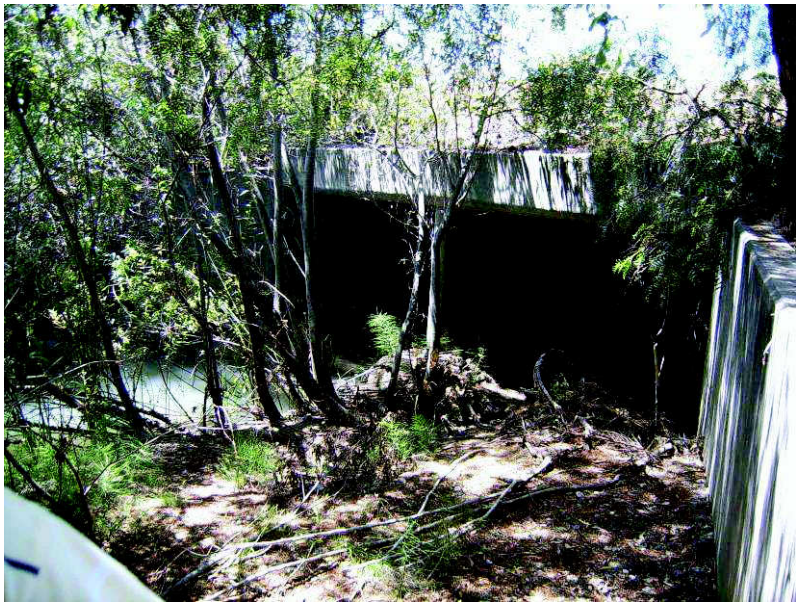
Los Osos Valley Road/US 101 Interchange Improvement Project
San Luis Obispo County, California

Revised Location Hydraulic Study Report



Prepared for:

Prepared by:

November 2010

Los Osos Valley Road/US 101 Interchange Improvement Project
San Luis Obispo County, California

Revised Location Hydraulic Study Report

Submitted to:
City of San Luis Obispo

This report has been prepared by or under the supervision of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and has judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

Han-Bin Liang, Ph.D., P.E.
Registered Civil Engineer

11/22/2010
Date

REGISTERED PROFESSIONAL ENGINEER
HAN-BIN LIANG
No. C 048404
Exp. 6/30/2012
CIVIL
STATE OF CALIFORNIA

November 2010

Table of Contents

Acronyms iv
1 General Description 1
1.1 Project Description 1
1.2 Project Location 1
1.3 Key Tasks 1
1.4 Design Standards 5
1.5 Creek, Stream, and River Crossings 5
1.6 Existing Bridge and Culverts 6
1.7 Description of Proposed Action 10
1.8 Traffic 14
1.9 Traffic Interruptions for Base Flood (Q_{100}) 14
2 Description of Watershed 15
2.1 Geographic Location 15
2.2 Receiving Water 15
2.3 Land Use 15
2.4 Vegetation 15
2.5 Historic Flooding 15
3 Discussion of Stream and Site 17
3.1 Stream Channel 17
3.2 Soils at Existing Bridge and Culvert 17
4 Hydrologic and Hydraulic Data 18
4.1 Hydrologic Stability 18
4.2 Federal Emergency Management Agency Data 18
4.3 Map of Floodplain 19
4.4 Base Flood (Q_{100}) Backwater Potential 21
4.5 San Luis Obispo Creek Waterway Management Plan 21
4.6 Froom Creek Hydrologic Analysis 21
4.7 On-Site Hydrology and Hydraulics 22
4.8 Prefumo Creek Commons Project 22
4.9 Design Discharges 24
5 Hydraulic Assessment 25
5.1 Design Tool 25
5.2 Cross Section Data 25
5.3 Manning's n Value 25
5.4 Expansion and Contraction Coefficient 26
5.5 Water Surface Elevations, Existing Condition 28
5.6 Proposed Condition 29
5.6.1 Adjustments to the Hydraulic Analyses 29
5.6.2 Water Surface Elevations, Proposed Condition 30
5.7 Proposed Condition with PCC Project 31
5.7.1 Adjustment to the Hydraulic Analyses 31
5.7.2 Water Surface Elevations, Proposed Condition with PCC Project 32
5.8 Discussion – Water Surface Elevations 33
5.9 Flow Velocities 35

6 Project Evaluation ... 39
6.1 Risk associated with implementation of the action ... 39
6.2 Impacts on natural and beneficial floodplain values ... 39
6.3 Support of probable incompatible floodplain development ... 40
6.4 Measures to minimize floodplain impacts associated with the action ... 40
6.5 Measures to restore and preserve the natural and beneficial floodplain values impacted by this action ... 40
6.6 Practicability of alternatives to any significant encroachments ... 41
6.7 Practicability of alternatives to any longitudinal encroachments ... 41
7 References ... 43

Figures

Figure 1. Project Location Map ... 2
Figure 2. Project Vicinity Map ... 3
Figure 3. Project Vicinity Map, Aerial View ... 4
Figure 4. Alternative 3, Plan View ... 11
Figure 5. Alternative 6, Plan View ... 13
Figure 6. Watershed Map, San Luis Obispo Creek ... 16
Figure 7. FEMA FIRM, San Luis Obispo County, California and Incorporated Areas ... 20
Figure 8. Project Footprint of Prefumo Creek Commons Project ... 23
Figure 9. HEC-RAS Model, Plan View ... 26
Figure 10. HEC-RAS Model, 3-D View ... 27
Figure 11. 100-year Water Surface Elevation Profiles, Existing, Proposed and Proposed Condition with PCC Project ... 33

Tables

Table 1. FEMA Flood Insurance Study Hydrologic Data ... 18
Table 2. FEMA Floodway Data ... 19
Table 3. Peak Flow Rates from Waterway Management Plan ... 21
Table 4. Peak Flow Rates, HEC-HMS Model ... 22
Table 5. On-Site Flows, Existing and Proposed Conditions ... 22
Table 6. Peak Discharges from Prefumo Creek Commons Project ... 23
Table 7. Manning's n Values Selected for the Hydraulic Model ... 25
Table 8. Water Surface Elevations, Existing Condition ... 28
Table 9. Change in Design Flows from the Project ... 29
Table 10. Design Flows, Proposed Condition ... 29
Table 11. Water Surface Elevations, Proposed Condition ... 30
Table 12. Added Peak Flows from Project and PCC Project ... 31
Table 13. Design Peak Flows, Proposed Condition with PCC Project ... 31
Table 14. Water Surface Elevations, Proposed Condition with PCC Project ... 32
Table 15. 100-year Water Surface Elevations, Existing Condition, Proposed Condition, and Proposed Condition with PCC Project ... 34
Table 16. Channel Flow Velocities, Existing Condition ... 35

Table 17. Channel Flow Velocities, Proposed Condition..... 36
Table 18. Channel Flow Velocities, Proposed Condition with PCC Project..... 37
Table 19. 100-year Channel Flow Velocities, Existing Condition, Proposed Condition, and Proposed Condition with PCC Project..... 38
Table 20. LOVR Longitudinal Encroachment Conditions – Alternative 3 41
Table 21. LOVR Longitudinal Encroachment Conditions – Alternative 6 42

Photos

Photo 1. Downstream of US 101 Off-ramp crossing Prefumo Creek..... 6
Photo 2. Upstream of the Existing US 101 Culvert Crossing at Prefumo Creek..... 7
Photo 3. Downstream of Middle Arch Culvert Crossing at San Luis Obispo Creek 8
Photo 4. Upstream of the Existing US 101 Culvert Crossing at Froom Creek..... 9
Photo 5. San Luis Obispo Creek, Downstream of Los Osos Valley Road Crossing..... 17

Appendices

Appendix A Summaries of Floodplain Encroachment
Appendix B Hydraulic Information
Appendix B.1 FEMA FIS and FIRM
Appendix B.2 San Luis Obispo County Waterway Management Plan
Appendix B.3 Prefumo Creek Commons Project
Appendix C Cross Section Locations for Hydraulic Model
Appendix D Runoff Pattern Modifications
Appendix E Hydraulic Analyses, Existing Condition
Appendix F Hydraulic Analyses, Proposed Conditions
Appendix F.1 Proposed Condition
Appendix F.2 Proposed Condition with Prefumo Creek Commons Project
Appendix G Communication Records
Appendix H Caltrans Comments and Reponses

Acronyms

Caltrans	California Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HEC-HMS	Hydrologic Engineering Center's Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
LOVR	Los Osos Valley Road
NGVD	National Geodetic Vertical Datum
NAVD	North American Vertical Datum
NB	Northbound
NOAA	National Oceanic and Atmospheric Administration
PCC	Prefumo Creek Commons
PDP	Project Development Team
Project	US 101/Los Osos Valley Road Interchange Improvement Project
RCB	Reinforced Concrete Box
SB	Southbound
SBUH	Santa Barbara Unit Hydrograph
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WMP	The City and County of San Luis Obispo's Waterway Management Plan
WSE	Water Surface Elevation

1 GENERAL DESCRIPTION

1.1 Project Description

The purpose of this study is to perform a floodplain risk assessment and recommend mitigation measures for the proposed improvements of the Los Osos Valley Road (LOVR)/US 101 interchange in the City of San Luis Obispo. The improvements are proposed by the City of San Luis Obispo, the California Department of Transportation (Caltrans) and the Federal Highway Administration (FHWA). This project is currently in the Project Approval/Environmental Document phase, and the lead consultant for the interchange design is Dokken Engineering. WRECO is the hydrology and hydraulics subconsultant.

1.2 Project Location

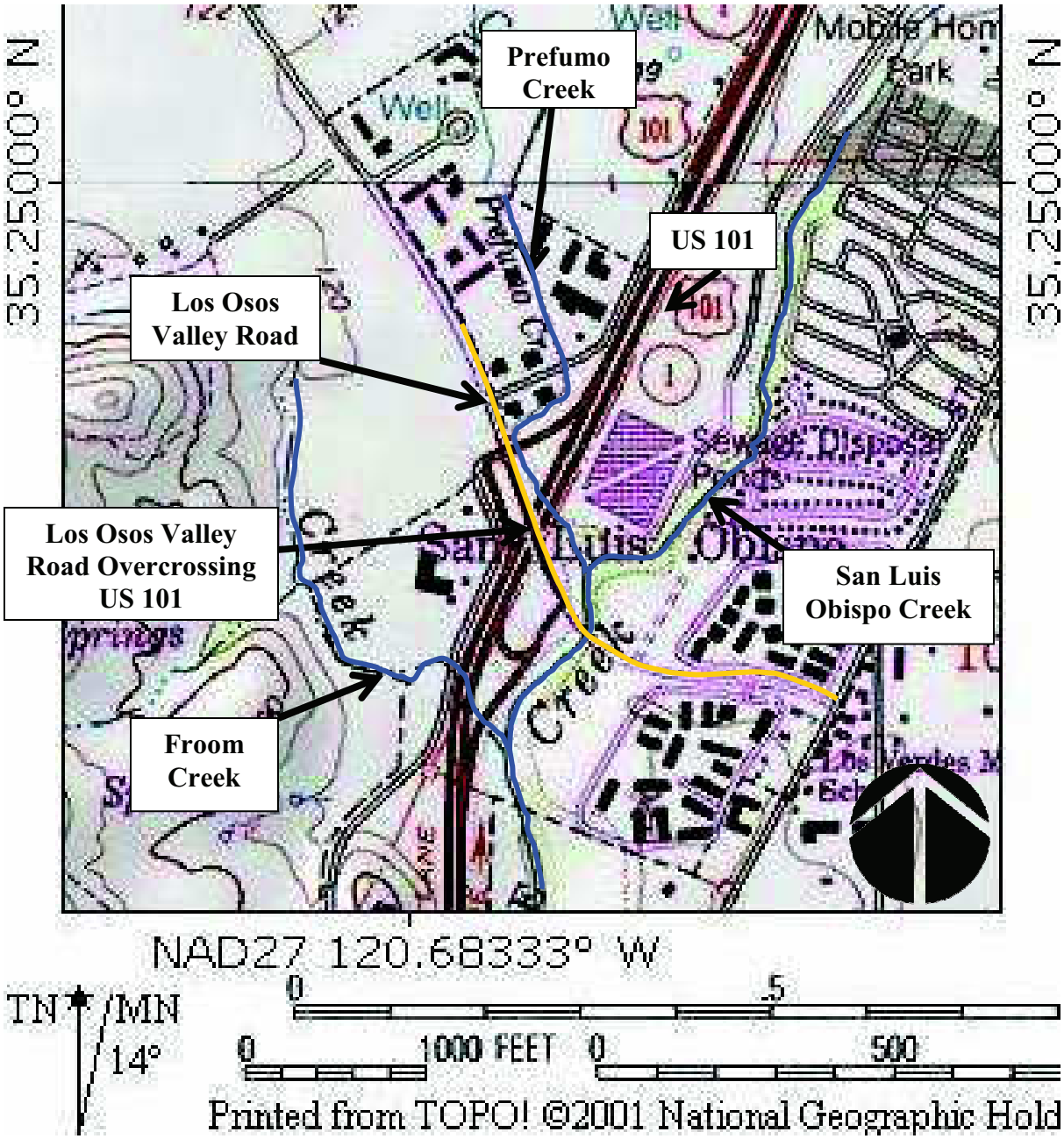
The LOVR/US 101 Interchange Improvement Project (Project) is located in the City of San Luis Obispo, California (see Figure 1 for Project Location Map). The Project limits extend along LOVR between Auto Park Way to the west and South Higuera Street to the east and along US 101, approximately 2,500 feet (ft) south and 4,300 ft north of the LOVR overcrossing. The Project covers a distance of 0.52 miles (mi) (see Figure 2 and Figure 3 for a vicinity map and an aerial map).

1.3 Key Tasks

This study performed floodplain risk assessments for the following bridge/culvert crossings: LOVR over San Luis Obispo Creek, US 101 over Prefumo Creek, the US 101 southbound (SB) off-ramp over Prefumo Creek, and US 101 over Froom Creek. For each bridge/culvert, the key tasks included: performing a hydraulic analysis to determine the peak discharges, water surface elevations (WSEs), and flow velocities for the existing, proposed project, and proposed project with the recently approved 18-acre (ac) Prefumo Creek Commons (PCC) development in the Prefumo Creek watershed upstream from the US 101/LOVR interchange.

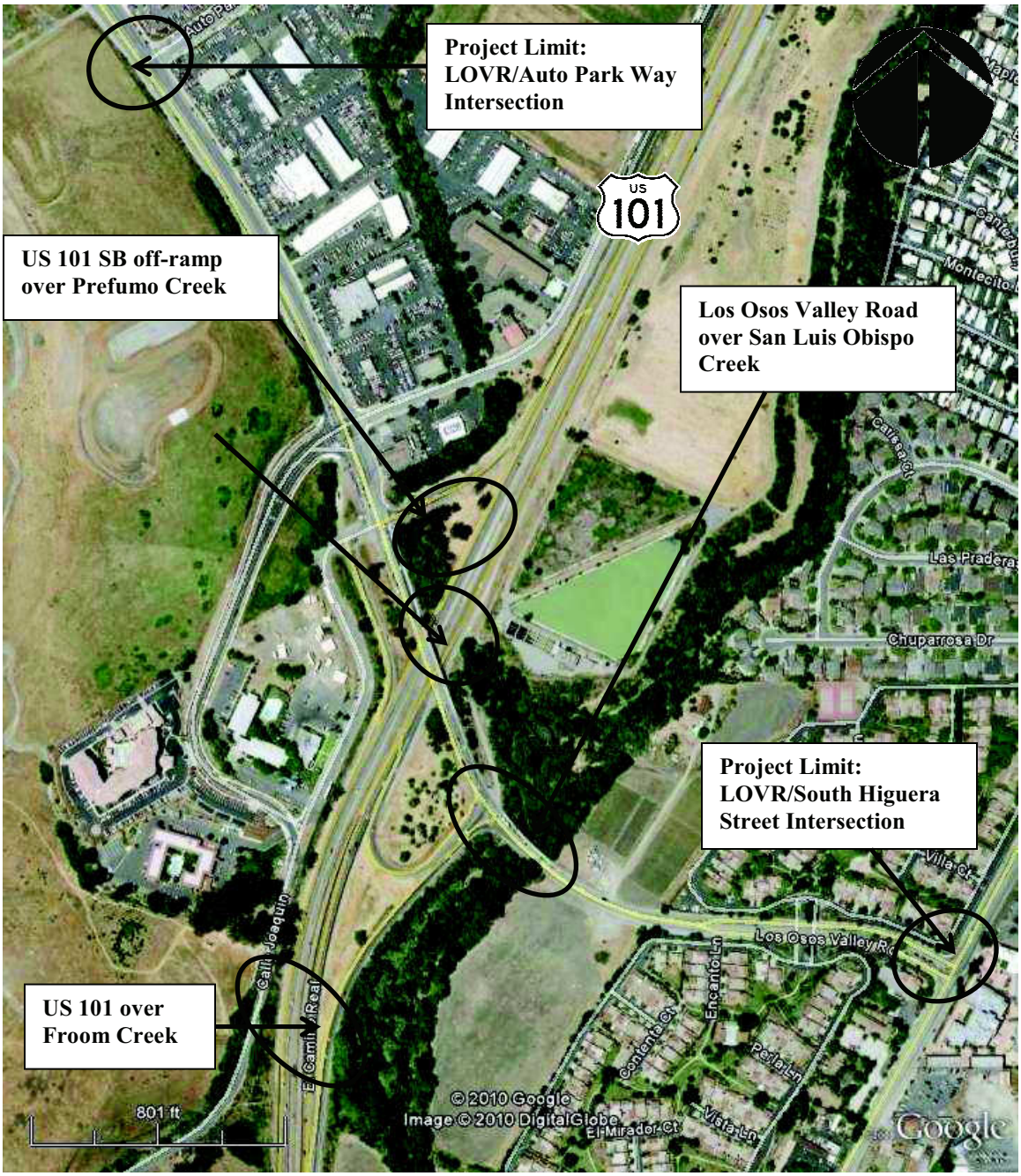
Source: United States Geological Survey (USGS)

Figure 1. Project Location Map



Source: USGS

Figure 2. Project Vicinity Map



Source: Google Earth, Imagery Date: July 2007

Figure 3. Project Vicinity Map, Aerial View

1.4 Design Standards

The City of San Luis Obispo design standards for bridges and culverts follow Caltrans design standards. According to the Caltrans design criteria, the basic criterion for hydraulic design of bridges is that designs pass the 2% probability flood (50-year flood). Freeboard, often assumed to be 2 ft at the preliminary bridge design, should be sufficient to pass the 1% probability flood (100-year flood). Caltrans design criteria for culverts requires the design to meet two primary design criteria: 1) pass the 10% probability flood (10-year flood) without causing the headwater elevation to rise above the inlet top of the culvert end; and 2) pass the 1% probability flood (100-year flood) without headwater rising above an elevation that would cause objectionable backwater depths or outlet velocities. When it is economically infeasible to provide the facilities to pass peak discharges, as suggested by the criteria above, the selection of a design flood with a lesser peak discharge may be warranted.

In addition, design of the hydraulic structures should comply with the design standards specified in the Drainage Design Manual in the Waterway Management Plan of San Luis Obispo Creek Watershed (City and County of San Luis Obispo, 2003). The latter document specifies channel design flows of streams necessary for the 100-year storm event. It also includes guidelines for the integrated management and maintenance of the natural stream corridors of the Project location.

This Project does not propose to replace any of the hydraulic structures within the US 101/LOVR interchange. Additional flows into Prefumo and San Luis Obispo creeks due to the fact that widening of the LOVR and the PCC project are considered incidental, accounting for an increase of less than 0.5% of the flows in these creeks.

The prior version of this report, dated April 2008, presented improvements to Prefumo Creek under US 101 that would provide the capacity to pass the 25-year flood under US 101. However, in order to pass the 25-year flood, sediment removal downstream on San Luis Obispo Creek is necessary. During discussions with the National Oceanic and Atmospheric Administration (NOAA) in 2009, they discouraged the removal of sediment in the creek bed. Without the removal of sediment, the backwater condition downstream of the Prefumo Creek US 101 culverts cannot be improved. During final design of the culverts, it was determined that difficult soil conditions for boring under US 101 and the upstream creek reconstruction costs to comply with NOAA requests made the cost of the two bore and jack culverts approximately 75% of the cost to replace the existing box culvert with a slab bridge for US 101. The combined cost of the culverts, minimal additional flow from the Project and the diminished effectiveness resulted in the project deletion of this feature.

1.5 Creek, Stream, and River Crossings

Three creeks have been identified within the Project limits: San Luis Obispo Creek, Prefumo Creek, and Froom Creek (see Figure 2 and Figure 3).

1.6 Existing Bridge and Culverts

A total of three cross culverts and one bridge were identified within the Project limits. Prefumo Creek flows underneath the US 101 SB off-ramp and US 101 mainline in a double 12 ft x 8 ft reinforced concrete box (RCB) cross culvert and an 18 ft x 8 ft RCB cross culvert, respectively. Froom Creek flows underneath US 101 inside a 5 ft x 5ft RCB cross culvert. San Luis Obispo Creek travels under a four-span concrete arch bridge supporting LOVR. The general specifications of the cross culverts and bridge within the Project limits are summarized below:

49-0062K	**US 101 SB off-ramp over Prefumo Creek**
Alignment:	The creek has a sharp bend as it enters the culvert from the upstream end.
Culvert Length:	73.7 ft
Lanes:	2
Structure:	Double 12 ft x 8 ft RCB culvert (a bridge as defined by Caltrans)
Capacity:	It overtops during storm events greater than the 10-year event.

Photo 1. Downstream of US 101 Off-ramp crossing Prefumo Creek

49-0062	**US 101 over Prefumo Creek**
Alignment:	The existing culvert is aligned to the creek flow direction with an approximately 30° skew.
Culvert Length:	165 ft
Lanes:	4
Structure:	Single 18 ft x 8 ft RCB culvert (a bridge as defined by Caltrans)
Capacity:	It overtops during storm events greater than the 10-year event.

Photo 2. Upstream of the Existing US 101 Culvert Crossing at Prefumo Creek

49-185	**Los Osos Valley Road over San Luis Obispo Creek**
Alignment:	The existing culvert is aligned parallel to the creek flow direction.
Bridge Width:	58.3 ft
Lanes	3 (2 through lanes and 1 left turn lane)
Structure:	Three 36 ft x 22 ft corrugated metal plate arch culverts (a bridge)
Capacity:	It passes the 100-year event.

Photo 3. Downstream of Middle Arch Culvert Crossing at San Luis Obispo Creek

US 101 over Froom Creek

Alignment:	The existing culvert is aligned perpendicularly to the creek flow direction with an approximately 45° skew from US 101.
Length:	400 ft
Lanes	4
Structure:	Double 5'x 5' RCB culvert
Capacity:	It overtops during the 10-year event.

Photo 4. Upstream of the Existing US 101 Culvert Crossing at Froom Creek

1.7 Description of Proposed Action

The Project Development Team (PDT) has identified two viable build alternatives that satisfy the Project's purpose and need. The major differences between the alternatives relate to the type and location of the SB on-/off-ramps and the configuration of the northbound on-/off-ramp intersection with LOVR. Brief descriptions of the two alternatives are as follows:

Alternative 3 – Minimum Build

Alternative 3 is the minimum build alternative for this Project (see Figure 4). This alternative proposes to widen LOVR between the recently constructed Calle Joaquin intersection with LOVR, west of US 101 and the Los Verdes community, and east of US 101, to four lanes; this would include the existing LOVR overcrossing structure and the San Luis Obispo Creek culvert crossing. The widening would be accomplished by constructing a separate US 101 overcrossing to carry the two eastbound lanes. LOVR would be a split profile over US 101 to accommodate the westbound lanes on the existing overcrossing. The Project would lengthen the San Luis Obispo Creek culvert crossing on the south side. These widening efforts would accommodate four 12-ft through lanes, bike lanes, sidewalks (on both sides), and a median 5 ft to 16 ft in width, which would be used for left-turn pockets where needed. The northbound US 101 off-ramp would be widened from the intersection with LOVR to a location 500 ft south. The SB on-ramp would be reconstructed near the current location opposite the SB off-ramp.

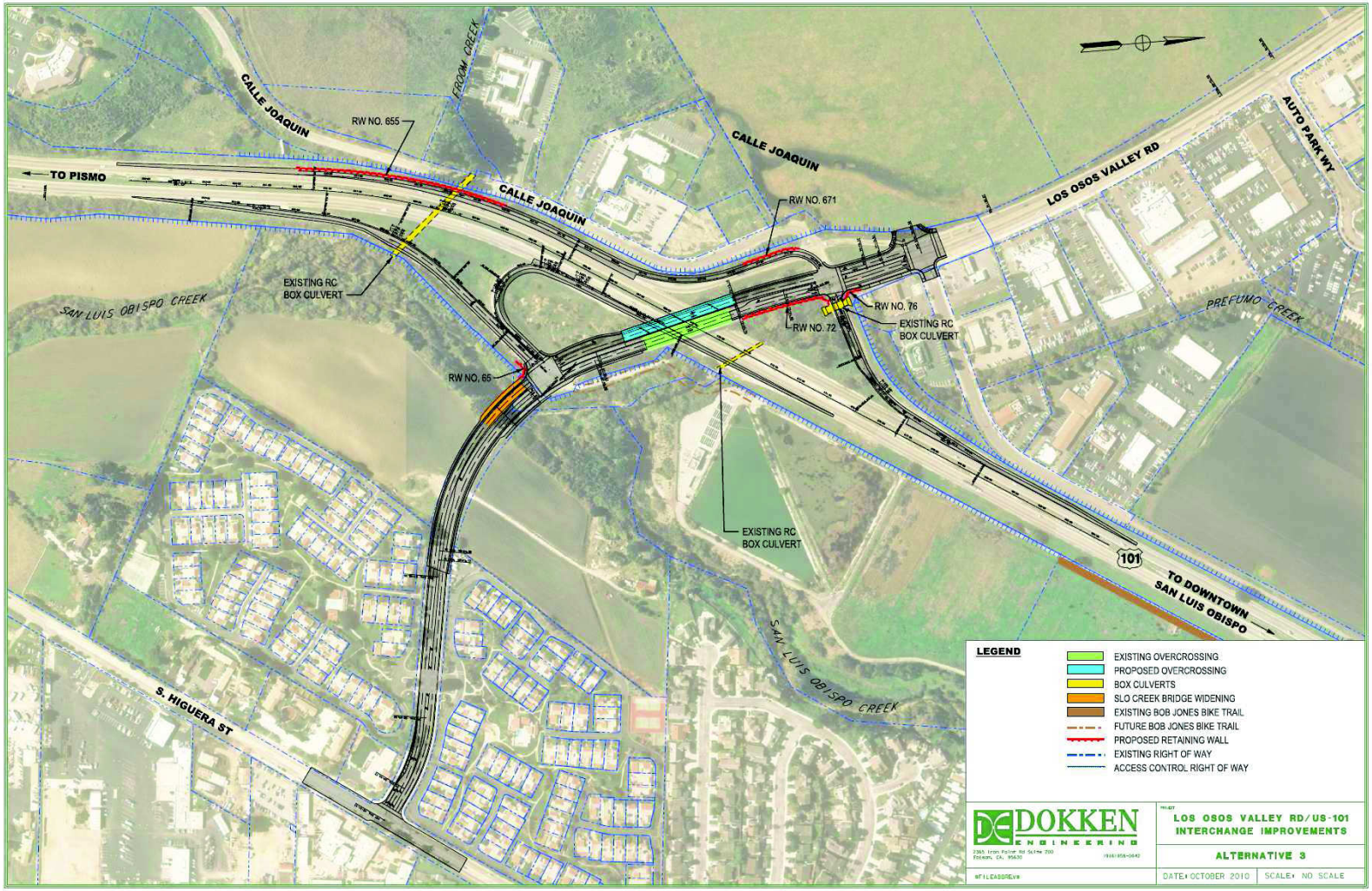


Figure 4. Alternative 3, Plan View

Source: Dokken Engineering

Alternative 6 – Moderate Build, Near Full Standard
This alternative proposes to widen LOVR between Calle Joaquin west and the Los Verdes Communities east of US 101 (see Figure 5). The existing LOVR overcrossing would be replaced to improve the profile, vertical clearance and space required for the SB hook off-ramp. The existing northbound (NB) loop on-ramp to US 101 would be reconstructed, and the NB off-ramp would be widened. A new NB diagonal on-ramp to US 101 would be added in the northeast quadrant of the interchange as a phased improvement. An auxiliary lane would be added to NB US 101 beginning at the terminus of the NB loop on-ramp and ending 1,000 ft beyond the terminus of the NB diagonal on-ramp. The NB diagonal on-ramp would be supported by retaining walls and an additional bridge over Prefumo Creek. The existing SB on- and off-ramps from US 101 would be removed. South of LOVR, new SB on- and off-ramps from US 101 would be constructed in a "Hook Ramp" configuration. Calle Joaquin, south of LOVR, would be re-aligned to accommodate the realigned SB US 101 ramps and to create a "Four-Leg" intersection with Calle Joaquin north of LOVR.

Under both build alternatives, the LOVR San Luis Obispo Creek Arch Culvert would be modified. The existing three-barrel structural steel plate arch culvert is a large and modern structure (constructed in 1986), carrying LOVR over San Luis Obispo Creek. This Project would widen and raise the roadway. These roadway improvements require extending the culvert with a new structural steel arch (matching the existing), as well as increasing the loading on the existing culvert, which would remain in place. As-built plans that show the structures in detail are available for the existing culvert.

To determine the feasibility of this increased loading, a structural analysis was made using the current American Association of State Highway and Transportation Officials culvert design criteria. The analysis showed that the existing culvert can easily carry the additional load. Therefore, lengthening the culvert is a viable alternative. It is probably also the least expensive.

Alternative 6 would build a new SB off-ramp adjacent to the highway, so the existing culvert would not be modified or removed. Construction alternatives would not impact the existing Froom Creek culvert crossing US 101.

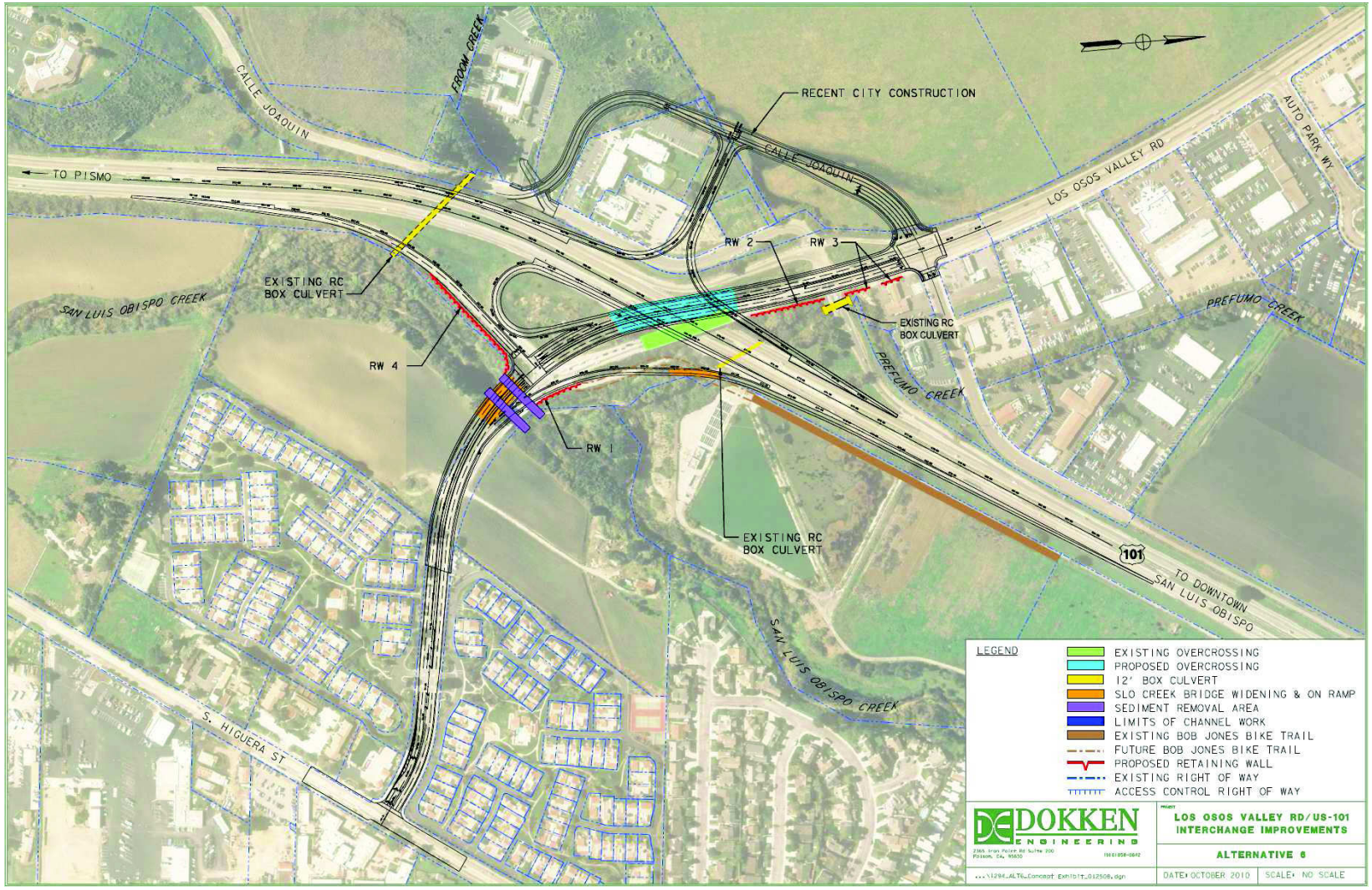


Figure 5. Alternative 6, Plan View

Source: Dokken Engineering

1.8 Traffic

The annual average daily traffic for US 101 at the LOVR interchange is approximately 63,000 vehicles per day (Caltrans, 2007).

- Emergency Supply or Evacuation Route Yes
- Emergency Vehicle Access Yes
- Practical Detour Route Yes
- School Bus or Mail Route Yes

1.9 Traffic Interruptions for Base Flood (Q_{100})

The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Map (FIRM) for San Luis Obispo County and Incorporated Areas shows that base flood conditions would cause Prefumo Creek to inundate US 101 and the US 101 SB off-ramp; there would be possible backwater from San Luis Obispo Creek under the conditions of a base flood. The FIRM indicates that the LOVR overcrossing would not be overtopped with the base flood. However, it shows that the intersection of Calle Joaquin and LOVR immediately after crossing US 101 would be inundated in a 100-year storm event. In a 100-year storm event, both US 101 and LOVR would be inaccessible by the traffic. Therefore, under the existing conditions, flooding from San Luis Obispo Creek, Prefumo Creek, and Froom Creek would impact traffic during a 100-year storm event.

2 DESCRIPTION OF WATERSHED

2.1 Geographic Location

The studied bridges and culverts are located in the San Luis Obispo Creek Watershed, which is approximately 84 square miles (mi^2) at the outfall to the Pacific Ocean. The area of watershed influencing the Project site is approximately 46 mi^2 (Questa, 2002). San Luis Obispo Creek originates approximately 9 mi upstream of the Project site. Prefumo Creek and Froom Creek are both tributaries to San Luis Obispo Creek. Prefumo Creek begins at Laguna Lake, located 1 mi upstream of the Project site. Froom Creek begins 3.4 mi upstream of the Project site. The confluence of San Luis Obispo Creek and Prefumo Creek occurs approximately 390 ft upstream of the LOVR bridge over San Luis Obispo Creek. The Froom Creek confluence with San Luis Obispo Creek occurs approximately 1,200 ft downstream of the LOVR crossing with San Luis Obispo Creek.

2.2 Receiving Water

The receiving waters within the Project limits are San Luis Obispo Creek, Prefumo Creek, and Froom Creek. Both Prefumo and Froom Creeks discharge to San Luis Obispo Creek within the Project limits. San Luis Obispo Creek discharges to the Pacific Ocean at Avila Beach, approximately 7 mi downstream of the Project site.

2.3 Land Use

In general, the areas surrounding the LOVR/US 101 interchange consist of suburban residential land and open space. The land uses north and east of the Project site include suburban expansion of the City of San Luis Obispo, which includes mostly low-density residential development and some farmland. West and south of the Project site, there is mainly open space.

2.4 Vegetation

The San Luis Obispo Creek corridor has continuous riparian vegetation cover consisting largely of mixed willows, with Hinds Walnut, Black Cottonwood, California Sycamore, and Eucalyptus. At the Project site, creeks have dense vegetation cover, and the ground is obscured.

2.5 Historic Flooding

Flooding within the San Luis Obispo Creek system is generally caused by intense Pacific storm systems during the months of December through March. San Luis Obispo Creek responds very quickly to short, high-intensity rainfall bursts, which tend to result in high magnitude and relatively short duration floods. According to the 1981 FEMA Flood Insurance Study (FIS), seven damaging floods have occurred in the San Luis Obispo Creek drainage area between 1884 and 1973. The most serious of those floods were in January 1969 and February 1973; they caused $1.5 million and $4.5 million in damage, respectively. In addition, there was a 1995 flood that overtopped US 101 in the proposed

Project site. The 1995 flood event caused approximately $2.3 million in damage and $1 million to repair bank erosion (City and County of San Luis Obispo, 2003).

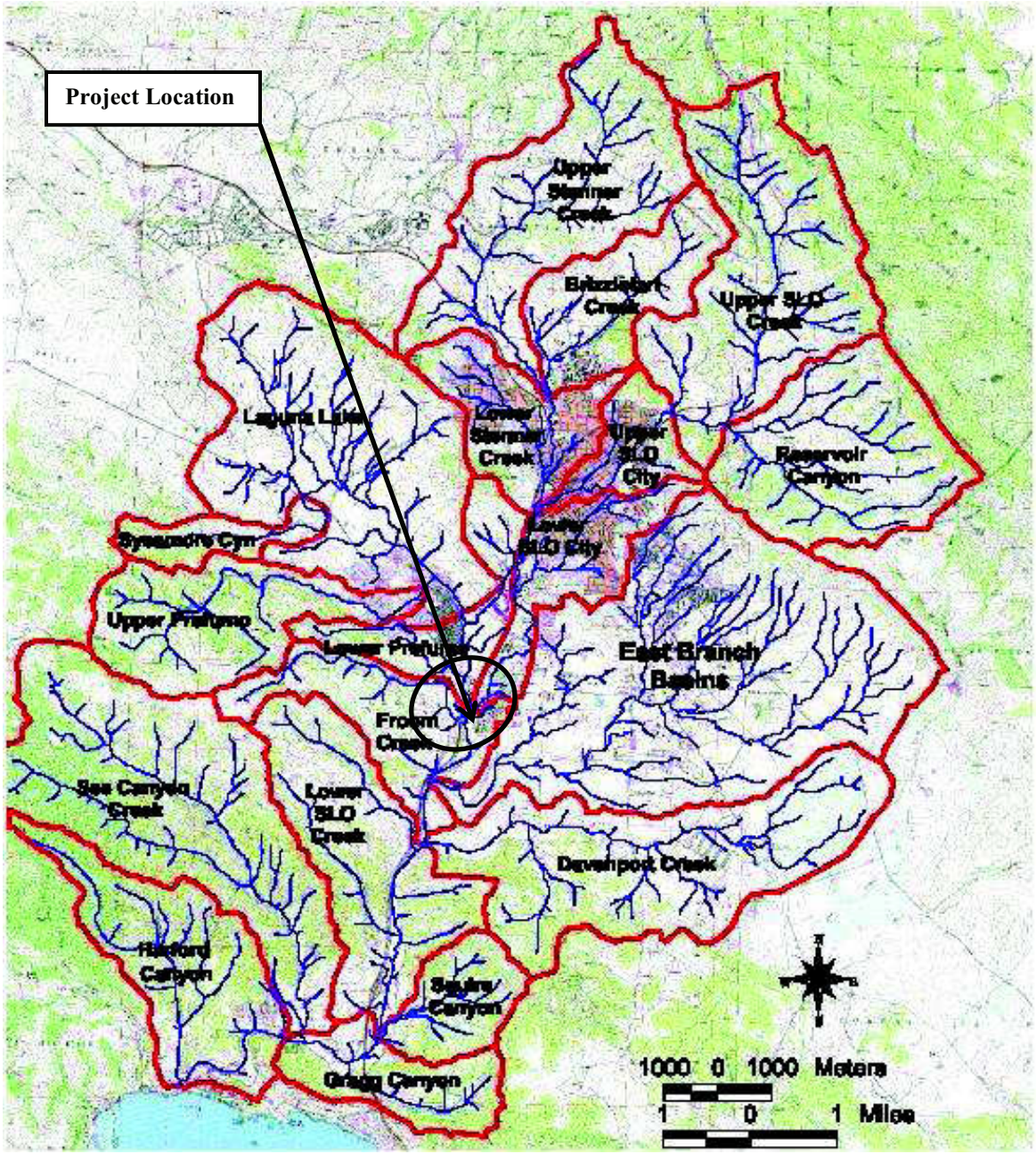


Figure 6. Watershed Map, San Luis Obispo Creek

Source: City and County of San Luis Obispo, 2003

3 DISCUSSION OF STREAM AND SITE

3.1 Stream Channel

San Luis Obispo Creek flows north to south as it crosses LOVR. It makes a sharp bend upstream of the LOVR crossing. With the exception of the 1978 widening, performed immediately upstream of the Prefumo Creek confluence, San Luis Obispo Creek remains in its natural state throughout the Project site (see Photo 5).

Prefumo Creek also flows from north to south through the Project site. Prefumo Creek runs through a trapezoidal earthen channel. The creek is sensitive to local developments. Upstream of Prefumo Creek is Laguna Lake, which functions as a detention basin during large flooding events. Therefore, only the watershed area below the lake is responsible for the flooding of Prefumo Creek.

Froom Creek is a relatively small creek flowing from west to east with a drainage area of approximately 1.7 mi^2. During flooding events, it is possible for Froom Creek to spill over its banks and flow into the Prefumo Creek watershed.

Photo 5. San Luis Obispo Creek, Downstream of Los Osos Valley Road Crossing

3.2 Soils at Existing Bridge and Culvert

According to the *Soil Survey of San Luis Obispo County*, soil at the US 101 crossing is a mix of Cropley Clay and Salinas Silty Clay Soil; at the San Luis Obispo Creek crossing, it is mostly Salinas Silty Clay (United States Department of Agriculture, Natural Resources Conservation Service, accessed May 14, 2007).

4 HYDROLOGIC AND HYDRAULIC DATA

4.1 Hydrologic Stability

As stated earlier, the San Luis Obispo Creek watershed at the Project site has an area of approximately 46 mi^2. The watershed at the Project site is composed of suburban city developments and open field. The regional growth in the watershed area is insignificant, according to the 2002 hydrologic/hydraulic analysis conducted by Questa Engineering for the City and County of San Luis Obispo. They found that, since the early 1960s the flow in San Luis Obispo Creek during the 100-year flood event has only increased by a small percentage. For this study, we compared design flows from FEMA and the City and County of San Luis Obispo. The PCC project is a recently proposed development located north of the US 101/LOVR interchange. WRECO will investigate the potential impacts from the PCC project to the proposed interchange improvement project.

4.2 Federal Emergency Management Agency Data

Flows for San Luis Obispo Creek and Prefumo Creek were provided in the FIS, San Luis Obispo County and Incorporated Areas (FEMA, 2008). FEMA flows for Froom Creek are unavailable. The flow rates in the 2008 FIS were not updated from the 1981 FIS. Table 1 shows the 10-, 50-, and 100-year flows of San Luis Obispo and Prefumo creeks at the Project site. Table 2 shows the base flood (100-year flood or Q_{100}) WSE of San Luis Obispo Creek in the Project vicinity. The Froom Creek and Prefumo Creek confluences with San Luis Obispo Creek are approximately 39,000 ft and 40,000 ft upstream of San Luis Obispo Bay, respectively.

