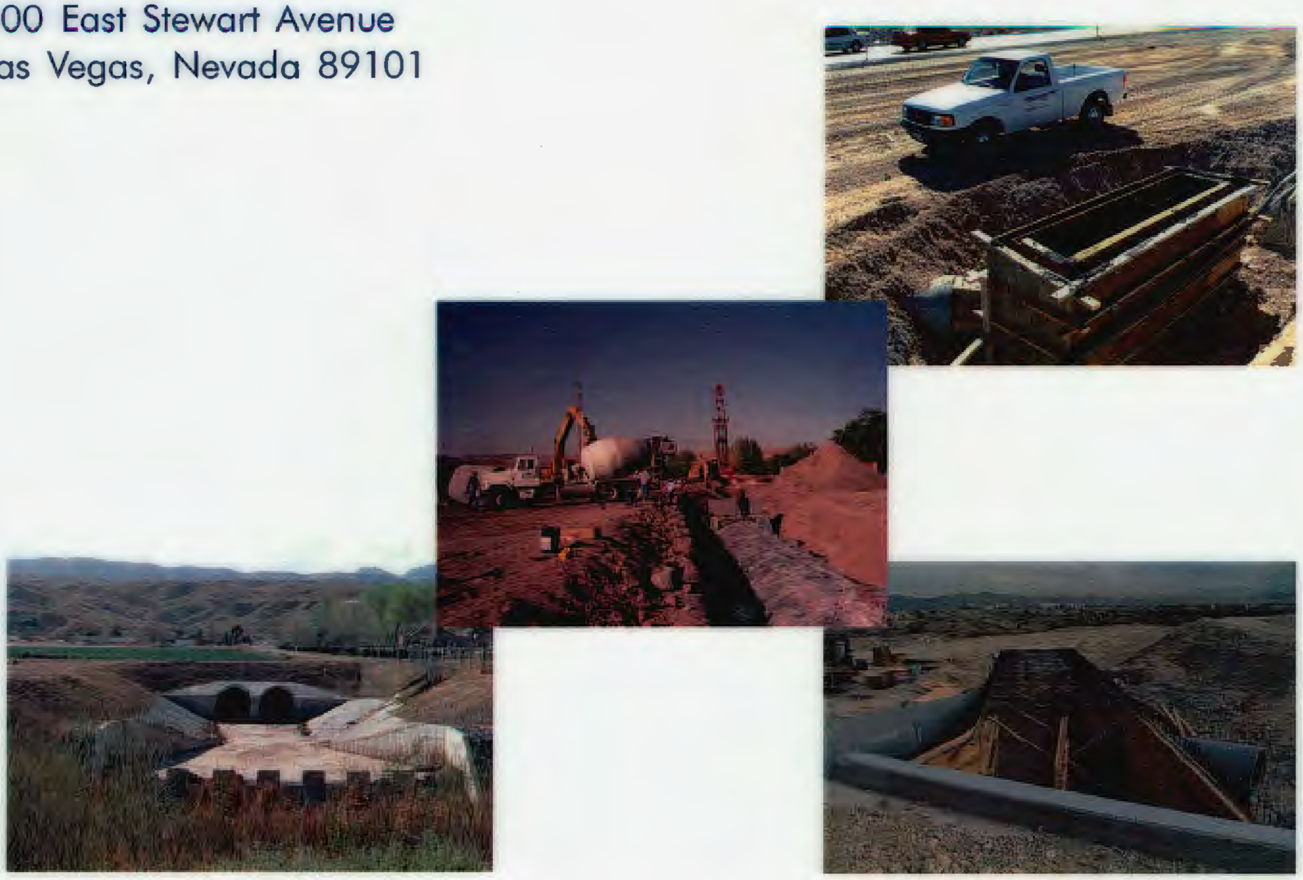
DRAINAGE STUDY FOR

'B' STREET
FROM WASHINGTON AVENUE
TO OWENS AVENUE

Prepared For:

City of Las Vegas
400 East Stewart Avenue
Las Vegas, Nevada 89101



Project No.: 0133.0141

January 2000

PENTACORE
6763 W. Charleston Boulevard
Las Vegas, Nevada 89146

PENTACORE

Civil Engineering
Surveying • GPS
Land Planning • GIS
Landscape Architecture
Environmental and Natural Resources Management
Construction Administration
Program Management
ADA Consulting
Measurement Technologies
Water Ventures International

0133.0141

January 12, 2000

City of Las Vegas
Department of Public Works
731 South Fourth Street
Las Vegas, Nevada 89101

Attn: **Mr. Joe Christensen, P.E.**

Subject: **Technical Drainage Study for B Street**

Dear Mr. Christensen:

Please find enclosed two (2) copies of the above subject report for your review and approval. This submittal utilizes the excepted hydrology findings presented in the "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue," submitted to the City of Las Vegas on October 5, 1999. This submittal addresses the comments of Randy Fultz in the memorandum dated October 18, 1999. In addition, this submittal also includes Randy Fultz comments during our progress meeting at the City of Las Vegas on January 4, 2000. Included with this submittal is a revised cost estimate for the 10-year and 100-year events.

If you have questions please do not hesitate to call me or Myron Welsh at (702) 258-0115.

Sincerely,
PENTACORE ENGINEERING, INCORPORATED

Joe Alvin Haun, EI, MS	Benjamin Torella, PE	Myron Welsh, PE
Hydrologist	Project Engineer	Project Manager

cc: Randy Fultz, P.E.

355 East 50 South • American Fork, UT 84003 • Telephone 801.763.5893 • Fax 801.763.5856

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: **B Street from Washington Avenue to Owens Avenue** Date: **Jan. 12, 2000**

Location of Development: a) Descriptive **B Street from Washington Avenue to Owens Avenue**
b) Sect. **27 and 28** Twn. **20S** Rng. **61E**

Name of Owner: **City of Las Vegas** Assessors Parcel No: **139-27-210-001; 111-001**
139-27-310-001; 211-001
139-28-701-031; 702-001 to 003

Contact Person- Name: **Myron Welsh, P.E.** Telephone No: **(702) 258-0115**
Firm: **Pentacore Engineering, Inc.**
Address: **6763 West Charleston Boulevard, Las Vegas, NV 89146**

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 ± Acres** Being Developed/Disturbed: **12 ± Acres**
2. Is a Portion or all of the subject property in a designated FEMA Flood Hazard Area? (YES*) NO
3. Is the Property bordered or crossed by an existing of proposed Clark County Regional Flood Control District Master Planned Facility? (YES*) NO
4. Proposed type of development (Residential, Commercial, Etc.)? **Public Works**
5. Approximate upstream land area which drains to the subject site? **1.52 ± square miles**
6. Has the site drainage been evaluated in the past? (YES) NO If Yes, please identify documentation: **"City of Las Vegas - Flood Control Facilities Inventory and City Wide Hydrology Analysis" dated December 1997 by PBS&J; "City of Las Vegas - Neighborhood Flood Control for the Lake Mead/Rancho/U.S. 95/Oran K. Gragson Area" by Montgomery Watson**
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: **Into the existing 7-ft by 5-ft. open channel situated north of Owens Avenue & west of I-15**
8. Briefly describe your proposed schedule for the subject project: **Within 6 Months**

REGISTERED PROFESSIONAL ENGINEER STATE OF NEVADA
MYRON R. WELSH
CIVIL
No. 2646

1/19/00

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

Local Entity file No.

revision	date

REFERENCE:

STANDARD FORM 1

TABLE OF CONTENTS

1.0 GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Introduction 1
1.2 Scope 1
1.3 Location 2
1.4 Overall Description of Project 2

2.0 DRAINAGE BASIN DESCRIPTION

2.1 General Drainage Description 4
2.2 Existing Drainage Description 5
2.3 Proposed Drainage Description 14
2.4 Previous Drainage Studies 14

3.0 PROPOSED DRAINAGE FACILITIES

3.1 General Drainage Description 16
3.2 Facility Design Calculations 17

4.0 CONCLUSIONS AND RECOMMENDATION 19

5.0 REFERENCES 20

6.0 APPENDICES

- Hydrology
- Hydraulic Calculations
- Reference Material

LIST OF FIGURES AND TABLES

Figures		**Page**
Figure 1	Vicinity Map	3
Figure 2	Washington Avenue and B Street Drainage Map	Pocket A
Figure 3	B Street Drainage Map	Pocket B

Tables		**Page**
Table 1	B Street Flow	12
Table 2	Existing Flow Condition Summary	13
Table 3	Proposed Design Facility Summary	17

1.0 GENERAL LOCATION AND DEVELOPMENT DESCRIPTION

1.1 Introduction

This report presents the hydrologic and hydraulic parameters for the improvements associated with the construction of the reinforced concrete box culvert proposed along B Street from Washington Avenue to Owens Avenue and west of I-15. This report presents information supplementary to the "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue" by Pentacore Engineering, Inc., which was submitted to the City of Las Vegas on October 5, 1999 and resubmitted on January 13, 2000. Due to interconnecting designs between the two reports, the City of Las Vegas shall review the "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue" concurrently with this study. This report also utilizes information from two previous reports; the approved "Drainage Study for Washington Avenue" (reviewed by the City of Las Vegas in October 1997); and the "City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis." The existing condition concept utilized for this submittal applies the "Ultimate" drainage conditions as defined by the "Drainage Study for Washington Avenue." The "Ultimate" drainage condition refers to that drainage condition resulting from future drainage facilities constructed downstream and upstream of the project. The tributary watershed boundary for this submittal reflects the compilation of the tributary areas of the above-referenced studies.

1.2 Scope

The purpose of this report is to present a detailed study for the improvements associated with the construction of the reinforced concrete box culvert proposed along B Street from Washington Avenue to Owens Avenue and west of I-15. The "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue" requires sizes varying from

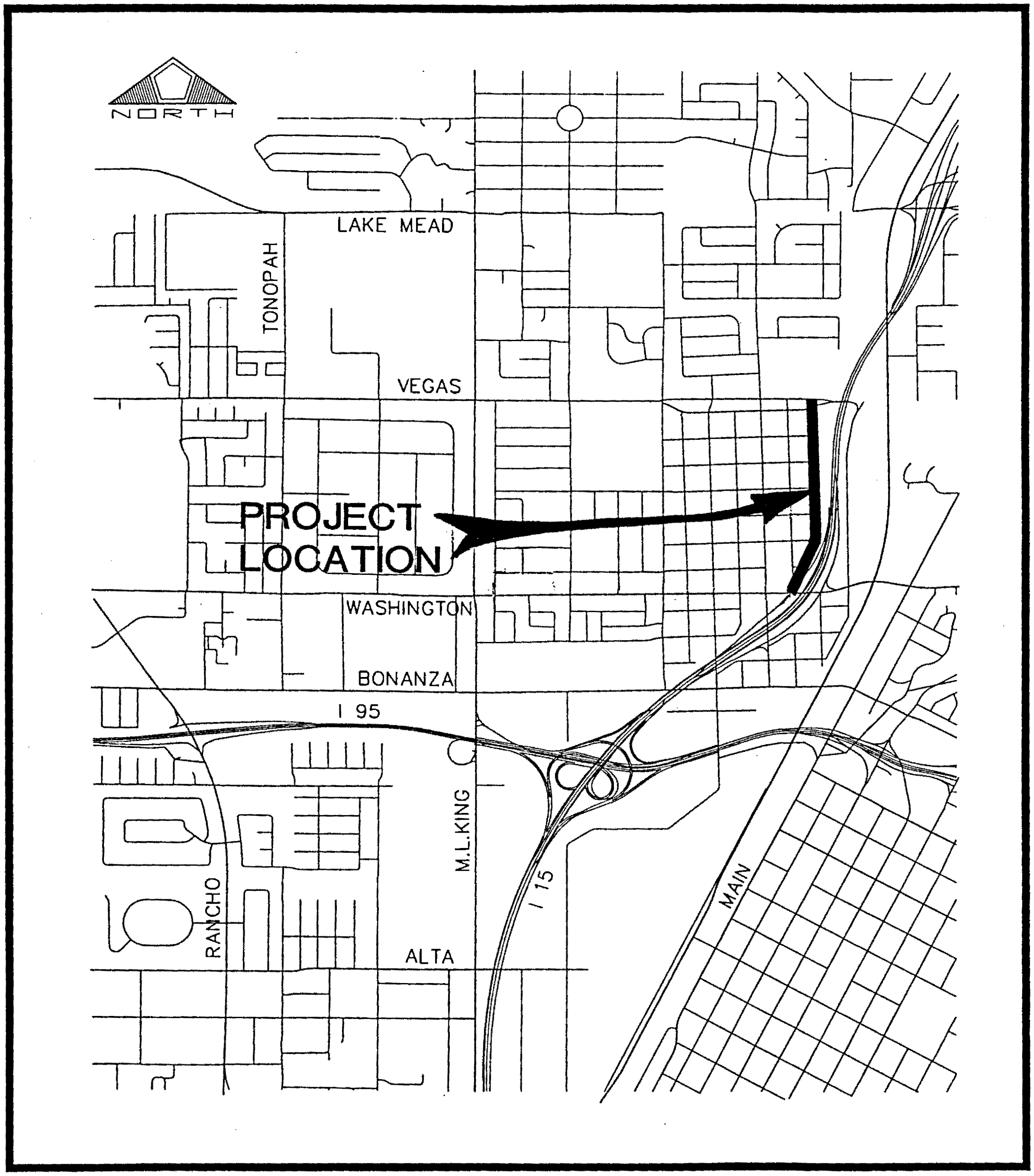
11ft x 6ft to 14ft x 6ft reinforced concrete box (RCB) from Washington Avenue north to Owens Avenue with no additional inflow. This study will add additional flow to the storm drain at several streets from Adams Avenue north to Harrison Avenue along B Street. This submittal also addresses the comments from the City of Las Vegas's memorandum dated October 18, 1999 included in the Appendix of this submittal. This study presents the hydrologic and hydraulic determinations for the design of flood control facilities associated with the construction of the B Street RCB alignment. This report presents the hydraulic details as a result of the expanded design concept for the Washington Avenue project. The criteria set forth in the Clark County Regional Flood Control District "Hydrologic Criteria and Drainage Design Manual" hereafter referred to as the "Drainage Criteria Manual" has been used as the technical basis for this study.

1.3 Location

This report only addresses the improvements associated with the construction of the reinforced concrete box culvert proposed along B Street from Washington Avenue to Owens Avenue and west of I-15. The limits of this project are found within portions of Section 27 and Section 28, Township 20 South, Range 61 East, M.D.M. (see *Vicinity Map*, Figure 1).

1.4 Overall Description of Project

Overall, the project includes Washington Avenue full street improvements along with the B Street improvements associated with the Washington Avenue design facilities. This submittal addresses the design for improvements along B Street. The hydrology and hydraulic calculations found in this report only address the inflow into the storm drain from Washington Avenue to Owens Avenue. The upstream flow in the storm drain at Washington Avenue and D Street has been determined in the "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue"



PENTACORE Civil Engineering • Construction Management Land Surveying • Planning • ADA Consulting	VICINITY MAP B Street from Washington Avenue to Owens Avenue	FIGURE 1 Job #: 0133.0141

by Pentacore Engineering, Inc. Ultimately, the proposed RCB to Owens Avenue will adjoin a future drainage facility currently under design by Kimley-Horn & Associates. The proposed design facilities will result in the collection of significant storm water flows impacting the existing B Street alignment. Proposed improvements for B Street will included modification and/or repair to curb, gutter, sidewalk, drop inlets, laterals, and the extension of the proposed RCB.

2.0 DRAINAGE DESCRIPTION

2.1 General Drainage Description

The hydrology for B Street is based on site visits and information from the previously reviewed studies referenced in section 1.1. This study utilizes this accepted hydrology for the design factors associated with the B Street improvements.

This report presents the existing condition as that which results from application of the "Ultimate" flow condition to the current drainage characteristics. The "Ultimate" flow condition is that which would result from the construction of future drainage facilities downstream and upstream of the project. This report looks at the excess flows to the existing facilities at B Street. The design concept anticipates the collection of the "Ultimate" 100-year storm flow event by the proposed drainage facilities.

The improvements associated with Washington Avenue proposes the construction of an 7ft x 6ft to 14ft x 6ft RCB extending east from just west of Washington Avenue to C Street and transitioning north along B Street from Washington Avenue to Owens Avenue. The RCB will route the overall storm water flow contribution from Washington Avenue, McWilliams Avenue, and B Street to the existing NDOT RCB situated north of Owens Avenue and west of I-15. An analysis for the overall area is included in the Appendix.

The storm water flow quantities used in this report are the result of a combination of HEC-1 models of the aforementioned referenced studies. The HEC-1 analysis for the overall area reveals a combined 100-year flow contribution of approximately 1,331cfs from the Washington Avenue, McWilliams Avenue, and B Street watersheds. It is anticipated that approximately 1,124cfs will route through the proposed RCB and discharge into the NDOT facility on the north side of Owens Avenue. During the "Ultimate" 100-year storm event, the hydrology for Washington Avenue at C Street will result in a flow contribution of approximately 777cfs. An additional "Ultimate" flow contribution of approximately 189cfs is anticipated from the watershed area associated with the drainage for McWilliams Avenue and 374cfs from the watershed area associated with the drainage for B Street. The overall tributary watershed area is delineated on Figure 2, the *Washington Avenue and B Street Drainage Map.*

2.2 Existing Drainage Condition

The interception of storm water flows by existing facilities along B Street and McWilliams Avenue have been analyzed. A review of the MPU drainage basins and site visits reveal that the tributary area for B Street and McWilliams Avenue, which were not considered in the previous analysis of Washington Avenue. B Street's tributary includes an area north of Washington Avenue that is bounded north from approximately 900 feet south of Owens Avenue at Tonopah Drive, and from approximately 500 feet south of Owens Avenue at Martin Luther King Boulevard, and from that area tributary to Harrison Avenue to I-15. McWilliams Avenue's tributary includes an area south of Washington Avenue that is bounded south from just north of Bonanza Avenue at approximately 650-feet west of Tonopah Drive to I-15. A delineation of the tributary watershed boundary tributary to McWilliams Avenue and B Street is presented on Figure 3, the *B Street Drainage Map.*

This report provides an analysis of the existing inlet system along B Street and the intersection of McWilliams Avenue and E Street. The proposed storm drain system will intercept excess flows from the intersection of McWilliams Avenue and E Street, and the all of the flows from Adams Avenue, Jefferson Avenue, Madison Avenue, Monroe Avenue, Jackson Avenue, Van Buren Avenue, and Harrison Avenue. Storm water runoff impacting this system is routed to the existing drainage facilities within the NDOT right-of-way from McWilliams Avenue at E Street to James Gay Park (B Street Park) at Owens Avenue to the existing open channel situated north of Owens Avenue and west of I-15. The method of analysis for the particular area utilizes the idea that storm water flow conveyance impacts each existing drainage facility sequentially as flow conveyance continues downstream. This method of analysis results in the introduction of a factor of safety for future design facilities complimenting the existing facilities. The analysis for this system reveals an actual discharge amount of 214cfs from the NDOT facility to the existing open channel north of Owens Avenue. However, a full flow capacity of 367cfs is anticipated for this drainage system within the NDOT right-of-way. Hydraulic calculations for the existing drainage facilities are included in the Appendix.

The overall tributary area to this existing NDOT facility may be described as three distinct watersheds. The watershed areas are summarized as follows:

Watershed #1.

This watershed includes the area tributary to McWilliams Avenue and Adams Avenue. The watershed includes drainage basins WA17B, WA20, WA21A, WA21B AND WA19C. The McWilliams Avenue tributary area consists of all of the drainage basins with the exception of 80% of basin WA19C. The area includes the area generally south of Morgan Avenue, north of Bonanza, and from approximately 650-feet west of Tonopah Drive to the intersection of E Street and McWilliams Avenue. The area is generally developed with residential and commercial properties, and slopes at approximately 0.5 to 1 percent.

The area tributary to Adams Avenue includes only the area east of D Street which is about 80% of the drainage basin WA19C. The area is generally residential properties, slopes at approximately 2.5%, and is small in comparison to the area tributary to McWilliams Avenue.

An existing 42-foot drop inlet with curb opening is situated at the intersection of McWilliams Avenue and E Street. Storm water flowing to the 42-foot inlet is expected to weir over to an existing 11-foot and 5-inch by 19-foot concrete apron with a 3-foot and 5-inch by 5-foot grate opening situated atop the existing drainage pipe at the NDOT right-of-way. The storm flow analysis for the McWilliams Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 189cfs at the intersection of McWilliams Avenue and E Street. The curb opening drop inlet is expected to intercept approximately 53cfs and approximately 36cfs is expected to weir over the existing curb and drop inlet to the existing concrete apron and grate opening where approximately 2cfs is intercepted and routed through the existing NDOT facility. This results in approximately 89cfs exiting the street section at the intersection of McWilliams Avenue and E Street; the NDOT facilities capture 55cfs (of the 89cfs) and route this runoff to the existing open channel at Owens Avenue. The remanding 100-cfs turns north on E-Street and travels north to Washington Avenue. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

Storm water runoff to Adams Avenue is subject to an existing 11-foot 5-inch by 19-foot concrete apron with a 3-foot 5-inch by 5-foot grate opening situated within the NDOT right-of-way. The storm flow analysis for the Adams Avenue area applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 13cfs at Adams Avenue. However, only 6-cfs is intercepted and routed to the existing open channel at Owens Avenue, the remainder of the

13cfs is expected to pond at the particular location. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

Watershed #2.

The area between Monroe Avenue and Adams Avenue is another distinct watershed. Storm water runoff analysis for this area provides flow values for Jefferson Avenue, Madison Avenue, and a small portion of the B Street park area. The area tributary to Jefferson Avenue includes the area north of the area tributary to Adams Avenue from east of H Street to the I-15 (about 51% of drainage basin VG09), is generally residential, slopes at approximately 2.5%, and is small in comparison to the area tributary to Madison Avenue. The area tributary to Madison Avenue includes the area generally south of Monroe Avenue, north of the area tributary to Jefferson Avenue, east of Tonopah Drive and west of I-15 (about 87% of the combined flows from drainage basins VG07A, VG08 and VG09). This area is generally developed residential and commercial, and slopes at approximately 0.5 to 1.5 – percent.

Storm water runoff to Jefferson Avenue is subject to an existing 11-foot 5-inch by 19-foot concrete apron with a 3-foot 5-inch by 5-foot grate opening situated at the NDOT right-of-way. The storm flow analysis for the Jefferson Avenue area applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 31cfs at Jefferson Avenue. However, only 10cfs (of the 31cfs) is intercepted and routed to the existing open channel at Owens Avenue. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

Madison Avenue is situated west and perpendicular to B Street. Storm water flow from Madison Avenue is subject to an existing 42-foot drop inlet with curb opening at B Street. Storm water flow to the 42-foot inlet is expected to weir over into the B Street Park area where it continues east. The storm flow analysis for the Madison Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 209cfs at Madison Avenue and B Street. Based on the existing drainage condition approximately 88cfs is expected to exit the street section at Madison Avenue and B Street. Approximately 53cfs will be intercepted at the curb opening drop inlet and routed to the existing open channel north of Owens Avenue. Approximately 35cfs is expected to weir over the existing curb and drop inlet to the B Street Park area. The weir flow is expected to continue east and north to the existing grate openings situated atop the existing NDOT drainage facilities at the eastern edge of the B Street Park area. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

Watershed #3.

The area south of the area tributary to Harrison Avenue is another distinct watershed. Storm water runoff analysis for this area provides flow values for Monroe Avenue, Jackson Avenue, Van Buren Avenue, Harrison Avenue, and a small portion of the B Street Park area. The watershed includes drainage basins VG10, VG11 and VG12.

The area tributary to Monroe Avenue includes the area south of the area tributary to Jackson Avenue, north of the area tributary to Madison Avenue, and approximately 950-feet west of J Street to B Street (about 77% of the combined flows from drainage basins VG10 and VG11). This area is generally residential and commercial properties, and slopes at approximately 1-percent. Monroe Avenue is situated west and perpendicular to B Street. Storm water flow from Monroe Avenue is subject to two existing circular open grates with approximate diameters of 18-inches at the intersection and an existing 42-foot drop inlet with curb opening along the east side of B Street. The storm flow analysis for the Monroe Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 75cfs at Monroe Avenue and B Street. Based on the existing drainage condition for this area approximately 12-cfs of the 75cfs is intercepted at the two existing circular open grates before reaching the 42-foot curb opening drop inlet where 28cfs is intercepted. This results in approximately 40cfs routing to the existing open channel at Owens Avenue. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

The area tributary to Jackson Avenue includes the area generally south of the area tributary to Van Buren Avenue, north of the area tributary to Monroe Avenue, east of H Street and west of B Street (about 45% of drainage basin VG11). This area is generally developed residential and commercial, and slopes at approximately 1.5 – percent. Jackson Avenue is also situated west and perpendicular to B Street. Storm water flow from Jackson Avenue is subject to an existing 42-foot drop inlet with curb opening at the east side of B Street. The storm flow analysis for Jackson Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 26cfs at Jackson Avenue and B Street. Based on the existing drainage condition for this area approximately 18cfs of the 26cfs is intercepted at the existing 42-foot drop inlet and routed to the existing open channel at Owens Avenue. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

The area tributary to Van Buren Avenue includes the area generally south of the area tributary to Harrison Avenue, north of the area tributary to Jackson Avenue, east of H Street and west of B Street (about 71% of drainage basin VG12). This area is generally developed residential and commercial propoerties, and slopes at approximately 2 – percent. Van Buren Avenue is also situated west and perpendicular to B Street. Storm water flow from Van Buren Avenue is subject to an existing 42-foot drop inlet with curb opening at the east side of B Street. The storm flow analysis for Van Buren Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 31cfs at Van Buren Avenue and B Street. This storm water runoff value is before consumptive use factors are considered. Based on the existing drainage condition for this area approximately 19cfs is intercepted at the existing 42-foot drop inlet and routed to the existing open channel at Owens Avenue. Storm water runoff exceeding the capacity of the existing facilities at Van Buren is expected to pond at the street section of Van Buren Avenue and B Street per the existing condition. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

The area tributary to Harrison Avenue includes the area generally south of the area tributary to Owens Avenue, north of the area tributary to Van Buren Avenue, east of H Street and west of B Street (about 14% of drainage basin VG12). This area is generally developed residential and commercial, and slopes at approximately 2.5 – percent. Harrison Avenue is situated west B Street and south of Owens Avenue. Storm water flow from Harrison Avenue is subject to an existing 21-foot drop inlet with curb opening at the Harrison Avenue and B Street northeast corner. The storm flow analysis for Harrison Avenue applies the anticipated major storm water runoff resulting in the occurrence of the ultimate design flow of 7cfs at Harrison Avenue and B Street. The existing 21-foot drop inlet will intercept approximately 5cfs and route it to the existing open channel at Owens Avenue. Storm water runoff exceeding the capacity of the existing facility is expected to pond in the street at Harrison Avenue and B Street. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix.

The B Street Park (James Gay Park) area is approximately 5 acres and slopes at approximately 0.46 to 1-percent. This area is expected to contribute approximately 7cfs to the total storm water flows for the overall drainage area. There are five grate openings along the east edge of the park area. Four of the grates are 2-foot by 3-foot 5-inch grate openings aligned with Madison, Monroe, Jackson, and Van Buren. A 7-foot wide by 7-foot 2-inch long by 10-inch deep modified drop inlet with a 2-foot by 6-foot 2-inch opening with grate and 1-foot headwall is situated on a concrete apron at the very northeast edge of the B Street park area. The concrete apron has 11% side-slopes. The total expected flow in the B Street Park area is approximately 42cfs with the 35cfs weir flow from Madison Avenue. The various existing inlet openings atop the NDOT drainage pipes at the eastern edge of the park are expected to intercept approximately 37cfs. This flow is routed to the existing open channel at Owens Avenue. An analysis of the existing condition for this area based on the application of the "Ultimate" flow is included in the Appendix of this submittal.

A summary of the existing drainage watersheds and street flows is shown in Table 1, *Street Flow*. A summary of the existing drainage condition based on the "Ultimate" design conditions is presented in Table 2, the *Existing Flow Condition Summary.*

Table 1. B Street Flow

WATERSHED								
Reference Basin	Total Basin Area (mi^2)	Adams	Jefferson	Madison	Monroe	Jackson	Van Buren	Harrison
WA19C	0.01707	0.0086						
VG07A	0.1376			0.1376				
VG08	0.0608			0.0608				
VG09	0.584		0.0299	0.0274				
VG10	0.0930				0.0930			
VG11	0.660				0.0300	0.0300		
VG12	0.510						0.0362	0.0069
TOTAL TRIBUTARY AREA (mi^2)		0.0086	0.0299	0.2258	0.1230	0.0300	0.0362	0.0069
OVERALL WATERSHED		WA19C	VG09	VG09C	VG11C	VG11	VG12	VG12
TOTAL WATERSHED AREA (mi^2)		0.0107	0.0584	0.2600	0.1600	0.0660	0.0510	0.0510
RATIO (street/overall watershed)		80%	51%	87%	77%	45%	71%	14%

FLOW ON THE STREET							
Related Basin	WA19C	VG09	VG09C	VG11C	VG11	VG12	VG12
Total Q_{10}	7	22	93	36	20	17	17
Street Q_{10}	6	12	32	28	10	13	3
Total Q_{100}	16	60	240	97	57	46	46
Street Q_{100}	13	31	209	75	26	33	7
Street Name	Adams	Jefferson	Madison	Monroe	Jackson	Van Buren	Harrison

Table 2. Existing Flow Condition Summary

Location	Basin Flow from "Ultimate" HEC-1 Output (cfs)	Total Flow Intercepted and Routed via Existing Facilities (cfs)	Total Weir Flow Exiting Street Section (cfs)	Flow Retained @ Facility (cfs)	Anticipated Flow Leaving Street Section (cfs)
McWilliams Ave	189	55	36	34	89
	42' curb opening drop inlet and 11'5" x 19'0" concrete apron with 3'5" x 5'0" grate opening at NDOT right-of-way.				
Adams Ave	13	6	0	7	13
	11'5" x 19'0" concrete apron with 3'5" x 5'0" grate opening at NDOT right-of-way.				
Jefferson Ave	31	10	0	21	31
	11'5" x 19'0" concrete apron with 3'5" x 5'0" grate opening at NDOT right-of-way.				
Madison Ave	209	53	35	0	88
	42' curb opening drop inlet @ B Street				
Monroe Ave	75	40	0	0	40
	Two-circular grate opening with approximately 18" diameters, and a 42' curb opening drop inlet @ B Street.				
Jackson Ave	26	18	0	0	18
	42' curb opening drop inlet @ B Street				
Van Buren Ave	33	19	0	0	19
	42' curb opening drop inlet @ B Street				
Harrison Ave	7	5	0	0	5
	21' curb opening drop inlet @ B Street				
B Street Park Area	7	37	0	5	7
	Four 2'0" x 3'5" grate opening at far east edge of park (one each aligned with Madison Avenue, Jackson Avenue and Van Buren) and a 7'0"W x 7'2"L x 0'10"D modified drop inlet with 2'0"W x 6'2"L grate opening and headwall at far.				
Total	590	244	71	66	310

2.3 Proposed Drainage Description

The drainage basin generated runoff associated with the design of B Street is based on the hydrologic analysis from two previous studies. The "City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis" by PBS&J, dated December 1997, established the ultimate drainage basins within the vicinity of Washington Ave. The "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue," by Pentacore Engineering, Inc., dated October 5, 1999, currently under review by the City of Las Vegas, established the storm drain capacity in

Washington Avenue. These studies established the tributary watershed for Washington Avenue as extending west to east from Buffalo Drive to I-15, and south to north from U.S. 95 to Vegas Drive.

The existing condition is that which results from current drainage characteristics and the ultimate condition is that which would result from the future drainage facilities constructed downstream and upstream of the project.

The design concept for this report's purpose assumes the following:

1. The "Ultimate" flow condition,
2. The operation of the inlets west of Martin Luther King are designed to collect the "Ultimate" 10-year flow,
3. The operation of the inlets east of Martin Luther King to D Street are designed to collect the "Ultimate" 100-year flow, and
4. Future drainage facilities have been constructed downstream and upstream of the Washington Avenue project limits.

2.4 Previous Drainage Studies

The storm flow analysis for this report utilizes the information from three studies:

1. The "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue,"
2. The "Drainage Study for Washington Avenue" and
3. The "City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis."

The storm flow analysis is referenced and included in the Appendix.

The "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue" updates the "Drainage Study for Washington Avenue," provided by Pentacore and reviewed by the City of Las Vegas initially in June 1997 and again in September 1997. The "City of Las

Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis" (City Wide Study) was also utilized. The City Wide Study was conducted by PBS&J and includes drainage concepts utilized by the initial drainage study for Washington Avenue. The City Wide Study also incorporates information from the "Clark County Regional Flood Control District, The Master Plan Update of the Las Vegas Valley." This report concurs with the hydrology of the above-mentioned studies.

3.0 PROPOSED DRAINAGE FACILITIES

3.1 General Drainage Description

This submittal addresses the design for improvements at B Street associated with the improvements from Washington Avenue. An extensive storm drain system will be constructed to enhance the drainage capacity of the overall area. The drainage system has been designed to convey storm water flow resulting from the major storm event to ensure positive drainage.

Drop inlets will be provided on B Street to accommodate the excess flows to the existing NDOT facilities. The proposed design will result in the collection of significant storm water flows impacting the existing B Street alignments. Proposed improvements for B Street will included modification and/or repair to curb, gutter, sidewalk, drop inlets, laterals, and the extension of the 11ft x 6ft to 14ft x 6ft RCB. Due to constructability, the four 42ft long drop inlets on the east side of B Street will be removed and replaced with two 4ft drop inlets. The RCB will outlet to a temporary junction structure that will transition to the existing 7ft x 5ft open channel north of Owens Avenue. The proposed grading for this project will result in positive drainage.

The box will collect approximately 776cfs from the improvements associated with Washington Avenue and approximately 349cfs from the improvements associated with B Street. It should be noted that until the box west of Martin

Luther King Boulevard is installed the anticipated flow to the 7ft x 5ft open channel would be approximately 669cfs. This storm flow amount results from the interception of approximately 226cfs at the drop inlets situated just west of Martin Luther King Boulevard, approximately 94cfs at the drop inlets situated from Martin Luther King to D Street, and approximately 349cfs from the above-mentioned improvements.

3.2 Facility Design Calculations

Hydraulic calculations for the typical drainage sections are based on Manning's Equation. The drop inlet designs are based on the methods of the Federal Highway Administration, Hydrologic Engineering Circular (HEC) Numbers 12 and 22, and from the FlowMaster® version 6.0 computer software purchased from Haestad Methods, Incorporated, which is also based on the same documents. The computer software, Water Surface Pressure Gradient (W.S.P.G.) version 12.9 purchased from CIVILDESIGN, Incorporated, was utilized for the hydraulic modeling of proposed RCB. The computational procedure of this program is based on two principles. The Bernoulli's equation for the total energy at each section and the Manning's formula for friction loss between the sections in a reach. A hydraulic analysis was conducted for the entire system and is presented in the Appendix. The results of this analysis reveal the proposed RCB as adequate for conveyance of the 1,124-cfs design flow. The hydraulic grade line (HGL) is maintained within the RCB at all locations. The HGL for the drainage facility is included on the RCB profile (See Storm Drain Plan & Profile Sheets, U-1 through U-8).

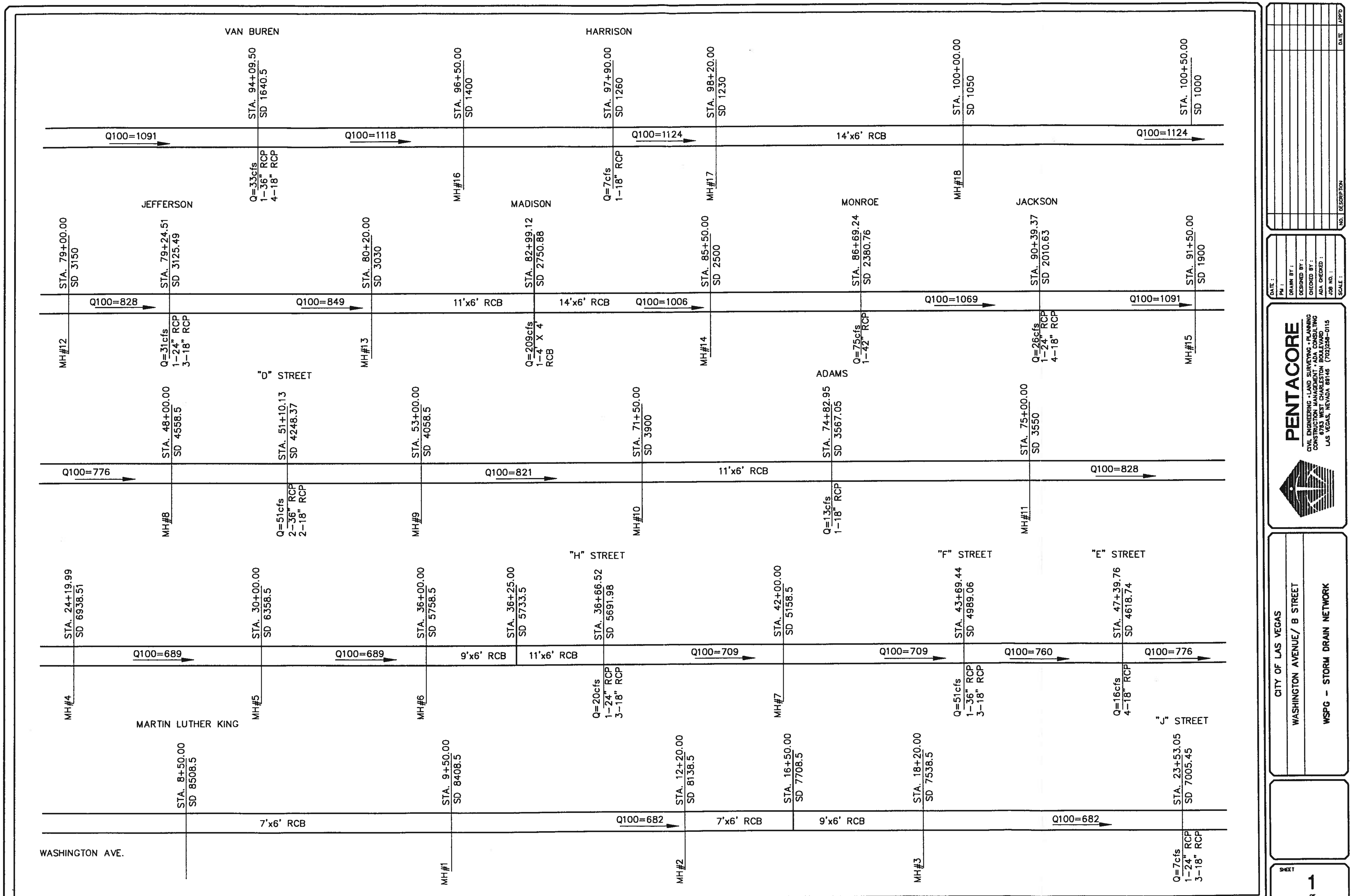
The hydraulic calculations for the proposed drainage facilities are included in the Appendix of this submittal. The drainage facilities proposed with this submittal are shown in Table 3, *Proposed Design Facility Summary.*

Table 2. Proposed Design Facility Summary.

EXISTING FLOW INTERCEPTED				
Location	Depth of Flow (ft)	Street Slope (%)	Basin flow from HEC-1 Model (cfs)	Current Anticipated Flow Intercepted @ Existing Facilities (cfs)
McWilliams Ave	1.10	0.69	189	53
Adams Ave	0.37	2.50	13	6
Jefferson Ave	0.49	2.45	31	10
Madison Ave	1.07	1.00	209	53
Monroe Ave	0.71	1.08	75	40
Jackson Ave	0.50	1.54	26	18
Van Buren Ave	0.51	1.92	33	19
Harrison Ave	0.33	2.50	7	5
B Street Park Area	0.35	N/A	7	7
Total			590	211

TOTAL CAPACITY OF PROPOSED DESIGN					
	SUMP CONDITION		AT GRADE CONDITION		Total Capacity of Proposed Design (cfs)
	Proposed Design Facility	Capacity @ Proposed Design Facility (cfs)	Proposed Design Facility	Capacity @ Proposed Design Facility (cfs)	
McWilliams Ave	Existing – One-42 foot drop inlet with curb opening and 16ft x ft grate opening	N/A		N/A	N/A
Adams Ave			Two-10 foot drop inlets with curb opening & grate	6.74	7
Jefferson Ave			Two-12.5 foot and two-10 foot drop inlets with curb opening & grate	23.86	24
Madison Ave			Two-22.5 foot drop inlets with curb opening & grate and 51 foot long trench drain also used for draining B Street	209.00	209
Monroe Ave			Two-17.5 foot drop inlet with curb opening & grate and 51 foot long trench drain also used for draining B Street	75.00	75
Jackson Ave			Two-12.5 foot and two 10 foot drop inlets with curb opening & grate	19.94	20
Van Buren Ave			Two-12.5 foot and two-10 foot drop inlets with curb opening & grate	25.40	25
Harrison Ave			Existing 21 foot drop inlet with curb opening & grate	N/A	N/A
B Street			Four-4 foot drop inlets with curb opening & grate and a portion of the two trench drains	27.14	27
B Street Park Area			N/A-Existing 7'0"x7'2" modified drop inlet with 2'0"x6'2" opening and grate	N/A	N/A
Total		N/A		527	527

G:\0133\0140\New dwgs\EXHIBITS\Existing\ultimate.dwg Wed Jan 12 16:13:46 2000



4.0 CONCLUSIONS AND RECOMMENDATIONS

1. The off-site and onsite 100-year flow can be safely conveyed through and around the site.

2. The computer program W.S.P.G. version 12.9 was used for the analysis of the proposed RCB. Hydrology was based on the HEC-1 computer model of the previously reviewed study and on generally accepted engineering practices in accordance with the Drainage Criteria Manual.

3. The study shows that development of the site along with the proposed drainage improvements, diminishes runoff to downstream properties.

4. The overall drainage concept for this site concurs with the drainage concept of the studies referenced in the Appendix.

5. Storm drain facilities and inlets west of B Street will be constructed for the purpose of major flow conveyance. Eventually the proposed RCB will join the drainage facility along Owens Avenue currently under design by Kimley-Horn & Associates. Until the Kimley-Horn facility is constructed, drop inlets and storm drain pipe will collect and route flows to the proposed RCB through the site and into the existing 7' x 5' open channel downstream.

6. The hydrologic analysis presented in this report is based on the existing facilities, and ultimate development of the surrounding area.

5.0 REFERENCES

1. Department of Public Works, Clark County, Nevada, "Improvement Standards," 1993.

2. Department of Agriculture, Soils Conservation Services, Technical Release 55, "Urban Hydrology for Small Watersheds," Washington, D.C. January 1975, revised June 1986.

3. Department of Agriculture, Soils Conservation Services, "Soil Survey of Las Vegas Valley Area," July 1985.

4. Army Corps of Engineers, "HEC-1 Flood Hydrograph Package," September 1981, Revised January 1985.

5. Federal Highway Administration, "Hydrologic Engineering Circular No. 12," March 1984.

6. Federal Highway Administration, "Hydrologic Engineering Circular No. 22," November 1996.

7. CIVILDESIGN, Inc., "Water Surface Pressure Gradient Package," version 12.9, Copyright © 1991 – 1998.

8. Haestad Methods, Inc., "FlowMaster®," version 6.0, Copyright © 1994 – 2000.

9. Clark County Regional Flood Control District, "Flood Control Master Plan Update Las Vegas Valley 1996" by PBS&J, February 1996.

10. Clark County Regional Flood Control District, "Hydrologic Criteria and Drainage Design Manual," October 1990.

11. Pentacore Engineering, Inc., "Update to the Drainage Study for Washington Avenue, Martin Luther King Boulevard to I-15 to Owens Avenue," submitted and reviewed by City of Las Vegas, October 5, 1999.

12. Pentacore Engineering, Inc., "Drainage Study for Washington Avenue," submitted and reviewed by City of Las Vegas, October 1997.

13. City of Las Vegas, "Flood Control Facilities Inventory and City Wide Hydrology Analysis" by PBS&J, December 1997.

WASHINGTON AVENUE

CONSTRUCTION COST ESTIMATE OF 100-YEAR STORM DRAIN SYSTEM

ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
CONSTRUCTION CONFLICTS	LS	1	$ 20,000.00	$ 20,000.00
MISC. REMOVAL/ABANDON/CAP EXIST. FACILITIES	LS	1	$ 20,000.00	$ 20,000.00
REMOVE & REPLACE 3" A.C. PAVEMENT - "B" Street	SY	7000	$ 6.00	$ 42,000.00
REMOVE & REPLACE TYPE II AGG. BASE - "B" Street	CY	2500	$ 13.00	$ 32,500.00
18" RCP	LF	1945	$ 60.00	$ 116,700.00
24" RCP	LF	235	$ 70.00	$ 16,450.00
30" RCP	LF	70	$ 80.00	$ 5,600.00
36" RCP	LF	565	$ 100.00	$ 56,500.00
42" RCP	LF	32	$ 120.00	$ 3,840.00
48" RCP	LF	80	$ 130.00	$ 10,400.00
54" RCP	LF	60	$ 140.00	$ 8,400.00
54" CMP	LF	210	$ 60.00	$ 12,600.00
4'x4' RCB	LF	35	$ 200.00	$ 7,000.00
7'x6' RCB	LF	780	$ 440.00	$ 343,200.00
9'x6' RCB	LF	1955	$ 480.00	$ 938,400.00
11'x6' RCB	LF	3017	$ 520.00	$ 1,568,840.00
14'x6' RCB	LF	1715	$ 650.00	$ 1,114,750.00
JUNCTION STRUCTURE Sta. 8+80	LS	1	$ 20,000.00	$ 20,000.00
TRANSITION/JUNCTION STRUCTURE Sta. 83+20	LS	1	$ 30,000.00	$ 30,000.00
JUNCTION STRUCTURE Sta. 87+05	LS	1	$ 25,000.00	$ 25,000.00
JUNCTION STRUCT. W/TRENCH DRAIN Sta. 83+00 Lt.	LS	1	$ 35,000.00	$ 35,000.00
JUNCTION STRUCT. W/TRENCH DRAIN Sta. 86+85 Lt.	LS	1	$ 30,000.00	$ 30,000.00
60" MANHOLE	EA	3	$ 3,500.00	$ 10,500.00
4' TYPE C D.I.	EA	31	$ 2,500.00	$ 77,500.00
10' TYPE "CM2" D.I.	EA	10	$ 10,000.00	$ 100,000.00
12.5' TYPE "CM2" D.I.	EA	11	$ 11,000.00	$ 121,000.00
17.5' TYPE "CM2" D.I.	EA	4	$ 14,000.00	$ 56,000.00
20' TYPE "CM2" D.I.	EA	14	$ 15,000.00	$ 210,000.00
20' TYPE "DM2" D.I.	EA	3	$ 14,000.00	$ 42,000.00
22.5' TYPE "CM2" D.I.	EA	2	$ 17,000.00	$ 34,000.00
			TOTAL	$ 5,108,180.00
			10% Contingency	$ 510,818.00
			TOTAL	**$ 5,618,998.00**

CONSTRUCTION COST ESTIMATE OF 10-YEAR STORM DRAIN SYSTEM

ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
CONSTRUCTION CONFLICTS	LS	1	$ 5,000.00	$ 5,000.00
MISC. REMOVAL/ABANDON/CAP EXIST. FACILITIES	LS	1	$ 5,000.00	$ 5,000.00
24" RCP	LF	1520	$ 80.00	$ 121,600.00
48" RCP	LF	60	$ 150.00	$ 9,000.00
60" RCP	LF	4650	$ 200.00	$ 930,000.00
48" MANHOLE	EA	8	$ 2,500.00	$ 20,000.00
2.5' TYPE "DM2" D.I.	EA	46	$ 2,500.00	$ 115,000.00
4' TYPE "CM2" D.I.	EA	2	$ 10,000.00	$ 20,000.00
165' TYPE "DM2" D.I.	EA	1	$ 17,000.00	$ 17,000.00
			TOTAL	$ 1,242,600.00
			10% Contingency	$ 124,260.00
			TOTAL	**$ 1,366,860.00**

ESTIMATED 100-YEAR SYSTEM COST	$ 5,618,998.00
ESTIMATED 10-YEAR SYSTEM COST (RTC)	$ 1,366,860.00
COST DIFFERENCE - TO BE FUNDED BY CCRFCD	**$ 4,252,138.00**

APPENDIX A

CITY OF LAS VEGAS COMMENTS

CITY OF LAS VEGAS **INTER-OFFICE MEMORANDUM**	**DATE:** October 18, 1999
TO Joe Christensen, P.E. Project Manager, Engineering Design Department of Public Works	**FROM:** Randy L. Fultz, P.E. Flood Control, Project Manager Department of Public Works
SUBJECT: Washington Avenue (Martin Luther King to I-15 and Owens)	**COPIES TO:** Charles Kajkowski, P.E. Myron Welsh, P.E. - Pentacore

We have reviewed the Update to the Drainage Study for Washington Avenue - Martin Luther King to I-15 and Owens dated October 1999 and have the following comments:

1. A recent field investigation by Flood Control staff revealed that additional areas drain to B Street between Monroe Avenue and Owens Avenue. It was observed that basins VG07A, VG08, and VG10 must be extended approximately to Owens Avenue, as these areas are tributary to B Street.
2. The Off-Site/On-Site Basin Map submitted with the Update showed basins that are tributary only to the existing NDOT facility, it did not include the entire watershed. All drainage basins that are tributary to the project must be shown on one map along with critical concentration points. This project is a CCRFCD facility which needs to be designed to collect the 100-year flow, all references to 50-year flows must be deleted from the study and the maps as they have no bearing on the project.
3. It was previously requested in our September 27, 1999 memorandum that "*The existing inlet system along B Street which intercepts flows from Adams, Jefferson, Madison, Monroe, Jackson, Van Buren and Harrison Streets must be analyzed to ensure the 100-year flow is intercepted. A complete analysis of the existing inlets along B Street must be done to determine the capacity of these inlets.*" The report did not include an evaluation as was requested for the existing inlet system in B Street. It was shown only that the existing NDOT facility could convey a maximum of 367 cfs and that each 42-foot inlet could intercept 18 cfs. The total collected flow must be determined for the inlets to the NDOT facility. If the existing inlets along B Street and in the park area cannot intercept sufficient flow to fill the NDOT facility, then additional inlets must be provided. It is the City's recommendation that (2) 20-foot Type 'C' inlets be placed on Van Buren Avenue, Jackson Avenue, Monroe Avenue, Madison Avenue west of B Street in order to collect the flows. An additional 20-foot Type 'C' inlet should be placed along the east side of B Street just north of Jefferson Avenue as this area is a low point. The engineer must determine the total capacity of the existing and proposed inlets in B Street to verify that the 100 year flow can be collected.
4. The report proposed to increase the 11'X5' RCB in B Street to a 11'X6' RCB to accommodate the additional flows that are tributary to B Street. In the last meeting for the project it was discussed that the box may need to be widened to compensate for the shallow cover near Owens Drive. This submittal

shows the box being higher rather than wider at this location. Design drawings must be submitted to verify that this can be accomplished.

