloan Channel**
4. FEMA zone designations affected: **ZONE A**
   (example: A, AH, AO. A1-30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX: 480301	Katy, City	Harris, Fort Bend	TX	480301	0005D	02/08/83
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**1790 D**	**8/16/95**
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**2176 D**	**8/16/95**
320003	**Clark County**	**Clark**	**NV**	**32003C**	**2180 D**	**8/16/95**
320007	**North Las Vegas, City**	**Clark**	**NV**	**32003C**	**2180 D**	**8/16/95**
320003	**Clark County**	**Clark**	**NV**	**32003C**	**2200 D**	**8/16/95**

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding

- ☒ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☐ Shallow Flooding *(e.g. Zones AO and AH)*
- ☐ Lakes

Affected by wind/wave action
- ☐ Yes
- ☐ No

- ☐ Other (describe) _____

Structures

- ☒ Channelization
- ☒ Levee/Floodwall
- ☐ Bridge/Culvert
- ☒ Dam
- ☐ Coastal
- ☒ Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☐ Other *(describe)* _____

Disciplines*

- ☒ Water Resources
  - ☒ Hydrology
  - ☒ Hydraulics
  - ☒ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)* **CIVIL ENGINEER**

*** Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☒ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM ☐ Yes ☒ No
   If yes, give reason: _____

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions

9. Does the state have jurisdiction over the floodway or its adoption by communities participating in the NFIP?
☐ Yes ☒ No

If yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvements, or other development in the floodway? ☐ Yes ☐ No

1B If yes, does the development cause the 100-year water surface elevation to increase at any location by more that 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvements, or other development in the 100-year floodplain? ☒ Yes ☐ No

2B If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot *(or other surcharge limit if community or state has adopted more stringent criteria)?* ☐ Yes ☒ No

If the answer to either Items 1B or 2B is yes, please provide documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

4. REVISION REQUESTOR ACKNOWLEDGMENT

12. Having read NFIP Regulations, 44 CFR Ch.1, parts 59, 60, 61, and 72, I believe that the proposed revision ☒ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☒ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☒ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgment and/or notification is required for all requests as outlined in Section 65.4 (b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g., levees, floodwalls, channelization, basins, dams)?
☒ Yes ☐ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by **Clark County Regional Flood Control District** (entity) with a maximum interval of **12** months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by **City of North Las Vegas and Clark County Department of Public Works** (entity) to ensure the integrity and degree of flood protection of the structure

C. A formal plan of operation, including documentation of the flood warning system, specifications and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☒ has ☐ has not been prepared for the flood control structure.

D. The community is willing to assume responsibility for ☒ performing ☒ overseeing compliance with the maintenance and operation plan of the West Range Wash Dike, Range/Sloan Confluence Det. Basin,Sloan Channel
(Name)

flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled " Appeals, Revisions, and Amendments to Flood Insurance Maps: A guide for Community Officials," dated January 1990, this request is for a:

X	a.	CLOMR	A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch.I, Parts 60, 65, and 72).*
X	b.	LOMR	A letter from FEMA officially revising the current NFIP map to show changes in floodplain, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(see 44 CFR Ch.I Parts 60 and 65.)*
	c.	PMR	A reprinted NFIP map incorporating changes to flood plains, floodways, or flood elevations Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch.I, Parts 60 and 65.)*
	d.	Other	Describe _____

8. FORMS INCLUDED

17. Form 2 entitled, "Certification By Registered Professional Engineer and/or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☒ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☒ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☒ Riverine/Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☒ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☒ Bridge/Culvert Form (Form 7)
• The request involves a new levee/floodwall system	☒ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☒ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The Minimum initial review fee for the appropriate request category has been included. ☐ Yes ☒ No
Initial fee amount: $ _____

Check or money order only. Make check or money order payable to: **National Flood Insurance Program.** If paying by Visa or Mastercard please refer to the credit card information form which follows this form.

or

19. This request is for a project that is for public benefit and is primarily intended for flood loss reduction to insurable structures in identified flood hazard areas which were in existence prior to the commencement of construction of the flood control project. ☒ Yes ☐ No

or

20. This request is to correct map errors, to include the effects of natural changes within the areas of special flood hazard, or solely to provide more detailed data. ☐ Yes ☒ No

Note: I understand that my signature indicates that all information submitted in support of this request is correct.

Signature of Revision Requester

Donald W. Davis, P.E., Project Manager
Printed Name and Title of Revision Requester

Post, Buckley, Schuh, and Jernigan, Inc.
Company Name

(702) 263-7275 **January 22, 1996**
Telephone No. Date

Note: Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.

Signature of Community Official

Printed Name and Title of Community Official

Community Name

Date

Does this request impact any other communities? ☒ Yes ☐ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, If applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average .23 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2

2. I am licensed with an expertise in **water resources (hydrology, hydraulics)**
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)** structural, geotechnical, land surveying.]

3. I have **14** years experience in the expertise listed above.

4. I have ☐ prepared ☒ reviewed the attached supporting data and analyses related to my expertise.

5. I ☒ have ☐ have not visited and physically viewed the project.

6. In my opinion, the following analyses and/or designs, is/are being certified:
   West Range Wash Dike, Confluence Detention Basin, Sloan Channel Owens to Charleston, Channel Lamb to Alexander

7. Based upon the following review, the modifications in place have been constructed in general concordance with plans and specifications.

   Basis for above statement: (check all that apply)
   - a. ☐ Viewed all phases of actual construction.
   - b. ☒ Compared plans and specifications with as-built survey information.
   - c. ☒ Examined plans and specifications and compared with competed projects.
   - d. ☐ Other _____

8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under title 18 of the United States Code, Section 1001.

Name: **Donald W. Davis**
(please print or type)

Title: **Project Manager**
(please print or type)

Registration No. **8087** Expiration Date: **12/31/98**

State **Nevada**

Type of License **Civil Engineer**

_____
Signature

_____
Date

_____
Seal
(Optional)

* Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.67 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**
(One form for each flooding source)

Project Name / Identifier: **Range Wash FIS Restudy**

1. HYDROLOGIC ANALYSIS IN FIS

☒ Approximate study stream (Zone A)
☐ Detailed study stream (briefly explain methodology) _____

2. REASON FOR NEW HYDROLOGIC ANALYSIS

☐ No existing analysis
☒ Improved Data *(see data revision on page 3)*
☒ Changed physical conditions of watershed *(explain)* **Major flood control facilities have been constructed or are under construction, including a diversion dike to the North Las Vegas Detention Basin and the Range Wash/Sloan Channel Confluence Detention Basin, & Sloan Channel**
☐ Alternative methodology *(justify why the revised model is better than model used in the effective FIS)*

☒ Evaluation of proposed conditions (CLOMRs only) (explain) **The Sloan Channel between Stewart Avenue and Charleston Boulevard is not yet constructed**
☐ Other _____

If a computer program/model was used in revising the hydrologic analysis, please provide a diskette with the input files for the 10-, 50-, 100- and 500-year recurrence intervals.

Only the 100-year recurrence interval need be included for SFHA designated as Zone A.