Table 1. FEMA Flood Insurance Study Hydrologic Data

Flooding Source and Location	Drainage Area (mi^2)	Peak Discharge (cfs)		
		10-year	50-year	100-year
San Luis Obispo Creek				
Upstream of Confluence of Prefumo Creek	26.4	4,100	9,800	12,900
Downstream of Confluence of Prefumo Creek	42.6	4,300	10,300	13,500
Prefumo Creek				
Upstream of Confluence of San Luis Obispo Creek	14.3	1,000	2,400	3,100

Source: FEMA, 1981 & 2008

Table 2. FEMA Floodway Data

Distance Above San Luis Obispo Bay (Pacific Ocean) (ft)	Water Surface Elevation (ft, NAVD*)	Base Flood Width (ft)
2,640	16.9	360.0
38,016	102.5	214.0
38,886	104.6	144.0
40,128	112.0	206.0
41,184	114.9	183.0
42,082	117.9	163.0
42,678	120.9	192.0
43,718	126.9	80.0

Source: FEMA, 1981 & 2008

*Vertical datum in FEMA FIS was National Geodetic Vertical Datum (NGVD). A conversion factor of 2.87 ft was used to convert from NGVD to North American Vertical Datum (NAVD).

4.3 Map of Floodplain

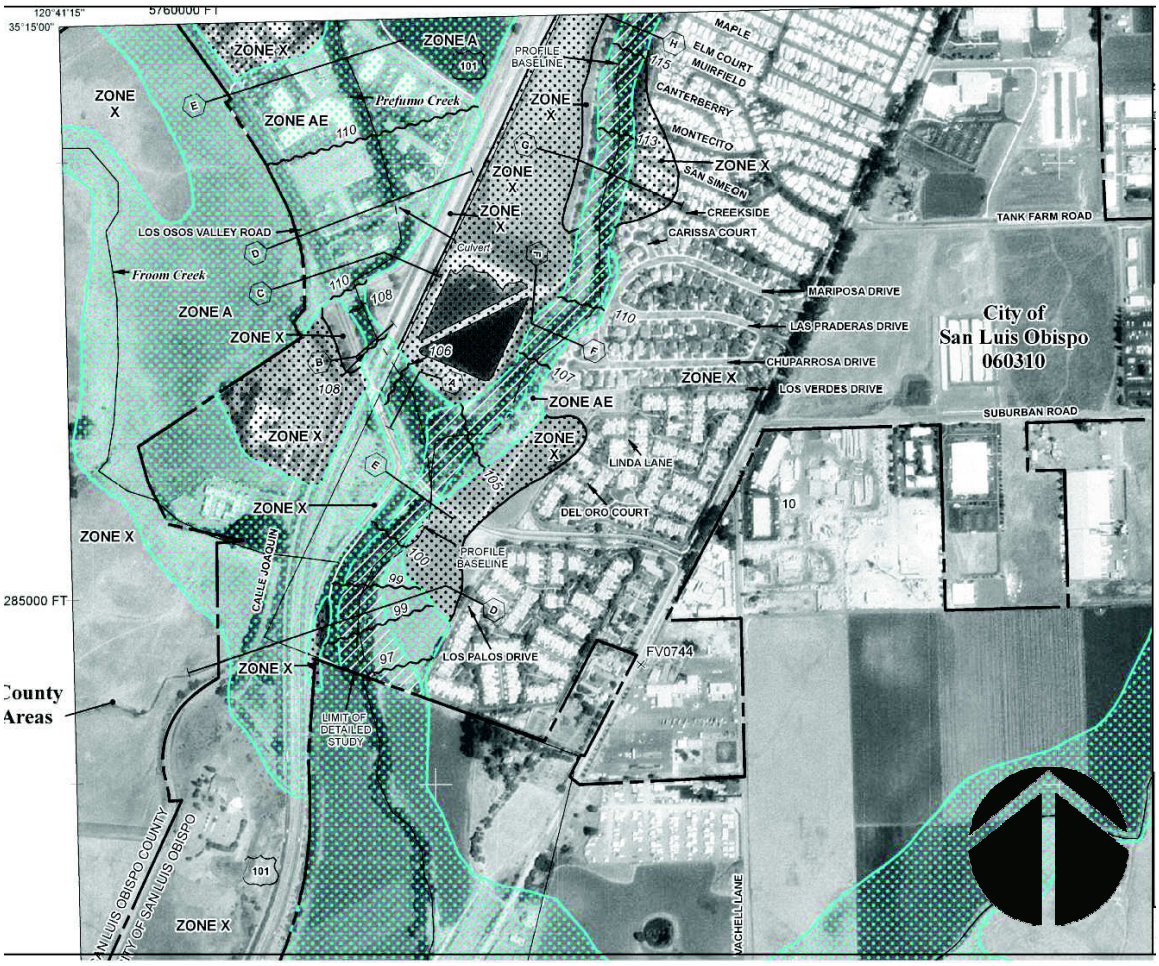
The FEMA FIRM at the Project location shows the limits of the 100-year floodplain at the Project site (see Figure 7). The majority of the Project site is classified as Zone A and Zone AE, but some areas are classified as Zone X (shaded) and Zone X (unshaded).

Zone AE is a Special Flood Hazard Area, which would be inundated by the 100-year (base) flood; base flood elevations are shown in the FIRM. A floodplain is classified as a Zone AE floodplain when the areas are inundated by the base flood and determined by using the detailed method.

Zone A is a Special Flood Hazard Area that would be inundated by the 100-year flood. FEMA determined this by approximate methods; no base flood elevations are shown in the FIRM.

Zone X (shaded) is an area between Zone A and the limits of the 500-year floodplain. Zone X (shaded) includes conditions such as: areas in the 500-year floodplain protected from the 100-year flood by water control structure; 100-year flooding less than 1.0 ft, and 100-year flooding from the sources with drainage areas less than 1 mi^2. There is no subdivision in Zone X (shaded). The floodplain between US 101 and San Luis Obispo Creek is located in Zone X (shaded).

Zone X (unshaded) is an area of minimal flooding. Zone X (unshaded) includes LOVR at the US 101 overcrossing and the areas containing suburban developments within the Project limits. Additionally, most of residential developments near the Project site are located in Zone X (unshaded).



Not to scale
Source: FEMA, 2008

Figure 7. FEMA FIRM, San Luis Obispo County, California and Incorporated Areas

4.4 Base Flood (Q_{100}) Backwater Potential

According to the FEMA FIRM, the base flood (100-year storm event, or Q_{100}) has the potential to inundate a large area within the Project site. Although most of the area covered by the base flood is unused open space, the US 101 crossing of Prefumo Creek, US 101 SB off-ramp crossing Prefumo Creek, and US 101 crossing of Froom Creek would be inundated by the base flood. Properties with potential to be flooded include: commercial development at Prefumo Creek and two building structures southwest of the LOVR/US 101 interchange. In addition, residential units located adjacent to the San Luis Obispo Creek are subject to flooding at less than 1.0 ft. Other residential homes, commercial buildings, and other developments within the Project vicinity are located in areas with minimal flooding risk.

4.5 San Luis Obispo Creek Waterway Management Plan

The City and County of San Luis Obispo's Waterway Management Plan (WMP) calculated a 100-year flow rate for San Luis Obispo Creek Watershed at the Project site with technical engineering support by Questa Engineering Corporation. Table 3 shows the peak discharges rates of San Luis Obispo Creek and Prefumo Creek during the design 10-, 25-, 50-, and 100-year storm events at the Project location. The peak flow data for Froom Creek were not available in the WMP.

Table 3. Peak Flow Rates from Waterway Management Plan

Flooding Source and Location	Peak Discharge Rates* (cfs)			
	10-year	25-year	50-year	100-year
San Luis Obispo Creek				
At Meadow Creek Confluence	8,158	10,312	12,043	13,350
At Prefumo Creek Confluence	9,112	11,760	13,738	15,292
At Froom Creek Confluence	9,324	12,078	14,056	15,680
Prefumo Creek				
At Calle Joaquin (immediately upstream of the SLO Creek confluence)	1,237	1,802	2,190	2,508

Source: City and County of San Luis Obispo, March 2003

* City and County data flow rates were given in cms in the reference (see Appendix B.2). A conversion factor of 35.315 was used to convert the flow rate from cms to cfs, which was rounded up to nearest 1 cfs.

4.6 Froom Creek Hydrologic Analysis

The FEMA FIS and WMP did not include peak flow rates for Froom Creek. To estimate the peak discharge rates of Froom Creek at the Project location, outputs from the United States Army Corps of Engineer's (USACE) Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) hydrologic model were used (see Table 4). The HEC-HMS model of Froom Creek was provided by the City of San Luis Obispo.

Table 4. Peak Flow Rates, HEC-HMS Model

Flooding Source and Location	Drainage Area (mi^2)	Peak Discharge* (cfs)			
		10-year	25-year	50-year	100-year
Froom Creek					
At US 101	0.43	547	750	939	1,066

Source: City of San Luis Obispo

4.7 On-Site Hydrology and Hydraulics

The project proposes widening of LOVR at the Project location from two through lanes to four through lanes. This proposed widening will increase the impervious surface within the watershed of San Luis Obispo Creek. According to the hydraulic analyses provided by the Dokken Engineering, on-site flows outfalling into Prefumo Creek and San Luis Obispo Creek during the design 25- and 100-year storm events will increase by 4.93 cfs and 6.10 cfs, respectively (see Table 5). However, the additional on-site flows during the design 25- and 100-year storm events are very small in comparison to the peak flows of Prefumo Creek and San Luis Obispo Creek from the FEMA FIS and WMP; the increase in design peak flow is at most 0.13%. The proposed modifications of the land use within the Project limits would not significantly impact the local hydraulic characteristic of the Project location.

Table 5. On-Site Flows, Existing and Proposed Conditions

	On-Site Flows (cfs)	
	25-year	100-year
On-Site Flow, Existing Condition	41.79	51.70
On-Site Flow, Proposed Condition	46.72	57.80
On-Site Flow, Changes in Prefumo Creek	2.60	3.20
% Impact to FEMA FIS Peak Flow Rates	-	0.10%
% Impact to WMP Peak Flow Rates	0.14%	0.13%
On-Site Flow, Changes at San Luis Obispo Creek	4.93	6.10
% Impact to FEMA FIS Peak Flow Rates	-	0.05%
% Impact to WMP Peak Flow Rates	0.04%	0.04%

Source: Dokken Engineering and FEMA, 2008

Notes: The FEMA FIS for San Luis Obispo County does not include 25-year flow rates.
WMP = The City and County of San Luis Obispo's Waterway Management Plan

4.8 Prefumo Creek Commons Project

The PCC project is a proposed development of commercial retail center of approximately 18 ac, located approximately 0.5 mi north of the US 101/LOVR interchange. The existing PCC site is agricultural land surrounded by a residential neighborhood in the north, a commercial retail center in the south and west, and Prefumo Creek in the west (see Figure 8). The proposed PCC project will maintain the existing drainage pattern and continue to discharge storm runoff to Prefumo Creek. However, the conversion of agricultural land into commercial space and a parking lot would decrease the on-site

infiltration of the storm runoff and would increase the peak runoff from the PCC site entering Prefumo Creek.

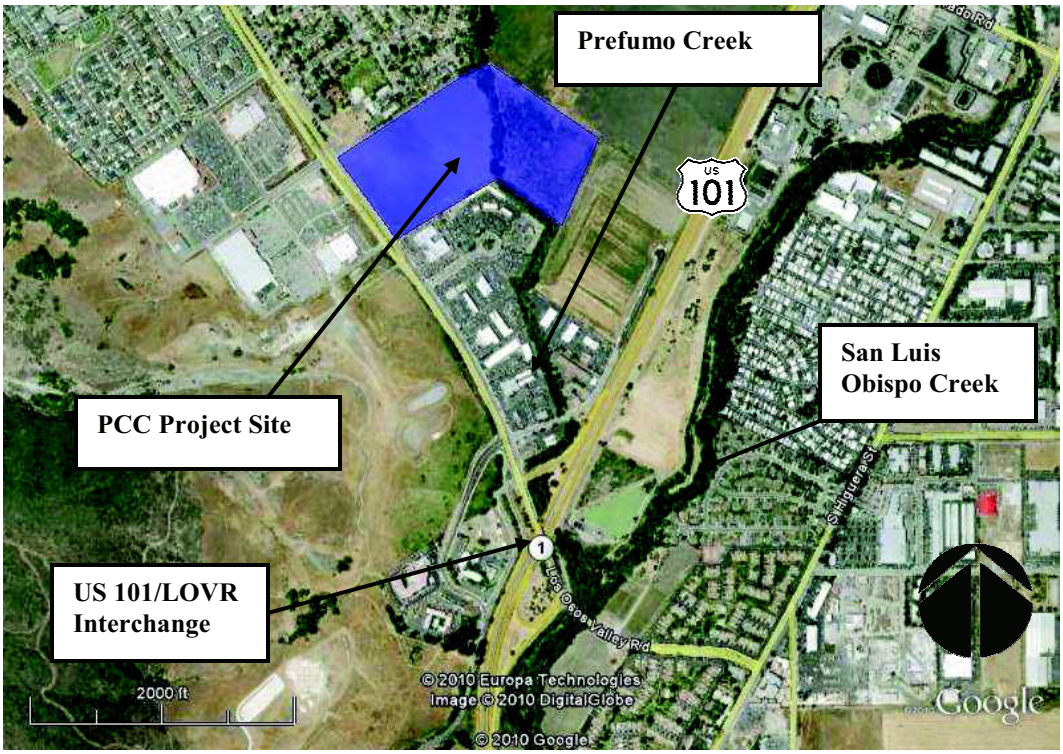


Figure 8. Project Footprint of Prefumo Creek Commons Project

The hydrologic analysis of the tributary area including the PCC site was conducted by Wallace Group (August 2008) using the Santa Barbara Unit Hydrograph (SBUH) Method and Rational Method. Both methods showed that the peak runoff from the tributary area would increase after the development of the PCC site (see Table 6).

Table 6. Peak Discharges from Prefumo Creek Commons Project

Flooding Source and Location	Peak Discharge Rates (cfs)			
	10-year	25-year	50-year	100-year
Prefumo Creek Commons - Rational Method				
Existing	26.4	32.5	37.5	43.0
Proposed	87.1	98.8	115.3	125.1
Increase	60.7	66.2	77.9	82.2
% Increase	230%	204%	208%	191%
Prefumo Creek Commons - SBUH Method				
Existing	45.4	54.1	60.0	68.7
Proposed	82.9	96.2	105.0	118.2
Increase	37.5	42.1	45.1	49.5
% Increase	83%	78%	75%	72%

Wallace Group, 2008

According to Wallace Group, although there is an increase in flow from the PCC project, the peak flow from the development would reach the US 101 cross culvert and pass through the culvert sooner than the rest of the watershed. Therefore, the impacts from the PCC project on the Project site would be insignificant.

4.9 Design Discharges

The flows from the WMP were used in WRECO's hydraulic analysis in order to provide a conservative estimate. The hydraulic analyses in WMP, dated 2003, included more current data and provided more accurate flood estimates than the 2008 FEMA FIS, which was not revised from the values shown in the 1981 FEMA FIS. For Froom Creek, peak flows from the HEC-HMS hydrologic model were selected. The changes to the on-site hydraulics and additional flows from the PCC site will be implemented in the hydraulic analyses of the proposed condition.

5 HYDRAULIC ASSESSMENT

5.1 Design Tool

The hydraulic analysis for the streams in the LOVR/US 101 Interchange Project involved a standard step backwater calculation using the USACE's Hydrologic Engineering Center's River Analysis System (HEC-RAS) computer program version 4.1 to provide flow characteristics, water surface profiles, and channel velocities for the existing and proposed conditions. Appendices E and F provide detailed outputs from HEC-RAS for existing and proposed conditions.

5.2 Cross Section Data

A total of 32 creek cross sections were obtained from the survey data provided by Dokken Engineering: 17 cross sections in a 2,200 ft corridor for San Luis Obispo Creek, 11 cross sections in a 1,200 ft corridor for Prefumo Creek, and 4 cross sections in a 500 ft corridor for Froom Creek. The vertical datum used in the survey data was NAVD. These cross-sections were incorporated into the geometry file of the hydraulic model (see Figure 9, Figure 10, and Appendix C).

The WSEs from Questa Engineering Corporation's Preliminary Hydrologic/Hydraulic Analysis were used for the downstream control WSEs for the design 10-, 25-, 50-, and 100-year storm events, which were 95.9 ft, 97.9 ft, 98.9 ft, and 99.9 ft, respectively. The downstream limit of the hydraulic model is approximately 1,600 ft downstream of LOVR bridge over San Luis Obispo Creek.

5.3 Manning's n Value

Manning's n values were used in the hydraulic model to estimate energy losses in the flow due to friction. The Manning's n values were selected to best describe the existing and proposed conditions, based on the design guidelines in the HEC-RAS Hydraulic Reference Manual (see Table 7).

Table 7. Manning's n Values Selected for the Hydraulic Model

Manning's n value	Channel Characteristics
0.027	Low Flow Channel underneath LOVR Bridge
0.035	Low Flow Channel
0.050	Channel bed with low to moderate vegetation growth
0.070	Channel bed with dense vegetation growth, channel side slopes, and floodplain area

5.4 Expansion and Contraction Coefficient

The expansion and contraction coefficients used to represent the creek channels were 0.3 and 0.1, respectively. These values describe a creek with gradual transitions between cross sections. The expansion and contraction coefficients used in the vicinity of the bridges and culverts were 0.5 and 0.3, respectively. These values were used because the culvert geometry intrudes into the channel.

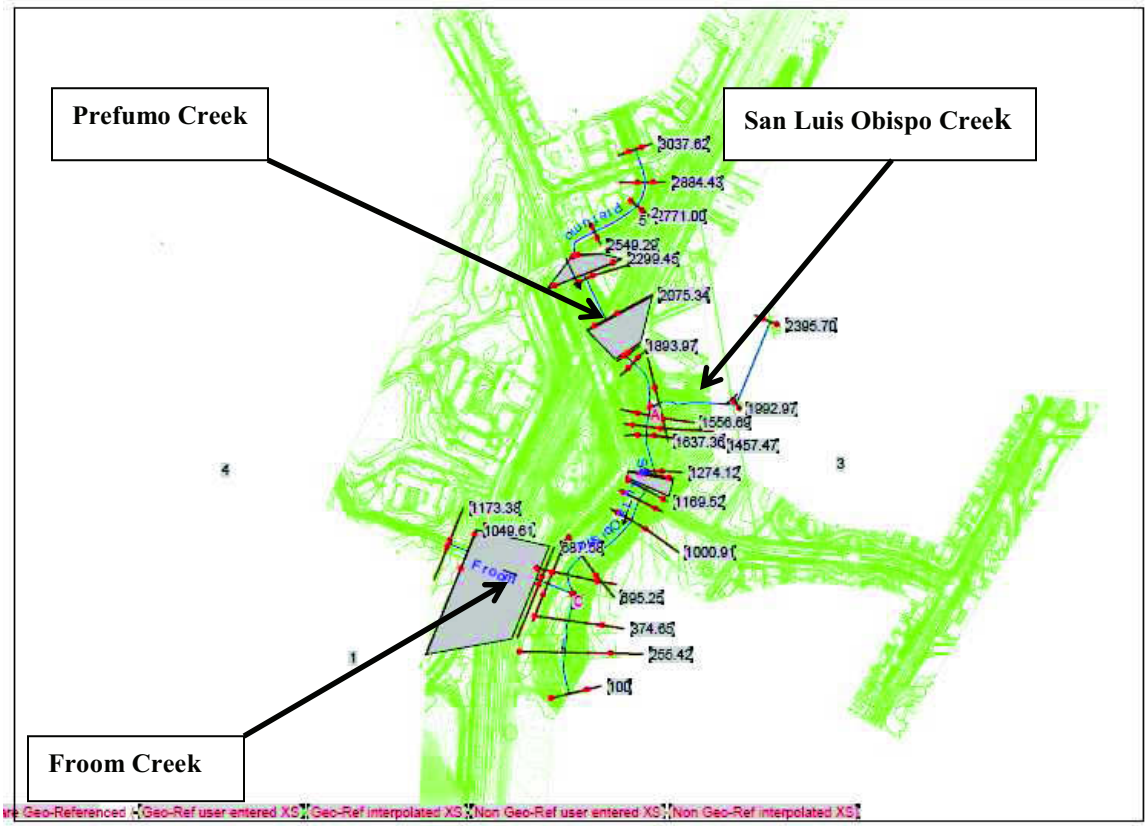


Figure 9. HEC-RAS Model, Plan View

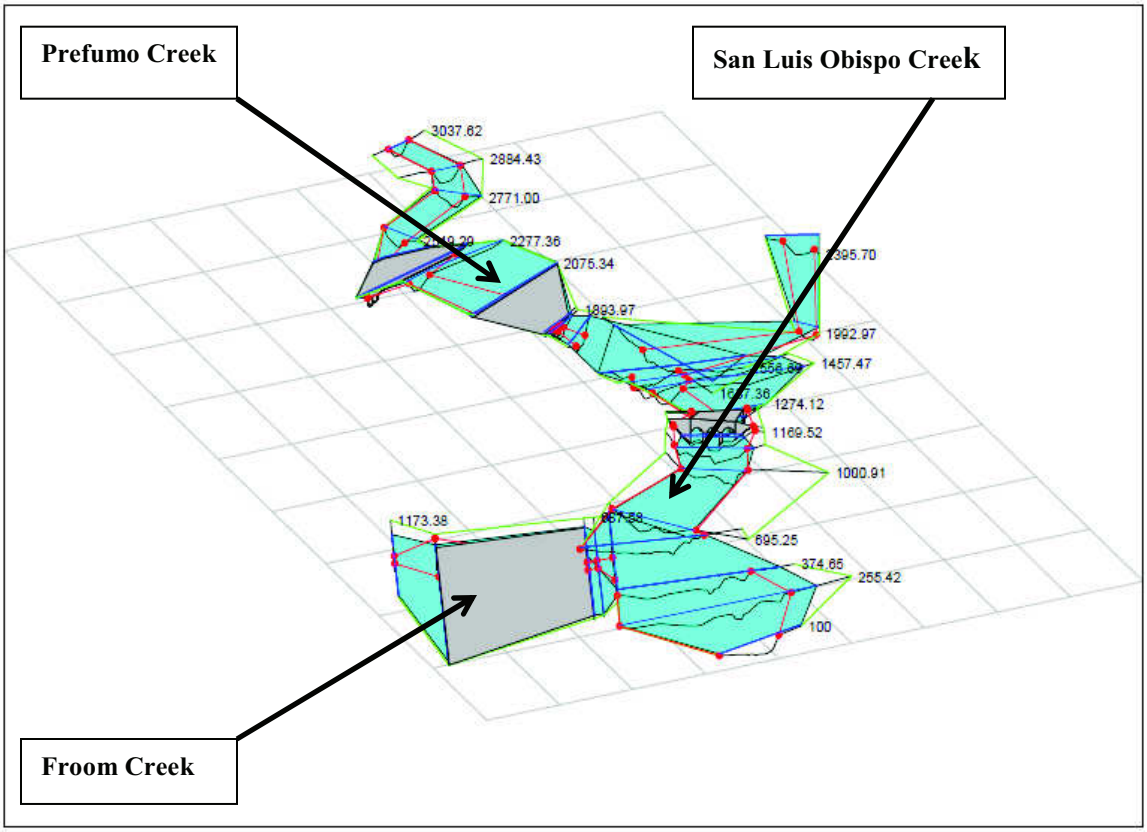


Figure 10. HEC-RAS Model, 3-D View

5.5 Water Surface Elevations, Existing Condition

Table 8 summarizes the calculated existing 10-, 25-, 50- and 100-year water surface profiles from the HEC-RAS hydraulic modeling. If the flood overtops US 101, a portion of the overflow would be traveling down the US 101 main line.

Table 8. Water Surface Elevations, Existing Condition

Creek Name Station	Note	WSE (ft, NAVD)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	105.8	107.6	108.8	109.9
1191.21	LOVR Bridge Upstream Face	103.7	105.3	106.4	107.3
1191.21	LOVR Bridge Downstream Face	102.3	103.7	104.6	105.3
374.65	Downstream of confluence with Froom Creek	97.9	99.9	100.9	101.8
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	108.8	111.0	111.5	111.9
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	108.2	110.1	110.7	111.1
2075.34	US 101 Cross Culvert, Culvert Upstream Face	108.1	110.0	110.6	111.0
1893.97	US 101 Cross Culvert, Culvert Downstream Face	106.1	107.9	109.2	110.2
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	104.1	104.3	104.4	104.5
687.58	US 101 Cross Culvert, Culvert Downstream Face	98.5	100.4	101.5	102.4

5.6 Proposed Condition

5.6.1 Adjustments to the Hydraulic Analyses

The Project proposes the widening of LOVR at the Project location from two through lanes to four through lanes. Based on the plan view of the proposed LOVR bridge over San Luis Obispo Creek, the bridge width will increase from 58.3 ft to 102.0 ft. Due to this bridge widening, Station 1169.52 (downstream face of the existing LOVR bridge) was removed from the hydraulic model. There were no other changes to the cross sectional geometry and design of the hydraulic structures in the hydraulic model.

The design 25- and 100-year flows for the proposed condition included modifications to the on-site peak flows discussed in Section 4.7. The modifications to the on-site flows during the design 10- and 50-year storm events were assumed to be equivalent to the increase of on-site peak flows with the design 25- and 100-year storm events, respectively (see Table 9). See Table 10 for the design peak flows used for the hydraulic analyses of the proposed condition.

Table 9. Change in Design Flows from the Project

Flooding Source and Location	Added Peak Discharge Rates (cfs)			
	10-year	25-year	50-year	100-year
San Luis Obispo Creek				
At Meadow Creek Confluence	0.0	0.0	0.0	0.0
At Prefumo Creek Confluence	1.1	1.1	1.4	1.4
At Froom Creek Confluence	4.9	4.9	6.1	6.1
Prefumo Creek				
At Calle Joaquin (immediately upstream of the SLO Creek confluence)	2.6	2.6	3.2	3.2

Source: Dokken Engineering

Note: The additional flows are the difference between existing condition and proposed condition.

Table 10. Design Flows, Proposed Condition

Flooding Source and Location	Peak Discharge Rates (cfs)			
	10-year	25-year	50-year	100-year
San Luis Obispo Creek				
At Meadow Creek Confluence	8,158	10,312	12,043	13,350
At Prefumo Creek Confluence	9,114	11,762	13,740	15,294
At Froom Creek Confluence	9,329	12,083	14,063	15,687
Prefumo Creek				
At Calle Joaquin (immediately upstream of the SLO Creek confluence)	1,240	1,805	2,194	2,512

Source: Dokken Engineering and City and County of San Luis Obispo, March 2003

5.6.2 Water Surface Elevations, Proposed Condition

The resulting 10-, 25-, 50-, and 100-year WSEs are summarized in Table 11. The output shows slight increase of the WSEs between the proposed LOVR bridge and US 101 crossing.

Table 11. Water Surface Elevations, Proposed Condition

Creek Name Station	Note	WSE (ft, NAVD)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	105.9	107.7	109.0	110.1
1191.21	LOVR Bridge Upstream Face	103.9	105.6	106.8	107.7
1191.21	LOVR Bridge Downstream Face	102.1	103.5	104.4	105.1
374.65	Downstream of confluence with Froom Creek	98.0	99.9	100.9	101.8
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	108.9	111.0	111.5	111.9
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	108.3	110.1	110.7	111.1
2075.34	US 101 Cross Culvert, Culvert Upstream Face	108.2	110.0	110.6	111.0
1893.97	US 101 Cross Culvert, Culvert Downstream Face	106.2	108.1	109.4	110.5
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	104.1	104.3	104.5	104.5
687.58	US 101 Cross Culvert, Culvert Downstream Face	98.5	100.4	101.5	102.4

5.7 Proposed Condition with PCC Project

5.7.1 Adjustment to the Hydraulic Analyses

The Project team also performed hydraulic analyses with the completion of the PCC project, discussed in Section 4.8. The hydraulic model used in these analyses is equivalent to the hydraulic analyses of the proposed condition discussed in Section 5.6.

The design flows used in the hydraulic analyses added the increased peak flow from the PCC project using the SBUH method (see Table 6 in Section 4.8) into the peak flows used for the hydraulic analyses of the proposed condition (see Table 10). The added peak flows based on the SBUH method were selected to account for the lag of peak flow between the outfall location of the PCC project into Prefumo Creek and Prefumo Creek at the Project location (see Table 12). See Table 13 for the design flows used in the hydraulic analyses of the proposed condition with the PCC project.

Table 12. Added Peak Flows from Project and PCC Project

Flooding Source and Location	Added Peak Discharge Rates (cfs)			
	10-year	25-year	50-year	100-year
San Luis Obispo Creek				
At Meadow Creek Confluence	0.0	0.0	0.0	0.0
At Prefumo Creek Confluence	38.6	43.2	46.5	50.9
At Froom Creek Confluence	42.4	47.0	51.2	55.6
Prefumo Creek				
At Calle Joaquin (immediately upstream of the SLO Creek confluence)	40.1	44.7	48.3	52.7

Source: Dokken Engineering and Wallace Group, 2008

Note: The additional flows are the difference between existing condition and proposed condition with the PCC project.

Table 13. Design Peak Flows, Proposed Condition with PCC Project

Flooding Source and Location	Peak Discharge Rates (cfs)			
	10-year	25-year	50-year	100-year
San Luis Obispo Creek				
At Meadow Creek Confluence	8,158	10,312	12,043	13,350
At Prefumo Creek Confluence	9,151	11,804	13,785	15,343
At Froom Creek Confluence	9,367	12,126	14,108	15,736
Prefumo Creek				
At Calle Joaquin (immediately upstream of the SLO Creek confluence)	1,278	1,847	2,239	2,561

5.7.2 Water Surface Elevations, Proposed Condition with PCC Project

The resulting 10-, 25-, 50-, and 100-year WSEs are summarized in Table 14. The added flows from the PCC site to Prefumo Creek have an insignificant impact to the design 10-, 25-, 50-, and 100-year WSEs at the Project location.

Table 14. Water Surface Elevations, Proposed Condition with PCC Project

Creek Name Station	Note	WSE (ft, NAVD)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	105.9	107.7	109.0	110.1
1191.21	LOVR Bridge Upstream Face	103.9	105.6	106.8	107.7
1191.21	LOVR Bridge Downstream Face	102.1	103.5	104.4	105.1
374.65	Downstream of confluence with Froom Creek	98.0	99.9	100.9	101.8
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	108.9	111.0	111.5	111.9
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	108.3	110.1	110.7	111.1
2075.34	US 101 Cross Culvert, Culvert Upstream Face	108.2	110.0	110.6	111.0
1893.97	US 101 Cross Culvert, Culvert Downstream Face	106.2	108.1	109.4	110.5
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	104.1	104.3	104.5	104.5
687.58	US 101 Cross Culvert, Culvert Downstream Face	98.5	100.4	101.5	102.4

5.8 Discussion – Water Surface Elevations

The widening of the LOVR bridge would increase the backwater effect upstream and would also increase the WSE upstream of the LOVR bridge. However, this would only impact the design WSE of San Luis Obispo Creek and Prefumo Creek between the LOVR bridge and the US 101 cross culvert (see Figure 11 and Table 15). The increase in peak flows expected from the PCC project would not increase the design WSE by more than 0.1 ft, which would be considered an insignificant elevation difference. Overall, the proposed Project and the PCC project would not have a significant impact on the overall floodplain within the Project limits.

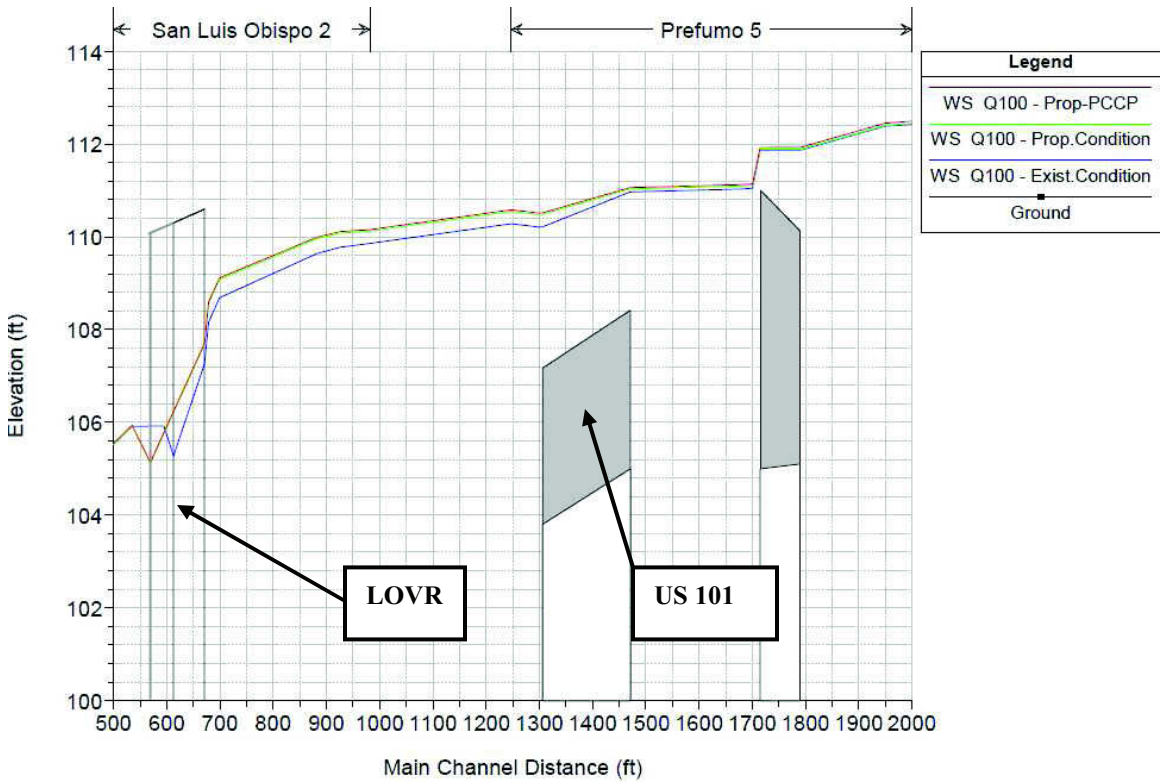


Figure 11. 100-year Water Surface Elevation Profiles, Existing, Proposed and Proposed Condition with PCC Project

Table 15. 100-year Water Surface Elevations, Existing Condition, Proposed Condition, and Proposed Condition with PCC Project

Creek Name Station	Note	Existing	Proposed	Proposed+PCC
San Luis Obispo Creek				
1556.69	Downstream of confluence with Prefumo Creek	109.9	110.1	110.1
1191.21	LOVR Bridge Upstream Face	107.3	107.7	107.7
1191.21	LOVR Bridge Downstream Face	105.3	105.1	105.1
374.65	Downstream of confluence with Froom Creek	101.8	101.8	101.8
Prefumo Creek				
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	111.9	111.9	111.9
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	111.1	111.1	111.1
2075.34	US 101 Cross Culvert, Culvert Upstream Face	111.0	111.0	111.0
1893.97	US 101 Cross Culvert, Culvert Downstream Face	110.2	110.5	110.5
Froom Creek				
1049.61	US 101 Cross Culvert, Culvert Upstream Face	104.5	104.5	104.5
687.58	US 101 Cross Culvert, Culvert Downstream Face	102.4	102.4	102.4

5.9 Flow Velocities

The average flow velocities in the main channel of San Luis Obispo Creek, Prefumo Creek, and Froom Creek for the existing condition, proposed condition, and proposed condition with PCC project are shown in Table 16, Table 17, and Table 18.

Table 16. Channel Flow Velocities, Existing Condition

Creek Name Station	Note	Average Channel Flow Velocity (ft/sec)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	4.1	4.2	4.3	4.4
1191.21	LOVR Bridge Upstream Face	8.2	9.3	10.2	10.8
1191.21	LOVR Bridge Downstream Face	10.8	12.1	13.0	13.7
374.65	Downstream of confluence with Froom Creek	5.1	5.2	5.5	5.6
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	4.7	5.1	5.7	6.2
2352.5	Inside of the US 101 Southbound Off-Ramp Cross Culvert	6.4	7.3	7.3	7.4
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	1.6	1.3	1.4	1.5
2075.34	US 101 Cross Culvert, Culvert Upstream Face	1.4	1.5	1.7	1.8
1993.09	Inside of the US 101 Cross Culvert	8.6	8.9	7.2	5.4
1893.97	US 101 Cross Culvert, Culvert Downstream Face	3.7	3.7	3.6	3.6
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	0.4	0.5	0.6	0.7
1000	Inside of the US 101 Cross Culvert	10.0	8.3	7.2	6.2
687.58	US 101 Cross Culvert, Culvert Downstream Face	0.8	0.6	0.6	0.6

Table 17. Channel Flow Velocities, Proposed Condition

Creek Name Station	Note	Average Channel Flow Velocity (ft/sec)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	4.5	4.7	4.9	4.9
1191.21	LOVR Bridge Upstream Face	8.0	9.1	10.0	10.6
1191.21	LOVR Bridge Downstream Face	11.0	12.4	13.2	13.9
374.65	Downstream of confluence with Froom Creek	5.1	5.2	5.5	5.6
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	4.6	5.1	5.7	6.2
2352.5	Inside of the US 101 Southbound Off-Ramp Cross Culvert	6.5	7.3	7.3	7.2
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	1.5	1.3	1.4	1.5
2075.34	US 101 Cross Culvert, Culvert Upstream Face	1.4	1.5	1.7	1.8
1993.09	Inside of the US 101 Cross Culvert	8.6	8.6	6.8	4.7
1893.97	US 101 Cross Culvert, Culvert Downstream Face	3.6	3.6	3.5	3.4
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	0.4	0.5	0.6	0.7
1000	Inside of the US 101 Cross Culvert	10.0	8.3	7.3	6.1
687.58	US 101 Cross Culvert, Culvert Downstream Face	0.8	0.6	0.6	0.6

Table 18. Channel Flow Velocities, Proposed Condition with PCC Project

Creek Name Station	Note	Average Channel Flow Velocity (ft/sec)			
		Q_{10}	Q_{25}	Q_{50}	Q_{100}
San Luis Obispo Creek					
1556.69	Downstream of confluence with Prefumo Creek	4.5	4.7	4.9	4.9
1191.21	LOVR Bridge Upstream Face	8.0	9.1	10.0	10.6
1191.21	LOVR Bridge Downstream Face	11.1	12.4	13.2	13.9
374.65	Downstream of confluence with Froom Creek	5.1	5.3	5.5	5.6
Prefumo Creek					
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	4.6	5.2	5.8	6.3
2352.5	Inside of the US 101 Southbound Off-Ramp Cross Culvert	6.7	7.3	7.3	7.3
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	1.5	1.3	1.4	1.5
2075.34	US 101 Cross Culvert, Culvert Upstream Face	1.4	1.6	1.7	1.8
1993.09	Inside of the US 101 Cross Culvert	8.9	8.7	6.8	4.7
1893.97	US 101 Cross Culvert, Culvert Downstream Face	3.7	3.7	3.6	3.5
Froom Creek					
1049.61	US 101 Cross Culvert, Culvert Upstream Face	0.4	0.5	0.6	0.7
1000	Inside of the US 101 Cross Culvert	10.0	8.3	7.2	6.1
687.58	US 101 Cross Culvert, Culvert Downstream Face	0.8	0.6	0.6	0.6

The 100-year channel flow velocities of San Luis Obispo Creek, Prefumo Creek, and Froom Creek for the existing condition, proposed condition, and proposed condition with the PCC project are summarized in Table 19. The widening of the LOVR bridge would increase the backwater effects upstream and would also impact the flow velocity upstream of the LOVR bridge. However, the change in average flow velocity upstream of the LOVR bridge is insignificant. The increase in peak flows expected from the PCC project would also have insignificant impact to the channel flow velocities of San Luis Obispo Creek, Prefumo Creek, and Froom Creek. Overall the proposed Project and PCC project would have insignificant impacts on the channel flow velocities of San Luis Obispo Creek, Prefumo Creek, and Froom Creek.

Table 19. 100-year Channel Flow Velocities, Existing Condition, Proposed Condition, and Proposed Condition with PCC Project

Creek Name Station	Note	Average Channel Flow Velocity, Q_{100} (ft/sec)		
		Existing	Proposed	Proposed+PCC
San Luis Obispo Creek				
1556.69	Downstream of confluence with Prefumo Creek	4.4	4.9	4.9
1191.21	LOVR Bridge Upstream Face	10.8	10.6	10.6
1191.21	LOVR Bridge Downstream Face	13.7	13.9	13.9
374.65	Downstream of confluence with Froom Creek	5.6	5.6	5.6
Prefumo Creek				
2389.59	US 101 Southbound Off-Ramp Cross Culvert, Upstream Face	6.2	6.2	6.3
2352.5	Inside of the US 101 Southbound Off-Ramp Cross Culvert	7.4	7.2	7.3
2299.45	US 101 Southbound Off-Ramp Cross Culvert, Downstream Face	1.5	1.5	1.5
2075.34	US 101 Cross Culvert, Culvert Upstream Face	1.8	1.8	1.8
1993.09	Inside of the US 101 Cross Culvert	5.4	4.7	4.7
1893.97	US 101 Cross Culvert, Culvert Downstream Face	3.6	3.4	3.5
Froom Creek				
1049.61	US 101 Cross Culvert, Culvert Upstream Face	0.7	0.7	0.7
1000	Inside of the US 101 Cross Culvert	6.2	6.1	6.1
687.58	US 101 Cross Culvert, Culvert Downstream Face	0.6	0.6	0.6

6 PROJECT EVALUATION

6.1 Risk associated with implementation of the action

The FHWA defines a significant encroachment as a highway encroachment and any direct support of likely base floodplain development that would involve one or more of the following construction or flood related impacts: 1) a significant potential for interruption or termination of a transportation facility that is needed for emergency vehicles or provides a community's only evacuation route; 2) a significant risk; or 3) a significant adverse impact on the natural and beneficial floodplain values.

Based on available information, this Project would not be considered a significant floodplain encroachment. Under existing conditions, culvert flow capacities on Prefumo and Froom creeks are insufficient for the 100-year flood, which would cause flow overtopping at US 101 and the US 101 SB off-ramp. The proposed widening of the LOVR bridge over San Luis Obispo Creek would not significantly impact the extent of the base floodplain.

This Project would not impact the route used by emergency vehicles. The local traffic route connecting the east and west of sides US 101 is available approximately 1.5 mi north of the Project site. Local streets running parallel to the highway can serve as a temporary detour route for interregional traffic. In addition, the stage construction method can be applied to avoid detours from the site. The WSE from the 100-year flow would not increase significantly in the Project location. Therefore, the risk associated with implementation of the action will be insignificant.

6.2 Impacts on natural and beneficial floodplain values

Natural and beneficial floodplain values include, but are not limited to: fish, wildlife, plants, open space, natural beauty, scientific study, outdoor recreation, agriculture, aquaculture, forestry, natural moderation of floods, water quality maintenance, and ground water recharge.

Identified short-term impacts to the natural and beneficial floodplain values include: 1) temporary loss of vegetation, 2) potential effects on endangered species or their habitats (within the Project site) during maintenance and management activities, and 3) the potential removal of bank aquatic habitats during construction. The proposed Project will minimize impacts to the extent practicable. Construction must avoid fish migration season.

For this highway interchange improvement Project there would be no significant long-term impacts to the natural and beneficial floodplain values.

6.3 Support of probable incompatible floodplain development

As defined by the FHWA, the support of incompatible base floodplain development will encourage, allow, serve, or otherwise facilitate incompatible base floodplain development, such as commercial development or urban growth.

This highway improvement Project would not support any incompatible floodplain development. The purpose of the interchange improvements is to maximize the efficiency of LOVR and LOVR/US 101 interchange. It will not support any incompatible floodplain development. The proposed improvements would maintain local and regional access to existing commercial and industrial facilities in the Project vicinity and would not create new access to developed or undeveloped lands. As stated in Section 5.6.2 and 5.7.2, the proposed Project and the PCC project both have insignificant impact on the local WSEs.