5. It was previously requested in our September 27, 1999 memorandum that "*The existing 66" RCP must be utilized and flow equalizers provided between the existing and proposed systems. The existing laterals and inlets appear to conflict with the proposed box, these laterals must be shown on the profiles. All existing inlets must be identified on the plans by size, type and invert elevations.*" This still has not been completed as no plans were submitted.

attachment

RLF/gam

mem991014

APPENDIX B

HYDROLOGIC ANALYSIS
HEC-1 MODEL; PROPOSED DESIGN

```
HEC1 S/N: 1333000362        HMVersion: 6.40    Data File: WB.hc1

****************************************                                    ****************************************
*                                      *                                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
*             SEPTEMBER 1990           *                                    *    HYDROLOGIC ENGINEERING CENTER     *
*              VERSION 4.0             *                                    *          609 SECOND STREET           *
*                                      *                                    *       DAVIS, CALIFORNIA 95616        *
*  RUN DATE  01/11/2000  TIME  08:19:02 *                                   *           (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


                                   :::::::::::::::::::::::::::::::::::::::::::
                                   :::::::::::::::::::::::::::::::::::::::::::
                                   :::                                     :::
                                   :::  Full Microcomputer Implementation  :::
                                   :::                 by                  :::
                                   :::         Haestad Methods, Inc.       :::
                                   :::                                     :::
                                   :::::::::::::::::::::::::::::::::::::::::::
                                   :::::::::::::::::::::::::::::::::::::::::::

                          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 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
           ID        WASHINGTON AVENUE AND B STREET HYDROLOGY
           ID        PROJECT NO. 0133.0141
           ID        REF.1 "DRAINAGE STUDY FOR WASHINGTON AVENUE," SEPTEMBER 1997
           ID              CITY OF LAS VEGAS - WASHINGTON AVENUE
           ID              ULTIMATE OFFSITE/ONSITE CONDITIONS MODEL (DESIGN)
           ID              MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE
           ID
           ID         REF.2 "CITY OF LAS VEGAS FLOOD CONTROL FACILITIES INVENTORY
           ID               AND CITY WIDE HYDROLOGY ANALYSIS," DECEMBER 1997
           ID         RATIO PER 100-YR:                           AREA        DARF
           ID           10-YR = 0.57                           0.1 - 1.0      1.00
           ID           25-YR = 0.74                           1.0 - 1.5      0.97
           ID           50-YR = 0.87                           1.5 - 2.0      0.95
           ID          100-YR = 1.00                           2.0 - 2.5      0.93
           ID
           ID         FILE: WB.HC1 (MODIFIED RUN)
           ID
           IT       5       0       0     300
           IO       5       0       0
           IN       5       0       0
           JR    PREC    0.57    0.74    0.87    1.00    0.97    0.95    0.93

           KK    WA12
           BA   .0700
           PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
           PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
           PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
           PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
           PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
           PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
           PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
           PC    .998    .999    1.00
           PB    2.77
           LS              92
           UD   0.220

           KK   WA12R
           KM   ROUTE TO WA13
           RM       6    0.46    0.15

           KK    WA13
           BA  0.1345
           LS       0      92
           UD   0.530

           KK   WA13C WA13+WA12R (PLEASE SEE REF 1 FOR DETAILS)
           HC       2

           KK  RANSDI DIVERT OUT FROM RANCHO STORM DRAIN: CPA 144 CFS
           KM         RANSDM = FLOWS WHICH CONTINUE IN THE RANCHO STORMDRAIN
           KM         RANDUN = FLOWS WHICH ARE DIVERTED EAST THRTOUGH EXISTING STREETS
           DT  RANDUN
           DI       0     144    1000
           DQ       0       0     856
```

HEC-1 INPUT

```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 50             KK   WA13R (PLEASE SEE REF 1 FOR DETAILS)
 51             KM  ROUTE TO WA14
 52             RM       1    0.07    0.15

 53             KK    WA01 (PLEASE SEE REF 1 DETAILS)
 54             BA  0.0724
 55             LS       0      81
 56             UD   0.340

 57             KK    WA02
 58             BA  0.1514
 59             LS       0      92
 60             UD   0.350

 61             KK   WA02R
 62             KM   ROUTE TO WA03
 63             RM       3    0.22    0.15

 64             KK    WA03
 65             BA  0.0891
 66             LS       0      92
 67             UD   0.210

 68             KK   WA03C
 69             HC       3

 70             KK   OGO11
 71             BA  0.1614
 72             LS       0      79
 73             UD   0.470

 74             KK  WASSD1 DIVERT FLOW IN EXCESS OF 30" RCP CAP TO VEGAS VALLEY SUB BASINS
 75             KM         WASSD1 = FLOWS FOUND WITHIN THE EXISTING DTORM DRAIN SYSTEM
 76             KM         VEGSY1 = FLOWS WHICH ARE DIVERTED OUT OF THE WASHINGTON SUB BASIN
 77             DT  VEGSY1
 78             DI       0      40    1000
 79             DQ       0       0     960

 80             KK  OGO11R
 81             KM  ROUTE REMAINING FLOWS TO VG011
 82             RM       1    0.05    0.15

 83             KK   VG011
 84             BA  0.0277
 85             LS       0      82
 86             UD   0.420

 87             KK  VG011C VG011+OGO11R
 88             HC       2
```

```
                              HEC-1 INPUT

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   89          KK  WASSD2 DIVERT FLOW IN EXCESS OF 30" RCP CAP TO VEGAS VALLEY SUB BASINS
   90          KM         WASSD2 = FLOWS FOUND WITHIN THE EXISTING DTORM DRAIN SYSTEM
   91          KM         VEGSY2 = FLOWS WHICH ARE DIVERTED OUT OF THE WASHINGTON SUB BASIN
   92          DT  VEGSY2
   93          DI       0      10    1000
   94          DQ       0       0     990

   95          KK  VG011R
   96          KM   ROUTE REMAINING FLOWS TO WA03C
   97          RM       2    0.17    0.15

   98          KK   WA03C PRV WA03+VG011R
   99          HC       2

  100          KK   WA03R
  101          RM       3    0.25    0.15

  102          KK    WA04
  103          BA  0.1040
  104          LS       0      90
  105          UD   0.370

  106          KK   WA04C WA03R+WA04
  107          HC       2

  108          KK   WA04R
  109          KM  ROUTE TO WA06
  110          RM       2    0.16    0.15

  111          KK    WA06
  112          BA  0.0779
  113          LS       0      92
  114          UD   0.370

  115          KK   WA06C WA04R+WA06
  116          HC       2

  117          KK   WA06R
  118          KM  ROUTE TO WA05
  119          RM       0    0.04    0.15

  120          KK    WA05
  121          BA  0.0276
  122          LS       0      91
  123          UD   0.170

  124          KK   WA05C WA06R+WA05
  125          HC       2
```

HEC-1 INPUT

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 126      KK   WA05R
 127      KM   ROUTE TO WA06A
 128      RK    1400   0.029   0.013       0    CIRC       5

 129      KK   WA05R
 130      KM  ROUTE TO WA06A
 131      RM       1    0.07    0.15

 132      KK   WA06A
 133      BA  0.0583
 134      LS       0      92
 135      UD   0.250

 136      KK   WA06C WA05R+WA06
 137      HC       2

 138      KK   WA06R
 139      KM  ROUTE TO WA07 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
 140      RK    1400   0.014   0.013       0    CIRC       5

 141      KK    WA07
 142      BA  0.0340
 143      LS       0      93
 144      UD   0.270

 145      KK   WA07C WA06R+WA07
 146      HC       2

 147      KK   WA07R
 148      KM  ROUTE TO WA09 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
 149      RK    2500   0.012   0.013       0    CIRC       5

 150      KK    WA09
 151      BA  0.0545
 152      LS       0      93
 153      UD   0.360

 154      KK   WA09C WA07R+WA09
 155      HC       2

 156      KK   WA09R
 157      KM   ROUTE TO WA06A
 158      RK    2800   0.018   0.013       0    CIRC     5.5

 159      KK    WA11
 160      BA  0.0326
 161      LS       0      92
 162      UD   0.170
```

HEC-1 INPUT

LINE	ID	1	2	3	4	5	6	7	8	9	10
163	KK	WA11C									
164	HC	2									
165	KK	WA11R									
166	KM	ROUTE									
167	RK	2700	0.015	0.013	0	CIRC	5.5				
168	KK	WA14									
169	BA	0.0453									
170	LS	0	92								
171	UD	0.390									
172	KK	WA14C									
173	HC	2									
174	KK	WA14C									
175	HC	2									
176	KK	RANWAS									
177	DT	RANSD2									
178	DI	0	197	1000							
179	DQ	0	197	197							
180	KK	RANDUN									
181	DR	RANDUN									
182	KK	WA15A									
183	BA	0.0887									
184	LS	0	92								
185	UD	0.170									
186	KK	WA15AC									
187	HC	2									
188	KK	WA13AR									
189	KM	ROUTE									
190	RM	4	0.37	0.15							
191	KK	WA15B									
192	BA	0.0943									
193	LS	0	94								
194	UD	0.190									
195	KK	WA15BC									
196	HC	3									
197	KK	WA15BR									
198	KM	ROUTE									
199	RK	1400	0.012	0.0130	0	TRAP	9	0			

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 200          KK   WA16A
 201          BA  0.0646
 202          LS       0       92
 203          UD   0.220

 204          KK  WA16AC WA16A+WA15B
 205          HC       2

 206          KK  WA16AR
 207          KM    ROUTE TO WA17AC ASSUMES MAJORITY OF 100 YEAR IS IN SD
 208          RK    2600   0.005   0.013       0    TRAP       9       0

 209          KK   WA17A DEVELOPED CONDITIONS
 210          BA  0.0826
 211          LS       0       89
 212          UD   0.320

 213          KK   VG07B DEVELOPED CONDITIONS
 214          BA  0.0299
 215          LS       0       85
 216          UD   0.260

 217          KK  WA17AC WA16AR+WA17A+VG07B
 218          HC       3

 219          KK  WA17AR
 220          KM  ROUTE TO WA18A ASSUMES MAJORITY OF 100 YEAR IS IN SD
 221          RK    1100   0.007   0.013       0    TRAP       9       0

 222          KK   WA18A DEVELOPED CONDITIONS
 223          BA  0.0153
 224          LS       0       85
 225          UD   0.170

 226          KK  WA18AC
 227          HC       2

 228          KK  WA18AR
 229          KM   ROUTE
 230          RK    1400   0.007   0.013       0    TRAP       9       0

 231          KK   WA18B
 232          BA  0.0375
 233          LS       0       85
 234          UD   0.190

 235          KK  WA18BC
 236          HC       2
```

HEC-1 INPUT

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 237          KK   WA19A
 238          BA  0.0227
 239          LS       0      87
 240          UD   0.180

 241          KK    WA23
 242          BA  0.0461
 243          LS       0      85
 244          UD   0.250

 245          KK   WA19B
 246          BA  0.0238
 247          LS       0      87
 248          UD   0.180

 249          KK  WA19BC
 250          HC       2

 251          KK  WA19AC
 252          HC       3

 253          KK   WA17B DEVELOPED CONDITIONS
 254          BA  0.0911
 255          LS       0      86
 256          UD   0.330

 257          KK  WA17BR
 258          KM   ROUTE TO WA20 KINEMATIC WAVE ROUTING FOR STREET SECTION
 259          RK    2600   0.007   0.016       0    TRAP      70       0

 260          KK    WA20
 261          BA  0.0858
 262          LS       0      87
 263          UD   0.250

 264          KK   WA20C WA20+WA17BR
 265          HC       2

 266          KK   WA21A
 267          BA  0.0214
 268          LS       0      87
 269          UD   0.170

 270          KK  WA21AC WA21A+WA20C
 271          HC       2

 272          KK   WA21B
 273          BA  0.0083
 274          LS       0      87
 275          UD   0.130
```

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 276      KK  WA21BC WA21B+WA21AC
 277      HC       2

 278      KK  DWA21C DETERMINES THE FLOWS ENTERING THE SD AT D ST AND WASHINGTON AVE
 279      DT  DWA21C
 280      DI       0     189
 281      DQ       0     138

 282      KK  WA21CC (PROPOSED SD CAPACITY AT D ST AND WASHINGTON AVE)
 283      HC       2

 284      KK   WA19C
 285      BA  0.0107
 286      LS       0      91
 287      UD   0.160

 288      KK  DWA19C DETERMINES THE FLOWS EXITING ADAMS AND DISCHARGING INTO THE PROPOSED SD
 289      DT  DWA19C
 290      DI       0     100    1000   10000
 291      DQ       0      20     200    2000

 292      KK  WA19CC (PROPOSED SD CAPACITY AT ADAMS AVE)
 293      HC       2

 294      KK    VG09
 295      BA  0.0584
 296      LS       0      85
 297      UD   0.220

 298      KK   DVG09 DETERMINES THE FLOWS EXITING JEFFERSON ONTO B STREET
 299      DT   DVG09
 300      DI       0     100    1000   10000
 301      DQ       0      49     490    4900

 302      KK   VG09C (PROPOSED SD CAPACITY AT JEFFERSON AVE)
 303      HC       2

 304      KK   VG07A
 305      BA  0.1376
 306      LS       0      89
 307      UD   0.290

 308      KK  VG07AR ROUTE TO VG08
 309      RK    2600   0.006   0.017       0    TRAP      70       0

 310      KK    VG08
 311      BA  0.0608
 312      LS       0      84
 313      UD   0.340
```

HEC-1 INPUT

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 314      KK   VG08C VG07AR+VG08
 315      HC       2

 316      KK   VG08R ROUTE TO VG09
 317      RK    2400   0.010   0.016       0    TRAP      70       0

 318      KK    VG09
 319      BA  0.0584
 320      LS       0      85
 321      UD   0.220

 322      KK   VG09C VG09+VG08R (MODIFIED FOR EXISTING FACILITY FLOWS ONLY)
 323      HC       2

 324      KK  DVG09C DETERMINES THE FLOWS EXITING MADISON ONTO B STREET
 325      DT  DVG09C
 326      DI       0     100    1000   10000
 327      DQ       0      13     130    1300

 328      KK  VG09CC (PROPOSED SD CAPACITY AT MADISON AVE)
 329      HC       2

 330      KK    VG10
 331      BA  0.0930
 332      LS       0      86
 333      UD   0.503

 334      KK   RVG10
 335      KM   ROUTE TO VG11
 336      RM       3    0.23    0.15

 337      KK    VG11
 338      BA   0.066
 339      LS       0      85
 340      UD   0.326

 341      KK   VG11C
 342      HC       2

 343      KK  DVG11C DETERMINE THE FLOW EXITING MONROE ONTO B STREET
 344      DT  DVG11C
 345      DI       0     100    1000   10000
 346      DQ       0      23     230    2300

 347      KK  VG11CC (PROPOSED SD CAPACITY AT MONROE AVE)
 348      HC       2

 349      KK    VG11
 350      BA   0.066
 351      LS       0      85
 352      UD   0.326
```

HEC-1 INPUT

```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 353            KK   DVG11 DETERMINE THE FLOW EXITING JACKSON ONTO B STREET
 354            DT   DVG11
 355            DI       0     100    1000   10000
 356            DQ       0      55     550    5500

 357            KK   VG11C (PROPOSED SD CAPACITY AT JACKSON AVE)
 358            HC       2

 359            KK    VG12
 360            BA  0.0510
 361            LS       0      85
 362            UD   0.302

 363            KK  DVG12V DETERMINE THE FLOW EXITING VAN BUREN ONTO B STREET
 364            DT  DVG12V
 365            DI       0     100    1000   10000
 366            DQ       0      29     290    2900

 367            KK  VG12VC (PROPOSED SD CAPACITY AT VAN BUREN AVE)
 368            HC       2

 369            KK    VG12
 370            BA  0.0510
 371            LS       0      85
 372            UD   0.302

 373            KK  DVG12H DETERMINE THE FLOW EXITING HARRISON ONTO B STREET
 374            DT  DVG12H
 375            DI       0     100    1000   10000
 376            DQ       0      86     860    8600

 377            KK  VG12HC (PROPOSED SD CAPACITY AT HARRISON AVE)
 378            HC       2

 379            KK  WA21BC WA21B+WA21AC
 380            DR  DWA21C

 381            KK   WA19C
 382            DR  DWA19C

 383            KK  WA19CC
 384            HC       2

 385            KK   VGO9C
 386            DR  DVG09C

 387            KK   CVG11
 388            DR  DVG11C
```

HEC-1 INPUT

```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 389           KK   RVG11
 390           KM   ROUTE TO VG12
 391           RK     600   0.005     0.02        0    TRAP       80        2

 392           KK    VG12V
 393           DR  DVG12V

 394           KK    VG12H
 395           DR  DVG12H

 396           KK    CVG12
 397           KM   COMBINE VG10, VG11, VG12
 398           HC        3

 399           KK  CCVG12 (FOR COMPARISON ONLY)
 400           KM   COMBINE CVG12, VG09C, WA19CC
 401           HC        3

 402           KK    OWENS (COMBINED WASHINGTON AVENUE B STREET HYDROLOGY)
 403           HC        2

 404           KK      V1A
 405           BA  0.0352
 406           LS        0       95
 407           UD   0.210

 408           KK    WA22A
 409           BA  0.0543
 410           LS        0       94
 411           UD   0.280

 412           KK     V1AC V1A+WA22AC
 413           HC        2
 414           ZZ
```

```
                    SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V)  ROUTING           (--->)  DIVERSION OR PUMP FLOW

  NO.       (.)  CONNECTOR         (<---)  RETURN OF DIVERTED OR PUMPED FLOW

  22        WA12
               V
               V
  35       WA12R
               .
               .
  38           .         WA13
               .            .
               .            .
  42       WA13C............
               .
               .
  47           .------->  RANDUN
  44      RANSDI
               V
               V
  50       WA13R
               .
               .
  53           .         WA01
               .            .
               .            .
  57           .            .          WA02
               .            .             V
               .            .             V
  61           .            .         WA02R
               .            .             .
               .            .             .
  64           .            .             .         WA03
               .            .             .            .
               .            .             .            .
  68           .         WA03C.........................
               .            .
               .            .
  70           .            .         OGO11
               .            .             .
               .            .             .
  77           .            .             .------->  VEGSY1
  74           .            .        WASSD1
               .            .             V
               .            .             V
  80           .            .        OGO11R
               .            .             .
               .            .             .
  83           .            .             .         VG011
               .            .             .            .
               .            .             .            .
  87           .            .        VG011C............
               .            .             .
               .            .             .
  92           .            .             .------->  VEGSY2
  89           .            .        WASSD2
```

```
                    .         .        V
                    .         .        V
95                  .         .     VG011R
                    .         .          .
                    .         .          .
98                  .      WA03C...........
                    .         V
                    .         V
100                 .      WA03R
                    .         .
102                 .         .        WA04
                    .         .           .
                    .         .           .
106                 .      WA04C...........
                    .         V
                    .         V
108                 .      WA04R
                    .         .
111                 .         .        WA06
                    .         .           .
                    .         .           .
115                 .      WA06C...........
                    .         V
                    .         V
117                 .      WA06R
                    .         .
120                 .         .        WA05
                    .         .           .
                    .         .           .
124                 .      WA05C...........
                    .         V
                    .         V
126                 .      WA05R
                    .         V
                    .         V
129                 .      WA05R
                    .         .
132                 .         .        WA06A
                    .         .           .
                    .         .           .
136                 .      WA06C...........
                    .         V
                    .         V
138                 .      WA06R
                    .         .
141                 .         .        WA07
                    .         .           .
                    .         .           .
145                 .      WA07C...........
                    .         V
                    .         V
147                 .      WA07R
                    .         .
                    .         .
```

```
 150        .          .        WA09
            .          .          .
            .          .          .
 154        .     WA09C............
            .          V
            .          V
 156        .     WA09R
            .          .
            .          .
 159        .          .        WA11
            .          .          .
            .          .          .
 163        .     WA11C............
            .          V
            .          V
 165        .     WA11R
            .          .
            .          .
 168        .          .        WA14
            .          .          .
            .          .          .
 172        .     WA14C............
            .          .
            .          .
 174   WA14C............
            .
            .
 177        .------->  RANSD2
 176  RANWAS
            .
            .
 181        .          .<-------   RANDUN
 180        .     RANDUN
            .          .
            .          .
 182        .          .        WA15A
            .          .          .
            .          .          .
 186        .     WA15AC...........
            .          V
            .          V
 188        .     WA13AR
            .          .
            .          .
 191        .          .        WA15B
            .          .          .
            .          .          .
 195   WA15BC.......................
            V
            V
 197   WA15BR
            .
            .
 200        .     WA16A
            .          .
            .          .
 204   WA16AC............
            V
            V
```

```
206   WA16AR
         .
         .
209      .    WA17A
         .        .
         .        .
213      .        .    VG07B
         .        .        .
         .        .        .
217   WA17AC.......................
         V
         V
219   WA17AR
         .
         .
222      .    WA18A
         .        .
         .        .
226   WA18AC............
         V
         V
228   WA18AR
         .
         .
231      .    WA18B
         .        .
         .        .
235   WA18BC............
         .
         .
237      .    WA19A
         .        .
         .        .
241      .        .    WA23
         .        .       .
         .        .       .
245      .        .       .    WA19B
         .        .       .        .
         .        .       .        .
249      .        .    WA19BC............
         .        .       .
         .        .       .
251   WA19AC.......................
         .
         .
253      .    WA17B
         .        V
         .        V
257      .    WA17BR
         .        .
         .        .
260      .        .    WA20
         .        .       .
         .        .       .
264      .    WA20C............
         .        .
         .        .
266      .        .    WA21A
         .        .       .
```

```
                     .          .          .
270                  .   WA21AC...........
                     .          .
                     .          .
272                  .          .          WA21B
                     .          .            .
                     .          .            .
276                  .   WA21BC...........
                     .          .
                     .          .
279                  .          .------->  DWA21C
278                  .   DWA21C
                     .          .
                     .          .
282         WA21CC...........
                     .
                     .
284                  .     WA19C
                     .          .
                     .          .
289                  .          .------->  DWA19C
288                  .   DWA19C
                     .          .
                     .          .
292         WA19CC...........
                     .
                     .
294                  .      VG09
                     .          .
                     .          .
299                  .          .------->   DVG09
298                  .     DVG09
                     .          .
                     .          .
302          VG09C...........
                     .
                     .
304                  .     VG07A
                     .          V
                     .          V
308                  .    VG07AR
                     .          .
                     .          .
310                  .          .          VG08
                     .          .            .
                     .          .            .
314                  .     VG08C...........
                     .          V
                     .          V
316                  .     VG08R
                     .          .
                     .          .
318                  .          .          VG09
                     .          .            .
                     .          .            .
322                  .     VG09C...........
                     .          .
                     .          .
325                  .          .------->  DVG09C
```

```
324            .     DVG09C
               .          .
               .          .
328      VG09CC............
               .
               .
330            .       VG10
               .          V
               .          V
334            .      RVG10
               .          .
               .          .
337            .          .        VG11
               .          .           .
               .          .           .
341            .      VG11C............
               .          .
               .          .
344            .          .-------> DVG11C
343            .     DVG11C
               .          .
               .          .
347      VG11CC............
               .
               .
349            .       VG11
               .          .
               .          .
354            .          .------->   DVG11
353            .      DVG11
               .          .
               .          .
357       VG11C............
               .
               .
359            .       VG12
               .          .
               .          .
364            .          .-------> DVG12V
363            .     DVG12V
               .          .
               .          .
367      VG12VC............
               .
               .
369            .       VG12
               .          .
               .          .
374            .          .-------> DVG12H
373            .     DVG12H
               .          .
               .          .
377      VG12HC............
               .
               .
380            .          .<-------  DWA21C
379            .     WA21BC
               .          .
               .          .
```

```
382            .           .           .<-------  DWA19C
381            .           .      WA19C
               .           .           .
               .           .           .
383            .      WA19CC............
               .           .
               .           .
386            .           .           .<-------  DVG09C
385            .           .      VGO9C
               .           .           .
               .           .           .
388            .           .           .           .<-------  DVG11C
387            .           .           .      CVG11
               .           .           .           V
               .           .           .           V
389            .           .           .      RVG11
               .           .           .           .
               .           .           .           .
393            .           .           .           .           .<-------  DVG12V
392            .           .           .           .      VG12V
               .           .           .           .           .
               .           .           .           .           .           .<-------  DVG12H
395            .           .           .           .           .
394            .           .           .           .           .      VG12H
               .           .           .           .           .           .
               .           .           .           .           .           .
396            .           .           .      CVG12.........................
               .           .           .           .
               .           .           .           .
399            .      CCVG12........................
               .           .
               .           .
402      OWENS............
               .
               .
404            .           V1A
               .           .
               .           .
408            .           .      WA22A
               .           .           .
               .           .           .
412            .          V1AC............
(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
HEC1 S/N: 1333000362       HMVersion: 6.40    Data File: WB.hcl

*****************************************                 *****************************************
*                                       *                 *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                 *   U.S. ARMY CORPS OF ENGINEERS        *
*            SEPTEMBER 1990             *                 *   HYDROLOGIC ENGINEERING CENTER       *
*             VERSION 4.0               *                 *        609 SECOND STREET              *
*                                       *                 *      DAVIS, CALIFORNIA 95616          *
*  RUN DATE  01/11/2000  TIME  08:19:02 *                 *          (916) 756-1104               *
*                                       *                 *                                       *
*****************************************                 *****************************************


                    WASHINGTON AVENUE AND B STREET HYDROLOGY
                    PROJECT NO. 0133.0141
                    REF.1 "DRAINAGE STUDY FOR WASHINGTON AVENUE," SEPTEMBER 1997
                          CITY OF LAS VEGAS - WASHINGTON AVENUE
                          ULTIMATE OFFSITE/ONSITE CONDITIONS MODEL (DESIGN)
                          MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE

                     REF.2 "CITY OF LAS VEGAS FLOOD CONTROL FACILITIES INVENTORY
                           AND CITY WIDE HYDROLOGY ANALYSIS," DECEMBER 1997
                     RATIO PER 100-YR:                   AREA         DARF
                       10-YR = 0.57                   0.1 - 1.0       1.00
                       25-YR = 0.74                   1.0 - 1.5       0.97
                       50-YR = 0.87                   1.5 - 2.0       0.95
                      100-YR = 1.00                   2.0 - 2.5       0.93

                     FILE: WB.HC1 (MODIFIED RUN)

  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         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        0055  ENDING TIME
                      ICENT          19  CENTURY MARK

                COMPUTATION INTERVAL     .08 HOURS
                     TOTAL TIME BASE   24.92 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
                       .57       .74       .87      1.00       .97       .95       .93
```

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 .74	RATIO 3 .87	RATIO 4 1.00	RATIO 5 .97	RATIO 6 .95	RATIO 7 .93
HYDROGRAPH AT	WA12	.07	1	FLOW	44.	64.	79.	95.	91.	89.	86.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO	WA12R	.07	1	FLOW	36.	52.	65.	78.	75.	73.	71.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT	WA13	.13	1	FLOW	55.	80.	100.	119.	115.	112.	109.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	WA13C	.20	1	FLOW	89.	129.	160.	192.	185.	180.	175.
				TIME	4.08	4.08	4.08	4.00	4.00	4.00	4.08
DIVERSION TO	RANDUN	.20	1	FLOW	0.	0.	16.	48.	41.	36.	31.
				TIME	.08	.08	4.08	4.00	4.00	4.00	4.08
HYDROGRAPH AT	RANSDI	.20	1	FLOW	89.	129.	144.	144.	144.	144.	144.
				TIME	4.08	4.08	3.92	3.83	3.83	3.83	3.83
ROUTED TO	WA13R	.20	1	FLOW	87.	128.	144.	144.	144.	144.	144.
				TIME	4.17	4.08	4.17	4.25	4.25	4.25	4.25
HYDROGRAPH AT	WA01	.07	1	FLOW	15.	28.	39.	50.	47.	46.	44.
				TIME	3.83	3.83	3.83	3.75	3.83	3.83	3.83
HYDROGRAPH AT	WA02	.15	1	FLOW	78.	114.	141.	169.	163.	158.	154.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO	WA02R	.15	1	FLOW	73.	106.	132.	158.	152.	148.	144.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	WA03	.09	1	FLOW	57.	82.	102.	122.	117.	114.	111.
				TIME	3.67	3.67	3.67	3.58	3.58	3.58	3.58
3 COMBINED AT	WA03C	.31	1	FLOW	115.	174.	220.	267.	256.	249.	241.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83

HYDROGRAPH AT	OGO11	.16	1	FLOW	23.	45.	64.	85.	80.	77.	73.
				TIME	4.00	4.00	3.92	3.92	3.92	3.92	3.92
DIVERSION TO	VEGSY1	.16	1	FLOW	0.	5.	24.	45.	40.	37.	33.
				TIME	.08	4.00	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT	WASSD1	.16	1	FLOW	23.	40.	40.	40.	40.	40.	40.
				TIME	4.00	3.83	3.67	3.67	3.67	3.67	3.67
ROUTED TO	OGO11R	.16	1	FLOW	23.	40.	40.	40.	40.	40.	40.
				TIME	4.08	4.00	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	VG011	.03	1	FLOW	6.	10.	14.	18.	17.	17.	16.
				TIME	3.92	3.92	3.92	3.83	3.92	3.92	3.92
2 COMBINED AT	VG011C	.19	1	FLOW	28.	50.	54.	58.	57.	57.	56.
				TIME	4.00	3.92	3.92	3.83	3.92	3.92	3.92
DIVERSION TO	VEGSY2	.19	1	FLOW	18.	40.	44.	48.	47.	47.	46.
				TIME	4.00	3.92	3.92	3.83	3.92	3.92	3.92
HYDROGRAPH AT	WASSD2	.19	1	FLOW	10.	10.	10.	10.	10.	10.	10.
				TIME	3.67	3.50	3.50	3.42	3.42	3.42	3.42
ROUTED TO	VG011R	.19	1	FLOW	10.	10.	10.	10.	10.	10.	10.
				TIME	4.42	4.25	4.17	4.08	4.33	4.25	4.25
2 COMBINED AT	WA03C	.50	1	FLOW	124.	183.	230.	277.	266.	259.	251.
				TIME	3.92	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO	WA03R	.50	1	FLOW	119.	175.	220.	265.	254.	247.	240.
				TIME	4.17	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT	WA04	.10	1	FLOW	45.	68.	86.	104.	100.	97.	94.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT	WA04C	.61	1	FLOW	150.	225.	284.	343.	329.	320.	311.
				TIME	4.08	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO	WA04R	.61	1	FLOW	147.	219.	276.	334.	320.	312.	303.
				TIME	4.25	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA06	.08	1	FLOW	39.	57.	70.	84.	81.	79.	77.
				TIME	3.83	3.83	3.83	3.75	3.75	3.75	3.83

2 COMBINED AT	WA06C	.68	1	FLOW	169.	252.	317.	383.	368.	358.	348.
				TIME	4.17	4.17	4.08	4.08	4.08	4.08	4.08
ROUTED TO	WA06R	.68	1	FLOW	168.	252.	317.	383.	367.	357.	347.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA05	.03	1	FLOW	18.	27.	34.	40.	39.	38.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA05C	.71	1	FLOW	172.	257.	323.	390.	374.	364.	354.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA05R	.71	1	FLOW	171.	257.	323.	390.	374.	364.	354.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA05R	.71	1	FLOW	170.	254.	320.	386.	371.	360.	350.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT	WA06A	.06	1	FLOW	35.	51.	64.	76.	73.	71.	69.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	WA06C	.77	1	FLOW	179.	268.	338.	408.	392.	381.	370.
				TIME	4.25	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA06R	.77	1	FLOW	179.	267.	337.	407.	391.	380.	369.
				TIME	4.25	4.25	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA07	.03	1	FLOW	21.	30.	37.	44.	43.	42.	41.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	WA07C	.80	1	FLOW	185.	278.	350.	422.	405.	394.	383.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA07R	.80	1	FLOW	185.	276.	348.	421.	404.	393.	382.
				TIME	4.25	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA09	.05	1	FLOW	29.	42.	52.	62.	60.	58.	57.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	WA09C	.86	1	FLOW	200.	299.	376.	454.	436.	424.	412.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA09R	.86	1	FLOW	200.	299.	376.	454.	436.	424.	412.

				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA11	.03	1	FLOW	23.	33.	41.	49.	48.	46.	45.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA11C	.89	1	FLOW	204.	305.	383.	462.	444.	432.	420.
				TIME	4.17	4.17	4.17	4.08	4.17	4.17	4.17
ROUTED TO	WA11R	.89	1	FLOW	204.	305.	383.	462.	444.	432.	420.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA14	.05	1	FLOW	22.	32.	40.	48.	46.	45.	44.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT	WA14C	.94	1	FLOW	218.	326.	410.	495.	475.	462.	449.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08
2 COMBINED AT	WA14C	1.14	1	FLOW	306.	453.	554.	639.	619.	606.	593.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08
DIVERSION TO	RANSD2	1.14	1	FLOW	197.	197.	197.	197.	197.	197.	197.
				TIME	3.75	3.58	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT	RANWAS	1.14	1	FLOW	109.	256.	357.	442.	422.	409.	396.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT	RANDUN	.00	1	FLOW	0.	0.	16.	48.	41.	36.	31.
				TIME	.08	.08	4.08	4.00	4.00	4.00	4.08
HYDROGRAPH AT	WA15A	.09	1	FLOW	62.	91.	113.	134.	129.	126.	123.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA15AC	.09	1	FLOW	62.	91.	113.	134.	129.	126.	123.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO	WA13AR	.09	1	FLOW	48.	70.	87.	106.	101.	98.	95.
				TIME	4.00	4.00	3.92	4.00	4.00	4.00	4.00
HYDROGRAPH AT	WA15B	.09	1	FLOW	72.	101.	123.	146.	141.	137.	134.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT	WA15BC	1.32	1	FLOW	175.	351.	481.	599.	573.	555.	537.
				TIME	4.00	4.00	4.00	3.92	3.92	3.92	3.92
ROUTED TO											

	WA15BR	1.32	1	FLOW TIME	174. 4.00	350. 4.00	480. 4.00	598. 3.92	571. 3.92	554. 3.92	536. 3.92
HYDROGRAPH AT	WA16A	.06	1	FLOW TIME	41. 3.67	59. 3.67	73. 3.67	87. 3.67	84. 3.67	82. 3.67	80. 3.67
2 COMBINED AT	WA16AC	1.39	1	FLOW TIME	192. 4.00	376. 4.00	517. 3.92	646. 3.92	618. 3.92	599. 3.92	580. 3.92
ROUTED TO	WA16AR	1.39	1	FLOW TIME	192. 4.00	376. 4.00	514. 3.92	646. 3.92	616. 3.92	597. 3.92	578. 3.92
HYDROGRAPH AT	WA17A	.08	1	FLOW TIME	36. 3.75	55. 3.75	71. 3.75	86. 3.75	83. 3.75	80. 3.75	78. 3.75
HYDROGRAPH AT	VG07B	.03	1	FLOW TIME	10. 3.75	17. 3.67	23. 3.67	29. 3.67	27. 3.67	26. 3.67	25. 3.67
3 COMBINED AT	WA17AC	1.50	1	FLOW TIME	227. 3.92	431. 3.92	590. 3.92	743. 3.83	707. 3.83	683. 3.83	661. 3.92
ROUTED TO	WA17AR	1.50	1	FLOW TIME	226. 3.92	430. 3.92	589. 3.92	741. 3.83	705. 3.92	683. 3.92	661. 3.92
HYDROGRAPH AT	WA18A	.02	1	FLOW TIME	6. 3.58	10. 3.58	14. 3.58	17. 3.58	17. 3.58	16. 3.58	16. 3.58
2 COMBINED AT	WA18AC	1.52	1	FLOW TIME	229. 3.92	435. 3.92	595. 3.92	751. 3.83	714. 3.83	690. 3.83	667. 3.92
ROUTED TO	WA18AR	1.52	1	FLOW TIME	228. 3.92	434. 3.92	595. 3.92	748. 3.83	712. 3.92	690. 3.92	667. 3.92
HYDROGRAPH AT	WA18B	.04	1	FLOW TIME	15. 3.67	24. 3.58	32. 3.58	40. 3.58	38. 3.58	37. 3.58	36. 3.58
2 COMBINED AT	WA18BC	1.55	1	FLOW TIME	236. 3.92	447. 3.92	611. 3.92	774. 3.83	736. 3.83	711. 3.83	686. 3.83
HYDROGRAPH AT	WA19A	.02	1	FLOW TIME	11. 3.58	17. 3.58	22. 3.58	28. 3.58	26. 3.58	26. 3.58	25. 3.58
HYDROGRAPH AT	WA23	.05	1	FLOW TIME	16. 3.67	27. 3.67	36. 3.67	45. 3.67	43. 3.67	42. 3.67	40. 3.67

HYDROGRAPH AT	WA19B	.02	1	FLOW	11.	18.	23.	29.	28.	27.	26.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA19BC	.07	1	FLOW	27.	44.	58.	72.	69.	67.	65.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT	WA19AC	1.65	1	FLOW	258.	485.	666.	846.	805.	777.	750.
				TIME	3.92	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	WA17B	.09	1	FLOW	31.	50.	66.	82.	79.	76.	73.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO	WA17BR	.09	1	FLOW	30.	49.	65.	82.	77.	75.	72.
				TIME	3.92	3.92	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	WA20	.09	1	FLOW	36.	57.	74.	92.	88.	85.	82.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	WA20C	.18	1	FLOW	60.	98.	130.	163.	155.	150.	145.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	WA21A	.02	1	FLOW	10.	17.	22.	27.	26.	25.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA21AC	.20	1	FLOW	66.	111.	146.	182.	174.	168.	162.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	WA21B	.01	1	FLOW	4.	7.	9.	11.	11.	10.	10.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA21BC	.21	1	FLOW	68.	115.	152.	189.	180.	174.	168.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
DIVERSION TO	DWA21C	.21	1	FLOW	50.	84.	111.	138.	131.	127.	123.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	DWA21C	.21	1	FLOW	18.	31.	41.	51.	49.	47.	45.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	WA21CC	1.85	1	FLOW	275.	515.	704.	894.	850.	821.	793.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	WA19C	.01	1	FLOW	7.	11.	13.	16.	15.	15.	15.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58

DIVERSION TO												
	DWA19C	.01	1	FLOW	1.	2.	3.	3.	3.	3.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT											
	DWA19C	.01	1	FLOW	6.	9.	11.	13.	12.	12.	12.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT											
	WA19CC	1.86	1	FLOW	278.	519.	710.	900.	856.	828.	799.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT											
	VG09	.06	1	FLOW	22.	36.	48.	60.	57.	55.	53.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
DIVERSION TO											
	DVG09	.06	1	FLOW	11.	18.	23.	29.	28.	27.	26.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT											
	DVG09	.06	1	FLOW	11.	18.	24.	31.	29.	28.	27.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT											
	VG09C	1.92	1	FLOW	287.	533.	728.	923.	878.	849.	819.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT											
	VG07A	.14	1	FLOW	63.	96.	122.	149.	142.	138.	134.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO											
	VG07AR	.14	1	FLOW	62.	95.	120.	147.	141.	137.	132.
				TIME	3.83	3.83	3.83	3.75	3.75	3.75	3.83
HYDROGRAPH AT											
	VG08	.06	1	FLOW	17.	29.	39.	49.	47.	45.	43.
				TIME	3.83	3.83	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT											
	VG08C	.20	1	FLOW	79.	124.	158.	196.	188.	182.	175.
				TIME	3.83	3.83	3.83	3.75	3.75	3.75	3.75
ROUTED TO											
	VG08R	.20	1	FLOW	78.	122.	158.	195.	187.	181.	175.
				TIME	3.92	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT											
	VG09	.06	1	FLOW	22.	36.	48.	60.	57.	55.	53.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT											
	VG09C	.26	1	FLOW	93.	150.	194.	240.	229.	223.	215.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO											
	DVG09C	.26	1	FLOW	12.	19.	25.	31.	30.	29.	28.

				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	DVG09C	.26	1	FLOW	81.	130.	169.	209.	200.	194.	187.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT	VG09CC	2.18	1	FLOW	368.	664.	897.	1132.	1078.	1042.	1006.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	VG10	.09	1	FLOW	25.	41.	53.	67.	64.	62.	59.
				TIME	4.00	4.00	4.00	3.92	3.92	3.92	3.92
ROUTED TO	RVG10	.09	1	FLOW	24.	39.	51.	64.	61.	59.	57.
				TIME	4.25	4.17	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	VG11	.07	1	FLOW	20.	34.	46.	57.	55.	53.	51.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	VG11C	.16	1	FLOW	36.	58.	77.	97.	92.	89.	86.
				TIME	4.08	4.00	4.00	4.00	4.00	4.00	4.00
DIVERSION TO	DVG11C	.16	1	FLOW	8.	13.	18.	22.	21.	21.	20.
				TIME	4.08	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT	DVG11C	.16	1	FLOW	27.	45.	60.	75.	71.	69.	66.
				TIME	4.08	4.00	4.00	4.00	4.00	4.00	4.00
2 COMBINED AT	VG11CC	2.34	1	FLOW	392.	706.	953.	1202.	1145.	1107.	1069.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	VG11	.07	1	FLOW	20.	34.	46.	57.	55.	53.	51.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
DIVERSION TO	DVG11	.07	1	FLOW	11.	19.	25.	32.	30.	29.	28.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	DVG11	.07	1	FLOW	9.	15.	21.	26.	25.	24.	23.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	VG11C	2.40	1	FLOW	402.	721.	973.	1227.	1169.	1130.	1091.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	VG12	.05	1	FLOW	17.	28.	37.	46.	44.	42.	41.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75
DIVERSION TO											

	DVG12V	.05	1	FLOW TIME	5. 3.75	8. 3.75	11. 3.75	13. 3.75	13. 3.75	12. 3.75	12. 3.75
HYDROGRAPH AT	DVG12V	.05	1	FLOW TIME	12. 3.75	20. 3.75	26. 3.75	33. 3.75	31. 3.75	30. 3.75	29. 3.75
2 COMBINED AT	VG12VC	2.45	1	FLOW TIME	413. 3.83	739. 3.83	998. 3.83	1258. 3.83	1198. 3.83	1159. 3.83	1118. 3.83
HYDROGRAPH AT	VG12	.05	1	FLOW TIME	17. 3.75	28. 3.75	37. 3.75	46. 3.75	44. 3.75	42. 3.75	41. 3.75
DIVERSION TO	DVG12H	.05	1	FLOW TIME	14. 3.75	24. 3.75	31. 3.75	39. 3.75	38. 3.75	36. 3.75	35. 3.75
HYDROGRAPH AT	DVG12H	.05	1	FLOW TIME	2. 3.75	4. 3.75	5. 3.75	6. 3.75	6. 3.75	6. 3.75	6. 3.75
2 COMBINED AT	VG12HC	2.51	1	FLOW TIME	415. 3.83	743. 3.83	1003. 3.83	1264. 3.83	1204. 3.83	1164. 3.83	1124. 3.83
HYDROGRAPH AT	WA21BC	.00	1	FLOW TIME	50. 3.83	84. 3.75	111. 3.75	138. 3.75	131. 3.75	127. 3.75	123. 3.75
HYDROGRAPH AT	WA19C	.00	1	FLOW TIME	1. 3.58	2. 3.58	3. 3.58	3. 3.58	3. 3.58	3. 3.58	3. 3.58
2 COMBINED AT	WA19CC	.00	1	FLOW TIME	51. 3.83	85. 3.75	113. 3.75	140. 3.75	133. 3.75	129. 3.75	125. 3.75
HYDROGRAPH AT	VGO9C	.00	1	FLOW TIME	12. 3.83	19. 3.83	25. 3.83	31. 3.83	30. 3.83	29. 3.83	28. 3.83
HYDROGRAPH AT	CVG11	.00	1	FLOW TIME	8. 4.08	13. 4.00	18. 4.00	22. 4.00	21. 4.00	21. 4.00	20. 4.00
ROUTED TO	RVG11	.00	1	FLOW TIME	8. 4.08	13. 4.08	18. 4.08	22. 4.00	21. 4.00	20. 4.00	20. 4.00
HYDROGRAPH AT	VG12V	.00	1	FLOW TIME	5. 3.75	8. 3.75	11. 3.75	13. 3.75	13. 3.75	12. 3.75	12. 3.75
HYDROGRAPH AT	VG12H	.00	1	FLOW TIME	14. 3.75	24. 3.75	31. 3.75	39. 3.75	38. 3.75	36. 3.75	35. 3.75

3 COMBINED AT	CVG12	.00	1	FLOW	25.	42.	56.	71.	67.	65.	63.
				TIME	3.83	3.83	3.75	3.75	3.75	3.75	3.75
3 COMBINED AT	CCVG12	.00	1	FLOW	88.	145.	193.	241.	230.	222.	215.
				TIME	3.83	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	OWENS	2.51	1	FLOW	503.	886.	1189.	1495.	1424.	1378.	1331.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT	V1A	.04	1	FLOW	27.	37.	45.	53.	51.	50.	49.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	WA22A	.05	1	FLOW	35.	50.	61.	72.	69.	67.	66.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	V1AC	.09	1	FLOW	62.	87.	105.	124.	120.	117.	114.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67

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= .57									
WA05R	MANE	.40	171.73	250.62	.62	5.00	171.49	250.00	.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2341E+02 EXCESS= .0000E+00 OUTFLOW= .2341E+02 BASIN STORAGE= .1501E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .74									
WA05R	MANE	.35	256.81	250.29	.91	5.00	256.69	250.00	.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3458E+02 EXCESS= .0000E+00 OUTFLOW= .3458E+02 BASIN STORAGE= .1556E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .87									
WA05R	MANE	.32	323.00	250.38	1.15	5.00	322.95	250.00	1.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4352E+02 EXCESS= .0000E+00 OUTFLOW= .4352E+02 BASIN STORAGE= .1434E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00									
WA05R	MANE	.30	389.68	250.12	1.39	5.00	389.66	250.00	1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5272E+02 EXCESS= .0000E+00 OUTFLOW= .5271E+02 BASIN STORAGE= .1502E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97									
WA05R	MANE	.27	374.25	250.35	1.33	5.00	374.21	250.00	1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5057E+02 EXCESS= .0000E+00 OUTFLOW= .5057E+02 BASIN STORAGE= .1572E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .95									
WA05R	MANE	.28	363.95	250.12	1.30	5.00	363.92	250.00	1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4915E+02 EXCESS= .0000E+00 OUTFLOW= .4915E+02 BASIN STORAGE= .1507E-11 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .93									
WA05R	MANE	.36	353.68	250.32	1.26	5.00	353.65	250.00	1.26

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4773E+02 EXCESS= .0000E+00 OUTFLOW= .4773E+02 BASIN STORAGE= .1562E-11 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .57
             WA06R  MANE          .47    179.18    255.20       .64      5.00    179.16    255.00         .64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2611E+02 EXCESS= .0000E+00 OUTFLOW= .2611E+02 BASIN STORAGE= .1790E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             WA06R  MANE          .38    268.02    250.93       .94      5.00    267.17    255.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3857E+02 EXCESS= .0000E+00 OUTFLOW= .3857E+02 BASIN STORAGE= .1829E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
             WA06R  MANE          .47    337.68    250.82      1.18      5.00    336.90    250.00        1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4853E+02 EXCESS= .0000E+00 OUTFLOW= .4853E+02 BASIN STORAGE= .1721E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO= 1.00
             WA06R  MANE          .40    407.91    250.89      1.43      5.00    407.15    250.00        1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5877E+02 EXCESS= .0000E+00 OUTFLOW= .5877E+02 BASIN STORAGE= .1698E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .97
             WA06R  MANE          .47    391.54    251.05      1.37      5.00    390.87    250.00        1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5638E+02 EXCESS= .0000E+00 OUTFLOW= .5638E+02 BASIN STORAGE= .1799E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .95
             WA06R  MANE          .42    380.82    250.75      1.33      5.00    380.04    250.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5480E+02 EXCESS= .0000E+00 OUTFLOW= .5480E+02 BASIN STORAGE= .1732E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .93
             WA06R  MANE          .42    369.97    251.00      1.30      5.00    369.23    250.00        1.30

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5322E+02 EXCESS= .0000E+00 OUTFLOW= .5322E+02 BASIN STORAGE= .1779E-10 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .57
             WA07R  MANE          .76    185.36    251.56       .65      5.00    185.20    255.00         .65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2781E+02 EXCESS= .0000E+00 OUTFLOW= .2781E+02 BASIN STORAGE= .1696E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             WA07R  MANE          .66    277.54    251.59       .96      5.00    276.37    250.00         .96
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4104E+02 EXCESS= .0000E+00 OUTFLOW= .4104E+02 BASIN STORAGE= .1580E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
             WA07R  MANE          .68    349.47    251.50      1.20      5.00    348.41    250.00        1.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5161E+02 EXCESS= .0000E+00 OUTFLOW= .5161E+02 BASIN STORAGE= .1583E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO= 1.00
             WA07R  MANE          .68    421.95    251.33      1.46      5.00    420.93    250.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6247E+02 EXCESS= .0000E+00 OUTFLOW= .6247E+02 BASIN STORAGE= .1590E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .97
             WA07R  MANE          .60    405.08    250.92      1.40      5.00    404.13    250.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5994E+02 EXCESS= .0000E+00 OUTFLOW= .5994E+02 BASIN STORAGE= .1694E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .95
             WA07R  MANE          .66    393.91    251.49      1.36      5.00    392.95    250.00        1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5826E+02 EXCESS= .0000E+00 OUTFLOW= .5826E+02 BASIN STORAGE= .1501E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .93
             WA07R  MANE          .67    382.90    251.31      1.32      5.00    381.79    250.00        1.32

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5659E+02 EXCESS= .0000E+00 OUTFLOW= .5659E+02 BASIN STORAGE= .1499E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .57
             WA09R  MANE          .73    200.41    251.43       .67      5.00    199.94    250.00         .67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3054E+02 EXCESS= .0000E+00 OUTFLOW= .3054E+02 BASIN STORAGE= .2949E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             WA09R  MANE          .72    299.00    251.14       .98      5.00    298.73    250.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4501E+02 EXCESS= .0000E+00 OUTFLOW= .4501E+02 BASIN STORAGE= .3256E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
             WA09R  MANE          .62    376.12    251.18      1.24      5.00    375.92    250.00        1.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5655E+02 EXCESS= .0000E+00 OUTFLOW= .5655E+02 BASIN STORAGE= .3752E-09 PERCENT ERROR=    .0
```

```
          FOR PLAN = 1  RATIO= 1.00
             WA09R  MANE          .56    453.71    250.97      1.49      5.00    453.58    250.00         1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6840E+02 EXCESS= .0000E+00 OUTFLOW= .6840E+02 BASIN STORAGE= .3306E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .97
             WA09R  MANE          .55    435.82    251.10      1.43      5.00    435.60    250.00         1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6564E+02 EXCESS= .0000E+00 OUTFLOW= .6564E+02 BASIN STORAGE= .3761E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .95
             WA09R  MANE          .59    423.75    251.10      1.39      5.00    423.62    250.00         1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6381E+02 EXCESS= .0000E+00 OUTFLOW= .6381E+02 BASIN STORAGE= .3252E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .93
             WA09R  MANE          .61    411.82    250.71      1.35      5.00    411.67    250.00         1.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6198E+02 EXCESS= .0000E+00 OUTFLOW= .6198E+02 BASIN STORAGE= .3429E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .57
             WA11R  MANE          .70    204.29    251.36       .67      5.00    203.95    250.00          .67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3205E+02 EXCESS= .0000E+00 OUTFLOW= .3206E+02 BASIN STORAGE= .1112E-08 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             WA11R  MANE          .73    304.67    250.60       .99      5.00    304.53    250.00          .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4724E+02 EXCESS= .0000E+00 OUTFLOW= .4725E+02 BASIN STORAGE= .8668E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
             WA11R  MANE          .70    383.22    250.23      1.25      5.00    383.19    250.00         1.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5936E+02 EXCESS= .0000E+00 OUTFLOW= .5936E+02 BASIN STORAGE= .9511E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO= 1.00
             WA11R  MANE          .57    462.45    246.21      1.51      5.00    462.36    250.00         1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7179E+02 EXCESS= .0000E+00 OUTFLOW= .7179E+02 BASIN STORAGE= .9808E-09 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .97
```

```
        WA11R  MANE          .68    444.03    250.05      1.45      5.00    444.03    250.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6890E+02 EXCESS= .0000E+00 OUTFLOW= .6890E+02 BASIN STORAGE= .1073E-08 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .95
        WA11R  MANE          .73    431.82    250.19      1.41      5.00    431.82    250.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6698E+02 EXCESS= .0000E+00 OUTFLOW= .6698E+02 BASIN STORAGE= .8810E-09 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .93
        WA11R  MANE          .57    419.71    251.06      1.37      5.00    419.65    250.00        1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6506E+02 EXCESS= .0000E+00 OUTFLOW= .6506E+02 BASIN STORAGE= .1134E-08 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .57
       WA15BR  MANE          .47    174.80    240.68       .21      5.00    174.28    240.00         .21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1509E+02 EXCESS= .0000E+00 OUTFLOW= .1509E+02 BASIN STORAGE= .6567E-05 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .74
       WA15BR  MANE          .32    350.87    240.58       .46      5.00    350.31    240.00         .46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3212E+02 EXCESS= .0000E+00 OUTFLOW= .3213E+02 BASIN STORAGE= .5098E-05 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .87
       WA15BR  MANE          .37    480.50    240.00       .67      5.00    480.50    240.00         .67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4696E+02 EXCESS= .0000E+00 OUTFLOW= .4697E+02 BASIN STORAGE= .5880E-05 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO= 1.00
       WA15BR  MANE          .27    599.02    235.50       .89      5.00    598.08    235.00         .89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6263E+02 EXCESS= .0000E+00 OUTFLOW= .6264E+02 BASIN STORAGE= .5421E-05 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .97
       WA15BR  MANE          .29    572.41    235.69       .84      5.00    571.32    235.00         .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5898E+02 EXCESS= .0000E+00 OUTFLOW= .5898E+02 BASIN STORAGE= .6018E-05 PERCENT ERROR=    .0

      FOR PLAN = 1  RATIO=  .95
       WA15BR  MANE          .28    554.80    235.67       .80      5.00    553.52    235.00         .80
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5656E+02 EXCESS= .0000E+00 OUTFLOW= .5656E+02 BASIN STORAGE= .6461E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .93

WA15BR	MANE	.31	537.08	235.78	.77	5.00	535.71	235.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5414E+02 EXCESS= .0000E+00 OUTFLOW= .5414E+02 BASIN STORAGE= .6218E-05 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .57

WA16AR	MANE	.87	192.08	241.42	.24	5.00	191.90	240.00	.24

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1809E+02 EXCESS= .0000E+00 OUTFLOW= .1811E+02 BASIN STORAGE= .6977E-04 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .74

WA16AR	MANE	.57	375.71	240.81	.49	5.00	375.53	240.00	.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3657E+02 EXCESS= .0000E+00 OUTFLOW= .3659E+02 BASIN STORAGE= .7117E-04 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .87

WA16AR	MANE	.52	516.74	236.23	.71	5.00	514.40	235.00	.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5255E+02 EXCESS= .0000E+00 OUTFLOW= .5257E+02 BASIN STORAGE= .6491E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= 1.00

WA16AR	MANE	.50	645.82	235.71	.94	5.00	645.57	235.00	.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6938E+02 EXCESS= .0000E+00 OUTFLOW= .6941E+02 BASIN STORAGE= .6830E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .97

WA16AR	MANE	.58	616.96	235.97	.88	5.00	616.50	235.00	.88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6546E+02 EXCESS= .0000E+00 OUTFLOW= .6548E+02 BASIN STORAGE= .6550E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .95

WA16AR	MANE	.51	598.27	236.07	.85	5.00	597.19	235.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6285E+02 EXCESS= .0000E+00 OUTFLOW= .6287E+02 BASIN STORAGE= .7089E-04 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .93

WA16AR	MANE	.64	578.81	236.23	.81	5.00	577.81	235.00	.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6025E+02 EXCESS= .0000E+00 OUTFLOW= .6027E+02 BASIN STORAGE= .6621E-04 PERCENT ERROR= .0

