TROPICANA WASH AT SWENSON STREET
CONDITIONAL LETTER OF MAP REVISION (CLOMR)

500-881

September 2012

Prepared for:

Clark County Public Works
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ENGINEERS | PLANNERS | SURVEYORS

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G. C. WALLACE HOLDINGS, INC.

500-881

September 13, 2012

Writer's Contact Information:

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LOMC Clearinghouse
7390 Coca Cola Drive, Suite 204
Hanover, Maryland 21076

Subject: CLOMR for the Tropicana Wash at Swenson Street

Attention: LOMC Manager

G. C. Wallace, Inc. (GCW) has been contracted by Clark County Public Works (CCPW) to complete a Conditional Letter of Map Revision (CLOMR) for a portion of the Tropicana Wash – Central Branch located within Clark County, Nevada. The project encompasses the reach of the Tropicana Wash between Palos Verdes Street and Flamingo Road tying into the existing upstream and downstream improvements. The purpose of this CLOMR is to lay the groundwork for a Letter of Map Revision (LOMR) in order to clarify and/or correct the existing Community Panel to reflect the proposed developed condition within the watershed. The CLOMR methodology is in accordance with *Guidelines and Specifications for Flood Hazard Mapping Partners* (Reference 1).

The current FIRM panel indicates the subject reach of the Tropicana Wash is located within a Zone AE Special Flood Hazard Area (SFHA). Zone AE SFHA's are floodplains with determined base flood elevations (BFE). The affected Community Panel Map Number is 32003C2557F dated November 16, 2011. See Figures 1 and 2 for the project vicinity and location. The Effective FIRM is shown on Figure 3. There have been no flood control improvements within the Tropicana Wash since the effective FIRM was completed.

The following information supporting this request for a CLOMR is enclosed. This request is based on the proposed improvements consisting of installation of an open and closed channel system that will convey flows from the existing six (6) barrel 12-foot wide by 4-foot high Terrible Herbst RCBs to the existing Vegas Grand Channel and Arches located north of the existing Flamingo Road Bridge.

- Figure 1 – Vicinity Map
- Figure 2 – Location Map
- Figure 3 – Effective FIRM
- Figure 4 – Work Map: HEC-RAS/WSPGW Model
- Figure 5 – Revised FIRM Map
- Figure 6 – Annotated FIRM Map
- FEMA Forms
- A copy of the check in the amount of $6,050.00 payable to the National Flood Insurance Program has been included with this submittal. The actual check has been sent to the FEMA Fee Charge System Administrator.
- Hydraulic Modeling Computations
- Structural analysis of channel, storm drain, bridges and floodwalls
- Site Photographs
- Field Survey Information
- Operation and Maintenance Plan

- Environmental analysis to ensure compliance with Endangered Species Act (ESA)
- References
- As-Built Plans
  - Vegas Grand Improvement Plans, Mark E. Jones 11/10/04
  - CCPW 1979 Improvements of Swenson Street, R.E.H., 5/15/81
  - Terrible Herbst Casino (formerly Acapulco Inn) Improvement Plans, Richard J. Baughman, 9/28/79
- Certification of the plan set specifically for substantial conformance
- Electronic Files on disk (Aerial topography, Survey data, GIS Files, HEC-RAS Models and WSPGW Models)

Proposed Improvements

Note that all channel improvements modeling and mapping in support of this CLOMR are based on the NAVD88 Datum. See Figure 4 for the location of the proposed improvements included in the attached Supporting Documentation 1.0.

Hydrology

The Tropicana Wash was previously analyzed in the *Letter of Map Revision for Hard Rock Casino Hotel* (Reference 2, hereinafter referred to as LOMR Case No. 07-09-1179P). The FEMA adopted flowrate of 4,473 cfs, prepared as part of the LOMR Case No. 07-09-1179P was used to confirm the capacity of the proposed facilities. The results of the LOMR Case No. 07-09-1179P were incorporated into the latest effective FIRM.

Aerial Topography and Survey Data

Topographic mapping with a contour interval of 1-foot was generated by AeroTech Mapping (flight date January 20, 2008). The vertical control is based on North American Vertical Datum of 1988 (NAVD 1988), and horizontal control is based on Nevada State Plane Coordinate System (NAD 1983/94). In addition to topographic mapping, field surveys were performed to obtain as-built information for the existing bridges, culverts, and storm drain facilities.

Hydraulic Modeling

Review of the hydraulic models for the Tropicana Wash from the *Technical Drainage Study for Vegas Grand* (Reference 3, hereinafter referred to as the Vegas Grand Study) and the *International Gaming Institute – Drainage Study* (Reference 4, hereinafter referred to as the International Gaming Study) indicated that under existing conditions, flows are not contained within the wash at the Swenson Street Bridge or the Flamingo Road Bridge.

Detailed hydraulic modeling of the proposed concrete-lined Tropicana Wash Channel from the existing Terrible Herbst Culverts to the proposed Flamingo Road Bridge expansion shows that the LOMR Case No. 07-09-1179P flows will be contained within the proposed channel and storm drain improvements and will not overtop at Swenson Street or Flamingo Road. The recommended channel system proposes a rectangular concrete-lined channel with an 80-foot-wide bottom width and a 2 percent cross slope (for nuisance flows) between the existing

Terrible Herbst RCBs and the Swenson Street Bridge. The proposed channel has wall heights ranging from 5.5 feet to 13.8 feet high. Downstream of the Swenson Street Bridge, a closed conduit system consisting of five (5) barrel 14-foot wide by 5-foot high RCBs will convey flows to the existing Flamingo Road Bridge. The existing Flamingo Road Bridge will be expanded from three (3) 12-foot wide by 5-foot high RCBCs by adding two (2) additional 16.5-foot-wide by 5-foot high RCBCs. The expanded structure will tie into the Vegas Grand Channel and Arches System downstream of the Flamingo Road Bridge. As previously noted, the design flows are based on the FEMA adopted flow of 4,473 cfs. The proposed channel and storm drain system will convey the FEMA adopted flow.

Hydraulic modeling for the proposed channel improvements were performed within the *U.S. Army Corps of Engineers HEC-RAS River Analysis System* (Reference 5, HEC-RAS) and the *Water Surface Pressure Gradient for Windows* (Reference 6, WSPGW) computer programs. The HEC-RAS and WSPGW models output have been provided in the attached Supporting Documentation 3.1. The stations used in the hydraulic models correspond to the appropriate improvement plan centerline stationing and have been included in tables in the attached Supporting Documentation 3.1 and on Figure 4 provided in the attached Supporting Documentation 1.0.

Super-elevation heights for the proposed channel were calculated using Equation 748 from the *CCRFCD Hydrologic Criteria Drainage and Design Manual* (Reference 7, hereinafter referred to as the Manual). The proposed channel wall heights have been set above the calculated super-elevation heights. Where the proposed BFE is above the adjacent dry side ground elevations (between Stations "TW" 21+78.56 and 22+87.77), the channel walls serve as floodwalls. A minimum of 4.0 feet of freeboard has been provided for the proposed floodwalls upstream of the Swenson Street Bridge as described in the FEMA Code of Federal Regulations Title 44, Part 65.10(ii) (Reference 8). Improvement Plan Sheet C2 shows the adjacent dry ground elevations at the right and left side of the proposed channel floodwalls. The proposed BFE at the proposed floodwalls is a maximum of 2.48 ft above the adjacent finished dry side grade. Copies of the HEC-RAS and WSPGW models (including digital files) using a mixed flow regime for the FEMA adopted flow of 4,473 cfs have been provided in the attached Supporting Documentation 3.1. Structural calculations for the proposed Swenson Street Floodwalls have been provided in the attached Supporting Documentation 3.2.

The WSPGW model extends from the existing Terrible Herbst RCBs at the upstream end through portions of the Vegas Grand Study Improvements to the existing Vegas Grand Arches at the downstream end. The HEC-RAS model extends from the Terrible Herbst RCBs at the upstream end through the Swenson Street Bridge at the downstream end as a check on the pressure head on the upstream side of the Swenson Street Bridge and to verify depths in the upstream channel improvements. Mixed, subcritical and supercritical flow regimes for the HEC-RAS model were reviewed. Results indicate that the mixed flow regime for the design flow rate of 4,473 cfs best represented the hydraulics of the Tropicana Wash Channel improvements and governed the proposed design of the Tropicana Wash Channel improvements. Table 2 in the attached Supporting Documentation 3.1 summarizes the HEC-RAS and WSPGW results using the mixed flow regime with the calculated super-elevation and flood wall freeboard in order to determine the appropriate wall heights necessary for the proposed channel. Velocities within the channel are less than 30 feet per second.

Per the HEC-RAS model using the mixed flow regime for the FEMA adopted flow of 4,473 cfs, the proposed channel starting at the upstream end (Terrible Herbst Culverts) will flow under supercritical conditions and transition to subcritical conditions just upstream of the DRI Bridge. Flows will be conveyed through the DRI Bridge under subcritical flow conditions to the Swenson Street Bridge. The headwall of the Swenson Street Bridge will be reconstructed to contain the flows within the channel. Flows will then be conveyed through the Swenson Street Bridge under pressure flow and into the proposed closed conduit system and expanded Flamingo Road Bridge.

HEC-RAS cross sections have been located at the upstream and downstream face of the DRI and Swenson Street Bridges. Cross sections have also been added at wall height transitions, transitions upstream and downstream of the bridges where the proposed channel geometry will transition to the existing slope of the bridges. Previously, the Vegas Grand Study overlapped HEC-RAS and WSPG models to analyze the facilities downstream of the Flamingo Road Bridge. The proposed WSPGW model for the Tropicana Wash improvements include referenced cross section information and locations based on the Vegas Grand improvement plans. Copies of the improvement and structural plans for the existing Vegas Grand Channel as well as pertinent reference material from the study have been included in the attached Supporting Documentation 5.0.

Manning's "n" Values and Losses

Manning's "n" roughness values of 0.013 were referenced from the Vegas Grand Study. Manning's "n" roughness values of 0.015 are for the proposed Tropicana Wash Channel improvements and are in conformance with the Manual criteria.

Expansion and contraction coefficients for the Tropicana Wash cross sections, bridges and transitions have been utilized in the model according to the *HEC-RAS River Analysis System Hydraulic Reference Manual* (Reference 9, hereinafter referred to as the HEC-RAS Manual). An excerpt from the HEC-RAS Manual has been included in the attached Supporting Documentation 5.0 showing coefficients for gradual transitions under supercritical flow conditions, and coefficients for subcritical flow conditions at gradual transitions and typical bridge sections. In general, contraction and expansion coefficients at the majority of the cross sections assume values of 0.1 and 0.3, respectively, for gradual transitions under subcritical flow conditions. Contraction and expansion coefficients at the DRI, Swenson Street and Flamingo Road Bridge assume values of 0.3 and 0.5, respectively.

Boundary Condition and Floodplain Tie-in Locations

Downstream: The floodplain tie-in location is at the upstream end of the existing Vegas Grand Arches.

Upstream: The floodplain tie-in location is at the downstream end of the existing Terrible Herbst Culverts.

Mapping

The 100-year floodplain, floodway, and base flood elevations (BFE) are based on HEC-RAS modeling for mixed flow. The floodplain and BFE were delineated on topographic maps based on the proposed improvements. The top widths calculated in the HEC-RAS model will be contained within the proposed concrete-lined channel from the existing Terrible Herbst Culverts to the Swenson Street Bridge. The top widths calculated in the WSPGW model will be contained within the proposed closed conduit system from the existing Swenson Street Bridge to the expanded Flamingo Road Bridge. The top widths calculated in the WSPGW model will be contained within the expanded Flamingo Road Bridge to the existing Vegas Grand Arches.

The Proposed FIRM revisions are shown on Figure 5 and the Annotated FIRM is shown on Figure 6.

GCW trusts that this submittal will provide the required information needed to support a CLOMR for the subject project.

If you have any questions or require additional information, please do not hesitate to call us at (702) 804-2000.

Cordially,

G. C. WALLACE, INC.

Rachael R. Dennis, PE
Project Engineer
Flood Control Division

Ryan Belsick, PE
Vice President
Flood Control Division

Encl.
cc: Kevin Eubanks, CCRFCD
Joe Damiani, CCRFCD
Mona Stammetti, CCPW
Calvin Black, GCW
Jerry Pruitt, GCW

REFERENCES

1. Federal Emergency Management Agency. *Guidelines and Specifications for Flood Hazard Mapping Partners.* April 2003.
2. Kimley-Horn and Associates, Inc., *Letter of Map Revision Hard Rock Casino Hotel.* April 2007.
3. Southwest Engineering, *Technical Drainage Study for Vegas Grand.* June 2003.
4. Louis Berger & Associates, Inc., *Technical Drainage Study for International Gaming Institute.* October 1998.
5. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System.* March 2008 Version 4.0.
6. CIVILDESIGN Corporation, WSPGW Water Surface Pressure Gradient Package, 1991-2000. Version 12.99.
7. Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Design Manual.* August 1999.
8. FEMA, Department of Homeland Security, *Code of Federal Regulations - Emergency Management and Assistance.* Accessed: October 13, 2011.
9. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System Hydraulic Reference Manual.* November 2002 Version 3.1.
10. Louis Berger & Associates, Inc., *Technical Drainage Study for DRI – Swenson Street Bridge.* October 1998.

SUPPORTING DOCUMENTATION FOR CLOMR (PAGE 1 of 2)

1. FIGURES AND AFFECTED FIRM PANELS

- Figure 1 - Vicinity Map
- Figure 2 - Location Map
- Figure 3 - Effective FIRM
- Figure 4 - Work Map: HEC-RAS/WSPGW Model
- Figure 6 - Revised FIRM Map
- Figure 7 - Annotated FIRM Map

2. FEMA FORMS

- MT-2 Form 1: Overview & Concurrence Form
- MT-2 Form 2: Riverine Hydrology & Hydraulics Form
- MT-2 Form 3: Riverine Structures Form
- MT-2 Form 7 (Copy): Payment Information Form

3. ENGINEERING ANALYSIS

3.1 HYDRAULIC MODELING COMPUTATIONS

- HEC-RAS Model: Tropicana Wash through Swenson Street Bridge
- WSPGW Model: Tropicana Wash to Vegas Grand Arches
- Hydraulic Models Results Summary: Table 1, HEC-RAS and WSPGW
- Hydraulic Models Results Summary: Table 2, Super-Elevation

3.2 STRUCTURAL CALCULATIONS (ON CD)

4. SUPPORTING INFORMATION (ON CD)

- Site Investigation Photographs
- Field Survey Information
- Operation and Maintenance Plan
- ESA Compliance
- Topography

5. REFERENCE MATERIALS (ON CD)

- Excerpts from the *LOMR for Hard Rock Casino Hotel* (FEMA Case No 07-09-1179P): Approved FEMA flowrate, Hydraulics, LOMR Workmap, WSPG Model, HEC-2 Model, Hydraulic Analysis Summary
- Excerpts from the *Technical Drainage Study for Vegas Grand*: CCRFCD Concurrence, CCDDDS Approval, Tropicana Wash Figures Upstream of Confluence, HEC-RAS Model, WSPGW Models, HEC-RAS Station correlations, Improvement Plans
- Excerpts from the *International Gaming Institute – Drainage Study*: CCRFCD Concurrence, CCPW Approval, Overtopping flows at Swenson Street and Flamingo Road Bridges
- Excerpts from the *CCRFCD Hydrologic Criteria and Drainage Design Manual*: Super-Elevation Calculations
- Excerpts from the *FEMA Code of Federal Regulations Title 44, Part 65.10(ii)*: Minimum Freeboard Elevations
- Excerpts from the *HEC-RAS River Analysis System Hydraulic Manual* (2002): Contraction and Expansion Coefficients
- *CCPW 1979 Improvements of Swenson Street*, R.E.H., 5/15/81

SUPPORTING DOCUMENTATION FOR CLOMR (PAGE 2 of 2)

- *Terrible Herbst Casino (formerly Acapulco Inn) Improvement Plans*, Richard J. Baughman, 9/28/79

6. IMPROVEMENT PLANS (ON CD)

- Tropicana Wash at Swenson Street

7. ADDITIONAL ELECTRONIC FILES

- Report PDF
- HEC-RAS Model
- WSPGW Model
- Supporting Information
- Reference Materials
- GIS Shape Files

1. FIGURES AND AFFECTED FIRM PANELS

Figure 1 - Vicinity Map
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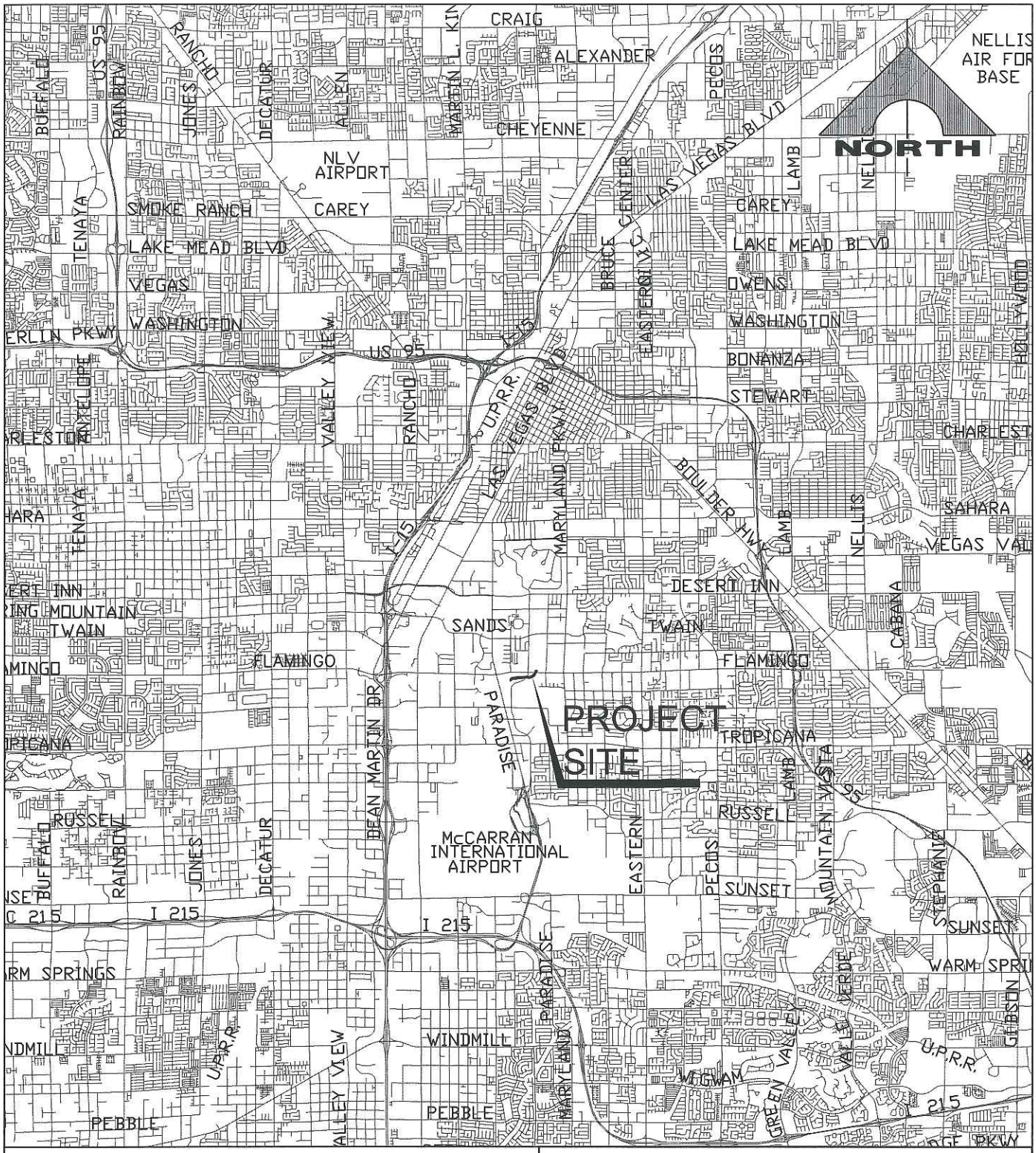

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GRAPHIC SCALE

10000 0 5000 10000

(IN FEET)

1 inch =10000 ft.

TROPICANA WASH
PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 1

VICINITY MAP

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GRAPHIC SCALE

2000 0 1000 2000

(IN FEET)

1 inch = 2000 ft.