6.4 Measures to minimize floodplain impacts associated with the action

There are no significant floodplain impacts associated with this Project. The existing cross culverts underneath US 101 (Prefumo Creek and Froom Creek) and US 101 SB off-ramp (Prefumo Creek) would remain as is. The proposed LOVR bridge widening over San Luis Obispo Creek would not significantly impact the existing base floodplain.

6.5 Measures to restore and preserve the natural and beneficial floodplain values impacted by this action

As mentioned previously, identified potential impacts to the natural and beneficial floodplain values include: 1) temporary loss of vegetation, 2) potential effects on endangered species or their habitats (within the Project site) during maintenance and management activities, and 3) the potential removal of bank aquatic habitats during construction. Most of the environmental impacts resulting from construction activities can be mitigated with standard measures such as re-vegetation, best management practices, and other activities that meet the requirements that are part of the Project permit conditions.

One of the environmental impacts not mitigated with standard measures is the impact on fish migration. Mitigation involves: having a biologist on site during construction, setting up Environmental Sensitive Area (ESA) fences to protect habitats during construction, and providing a bypass system if construction is necessary in the flowing channels.

The City of San Luis Obispo and Dokken Engineering will obtain, as necessary, permits or approvals from the USACE, the Central Coast Regional Water Quality Control Board, the California Department of Fish and Game, the United States Fish and Wildlife Service, and the National Marine Fisheries Service. Additional guidance may be required from

the American Fisheries Society and the California Department of Fish and Game's Salmonid Stream Habitat Restoration Manual.

6.6 Practicability of alternatives to any significant encroachments

As defined by the FHWA, risk shall mean the consequences associated with the probability of flooding attributable to an encroachment. It shall include the potential for property loss and hazard to life during the service life of the bridge and roadway.

The Project would not significantly encroach onto the existing floodplain. Therefore, other alternatives were not considered for this Project.

6.7 Practicability of alternatives to any longitudinal encroachments

As defined by the FHWA, a longitudinal encroachment is an action within the limits of the base floodplain that is longitudinal to the normal direction of the floodplain.

A longitudinal encroachment is "[a]n encroachment that is parallel to the direction of flow. Example: A highway that runs along the edge of a river is, usually considered a longitudinal encroachment." The requirement for consideration of avoidance alternatives must be included in a Location Hydraulic Study by including an evaluation and a discussion of the practicability of alternatives to any significant encroachment or any support of incompatible floodplain development.

LOVR runs parallel to Prefumo Creek between the Prefumo Creek crossings at US 101 and the US 101 SB off-ramp. The widening of LOVR is on the opposite side from the Prefumo Creek. The proposed design modification of LOVR on the side facing Prefumo Creek is minimal; it did not have a significant impact to the design 100-year WSEs for Alternatives 3 and 6 (see Table 20 and Table 21). Therefore, it is not anticipated that the LOVR modification would constitute a longitudinal encroachment.

Table 20. LOVR Longitudinal Encroachment Conditions – Alternative 3

	100-year WSE (ft NAVD)	Longitudinal Encroachment?	
		Yes	No
Existing	111.05		√
Proposed	111.12		√
Proposed & PCC	111.14		√

Table 21. LOVR Longitudinal Encroachment Conditions – Alternative 6

	100-year WSE (ft NAVD)	Longitudinal Encroachment?	
		Yes	No
Existing	111.05		√
Proposed	111.12		√
Proposed & PCC	111.14		√

The proposed roadway improvements on LOVR over San Luis Obispo Creek and on US 101 over Froom Creek would not be considered a longitudinal encroachment to the 100-year floodplain. Therefore, widening the US 101 northbound off-ramp to add an auxiliary lane and retaining wall would not be considered a longitudinal encroachment.

7 REFERENCES

California Department of Transportation, Traffic Operations Division. (2007). <http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/2006all/r101i.htm> (Last Accessed: Feb 10, 2010).

California Department of Transportation. (2003). *Storm Water Data Report, Central Coast Region 3.*

City of San Luis Obispo and San Luis Obispo County. (March 2003). *Waterway Management Plan.* Volume I. "San Luis Obispo Creek Watershed."

City of San Luis Obispo and San Luis Obispo County. (March 2003). *Waterway Management Plan*. Volume 2. "Stream Management and Maintenance Program for the San Luis Obispo Creek Watershed."

City of San Luis Obispo and San Luis Obispo County. (February 2003). *Waterway Management Plan*. Volume 3. "Drainage Design Manual."

City of San Luis Obispo – Public Works Transportation Program. (2009). *US 101/Los Osos Valley Road Interchange*. <http://www.ci.san-luis-obispo.ca.us/publicworks/lovric.asp> (Last Accessed: February 10, 2010)

Federal Emergency Management Agency. (1981). *Flood Insurance Rate Map for City of San Luis Obispo, San Luis Obispo County, CA*.

Federal Emergency Management Agency. (August 2008). *Flood Insurance Rate Map, San Luis Obispo County, California and Incorporated Areas, Panel 1331 of 2050, Map Number 06079C1331F.*

Federal Emergency Management Agency. (August 2008). *Flood Insurance Study, San Luis Obispo County, California and Incorporated Areas, Flood Insurance Study Number 06079V000A.* .

Questa Engineering Corporation. (November 21, 2002). *Preliminary Hydrologic/Hydraulic Analysis, Los Osos Valley Road/U.S. 101 Interchange Project.*

United States Department of Agriculture, Natural Resources Conservation Service. *Web Soil Survey* <http://websoilsurvey.nrcs.usda.gov/app/> (Last Accessed: May 14, 2007).

Wallace Group. (August 2008). Drainage Report – *Prefumo Creek Commons, Proposed Commercial Retail Project, San Luis Obispo, California*

Appendix A Summaries of Floodplain Encroachment

Technical Information for Location Hydraulic Study
US 101 over Prefumo Creek

Dist. 5 Co. San Luis Obispo Rte. 101 P.M 25.95

Project No. Bridge No. 49-0062K, 49-0062

Floodplain Description:

San Luis Obispo, Prefumo, and Froom Creek contribute to the floodplains within the Project vicinity. Prefumo Creek crosses US 101 and joins with San Luis Obispo Creek immediately upstream of the LOVR crossing. San Luis Obispo Creek flows parallel to the US 101 in the Project vicinity and joins with Froom Creek approximately 1,000 ft downstream of the LOVR crossing over San Luis Obispo Creek.

1. Description of Proposal (Include physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts

2. ADT: Current 72,000 Projected N/A

3.	Hydraulic Data: Base Flood	Q_{100}	2,500	WSE_{100}	111.04
	The flood of record, if greater than Q_{100}	Q		WSE	
	Overtopping flood	Q	1,290	WSE	108.54 ft

4. Are NFIP maps and studies available? Yes √ No

		Yes	No
5.	Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain. Potential Q100 backwater damages:		
	A. Residences?	√	
	B. Other Bldgs?	√	
	C. Crops?	√	
	D. Natural and beneficial Floodplain Values?	√	
6.	Type of Traffic		
	A. Emergency supply or evacuation route?	√	
	B. Emergency vehicle access?	√	
	C. Practicable detour available?	√	
	D. School bus or mail route?	√	

7. Estimated duration of traffic interruption for 100-year event

8. Estimated value of Q_{100} flood damage (if any) – moderate risk level.

A.	Roadway	$ N/A
B.	Property	$ N/A
	Total	$ N/A

9. Assessment of Level of Risk

Low √ Moderate High

For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative

Prepared By:

Signature – Hydraulic Engineer

11/22/2010
Date

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development?

No √ Yes

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirements for the Location Hydraulic Study shall be retained in the project files.

Technical Information for Location Hydraulic Study
Los Osos Valley Road over San Luis Obispo Creek

Dist. 5 Co. San Luis Obispo Rte. 101 P.M 25.91

Project No. Bridge No. 49-185

Floodplain Description:

San Luis Obispo, Prefumo, and Froom Creek contribute to the floodplains within the Project vicinity. Prefumo Creek crosses US 101 and joins with San Luis Obispo Creek immediately upstream of the LOVR crossing. San Luis Obispo Creek flows parallel to the US 101 in the Project vicinity and joins with Froom Creek approximately 1,000 ft downstream of the LOVR crossing over San Luis Obispo Creek.

1. Description of Proposal (Include physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts

2. ADT: Current N/A Projected N/A

3.	Hydraulic Data: Base Flood	Q_{100}	15,294	WSE_{100}	107.69 ft
	The flood of record, if greater than Q_{100}	Q		WSE	
	Overtopping flood	Q	20,886	WSE	110.61 ft

4. Are NFIP maps and studies available? Yes √ No

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
Potential Q100 backwater damages:

	Yes	No
A. Residences?	√	
B. Other Bldgs?	√	
C. Crops?	√	
D. Natural and beneficial Floodplain Values?	√	

6. Type of Traffic

A. Emergency supply or evacuation route?	√	
B. Emergency vehicle access?	√	
C. Practicable detour available?	√	
D. School bus or mail route?	√	

7. Estimated duration of traffic interruption for 100-year event

8. Estimated value of Q_{100} flood damage (if any) – moderate risk level.

A.	Roadway	$ N/A
B.	Property	$ N/A
	Total	$ N/A

9. Assessment of Level of Risk

Low √ Moderate High

For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative

Prepared By:

Signature – Hydraulic Engineer

11/22/2010
Date

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development?

No √ Yes

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirements for the Location Hydraulic Study shall be retained in the project files.

Floodplain Evaluation Report Summary

Dist. 5 Co. San Luis Obispo Rte. 101 P.M 25.95

Project No. Bridge No. 49-0062K, 49-0062, 49-185

Limit:

Auto Park Way to South Higuera Street
2,500 ft south and 4,300 ft north of the LOVR overcrossing

Floodplain Description:

San Luis Obispo, Prefumo, and Froom Creek contribute to the floodplains within the Project vicinity. Prefumo Creek crosses US 101 and joins with San Luis Obispo Creek immediately upstream of the LOVR crossing. San Luis Obispo Creek flows parallel to the US 101 in the Project vicinity and joins with Froom Creek approximately 1,000 ft downstream of the LOVR crossing over San Luis Obispo Creek.

		Yes	No
1.	Is the proposed action a longitudinal encroachment of the base floodplain?		√
2.	Are the risks associated with the implementation of the proposed action significant?		√
3.	Will the proposed action support probable incompatible floodplain development?		√
4.	Are there any significant impacts on natural and beneficial floodplain values?		√
5.	Routine construction procedures are required to minimize impacts on the floodplain. Area there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain.		√
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q).		√
7.	Are Location Hydraulic Studies that document the above answers on file? If not explain.	√	

Concurrence:

Kristen Inbrott 12/1/2010

Signature – Hydraulic Engineer Date

Signature – Dist. Environmental Branch Chief Date

Prepared By: 11/22/2010

Signature – Han-Bin Liang, Ph.D., P.E. (Hydraulic Engineer) Date

Appendix B Hydraulic Information

Appendix B.1 FEMA FIS and FIRM

FLOOD INSURANCE STUDY

SAN LUIS OBISPO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
ARROYO GRANDE, CITY OF	060305
ATASCADERO, CITY OF	060700
EL PASO DEROBLES, CITY OF	060308
GROVER BEACH, CITY OF	060306
MORRO BAY, CITY OF	060307
PISMO BEACH, CITY OF	060309
SAN LUIS OBISPO, CITY OF	060310
SAN LUIS OBISPO COUNTY (UNINCORPORATED AREAS)	060304

EFFECTIVE:
AUGUST 28, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06079CV000A

TABLE 4 – SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
NONAME CREEK					
At Mouth[1]	0.5	100	170	210	390
At Yerba Buena Street[1]	0.5	100	170	210	480
At Tide Avenue[1]	0.5	100	240	340	880
At Panorama Drive[1]	0.5	105	615	1,010	2,600
At Whidbey Way (extended)	0.5	180	700	1,100	2,700
NORTH FORK LOS BERROS CREEK					
At confluence with Los Berros Creek	2.6	270	870	1,200	2,700
NORTH FORK PALOMA CREEK					
At U.S. Highway 101	1.6	160	500	660	830
OLD GARDEN CREEK					
At Lincoln Avenue	1.46	360	860	1,100	2,100
At Northwest of Murray Street	1.08	260	620	800	1,500
At Verde Drive	0.92	220	530	700	1,300
At Cuesta Drive	0.76	180	430	600	1,100
At Tassajara Drive	0.57	140	340	400	830
At Rockview Place	0.33	100	190	250	470
PALOMA CREEK					
At Union Pacific Railroad	5.8	600	1,730	2,290	2,880
At U.S. Highway 101	3.4	440	1,180	1,550	1,940
Approximately 6,400 feet above U.S. Highway 101	1.1	108	450	570	720
PEACHY CANYON CREEK					
Below Vine Street	0.9	65[2]	145[2]	380[2]	560
Above Vine Street	0.9	100	340	420	560
PISMO CREEK					
At U.S. Highway 101	37.9	3,200	10,200	14,700	32,000
PREFUMO CANYON CREEK					
At Prefumo Canyon Road	3.4	600	1,400	1,900	3,500
PREFUMO CREEK					
Upstream of confluence of San Luis Obispo Creek	14.3	1,000	2,400	3,100	5,800

[1]Channel flow only; does not include overflow from channel
[2]Reduced or constant flow values due to capacity restriction

TABLE 4 – SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
SALINAS RIVER					
At USGS gage at Paso Robles	387	16,000	33,000	43,000	66,000
Below Paso Robles Creek	331	15,500	32,000	42,000	62,500
Below Santa Margarita Creek	200	7,800	14,500	21,000	31,000
SAN LUIS OBISPO CREEK					
At Mouth	83.1	4,900	15,300	22,000	50,700
Downstream of confluence of Prefumo Creek	42.60	4,300	10,200	13,400	25,100
Upstream of confluence of Prefumo Creek	26.40	4,100[2]	9,800[2]	12,900[2]	24,200[2]
At Marsh Street and Archer Street	23.40	4,300	10,300	13,500	25,400
At Carmel Street and Higuera Street	12.60	2,500	6,000	7,800	14,600
South of U.S. Highway 101	11.50	2,400	5,800	7,600	14,300
SANTA MARGARITA CREEK					
At confluence with Trout Creek	23.2	4,800	11,300	13,800	18,100
At El Camino Real	22.4	3,450	7,850	9,435	12,300
At confluence with Yerba Buena Creek	19.4	3,390	7,510	8,220	8,500
Near El Camino Real 400 feet southwest of Wilhelmina Avenue	11.2	2,130	4,580	5,400	7,040
SANTA ROSA CREEK					
At Mouth	46.4	3,900	12,500	18,000	39,200
At State Highway 41	20.9	2,900	9,200	13,300	28,800
SANTA ROSA CREEK SPLIT FLOW					
At Cambria Road	--[1]	--[1]	1,800	2,700	7,600
SOUTH BRANCH TOAD CREEK					
Below U.S. Highway 101	1.1	160[2]	290[2]	320[2]	380[2]
Above U.S. Highway 101	1.1	290	600	720	920

[1]Data not available

[2]Reduced or constant flow values due to capacity restriction

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Salinas River (continued)								
BA	728,534	764	4,959	4.5	870.9	870.9	870.9	0.0
BB	730,805	783	4,775	4.4	877.2	877.2	877.3	0.1
BC	733,286	806	5,583	3.8	882.4	882.4	882.6	0.2
BD	736,190	639	4,775	4.4	889.5	889.5	889.6	0.1
BE	738,197	490	4,289	4.9	894.8	894.8	894.8	0.0
San Luis Obispo Creek								
A	143	426	3,148	7.0	10.5	10.5	11.5	1.0
B	2,154	295	3,690	6.0	12.6	12.6	13.3	0.7
C	2,640	360	4,558	4.8	13.1	13.1	14.0	0.9
D	38,016	241	3,231	4.1	98.8	98.8	99.6	0.8
E	38,886	144	1,492	9.0	101.4	101.4	101.7	0.3
F	40,128	206	2,020	6.6	109.0	109.0	109.1	0.1
G	41,184	183	1,740	7.7	112.0	112.0	112.0	0.0
H	42,082	163	1,564	8.6	115.6	115.6	115.6	0.0
I	42,768	192	1,923	7.0	118.4	118.4	118.4	0.0
J	43,718	80	804	16.7	123.9	123.9	124.0	0.1
K – AO*								

[1]Feet above Pacific Ocean
*Data Not Available

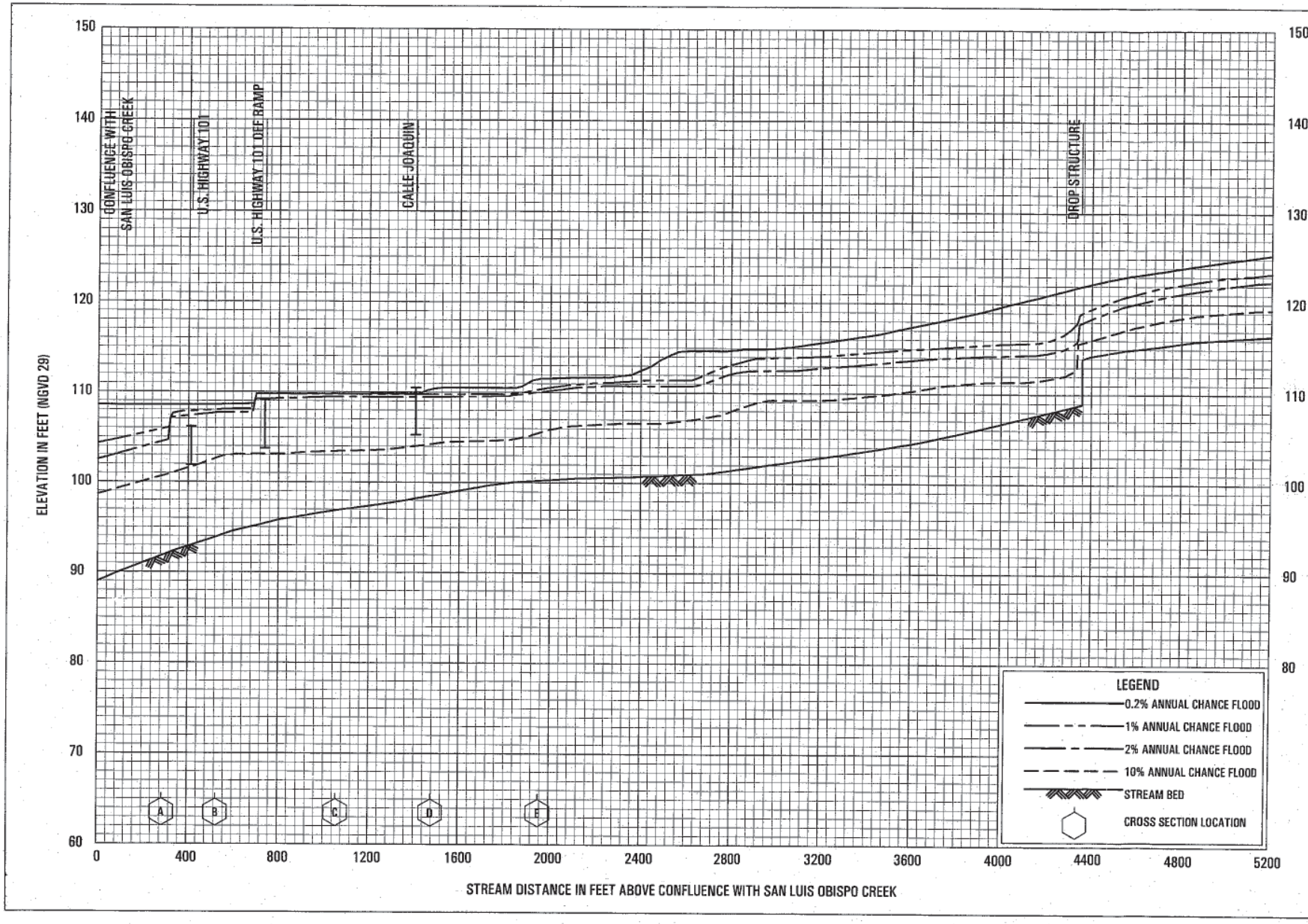
TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN LUIS OBISPO COUNTY, CA AND INCORPORATED AREAS

FLOODWAY DATA

SALINAS RIVER - SAN LUIS OBISPO CREEK



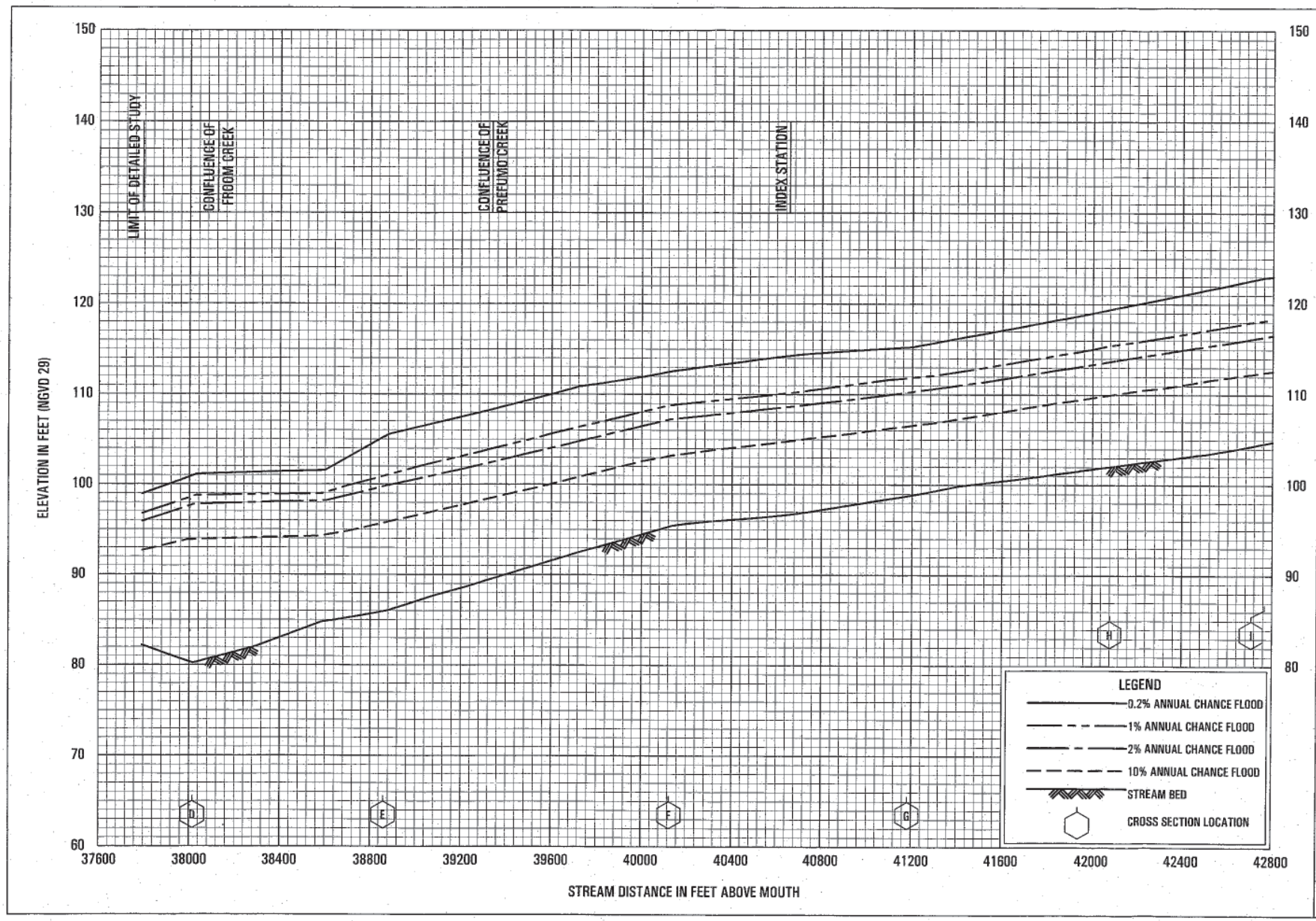
FLOOD PROFILES

PREFUMO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN LUIS OBISPO COUNTY, CA

AND INCORPORATED AREAS



FLOOD PROFILES

SAN LUIS OBISPO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN LUIS OBISPO COUNTY, CA

AND INCORPORATED AREAS

Appendix B.2 San Luis Obispo County Waterway Management Plan

Waterway Management Plan

VOLUME I

San Luis Obispo Creek Watershed

City of San Luis Obispo
Department of Public Works
955 Morro Street
San Luis Obispo, California 93401

County of San Luis Obispo
Flood Control District - Zone 9
1050 Monterey Street, Room 207
San Luis Obispo, California 93408

depending on recurrence interval and location in the watershed. Most of this effect likely occurred fairly early in this century, at least before the 1960's. However, the construction of the two Highway 101 crossings of San Luis Obispo Creek at Cuesta Park has essentially negated this increase.

Table C-7. Selected Hydrology Model Results for Existing Watershed Conditions

				Flow Rates (m ^{3}/s)					
Creek	**Station**	**Description**	**Storm Size**	**Q100**	**Q50**	**Q25**	**Q10**	**Q2**	**1995 Flow**
SLO	20627	Cuesta Park	A	176	166	147	123	71	136
SLO	19319	At California Boulevard	A	190	179	160	133	79	148
SLO	16935	At Stenner Creek Confluence	B	354	319	274	220	119	247
SLO	15583	At Meadow Creek Confluence	B	378	341	292	231	127	268
SLO	12148	At Prefumo Creek Confluence	B	433	389	333	258	142	323
SLO	11897	At Froom Creek Confluence	B	444	398	342	264	145	333
SLO	10182	At E. Branch Confluence	C	538	476	412	309	165	468
SLO	9159	At Davenport Creek Confluence	C	596	525	455	338	179	516
SLO	4929	At Squire Creek Confluence	C	624	548	478	353	185	559
SLO	4554	At Gragg Canyon Confluence	C	632	555	485	357	186	570
SLO	3131	At Miguelito Creek Confluence	D	671	589	506	374	194	639
SLO	214	At Harford Canyon Confluence	D	686	603	513	376	191	669
Prefumo	1906	Laguna Lake Outlet	A	58	48	40	28	17	49
Prefumo	1385	At Drainage from Madonna Plaza	A	60	50	42	29	18	51
Prefumo [1]	432	At Calle Joaquin	A	71	62	51	35	21	56
Stenner		Above Brizziolari Creek	A	106	93	76	59	30	58
Stenner	2449	At Brizziolari Creek Confluence	A	166	146	120	93	48	85
Stenner	976	At Garden Creek Confluence	A	206	181	149	115	58	106
Brizziolari	n/a	Entire Sub-basin	A	70	62	51	40	21	30
Orcutt	2416	At Orcutt Road	A	6.2	5.5	4.6	3.4	1.7	2.8
Orcutt	1079	At Broad Street	A	12	11	9	6.9	3.5	5.2
Orcutt	583	At Confluence with Acacia Creek	A	15	14	11	8.6	4.3	6.6
Acacia	1877	At Orcutt Road	A	11	10	8.2	6.2	3.2	5.9
Acacia	1593	At Broad Street	A	40	35	29	22	11	22
Acacia	489	At Confluence with East Branch	A	42	37	30	23	11	23
East Branch SLO	6685	Above Acacia Creek Confluence	A	115	101	83	61	29	81
East Branch SLO	5984	Below Acacia Creek Confluence	A	154	136	112	83	40	107
East Branch SLO	4040		A	178	157	130	96	47	116
East Branch SLO	3425	Below Airport Tributary Confluence	A	186	164	136	100	49	120
East Branch SLO	1834	Below Tank Farm Creek Confluence	A	212	187	155	114	56	136
East Branch SLO	740	At Mouth	A	215	189	158	116	57	139

[1] Includes "Froom Tributary" basin, which during low flow drains to Froom Creek.
Inclusion of this basin results in conservative flow estimate where Prefumo Creek crosses under U.S. 101.

Appendix B.3 Prefumo Creek Commons Project

DRAINAGE REPORT

PREFUMO CREEK COMMONS

Proposed Commercial Retail Project
San Luis Obispo, California

Prepared for
Madonna Enterprises
c/o Ms. C. M. Florence, AICP Agent
Oasis Associates, Inc.
3427 Miguelito Court
San Luis Obispo, CA 93401

Submitted by

WALLACE GROUP

612 Clarion Court
San Luis Obispo, CA 93401
T 805 544-4011 F 805 544-4294
Job Number: 0658.0002
August 15, 2008

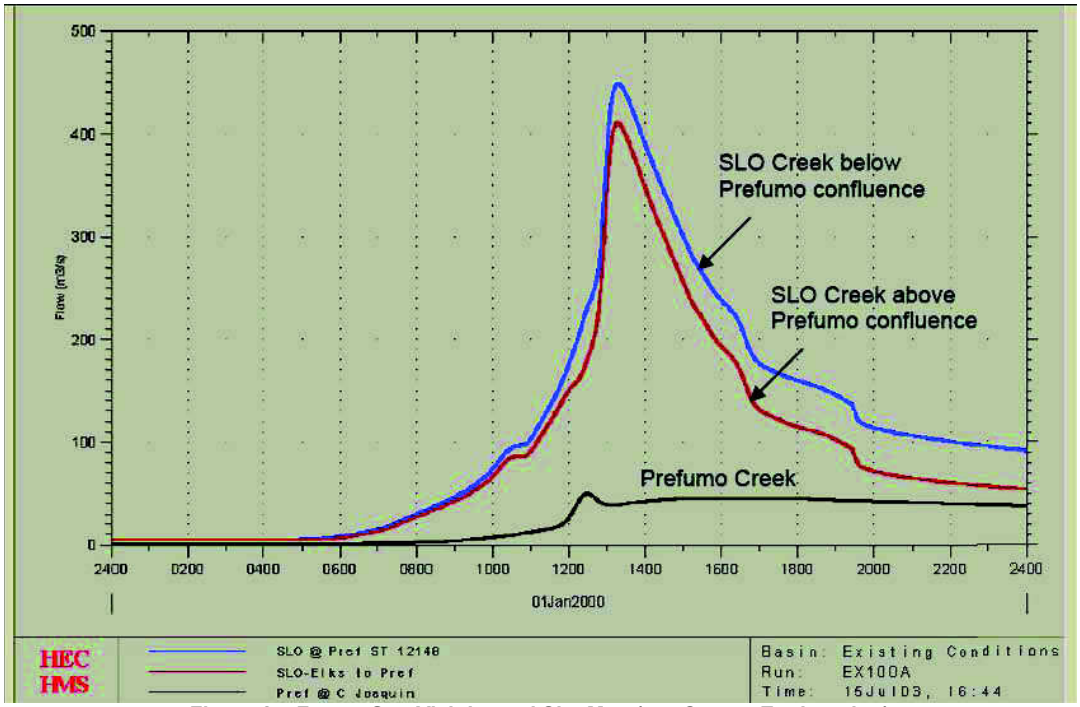


Figure 2 – Froom Gap Vicinity and Site Map (per Questa Engineering)

Based on the Costco/Froom Ranch EIR (Morro Group, June 2003) and Figure 2, on-site detention to mitigate increase runoff rates is not desirable.

> *Any delays in runoff originating below Laguna Lake leaving the Prefumo Creek watershed will likely cause the detained flow to be added to the higher flows being released from Laguna Lake, potentially making flooding along Prefumo Creek worse. Consequently, the use of detention basins to mitigate increased runoff rates in areas draining to Prefumo Creek is not desirable and could even exacerbate the flooding along lower Prefumo Creek.*
>
> *--Costco EIR (Questa, 2002)*

As Laguna Lake buffers the lower Prefumo Creek Basin from upstream runoff, it is appropriate to isolate and evaluate the area below Laguna Lake for peak flow calculations. Peak flows associated with the watershed as a whole will be considered through the use of the City's Zone 9 HEC RAS Model. This one-dimensional model will be used as the basis for existing in-stream flow rates.

HYDROLOGIC ANALYSIS

The conversion of agricultural land to accommodate commercial buildings and parking will result in an increase in runoff generated from the site and discharged to Prefumo Creek. Two methods were used to quantity the increase: the Rational Method and the Santa Barbara Unit Hydrograph method.

<u>Rational Method</u> Table 2 summarizes the increase in peak runoff as a result of this project according to Rational Method calculations.

Table 2 – Rational Method Peak Flow Runoff Calculations

Return (Yr)	Area (ac)	Existing Conditions			Proposed Conditions			Increase		
		Weighted Rational C	Rainfall Intensity (in/hr)	Peak Runoff Rate (cfs)	Weighted Rational C	Rainfall Intensity (in/hr)	Peak Runoff Rate (cfs)	cfs	%	cms
2	32	0.35	1.35	15.3	0.76	2.09	50.9	35.6	232	1.0
10	32	0.35	2.33	26.4	0.76	3.58	87.1	60.7	229	1.7
25	32	0.38	2.70	32.5	0.77	4.02	98.8	66.2	203	1.9
50	32	0.40	2.94	37.5	0.78	4.61	115.3	77.9	207	2.2
100	32	0.41	3.28	43.0	0.78	5.00	125.1	82.2	191	2.3

The above calculations were based on a tributary area of 32 acres, shown in Blue in Figure 3. The portion of the project on the east side of Prefumo Creek is not included in the calculation as the land use-agriculture/open space, will remain the same after completion of the project. The 'pan handle', while consistent between the two scenarios, was included in the calculations since the area contributes runoff to the site.

Figure 3 – Approximate Tributary Area

Rainfall intensities for the site were taken from the Table 4-6 of the Waterway Management Plan. This is the table that corresponds to an annual rainfall between 21.6 and 27.5-inches. The times of concentrations were determined using Figure 4-1 'Overland Flow Time' of the Waterway Management Plan. The time of concentration for the existing site was determined to be 26-minutes. The time of concentration for the proposed site was determined to be 10-minutes.

The pre-developed and post-developed weighted Rational Coefficients were calculated using the required antecedent moisture factor provided in Table 4.2 of the Waterway Management Plan. A map showing the land use coefficients applied to the various areas within the project's tributary area is provided in Appendix B, as well as the actual calculations. The hydrologic soil group is type D.

SBUH Method Table 3 summarizes the increase in peak runoff as a result of this project based on SBUH calculations. The existing condition is based on a time of concentration of 26-minutes and a weighted Curve Number (CN) value of 87. The proposed condition is based on a time of concentration of 10 minutes and a weighted CN value of 93.

Table 3 – SBUH Method Flow Runoff Calculations

Return (Yr)	Rainfall Depth (in)	Area (ac)	Peak Runoff Rate (cfs)		Increase		
			Existing Condition	Proposed Condition	cfs	%	cms
2	2.88	32	19.7	42.5	22.8	115.8	0.6
10	5.04	32	45.4	82.9	37.5	82.7	1.1
25	5.76	32	54.1	96.2	42.1	77.8	1.2
50	6.24	32	60.0	105.0	45.1	75.1	1.3
100	6.96	32	68.7	118.2	49.5	72.1	1.4

The Rational Method provided consistently lower peak flow rates for the existing conditions and consistently higher rates for the post developed conditions than the SBUH method. To be conservative, this report uses values derived from the Rational Method in all subsequent calculations.

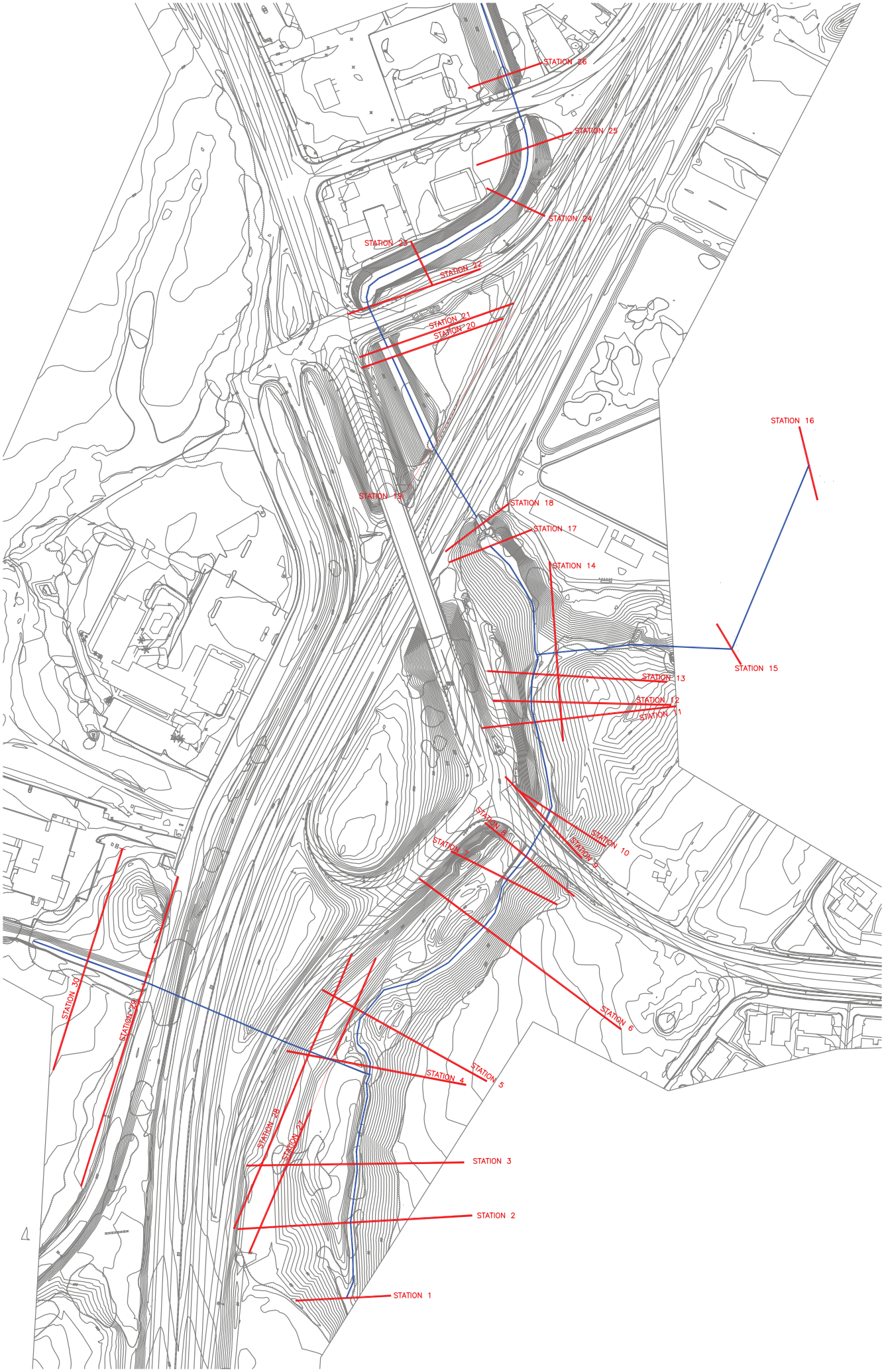
HYDRAULIC ANALYSIS

The City's Zone 9 HEC RAS model was used as the basis of evaluating the project's likely impacts to Prefumo Creek and surrounding areas. This is a 1-dimensional model that does not take into effect how the project reacts over time, but can provide insight into the magnitude of responses (e.g., velocity, water surface elevation, shear stresses and top widths) expected within Prefumo Creek, as a result of the project.

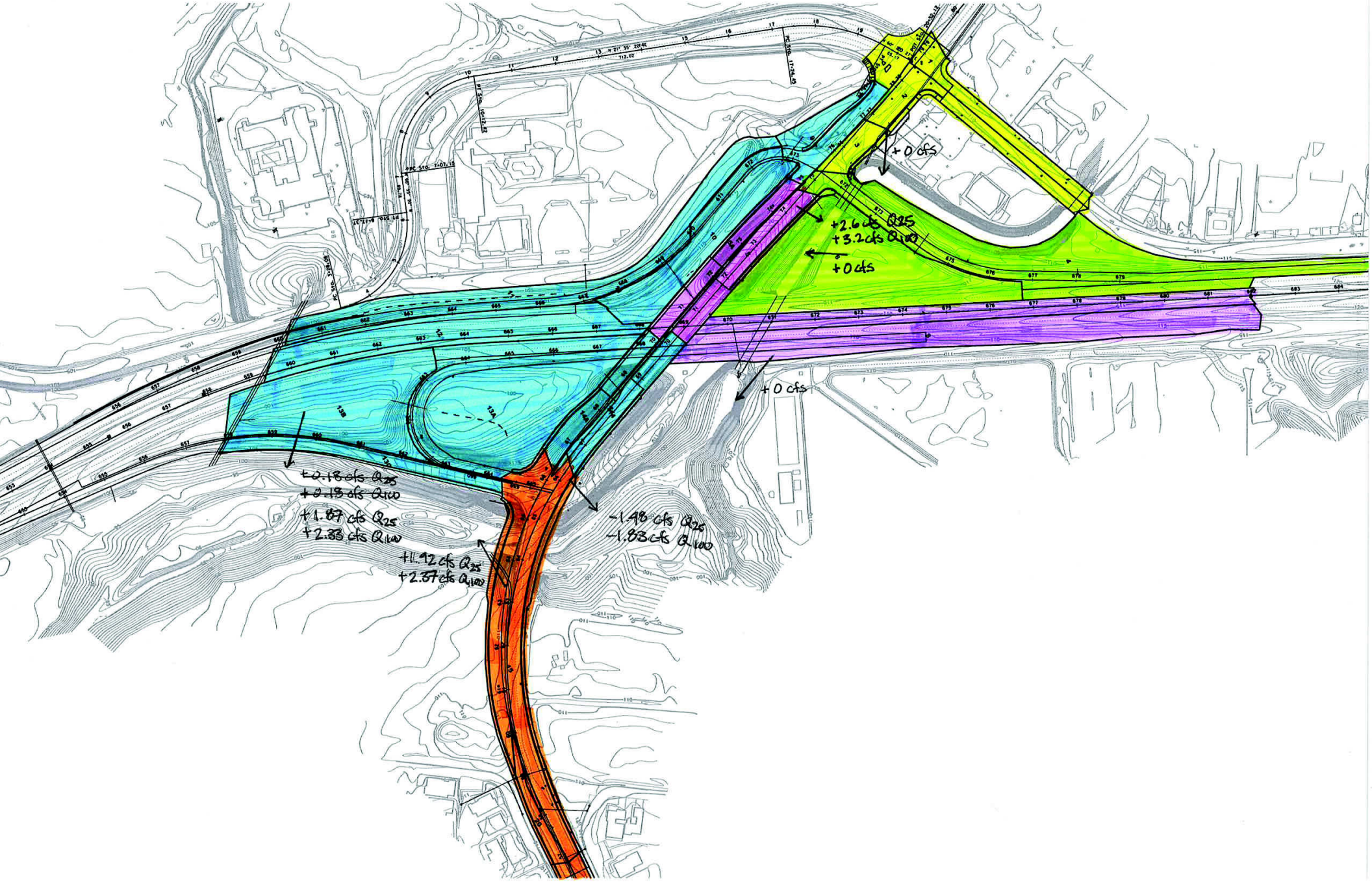
Because there were only two existing cross-sections in the City model within the reach being studied, additional topographic survey was conducted to increase the number of cross sections between City model river stations 710.02 and 1402.671.

While both surveys utilized the same datum, differences in elevations were identified. Where conflicts existed between the shots taken in the recent ground survey and those taken previously from the City's aerial survey, the ground shots were presumed more accurate.