```
         FOR PLAN = 1  RATIO=  .57
           WA17AR  MANE          .39    226.62    235.93       .27      5.00    225.96    235.00         .27

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2195E+02 EXCESS= .0000E+00 OUTFLOW= .2195E+02 BASIN STORAGE= .4320E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .74
           WA17AR  MANE          .32    430.72    235.29       .53      5.00    430.37    235.00         .53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4265E+02 EXCESS= .0000E+00 OUTFLOW= .4265E+02 BASIN STORAGE= .4410E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .87
           WA17AR  MANE          .32    589.45    235.07       .76      5.00    589.38    235.00         .76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6043E+02 EXCESS= .0000E+00 OUTFLOW= .6043E+02 BASIN STORAGE= .4471E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO= 1.00
           WA17AR  MANE          .23    742.76    230.56       .99      5.00    740.77    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7914E+02 EXCESS= .0000E+00 OUTFLOW= .7914E+02 BASIN STORAGE= .4484E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .97
           WA17AR  MANE          .25    706.61    230.69       .93      5.00    704.65    235.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7478E+02 EXCESS= .0000E+00 OUTFLOW= .7478E+02 BASIN STORAGE= .4475E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .95
           WA17AR  MANE          .26    682.69    230.53       .90      5.00    682.69    235.00         .90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7187E+02 EXCESS= .0000E+00 OUTFLOW= .7187E+02 BASIN STORAGE= .4262E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .93
           WA17AR  MANE          .28    660.59    235.15       .86      5.00    660.59    235.00         .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6899E+02 EXCESS= .0000E+00 OUTFLOW= .6899E+02 BASIN STORAGE= .4262E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .57
           WA18AR  MANE          .44    228.79    235.80       .28      5.00    227.81    235.00         .28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2238E+02 EXCESS= .0000E+00 OUTFLOW= .2239E+02 BASIN STORAGE= .7260E-04 PERCENT ERROR=    .0

         FOR PLAN = 1  RATIO=  .74
           WA18AR  MANE          .37    434.71    235.46       .54      5.00    434.20    235.00         .54
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4335E+02 EXCESS= .0000E+00 OUTFLOW= .4336E+02 BASIN STORAGE= .7240E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
            WA18AR  MANE          .35    595.05    235.28       .76      5.00    594.84    235.00          .76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6136E+02 EXCESS= .0000E+00 OUTFLOW= .6137E+02 BASIN STORAGE= .6902E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO= 1.00
            WA18AR  MANE          .22    750.64    230.41       .99      5.00    748.05    230.00          .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8032E+02 EXCESS= .0000E+00 OUTFLOW= .8033E+02 BASIN STORAGE= .7489E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .97
            WA18AR  MANE          .31    713.92    230.80       .94      5.00    711.87    235.00          .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7591E+02 EXCESS= .0000E+00 OUTFLOW= .7591E+02 BASIN STORAGE= .7393E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .95
            WA18AR  MANE          .23    689.70    230.60       .90      5.00    689.54    235.00          .90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7297E+02 EXCESS= .0000E+00 OUTFLOW= .7297E+02 BASIN STORAGE= .7521E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .93
            WA18AR  MANE          .29    667.05    235.15       .87      5.00    667.01    235.00          .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7005E+02 EXCESS= .0000E+00 OUTFLOW= .7005E+02 BASIN STORAGE= .7199E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .57
            WA17BR  MANE         3.52     30.48    233.33       .55      5.00     30.48    235.00          .55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2649E+01 EXCESS= .0000E+00 OUTFLOW= .2656E+01 BASIN STORAGE= .3962E-03 PERCENT ERROR=   -.3

          FOR PLAN = 1  RATIO=  .74
            WA17BR  MANE         3.03     49.95    231.60       .89      5.00     49.10    235.00          .89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4309E+01 EXCESS= .0000E+00 OUTFLOW= .4317E+01 BASIN STORAGE= .4450E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .87
            WA17BR  MANE         2.68     65.88    230.44      1.17      5.00     65.47    230.00         1.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5686E+01 EXCESS= .0000E+00 OUTFLOW= .5697E+01 BASIN STORAGE= .3745E-03 PERCENT ERROR=   -.2
```

FOR PLAN = 1 RATIO= 1.00
WA17BR MANE 2.43 82.01 230.39 1.47 5.00 81.71 230.00 1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7129E+01 EXCESS= .0000E+00 OUTFLOW= .7143E+01 BASIN STORAGE= .3435E-03 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .97
WA17BR MANE 2.55 77.90 231.16 1.41 5.00 77.44 230.00 1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6791E+01 EXCESS= .0000E+00 OUTFLOW= .6827E+01 BASIN STORAGE= .3659E-03 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .95
WA17BR MANE 2.50 75.25 231.59 1.36 5.00 75.07 230.00 1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6567E+01 EXCESS= .0000E+00 OUTFLOW= .6588E+01 BASIN STORAGE= .4714E-03 PERCENT ERROR= -.3

FOR PLAN = 1 RATIO= .93
WA17BR MANE 2.55 73.00 231.12 1.31 5.00 72.48 230.00 1.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6345E+01 EXCESS= .0000E+00 OUTFLOW= .6374E+01 BASIN STORAGE= .3957E-03 PERCENT ERROR= -.5

FOR PLAN = 1 RATIO= .57
VG07AR MANE 2.89 62.31 231.15 .69 5.00 62.02 230.00 .69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5069E+01 EXCESS= .0000E+00 OUTFLOW= .5087E+01 BASIN STORAGE= .4557E-03 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .74
VG07AR MANE 2.53 95.37 229.51 1.07 5.00 94.82 230.00 1.08

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7848E+01 EXCESS= .0000E+00 OUTFLOW= .7882E+01 BASIN STORAGE= .4699E-03 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .87
VG07AR MANE 2.30 121.44 228.49 1.38 5.00 119.97 230.00 1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1010E+02 EXCESS= .0000E+00 OUTFLOW= .1014E+02 BASIN STORAGE= .4408E-03 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= 1.00
VG07AR MANE 2.20 147.95 227.74 1.70 5.00 146.60 225.00 1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1243E+02 EXCESS= .0000E+00 OUTFLOW= .1248E+02 BASIN STORAGE= .4782E-03 PERCENT ERROR= -.4

FOR PLAN = 1 RATIO= .97
VG07AR MANE 2.16 141.91 228.46 1.63 5.00 140.85 225.00 1.63

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1188E+02 EXCESS= .0000E+00 OUTFLOW= .1194E+02 BASIN STORAGE= .5093E-03 PERCENT ERROR=   -.4

          FOR PLAN = 1  RATIO=  .95
            VG07AR  MANE          2.22    137.71    228.88      1.58      5.00    137.09    225.00         1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1152E+02 EXCESS= .0000E+00 OUTFLOW= .1158E+02 BASIN STORAGE= .4486E-03 PERCENT ERROR=   -.5

          FOR PLAN = 1  RATIO=  .93
            VG07AR  MANE          2.21    133.68    228.10      1.53      5.00    132.07    230.00         1.53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1117E+02 EXCESS= .0000E+00 OUTFLOW= .1121E+02 BASIN STORAGE= .5516E-03 PERCENT ERROR=   -.4

          FOR PLAN = 1  RATIO=  .57
             VG08R  MANE          2.12     78.45    233.62       .62      5.00     77.87    235.00          .62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6586E+01 EXCESS= .0000E+00 OUTFLOW= .6587E+01 BASIN STORAGE= .8459E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             VG08R  MANE          1.71    123.15    232.38       .99      5.00    122.17    230.00          .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1042E+02 EXCESS= .0000E+00 OUTFLOW= .1043E+02 BASIN STORAGE= .8611E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .87
             VG08R  MANE          1.54    158.39    232.95      1.28      5.00    158.24    230.00         1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1353E+02 EXCESS= .0000E+00 OUTFLOW= .1356E+02 BASIN STORAGE= .7685E-03 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO= 1.00
             VG08R  MANE          1.53    195.57    228.51      1.59      5.00    195.28    230.00         1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1679E+02 EXCESS= .0000E+00 OUTFLOW= .1680E+02 BASIN STORAGE= .8950E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .97
             VG08R  MANE          1.56    187.16    228.95      1.52      5.00    186.82    230.00         1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1604E+02 EXCESS= .0000E+00 OUTFLOW= .1605E+02 BASIN STORAGE= .9001E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .95
             VG08R  MANE          1.50    182.02    228.24      1.47      5.00    181.40    230.00         1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1554E+02 EXCESS= .0000E+00 OUTFLOW= .1556E+02 BASIN STORAGE= .8237E-03 PERCENT ERROR=   -.1
```

```
        FOR PLAN = 1  RATIO=  .93
           VG08R  MANE          1.59     175.32     229.59      1.42       5.00     175.30    230.00        1.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1502E+02 EXCESS= .0000E+00 OUTFLOW= .1503E+02 BASIN STORAGE= .8875E-03 PERCENT ERROR=   -.1

        FOR PLAN = 1  RATIO=  .57
           RVG11  MANE          1.95       8.16     247.55     -1.00       5.00       8.15    245.00       -1.00

        FOR PLAN = 1  RATIO=  .74
           RVG11  MANE          1.64      13.44     243.45     -1.00       5.00      13.42    245.00       -1.00

        FOR PLAN = 1  RATIO=  .87
           RVG11  MANE          1.39      17.77     242.61     -1.00       5.00      17.69    245.00       -1.00

        FOR PLAN = 1  RATIO= 1.00
           RVG11  MANE          1.29      22.23     241.75     -1.00       5.00      22.17    240.00       -1.00

        FOR PLAN = 1  RATIO=  .97
           RVG11  MANE          1.41      21.18     243.03     -1.00       5.00      21.12    240.00       -1.00

        FOR PLAN = 1  RATIO=  .95
           RVG11  MANE          1.37      20.50     243.00     -1.00       5.00      20.42    240.00       -1.00

        FOR PLAN = 1  RATIO=  .93
           RVG11  MANE          1.32      19.81     242.19     -1.00       5.00      19.73    240.00       -1.00


*** NORMAL END OF HEC-1 ***
NORMAL END OF HEC-1
```

APPENDIX C

HYDROGOLIC CALCULATIONS
TRIBUTARY WATERSHEDS

"B" STREET - WATERSHED

(square miles)

Reference Basin	Total Basin Area (mi^2)	Adams	Jeffferson	Madison	Monroe	Jackson	Van Buren	Harrison
WA19C	0.0107	0.0086						
VG07A	0.1376			0.1376				
VG08	0.0608			0.0608				
VG09	0.0584		0.0299	0.0274				
VG10	0.0930				0.0930			
VG11	0.0660				0.0300	0.0300		
VG12	0.0510						0.0362	0.0069
TOTAL TRIBUTARY AREA (mi^2):		0.0086	0.0299	0.2258	0.1230	0.0300	0.0362	0.0069
OVERALL WATERSHED:		WA19C	VG09	VG09C	CVG11	VG11	VG12	VG12
TOTAL WATERSHED AREA (mi^2):		0.0107	0.0584	0.2600	0.1600	0.0660	0.0510	0.0510
RATIO (street/overall watershed):		80%	51%	87%	77%	45%	71%	14%

FLOW ON STREET

(CFS)

Related Basin	WA19C	VG09	VG09C	CVG11	VG11	VG12	VG12
Total Q_{10}	7	22	93	36	20	17	17
Street Q_{10}	6	12	32	28	10	13	3
Total Q_{100}	16	60	240	97	57	46	46
Street Q_{100}	13	31	209	75	26	33	7
STREET NAME:	Adams	Jeffferson	Madison	Monroe	Jackson	Van Buren	Harrison

APPENDIX D

HYDRAULIC CALCULATIONS
EXISITNG STORM DRAIN INLET ANALYSIS

STORM DRAIN ANALYSIS
FOR
MCWILLIAMS AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: MCWILLIAMS AVENUE AT E STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	ACTUAL FLOW DEPTH @ FACILITY (FT.)	ACTUAL CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
42' CURB OPENING D.I.	0.0069	189.00	1.10	59.18	0.94	53.00	53.00	53.00	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE
11'5" x 19'0" CONCRETE APRON	0.01	36.00	1.00	62.72	0.21	3.18		36.00	WEIR FLOW ASSUMING 100% CLOGGED @ DROP INLET
3'5" x 5'0" GRATE OPENING	0.01	3.18	1.00	25.25	0.21	2.43	2.43		FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 89.00 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 55.43 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS)	189.00	CFS
ANTICIPATED DISCHARGE ROUTED (CFS)	53.00	CFS
ANTICIPATED EXCESS FLOW (CFS)	136.00	CFS

100-YEAR @ MCWILLIAMS AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' MCWILLIAMS AVENUE SECTION
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.006900 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 189.00 cfs ←

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	1.10	ft
Flow Area	29.04	ft^2
Wetted Perimeter	39.12	ft
Top Width	37.00	ft
Height	1.10	ft ←
Critical Depth	1.25	ft
Critical Slope	0.003918	ft/ft
Velocity	6.51	ft/s
Velocity Head	0.66	ft
Specific Energy	1.76	ft
Froude Number	1.30	

Flow is supercritical.

Water elevation exceeds lowest end station by 0.60 ft.

Notes:

"B" STREET

DROP INLET @ MCWILLIAMS AVENUE / E STREET - Ideal

CURB OPENING DROP INLET--

Flow depth, y......	1.10	feet	(y/h) percentage.......	189	%
Inlet length, L....	42.0	feet	Weir flow..............	118.61	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	118.36	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	59.18	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

DROP INLET @ MCWILLIAMS AVENUE / E STREET

CURB OPENING DROP INLET--

Flow depth, y......	0.94	feet	(y/h) percentage.......	161	%
Inlet length, L....	42.0	feet	Weir flow..............	93.70	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	106.00	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	53.00	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

SUBMERGED WEIR FLOW AT MCWILLIAMS / E STREET DROP INLET

Given:

$Q_{100} := 189$

Approach flow at drop inlet in cubic feet per seconds (assuming total blockage of drain).

$C_W := 3$

Weir coefficient

$L := 42$

Total weir length in feet

$V := 6.51$

Velocity of flow just upstream from weir in feet per second (see "Madison Avenue" FlowMaster calculations)

$$\Delta h := \left[\left[\frac{Q_{100}}{C_W \cdot \frac{2\cdot\sqrt{64.4}}{3} \cdot L}\right] + \left(\frac{V^2}{64.4}\right)^{\frac{3}{2}}\right]^{\frac{2}{3}} - \frac{V^2}{64.4}$$

Standard formula for weir without end contractions

$\Delta h = 0.21$

Change in flow depth at weir in feet

The Nappe downstream of weir: non-uniform velocity

$$C_1 := \left[0.6035 + 0.0813\cdot\left(\frac{\Delta h}{L}\right) + \frac{0.000295}{L}\right] + \left(1 + \frac{0.00361}{\Delta h}\right)^{\frac{3}{2}}$$

$C_1 = 1.63$

Non-uniform velocity distribution coefficient

$$Q_{freeflow} := \frac{2\cdot C_1 \cdot L \cdot \sqrt{64.4}}{3}\cdot \Delta h^{\frac{3}{2}}$$

Standard formula for weir without end contractions

$Q_{freeflow} = 36$

Discharge downstream of weir in cubic feet per second

CAPACITY - WEIR FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ MCWILLIAMS/E STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.010000	ft/ft
Water Surface Elevation	0.21	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.42	0.013
4.00	0.00			
7.42	0.00			
11.42	1.00			

Results		
Wtd. Mannings Coefficient	0.013	
Discharge	3.18	cfs
Flow Area	0.89	ft²
Wetted Perimeter	5.15	ft
Top Width	5.10	ft
Height	0.21	ft
Critical Depth	0.27	ft
Critical Slope	0.004166	ft/ft
Velocity	3.56	ft/s
Velocity Head	0.20	ft
Specific Energy	0.41	ft
Froude Number	1.50	

Flow is supercritical.

IDEAL CAPACITY
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ MCWILLIAMS/E STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data

Channel Slope	0.010000	ft/ft
Water Surface Elevation	1.00	ft ←

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.42	0.013
4.00	0.00			
7.42	0.00			
11.42	1.00			

Results

Wtd. Mannings Coefficient	0.013	
Discharge	62.72	cfs ←
Flow Area	7.42	ft^2
Wetted Perimeter	11.67	ft
Top Width	11.42	ft
Height	1.00	ft
Critical Depth	1.33	ft
Critical Slope	0.002746	ft/ft
Velocity	8.45	ft/s
Velocity Head	1.11	ft
Specific Energy	2.11	ft
Froude Number	1.85	

Flow is supercritical.

3' 5" x 5' 0" GRATE OPENING @ MCWILLIAMS/E STREET

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..........	0.21	feet	Weir flow..............	4.86	cfs
Grate clear opening a	14.77	sq.ft.	Orifice flow...........	36.37	cfs
Grate Perimeter, P.....	16.83	feet	Weir Intercepted flow..	2.43	cfs
Clogging factor........	50	%	Orfice Intercepted flow	18.18	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

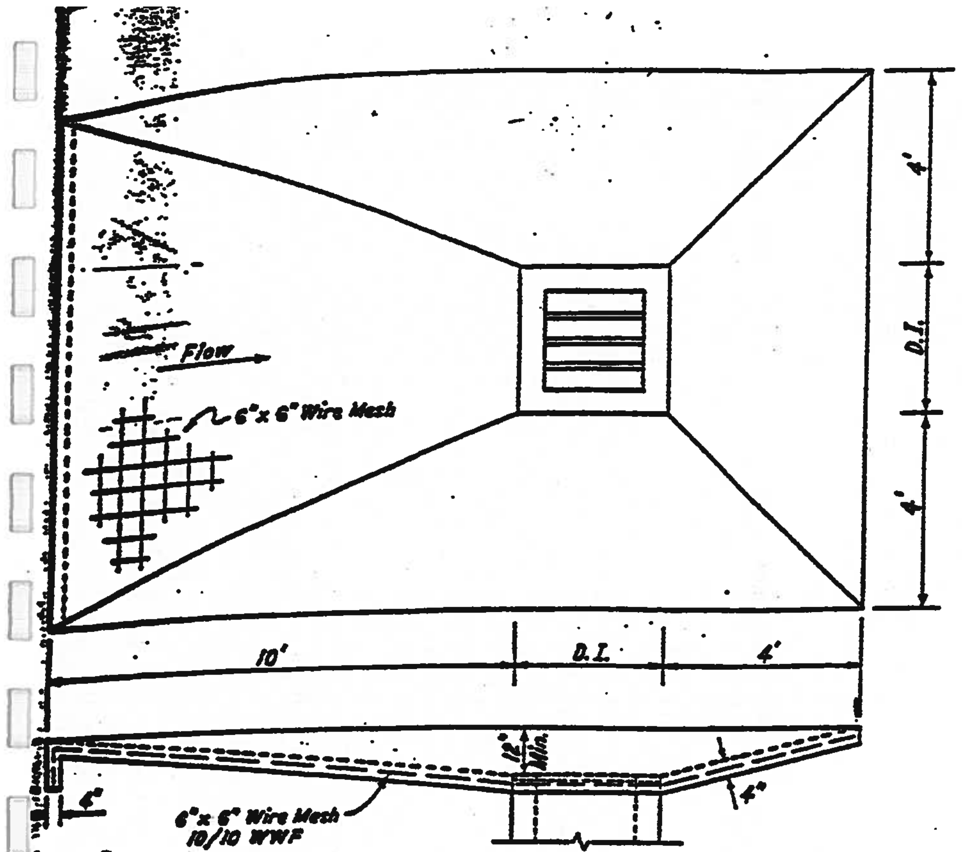
3' 5" x 5' 0" GRATE OPENING @ MCWILLIAMS/E STREET - IDEAL CONDITION

RECTANGULAR GRATE INLET -- SUMP

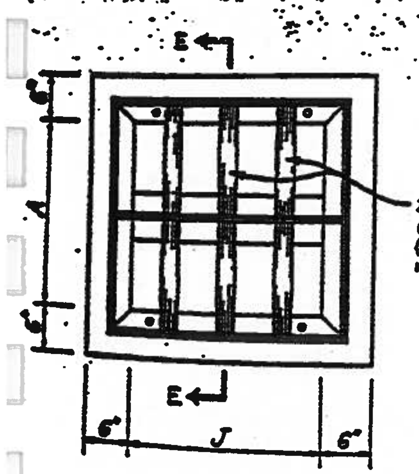
Flow depth, y..........	1.00	feet	Weir flow..............	50.50	cfs
Grate clear opening a:	14.77	sq.ft.	Orifice flow...........	79.36	cfs
Grate Perimeter, P.....	16.83	feet	Weir Intercepted flow..	25.25	cfs
Clogging factor........	50	%	Orfice Intercepted flow	39.68	cfs

Note:

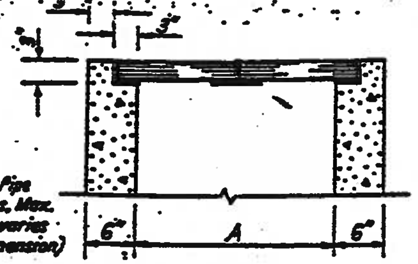
1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.



CONCRETE APRON



PLAN

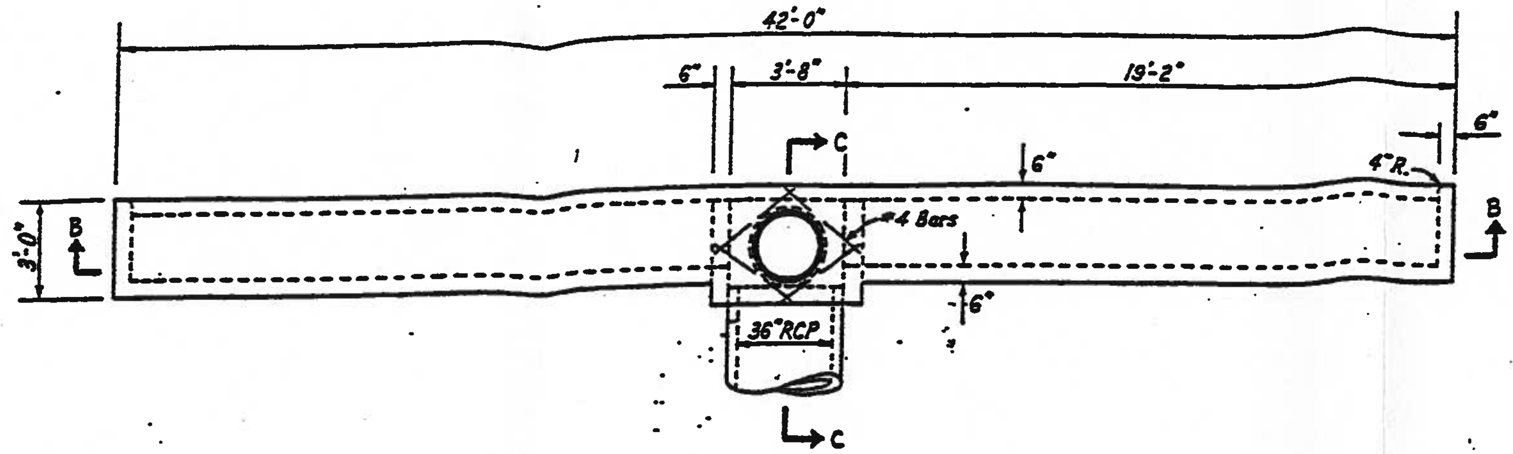


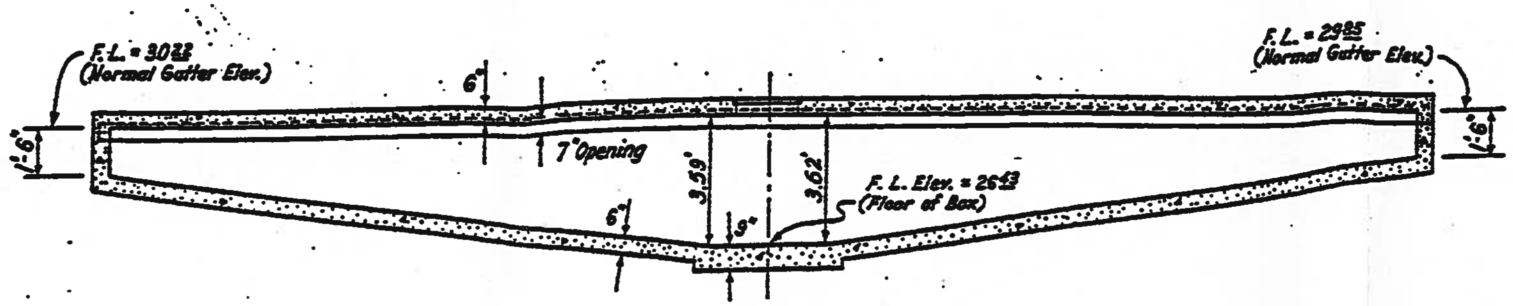
SEC. E-E

Station	A	J	Concrete	Reinf. Steel	Struc. Steel	G. E.
140' Lt "Fwy" 515+62	3'-0"	3'-0"	1.17 Cu. Yd.	56 Lb.	210 Lb. 5 Pipe	32.80'
148' Lt "Fwy" 520+20	4'-3"	4'-2"	1.96 Cu. Yd.	80 Lb.	318 Lb. 7 Pipe	29.16'
198' Lt "Fwy" 534+95	3'-0"	6'-10"	3.36 Cu. Yd.	158 Lb.	406 Lb. 12 Pipe	16.60'

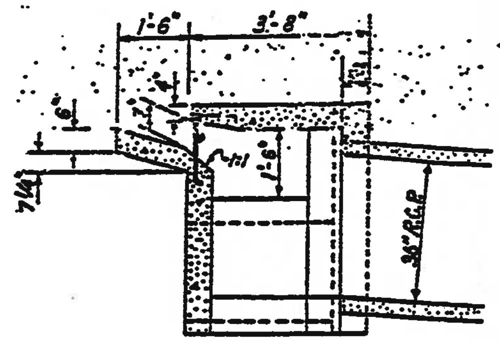
Note: For details not shown see Type 2A Drop Inlet (Sheet R-4.2.2).

MODIFIED TYPE 2A DROP INLET

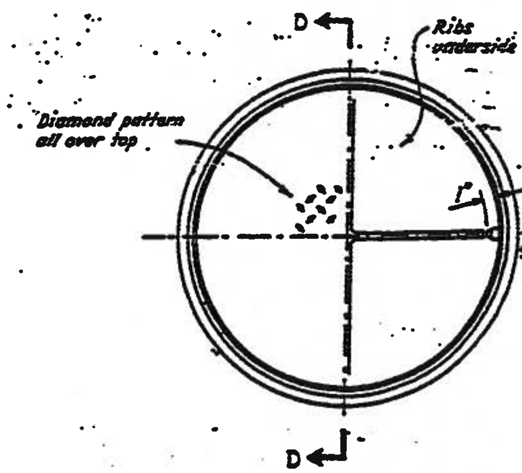




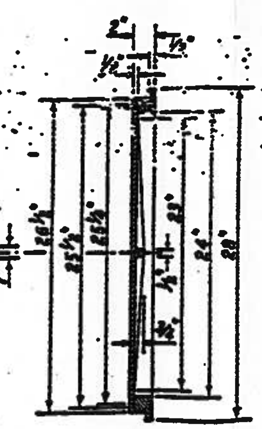
SEC. B-B



SEC. C-C



MANHOLE COVER, SIDEWALK TYPE, CAST IRON, APPROX. WT. 122 LBS.



SEC. D-D

Note: For details not shown see Standard Sheet R-4.5.1

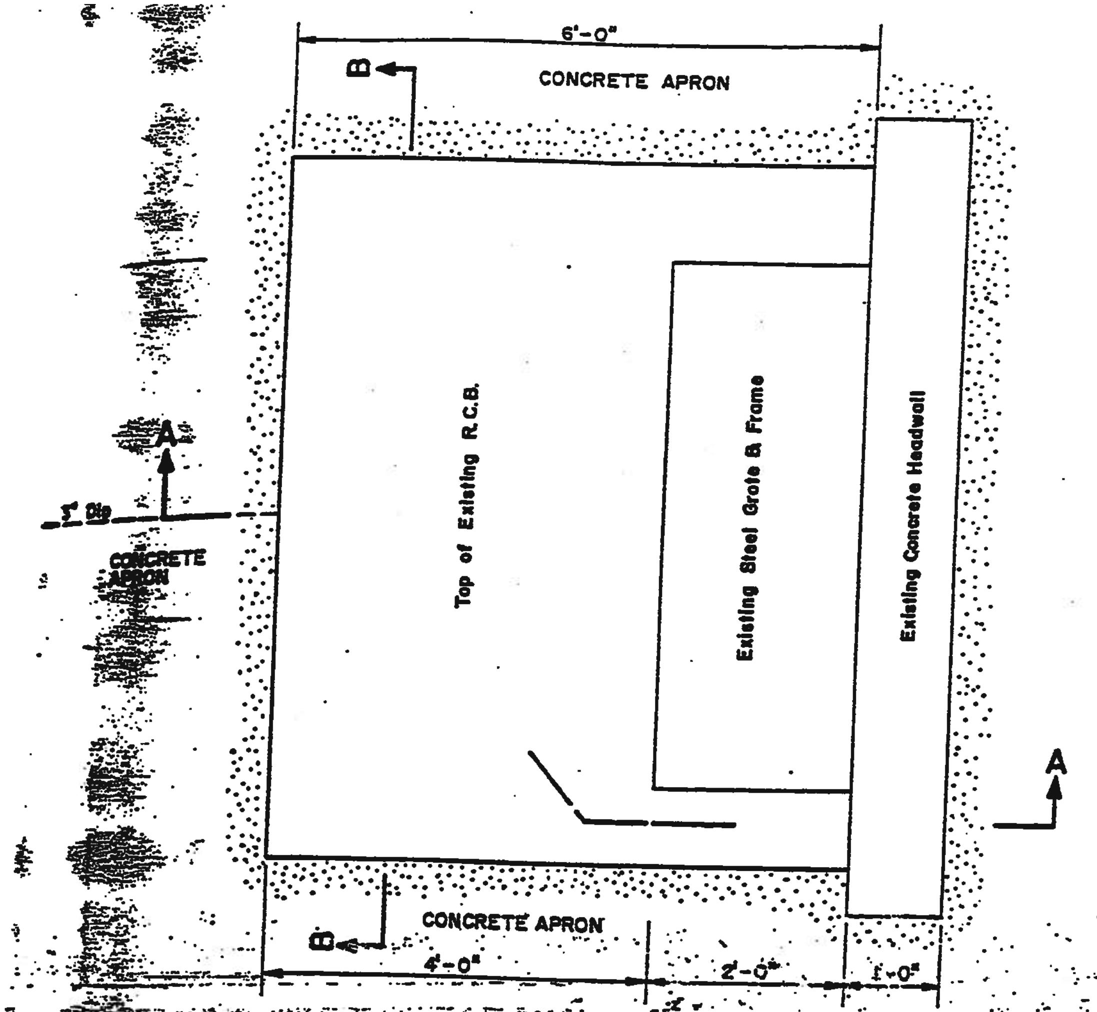
MODIFIED TYPE 4 DROP INLET

"ME" 0 + 21.04 to "ME" 0 + 53.48

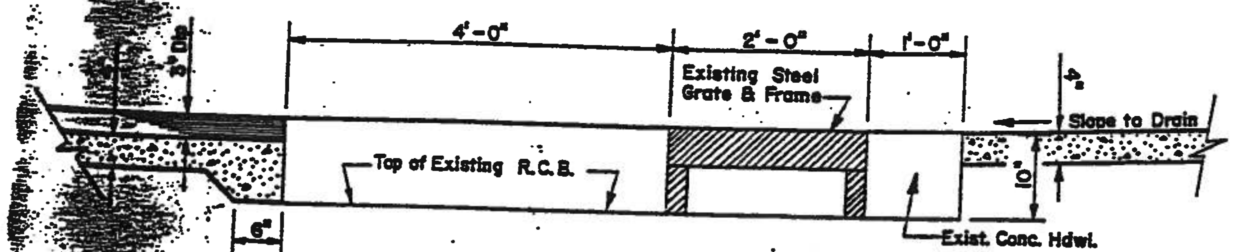
STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

DRAINAGE DETAILS

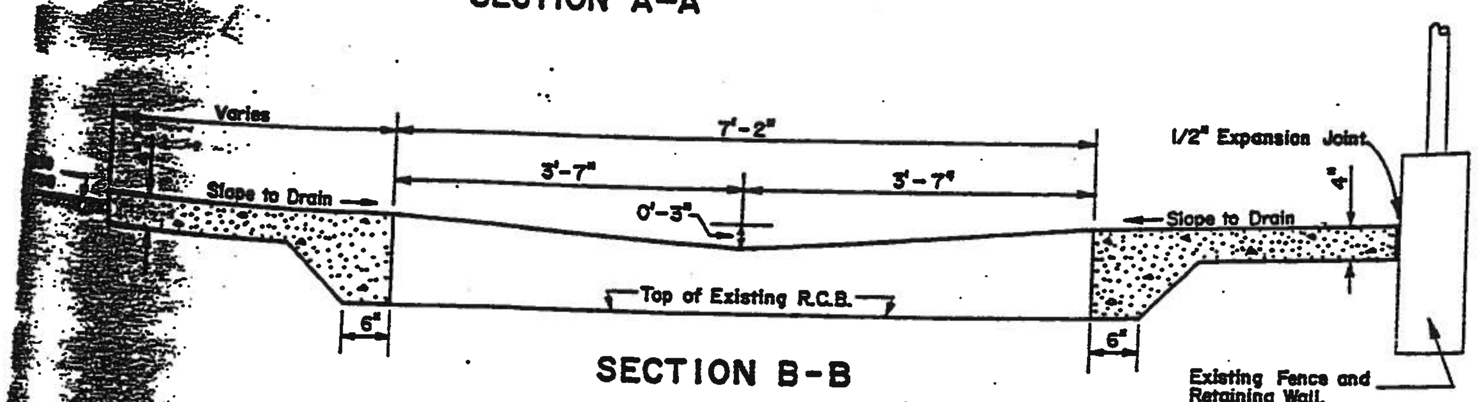
A-6 1538



PLAN



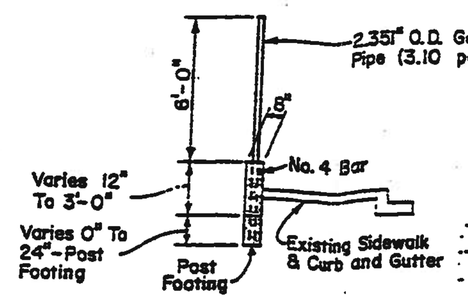
SECTION A-A



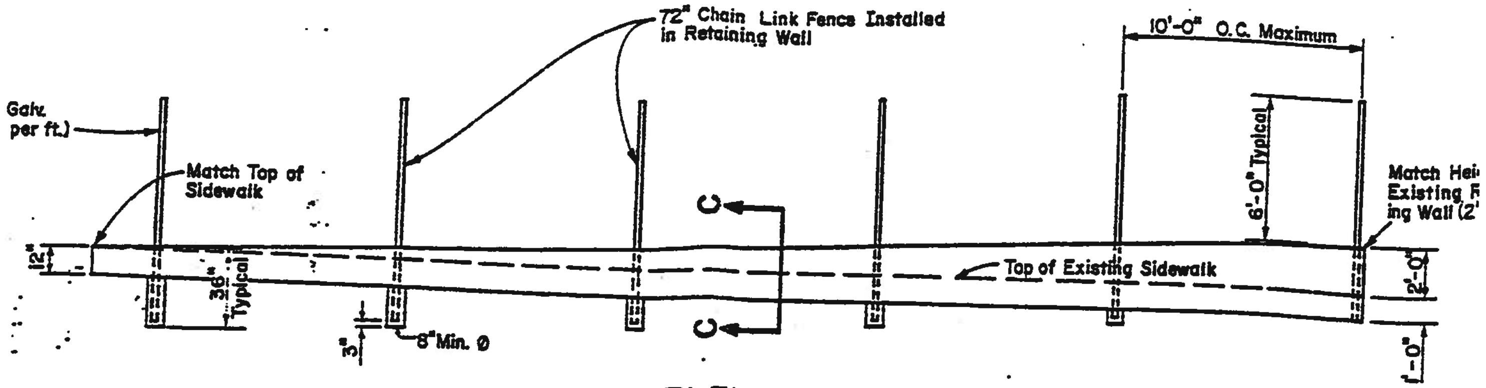
SECTION B-B

MODIFIED EXISTING DROP INLET

(212'± RT. OF "B" 19+00±)



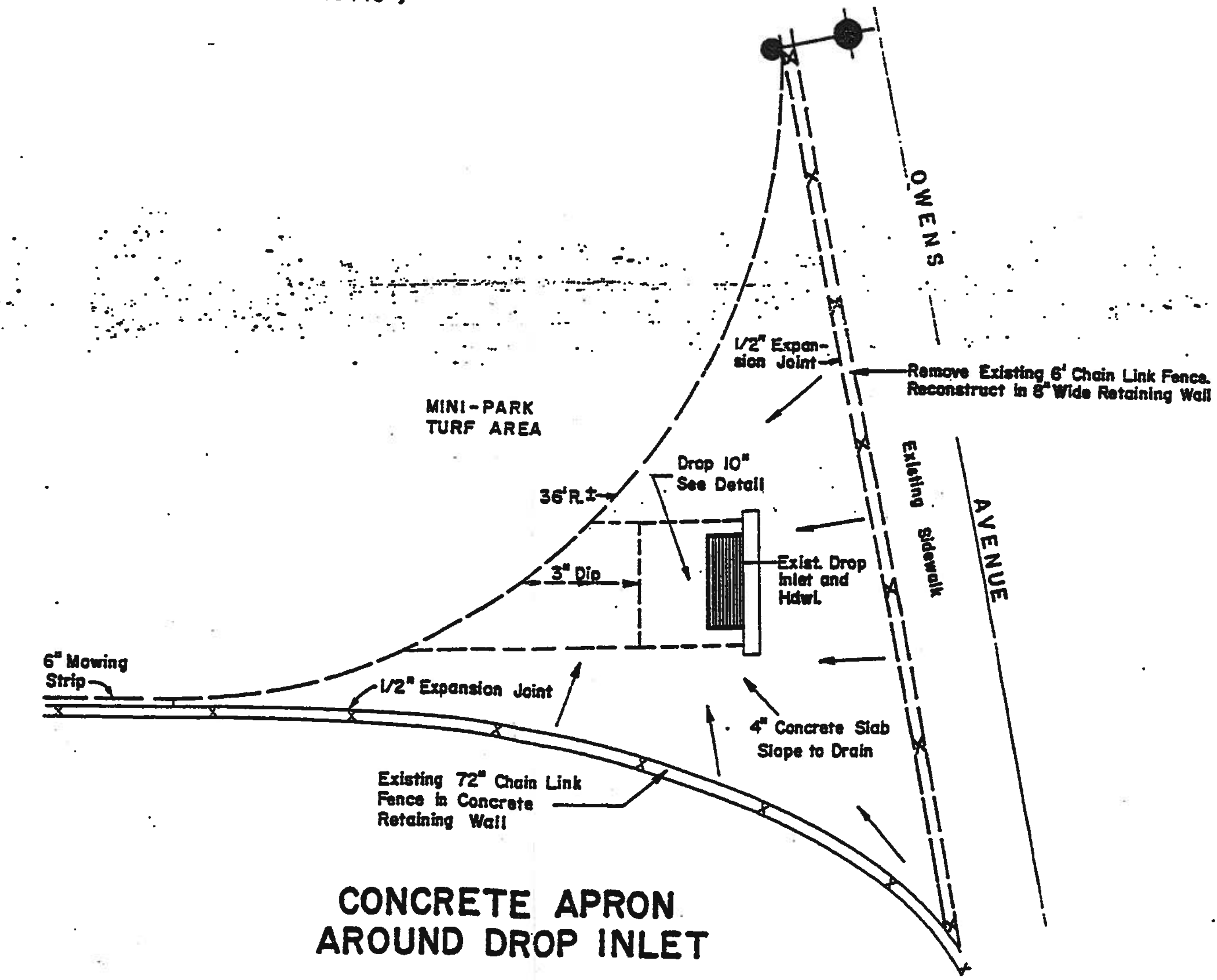
SECTION C-C



ELEVATION

FENCE IN RETAINING WALL

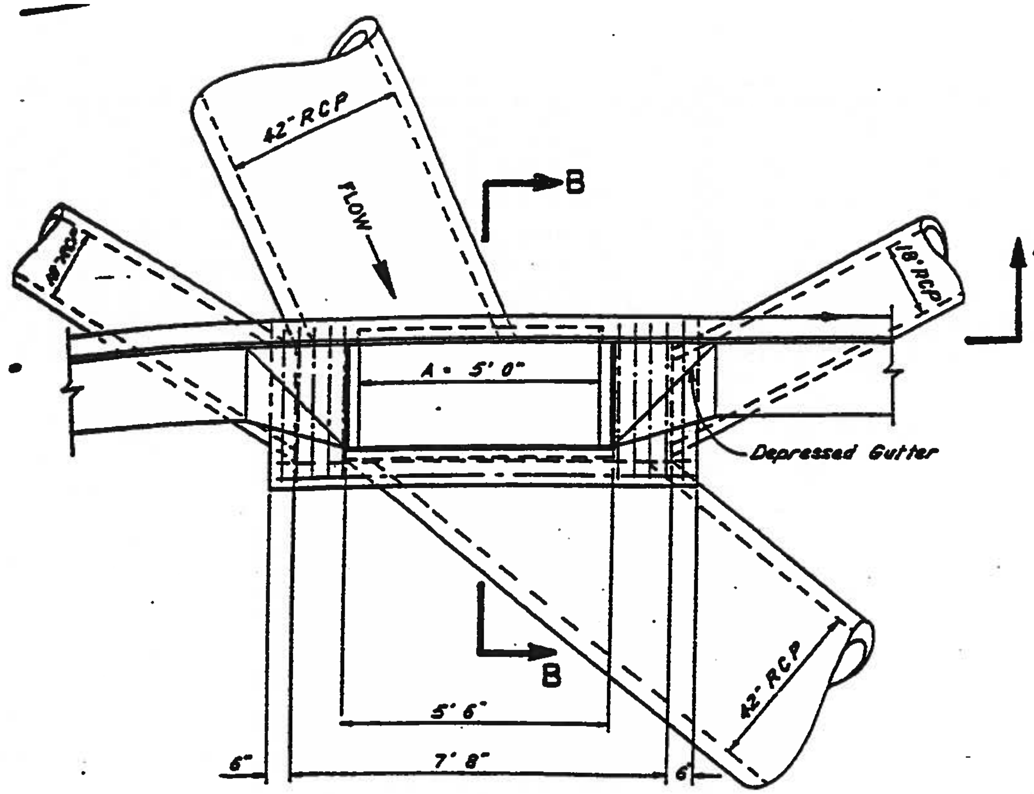
(200'± RT. OF "B" 19+10±)