3. APPROVAL OF ANALYSIS

☒ Approval of hydrologic analysis, including the resulting peak discharge value (s) has been provided by the appropriate local, state, or Federal Agency. (i.e., **Clark County Regional Flood Control District**)
Attach evidence of approval.

☐ Approval of the hydrologic analysis is not required by any local, state, or Federal Agency.

4. REVIEW OF RESULTS

Stream: **Range Wash**

Comparison of 100-year Discharges

Location:	Drainage area (Sq. mi.) w/o dike - w/ dike - w/ DB	FIS (cfs): w/o dike - w/ dike	Revised (cfs): w/ dike - w/ DB
West Tributary at Las Vegas Blvd	49 - 11, 8_R - N/A	6,300 - 2,900	1,550
Sloan Channel at Owens	138 - 89 - 85_R	8,000 - 5,200	1,940
Sloan Channel at Las Vegas Wash	151 - 102 - 16	8,300 - 6,000	4,000
$_R$: Revised areas of Restudy			

Note: When revised discharges are not significantly different than FIS discharges, FEMA may require a confidence limits analysis on attachment D at a later date to complete the review

As is often the case with revision requests, only a portion of a stream may actually be revised or be affected by a revision. Therefore, transition to the unrevised portion is important to maintain the continuity of the study. NFIP regulations stipulate that such a transition must be assured. What is the transition from the proposed discharges to the effective discharges? Please explain how the transition was made *(attach separate sheet if necessary)*

ATTACH A COMPLETED REVIEW OF RESULTS PAGE FOR EACH FLOODING SOURCE.

Is the new hydrologic analysis being developed solely to revise the flow values presented in the FIS *(i.e. no changed hydraulic conditions)?* ☐ Yes ☒ No

If yes, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

FEMA does not normally revise NFIP maps solely due to insignificant flow changes where changes in the 100-year water surface elevation are less than 1.0 foot.

5. HISTORICAL FLOODING INFORMATION

Is historical data available for the flooding source? ☐ Yes ☒ No

If yes, provide the following:

Location along flooding source: _____

Maximum peak discharge: _____ cfs

Second highest peak discharge: _____ cfs

Source of information: _____

6. GAGE RECORD INFORMATION

Location of the nearest gage to project site *(along flooding source or similar watershed: specify)*

N/A

Gaging Station: _____

Drainage area at gage: _____ mi^2

Number of years of data: _____

7. DATA REVISION

Please use the following table to list all the data and/or parameters affected by this request and identify them as new data *(New)* or as revising existing data *(Revised)*. *(If necessary, attach a separate sheet.)*

Data Parameter	New	Revised	Data Source
Basin Delineation	☐	☒	Changes due to development
Lag times	☐	☒	CCRFCD Criteria Manual
	☐	☐	
	☐	☐	
	☐	☐	

- Data source can be from Federal, State, or local government agency, or from a private source. Some State and local governments may have less strict data requirements than Federal Agencies, in which case the hydrologic data may not be accepted by FEMA unless it is demonstrated that the data give a better estimate of the flood discharge.

- Attach documentation corroborating each data source *(i.e. certified statement, report, bibliographical reference to a published document)*. In each case of a published document or a government report, providing copies of the cover and pertinent pages may be helpful.

8. METHODOLOGY FOR NEW ANALYSIS

☐ Statistical Analysis of Gage Records *(use Attachment A)*

☐ Regional Regression Equations *(use Attachment B)*

☒ Precipitation/Runoff Model *(use Attachment C)*

☐ Other *(specify; attach backup computations and supporting data)* _____

ATTACHMENT A: STATISTICAL ANALYSIS OF GAGE RECORDS

Gaging Station: _____

Gage Location (latitude and longitude): _____

	FIS:	Revised:
1. Number of years of data		
Systematic		
Historical		
2. Homogeneous data	☐ Yes ☐ No	☐ Yes ☐ No
3. Data adjustments	☐ Yes ☐ No	☐ Yes ☐ No
4. Number of high outliers		
Low outliers		
Zero events		
5. Generalized skew		
6. Station skew		
7. Adopted skew		
8. Probability distribution used (justify if log-Pearson III was not used)		
9. Transfer equations to ungaged sites		☐ Yes ☐ No
If yes, specify method		
10. Expected probability*	☐ Yes ☐ No	☐ Yes ☐ No
11. Comparison of results with other analyses	☐ Yes ☐ No	☐ Yes ☐ No
If yes, describe comparison		

*FEMA does not accept expected probability analyses for the purpose of reflecting flood hazard information in a FIS.

If any data is not available, indicate by N/A

Attach analysis including plot of flood frequency curve.

ATTACHMENT B: REGIONAL REGRESSION EQUATIONS

1. Bibliographic Reference:

_____

_____

_____

(attach a copy of title page, table of contents, and pertinent pages including equations)

2. Gaged or ungaged stream: _____

3. Hydrologic region(s): _____
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

_____

_____

_____

		FIS:	Revised:
5.	Urbanized conditions calculations	☐ Yes ☐ No	☐ Yes ☐ No
6.	Percent of watershed urbanization	_____	_____
7.	Is the watershed controlled?	☐ Yes ☐ No	☐ Yes ☐ No
8.	Comparison with other analyses	☐ Yes ☐ No	☐ Yes ☐ No

If the answer to 5, 7, or 8, is yes, explain methodology in comments.
If data is not available, indicate by N/A.

Comments

_____

_____

_____

_____

Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT C: PRECIPITATION / RUNOFF MODEL

		FIS:	Revised:
1.	Method or model used:	HEC-1	HEC-1
	Version:	Haested 5.2	4.0
	Date:	Aug. 1988	Sept. 1990
2.	Source of Rainfall Depth:	CCRFCD	CCRFCD
3.	Source of rainfall distribution	CCRFCD	CCRFCD
4.	Rainfall duration:	6 hours	6 hours
5.	Areal adjustment to precipitation (%):	CCRFCD DARFS	CCRFCD DARFS
6.	Maximum overland flow length	500 ft	500 ft
7.	Hydrograph development method:	SCS Unit Hydrograph	SCS Unit Hydrograph
8.	Loss rate method:	SCS	SCS
	Source of soils information	SCS	SCS
	Source of land use information	1990 Aerial Photos	1995 Aerial Photos
9.	Channel routing method:	Muskingum	Muskingum
10.	Reservoir routing	☐ Yes ☒ No	☒ Yes ☐ No
11.	Baseflow considerations:	☐ Yes ☒ No	☐ Yes ☒ No
	If yes, explain how baseflow was determined:		
12.	Snowmelt considerations:	☐ Yes ☒ No	☐ Yes ☒ No
13.	Model calibration:	☐ Yes ☒ No	☐ Yes ☒ No
	If yes, explain how calibration was performed		
14.	Future land use condition:		☐ Yes ☒ No
	If yes, explain why		

NOTE: FEMA policy is to base flooding on existing conditions.
If data is not available, indicate by N/A.

Attach precipitation / runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.