TROPICANA WASH
PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 2

LOCATION MAP

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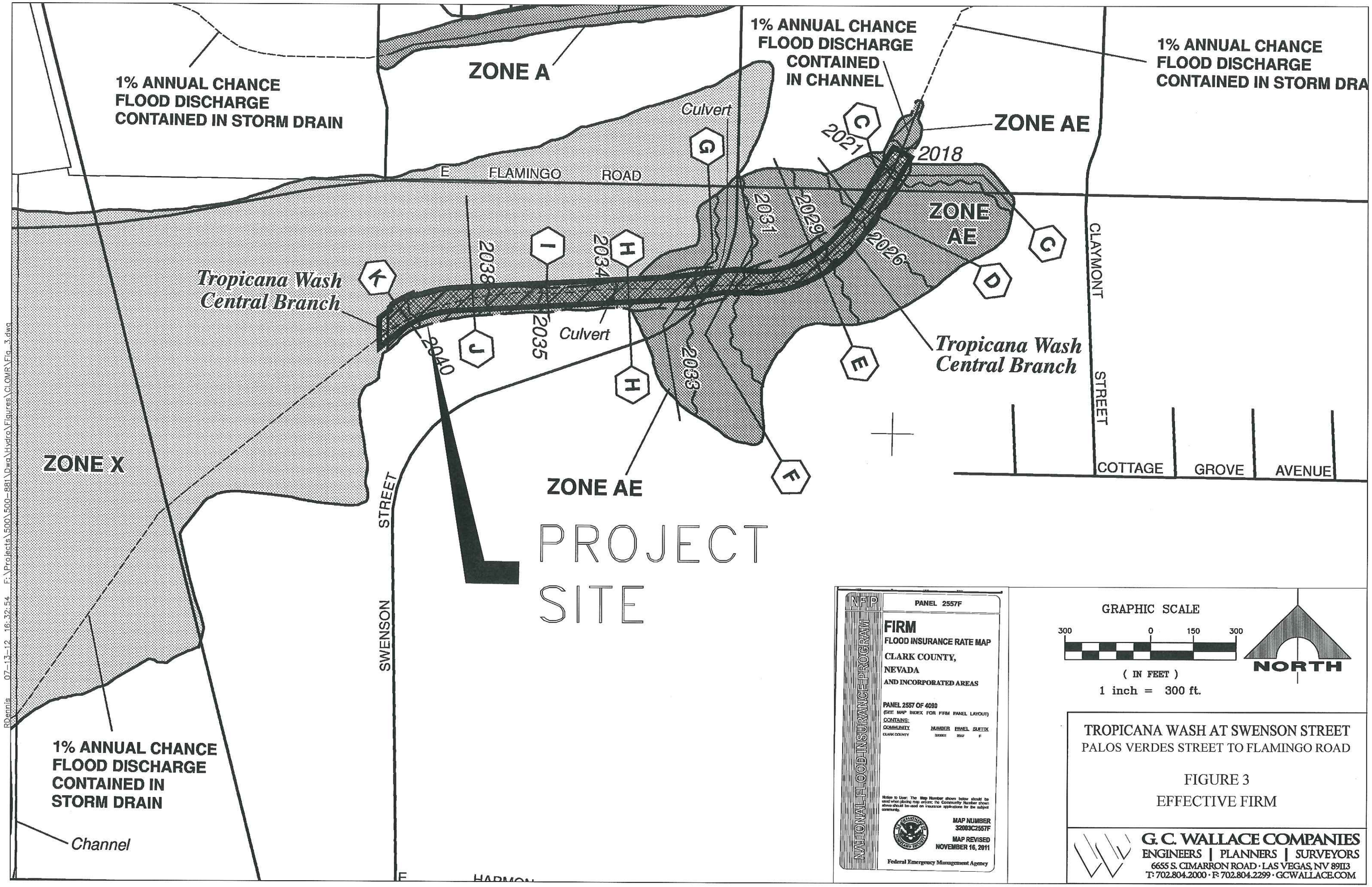

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NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2557F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA
AND INCORPORATED AREAS

PANEL 2557 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2557	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2557F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

GRAPHIC SCALE
300 0 150 300
(IN FEET)
1 inch = 300 ft.

NORTH

TROPICANA WASH AT SWENSON STREET
PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 3
EFFECTIVE FIRM

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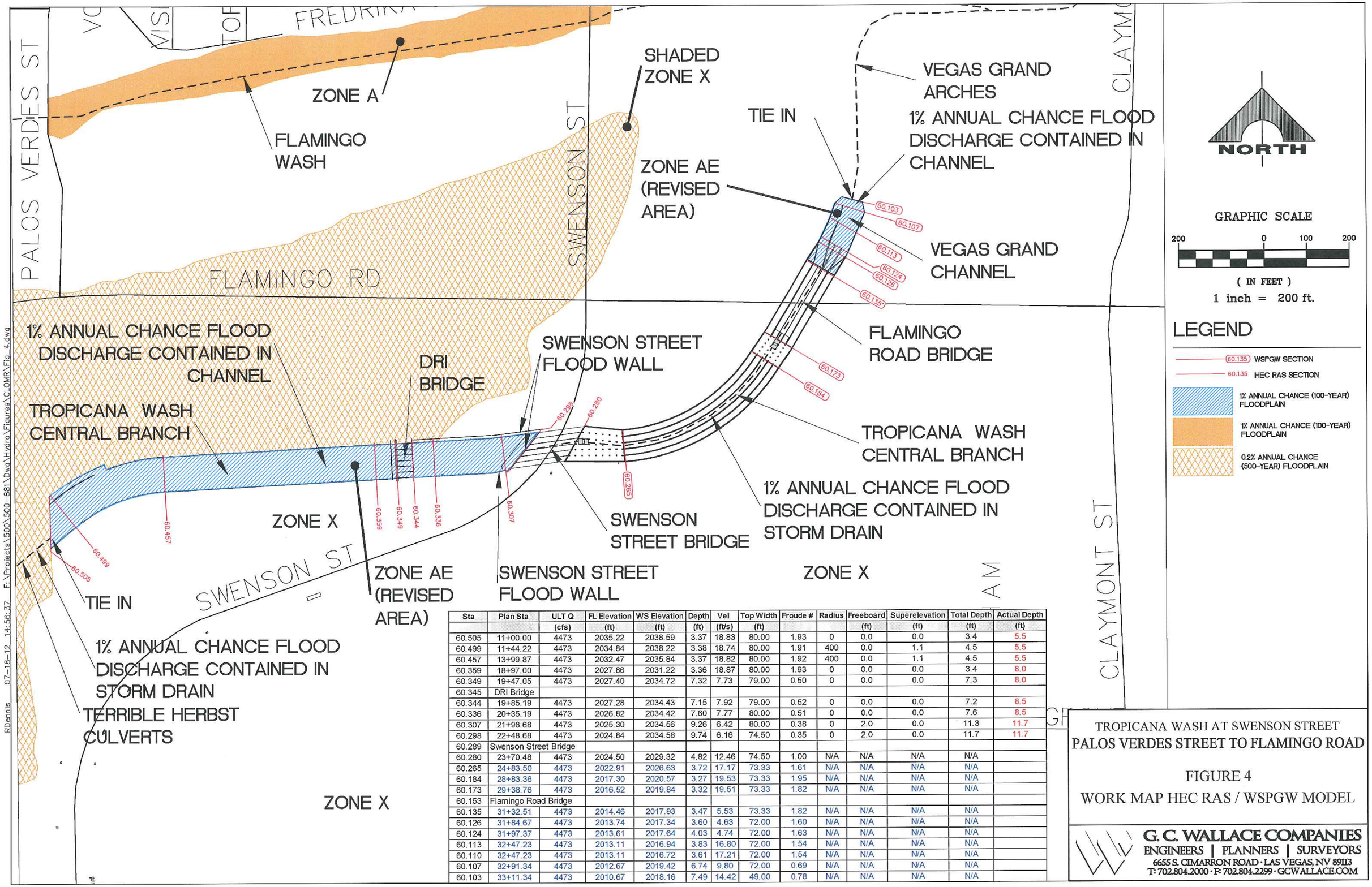

Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)
60.505	11+00.00	4473	2035.22	2038.59	3.37	18.83	80.00	1.93	0	0.0	0.0	3.4	5.5
60.499	11+44.22	4473	2034.84	2038.22	3.38	18.74	80.00	1.91	400	0.0	1.1	4.5	5.5
60.457	13+99.87	4473	2032.47	2035.84	3.37	18.82	80.00	1.92	400	0.0	1.1	4.5	5.5
60.359	18+97.00	4473	2027.86	2031.22	3.36	18.87	80.00	1.93	0	0.0	0.0	3.4	8.0
60.349	19+47.05	4473	2027.40	2034.72	7.32	7.73	79.00	0.50	0	0.0	0.0	7.3	8.0
60.345	DRI Bridge												
60.344	19+85.19	4473	2027.28	2034.43	7.15	7.92	79.00	0.52	0	0.0	0.0	7.2	8.5
60.336	20+35.19	4473	2026.82	2034.42	7.60	7.77	80.00	0.51	0	0.0	0.0	7.6	8.5
60.307	21+98.68	4473	2025.30	2034.56	9.26	6.42	80.00	0.38	0	2.0	0.0	11.3	11.7
60.298	22+48.68	4473	2024.84	2034.58	9.74	6.16	74.50	0.35	0	2.0	0.0	11.7	11.7
60.289	Swenson Street Bridge												
60.280	23+70.48	4473	2024.50	2029.32	4.82	12.46	74.50	1.00	N/A	N/A	N/A	N/A	
60.265	24+83.50	4473	2022.91	2026.63	3.72	17.17	73.33	1.61	N/A	N/A	N/A	N/A	
60.184	28+83.36	4473	2017.30	2020.57	3.27	19.53	73.33	1.95	N/A	N/A	N/A	N/A	
60.173	29+38.76	4473	2016.52	2019.84	3.32	19.51	73.33	1.82	N/A	N/A	N/A	N/A	
60.153	Flamingo Road Bridge												
60.135	31+32.51	4473	2014.46	2017.93	3.47	5.53	73.33	1.82	N/A	N/A	N/A	N/A	
60.126	31+84.67	4473	2013.74	2017.34	3.60	4.63	72.00	1.60	N/A	N/A	N/A	N/A	
60.124	31+97.37	4473	2013.61	2017.64	4.03	4.74	72.00	1.63	N/A	N/A	N/A	N/A	
60.113	32+47.23	4473	2013.11	2016.94	3.83	16.80	72.00	1.54	N/A	N/A	N/A	N/A	
60.110	32+47.23	4473	2013.11	2016.72	3.61	17.21	72.00	1.54	N/A	N/A	N/A	N/A	
60.107	32+91.34	4473	2012.67	2019.42	6.74	9.80	72.00	0.69	N/A	N/A	N/A	N/A	
60.103	33+11.34	4473	2010.67	2018.16	7.49	14.42	49.00	0.78	N/A	N/A	N/A	N/A	

TROPICANA WASH AT SWENSON STREET
PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 4
WORK MAP HEC RAS / WSPGW MODEL

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PALOS VERDES ST

FREDRIKA

SHADED ZONE X

ZONE A

FLAMINGO WASH

SWENSON ST

TIE IN

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CHANNEL

ZONE AE (REVISED AREA)

CLAYMONT ST

FLAMINGO RD

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CHANNEL

TROPICANA WASH CENTRAL BRANCH

SWENSON STREET FLOOD WALL

TROPICANA WASH CENTRAL BRANCH

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STORM DRAIN

ZONE X

SWENSON ST

ZONE AE (REVISED AREA)

SWENSON STREET FLOOD WALL

ZONE X

TIE IN

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STORM DRAIN

CHATHAM CIR

CLAYMONT ST

COTTAGE GR

ZONE X

NORTH

GRAPHIC SCALE

200 0 100 200

(IN FEET)

1 inch = 200 ft.

LEGEND

- 1% ANNUAL CHANCE (100-YEAR) FLOODPLAIN
- 1% ANNUAL CHANCE (100-YEAR) FLOODPLAIN
- 0.2% ANNUAL CHANCE (500-YEAR) FLOODPLAIN
- REMOVED FLOODPLAIN

NFIP

PANEL 2557F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2557 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2557	F

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MAP NUMBER 32003C2557F

MAP REVISED NOVEMBER 16, 2011

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

TROPICANA WASH AT SWENSON STREET

PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 5

REVISED FIRM

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PALOS VERDES ST

SWENSON ST

CLAYMONT ST

FLAMINGO RD

SWENSON ST

COTTAGE GR

CHATHAM CIR

ZONE A

FLAMINGO WASH

SHADED ZONE X

ZONE AE (REVISED AREA)

TIE IN

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CHANNEL

2019
2018
2017

SWENSON STREET FLOOD WALL

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CHANNEL

TROPICANA WASH CENTRAL BRANCH

2038 2037 2036 2035 2034 2033 2032 2034 2033

ZONE X

TIE IN

ZONE AE (REVISED AREA)

SWENSON STREET FLOOD WALL

TROPICANA WASH CENTRAL BRANCH

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STORM DRAIN

ZONE X

1% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN STORM DRAIN

ZONE X

NORTH

GRAPHIC SCALE

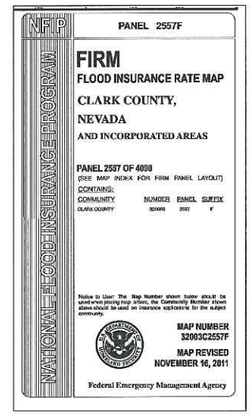
200 0 100 200

(IN FEET)

1 inch = 200 ft.

LEGEND

- 1% ANNUAL CHANCE (100-YEAR) FLOODPLAIN
- 1% ANNUAL CHANCE (100-YEAR) FLOODPLAIN
- 0.2% ANNUAL CHANCE (500-YEAR) FLOODPLAIN
- 2038 BFE (BASEFLOOD ELEVATION)


NFIP
NATIONAL FLOOD INSURANCE PROGRAM
PANEL 2557F
FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS
PANEL 2557 OF 4000
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
CLARK COUNTY 320003 2557 F
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER
32003C2557F
MAP REVISED
NOVEMBER 16, 2011
Federal Emergency Management Agency

TROPICANA WASH AT SWENSON STREET
PALOS VERDES STREET TO FLAMINGO ROAD

FIGURE 6
ANNOTATED FIRM

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
6655 S. CIMARRON ROAD · LAS VEGAS, NV 89113
T: 702.804.2000 · F: 702.804.2299 · GCWALLACE.COM

2. FEMA FORMS

MT-2 Form 1: Overview & Concurrence Form
MT-2 Form 2: Riverine Hydrology & Hydraulics Form
MT-2 Form 3: Riverine Structures Form
MT-2 Form 7 (Copy): Payment Information Form

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☒ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
32003	Clark County	NV	32003C	2557F	11/16/11

2. a. Flooding Source: Tropicana Wash - Central Branch

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Tropicana Wash at Swenson Street

4. FEMA zone designations affected: AE & X (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☒ Physical Change ☒ Improved Methodology/Data ☒ Regulatory Floodway Revision ☐ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☒ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☒ Channelization ☒ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☒ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $6,050

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

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

Name: Mona W. Stammetti	Company: Clark County Public Works Departmen	
Mailing Address: 500 S. Grand Central Pkwy Las Vegas, NV 89155-4000	Daytime Telephone No.: (702) 455-6077	Fax No.: (702)455-6113
	E-Mail Address: monas@ClarkCountyNV.gov	
Signature of Requester (required): Mona W. Stammetti	Date: 9/12/12	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Mona W. Stammetti, PE - Principal Civil Engineer	Community Name: Clark County	
Mailing Address: 500 S. Grand Central Pkwy Las Vegas, NV 89155-4000	Daytime Telephone No.: (702) 455-6077	Fax No.: (702)455-6113
	E-Mail Address: monas@ClarkCountyNV.gov	
Community Official's Signature (required): Mona W. Stammetti	Date: 9/12/12	

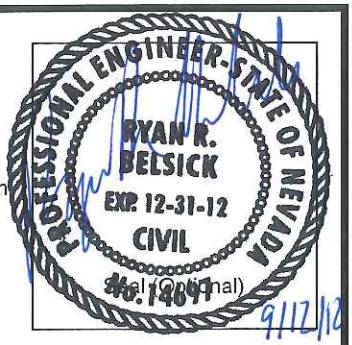
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Ryan R. Belsick, PE	License No.: 14697	Expiration Date: 12/31/10	
Company Name: G.C. Wallace, Inc.	Telephone No.: (702) 804-2129	Fax No.: (702) 804-2299	
Signature: Ryan R. Belsick	Date: 9/12/12	E-Mail Address: rbelsick@gcwallace.com	

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans



Seal (Optional)

9/12/12

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Tropicana Wash - Central Branch

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B) ☐ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model → Specify Model: _____
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	Vegas Grand Arches	33+11.34	2019.06	2018.16
Upstream Limit*	Terrible Herbst Culverts	11+00	2041.62	2038.59

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS and WSPGW

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: N/A	Plan Name: N/A	File Name: N/A	Plan Name: N/A	N/A
Corrected Effective Model*	File Name: N/A	Plan Name: N/A	File Name: N/A	Plan Name: N/A	N/A
Existing or Pre-Project Conditions Model	File Name: WSPG.WSW	Plan Name: N/A	File Name: N/A	Plan Name: N/A	N/A
Revised or Post-Project Conditions Model	File Name:	Plan Name: N/A	File Name: TWCLOMR.prj	Plan Name: CLOMR FINAL	NAVD88
Other - (attach description)	File Name: VGCT2ANEW.WSW	Plan Name: N/A	File Name: Trop-LOMR100.WSW	Plan Name: N/A	NAVD88

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A certified topographic work map must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: Topography / Survey

Source: AeroTech Mapping / GC Wallace Survey Date: January 2008 / 2008-2011

Accuracy: See Attached.

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

      - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
      - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☐ No

      If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☒ Yes ☐ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☐ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

MT-2 FORM 2 ATTACHMENT

MT-2 Form 2

B. #4 – The "Effective Model" for the Hard Rock (LOMR Case No. 07-09-11479P, dated Feb 18, 2008) used a flowrate of 4,473 cfs, but has an incorrect flowline elevation at the outlet of the existing Terrible Herbst Culverts (upstream end of project) (WSPG.WSW). The "Effective Model" for the Vegas Grand (LOMR Case No. 06-09-BC35P, dated Oct 24, 2006), used a flowrate higher than the Hard Rock (LOMR Case No. 07-09-11479 dated Feb 18, 2008) for the existing Vegas Grand Arches(downstream end of project) (VGCT2ANEW.WSW). Additionally, no man-made physical changes were made since the date of the effective Hard Rock and Vegas Grand LOMR's; therefore, no "Duplicate", "Corrected" or "Existing" Model has been included. Model "TWCLOMR.prj" is a hydraulic model of the proposed LOMR flows from the Terrible Herbst Culverts through the Swenson Street Bridge. Model "Trop-LOMR100.WSW" is a hydraulic model of the proposed closed conduit from the Terrible Herbst Culverts to the Vegas Grand Arches.

C. This is to certify that all work accomplished in the conduct of this CLOMR was done in accordance with the Statement of Work and General Provisions of Contract 500.881, and all amendments thereto, together with all such modifications, either written or oral, as the Regional PO and/or the Contracting Officer or their representatives have directed, such as modifications affecting this contract, and that all such work has been accomplished in accordance with sound and accepted engineering practices within the contract provisions for respective phases of work. Topographic data on base maps, work maps, cross section maps, and exhibits is certified to represent existing conditions and to be accurate to the best of my knowledge as per Volume 2, Section 2.1.5 Guidelines and Specifications for Flood Hazard Mapping Partners, FEMA, April 2003.

Ryan Belsick, PE – Vice President
G. C. WALLACE, INC.

C. Accuracy – Topography: Aero Tech Mapping, January 2008, Project accuracy to conform to generally accepted Class I. Photogrammetric Standards established by American Society of Photogrammetric & Remote Sensing (ASPRS).

C. Accuracy – Survey: G.C. Wallace Survey, 2008-2011, Project accuracy +/- 0.03 feet horizontal, +/- 0.07 feet vertical @ 95% confidence.

D. #4 – Clark County has obtained the Section 10 Incidental Take Permit from U.S. Fish and Wildlife for all land disturbance conducted by local government on non-Federal land. The attached Incidental Take Permit is the demonstration of Endangered Species Act (ESA) compliance as the Incidental Take Permit issued by U.S. Fish and Wildlife indicated "non-Federal lands in Clark County Nevada, for cities and Clark County". The proposed flood control project is one of the "Covered Activities". Permits for construction within the Flood Zone will not be allowed until receipt of the CLOMR from FEMA. Supporting information including additional compliance permits and environmental studies have also been included with this document in the attached Supporting Documentation 4.4.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Tropicana Wash - Central Branch

Note: Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Tropicana Wash Concrete Channel

   Type (check one): ☒ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Terrible Herbst Culverts (west end of project) to Swenson Street Bridge

   Downstream Limit/Cross Section: 22+48.68

   Upstream Limit/Cross Section: 11+00.00

2. Name of Structure: DRI Bridge

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: West end of the Desert Resarch Institute Buildings and Tropicana Wash

   Downstream Limit/Cross Section: 19+85.19

   Upstream Limit/Cross Section: 19+47.05

3. Name of Structure: Swenson Street Bridge

   Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: Swenson Street and the Tropicana Wash

   Downstream Limit/Cross Section: 23+70.48

   Upstream Limit/Cross Section: 22+48.68

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Tropicana Wash - Central Branch

Name of Structure: Structures #1, #5, #6, #7, and #9

1. Hydraulic Considerations

The channel was designed to carry 4473 (cfs) and/or the 100-year flood.

The design elevation in the channel is based on (check one):

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

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☒ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☒ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☒ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Tropicana Wash - Central Branch

Name of Structure: Structures #2, #3 and #8

1. This revision reflects (check one):

☐ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☒ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS/ WSPG
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☒ Dimensions (height, width, span, radius, length)

☒ Shape (culverts only)

☒ Material

☒ Beveling or Rounding

☒ Wing Wall Angle

☒ Skew Angle

☒ Distances Between Cross Sections

☒ Erosion Protection

☒ Low Chord Elevations – Upstream and Downstream

☒ Top of Road Elevations – Upstream and Downstream

☒ Structure Invert Elevations – Upstream and Downstream

☒ Stream Invert Elevations – Upstream and Downstream

☒ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: _____
Name of Structure: _____

1. This request is for (check one): ☐ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin

2. The dam/basin was designed by (check one): ☐ Federal agency ☐ State agency ☐ Private organization ☐ Local government agency

   Name of the agency or organization: _____

3. The Dam was permitted as (check one): ☐ Federal Dam ☐ State Dam

   Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

   Permit or ID number _____ Permitting Agency or Organization _____

   a. ☐ Local Government Dam ☐ Private Dam

   Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

FREQUENCY (% annual chance)	Stillwater Elevation Behind the Dam/Basin FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one): ☐ upgrading of an existing levee/floodwall system ☒ a newly constructed levee/floodwall system ☐ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☐ earthen embankment, dike, berm, etc.	Station _____ to _____
☒ structural floodwall	Station 21+78.56 to 22+87.77
☐ Other (describe):	Station _____ to _____

c. Structural Type (check one): ☒ monolithic cast-in place reinforced concrete ☐ reinforced concrete masonry block ☐ sheet piling ☐ Other (describe): _____

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☒ No

If Yes, by which agency? _____

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

1. Plan of the levee embankment and floodwall structures. Sheet Numbers: C2, C16, S3 & S6
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers: C2
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. Sheet Numbers: C2
4. A layout detail for the embankment protection measures. Sheet Numbers: _____
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, Floodwall structure, closure structures, and pump stations. Sheet Numbers: _____

2. Freeboard

a. The minimum freeboard provided above the BFE is:

4-feet

Riverine

3.0 feet or more at the downstream end and throughout	☐ Yes	☒ No
3.5 feet or more at the upstream end	☐ Yes	☒ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☒ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater).	☐ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation	☐ Yes	☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☒ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☒ does not exist

If opening exists, list all closures:

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

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

Note: Geotechnical and geologic data

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

4. Embankment Protection

a. The maximum levee slope land side is: 3:1

b. The maximum levee slope flood side is: 0:1

c. The range of velocities along the levee during the base flood is: 7.8 fps (min.) to 6.4 fps (max.)

d. Embankment material is protected by (describe what kind): monolithic cast in place reinforced concrete

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

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

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

f. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:

_____

☐ Overall height: Sta.: _____, height _____ ft.