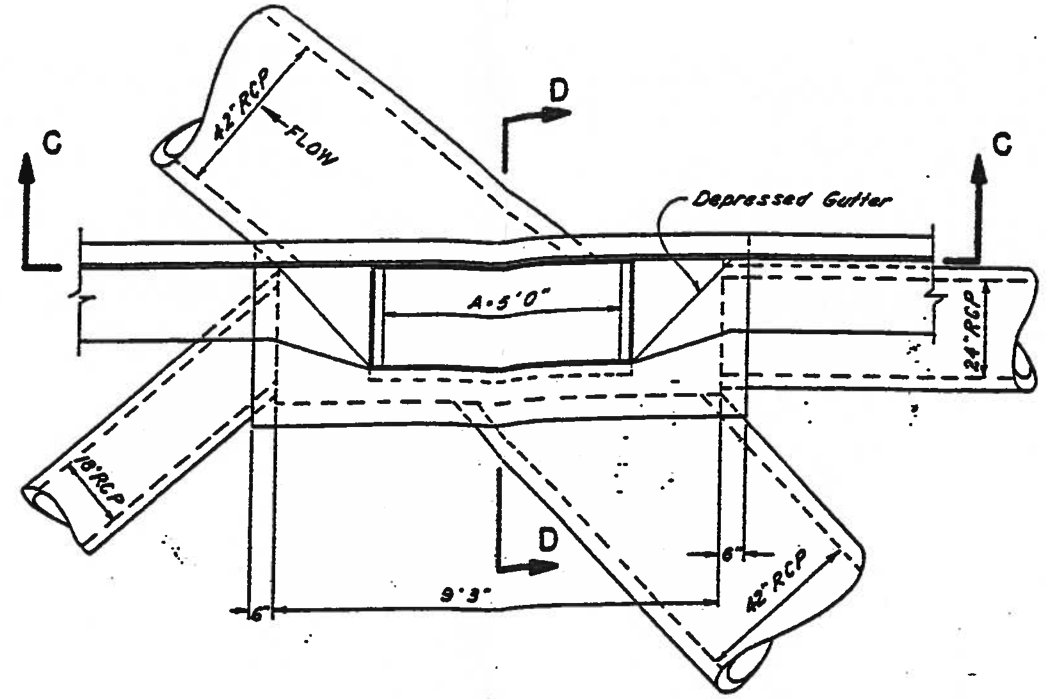
CONCRETE APRON AROUND DROP INLET

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

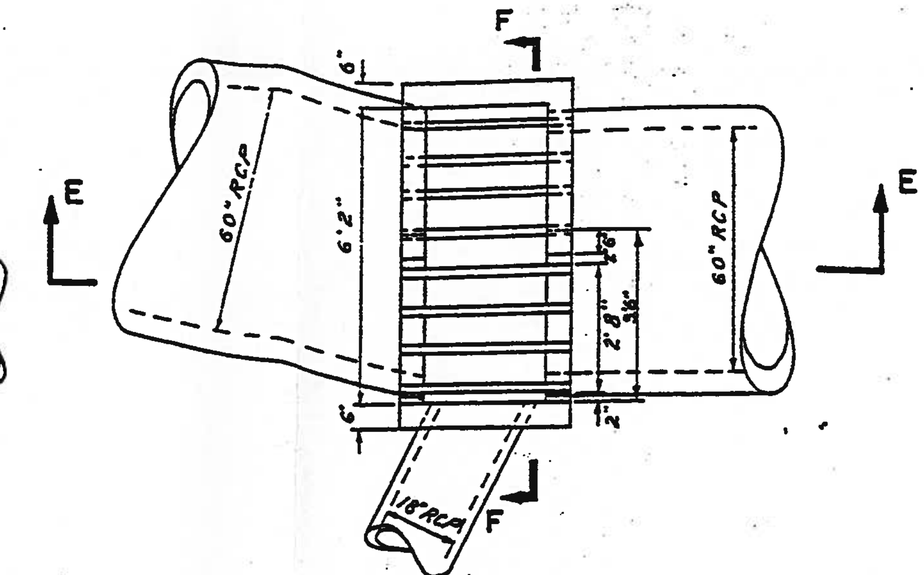
SPECIAL DETAILS



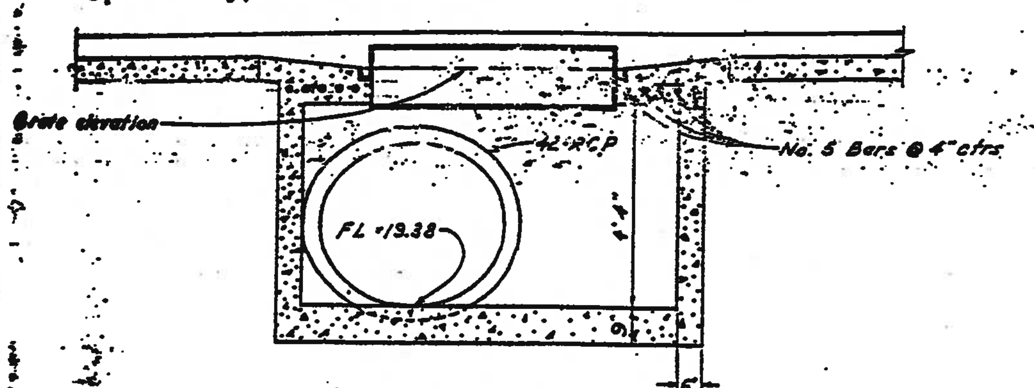
PLAN VIEW
Special Type 3 D.I. 35.5' Lt "D"-8+08



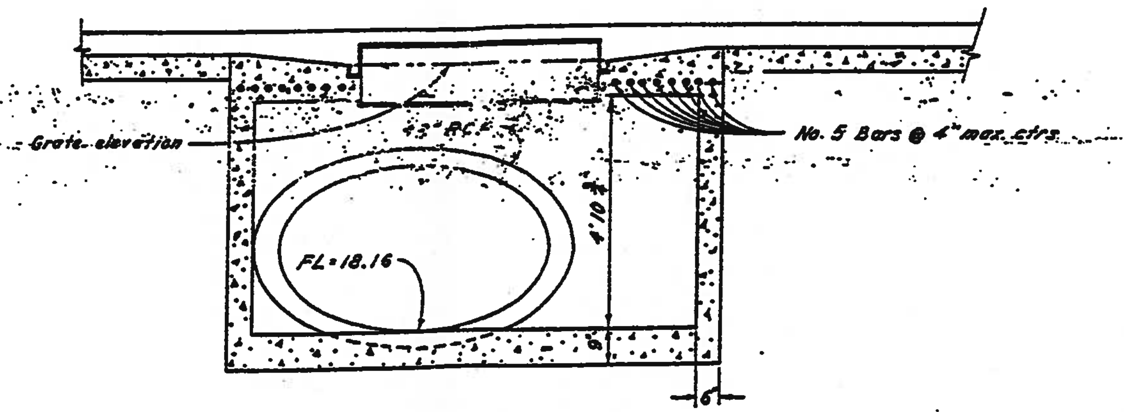
PLAN VIEW
Special Type 3 D.I. 35.5' Rt "D"~8+82.11



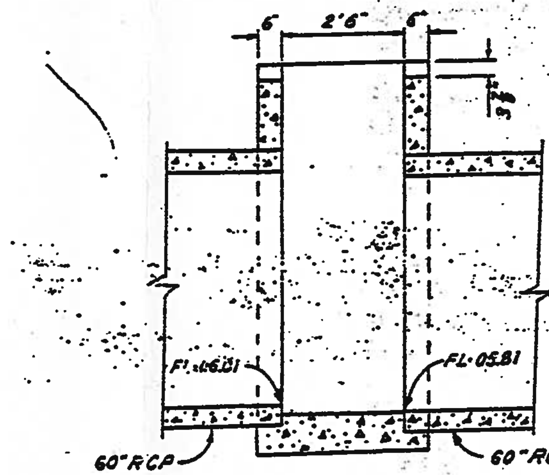
PLAN VIEW
Special Type 7 D.I. 120' Lt "Fwy"~539+75±



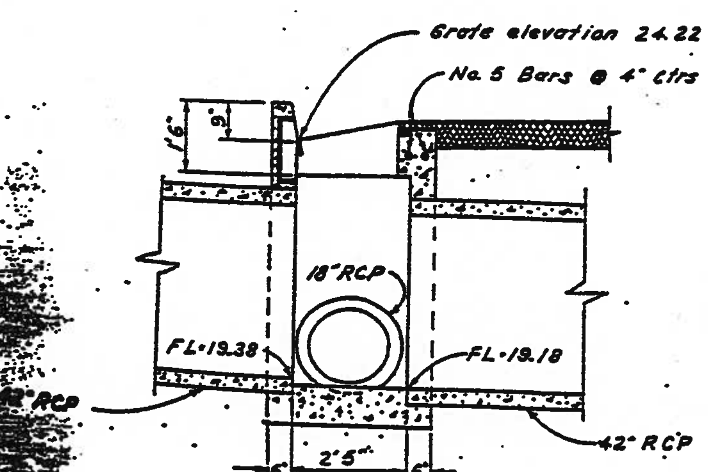
SECTION AA



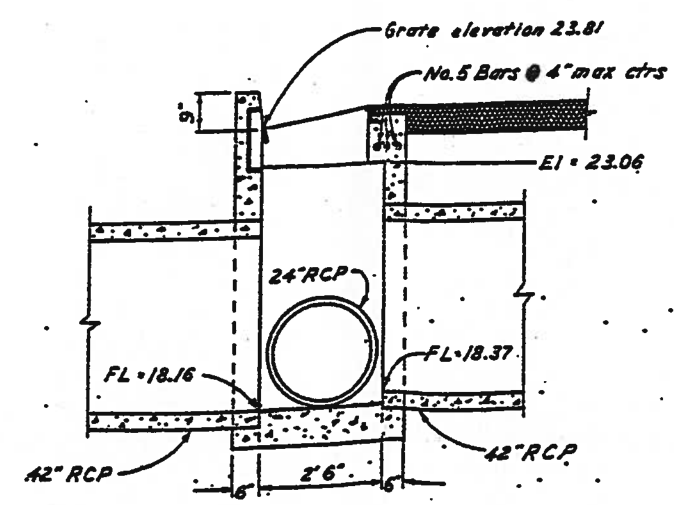
SECTION CC



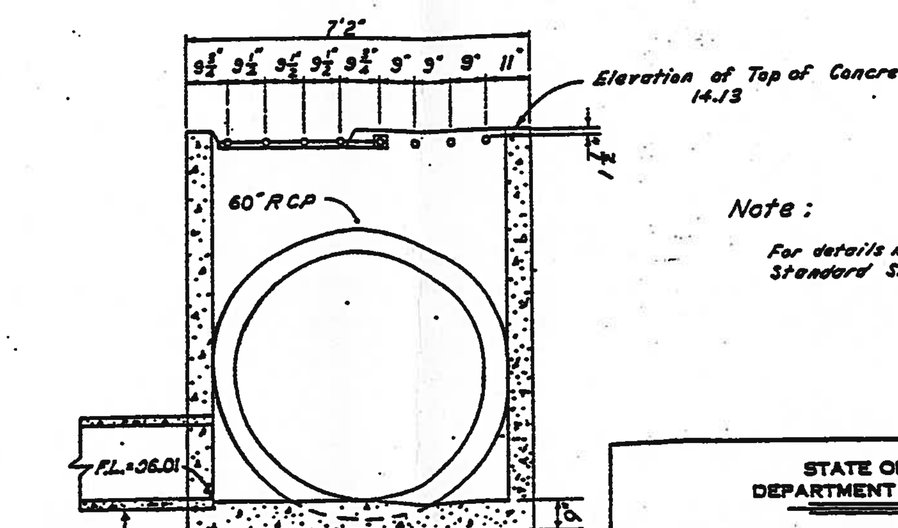
SECTION EE



SECTION BB



SECTION DD

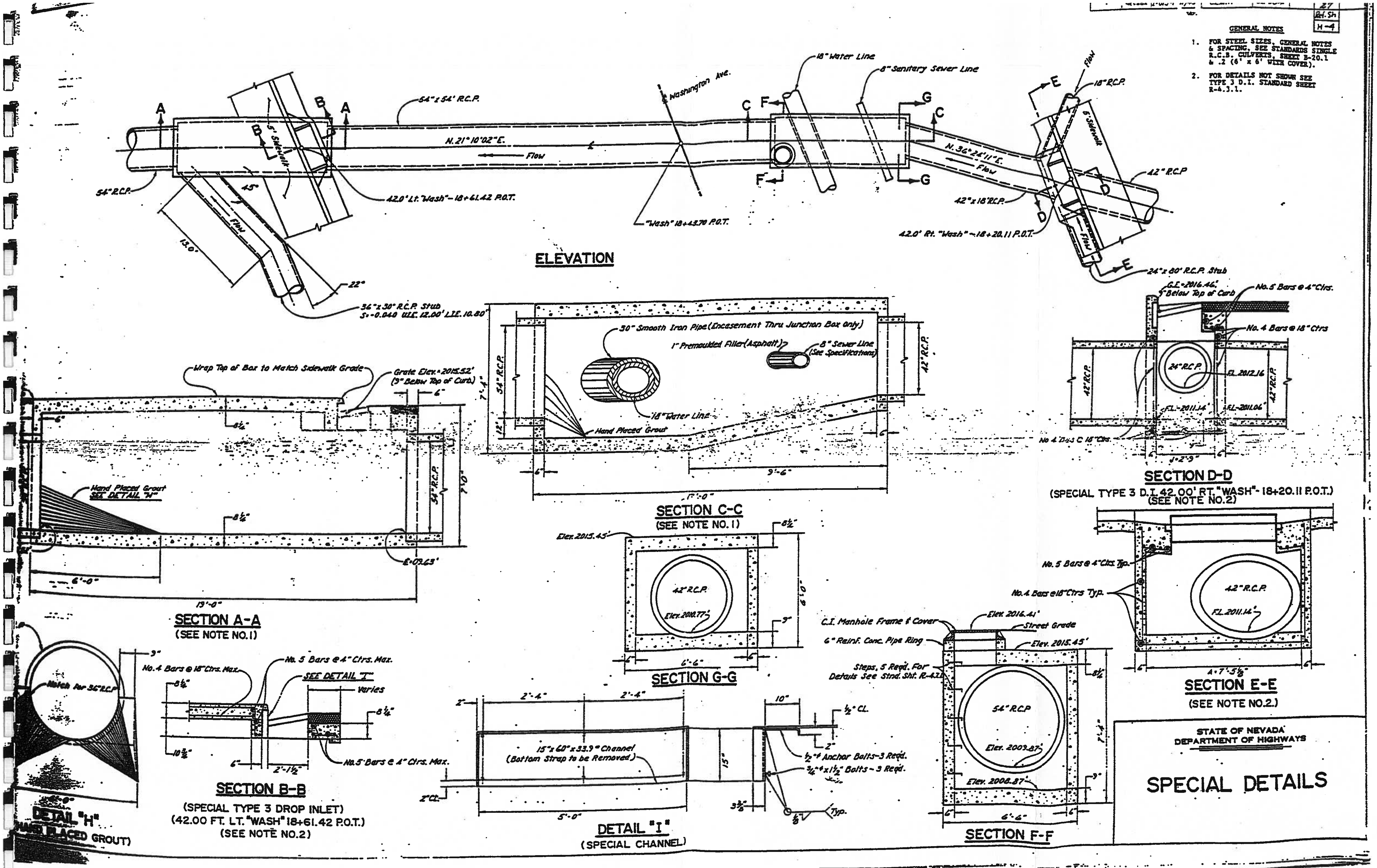


SECTION FF

Note :
For details not shown, see Standard Sheets.

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

DRAINAGE DETAILS



GENERAL NOTES
1. FOR STEEL SIZES, GENERAL NOTES & SPACING, SEE STANDARDS SINGLE R.C.B. CULVERTS, SHEET B-20.1 & .2 (6' x 6' WITH COVER).
2. FOR DETAILS NOT SHOWN SEE TYPE 3 D.I. STANDARD SHEET R-4.3.1.
ELEVATION
54" x 54" R.C.P.
54" R.C.P.
N. 21° 10' 02" E.
Flow
Washington Ave.
18" Water Line
8" Sanitary Sewer Line
18" R.C.P.
N. 36° 24' 11" E.
42" R.C.P.
42" x 18" R.C.P.
42.0' Lt. "Wash" - 18+61.42 P.O.T.
"Wash" 18+43.70 P.O.T.
42.0' Rt. "Wash" - 18+20.11 P.O.T.
24" x 80" R.C.P. Stub
36" x 30" R.C.P. Stub S = -0.040 U.I.E. 12.00' L.I.E. 10.80'
5' Sidewalk
45°
13.0'
22°
SECTION A-A
(SEE NOTE NO. 1)
Wrap Top of Box to Match Sidewalk Grade
Grate Elev. = 2015.52' (3" Below Top of Curb)
Hand Placed Grout SEE DETAIL "H"
54" R.C.P.
7'-0"
6'-0"
19'-0"
E = 09.63'
SECTION C-C
(SEE NOTE NO. 1)
30" Smooth Iron Pipe (Encasement Thru Junction Box only)
1" Premoulded Filler (Asphalt)
8" Sewer Line (See Specifications)
18" Water Line
Hand Placed Grout
54" R.C.P.
42" R.C.P.
7'-4"
9'-6"
17'-0"
SECTION D-D
(SPECIAL TYPE 3 D.I. 42.00' RT. "WASH" - 18+20.11 P.O.T.)
(SEE NOTE NO. 2)
G.E. = 2016.46' 3" Below Top of Curb
No. 5 Bars @ 4" Ctrs.
No. 4 Bars @ 18" Ctrs.
24" R.C.P.
F.L. 2012.16
F.L. = 2011.14'
F.L. = 2011.06'
42" R.C.P.
No 4 Bars @ 18" Ctrs.
2'-9"
SECTION G-G
Elev. 2015.45'
42" R.C.P.
Elev. 2010.77'
6'-0"
6'-6"
SECTION E-E
(SEE NOTE NO. 2.)
No. 5 Bars @ 4" Ctrs Typ.
No. 4 Bars @ 18" Ctrs Typ.
42" R.C.P.
F.L. 2011.14'
4'-7 5/8"
SECTION F-F
C.I. Manhole Frame & Cover
6" Reinf. Conc. Pipe Ring
Elev. 2016.41'
Street Grade
Elev. 2015.45'
Steps, 5 Reqd. For Details See Stnd. Sht. R-4.3.1
54" R.C.P.
Elev. 2009.87'
Elev. 2008.87'
7'-4"
6'-6"
DETAIL "H"
(HAND PLACED GROUT)
Match For 36" R.C.P.
SECTION B-B
(SPECIAL TYPE 3 DROP INLET)
(42.00 FT. LT. "WASH" 18+61.42 P.O.T.)
(SEE NOTE NO. 2)
No. 4 Bars @ 18" Ctrs. Max.
No. 5 Bars @ 4" Ctrs. Max.
SEE DETAIL "I"
Varies
No. 5 Bars @ 4" Ctrs. Max.
2'-1 1/2"
DETAIL "I"
(SPECIAL CHANNEL)
15" x 60" x 33.9" Channel (Bottom Strap to be Removed)
2'-4"
5'-0"
1/2" Cl.
2" Cl.
1/2" Anchor Bolts - 3 Reqd.
3/4" x 1 1/2" Bolts - 3 Reqd.
Typ.
STATE OF NEVADA
DEPARTMENT OF HIGHWAYS
SPECIAL DETAILS

STORM DRAIN ANALYSIS
FOR
ADAMS AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: ADAMS AVENUE AT NDOT RIGHT-OF-WAY

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	ACTUAL FLOW DEPTH @ FACILITY (FT.)	ACTUAL CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
11'5" x 19'0" CONCRETE APRON	0.025	13	1.00	95.35	0.37	13.56		13.00	FLOW IN RETENTION AT CONCRETE APRON
3'5" x 5'0" GRATE OPENING	0.025	13	1.00	28.50	0.37	6.41	6.41		FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 13.00 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 6.41 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTINCIPATED DISCHARGE TO FACILITY (CFS)	13.00	CFS
ANTINCIPATED ROUTED FLOW (CFS)	6.41	CFS
ANTICIPATED EXCESS FLOW (CFS)	6.59	CFS

3′ 6" x 7′ 2" GRATE OPENING @ ADAMS AVENUE

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.37	feet	Weir flow..............	12.83	cfs
Grate clear opening area, A..	13.33	sq.ft.	Orifice flow...........	43.58	cfs
Grate Perimeter, P.............	19.00	feet	Weir Intercepted flow..	6.41	cfs
Clogging factor................	50 %		Orfice Intercepted flow	21.79	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR @ ADAMS
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ ADAMS & JEFFERSON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.022500	ft/ft
Water Surface Elevation	0.37	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.50	0.013
4.00	0.00			
7.50	0.00			
11.50	1.00			

Results		
Wtd. Mannings Coefficient	0.013	
Discharge	13.56	cfs
Flow Area	1.84	ft^2
Wetted Perimeter	6.55	ft
Top Width	6.46	ft
Height	0.37	ft
Critical Depth	0.61	ft
Critical Slope	0.003333	ft/ft
Velocity	7.36	ft/s
Velocity Head	0.84	ft
Specific Energy	1.21	ft
Froude Number	2.43	

Flow is supercritical.

100-YEAR @ ADAMS AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET SECTION
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.025000 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 13.00 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.37	ft
Flow Area	2.96	ft²
Wetted Perimeter	24.00	ft
Top Width	23.28	ft
Height	0.37	ft
Critical Depth	0.47	ft
Critical Slope	0.005524	ft/ft
Velocity	4.39	ft/s
Velocity Head	0.30	ft
Specific Energy	0.67	ft
Froude Number	2.17	
Flow is supercritical.		
Flow is divided.		

Notes:

"B" STREET

STORM DRAIN ANALYSIS
FOR
JEFFERSON AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: JEFFERSON AVENUE AT NDOT RIGHT-OF-WAY

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	ACTUAL FLOW DEPTH @ FACILITY (FT.)	ACTUAL CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
11'5" x 19'0" CONCRETE APRON	0.0245	31	1.00	99.50	0.49	23.99		31.00	FLOW IN RETENTION AT CONCRETE APRON
3'5" x 5'0" GRATE OPENING	0.0245	31	1.00	28.50	0.49	9.78	9.78		FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 31.00 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 9.78 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTINCIPATED DISCHARGE TO FACILITY (CFS)	31.00	CFS
ANTINCIPATED ROUTED FLOW (CFS)	9.78	CFS
ANTICIPATED EXCESS FLOW (CFS)	21.22	CFS

3' 6" x 7' 2" GRATE OPENING @ JEFFERSON AVENUE

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.49	feet	Weir flow..............	19.55	cfs
Grate clear opening area, A..	13.33	sq.ft.	Orifice flow...........	50.14	cfs
Grate Perimeter, P.............	19.00	feet	Weir Intercepted flow..	9.78	cfs
Clogging factor................	50 %		Orfice Intercepted flow	25.07	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR @ JEFFERSON
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ ADAMS & JEFFERSON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.024500	ft/ft
Water Surface Elevation	0.49	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.50	0.013
4.00	0.00			
7.50	0.00			
11.50	1.00			

Results		
Wtd. Mannings Coefficient	0.013	
Discharge	23.99	cfs
Flow Area	2.68	ft^2
Wetted Perimeter	7.54	ft
Top Width	7.42	ft
Height	0.49	ft
Critical Depth	0.83	ft
Critical Slope	0.003072	ft/ft
Velocity	8.97	ft/s
Velocity Head	1.25	ft
Specific Energy	1.74	ft
Froude Number	2.63	

Flow is supercritical.

100-YEAR @ JEFFERSON AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET SECTION
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.024500 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 31.00 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.49	ft
Flow Area	6.21	ft²
Wetted Perimeter	35.73	ft
Top Width	34.82	ft
Height	0.49	ft
Critical Depth	0.60	ft
Critical Slope	0.005409	ft/ft
Velocity	4.99	ft/s
Velocity Head	0.39	ft
Specific Energy	0.87	ft
Froude Number	2.08	

Flow is supercritical.
Flow is divided.

Notes:

"B" STREET

3′ 6" x 7′ 2" GRATE OPENING @ ADAMS /JEFFERSON AVENUE - IDE

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	1.00	feet	Weir flow..............	57.00	cfs
Grate clear opening area, A..	13.33	sq.ft.	Orifice flow...........	71.64	cfs
Grate Perimeter, P.............	19.00	feet	Weir Intercepted flow..	28.50	cfs
Clogging factor................	50 %		Orfice Intercepted flow	35.82	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

IDEAL CAPACITY @ ADAMS
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ ADAMS & JEFFERSON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.022500	ft/ft
Water Surface Elevation	1.00	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.50	0.013
4.00	0.00			
7.50	0.00			
11.50	1.00			

Results		
Wtd. Mannings Coefficient	0.013	
Discharge	95.35	cfs
Flow Area	7.50	ft²
Wetted Perimeter	11.75	ft
Top Width	11.50	ft
Height	1.00	ft
Critical Depth	1.64	ft
Critical Slope	0.002670	ft/ft
Velocity	12.71	ft/s
Velocity Head	2.51	ft
Specific Energy	3.51	ft
Froude Number	2.78	

Flow is supercritical.

IDEAL CAPACITY @ JEFFERSON
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	CONCRETE APRON @ ADAMS & JEFFERSON
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data

Channel Slope	0.024500	ft/ft
Water Surface Elevation	1.00	ft

Elevation range: 0.00 ft to 1.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.00	0.00	11.50	0.013
4.00	0.00			
7.50	0.00			
11.50	1.00			

Results

Wtd. Mannings Coefficient	0.013	
Discharge	99.50	cfs
Flow Area	7.50	ft^2
Wetted Perimeter	11.75	ft
Top Width	11.50	ft
Height	1.00	ft
Critical Depth	1.67	ft
Critical Slope	0.002665	ft/ft
Velocity	13.27	ft/s
Velocity Head	2.73	ft
Specific Energy	3.73	ft
Froude Number	2.90	

Flow is supercritical.

STORM DRAIN ANALYSIS
FOR
MADISON AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: MADISON AVENUE AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	ACTUAL FLOW DEPTH @ FACILITY (FT.)	ACTUAL CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
42' CURB OPENING D.I.	0.010	209	1.06	57.70	0.94	53.00	53.00	53.00	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE
WEIR FLOW AT B STREET 11.28-INCH CURB	0.01	209	1.06	0.00	0.21	35.00		35.00	WEIR FLOW ASSUMING 100% CLOGGED @ DROP INLET

TOTAL FLOW EXITING STREET SECTION 88.00 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 53.00 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS) 209.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 53.00 CFS

ANTICIPATED EXCESS FLOW (CFS) 156.00 CFS

SUBMERGED WEIR FLOW AT B STREET DROP INLET

LOCATION: MADISON AVENUE

Given:

$Q_{100} := 209$

Approach flow at drop inlet in cubic feet per seconds (assuming total blockage of drain).

$C_W := 3$

Weir coefficient

$L := 42$

Total weir length in feet

$V := 7.58$

Velocity of flow just upstream from weir in feet per second (see "Madison Avenue" FlowMaster calculations)

$$\Delta h := \left[\left[\frac{Q_{100}}{C_W \cdot \frac{2\cdot\sqrt{64.4}}{3}\cdot L}\right] + \left(\frac{V^2}{64.4}\right)^{\frac{3}{2}}\right]^{\frac{2}{3}} - \frac{V^2}{64.4}$$

Standard formula for weir without end contractions

$\Delta h = 0.21$

Change in flow depth at weir in feet

The Nappe downstream of weir: non-uniform velocity

$$C_1 := \left[0.6035 + 0.0813\cdot\left(\frac{\Delta h}{L}\right) + \frac{0.000295}{L}\right] + \left(1 + \frac{0.00361}{\Delta h}\right)^{\frac{3}{2}}$$

$C_1 = 1.63$

Non-uniform velocity distribution coefficient

$$Q_{freeflow} := \frac{2\cdot C_1\cdot L\cdot\sqrt{64.4}}{3}\cdot\Delta h^{\frac{3}{2}}$$

Standard formula for weir without end contractions

$Q_{freeflow} = 35$

Discharge downstream of weir in cubic feet per second

B STREET DROP INLET @ MADISON AVENUE - IDEAL CONDITIONS

CURB OPENING DROP INLET--

Flow depth, y......	1.06	feet	(y/h) percentage.......	182	%
Inlet length, L....	42.0	feet	Weir flow..............	112.20	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	115.40	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	57.70	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

TYPICAL B STREET DROP INLET

CURB OPENING DROP INLET--

Flow depth, y......	0.94	feet	(y/h) percentage.......	161	%
Inlet length, L....	42.0	feet	Weir flow..............	93.70	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	106.00	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	53.00	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR @ MADISON AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET ADJOINING B STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.010000 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)
0.00	0.50
0.50	0.48
0.58	0.00
2.00	0.13
2.00	0.17
18.50	0.50
35.00	0.17
35.00	0.13
36.42	0.00
36.50	0.48
37.00	0.50

Start Station	End Station	Roughness
0.00	2.00	0.013
2.00	35.00	0.016
35.00	37.00	0.013

Discharge 209.00 cfs

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	1.06	ft
Flow Area	27.58	ft²
Wetted Perimeter	39.04	ft
Top Width	37.00	ft
Height	1.06	ft
Critical Depth	1.32	ft
Critical Slope	0.003844	ft/ft
Velocity	7.58	ft/s
Velocity Head	0.89	ft
Specific Energy	1.96	ft
Froude Number	1.55	

Flow is supercritical.

Water elevation exceeds lowest end station by 0.56 ft.

Notes:

"B" STREET

STORM DRAIN ANALYSIS
FOR
MONROE AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: MONROE AVENUE AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	ACTUAL FLOW DEPTH @ FACILITY (FT.)	ACTUAL CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
TWO -CIRCULAR GRATES WITH APPROXIMATELY 18" DIAMETERS	0.011	75	0.71	12.02	0.71	12.02	12.02	12.02	FLOW ROUTED TO 42-FT DROP INLET AT B STREET
42' CURB OPENING D.I.	0.011	75	0.71	30.75	0.67	28.19	28.19	28.19	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 40.21 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 40.21 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS) 75.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 40.21 CFS

ANTICIPATED EXCESS FLOW (CFS) 34.79 CFS

100-YEAR @ MONROE AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET ADJOINING B STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.010800 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 75.00 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.71	ft
Flow Area	14.40	ft^2
Wetted Perimeter	38.33	ft
Top Width	37.00	ft
Height	0.71	ft
Critical Depth	0.82	ft
Critical Slope	0.004657	ft/ft
Velocity	5.21	ft/s
Velocity Head	0.42	ft
Specific Energy	1.13	ft
Froude Number	1.47	

Flow is supercritical.

Water elevation exceeds lowest end station by 0.21 ft.

Notes:

"B" STREET

Two Approximately 18" Diameter Circular Grates similar to Neenah grate R-3250-A @ Monroe Avenue/B Street

CIRCULAR GRATE INLET -- SUMP

Flow depth, y..................	0.71	feet	Weir flow..............	8.41	cfs
Grate clear opening area, A..	1.05	sq.ft.	Orifice flow...........	4.75	cfs
Grate Perimeter, P.............	4.68	feet	Weir Intercepted flow..	4.20	cfs
Clogging factor................	50 %		Orfice Intercepted flow	2.38	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

DROP INLET @ MONROE AVENUE

CURB OPENING DROP INLET--

Flow depth, y......	0.71	feet	(y/h) percentage.......	142	%
Inlet length, L....	9.0	feet	Weir flow..............	16.10	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	16.40	cfs
Orifice height, h..	0.50	feet			
Clogging factor....	50	%	Intercepted flow.......	8.20	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

CARRYOVER @ MONROE AVENUE/B STREET D.I.
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' MONROE AVENUE SECTION
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.010800 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 62.98 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.67	ft
Flow Area	12.94	ft²
Wetted Perimeter	38.25	ft
Top Width	37.00	ft
Height	0.67	ft
Critical Depth	0.77	ft
Critical Slope	0.004806	ft/ft
Velocity	4.87	ft/s
Velocity Head	0.37	ft
Specific Energy	1.04	ft
Froude Number	1.45	

Flow is supercritical.

Water elevation exceeds lowest end station by 0.17 ft.

Notes:

"B" STREET

B STREET DROP INLET @ MONROE AVENUE

CURB OPENING DROP INLET--

Flow depth, y......	0.67	feet	(y/h) percentage.......	115	%
Inlet length, L....	42.0	feet	Weir flow..............	56.38	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	80.98	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	28.19	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

STORM DRAIN ANALYSIS
FOR
JACKSON AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: JACKSON AVENUE AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	FLOW DEPTH @ FACILITY (FT.)	CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
42' CURB OPENING D.I.	0.0154	26	0.5	18.17	0.5	18.2	18.2	18.2	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 18.2 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 18.2 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS) 26.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 18.17 CFS

ANTICIPATED EXCESS FLOW (CFS) 7.83 CFS

B STREET DROP INLET @ JACKSON AVENUE

CURB OPENING DROP INLET--			WEIR CONDITION		
Flow depth, y......	0.50	feet	(y/h) percentage.......	86	%
Inlet length, L....	42.0	feet	Weir flow..............	36.35	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	60.09	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	18.17	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR @ JACKSON AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET ADJOINING B STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.015400 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)
0.00	0.50
0.50	0.48
0.58	0.00
2.00	0.13
2.00	0.17
18.50	0.50
35.00	0.17
35.00	0.13
36.42	0.00
36.50	0.48
37.00	0.50

Start Station	End Station	Roughness
0.00	2.00	0.013
2.00	35.00	0.016
35.00	37.00	0.013

Discharge 26.00 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.50	ft
Flow Area	6.62	ft^2
Wetted Perimeter	37.46	ft
Top Width	36.55	ft
Height	0.50	ft
Critical Depth	0.57	ft
Critical Slope	0.005549	ft/ft
Velocity	3.93	ft/s
Velocity Head	0.24	ft
Specific Energy	0.74	ft
Froude Number	1.63	

Flow is supercritical.
Flow is divided.

Notes:

"B" STREET

STORM DRAIN ANALYSIS
FOR
VAN BUREN AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: VAN BUREN AVENUE AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	FLOW DEPTH @ FACILITY (FT.)	CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
42' CURB OPENING D.I.	0.0192	33	0.51	18.72	0.51	18.72	18.72	18.72	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 18.72 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 18.72 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS) 33.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 18.72 CFS

ANTICIPATED EXCESS FLOW (CFS) 14.28 CFS

B STREET DROP INLET @ VAN BUREN AVENUE

CURB OPENING DROP INLET-- WEIR CONDITION

Flow depth, y......	0.51	feet	(y/h) percentage.......	87	%
Inlet length, L....	42.0	feet	Weir flow..............	37.44	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	61.51	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	18.72	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR @ VAN BUREN AVENUE
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 37' STREET ADJOINING B STREET
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.019200 ft/ft

Elevation range: 0.00 ft to 0.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	35.00	0.016
0.58	0.00	35.00	37.00	0.013
2.00	0.13			
2.00	0.17			
18.50	0.50			
35.00	0.17			
35.00	0.13			
36.42	0.00			
36.50	0.48			
37.00	0.50			

Discharge 33.00 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.51	ft
Flow Area	7.23	ft²
Wetted Perimeter	37.94	ft
Top Width	37.00	ft
Height	0.51	ft
Critical Depth	0.61	ft
Critical Slope	0.005359	ft/ft
Velocity	4.56	ft/s
Velocity Head	0.32	ft
Specific Energy	0.84	ft
Froude Number	1.82	

Flow is supercritical.

Water elevation exceeds lowest end station by 0.01 ft.

Notes:

"B" STREET

STORM DRAIN ANALYSIS
FOR
HARRISON AVENUE

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: HARRISON AVENUE AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	ULTIMATE DISCHARGE TO FACILITY (CFS)	IDEAL FLOW DEPTH (FT.)	IDEAL CAPACITY @ MAXIMUM FLOW DEPTH (FT.)	FLOW DEPTH @ FACILITY (FT.)	CAPACITY (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	FLOW EXITING STREET SECTION (CFS)	COMMENTS
42' CURB OPENING D.I.	0.025	7	0.33	5.17	0.33	5.17	5.17	5.17	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW EXITING STREET SECTION 5.17 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 5.17 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED DISCHARGE TO FACILITY (CFS) 7.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 5.17 CFS

ANTICIPATED EXCESS FLOW (CFS) 1.83 CFS

B STREET DROP INLET @ HARRISON AVENUE

CURB OPENING DROP INLET-- WEIR CONDITION

Flow depth, y......	0.33	feet	(y/h) percentage.......	57	%
Inlet length, L....	21.0	feet	Weir flow..............	10.33	cfs
Lateral Width, W...	1.50	feet	Orifice flow...........	12.89	cfs
Orifice height, h..	0.58	feet			
Clogging factor....	50	%	Intercepted flow.......	5.17	cfs

Note:

1. Equations from FHWA HEC-12 dated March, 1984.

100-YEAR
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	TYPICAL 58' HARRISON AVENUE SECTION
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.025000 ft/ft

Elevation range: 0.00 ft to 0.71 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.50	0.00	2.00	0.013
0.50	0.48	2.00	56.00	0.016
0.58	0.00	56.00	58.00	0.013
2.00	0.13			
2.00	0.17			
29.00	0.71			
56.00	0.17			
56.00	0.13			
57.42	0.00			
57.50	0.48			
58.00	0.50			

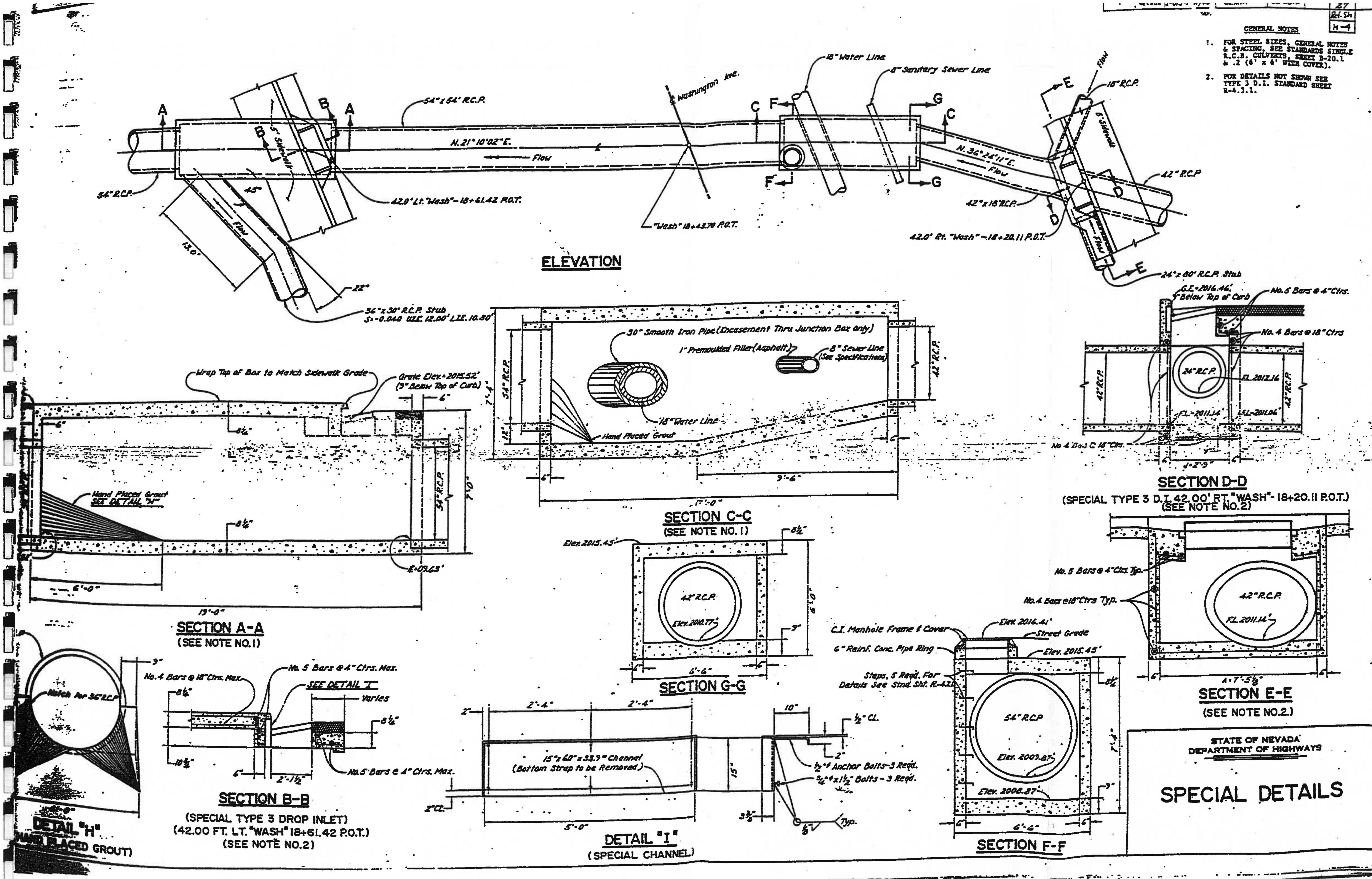
Discharge 7.00 cfs

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	0.33	ft
Flow Area	2.07	ft^2
Wetted Perimeter	19.72	ft
Top Width	19.06	ft
Height	0.33	ft
Critical Depth	0.39	ft
Critical Slope	0.005380	ft/ft
Velocity	3.38	ft/s
Velocity Head	0.18	ft
Specific Energy	0.51	ft
Froude Number	1.81	

Flow is supercritical.
Flow is divided.

Notes:

"B" STREET



GENERAL NOTES

1. FOR STEEL SIZES, GENERAL NOTES & SPACING, SEE STANDARDS SINGLE R.C.B. CULVERTS, SHEET B-20.1 & .2 (6' x 6' WITH COVER).
2. FOR DETAILS NOT SHOWN SEE TYPE 3 D.I. STANDARD SHEET R-4.3.1.

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

SPECIAL DETAILS

27
Ref. Sh. H-4

STORM DRAIN ANALYSIS
FOR
B STREET PARK AREA

EXISTING FLOW CONDITION SUMMARY

EXISTING FACILITY LOCATION: PARK AREA AT B STREET

EXISTING FACILITY	SLOPE (FT./FT.)	IDEAL FLOW DEPTH (FT.)	CAPACITY @ IDEAL FLOW DEPTH (FT.)	FLOW TO FACILITY (CFS)	FLOW DEPTH @ FACILITY (FT.)	CAPACITY @ FLOW DEPTH (CFS)	FLOW INTERCEPTED/ROUTED VIA EXISTING FACILITY (CFS)	PARK FLOW (CFS)	COMMENTS
2'0" x 3'5" GRATE OPENING @ MADISON	0.0043	1.00	12.55	36.00	0.58	7.18	7.18	1.00	35-CFS WEIR FLOW ASSUMING 100% CLOGGED @ MADISON DROP INLET
2'0" x 3'5" GRATE OPENING @ MONROE	0.0071	1.00	12.55	29.82	0.53	6.27	6.27	1.00	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE
2'0" x 3'5" GRATE OPENING @ JACKSON	0.0071	1.00	12.55	24.55	0.52	6.09	6.09	1.00	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE
2'0" x 3'5" GRATE OPENING @ VAN BUREN	0.0046	1.00	12.55	20.46	0.48	5.40	5.40	2.00	WEIR FLOW ASSUMING 100% CLOGGED @ DROP INLET
0'10"D x 7'0"W x 7'2"L MODIFIED DROP INLET W/ 2'0"W x 6'2"L GRATE OPENING & HEADWALL @ HARRISON/OWENS	0.95	0.83	30.25	17.06	0.62	11.96	11.96	2.0	FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE

TOTAL FLOW @ PARK AREA 42.00 CFS

TOTAL FLOW ROUTED TO OPEN CHANNEL AT OWENS AVENUE 36.90 CFS

TOTAL PROPOSED DESIGN FLOW:

ANTICIPATED PARK FLOW TO FACILITY (CFS) 7.00 CFS

ANTICIPATED DISCHARGE ROUTED (CFS) 7.00 CFS

ANTICIPATED EXCESS FLOW (CFS) 0.00 CFS

MADISON FLOW + PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	2' 0" x 3' 5" PARK GRATE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.004300 ft/ft

Elevation range: 0.00 ft to 2.08 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.08	0.00	109.00	0.013
100.00	0.00			
102.00	0.00			
109.00	1.00			

Discharge 36.00 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.58	ft
Flow Area	10.53	ft^2
Wetted Perimeter	34.16	ft
Top Width	34.11	ft
Height	0.58	ft
Critical Depth	0.60	ft
Critical Slope	0.003611	ft/ft
Velocity	3.42	ft/s
Velocity Head	0.18	ft
Specific Energy	0.76	ft
Froude Number	1.09	

Flow is supercritical.

2′ 0" x 3′ 5" GRATE OPENING @ MADISON AVE./PARK AREA

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.58	feet	Weir flow.............	14.35	cfs
Grate clear opening area, A..	4.67	sq.ft.	Orifice flow...........	19.11	cfs
Grate Perimeter, P.............	10.83	feet	Weir Intercepted flow..	7.18	cfs
Clogging factor................	50 %		Orfice Intercepted flow	9.56	cfs

Note:
1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

CARRYOVER + PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	2' 0" x 3' 5" PARK GRATE @ MONROE AVENUE
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.007100 ft/ft

Elevation range: 0.00 ft to 2.55 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.55	0.00	107.00	0.013
100.00	0.00			
102.00	0.00			
107.00	1.00			

Discharge 29.82 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.53	ft
Flow Area	7.18	ft^2
Wetted Perimeter	25.33	ft
Top Width	25.27	ft
Height	0.53	ft
Critical Depth	0.60	ft
Critical Slope	0.003602	ft/ft
Velocity	4.15	ft/s
Velocity Head	0.27	ft
Specific Energy	0.79	ft
Froude Number	1.37	
Flow is supercritical.		

2' 0" x 3' 5" GRATE OPENING @ MONROE AVE./PARK AREA

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.53	feet	Weir flow..............	12.54	cfs
Grate clear opening area, A..	4.67	sq.ft.	Orifice flow...........	18.27	cfs
Grate Perimeter, P.............	10.83	feet	Weir Intercepted flow..	6.27	cfs
Clogging factor................	50 %		Orfice Intercepted flow	9.13	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

CARRYOVER + PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	2' 0" x 3' 5" PARK GRATE @ JACKSON AVE.
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.004600 ft/ft

Elevation range: 0.00 ft to 2.63 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.63	0.00	112.00	0.013
100.00	0.00			
102.00	0.00			
112.00	1.00			

Discharge 24.55 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.52	ft
Flow Area	7.45	ft²
Wetted Perimeter	26.85	ft
Top Width	26.82	ft
Height	0.52	ft
Critical Depth	0.54	ft
Critical Slope	0.003732	ft/ft
Velocity	3.30	ft/s
Velocity Head	0.17	ft
Specific Energy	0.69	ft
Froude Number	1.10	

Flow is supercritical.

2' 0" x 3' 5" GRATE OPENING @ JACKSON AVE./PARK AREA

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.52	feet	Weir flow..............	12.18	cfs
Grate clear opening area, A..	4.67	sq.ft.	Orifice flow...........	18.10	cfs
Grate Perimeter, P.............	10.83	feet	Weir Intercepted flow..	6.09	cfs
Clogging factor................	50	%	Orfice Intercepted flow	9.05	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

CARRYOVER + PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	2' 0" x 3' 5" PARK GRATE @ VAN BUREN
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.004600 ft/ft

Elevation range: 0.00 ft to 2.50 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	2.50	0.00	109.00	0.013
100.00	0.00			
102.00	0.00			
109.00	1.00			

Discharge 20.46 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.48	ft
Flow Area	6.46	ft²
Wetted Perimeter	24.77	ft
Top Width	24.73	ft
Height	0.48	ft
Critical Depth	0.50	ft
Critical Slope	0.003815	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	0.64	ft
Froude Number	1.09	

Flow is supercritical.

2' 0" x 3' 5" GRATE OPENING @ VAN BUREN / PARK AREA

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.48	feet	Weir flow..............	10.81	cfs
Grate clear opening area, A..	4.67	sq.ft.	Orifice flow...........	17.39	cfs
Grate Perimeter, P.............	10.83	feet	Weir Intercepted flow..	5.40	cfs
Clogging factor................	50 %		Orfice Intercepted flow	8.69	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

EXISTING 7'0" x 7'2" MODIFIED DROP INLET WITH 2'0" x 6'2" OPENING AND GRATE AT B STREET PARK/OWENS

RECTANGULAR GRATE INLET -- SUMP

Flow depth, y..................	0.83	feet	Weir flow..............	37.28	cfs
Grate clear opening area, A..	12.33	sq.ft.	Orifice flow...........	60.50	cfs
Grate Perimeter, P............	16.33	feet	Weir Intercepted flow..	18.64	cfs
Clogging factor................	50 %		Orfice Intercepted flow	30.25	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

2'0" x 3'5" GRATE OPENING @ B STREET PARK - IDEAL CAPACITY

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	1.00	feet	Weir flow.............	32.49	cfs
Grate clear opening area, A..	4.67	sq.ft.	Orifice flow...........	25.09	cfs
Grate Perimeter, P.............	10.83	feet	Weir Intercepted flow..	16.25	cfs
Clogging factor................	50 %		Orfice Intercepted flow	12.55	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

EXISTING 7'0" x 7'2" MOIFIED DROP INLET WITH 2'0" x 6'2" OPENING AND GRATE @ B STREET PARK/OWENS

RECTANGULAR GRATE INLET -- SUMP

Flow depth, y..........	0.62	feet	Weir flow..............	23.92	cfs
Grate clear opening a:	12.33	sq.ft.	Orifice flow...........	52.18	cfs
Grate Perimeter, P.....	16.33	feet	Weir Intercepted flow..	11.96	cfs
Clogging factor........	50	%	Orfice Intercepted flow	26.09	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

CARRYOVER + PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	MODIFIED DROP INLET @ HARRISON/OWENS
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.009500 ft/ft

Elevation range: 0.00 ft to 0.83 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.83	0.00	4.50	0.013
0.50	0.83	4.50	6.50	0.011
0.50	0.00			
4.50	0.00			
4.50	0.83			
6.50	0.83			

Discharge 17.06 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.62	ft
Flow Area	2.48	ft²
Wetted Perimeter	5.24	ft
Top Width	4.00	ft
Height	0.62	ft
Critical Depth	0.92	ft
Critical Slope	0.003657	ft/ft
Velocity	6.88	ft/s
Velocity Head	0.74	ft
Specific Energy	1.36	ft
Froude Number	1.54	

Flow is supercritical.

EXISTING 7'0" x 7'2" MOIFIED DROP INLET WITH 2'0" X 6'2" OPENING AND GRATE @ B STREET PARK/OWENS

RECTANGULAR GRATE INLET -- SUMP
WEIR CONDITION

Flow depth, y..................	0.35	feet	Weir flow..............	10.14	cfs
Grate clear opening area, A..	12.33	sq.ft.	Orifice flow...........	39.20	cfs
Grate Perimeter, P.............	16.33	feet	Weir Intercepted flow..	5.07	cfs
Clogging factor................	50	%	Orfice Intercepted flow	19.60	cfs

Note:

1. Orifice condition depends on bar config., grate size, depth.
2. Equations from FHWA HEC-12 dated March, 1984.

PARK FLOW
Worksheet for Irregular Channel

Project Description	
Project File	c:\drainage\haestad\fmw\bstreet.fm2
Worksheet	MODIFIED DROP INLET @ HARRISON/OWENS
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.009500 ft/ft

Elevation range: 0.00 ft to 0.83 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.83	0.00	4.50	0.013
0.50	0.83	4.50	6.50	0.011
0.50	0.00			
4.50	0.00			
4.50	0.83			
6.50	0.83			

Discharge 7.00 cfs

Results		
Wtd. Mannings Coefficient	0.013	
Water Surface Elevation	0.35	ft
Flow Area	1.40	ft²
Wetted Perimeter	4.70	ft
Top Width	4.00	ft
Height	0.35	ft
Critical Depth	0.46	ft
Critical Slope	0.004092	ft/ft
Velocity	5.02	ft/s
Velocity Head	0.39	ft
Specific Energy	0.74	ft
Froude Number	1.50	

Flow is supercritical.