ATTACHMENT D: CONFIDENCE LIMITS EVALUATION

Stream: _____

Select one location for Confidence Limits Evaluation *(describe location)*: _____

_____

Discharge for selected location.

Exceedance Probability		FIS		Revised	
10%	(10-year)	_____	cfs	_____	cfs
2%	(50-year)	_____	cfs	_____	cfs
1%	(100-year)	_____	cfs	_____	cfs
0.2%	(500-year)	_____	cfs	_____	cfs

1% (100-year) Flood Confidence Intervals

90% Confidence Interval: 5% limit _____ cfs

95% limit _____

50% Confidence Interval: 25% limit _____

75% limit _____

If the value of the 100-year frequency flood in the FIS is beyond the 50% confidence interval but within the 90% confidence interval, does the 100-year water surface elevation change by 1.0 foot or more? ☐ Yes ☐ No

An example of confidence limits analysis can be found in Appendix 9 of Bulletin 17B.

Attach Confidence Limits Analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**
(One form for each flooding source)

Project Name / Identifier: **Range Wash FIS Restudy**

1. REACH TO BE REVISED

Downstream limit: **Confluence with Las Vegas Wash**
Upstream limit: **Elkhorn Road**

2. EFFECTIVE FIS

☐ Not studied

☒ Studied by approximate methods
Downstream limit of study: Confluence with Las Vegas Wash
Upstream limit of study: Elkhorn Road

☐ Studied by detailed methods
Downstream limit of study:
Upstream limit of study:

☐ Floodway delineated
Downstream limit of study:
Upstream limit of study:

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM. *(Check all that apply)*

☐ Not studied in FIS

☐ Improved hydrologic data / analysis. Explain: Basins have been delineated in more detail and reflect recent improvements by developers.

☐ Improved hydraulic analysis. Explain:

☒ Flood control structure. Explain: Range Wash Dike has been constructed, Confluence Detention Basin has been constructed, Sloan Channel improvements have been constructed and are under construction.

☐ Other. Explain:

3. RIVERINE HYDRAULIC ANALYSIS FORM
Models Submitted

For areas which have detailed flooding:

Full input and output listings along with files on diskette (if available) for each of the models listed below (items 1, 2, 3, 4, and 5) and summary of the source of input parameters used in the models must be provided. The summary must include a complete description of any changes made from model to model (e.g. duplicate effective model to corrected effective model.) At a minimum, the Duplicate Effective (item 1) and the Revised or Post-Project Conditions (item 4) models must be submitted. See instructions for directions on when other models may be required.

For areas which do not have detailed flooding:

Only the 100-year flood profile is required. A hydraulic model is not required for areas which do not have detailed flooding; however, BFEs may not be added to the revised FIRM. If a hydraulic model is developed for the area, items 3 and 4 described below must be submitted.

If hydraulic models are not developed, hydraulic analyses for existing or pre-project conditions and revised or post-project conditions must be submitted. All calculations must be submitted for these analyses. (see item 6 below)

	Natural	Floodway
1. Duplicate Effective Model Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models *(10-, 50-, 100-, and 500-year multi-profile runs and the floodway run)* must be obtained and then reproduced on the requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.	☐	☐
2. Corrected Effective Model The corrected effective model is the model that corrects any errors that occur in the duplicate effective model, adds any additional cross sections to the duplicate effective model, or incorporates more detailed topographic information than that used in the currently effective model. The corrected effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.	☐	☐
3. Existing or Pre-Project Conditions Model The duplicate effective or corrected model is modified to produce the existing or pre-project conditions model to reflect any modifications that have occurred within the floodplain since the date of the effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the corrected effective or duplicate effective model.	☐	☐
4. Revised or Post-Project Conditions Model The existing or pre-project conditions model *(or duplicate effective or corrected effective model, as appropriate)* is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for proposed project this model should reflect proposed conditions.	☐	☐
5. Other: Please attach a sheet describing all other models submitted	Natural	Floodway
6. Hydraulic Analyses (Only if Hydraulic Models are not developed)	☒	☒

Please Attach all calculations for the existing or pre-project conditions and the revised or post-project conditions. Proceed to form 5, "Riverine/Coastal Mapping Form".

4. MODEL PARAMETERS (from model used to revise 100-year water surface elevation)

1. Discharges:

	Upstream limit	Downstream limit
10-year		
50-year		
100-year		
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined _____

3. Give range of friction loss coefficient *(Manning's "N")* Channel . . . . . _____

Overbanks . . . . . _____

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and the revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised

Explain: _____

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

5. Were natural channel banks selected as the location of the left and right channel banks in the model?

☐ Yes ☐ No If no, explain why not: _____

4. MODEL PARAMETERS (Cont'd)

6. Explain how reach lengths for channel and overbanks were determined:

_____

_____

_____

_____

5. RESULTS (from model used to revise 100-year water surface elevations)

1. Do the results indicate:

   a. Water surface elevations higher than end points of cross sections? . . . . . ☐ Yes ☐ No

   b. Supercritical depth? . . . . . ☐ Yes ☐ No

   c. Critical depth? . . . . . ☐ Yes ☐ No

   d. Other unique situations . . . . . ☐ Yes ☐ No

   If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? . . . . . _____
   Specify location . . . . . _____

3. What is the distance between the cross-sections in 2 above? . . . . . _____

4. What is the maximum distance between cross-sections? . . . . . _____
   Specify location . . . . . _____

5. Floodway determination
   a. What is the maximum surcharge allowed by the community or State? . . . . . _____ foot
   b. What is the maximum surcharge for the revised conditions? . . . . . _____ foot
   Specify location . . . . . _____
   c. What is the maximum velocity? . . . . . _____ fps
   Specify location . . . . . _____

   d. Are there any negative surcharge values at any cross-section ☐ Yes ☐ No
   If yes, the floodway may need to widen. If it is not widened, please explain and indicate the maximum negative surcharge.

Explain: _____

_____

_____

5. RESULTS (Cont'd)

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? . . . . . ☐ Yes ☐ No
If yes, explain:

_____

_____

_____

7. Do 100-year water surface elevations increase at any location? . . . . . ☐ Yes ☐ No
If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases. *(For example: State if the increase is due to fill placed within the floodway fringe or placed within the currently adopted floodway limits)*

_____

_____

_____

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)* downstream of the project at cross-section _____ within _____ feet *(vertical)* and upstream of the project at cross section _____ within _____ feet *(vertical)*.

B. The revised floodway elevations tie into those computed by the effective FIS model, downstream of the project at cross section _____ within _____ feet *(vertical)* and upstream of the project at cross section _____ within _____ feet *(vertical)*.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord an top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets.

D. Attach a Floodway Data Table showing data for each cross section listed in the published Floodway Data Table in the FIS report.