☐ Limiting foundation soil strength:

Strength ϕ = _____ degrees, c = _____ psf

Slope: SS = _____ (h) to _____ (v)

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

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):

_____

c. Summary of stability analysis results:

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

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

(Reference: USACE EM-1110-2-1913 Table 6-1)

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

If Yes, describe methodology used:

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

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

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

h. The duration of the base flood hydrograph against the embankment is _____ hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☒ Other (specify): IBC 2009

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = 40 psf; P_p = 250 psf

☒ Surcharge-Slope @ _____, ☒ surface 100 psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☒ Earthquake @ P_{eq} = 0.20 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

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

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5	3.40	1.60	3.43	1.58
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3	2.46	1.34	2.46	1.31

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)
Note: (Extend table on an added sheet as needed and reference)

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability (continued)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum	1011	1380
Maximum allowable	2500	3333.3

f. Foundation scour protection ☐ is, ☒ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No

b. The computed range of settlement is 0.04 ft. to 0.08 ft.

c. Settlement of the levee crest is determined to be primarily from : ☒ Foundation consolidation ☐ Embankment compression ☐ Other (Describe): _____

d. Differential settlement of floodwalls ☒ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage

a. Specify size of each interior watershed:

Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☐ No
Ponding elevation vs. gravity flow	☐ Yes	☐ No
Differential head vs. gravity flow	☐ Yes	☐ No

c. The river flow duration curve is enclosed: ☐ Yes ☐ No

d. Specify the discharge capacity of the head pressure conduit: _____ cfs

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☐ Yes	☐ No
• Common storm (River Watershed)	☐ Yes	☐ No
• Historical ponding probability	☐ Yes	☐ No
• Coastal wave overtopping	☐ Yes	☐ No

If No for any of the above, attach explanation.

e. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is _____ cfs

h. The length of levee system used to drive this seepage rate in item g: _____ ft.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☐ Yes ☐ No

If Yes, include the number of pumping plants: _____ For each pumping plant, list:

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

Will the operation be automatic? ☐ Yes ☐ No

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

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

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

9. Other Design Criteria

a. The following items have been addressed as stated:

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

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

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☒ No Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☒ No
If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why sediment transport was not considered.

10. Operational Plan And Criteria

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☒ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
☐ Yes ☒ No

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
☐ Yes ☒ No If the answer is No to any of the above, please attach supporting documentation.

E. LEVEE/FLOODWALL (CONTINUED)

11. Maintenance Plan

Please attach a copy of the fomal maintenance plan for the levee/floodwall

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

CERTIFICATION OF THE LEVEE DOCUMENTION

This certification is to be signed and sealed by a licensed registered professional engineer authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.10(e) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: _____ License No.: _____ Expiration Date: _____

Company Name: _____ Telephone No.: _____ Fax No.: _____

Signature: _____ Date: _____ E-Mail Address: _____

F. SEDIMENT TRANSPORT

Flooding Source: _____

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport: _____

Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

MT-2 FORM 3 ATTACHMENT

MT-2 Form 3

A. **#4 – Name of Structure:** Swenson Street Concrete Floodwall
Type: Floodwall
Location of Structure: Upstream of Swenson Street Bridge
Downstream Limit/Cross Section: 22+87.77
Upstream Limit/Cross Section: 21+78.56

A. **#5 – Name of Structure:** Swenson Street Transition Structure
Type: Channelization
Location of Structure: Downstream of Swenson Street Bridge
Downstream Limit/Cross Section: 24+83.36
Upstream Limit/Cross Section: 23+70.48

A. **#6 – Name of Structure:** (5) 14' x 5' Reinforced Concrete Box
Type: Channelization
Location of Structure: Downstream of Swenson Street Transition Structure to Flamingo Road Bridge
Downstream Limit/Cross Section: 28+83.50
Upstream Limit/Cross Section: 24+83.36

A. **#7 – Name of Structure:** Flamingo Road Transition Structure
Type: Channelization
Location of Structure: Upstream of the Flamingo Road Bridge
Downstream Limit/Cross Section: 29+38.76
Upstream Limit/Cross Section: 28+83.36

A. **#8 – Name of Structure:** Flamingo Road Bridge Expansion
Type: Bridge/Culvert
Location of Structure: Flamingo Road and Tropicana Wash
Downstream Limit/Cross Section: 31+32.51
Upstream Limit/Cross Section: 29+38.76

A. **#9 – Name of Structure:** Vegas Grand Channel
Type: Channelization
Location of Structure: Downstream of the Flamingo Road Bridge Expansion
Downstream Limit/Cross Section: 33+11.34
Upstream Limit/Cross Section: 31+32.51

B. #1 – The "Effective Model" for the Hard Rock (LOMR Case No. 07-09-11479P, dated Feb 18, 2008) used a flowrate of 4,473 cfs, but has an incorrect flowline elevation at the outlet of the existing Terrible Herbst

Culverts (upstream end of project). The "Effective Model" for the Vegas Grand (LOMR Case No. 06-09-BC35P, dated Oct 24, 2006), used a flowrate higher than the Hard Rock (LOMR Case No. 07-09-11479 dated Feb 18, 2008) for the existing Vegas Grand Arches(downstream end of project). Additionally, no man-made physical changes were made since the date of the effective Hard Rock and Vegas Grand LOMR's; therefore, no "Duplicate", "Corrected" or "Existing" Model has been included. Model "TWCLOMR.prj" is a hydraulic model of the proposed LOMR flows from the Terrible Herbst Culverts through the Swenson Street Bridge. Model "Trop-LOMR100.WSW" is a hydraulic model of the proposed closed conduit from the Terrible Herbst Culverts to the Vegas Grand Arches.

B. #4 – The overall design is a closed conduit system upstream and downstream of the proposed Tropicana Wash improvements. Because there is no opportunity for sediment to build up inside the proposed system, sedimentation was not considered for design.

C. #2 – The computer program *Water Surface and Pressure Gradient Hydraulic Analysis System* (WSPGW) as written for use by the Los Angeles County Flood Control District was utilized to evaluate the water surface profile through the proposed storm drain system from the Swenson Street Bridge to the Vegas Grand Arches. The WSPGW computer program was selected in lieu of HEC-RAS because its modeling approach for storm drain systems is more relevant, however a comparison to the HEC-RAS model results has been included.

C. #4 – The overall design is a closed conduit system upstream and downstream of the proposed Tropicana Wash improvements. Because there is no opportunity for sediment to build up inside the proposed system, sedimentation was not considered for design.

E. #2a – The overall design is an open channel system that contains the LOMR flowrate of 4,473 cfs from the Hard Rock (LOMR Case No. 07-09-11479P, dated Feb 18, 2008). The channel walls are above the adjacent finished grade; therefore, the left and right channel walls are considered a levee/floodwall. A minimum of 4-feet of freeboard as described in the NFIP regulations has been provided for the LOMR flows.

E. #4e – Not applicable for monolithic cast in place reinforced concrete floodwall.

E. #4g – Not applicable.

E. #5 – Not applicable.

E. #6d – Columns 1 &2 from Stations 21+57.56 to 21+78.56. Columns 3 &4 from Stations 21+78.56 to 22+87.77.
E. #6f – Concrete Lined Channel prevents scour at floodwall.
E. #8 – Not applicable.
E. #9c – The floodwall provided will provide additional protection along the Tropicana Wash.
E. #9d – The overall design is a closed conduit system upstream and downstream of the proposed Tropicana Wash improvements. Because there is no opportunity for sediment to build up inside the proposed system, sedimentation was not considered for design.

FEDERAL EMERGENCY MANAGEMENT AGENCY

PAYMENT INFORMATION FORM

Community Name: Clark County

Project Identifier: Tropicana Wash at Swenson Street

THIS FORM MUST BE MAILED, ALONG WITH THE APPROPRIATE FEE, TO THE ADDRESS BELOW OR FAXED TO THE FAX NUMBER BELOW.

Type of Request:

☐ MT-1 application
☒ MT-2 application

LOMC Clearinghouse
7390 Coca Cola Drive
Suite 204
Hanover, MD 21076

☐ EDR application

FEMA Project Library
847 South Pickett St.
Alexandria, VA 22304
FAX (703) 212-4090

Request No.: _____ (if known)

Amount: $6,050.00

☐ INITIAL FEE* ☒ FINAL FEE ☐ FEE BALANCE** ☐ MASTER CARD ☐ VISA ☒ CHECK ☐ MONEY ORDER

*Note: Check only for EDR and/or Alluvial Fan requests (as appropriate).

**Note: Check only if submitting a corrected fee for an ongoing request.

COMPLETE THIS SECTION ONLY IF PAYING BY CREDIT CARD

CARD NUMBER

☐☐☐☐ — ☐☐☐☐ — ☐☐☐☐ — ☐☐☐☐

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

EXP. DATE

☐☐ — ☐☐

Month Year

_____ _____

Date Signature

NAME *(AS IT APPEARS ON CARD)*: _____
(please print or type)

ADDRESS: _____
(for your credit card receipt-please print or type) _____

DAYTIME PHONE: _____

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P.O. Box 990
Las Vegas, NV 89125-0990
94-77/1224

101656

September 14, 2012

Details on back.

AMOUNT

Six Thousand Fifty and 00/100 Dollars

PAY TO THE ORDER OF National Flood Insurance Program

VOID AFTER 180 DAYS

6,050.00

James A Duddleston MP

MP

MP

Security Features Included.

DOCUMENT INCLUDES A HIDDEN WORD. DO NOT CASH IF THE WORD VOID IS VISIBLE. ALSO INCLUDES AN ORIGINAL WATERMARK

⑈101656⑈ ⑆122400779⑆ 055202328⑈

G.C. WALLACE, INC. - Engineers | Planners | Surveyors - 1555 S. Rainbow Blvd. - Las Vegas, Nevada 89146

101656

Check Date: 9/14/2012

Invoice Number	Date	Voucher	Amount	Discounts	Previous Pay	Net Amount
RB500881	9/13/2012	000000140383	6,050.00			6,050.00
National Flood Insurance Program		TOTAL	6,050.00			6,050.00
110101	1	10237				

101656

3.1 HYDRAULIC MODELING COMPUTATIONS

HEC-RAS Model: Tropicana Wash through Swenson Street Bridge
WSPGW Model: Tropicana Wash to Vegas Grand Arches
Hydraulic Models Results Summary: Table 1, HEC-RAS and WSPGW
Hydraulic Models Results Summary: Table 2, Super-Elevation

HEC-RAS Version 4.0.0 March 2008
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

****

PROJECT DATA
Project Title: Tropicana Wash - CLOMR - Final
Project File : TWCLOMR.prj
Run Date and Time: 7/13/2012 8:12:42 PM

Project in English units

Project Description:
Terribles Culverts to DS end of Swenson Street Bridge

****

PLAN DATA

Plan Title: CLOMR FINAL
Plan File : F:\Projects\500\500-881\Calc\Hydro\CLOMR\HEC-RAS\FINAL\TWCLOMR.p15

Geometry Title: CLOMR - FINAL
Geometry File : F:\Projects\500\500-881\Calc\Hydro\CLOMR\HEC-RAS\FINAL\TWCLOMR.g09

Flow Title : LOMR Only
Flow File : F:\Projects\500\500-881\Calc\Hydro\CLOMR\HEC-RAS\FINAL\TWCLOMR.f01

Plan Summary Information:
Number of: Cross Sections = 11 Multiple Openings = 0
Culverts = 0 Inline Structures = 0
Bridges = 2 Lateral Structures = 0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

****

FLOW DATA

Flow Title: LOMR Only
Flow File : F:\Projects\500\500-881\Calc\Hydro\CLOMR\HEC-RAS\FINAL\TWCLOMR.f01

Flow Data (cfs)

River	Reach	RS	PF 1
Reach #1	Terribles RCB to	60.505	4473

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Reach #1	Terribles RCB to	PF 1	Normal S = 0.0092	Normal S = 0.014

****

GEOMETRY DATA

Geometry Title: CLOMR - FINAL
Geometry File : F:\Projects\500\500-881\Calc\Hydro\CLOMR\HEC-RAS\FINAL\TWCLOMR.g09

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to RS: 60.505

```
INPUT
Description: Sta. 11+00.00 - D.S. of Terrible's Culverts: 6- 12' x 4' RCBs
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
    1000 2045.22    1000 2036.02    1040 2035.22    1080 2036.02    1080 2045.22

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
    1000    .015    1000    .015    1080    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1000    1080            44.22   44.22   44.22            .1       .3

CROSS SECTION OUTPUT  Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 2044.10  * Element               *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    5.51  * Wt. n-Val.            *          *    0.015  *          *
* W.S. Elev (ft)         * 2038.59  * Reach Len. (ft)       *   44.22  *   44.22  *   44.22  *
* Crit W.S. (ft)         * 2040.22  * Flow Area (sq ft)     *          *  237.53  *          *
* E.G. Slope (ft/ft)     *0.009203  * Area (sq ft)          *          *  237.53  *          *
* Q Total (cfs)          * 4473.00  * Flow (cfs)            *          * 4473.00  *          *
* Top Width (ft)         *   80.00  * Top Width (ft)        *          *   80.00  *          *
* Vel Total (ft/s)       *   18.83  * Avg. Vel. (ft/s)      *          *   18.83  *          *
* Max Chl Dpth (ft)      *    3.37  * Hydr. Depth (ft)      *          *    2.97  *          *
* Conv. Total (cfs)      * 46626.0  * Conv. (cfs)           *          * 46626.0  *          *
* Length Wtd. (ft)       *   44.22  * Wetted Per. (ft)      *          *   85.15  *          *
* Min Ch El (ft)         * 2035.22  * Shear (lb/sq ft)      *          *    1.60  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s) *          *   30.18  *          *
* Frctn Loss (ft)        *          * Cum Volume (acre-ft)  *          *   10.77  *          *
* C & E Loss (ft)        *          * Cum SA (acres)        *          *    2.49  *          *
*****************************************************************************************

CROSS SECTION


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.499

INPUT
Description: Sta. 11+44.22 - PC
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
 1031.43 2044.82 1031.43 2035.64 1071.43 2034.84 1111.43 2035.64 1111.43 2044.82

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
 1031.43    .015 1031.43    .015 1111.43    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1031.43 1111.43            281.21  255.65  230.08            .1       .3

CROSS SECTION OUTPUT  Profile #PF 1
*****************************************************************************************
* E.G. Elev (ft)         * 2043.68  * Element               *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    5.45  * Wt. n-Val.            *          *    0.015  *          *
* W.S. Elev (ft)         * 2038.22  * Reach Len. (ft)       *  281.21  *  255.65  *  230.08  *
* Crit W.S. (ft)         * 2039.84  * Flow Area (sq ft)     *          *  238.75  *          *
* E.G. Slope (ft/ft)     *0.009052  * Area (sq ft)          *          *  238.75  *          *
* Q Total (cfs)          * 4473.00  * Flow (cfs)            *          * 4473.00  *          *
* Top Width (ft)         *   80.00  * Top Width (ft)        *          *   80.00  *          *
* Vel Total (ft/s)       *   18.74  * Avg. Vel. (ft/s)      *          *   18.74  *          *
* Max Chl Dpth (ft)      *    3.38  * Hydr. Depth (ft)      *          *    2.98  *          *
* Conv. Total (cfs)      * 47014.9  * Conv. (cfs)           *          * 47014.9  *          *
* Length Wtd. (ft)       *  255.65  * Wetted Per. (ft)      *          *   85.18  *          *
* Min Ch El (ft)         * 2034.84  * Shear (lb/sq ft)      *          *    1.58  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s) *          *   29.67  *          *
* Frctn Loss (ft)        *    0.40  * Cum Volume (acre-ft)  *          *   10.53  *          *
* C & E Loss (ft)        *    0.02  * Cum SA (acres)        *          *    2.41  *          *
*****************************************************************************************

CROSS SECTION


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.457

INPUT
Description: Sta. 13+99.87 - PT
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
 1031.43 2042.46 1031.43 2033.27 1071.43 2032.47 1111.43 2033.27 1111.43 2042.46

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
 1031.43    .015 1031.43    .015 1111.43    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1031.43 1111.43            497.13  497.13  497.13            .1       .3
```

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	2041.34	Element	Left OB	Channel	Right OB	
Vel Head (ft)	5.50	Wt. n-Val.		0.015		
W.S. Elev (ft)	2035.84	Reach Len. (ft)	497.13	497.13	497.13	
Crit W.S. (ft)	2037.47	Flow Area (sq ft)		237.71		
E.G. Slope (ft/ft)	*0.009180	Area (sq ft)		237.71		
Q Total (cfs)	4473.00	Flow (cfs)		4473.00		
Top Width (ft)	80.00	Top Width (ft)		80.00		
Vel Total (ft/s)	18.82	Avg. Vel. (ft/s)		18.82		
Max Chl Dpth (ft)	3.37	Hydr. Depth (ft)		2.97		
Conv. Total (cfs)	46685.1	Conv. (cfs)		46685.1		
Length Wtd. (ft)	497.13	Wetted Per. (ft)		85.16		
Min Ch El (ft)	2032.47	Shear (lb/sq ft)		1.60		
Alpha	1.00	Stream Power (lb/ft s)		30.10		
Frctn Loss (ft)	2.33	Cum Volume (acre-ft)		9.13		
C & E Loss (ft)	0.00	Cum SA (acres)		1.94		

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.359

INPUT
Description: Sta. 18+97.00 - US End of Crossfall Transition
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1008.47	2037.86	1008.47	2028.66	1048.47	2027.86	1088.47	2028.66	1088.47	2037.86

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1008.47	.015	1008.47	.015	1088.47	.015

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1008.47	1088.47	50.05 50.05	50.05	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	2036.75	Element	Left OB	Channel	Right OB	
Vel Head (ft)	5.53	Wt. n-Val.		0.015		
W.S. Elev (ft)	2031.22	Reach Len. (ft)	50.05	50.05	50.05	
Crit W.S. (ft)	2032.86	Flow Area (sq ft)		237.09		
E.G. Slope (ft/ft)	*0.009259	Area (sq ft)		237.09		
Q Total (cfs)	4473.00	Flow (cfs)		4473.00		
Top Width (ft)	80.00	Top Width (ft)		80.00		
Vel Total (ft/s)	18.87	Avg. Vel. (ft/s)		18.87		
Max Chl Dpth (ft)	3.36	Hydr. Depth (ft)		2.96		
Conv. Total (cfs)	46486.4	Conv. (cfs)		46486.4		
Length Wtd. (ft)	50.05	Wetted Per. (ft)		85.14		
Min Ch El (ft)	2027.86	Shear (lb/sq ft)		1.61		
Alpha	1.00	Stream Power (lb/ft s)		30.37		
Frctn Loss (ft)	4.58	Cum Volume (acre-ft)		6.42		
C & E Loss (ft)	0.00	Cum SA (acres)		1.03		

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.349

INPUT
Description: Sta. 19+47.05 - U.S. of DRI Swenson Bridge
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1008.59	2037.4	1008.59	2027.4	1048.09	2027.4	1087.59	2027.4	1087.59	2037.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1008.59	.015	1008.59	.015	1087.59	.015