Appendix C Cross Section Locations for Hydraulic Model


STATION 26
STATION 25
STATION 24
STATION 23
STATION 22
STATION 21
STATION 20
STATION 19
STATION 18
STATION 17
STATION 16
STATION 15
STATION 14
STATION 13
STATION 12
STATION 11
STATION 10
STATION 9
STATION 8
STATION 7
STATION 6
STATION 5
STATION 4
STATION 3
STATION 2
STATION 1
STATION 30
STATION 29
STATION 28
STATION 27

Appendix D Runoff Pattern Modifications


+0 cfs
+2.6 cfs Q25
+3.2 cfs Q100
+0 cfs
+0 cfs
+0.18 cfs Q25
+0.13 cfs Q100
+1.87 cfs Q25
+2.33 cfs Q100
+11.92 cfs Q25
+2.37 cfs Q100
-1.48 cfs Q25
-1.83 cfs Q100

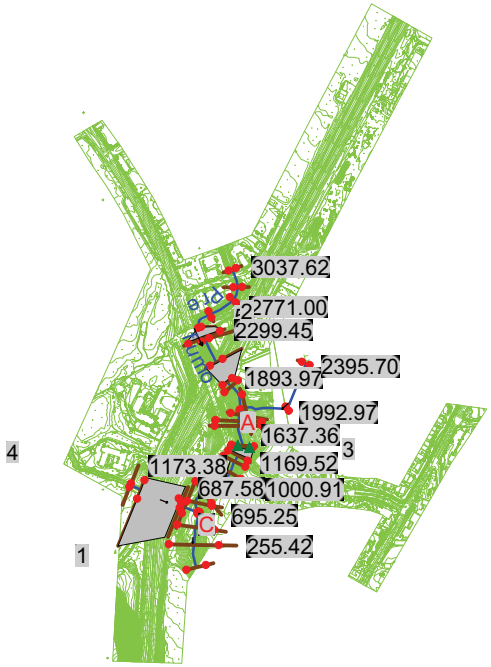
1761 - US-101/Los Osos Valley Road Interchange Improvement Project
Table 1 - Existing Peak Flow

Watershed Sub-Area	Area (Acres)	Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity (in/hr)		Peak Discharge (cfs)	
				i_{25}	i_{100}	Q_{25}	Q_{100}
1	0.425	0.95	6	3.822	4.728	1.54	1.91
2	0.556	0.95	6	3.822	4.728	2.02	2.50
3	0.219	0.95	6	3.822	4.728	0.80	0.98
4	2.510	0.59	6	3.822	4.728	5.66	7.00
5	0.281	0.95	5	4.151	5.135	1.11	1.37
6	2.234	0.52	5	4.151	5.135	4.82	5.96
7	1.076	0.42	10	3.034	3.754	1.37	1.70
8	1.902	0.68	10	3.034	3.754	3.92	4.85
9	0.761	0.79	20	2.218	2.744	1.33	1.65
10	0.917	0.47	20	2.218	2.744	0.96	1.18
11	1.828	0.47	20	2.218	2.744	1.91	2.36
12	1.385	0.65	20	2.218	2.744	2.00	2.47
13A	2.940	0.53	20	2.218	2.744	3.46	4.28
13B	1.871	0.38	20	2.218	2.744	1.58	1.95
13C	0.331	0.95	20	2.218	2.744	0.70	0.86
14	0.407	0.95	6	3.822	4.728	1.48	1.83
15	1.173	0.95	11	2.906	3.595	3.24	4.01
16	0.293	0.95	11	2.906	3.595	0.81	1.00
17	0.289	0.95	11	2.906	3.595	0.80	0.99
18	0.317	0.95	11	2.906	3.595	0.88	1.08
19	0.334	0.95	11	2.906	3.595	0.92	1.14
20	0.183	0.95	11	2.906	3.595	0.51	0.63
						41.79	**51.70** cfs

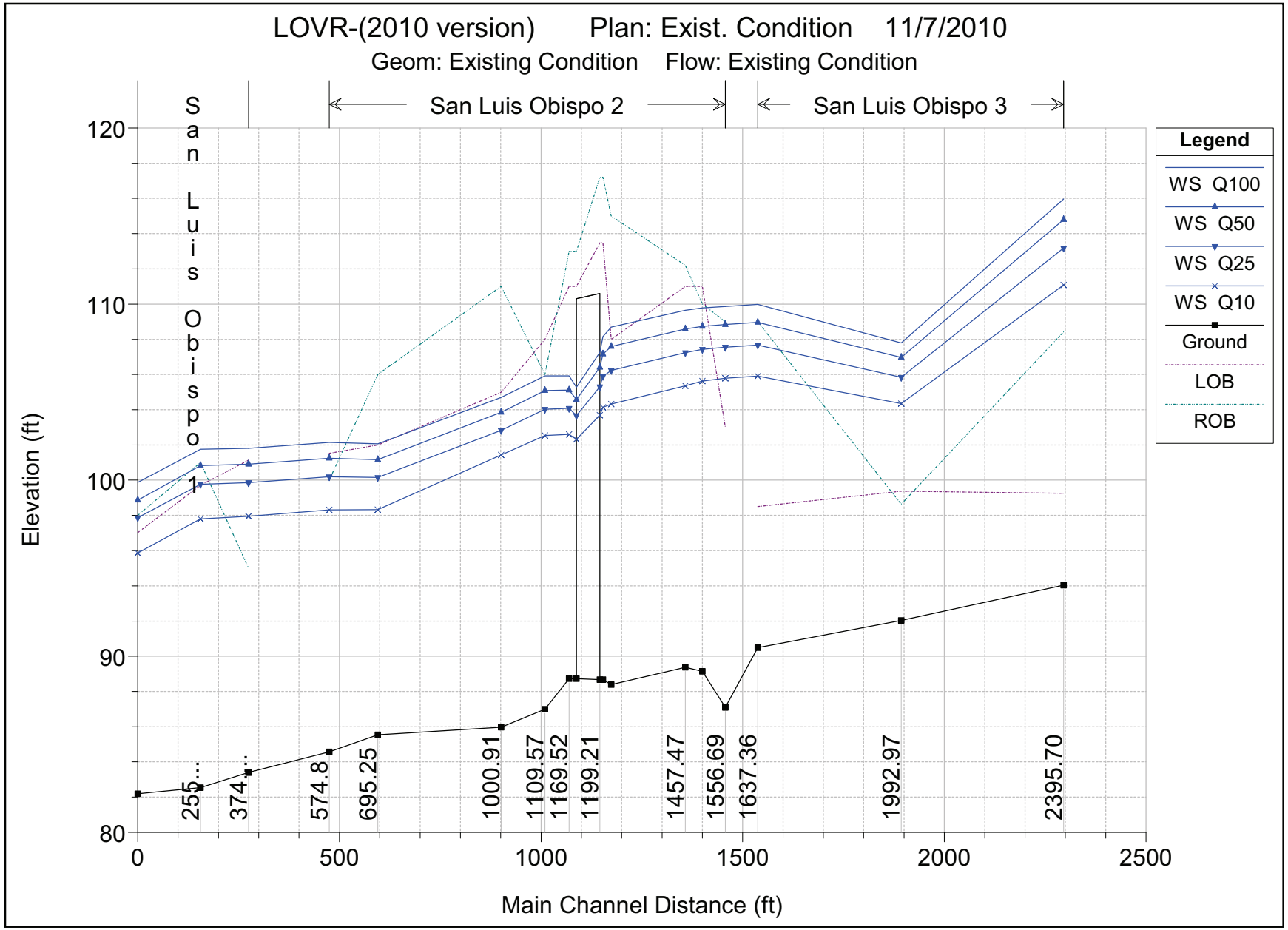
1761 - US-101/Los Osos Valley Road Interchange Improvement Project
Table 2 - Proposed Peak Flow

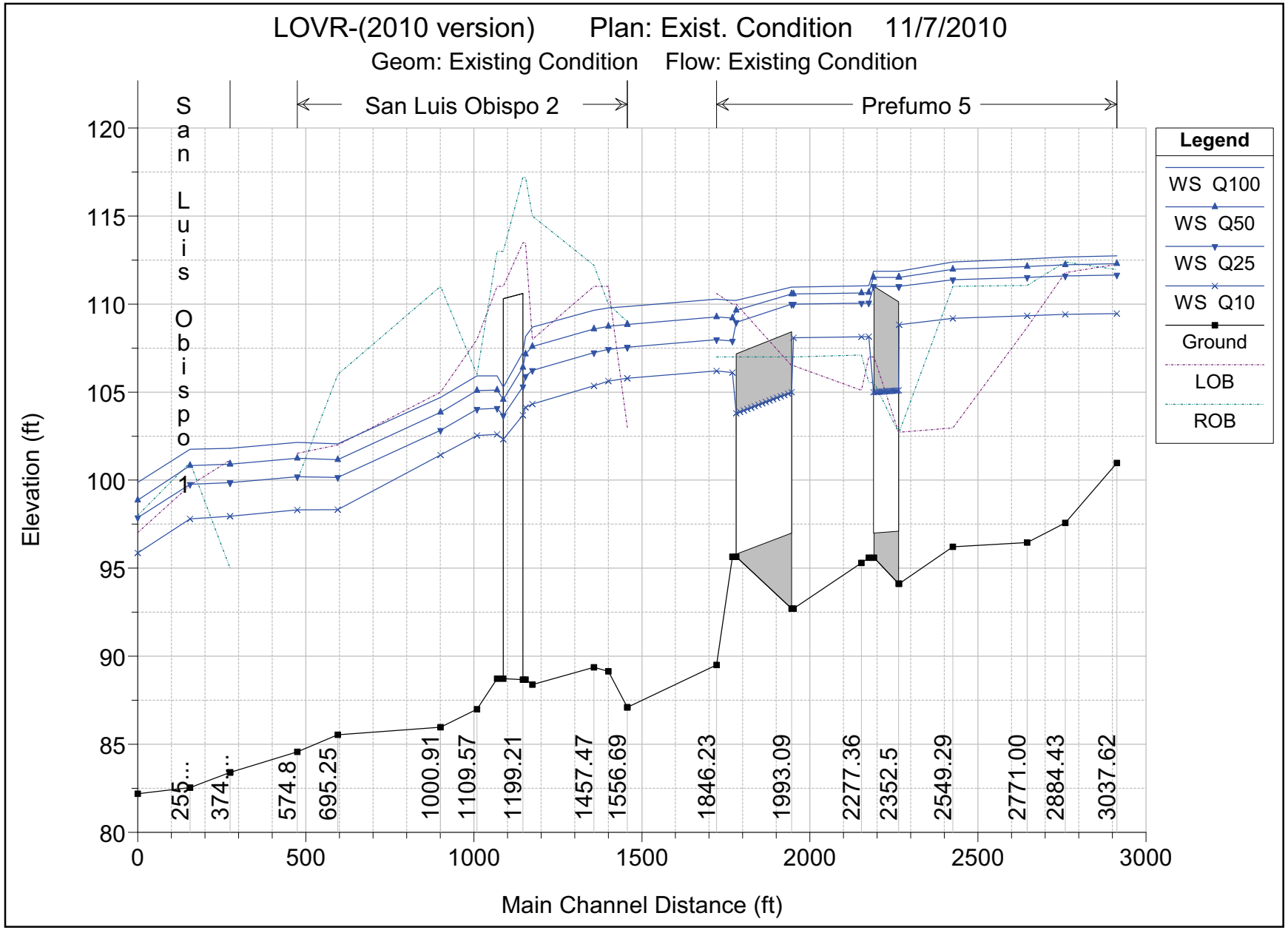
Watershed Sub-Area	Area (Acres)	Runoff Coefficient	Time of Concentration (min)	Rainfall Intensity (in/hr)		Peak Discharge (cfs)	
				i_{25}	i_{100}	Q_{25}	Q_{100}
1	0.425	0.95	6	3.822	4.728	1.54	1.91
2	0.556	0.95	6	3.822	4.728	2.02	2.50
3	0.219	0.95	6	3.822	4.728	0.80	0.98
4	2.510	0.59	6	3.822	4.728	5.66	7.00
5	0.485	0.95	5	4.151	5.135	1.91	2.37
5A	0.457	0.95	5	4.151	5.135	1.80	2.23
6	2.234	0.52	5	4.151	5.135	4.82	5.96
7	1.076	0.42	10	3.034	3.754	1.37	1.70
8	1.902	0.68	10	3.034	3.754	3.92	4.85
9	0.514	0.74	20	2.218	2.744	0.84	1.04
10	0.997	0.53	20	2.218	2.744	1.17	1.45
11	1.376	0.69	20	2.218	2.744	2.11	2.61
12	1.349	0.73	20	2.218	2.744	2.18	2.70
13A	2.494	0.58	20	2.218	2.744	3.21	3.97
13B	1.871	0.38	20	2.218	2.744	1.58	1.95
13C	0.464	0.95	20	2.218	2.744	0.98	1.21
14	0.407	0.95	20	2.218	2.744	0.86	1.06
14A	0.417	0.95	20	2.218	2.744	0.88	1.09
15	1.868	0.95	11	2.906	3.595	5.16	6.38
16	0.293	0.95	11	2.906	3.595	0.81	1.00
17	0.289	0.95	11	2.906	3.595	0.80	0.99
18	0.317	0.95	11	2.906	3.595	0.88	1.08
19	0.334	0.95	11	2.906	3.595	0.92	1.14
20	0.183	0.95	11	2.906	3.595	0.51	0.63
						46.72	**57.80** cfs

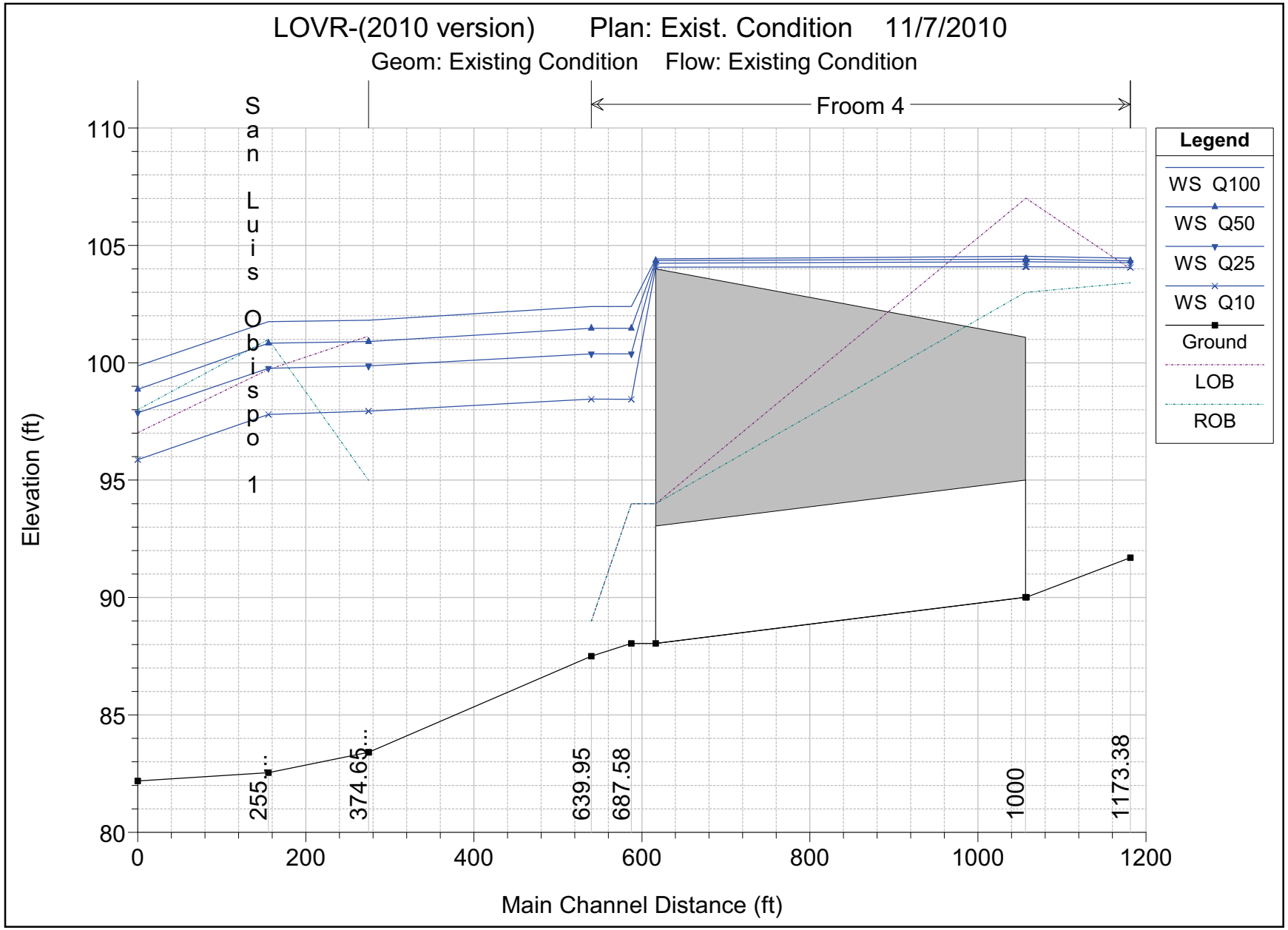
Appendix E Hydraulic Analyses, Existing Condition



None of the XS's are Geo-Referenced (Geo-Ref user entered XS Geo-Ref interpolated XS Non Geo-Ref user entered XS Non Geo-Ref interpolated XS)

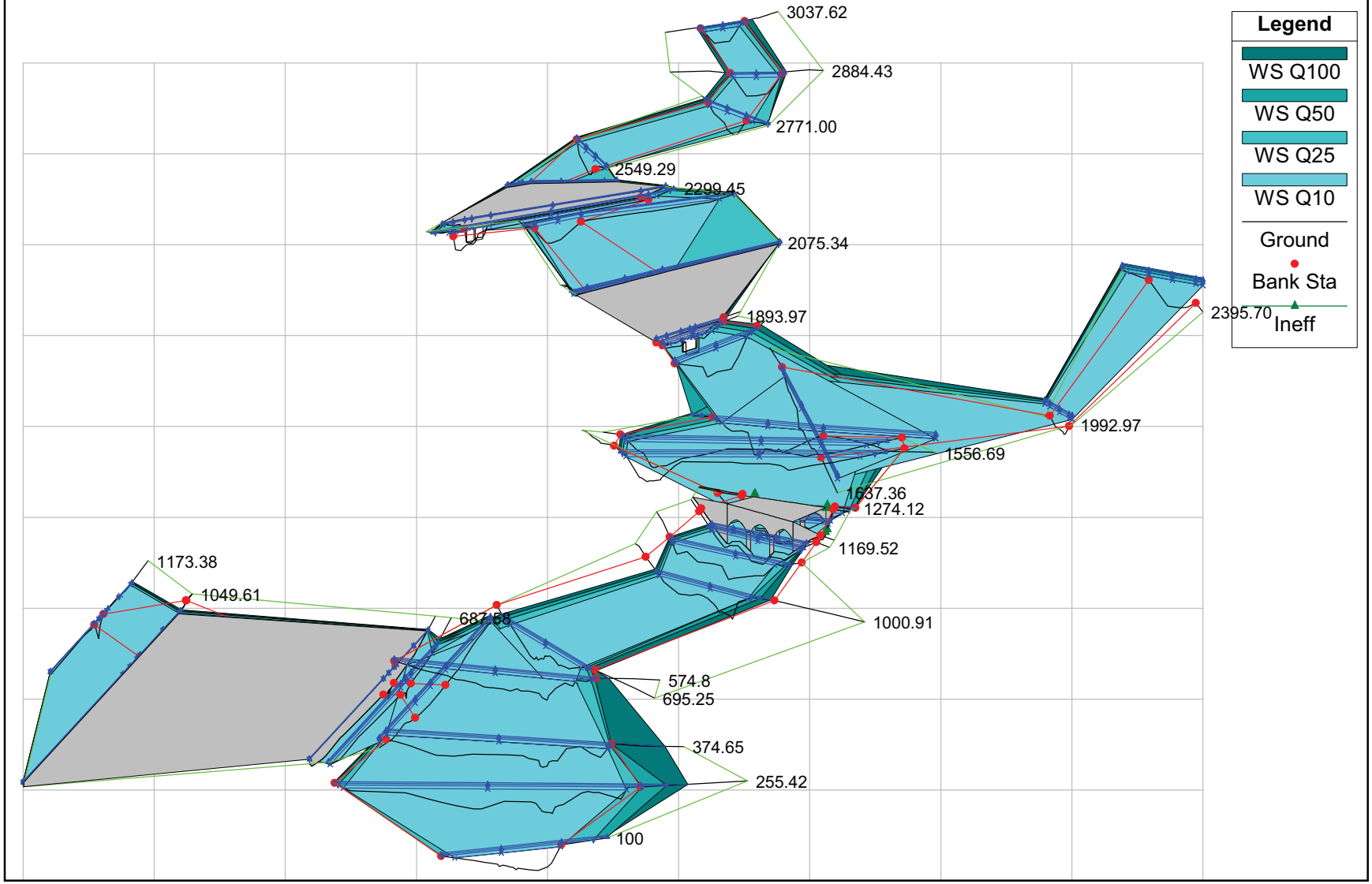

LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
San Luis Obispo 1
San Luis Obispo 2
San Luis Obispo 3
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
120
110
100
90
80
0
500
1000
1500
2000
2500
255...
374...
574.8
695.25
1000.91
1109.57
1169.52
1199.21
1457.47
1556.69
1637.36
1992.97
2395.70


LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
San Luis Obispo 2
Prefumo 5
San Luis Obispo 1
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
120
115
110
105
100
95
90
85
80
0
500
1000
1500
2000
2500
3000
255...
374...
574.8
695.25
1000.91
1109.57
1199.21
1457.47
1556.69
1846.23
1993.09
2277.36
2352.5
2549.29
2771.00
2884.43
3037.62


LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
Froom 4
San Luis Obispo 1
Elevation (ft)
Main Channel Distance (ft)
110
105
100
95
90
85
80
0
200
400
600
800
1000
1200
255...
374.65...
639.95
687.58
1000
1173.38
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB

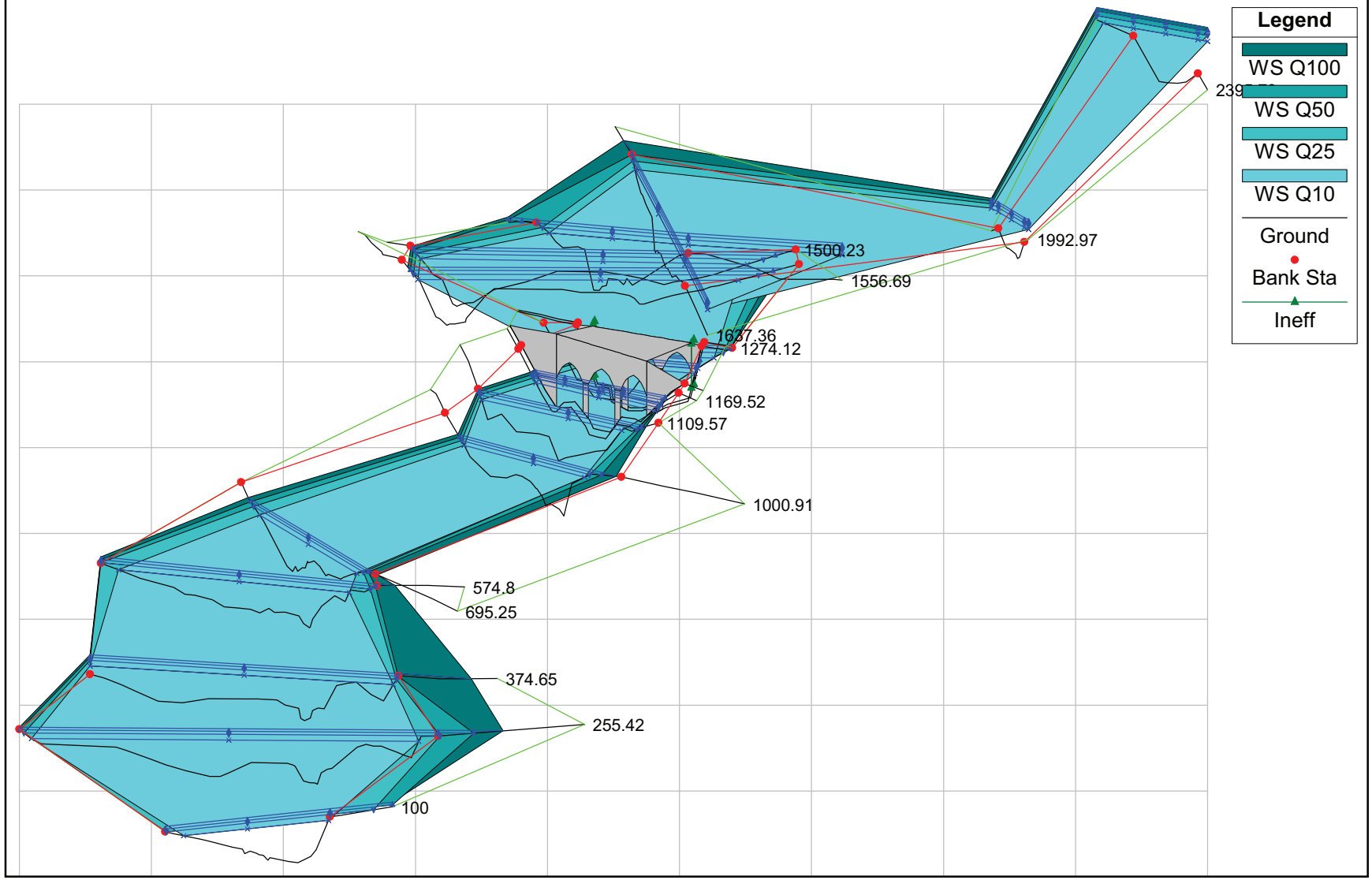
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010

Geom: Existing Condition Flow: Existing Condition



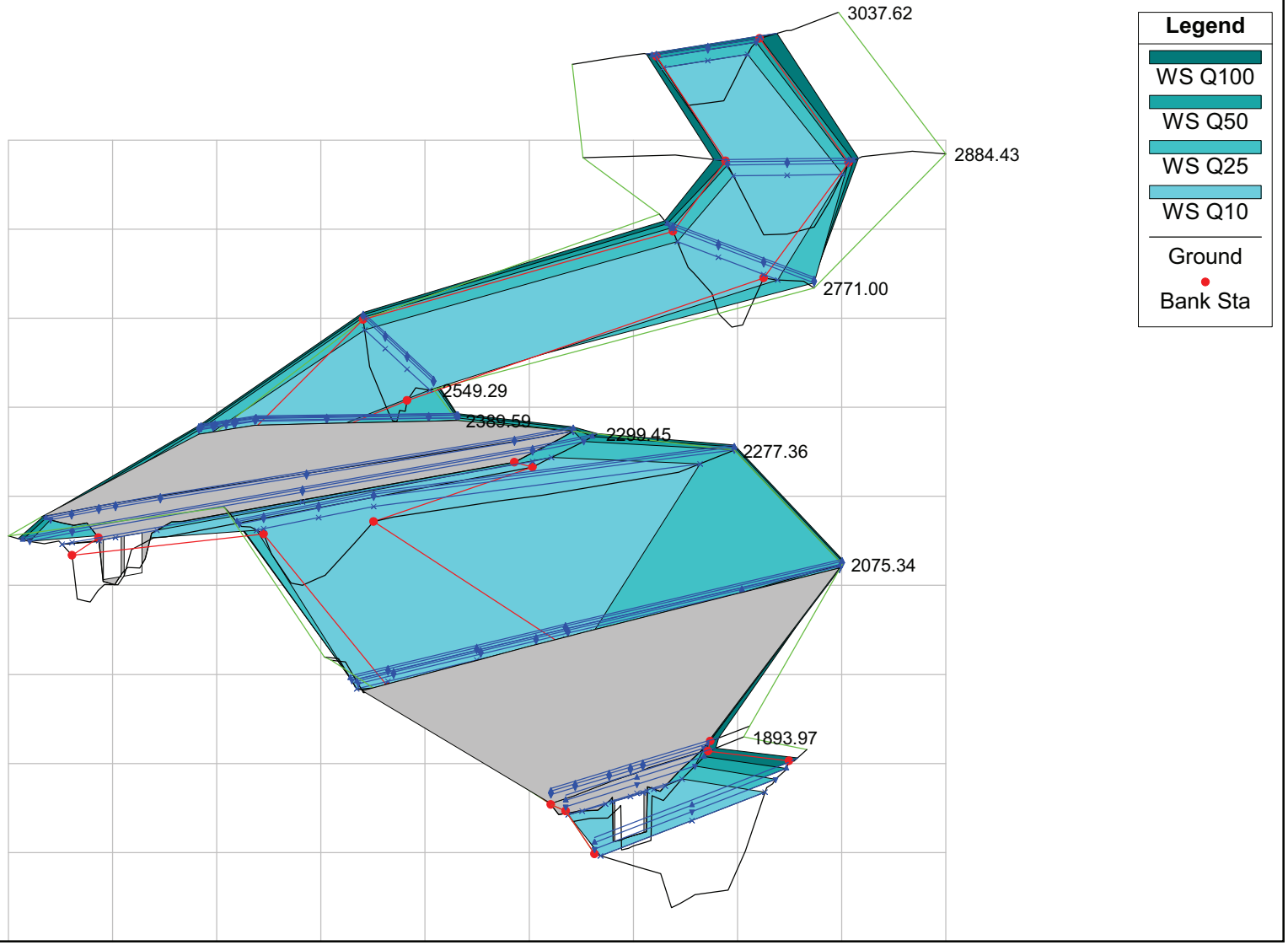
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010

Geom: Existing Condition Flow: Existing Condition



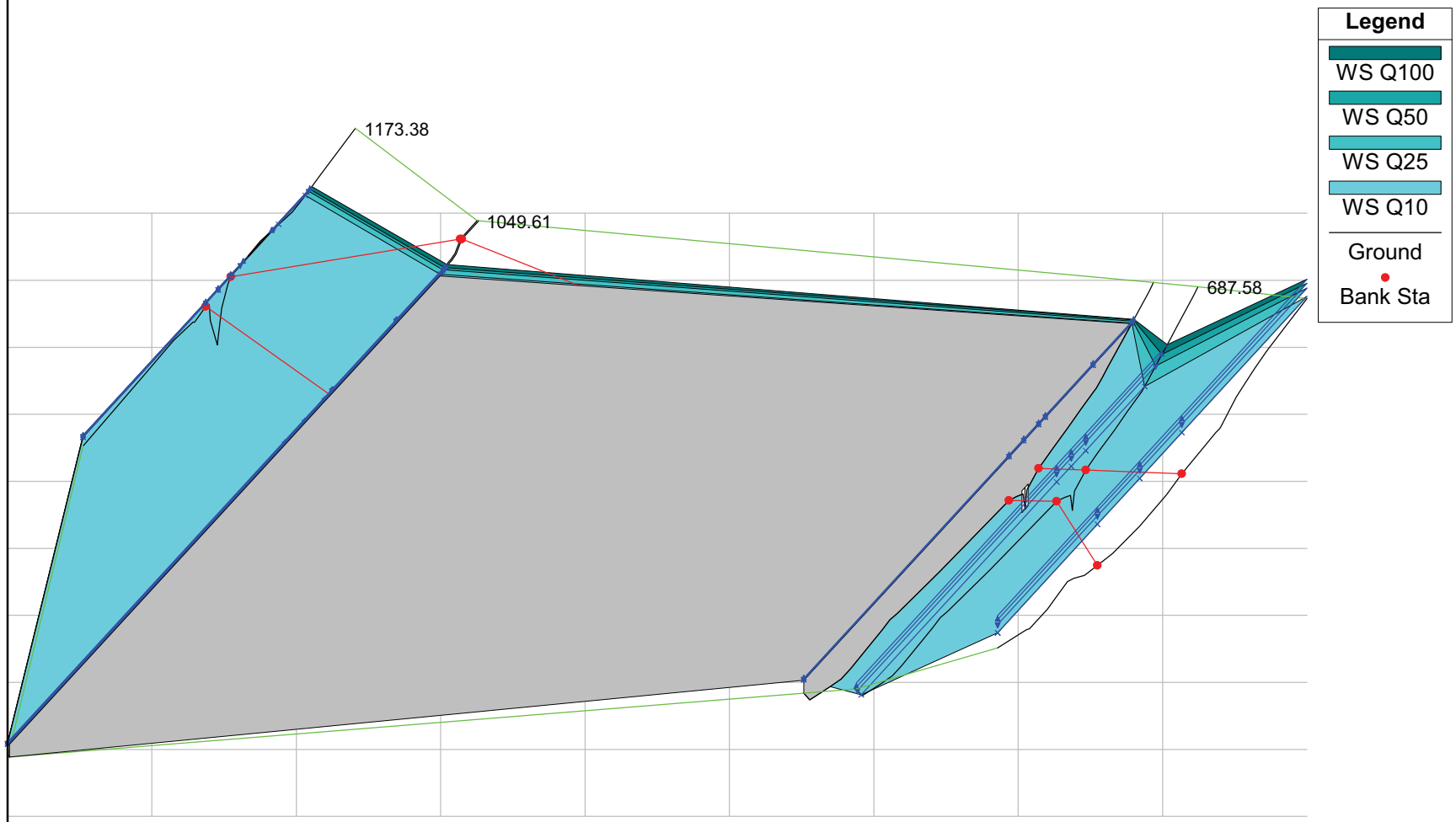
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010

Geom: Existing Condition Flow: Existing Condition



LOVR-(2010 version) Plan: Exist. Condition 11/7/2010

Geom: Existing Condition Flow: Existing Condition



HEC-RAS Plan: Exist.Condition

River	Reach	River Sta	Profile	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)	
San Luis Obispo	3	2395.70	Q100	13350.00	94.04	115.97		117.21	0.002974	9.41	1680.30	117.73	0.39
San Luis Obispo	3	2395.70	Q50	12043.00	94.04	114.80		115.98	0.003092	9.17	1541.67	117.73	0.39
San Luis Obispo	3	2395.70	Q25	10312.00	94.04	113.19		114.30	0.003258	8.81	1352.29	117.73	0.39
San Luis Obispo	3	2395.70	Q10	8158.00	94.04	111.08		112.07	0.003444	8.22	1106.36	110.52	0.40
San Luis Obispo	3	1992.97	Q100	13350.00	92.03	107.79	107.79	114.17	0.020986	21.14	724.69	60.01	1.03
San Luis Obispo	3	1992.97	Q50	12043.00	92.03	106.98	106.98	112.90	0.021217	20.36	675.68	60.01	1.02
San Luis Obispo	3	1992.97	Q25	10312.00	92.03	105.85	105.85	111.16	0.021572	19.26	607.88	60.01	1.02
San Luis Obispo	3	1992.97	Q10	8158.00	92.03	104.35	104.35	108.86	0.022062	17.69	518.24	60.01	1.00
San Luis Obispo	3	1637.36	Q100	13350.00	90.49	109.98		110.16	0.000404	3.72	4145.25	361.95	0.19
San Luis Obispo	3	1637.36	Q50	12043.00	90.49	108.96		109.14	0.000422	3.68	3790.23	335.15	0.19
San Luis Obispo	3	1637.36	Q25	10312.00	90.49	107.67		107.84	0.000432	3.57	3363.34	329.33	0.20
San Luis Obispo	3	1637.36	Q10	8158.00	90.49	105.90		106.06	0.000452	3.44	2788.07	321.34	0.20
San Luis Obispo	2	1556.69	Q100	15292.00	87.10	109.86		110.11	0.001120	4.35	3973.59	363.33	0.21
San Luis Obispo	2	1556.69	Q50	13738.00	87.10	108.84		109.08	0.001212	4.29	3604.91	346.76	0.22
San Luis Obispo	2	1556.69	Q25	11760.00	87.10	107.55		107.78	0.001288	4.22	3175.59	325.69	0.23
San Luis Obispo	2	1556.69	Q10	9112.00	87.10	105.79		106.00	0.001387	4.07	2608.32	318.17	0.23
San Luis Obispo	2	1500.23	Q100	15292.00	89.14	109.78		110.03	0.001737	4.02	3803.24	400.26	0.23
San Luis Obispo	2	1500.23	Q50	13738.00	89.14	108.74		108.99	0.001961	4.05	3393.49	387.71	0.24
San Luis Obispo	2	1500.23	Q25	11760.00	89.14	107.43		107.68	0.002300	4.06	2896.03	371.91	0.26
San Luis Obispo	2	1500.23	Q10	9112.00	89.14	105.63		105.88	0.002956	4.06	2246.90	349.96	0.28
San Luis Obispo	2	1457.47	Q100	15292.00	89.38	109.64		109.94	0.002248	4.35	3512.48	403.25	0.26
San Luis Obispo	2	1457.47	Q50	13738.00	89.38	108.58		108.89	0.002632	4.44	3092.12	388.40	0.28
San Luis Obispo	2	1457.47	Q25	11760.00	89.38	107.24		107.56	0.003280	4.55	2582.24	369.58	0.30
San Luis Obispo	2	1457.47	Q10	9112.00	89.38	105.36		105.71	0.004816	4.76	1914.08	343.37	0.36
San Luis Obispo	2	1274.12	Q100	15292.00	88.39	108.69		109.39	0.003427	6.75	2266.46	190.30	0.34
San Luis Obispo	2	1274.12	Q50	13738.00	88.39	107.60		108.29	0.003651	6.67	2060.26	185.96	0.35
San Luis Obispo	2	1274.12	Q25	11760.00	88.39	106.23		106.88	0.003769	6.49	1812.96	175.86	0.36
San Luis Obispo	2	1274.12	Q10	9112.00	88.39	104.33		104.91	0.003840	6.11	1491.64	162.32	0.36
San Luis Obispo	2	1253.52	Q100	15292.00	88.67	108.16	100.11	109.30	0.001801	8.57	1784.35	123.83	0.37
San Luis Obispo	2	1253.52	Q50	13738.00	88.67	107.16	99.52	108.20	0.001790	8.19	1676.44	122.04	0.37
San Luis Obispo	2	1253.52	Q25	11760.00	88.67	105.90	98.74	106.81	0.001734	7.63	1541.58	119.80	0.36
San Luis Obispo	2	1253.52	Q10	9112.00	88.67	104.14	97.56	104.84	0.001612	6.74	1351.99	116.66	0.33
San Luis Obispo	2	1199.21		Bridge									
San Luis Obispo	2	1169.52	Q100	15292.00	88.72	105.92		107.25	0.005799	9.27	1650.33	161.10	0.51
San Luis Obispo	2	1169.52	Q50	13738.00	88.72	105.12		106.38	0.005833	9.02	1522.54	157.13	0.51
San Luis Obispo	2	1169.52	Q25	11760.00	88.72	104.09		105.24	0.005788	8.63	1363.42	152.04	0.51

HEC-RAS Plan: Exist.Condition (Continued)

River	Reach	River Sta	Profile	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)	
San Luis Obispo	2	1169.52	Q10	9112.00	88.72	102.60		103.59	0.005659	7.97	1143.29	144.71	0.50
San Luis Obispo	2	1109.57	Q100	15292.00	86.99	105.92		106.81	0.004744	7.57	2019.65	201.42	0.42
San Luis Obispo	2	1109.57	Q50	13738.00	86.99	105.09		105.94	0.004798	7.40	1855.92	194.73	0.42
San Luis Obispo	2	1109.57	Q25	11760.00	86.99	104.03		104.82	0.004812	7.11	1653.60	187.42	0.42
San Luis Obispo	2	1109.57	Q10	9112.00	86.99	102.53		103.20	0.004341	6.57	1387.70	167.95	0.40
San Luis Obispo	2	1000.91	Q100	15292.00	85.97	104.70		106.03	0.010362	9.27	1650.36	197.82	0.57
San Luis Obispo	2	1000.91	Q50	13738.00	85.97	103.85		105.16	0.010031	9.21	1491.42	177.51	0.56
San Luis Obispo	2	1000.91	Q25	11760.00	85.97	102.83		104.06	0.009483	8.91	1320.56	160.07	0.55
San Luis Obispo	2	1000.91	Q10	9112.00	85.97	101.43		102.49	0.009395	8.25	1104.58	150.41	0.54
San Luis Obispo	2	695.25	Q100	15292.00	85.54	102.06		103.12	0.008298	8.27	1850.10	233.54	0.51
San Luis Obispo	2	695.25	Q50	13738.00	85.54	101.17		102.24	0.008694	8.32	1651.64	212.63	0.53
San Luis Obispo	2	695.25	Q25	11760.00	85.54	100.15		101.18	0.008968	8.15	1443.16	197.88	0.53
San Luis Obispo	2	695.25	Q10	9112.00	85.54	98.32		99.38	0.011036	8.27	1101.84	175.65	0.58
San Luis Obispo	2	574.8	Q100	15292.00	84.57	102.15		102.63	0.001296	5.56	2754.82	322.08	0.33
San Luis Obispo	2	574.8	Q50	13738.00	84.57	101.24		101.72	0.001386	5.55	2477.30	301.43	0.34
San Luis Obispo	2	574.8	Q25	11760.00	84.57	100.20		100.65	0.001443	5.43	2164.42	295.51	0.35
San Luis Obispo	2	574.8	Q10	9112.00	84.57	98.31		98.79	0.001693	5.54	1644.69	253.14	0.38
San Luis Obispo	1	374.65	Q100	15680.00	83.41	101.81		102.30	0.002118	5.61	2827.69	309.82	0.30
San Luis Obispo	1	374.65	Q50	14056.00	83.41	100.91		101.37	0.002204	5.48	2565.80	250.26	0.30
San Luis Obispo	1	374.65	Q25	12078.00	83.41	99.86		100.29	0.002239	5.24	2305.22	248.86	0.30
San Luis Obispo	1	374.65	Q10	9324.00	83.41	97.94		98.35	0.002624	5.09	1830.36	246.29	0.33
San Luis Obispo	1	255.42	Q100	15680.00	82.54	101.75		102.09	0.000930	4.69	3386.81	388.98	0.26
San Luis Obispo	1	255.42	Q50	14056.00	82.54	100.83		101.16	0.000977	4.65	3039.07	364.93	0.27
San Luis Obispo	1	255.42	Q25	12078.00	82.54	99.77		100.08	0.001001	4.53	2666.92	334.64	0.28
San Luis Obispo	1	255.42	Q10	9324.00	82.54	97.80		98.12	0.001156	4.56	2043.98	311.67	0.31
San Luis Obispo	1	100	Q100	15680.00	82.19	99.87	96.59	101.61	0.009802	10.73	1540.26	188.14	0.58
San Luis Obispo	1	100	Q50	14056.00	82.19	98.87	95.89	100.66	0.011221	10.79	1352.12	188.14	0.62
San Luis Obispo	1	100	Q25	12078.00	82.19	97.87	95.03	99.57	0.012039	10.47	1167.03	171.59	0.63
San Luis Obispo	1	100	Q10	9324.00	82.19	95.87	93.61	97.55	0.013764	10.42	895.12	119.88	0.67
Prefumo	5	3037.62	Q100	2508.00	100.97	112.74		113.15	0.003180	5.18	488.55	77.89	0.33
Prefumo	5	3037.62	Q50	2190.00	100.97	112.29		112.65	0.002957	4.80	456.51	64.80	0.31
Prefumo	5	3037.62	Q25	1802.00	100.97	111.65		111.94	0.002514	4.32	417.19	59.16	0.29
Prefumo	5	3037.62	Q10	1237.00	100.97	109.46		109.73	0.002690	4.14	298.58	50.07	0.30
Prefumo	5	2884.43	Q100	2508.00	97.58	112.67		112.85	0.000892	3.45	730.15	81.30	0.19
Prefumo	5	2884.43	Q50	2190.00	97.58	112.22		112.38	0.000780	3.15	696.79	71.66	0.17
Prefumo	5	2884.43	Q25	1802.00	97.58	111.60		111.71	0.000632	2.76	653.24	67.72	0.16

HEC-RAS Plan: Exist.Condition (Continued)