Proceed to Riverine / Coastal Mapping Form

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE/COASTAL MAPPING FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy**

1. MAPPING CHANGES

1. A topographic work map of suitable scale, contour interval, and planimetric definition must be submitted showing *(indicate N/A when not applicable):*

		Included		
A.	Revised approximate 100-year floodplain boundaries (Zone A)	☒ Yes	☐ No	☐ N/A
B.	Revised detailed 100- and 500-year floodplain boundaries	☐ Yes	☐ No	☒ N/A
C.	Revised 100-year floodway boundaries	☐ Yes	☐ No	☒ N/A
D.	Location and alignment of all cross sections used in the revised hydraulic model with stationing control indicated	☒ Yes	☐ No	☐ N/A
E.	Stream alignments, road and dam alignments	☒ Yes	☐ No	☐ N/A
F.	Current community boundaries	☒ Yes	☐ No	☐ N/A
G.	Effective 100-~~and 500~~-year floodplain ~~and 100-year floodway~~ boundaries from the FIRM/~~FBFM~~ reduced or enlarged to the scale of the topographic work map	☒ Yes	☐ No	☐ N/A
H.	Tie-ins between the effective and revised 100- ~~and 500~~-year floodplains ~~and 100-year floodway~~ boundaries	☐ Yes	☐ No	☒ N/A
I.	The requestor's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
J.	The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
K.	Location and description of reference marks	☐ Yes	☐ No	☒ N/A
L.	Vertical datum (example: NGVD, NAVD etc.)	☒ Yes	☐ No	☐ N/A
M.	Coastal zone designations tie into adjacent areas not being revise	☐ Yes	☐ No	☒ N/A
N.	Location and alignment of all coastal transects used to revise the coastal analyses	☐ Yes	☐ No	☒ N/A

If any of the items above are marked no or N/A, please Explain:

Study includes the entire mapped reach of Range Wash by approximate methods no base flood elevations are determined.

2. What is the source and data of the updated topographic information *(example: orthophoto maps, July 1985: field survey, May 1979, beach profiles, June 1987, etc.)?* **Aerial Survey Topographic Mapping 3/15/95**

3. What is the scale and contour interval of the following work maps?

a. Effective FIS **1" = 400'** scale **4 ft** Contour interval

b. Revision Request **1" = 400'** scale **2 ft** Contour interval

NOTE: Revised topographic information must be of equal or greater detail.

4. Attach an annotated FIRM and FBFM at the scale of the effective FIRM and FBFM showing the revised 100-year and 500-year floodplains and the 100-year floodway boundaries and how they tie into those shown on the effective FIRM and FBFM downstream and upstream of the revision or adjacent to the area of revision for coastal studies.

Attach additional pages if needed.

1. MAPPING CHANGES (Cont'd)

5. Flood boundaries and 100-year water surface elevations:

Has the 100-year floodplain been shifted or increased or the 100-year water surface elevation increased at any location on the property other than the requestor's or community's? ☐ Yes ☒ No

If yes, please give the location of shift or increase and an explanation of the increase.

Shifted within community, due to more detailed and accurate topography

a. Have the affected property owners been notified of this shift or increase and the effect it will have on their property? . . . . . ☐ Yes ☒ No

If yes, please attach letters from these property owners stating they have no objections to the revised flood boundaries if a LOMR is being requested.

b. What is the number of insurable structures that will be impacted by this shift or increase? **none**

6. Have the floodway boundaries shifted or increased at any location compared to those shown on the effective FBFM or FIRM? . . . . . ☒ Yes ☐ No

If yes, explain:

Shifted within community, due to more detailed and accurate topography

7. If a V-zone has been designated, has it been delineated to extend landward to the heel of the primary frontal dune? ☐ Yes ☐ No

If no, explain:

8. Manual or digital map submission:

☒ Manual

☒ Digital

Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA headquarters as far in advance of submission as possible.

2. EARTH FILL PLACEMENT

1. The fill is: ☒ Existing ☐ Proposed **Fill is associated with Cibola Project Case No. 95-09-1021C**

2. Has fill been / will be placed in the regulatory floodway? . . . . . ☐ Yes ☒ No
If yes, please attach complete Riverine Hydraulic Analysis Form.

3. Has fill been / will be placed in the floodway fringe *(area between the floodway and 100-year floodplain boundaries)?* . . . . . ☒ Yes ☐ No

   A. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? . . . . . ☐ Yes ☒ No

   If yes, justify steeper slopes _____

   B. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? *(Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)* . . . . . ☒ Yes ☐ No

   If no, describe erosion protection provided _____

   C. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? ☒ Yes ☐ No

   D. Can structures conceivably be constructed on the fill at any time in the future? ☒ Yes ☐ No

   If yes, provide certification of fill compaction (item C. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer.

4. Has fill been / will be placed in a V-zone? ☐ Yes ☒ No

   If yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall? ☐ Yes ☐ No

   If yes, attach the coastal structures form.

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy Channelization associated with Sloan Channel**

1. EXTENT OF CHANNELIZATION

Downstream limit: **Charleston Boulevard**

Upstream limit: **Owens Avenue**

2. CHANNEL DESCRIPTION

1. Describe the inlet to the channel
Continuation of Existing Concrete Channel

2. Briefly describe the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)* **Concrete lined trapezoidal channel, 60 ft base width, 6.6 ft deep, 2:1 side slopes,**

3. Describe the outlet from the channel
Bridge and concrete apron at Charleston Boulevard

4. The channelization includes:

- ☐ Levees *(Attach Levee Form)*
- ☐ Drop structures
- ☐ Superelevated sections
- ☒ Transitions in cross section geometry
- ☐ Debris basin/detention basin
- ☐ Energy Dissipater
- ☐ Other

5. Attach the following:

a. Certified engineering drawings showing channel alignment and locations of inlet, outlet, and items checked in item 4

b. Typical cross sections and profiles of channel banks and invert

3. HYDRAULIC CONSIDERATIONS

1. What is the 100-year discharge? . . . . . **3,300 used in model** cfs

2. Do the cross sections in the hydraulic model match the typical cross sections in the plans? ☒ Yes ☒ No

3. Are the channel banks higher than the 100-year flood elevations everywhere? . . . . . ☒ Yes ☐ No

4. Are the channel banks higher than the 100-year flood energy grade lines everywhere? . . . ☒ Yes ☐ No

5. Is the land on both sides of the channel above the adjacent 100-year flood elevation at all points along the channel? . . . . . ☒ Yes ☐ No

6. What is the range of freeboard . . . . . **1.5** — **'1.67** feet

7. What is the range of the 100-year flood velocities? . . . . . **7** — **18** ft/sec

8. What is the lining type? (both bottom and sides) **Concrete**
   Explain how the channel lining prevents erosion and maintains channel stability *(attach documentation)*

9. What is the design elevation in the channel based on?

   ☒ Subcritical flow
   ☐ Critical flow
   ☒ Supercritical flow
   ☐ Energy grade line

   Is 100-year flood profiles based on the above type of flow? . . . . . ☐ Yes ☒ No

   If no, explain: Profiles included in the Sloan Channel Predesign Report are based on the above types of flow. No base flood elevations are determined for this area.