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
1008.59	1087.59	38.14 38.14	38.14	.3	.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	2035.65	Element	Left OB	Channel	Right OB	
Vel Head (ft)	0.93	Wt. n-Val.		0.015		
W.S. Elev (ft)	2034.72	Reach Len. (ft)	0.10	0.10	0.10	
Crit W.S. (ft)	2032.03	Flow Area (sq ft)		578.56		
E.G. Slope (ft/ft)	*0.000537	Area (sq ft)		578.56		
Q Total (cfs)	4473.00	Flow (cfs)		4473.00		
Top Width (ft)	79.00	Top Width (ft)		79.00		

```
* Vel Total (ft/s)       *    7.73  * Avg. Vel. (ft/s)       *          *    7.73  *          *
* Max Chl Dpth (ft)      *    7.32  * Hydr. Depth (ft)       *          *    7.32  *          *
* Conv. Total (cfs)      *192971.8  * Conv. (cfs)            *          *192971.8  *          *
* Length Wtd. (ft)       *    0.10  * Wetted Per. (ft)       *          *   93.65  *          *
* Min Ch El (ft)         * 2027.40  * Shear (lb/sq ft)       *          *    0.21  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s) *          *    1.60  *          *
* Frctn Loss (ft)        *          * Cum Volume (acre-ft)   *          *    5.95  *          *
* C & E Loss (ft)        *          * Cum SA (acres)         *          *    0.94  *          *
*********************************************************************************************

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.
Note:    Hydraulic jump has occurred between this cross section and the previous upstream section.

BRIDGE


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.3445

INPUT
Description: Desert Research Institute Swenson Street Bridge:
6 - 12.62' x 8'
             RCBs
Distance from Upstream XS =      .1
Deck/Roadway Width        =    36.1
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=        5
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*****************************************************************************
    1000 2039.65       0 1008.09 2039.65  2035.4 1051.72 2039.65  2035.4
 1088.09 2039.65  2035.4 1093.56 2039.65       0

Upstream Bridge Cross Section Data
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
 1008.59  2037.4 1008.59  2027.4 1048.09  2027.4 1087.59  2027.4 1087.59  2037.4

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
 1008.59    .015 1008.59    .015 1087.59    .015

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1008.59 1087.59             .3       .5

Downstream  Deck/Roadway Coordinates
    num=        5
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
*****************************************************************************
    1000  2039.9       0 1005.64  2039.9 2035.27 1072.45  2039.9 2035.27
 1085.64  2039.9 2035.27 1092.75  2039.9       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
 1005.64 2037.28 1005.64 2027.28 1045.14 2027.28 1084.64 2027.28 1084.64 2037.28

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
***********************************************
 1005.64    .015 1005.64    .015 1084.64    .015

Bank Sta: Left   Right    Coeff Contr.   Expan.
       1005.64 1084.64             .3       .5

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins        = 2038.26
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Piers =  5

Pier Data
Pier Station     Upstream= 1021.47    Downstream= 1018.42
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
     .67  2027.4     .67  2035.4
Downstream   num=       2
    Width   Elev    Width   Elev
*********************************
     .67 2027.27     .67 2035.27

Pier Data
Pier Station     Upstream= 1034.76    Downstream= 1031.71
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
```

```
     .67  2027.4     .67  2035.4
Downstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67 2027.27     .67 2035.27

Pier Data
Pier Station     Upstream= 1048.05    Downstream=    1045
Upstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67  2027.4     .67  2035.4
Downstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67  2027.4     .67 2035.27

Pier Data
Pier Station     Upstream= 1061.34    Downstream= 1058.29
Upstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67  2027.4     .67  2035.4
Downstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67 2027.27     .67 2035.27

Pier Data
Pier Station     Upstream= 1074.63    Downstream= 1071.58
Upstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67  2027.4     .67  2035.4
Downstream     num=       2
    Width   Elev    Width   Elev
*******************************
     .67 2027.27     .67 2035.27

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum              Cd   =       2
       Yarnell               KVal =    1.25
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #PF 1
*********************************************************************************************
* E.G. US. (ft)          *    2035.65  * Element               *Inside BR US *Inside BR DS *
* W.S. US. (ft)          *    2034.72  * E.G. Elev (ft)        *    2035.58  *    2035.40  *
* Q Total (cfs)          *    4473.00  * W.S. Elev (ft)        *    2034.50  *    2034.30  *
* Q Bridge (cfs)         *    4473.00  * Crit W.S. (ft)        *    2032.17  *    2032.05  *
* Q Weir (cfs)           *             * Max Chl Dpth (ft)     *       7.10  *       7.02  *
* Weir Sta Lft (ft)      *             * Vel Total (ft/s)      *       8.33  *       8.42  *
* Weir Sta Rgt (ft)      *             * Flow Area (sq ft)     *     536.95  *     531.34  *
* Weir Submerg           *             * Froude # Chl          *       0.55  *       0.56  *
* Weir Max Depth (ft)    *             * Specif Force (cu ft)  *    3062.77  *    3035.40  *
* Min El Weir Flow (ft)  *    2039.91  * Hydr Depth (ft)       *       7.10  *       7.02  *
* Min El Prs (ft)        *    2035.40  * W.P. Total (ft)       *     160.82  *     159.93  *
* Delta EG (ft)          *       0.25  * Conv. Total (cfs)     *   118820.2  *   117192.3  *
* Delta WS (ft)          *       0.30  * Top Width (ft)        *      75.65  *      75.65  *
* BR Open Area (sq ft)   *     604.44  * Frctn Loss (ft)       *             *             *
* BR Open Vel (ft/s)     *       8.42  * C & E Loss (ft)       *             *             *
* Coef of Q              *             * Shear Total (lb/sq ft) *       0.30  *       0.30  *
* Br Sel Method          *   Momentum  * Power Total (lb/ft s)  *       2.46  *       2.54  *
*********************************************************************************************

Note:    Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow.
         The Yarnell answer has been disregarded.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional cross sections.
Warning: Critical depth could not be determined within the specified number of iterations.  The program
         used the iteration with the lowest energy.

CROSS SECTION


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.344

INPUT
Description: Sta. 19+85.19 - D.S. of DRI Swenson Bridge
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
```

```
*****************************************************************************
 1005.64 2037.28 1005.64 2027.28 1045.14 2027.28 1084.64 2027.28 1084.64 2037.28

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
 1005.64    .015 1005.64    .015 1084.64    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1005.64 1084.64               50      50      50             .3      .5

CROSS SECTION OUTPUT  Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)         * 2035.40  * Element               *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.98  * Wt. n-Val.            *          *    0.015  *          *
* W.S. Elev (ft)         * 2034.43  * Reach Len. (ft)       *   50.00  *   50.00  *   50.00  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)     *          *  564.43  *          *
* E.G. Slope (ft/ft)     *0.000581  * Area (sq ft)          *          *  564.43  *          *
* Q Total (cfs)          * 4473.00  * Flow (cfs)           *          * 4473.00  *          *
* Top Width (ft)         *   79.00  * Top Width (ft)       *          *   79.00  *          *
* Vel Total (ft/s)       *    7.92  * Avg. Vel. (ft/s)     *          *    7.92  *          *
* Max Chl Dpth (ft)      *    7.14  * Hydr. Depth (ft)     *          *    7.14  *          *
* Conv. Total (cfs)      *185650.6  * Conv. (cfs)          *          *185650.6  *          *
* Length Wtd. (ft)       *   50.00  * Wetted Per. (ft)     *          *   93.29  *          *
* Min Ch El (ft)         * 2027.28  * Shear (lb/sq ft)     *          *    0.22  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s) *          *    1.74  *          *
* Frctn Loss (ft)        *    0.03  * Cum Volume (acre-ft)  *          *    5.48  *          *
* C & E Loss (ft)        *    0.02  * Cum SA (acres)        *          *    0.87  *          *
*************************************************************************************************

CROSS SECTION


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.336

INPUT
Description: Sta. 20+35.19 - DS End of Crossfall Transition
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
 1010.84 2036.82 1010.84 2027.62 1050.84 2026.82 1090.84 2027.62 1090.84 2036.82

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
 1010.84    .015 1010.84    .015 1090.84    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1010.84 1090.84           163.49  163.49  163.49             .1      .3

CROSS SECTION OUTPUT  Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)         * 2035.35  * Element               *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.94  * Wt. n-Val.            *          *    0.015  *          *
* W.S. Elev (ft)         * 2034.42  * Reach Len. (ft)       *  163.49  *  163.49  *  163.49  *
* Crit W.S. (ft)         *          * Flow Area (sq ft)     *          *  575.61  *          *
* E.G. Slope (ft/ft)     *0.000546  * Area (sq ft)          *          *  575.61  *          *
* Q Total (cfs)          * 4473.00  * Flow (cfs)           *          * 4473.00  *          *
* Top Width (ft)         *   80.00  * Top Width (ft)       *          *   80.00  *          *
* Vel Total (ft/s)       *    7.77  * Avg. Vel. (ft/s)     *          *    7.77  *          *
* Max Chl Dpth (ft)      *    7.60  * Hydr. Depth (ft)     *          *    7.20  *          *
* Conv. Total (cfs)      *191385.5  * Conv. (cfs)          *          *191385.5  *          *
* Length Wtd. (ft)       *  163.49  * Wetted Per. (ft)     *          *   93.61  *          *
* Min Ch El (ft)         * 2026.82  * Shear (lb/sq ft)     *          *    0.21  *          *
* Alpha                  *    1.00  * Stream Power (lb/ft s) *          *    1.63  *          *
* Frctn Loss (ft)        *    0.06  * Cum Volume (acre-ft)  *          *    4.83  *          *
* C & E Loss (ft)        *    0.09  * Cum SA (acres)        *          *    0.78  *          *
*************************************************************************************************

CROSS SECTION


RIVER: Reach #1
REACH: Terribles RCB to   RS: 60.307

INPUT
Description: Sta. 21+98.68 - US End of Crossfall Transition
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*****************************************************************************
 1036.07  2035.3 1036.07  2026.4 1076.07  2025.3 1116.07  2026.4 1116.07  2035.3

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
 1036.07    .015 1036.07    .015 1116.07    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       1036.07 1116.07            88.97      50    7.86             .1      .3

CROSS SECTION OUTPUT  Profile #PF 1
*************************************************************************************************
* E.G. Elev (ft)         * 2035.20  * Element               *  Left OB *  Channel * Right OB *
* Vel Head (ft)          *    0.64  * Wt. n-Val.            *          *    0.015  *          *
```

* W.S. Elev (ft)	* 2034.56	* Reach Len. (ft)	* 88.97	* 50.00	* 7.86	*
* Crit W.S. (ft)	*	* Flow Area (sq ft)	*	* 696.67	*	*
* E.G. Slope (ft/ft)	*0.000300	* Area (sq ft)	*	* 696.67	*	*
* Q Total (cfs)	* 4473.00	* Flow (cfs)	*	* 4473.00	*	*
* Top Width (ft)	* 80.00	* Top Width (ft)	*	* 80.00	*	*
* Vel Total (ft/s)	* 6.42	* Avg. Vel. (ft/s)	*	* 6.42	*	*
* Max Chl Dpth (ft)	* 9.26	* Hydr. Depth (ft)	*	* 8.71	*	*
* Conv. Total (cfs)	*258064.5	* Conv. (cfs)	*	*258064.5	*	*
* Length Wtd. (ft)	* 50.00	* Wetted Per. (ft)	*	* 96.35	*	*
* Min Ch El (ft)	* 2025.30	* Shear (lb/sq ft)	*	* 0.14	*	*
* Alpha	* 1.00	* Stream Power (lb/ft s)	*	* 0.87	*	*
* Frctn Loss (ft)	* 0.01	* Cum Volume (acre-ft)	*	* 2.44	*	*
* C & E Loss (ft)	* 0.02	* Cum SA (acres)	*	* 0.48	*	*

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to RS: 60.298

INPUT
Description: Sta. 22+48.68 - U.S. Swenson Street Bridge
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
713.75	2034.84	713.75	2024.84	751	2024.84	788.25	2024.84	788.25	2034.84

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
713.75	.015	713.75	.015	788.25	.015

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

Left	Right	Left	Channel	Right	Coeff Contr.	Expan.
713.75	788.25	121.8	121.8	121.8	.3	.5

Skew Angle = 41.5

CROSS SECTION OUTPUT Profile #PF 1

* E.G. Elev (ft)	* 2035.17	* Element	* Left OB	* Channel	* Right OB	*
* Vel Head (ft)	* 0.59	* Wt. n-Val.	*	* 0.015	*	*
* W.S. Elev (ft)	* 2034.58	* Reach Len. (ft)	* 0.10	* 0.10	* 0.10	*
* Crit W.S. (ft)	* 2029.66	* Flow Area (sq ft)	*	* 725.63	*	*
* E.G. Slope (ft/ft)	*0.000254	* Area (sq ft)	*	* 725.63	*	*
* Q Total (cfs)	* 4473.00	* Flow (cfs)	*	* 4473.00	*	*
* Top Width (ft)	* 74.50	* Top Width (ft)	*	* 74.50	*	*
* Vel Total (ft/s)	* 6.16	* Avg. Vel. (ft/s)	*	* 6.16	*	*
* Max Chl Dpth (ft)	* 9.74	* Hydr. Depth (ft)	*	* 9.74	*	*
* Conv. Total (cfs)	*280805.1	* Conv. (cfs)	*	*280805.1	*	*
* Length Wtd. (ft)	* 0.10	* Wetted Per. (ft)	*	* 93.98	*	*
* Min Ch El (ft)	* 2024.84	* Shear (lb/sq ft)	*	* 0.12	*	*
* Alpha	* 1.00	* Stream Power (lb/ft s)	*	* 0.75	*	*
* Frctn Loss (ft)	*	* Cum Volume (acre-ft)	*	* 1.63	*	*
* C & E Loss (ft)	*	* Cum SA (acres)	*	* 0.39	*	*

BRIDGE

RIVER: Reach #1
REACH: Terribles RCB to RS: 60.29

INPUT
Description: Swenson Street Bridge: 6 - 12' x 4' RCBs
Distance from Upstream XS = .1
Deck/Roadway Width = 121.2
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 4

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
713.75	2036.6 2028.84	725.33	2036.6 2028.84	763.83	2036.6 2028.84
788.25	2036.6 2028.84				

Upstream Bridge Cross Section Data
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
713.75	2034.84	713.75	2024.84	751	2024.84	788.25	2024.84	788.25	2034.84

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
713.75	.015	713.75	.015	788.25	.015

Bank Sta: Left Right Coeff Contr. Expan.

Left	Right	Coeff Contr.	Expan.
713.75	788.25	.3	.5

Skew Angle = 41.5

Downstream Deck/Roadway Coordinates
num= 4

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
713.75	2036.6 2028.5	725.33	2036.6 2028.5	763.83	2036.6 2028.5
788.25	2036.6 2028.5				

```
Downstream Bridge Cross Section Data
Station Elevation Data    num=       5
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
*********************************************************************************
  713.75  2029.5  713.75  2024.5     751  2024.5  788.25  2024.5  788.25  2029.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
*********************************************
  713.75    .015  713.75    .015  788.25    .015

Bank Sta: Left   Right    Coeff Contr.   Expan.
        713.75  788.25             .3       .5
Skew Angle = 41.5

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .99
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Piers =  5

Pier Data
Pier Station     Upstream=     726    Downstream=     726
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030
Downstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030

Pier Data
Pier Station     Upstream=   738.5    Downstream=   738.5
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030
Downstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030

Pier Data
Pier Station     Upstream=     751    Downstream=     751
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030
Downstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030

Pier Data
Pier Station     Upstream=   763.5    Downstream=   763.5
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030
Downstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030

Pier Data
Pier Station     Upstream=     776    Downstream=     776
Upstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030
Downstream     num=       2
    Width   Elev    Width   Elev
*********************************
      .5    2024      .5    2030

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum               Cd   =       2
       Yarnell                KVal =    1.25
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =
```

Additional Bridge Parameters
Add Friction component to Momentum
Do not add Weight component to Momentum
Class B flow critical depth computations use critical depth
inside the bridge at the upstream end
Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT Profile #PF 1

E.G. US. (ft)	2035.17	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	2034.58	E.G. Elev (ft)	2035.17	2031.73
Q Total (cfs)	4473.00	W.S. Elev (ft)	2028.84	2028.50
Q Bridge (cfs)	4473.00	Crit W.S. (ft)	2028.85	2028.51
Q Weir (cfs)		Max Chl Dpth (ft)	4.00	4.00
Weir Sta Lft (ft)		Vel Total (ft/s)	15.53	15.53
Weir Sta Rgt (ft)		Flow Area (sq ft)	288.00	288.00
Weir Submerg		Froude # Chl	1.37	1.37
Weir Max Depth (ft)		Specif Force (cu ft)	2733.49	2733.49
Min El Weir Flow (ft)	2036.61	Hydr Depth (ft)	4.00	4.00
Min El Prs (ft)	2028.84	W.P. Total (ft)	120.00	120.00
Delta EG (ft)	3.44	Conv. Total (cfs)	51141.2	51141.2
Delta WS (ft)	5.26	Top Width (ft)	72.00	72.00
BR Open Area (sq ft)	288.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	15.53	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.15	1.15
Br Sel Method	Press Only	Power Total (lb/ft s)	17.80	17.80

Note: Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow. The Yarnell answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Note: The downstream water surface is above the minimum elevation required for orifice flow. The orifice flow equation was used for pressure flow.

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to RS: 60.28

INPUT
Description: Sta. 23+70.48 - D.S. Swenson Street Bridge
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
713.75	2029.5	713.75	2024.5	751	2024.5	788.25	2024.5	788.25	2029.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
713.75	.015	713.75	.015	788.25	.015

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
713.75 788.25 113.02 113.02 113.02 .3 .5
Skew Angle = 41.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	2031.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.41	Wt. n-Val.		0.015	
W.S. Elev (ft)	2029.32	Reach Len. (ft)	113.02	113.02	113.02
Crit W.S. (ft)	2029.32	Flow Area (sq ft)		358.92	
E.G. Slope (ft/ft)	0.002287	Area (sq ft)		358.92	
Q Total (cfs)	4473.00	Flow (cfs)		4473.00	
Top Width (ft)	74.50	Top Width (ft)		74.50	
Vel Total (ft/s)	12.46	Avg. Vel. (ft/s)		12.46	
Max Chl Dpth (ft)	4.82	Hydr. Depth (ft)		4.82	
Conv. Total (cfs)	93523.0	Conv. (cfs)		93523.0	
Length Wtd. (ft)	113.02	Wetted Per. (ft)		84.14	
Min Ch El (ft)	2024.50	Shear (lb/sq ft)		0.61	
Alpha	1.00	Stream Power (lb/ft s)		7.59	
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)		0.82	
C & E Loss (ft)	0.01	Cum SA (acres)		0.19	

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Reach #1
REACH: Terribles RCB to RS: 60.265

INPUT
Description: Sta. 24+83.50
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

964 2027.91 964 2022.91 1000 2022.91 1037.33 2022.91 1037.33 2027.91

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
964	.015	964	.015	1037.33	.015

Bank Sta: Left Right Coeff Contr. Expan.
964 1037.33 .1 .3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	2030.81	Element	Left OB	Channel	Right OB
Vel Head (ft)	4.19	Wt. n-Val.		0.015	
W.S. Elev (ft)	2026.62	Reach Len. (ft)			
Crit W.S. (ft)	2027.76	Flow Area (sq ft)		272.28	
E.G. Slope (ft/ft)	0.005439	Area (sq ft)		272.28	
Q Total (cfs)	4473.00	Flow (cfs)		4473.00	
Top Width (ft)	73.33	Top Width (ft)		73.33	
Vel Total (ft/s)	16.43	Avg. Vel. (ft/s)		16.43	
Max Chl Dpth (ft)	3.71	Hydr. Depth (ft)		3.71	
Conv. Total (cfs)	60649.0	Conv. (cfs)		60649.0	
Length Wtd. (ft)		Wetted Per. (ft)		80.76	
Min Ch El (ft)	2022.91	Shear (lb/sq ft)		1.14	
Alpha	1.00	Stream Power (lb/ft s)		18.81	
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)			
C & E Loss (ft)	0.53	Cum SA (acres)			

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

SUMMARY OF MANNING'S N VALUES

River:Reach #1

Reach	River Sta.	n1	n2	n3
Terribles RCB to	60.505	.015	.015	.015
Terribles RCB to	60.499	.015	.015	.015
Terribles RCB to	60.457	.015	.015	.015
Terribles RCB to	60.359	.015	.015	.015
Terribles RCB to	60.349	.015	.015	.015
Terribles RCB to	60.3445	Bridge		
Terribles RCB to	60.344	.015	.015	.015
Terribles RCB to	60.336	.015	.015	.015
Terribles RCB to	60.307	.015	.015	.015
Terribles RCB to	60.298	.015	.015	.015
Terribles RCB to	60.29	Bridge		
Terribles RCB to	60.28	.015	.015	.015
Terribles RCB to	60.265	.015	.015	.015

SUMMARY OF REACH LENGTHS

River: Reach #1

Reach	River Sta.	Left	Channel	Right
Terribles RCB to	60.505	44.22	44.22	44.22
Terribles RCB to	60.499	281.21	255.65	230.08
Terribles RCB to	60.457	497.13	497.13	497.13
Terribles RCB to	60.359	50.05	50.05	50.05
Terribles RCB to	60.349	38.14	38.14	38.14
Terribles RCB to	60.3445	Bridge		
Terribles RCB to	60.344	50	50	50
Terribles RCB to	60.336	163.49	163.49	163.49
Terribles RCB to	60.307	88.97	50	7.86
Terribles RCB to	60.298	121.8	121.8	121.8
Terribles RCB to	60.29	Bridge		
Terribles RCB to	60.28	113.02	113.02	113.02
Terribles RCB to	60.265			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Reach #1

Reach	River Sta.	Contr.	Expan.
Terribles RCB to	60.505	.1	.3
Terribles RCB to	60.499	.1	.3
Terribles RCB to	60.457	.1	.3
Terribles RCB to	60.359	.1	.3
Terribles RCB to	60.349	.3	.5
Terribles RCB to	60.3445	Bridge	
Terribles RCB to	60.344	.3	.5

```
*Terribles RCB to*     60.336  *        .1*        .3*
*Terribles RCB to*     60.307  *        .1*        .3*
*Terribles RCB to*     60.298  *        .3*        .5*
*Terribles RCB to*     60.29   *Bridge   *          *
*Terribles RCB to*     60.28   *        .3*        .5*
*Terribles RCB to*     60.265  *        .1*        .3*
*****************************************************
```