River	Reach	River Sta	Profile	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)	
Prefumo	5	2884.43	Q10	1237.00	97.58	109.43		109.52	0.000548	2.41	512.92	61.53	0.15
Prefumo	5	2771.00	Q100	2508.00	96.46	112.57		112.74	0.001039	3.42	799.11	110.99	0.19
Prefumo	5	2771.00	Q50	2190.00	96.46	112.13		112.28	0.000933	3.15	751.26	109.20	0.18
Prefumo	5	2771.00	Q25	1802.00	96.46	111.51		111.63	0.000805	2.80	684.72	106.66	0.16
Prefumo	5	2771.00	Q10	1237.00	96.46	109.33		109.44	0.000880	2.56	485.86	74.69	0.16
Prefumo	5	2549.29	Q100	2508.00	96.21	112.38		112.53	0.000812	3.18	871.94	91.96	0.16
Prefumo	5	2549.29	Q50	2190.00	96.21	111.97		112.09	0.000700	2.90	834.12	91.96	0.15
Prefumo	5	2549.29	Q25	1802.00	96.21	111.38		111.48	0.000571	2.55	779.92	91.96	0.13
Prefumo	5	2549.29	Q10	1237.00	96.21	109.20		109.27	0.000574	2.29	582.37	85.11	0.13
Prefumo	5	2389.59	Q100	2508.00	94.12	111.87	105.38	112.36	0.000895	6.20	696.13	145.50	0.30
Prefumo	5	2389.59	Q50	2190.00	94.12	111.52	104.77	111.94	0.000785	5.71	645.46	145.50	0.28
Prefumo	5	2389.59	Q25	1802.00	94.12	111.00	103.98	111.35	0.000657	5.08	570.44	145.50	0.25
Prefumo	5	2389.59	Q10	1237.00	94.12	108.82	102.70	109.15	0.000714	4.67	319.21	73.13	0.25
Prefumo	5	2352.5		Culvert									
Prefumo	5	2299.45	Q100	2508.00	95.60	111.05		111.09	0.000503	1.51	1733.85	352.18	0.11
Prefumo	5	2299.45	Q50	2190.00	95.60	110.65		110.68	0.000497	1.43	1593.58	346.12	0.11
Prefumo	5	2299.45	Q25	1802.00	95.60	110.06		110.09	0.000508	1.34	1393.55	336.52	0.11
Prefumo	5	2299.45	Q10	1237.00	95.60	108.15		108.19	0.001424	1.58	790.39	296.57	0.17
Prefumo	5	2277.36	Q100	2508.00	95.30	111.03		111.07	0.000265	1.96	1802.85	297.06	0.10
Prefumo	5	2277.36	Q50	2190.00	95.30	110.63		110.67	0.000244	1.84	1684.38	296.08	0.10
Prefumo	5	2277.36	Q25	1802.00	95.30	110.05		110.08	0.000220	1.69	1511.95	294.64	0.09
Prefumo	5	2277.36	Q10	1237.00	95.30	108.14		108.18	0.000290	1.70	979.07	263.69	0.10
Prefumo	5	2075.34	Q100	2508.00	92.70	110.97	99.59	111.02	0.000306	1.83	1668.18	314.79	0.10
Prefumo	5	2075.34	Q50	2190.00	92.70	110.58	99.18	110.62	0.000278	1.70	1544.39	314.13	0.09
Prefumo	5	2075.34	Q25	1802.00	92.70	110.00	98.56	110.03	0.000246	1.54	1363.50	313.14	0.09
Prefumo	5	2075.34	Q10	1237.00	92.70	108.09	97.52	108.12	0.000271	1.39	903.58	151.60	0.09
Prefumo	5	1993.09		Culvert									
Prefumo	5	1893.97	Q100	2508.00	95.65	110.22		110.41	0.001073	3.56	704.40	103.48	0.23
Prefumo	5	1893.97	Q50	2190.00	95.65	109.20		109.40	0.001181	3.62	604.80	95.60	0.25
Prefumo	5	1893.97	Q25	1802.00	95.65	107.90		108.11	0.001326	3.72	484.65	89.38	0.28
Prefumo	5	1893.97	Q10	1237.00	95.65	106.12		106.33	0.001367	3.70	333.96	78.72	0.32
Prefumo	5	1846.23	Q100	2508.00	89.51	110.28		110.32	0.000141	1.43	1755.79	150.08	0.07
Prefumo	5	1846.23	Q50	2190.00	89.51	109.27		109.30	0.000139	1.36	1609.05	143.29	0.07
Prefumo	5	1846.23	Q25	1802.00	89.51	107.98		108.01	0.000127	1.26	1428.72	135.26	0.07
Prefumo	5	1846.23	Q10	1237.00	89.51	106.20		106.22	0.000091	1.03	1197.85	123.18	0.06

HEC-RAS Plan: Exist.Condition (Continued)

River	Reach	River Sta	Profile	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)	
Froom	4	1173.38	Q100	1066.00	91.70	104.46		104.59	0.000822	3.34	608.46	357.33	0.25
Froom	4	1173.38	Q50	939.00	91.70	104.34		104.46	0.000723	3.09	567.95	341.78	0.24
Froom	4	1173.38	Q25	750.00	91.70	104.26		104.34	0.000505	2.56	540.08	330.66	0.20
Froom	4	1173.38	Q10	547.00	91.70	104.06		104.11	0.000336	2.03	476.02	303.55	0.16
Froom	4	1049.61	Q100	1066.00	90.01	104.53	98.99	104.54	0.000034	0.66	2685.12	755.86	0.05
Froom	4	1049.61	Q50	939.00	90.01	104.41	98.81	104.41	0.000029	0.60	2590.80	751.86	0.05
Froom	4	1049.61	Q25	750.00	90.01	104.31	98.53	104.31	0.000020	0.50	2513.32	749.20	0.04
Froom	4	1049.61	Q10	547.00	90.01	104.09	98.11	104.09	0.000013	0.39	2350.51	743.65	0.03
Froom	4	1000		Culvert									
Froom	4	687.58	Q100	1066.00	88.05	102.39		102.40	0.000011	0.62	3595.66	535.23	0.03
Froom	4	687.58	Q50	939.00	88.05	101.47		101.47	0.000014	0.64	3104.68	526.08	0.04
Froom	4	687.58	Q25	750.00	88.05	100.38		100.38	0.000016	0.63	2539.45	513.37	0.04
Froom	4	687.58	Q10	547.00	88.05	98.45		98.45	0.000034	0.76	1570.84	488.14	0.06
Froom	4	639.95	Q100	1066.00	87.50	102.39		102.40	0.000001	0.31	5813.77	532.17	0.01
Froom	4	639.95	Q50	939.00	87.50	101.47		101.47	0.000001	0.29	5321.45	532.17	0.01
Froom	4	639.95	Q25	750.00	87.50	100.38		100.38	0.000001	0.26	4743.21	532.17	0.01
Froom	4	639.95	Q10	547.00	87.50	98.45		98.45	0.000001	0.24	3714.26	532.17	0.01

HEC-RAS Plan: Exist.Condition

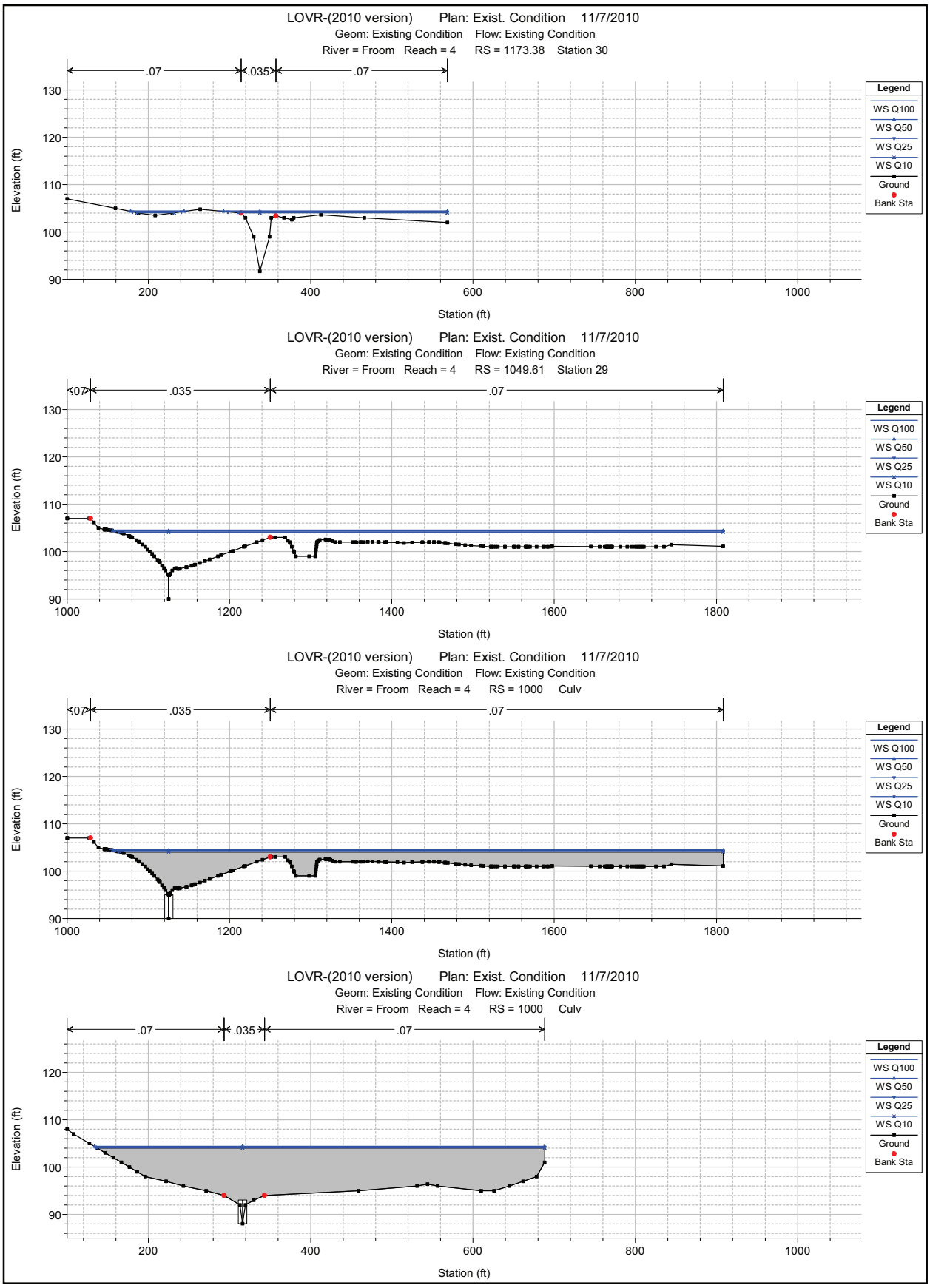
River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
San Luis Obispo	2	1274.12	Q100	109.39	108.69		0.05	0.04	190.30		15292.00		6.75
San Luis Obispo	2	1274.12	Q50	108.29	107.60		0.05	0.04	185.96		13738.00		6.67
San Luis Obispo	2	1274.12	Q25	106.88	106.23		0.05	0.03	175.86		11760.00		6.49
San Luis Obispo	2	1274.12	Q10	104.91	104.33		0.05	0.01	162.32		9112.00		6.11
San Luis Obispo	2	1253.52	Q100	109.30	108.16	100.11	0.02	0.20	123.83		15292.00		8.57
San Luis Obispo	2	1253.52	Q50	108.20	107.16	99.52	0.02	0.17	122.04		13738.00		8.19
San Luis Obispo	2	1253.52	Q25	106.81	105.90	98.74	0.02	0.13	119.80		11760.00		7.63
San Luis Obispo	2	1253.52	Q10	104.84	104.14	97.56	0.02	0.10	116.66		9112.00		6.74
San Luis Obispo	2	1199.21 BR U	Q100	109.07	107.26	101.20	0.55	0.33	67.28		15292.00		10.81
San Luis Obispo	2	1199.21 BR U	Q50	108.01	106.41	100.56	0.49	0.31	76.22		13738.00		10.15
San Luis Obispo	2	1199.21 BR U	Q25	106.65	105.31	99.71	0.42	0.28	85.90		11760.00		9.30
San Luis Obispo	2	1199.21 BR U	Q10	104.73	103.69	98.46	0.36	0.23	94.35		9112.00		8.17
San Luis Obispo	2	1199.21 BR D	Q100	108.20	105.28	102.73	0.15	0.79	83.55		15292.00		13.71
San Luis Obispo	2	1199.21 BR D	Q50	107.21	104.58	102.08	0.14	0.69	89.72		13738.00		13.03
San Luis Obispo	2	1199.21 BR D	Q25	105.95	103.66	101.23	0.14	0.57	94.26		11760.00		12.13
San Luis Obispo	2	1199.21 BR D	Q10	104.13	102.32	100.00	0.13	0.41	94.26		9112.00		10.81
San Luis Obispo	2	1169.52	Q100	107.25	105.92		0.31	0.13	161.10		15292.00		9.27
San Luis Obispo	2	1169.52	Q50	106.38	105.12		0.32	0.12	157.13		13738.00		9.02
San Luis Obispo	2	1169.52	Q25	105.24	104.09		0.32	0.11	152.04		11760.00		8.63
San Luis Obispo	2	1169.52	Q10	103.59	102.60		0.30	0.10	144.71		9112.00		7.97
San Luis Obispo	2	1109.57	Q100	106.81	105.92		0.73	0.04	201.42		15292.00		7.57
San Luis Obispo	2	1109.57	Q50	105.94	105.09		0.73	0.05	194.73		13738.00		7.40
San Luis Obispo	2	1109.57	Q25	104.82	104.03		0.71	0.04	187.42		11760.00		7.11
San Luis Obispo	2	1109.57	Q10	103.20	102.53		0.67	0.04	167.95		9112.00		6.57

HEC-RAS Plan: Exist.Condition

River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Prefumo	5	2549.29	Q100	112.53	112.38	0.14	0.14	0.03	293.87	2214.13		91.96
Prefumo	5	2549.29	Q50	112.09	111.97	0.12	0.12	0.03	238.84	1951.16		91.96
Prefumo	5	2549.29	Q25	111.48	111.38	0.09	0.10	0.03	174.00	1628.00		91.96
Prefumo	5	2549.29	Q10	109.27	109.20	0.08	0.10	0.02	57.82	1179.18		85.11
Prefumo	5	2389.59	Q100	112.36	111.87	0.49			382.56	2035.32	90.12	145.50
Prefumo	5	2389.59	Q50	111.94	111.52	0.42			286.92	1824.58	78.50	145.50
Prefumo	5	2389.59	Q25	111.35	111.00	0.35			176.61	1561.42	63.97	145.50
Prefumo	5	2389.59	Q10	109.15	108.82	0.32			17.35	1185.28	34.37	73.13
Prefumo	5	2352.5		Culvert								
Prefumo	5	2299.45	Q100	111.09	111.05	0.03	0.01	0.00	65.15	2392.91	49.94	352.18
Prefumo	5	2299.45	Q50	110.68	110.65	0.03	0.01	0.00	48.68	2104.39	36.93	346.12
Prefumo	5	2299.45	Q25	110.09	110.06	0.03	0.01	0.00	30.62	1749.03	22.36	336.52
Prefumo	5	2299.45	Q10	108.19	108.15	0.04	0.01	0.00	3.69	1226.01	7.31	296.57
Prefumo	5	2277.36	Q100	111.07	111.03	0.04	0.06	0.00	916.64	1570.68	20.68	297.06
Prefumo	5	2277.36	Q50	110.67	110.63	0.04	0.05	0.00	754.91	1420.39	14.70	296.08
Prefumo	5	2277.36	Q25	110.08	110.05	0.03	0.05	0.00	558.63	1235.27	8.10	294.64
Prefumo	5	2277.36	Q10	108.18	108.14	0.04	0.06	0.00	211.26	1025.21	0.53	263.69
Prefumo	5	2075.34	Q100	111.02	110.97	0.05			234.70	2214.70	58.61	314.79
Prefumo	5	2075.34	Q50	110.62	110.58	0.04			160.27	1984.19	45.54	314.13
Prefumo	5	2075.34	Q25	110.03	110.00	0.03			78.05	1693.83	30.12	313.14
Prefumo	5	2075.34	Q10	108.12	108.09	0.03			1.51	1232.62	2.87	151.60
Prefumo	5	1993.09		Culvert								
Prefumo	5	1893.97	Q100	110.41	110.22	0.20	0.01	0.08	0.09	2507.92		103.48
Prefumo	5	1893.97	Q50	109.40	109.20	0.20	0.01	0.09		2190.00		95.60
Prefumo	5	1893.97	Q25	108.11	107.90	0.21	0.01	0.09		1802.00		89.38
Prefumo	5	1893.97	Q10	106.33	106.12	0.21	0.01	0.10		1237.00		78.72
Prefumo	5	1846.23	Q100	110.32	110.28	0.03	0.19	0.02	0.05	2507.95		150.08
Prefumo	5	1846.23	Q50	109.30	109.27	0.03	0.20	0.02		2190.00		143.29
Prefumo	5	1846.23	Q25	108.01	107.98	0.02	0.20	0.02		1802.00		135.26
Prefumo	5	1846.23	Q10	106.22	106.20	0.02	0.20	0.02		1237.00		123.18

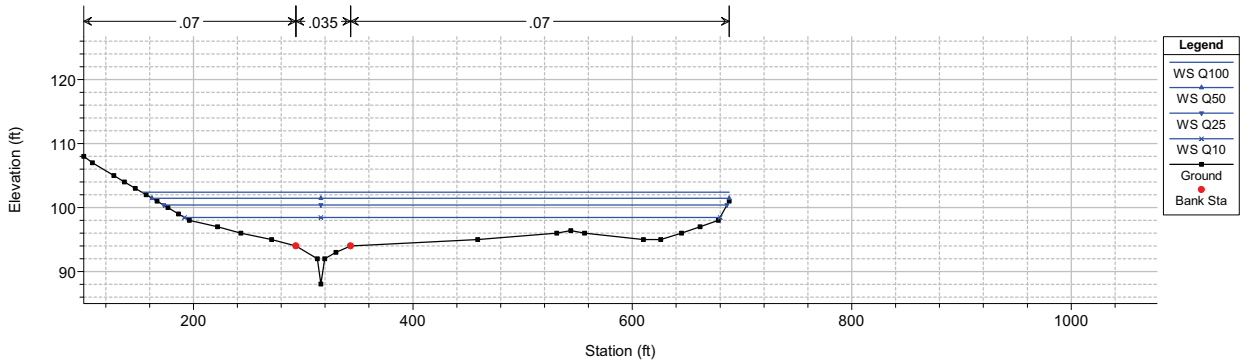
HEC-RAS Plan: Exist.Condition (Continued)

River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Froom	4	1173.38	Q100	104.59	104.46	0.13	0.01	0.04	15.63	779.76	270.61	357.33
Froom	4	1173.38	Q50	104.46	104.34	0.11	0.01	0.03	10.12	705.45	223.42	341.78
Froom	4	1173.38	Q25	104.34	104.26	0.08	0.01	0.02	6.30	574.33	169.37	330.66
Froom	4	1173.38	Q10	104.11	104.06	0.05	0.00	0.02	2.17	438.81	106.02	303.55
Froom	4	1049.61	Q100	104.54	104.53	0.00				596.39	469.61	755.86
Froom	4	1049.61	Q50	104.41	104.41	0.00				533.22	405.78	751.86
Froom	4	1049.61	Q25	104.31	104.31	0.00				431.03	318.97	749.20
Froom	4	1049.61	Q10	104.09	104.09	0.00				323.01	223.99	743.65
Froom	4	1000		Culvert								
Froom	4	687.58	Q100	102.40	102.39	0.00	0.00	0.00	149.56	300.16	616.28	535.23
Froom	4	687.58	Q50	101.47	101.47	0.00	0.00	0.00	124.60	279.58	534.82	526.08
Froom	4	687.58	Q25	100.38	100.38	0.00	0.00	0.00	91.52	242.33	416.15	513.37
Froom	4	687.58	Q10	98.45	98.45	0.00	0.00	0.00	51.45	220.89	274.66	488.14
Froom	4	639.95	Q100	102.40	102.39	0.00	0.05	0.05	212.89	637.80	215.31	532.17
Froom	4	639.95	Q50	101.47	101.47	0.00	0.05	0.05	179.04	573.87	186.08	532.17
Froom	4	639.95	Q25	100.38	100.38	0.00	0.05	0.04	133.53	471.98	144.49	532.17
Froom	4	639.95	Q10	98.45	98.45	0.00	0.06	0.04	80.97	368.33	97.70	532.17

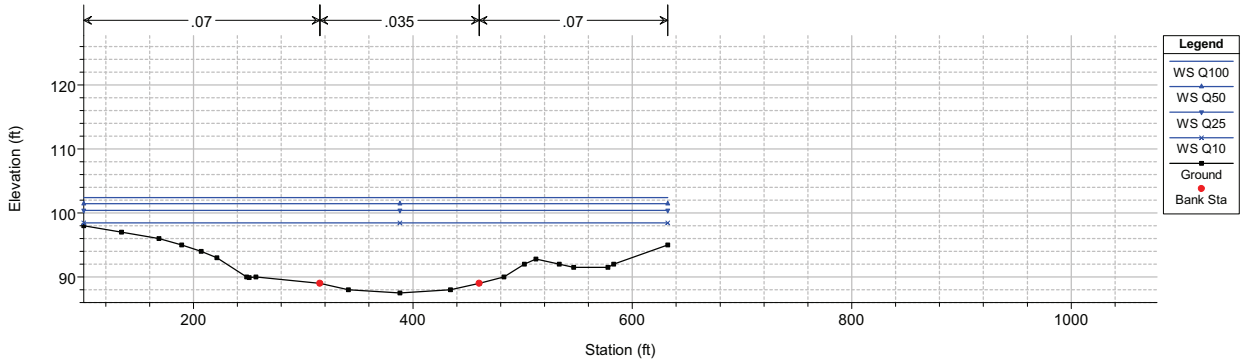


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

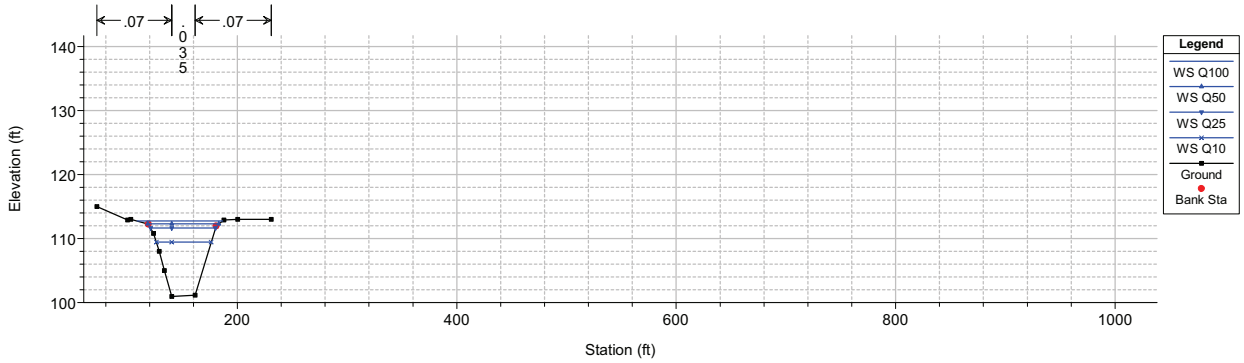
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Froom Reach = 4 RS = 687.58 Station 28



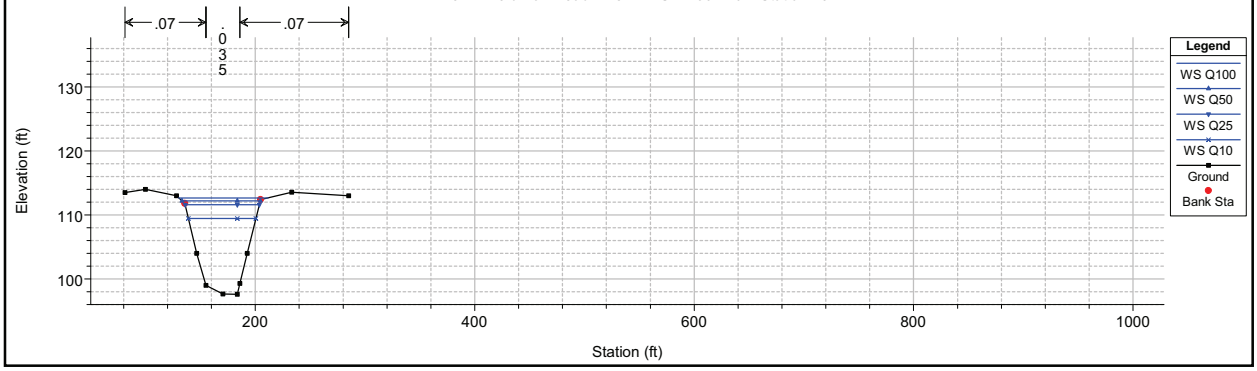
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Froom Reach = 4 RS = 639.95 Station 27



LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 3037.62 Station 26

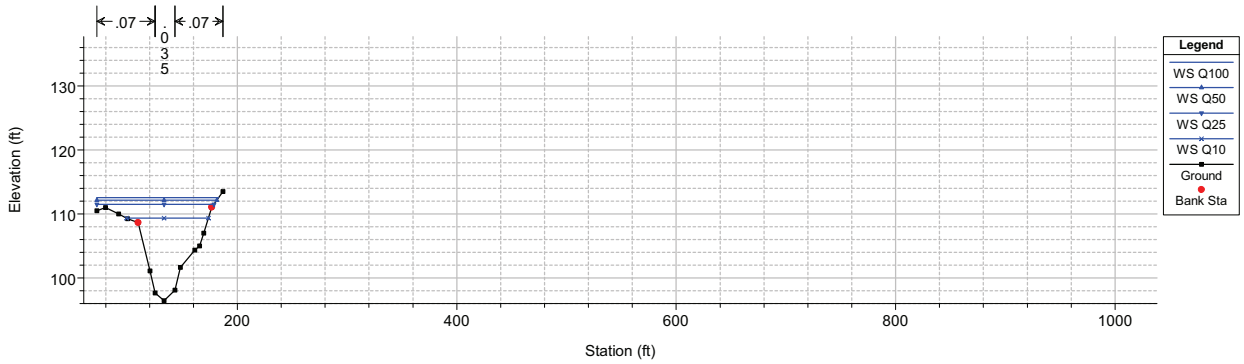


LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2884.43 Station 25

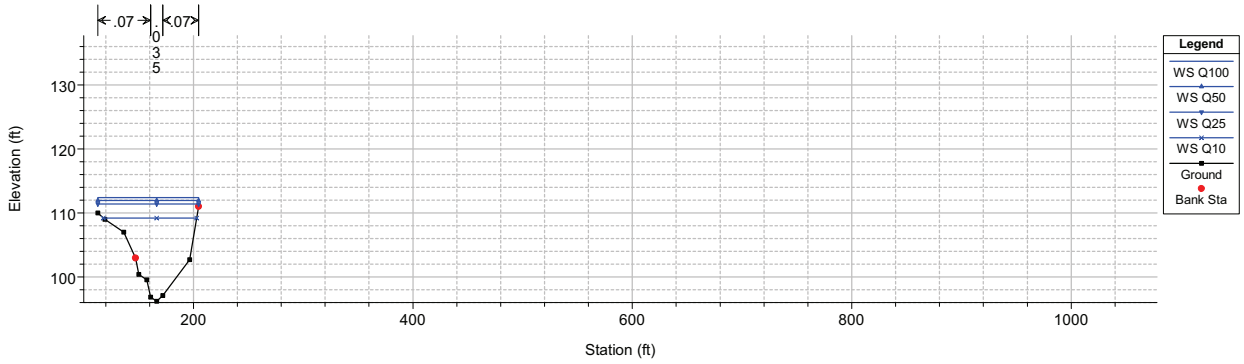


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

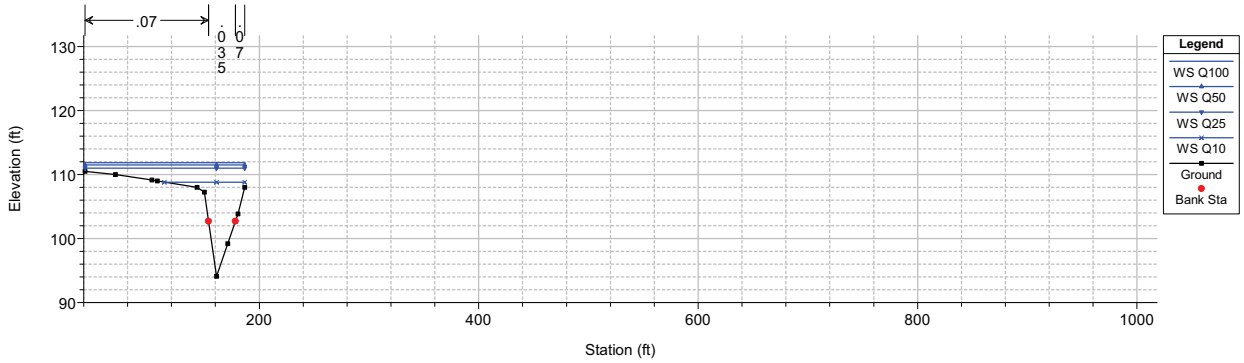
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2771.00 Station 24



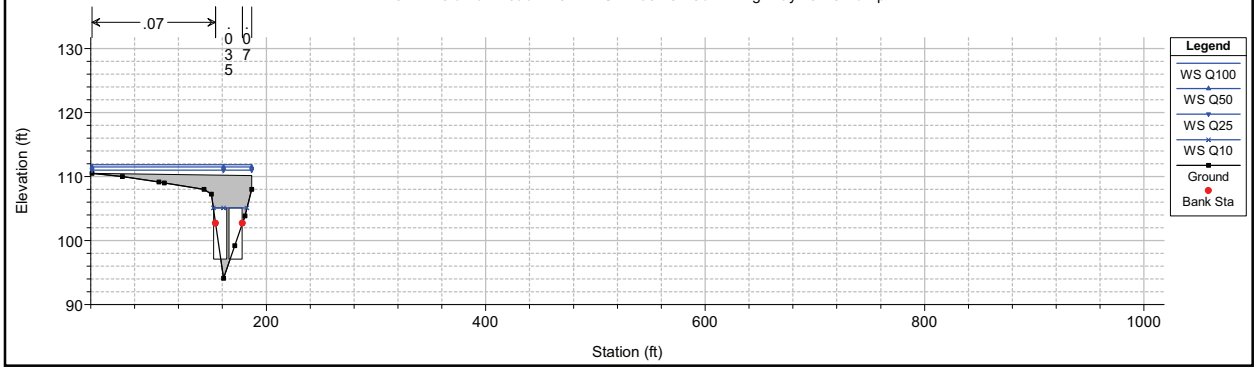
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2549.29 Station 23



LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2389.59 Station 22

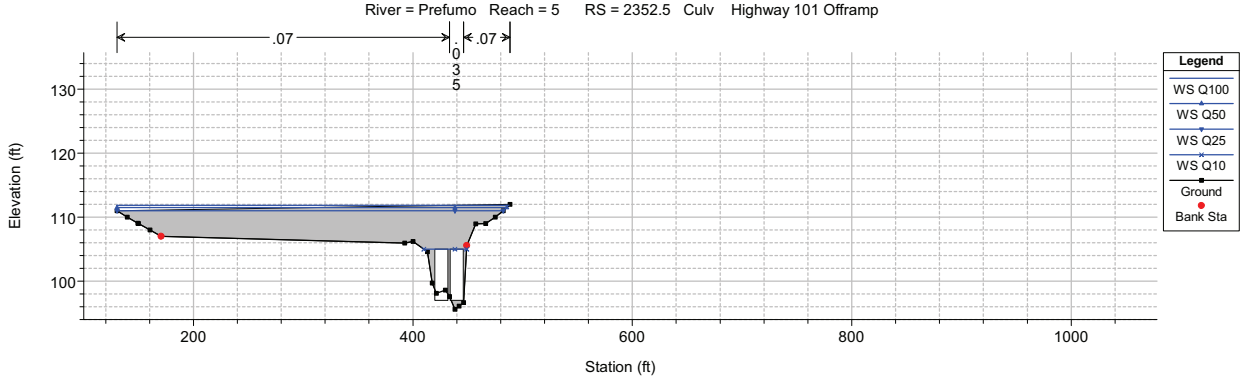


LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2352.5 Culv Highway 101 Offramp

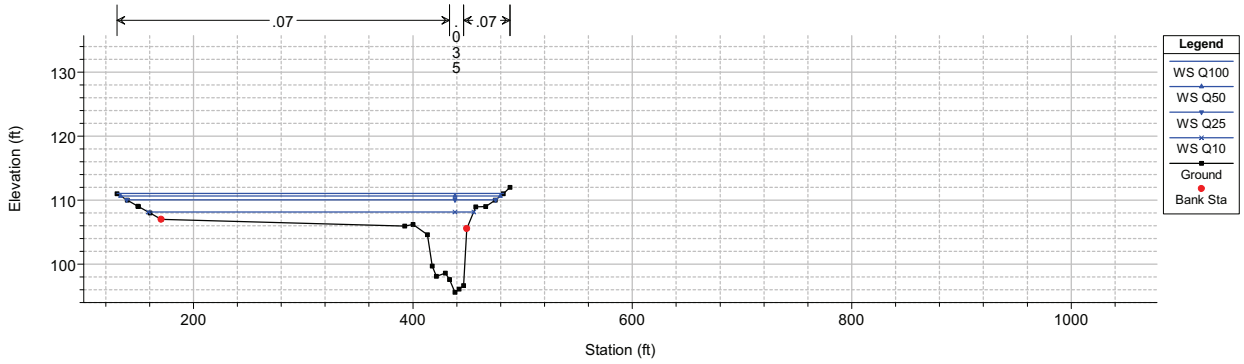


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

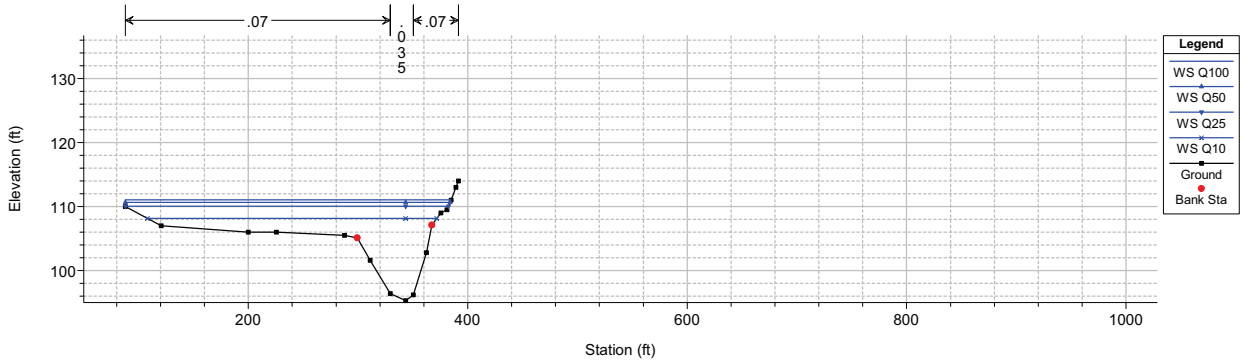
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2352.5 Culv Highway 101 Offramp



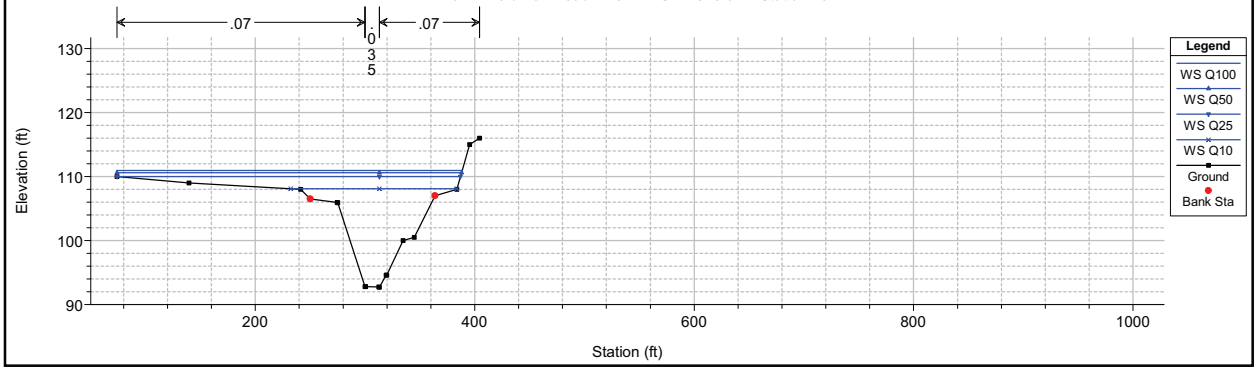
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2299.45 Station 21



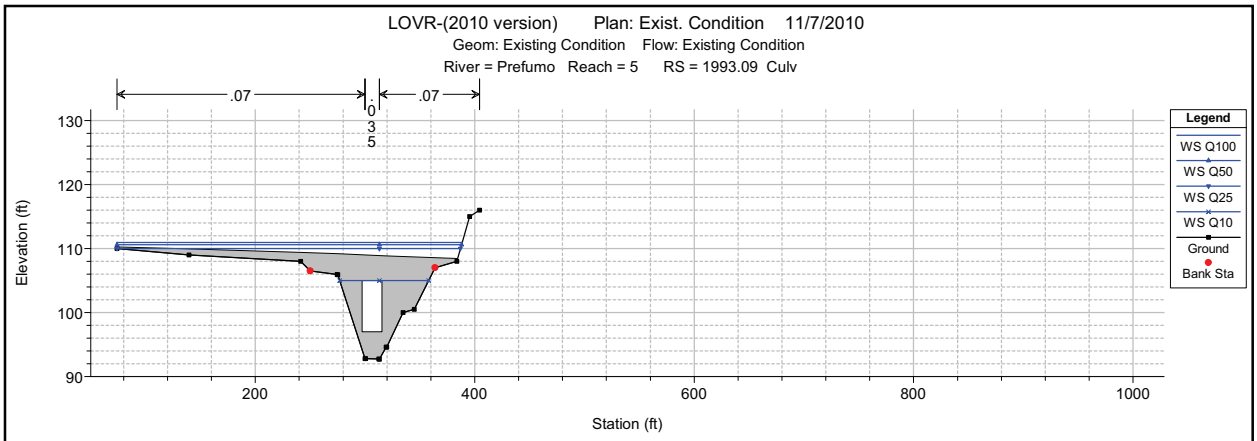
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2277.36 Station 20

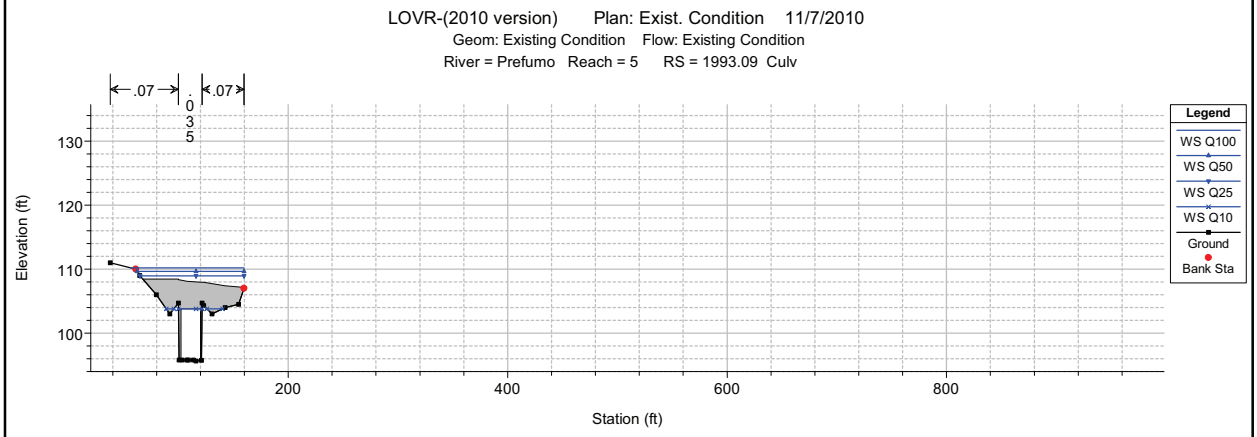


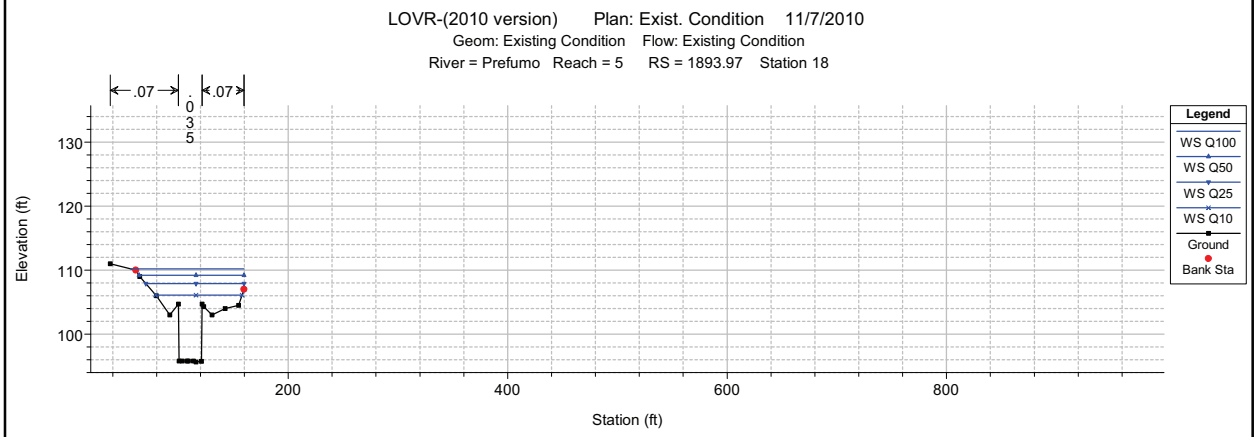
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = Prefumo Reach = 5 RS = 2075.34 Station 19