APPENDIX E

HYDRAULIC CALCULATIONS
PROPOSED STORM DRAIN ANALYSIS

```
T1   City of Las Vegas - Washington Ave.                                          0
T2   Ultimate Condition 100-year Storm Flow
T3   Jan 11, 2000           File: wash90      By: JSL
SO     1000.0001990.690 32                              1996.690
R      1250.0001991.950 32       .014                                          .000     .000 0
JX     1260.0001992.000 32  3    .014    6.000            1995.000             -45.0           .000
R      1640.00 1993.98  32       .014
JX     1650.0001994.030 32  5    .014   27.000            1996.000             -90.0           .000
R      1990.00 1995.68  32       .014
JX     2000.0001995.730 32  6    .014   22.000            1999.000             -90.0           .000
R      2340.00 1997.44  32       .014
JX     2350.0001997.490 32  7    .014   63.000            1999.000             -60.0           .000
R      2740.00 1999.45  32       .014
JX     2750.0001999.500 32  8    .014  157.000            1999.500             -30.0           .000
TS     2760.0001999.550  1       .014                                          .000
R      3040.00 2000.96   1       .014
JX     3050.0002001.010  1 18    .014   21.000            2004.500             -60.0           .000
R      3150.0002001.520  1       .014                                      -33.000     .000 0
R      3540.00 2003.48   1       .014
JX     3550.0002003.530  1 20    .014    7.000            2007.500             -60.0           .000
R      3900.0002005.290  1       .014                                      -57.000     .000 0
R      4050.00 2006.05   1       .014
R      4240.00 2007.304  1       .014
JX     4250.0002007.370  1 12    .014   45.000            2008.500             -90.0           .000
R      4590.00 2009.61   1       .014
JX     4600.0002009.680  1 13    .014   16.000            2013.000             -90.0           .000
R      4990.00 2012.25   1       .014
JX     5000.0002012.320  1 14    .014   51.000            2014.500             -90.0           .000
R      5690.00 2016.87   1       .014
JX     5700.0002016.940  1 15    .014   20.000            2020.000             -90.0           .000
TS     5710.0002017.000 35       .014                                          .000
R      6990.00 2025.45  35       .014
JX     7000.0002025.520 35 22    .014    7.000            2029.000             -90.0           .000
R      7708.5002030.200 35       .014                                          .000     .000 0
TS     7718.5002030.300 33       .014                                          .000     .000 0
R      8108.5002033.860 33       .014                                          .000     .000 0
R      8118.5002033.952 33       .014                                          .000     .000 0
R      8128.5002034.043 33       .014                                          .000     .000 0
R      8158.5002034.316 33       .014                                          .000     .000 0
R      8208.5002034.771 33       .014                                          .000     .000 0
R      8308.5002035.681 33       .014                                          .000     .000 0
R      8408.5002036.590 33       .014                                          .000     .000 0
R      8498.5002037.410 33       .014
R      8508.5002037.500 33       .014                                          .000     .000 0
SH     8508.5002037.500 33                              2043.500
CD    1   3    0    .000    6.000    11.000  .000  .000   .00
CD    2   4    1    .000    2.000      .000  .000  .000   .00
CD    3   4    1    .000    2.000      .000  .000  .000   .00
CD    5   4    1    .000    3.000      .000  .000  .000   .00
CD    6   4    1    .000    2.000      .000  .000  .000   .00
CD    7   4    1    .000    3.500      .000  .000  .000   .00
CD    8   3    0    .000    4.000     4.000  .000  .000   .00
CD    9   4    1    .000    2.000      .000  .000  .000   .00
CD   10   4    1    .000    1.500      .000  .000  .000   .00
CD   11   4    1    .000    3.000      .000  .000  .000   .00
CD   12   4    1    .000    3.000      .000  .000  .000   .00
CD   13   4    1    .000    1.500      .000  .000  .000   .00
CD   14   4    1    .000    3.000      .000  .000  .000   .00
CD   15   4    1    .000    2.000      .000  .000  .000   .00
```

CD	16	4	1	.000	2.000	.000	.000	.000	.00
CD	18	4	1	.000	2.000	.000	.000	.000	.00
CD	20	4	1	.000	1.500	.000	.000	.000	.00
CD	22	4	1	.000	2.000	.000	.000	.000	.00
CD	32	3	0	.000	6.000	14.000	.000	.000	.00
CD	33	3	0	.000	6.000	7.000	.000	.000	.00
CD	35	3	0	.000	6.000	9.000	.000	.000	.00
Q			682.000	.0					

FILE: WASH90.WSW

W S P G W - EDIT LISTING - Version 12.91 Date: 1-12-2000 Time: 6:26:38

WATER SURFACE PROFILE - CHANNEL DEFINITION LISTING PAGE 1

CARD CODE	SECT NO	CHN TYPE	NO OF PIER/PIP	AVE PIER WIDTH	HEIGHT 1 DIAMETER	BASE WIDTH	ZL	ZR	INV DROP	Y(1)	Y(2)	Y(3)	Y(4)	Y(5)	Y(6)	Y(7)	Y(8)	Y(9)	Y(10)
CD	1	3	0	.000	6.000	11.000	.000	.000	.00										
CD	2	4	1		2.000														
CD	3	4	1		2.000														
CD	5	4	1		3.000														
CD	6	4	1		2.000														
CD	7	4	1		3.500														
CD	8	3	0	.000	4.000	4.000	.000	.000	.00										
CD	9	4	1		2.000														
CD	10	4	1		1.500														
CD	11	4	1		3.000														
CD	12	4	1		3.000														
CD	13	4	1		1.500														
CD	14	4	1		3.000														
CD	15	4	1		2.000														
CD	16	4	1		2.000														
CD	18	4	1		2.000														
CD	20	4	1		1.500														
CD	22	4	1		2.000														
CD	32	3	0	.000	6.000	14.000	.000	.000	.00										
CD	33	3	0	.000	6.000	7.000	.000	.000	.00										
CD	35	3	0	.000	6.000	9.000	.000	.000	.00										

W S P G W PAGE NO 1

WATER SURFACE PROFILE - TITLE CARD LISTING

HEADING LINE NO 1 IS - City of Las Vegas - Washington Ave.

HEADING LINE NO 2 IS - Ultimate Condition 100-year Storm Flow

HEADING LINE NO 3 IS - Jan 11, 2000 File: wash90 By: JSL

W S P G W PAGE NO 2

WATER SURFACE PROFILE - ELEMENT CARD LISTING

```
ELEMENT NO   1 IS A SYSTEM OUTLET     *          *      *
              U/S DATA    STATION     INVERT   SECT                                             W S ELEV
                          1000.000 1990.690     32                                               1996.690
ELEMENT NO   2 IS A REACH             *          *      *
              U/S DATA    STATION     INVERT   SECT                   N                            RADIUS     ANGLE     ANG PT   MAN H
                          1250.000 1991.950     32                  .014                            .000      .000      .000      0
ELEMENT NO   3 IS A JUNCTION          *          *      *      *                *                 *                *
              U/S DATA    STATION     INVERT   SECT LAT-1 LAT-2     N       Q3            Q4     INVERT-3 INVERT-4  PHI 3   PHI 4
                          1260.000 1992.000     32     3     0    .014      6.000          .000  1995.000     .000 -45.000    .000
                                                                                                  RADIUS     ANGLE
                                                                                                    .000      .000

ELEMENT NO   4 IS A REACH             *          *      *
              U/S DATA    STATION     INVERT   SECT                   N                            RADIUS     ANGLE     ANG PT   MAN H
                          1640.000 1993.980     32                  .014                            .000      .000      .000      0
ELEMENT NO   5 IS A JUNCTION          *          *      *      *                *                 *                *
              U/S DATA    STATION     INVERT   SECT LAT-1 LAT-2     N       Q3            Q4     INVERT-3 INVERT-4  PHI 3   PHI 4
                          1650.000 1994.030     32     5     0    .014     27.000          .000  1996.000     .000 -90.000    .000
                                                                                                  RADIUS     ANGLE
                                                                                                    .000      .000

ELEMENT NO   6 IS A REACH             *          *      *
              U/S DATA    STATION     INVERT   SECT                   N                            RADIUS     ANGLE     ANG PT   MAN H
                          1990.000 1995.680     32                  .014                            .000      .000      .000      0
ELEMENT NO   7 IS A JUNCTION          *          *      *      *                *                 *                *
```

```
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               2000.000 1995.730    32     6     0   .014    22.000         .000  1999.000      .000 -90.000      .000
                                                                                                     RADIUS      ANGLE
                                                                                                      .000       .000

ELEMENT NO   8 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               2340.000 1997.440    32               .014                                 .000       .000        .000      0
                                                          W S P G W                                                             PAGE NO    3
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO   9 IS A JUNCTION             *         *      *     *                 *                       *               *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               2350.000 1997.490    32     7     0   .014    63.000         .000  1999.000      .000 -60.000      .000
                                                                                                     RADIUS      ANGLE
                                                                                                      .000       .000

ELEMENT NO  10 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               2740.000 1999.450    32               .014                                 .000       .000        .000      0
ELEMENT NO  11 IS A JUNCTION             *         *      *     *                 *                       *               *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               2750.000 1999.500    32     8     0   .014   157.000         .000  1999.500      .000 -30.000      .000
                                                                                                     RADIUS      ANGLE
                                                                                                      .000       .000

ELEMENT NO  12 IS A TRANSITION           *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS     ANGLE
                               2760.000 1999.550     1               .014                                 .000       .000
ELEMENT NO  13 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               3040.000 2000.960     1               .014                                 .000       .000        .000      0
ELEMENT NO  14 IS A JUNCTION             *         *      *     *                 *                       *               *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               3050.000 2001.010     1    18     0   .014    21.000         .000  2004.500      .000 -60.000      .000
                                                                                                     RADIUS      ANGLE
                                                                                                      .000       .000

ELEMENT NO  15 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               3150.000 2001.520     1               .014                               173.624    -33.000       .000      0
ELEMENT NO  16 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               3540.000 2003.480     1               .014                                 .000       .000        .000      0
                                                          W S P G W                                                             PAGE NO    4
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  17 IS A JUNCTION             *         *      *     *                 *                       *               *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               3550.000 2003.530     1    20     0   .014     7.000         .000  2007.500      .000 -60.000      .000
                                                                                                     RADIUS      ANGLE
                                                                                                      .000       .000

ELEMENT NO  18 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               3900.000 2005.290     1               .014                               351.816    -57.000       .000      0
ELEMENT NO  19 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               4050.000 2006.050     1               .014                                 .000       .000        .000      0
ELEMENT NO  20 IS A REACH                *         *      *
                    U/S DATA   STATION    INVERT   SECT                N                                 RADIUS      ANGLE      ANG PT   MAN H
                               4240.000 2007.304     1               .014                                 .000       .000        .000      0
ELEMENT NO  21 IS A JUNCTION             *         *      *     *                 *                       *               *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N       Q3         Q4      INVERT-3 INVERT-4  PHI 3   PHI 4
                               4250.000 2007.370     1    12     0   .014    45.000         .000  2008.500      .000 -90.000      .000
                                                                                                     RADIUS      ANGLE
```

```
                                                                                                   .000     .000
ELEMENT NO  22 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               4590.000 2009.610    1                .014                       .000     .000       .000      0
ELEMENT NO  23 IS A JUNCTION           *         *     *     *                  *                  *                 *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N        Q3        Q4    INVERT-3 INVERT-4  PHI 3   PHI 4
                               4600.000 2009.680    1    13     0    .014     16.000       .000  2013.000     .000 -90.000      .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000     .000
ELEMENT NO  24 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               4990.000 2012.250    1                .014                       .000     .000       .000      0
                                                     W S P G W                                                      PAGE NO    5
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  25 IS A JUNCTION           *         *     *     *                  *                  *                 *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N        Q3        Q4    INVERT-3 INVERT-4  PHI 3   PHI 4
                               5000.000 2012.320    1    14     0    .014     51.000       .000  2014.500     .000 -90.000      .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000     .000
ELEMENT NO  26 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               5690.000 2016.870    1                .014                       .000     .000       .000      0
ELEMENT NO  27 IS A JUNCTION           *         *     *     *                  *                  *                 *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N        Q3        Q4    INVERT-3 INVERT-4  PHI 3   PHI 4
                               5700.000 2016.940    1    15     0    .014     20.000       .000  2020.000     .000 -90.000      .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000     .000
ELEMENT NO  28 IS A TRANSITION         *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS   ANGLE
                               5710.000 2017.000   35                .014                       .000     .000
ELEMENT NO  29 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               6990.000 2025.450   35                .014                       .000     .000       .000      0
ELEMENT NO  30 IS A JUNCTION           *         *     *     *                  *                  *                 *
                    U/S DATA   STATION    INVERT   SECT LAT-1 LAT-2    N        Q3        Q4    INVERT-3 INVERT-4  PHI 3   PHI 4
                               7000.000 2025.520   35    22     0    .014      7.000       .000  2029.000     .000 -90.000      .000
                                                                                                RADIUS    ANGLE
                                                                                                  .000     .000
ELEMENT NO  31 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               7708.500 2030.200   35                .014                       .000     .000       .000      0
ELEMENT NO  32 IS A TRANSITION         *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS   ANGLE
                               7718.500 2030.300   33                .014                       .000     .000
                                                     W S P G W                                                      PAGE NO    6
                          WATER SURFACE PROFILE - ELEMENT CARD LISTING
ELEMENT NO  33 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               8108.500 2033.860   33                .014                       .000     .000       .000      0
ELEMENT NO  34 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               8118.500 2033.952   33                .014                       .000     .000       .000      0
ELEMENT NO  35 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               8128.500 2034.043   33                .014                       .000     .000       .000      0
ELEMENT NO  36 IS A REACH              *         *     *
                    U/S DATA   STATION    INVERT   SECT                N                       RADIUS    ANGLE      ANG PT   MAN H
                               8158.500 2034.316   33                .014                       .000     .000       .000      0
ELEMENT NO  37 IS A REACH              *         *     *
```

```
                    U/S DATA   STATION    INVERT  SECT               N                          RADIUS     ANGLE      ANG PT   MAN H
                               8208.500 2034.771   33              .014                          .000      .000       .000      0
ELEMENT NO  38 IS A REACH              *          *     *
                    U/S DATA   STATION    INVERT  SECT               N                          RADIUS     ANGLE      ANG PT   MAN H
                               8308.500 2035.681   33              .014                          .000      .000       .000      0
ELEMENT NO  39 IS A REACH              *          *     *
                    U/S DATA   STATION    INVERT  SECT               N                          RADIUS     ANGLE      ANG PT   MAN H
                               8408.500 2036.590   33              .014                          .000      .000       .000      0
ELEMENT NO  40 IS A REACH              *          *     *
                    U/S DATA   STATION    INVERT  SECT               N                          RADIUS     ANGLE      ANG PT   MAN H
                               8498.500 2037.410   33              .014                          .000      .000       .000      0
ELEMENT NO  41 IS A REACH              *          *     *
                    U/S DATA   STATION    INVERT  SECT               N                          RADIUS     ANGLE      ANG PT   MAN H
                               8508.500 2037.500   33              .014                          .000      .000       .000      0
ELEMENT NO  42 IS A SYSTEM HEADWORKS                    *                       *
                    U/S DATA   STATION    INVERT  SECT                                    W S ELEV
                               8508.500 2037.500   33                                    2043.500
```

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1000.000	1990.690	5.169	1995.859	1124.00	15.53	3.75	1999.60	.00	5.85	14.00	6.000	14.000	.00	0 .0
250.000	.0050					.0049	1.22	5.17	1.20	5.16	.014	.00	.00	BOX
1250.000	1991.950	5.257	1997.207	1124.00	15.27	3.62	2000.83	.00	5.85	14.00	6.000	14.000	.00	0 .0
JUNCT STR	.0050					.0050	.05	5.26	1.17		.014	.00	.00	BOX
1260.000	1992.000	5.085	1997.085	1118.00	15.71	3.83	2000.91	.00	5.83	14.00	6.000	14.000	.00	0 .0
293.821	.0052					.0049	1.44	5.08	1.23	5.08	.014	.00	.00	BOX
1553.821	1993.531	5.298	1998.829	1118.00	15.07	3.53	2002.36	.00	5.83	14.00	6.000	14.000	.00	0 .0
71.653	.0052					.0043	.31	5.30	1.15	5.08	.014	.00	.00	BOX
1625.474	1993.904	5.557	1999.461	1118.00	14.37	3.21	2002.67	.00	5.83	14.00	6.000	14.000	.00	0 .0
14.526	.0052					.0038	.06	5.56	1.07	5.08	.014	.00	.00	BOX
-------------------- WARNING - Flow depth near top of box conduit --------------------														
1640.000	1993.980	5.829	1999.809	1118.00	13.70	2.91	2002.72	.00	5.83	14.00	6.000	14.000	.00	0 .0
JUNCT STR	.0050					.0056	.06	5.83	1.00		.014	.00	.00	BOX
-------------------- WARNING - Flow depth near top of box conduit --------------------														
1650.000	1994.030	6.240	2000.270	1091.00	13.03	2.64	2002.90	.00	5.74	14.00	6.000	14.000	.00	0 .0
340.000	.0049					.0056	1.91	6.24	.94	5.12	.014	.00	.00	BOX

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
1990.000	1995.680	6.502	2002.182	1091.00	13.03	2.64	2004.82	.00	5.74	14.00	6.000	14.000	.00	0 .0
JUNCT STR	.0050					.0054	.05	6.50	.94		.014	.00	.00	BOX
2000.000	1995.730	6.717	2002.447	1069.00	12.76	2.53	2004.98	.00	5.66	14.00	6.000	14.000	.00	0 .0
340.000	.0050					.0054	1.84	6.72	.92	4.98	.014	.00	.00	BOX
2340.000	1997.440	6.843	2004.283	1069.00	12.76	2.53	2006.81	.00	5.66	14.00	6.000	14.000	.00	0 .0
JUNCT STR	.0050					.0048	.05	6.84	.92		.014	.00	.00	BOX
2350.000	1997.490	7.346	2004.836	1006.00	12.01	2.24	2007.08	.00	5.43	14.00	6.000	14.000	.00	0 .0
390.000	.0050					.0048	1.86	7.35	.87	4.77	.014	.00	.00	BOX
2740.000	1999.450	7.251	2006.701	1006.00	12.01	2.24	2008.94	.00	5.43	14.00	6.000	14.000	.00	0 .0
JUNCT STR	.0050					.0034	.03	7.25	.87		.014	.00	.00	BOX
2750.000	1999.500	8.028	2007.528	849.00	10.14	1.60	2009.12	.00	4.85	14.00	6.000	14.000	.00	0 .0
TRANS STR	.0050					.0034	.03	8.03	.73		.014	.00	.00	BOX
2760.000	1999.550	7.376	2006.927	849.00	12.91	2.59	2009.52	.00	5.70	11.00	6.000	11.000	.00	0 .0
280.000	.0050					.0061	1.72	7.38	.93	5.29	.014	.00	.00	BOX
3040.000	2000.960	7.686	2008.646	849.00	12.91	2.59	2011.24	.00	5.70	11.00	6.000	11.000	.00	0 .0
JUNCT STR	.0050					.0058	.06	.00	.93		.014	.00	.00	BOX
3050.000	2001.010	7.916	2008.926	828.00	12.59	2.46	2011.39	.00	5.60	11.00	6.000	11.000	.00	0 .0
100.000	.0051					.0058	.58	.00	.91	5.17	.014	.00	.00	BOX

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth / Type Ch	Prs/Pip
3150.000	2001.520	8.289	2009.809	828.00	12.59	2.46	2012.27	.00	5.60	11.00	6.000	11.000	.00	0	.0
390.000	.0050					.0058	2.28	8.29	.91	5.20	.014	.00	.00	BOX	
3540.000	2003.480	8.607	2012.087	828.00	12.59	2.46	2014.55	.00	5.60	11.00	6.000	11.000	.00	0	.0
JUNCT STR	.0050					.0057	.06	.00	.91		.014	.00	.00	BOX	
3550.000	2003.530	8.692	2012.222	821.00	12.49	2.42	2014.64	.00	5.57	11.00	6.000	11.000	.00	0	.0
350.000	.0050					.0057	2.01	.00	.90	5.16	.014	.00	.00	BOX	
3900.000	2005.290	9.327	2014.617	821.00	12.49	2.42	2017.04	.00	5.57	11.00	6.000	11.000	.00	0	.0
150.000	.0051					.0057	.86	9.33	.90	5.15	.014	.00	.00	BOX	
4050.000	2006.050	9.429	2015.479	821.00	12.49	2.42	2017.90	.00	5.57	11.00	6.000	11.000	.00	0	.0
190.000	.0066					.0057	1.09	9.43	.90	4.67	.014	.00	.00	BOX	
4240.000	2007.304	9.266	2016.570	821.00	12.49	2.42	2018.99	.00	5.57	11.00	6.000	11.000	.00	0	.0
JUNCT STR	.0066					.0051	.05	9.27	.90		.014	.00	.00	BOX	
4250.000	2007.370	9.771	2017.141	776.00	11.80	2.16	2019.30	.00	5.37	11.00	6.000	11.000	.00	0	.0
340.000	.0066					.0051	1.74	9.77	.85	4.48	.014	.00	.00	BOX	
4590.000	2009.610	9.276	2018.886	776.00	11.80	2.16	2021.05	.00	5.37	11.00	6.000	11.000	.00	0	.0
JUNCT STR	.0070					.0049	.05	9.28	.85		.014	.00	.00	BOX	
4600.000	2009.680	9.432	2019.112	760.00	11.56	2.07	2021.19	.00	5.29	11.00	6.000	11.000	.00	0	.0
390.000	.0066					.0049	1.92	9.43	.83	4.41	.014	.00	.00	BOX	

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth Prs/Pip / Type Ch
4990.000	2012.250	8.782	2021.032	760.00	11.56	2.07	2023.11	.00	5.29	11.00	6.000	11.000	.00	0 .0
JUNCT STR	.0070					.0043	.04	8.78	.83		.014	.00	.00	BOX
5000.000	2012.320	9.296	2021.616	709.00	10.78	1.81	2023.42	.00	5.05	11.00	6.000	11.000	.00	0 .0
690.000	.0066					.0043	2.96	9.30	.78	4.20	.014	.00	.00	BOX
5690.000	2016.870	7.702	2024.572	709.00	10.78	1.81	2026.38	.00	5.05	11.00	6.000	11.000	.00	0 .0
JUNCT STR	.0070					.0040	.04	7.70	.78		.014	.00	.00	BOX
5700.000	2016.940	7.875	2024.815	689.00	10.48	1.71	2026.52	.00	4.96	11.00	6.000	11.000	.00	0 .0
TRANS STR	.0060					.0040	.04	7.87	.76		.014	.00	.00	BOX
5710.000	2017.000	7.191	2024.191	689.00	12.82	2.55	2026.74	.00	5.67	9.00	6.000	9.000	.00	0 .0
1280.000	.0066					.0067	8.58	7.19	.92	5.00	.014	.00	.00	BOX
6990.000	2025.450	7.320	2032.770	689.00	12.82	2.55	2035.32	.00	5.67	9.00	6.000	9.000	.00	0 .0
JUNCT STR	.0070					.0066	.07	7.32	.92		.014	.00	.00	BOX
7000.000	2025.520	7.420	2032.940	682.00	12.69	2.50	2035.44	.00	5.63	9.00	6.000	9.000	.00	0 .0
708.500	.0066					.0066	4.65	7.42	.91	4.96	.014	.00	.00	BOX
7708.500	2030.200	7.392	2037.592	682.00	12.69	2.50	2040.09	.00	5.63	9.00	6.000	9.000	.00	0 .0
TRANS STR	.0100							7.39	.91		.014	.00	.00	BOX
7718.500	2030.300	5.728	2036.028	682.00	17.01	4.49	2040.52	.00	6.00	7.00	6.000	7.000	.00	0 .0
104.820	.0091					.0091	.96	5.73	1.25	5.73	.014	.00	.00	BOX

-------------------- WARNING - Flow depth near top of box conduit --------------------

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth / Type Ch	Prs/Pip
7823.320	2031.257	5.728	2036.984	682.00	17.01	4.49	2041.48	.00	6.00	7.00	6.000	7.000	.00	0	.0
285.180	.0091					.0091	2.59	5.73	1.25	5.73	.014	.00	.00	BOX	
WARNING - Flow depth near top of box conduit															
8108.500	2033.860	5.744	2039.604	682.00	16.96	4.47	2044.07	.00	6.00	7.00	6.000	7.000	.00	0	.0
HYDRAULIC DROP															
WARNING - Flow depth near top of box conduit															
8118.500	2033.952	7.459	2041.411	682.00	16.34	4.14	2045.56	.00	6.00	7.00	6.000	7.000	.00	0	.0
10.000	.0091					.0126	.13	7.46	1.18	5.74	.014	.00	.00	BOX	
8128.500	2034.043	7.494	2041.537	682.00	16.34	4.14	2045.68	.00	6.00	7.00	6.000	7.000	.00	0	.0
30.000	.0091					.0126	.38	7.49	1.18	5.73	.014	.00	.00	BOX	
8158.500	2034.316	7.599	2041.915	682.00	16.34	4.14	2046.06	.00	6.00	7.00	6.000	7.000	.00	0	.0
50.000	.0091					.0126	.63	7.60	1.18	5.73	.014	.00	.00	BOX	
8208.500	2034.771	7.774	2042.545	682.00	16.34	4.14	2046.69	.00	6.00	7.00	6.000	7.000	.00	0	.0
100.000	.0091					.0126	1.26	7.77	1.18	5.73	.014	.00	.00	BOX	

FILE: WASH90.WSW

W S P G W - CIVILDESIGN Version 12.91
For: PENTACORE Engineering, Las Vegas, Nevada - S/N 791
WATER SURFACE PROFILE LISTING

Date: 1-12-2000 Time: 6:26:45

City of Las Vegas - Washington Ave.
Ultimate Condition 100-year Storm Flow
Jan 11, 2000 File: wash90 By: JSL

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / X-Fall	ZL / ZR	No Wth / Type Ch	Prs/Pip
8308.500	2035.681	8.124	2043.805	682.00	16.34	4.14	2047.95	.00	6.00	7.00	6.000	7.000	.00	0	.0
100.000	.0091					.0126	1.26	8.12	1.18	5.74	.014	.00	.00	BOX	
8408.500	2036.590	8.474	2045.064	682.00	16.34	4.14	2049.21	.00	6.00	7.00	6.000	7.000	.00	0	.0
90.000	.0091					.0126	1.13	8.47	1.18	5.73	.014	.00	.00	BOX	
8498.500	2037.410	8.788	2046.198	682.00	16.34	4.14	2050.34	.00	6.00	7.00	6.000	7.000	.00	0	.0
10.000	.0090					.0126	.13	8.79	1.18	5.76	.014	.00	.00	BOX	
8508.500	2037.500	8.824	2046.324	682.00	16.34	4.14	2050.47	.00	6.00	7.00	6.000	7.000	.00	0	.0

```
              City of Las Vegas - Washington Ave.

                Ultimate Condition 100-year Storm Flow

                  Jan 11, 2000         File: wash90     By: JSL


                .         .         .         .         .         .         .         .         .         .         .

 1000.00       .I        WCH   E                                                                                       .    R

 1086.30       .                                                                                                       .

 1172.61       .                                                                                                       .

 1258.91       .  I        WCH   E                                                                                     .    JX

 1345.22       .  I        WCH    E                                                                                    .    R

 1431.52       .                                                                                                       .

 1517.83       .                                                                                                       .

 1604.13       .   I         WH    E                                                                                   .    R

 1690.44       .    I         WH    E                                                                                  .    R

 1776.74       .    I          H    E                                                                                  .    JX

 1863.05       .    I          HW   E                                                                                  .    R

 1949.35       .                                                                                                       .

 2035.66       .       I         CHW   E                                                                               .    JX

 2121.96       .       I         CHW   E                                                                               .    R

 2208.26       .                                                                                                       .
```

```
2294.57    .                                                                                                    .
2380.87    .           I       CHW    E                                                                         .   JX
2467.18    .           I       CH W    E                                                                        .   R
2553.48    .                                                                                                    .
2639.79    .                                                                                                    .
2726.09    .                                                                                                    .
2812.40    .              I       CH W   E                                                                      .   JX
2898.70    .              I      C H   W E                                                                      .   TX
2985.01    .              I         H  W   E                                                                    .   R
3071.31    .                 I       CH   W   E                                                                 .   JX
3157.61    .                 I       CH   W   E                                                                 .   R
3243.92    .                  I       CH   W    E                                                               .   R
3330.22    .                                                                                                    .
3416.53    .                                                                                                    .
3502.83    .                                                                                                    .
3589.14    .                     I       CH    W   E                                                            .   JX
3675.44    .                     I       CH     W   E                                                           .   R
3761.75    .                                                                                                    .
3848.05    .                                                                                                    .
```

```
3934.36  .              I       CH     W   E                                                     .   R
4020.66  .                                                                                       .
4106.97  .               I        H     W   E                                                    .   R
4193.27  .                                                                                       .
4279.57  .                 I        H     W   E                                                  .   JX
4365.88  .                 I       CH      W  E                                                  .   R
4452.18  .                                                                                       .
4538.49  .                                                                                       .
4624.79  .                     I       CH     W  E                                               .   JX
4711.10  .                     I       CH     W   E                                              .   R
4797.40  .                                                                                       .
4883.71  .                                                                                       .
4970.01  .                                                                                       .
5056.32  .                          I      C H   W   E                                           .   JX
5142.62  .                          I      C H    W  E                                           .   R
5228.93  .                                                                                       .
5315.23  .                                                                                       .
5401.53  .                                                                                       .
5487.84  .                                                                                       .
5574.14  .                                                                                       .
```

```
5660.45  .                                                          .
5746.75  .                     I       CH  W  E                     .   JX
5833.06  .                     I       CH   W E                     .   TX
5919.36  .                      I       CH W   E                    .   R
6005.67  .                                                          .
6091.97  .                                                          .
6178.28  .                                                          .
6264.58  .                                                          .
6350.88  .                                                          .
6437.19  .                                                          .
6523.49  .                                                          .
6609.80  .                                                          .
6696.10  .                                                          .
6782.41  .                                                          .
6868.71  .                                                          .
6955.02  .                                                          .
7041.32  .                                   I       CH W   E       .   JX
7127.63  .                                   I       CH W   E       .   R
7213.93  .                                                          .
7300.24  .                                                          .
```

```
7386.54    .                                                                                                     .

7472.84    .                                                                                                     .

7559.15    .                                                                                                     .

7645.45    .                                                                                                     .

7731.76    .                                                                  I        CH W   E                  .    TX

7818.06    .                                                                  I        WH      E                 .    R

7904.37    .                                                                   I         H      E                .    R

7990.67    .                                                                                                     .

8076.98    .                                                                                                     .

8163.28    .                                                                        I        WH      E           .    R

8249.59    .                                                                        I         H W      E         .    R

8335.89    .                                                                        I         H  W     E         .    R

8422.20    .                                                                        I          H W      E        .    R

8508.50    .                                                                         I         H  W      E       .    R

            .         .         .         .         .         .         .         .         .         .         .

         1990.690  1996.668  2002.646  2008.623  2014.601  2020.579  2026.557  2032.534  2038.512  2044.490  2050.468
```

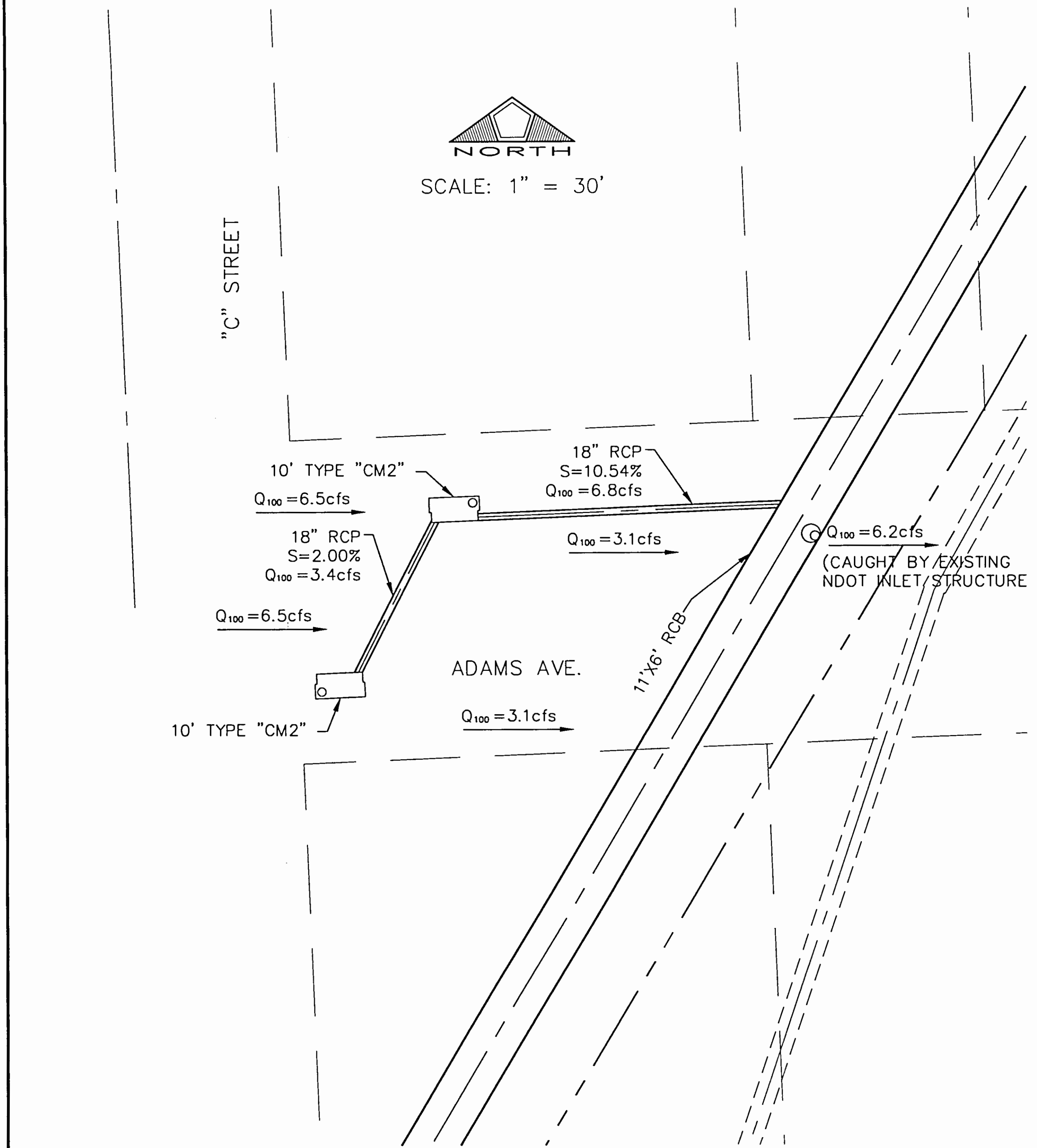
N O T E S
1. GLOSSARY
   I = INVERT ELEVATION
   C = CRITICAL DEPTH
   W = WATER SURFACE ELEVATION
   S = SUPER-ELEVATION
   H = HEIGHT OF CHANNEL

```
    E = ENERGY GRADE LINE
    X = CURVES CROSSING OVER
    B = BRIDGE ENTRANCE OR EXIT
    Y = WALL ENTRANCE OR EXIT
 2. STATIONS FOR POINTS AT A JUMP MAY NOT BE PLOTTED EXACTLY
```

APPENDIX F

HYDRAULIC CALCULATIONS
PROPOSED STORM DRAIN INLET ANALYSIS

STORM DRAIN ANALYSIS
FOR
ADAMS AVENUE



ADAMS AVENUE & "C" STREET

CITY OF LAS VEGAS
WASHINGTON AVENUE
PROPOSED STORM DRAIN INLET FACILITIES

PENTACORE

CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet

Worksheet for Combination Inlet On Grade

Adams Ave & 'B' Street (q3)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	6.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Length	8.17	ft
Grate Length	8.17	ft
Intercepted Flow	3.37	cfs
Bypass Flow	3.13	cfs
Spread	12.78	ft
Depth	0.39	ft
Flow Area	1.7	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	3.75	ft/s
Splash Over Velocity	11.65	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.24	
Grate Flow Ratio	0.37	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	4.09	ft
Length Factor	0.00	
Total Interception Ler	0.00	ft

6.50

→ 3.4 : 10' D.I.

↓ 3.1

Worksheet
Worksheet for Circular Channel

Adams

(1)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	020000	ft/ft
Diameter	18	in
Discharge	3.40	cfs

Results		
Depth	0.49	ft
Flow Area	0.5	ft²
Wetted Perime	1.82	ft
Top Width	1.41	ft
Critical Depth	0.70	ft
Percent Full	32.5	%
Critical Slope	0.005230	ft/ft
Velocity	6.82	ft/s
Velocity Head	0.72	ft
Specific Energ;	1.21	ft
Froude Numbe	2.02	
Maximum Disc	15.98	cfs
Discharge Full	14.85	cfs
Slope Full	0.001048	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

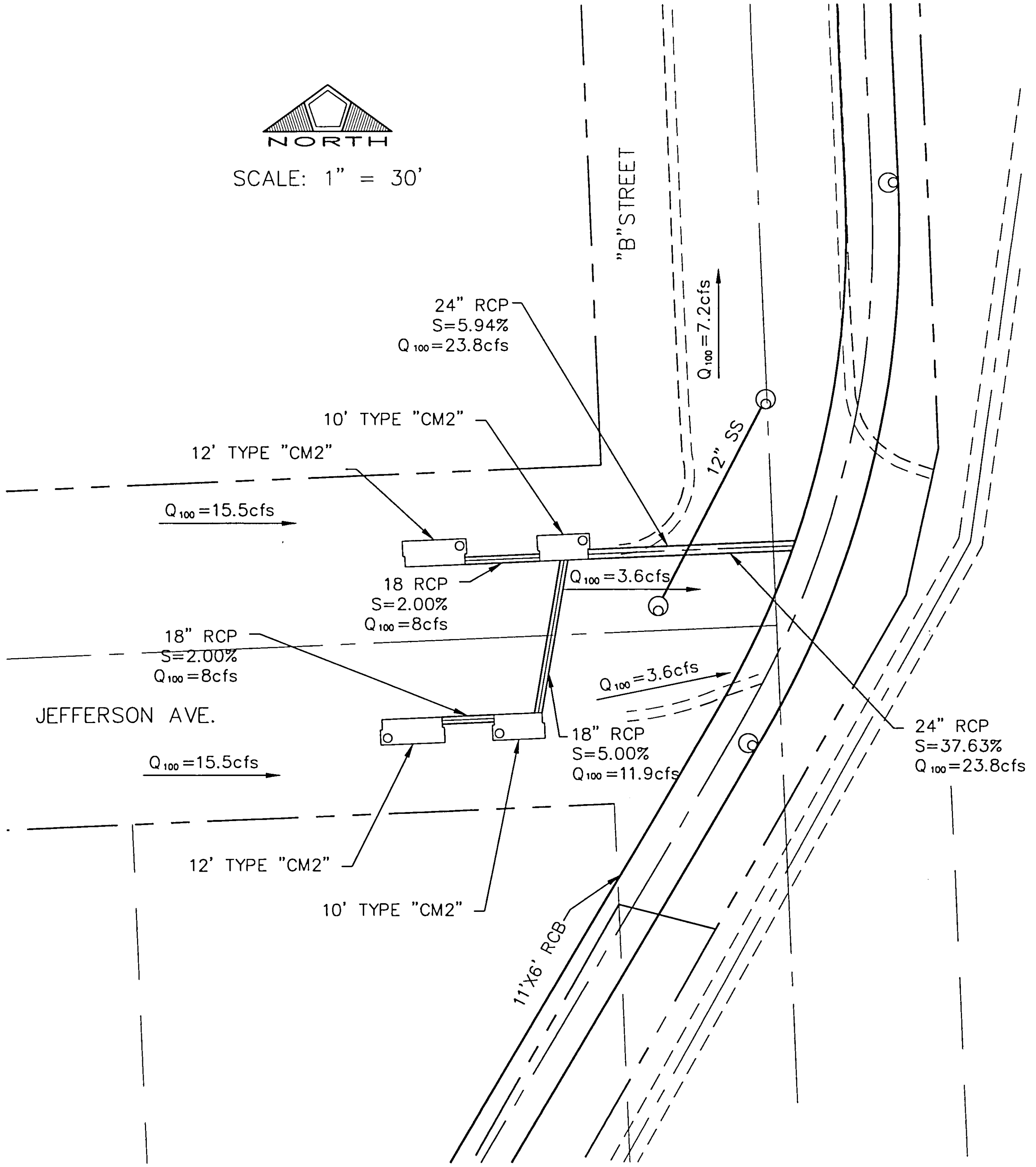
Adams (2)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	020000	ft/ft
Diameter	18	in
Discharge	6.80	cfs

Results		
Depth	0.71	ft
Flow Area	0.8	ft^2
Wetted Perime	2.28	ft
Top Width	1.50	ft
Critical Depth	1.01	ft
Percent Full	47.5	%
Critical Slope	0.006647	ft/ft
Velocity	8.22	ft/s
Velocity Head	1.05	ft
Specific Energ;	1.76	ft
Froude Numbe	1.95	
Maximum Disc	15.98	cfs
Discharge Full	14.85	cfs
Slope Full	0.004191	ft/ft
Flow Type	;upercritical	

STORM DRAIN ANALYSIS
FOR
JEFFERSON AVENUE



"B" STREET & JEFFERSON AVENUE

CITY OF LAS VEGAS

WASHINGTON AVENUE

PROPOSED STORM DRAIN
INLET FACILITIES

PENTACORE

CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet
Worksheet for Combination Inlet On Grade

Jefferson Ave and 'B' Street (q4)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	15.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Lengtl	12.14	ft
Grate Length	12.14	ft
Intercepted Flow	8.04	cfs
Bypass Flow	7.46	cfs
Spread	18.17	ft
Depth	0.50	ft
Flow Area	3.4	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	4.55	ft/s
Splash Over Velocity	15.20	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.36	
Grate Flow Ratio	0.25	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	6.07	ft
Length Factor	0.00	
Total Interception Le	0.00	ft

15.5
↳ 8.0 : 12.5' D.I.
↓
7.5
↳ 3.9 : 10' D.I.
↓
3.6

Worksheet
Worksheet for Combination Inlet On Grade
Jefferson Ave and 'B' Street (94)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	7.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	ɔ mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Lengtl	8.88	ft
Grate Length	8.88	ft
Intercepted Flow	3.89	cfs
Bypass Flow	3.61	cfs
Spread	13.56	ft
Depth	0.41	ft
Flow Area	1.9	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	3.86	ft/s
Splash Over Velocity	12.18	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.27	
Grate Flow Ratio	0.34	
Equivalent Cross Slo|	028216	ft/ft
Active Grate Length	4.44	ft
Length Factor	0.00	
Total Interception Lei	0.00	ft

Worksheet
Worksheet for Circular Channel

Jefferson (3) & (5)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	020000	ft/ft
Diameter	18	in
Discharge	8.00	cfs

Results		
Depth	0.78	ft
Flow Area	0.9	ft²
Wetted Perime	2.42	ft
Top Width	1.50	ft
Critical Depth	1.10	ft
Percent Full	52.3	%
Critical Slope	0.007429	ft/ft
Velocity	8.56	ft/s
Velocity Head	1.14	ft
Specific Energ	1.92	ft
Froude Numbe	1.91	
Maximum Disc	15.98	cfs
Discharge Full	14.85	cfs
Slope Full	0.005801	ft/ft
Flow Type	3upercritical	

Worksheet
Worksheet for Circular Channel

Jefferson (4)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	020000	ft/ft
Diameter	18	in
Discharge	11.90	cfs

Results		
Depth	1.02	ft
Flow Area	1.3	ft²
Wetted Perime	2.90	ft
Top Width	1.40	ft
Critical Depth	1.31	ft
Percent Full	67.7	%
Critical Slope	0.011650	ft/ft
Velocity	9.34	ft/s
Velocity Head	1.36	ft
Specific Energ:	2.37	ft
Froude Numbe	1.73	
Maximum Disc	15.98	cfs
Discharge Full	14.85	cfs
Slope Full	0.012835	ft/ft
Flow Type	ȝupercritical	

Worksheet
Worksheet for Circular Channel

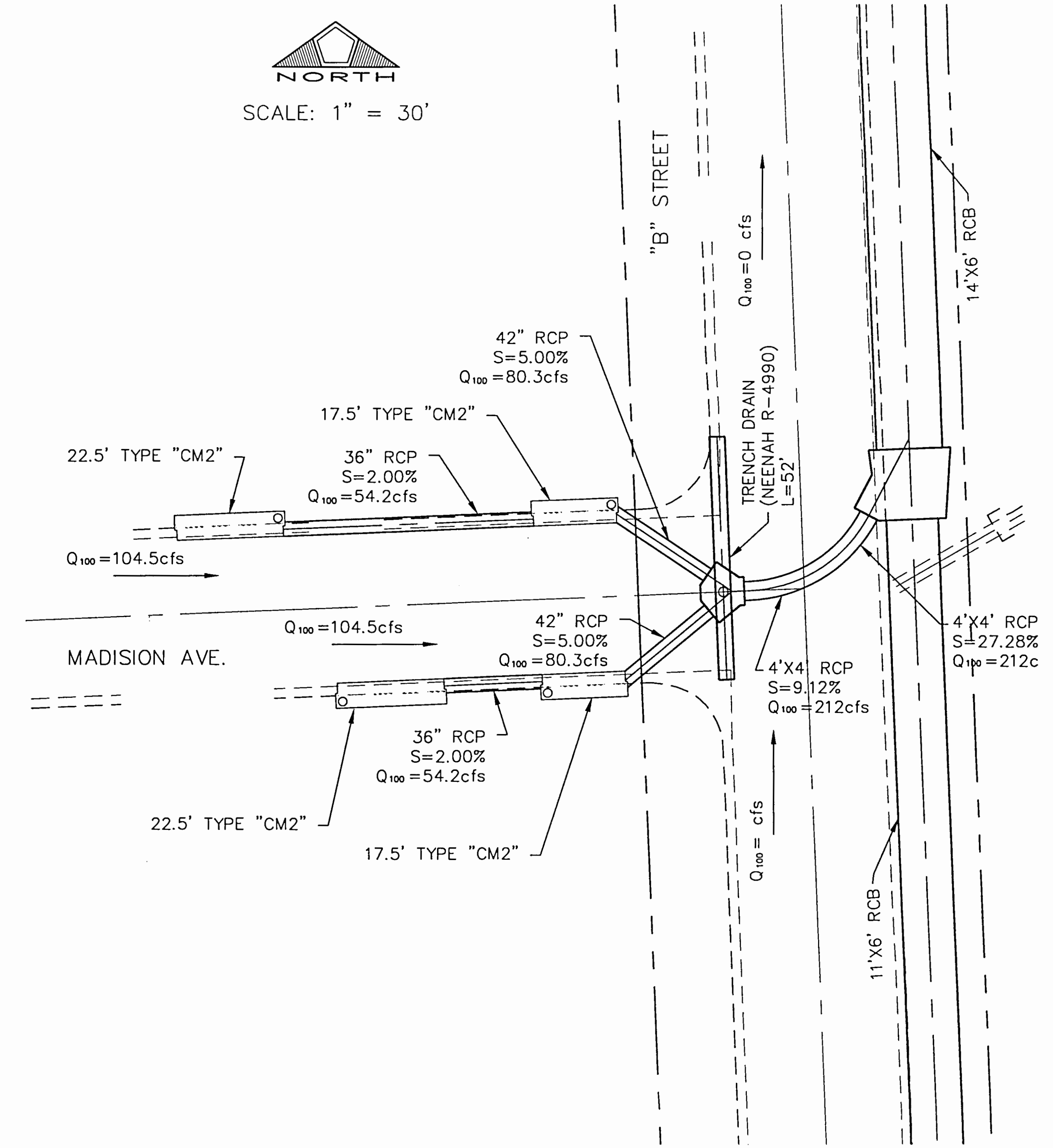
Jefferson (6)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	020000	ft/ft
Diameter	24	in
Discharge	23.80	cfs

Results		
Depth	1.29	ft
Flow Area	2.1	ft^2
Wetted Perime	3.72	ft
Top Width	1.92	ft
Critical Depth	1.73	ft
Percent Full	64.3	%
Critical Slope	0.010174	ft/ft
Velocity	11.16	ft/s
Velocity Head	1.93	ft
Specific Energ;	3.22	ft
Froude Numbe	1.86	
Maximum Disc	34.41	cfs
Discharge Full	31.99	cfs
Slope Full	0.011069	ft/ft
Flow Type	;upercritical	

STORM DRAIN ANALYSIS
FOR
MADISON AVENUE



"B" STREET & MADISION AVENUE

CITY OF LAS VEGAS

WASHINGTON AVENUE

PROPOSED STORM DRAIN INLET FACILITIES

PENTACORE

CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet

Worksheet for Combination Inlet On Grade

Madison Ave and 'B' Street (Q5)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	104.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti :lude	None

Results		
Curb Opening Lengtl	20.90	ft
Grate Length	20.90	ft
Intercepted Flow	54.18	cfs
Bypass Flow	50.32	cfs
Spread	37.90	ft
Depth	0.89	ft
Flow Area	14.5	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	7.22	ft/s
Splash Over Velocity	36.91	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.46	
Grate Flow Ratio	0.11	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	10.45	ft
Length Factor	0.00	
Total Interception Le	0.00	ft

104.5
→ 54.2 : 22.5' D.I
↓
50.3
→ 26.1 : 17.5' D.I
↓
24.2

Worksheet

Worksheet for Combination Inlet On Grade

Madison Ave and 'B' Street (Q5)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	50.30	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Lengtl	17.36	ft
Grate Length	17.36	ft
Intercepted Flow	26.08	cfs
Bypass Flow	24.22	cfs
Spread	28.69	ft
Depth	0.71	ft
Flow Area	8.3	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	6.03	ft/s
Splash Over Velocity	24.65	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.43	
Grate Flow Ratio	0.15	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	8.68	ft
Length Factor	0.00	
Total Interception Le	0.00	ft

Worksheet
Worksheet for Circular Channel

Madison (7) & (9)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	36	in
Discharge	54.20	cfs

Results		
Depth	2.05	ft
Flow Area	5.2	ft²
Wetted Perime	5.85	ft
Top Width	2.79	ft
Critical Depth	2.39	ft
Percent Full	68.4	%
Critical Slope	0.006964	ft/ft
Velocity	10.51	ft/s
Velocity Head	1.72	ft
Specific Energ:	3.77	ft
Froude Numbe	1.36	
Maximum Disc	71.74	cfs
Discharge Full	66.69	cfs
Slope Full	0.006604	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

Madison (8) & (10)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	42	in
Discharge	80.30	cfs

Results		
Depth	2.36	ft
Flow Area	6.9	ft²
Wetted Perime	6.75	ft
Top Width	3.28	ft
Critical Depth	2.80	ft
Percent Full	67.5	%
Critical Slope	0.006671	ft/ft
Velocity	11.61	ft/s
Velocity Head	2.10	ft
Specific Energ	4.46	ft
Froude Numbe	1.41	
Maximum Disc	108.22	cfs
Discharge Full	100.60	cfs
Slope Full	0.006371	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

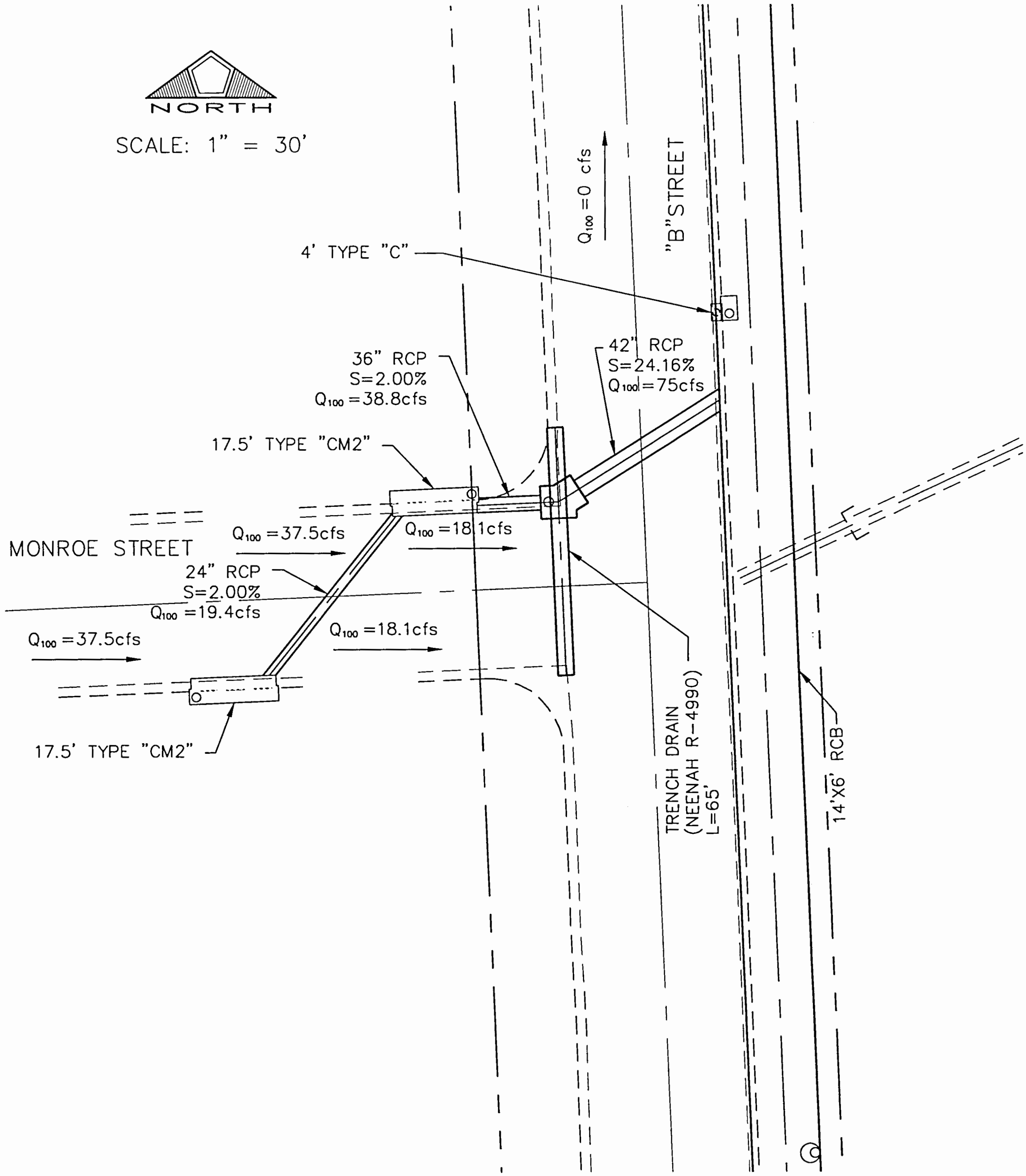
Madison (11)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	60	in
Discharge	212.00	cfs

Results		
Depth	3.43	ft
Flow Area	14.3	ft²
Wetted Perime	9.75	ft
Top Width	4.64	ft
Critical Depth	4.14	ft
Percent Full	68.5	%
Critical Slope	0.006501	ft/ft
Velocity	14.78	ft/s
Velocity Head	3.40	ft
Specific Energ:	6.82	ft
Froude Numbe	1.48	
Maximum Disc	280.14	cfs
Discharge Full	260.43	cfs
Slope Full	0.006627	ft/ft
Flow Type	Supercritical	

STORM DRAIN ANALYSIS
FOR
MONROE AVENUE



"B" STREET & MONROE AVENUE

CITY OF LAS VEGAS

WASHINGTON AVENUE

PROPOSED STORM DRAIN
INLET FACILITIES

PENTACORE
CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet

Worksheet for Combination Inlet On Grade

Monroe Ave and 'B' Street (#6)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	37.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	0 mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	lude None

Results		
Curb Opening Lengtl	16.02	ft
Grate Length	16.02	ft
Intercepted Flow	19.44	cfs
Bypass Flow	18.06	cfs
Spread	25.63	ft
Depth	0.65	ft
Flow Area	6.7	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	5.62	ft/s
Splash Over Velocity	21.42	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.42	
Grate Flow Ratio	0.17	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	8.01	ft
Length Factor	0.00	
Total Interception Lei	0.00	ft

37.5

↳ 19.4 : 17.5' D.I.