HEC-RAS Plan: CLOMRFINAL River: Reach #1 Reach: Terribles RCB to Profile: PF 1

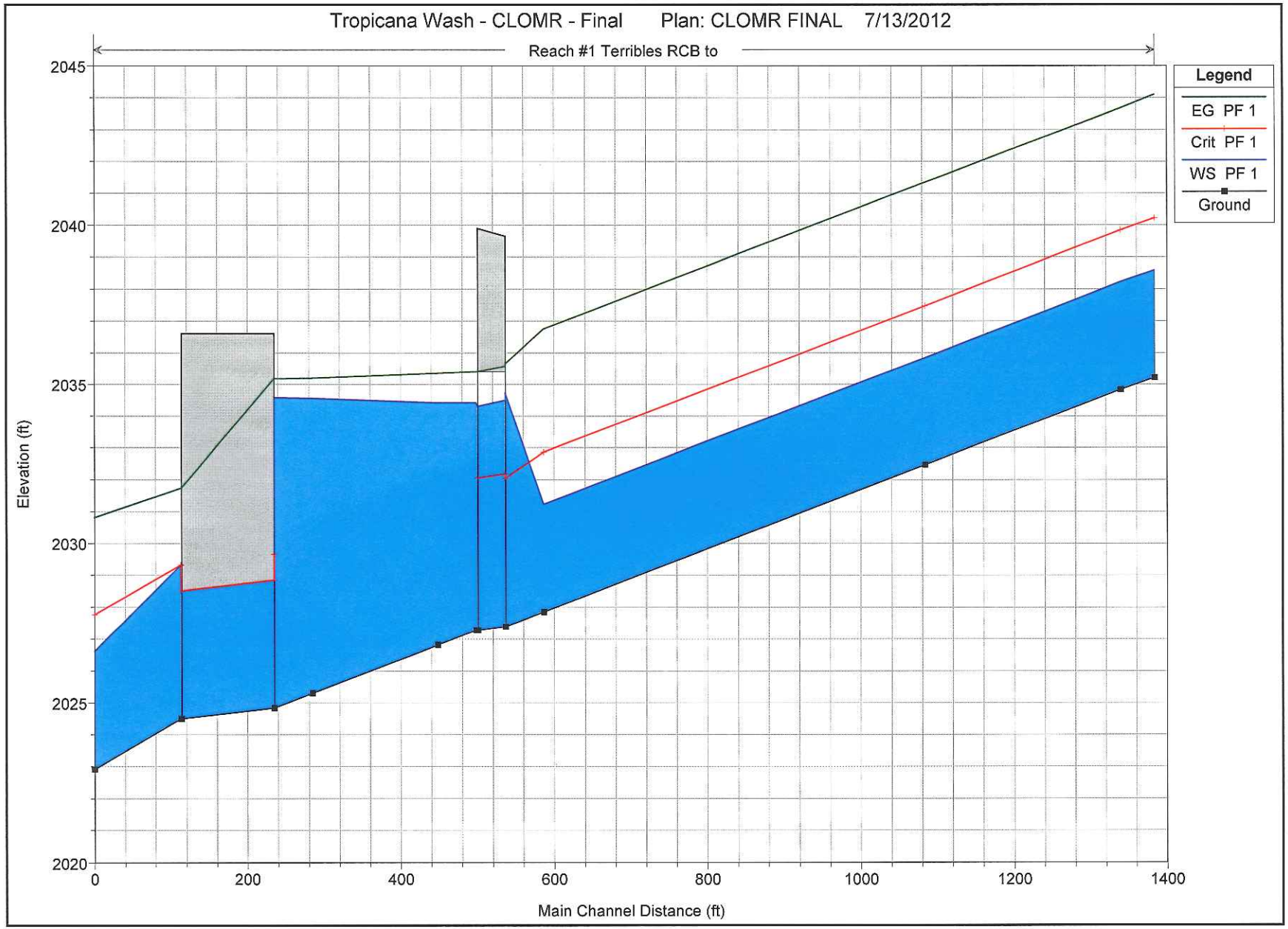
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Terribles RCB to	60.505	4473.00	2035.22	2038.59	2040.22	2044.10	0.009203	18.83	237.53	80.00	1.93
Terribles RCB to	60.499	4473.00	2034.84	2038.22	2039.84	2043.68	0.009052	18.74	238.75	80.00	1.91
Terribles RCB to	60.457	4473.00	2032.47	2035.84	2037.47	2041.34	0.009180	18.82	237.71	80.00	1.92
Terribles RCB to	60.359	4473.00	2027.86	2031.22	2032.86	2036.75	0.009259	18.87	237.09	80.00	1.93
Terribles RCB to	60.349	4473.00	2027.40	2034.72	2032.03	2035.65	0.000537	7.73	578.56	79.00	0.50
Terribles RCB to	60.3445	Bridge									
Terribles RCB to	60.344	4473.00	2027.28	2034.43		2035.40	0.000581	7.92	564.43	79.00	0.52
Terribles RCB to	60.336	4473.00	2026.82	2034.42		2035.35	0.000546	7.77	575.61	80.00	0.51
Terribles RCB to	60.307	4473.00	2025.30	2034.56		2035.20	0.000300	6.42	696.67	80.00	0.38
Terribles RCB to	60.298	4473.00	2024.84	2034.58	2029.66	2035.17	0.000254	6.16	725.63	74.50	0.35
Terribles RCB to	60.29	Bridge									
Terribles RCB to	60.28	4473.00	2024.50	2029.32	2029.32	2031.73	0.002287	12.46	358.92	74.50	1.00
Terribles RCB to	60.265	4473.00	2022.91	2026.62	2027.76	2030.81	0.005439	16.43	272.28	73.33	1.50

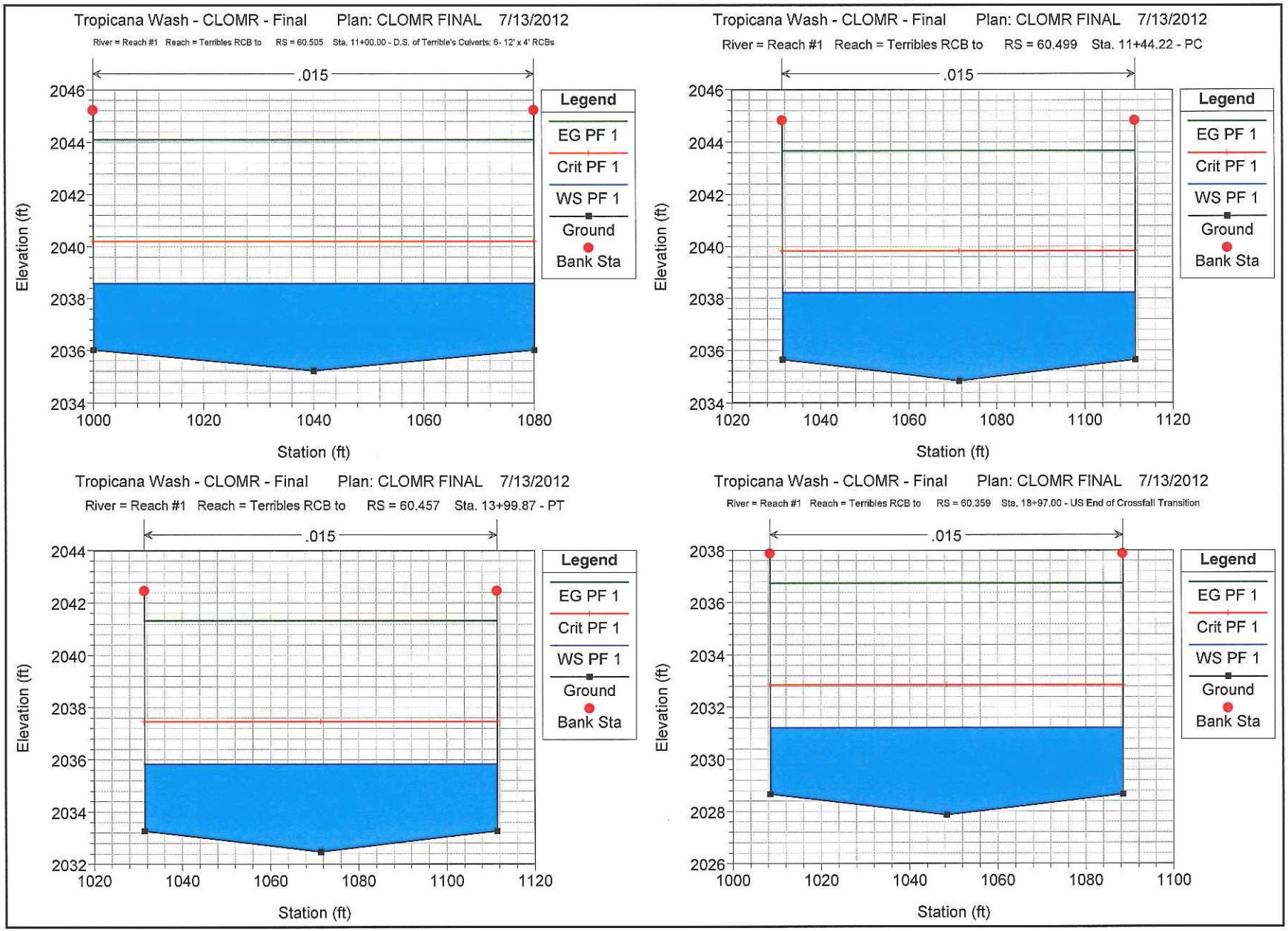
Plan: CLOMRFINAL Reach #1 Terribles RCB to RS: 60.3445 Profile: PF 1

E.G. US. (ft)	2035.65	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	2034.72	E.G. Elev (ft)	2035.58	2035.40
Q Total (cfs)	4473.00	W.S. Elev (ft)	2034.50	2034.30
Q Bridge (cfs)	4473.00	Crit W.S. (ft)	2032.17	2032.05
Q Weir (cfs)		Max Chl Dpth (ft)	7.10	7.02
Weir Sta Lft (ft)		Vel Total (ft/s)	8.33	8.42
Weir Sta Rgt (ft)		Flow Area (sq ft)	536.95	531.34
Weir Submerg		Froude # Chl	0.55	0.56
Weir Max Depth (ft)		Specif Force (cu ft)	3062.77	3035.40
Min El Weir Flow (ft)	2039.91	Hydr Depth (ft)	7.10	7.02
Min El Prs (ft)	2035.40	W.P. Total (ft)	160.82	159.93
Delta EG (ft)	0.25	Conv. Total (cfs)	118820.2	117192.3
Delta WS (ft)	0.30	Top Width (ft)	75.65	75.65
BR Open Area (sq ft)	604.44	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.42	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.30	0.30
Br Sel Method	Momentum	Power Total (lb/ft s)	2.46	2.54

Plan: CLOMRFINAL Reach #1 Terribles RCB to RS: 60.29 Profile: PF 1

E.G. US. (ft)	2035.17	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	2034.58	E.G. Elev (ft)	2035.17	2031.73
Q Total (cfs)	4473.00	W.S. Elev (ft)	2028.84	2028.50
Q Bridge (cfs)	4473.00	Crit W.S. (ft)	2028.85	2028.51
Q Weir (cfs)		Max Chl Dpth (ft)	4.00	4.00
Weir Sta Lft (ft)		Vel Total (ft/s)	15.53	15.53
Weir Sta Rgt (ft)		Flow Area (sq ft)	288.00	288.00
Weir Submerg		Froude # Chl	1.37	1.37
Weir Max Depth (ft)		Specif Force (cu ft)	2733.49	2733.49
Min El Weir Flow (ft)	2036.61	Hydr Depth (ft)	4.00	4.00
Min El Prs (ft)	2028.84	W.P. Total (ft)	120.00	120.00
Delta EG (ft)	3.44	Conv. Total (cfs)	51141.2	51141.2
Delta WS (ft)	5.26	Top Width (ft)	72.00	72.00
BR Open Area (sq ft)	288.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	15.53	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.15	1.15
Br Sel Method	Press Only	Power Total (lb/ft s)	17.80	17.80


Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
Reach #1 Terribles RCB to
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Elevation (ft)
2045
2040
2035
2030
2025
2020
0
200
400
600
800
1000
1200
1400
Main Channel Distance (ft)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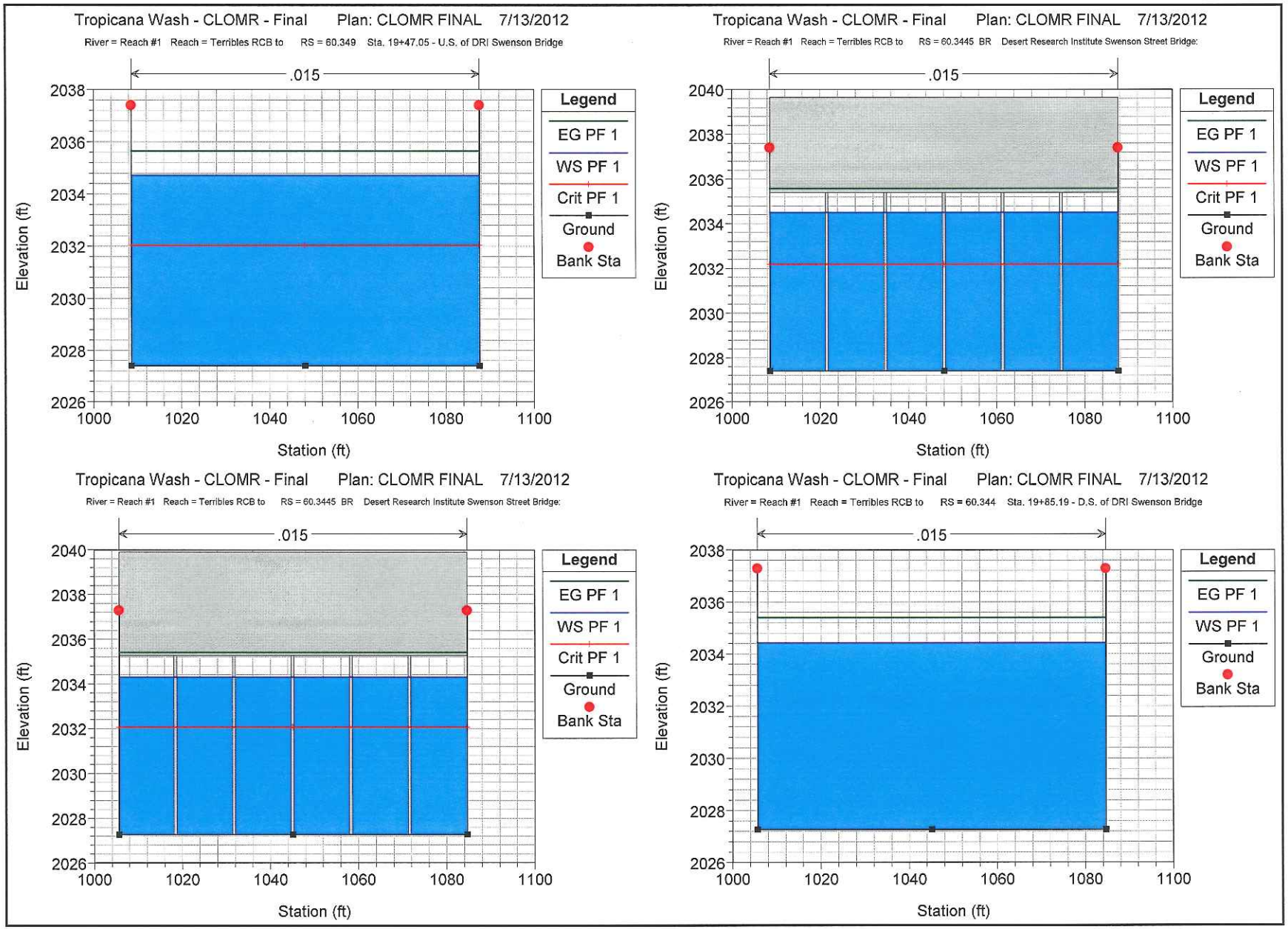
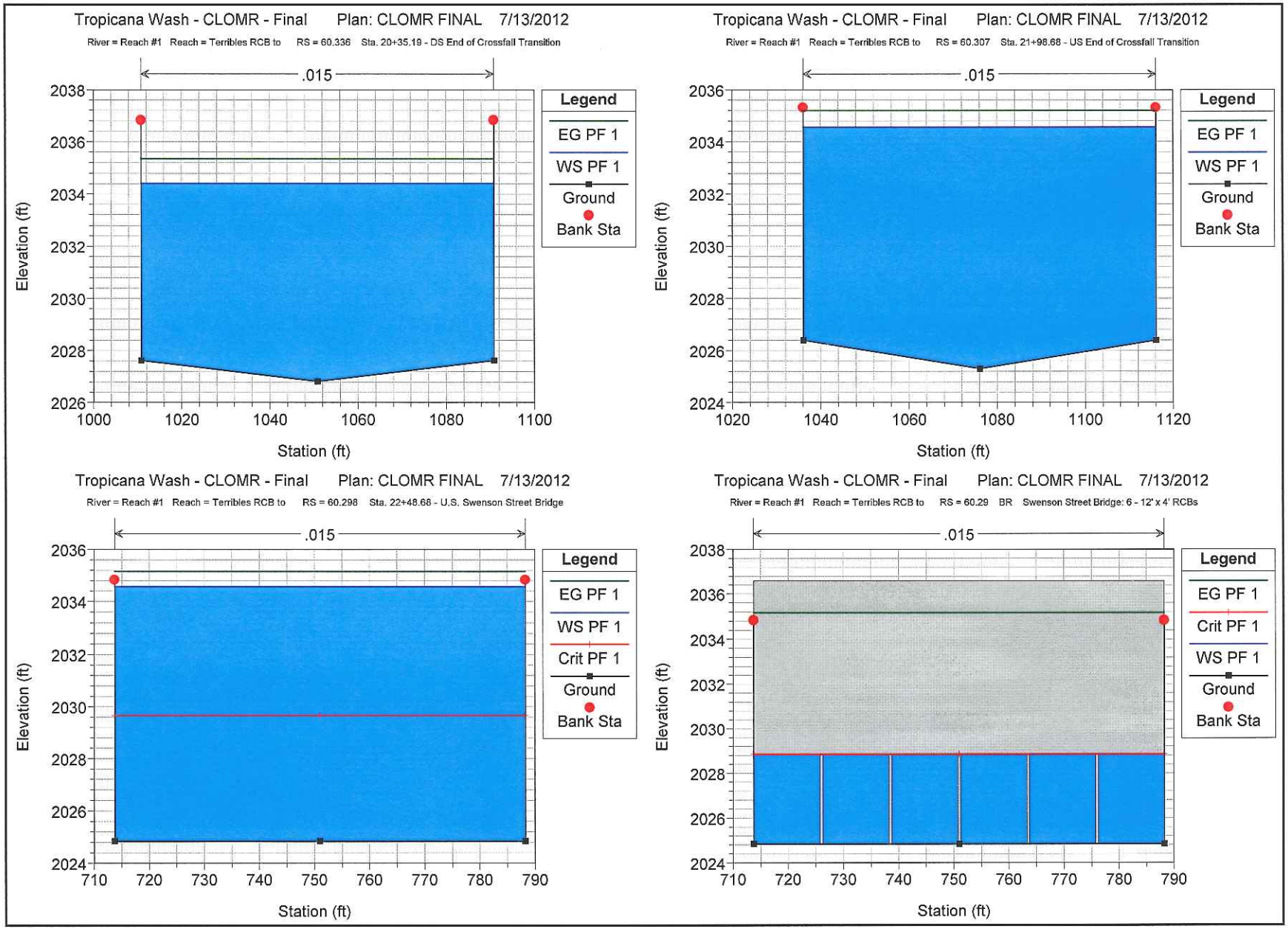
River = Reach #1 Reach = Terribles RCB to RS = 60.505 Sta. 11+00.00 - D.S. of Terrible's Culverts: 6- 12' x 4' RCBs
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.499 Sta. 11+44.22 - PC
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.457 Sta. 13+99.87 - PT
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.359 Sta. 18+97.00 - US End of Crossfall Transition
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.349 Sta. 19+47.05 - U.S. of DRI Swenson Bridge
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.3445 BR Desert Research Institute Swenson Street Bridge:
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.3445 BR Desert Research Institute Swenson Street Bridge:
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.344 Sta. 19+85.19 - D.S. of DRI Swenson Bridge
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta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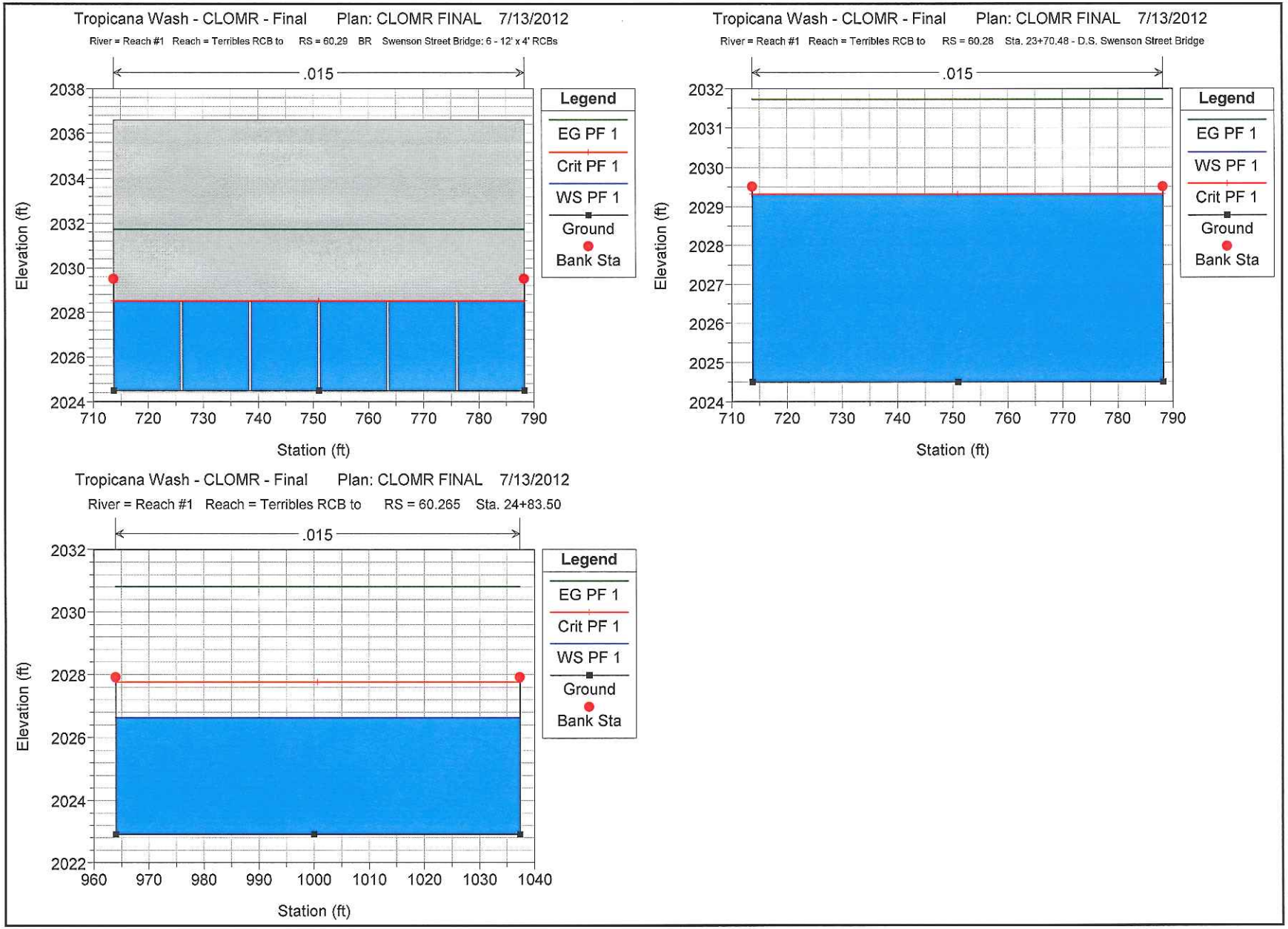
River = Reach #1 Reach = Terribles RCB to RS = 60.336 Sta. 20+35.19 - DS End of Crossfall Transition
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.307 Sta. 21+98.68 - US End of Crossfall Transition
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.298 Sta. 22+48.68 - U.S. Swenson Street Bridge
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.29 BR Swenson Street Bridge: 6 - 12' x 4' RCBs
.015
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.29 BR Swenson Street Bridge: 6 - 12' x 4' RCBs
.015
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.28 Sta. 23+70.48 - D.S. Swenson Street Bridge
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
Tropicana Wash - CLOMR - Final Plan: CLOMR FINAL 7/13/2012
River = Reach #1 Reach = Terribles RCB to RS = 60.265 Sta. 24+83.50
.015
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

```
T1 TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD                                  0
T2 LOMR FLOWS - 4,473 CFS
T3 July 7, 2011 - RRD
SO  -3311.3402010.670 13      .013                2010.670
BE  -3311.3402010.670 13      .000                                  .000    .000 0
TS  -3291.3402012.670 11      .013                                  .000    .000 0
BX                    12      .000                                  .000    .000 0
R   -3271.8102012.870 12      .013                                 2.238    .000 0
BE                    11      .000                                  .000    .000 0
R   -3247.2302013.110 11      .013                                 2.817    .000 0
BX                    12      .000                                  .000    .000 0
R   -3197.3702013.610 12      .013                                 2.854    .000 0
BE                    11      .000                                  .000    .000 0
R   -3184.6702013.740 11      .013                                12.223    .000 0
TS  -3171.8902013.910 11      .015                                  .000    .000 0
BX                    18      .000                                  .000    .000 0
R   -3170.8902013.920 18      .015                                  .000    .000 0
BE                    18      .000                                  .000    .000 0
TS  -3155.9002014.160 17      .015                                  .000    .000 0
BX                    16      .000                                  .000    .000 0
R   -3154.9002014.170 16      .015                                  .000    .000 0
BE                    16      .000                                  .000    .000 0
TS  -3132.5102014.460 10      .015                                  .000    .000 0
WX                     9      .500                                  .000    .000 0
R   -2938.7602016.520  9      .015                                  .000    .000 0
TS  -2883.3602017.300  7      .015                                  .000    .000 0
R   -2483.5002022.910  7      .015                                53.000    .000 0
TS  -2370.4802024.500  4      .015                                  .000 -15.000 0
R   -2248.6802024.840  4      .015                                  .000    .000 0
WE                     6      .300                                  .000    .000 0
TS  -2198.6802025.300  1      .015                                  .000    .000 0
R   -2035.1902026.820  1      .015                                  .000    .000 0
TS  -1985.1902027.280  2      .015                                  .000    .000 0
BX                     3      .000                                  .000    .000 0
R   -1947.0502027.400  3      .015                                  .000    .000 0
BE                     2      .000                                  .000    .000 0
TS  -1897.0002027.860  1      .015                                  .000    .000 0
R   -1399.8702032.470  1      .015                                  .000    .000 0
R   -1144.2202034.840  1      .015                                -36.600    .000 0
R   -1100.0002035.220  1      .015                                  .000    .000 0
SH  -1100.0002035.220  1      .015                     2038.590
CD   1  2   0    .000   6.000   80.000  .000  .000 -9.60
CD   2  2   0    .000   6.000   79.000  .000  .000   .00
CD   3  3   5   0.667   8.000   79.000  .000  .000   .00
CD   4  3   5   0.500   4.000   74.500  .000  .000   .00
CD   5  3   0    .000   5.000   74.500  .000  .000   .00
CD   6  2   0    .000   6.000   74.500  .000  .000   .00
CD   7  3   4   0.833   5.000   73.330  .000  .000   .00
CD   8  3   0    .000   5.000   73.330  .000  .000   .00
CD   9  3   4   1.083   5.000   73.330  .000  .000   .00
CD  10  2   0    .000   7.500   73.330  .000  .000   .00
CD  11  2   0    .000   7.500   72.000  .000  .000   .00
CD  12  2   3    .833   7.500   72.000  .000  .000   .00
CD  13  2   1   1.000   7.500   49.000  .000  .000   .00
CD  14  2   0   0.000   5.000   72.000  .000  .000   .00
CD  15  2   0   0.000   5.000   72.000  .000  .000   .00
CD  16  2   2   1.167   7.500   72.000  .000  .000   .00
CD  17  2   0   0.000   7.500   72.000  .000  .000   .00
CD  18  2   3   1.167   7.500   72.000  .000  .000   .00
Q          4473.000   .0
```