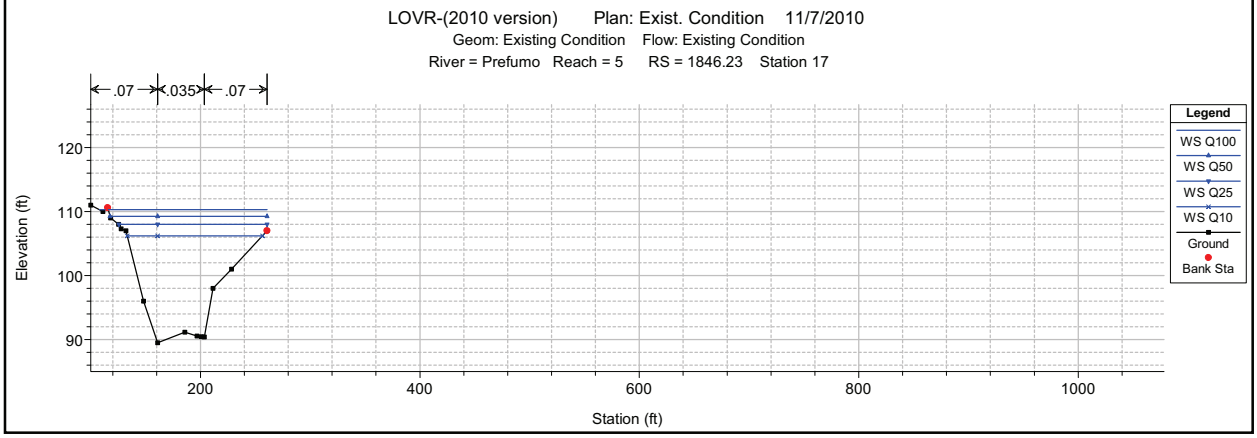


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

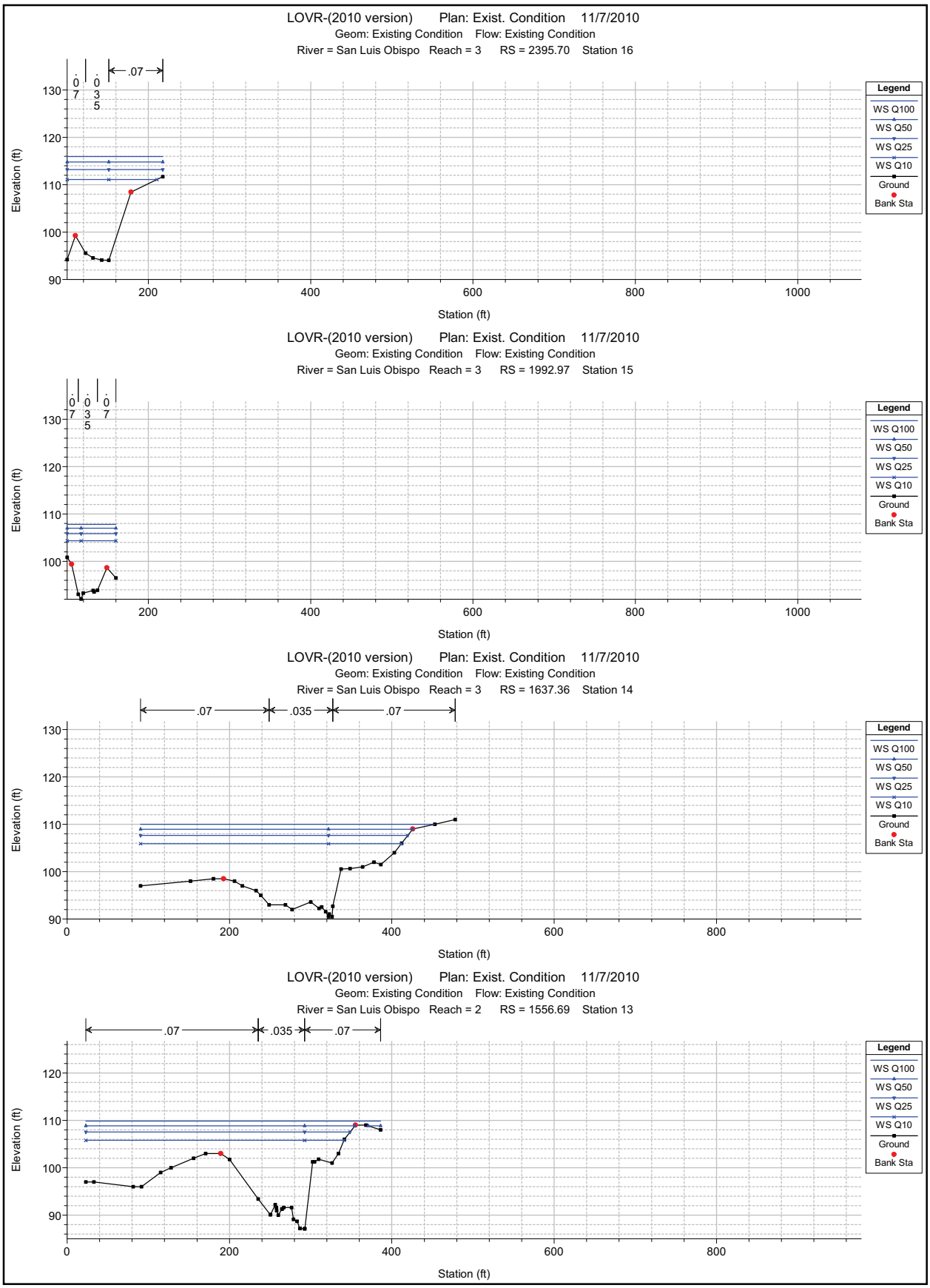




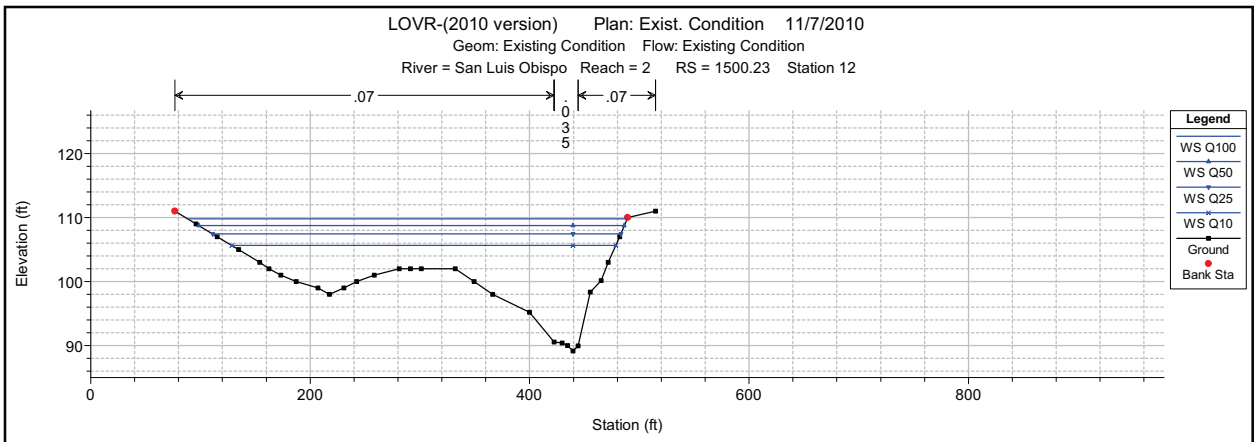


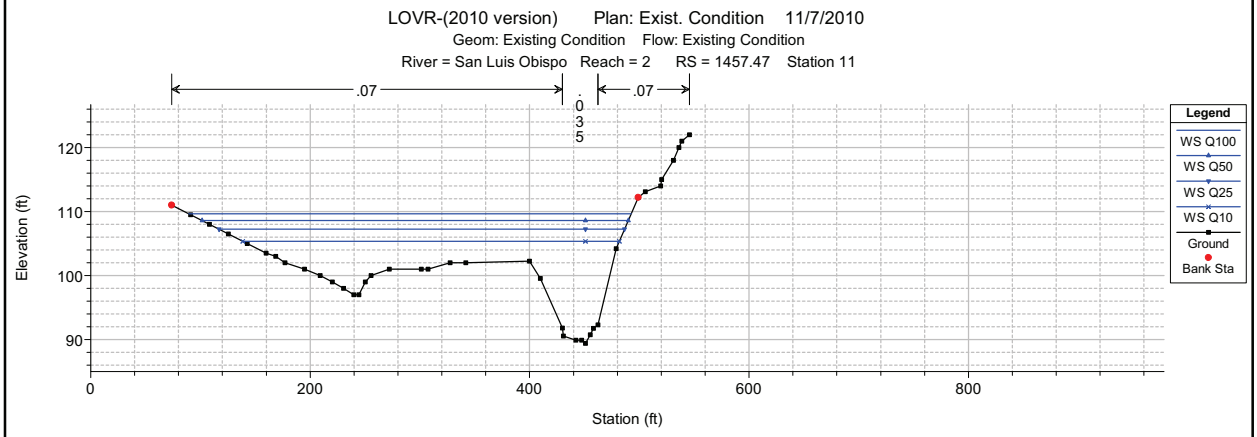


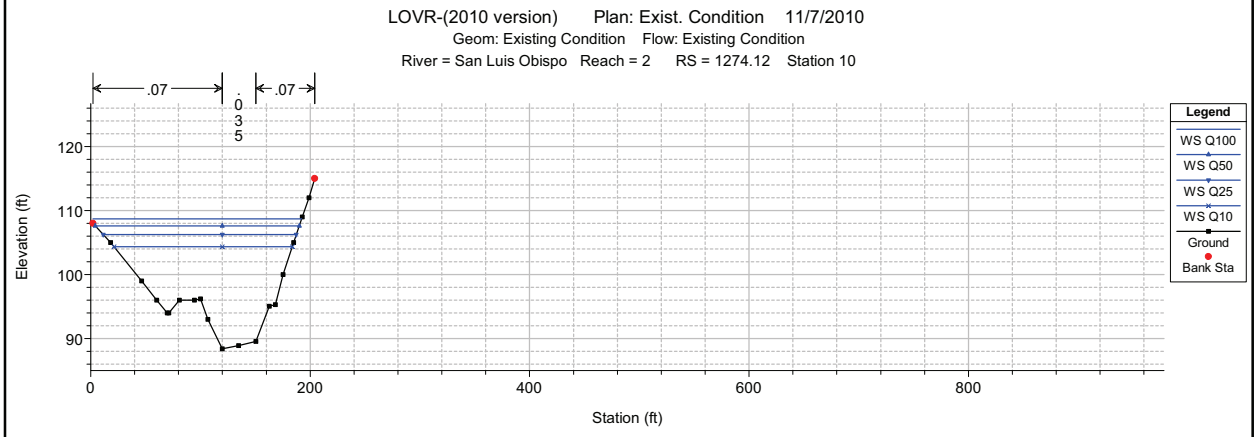
1 in Horiz. = 175 ft 1 in Vert. = 30 ft

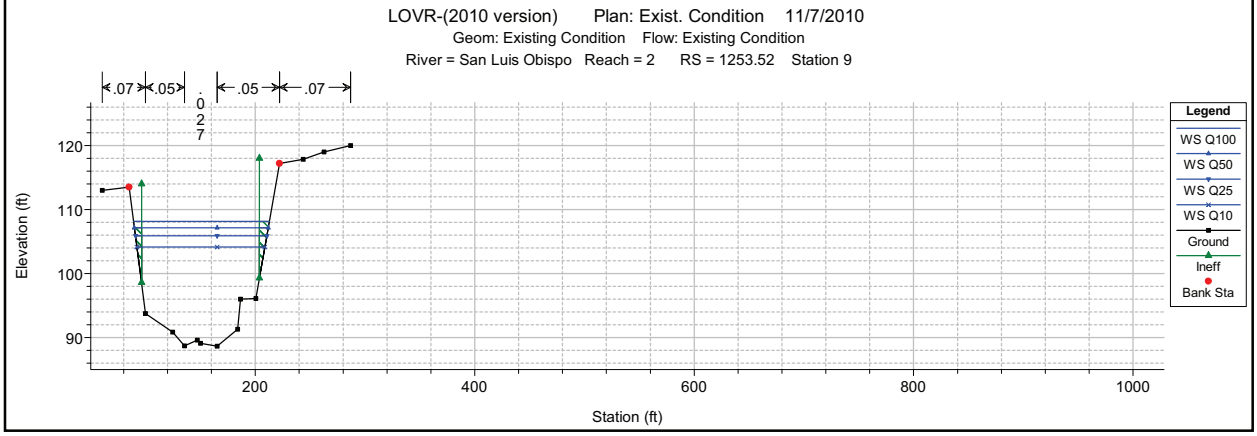


1 in Horiz. = 175 ft 1 in Vert. = 30 ft



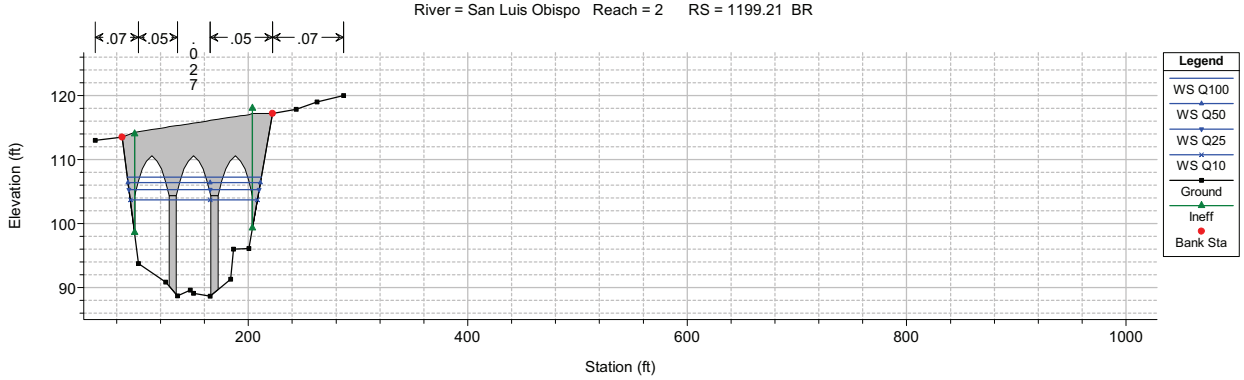




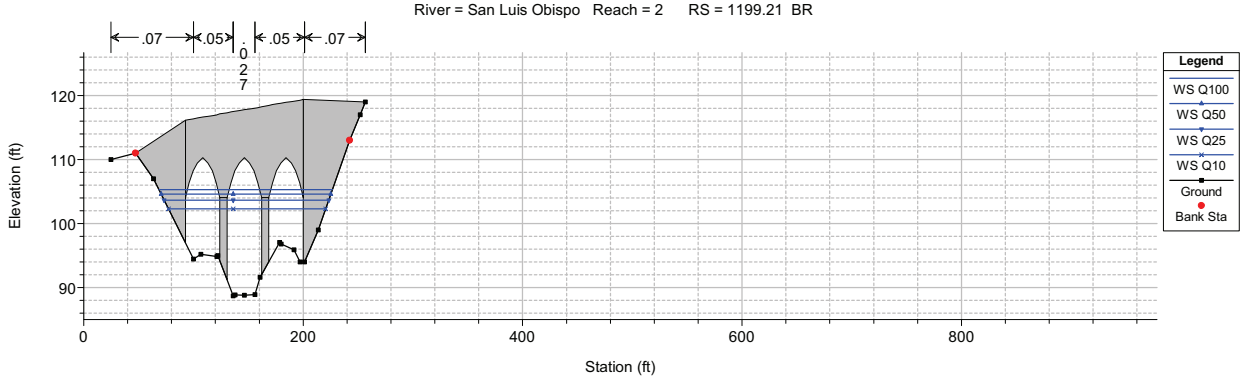


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

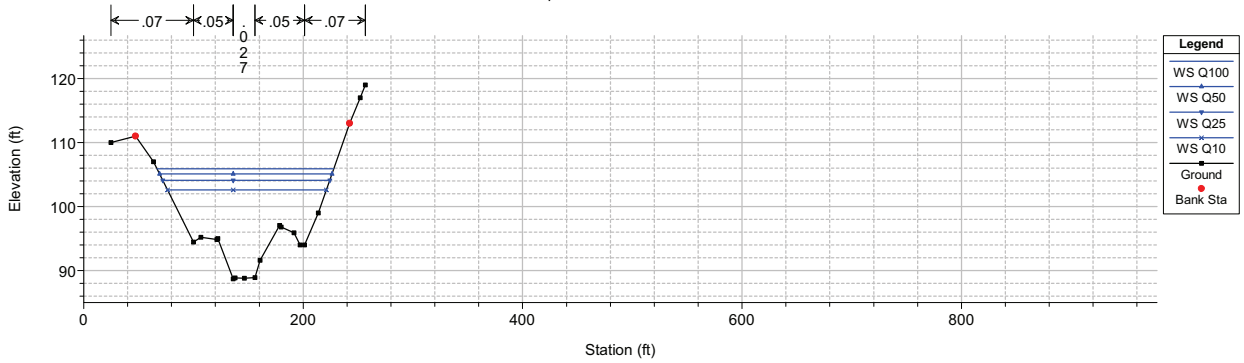
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = San Luis Obispo Reach = 2 RS = 1199.21 BR



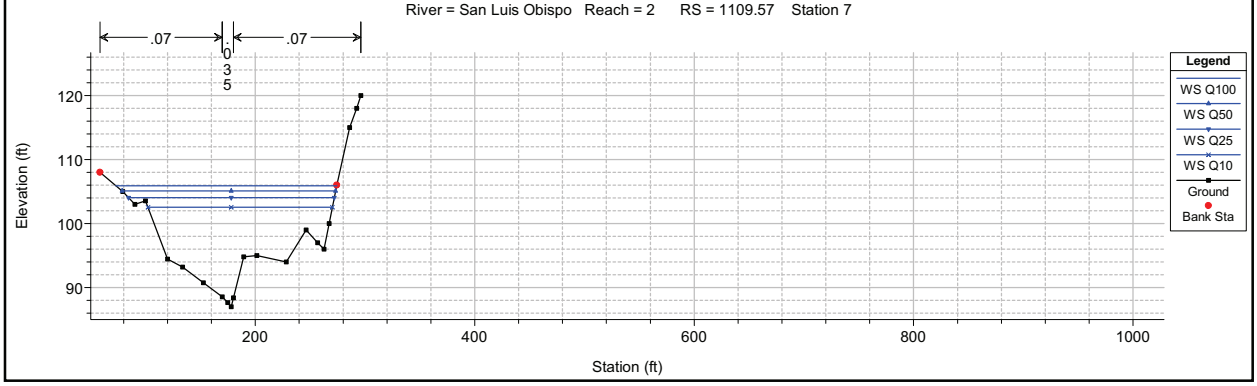
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = San Luis Obispo Reach = 2 RS = 1199.21 BR



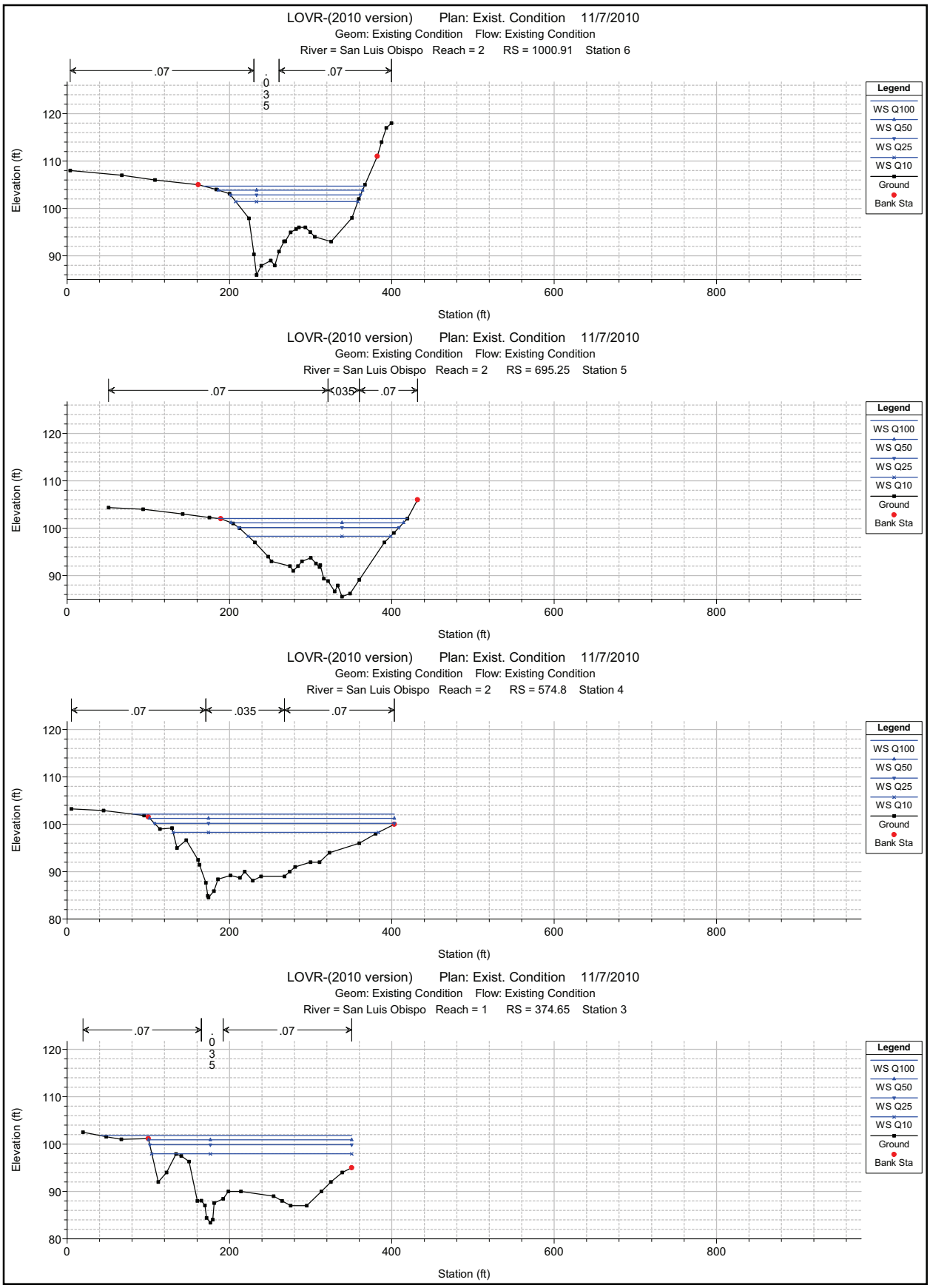
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = San Luis Obispo Reach = 2 RS = 1169.52 Station 7



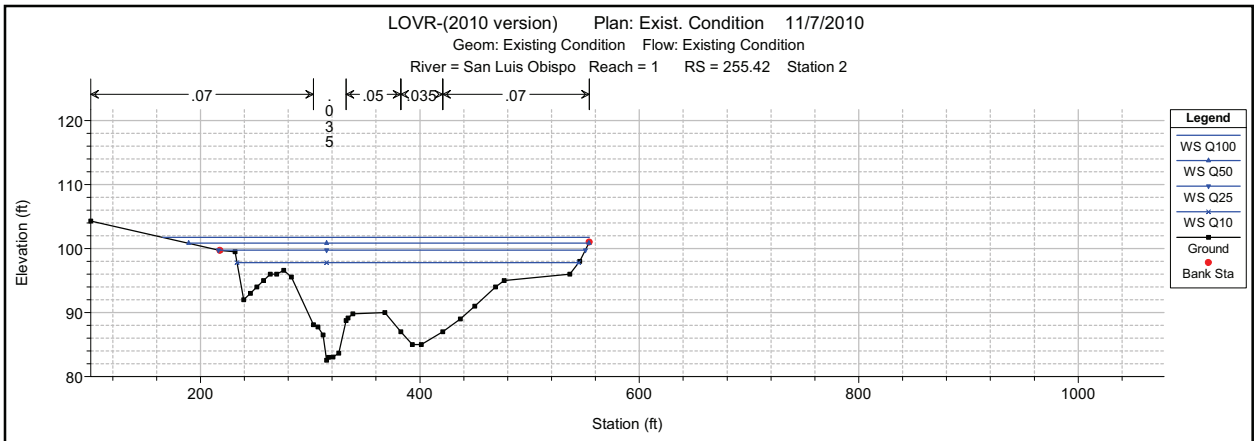
LOVR-(2010 version) Plan: Exist. Condition 11/7/2010
Geom: Existing Condition Flow: Existing Condition
River = San Luis Obispo Reach = 2 RS = 1109.57 Station 7

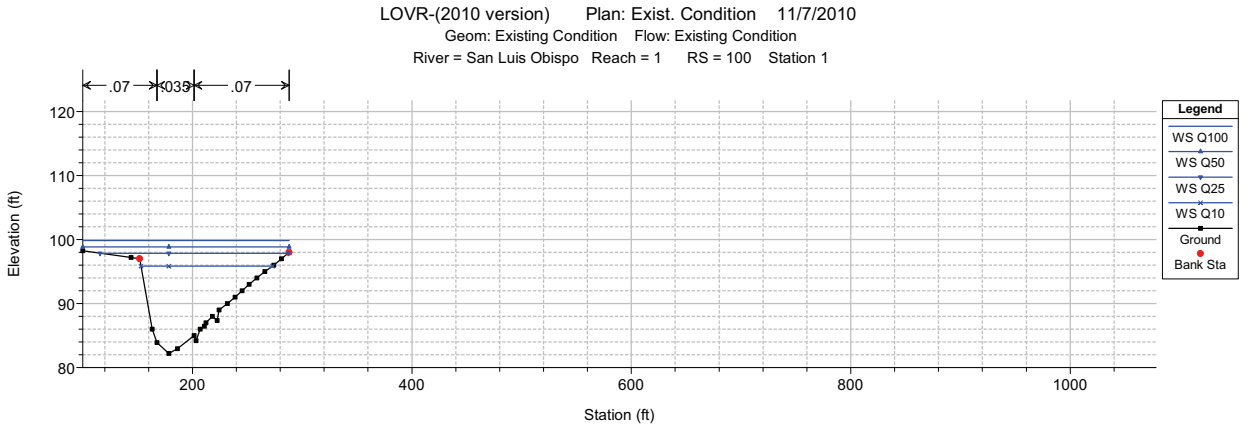


1 in Horiz. = 175 ft 1 in Vert. = 30 ft



1 in Horiz. = 175 ft 1 in Vert. = 30 ft

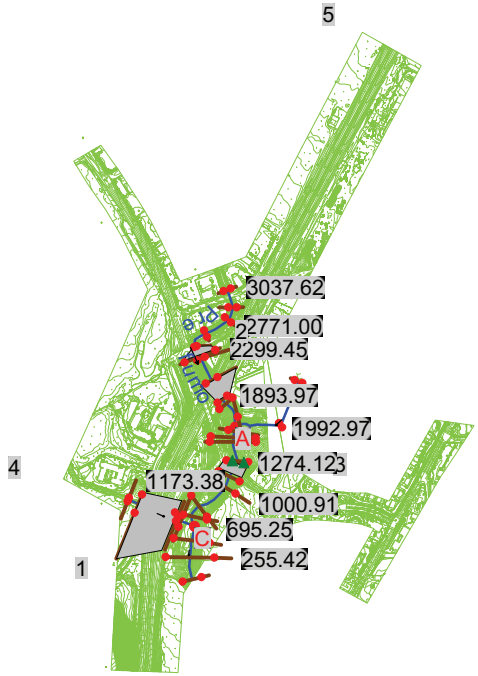




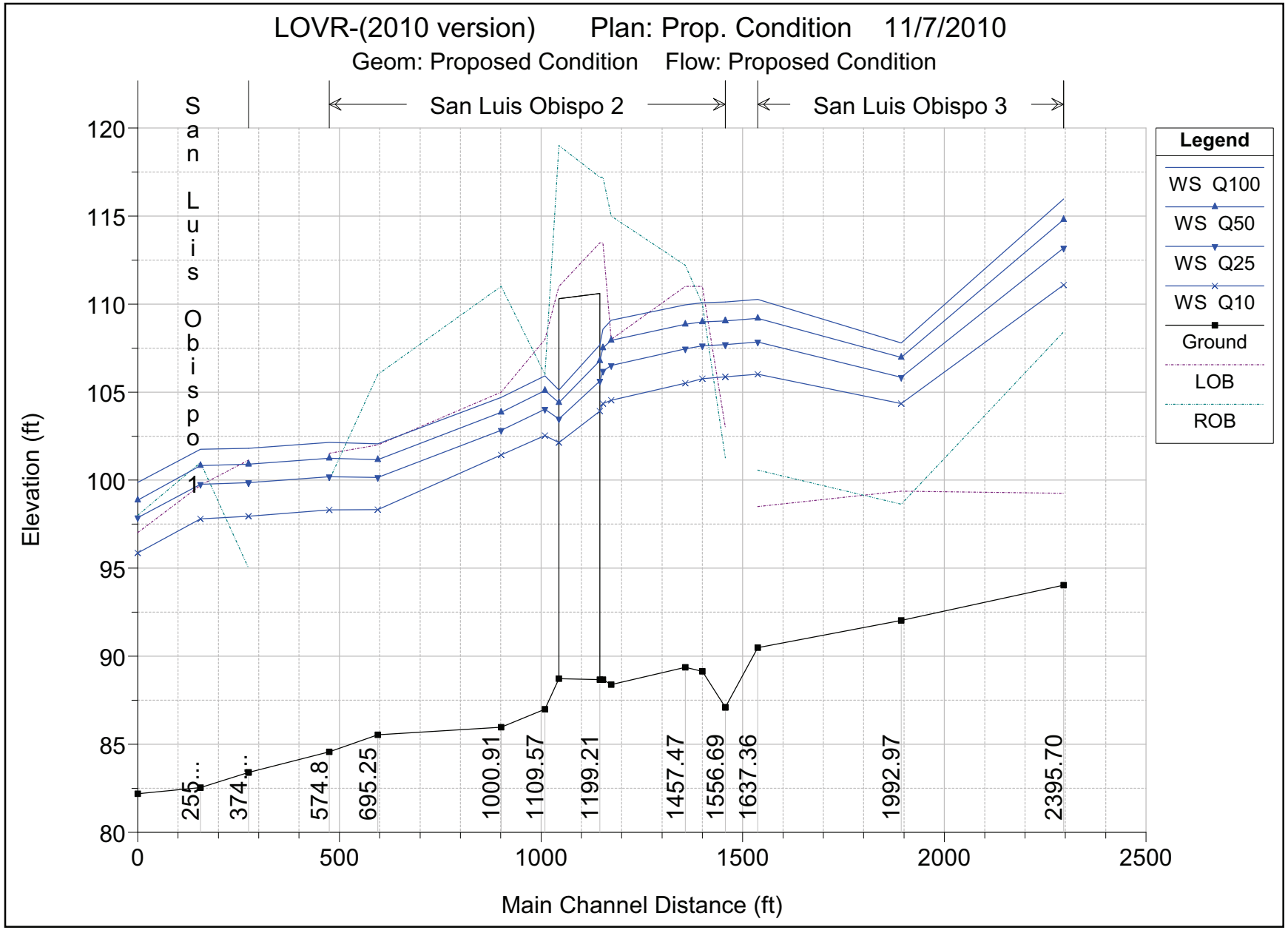
1 in Horiz. = 175 ft 1 in Vert. = 30 ft

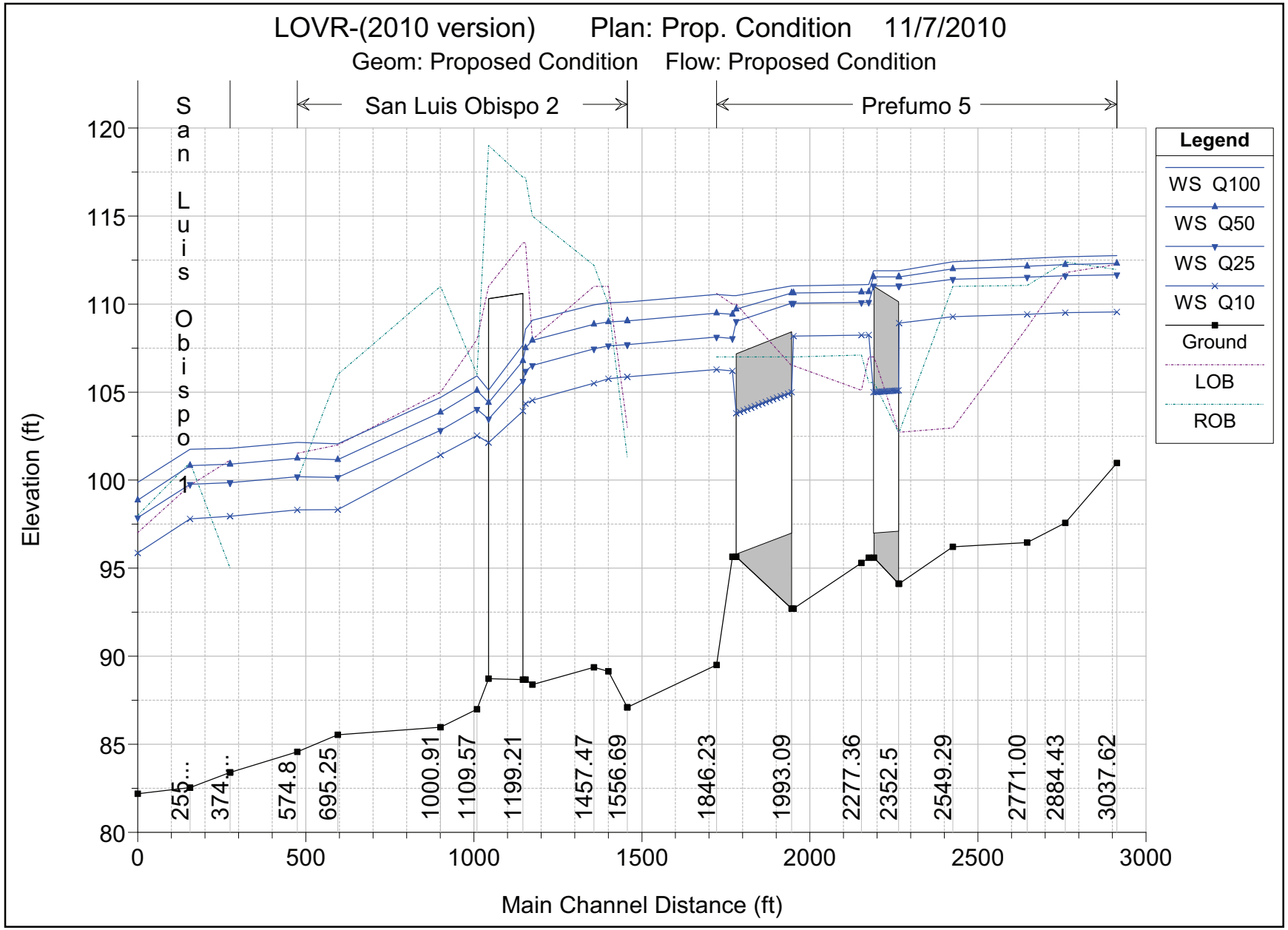
Appendix F Hydraulic Analyses, Proposed Conditions

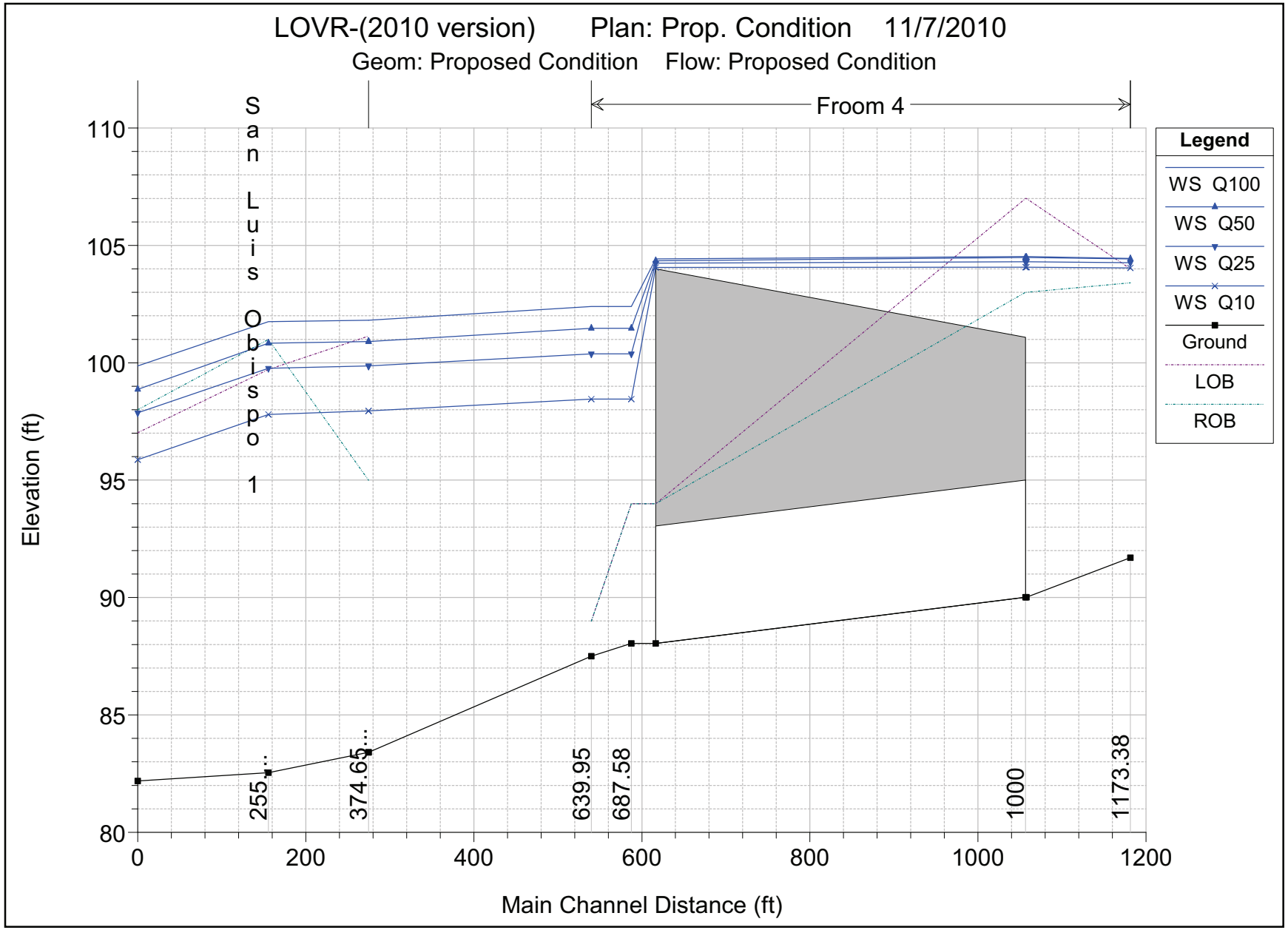
Appendix F.1 Proposed Condition



None of the XS's are Geo-Referenced ([Geo-Ref user entered XS][Geo-Ref interpolated XS][Non Geo-Ref user entered XS][Non Geo-Ref interpolated XS])

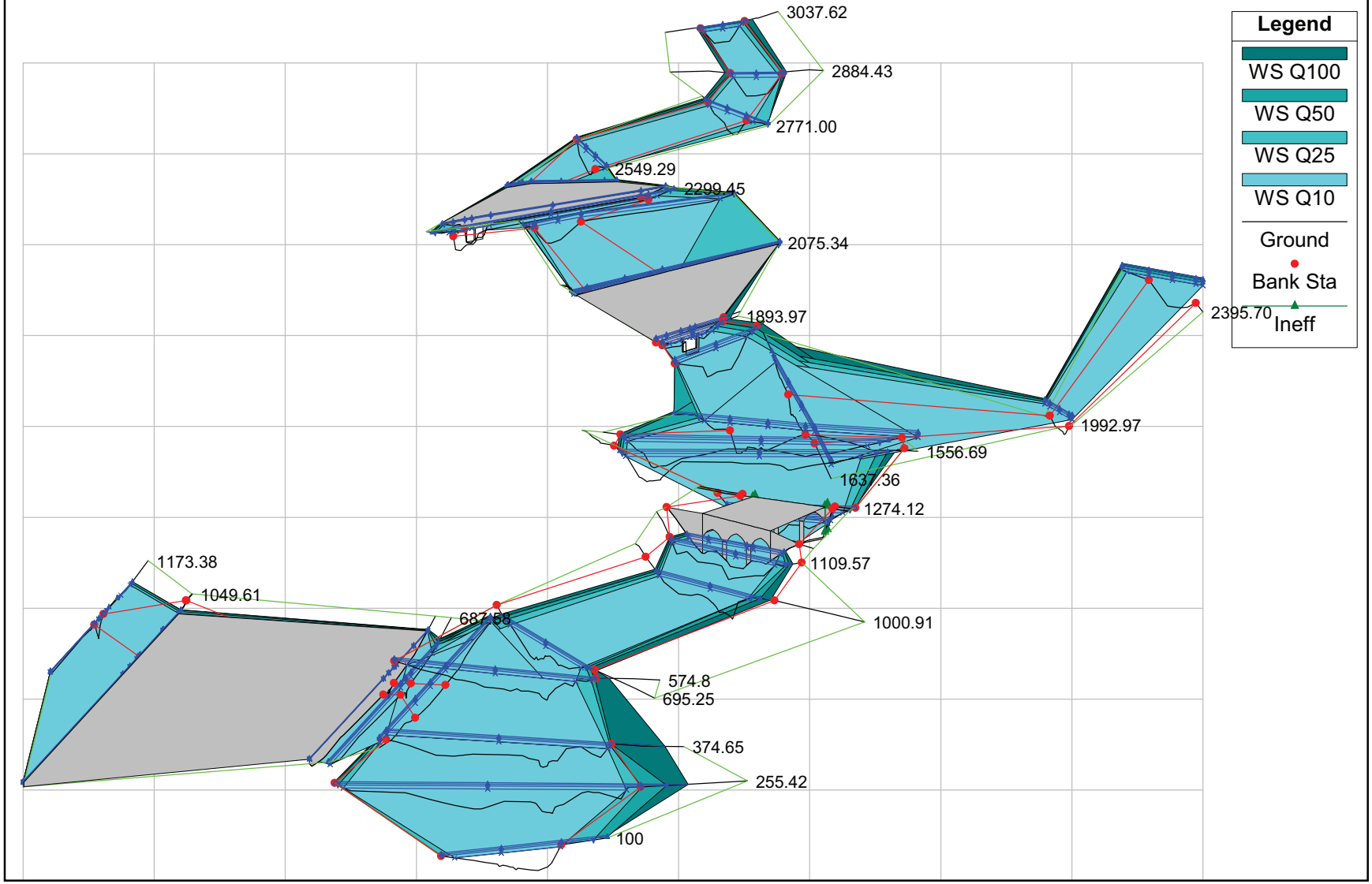

LOVR-(2010 version) Plan: Prop. Condition 11/7/2010
Geom: Proposed Condition Flow: Proposed Condition
San Luis Obispo 1
San Luis Obispo 2
San Luis Obispo 3
Elevation (ft)
Main Channel Distance (ft)
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
255...
374...
574.8
695.25
1000.91
1109.57
1199.21
1457.47
1556.69
1637.36
1992.97
2395.70


LOVR-(2010 version) Plan: Prop. Condition 11/7/2010
Geom: Proposed Condition Flow: Proposed Condition
San Luis Obispo 1
San Luis Obispo 2
Prefumo 5
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
120
115
110
105
100
95
90
85
80
0
500
1000
1500
2000
2500
3000
255...
374...
574.8
695.25
1000.91
1109.57
1199.21
1457.47
1556.69
1846.23
1993.09
2277.36
2352.5
2549.29
2771.00
2884.43
3037.62


LOVR-(2010 version) Plan: Prop. Condition 11/7/2010
Geom: Proposed Condition Flow: Proposed Condition
Froom 4
San Luis Obispo 1
Elevation (ft)
Main Channel Distance (ft)
110
105
100
95
90
85
80
0
200
400
600
800
1000
1200
255...
374.65...
639.95
687.58
1000
1173.38
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB

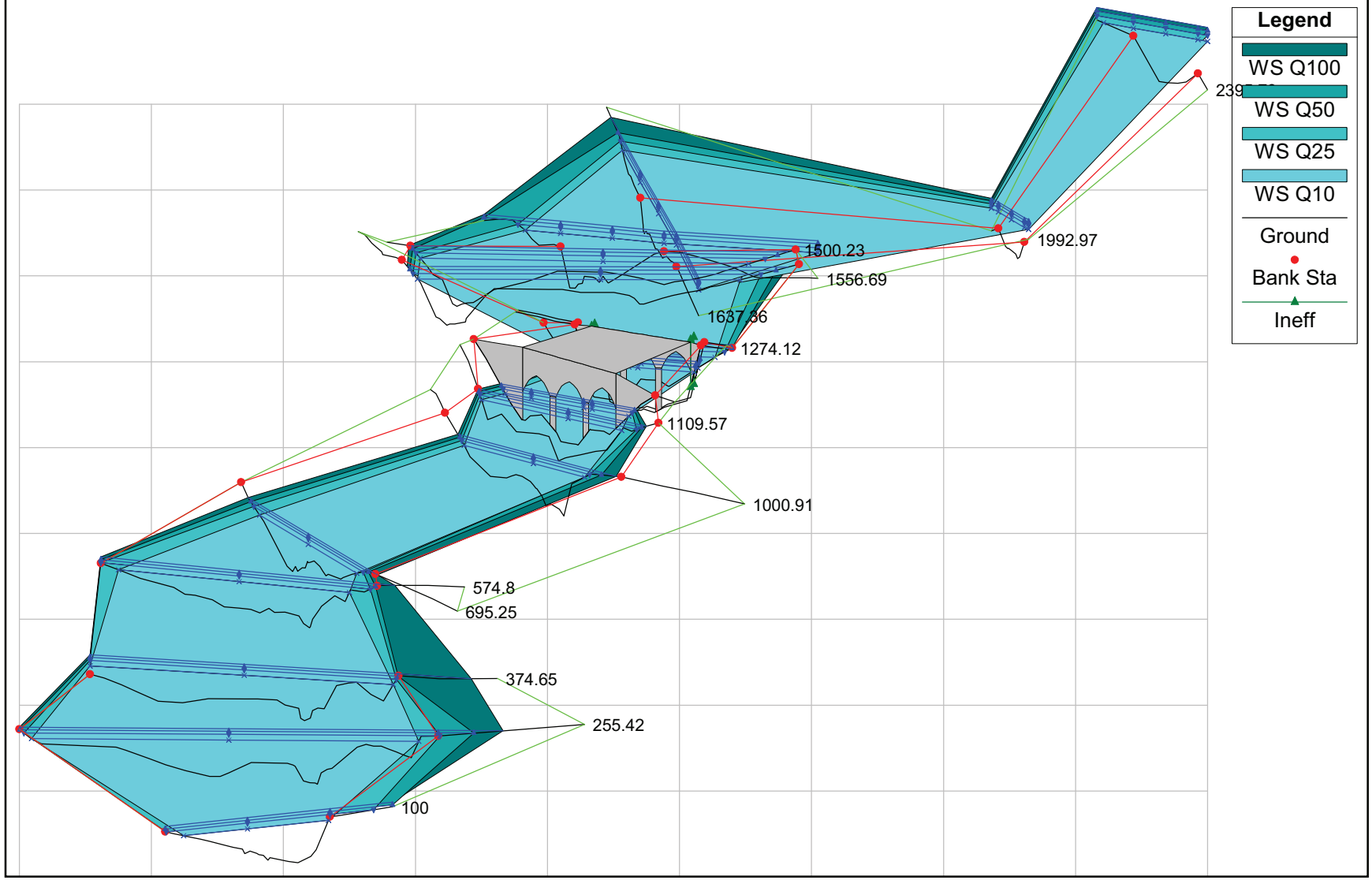
LOVR-(2010 version) Plan: Prop. Condition 11/7/2010

Geom: Proposed Condition Flow: Proposed Condition



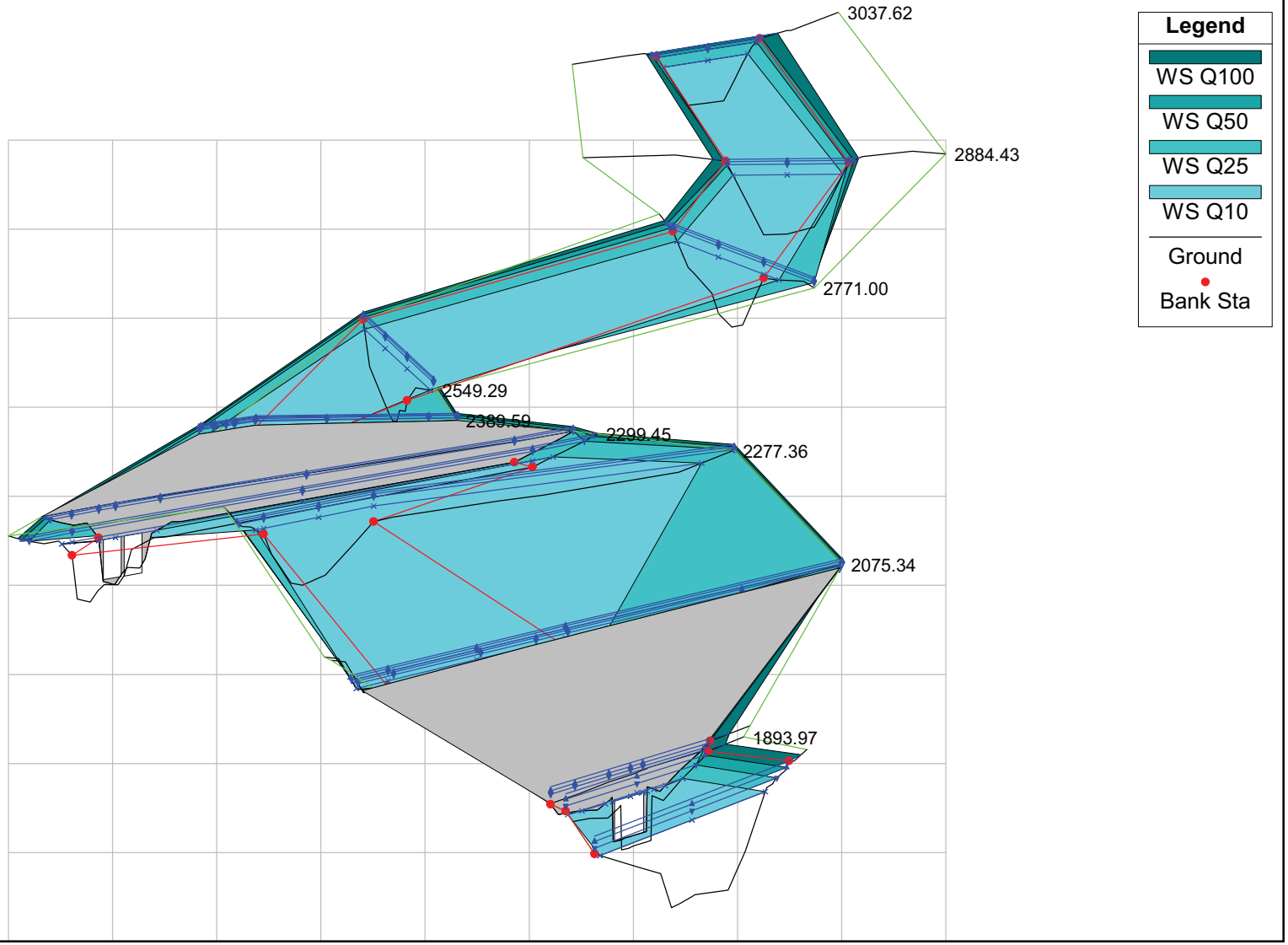
LOVR-(2010 version) Plan: Prop. Condition 11/7/2010

Geom: Proposed Condition Flow: Proposed Condition



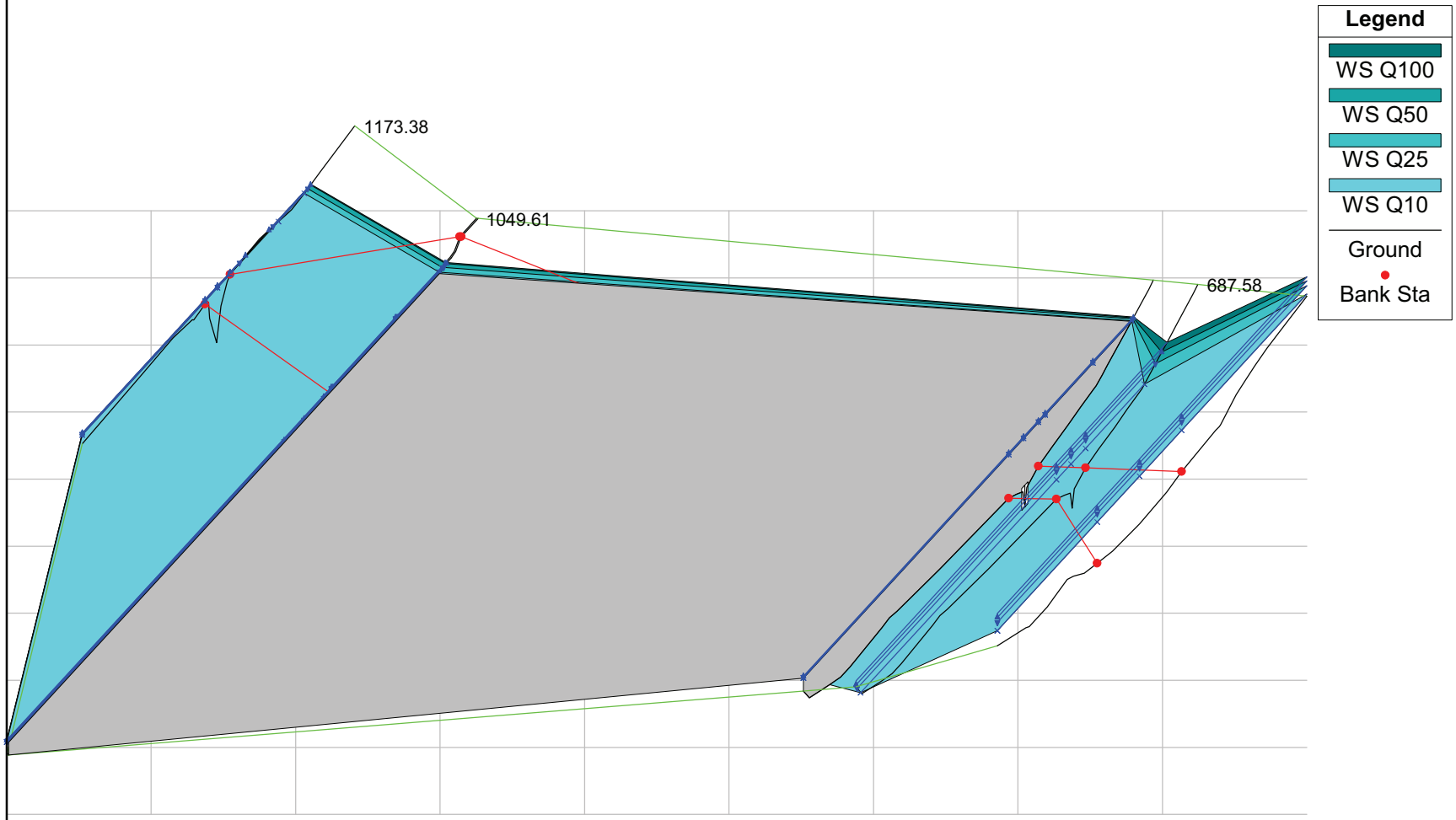
LOVR-(2010 version) Plan: Prop. Condition 11/7/2010

Geom: Proposed Condition Flow: Proposed Condition



LOVR-(2010 version) Plan: Prop. Condition 11/7/2010

Geom: Proposed Condition Flow: Proposed Condition



HEC-RAS Plan: Prop.Condition

River	Reach	River Sta	Profile	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)	
San Luis Obispo	3	2395.70	Q100	13350.00	94.04	115.97		117.21	0.002974	9.41	1680.30	117.73	0.39
San Luis Obispo	3	2395.70	Q50	12043.00	94.04	114.80		115.98	0.003092	9.17	1541.67	117.73	0.39
San Luis Obispo	3	2395.70	Q25	10312.00	94.04	113.19		114.30	0.003258	8.81	1352.29	117.73	0.39
San Luis Obispo	3	2395.70	Q10	8158.00	94.04	111.08		112.07	0.003444	8.22	1106.36	110.52	0.40
San Luis Obispo	3	1992.97	Q100	13350.00	92.03	107.79	107.79	114.17	0.020986	21.14	724.69	60.01	1.03
San Luis Obispo	3	1992.97	Q50	12043.00	92.03	106.98	106.98	112.90	0.021217	20.36	675.68	60.01	1.02
San Luis Obispo	3	1992.97	Q25	10312.00	92.03	105.85	105.85	111.16	0.021572	19.26	607.88	60.01	1.02
San Luis Obispo	3	1992.97	Q10	8158.00	92.03	104.35	104.35	108.86	0.022062	17.69	518.24	60.01	1.00
San Luis Obispo	3	1637.36	Q100	13350.00	90.49	110.26		110.46	0.000533	4.01	4249.28	369.12	0.18
San Luis Obispo	3	1637.36	Q50	12043.00	90.49	109.19		109.38	0.000555	3.91	3869.86	340.61	0.18
San Luis Obispo	3	1637.36	Q25	10312.00	90.49	107.85		108.02	0.000583	3.76	3421.20	330.13	0.18
San Luis Obispo	3	1637.36	Q10	8158.00	90.49	106.01		106.18	0.000641	3.58	2823.22	321.82	0.18
San Luis Obispo	2	1556.69	Q100	15294.00	87.10	110.12		110.39	0.000920	4.91	4067.94	363.33	0.22
San Luis Obispo	2	1556.69	Q50	13740.00	87.10	109.04		109.31	0.000996	4.88	3675.36	363.33	0.22
San Luis Obispo	2	1556.69	Q25	11762.00	87.10	107.70		107.95	0.001051	4.70	3222.76	326.34	0.23
San Luis Obispo	2	1556.69	Q10	9114.00	87.10	105.86		106.10	0.001150	4.47	2632.30	318.36	0.23
San Luis Obispo	2	1500.23	Q100	15294.00	89.14	110.08		110.32	0.001582	3.90	3925.87	405.79	0.22
San Luis Obispo	2	1500.23	Q50	13740.00	89.14	108.99		109.23	0.001802	3.93	3492.07	390.77	0.23
San Luis Obispo	2	1500.23	Q25	11762.00	89.14	107.62		107.87	0.002135	3.96	2969.77	374.29	0.25
San Luis Obispo	2	1500.23	Q10	9114.00	89.14	105.76		106.00	0.002785	3.98	2292.10	351.54	0.27
San Luis Obispo	2	1457.47	Q100	15294.00	89.38	109.96		110.24	0.002024	4.20	3641.51	407.70	0.25
San Luis Obispo	2	1457.47	Q50	13740.00	89.38	108.85		109.14	0.002389	4.30	3196.56	392.14	0.27
San Luis Obispo	2	1457.47	Q25	11762.00	89.38	107.45		107.75	0.003000	4.42	2661.54	372.57	0.29
San Luis Obispo	2	1457.47	Q10	9114.00	89.38	105.51		105.84	0.004451	4.64	1965.11	345.45	0.34
San Luis Obispo	2	1274.12	Q100	15294.00	88.39	109.08		109.74	0.003104	6.53	2341.45	191.08	0.33
San Luis Obispo	2	1274.12	Q50	13740.00	88.39	107.93		108.58	0.003367	6.47	2123.72	188.47	0.34
San Luis Obispo	2	1274.12	Q25	11762.00	88.39	106.51		107.13	0.003506	6.31	1862.66	177.94	0.34
San Luis Obispo	2	1274.12	Q10	9114.00	88.39	104.54		105.09	0.003609	5.97	1525.83	163.71	0.34
San Luis Obispo	2	1253.52	Q100	15294.00	88.67	108.57	100.11	109.65	0.001661	8.37	1828.20	124.55	0.36
San Luis Obispo	2	1253.52	Q50	13740.00	88.67	107.50	99.52	108.50	0.001663	8.02	1713.78	122.66	0.35
San Luis Obispo	2	1253.52	Q25	11762.00	88.67	106.19	98.74	107.06	0.001625	7.48	1572.19	120.31	0.34
San Luis Obispo	2	1253.52	Q10	9114.00	88.67	104.35	97.56	105.03	0.001527	6.63	1374.50	117.03	0.33
San Luis Obispo	2	1199.21		Bridge									
San Luis Obispo	2	1109.57	Q100	15294.00	86.99	105.92		106.81	0.004744	7.57	2019.86	201.43	0.42
San Luis Obispo	2	1109.57	Q50	13740.00	86.99	105.09		105.94	0.004797	7.40	1856.18	194.74	0.42
San Luis Obispo	2	1109.57	Q25	11762.00	86.99	104.03		104.82	0.004812	7.11	1653.81	187.43	0.42

HEC-RAS Plan: Prop.Condition (Continued)

River	Reach	River Sta	Profile	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)	
San Luis Obispo	2	1109.57	Q10	9114.00	86.99	102.53		103.20	0.004342	6.57	1387.89	167.95	0.40
San Luis Obispo	2	1000.91	Q100	15294.00	85.97	104.70		106.03	0.010362	9.27	1650.58	197.84	0.57
San Luis Obispo	2	1000.91	Q50	13740.00	85.97	103.85		105.17	0.010031	9.21	1491.69	177.54	0.56
San Luis Obispo	2	1000.91	Q25	11762.00	85.97	102.83		104.06	0.009483	8.91	1320.74	160.08	0.55
San Luis Obispo	2	1000.91	Q10	9114.00	85.97	101.44		102.49	0.009395	8.25	1104.74	150.42	0.54
San Luis Obispo	2	695.25	Q100	15294.00	85.54	102.06		103.12	0.008294	8.26	1850.59	233.66	0.51
San Luis Obispo	2	695.25	Q50	13740.00	85.54	101.17		102.24	0.008691	8.32	1652.12	212.68	0.53
San Luis Obispo	2	695.25	Q25	11762.00	85.54	100.15		101.18	0.008965	8.15	1443.50	197.91	0.53
San Luis Obispo	2	695.25	Q10	9114.00	85.54	98.32		99.38	0.011031	8.27	1102.22	175.68	0.58
San Luis Obispo	2	574.8	Q100	15294.00	84.57	102.15		102.63	0.001295	5.56	2755.50	322.18	0.33
San Luis Obispo	2	574.8	Q50	13740.00	84.57	101.25		101.72	0.001385	5.54	2477.98	301.44	0.34
San Luis Obispo	2	574.8	Q25	11762.00	84.57	100.20		100.66	0.001443	5.43	2164.94	295.52	0.35
San Luis Obispo	2	574.8	Q10	9114.00	84.57	98.31		98.79	0.001692	5.54	1645.26	253.16	0.38
San Luis Obispo	1	374.65	Q100	15687.00	83.41	101.81		102.30	0.002119	5.61	2828.22	309.87	0.30
San Luis Obispo	1	374.65	Q50	14063.00	83.41	100.91		101.37	0.002205	5.48	2566.29	250.26	0.30
San Luis Obispo	1	374.65	Q25	12083.00	83.41	99.86		100.29	0.002240	5.24	2305.61	248.86	0.30
San Luis Obispo	1	374.65	Q10	9329.00	83.41	97.95		98.35	0.002625	5.10	1830.87	246.30	0.33
San Luis Obispo	1	255.42	Q100	15687.00	82.54	101.75		102.09	0.000930	4.69	3387.47	389.02	0.26
San Luis Obispo	1	255.42	Q50	14063.00	82.54	100.83		101.17	0.000977	4.65	3039.78	364.98	0.27
San Luis Obispo	1	255.42	Q25	12083.00	82.54	99.77		100.09	0.001002	4.53	2667.44	334.69	0.28
San Luis Obispo	1	255.42	Q10	9329.00	82.54	97.80		98.13	0.001157	4.56	2044.62	311.68	0.31
San Luis Obispo	1	100	Q100	15687.00	82.19	99.87	96.60	101.62	0.009811	10.73	1540.26	188.14	0.58
San Luis Obispo	1	100	Q50	14063.00	82.19	98.87	95.90	100.66	0.011232	10.79	1352.12	188.14	0.62
San Luis Obispo	1	100	Q25	12083.00	82.19	97.87	95.03	99.57	0.012049	10.48	1167.03	171.59	0.63
San Luis Obispo	1	100	Q10	9329.00	82.19	95.87	93.61	97.56	0.013779	10.42	895.12	119.88	0.67
Prefumo	5	3037.62	Q100	2512.00	100.97	112.76		113.17	0.003163	5.17	490.10	78.47	0.33
Prefumo	5	3037.62	Q50	2194.00	100.97	112.31		112.67	0.002941	4.80	457.85	65.40	0.31
Prefumo	5	3037.62	Q25	1805.00	100.97	111.67		111.96	0.002506	4.31	418.36	59.26	0.29
Prefumo	5	3037.62	Q10	1240.00	100.97	109.55		109.81	0.002605	4.09	302.94	50.39	0.29
Prefumo	5	2884.43	Q100	2512.00	97.58	112.69		112.87	0.000889	3.45	731.81	81.91	0.19
Prefumo	5	2884.43	Q50	2194.00	97.58	112.24		112.40	0.000779	3.14	698.28	71.82	0.17
Prefumo	5	2884.43	Q25	1805.00	97.58	111.62		111.73	0.000631	2.76	654.58	67.78	0.16
Prefumo	5	2884.43	Q10	1240.00	97.58	109.51		109.60	0.000537	2.39	518.31	61.78	0.15
Prefumo	5	2771.00	Q100	2512.00	96.46	112.59		112.76	0.001034	3.42	801.44	111.08	0.19
Prefumo	5	2771.00	Q50	2194.00	96.46	112.15		112.30	0.000929	3.15	753.59	109.29	0.18
Prefumo	5	2771.00	Q25	1805.00	96.46	111.53		111.65	0.000801	2.80	686.90	106.75	0.16

HEC-RAS Plan: Prop.Condition (Continued)

River	Reach	River Sta	Profile	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)	
Prefumo	5	2771.00	Q10	1240.00	96.46	109.42		109.52	0.000853	2.54	492.63	75.84	0.16
Prefumo	5	2549.29	Q100	2512.00	96.21	112.41		112.55	0.000809	3.17	873.92	91.96	0.16
Prefumo	5	2549.29	Q50	2194.00	96.21	111.99		112.11	0.000698	2.90	836.13	91.96	0.15
Prefumo	5	2549.29	Q25	1805.00	96.21	111.40		111.50	0.000569	2.54	781.84	91.96	0.13
Prefumo	5	2549.29	Q10	1240.00	96.21	109.29		109.37	0.000557	2.27	590.43	85.80	0.13
Prefumo	5	2389.59	Q100	2512.00	94.12	111.89	105.39	112.38	0.000889	6.19	699.81	145.50	0.30
Prefumo	5	2389.59	Q50	2194.00	94.12	111.54	104.76	111.97	0.000780	5.69	649.08	145.50	0.28
Prefumo	5	2389.59	Q25	1805.00	94.12	111.03	103.97	111.37	0.000653	5.07	573.84	145.50	0.25
Prefumo	5	2389.59	Q10	1240.00	94.12	108.93	102.71	109.24	0.000691	4.62	326.98	76.87	0.25
Prefumo	5	2352.5		Culvert									
Prefumo	5	2299.45	Q100	2512.00	95.60	111.12		111.15	0.000484	1.49	1756.88	352.59	0.11
Prefumo	5	2299.45	Q50	2194.00	95.60	110.70		110.73	0.000483	1.42	1610.64	346.92	0.11
Prefumo	5	2299.45	Q25	1805.00	95.60	110.11		110.13	0.000494	1.33	1408.10	337.23	0.11
Prefumo	5	2299.45	Q10	1240.00	95.60	108.25		108.28	0.001283	1.53	817.49	297.77	0.16
Prefumo	5	2277.36	Q100	2512.00	95.30	111.10		111.14	0.000259	1.95	1822.39	297.20	0.10
Prefumo	5	2277.36	Q50	2194.00	95.30	110.68		110.72	0.000239	1.83	1699.04	296.20	0.10
Prefumo	5	2277.36	Q25	1805.00	95.30	110.09		110.12	0.000216	1.67	1524.74	294.74	0.09
Prefumo	5	2277.36	Q10	1240.00	95.30	108.23		108.27	0.000276	1.67	1003.25	265.07	0.10
Prefumo	5	2075.34	Q100	2512.00	92.70	111.04	99.60	111.08	0.000298	1.81	1689.39	314.91	0.10
Prefumo	5	2075.34	Q50	2194.00	92.70	110.63	99.18	110.67	0.000273	1.69	1560.28	314.21	0.09
Prefumo	5	2075.34	Q25	1805.00	92.70	110.04	98.57	110.08	0.000242	1.53	1377.34	313.23	0.09
Prefumo	5	2075.34	Q10	1240.00	92.70	108.18	97.53	108.21	0.000261	1.38	918.15	161.24	0.09
Prefumo	5	1993.09		Culvert									
Prefumo	5	1893.97	Q100	2512.00	95.65	110.49		110.67	0.000593	3.44	733.17	109.78	0.22
Prefumo	5	1893.97	Q50	2194.00	95.65	109.41		109.60	0.000732	3.51	625.46	96.36	0.24
Prefumo	5	1893.97	Q25	1805.00	95.65	108.05		108.26	0.000965	3.62	498.24	90.14	0.27
Prefumo	5	1893.97	Q10	1240.00	95.65	106.20		106.41	0.001383	3.64	340.51	79.30	0.31
Prefumo	5	1846.23	Q100	2512.00	89.51	110.55		110.58	0.000133	1.40	1796.49	155.39	0.07
Prefumo	5	1846.23	Q50	2194.00	89.51	109.48		109.51	0.000132	1.34	1639.44	143.62	0.07
Prefumo	5	1846.23	Q25	1805.00	89.51	108.13		108.15	0.000123	1.25	1448.76	136.29	0.07
Prefumo	5	1846.23	Q10	1240.00	89.51	106.28		106.30	0.000090	1.03	1207.66	123.72	0.06
Froom	4	1173.38	Q100	1066.00	91.70	104.44		104.58	0.000833	3.36	603.93	355.63	0.25
Froom	4	1173.38	Q50	939.00	91.70	104.42		104.53	0.000662	2.99	596.15	352.68	0.23
Froom	4	1173.38	Q25	750.00	91.70	104.26		104.34	0.000505	2.56	539.82	330.55	0.20
Froom	4	1173.38	Q10	547.00	91.70	104.04		104.09	0.000342	2.05	470.99	301.32	0.16

HEC-RAS Plan: Prop.Condition (Continued)

River	Reach	River Sta	Profile	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)	
Froom	4	1049.61	Q100	1066.00	90.01	104.52	98.99	104.53	0.000034	0.66	2676.31	755.40	0.05
Froom	4	1049.61	Q50	939.00	90.01	104.48	98.81	104.49	0.000027	0.59	2647.67	754.10	0.05
Froom	4	1049.61	Q25	750.00	90.01	104.30	98.53	104.31	0.000020	0.50	2512.77	749.18	0.04
Froom	4	1049.61	Q10	547.00	90.01	104.07	98.09	104.07	0.000013	0.39	2338.59	743.27	0.03
Froom	4	1000		Culvert									
Froom	4	687.58	Q100	1066.00	88.05	102.40		102.40	0.000011	0.62	3596.74	535.25	0.03
Froom	4	687.58	Q50	939.00	88.05	101.47		101.47	0.000013	0.63	3105.89	526.10	0.04
Froom	4	687.58	Q25	750.00	88.05	100.38		100.39	0.000016	0.63	2540.39	513.39	0.04
Froom	4	687.58	Q10	547.00	88.05	98.45		98.45	0.000034	0.76	1571.96	488.17	0.06
Froom	4	639.95	Q100	1066.00	87.50	102.40		102.40	0.000001	0.31	5814.85	532.17	0.01
Froom	4	639.95	Q50	939.00	87.50	101.47		101.47	0.000001	0.29	5322.66	532.17	0.01
Froom	4	639.95	Q25	750.00	87.50	100.38		100.39	0.000001	0.26	4744.18	532.17	0.01
Froom	4	639.95	Q10	547.00	87.50	98.45		98.45	0.000001	0.24	3715.48	532.17	0.01

HEC-RAS Plan: Prop.Condition

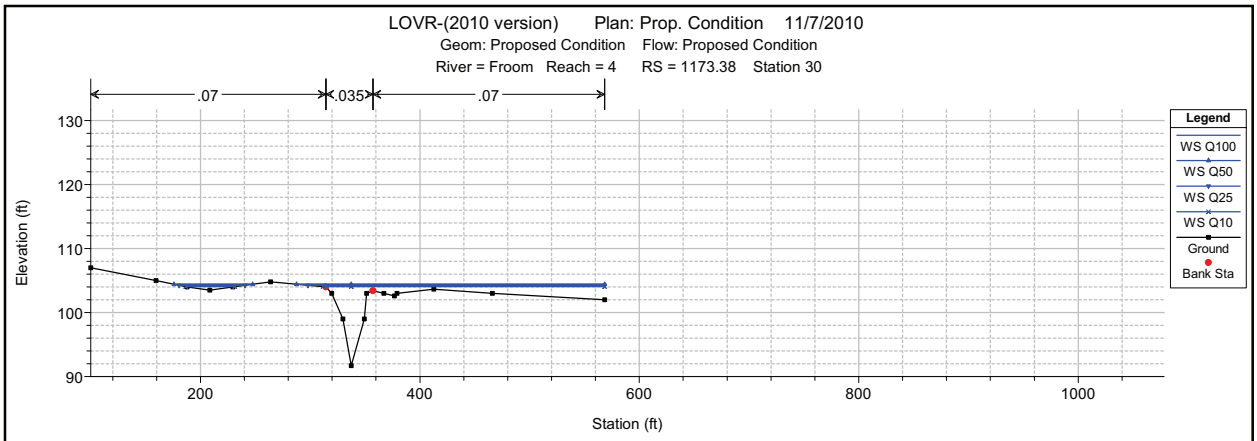
River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
San Luis Obispo	2	1274.12	Q100	109.74	109.08		0.05	0.04	191.08		15294.00		6.53
San Luis Obispo	2	1274.12	Q50	108.58	107.93		0.05	0.03	188.47		13740.00		6.47
San Luis Obispo	2	1274.12	Q25	107.13	106.51		0.05	0.02	177.94		11762.00		6.31
San Luis Obispo	2	1274.12	Q10	105.09	104.54		0.05	0.01	163.71		9114.00		5.97
San Luis Obispo	2	1253.52	Q100	109.65	108.57	100.11	0.02	0.20	124.55		15294.00		8.37
San Luis Obispo	2	1253.52	Q50	108.50	107.50	99.52	0.02	0.16	122.66		13740.00		8.02
San Luis Obispo	2	1253.52	Q25	107.06	106.19	98.74	0.02	0.13	120.31		11762.00		7.48
San Luis Obispo	2	1253.52	Q10	105.03	104.35	97.56	0.02	0.09	117.03		9114.00		6.63
San Luis Obispo	2	1199.21 BR U	Q100	109.43	107.69	101.21	0.95	0.37	62.43		15294.00		10.60
San Luis Obispo	2	1199.21 BR U	Q50	108.32	106.78	100.56	0.84	0.35	72.65		13740.00		9.95
San Luis Obispo	2	1199.21 BR U	Q25	106.91	105.62	99.71	0.74	0.32	83.16		11762.00		9.11
San Luis Obispo	2	1199.21 BR U	Q10	104.92	103.92	98.45	0.62	0.27	94.35		9114.00		8.01
San Luis Obispo	2	1199.21 BR D	Q100	108.11	105.12	102.73	0.25	1.05	84.91		15294.00		13.88
San Luis Obispo	2	1199.21 BR D	Q50	107.12	104.41	102.07	0.25	0.93	91.20		13740.00		13.22
San Luis Obispo	2	1199.21 BR D	Q25	105.85	103.48	101.23	0.24	0.79	94.26		11762.00		12.35
San Luis Obispo	2	1199.21 BR D	Q10	104.03	102.14	100.00	0.22	0.61	94.26		9114.00		11.04
San Luis Obispo	2	1109.57	Q100	106.81	105.92		0.73	0.04	201.43		15294.00		7.57
San Luis Obispo	2	1109.57	Q50	105.94	105.09		0.73	0.05	194.74		13740.00		7.40
San Luis Obispo	2	1109.57	Q25	104.82	104.03		0.71	0.04	187.43		11762.00		7.11
San Luis Obispo	2	1109.57	Q10	103.20	102.53		0.67	0.04	167.95		9114.00		6.57
San Luis Obispo	2	1000.91	Q100	106.03	104.70		2.82	0.08	197.84		15294.00		9.27
San Luis Obispo	2	1000.91	Q50	105.17	103.85		2.85	0.07	177.54		13740.00		9.21
San Luis Obispo	2	1000.91	Q25	104.06	102.83		2.82	0.06	160.08		11762.00		8.91
San Luis Obispo	2	1000.91	Q10	102.49	101.44		3.11	0.00	150.42		9114.00		8.25

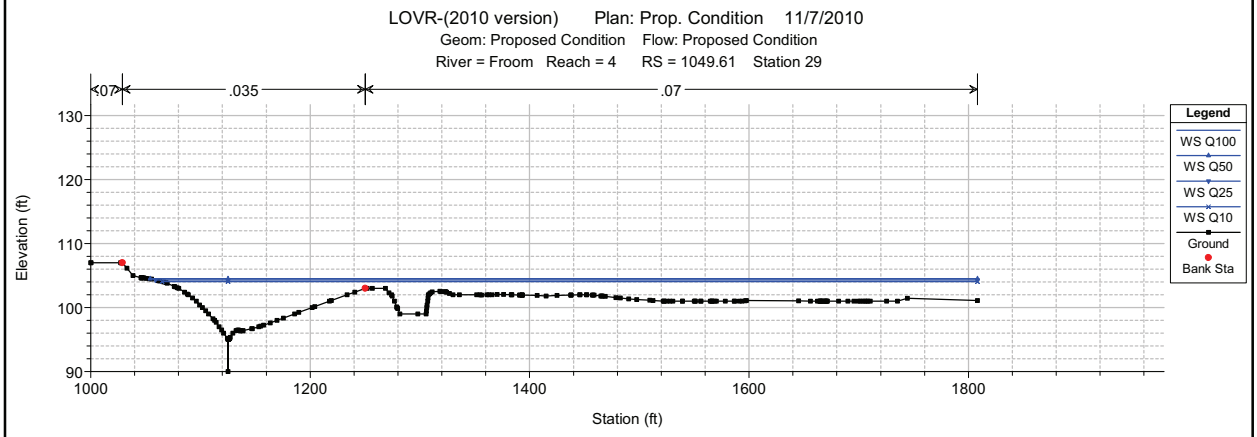
HEC-RAS Plan: Prop.Condition

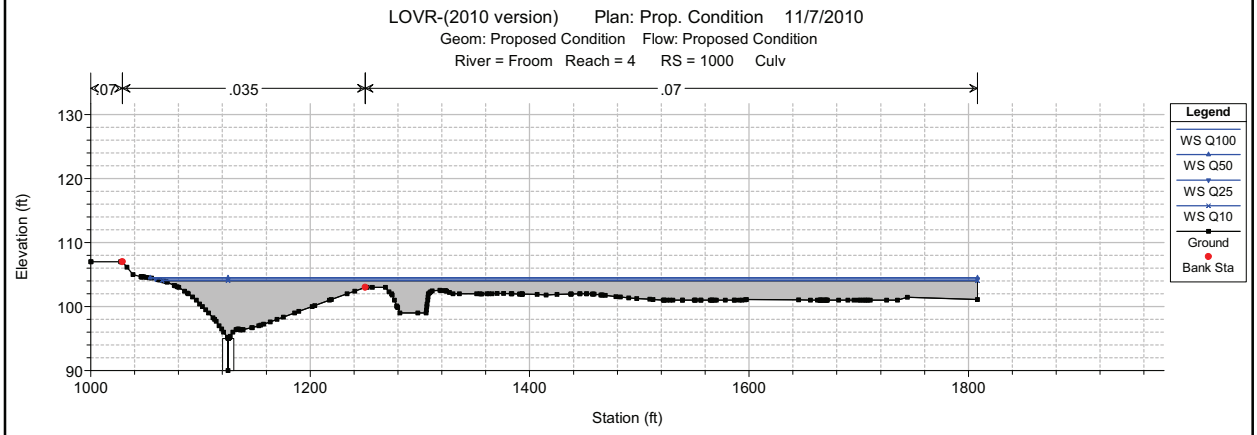
River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Prefumo	5	2549.29	Q100	112.55	112.41	0.14	0.14	0.03	295.38	2216.62		91.96
Prefumo	5	2549.29	Q50	112.11	111.99	0.12	0.12	0.03	240.25	1953.75		91.96
Prefumo	5	2549.29	Q25	111.50	111.40	0.09	0.10	0.03	175.12	1629.88		91.96
Prefumo	5	2549.29	Q10	109.37	109.29	0.08	0.10	0.02	60.21	1179.79		85.80
Prefumo	5	2389.59	Q100	112.38	111.89	0.49			387.02	2034.71	90.27	145.50
Prefumo	5	2389.59	Q50	111.97	111.54	0.42			290.87	1824.46	78.67	145.50
Prefumo	5	2389.59	Q25	111.37	111.03	0.35			179.63	1561.25	64.12	145.50
Prefumo	5	2389.59	Q10	109.24	108.93	0.32			19.64	1185.15	35.21	76.87
Prefumo	5	2352.5		Culvert								
Prefumo	5	2299.45	Q100	111.15	111.12	0.03	0.01	0.00	67.23	2393.47	51.30	352.59
Prefumo	5	2299.45	Q50	110.73	110.70	0.03	0.01	0.00	49.73	2106.45	37.82	346.92
Prefumo	5	2299.45	Q25	110.13	110.11	0.03	0.01	0.00	31.36	1750.65	22.99	337.23
Prefumo	5	2299.45	Q10	108.28	108.25	0.04	0.01	0.00	4.28	1228.11	7.60	297.77
Prefumo	5	2277.36	Q100	111.14	111.10	0.04	0.06	0.00	926.17	1564.47	21.36	297.20
Prefumo	5	2277.36	Q50	110.72	110.68	0.04	0.05	0.00	762.21	1416.65	15.14	296.20
Prefumo	5	2277.36	Q25	110.12	110.09	0.03	0.05	0.00	564.57	1232.03	8.40	294.74
Prefumo	5	2277.36	Q10	108.27	108.23	0.04	0.05	0.00	221.73	1017.63	0.64	265.07
Prefumo	5	2075.34	Q100	111.08	111.04	0.05			243.71	2208.52	59.77	314.91
Prefumo	5	2075.34	Q50	110.67	110.63	0.04			166.35	1981.27	46.37	314.21
Prefumo	5	2075.34	Q25	110.08	110.04	0.03			82.22	1692.02	30.76	313.23
Prefumo	5	2075.34	Q10	108.21	108.18	0.03			1.67	1234.74	3.59	161.24
Prefumo	5	1993.09		Culvert								
Prefumo	5	1893.97	Q100	110.67	110.49	0.18	0.01	0.08	0.55	2511.45		109.78
Prefumo	5	1893.97	Q50	109.60	109.41	0.19	0.01	0.08		2194.00		96.36
Prefumo	5	1893.97	Q25	108.26	108.05	0.20	0.01	0.09		1805.00		90.14
Prefumo	5	1893.97	Q10	106.41	106.20	0.21	0.01	0.09		1240.00		79.30
Prefumo	5	1846.23	Q100	110.58	110.55	0.03	0.16	0.02	0.29	2511.71		155.39
Prefumo	5	1846.23	Q50	109.51	109.48	0.03	0.17	0.02		2194.00		143.62
Prefumo	5	1846.23	Q25	108.15	108.13	0.02	0.18	0.02		1805.00		136.29
Prefumo	5	1846.23	Q10	106.30	106.28	0.02	0.18	0.02		1240.00		123.72

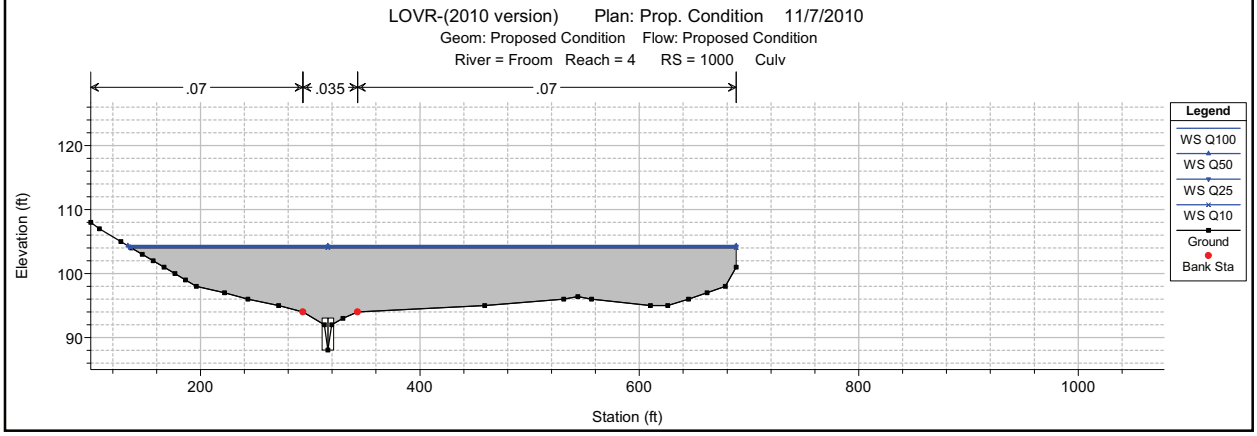
HEC-RAS Plan: Prop.Condition (Continued)

River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Froom	4	1173.38	Q100	104.58	104.44	0.13	0.01	0.04	15.15	782.05	268.81	355.63
Froom	4	1173.38	Q50	104.53	104.42	0.10	0.01	0.03	12.62	692.37	234.01	352.68
Froom	4	1173.38	Q25	104.34	104.26	0.08	0.01	0.02	6.28	574.44	169.28	330.55
Froom	4	1173.38	Q10	104.09	104.04	0.05	0.00	0.02	2.01	440.49	104.50	301.32
Froom	4	1049.61	Q100	104.53	104.52	0.00				597.27	468.73	755.40
Froom	4	1049.61	Q50	104.49	104.48	0.00				528.52	410.48	754.10
Froom	4	1049.61	Q25	104.31	104.30	0.00				431.07	318.93	749.18
Froom	4	1049.61	Q10	104.07	104.07	0.00				323.68	223.32	743.27
Froom	4	1000		Culvert								
Froom	4	687.58	Q100	102.40	102.40	0.00	0.00	0.00	149.57	300.12	616.30	535.25
Froom	4	687.58	Q50	101.47	101.47	0.00	0.00	0.00	124.62	279.54	534.84	526.10
Froom	4	687.58	Q25	100.39	100.38	0.00	0.00	0.00	91.54	242.29	416.17	513.39
Froom	4	687.58	Q10	98.45	98.45	0.00	0.00	0.00	51.47	220.81	274.71	488.17
Froom	4	639.95	Q100	102.40	102.40	0.00	0.05	0.05	212.91	637.77	215.32	532.17
Froom	4	639.95	Q50	101.47	101.47	0.00	0.05	0.05	179.06	573.84	186.09	532.17
Froom	4	639.95	Q25	100.39	100.38	0.00	0.05	0.04	133.55	471.96	144.50	532.17
Froom	4	639.95	Q10	98.45	98.45	0.00	0.06	0.04	80.99	368.29	97.71	532.17