↓

18.1

~~↳ 9.4 : 15' D.I.~~

~~↓~~

~~8.7~~

Worksheet
Worksheet for Circular Channel

Monroe (12)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	24	in
Discharge	19.40	cfs

Results		
Depth	1.43	ft
Flow Area	2.4	ft²
Wetted Perime	4.02	ft
Top Width	1.81	ft
Critical Depth	1.58	ft
Percent Full	71.3	%
Critical Slope	0.007856	ft/ft
Velocity	8.09	ft/s
Velocity Head	1.02	ft
Specific Energ:	2.44	ft
Froude Numbe	1.24	
Maximum Disc	24.33	cfs
Discharge Full	22.62	cfs
Slope Full	0.007355	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Monroe (13)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	36	in
Discharge	38.80	cfs

Results		
Depth	1.64	ft
Flow Area	4.0	ft²
Wetted Perime	5.00	ft
Top Width	2.99	ft
Critical Depth	2.03	ft
Percent Full	54.8	%
Critical Slope	0.005303	ft/ft
Velocity	9.79	ft/s
Velocity Head	1.49	ft
Specific Energ	3.13	ft
Froude Numbe	1.50	
Maximum Disc	71.74	cfs
Discharge Full	66.69	cfs
Slope Full	0.003384	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

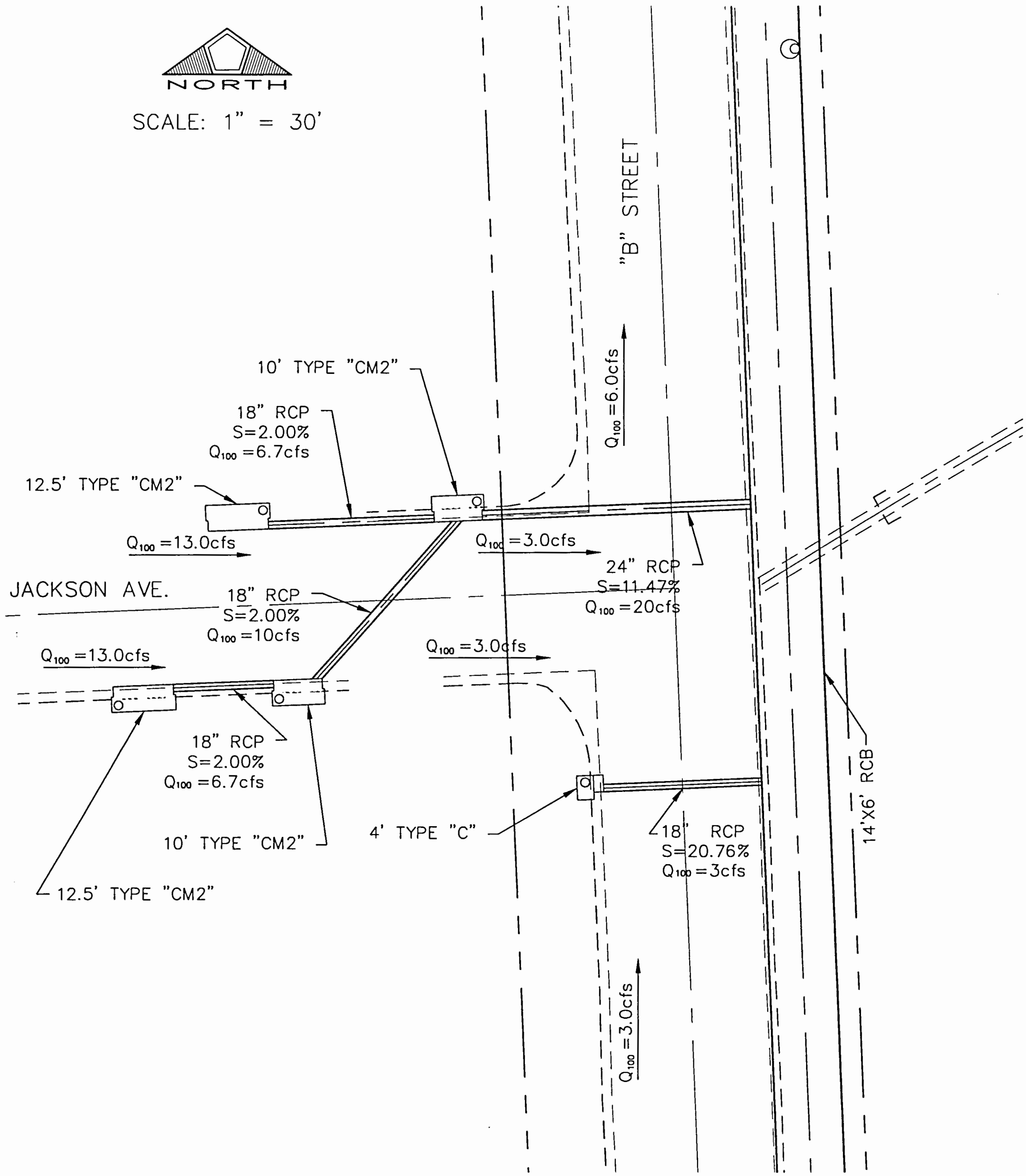
Monroe (14)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	42	in
Discharge	75.00	cfs

Results		
Depth	2.25	ft
Flow Area	6.5	ft^2
Wetted Perime	6.52	ft
Top Width	3.35	ft
Critical Depth	2.71	ft
Percent Full	64.3	%
Critical Slope	0.006217	ft/ft
Velocity	11.46	ft/s
Velocity Head	2.04	ft
Specific Energ:	4.29	ft
Froude Numbe	1.45	
Maximum Disc	108.22	cfs
Discharge Full	100.60	cfs
Slope Full	0.005558	ft/ft
Flow Type	;upercritical	

STORM DRAIN ANALYSIS
FOR
JACKSON AVENUE



"B" STREET & JACKSON AVENUE

CITY OF LAS VEGAS

WASHINGTON AVENUE

PROPOSED STORM DRAIN
INLET FACILITIES

PENTACORE

CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet

Worksheet for Combination Inlet On Grade

Jackson Ave and 'B' Street (q7)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	13.00	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Lengtł	11.38	ft
Grate Length	11.38	ft
Intercepted Flow	6.74	cfs
Bypass Flow	6.26	cfs
Spread	16.95	ft
Depth	0.48	ft
Flow Area	3.0	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	4.37	ft/s
Splash Over Velocity	14.37	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.34	
Grate Flow Ratio	0.27	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	5.69	ft
Length Factor	0.00	
Total Interception Lei	0.00	ft

13.0
→ 6.7 : 12.5' D.I.
↓
6.3
→ 3.3 : 10' D.I.
↓
3.0

Worksheet
Worksheet for Combination Inlet On Grade
Jackson Ave and 'B'Street (g4)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	6.30	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	ɔ mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Lengtl	8.02	ft
Grate Length	8.02	ft
Intercepted Flow	3.27	cfs
Bypass Flow	3.03	cfs
Spread	12.61	ft
Depth	0.39	ft
Flow Area	1.7	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	3.72	ft/s
Splash Over Velocity	11.53	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.23	
Grate Flow Ratio	0.37	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	4.01	ft
Length Factor	0.00	
Total Interception Lei	0.00	ft

Worksheet
Worksheet for Circular Channel

Jackson (15) & (17)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptt

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	18	in
Discharge	6.70	cfs

Results		
Depth	0.87	ft
Flow Area	1.1	ft²
Wetted Perime	2.60	ft
Top Width	1.48	ft
Critical Depth	1.00	ft
Percent Full	58.0	%
Critical Slope	0.006589	ft/ft
Velocity	6.30	ft/s
Velocity Head	0.62	ft
Specific Energ;	1.49	ft
Froude Numbe	1.31	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.004069	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

Jackson (16)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	18	in
Discharge	10.00	cfs

Results		
Depth	1.17	ft
Flow Area	1.5	ft²
Wetted Perime	3.25	ft
Top Width	1.24	ft
Critical Depth	1.22	ft
Percent Full	78.0	%
Critical Slope	0.009206	ft/ft
Velocity	6.77	ft/s
Velocity Head	0.71	ft
Specific Energ;	1.88	ft
Froude Numbe	1.09	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.009064	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

Jackson (18)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	24	in
Discharge	20.00	cfs

Results		
Depth	1.46	ft
Flow Area	2.5	ft²
Wetted Perime	4.10	ft
Top Width	1.77	ft
Critical Depth	1.61	ft
Percent Full	73.1	%
Critical Slope	0.008120	ft/ft
Velocity	8.13	ft/s
Velocity Head	1.03	ft
Specific Energ:	2.49	ft
Froude Numbe	1.22	
Maximum Disc	24.33	cfs
Discharge Full	22.62	cfs
Slope Full	0.007817	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

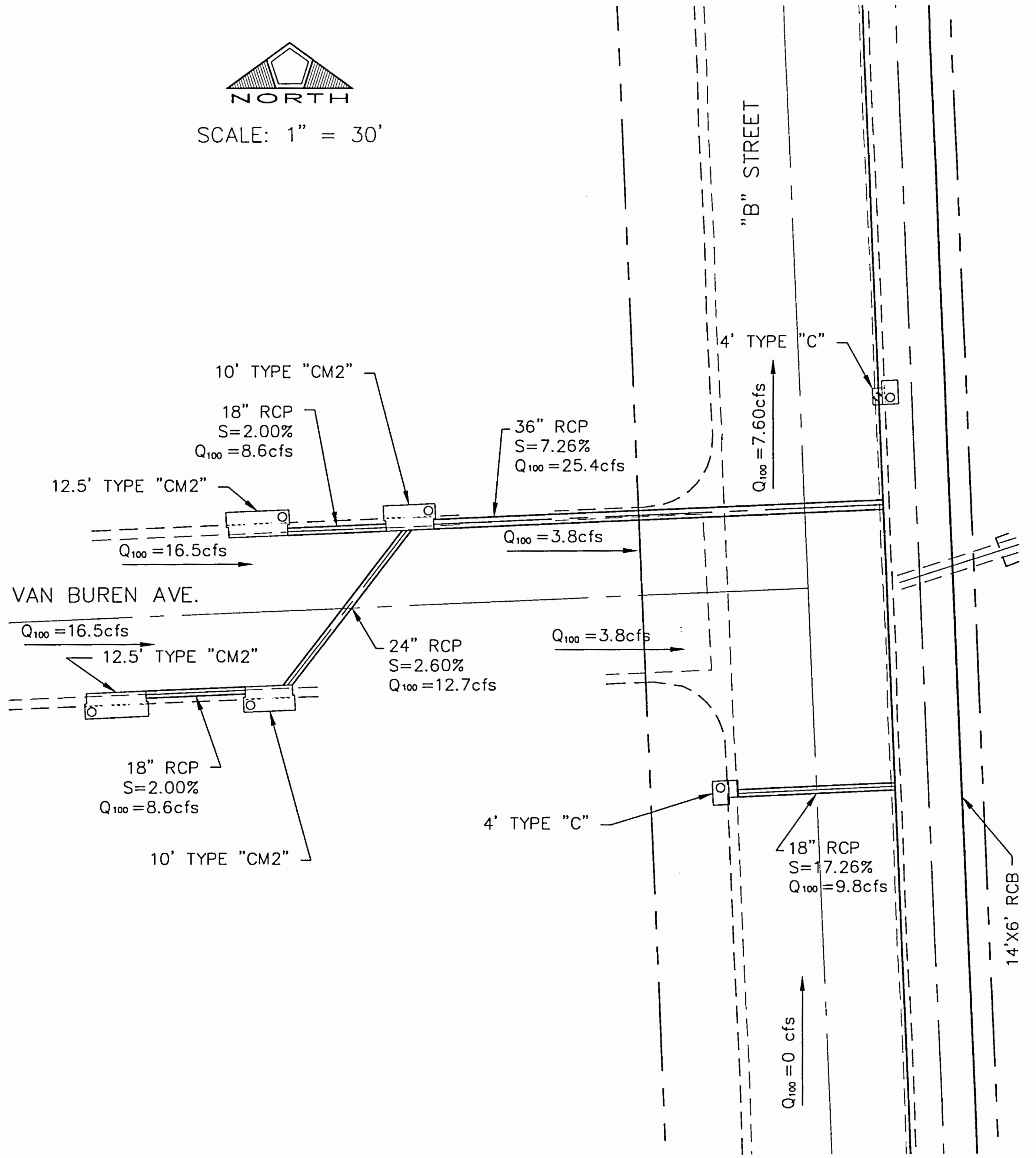
Jackson (19)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	18	in
Discharge	3.00	cfs

Results		
Depth	0.55	ft
Flow Area	0.6	ft²
Wetted Perime	1.95	ft
Top Width	1.44	ft
Critical Depth	0.66	ft
Percent Full	36.6	%
Critical Slope	0.005129	ft/ft
Velocity	5.13	ft/s
Velocity Head	0.41	ft
Specific Energ	0.96	ft
Froude Numbe	1.42	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.000816	ft/ft
Flow Type	;upercritical	

STORM DRAIN ANALYSIS
FOR
VAN BUREN AVENUE



"B" STREET & VAN BUREN AVENUE

CITY OF LAS VEGAS

WASHINGTON AVENUE

PROPOSED STORM DRAIN INLET FACILITIES

PENTACORE
CIVIL ENGINEERING • LAND SURVEYING • PLANNING
CONSTRUCTION MANAGEMENT • ADA CONSULTING
6763 WEST CHARLESTON BOULEVARD
LAS VEGAS, NEVADA 89146 (702)258-0115

Worksheet
Worksheet for Combination Inlet On Grade
Van Buren Ave and 'B' Street (@ 8)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	16.50	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	ↄ mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	ɔlude None

Results		
Curb Opening Lengtl	12.42	ft
Grate Length	12.42	ft
Intercepted Flow	8.56	cfs
Bypass Flow	7.94	cfs
Spread	18.62	ft
Depth	0.51	ft
Flow Area	3.6	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	4.62	ft/s
Splash Over Velocity	15.52	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.36	
Grate Flow Ratio	0.25	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	6.21	ft
Length Factor	0.00	
Total Interception Le	0.00	ft

16.5
↳ 8.6 : 12.5' D.I
↓
7.9
↳ 4.1 : 10' D.I.
↓
3.8

Worksheet

Worksheet for Combination Inlet On Grade

Van Buren -Ave and 'B' Street (9-8)

Project Description	
Worksheet	Combination Inlet - At G
Type	Combination Inlet On G
Solve For	Equal Opening Lengths

Input Data		
Discharge	7.90	cfs
Local Depression	2.0	in
Local Depression \	1.50	ft
Efficiency	0.52	
Slope	0.010000	ft/ft
Gutter Width	1.50	ft
Gutter Cross Slope	0.111111	ft/ft
Road Cross Slope	0.020000	ft/ft
Mannings Coefficie	0.013	
Grate Width	1.50	ft
Grate Type	) mm (P-1-7/8")	
Clogging	0.50	

Options	
Calculation Opt	Use Both
Grate Flow Opti	:lude None

Results		
Curb Opening Length	9.13	ft
Grate Length	9.13	ft
Intercepted Flow	4.10	cfs
Bypass Flow	3.80	cfs
Spread	13.85	ft
Depth	0.41	ft
Flow Area	2.0	ft²
Gutter Depression	1.6	in
Total Depression	3.6	in
Velocity	3.91	ft/s
Splash Over Velocity	12.38	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.27	
Grate Flow Ratio	0.34	
Equivalent Cross Slo	028216	ft/ft
Active Grate Length	4.56	ft
Length Factor	0.00	
Total Interception Le	0.00	ft

Worksheet
Worksheet for Circular Channel

Van Buren (20) & (22)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	18	in
Discharge	8.60	cfs

Results		
Depth	1.03	ft
Flow Area	1.3	ft²
Wetted Perime	2.94	ft
Top Width	1.39	ft
Critical Depth	1.14	ft
Percent Full	68.8	%
Critical Slope	0.007889	ft/ft
Velocity	6.63	ft/s
Velocity Head	0.68	ft
Specific Energ:	1.72	ft
Froude Numbe	1.21	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.006704	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Van Buren (21)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	24	in
Discharge	12.70	cfs

Results		
Depth	1.07	ft
Flow Area	1.7	ft²
Wetted Perime	3.29	ft
Top Width	1.99	ft
Critical Depth	1.28	ft
Percent Full	53.6	%
Critical Slope	0.005735	ft/ft
Velocity	7.41	ft/s
Velocity Head	0.85	ft
Specific Energ:	1.92	ft
Froude Numbe	1.41	
Maximum Disc	24.33	cfs
Discharge Full	22.62	cfs
Slope Full	0.003152	ft/ft
Flow Type	;upercritical	

Worksheet
Worksheet for Circular Channel

Van Buren (23)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	36	in
Discharge	25.40	cfs

Results		
Depth	1.28	ft
Flow Area	2.9	ft^2
Wetted Perime	4.28	ft
Top Width	2.97	ft
Critical Depth	1.63	ft
Percent Full	42.8	%
Critical Slope	0.004427	ft/ft
Velocity	8.80	ft/s
Velocity Head	1.20	ft
Specific Energ:	2.49	ft
Froude Numbe	1.57	
Maximum Disc	71.74	cfs
Discharge Full	66.69	cfs
Slope Full	0.001450	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Van Buren (24)

Project Description	
Worksheet	laterial
Flow Element	Circular Chann
Method	Manning's Forr
Solve For	Channel Deptr

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	18	in
Discharge	9.80	cfs

Results		
Depth	1.15	ft
Flow Area	1.5	ft²
Wetted Perime	3.20	ft
Top Width	1.27	ft
Critical Depth	1.21	ft
Percent Full	76.5	%
Critical Slope	0.008996	ft/ft
Velocity	6.75	ft/s
Velocity Head	0.71	ft
Specific Energ	1.86	ft
Froude Numbe	1.11	
Maximum Disc	11.30	cfs
Discharge Full	10.50	cfs
Slope Full	0.008705	ft/ft
Flow Type	3upercritical	

APPENDIX G

REFERENCES
"DRAINAGE STUDY FOR WASHINGTON"
DATED
SEPTEMBER 1997
BY
PENTACORE ENGINEERING, INC.

DRAINAGE STUDY

FOR

WASHINGTON AVENUE

September 1997

Prepared for

City of Las Vegas
400 East Stewart Avenue
Las Vegas, Nevada 89101

Project No.: 0133.0100

PENTACORE

6763 W. Charleston Blvd. • Las Vegas, NV 89102
Tel. (702) 258-0115 • Fax (702) 258-0865

UPDATE TO THE DRAINAGE STUDY

FOR

WASHINGTON AVENUE,

MARTIN LUTHER KING BOULEVARD

TO I-15 TO

OWENS AVENUE

October 1999

Prepared for

City of Las Vegas
400 East Stewart Avenue
Las Vegas, Nevada 89101

Project No.: 0133.0141

```
1**************************************                                          **************************************
*                                    *                                          *                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                                          *  U.S. ARMY CORPS OF ENGINEERS      *
*           SEPTEMBER 1990           *                                          *  HYDROLOGIC ENGINEERING CENTER     *
*            VERSION 4.0             *                                          *        609 SECOND STREET           *
*                                    *                                          *     DAVIS, CALIFORNIA 95616        *
* RUN DATE  09/29/1999  TIME  14:43:48 *                                        *         (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

1                                        HEC-1 INPUT                                                PAGE  1

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

               *DIAGRAM
   1           ID        B STREET HYDROLOGY
   2           ID
   3           ID        REF.1:  "DRAINAGE STUDY FOR WASHINGTON AVENUE," SEPTEMBER 1997
   4           ID                CITY OF LAS VEGAS - WASHINGTON AVENUE
   5           ID                ULTIMATE OFFSITE/ONSITE CONDITIONS MODEL (DESIGN)
   6           ID                MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE
   7           ID
   8           ID        REF.2:  "CITY OF LAS VEGAS FLOOD CONTROL FACILITIES INVENTORY
   9           ID                AND CITY WIDE HYDROLOGY ANALYSIS," DECEMBER 1997
  10           ID
  11           ID        RATIO PER 100-YR:
  12           ID
  13           ID          10-YR = 0.57
  14           ID          25-YR = 0.74
  15           ID          50-YR = 0.87
  16           ID         100-YR = 1.00
  17           ID
  18           ID
  19           ID        FILE: BST.DAT (MODIFIED RUN)
  20           ID
  21           ID
  22           ID
  23           IT       5       0       0     300
  24           IO       5       0       0
  25           IN       5       0       0
  26           JR    PREC    0.57    0.74    0.87    1.00

  27           KK   WA17B  DEVELOPED CONDITIONS
  28           BA  0.0911
  29           PB    2.77
  30           PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
  31           PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
  32           PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
  33           PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
  34           PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
  35           PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
  36           PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
  37           PC    .998    .999    1.00
  38           LS       0      86
  39           UD    0.33
               *

  40           KK  WA17BR  ROUTE TO WA20 KINEMATIC WAVE ROUTING FOR STREET SECTION
  41           RK    2600   0.007   0.016       0    TRAP      70       0
               *

  42           KK    WA20
  43           BA  0.0858
  44           LS       0      87
  45           UD    0.25
               *
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 46           KK   WA20C  WA20+WA17BR
 47           HC       2
              *

 48           KK   WA21A
 49           BA  0.0214
 50           LS       0      87
 51           UD    0.17
              *

 52           KK  WA21AC  WA21A+WA20C
 53           HC       2
              *

 54           KK   WA21B
 55           BA  0.0083
 56           LS       0      87
 57           UD    0.13
              *

 58           KK  WA21BC  WA21B+WA21AC
 59           HC       2
              *

 60           KK   WA19C
 61           BA  0.0107
 62           LS       0      91
 63           UD    0.16
              *

 64           KK  WA19CC  WA21BC+WA19C  (MODIFIED FOR EXISTING FACILITY FLOWS ONLY)
 65           HC       2
              *

 66           KK   VG07A
 67           BA  0.1376
 68           LS       0      89
 69           UD    0.29
              *

 70           KK  VG07AR  ROUTE TO VG08
 71           RK    2600   0.006   0.017       0    TRAP      70       0
              *

 72           KK    VG08
 73           BA  0.0608
 74           LS       0      84
 75           UD    0.34
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 76           KK   VG08C  VG07AR+VG08
 77           HC       2
              *

 78           KK   VG08R  ROUTE TO VG09
 79           RK    2400   0.010   0.016       0    TRAP      70       0
              *

 80           KK    VG09
 81           BA  0.0584
 82           LS       0      85
 83           UD    0.22
              *

 84           KK   VG09C  VG09+VG08R (MODIFIED FOR EXISTING FACILITY FLOWS ONLY)
 85           HC       2
              *
```

```
                 *
                 *
                 *  BEGIN REF.2 - FOR AREA WEST OF B STREET
                 *
                 *

  86             KK    VG10
  87             BA   0.093
  88             LS       0      86
  89             UD   0.503
                 *

  90             KK   RVG10
  91             KM   ROUTE TO VG11
  92             RM       3    0.23     0.15
                 *

  93             KK    VG11
  94             BA   0.066
  95             LS       0      85
  96             UD   0.326
                 *

  97             KK   CVG11
  98             HC       2
                 *

  99             KK   RVG11
 100             KM   ROUTE TO VG12
 101             RK    ¯600   0.005     0.02       0     TRAP       80        2
                 *
```



```
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 102             KK    VG12
 103             BA   0.051
 104             LS       0      85
 105             UD   0.302
                 *

 106             KK   CVG12
 107             KM   COMBINE VG10, VG11, VG12
 108             HC       2
                 *

 109             KK  CCVG12   (FOR COMPARISON ONLY)
 110             KM   COMBINE CVG12, VG09C, WA19CC
 111             HC       3
                 *
                 *  REF.1:  "DRAINAGE STUDY FOR WASHINGTON AVENUE," SEPTEMBER 1997
                 *
                 *

 112             KK     V1A
 113             BA  0.0352
 114             LS       0      95
 115             UD    0.21
                 *

 116             KK   WA22A
 117             BA  0.0543
 118             LS       0      94
 119             UD    0.28
                 *

 120             KK    VIAC  V1A+WA22AC
 121             HC       2
                 *
 122             ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   27        WA17B
                 V
                 V
   40       WA17BR
                 .
                 .
   42            .        WA20
                 .           .
                 .           .
   46        WA20C............
                 .
                 .
   48            .       WA21A
                 .           .
                 .           .
   52       WA21AC............
                 .
                 .
   54            .       WA21B
                 .           .
                 .           .
   58       WA21BC............
                 .
                 .
   60            .       WA19C
                 .           .
                 .           .
   64       WA19CC............
                 .
                 .
   66            .       VG07A
                 .           V
                 .           V
   70            .      VG07AR
                 .           .
                 .           .
   72            .           .        VG08
                 .           .           .
                 .           .           .
   76            .       VG08C............
                 .           V
                 .           V
   78            .       VG08R
                 .           .
                 .           .
   80            .           .        VG09
                 .           .           .
                 .           .           .
   84            .       VG09C............
                 .           .
                 .           .
   86            .           .        VG10
                 .           .           V
                 .           .           V
   90            .           .       RVG10
                 .           .           .
                 .           .           .
   93            .           .           .        VG11
                 .           .           .           .
                 .           .           .           .
   97            .           .       CVG11............
                 .           .           V
                 .           .           V
   99            .           .       RVG11
                 .           .           .
                 .           .           .
  102            .           .           .        VG12
                 .           .           .           .
                 .           .           .           .
  106            .           .       CVG12............
                 .           .           .
                 .           .           .
  109       CCVG12........................
                 .
                 .
  112            .         V1A
                 .           .
                 .           .
  116            .           .       WA22A
                 .           .           .
                 .           .           .
  120            .        VIAC............
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1***************************************                              ***************************************
 *                                     *                              *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                              *   U.S. ARMY CORPS OF ENGINEERS      *
 *           SEPTEMBER 1990            *                              *   HYDROLOGIC ENGINEERING CENTER     *
 *             VERSION 4.0             *                              *         609 SECOND STREET           *
 *                                     *                              *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE  09/29/1999  TIME  14:43:48 *                            *         (916) 756-1104              *
 *                                     *                              *                                     *
 ***************************************                              ***************************************
```

```
                                 B STREET HYDROLOGY

                                 REF.1:  "DRAINAGE STUDY FOR WASHINGTON AVENUE," SEPTEMBER 1997
                                         CITY OF LAS VEGAS - WASHINGTON AVENUE
                                         ULTIMATE OFFSITE/ONSITE CONDITIONS MODEL (DESIGN)
                                         MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE

                                 REF.2:  "CITY OF LAS VEGAS FLOOD CONTROL FACILITIES INVENTORY
                                         AND CITY WIDE HYDROLOGY ANALYSIS," DECEMBER 1997

                                 RATIO PER 100-YR:

                                   10-YR = 0.57
                                   25-YR = 0.74
                                   50-YR = 0.87
                                  100-YR = 1.00

                                 FILE: BST.DAT (MODIFIED RUN)
```

```
  24 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
                       ICENT          19  CENTURY MARK

                    COMPUTATION INTERVAL     .08 HOURS
                         TOTAL TIME BASE   24.92 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
                       .57       .74       .87      1.00
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 .57	RATIO 2 .74	RATIO 3 .87	RATIO 4 1.00
HYDROGRAPH AT +	WA17B	.09	1	FLOW	31.	50.	66.	82.
				TIME	3.75	3.75	3.75	3.75
ROUTED TO +	WA17BR	.09	1	FLOW	30.	49.	65.	82.
				TIME	3.92	3.92	3.83	3.83
HYDROGRAPH AT +	WA20	.09	1	FLOW	36.	57.	74.	92.
				TIME	3.67	3.67	3.67	3.67
2 COMBINED AT +	WA20C	.18	1	FLOW	60.	98.	130.	163.
				TIME	3.83	3.75	3.75	3.75
HYDROGRAPH AT +	WA21A	.02	1	FLOW	10.	17.	22.	27.
				TIME	3.58	3.58	3.58	3.58
2 COMBINED AT +	WA21AC	.20	1	FLOW	66.	111.	146.	182.
				TIME	3.83	3.75	3.75	3.75
HYDROGRAPH AT +	WA21B	.01	1	FLOW	4.	7.	9.	11.
				TIME	3.58	3.58	3.58	3.58
2 COMBINED AT +	WA21BC	.21	1	FLOW	68.	115.	152.	189.
				TIME	3.83	3.75	3.75	3.75
HYDROGRAPH AT +	WA19C	.01	1	FLOW	7.	11.	13.	16.
				TIME	3.58	3.58	3.58	3.58
2 COMBINED AT +	WA19CC	.22	1	FLOW	73.	122.	161.	200.
				TIME	3.75	3.75	3.75	3.75
HYDROGRAPH AT +	VG07A	.14	1	FLOW	63.	96.	122.	149.
				TIME	3.75	3.75	3.75	3.75
ROUTED TO +	VG07AR	.14	1	FLOW	62.	95.	120.	147.
				TIME	3.83	3.83	3.83	3.75
HYDROGRAPH AT +	VG08	.06	1	FLOW	17.	29.	39.	49.
				TIME	3.83	3.83	3.75	3.75
2 COMBINED AT +	VG08C	.20	1	FLOW	79.	124.	158.	196.
				TIME	3.83	3.83	3.83	3.75
ROUTED TO +	VG08R	.20	1	FLOW	78.	122.	158.	195.
				TIME	3.92	3.83	3.83	3.83
HYDROGRAPH AT +	VG09	.06	1	FLOW	22.	36.	48.	60.
				TIME	3.67	3.67	3.67	3.67
2 COMBINED AT +	VG09C	.26	1	FLOW	93.	150.	194.	240.
				TIME	3.83	3.83	3.83	3.83

HYDROGRAPH AT +	VG10	.09	1	FLOW	25.	41.	53.	67.
				TIME	4.00	4.00	4.00	3.92
ROUTED TO +	RVG10	.09	1	FLOW	24.	39.	51.	64.
				TIME	4.25	4.17	4.17	4.17
HYDROGRAPH AT +	VG11	.07	1	FLOW	20.	34.	46.	57.
				TIME	3.75	3.75	3.75	3.75
2 COMBINED AT +	CVG11	.16	1	FLOW	36.	58.	77.	97.
				TIME	4.08	4.00	4.00	4.00
ROUTED TO +	RVG11	.16	1	FLOW	35.	58.	77.	97.
				TIME	4.08	4.08	4.00	4.00
HYDROGRAPH AT +	VG12	.05	1	FLOW	17.	28.	37.	46.
				TIME	3.75	3.75	3.75	3.75
2 COMBINED AT +	CVG12	.21	1	FLOW	48.	79.	105.	132.
				TIME	3.92	3.92	3.92	3.83
3 COMBINED AT +	CCVG12	.68	1	FLOW	211.	344.	450.	563.
				TIME	3.83	3.83	3.83	3.75
HYDROGRAPH AT +	V1A	.04	1	FLOW	27.	37.	45.	53.
				TIME	3.58	3.58	3.58	3.58
HYDROGRAPH AT +	WA22A	.05	1	FLOW	35.	50.	61.	72.
				TIME	3.67	3.67	3.67	3.67
2 COMBINED AT +	VIAC	.09	1	FLOW	62.	87.	105.	124.
				TIME	3.67	3.67	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	DT	PEAK	TIME TO PEAK	VOLUME
						INTERPOLATED TO COMPUTATION INTERVAL			
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .57									
WA17BR	MANE	3.52	30.48	233.33	.55	5.00	30.48	235.00	.55
CONTINUITY SUMMARY (AC-FT) - INFLOW= .2649E+01 EXCESS= .0000E+00 OUTFLOW= .2656E+01 BASIN STORAGE= .3962E-03 PERCENT ERROR= -.3									
FOR PLAN = 1 RATIO= .74									
WA17BR	MANE	3.03	49.95	231.60	.89	5.00	49.10	235.00	.89
CONTINUITY SUMMARY (AC-FT) - INFLOW= .4309E+01 EXCESS= .0000E+00 OUTFLOW= .4317E+01 BASIN STORAGE= .4450E-03 PERCENT ERROR= -.2									
FOR PLAN = 1 RATIO= .87									
WA17BR	MANE	2.68	65.88	230.44	1.17	5.00	65.47	230.00	1.17
CONTINUITY SUMMARY (AC-FT) - INFLOW= .5686E+01 EXCESS= .0000E+00 OUTFLOW= .5697E+01 BASIN STORAGE= .3745E-03 PERCENT ERROR= -.2									
FOR PLAN = 1 RATIO= 1.00									
WA17BR	MANE	2.43	82.01	230.39	1.47	5.00	81.71	230.00	1.47
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7129E+01 EXCESS= .0000E+00 OUTFLOW= .7143E+01 BASIN STORAGE= .3435E-03 PERCENT ERROR= -.2									
FOR PLAN = 1 RATIO= .57									
VG07AR	MANE	2.89	62.31	231.15	.69	5.00	62.02	230.00	.69
CONTINUITY SUMMARY (AC-FT) - INFLOW= .5069E+01 EXCESS= .0000E+00 OUTFLOW= .5087E+01 BASIN STORAGE= .4557E-03 PERCENT ERROR= -.4									
FOR PLAN = 1 RATIO= .74									
VG07AR	MANE	2.53	95.37	229.51	1.07	5.00	94.82	230.00	1.08
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7848E+01 EXCESS= .0000E+00 OUTFLOW= .7882E+01 BASIN STORAGE= .4699E-03 PERCENT ERROR= -.4									
FOR PLAN = 1 RATIO= .87									
VG07AR	MANE	2.30	121.44	228.49	1.38	5.00	119.97	230.00	1.38
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1010E+02 EXCESS= .0000E+00 OUTFLOW= .1014E+02 BASIN STORAGE= .4408E-03 PERCENT ERROR= -.4									
FOR PLAN = 1 RATIO= 1.00									
VG07AR	MANE	2.20	147.95	227.74	1.70	5.00	146.60	225.00	1.70
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1243E+02 EXCESS= .0000E+00 OUTFLOW= .1248E+02 BASIN STORAGE= .4782E-03 PERCENT ERROR= -.4									
FOR PLAN = 1 RATIO= .57									
VG08R	MANE	2.12	78.45	233.62	.62	5.00	77.87	235.00	.62
CONTINUITY SUMMARY (AC-FT) - INFLOW= .6586E+01 EXCESS= .0000E+00 OUTFLOW= .6587E+01 BASIN STORAGE= .8459E-03 PERCENT ERROR= .0									
FOR PLAN = 1 RATIO= .74									
VG08R	MANE	1.71	123.15	232.38	.99	5.00	122.17	230.00	.98
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1042E+02 EXCESS= .0000E+00 OUTFLOW= .1043E+02 BASIN STORAGE= .8611E-03 PERCENT ERROR= -.1									
FOR PLAN = 1 RATIO= .87									
VG08R	MANE	1.54	158.39	232.95	1.28	5.00	158.24	230.00	1.28
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1353E+02 EXCESS= .0000E+00 OUTFLOW= .1356E+02 BASIN STORAGE= .7685E-03 PERCENT ERROR= -.2									
FOR PLAN = 1 RATIO= 1.00									
VG08R	MANE	1.53	195.57	228.51	1.59	5.00	195.28	230.00	1.59

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1679E+02 EXCESS= .0000E+00 OUTFLOW= .1680E+02 BASIN STORAGE= .8950E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .57
             RVG11  MANE          1.14      35.49    245.88       .53      5.00     35.47    245.00          .53

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4473E+01 EXCESS= .0000E+00 OUTFLOW= .4474E+01 BASIN STORAGE= .9842E-05 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .74
             RVG11  MANE           .93      58.46    242.06       .86      5.00     58.25    245.00          .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7327E+01 EXCESS= .0000E+00 OUTFLOW= .7330E+01 BASIN STORAGE= .1144E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .87
             RVG11  MANE           .90      77.22    242.09      1.14      5.00     77.03    240.00         1.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9702E+01 EXCESS= .0000E+00 OUTFLOW= .9706E+01 BASIN STORAGE= .1007E-04 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO= 1.00
             RVG11  MANE           .72      96.71    241.08      1.44      5.00     96.54    240.00         1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1220E+02 EXCESS= .0000E+00 OUTFLOW= .1220E+02 BASIN STORAGE= .9387E-05 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
```

CITY OF LAS VEGAS

INTER - OFFICE MEMORANDUM | October 27, 1997

TO:	FROM:
Joe Christensen Project Manager Engineering Design	Randy Fultz, P.E. Flood Control Engineering Supervisor Department of Public Works
SUBJECT: Technical Drainage Study for Washington Avenue	**COPIES TO:** Myron Welsh, PE, Pentacore Mike Short, PE - Pentacore Charles Kajkowski, P.E.

We have reviewed the Washington Avenue Drainage Study dated September 1997and offer the following comments.

1) **Table 1 - Drainage Summary**

Concentration Point WA17AC indicates a Q10 future of 226 cfs. The inlet calculations were only done for existing conditions of 165 cfs. They need to be designed for future conditions.

2) **Page 7, Section 2.5 -**

(Insert) ....a designated Special Flood Hazard Zone. *However, this project when extended to Rancho Drive will cut off flows impacting the FEMA A flood zone along Bonanza Road.*

3) **Page 10, Section 3.1**
Text indicates a 11'x 6' RCB west of N Street but Figure 4A does not correspond.

4) **Appendix 6.4 - Hydraulic Calculations**

Inlet calculations for the Q100 at MLK should be removed since the inlets are designed for the *future* 10-year flow.

5) A field investigation with Pentacore staff indicated that an inlet on the northwest corner at D Street is needed to intercept low flows that are causing ponding along D Street south of Washington Avenue.

6) A spread sheet for the 10-Year and 100-year storm drain systems must be provided. The MLK inlets designed to collect the 10-year flow and 4-foot nuisance inlets should be assigned to the 10-year system cost. The inlets at "E, H, I and J Streets need to be sized and prorated for the 10/100 systems.

7) The F Street system should be designed to intercept the 10-year flow and not discharge it into the 100-year Washington Avenue system. This will require McWilliams/F Street to intercept more flow.