10. Is there the potential for a hydraulic jump at the following locations?

    Inlet to the channel . . . . . ☐ Yes ☒ No
    Outlet of the channel . . . . . ☐ Yes ☒ No
    At Drop Structures . . . . . ☒ Yes ☐ No
    At Transitions . . . . . ☐ Yes ☒ No
    At other locations. Explain

    If the answer to any of the above is yes, please explain how the hydraulic jump is controlled and the effects of the hydraulic jump on the stability of the channel.

    Explain: **Jumps are mild at upstream end of road crossing structures and are contained within the concrete channel section**

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

   B. Based on the conditions of the watershed and stream bed, is there a potential for sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (bed) load?
   _____ cfs (attach gradation curve)

   Explain method used to estimate load _____

   _____

   _____

   _____

   _____

   B. Is the 100-year flood velocity anywhere within the channel less than the 100-year flood velocity of the inlet? ☒ Yes ☐ No

   C. Will sediment accumulate anywhere within the channel? ☐ Yes ☒ No

   D. Will deposition or scour occur at or near the inlet? ☐ Yes ☒ No

   E. Will deposition or scour occur at or near the outlet? ☒ Yes ☐ No

Attach documentation showing affects on the hydrologic and hydraulic analyses

FEDERAL EMERGENCY MANAGEMENT AGENCY **CHANNELIZATION FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy Channelization associated with Collins Buisness Park**

1. EXTENT OF CHANNELIZATION

Downstream limit: **Alexander Road**

Upstream limit: **Lamb Boulevard**

2. CHANNEL DESCRIPTION

1. Describe the inlet to the channel
   3 - 9' x 6' RCB Culverts at Lamb Boulevard

2. Briefly describe the shape of the channel *(both cross sectional and planimetric configuration)* and its lining *(channel bottom and sides)* **Concrete lined trapezoidal channel, 32 ft base width, 5.5 ft deep, 2:1 side slopes,**

3. Describe the outlet from the channel
   4 - 12' x 7' RCB Culverts at Alexander Road

4. The channelization includes:

   - ☐ Levees *(Attach Levee Form)*
   - ☐ Drop structures
   - ☐ Superelevated sections
   - ☒ Transitions in cross section geometry
   - ☐ Debris basin/detention basin
   - ☐ Energy Dissipater
   - ☐ Other

5. Attach the following:

   a. Certified engineering drawings showing channel alignment and locations of inlet, outlet, and items checked in item 4

   b. Typical cross sections and profiles of channel banks and invert

3. HYDRAULIC CONSIDERATIONS

1. What is the 100-year discharge? . . . . . **2,140 used in model** cfs

2. Do the cross sections in the hydraulic model match the typical cross sections in the plans? ☒ Yes ☒ No

3. Are the channel banks higher than the 100-year flood elevations everywhere? . . . . . ☒ Yes ☐ No

4. Are the channel banks higher than the 100-year flood energy grade lines everywhere? . . . ☒ Yes ☐ No

5. Is the land on both sides of the channel above the adjacent 100-year flood elevation at all points along the channel? . . . . . ☒ Yes ☐ No

6. What is the range of freeboard . . . . . **1.5** — **2.8** feet

7. What is the range of the 100-year flood velocities? . . . . . **10.7** — **16.9** ft/sec

8. What is the lining type? (both bottom and sides) **Concrete**
   Explain how the channel lining prevents erosion and maintains channel stability *(attach documentation)*

9. What is the design elevation in the channel based on?

   ☐ Subcritical flow
   ☐ Critical flow
   ☒ Supercritical flow
   ☐ Energy grade line

   Is 100-year flood profiles based on the above type of flow? . . . . . ☐ Yes ☒ No

   If no, explain: Profiles included in the Collins Buisness Park Improvement Plans are based on the above types of flow. No base flood elevations are determined for this area.

10. Is there the potential for a hydraulic jump at the following locations?

    Inlet to the channel . . . . . ☐ Yes ☒ No
    Outlet of the channel . . . . . ☐ Yes ☒ No
    At Drop Structures . . . . . ☐ Yes ☒ No
    At Transitions . . . . . ☐ Yes ☒ No
    At other locations. Explain

    If the answer to any of the above is yes, please explain how the hydraulic jump is controlled and the effects of the hydraulic jump on the stability of the channel.

    Explain:

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

   B. Based on the conditions of the watershed and stream bed, is there a potential for sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the capacity of the channel? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (bed) load?
   _____ cfs (attach gradation curve)

   Explain method used to estimate load _____

   _____

   _____

   _____

   _____

   B. Is the 100-year flood velocity anywhere within the channel less than the 100-year flood velocity of the inlet? ☒ Yes ☐ No

   C. Will sediment accumulate anywhere within the channel? ☐ Yes ☒ No

   D. Will deposition or scour occur at or near the inlet? ☐ Yes ☒ No

   E. Will deposition or scour occur at or near the outlet? ☒ Yes ☐ No

Attach documentation showing affects on the hydrologic and hydraulic analyses

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE / CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

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Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy**

1. IDENTIFIER

1. Name of roadway, railroad, etc.: **Washington Ave.**
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): **Channel Station 35+45.61 to 37+75.36**
3. This revision reflects *(check one of the following):*

☐ New bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☒ New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed) New design flow based on construction of Range Wash/Sloan Channel Confluence Detention Basin upstream

2. BACKGROUND

Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of 3-foot diameter circular piers; 40-foot wide ogee shape spillway) **Bridge 2 continuous 2 ft wide piers on concrete trapezoidal channel with 60' base width and 1.5:1 Side Slope**
2. Entrance geometry of culvert/type of bridge opening (e.g. 30° - 75° wing walls with square top edge, sloping embankments and vertical abutments) **Channel Configuration contiuous through bridge Side slopes transition from 2:1 to 1.5:1 in 50 ft**
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* **HEC-2 with special bridge routine**

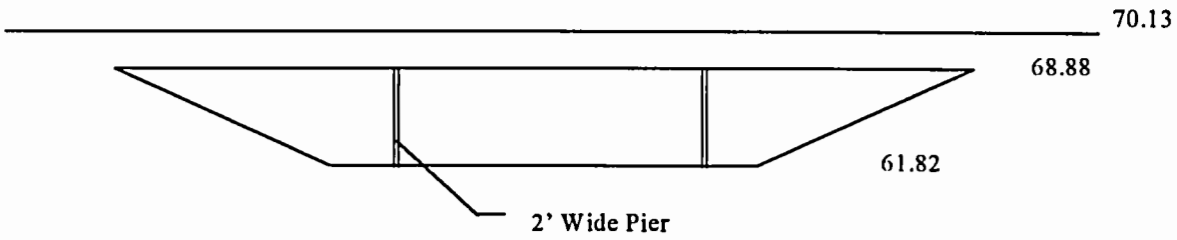
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A