Program Package Serial Number: 1622

WATER SURFACE PROFILE LISTING Date: 7-27-2011 Time: 3: 5: 4

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-3311.340	2010.670	6.460	2017.130	4473.00	14.42	3.23	2020.36	.00	6.46	49.00	7.500	49.000	.00 1 1.0
BRIDGE ENTRANCE													
-3311.340	2010.670	7.494	2018.164	4473.00	12.18	2.30	2020.47	.00	6.37	49.00	7.500	49.000	.00 0 .0
TRANS STR	.1000					.0009	.02	7.49	.78		.013	.00	.00 RECTANG
-3291.340	2012.670	6.745	2019.415	4473.00	9.21	1.32	2020.73	.38	4.93	72.00	7.500	72.000	.00 0 .0
BRIDGE EXIT													
-3291.340	2012.670	6.568	2019.238	4473.00	9.80	1.49	2020.73	.41	5.05	72.00	7.500	72.000	.00 3 .8
16.662	.0102					.0013	.02	6.98	.69	3.17	.013	.00	.00 RECTANG
-3274.678	2012.841	6.278	2019.119	4473.00	10.25	1.63	2020.75	.45	5.05	72.00	7.500	72.000	.00 3 .8
HYDRAULIC JUMP													
-3274.678	2012.841	3.985	2016.826	4473.00	16.15	4.05	2020.88	1.13	5.05	72.00	7.500	72.000	.00 3 .8
2.868	.0102					.0052	.01	5.11	1.45	3.17	.013	.00	.00 RECTANG
-3271.810	2012.870	4.002	2016.872	4473.00	16.08	4.02	2020.89	1.12	5.05	72.00	7.500	72.000	.00 3 .8
BRIDGE ENTRANCE													
-3271.810	2012.870	3.536	2016.406	4473.00	17.57	4.79	2021.20	1.38	4.93	72.00	7.500	72.000	.00 0 .0
24.580	.0098					.0048	.12	4.92	1.65	2.87	.013	.00	.00 RECTANG
-3247.230	2013.110	3.610	2016.720	4473.00	17.21	4.60	2021.32	.66	4.93	72.00	7.500	72.000	.00 0 .0
BRIDGE EXIT													

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or "N"	Base Wt| or I.D.| X-Fall	ZL	ZR	No Wth Prs/Pip	Type Ch
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp							
-3247.230	2013.110	3.831	2016.941	4473.00	16.80	4.38	2021.32	.61	5.05	72.00	7.500	72.000	.00	3	.8	
4.847	.0100					.0058	.03	4.44	1.54	3.19	.013	.00	.00			RECTANG
-3242.383	2013.159	3.847	2017.005	4473.00	16.73	4.35	2021.35	.60	5.05	72.00	7.500	72.000	.00	3	.8	
45.012	.0100					.0054	.24	4.45	1.53	3.19	.013	.00	.00			RECTANG
-3197.370	2013.610	4.034	2017.644	4473.00	15.95	3.95	2021.60	9.23	5.05	72.00	7.500	72.000	.00	3	.8	
BRIDGE ENTRANCE																
-3197.370	2013.610	3.557	2017.167	4473.00	17.47	4.74	2021.90	11.46	4.93	72.00	7.500	72.000	.00	0	.0	
12.700	.0102					.0048	.06	15.01	1.63	2.83	.013	.00	.00			RECTANG
-3184.670	2013.740	3.600	2017.340	4473.00	17.26	4.63	2021.96	.00	4.93	72.00	7.500	72.000	.00	0	.0	
TRANS STR	.0133					.0061	.08	3.60	1.60		.015	.00	.00			RECTANG
-3171.890	2013.910	3.651	2017.561	4473.00	17.01	4.50	2022.06	.00	4.93	72.00	7.500	72.000	.00	0	.0	
BRIDGE EXIT																
-3171.890	2013.910	3.984	2017.895	4473.00	16.39	4.17	2022.07	.00	5.10	72.00	7.500	72.000	.00	3	1.2	
1.000	.0100					.0072	.01	3.98	1.48	3.56	.015	.00	.00			RECTANG
-3170.890	2013.920	3.987	2017.907	4473.00	16.38	4.17	2022.07	.00	5.10	72.00	7.500	72.000	.00	3	1.2	
BRIDGE ENTRANCE																
-3170.890	2013.920	3.382	2017.302	4473.00	18.37	5.24	2022.54	.00	4.93	72.00	7.500	72.000	.00	0	.0	
TRANS STR	.0160					.0074	.11	3.38	1.76		.015	.00	.00			RECTANG

WATER SURFACE PROFILE LISTING Date: 7-27-2011 Time: 3: 5: 4

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT or "N"	Base Wt|I.D. X-Fall	ZL	ZR	No Wth Prs/Pip Type Ch
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp					
-3155.900	2014.160	3.436	2017.596	4473.00	18.08	5.08	2022.67	.00	4.93	72.00	7.500	72.000	.00	0	.0
BRIDGE EXIT															
-3155.900	2014.160	3.614	2017.774	4473.00	17.77	4.90	2022.68	.00	5.04	72.00	7.500	72.000	.00	2	1.2
1.000	.0100					.0083	.01	3.61	1.67	3.40	.015	.00	.00	RECTANG	
-3154.900	2014.170	3.614	2017.784	4473.00	17.76	4.90	2022.68	.00	5.04	72.00	7.500	72.000	.00	2	1.2
BRIDGE ENTRANCE															
-3154.900	2014.170	3.277	2017.447	4473.00	18.96	5.58	2023.03	.00	4.93	72.00	7.500	72.000	.00	0	.0
TRANS STR	.0129					.0085	.19	3.28	1.85		.015	.00	.00	RECTANG	
-3132.510	2014.460	3.231	2017.691	4473.00	18.88	5.53	2023.23	.00	4.87	73.33	7.500	73.330	.00	0	.0
WALL EXIT															
-3132.510	2014.460	3.471	2017.931	4473.00	18.67	5.42	2023.35	.00	5.00	73.33	5.000	73.330	.00	4	1.1
193.750	.0106					.0124	2.41	3.47	1.82	3.58	.015	.00	.00	BOX	
-2938.760	2016.520	3.322	2019.842	4473.00	19.51	5.91	2025.76	.00	5.00	73.33	5.000	73.330	.00	4	1.1
TRANS STR	.0141					.0133	.74	3.32	1.95		.015	.00	.00	BOX	
-2883.360	2017.300	3.273	2020.573	4473.00	19.53	5.92	2026.49	5.00	5.00	73.33	5.000	73.330	.00	4	.8
206.085	.0140					.0127	2.62	5.00	1.95	3.22	.015	.00	.00	BOX	
-2677.275	2020.191	3.383	2023.575	4473.00	18.89	5.54	2029.11	5.00	5.00	73.33	5.000	73.330	.00	4	.8
125.298	.0140					.0113	1.42	5.00	1.85	3.22	.015	.00	.00	BOX	

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/Dia.-FT or "N"	Base Wt|or I.D. X-Fall	ZL	ZR	No Wth Prs/Pip	Type Ch
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp						
-2551.977	2021.949	3.548	2025.498	4473.00	18.01	5.04	2030.53	5.00	5.00	73.33	5.000	73.330	.00		4	.8
68.477	.0140					.0099	.68	5.00	1.72	3.22	.015	.00	.00		BOX	
-2483.500	2022.910	3.722	2026.632	4473.00	17.17	4.58	2031.21	.00	5.00	73.33	5.000	73.330	.00		4	.8
TRANS STR	.0141					.0084	.95	3.72	1.61		.015	.00	.00		BOX	
-2370.480	2024.500	4.000	2028.500	4473.00	15.53	3.75	2032.25	.00	4.00	74.50	4.000	74.500	.00		5	.5
.000	.0028					.0076	.00	4.00	1.39	4.00	.015	.00	.00		BOX	
---------- WARNING - Flow depth near top of box conduit ----------																
-2370.479	2024.500	4.000	2028.500	4473.00	15.53	3.75	2032.25	.00	4.00	74.50	4.000	74.500	.00		5	.5
121.800	.0028					.0143	1.74	4.00	1.39	4.00	.015	.00	.00		BOX	
-2248.680	2024.840	5.404	2030.244	4473.00	15.53	3.75	2033.99	.00	4.00	74.50	4.000	74.500	.00		5	.5
HYDRAULIC JUMP																
-2248.680	2024.840	3.281	2028.121	4473.00	18.30	5.20	2033.32	.00	4.82	74.50	6.000	74.500	.00		0	.0
HYDRAULIC DROP																
-2248.680	2024.840	9.460	2034.300	4473.00	6.35	.63	2034.93	.00	4.82	74.50	6.000	74.500	.00		0	.0
TRANS STR	.0092					.0003	.01	9.46	.36		.015	-9.60	.00		RECTANG	
-2198.680	2025.300	8.990	2034.290	4473.00	6.51	.66	2034.95	.00	5.00	80.00	6.000	80.000	.00		0	.0
37.284	.0093					.0003	.01	8.99	.39	3.36	.015	-9.60	.00		RECTANG	

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-2161.396	2025.647	8.590	2034.236	4473.00	6.83	.72	2034.96	.00	5.00	80.00	6.000	80.000	.00	0 .0
34.682	.0093					.0004	.01	8.59	.42	3.36	.015	-9.60	.00	RECTANG
-2126.714	2025.969	8.209	2034.178	4473.00	7.16	.80	2034.97	.00	5.00	80.00	6.000	80.000	.00	0 .0
32.104	.0093					.0005	.01	8.21	.45	3.36	.015	-9.60	.00	RECTANG
-2094.610	2026.267	7.845	2034.113	4473.00	7.51	.88	2034.99	.00	5.00	80.00	6.000	80.000	.00	0 .0
29.535	.0093					.0005	.02	7.85	.49	3.36	.015	-9.60	.00	RECTANG
-2065.075	2026.542	7.499	2034.041	4473.00	7.88	.96	2035.00	.00	5.00	80.00	6.000	80.000	.00	0 .0
26.959	.0093					.0006	.02	7.50	.52	3.36	.015	-9.60	.00	RECTANG
-2038.116	2026.793	7.168	2033.961	4473.00	8.26	1.06	2035.02	.00	5.00	80.00	6.000	80.000	.00	0 .0
2.926	.0093					.0007	.00	7.17	.56	3.36	.015	-9.60	.00	RECTANG
-2035.190	2026.820	7.132	2033.952	4473.00	8.31	1.07	2035.02	.00	5.00	80.00	6.000	80.000	.00	0 .0
TRANS STR	.0092					.0007	.03	7.13	.56		.015	.00	.00	RECTANG
-1985.190	2027.280	6.668	2033.948	4473.00	8.49	1.12	2035.07	.00	4.64	79.00	6.000	79.000	.00	0 .0
BRIDGE EXIT														
-1985.190	2027.280	6.499	2033.779	4473.00	9.10	1.28	2035.06	.00	4.77	79.00	8.000	79.000	.00	5 .7
8.441	.0031					.0018	.02	6.50	.64	5.27	.015	.00	.00	BOX
-1976.749	2027.307	6.475	2033.781	4473.00	9.13	1.29	2035.08	.00	4.77	79.00	8.000	79.000	.00	5 .7
HYDRAULIC JUMP														

TROPICANA WASH PALOS VERDES STREET TO FLAMINGO ROAD
LOMR FLOWS - 4,473 CFS
July 7, 2011 - RRD

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"	X-Fall	ZR	Type Ch
-1976.749	2027.307	3.391	2030.698	4473.00	17.43	4.72	2035.42	.00	4.77	79.00	8.000	79.000	.00	5 .7
29.699	.0031					.0114	.34	3.39	1.70	5.27	.015	.00	.00	BOX
-1947.050	2027.400	3.268	2030.668	4473.00	18.09	5.08	2035.75	.00	4.77	79.00	8.000	79.000	.00	5 .7
BRIDGE ENTRANCE														
-1947.050	2027.400	2.899	2030.299	4473.00	19.53	5.92	2036.22	.00	4.64	79.00	6.000	79.000	.00	0 .0
TRANS STR	.0092					.0098	.49	2.90	2.02		.015	-9.60	.00	RECTANG
-1897.000	2027.860	3.363	2031.223	4473.00	18.87	5.53	2036.75	.00	5.00	80.00	6.000	80.000	.00	0 .0
497.130	.0093					.0092	4.59	3.36	1.93	3.36	.015	-9.60	.00	RECTANG
-1399.870	2032.470	3.368	2035.838	4473.00	18.84	5.51	2041.35	2.20	5.00	80.00	6.000	80.000	.00	0 .0
255.650	.0093					.0092	2.34	5.57	1.93	3.36	.015	-9.60	.00	RECTANG
-1144.220	2034.840	3.379	2038.219	4473.00	18.77	5.47	2043.69	.00	5.00	80.00	6.000	80.000	.00	0 .0
44.220	.0086					.0091	.40	3.38	1.92	3.43	.015	-9.60	.00	RECTANG
-1100.000	2035.220	3.370	2038.590	4473.00	18.83	5.50	2044.09	.00	5.00	80.00	6.000	80.000	.00	0 .0

TABLE 1 - HYDRAULIC MODELS RESULTS SUMMARY					
			LOMR Flow		
Station	Plan Station	Description	Flow (cfs)	WSPGW Depth (ft)	HEC-RAS Depth (ft)
60.103	33+11.34	US End of Vegas Grand Arches	4473	**7.49**	-
60.107	32+91.34	Vegas Grand Channel	4473	**6.75**	-
60.110	32+47.23	Vegas Grand Channel	4473	**3.61**	-
60.113	32+47.23	Vegas Grand Channel	4473	**3.83**	-
60.124	31+97.37	Vegas Grand Channel	4473	**4.03**	-
60.126	31+84.67	Vegas Grand Channel	4473	**3.60**	-
60.135	31+32.51	DS End of Flamingo Bridge	4473	**3.47**	-
60.173	29+38.76	US End of Flamingo Bridge	4473	**3.32**	-
60.184	28+83.36	PT	4473	**3.27**	-
60.265	24+83.50	PC	4473	**3.72**	3.71
60.280	23+70.48	DS End of Swenson Bridge	4473	4.00	**4.82**
60.298	22+48.68	US End of Swenson Bridge	4473	9.46	**9.74**
60.307	21+98.68	US End of Crossfall Transition	4473	8.99	**9.26**
60.336	20+35.19	DS End of Crossfall Transition	4473	7.13	**7.60**
60.344	19+85.19	DS End of DRI Bridge	4473	6.67	**7.15**
60.349	19+47.05	US End of DRI Bridge	4473	3.27	**7.32**
60.359	18+97.00	US End of Crossfall Transition	4473	3.36	**3.36**
60.457	13+99.87	PT	4473	3.37	**3.37**
60.499	11+44.22	PC	4473	3.38	**3.38**
60.505	11+00.00	DS End of Terrible's Culverts	4473	3.37	**3.37**

TABLE 2 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS													
Sta	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Superelevation	Total Depth	Actual Depth
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)	(ft)
60.505	11+00.00	4473	2035.22	2038.59	3.37	18.83	80.00	1.93	0	0.0	0.0	3.4	5.5
60.499	11+44.22	4473	2034.84	2038.22	3.38	18.74	80.00	1.91	400	0.0	1.1	4.5	5.5
60.457	13+99.87	4473	2032.47	2035.84	3.37	18.82	80.00	1.92	400	0.0	1.1	4.5	5.5
60.359	18+97.00	4473	2027.86	2031.22	3.36	18.87	80.00	1.93	0	0.0	0.0	3.4	8.0
60.349	19+47.05	4473	2027.40	2034.72	7.32	7.73	79.00	0.50	0	0.0	0.0	7.3	8.0
60.345	DRI Bridge												
60.344	19+85.19	4473	2027.28	2034.43	7.15	7.92	79.00	0.52	0	0.0	0.0	7.2	8.5
60.336	20+35.19	4473	2026.82	2034.42	7.60	7.77	80.00	0.51	0	0.0	0.0	7.6	8.5
60.307	21+98.68	4473	2025.30	2034.56	9.26	6.42	80.00	0.38	0	2.0	0.0	11.3	11.7
60.298	22+48.68	4473	2024.84	2034.58	9.74	6.16	74.50	0.35	0	2.0	0.0	11.7	11.7
60.289	Swenson Street Bridge												
60.280	23+70.48	4473	2024.50	2029.32	4.82	12.46	74.50	1.00	N/A	N/A	N/A	N/A	
60.265	24+83.50	4473	2022.91	2026.63	3.72	17.17	73.33	1.61	N/A	N/A	N/A	N/A	
60.184	28+83.36	4473	2017.30	2020.57	3.27	19.53	73.33	1.95	N/A	N/A	N/A	N/A	
60.173	29+38.76	4473	2016.52	2019.84	3.32	19.51	73.33	1.82	N/A	N/A	N/A	N/A	
60.153	Flamingo Road Bridge												
60.135	31+32.51	4473	2014.46	2017.93	3.47	5.53	73.33	1.82	N/A	N/A	N/A	N/A	
60.126	31+84.67	4473	2013.74	2017.34	3.60	4.63	72.00	1.60	N/A	N/A	N/A	N/A	
60.124	31+97.37	4473	2013.61	2017.64	4.03	4.74	72.00	1.63	N/A	N/A	N/A	N/A	
60.113	32+47.23	4473	2013.11	2016.94	3.83	16.80	72.00	1.54	N/A	N/A	N/A	N/A	
60.110	32+47.23	4473	2013.11	2016.72	3.61	17.21	72.00	1.54	N/A	N/A	N/A	N/A	
60.107	32+91.34	4473	2012.67	2019.42	6.74	9.80	72.00	0.69	N/A	N/A	N/A	N/A	
60.103	33+11.34	4473	2010.67	2018.16	7.49	14.42	49.00	0.78	N/A	N/A	N/A	N/A	

3.2 STRUCTURAL CALCULATIONS (ON CD)

JOB NUMBER: 500-A881
DATE: July 5, 2012
REVISED ON:

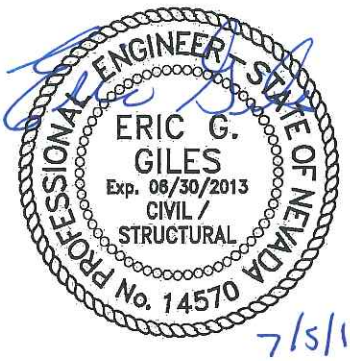
STRUCTURAL CALCULATIONS

Addendum to Original Calculations
Concrete Channel Retaining Walls

Prepared for:

	Name	Signature	Date
Prepared by:	*Eric Giles, PE/SE*	Eric Giles	7/5/12

APPROVED BY:
Eric Giles, PE/SE



7/5/12

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

1555 South Rainbow Boulevard · Las Vegas, NV 89146 · T: 702.804.2000 · F: 702.804.2299 · gcwallace.com

Project Description:

Structural calculations are provided for a rectangular concrete channel. Wall heights vary. A schedule is provided. Calculations are provided assuming level backfill behind the walls with a 100psf surcharge loading behind the walls. Walls are assumed to be backfilled to the top with soil. There are locations where the top of retaining wall extends a maximum of 4.5 feet above the soil.