File F:/...rtc/WashMLK2.doc

Drainage Summary East of Rancho Drive

Concentration Indentification	Existing Q 10	Existing Q 100	Ultimate Q 10	Ultimate Q 100	Location
WA14C	300	520	306	619	Flows which combine at the southwest corner of Basin WA14
RANSD2	197	197	197	197	Flows from WA14C which are diverted southeast in the existing Rancho Dr. Storm Drain System
RANWAS	103	323	109	422	Flows from WA14C which continue east across Ranch Dr. to Washington Ave.
WA13C	158	359	89	192	Flows which combine along the eastern boundary of WA13
RANDUN	14	215	0	48	Flows from WA13C which are diverted as a result of overflowing the existing Rancho Dr. Storm Drain System
RANSD1	144	144	89	144	Flows from WA13C which continue southeast in the existing Rancho Dr. Storm Drain System
WA15BC	126	522	175	573	Flows which combine at the southeast corner of Basin WA15B
WA16AC	132	531	192	618	Flows which combine at the southeast corner of Basin WA16B
WA17AC	165	550	226	682	Flows which combine at the northeast corner of Basin WA17A (Martin Luther King Blvd. and Washington Ave)
WA18AC	165	552	228	689	Flows which combine at the east edge of Basin WA18A ("J" St. and Washington Ave)
WA18BC	173	556	235	709	Flows which combine at the northeast corner of Basin WA18B (Revere St. and Washington Ave)
WA19AC	195	569	257	776	Flows which combine at the northeast corner of Basin WA19B ("D" St. and Washington Ave)
WA21AC	64	177	64	178	Flows which combine at the east edge of Basin WA21A ("F" St.)
WA21BC	66	184	68	184	Flows which combine at the northeast corner of Basin WA21B ("D" St.)
WA19CC	265	612	325	946	Flows which combine at the northeast corner of Basin WA19C
VG09C	351	775	413	1127	Flows which combine at the northeast corner of Basin VG09
V1AC	62	124	62	124	Flows which combine at the east edge of Basin V1A

Design=Ultimate

Table 1

ULTIMATE CONDITIONS
HEC-1 MODEL

(DESIGN CONDITIONS)

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            FEBRUARY 1981             *
*          REVISED 02 AUG 88           *
*                                      *
*  RUN DATE  09/02/1997  TIME  13:38:51 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

```
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
  1         ID        CITY OF LAS VEGAS - WASHINGTON AVENUE
  2         ID        ULTIMATE OFFSITE/ONSITE CONDITION MODEL (DESIGN CONDITION)
  3         ID        MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE
  4         ID        AUGUST 23, 1997          FILE:  WASR.DAT
  5         ID        ***********************************************************************
  6         ID        RATIO 10/100 = .57
  7         ID        AREA = 0.0               DARF = 1.00
  8         ID        AREA = 1.0               DARF = 0.97
  9         ID        AREA = 1.5               DARF = 0.95
 10         ID        AREA = 2.0               DARF = 0.93
 11         ID        ***********************************************************************
 12         ID        BASIN DATA WEST OF RANCHO DRIVE OBTAINED FROM MONTGOMERY WATSON 1995
 13         ID        DATA OBTAINED FROM NWEX_2.DAT INDICATED BY <== NOTE 1
 14         ID        DATA OBTAINED FROM ALT1K_FW.DAT INDICATED BY <== NOTE 2
 15         ID        KINIMATIC WAVE ROUTING UTILIZED FOR THE 1997 MPU FACILITIES
 16         ID        ***********************************************************************
 17         IT        5       0       0     300
 18         IO        5       0
 19         IN        5       0       0
 20         JR     PREC     .57       1     .97     .95     .93

 21         KK     WA12   <== NOTE 2
 22         BA    .0700
 23         PC     .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
 24         PC     .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
 25         PC     .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
 26         PC     .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
 27         PC     .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
 28         PC     .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
 29         PC     .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
 30         PC     .998    .999    1.00
 31         PB     2.77
 32         LS        0      92
 33         UD      .22

 34         KK    WA12R  TO WA13  <== NOTE 2
 35         RM        6     .46     .15

 36         KK     WA13   <== NOTE 2
 37         BA    .1345
 38         LS        0      92
 39         UD      .53

 40         KK    WA13C  WA13+WA12R
 41         HC        2

 42         KK   RANSD1  DIVERT OUT OVERFLOW FROM RANCHO STORM DRAIN; CPA 144 CFS <== NOTE 2
 43         KM           RANSDM = FLOWS WHICH CONTINUE IN THE RANCHO STORMDRAIN
 44         KM           RANDUN = FLOWS WHICH ARE DIVERTED EAST THROUGH EXISTING STREETS
 45         DT   RANDUN
 46         DI        0     144    1000
 47         DQ        0       0     856
```

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 48       KK   WA13R  TO WA14  <== NOTE 2
 49       RM       1     .07     .15

 50       KK    WA01  <== NOTE 2
 51       BA   .0724
 52       LS       0      81
 53       UD     .34

 54       KK    WA02  <== NOTE 2
 55       BA   .1514
 56       LS       0      92
 57       UD     .35

 58       KK   WA02R  TO WA03  <== NOTE 2
 59       RM       3     .22     .15

 60       KK    WA03  <== NOTE 2
 61       BA   .0891
 62       LS       0      92
 63       UD     .21

 64       KK   WA03C  WA03+WA01+WA02
 65       HC       3

 66       KK   OG011  <== NOTE 2  BASIN PER CLV REQUEST
 67       BA   .1614
 68       LS       0      79
 69       UD     .47

 70       KK  WASSD1  DIVERT FLOW IN EXCESS OF 30" RCP CAP TO VEGAS VALLEY SUB BASINS
 71       KM          WASSD1 = FLOWS FOUND WITHIN THE EXISTING STORM DRAIN SYSTEM
 72       KM          VEGSY1 = FLOWS WHICH ARE DIVERTED OUT OF THE WASHINGTON SUB BASIN
 73       DT  VEGSY1
 74       DI       0      40    1000
 75       DQ       0       0     960

 76       KK  OG011R  ROUTE REMAINING FLOWS TO VG011  <== NOTE 2
 77       RM       1     .05     .15

 78       KK   VG011  <== NOTE 2  BASIN PER CLV REQUEST
 79       BA   .0277
 80       LS       0      82
 81       UD     .42

 82       KK  VG011C  VG011+OG011R
 83       HC       2

 84       KK  WASSD2  DIVERT FLOW IN EXCESS OF 30" RCP CAP TO VEGAS VALLEY SUB BASINS
 85       KM          WASSD2 = FLOWS FOUND WITHIN THE EXISTING STORM DRAIN SYSTEM
 86       KM          VEGSY1 = FLOWS WHICH ARE DIVERTED OUT OF THE WASHINGTON SUB BASIN
 87       DT  VEGSY2
 88       DI       0      10    1000
 89       DQ       0       0     990
```

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 90       KK  VG011R  ROUTE REMAINING FLOWS TO WA03C  <== NOTE 2
 91       RM       2     .17     .15

 92       KK   WA03C  PRV WA03C+VG011R
 93       HC       2

 94       KK   WA03R  TO WA04  <== NOTE 2
 95       RM       3     .25     .15

 96       KK    WA04  <== NOTE 2
 97       BA   .1040
 98       LS       0      90
 99       UD     .37

100       KK   WA04C  WA03R+WA04
101       HC       2

102       KK   WA04R  TO WA06  <== NOTE 2
103       RM       2     .16     .15

104       KK    WA06  <== NOTE 2
105       BA   .0779
106       LS       0      92
107       UD     .37

108       KK   WA06C  WA04R+WA06
109       HC       2

110       KK   WA06R  TO WA05  <== NOTE 2
111       RM       0     .04     .15

112       KK    WA05  <== NOTE 2
113       BA   .0276
114       LS       0      91
115       UD     .17

116       KK   WA05C  WA06R+WA05
117       HC       2

118       KK   WA05R  TO WA06A
119       RK    1400    .029    .013       0    CIRC       5

120       KK   WA05R  TO WA06A  <== NOTE 2
121       RM       1     .07     .15

122       KK   WA06A  <== NOTE 2
123       BA   .0583
124       LS       0      92
125       UD     .25
```

```
LINE       ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

126        KK   WA06C  WA05R+WA06
127        HC       2

128        KK   WA06R  TO WA07 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
129        RK    1400    .014    .013       0    CIRC       5

130        KK    WA07  <== NOTE 2
131        BA   .0340
132        LS       0      93
133        UD     .27

134        KK   WA07C  WA06R+WA07
135        HC       2

136        KK   WA07R  TO WA09 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
137        RK    2500    .012    .013       0    CIRC       5

138        KK    WA09  <== NOTE 2
139        BA   .0545
140        LS       0      93
141        UD     .36

142        KK   WA09C  WA07R+WA09
143        KM          BASIN WA10 IS ASSUMED TO BE DIVERTED SOUTH PER NOTE 1 AND PER THE
144        KM          MPU 1997 PROPOESD MODEL NWBSD3.DAT
145        HC       2

146        KK   WA09R  TO WA11 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
147        RK    2800    .018    .013       0    CIRC     5.5

148        KK    WA11  <== NOTE 2
149        BA   .0326
150        LS       0      92
151        UD     .17

152        KK   WA11C  WA10R+WA11
153        HC       2

154        KK   WA11R  TO WA14 ASSUMES MAJORITY OF 100 YEAR FLOW IS IN SD (MPU PIPE)
155        RK    2700    .015    .013       0    CIRC     5.5

156        KK    WA14  <== NOTE 2
157        BA   .0453
158        LS       0      92
159        UD     .39

160        KK   WA14C  WA13R+WA14
161        HC       2
```

```
LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

162       KK   WA14C  PRV WA14C+WA11C
163       HC       2

164       KK  RANWAS  DIVERT ALL Q UP TO 54" CAP=197 CFS <== NOTE 2
165       KM          RANWAS = FLOWS WHICH CONTINUE EAST IN WASHINGTON
166       KM          RANSDM = FLOWS WHICH ARE DIVERTED BY THE RANCHO STORM DRAIN
167       DT  RANSD2
168       DI       0     197    1000
169       DQ       0     197     197

170       KK  RANDUN  RETRIEVE PREVIOUSLY DIVERTED OVERFLOWS FROM RANCHO STORM DRIAN  NOTE 2
171       DR  RANDUN

172       KK   WA15A  DEVELOPED CONDITIONS
173       BA   .0887
174       LS       0      92
175       UD     .17

176       KK  WA15AC  WA15AC+RANDUN
177       HC       2

178       KK  WA15AR  ROUTE TO WA15B  <== NOTE 2
179       RM       4     .37     .15

180       KK   WA15B  DEVELOPED CONDITIONS
181       BA   .0943
182       LS       0      94
183       UD     .19

184       KK  WA15BC  WA15B+WA15AC+RANWAS
185       HC       3

186       KK  WA15BR  ROUTE TO WA16 ASSUMES MAJORITY OF 100 YEAR IS IN SD
187       RK    1400    .012    .013       0    TRAP       9       0

188       KK   WA16A  DEVELOPED CONDITIONS
189       BA   .0646
190       LS       0      92
191       UD     .22

192       KK  WA16AC  WA16A+WA15B
193       HC       2

194       KK  WA16AR  ROUTE TO WA17AC ASSUMES MAJORITY OF 100 YEAR IS IN SD
195       RK    2600    .005    .013       0    TRAP       9       0

196       KK   WA17A  DEVELOPED CONDITIONS
197       BA   .0826
198       LS       0      89
199       UD     .32
```

```
LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 200           KK   VG07B  DEVELOPED CONDITIONS
 201           BA   .0299
 202           LS       0      85
 203           UD     .26

 204           KK  WA17AC  WA16AR+WA17A+VG07A
 205           HC       3

 206           KK  WA17AR  ROUTE TO WA18A ASSUMES MAJORITY OF 100 YEAR IS IN SD
 207           RK    1100    .007    .013       0    TRAP       9       0

 208           KK   WA18A  DEVELOPED CONDITIONS
 209           BA   .0153
 210           LS       0      85
 211           UD     .17

 212           KK  WA18AC  WA18A+WA17AR
 213           HC       2

 214           KK  WA18AR  ROUTE TO WA18B ASSUMES MAJORITY OF 100 YEAR IS IN SD
 215           RK    1400    .007    .013       0    TRAP       9       0

 216           KK   WA18B  DEVELOPED CONDITIONS
 217           BA   .0375
 218           LS       0      85
 219           UD     .19

 220           KK  WA18BC  WA18B+WA18AR
 221           HC       2

 222           KK   WA19A  DEVELOPED CONDITIONS
 223           BA   .0227
 224           LS       0      87
 225           UD     .18

 226           KK    WA23  DEVELOPED CONDITIONS
 227           BA   .0461
 228           LS       0      85
 229           UD     .25

 230           KK   WA19B  DEVELOPED CONDITIONS
 231           BA   .0238
 232           LS       0      87
 233           UD     .18

 234           KK  WA19BC  WA23+WA19B
 235           HC       2

 236           KK  WA19AC  WA19BC+WA19A+WA18BC
 237           HC       3
```

LINE	ID	.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
238	KK	WA17B DEVELOPED CONDITIONS
239	BA	.0911
240	LS	0 86
241	UD	.33
242	KK	WA17BR ROUTE TO WA20 KINAMATIC WAVE ROUTING FOR STREET SECTION
243	RK	2600 .007 .016 0 TRAP 70 0
244	KK	WA20 DEVELOPED CONDITIONS
245	BA	.0858
246	LS	0 87
247	UD	.25
248	KK	WA20C WA22A+WA20+WA17BR
249	HC	2
250	KK	WA21A DEVELOPED CONDITIONS
251	BA	.0214
252	LS	0 87
253	UD	.17
254	KK	WA21AC WA21A+WA20C
255	HC	2
256	KK	WA21B DEVELOPED CONDITIONS
257	BA	.0083
258	LS	0 87
259	UD	.13
260	KK	WA21BC WA21B+WA21AC
261	HC	2
262	KK	WA19C DEVELOPED CONDITIONS
263	BA	.0107
264	LS	0 91
265	UD	.16
266	KK	WA19CC WA19CC+WA21BC+WA19AC
267	HC	3
268	KK	VG07A DEVELOPED CONDITIONS
269	BA	.1376
270	LS	0 89
271	UD	.29
272	KK	VG07AR ROUTE TO VG08
273	RK	2600 .006 .017 0 TRAP 70 0
274	KK	VG08 DEVELOPED CONDITIONS
275	BA	.0608
276	LS	0 84
277	UD	.34

```
LINE     ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 278     KK   VG08C  VG07AR+VG08
 279     HC       2

 280     KK   VG08R  ROUTE TO VG09
 281     RK    2400   .010   .016      0   TRAP     70      0

 282     KK    VG09  DEVELOPED CONDITIONS
 283     BA   .0584
 284     LS       0     85
 285     UD     .22

 286     KK   VG09C  VG09C+VG08R
 287     HC       3

 288     KK     V1A  DEVELOPED CONDITIONS
 289     BA   .0352
 290     LS       0     95
 291     UD     .21

 292     KK   WA22A  DEVELOPED CONDITIONS
 293     BA   .0543
 294     LS       0     94
 295     UD     .28

 296     KK    V1AC  V1A+WA22AC
 297     HC       2
 298     ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

21            WA12
                 V
                 V
34           WA12R
                 .
                 .
36               .      WA13
                 .         .
                 .         .
40           WA13C..........
                 .
                 .
45               .-------> RANDUN
42          RANSD1
                 V
                 V
48           WA13R
                 .
                 .
50               .      WA01
                 .         .
                 .         .
54               .         .      WA02
                 .         .         V
                 .         .         V
58               .         .     WA02R
                 .         .         .
                 .         .         .
60               .         .         .      WA03
                 .         .         .         .
                 .         .         .         .
64               .     WA03C....................
                 .         .
                 .         .
66               .         .     OG011
                 .         .         .
                 .         .         .
73               .         .         .-------> VEGSY1
70               .         .    WASSD1
                 .         .         V
                 .         .         V
76               .         .    OG011R
                 .         .         .
                 .         .         .
78               .         .         .     VG011
                 .         .         .         .
                 .         .         .         .
82               .         .    VG011C..........
                 .         .         .
                 .         .         .
87               .         .         .-------> VEGSY2
84               .         .    WASSD2
                 .         .         V
```

```
                 .            .       V
90               .            .  VG011R
                 .            .       .
                 .            .       .
92               .        WA03C.........
                 .            V
                 .            V
94               .        WA03R
                 .            .
                 .            .
96               .            .    WA04
                 .            .       .
                 .            .       .
100              .        WA04C.........
                 .            V
                 .            V
102              .        WA04R
                 .            .
                 .            .
104              .            .    WA06
                 .            .       .
                 .            .       .
108              .        WA06C.........
                 .            V
                 .            V
110              .        WA06R
                 .            .
                 .            .
112              .            .    WA05
                 .            .       .
                 .            .       .
116              .        WA05C.........
                 .            V
                 .            V
118              .        WA05R
                 .            V
                 .            V
120              .        WA05R
                 .            .
                 .            .
122              .            .   WA06A
                 .            .       .
                 .            .       .
126              .        WA06C.........
                 .            V
                 .            V
128              .        WA06R
                 .            .
                 .            .
130              .            .    WA07
                 .            .       .
                 .            .       .
134              .        WA07C.........
                 .            V
                 .            V
136              .        WA07R
                 .            .
                 .            .
138              .            .    WA09
                 .            .       .
```

```
                 .              .                  .
142              .           WA09C............
                 .              V
                 .              V
146              .           WA09R
                 .              .
                 .              .
148              .              .              WA11
                 .              .                  .
                 .              .                  .
152              .           WA11C............
                 .              V
                 .              V
154              .           WA11R
                 .              .
                 .              .
156              .              .              WA14
                 .              .                  .
                 .              .                  .
160              .           WA14C............
                 .              .
                 .              .
162          WA14C............
                 .
                 .
167              .------->  RANSD2
164          RANWAS
                 .
                 .
171              .              .<-------   RANDUN
170              .           RANDUN
                 .              .
                 .              .
172              .              .             WA15A
                 .              .                 .
                 .              .                 .
176              .           WA15AC............
                 .              V
                 .              V
178              .           WA15AR
                 .              .
                 .              .
180              .              .             WA15B
                 .              .                 .
                 .              .                 .
184          WA15BC.......................
                 V
                 V
186          WA15BR
                 .
                 .
188              .           WA16A
                 .              .
                 .              .
192          WA16AC............
                 V
                 V
194          WA16AR
                 .
                 .
```

```
[redacted]96        .       WA17A
                    .         .
[redacted]00        .         .          VG07B
                    .         .            .
[redacted]04    WA17AC.........................
                    V
                    V
[redacted]06    WA17AR
                    .
208 [redacted]      .       WA18A
                    .         .
212 [redacted]  WA18AC...........
                    V
                    V
214 [redacted]  WA18AR
                    .
216 [redacted]      .       WA18B
                    .         .
[redacted]20    WA18BC...........
                    .
[redacted]2         .       WA19A
                    .         .
[redacted]6         .         .          WA23
                    .         .            .
[redacted]0         .         .            .          WA19B
                    .         .            .            .
[redacted]4         .         .        WA19BC...........
                    .         .            .
236 [redacted]  WA19AC.........................
                    .
238 [redacted]      .       WA17B
                    .         V
                    .         V
242 [redacted]      .       WA17BR
                    .         .
244 [redacted]      .         .          WA20
                    .         .            .
[redacted]48        .       WA20C...........
                    .         .
[redacted]0         .         .          WA21A
                    .         .            .
[redacted]4         .       WA21AC..........
                    .         .
[redacted]
```

```
256       .         .       WA21B
          .         .           .
          .         .           .
260       .     WA21BC...........
          .         .
          .         .
262       .         .       WA19C
          .         .           .
          .         .           .
266  WA19CC.......................
          .
          .
268       .      VG07A
          .          V
          .          V
272       .     VG07AR
          .          .
          .          .
274       .          .       VG08
          .          .          .
          .          .          .
278       .      VG08C...........
          .          V
          .          V
280       .      VG08R
          .          .
          .          .
282       .          .       VG09
          .          .          .
          .          .          .
286   VG09C......................
          .
          .
288       .        V1A
          .          .
          .          .
292       .          .      WA22A
          .          .          .
          .          .          .
296       .       V1AC...........
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
***************************************                      ***************************************
*                                     *                      *                                     *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                      *   U.S. ARMY CORPS OF ENGINEERS      *
*            FEBRUARY 1981            *                      * THE HYDROLOGIC ENGINEERING CENTER   *
*          REVISED 02 AUG 88          *                      *          609 SECOND STREET          *
*                                     *                      *       DAVIS, CALIFORNIA 95616       *
*  RUN DATE  09/02/1997  TIME  13:38:51 *                    *           (916) 551-1748            *
*                                     *                      *                                     *
***************************************                      ***************************************


                              CITY OF LAS VEGAS - WASHINGTON AVENUE
                              ULTIMATE OFFSITE/ONSITE CONDITION MODEL (DESIGN CONDITION)
                              MODEL CONSIDERS 1997 MPU FACILITIES UPSTREAM OF MLK ARE IN PLACE
                              AUGUST 23, 1997            FILE:  WASR.DAT
                              ********************************************************************
                              RATIO 10/100 = .57
                              AREA = 0.0                 DARF = 1.00
                              AREA = 1.0                 DARF = 0.97
                              AREA = 1.5                 DARF = 0.95
                              AREA = 2.0                 DARF = 0.93
                              ********************************************************************
                              BASIN DATA WEST OF RANCHO DRIVE OBTAINED FROM MONTGOMERY WATSON 1995
                              DATA OBTAINED FROM NWEX_2.DAT INDICATED BY <== NOTE 1
                              DATA OBTAINED FROM ALT1K_FW.DAT INDICATED BY <== NOTE 2
                              KINIMATIC WAVE ROUTING UTILIZED FOR THE 1997 MPU FACILITIES
                              ********************************************************************

 13 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
                    ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.92 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
               .57     1.00      .97      .95      .93
```

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
					.57	1.00	.97	.95	.93
IYDROGRAPH AT	WA12	.07	1	FLOW	44.	95.	91.	89.	86.
				TIME	3.67	3.67	3.67	3.67	3.67
ROUTED TO	WA12R	.07	1	FLOW	36.	78.	75.	73.	71.
				TIME	4.08	4.08	4.08	4.08	4.08
ROGRAPH AT	WA13	.13	1	FLOW	55.	119.	115.	112.	109.
				TIME	4.00	4.00	4.00	4.00	4.00
COMBINED AT	WA13C	.20	1	FLOW	89.	192.	185.	180.	175.
				TIME	4.08	4.00	4.00	4.00	4.08
ERSION TO	RANDUN	.20	1	FLOW	0.	48.	41.	36.	31.
				TIME	.08	4.00	4.00	4.00	4.08
ROGRAPH AT	RANSD1	.20	1	FLOW	89.	144.	144.	144.	144.
				TIME	4.08	3.83	3.83	3.83	3.83
ED TO	WA13R	.20	1	FLOW	87.	144.	144.	144.	144.
				TIME	4.17	4.25	4.25	4.25	4.25
YDROGRAPH AT	WA01	.07	1	FLOW	15.	50.	47.	46.	44.
				TIME	3.83	3.75	3.83	3.83	3.83
YDROGRAPH AT	WA02	.15	1	FLOW	78.	169.	163.	158.	154.
				TIME	3.75	3.75	3.75	3.75	3.75
OUTED TO	WA02R	.15	1	FLOW	73.	158.	152.	148.	144.
				TIME	4.00	4.00	4.00	4.00	4.00
DROGRAPH AT	WA03	.09	1	FLOW	57.	122.	117.	114.	111.
				TIME	3.67	3.58	3.58	3.58	3.58
OMBINED AT	WA03C	.31	1	FLOW	115.	267.	256.	249.	241.
				TIME	3.83	3.83	3.83	3.83	3.83
ROGRAPH AT	OG011	.16	1	FLOW	23.	85.	80.	77.	73.
				TIME	4.00	3.92	3.92	3.92	3.92
RSION TO	VEGSY1	.16	1	FLOW	0.	45.	40.	37.	33.
				TIME	.08	3.92	3.92	3.92	3.92
OGRAPH AT	WASSD1	.16	1	FLOW	23.	40.	40.	40.	40.
				TIME	4.00	3.67	3.67	3.67	3.67
ED TO	OG011R	.16	1	FLOW	23.	40.	40.	40.	40.
				TIME	4.08	3.83	3.83	3.83	3.83
DROGRAPH AT	VG011	.03	1	FLOW	6.	18.	17.	17.	16.

				TIME	3.92	3.83	3.92	3.92	3.92
2 COMBINED AT	VG011C	.19	1	FLOW	28.	58.	57.	57.	56.
				TIME	4.00	3.83	3.92	3.92	3.92
DIVERSION TO	VEGSY2	.19	1	FLOW	18.	48.	47.	47.	46.
				TIME	4.00	3.83	3.92	3.92	3.92
HYDROGRAPH AT	WASSD2	.19	1	FLOW	10.	10.	10.	10.	10.
				TIME	3.67	3.42	3.42	3.42	3.42
ROUTED TO	VG011R	.19	1	FLOW	10.	10.	10.	10.	10.
				TIME	4.42	4.08	4.33	4.25	4.25
2 COMBINED AT	WA03C	.50	1	FLOW	124.	277.	266.	259.	251.
				TIME	3.92	3.83	3.83	3.83	3.83
ROUTED TO	WA03R	.50	1	FLOW	119.	265.	254.	247.	240.
				TIME	4.17	4.08	4.08	4.08	4.08
HYDROGRAPH AT	WA04	.10	1	FLOW	45.	104.	100.	97.	94.
				TIME	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT	WA04C	.61	1	FLOW	150.	343.	329.	320.	311.
				TIME	4.08	4.00	4.00	4.00	4.00
ROUTED TO	WA04R	.61	1	FLOW	147.	334.	320.	312.	303.
				TIME	4.25	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA06	.08	1	FLOW	39.	84.	81.	79.	77.
				TIME	3.83	3.75	3.75	3.75	3.83
2 COMBINED AT	WA06C	.68	1	FLOW	169.	383.	368.	358.	348.
				TIME	4.17	4.08	4.08	4.08	4.08
ROUTED TO	WA06R	.68	1	FLOW	168.	383.	367.	357.	347.
				TIME	4.17	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA05	.03	1	FLOW	18.	40.	39.	38.	37.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA05C	.71	1	FLOW	172.	390.	374.	364.	354.
				TIME	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA05R	.71	1	FLOW	171.	390.	374.	364.	354.
				TIME	4.17	4.17	4.17	4.17	4.17
ROUTED TO	WA05R	.71	1	FLOW	170.	386.	371.	360.	350.
				TIME	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT	WA06A	.06	1	FLOW	35.	76.	73.	71.	69.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	WA06C	.77	1	FLOW	179.	408.	392.	381.	370.
				TIME	4.25	4.17	4.17	4.17	4.17
ROUTED TO	WA06R	.77	1	FLOW	179.	407.	391.	380.	369.
				TIME	4.25	4.17	4.17	4.17	4.17
HYDROGRAPH AT	WA07	.03	1	FLOW	21.	44.	43.	42.	41.

				TIME	3.67	3.67	3.67	3.67	3.67
COMBINED AT	WA07C	.80	1	FLOW	185.	422.	405.	394.	383.
				TIME	4.17	4.17	4.17	4.17	4.17
OUTED TO	WA07R	.80	1	FLOW	185.	421.	404.	393.	382.
				TIME	4.25	4.17	4.17	4.17	4.17
YDROGRAPH AT	WA09	.05	1	FLOW	29.	62.	60.	58.	57.
				TIME	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT	WA09C	.86	1	FLOW	200.	454.	436.	424.	412.
				TIME	4.17	4.17	4.17	4.17	4.17
OUTED TO	WA09R	.86	1	FLOW	200.	454.	436.	424.	412.
				TIME	4.17	4.17	4.17	4.17	4.17
ROGRAPH AT	WA11	.03	1	FLOW	23.	49.	48.	46.	45.
				TIME	3.58	3.58	3.58	3.58	3.58
COMBINED AT	WA11C	.89	1	FLOW	204.	462.	444.	432.	420.
				TIME	4.17	4.08	4.17	4.17	4.17
TED TO	WA11R	.89	1	FLOW	204.	462.	444.	432.	420.
				TIME	4.17	4.17	4.17	4.17	4.17
ROGRAPH AT	WA14	.05	1	FLOW	22.	48.	46.	45.	44.
				TIME	3.83	3.83	3.83	3.83	3.83
COMBINED AT	WA14C	.94	1	FLOW	218.	495.	475.	462.	449.
				TIME	4.08	4.08	4.08	4.08	4.08
2 COMBINED AT	WA14C	1.14	1	FLOW	306.	639.	619.	606.	593.
				TIME	4.08	4.08	4.08	4.08	4.08
IVERSION TO	RANSD2	1.14	1	FLOW	197.	197.	197.	197.	197.
				TIME	3.75	3.50	3.50	3.50	3.50
YDROGRAPH AT	RANWAS	1.14	1	FLOW	109.	442.	422.	409.	396.
				TIME	4.08	4.08	4.08	4.08	4.08
DROGRAPH AT	RANDUN	.00	1	FLOW	0.	48.	41.	36.	31.
				TIME	.08	4.00	4.00	4.00	4.08
ROGRAPH AT	WA15A	.09	1	FLOW	62.	134.	129.	126.	123.
				TIME	3.58	3.58	3.58	3.58	3.58
COMBINED AT	WA15AC	.09	1	FLOW	62.	134.	129.	126.	123.
				TIME	3.58	3.58	3.58	3.58	3.58
TED TO	WA15AR	.09	1	FLOW	48.	106.	101.	98.	95.
				TIME	4.00	4.00	4.00	4.00	4.00
ROGRAPH AT	WA15B	.09	1	FLOW	72.	146.	141.	137.	134.
				TIME	3.58	3.58	3.58	3.58	3.58
COMBINED AT	WA15BC	1.32	1	FLOW	175.	599.	573.	555.	537.
				TIME	4.00	3.92	3.92	3.92	3.92
TED TO	WA15BR	1.32	1	FLOW	174.	598.	571.	554.	536.

				TIME	4.00	3.92	3.92	3.92	3.92
YDROGRAPH AT	WA16A	.06	1	FLOW	41.	87.	84.	82.	80.
				TIME	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT	WA16AC	1.39	1	FLOW	192.	646.	618.	599.	580.
				TIME	4.00	3.92	3.92	3.92	3.92
ROUTED TO	WA16AR	1.39	1	FLOW	192.	645.	616.	597.	577.
				TIME	4.00	3.92	3.92	3.92	3.92
HYDROGRAPH AT	WA17A	.08	1	FLOW	36.	86.	83.	80.	78.
				TIME	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT	VG07B	.03	1	FLOW	10.	29.	27.	26.	25.
				TIME	3.75	3.67	3.67	3.67	3.67
3 COMBINED AT	WA17AC	1.50	1	FLOW	226.	742.	705.	682.	660.
				TIME	3.92	3.83	3.83	3.92	3.92
OUTED TO	WA17AR	1.50	1	FLOW	225.	739.	704.	682.	660.
				TIME	3.92	3.83	3.92	3.92	3.92
YDROGRAPH AT	WA18A	.02	1	FLOW	6.	17.	17.	16.	16.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA18AC	1.52	1	FLOW	228.	749.	713.	689.	667.
				TIME	3.92	3.83	3.83	3.92	3.92
OUTED TO	WA18AR	1.52	1	FLOW	227.	747.	712.	689.	667.
				TIME	3.92	3.83	3.92	3.92	3.92
HYDROGRAPH AT	WA18B	.04	1	FLOW	15.	40.	38.	37.	36.
				TIME	3.67	3.58	3.58	3.58	3.58
2 COMBINED AT	WA18BC	1.55	1	FLOW	235.	773.	735.	709.	684.
				TIME	3.92	3.83	3.83	3.83	3.92
HYDROGRAPH AT	WA19A	.02	1	FLOW	11.	28.	26.	26.	25.
				TIME	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	WA23	.05	1	FLOW	16.	45.	43.	42.	40.
				TIME	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT	WA19B	.02	1	FLOW	11.	29.	28.	27.	26.
				TIME	3.58	3.58	3.58	3.58	3.58
COMBINED AT	WA19BC	.07	1	FLOW	27.	72.	69.	67.	65.
				TIME	3.67	3.67	3.67	3.67	3.67
COMBINED AT	WA19AC	1.65	1	FLOW	257.	844.	803.	776.	748.
				TIME	3.92	3.83	3.83	3.83	3.83
DROGRAPH AT	WA17B	.09	1	FLOW	31.	82.	79.	76.	73.
				TIME	3.75	3.75	3.75	3.75	3.75
UTED TO	WA17BR	.09	1	FLOW	30.	81.	77.	75.	72.
				TIME	3.92	3.83	3.92	3.92	3.92
DROGRAPH AT	WA20	.09	1	FLOW	36.	92.	88.	85.	82.

				TIME	3.67	3.67	3.67	3.67	3.67
COMBINED AT	WA20C	.18	1	FLOW	58.	158.	150.	145.	140.
				TIME	3.83	3.75	3.75	3.75	3.75
YDROGRAPH AT	WA21A	.02	1	FLOW	10.	27.	26.	25.	24.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA21AC	.20	1	FLOW	64.	178.	169.	164.	158.
				TIME	3.83	3.75	3.75	3.75	3.75
HYDROGRAPH AT	WA21B	.01	1	FLOW	4.	11.	11.	10.	10.
				TIME	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT	WA21BC	.21	1	FLOW	66.	184.	175.	170.	164.
				TIME	3.83	3.75	3.75	3.75	3.75
DROGRAPH AT	WA19C	.01	1	FLOW	7.	16.	15.	15.	15.
				TIME	3.58	3.58	3.58	3.58	3.58
COMBINED AT	WA19CC	1.86	1	FLOW	325.	1028.	979.	946.	913.
				TIME	3.83	3.83	3.83	3.83	3.83
ROGRAPH AT	VG07A	.14	1	FLOW	63.	149.	142.	138.	134.
				TIME	3.75	3.75	3.75	3.75	3.75
TED TO	VG07AR	.14	1	FLOW	61.	148.	142.	138.	134.
				TIME	3.83	3.83	3.83	3.83	3.83
ROGRAPH AT	VG08	.06	1	FLOW	17.	49.	47.	45.	43.
				TIME	3.83	3.75	3.75	3.75	3.75
2 COMBINED AT	VG08C	.20	1	FLOW	78.	197.	188.	183.	177.
				TIME	3.83	3.83	3.83	3.83	3.83
OUTED TO	VG08R	.20	1	FLOW	78.	195.	186.	180.	174.
				TIME	3.92	3.83	3.83	3.83	3.92
YDROGRAPH AT	VG09	.06	1	FLOW	22.	60.	57.	55.	53.
				TIME	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT	VG09C	2.12	1	FLOW	413.	1268.	1207.	1167.	1127.
				TIME	3.92	3.83	3.83	3.83	3.83
ROGRAPH AT	V1A	.04	1	FLOW	27.	53.	51.	50.	49.
				TIME	3.58	3.58	3.58	3.58	3.58
OGRAPH AT	WA22A	.05	1	FLOW	35.	72.	69.	67.	66.
				TIME	3.67	3.67	3.67	3.67	3.67
OMBINED AT	V1AC	.09	1	FLOW	62.	124.	120.	117.	114.
				TIME	3.67	3.67	3.67	3.67	3.67

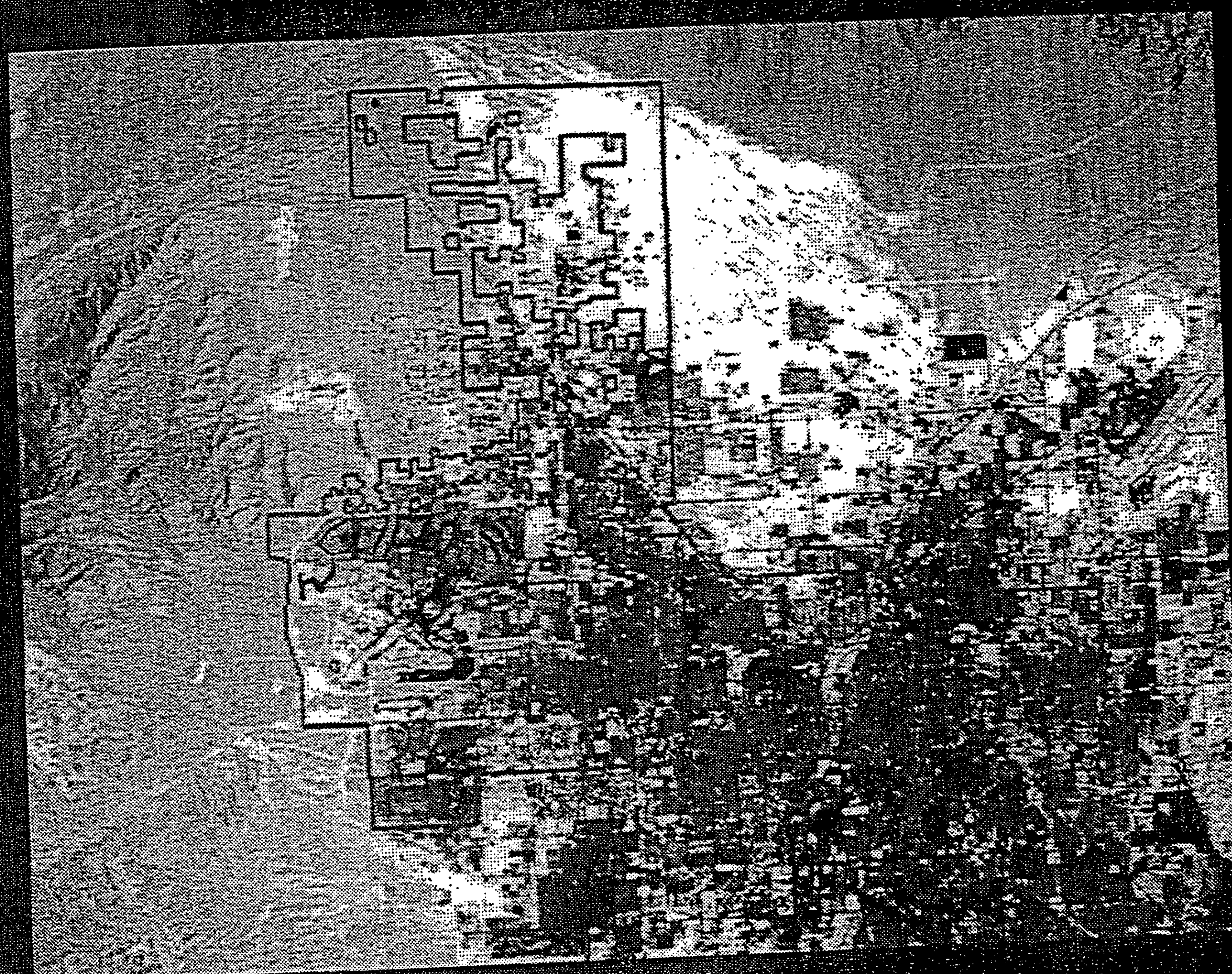
** NORMAL END OF HEC-1 ***

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX H

REFERENCES
"CITY OF LAS VEGAS FLOOD CONTROL FACILITIES INVENTORY AND CITY WIDE HYDROLOGY ANALYSIS"
DATED
DECEMBER 1997
BY
PBS&J

City of Las Vegas



Volume I

December 1997

City of Las Vegas Flood Control Facilities Inventory and City Wide Hydrology Analysis

```
1**************************************                           **************************************
*                                    *                           *                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                           *  U.S. ARMY CORPS OF ENGINEERS      *
*          SEPTEMBER 1990            *                           *  HYDROLOGIC ENGINEERING CENTER     *
*           VERSION 4.0              *                           *        609 SECOND STREET           *
*                                    *                           *     DAVIS, CALIFORNIA 95616        *
* RUN DATE  09/09/1997  TIME  16:51:41 *                         *         (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 ***
                     *DIAGRAM
          1          ID   NORTHWEST NEIGHBORHOOD STUDY AND CITY-WIDE HYDROLOGY STUDY UPDATE
          2          ID   FOR:  THE CITY OF LAS VEGAS
          3          ID
          4          ID   AUGUST 1997
          5          ID   REFERENCE NUMBER: 51300
          6          ID
          7          ID   HEC1 FILE: EXNWCEN3.DAT
          8          ID   NORTHWEST PORTION OF THE CENTRAL BASIN
          9          ID
         10          ID   EXISTING CONDITION, EXISTING FACILITIES AND ULTIMATE LAND USE.
         11          ID
         12          ID  SPECIAL NOTES:
         13          ID
         14          ID  1.   INTERPOLATION BETWEEN FLOWS WAS COMPLETED TO OBTAIN THE MOST ACCURATE
         15          ID       FLOW FOR EACH TRIBUTARY AREA AT EACH CONCENTRATION POINT.
         16          ID  2.   THERE ARE TWO INFLOW POINTS TO THIS HEC-1 MODEL FROM THE LOWER GOWAN
         17          ID       HEC-1 MODEL (EXNGOW3.DAT AND EXNGOW5.DAT).  HYDROGRAPHS WERE IMPORTED
         18          ID       TO THIS HEC-1 TO REPRESENT THE INCOMMING FLOWS.  THE LOCATIONS OF
         19          ID       THESE INFLOW POINTS ARE RANCHO AND CHEYENNE AND DECATUR AND GOWAN.
         20          ID       EACH HYDROGRAPH FOR BOTH THE SDN3 AND SDN5 MODELS WERE "DARFED"
         21          ID       ACCORDING TO THEIR TRIBUTARY AREA AND THEN IMPORTED INTO THE NORTHWEST
         22          ID       CENTRAL HEC-1 MODELS.
         23          ID  3.   IN SOME AREAS SURFACE FLOW IS SEPARATED FROM FACILITY FLOW TO
         24          ID       ACCOMMODATE SURFACE FLOW SPLITS.  THEREFORE, AT SOME CONCENTRATION
         25          ID       POINTS THE FACILITY FLOW THAT HAS BEEN TEMPROARILY DIVERTED OUT OF THE
         26          ID       MODEL MUST BE ADDED TO THE SURFACE FLOW TO OBTAIN THE TOTAL FLOW AT
         27          ID       THE CONCENTRATION POINT.
         28          ID  4.   DUE TO THE NUMBER OF DIVERSIONS AND THE FACT THAT TRIBUTARY AREA IS
         29          ID       NOT CARRIED WITH A DIVERTED FLOW, IT MAY BE DIFFICULT TO DETERMINE THE
         30          ID       CORRECT DARF TO USE FOR CERTAIN CONCENTRATION POINTS, HOWEVER, AS A
         31          ID       GENERAL RULE TRIBUTARY AREA WAS NOT MANUALLY CARRIED WITH A DIVERTED
         32          ID       FLOW UNLESS THE AREA WAS GREATER THAT 1 SQUARE MILE.  ADDITIONALLY,
         33          ID       IN SOME AREAS THE TRIBUTARY AREA FOR A DIVERTED FLOW WAS ESTIMATED
         34          ID       BASED ON THE AMOUNT OF THE TOTAL FLOW DIVERTED.
         35          ID  5.   IT SHOULD BE NOTED THAT THE HYDROGRAPH THAT IS BROUGHT IN AT CHEYENNE
         36          ID       AND RANCHO CARRIES A TRIBUTARY AREA WITH IT THAT IS GREATER THAN 10
         37          ID       SQUARE MILES, THEREFORE THE SDN5 HEC-1 MODEL MUST BE USED WHEN
         38          ID       CALCULATING PEAK FLOWS DOWNSTREAM OF THE IMPORTED HYDROGRAPH.  IT
         39          ID       SHOULD ALSO BE NOTED THAT AT RANCHO AND SMOKE RANCH THE "LOCAL FLOWS"
         40          ID       ARE EQUAL TO OR GREATER THAN THE SDN5 FLOWS, SO THE PEAK FLOWS MUST
         41          ID       THEN BE CALCULATED FROM THE SDN3 MODEL.  IT SHOULD SUFFICE TO SAY
         42          ID       THAT DUE TO THE LIMITATIONS OF THE HEC-1 PROGRAM IT IS UP TO THE USER
         43          ID       TO DETERMINE THE CORRECT TRIBUTARY AREA, CORRECT DARF, AND CORRECT
         44          ID       STORM DISTRIBUTION TO USE TO OBTAIN THE MOST ACCURATE AND HIGHEST
         45          ID       PEAK FLOW POSSIBLE FOR BOTH THE 10-YEAR AND 100-YEAR EVENTS WHICH MAY
         46          ID       OR MAY NOT BE OBTAINED FROM THE SAME HEC-1 MODEL.  THE FLOWS PRESENTED
         47          ID       IN VOLUME 2 OF THIS DOCUMENT REFLECT THIS EXCERSIZE.
         48          ID
         49          ID   JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)
         50          ID
         51          ID   100-YEAR,  6-HOUR STORM,  SDN3
         52          ID   DARF RATIOS FOR AREAS OF 0, 1, 2, 6 AND 10 SQUARE MILES FOR 100-YEAR
         53          ID   DARF RATIOS FOR AREAS OF 0, 2, 6 AND 10 SQUARE MILES FOR 10-YEAR
```



```
        LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

         54          ID
         55          JP       2
         56          JR    PREC       1    0.97    0.93     0.9    0.86    0.57    0.53   0.513    0.49
```

```
 57     IT      5       0       0     200
 58     IN      5
 59     IO      5
        *

 60     KK   OG02A
 61     PB    2.77
 62     BA    0.13
 63     PC       0    0.02   0.057    0.07   0.087   0.108   0.124    0.13    0.13    0.13
 64     PC    0.13    0.13    0.13   0.133    0.14   0.142   0.148   0.158   0.172   0.181
 65     PC    0.19   0.197   0.199     0.2   0.201   0.204   0.214   0.229   0.241   0.249
 66     PC   0.251   0.256    0.27   0.278   0.281   0.283   0.295   0.322   0.352   0.409
 67     PC   0.499    0.59    0.71   0.744   0.781   0.812   0.819   0.835   0.851   0.856
 68     PC    0.86   0.868   0.876   0.888    0.91   0.926   0.937    0.95    0.97   0.976
 69     PC   0.982   0.985   0.987   0.989    0.99   0.993   0.993   0.994   0.995   0.998
 70     PC   0.998   0.999       1
 71     LS       0      89
 72     UD   0.306
        *

 73     KK  ROG02A
 74     KM  ROUTE TO OG02B
 75     RK    2000   0.017    0.02       0    TRAP      80       2
        *

 76     KK   OG02B
 77     PB    2.77
 78     BA   0.188
 79     LS       0      89
 80     UD   0.306
        *

 81     KK  COG02B
 82     HC       2
        *

 83     KK  DOG02B
 84     KM  DIVERSION BASED ON CULVERT OKG 210 AND LMD 040
 85     KM  THE CAPACITY OF LMD 040 (260 CFS) IS EQUAL TO THE AMOUNT OF FLOW
 86     KM  DIVERTED THROUGH OKG 210, ALL OTHER FLOW IS ASSUMED TO CONTINUE
 87     KM  NORTH ALONG THE WEST SIDE OF U.S. 95.
 88     KM  DIVERSION FLOW TAKEN FROM LAS VEGAS NEIGHBORHOOD STUDY DATED 6/95
 89     KM  MINIMUM OF 1 CFS WILL REMAIN TO AVOID ZERO FLOW
 90     DT   DLM00
 91     DI       0      51     101     201     261     500    1000    5000
 92     DQ       0      50     100     200     260     260     260     260
        *
1                               HEC-1 INPUT                                          PAGE  3

LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 93     KK RDOG02B
 94     KM  ROUTE TO OG03B
 95     RM       5    0.44    0.15
        *

 96     KK   OG03A
 97     PB    2.77
 98     BA   0.127
 99     LS       0      85
100     UD   0.306
        *

101     KK RDOG03A
102     KM  ROUTE TO OG03B
103     RK    2000   0.017    0.02       0    TRAP      70       2
        *

104     KK   OG03B
105     PB    2.77
106     BA   0.198
107     LS       0      85
108     UD   0.306
        *

109     KK  COG03B
110     HC       3
        *

111     KK  DOG03B
112     KM  DIVERSION BASED ON 2 CULVERTS, A 6'X4' RCB (OKG 240) &
113     KM  A 36" RCP, (OKG 250) CAPACITY = 272 CFS
114     KM  DIVERSION FLOW TAKEN FROM LAS VEGAS NEIGHBORHOOD STUDY DATED 6/95
115     KM  MINIMUM OF 1 CFS WILL REMAIN TO AVOID ZERO FLOW
116     DT  DSR00A
117     DI       0      51     101     201     273     500    1000    5000
118     DQ       0      50     100     200     272     272     272     272
        *

119     KK RDOG03B
120     KM  ROUTE TO OG04B
121     RM       6    0.49    0.15
        *

122     KK   OG04A
123     PB    2.77
124     BA   0.127
125     LS       0      87
126     UD   0.272
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1674          KK   RWA19
1675          KM  ROUTE TO VG09
1676          RK    1500  0.0067   0.015       0     CIRC       5
              *

1677          KK    VG08
1678          PB    2.77
1679          BA   0.063
1680          LS       0       84
1681          UD   0.675
              *

1682          KK   RVG08
1683          KM  ROUTE TO VG09
1684          RM       3    0.22    0.15
              *

1685          KK    VG09
1686          PB    2.77
1687          BA   0.059
1688          LS       0       85
1689          UD   0.325
              *

1690          KK   CVG09
1691          HC       2
              *

1692          KK  2CVG09
1693          HC       2
              *
              * AT THIS POINT VG09 ENTERS REGIONAL FREEWAY CHANNEL
              *

1694          KK   RVG09
1695          KM  ROUTE TO VG12
1696          RK    1600   0.015   0.025       0     TRAP       8       1
              *

1697          KK    VG10
1698          PB    2.77
1699          BA   0.093
1700          LS       0       86
1701          UD   0.503
              *

1702          KK   RVG10
1703          KM  ROUTE TO VG11
1704          RM       3    0.23    0.15
              *
1                                      HEC-1 INPUT                                           PAGE 51

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1705          KK    VG11
1706          PB    2.77
1707          BA   0.066
1708          LS       0       85
1709          UD   0.326
              *

1710          KK   CVG11
1711          HC       2
              *

1712          KK   RVG11
1713          KM  ROUTE TO VG12
1714          RK     600   0.005    0.02       0     TRAP      80       2
              *

1715          KK    VG12
1716          PB    2.77
1717          BA   0.051
1718          LS       0       85
1719          UD   0.302
              *

1720          KK   CVG12
1721          KM  COMBINE VG10, VG11, VG12
1722          HC       2
              *

1723          KK  C2VG12
1724          HC       3
              *

1725          KK   RVG12
1726          KM  ROUTE TO LAKE MEAD BLVD.
1727          RK    3000   0.015   0.025       0     TRAP       8       1
              *
              * GOTO CHEYENNE AND RANCHO
              *

1728          KK     DN1
1729          KM  RETRIEVE FLOW DIVERTED ACROSS RANCHO TO CHEYENNE
1730          DR     DN1
```

```
1260       CVG21............
               V
               V
1262       RVG21
               .
               .
1271           .-------->  DHOLLY
1265       DVG21
               .
               .
1274           .        LM08
               .           V
               .           V
1279           .       RLM08
               .           .
               .           .
1282           .           .        VG20
               .           .           .
               .           .           .
1287       CVG20........................
               V
               V
1289       RVG20
               .
               .
1292           .        VG22
               .           .
               .           .
1297       CVG22............
               .
               .
1299           .      OG011A
               .           V
               .           V
1304           .     ROG011A
               .           .
               .           .
1307           .           .      OG011B
               .           .           .
               .           .           .
1312           .     COG011B............
               .           .
               .           .
1316           .           .-------->  DVG011
1314           .     DOG011B
               .           V
               .           V
1319           .      RC011B
               .           .
               .           .
1322           .           .      OG012A
               .           .           V
               .           .           V
1327           .           .     ROG012A
               .           .           .
               .           .           .
1330           .           .           .      OG012B
               .           .           .           .
               .           .           .           .
1335           .      COG12B........................
               .           V
               .           V
1337           .     ROG012B
               .           .
               .           .
1342           .           .       VG012
               .           .           .
               .           .           .
1347           .      CVG012............
               .           V
               .           V
1349           .      RVG012
               .           .
               .           .
1352           .           .        VG02
               .           .           .
               .           .           .
1357           .       CVG02............
               .           V
               .           V
1359           .       RVG02
               .           .
               .           .
1362           .           .       VG03A
               .           .           V
               .           .           V
1367           .           .      RVG03A
               .           .           .
               .           .           .
1370           .           .           .       VG03B
               .           .           .           .
               .           .           .           .
1375           .      CVG03B........................
               .           V
               .           V
1377           .      RVG03B
               .           .
               .           .
1380           .           .        VG04
               .           .           .
```

```
               .           .           .
1385           .     CVG04............
               .           v
               .           v
1387           .     RVG04
               .           .
               .           .
1390           .           .        VG05
               .           .           .
               .           .           .
1395           .     CVG05............
               .           v
               .           v
1397           .     RVG05
               .           .
               .           .
1400           .           .       WA08A
               .           .           .
               .           .           .
1405           .    CWA08A............
               .           v
               .           v
1407           .    RWA08A
               .           .
               .           .
1410           .           .        VG06
               .           .           .
               .           .           .
1415           .     CVG06............
               .           v
               .           v
1417           .     RVG06
               .           .
               .           .
1420      C2VG22............
               v
               v
1422       RVG22
               .
               .
1427           .           .<-------  DHOLLY
1425           .    DHOLLY
               .           v
               .           v
1428           .    RHOLLY
               .           .
               .           .
1431           .           .        VG23
               .           .           .
               .           .           .
1436       CVG23........................
               v
               v
1438       RVG23
               .
               .
1441           .     LM16B
               .           .
               .           .
1446      CLM16B............
               v
               v
1448      RLM16B
               .
               .
1451           .     LM17B
               .           .
               .           .
1456      CLM17B............
               v
               v
1458      RLM17B
               .
               .
1463           .           .<-------  DVG011
1461           .    DVG011
               .           v
               .           v
1464           .   RDVG011
               .           .
               .           .
1467           .           .       VG011
               .           .           .
               .           .           .
1472           .    CVG011............
               .           v
               .           v
1474           .    RVG011
               .           .
               .           .
1477           .           .        WA02
               .           .           v
               .           .           v
1482           .           .       RWA02
               .           .           .
               .           .           .
1485           .           .           .        WA03
               .           .           .           .
               .           .           .           .
1490           .           .           .           .        WA01
```

```
               .          .           .          .          .
               .          .           .          .          .
1495           .      CWA03..................................
               .          V
               .          V
1497           .      RWA03
               .          .
               .          .
1500           .          .        WA04
               .          .           .
               .          .           .
1505           .      CWA04............
               .          V
               .          V
1507           .      RWA04
               .          .
               .          .
1510           .          .        WA06
               .          .           .
               .          .           .
1515           .      CWA06............
               .          V
               .          V
1517           .      RWA06
               .          .
               .          .
1520           .          .        WA05
               .          .           .
               .          .           .
1525           .      CWA05............
               .          V
               .          V
1527           .      RWA05
               .          .
               .          .
1530           .          .       WA06A
               .          .           .
               .          .           .
1535           .     CWA06A............
               .          V
               .          V
1537           .     RWA06A
               .          .
               .          .
1540           .          .        WA07
               .          .           .
               .          .           .
1545           .      CWA07............
               .          V
               .          V
1547           .      RWA07
               .          .
               .          .
1550           .          .        WA09
               .          .           .
               .          .           .
1555           .      CWA09............
               .          V
               .          V
1557           .      RWA09
               .          .
               .          .
1560           .          .        WA11
               .          .           .
               .          .           .
1565           .      CWA11............
               .          V
               .          V
1567           .      RWA11
               .          .
               .          .
1570           .          .        WA14
               .          .           .
               .          .           .
1575           .      CWA14............
               .          V
               .          V
1577           .      RWA14
               .          .
               .          .
1580           .          .       WA15A
               .          .           V
               .          .           V
1585           .          .      RWA15A
               .          .           .
               .          .           .
1588           .          .           .      WA15B
               .          .           .          .
               .          .           .          .
1593           .     CWA15B.......................
               .          V
               .          V
1595           .     RWA15B
               .          .
               .          .
1598           .          .        WA16
               .          .           .
               .          .           .
1603           .      CWA16............
               .          V
```

```
            .               V
1605        .           RWA16
            .               .
            .               .
1608        .               .          WA17
            .               .             .
            .               .             .
1613        .               .             .          VG07
            .               .             .             .
            .               .             .             .
1618        .           CWA17............................
            .               V
            .               V
1620        .           RWA17
            .               .
            .               .
1623        .               .          WA18
            .               .             .
            .               .             .
1628        .           CWA18..............
            .               V
            .               V
1630        .           RWA18
            .               .
            .               .
1633        .               .          WA22
            .               .             V
            .               .             V
1638        .               .         RWA22
            .               .             .
            .               .             .
1641        .               .             .          WA20
            .               .             .             V
            .               .             .             V
1646        .               .             .         RWA20
            .               .             .             .
            .               .             .             .
1649        .               .             .             .          WA21
            .               .             .             .             .
            .               .             .             .             .
1654        .               .         CWA21............................
            .               .             V
            .               .             V
1656        .               .         RWA21
            .               .             .
            .               .             .
1659        .               .             .          WA23
            .               .             .             V
            .               .             .             V
1664        .               .             .         RWA23
            .               .             .             .
            .               .             .             .
1667        .               .             .             .          WA19
            .               .             .             .             .
            .               .             .             .             .
1672        .           CWA19..........................................
            .               V
            .               V
1674        .           RWA19
            .               .
            .               .
1677        .               .          VG08
            .               .             V
            .               .             V
1682        .               .         RVG08
            .               .             .
            .               .             .
1685        .               .             .          VG09
            .               .             .             .
            .               .             .             .
1690        .               .         CVG09..............
            .               .             .
            .               .             .
1692        .          2CVG09..............
            .               V
            .               V
1694        .           RVG09
            .               .
            .               .
1697        .               .          VG10
            .               .             V
            .               .             V
1702        .               .         RVG10
            .               .             .
            .               .             .
1705        .               .             .          VG11
            .               .             .             .
            .               .             .             .
1710        .               .         CVG11..............
            .               .             V
            .               .             V
1712        .               .         RVG11
            .               .             .
            .               .             .
1715        .               .             .          VG12
            .               .             .             .
            .               .             .             .
1720        .               .         CVG12..............
            .               .             .
            .               .             .
```

```
1723      C2VG12........................
               V
               V
1725      RVG12
               .
               .
1730           .          .<-------       DN1
1728           .         DN1
               .          V
               .          V
1731           .        RDN1
               .          .
               .          .
1734           .          .           N1
               .          .            .
               .          .            .
1740           .         CN1............
               .          .
               .          .
1746           .          .------->      DFN2
1742           .         DA1
               .          V
               .          V
1749           .        RDA1
               .          .
               .          .
1752           .          .           A1
               .          .            .
               .          .            .
1759           .          .            .          .<-------       DA2
1757           .          .            .         DA2
               .          .            .           .
               .          .            .           .
1760           .         CA1.......................
               .          V
               .          V
1762           .         RA1
               .          .
               .          .
1765           .          .           A2
               .          .            .
               .          .            .
1770           .         CA2............
               .          .
               .          .
1774           .          .            .<-------       DFN2
1772           .          .          DFN2
               .          .            V
               .          .            V
1775           .          .         RDFN2
               .          .            .
               .          .            .
1778           .          .            .          FN2
               .          .            .           .
               .          .            .           .
1783           .          .            .           .        GOWAN
               .          .            .           .          .
               .          .            .           .          .
1826           .          .            .           .          .         FN4
               .          .            .           .          .          .
               .          .            .           .          .          .
1831           .          .            .           .        CFN4............
               .          .            .           .          V
               .          .            .           .          V
1833           .          .            .           .        RFN4
               .          .            .           .          .
               .          .            .           .          .
1836           .          .          CFN2.......................
               .          .            .
               .          .            .
1842           .          .            .------->       DFN5
1838           .          .         DCFN2
               .          .            V
               .          .            V
1845           .          .         RCFN2
               .          .            .
               .          .            .
1848           .        C2A2............
               .          V
               .          V
1850           .         RA2
               .          .
               .          .
1853           .          .           A3
               .          .            .
               .          .            .
1858           .         CA3............
               .          .
               .          .
1862           .          .            .<-------       DFN5
1860           .          .          DFN5
               .          .            V
               .          .            V
1863           .          .         RDFN5
               .          .            .
               .          .            .
1865           .          .            .          F9
               .          .            .           V
               .          .            .           V
1870           .          .            .         RF9
```

```
2211          .           .          S
              .           .          .
              .           .          .
2216          .           CS..........
              .           V
              .           V
2219          .           RS
              .           V
              .           V
2222          .          ROUT
              .           .
              .           .
2225          .           .         S1
              .           .          .
              .           .          .
2230          .          CS1..........
              .           V
              .           V
2232          .          RS1
              .           .
              .           .
2235          .           .          V
              .           .          .
              .           .          .
2240          .           CV..........
              .           V
              .           V
2243          .           RV
              .           .
              .           .
2246      NWALL............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            SEPTEMBER 1990            *
*             VERSION 4.0              *
*                                      *
* RUN DATE  09/09/1997  TIME  16:51:41 *
*                                      *
****************************************
```

```
****************************************
*                                      *
*     U.S. ARMY CORPS OF ENGINEERS     *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

NORTHWEST NEIGHBORHOOD STUDY AND CITY-WIDE HYDROLOGY STUDY UPDATE
FOR: THE CITY OF LAS VEGAS

AUGUST 1997
REFERENCE NUMBER: 51300

HEC1 FILE: EXNWCEN3.DAT
NORTHWEST PORTION OF THE CENTRAL BASIN

EXISTING CONDITION, EXISTING FACILITIES AND ULTIMATE LAND USE.

SPECIAL NOTES:

1. INTERPOLATION BETWEEN FLOWS WAS COMPLETED TO OBTAIN THE MOST ACCURATE FLOW FOR EACH TRIBUTARY AREA AT EACH CONCENTRATION POINT.
2. THERE ARE TWO INFLOW POINTS TO THIS HEC-1 MODEL FROM THE LOWER GOWAN HEC-1 MODEL (EXNGOW3.DAT AND EXNGOW5.DAT). HYDROGRAPHS WERE IMPORTED TO THIS HEC-1 TO REPRESENT THE INCOMMING FLOWS. THE LOCATIONS OF THESE INFLOW POINTS ARE RANCHO AND CHEYENNE AND DECATUR AND GOWAN. EACH HYDROGRAPH FOR BOTH THE SDN3 AND SDN5 MODELS WERE "DARFED" ACCORDING TO THEIR TRIBUTARY AREA AND THEN IMPORTED INTO THE NORTHWEST CENTRAL HEC-1 MODELS.
3. IN SOME AREAS SURFACE FLOW IS SEPARATED FROM FACILITY FLOW TO ACCOMMODATE SURFACE FLOW SPLITS. THEREFORE, AT SOME CONCENTRATION POINTS THE FACILITY FLOW THAT HAS BEEN TEMPROARILY DIVERTED OUT OF THE MODEL MUST BE ADDED TO THE SURFACE FLOW TO OBTAIN THE TOTAL FLOW AT THE CONCENTRATION POINT.
4. DUE TO THE NUMBER OF DIVERSIONS AND THE FACT THAT TRIBUTARY AREA IS NOT CARRIED WITH A DIVERTED FLOW, IT MAY BE DIFFICULT TO DETERMINE THE CORRECT DARF TO USE FOR CERTAIN CONCENTRATION POINTS, HOWEVER, AS A GENERAL RULE TRIBUTARY AREA WAS NOT MANUALLY CARRIED WITH A DIVERTED FLOW UNLESS THE AREA WAS GREATER THAT 1 SQUARE MILE. ADDITIONALLY, IN SOME AREAS THE TRIBUTARY AREA FOR A DIVERTED FLOW WAS ESTIMATED BASED ON THE AMOUNT OF THE TOTAL FLOW DIVERTED.
5. IT SHOULD BE NOTED THAT THE HYDROGRAPH THAT IS BROUGHT IN AT CHEYENNE AND RANCHO CARRIES A TRIBUTARY AREA WITH IT THAT IS GREATER THAN 10 SQUARE MILES, THEREFORE THE SDN5 HEC-1 MODEL MUST BE USED WHEN CALCULATING PEAK FLOWS DOWNSTREAM OF THE IMPORTED HYDROGRAPH. IT SHOULD ALSO BE NOTED THAT AT RANCHO AND SMOKE RANCH THE "LOCAL FLOWS" ARE EQUAL TO OR GREATER THAN THE SDN5 FLOWS, SO THE PEAK FLOWS MUST THEN BE CALCULATED FROM THE SDN3 MODEL. IT SHOULD SUFFICE TO SAY THAT DUE TO THE LIMITATIONS OF THE HEC-1 PROGRAM IT IS UP TO THE USER TO DETERMINE THE CORRECT TRIBUTARY AREA, CORRECT DARF, AND CORRECT STORM DISTRIBUTION TO USE TO OBTAIN THE MOST ACCURATE AND HIGHEST PEAK FLOW POSSIBLE FOR BOTH THE 10-YEAR AND 100-YEAR EVENTS WHICH MAY OR MAY NOT BE OBTAINED FROM THE SAME HEC-1 MODEL. THE FLOWS PRESENTED IN VOLUME 2 OF THIS DOCUMENT REFLECT THIS EXCERSIZE.

JR CARD RATIOS REPRESENT DEPTH-AREA REDUCTION FACTORS (DARF'S)

100-YEAR, 6-HOUR STORM, SDN3
DARF RATIOS FOR AREAS OF 0, 1, 2, 6 AND 10 SQUARE MILES FOR 100-YEAR
DARF RATIOS FOR AREAS OF 0, 2, 6 AND 10 SQUARE MILES FOR 10-YEAR