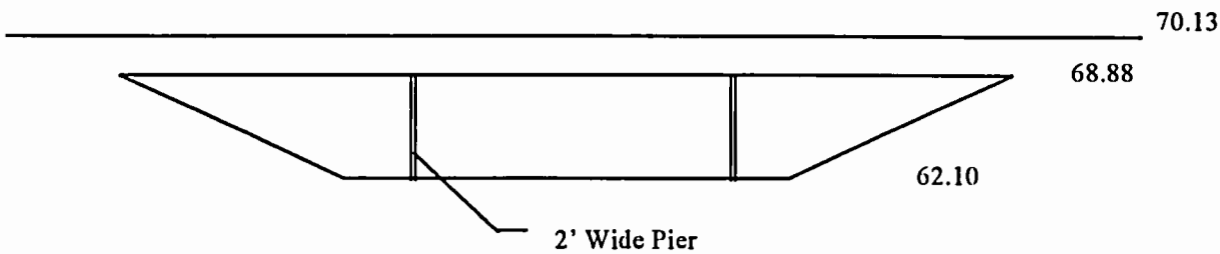
*** One form per new/revised bridge/culvert**

3. ANALYSIS

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



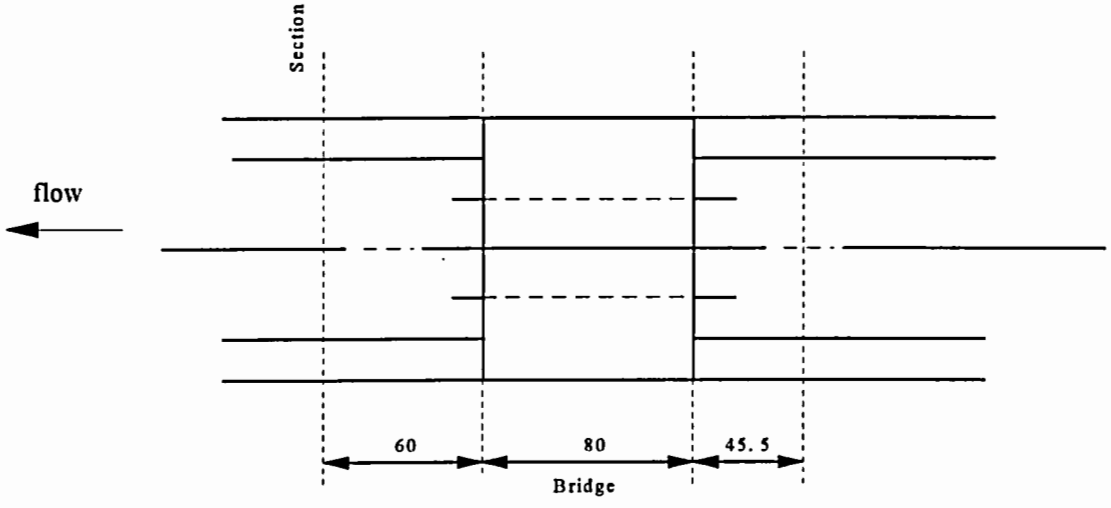
Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



3. ANALYSIS (Cont'd)

Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).

See: Improvement Plans for Sloan Channel Owens Ave. to Stewart Ave.
Sheet C-6, 6 of 14



Attach plans of the structure(s) certified by a registered Professional Engineer.

Culvert length or bridge width (ft)	**80 ft**
Calculated culvert/bridge area (ft^2) by the hydraulic model, if applicable	**234 SF**
Total culvert/bridge area (ft^2)	**437 SF**

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	70.7	70.7
Downstream face	70.7	70.7

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	70.13	70.13
Downstream face	70.13	70.13

100-year Elevations	Water Surface Elevations	Energy Gradient Elevations
Upstream face	66.13	68.74
Downstream face	65.41	68.49

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	3300	0	0	3300

The maximum depth of flow over the roadway/railroad (ft.) . . . . . _____

Weir length (ft . . . . . _____

Top Widths	Total Floodplain Width	Total Effective Flow Width	Floodway Width
Upstream face			
Downstream face			

Flow contained in 80 ft wide channel
Approximate Methods

3. ANALYSIS (Cont'd)

Loss Coefficients

Entrance loss coefficient	*
Manning's "n" value assigned to the structure(s)	0.015
Friction loss coefficient through structure(s)	0.015
Other loss coefficients (e.g. bend manhole, etc.)	*
Total loss coefficient	1.27
Weir coefficient	3
Pier coefficient	0.9
Contraction loss coefficient	0.2
Expansion loss coefficient	0.4

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?
   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and depth of scour and /or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (Floodway run) N/A

5. FLOODWAY ANALYSIS (Cont'd)

Comments *(explain any unusual situations):*

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE / CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

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Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy**

1. IDENTIFIER

1. Name of roadway, railroad, etc.: **Bonanza Road**
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): **Channel Station 62+33 to 63+33**
3. This revision reflects *(check one of the following):*

☐ New bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☒ New analysis of bridge/culvert previously modeled in the FIS

(Explain why new analysis was performed) New design flow based on construction of Range Wash/Sloan Channel Confluence Detention Basin upstream

2. BACKGROUND

Provide the following information about the structure:

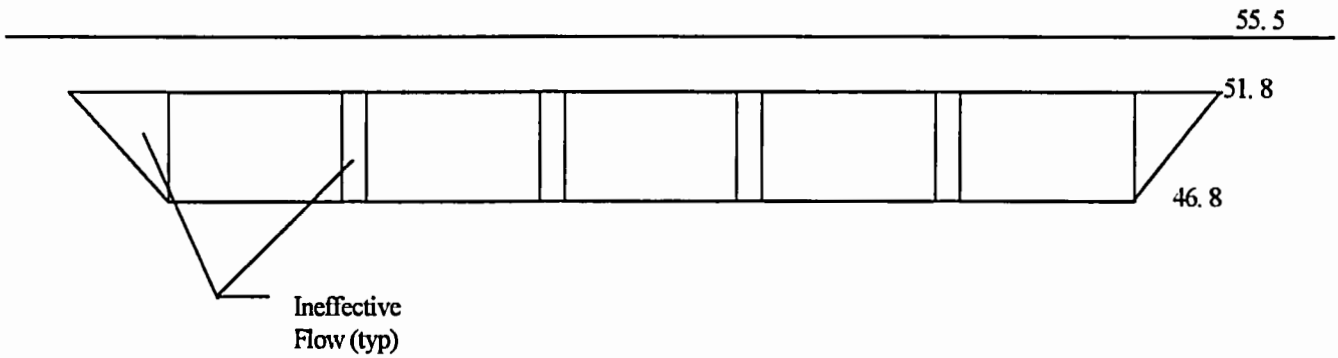
1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of 3-foot diameter circular piers; 40-foot wide ogee shape spillway) **5 - 10' x 5' RCBs**
2. Entrance geometry of culvert/type of bridge opening (e.g. 30° - 75° wing walls with square top edge, sloping embankments and vertical abutments) **Channel side walls transition from 2:1 side slope to vertical**
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* **HEC-2 with special bridge routine**

If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

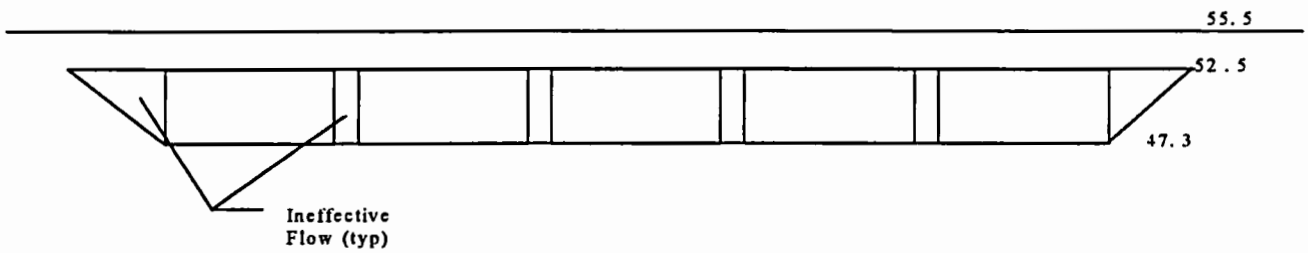
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A
*** One form per new/revised bridge/culvert**

3. ANALYSIS

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.