The channel is 80 feet wide. For sliding, the concrete in front of the retaining wall will help keep the retaining wall from sliding. Only 30 feet of channel invert concrete weight times the coefficient of friction was used as a resisting force.

Walls are designed once for soil pressure and surcharge loads and a second time for seismic loads.

Please note that 11.0 foot high calculations are used for actual maximum 10.90-foot high channel and the 12.0 foot high calculations are used for actual maximum 11.70 foot high channel wall.

Design Parameters:

f'c = 4000 psi
fy = 60000 psi

EFPa = 40 pcf/ft (Geotechnical Report allows 35 pcf/ft – Design Conservative)
EFPp = 250 pcf/ft
Allow Bearing Capacity = 2500 psf
Coef. of Friction = 0.35

For Seismic Loading the Mononobe-Okabe / Seed-Whitman procedure was used with Kh = 0.20 which is from the 2009 IBC using Kh = (Sds / 2.5) as shown in calculations

USGS Design Maps Summary Report

User-Specified Input

Report Title Tropicana Wash Improvements
Thu July 5, 2012 18:58:45 UTC

Building Code Reference Document 2006/2009 International Building Code
(which makes use of 2002 USGS hazard data)

Site Coordinates 36.1137°N, 115.147°W

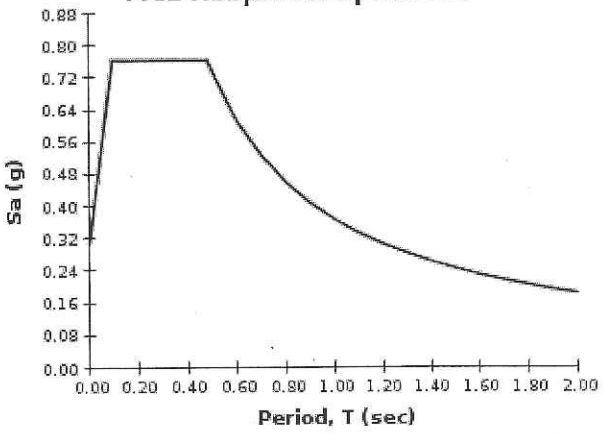
Site Soil Classification Site Class D – "Stiff Soil"

USGS-Provided Output

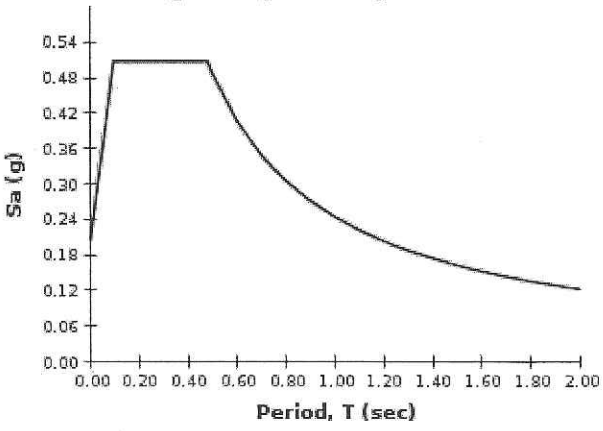
S_S =	0.565 g	S_{MS} =	0.762 g	S_{DS} =	0.508 g
S_1 =	0.173 g	S_{M1} =	0.365 g	S_{D1} =	0.244 g

FOR RETAINING WALLS USE $S_{DS}/2.5 = 0.203$

MCE Response Spectrum



Design Response Spectrum



G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash
Job # : 500-881 Dsgnr: EGG
Description....
11'-0" retaining wall

Page: ____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

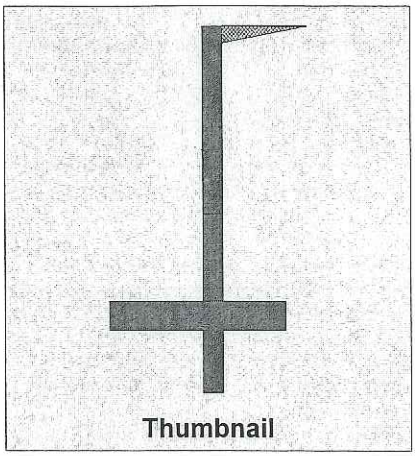
Code: IBC 2009

Criteria

Retained Height	=	11.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	100.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	3.40 OK
Sliding	=	1.36 Ratio < 1.5! Ok - See next Page
Total Bearing Load	=	8,103 lbs
...resultant ecc.	=	0.20 in
Soil Pressure @ Toe	=	964 psf OK
Soil Pressure @ Heel	=	942 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,350 psf
ACI Factored @ Heel	=	1,319 psf
Footing Shear @ Toe	=	31.6 psi OK
Footing Shear @ Heel	=	23.5 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	3,311.1 lbs
less 100% Passive Force	= -	1,680.6 lbs
less 100% Friction Force	= -	2,835.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	450.2 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Top Stem	2nd
		Stem OK	Stem OK
Design Height Above Ftg	ft =	3.50	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 4	# 5
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.681**	**0.662**
Total Force @ Section	lbs =	2,169.2	4,413.5
Moment....Actual	ft-# =	5,884.6	17,175.8
Moment.....Allowable	ft-# =	8,642.3	25,926.8
Shear.....Actual	psi =	18.5	37.7
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	12.00	12.26
LAP SPLICE IF BELOW	in =	12.00	
HOOK EMBED INTO FTG	in =		6.00

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

2

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Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash
Job # : 500-881 Dsgnr: EGG
Description....
11'-0" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

Code: IBC 2009

Footing Dimensions & Strengths

Toe Width	=	4.50 ft
Heel Width	=	4.00
Total Footing Width	=	8.50
Footing Thickness	=	14.00 in
Key Width	=	12.00 in
Key Depth	=	30.00 in
Key Distance from Toe	=	4.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,350	1,319 psf
Mu' : Upward	=	13,614	5,952 ft-#
Mu' : Downward	=	2,481	10,832 ft-#
Mu: Design	=	11,133	4,880 ft-#
Actual 1-Way Shear	=	31.60	23.53 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 7.75 in, #5@ 11.75 in, #6@ 16.75 in, #7@ 22.75 in, #8@ 29.75 in, #9@ 37
Heel: Not req'd, Mu < S * Fr
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,960.6	4.06	12,006.7	Soil Over Heel	= 4,290.0	7.00	30,030.0
Surcharge over Heel	=	374.4	6.08	2,277.4	Sloped Soil Over Heel	=		
Toe Active Pressure	=	-23.8	0.39	-9.3	Surcharge Over Heel	= 300.0	7.00	2,100.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
					Surcharge Over Toe	=		
					Stem Weight(s)	= 1,650.0	5.00	8,250.0
					Earth @ Stem Transitions	=		
Total	=	3,311.1	**O.T.M.** =	14,274.8	Footing Weight	= 1,487.5	4.25	6,321.9
Resisting/Overturning Ratio		= **3.40**			Key Weight	= 375.0	5.00	1,875.0
Vertical Loads used for Soil Pressure =		8,102.5 lbs			Vert. Component	=		
					Total =	8,102.5 lbs	**R.M.=**	48,576.9

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

SLIDING NOT A PROBLEM SINCE THIS IS A RECTANGULAR CHANNEL WITH BOTH SIDES ABOUT EQUAL. HOWEVER, ONLY USE 30' OF CHANNEL INVERT SLAB TO RESIST SLIDING.

SLAB FORCE = $75\ ^{lb}/_{ft^2}\ (30')(0.35) = 787.5\ lb$

↑ 6" SLAB ↑ COEF OF FRICTION

$F.S. = (1680.6\ lb + 2835.9\ lb + 787.5\ lb)/3311.1\ lb \Rightarrow 1.60$

3

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Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
11'-0" retaining wall

Page: _____
Date: JUN 6,2012

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Cantilevered Retaining Wall Design

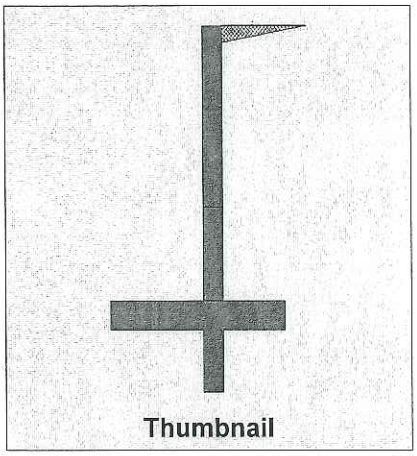
Code: IBC 2009

Criteria

Retained Height	=	11.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	0.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Design Kh	=	0.200 g

Using Mononobe-Okabe / Seed-Whitman procedure

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Kae for seismic earth pressure	=	0.406
Ka for static earth pressure	=	0.268
Difference: Kae - Ka	=	0.138

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Added seismic base force 942.5 lbs

4

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Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
11'-0" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

Code: IBC 2009

Design Summary

Wall Stability Ratios

Overturning	=	2.46 OK
Sliding	=	1.14 Ratio < 1.5!
		Ok - See below
Total Bearing Load	=	7,803 lbs
...resultant ecc.	=	8.55 in
Soil Pressure @ Toe	=	1,380 psf OK
Soil Pressure @ Heel	=	456 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,932 psf
ACI Factored @ Heel	=	639 psf
Footing Shear @ Toe	=	40.6 psi OK
Footing Shear @ Heel	=	30.0 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	3,879.3 lbs
less 100% Passive Force	= -	1,680.6 lbs
less 100% Friction Force	= -	2,730.9 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	1,407.5 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Top Stem	2nd
		Stem OK	Stem OK
Design Height Above Ftg	ft =	3.75	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 4	# 5
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.708**	**0.824**
Total Force @ Section	lbs =	2,153.4	4,957.1
Moment....Actual	ft-# =	6,115.3	21,359.2
Moment.....Allowable	ft-# =	8,642.3	25,926.8
Shear.....Actual	psi =	14.4	33.1
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	12.00	15.24
LAP SPLICE IF BELOW	in =	12.00	
HOOK EMBED INTO FTG	in =		6.78

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Footing Dimensions & Strengths

Toe Width	=	4.50 ft
Heel Width	=	4.00
Total Footing Width	=	8.50
Footing Thickness	=	14.00 in
Key Width	=	12.00 in
Key Depth	=	30.00 in
Key Distance from Toe	=	4.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,932	639 psf
Mu' : Upward	=	17,248	3,558 ft-#
Mu' : Downward	=	2,481	10,112 ft-#
Mu: Design	=	14,767	6,554 ft-#
Actual 1-Way Shear	=	40.59	30.01 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 5.75 in, #5@ 9.00 in, #6@ 12.75 in, #7@ 17.25 in, #8@ 22.75 in, #9@ 28.
Heel: #4@ 9.75 in, #5@ 15.00 in, #6@ 21.50 in, #7@ 29.00 in, #8@ 38.25 in, #9@ 48
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

For seismic loading, F.S. = 1.3 FOR sliding. channel in front of wall helps. FORCE = $75^{lb}/_{ft^2}$ (30')(0.35) = 787.5 lb
(↑ 6" SLAB, ↑ COEF OF FRICTION)

$$F.S. = \frac{(1680.6lb + 2730.9lb + 787.5lb)}{3879.3lb} = 1.34$$

5

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702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
11'-0" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

Code: IBC 2009

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	2,960.6	4.06	12,006.7	Soil Over Heel	= 4,290.0	7.00	30,030.0
Surcharge over Heel	=				Sloped Soil Over Heel	=		
Toe Active Pressure	=	-23.8	0.39	-9.3	Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
Seismic Earth Load	=	942.5	7.30	6,880.5	Surcharge Over Toe	=		
					Stem Weight(s)	= 1,650.0	5.00	8,250.0
					Earth @ Stem Transitions	=		
Total	=	3,879.3	O.T.M. =	18,877.9	Footing Weight	= 1,487.5	4.25	6,321.9
Resisting/Overturning Ratio			=	2.46	Key Weight	= 375.0	5.00	1,875.0
Vertical Loads used for Soil Pressure			=	7,802.5 lbs	Vert. Component	=		
					Total =	7,802.5 lbs	R.M.=	46,476.9

If seismic included the min. OTM and sliding ratios may be 1.1 per IBC '09, 1807.2.3.

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

6

G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash
Job # : 500-881 Dsgnr: EGG
Description....
12'-0" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

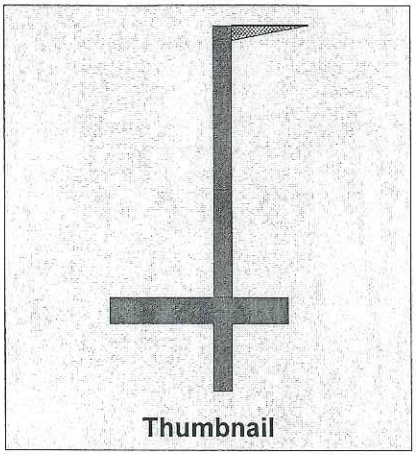
Code: IBC 2009

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	100.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	3.43 OK
Sliding	=	1.37 Ratio < 1.5! Ok, see next page
Total Bearing Load	=	8,893 lbs
...resultant ecc.	=	1.51 in
Soil Pressure @ Toe	=	861 psf OK
Soil Pressure @ Heel	=	1,011 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,206 psf
ACI Factored @ Heel	=	1,415 psf
Footing Shear @ Toe	=	37.1 psi OK
Footing Shear @ Heel	=	26.2 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	3,848.5 lbs
less 100% Passive Force	= -	2,170.1 lbs
less 100% Friction Force	= -	3,112.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	490.3 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Top Stem	2nd
Design Height Above Ftg	ft =	Stem OK 4.75	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 4	# 6
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.620**	**0.610**
Total Force @ Section	lbs =	2,038.9	5,198.8
Moment....Actual	ft-# =	5,358.7	21,976.6
Moment.....Allowable	ft-# =	8,642.3	36,040.0
Shear.....Actual	psi =	17.4	44.4
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	12.00	13.54
LAP SPLICE IF BELOW	in =	12.00	
HOOK EMBED INTO FTG	in =		6.00

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

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G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash
Job # : 500-881 Dsgnr: EGG
Description....
12'-0" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

Code: IBC 2009

Footing Dimensions & Strengths

Toe Width	=	5.50 ft
Heel Width	=	4.00
Total Footing Width	=	9.50
Footing Thickness	=	14.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	5.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,206	1,415 psf
Mu' : Upward	=	18,851	6,433 ft-#
Mu' : Downward	=	3,706	11,651 ft-#
Mu: Design	=	15,145	5,217 ft-#
Actual 1-Way Shear	=	37.14	26.24 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 5.75 in, #5@ 9.00 in, #6@ 12.75 in, #7@ 17.25 in, #8@ 22.75 in, #9@ 28.
Heel: #4@ 9.75 in, #5@ 15.00 in, #6@ 21.50 in, #7@ 29.00 in, #8@ 38.25 in, #9@ 48
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,467.2	4.39	15,217.3	Soil Over Heel	= 4,680.0	8.00	37,440.0
Surcharge over Heel	=	405.1	6.58	2,667.1	Sloped Soil Over Heel	=		
Toe Active Pressure	=	-23.8	0.39	-9.3	Surcharge Over Heel	= 300.0	8.00	2,400.0
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
					Surcharge Over Toe	=		
					Stem Weight(s)	= 1,800.0	6.00	10,800.0
					Earth @ Stem Transitions	=		
Total	=	3,848.5	O.T.M. =	17,875.1	Footing Weight	= 1,662.5	4.75	7,896.9
					Key Weight	= 450.0	6.00	2,700.0
					Vert. Component	=		
					Total =	8,892.5 lbs	R.M.=	61,236.9

Resisting/Overturning Ratio = 3.43
Vertical Loads used for Soil Pressure = 8,892.5 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

Added resistance due to channel in front of wall

$= (30')(75\ lb/ft^2)(0.35) = 787.5\ lb$

↑ 6" CONCRETE ↑ COEF. OF FRICTION

F.S. for sliding $= \dfrac{(2170.1\ lb + 3112.4\ lb + 787.5\ lb)}{3848.5\ lb} \Rightarrow 1.58$

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G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
12'-0" retaining wall

Page: _____
Date: JUN 6,2012

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Cantilevered Retaining Wall Design

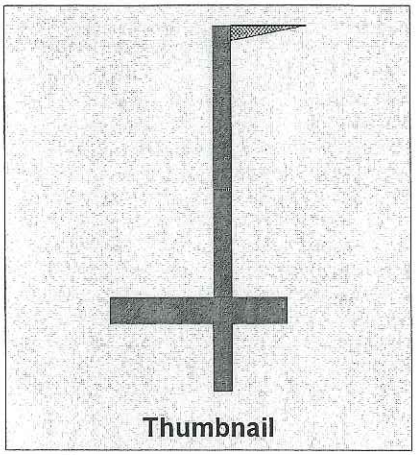
Code: IBC 2009

Criteria

Retained Height	=	12.00 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel = 0.0 psf
Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Design Kh = 0.200 g

Using Mononobe-Okabe / Seed-Whitman procedure

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Kae for seismic earth pressure	=	0.406
Ka for static earth pressure	=	0.268
Difference: Kae - Ka	=	0.138

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Added seismic base force 1,103.8 lbs

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G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
12'-0" retaining wall

Page: _____
Date: JUN 6,2012

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Registration #: RP-1173025 RP9.23
Licensed to: G. C. Wallace, Inc.

Cantilevered Retaining Wall Design

Code: IBC 2009

Design Summary

Wall Stability Ratios

Overturning	=	2.46 OK
Sliding	=	1.14 Ratio < 1.5! ok, See below
Total Bearing Load	=	8,593 lbs
...resultant ecc.	=	8.25 in
Soil Pressure @ Toe	=	1,297 psf OK
Soil Pressure @ Heel	=	512 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,816 psf
ACI Factored @ Heel	=	717 psf
Footing Shear @ Toe	=	47.8 psi OK
Footing Shear @ Heel	=	33.5 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	4,547.2 lbs
less 100% Passive Force	= -	2,170.1 lbs
less 100% Friction Force	= -	3,007.4 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	1,643.3 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Top Stem	2nd
		Stem OK	Stem OK
Design Height Above Ftg	ft =	4.75	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 4	# 6
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.708**	**0.769**
Total Force @ Section	lbs =	2,153.4	5,899.4
Moment....Actual	ft-# =	6,115.3	27,730.0
Moment.....Allowable	ft-# =	8,642.3	36,040.0
Shear.....Actual	psi =	14.4	39.4
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	12.00	17.08
LAP SPLICE IF BELOW	in =	12.00	
HOOK EMBED INTO FTG	in =		7.53

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Footing Dimensions & Strengths

Toe Width	=	5.50 ft
Heel Width	=	4.00
Total Footing Width	=	9.50
Footing Thickness	=	14.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	5.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,816	717 psf
Mu' : Upward	=	24,257	3,745 ft-#
Mu' : Downward	=	3,706	10,931 ft-#
Mu: Design	=	20,552	7,185 ft-#
Actual 1-Way Shear	=	47.84	33.45 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 5.50 in, #5@ 8.50 in, #6@ 12.00 in, #7@ 16.25 in, #8@ 21.25 in, #9@ 26.
Heel: #4@ 9.75 in, #5@ 15.00 in, #6@ 21.50 in, #7@ 29.00 in, #8@ 38.25 in, #9@ 48
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

For Seismic only F.S. = 1.3 FOR sliding

Channel in front of footing = $75^{lb}/_{ft^3}(30')(.35)$ ← COEF OF FRICTION
$= 787.5^{lb}$

$$F.S = \frac{(3007.4 + 2170.1 + 787.5)}{4547.2} = 1.31$$

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G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
12'-0" retaining wall

Date: JUN 6,2012

This Wall in File: f:\projects\500\500-881\calc\struct\channe

Cantilevered Retaining Wall Design

Code: IBC 2009

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,467.2	4.39	15,217.3	Soil Over Heel	= 4,680.0	8.00	37,440.0
Surcharge over Heel	=				Sloped Soil Over Heel	=		
Toe Active Pressure	=	-23.8	0.39	-9.3	Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
Seismic Earth Load	=	1,103.8	7.90	8,720.3	Surcharge Over Toe	=		
					Stem Weight(s)	= 1,800.0	6.00	10,800.0
					Earth @ Stem Transitions	=		
Total	=	4,547.2	**O.T.M.** =	23,928.3	Footing Weight	= 1,662.5	4.75	7,896.9
Resisting/Overturning Ratio			=	**2.46**	Key Weight	= 450.0	6.00	2,700.0
Vertical Loads used for Soil Pressure	=		8,592.5 lbs		Vert. Component	=		
					Total	= 8,592.5 lbs	**R.M.**=	58,836.9

If seismic included the min. OTM and sliding ratios may be 1.1 per IBC '09, 1807.2.3.