```
59 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          2  NUMBER OF PLANS

   JR         MULTI-RATIO OPTION
                  RATIOS OF PRECIPITATION
                 1.00      .97      .93      .90      .86      .57      .53      .51      .49

      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

      *** FDKRUT - NEWTON RAPHSON FAILEDFIXED POINT ITERATION USED - ITERATION=  1

      *** 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

      *** 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

      *** 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

      *** 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
```

```
*** 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=  1

*** 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

*** 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

*** 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

*** 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

*** 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

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 1.00	RATIO 2 .97	RATIO 3 .93	RATIO 4 .90	RATIO 5 .86	RATIO 6 .57	RATIO 7 .53	RATIO 8 .51	RATIO 9 .49
HYDROGRAPH AT													
+	OG02A	.13	1	FLOW	138.	132.	125.	119.	111.	58.	51.	48.	44.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			2	FLOW	138.	132.	125.	119.	111.	58.	51.	48.	44.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO													
+	ROG02A	.13	1	FLOW	136.	130.	122.	116.	109.	57.	50.	47.	44.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83	3.83
			2	FLOW	136.	130.	122.	116.	109.	57.	50.	47.	44.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83	3.83
HYDROGRAPH AT													
+	OG02B	.19	1	FLOW	200.	191.	180.	172.	161.	84.	74.	69.	64.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			2	FLOW	200.	191.	180.	172.	161.	84.	74.	69.	64.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75

2 COMBINED AT

			2	FLOW	45.	45.	45.	45.	45.	45.	45.	45.	43.
				TIME	3.42	3.42	3.42	3.42	3.50	3.58	3.67	3.67	3.75
ROUTED TO													
+	RDVG011	.00	1	FLOW	45.	45.	45.	45.	45.	45.	45.	45.	42.
				TIME	3.50	3.50	3.50	3.50	3.58	3.67	3.75	3.75	3.75
			2	FLOW	45.	45.	45.	45.	45.	45.	45.	45.	42.
				TIME	3.50	3.50	3.50	3.50	3.58	3.67	3.75	3.75	3.75
HYDROGRAPH AT													
+	VG011	.03	1	FLOW	44.	43.	41.	39.	37.	23.	21.	20.	19.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
			2	FLOW	44.	43.	41.	39.	37.	23.	21.	20.	19.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CVG011	.03	1	FLOW	89.	88.	86.	84.	82.	67.	64.	63.	58.
				TIME	3.58	3.58	3.58	3.58	3.58	3.67	3.67	3.67	3.67
			2	FLOW	89.	88.	86.	84.	82.	67.	64.	63.	58.
				TIME	3.58	3.58	3.58	3.58	3.58	3.67	3.67	3.67	3.67
ROUTED TO													
+	RVG011	.03	1	FLOW	89.	87.	85.	84.	82.	66.	64.	61.	57.
				TIME	3.67	3.67	3.67	3.67	3.67	3.75	3.75	3.75	3.83
			2	FLOW	89.	87.	85.	84.	82.	66.	64.	61.	57.
				TIME	3.67	3.67	3.67	3.67	3.67	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	WA02	.14	1	FLOW	163.	156.	148.	142.	134.	75.	67.	64.	59.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			2	FLOW	163.	156.	148.	142.	134.	75.	67.	64.	59.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO													
+	RWA02	.14	1	FLOW	143.	137.	130.	125.	118.	66.	59.	56.	52.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
			2	FLOW	143.	137.	130.	125.	118.	66.	59.	56.	52.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT													
+	WA03	.09	1	FLOW	115.	110.	105.	100.	94.	53.	47.	45.	42.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
			2	FLOW	115.	110.	105.	100.	94.	53.	47.	45.	42.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	WA01	.08	1	FLOW	52.	50.	46.	43.	40.	16.	13.	12.	10.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	52.	50.	46.	43.	40.	16.	13.	12.	10.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
4 COMBINED AT													
+	CWA03	.34	1	FLOW	368.	355.	338.	325.	307.	187.	171.	164.	153.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83	3.83
			2	FLOW	368.	355.	338.	325.	307.	187.	171.	164.	153.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83	3.83
ROUTED TO													
+	RWA03	.34	1	FLOW	296.	285.	271.	261.	247.	148.	133.	126.	117.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
			2	FLOW	296.	285.	271.	261.	247.	148.	133.	126.	117.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT													
+	WA04	.11	1	FLOW	103.	98.	92.	88.	82.	40.	35.	33.	30.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			2	FLOW	103.	98.	92.	88.	82.	40.	35.	33.	30.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CWA04	.44	1	FLOW	362.	349.	331.	318.	300.	173.	155.	147.	135.
				TIME	3.92	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
			2	FLOW	362.	349.	331.	318.	300.	173.	155.	147.	135.
				TIME	3.92	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO													
+	RWA04	.44	1	FLOW	330.	318.	301.	289.	273.	156.	140.	132.	122.
				TIME	4.17	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
			2	FLOW	330.	318.	301.	289.	273.	156.	140.	132.	122.
				TIME	4.17	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT													
+	WA06	.08	1	FLOW	89.	85.	81.	77.	73.	41.	37.	35.	33.
				TIME	3.75	3.75	3.75	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	89.	85.	81.	77.	73.	41.	37.	35.	33.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CWA06	.53	1	FLOW	380.	365.	346.	332.	313.	177.	158.	149.	138.
				TIME	4.08	4.08	4.17	4.17	4.17	4.17	4.17	4.17	4.17
			2	FLOW	380.	365.	346.	332.	313.	177.	158.	149.	138.
				TIME	4.08	4.08	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO													
+	RWA06	.53	1	FLOW	378.	363.	344.	330.	311.	176.	157.	148.	137.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
			2	FLOW	378.	363.	344.	330.	311.	176.	157.	148.	137.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
HYDROGRAPH AT													

+	WA05	.03	1	FLOW	41.	39.	37.	36.	33.	19.	17.	16.	15.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
			2	FLOW	41.	39.	37.	36.	33.	19.	17.	16.	15.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CWA05	.56	1	FLOW	388.	373.	354.	339.	319.	180.	161.	152.	140.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
			2	FLOW	388.	373.	354.	339.	319.	180.	161.	152.	140.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
ROUTED TO													
+	RWA05	.56	1	FLOW	379.	364.	345.	331.	312.	175.	156.	148.	137.
				TIME	4.33	4.33	4.33	4.33	4.33	4.42	4.42	4.42	4.42
			2	FLOW	379.	364.	345.	331.	312.	175.	156.	148.	137.
				TIME	4.33	4.33	4.33	4.33	4.33	4.42	4.42	4.42	4.42
HYDROGRAPH AT													
+	WA06A	.06	1	FLOW	80.	77.	73.	70.	66.	37.	33.	32.	29.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
			2	FLOW	80.	77.	73.	70.	66.	37.	33.	32.	29.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CWA06A	.62	1	FLOW	397.	382.	361.	346.	326.	183.	163.	154.	142.
				TIME	4.25	4.25	4.25	4.25	4.25	4.33	4.33	4.33	4.33
			2	FLOW	397.	382.	361.	346.	326.	183.	163.	154.	142.
				TIME	4.25	4.25	4.25	4.25	4.25	4.33	4.33	4.33	4.33
ROUTED TO													
+	RWA06A	.62	1	FLOW	389.	375.	355.	340.	321.	180.	160.	152.	140.
				TIME	4.42	4.42	4.42	4.42	4.42	4.50	4.50	4.50	4.50
			2	FLOW	389.	375.	355.	340.	321.	180.	160.	152.	140.
				TIME	4.42	4.42	4.42	4.42	4.42	4.50	4.50	4.50	4.50
HYDROGRAPH AT													
+	WA07	.03	1	FLOW	36.	35.	33.	32.	30.	17.	15.	14.	13.
				TIME	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83	3.83
			2	FLOW	36.	35.	33.	32.	30.	17.	15.	14.	13.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CWA07	.65	1	FLOW	401.	385.	365.	350.	329.	184.	164.	156.	144.
				TIME	4.33	4.33	4.42	4.42	4.42	4.50	4.50	4.50	4.50
			2	FLOW	401.	385.	365.	350.	329.	184.	164.	156.	144.
				TIME	4.33	4.33	4.42	4.42	4.42	4.50	4.50	4.50	4.50
ROUTED TO													
+	RWA07	.65	1	FLOW	370.	356.	337.	323.	305.	171.	152.	144.	133.
				TIME	4.75	4.75	4.75	4.75	4.75	4.83	4.83	4.83	4.83
			2	FLOW	370.	356.	337.	323.	305.	171.	152.	144.	133.
				TIME	4.75	4.75	4.75	4.75	4.75	4.83	4.83	4.83	4.83
HYDROGRAPH AT													
+	WA09	.05	1	FLOW	73.	70.	67.	64.	61.	35.	31.	30.	28.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
			2	FLOW	73.	70.	67.	64.	61.	35.	31.	30.	28.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CWA09	.70	1	FLOW	385.	370.	351.	337.	318.	179.	160.	151.	140.
				TIME	4.75	4.75	4.75	4.75	4.75	4.83	4.83	4.83	4.83
			2	FLOW	385.	370.	351.	337.	318.	179.	160.	151.	140.
				TIME	4.75	4.75	4.75	4.75	4.75	4.83	4.83	4.83	4.83
ROUTED TO													
+	RWA09	.70	1	FLOW	375.	361.	342.	328.	309.	174.	155.	147.	136.
				TIME	4.92	4.92	4.92	5.00	5.00	5.00	5.00	5.00	5.08
			2	FLOW	375.	361.	342.	328.	309.	174.	155.	147.	136.
				TIME	4.92	4.92	4.92	5.00	5.00	5.00	5.00	5.00	5.08
HYDROGRAPH AT													
+	WA11	.04	1	FLOW	62.	59.	56.	54.	51.	29.	26.	25.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
			2	FLOW	62.	59.	56.	54.	51.	29.	26.	25.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CWA11	.74	1	FLOW	386.	372.	352.	338.	319.	179.	160.	151.	140.
				TIME	4.92	4.92	4.92	4.92	4.92	5.00	5.00	5.00	5.00
			2	FLOW	386.	372.	352.	338.	319.	179.	160.	151.	140.
				TIME	4.92	4.92	4.92	4.92	4.92	5.00	5.00	5.00	5.00
ROUTED TO													
+	RWA11	.74	1	FLOW	362.	349.	330.	317.	299.	167.	149.	142.	131.
				TIME	5.42	5.42	5.42	5.42	5.42	5.50	5.50	5.50	5.50
			2	FLOW	362.	349.	330.	317.	299.	167.	149.	142.	131.
				TIME	5.42	5.42	5.42	5.42	5.42	5.50	5.50	5.50	5.50
HYDROGRAPH AT													
+	WA14	.04	1	FLOW	46.	44.	42.	40.	38.	21.	19.	18.	17.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	46.	44.	42.	40.	38.	21.	19.	18.	17.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CWA14	.79	1	FLOW	370.	356.	337.	323.	304.	170.	152.	144.	133.
				TIME	5.33	5.33	5.33	5.33	5.33	5.42	5.42	5.42	5.42
			2	FLOW	370.	356.	337.	323.	304.	170.	152.	144.	133.
				TIME	5.33	5.33	5.33	5.33	5.33	5.42	5.42	5.42	5.42

					1	.97	.93	.90	.86	.57	.53	.51	.49
ROUTED TO +	RWA14	.79	1	FLOW	362.	348.	330.	316.	298.	167.	149.	141.	131.
				TIME	5.58	5.58	5.58	5.58	5.58	5.67	5.67	5.67	5.67
			2	FLOW	362.	348.	330.	316.	298.	167.	149.	141.	131.
				TIME	5.58	5.58	5.58	5.58	5.58	5.67	5.67	5.67	5.67
HYDROGRAPH AT +	WA15A	.09	1	FLOW	86.	83.	78.	75.	71.	40.	36.	34.	32.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
			2	FLOW	86.	83.	78.	75.	71.	40.	36.	34.	32.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO +	RWA15A	.09	1	FLOW	78.	75.	71.	68.	64.	36.	32.	31.	28.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
			2	FLOW	78.	75.	71.	68.	64.	36.	32.	31.	28.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT +	WA15B	.15	1	FLOW	164.	158.	151.	145.	137.	81.	73.	70.	66.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	164.	158.	151.	145.	137.	81.	73.	70.	66.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
3 COMBINED AT +	CWA15B	1.02	1	FLOW	405.	389.	369.	354.	333.	187.	167.	158.	147.
				TIME	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42
			2	FLOW	405.	389.	369.	354.	333.	187.	167.	158.	147.
				TIME	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42
ROUTED TO +	RWA15B	1.02	1	FLOW	404.	388.	368.	353.	332.	186.	166.	158.	146.
				TIME	5.50	5.50	5.50	5.50	5.50	5.58	5.58	5.58	5.58
			2	FLOW	404.	388.	368.	353.	332.	186.	166.	158.	146.
				TIME	5.50	5.50	5.50	5.50	5.50	5.58	5.58	5.58	5.58
HYDROGRAPH AT +	WA16	.13	1	FLOW	94.	90.	85.	81.	76.	39.	34.	32.	30.
				TIME	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08	4.08
			2	FLOW	94.	90.	85.	81.	76.	39.	34.	32.	30.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
2 COMBINED AT +	CWA16	1.15	1	FLOW	429.	413.	391.	375.	353.	197.	176.	167.	155.
				TIME	5.42	5.42	5.42	5.42	5.42	5.50	5.50	5.50	5.50
			2	FLOW	429.	413.	391.	375.	353.	197.	176.	167.	155.
				TIME	5.42	5.42	5.42	5.42	5.42	5.50	5.50	5.50	5.50
ROUTED TO +	RWA16	1.15	1	FLOW	429.	412.	391.	374.	353.	197.	176.	167.	155.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
			2	FLOW	429.	412.	391.	374.	353.	197.	176.	167.	155.
				TIME	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
HYDROGRAPH AT +	WA17	.16	1	FLOW	94.	89.	83.	78.	72.	31.	26.	24.	21.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
			2	FLOW	94.	89.	83.	78.	72.	31.	26.	24.	21.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT +	VG07	.27	1	FLOW	255.	245.	230.	220.	206.	106.	93.	88.	81.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	255.	245.	230.	220.	206.	106.	93.	88.	81.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
3 COMBINED AT +	CWA17	1.59	1	FLOW	711.	681.	641.	611.	572.	297.	262.	247.	228.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08
			2	FLOW	711.	681.	641.	611.	572.	297.	262.	247.	228.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08
ROUTED TO +	RWA17	1.59	1	FLOW	710.	680.	640.	610.	571.	296.	262.	247.	228.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
			2	FLOW	710.	680.	640.	610.	571.	296.	262.	247.	228.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
HYDROGRAPH AT +	WA18	.05	1	FLOW	42.	40.	38.	36.	33.	15.	13.	12.	11.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
			2	FLOW	42.	40.	38.	36.	33.	15.	13.	12.	11.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT +	CWA18	1.64	1	FLOW	745.	714.	672.	640.	599.	310.	272.	257.	236.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
			2	FLOW	745.	714.	672.	640.	599.	310.	272.	257.	236.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO +	RWA18	1.64	1	FLOW	723.	692.	651.	621.	581.	301.	265.	250.	230.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
			2	FLOW	723.	692.	651.	621.	581.	301.	265.	250.	230.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT +	WA22	.05	1	FLOW	62.	60.	57.	55.	52.	31.	28.	27.	25.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75

			2	FLOW	62.	60.	57.	55.	52.	31.	28.	27.	25.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO													
+	RWA22	.05	1	FLOW	55.	53.	50.	48.	46.	27.	24.	23.	22.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
			2	FLOW	55.	53.	50.	48.	46.	27.	24.	23.	22.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
HYDROGRAPH AT													
+	WA20	.09	1	FLOW	72.	69.	65.	62.	57.	28.	24.	23.	21.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
			2	FLOW	72.	69.	65.	62.	57.	28.	24.	23.	21.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO													
+	RWA20	.09	1	FLOW	70.	67.	63.	59.	55.	27.	24.	22.	20.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
			2	FLOW	70.	67.	63.	59.	55.	27.	24.	22.	20.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
HYDROGRAPH AT													
+	WA21	.03	1	FLOW	22.	21.	20.	19.	17.	7.	6.	6.	5.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83
			2	FLOW	22.	21.	20.	19.	17.	7.	6.	6.	5.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
3 COMBINED AT													
+	CWA21	.17	1	FLOW	140.	134.	127.	121.	113.	59.	52.	49.	45.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
			2	FLOW	140.	134.	127.	121.	113.	59.	52.	49.	45.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO													
+	RWA21	.17	1	FLOW	140.	134.	126.	121.	113.	59.	52.	49.	45.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.08
			2	FLOW	140.	134.	126.	121.	113.	59.	52.	49.	45.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.08
HYDROGRAPH AT													
+	WA23	.05	1	FLOW	31.	29.	27.	26.	24.	11.	9.	9.	8.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
			2	FLOW	31.	29.	27.	26.	24.	11.	9.	9.	8.
				TIME	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08	4.08
ROUTED TO													
+	RWA23	.05	1	FLOW	28.	27.	25.	24.	22.	10.	9.	8.	7.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
			2	FLOW	28.	27.	25.	24.	22.	10.	9.	8.	7.
				TIME	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50
HYDROGRAPH AT													
+	WA19	.06	1	FLOW	42.	40.	38.	36.	33.	15.	13.	12.	11.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
			2	FLOW	42.	40.	38.	36.	33.	15.	13.	12.	11.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
4 COMBINED AT													
+	CWA19	1.92	1	FLOW	902.	863.	812.	773.	722.	372.	327.	308.	283.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
			2	FLOW	902.	863.	812.	773.	722.	372.	327.	308.	283.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
ROUTED TO													
+	RWA19	1.92	1	FLOW	897.	859.	807.	769.	719.	371.	326.	308.	283.
				TIME	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25	4.25
			2	FLOW	897.	859.	807.	769.	719.	371.	326.	308.	283.
				TIME	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT													
+	VG08	.06	1	FLOW	34.	33.	30.	29.	27.	12.	10.	9.	8.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
			2	FLOW	34.	33.	30.	29.	27.	12.	10.	9.	8.
				TIME	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
ROUTED TO													
+	RVG08	.06	1	FLOW	33.	32.	29.	28.	26.	11.	10.	9.	8.
				TIME	4.33	4.33	4.33	4.42	4.42	4.42	4.42	4.42	4.42
			2	FLOW	33.	32.	29.	28.	26.	11.	10.	9.	8.
				TIME	4.33	4.33	4.33	4.42	4.42	4.42	4.42	4.42	4.42
HYDROGRAPH AT													
+	VG09	.06	1	FLOW	51.	49.	46.	43.	40.	18.	16.	15.	13.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83
			2	FLOW	51.	49.	46.	43.	40.	18.	16.	15.	13.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CVG09	.12	1	FLOW	63.	60.	56.	53.	49.	22.	18.	17.	15.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.92	3.92	3.92
			2	FLOW	63.	60.	56.	53.	49.	22.	18.	17.	15.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.92	3.92	3.92
2 COMBINED AT													
+	2CVG09	2.04	1	FLOW	952.	911.	856.	815.	761.	390.	342.	323.	296.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
			2	FLOW	952.	911.	856.	815.	761.	390.	342.	323.	296.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
ROUTED TO													

Operation	Station	Area	Plan		1.00	.97	.93	.90	.86	.57	.53	.51	.49
+	RVG09	2.04	1	FLOW	948.	908.	854.	814.	760.	389.	341.	321.	295.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
			2	FLOW	948.	908.	854.	814.	760.	389.	341.	321.	295.
				TIME	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.25
HYDROGRAPH AT +	VG10	.09	1	FLOW	67.	64.	59.	56.	52.	25.	22.	20.	18.
				TIME	3.92	3.92	3.92	3.92	4.00	4.00	4.00	4.00	4.00
			2	FLOW	67.	64.	59.	56.	52.	25.	22.	20.	18.
				TIME	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
ROUTED TO +	RVG10	.09	1	FLOW	64.	61.	57.	54.	50.	24.	21.	19.	17.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
			2	FLOW	64.	61.	57.	54.	50.	24.	21.	19.	17.
				TIME	4.17	4.17	4.17	4.17	4.17	4.25	4.25	4.25	4.25
HYDROGRAPH AT +	VG11	.07	1	FLOW	57.	55.	51.	48.	45.	20.	17.	16.	15.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.83	3.83	3.83
			2	FLOW	57.	55.	51.	48.	45.	20.	17.	16.	15.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT +	CVG11	.16	1	FLOW	97.	92.	86.	82.	76.	36.	31.	28.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
			2	FLOW	97.	92.	86.	82.	76.	36.	31.	28.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
ROUTED TO +	RVG11	.16	1	FLOW	97.	92.	86.	81.	76.	35.	30.	28.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
			2	FLOW	97.	92.	86.	81.	76.	35.	30.	28.	26.
				TIME	4.00	4.00	4.00	4.00	4.00	4.08	4.08	4.08	4.08
HYDROGRAPH AT +	VG12	.05	1	FLOW	46.	44.	41.	39.	36.	17.	14.	13.	12.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			2	FLOW	46.	44.	41.	39.	36.	17.	14.	13.	12.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT +	CVG12	.21	1	FLOW	132.	126.	118.	111.	103.	48.	41.	38.	34.
				TIME	3.83	3.83	3.83	3.92	3.92	3.92	3.92	3.92	3.92
			2	FLOW	132.	126.	118.	111.	103.	48.	41.	38.	34.
				TIME	3.83	3.83	3.83	3.92	3.92	3.92	3.92	3.92	3.92
3 COMBINED AT +	C2VG12	10.76	1	FLOW	2029.	1935.	1825.	1743.	1621.	741.	648.	610.	559.
				TIME	4.25	4.25	4.33	4.33	4.33	4.25	4.33	4.33	4.33
			2	FLOW	2029.	1935.	1825.	1743.	1621.	741.	648.	610.	559.
				TIME	4.25	4.25	4.33	4.33	4.33	4.25	4.33	4.33	4.33
ROUTED TO +	RVG12	10.76	1	FLOW	2018.	1934.	1822.	1737.	1611.	739.	648.	610.	558.
				TIME	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33
			2	FLOW	2018.	1934.	1822.	1737.	1611.	739.	648.	610.	558.
				TIME	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33
HYDROGRAPH AT +	DN1	.00	1	FLOW	57.	51.	44.	38.	31.	1.	1.	1.	1.
				TIME	3.83	3.83	3.83	3.83	3.92	3.92	4.00	4.08	4.08
			2	FLOW	57.	51.	44.	38.	31.	1.	1.	1.	1.
				TIME	3.83	3.83	3.83	3.83	3.92	3.92	4.00	4.08	4.08
ROUTED TO +	RDN1	.00	1	FLOW	56.	50.	43.	38.	30.	1.	1.	1.	1.
				TIME	3.92	3.92	3.92	3.92	3.92	4.25	4.33	4.33	4.42
			2	FLOW	56.	50.	43.	38.	30.	1.	1.	1.	1.
				TIME	3.92	3.92	3.92	3.92	3.92	4.25	4.33	4.33	4.42
HYDROGRAPH AT +	N1	.10	1	FLOW	99.	95.	89.	84.	78.	39.	34.	31.	29.
				TIME	3.67	3.67	3.67	3.67	3.67	3.75	3.75	3.75	3.75
			2	FLOW	99.	95.	89.	84.	78.	39.	34.	31.	29.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT +	CN1	.10	1	FLOW	139.	130.	116.	105.	88.	39.	34.	31.	29.
				TIME	3.83	3.83	3.83	3.83	3.83	3.75	3.75	3.75	3.75
			2	FLOW	139.	130.	116.	105.	88.	39.	34.	31.	29.
				TIME	3.83	3.83	3.83	3.83	3.83	3.75	3.75	3.75	3.75
DIVERSION TO +	DFN2	.10	1	FLOW	114.	105.	91.	80.	64.	14.	9.	7.	5.
				TIME	3.83	3.83	3.83	3.83	3.83	3.75	3.75	3.75	3.75
			2	FLOW	114.	105.	91.	80.	64.	14.	9.	7.	5.
				TIME	3.83	3.83	3.83	3.83	3.83	3.75	3.75	3.75	3.75
HYDROGRAPH AT +	DA1	.10	1	FLOW	25.	25.	25.	25.	25.	24.	24.	24.	24.
				TIME	3.75	3.75	3.83	3.83	3.83	3.75	3.75	3.75	3.75
			2	FLOW	25.	25.	25.	25.	25.	24.	24.	24.	24.
				TIME	3.75	3.75	3.83	3.83	3.83	3.75	3.75	3.75	3.75
ROUTED TO +	RDA1	.10	1	FLOW	25.	25.	25.	25.	25.	24.	24.	24.	24.
				TIME	3.83	3.83	3.92	3.92	3.92	3.75	3.75	3.75	3.75
			2	FLOW	25.	25.	25.	25.	25.	24.	24.	24.	24.
				TIME	3.83	3.83	3.92	3.92	3.92	3.75	3.75	3.75	3.75

Central Watershed - Northwest

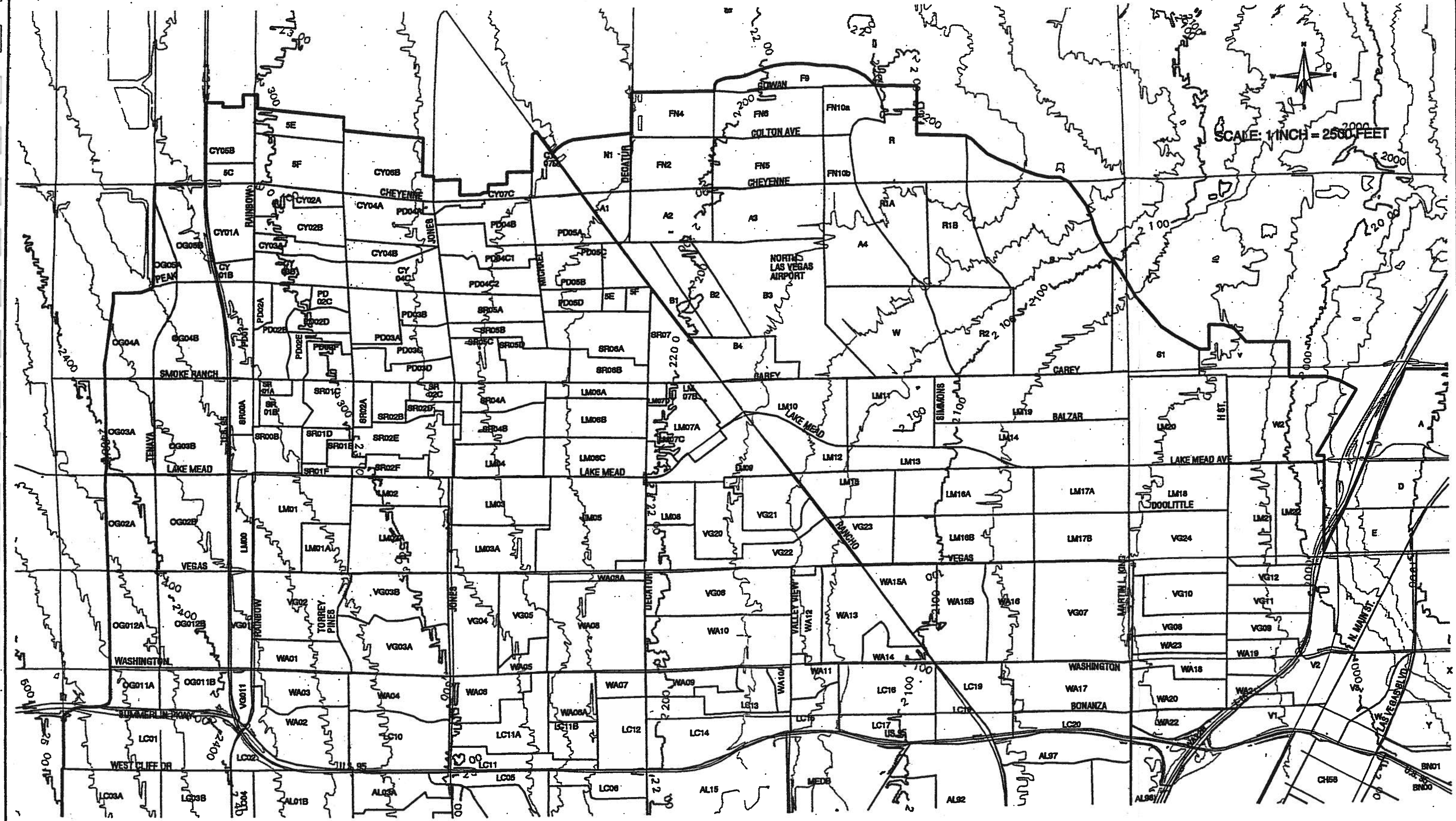
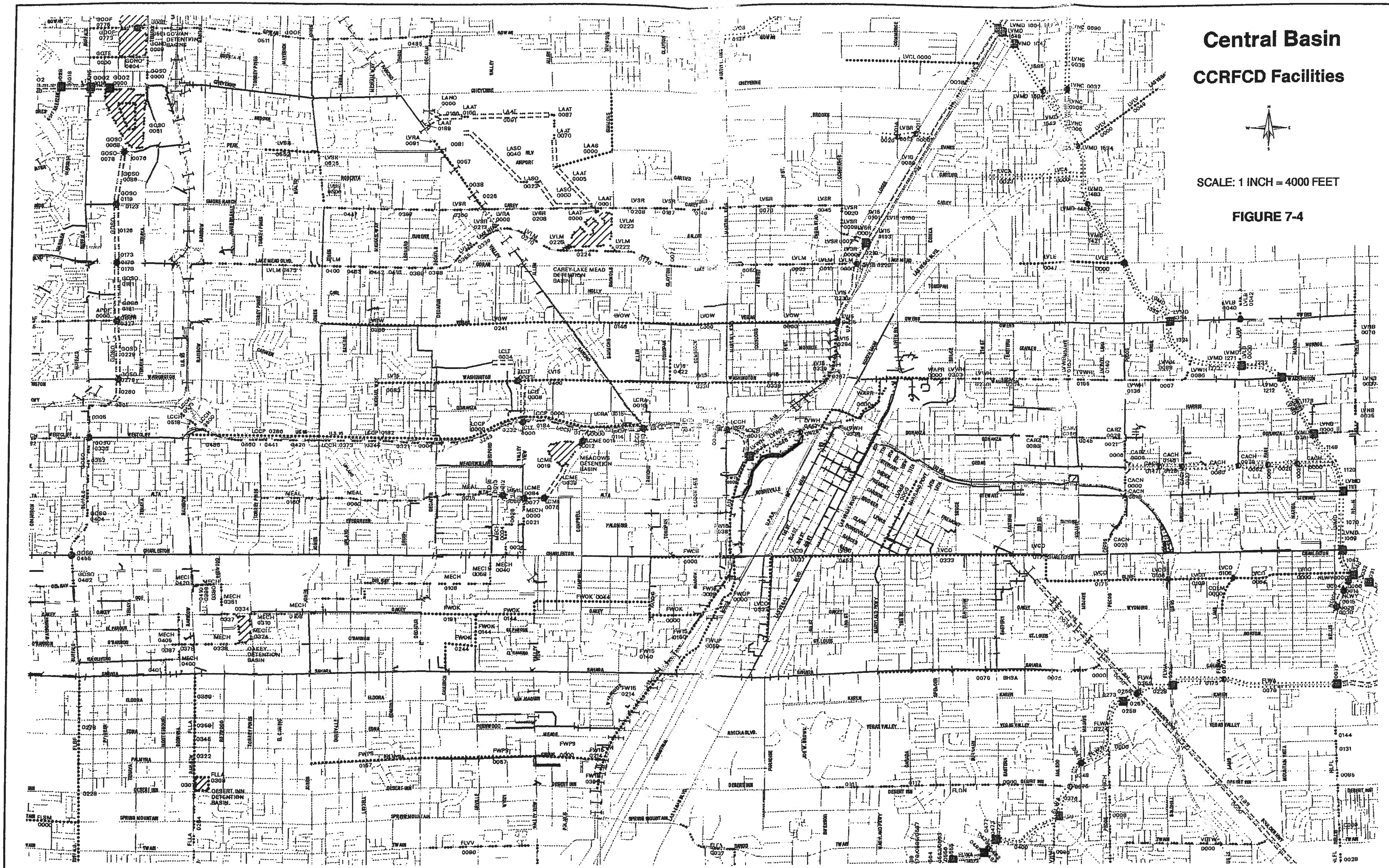
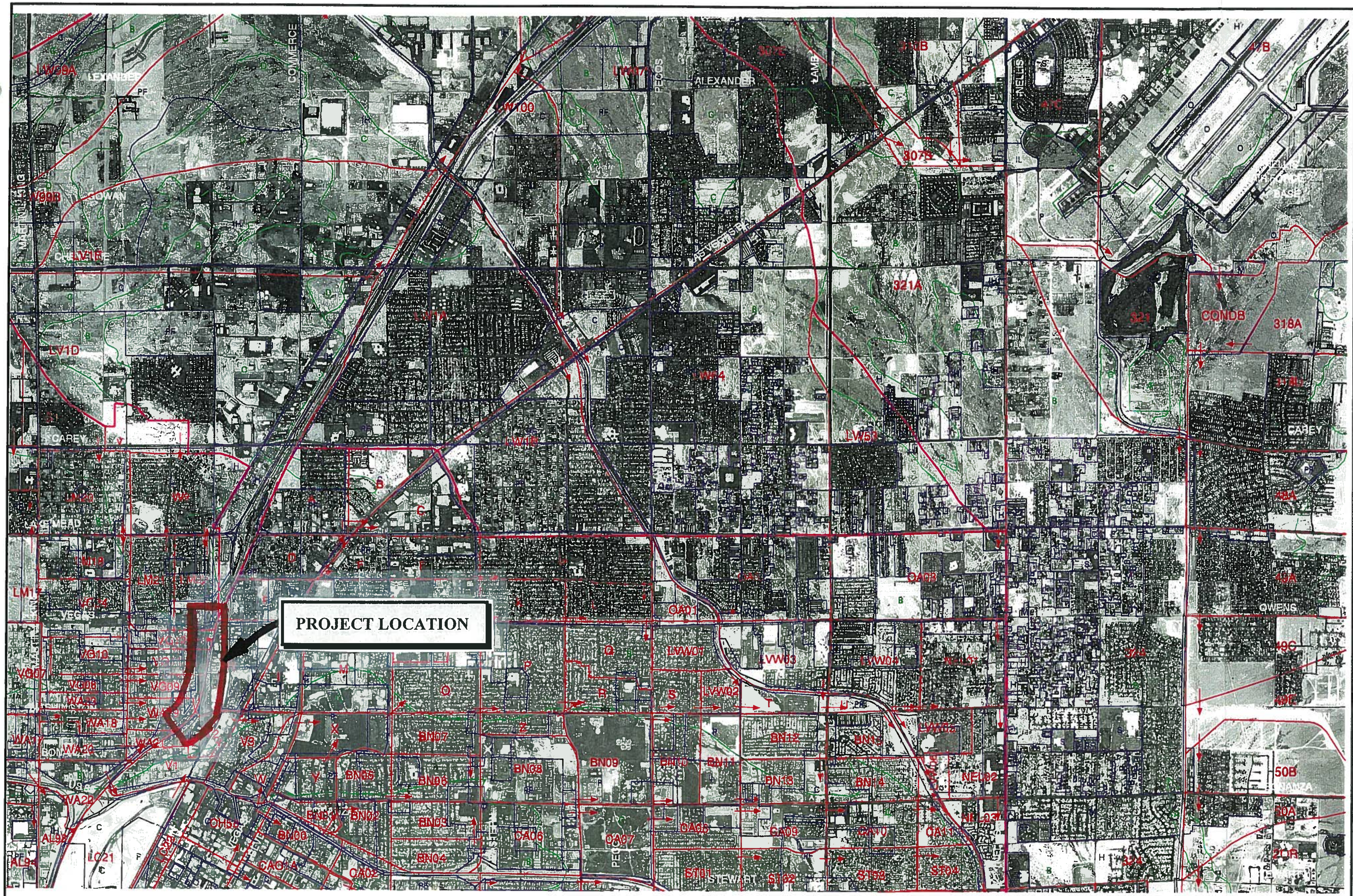


FIGURE 7-1



Central Basin
CCRFCD Facilities
SCALE: 1 INCH = 4000 FEET
FIGURE 7-4



PHOTOS BY LANDISCOR
DATED: AUGUST 1995

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	27	

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY 1996

LEGEND

- WATERSHED BOUNDARY
- SUBAREAS
- SOILS
- LAND USE

HYDROLOGIC SOIL GROUPS

A LOW RUN-OFF POTENTIAL
B MODERATELY LOW RUN-OFF POTENTIAL
C MODERATELY HIGH RUN-OFF POTENTIAL
D HIGH RUN-OFF POTENTIAL

TYPICAL LAND USE

O OPEN LAND (UNDEVELOPED)
P PARKS, GOLF COURSES
R RURAL RESIDENTIAL
L LOW DENSITY RESIDENTIAL
M MEDIUM DENSITY RESIDENTIAL
H HIGH DENSITY RESIDENTIAL
PF PUBLIC FACILITY
C COMMERCIAL
IL INDUSTRIAL - LOW IMP.
IH INDUSTRIAL - HIGH IMP.
S SCHOOLS
W WATER BODIES (LAKES, ETC.)

GRAPHIC SCALE

3000 1500 0 1000 2000 3000

(IN FEET)

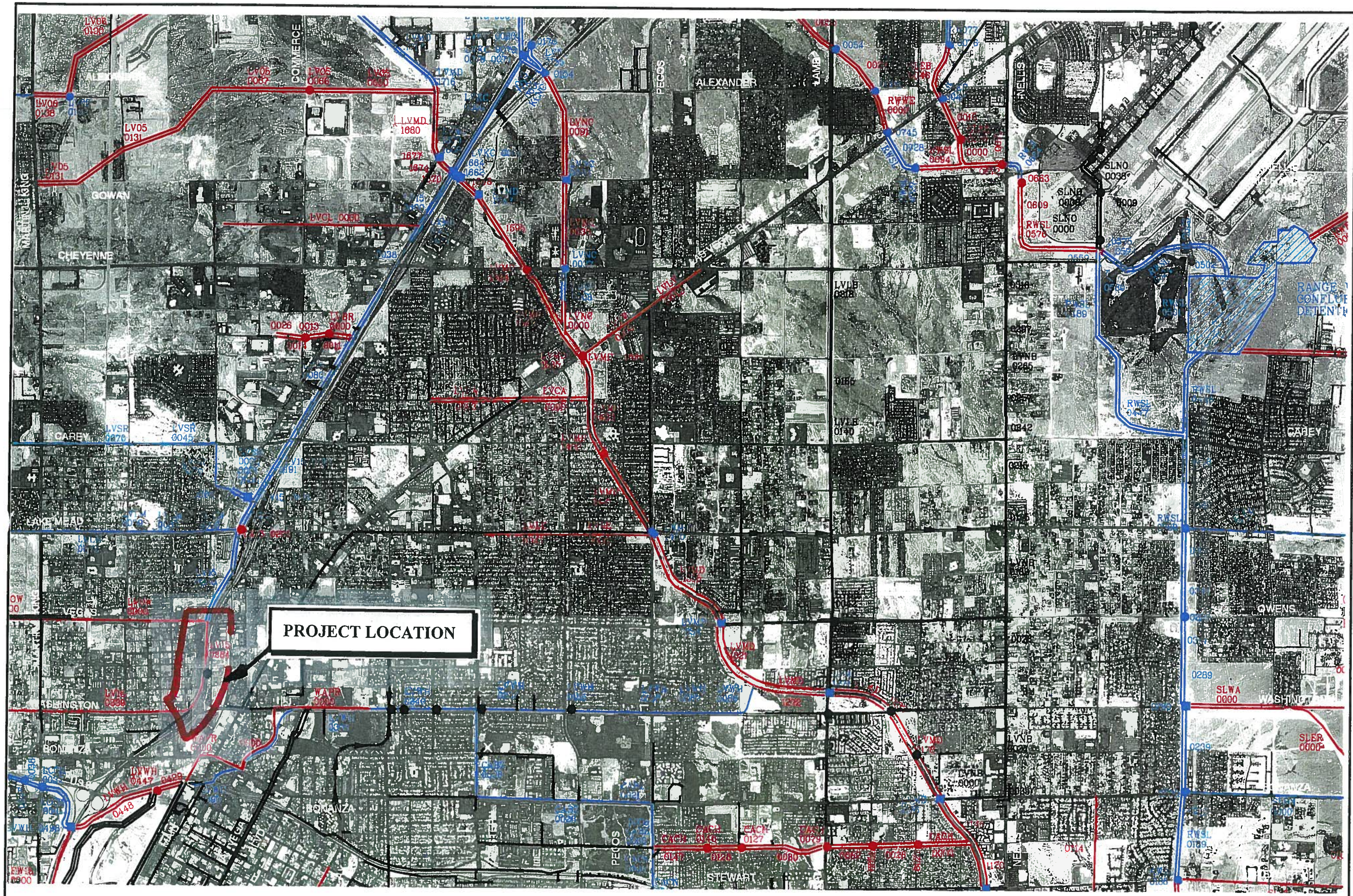
SCALE: 1 INCH = 3000 FEET

HYDROLOGIC SUBAREAS, LAND USE & SOILS

FIGURE H-11

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

vtn nevada



PHOTOS BY LANDISCOR
DATED: AUGUST 1995

CLARK COUNTY
REGIONAL FLOOD CONTROL DISTRICT

FLOOD CONTROL MASTER PLAN UPDATE LAS VEGAS VALLEY 1996

LEGEND

- EXISTING MASTER PLAN FACILITIES
- PROPOSED MASTER PLAN FACILITIES
- LOCAL OR UNSTUDIED FACILITIES
- DETENTION/DEBRIS BASIN
- CULVERT
- BRIDGE
- PIPELINE
- LINED CHANNEL
- UNLINED CHANNEL
- DIKE
- NATURAL WASH
- ULTIMATE DEVELOPMENT BOUNDARY
- SECONDARY FACILITIES

GRAPHIC SCALE

3000 1500 0 1000 2000 3000

(IN FEET)

SCALE: 1 INCH = 3000 FEET

FLOOD CONTROL FACILITIES

FIGURE F-11

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	27	

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

VTN nevada