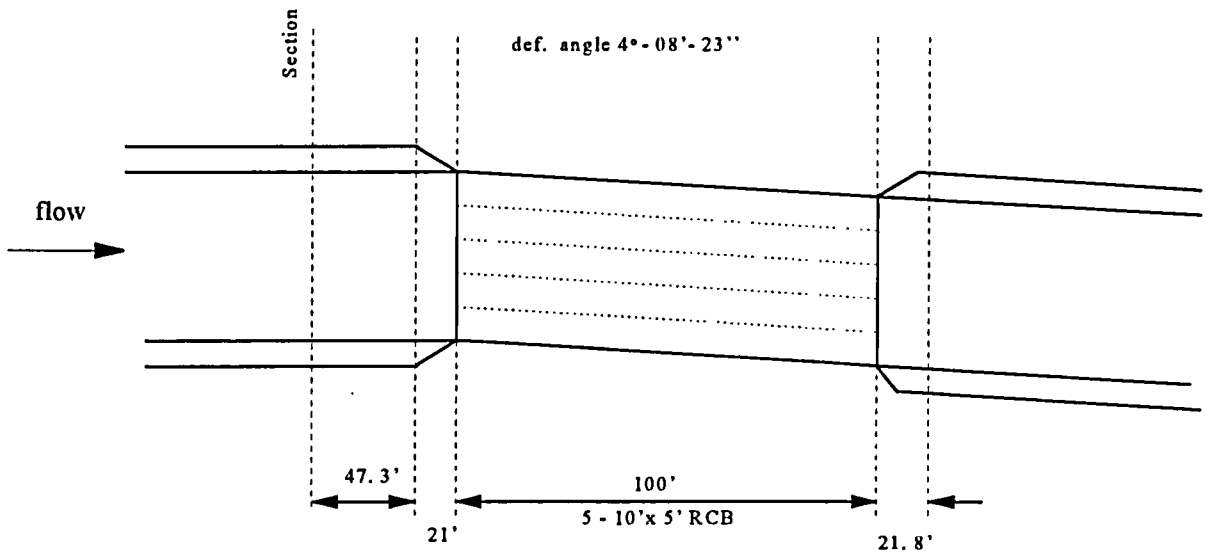


Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).

See: Improvement Plans for Sloan Channel Owens Ave. to Stewart Ave.
Sheet C-8, 8 of 14



Attach plans of the structure(s) certified by a registered Professional Engineer.

Culvert length or bridge width (ft)	**100 ft**
Calculated culvert/bridge area (ft^2) by the hydraulic model, if applicable	**250 SF**
Total culvert/bridge area (ft^2)	**250 SF**

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	55.5	55.5
Downstream face	55.5	55.5

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	55.5	55.5
Downstream face	55.5	55.5

100-year Elevations	Water Surface Elevations	Energy Gradient Elevations
Upstream face	53.59	55.29
Downstream face	51.86	54.35

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	0	3300	0	3300

The maximum depth of flow over the roadway/railroad (ft.) . . . . . _____

Weir length (ft . . . . . _____

Top Widths	Total Floodplain Width	Total Effective Flow Width	Floodway Width
Upstream face			
Downstream face			

Flow contained in 80 ft wide channel
Approximate Methods

3. ANALYSIS (Cont'd)

Loss Coefficients

Entrance loss coefficient	*
Manning's "n" value assigned to the structure(s)	0.015
Friction loss coefficient through structure(s)	0.015
Other loss coefficients (e.g. bend manhole, etc.)	*
Total loss coefficient	1.27
Weir coefficient	3
Pier coefficient	0.9
Contraction loss coefficient	0.2
Expansion loss coefficient	0.4

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?
   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and depth of scour and /or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (Floodway run) N/A

5. FLOODWAY ANALYSIS (Cont'd)

Comments *(explain any unusual situations):*

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE / CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.0 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: **Clark County, Nevada and Incorporated Areas, City of North Las Vegas**

Flooding Source: **Range Wash**

Project Name / Identifier: **Range Wash FIS Restudy**

1. IDENTIFIER

1. Name of roadway, railroad, etc.: **Stewart Avenue**
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): **Channel Station 88+40 to 89+40**
3. This revision reflects *(check one of the following):*

   ☐ New bridge/culvert not modeled in the FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☒ New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed) New design flow based on construction of Range Wash/Sloan Channel Confluence Detention Basin upstream

2. BACKGROUND

Provide the following information about the structure:

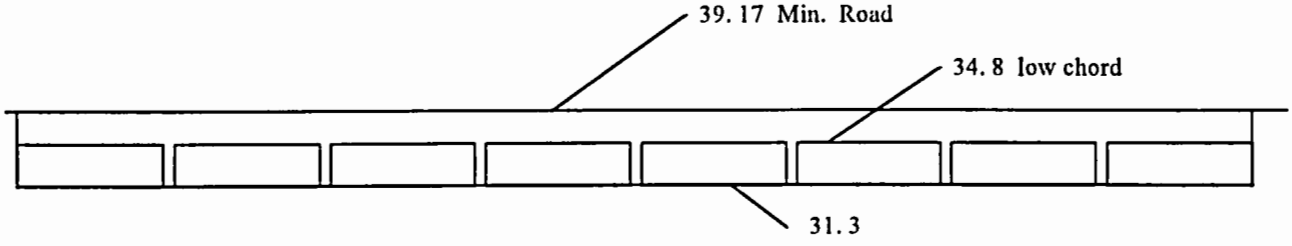
1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of 3-foot diameter circular piers; 40-foot wide ogee shape spillway) **8 - 10' x 3.5' RCBs**
2. Entrance geometry of culvert/type of bridge opening (e.g. 30° - 75° wing walls with square top edge, sloping embankments and vertical abutments) **Channel side walls transition from 2:1 side slope to vertical**
3. Hydraulic model used to analyze the structure *(e.g., HEC-2 with special bridge routine, WSPRO, HY8)* **HEC-2 with special bridge routine**

If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

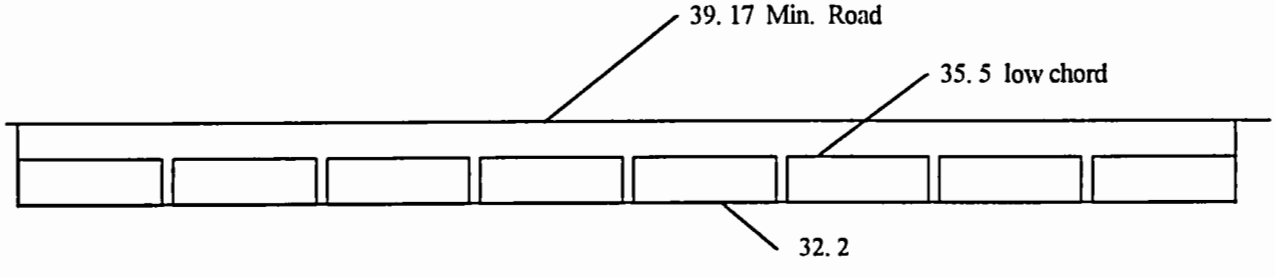
Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A
*** One form per new/revised bridge/culvert**

3. ANALYSIS

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.