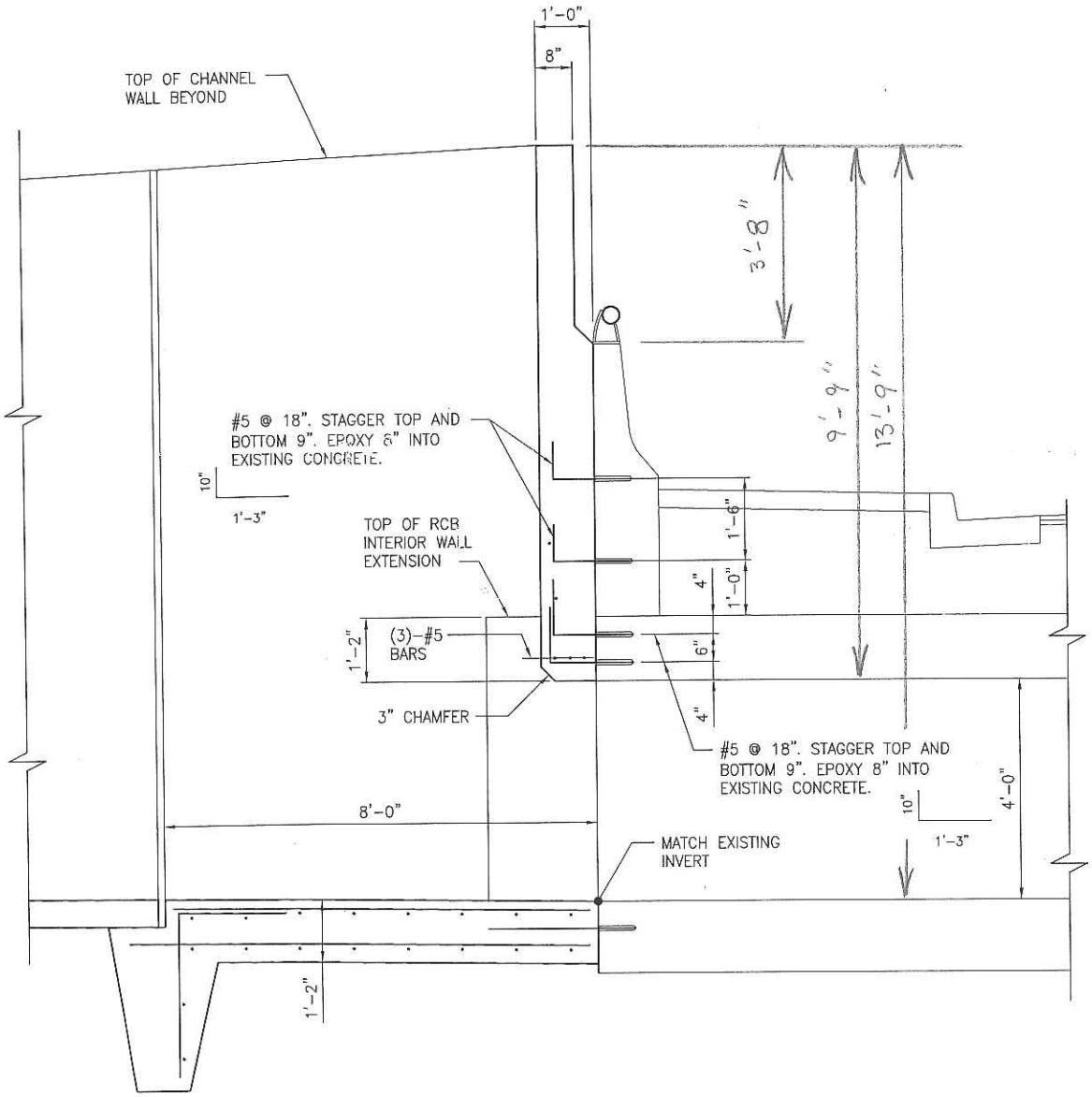
* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

11 of 1

DESIGN HEADWALL EXTENSION

ASSUME WATER LEVEL IS TO THE TOP.



VERTICAL LOAD OF NEW HEADWALL WILL BE SUPPORTED BY RCB INTERIOR WALL EXTENSION AND NEW FOOTING.

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

DATE: SHEET NO. OF
SUBJECT: JOB NO.
CLIENT: CHECKED BY CALC BY

DESIGN HEADWALL EXTENSION

MOMENT @ 3.67' BELOW TOP

$M = \frac{1}{2}(62.4\ lb/ft^3)(3.67)^2(\frac{1}{3}(3.67')) \Rightarrow 514.1\ lb.ft/ft$

MOMENT @ 9.75' BELOW TOP

$M = \frac{1}{2}(62.4\ lb/ft^3)(9.75)^2(\frac{1}{3}(9.75')) \Rightarrow 9.64\ K.ft/ft$

FACTORED $M_u = 1.6(9.64\ K.ft/ft)$

$= 15.42\ K.ft/ft$

USE #5 @ 8" - SEE CALC ON FOLLOWING PAGE

THE EXISTING BARRIER RAIL CAN RESIST A 15.42 K.ft/ft LOAD. TIE NEW WALL AND BARRIER RAIL TOGETHER USING EPOXY DOWELS AS SHOWN.

Concrete Beam Design

Used to determine reinforcing requirements

Factored Moment, Mu = 15.42 k*ft
Depth of beam or thickness of slab = 12.0 inches
Width of Beam, b = 12.0 inches
Size of Rebar = 5
Clearance to Reinforcing = 3.5 inches
d = 8.188 inches
ϕ = 0.90
f'c = 4000 psi
fy = 60000 psi

R = Mu / (ϕ * b * d^2)
= (15.42 * 12000) / (0.9 * 12 * 8.19^2)
= 255.59

m = fy / 0.85 * f'c
= 60000 / 0.85 * 4000
= 17.65

ρ = 1/m (1-sqrt(1 - 2mR / fy))
= (1 / 17.65) * (1 - sqrt(1 - (2 * 17.65 * 255.59 / 60000))
= 0.00443

Min ρ = 3*sqrt(f'c) / fy but not less than 200 / fy **(Eq. 10-3)**
= 0.00333

Instead of ρ min, you can use 4/3 ρ = 4/3 * 0.0044 **(10.5.3)**
= 0.0059

Use ρ = 0.00443

Required As = ρ * b * d
= 0.0044 * 12 * 8.188
= **0.44** **sq. inches**

Use As = 0.46 sq. inches

T = fy * As
= 27.6 kips

a = T / (0.85 * f'c * b)
= 0.67647 inches

ϕ Mn = ϕ * T (d-a/2)
ϕ Mn = 16.25 k*ft

G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
13'-9" retaining wall

Page: _____
Date: JUN 6,2012

This Wall in File: F:\Projects\500\500-881\Calc\Struct\chann

Retain Pro 9 © 1989 - 2011 Ver: 9.23 8164
Registration #: RP-1173025 RP9.23
Licensed to: G. C. Wallace, Inc.

Cantilevered Retaining Wall Design

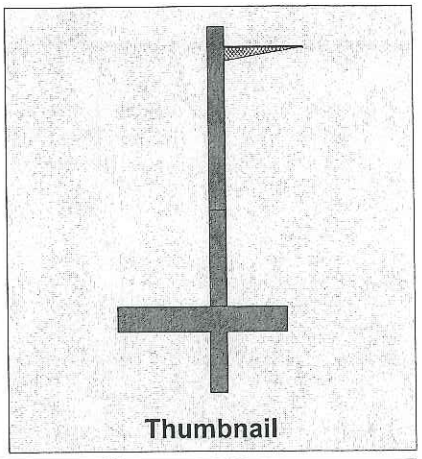
Code: IBC 2009

Criteria

Retained Height	=	12.75 ft
Wall height above soil	=	1.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel = 0.0 psf
Used To Resist Sliding & Overturning
Surcharge Over Toe = 0.0 psf
Used for Sliding & Overturning

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Earth Pressure Seismic Load

Design Kh = 0.200 g

Using Mononobe-Okabe / Seed-Whitman procedure

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Kae for seismic earth pressure	=	0.406
Ka for static earth pressure	=	0.268
Difference: Kae - Ka	=	0.138

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Added seismic base force 1,248.0 lbs

G. C. Wallace, Inc.
Engineers | Planners | Surveyors
1555 South Rainbow Blvd.
Las Vegas, NV 89146
702-804-2000

Title : Tropicana Wash (S)
Job # : 500-881 Dsgnr: EGG
Description....
13'-9" retaining wall

This Wall in File: F:\Projects\500\500-881\Calc\Struct\chann

Cantilevered Retaining Wall Design

Code: IBC 2009

Design Summary

Wall Stability Ratios

Overturning	=	2.51 OK
Sliding	=	1.13 Ratio < 1.5!
Total Bearing Load	=	10,189 lbs
...resultant ecc.	=	8.71 in
Soil Pressure @ Toe	=	1,463 psf OK
Soil Pressure @ Heel	=	575 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	2,048 psf
ACI Factored @ Heel	=	805 psf
Footing Shear @ Toe	=	49.5 psi OK
Footing Shear @ Heel	=	36.4 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	5,140.0 lbs
less 100% Passive Force	= -	2,257.8 lbs
less 100% Friction Force	= -	3,566.1 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	1,887.1 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Footing Dimensions & Strengths

Toe Width	=	5.50 ft
Heel Width	=	4.50
Total Footing Width	=	10.00
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	5.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Stem Construction

		Top Stem	2nd
		Stem OK	Stem OK
Design Height Above Ftg	ft =	4.75	0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 5	# 6
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.619**	**0.923**
Total Force @ Section	lbs =	2,622.0	6,659.9
Moment....Actual	ft-# =	8,216.3	33,261.1
Moment.....Allowable	ft-# =	13,282.3	36,040.0
Shear.....Actual	psi =	17.5	44.5
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	12.00	20.49
LAP SPLICE IF BELOW	in =	12.00	
HOOK EMBED INTO FTG	in =		9.14

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

Footing Design Results

		Toe	Heel
Factored Pressure	=	2,048	805 psf
Mu' : Upward	=	27,528	5,819 ft-#
Mu' : Downward	=	3,970	15,821 ft-#
Mu: Design	=	23,558	10,002 ft-#
Actual 1-Way Shear	=	49.47	36.41 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 5.25 in, #5@ 8.00 in, #6@ 11.50 in, #7@ 15.50 in, #8@ 20.25 in, #9@ 25.
Heel: #4@ 9.00 in, #5@ 14.00 in, #6@ 19.75 in, #7@ 26.75 in, #8@ 35.25 in, #9@ 44
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

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Title : Tropicana Wash (S)
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Description....
13'-9" retaining wall

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Cantilevered Retaining Wall Design

Code: IBC 2009

Summary of Overturning & Resisting Forces & Moments

Item		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#		.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Heel Active Pressure	=	3,920.0	4.67	18,293.3	Soil Over Heel	= 5,801.3	8.25	47,860.3
Surcharge over Heel	=				Sloped Soil Over Heel	=		
Toe Active Pressure	=	-27.3	0.42	-11.4	Surcharge Over Heel	=		
Surcharge Over Toe	=				Adjacent Footing Load	=		
Adjacent Footing Load	=				Axial Dead Load on Stem	=		
Added Lateral Load	=				* Axial Live Load on Stem	=		
Load @ Stem Above Soil	=				Soil Over Toe	=		
Seismic Earth Load	=	1,248.0	8.40	10,483.1	Surcharge Over Toe	=		
					Stem Weight(s)	= 2,062.5	6.00	12,375.0
					Earth @ Stem Transitions	=		
Total	=	5,140.6	**O.T.M.** =	28,765.0	Footing Weight	= 1,875.0	5.00	9,375.0
Resisting/Overturning Ratio			=	**2.51**	Key Weight	= 450.0	6.00	2,700.0
Vertical Loads used for Soil Pressure	=	10,188.8 lbs			Vert. Component	=		
					Total =	10,188.8 lbs	**R.M.**=	72,310.3

If seismic included the min. OTM and sliding ratios may be 1.1 per IBC '09, 1807.2.3.

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

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Title : Tropicana Wash
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Description....
13'-9" retaining wall

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Cantilevered Retaining Wall Design

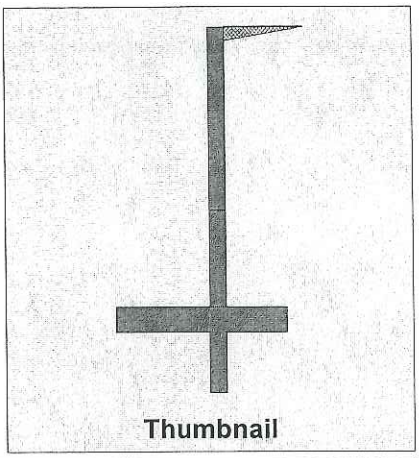
Code: IBC 2009

Criteria

Retained Height	=	13.75 ft
Wall height above soil	=	0.00 ft
Slope Behind Wall	=	0.00 : 1
Height of Soil over Toe	=	0.00 in
Water height over heel	=	0.0 ft

Soil Data

Allow Soil Bearing	=	2,500.0 psf
Equivalent Fluid Pressure Method		
Heel Active Pressure	=	40.0 psf/ft
Toe Active Pressure	=	35.0 psf/ft
Passive Pressure	=	250.0 psf/ft
Soil Density, Heel	=	130.00 pcf
Soil Density, Toe	=	120.00 pcf
Footing||Soil Friction	=	0.350
Soil height to ignore for passive pressure	=	0.00 in



Surcharge Loads

Surcharge Over Heel	=	100.0 psf
Used To Resist Sliding & Overturning		
Surcharge Over Toe	=	0.0 psf
Used for Sliding & Overturning		

Axial Load Applied to Stem

Axial Dead Load	=	0.0 lbs
Axial Live Load	=	0.0 lbs
Axial Load Eccentricity	=	0.0 in

Lateral Load Applied to Stem

Lateral Load	=	0.0 #/ft
...Height to Top	=	0.00 ft
...Height to Bottom	=	0.00 ft
The above lateral load has been increased by a factor of		1.00
Wind on Exposed Stem	=	0.0 psf

Adjacent Footing Load

Adjacent Footing Load	=	0.0 lbs
Footing Width	=	0.00 ft
Eccentricity	=	0.00 in
Wall to Ftg CL Dist	=	0.00 ft
Footing Type		Line Load
Base Above/Below Soil at Back of Wall	=	0.0 ft
Poisson's Ratio	=	0.300

Design Summary

Wall Stability Ratios

Overturning	=	3.04 OK
Sliding	=	1.24 Ratio < 1.5!
Total Bearing Load	=	10,994 lbs
...resultant ecc.	=	2.15 in
Soil Pressure @ Toe	=	1,217 psf OK
Soil Pressure @ Heel	=	981 psf OK
Allowable	=	2,500 psf
Soil Pressure Less Than Allowable		
ACI Factored @ Toe	=	1,704 psf
ACI Factored @ Heel	=	1,374 psf
Footing Shear @ Toe	=	45.0 psi OK
Footing Shear @ Heel	=	34.8 psi OK
Allowable	=	94.9 psi

Sliding Calcs (Vertical Component NOT Used)

Lateral Sliding Force	=	4,934.2 lbs
less 100% Passive Force	= -	2,257.8 lbs
less 100% Friction Force	= -	3,847.8 lbs
Added Force Req'd	=	0.0 lbs OK
....for 1.5 : 1 Stability	=	1,295.7 lbs NG

Load Factors

Building Code	IBC 2009
Dead Load	1.200
Live Load	1.600
Earth, H	1.600
Wind, W	1.600
Seismic, E	1.000

Stem Construction

		Top Stem	2nd
Design Height Above Ftg	ft =	Stem OK 4.75	Stem OK 0.00
Wall Material Above "Ht"	=	Concrete	Concrete
Thickness	=	12.00	12.00
Rebar Size	=	# 5	# 6
Rebar Spacing	=	12.00	6.00
Rebar Placed at	=	Edge	Edge
Design Data			
fb/FB + fa/Fa	=	**0.736**	**0.899**
Total Force @ Section	lbs =	3,035.1	6,726.9
Moment....Actual	ft-# =	9,769.8	32,383.0
Moment.....Allowable	ft-# =	13,282.3	36,040.0
Shear.....Actual	psi =	25.9	57.5
Shear.....Allowable	psi =	94.9	94.9
Wall Weight	psf =	150.0	150.0
Rebar Depth 'd'	in =	9.75	9.75
LAP SPLICE IF ABOVE	in =	13.61	19.95
LAP SPLICE IF BELOW	in =	13.61	
HOOK EMBED INTO FTG	in =		8.88

Lap splice above base reduced by stress ratio
Hook embedment reduced by stress ratio

Masonry Data

f'm	psi =	
Fs	psi =	
Solid Grouting	=	
Modular Ratio 'n'	=	
Short Term Factor	=	
Equiv. Solid Thick.	=	
Masonry Block Type	=	Medium Weight
Masonry Design Method	=	ASD

Concrete Data

f'c	psi =	4,000.0	4,000.0
Fy	psi =	60,000.0	60,000.0

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Cantilevered Retaining Wall Design

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Footing Dimensions & Strengths

Toe Width	=	5.50 ft
Heel Width	=	4.50
Total Footing Width	=	10.00
Footing Thickness	=	15.00 in
Key Width	=	12.00 in
Key Depth	=	36.00 in
Key Distance from Toe	=	5.50 ft

f'c = 4,000 psi Fy = 60,000 psi
Footing Concrete Density = 150.00 pcf
Min. As % = 0.0018
Cover @ Top 2.00 @ Btm.= 3.00 in

Footing Design Results

		Toe	Heel
Factored Pressure	=	1,704	1,374 psf
Mu' : Upward	=	24,862	8,651 ft-#
Mu' : Downward	=	3,970	17,916 ft-#
Mu: Design	=	20,892	9,264 ft-#
Actual 1-Way Shear	=	44.98	34.84 psi
Allow 1-Way Shear	=	94.87	94.87 psi

Toe Reinforcing = # 4 @ 6.00 in
Heel Reinforcing = # 4 @ 12.00 in
Key Reinforcing = # 4 @ 0.00 in

Other Acceptable Sizes & Spacings

Toe: #4@ 5.25 in, #5@ 8.25 in, #6@ 11.50 in, #7@ 15.75 in, #8@ 20.75 in, #9@ 26.
Heel: #4@ 9.00 in, #5@ 14.00 in, #6@ 19.75 in, #7@ 26.75 in, #8@ 35.25 in, #9@ 44
Key: #4@ 12.50 in, #5@ 19.25 in, #6@ 27.25 in, #7@ 37.25 in,

Summary of Overturning & Resisting Forces & Moments

		.....OVERTURNING..... Force lbs	Distance ft	Moment ft-#			.....RESISTING..... Force lbs	Distance ft	Moment ft-#
Item									
Heel Active Pressure	=	4,500.0	5.00	22,500.0	Soil Over Heel	=	6,256.3	8.25	51,614.1
Surcharge over Heel	=	461.5	7.50	3,461.5	Sloped Soil Over Heel	=			
Toe Active Pressure	=	-27.3	0.42	-11.4	Surcharge Over Heel	=	350.0	8.25	2,887.5
Surcharge Over Toe	=				Adjacent Footing Load	=			
Adjacent Footing Load	=				Axial Dead Load on Stem	=			
Added Lateral Load	=				* Axial Live Load on Stem	=			
Load @ Stem Above Soil	=				Soil Over Toe	=			
					Surcharge Over Toe	=			
					Stem Weight(s)	=	2,062.5	6.00	12,375.0
					Earth @ Stem Transitions	=			
					Footing Weight	=	1,875.0	5.00	9,375.0
					Key Weight	=	450.0	6.00	2,700.0
					Vert. Component	=			
Total	=	4,934.2	O.T.M. =	25,950.1	Total =		10,993.8 lbs	R.M.=	78,951.6

Resisting/Overturning Ratio = 3.04
Vertical Loads used for Soil Pressure = 10,993.8 lbs

* Axial live load NOT included in total displayed, or used for overturning resistance, but is included for soil pressure calculation.

DESIGNER NOTES:

4. SUPPORTING INFORMATION (ON CD)

Site Investigation Photographs
Field Survey Information
Operation and Maintenance Plan
ESA Compliance
Topography

5. REFERENCE MATERIALS (ON CD)

Excerpts from the LOMR *for Hard Rock Casino Hotel (FEMA Case No 07-09-1179P)*: Approved FEMA flowrate, Hydraulics, Work Map Exhibit, WSPGW Model, HEC-2 Model, LOMR Workmap, WSPG Model, HEC-2 Model, Hydraulic Analysis Summary

Excerpts from the *Technical Drainage Study for Vegas Grand*: CCRFCD Concurrence, CCDDDS Approval, Tropicana Wash Figures Upstream of Confluence, HEC-RAS Model, WSPGW Models, HEC-RAS Station correlations, Improvement Plans

Excerpts from the *International Gaming Institute – Drainage Study*: CCRFCD Concurrence, CCPW Approval, Overtopping flows at Swenson Street and Flamingo Road Bridges

Excerpts from the *CCRFCD Hydrologic Criteria and Drainage Design Manual*: Super-Elevation Calculations

Excerpts from the *FEMA Code of Federal Regulations Title 44, Part 65.10(ii)*: Minimum Freeboard Elevations

Excerpts from the *HEC-RAS River Analysis System Hydraulic Manual* (2002): Contraction and Expansion Coefficients

CCPW 1979 Improvements of Swenson Street and Flamingo Road Bridge, R.E.H., 5/15/81

Terrible Herbst Casino (formerly Acapulco Inn) Improvement Plans, Richard J. Baughman, 9/28/79

6. IMPROVEMENT PLANS (ON CD)

Tropicana Wash at Swenson Street

7. ELECTRONIC FILES (ON CD)

Report PDF
HEC-RAS Model
WSPGW Model
Structural Calculations
Supporting Information
Reference Materials
Improvement Plans
GIS Shape Files