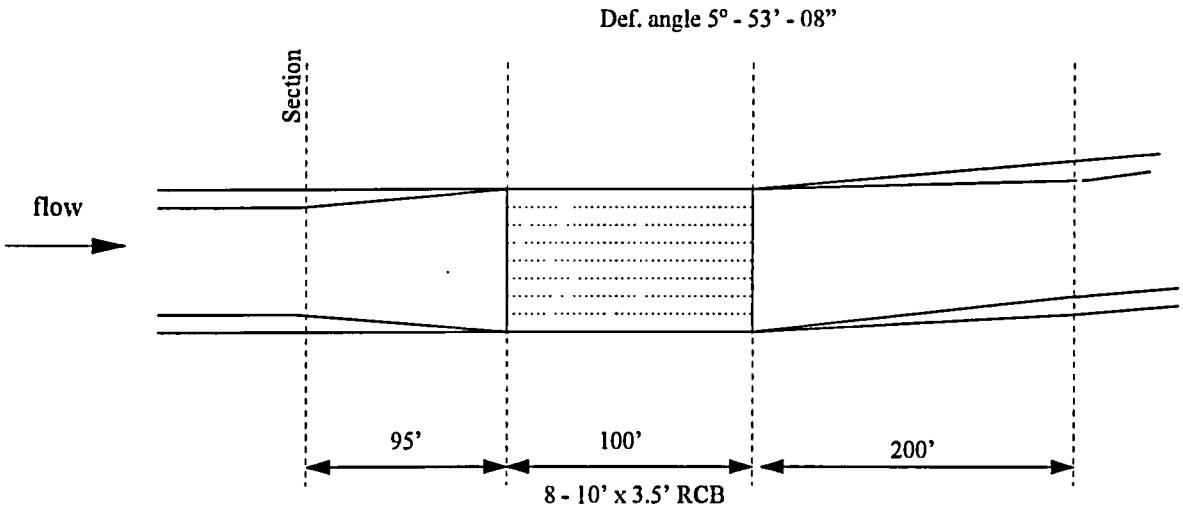


Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s). Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure(s).

See: Improvement Plans for Sloan Channel Owens Ave. to Stewart Ave. Sheet C-10, 10 of 14 & Stewart to Las Vegas Wash Sheet C-4, 4 of 9



Attach plans of the structure(s) certified by a registered Professional Engineer.

Culvert length or bridge width (ft)	**100 ft**
Calculated culvert/bridge area (ft^2) by the hydraulic model, if applicable	**280 SF**
Total culvert/bridge area (ft^2)	**280 SF**

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	39.17	39.17
Downstream face	39.17	39.17

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	39.17	39.17
Downstream face	39.17	39.17

100-year Elevations	Water Surface Elevations	Energy Gradient Elevations
Upstream face	36.72	38.7
Downstream face	35.82	37.8

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure(s) (cfs)	0	3300	0	3300

The maximum depth of flow over the roadway/railroad (ft.) . . . . . _____

Weir length (ft . . . . . _____

Top Widths	Total Floodplain Width	Total Effective Flow Width	Floodway Width
Upstream face			
Downstream face			

Flow contained in 80 ft wide channel
Approximate Methods

3. ANALYSIS (Cont'd)

Loss Coefficients

Entrance loss coefficient	*
Manning's "n" value assigned to the structure(s)	0.015
Friction loss coefficient through structure(s)	0.015
Other loss coefficients (e.g. bend manhole, etc.)	*
Total loss coefficient	1.27
Weir coefficient	3
Pier coefficient	0.9
Contraction loss coefficient	0.3
Expansion loss coefficient	0.5

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? . . . . . ☐ Yes ☒ No

   B. Based on the conditions *(such as geomorphology, vegetative cover and development of watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? . . . . . ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?
   _____ cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and depth of scour and /or deposition _____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert? _____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (Floodway run) N/A

5. FLOODWAY ANALYSIS (Cont'd)

Comments *(explain any unusual situations):*

Attach analysis.

APPENDIX G

OFFICIALLY ADOPTED MAINTENANCE AND OPERATIONS PLAN

The Operations and Maintenance Manual for Clark County Regional Flood Control District Facilities is included in the TSDN Volume 3, Section 5.3.7

A flood control facility maintenance plan and budget is approved each year for regional flood control facilities. Attached, herein, is the work program for fiscal year 1996-1997 for the Range Wash. As indicated, Mr. Gil Suckow of Clark County Public Works is the responsible local community official for the Range Wash Area.

REGIONAL FLOOD CONTROL DISTRICT MAINTENANCE WORK PROGRAM

Entity: Clark County 1996 - 97 **Date Prepared:** February 7, 1996

Facility: CLA05 - Las Vegas Range Wash

Force Account/ Contract	Activity	Approved Work Plan $ Amount	Amended Work Plan $ Amount	Percent Complete	Scheduled Completion Date
	5 Inspect Channels	$3,000			
	10 Clean and Reshape Channels	$20,000			
	15 Repair Lined Channel	$10,000			
	20 Provide/Maintain Erosion Control				
	25 Clean & Inspect Detention Debris Basins	$5,000			
	30 Erosion Repair				
	35 Fence Repair	$3,000			
	40 Vegetation Control - Chemical	$12,000			
	45 Vegetation Control - Mechanical				
	50 Maintain Access Road	$3,000			
	55 Clean & Inspect Inlet/Outlet Structures	$500			
	60 Repair Inlet/Outlet Structures				
	65 Clean Storm Sewer Lines				
	70 Storm Sewer Repair				
	75 Clean/Flush Culverts & Bridges				
	80 Miscellaneous Work Activities	$7,700			
	85 Engineering				
	TOTALS	$64,200			

DELAYS OR PROBLEM AREAS:

WORK TO BE COMPLETED DURING CURRENT QUARTER:

WORK TO BE COMPLETED DURING NEXT QUARTER:

CONSULTANT/CONTRACTOR: _____

PROJECT MANAGER: GIL SUCKOW PHONE NUMBER: 455-8569