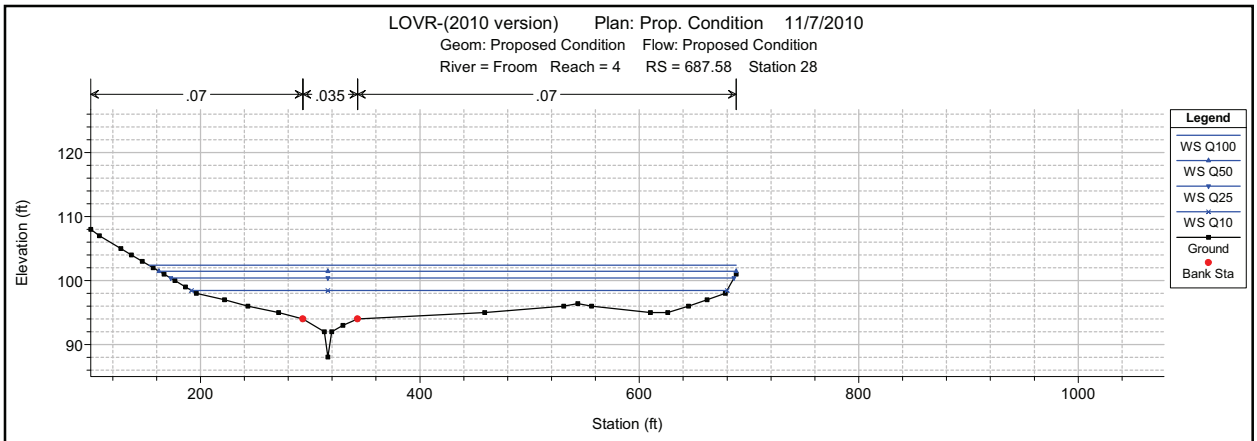


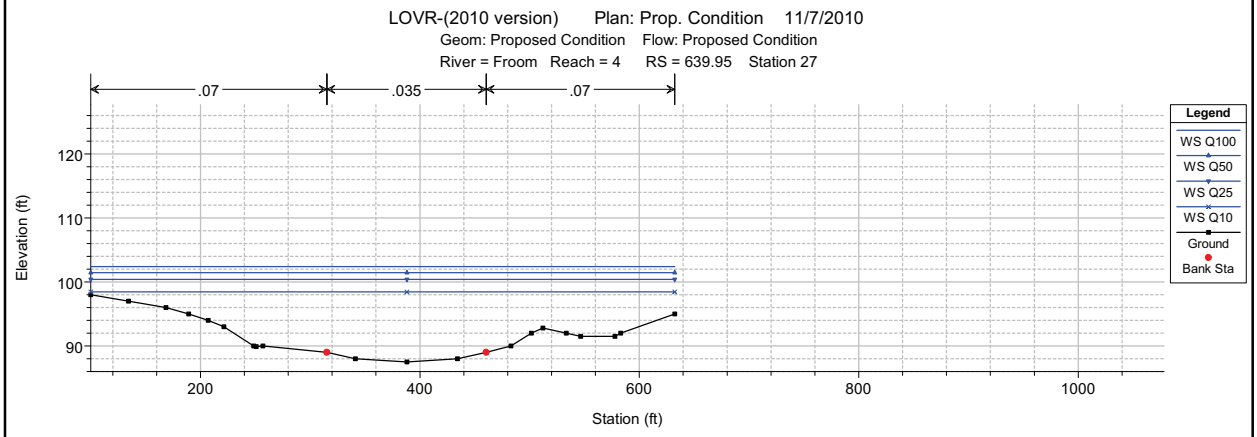


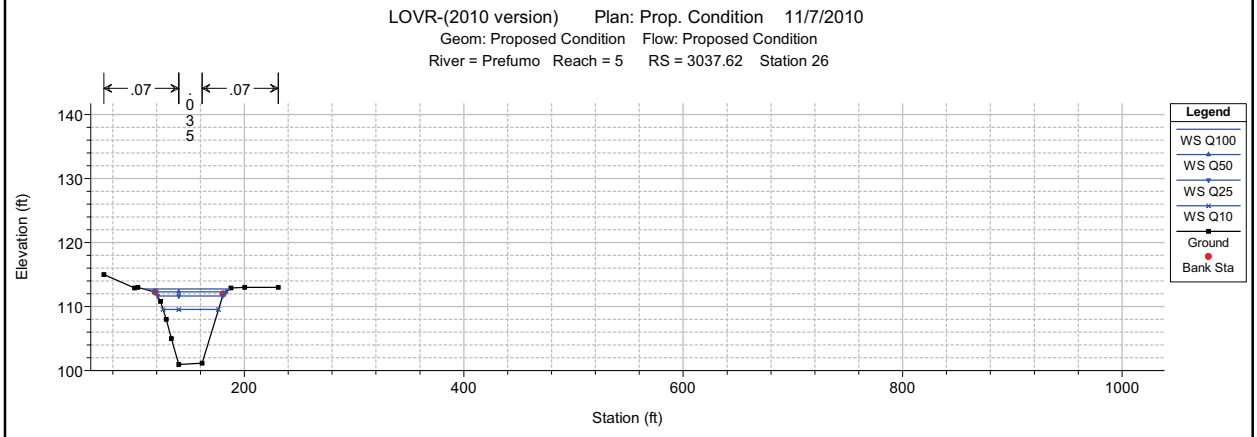


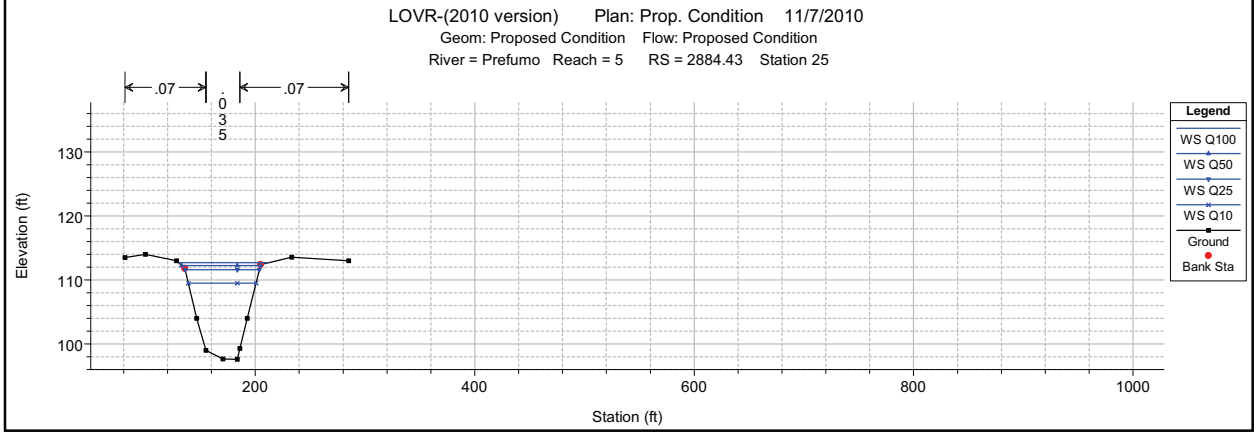


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

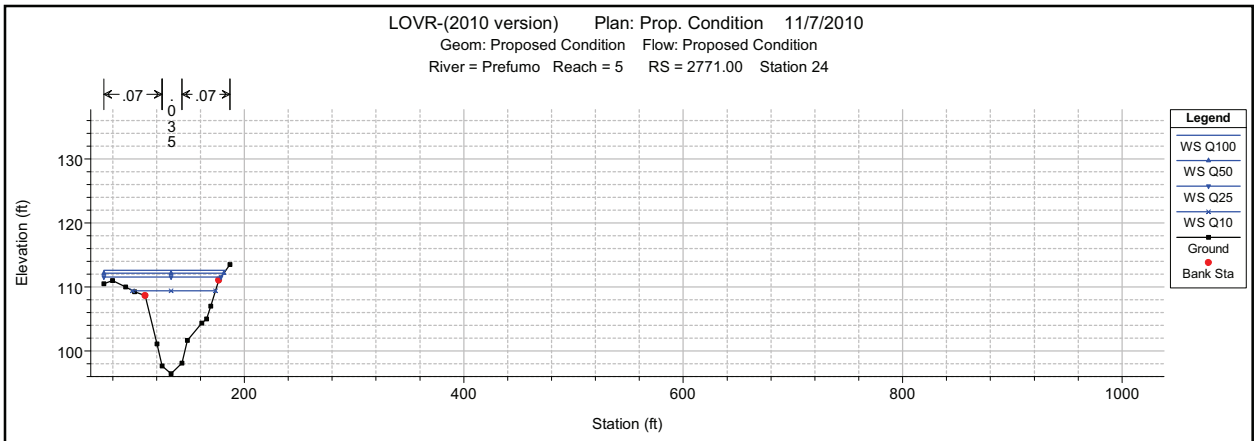


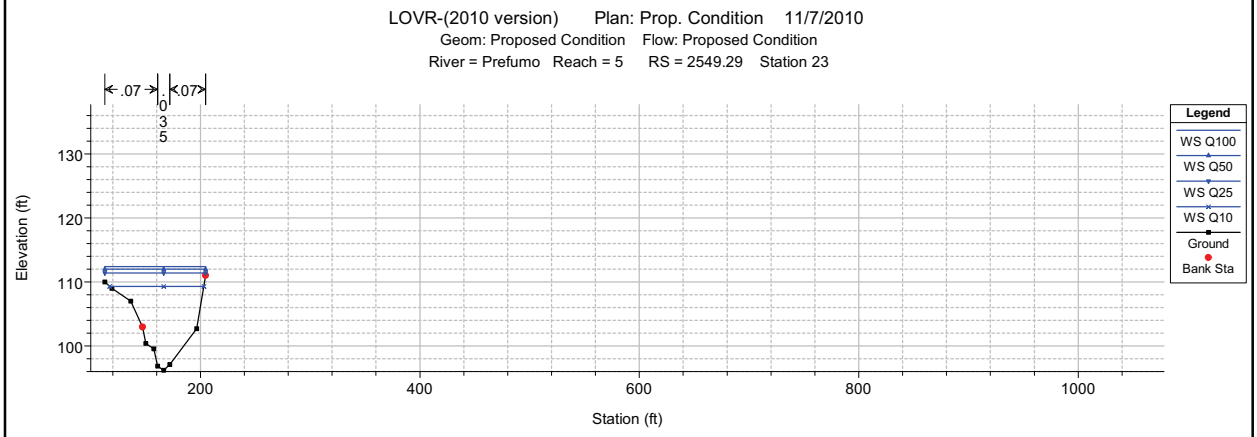


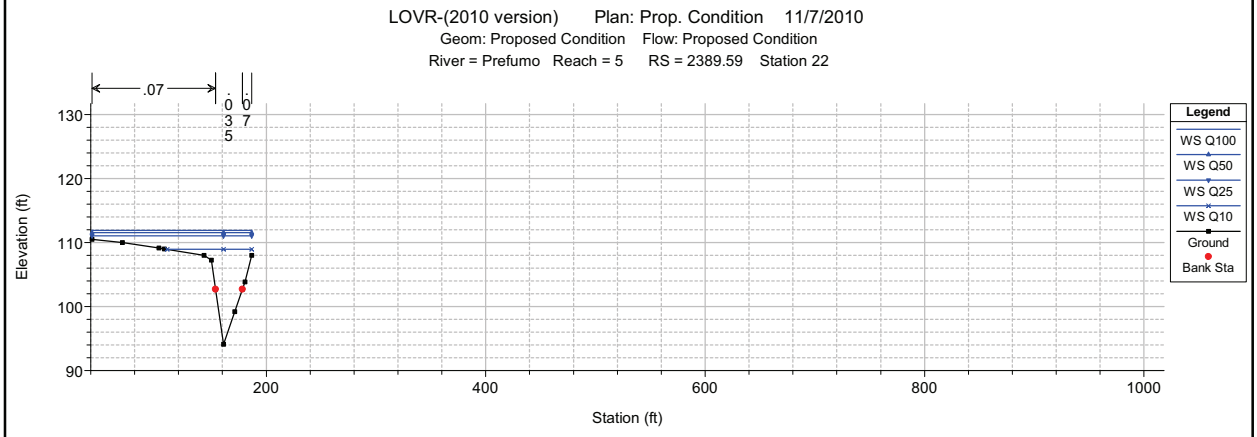


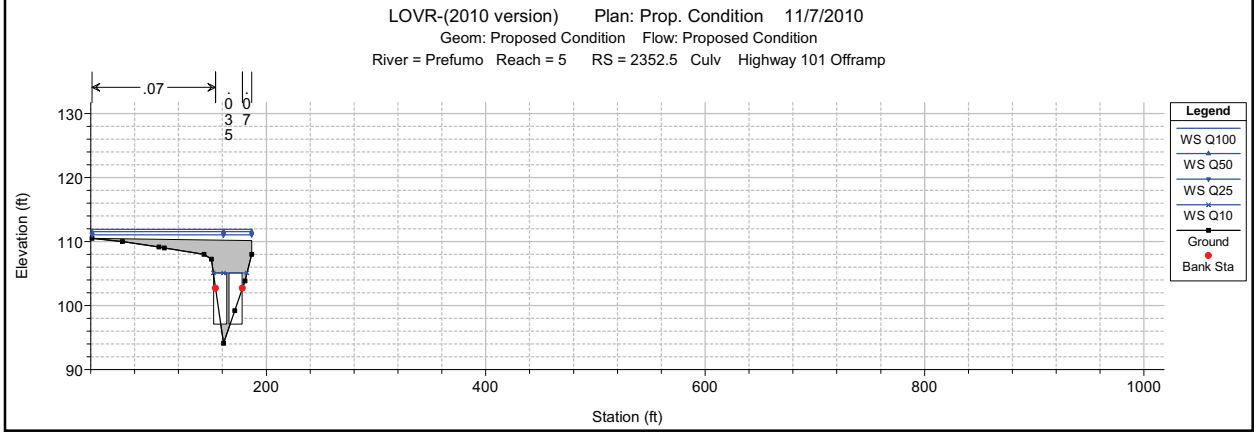


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

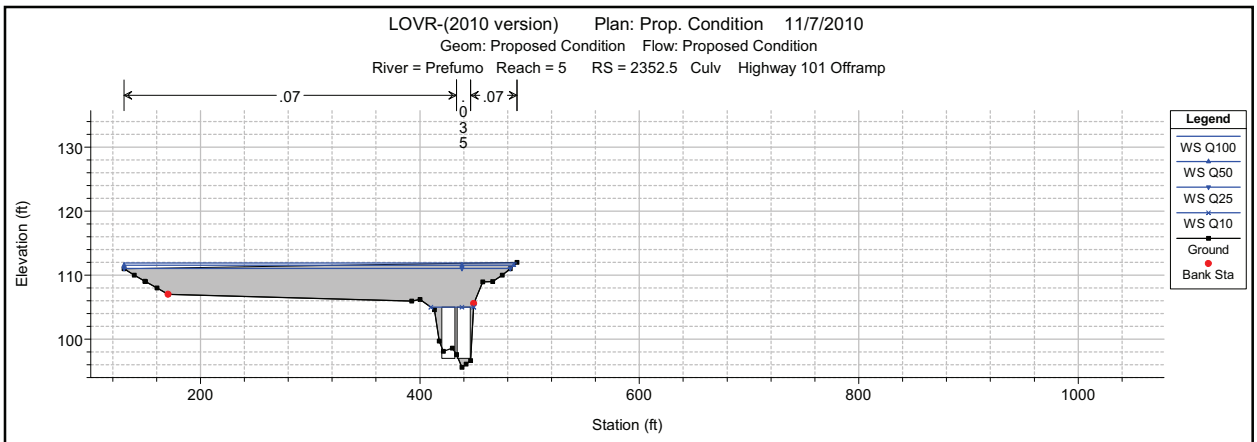


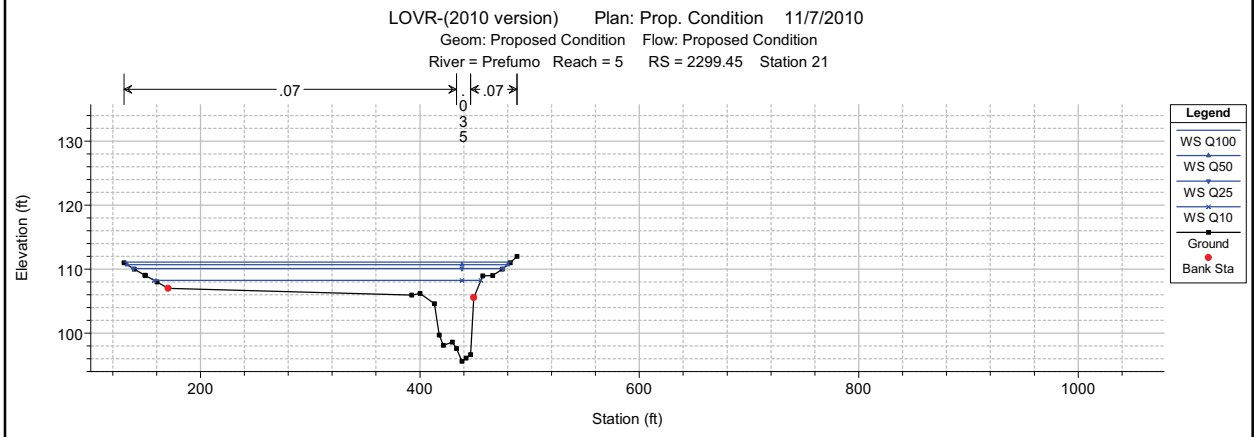


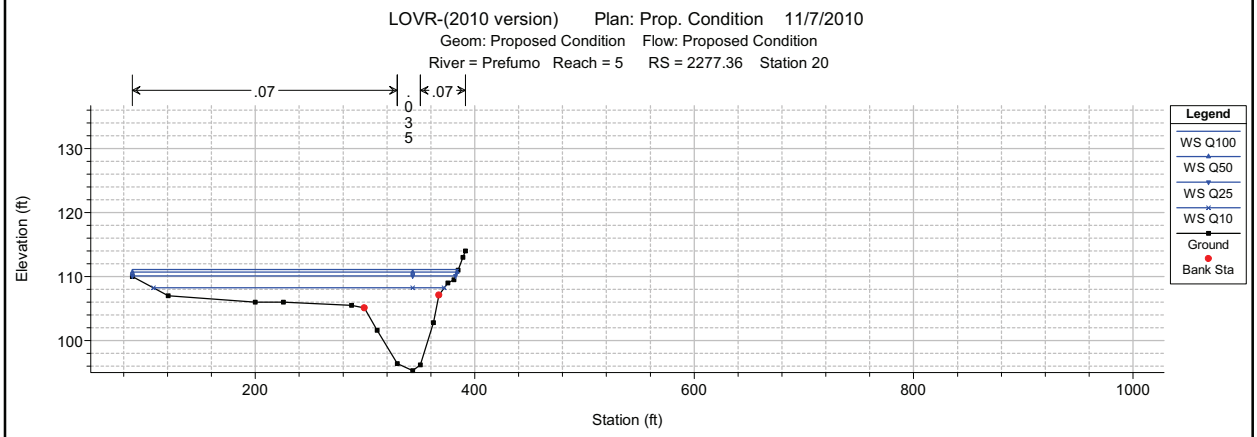


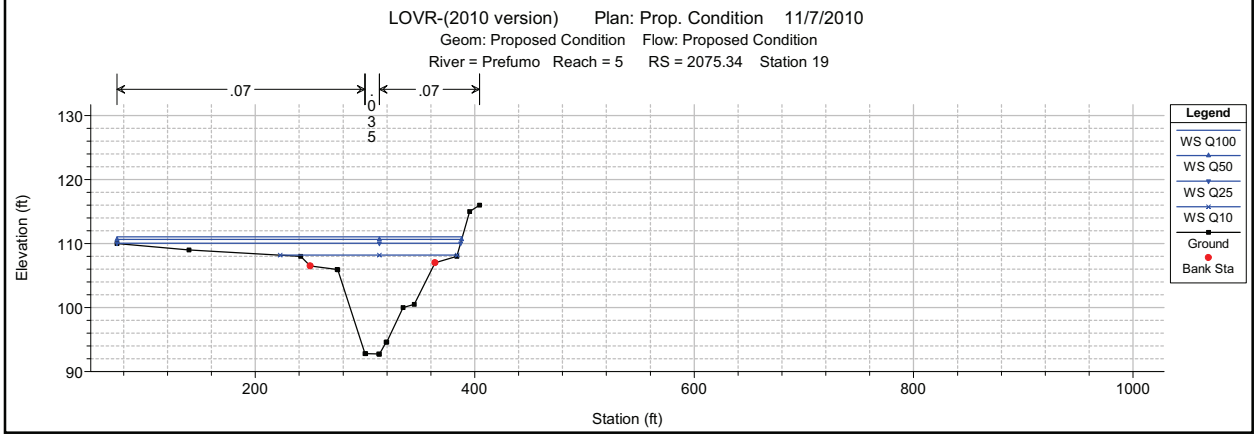


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

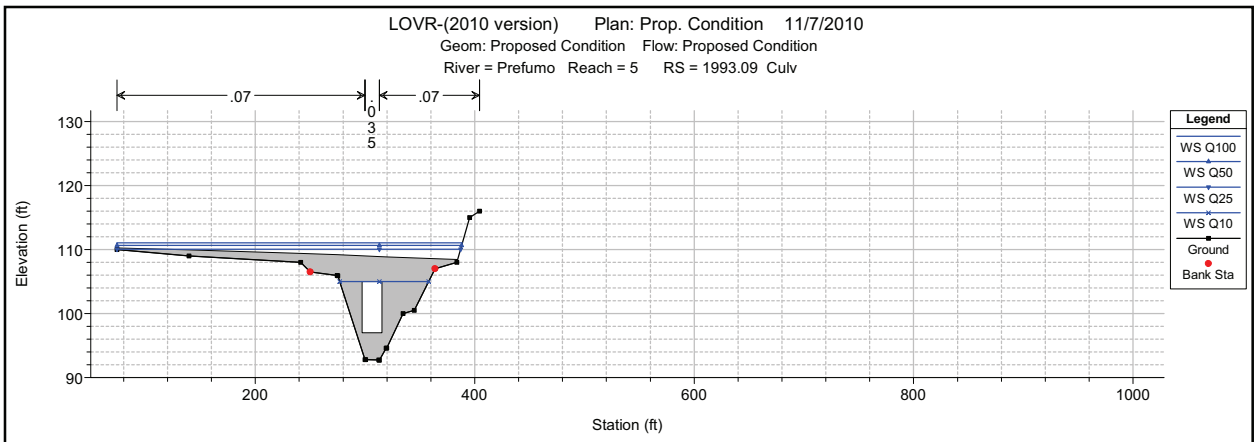


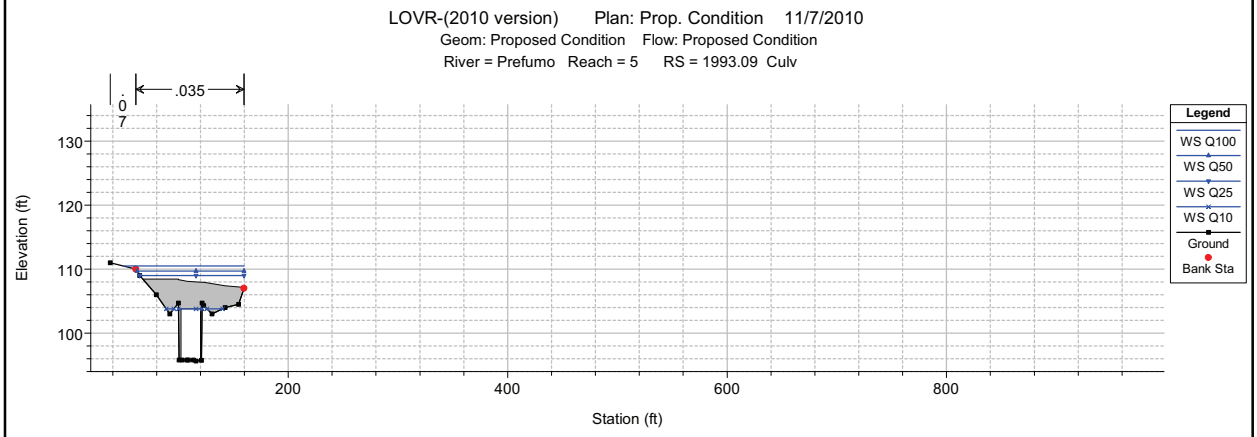


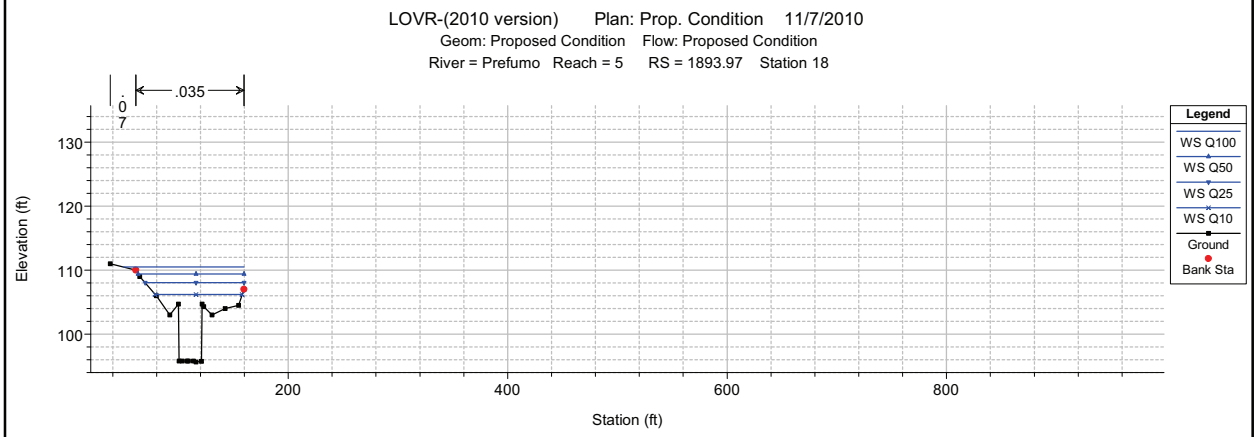


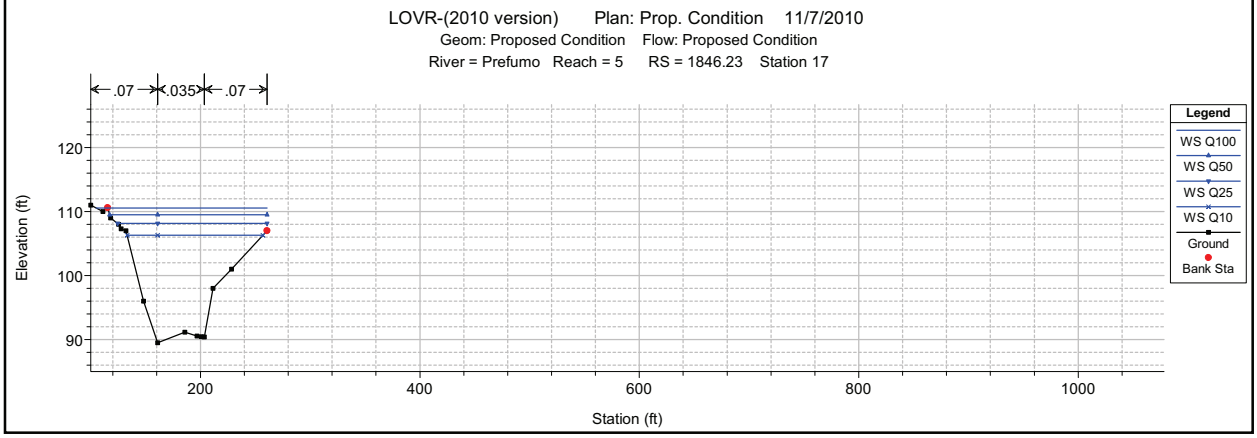


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

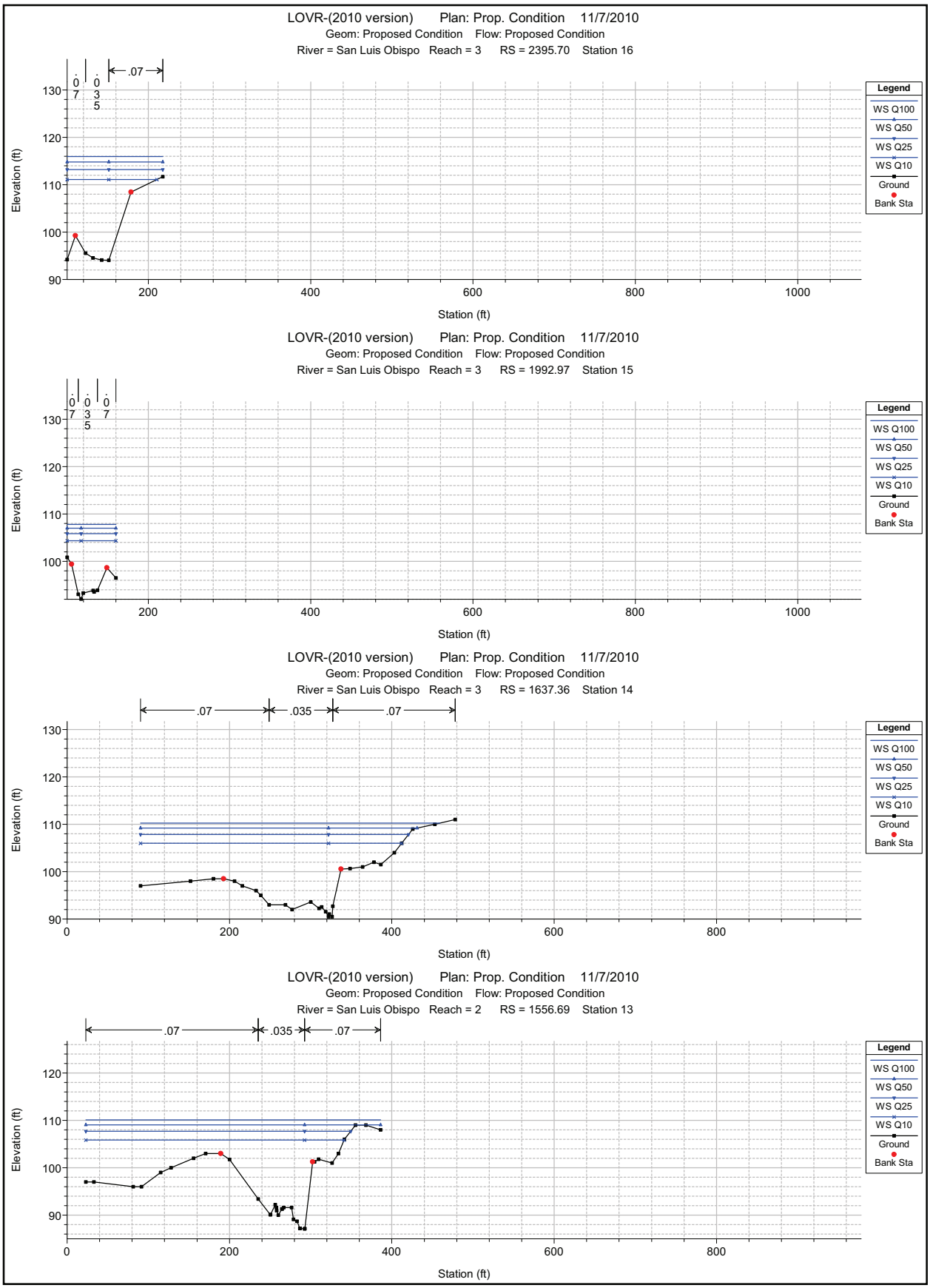




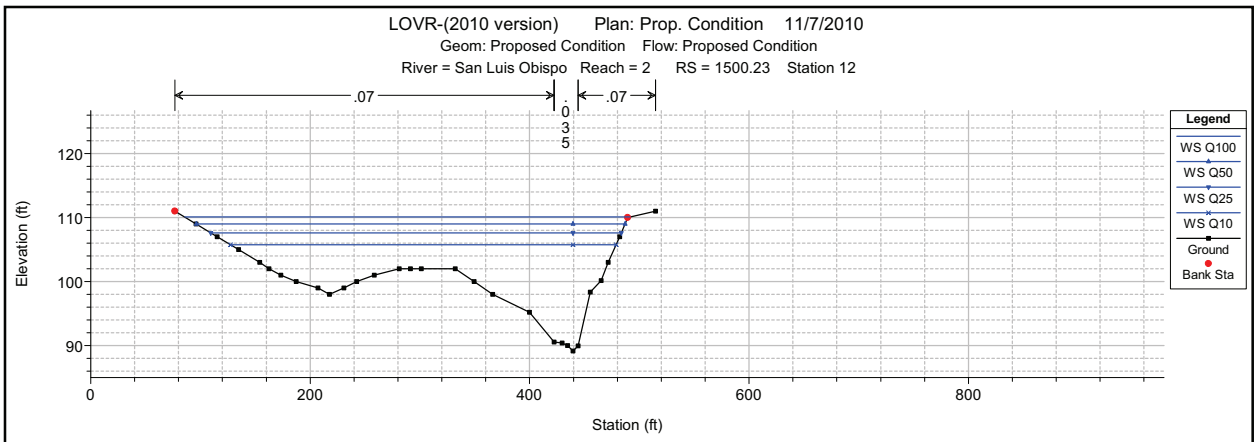


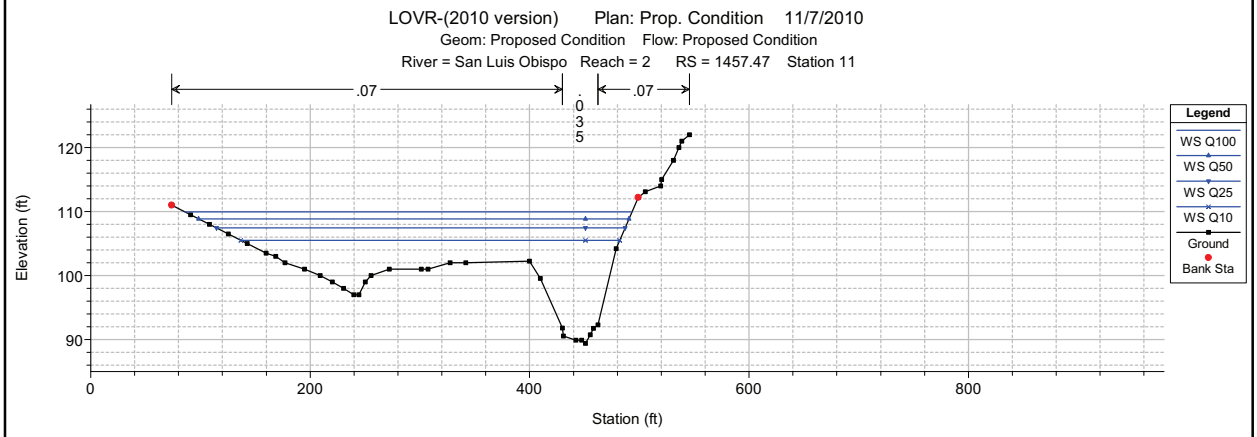


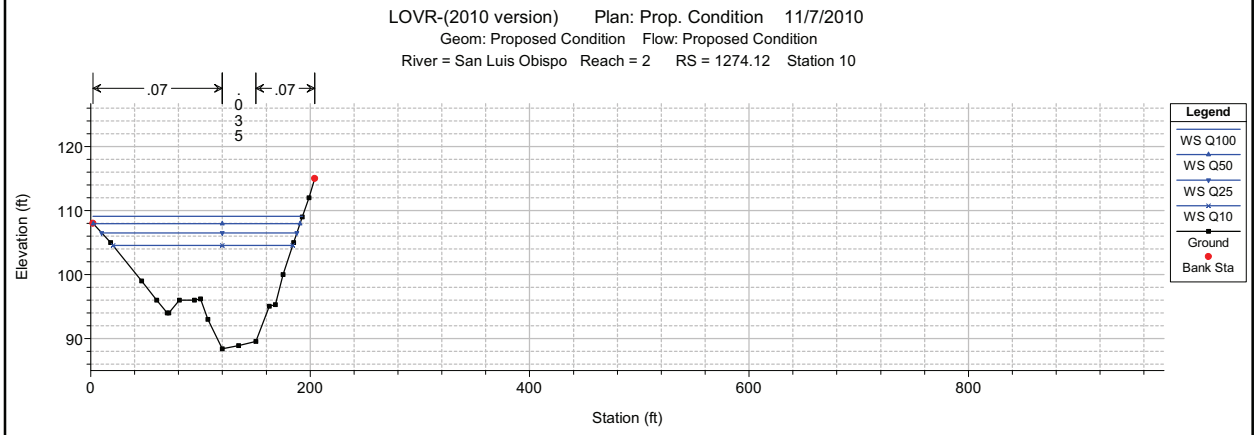
1 in Horiz. = 175 ft 1 in Vert. = 30 ft

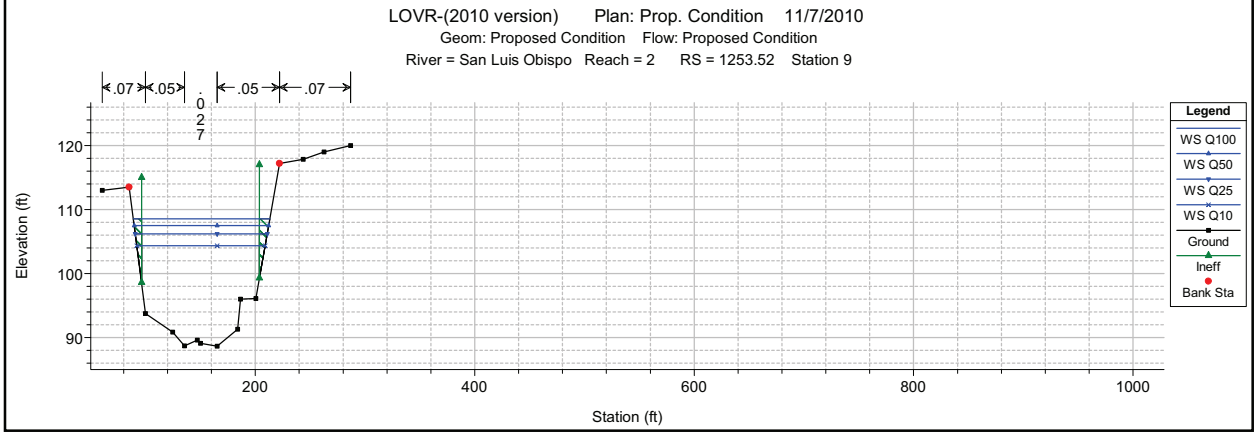


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

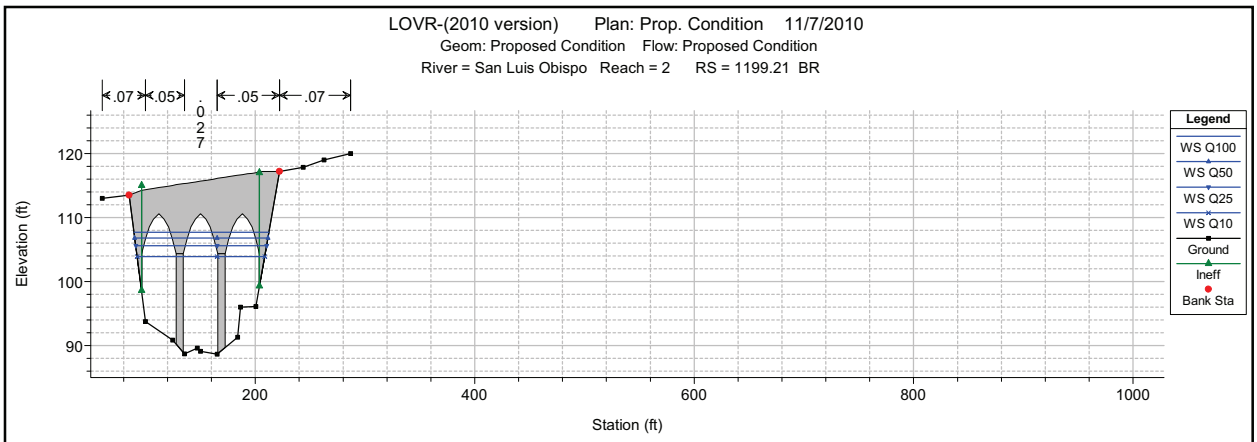


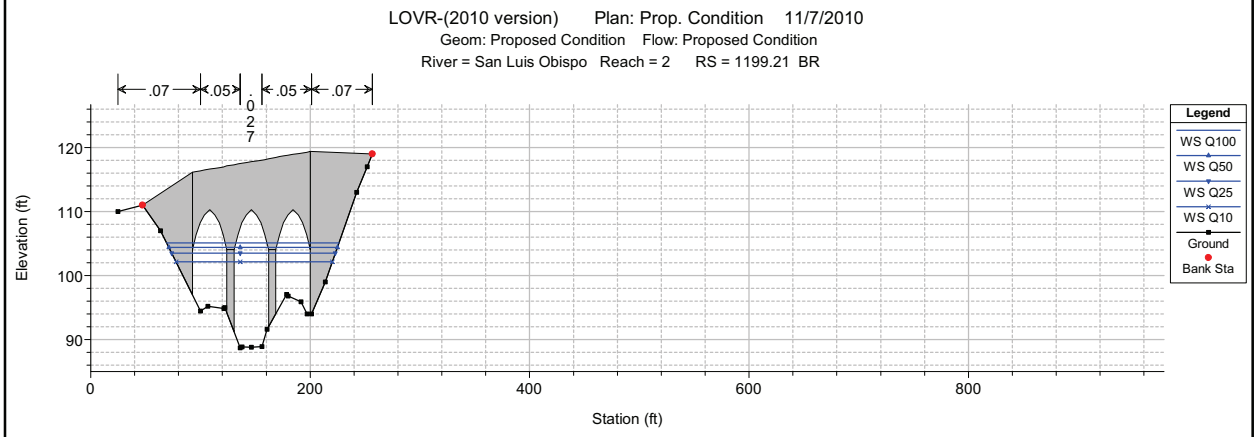


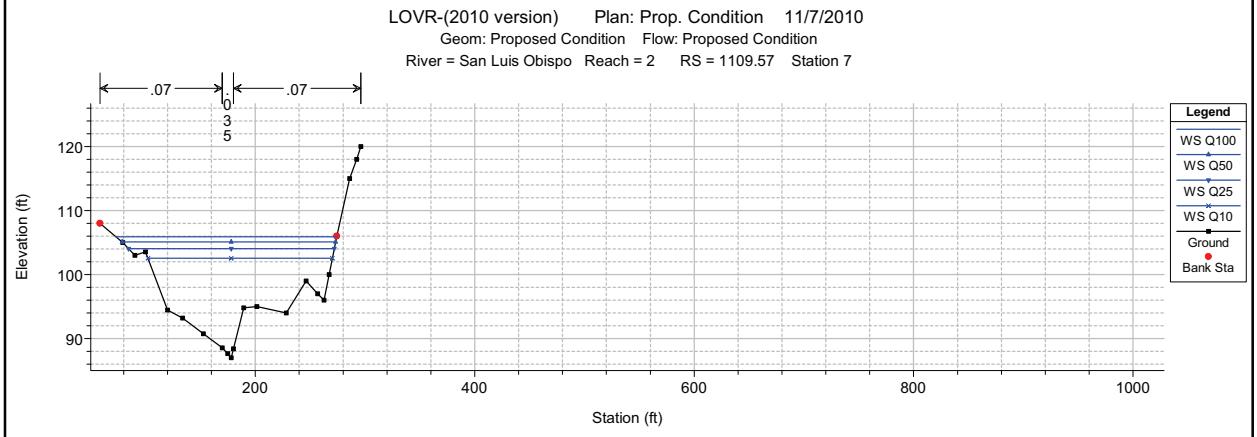


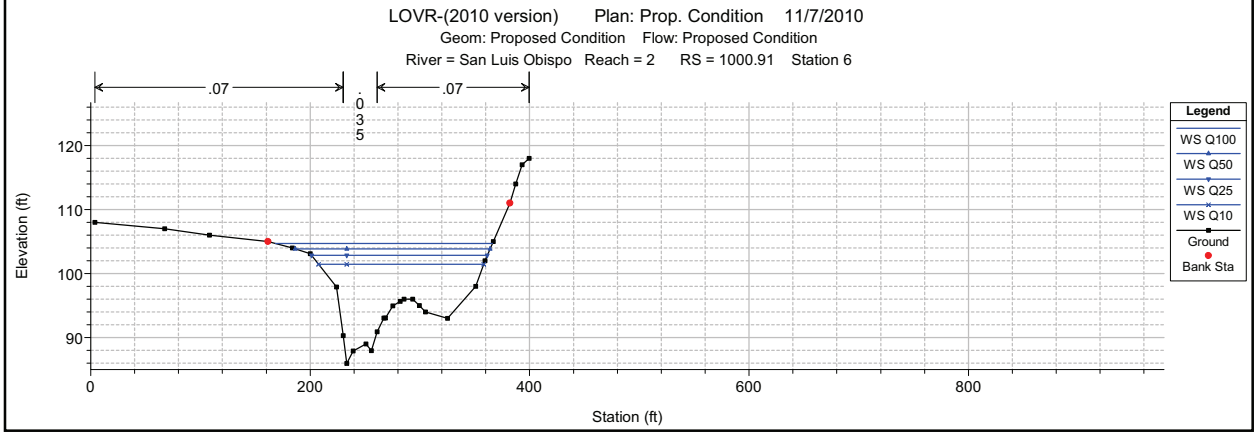


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

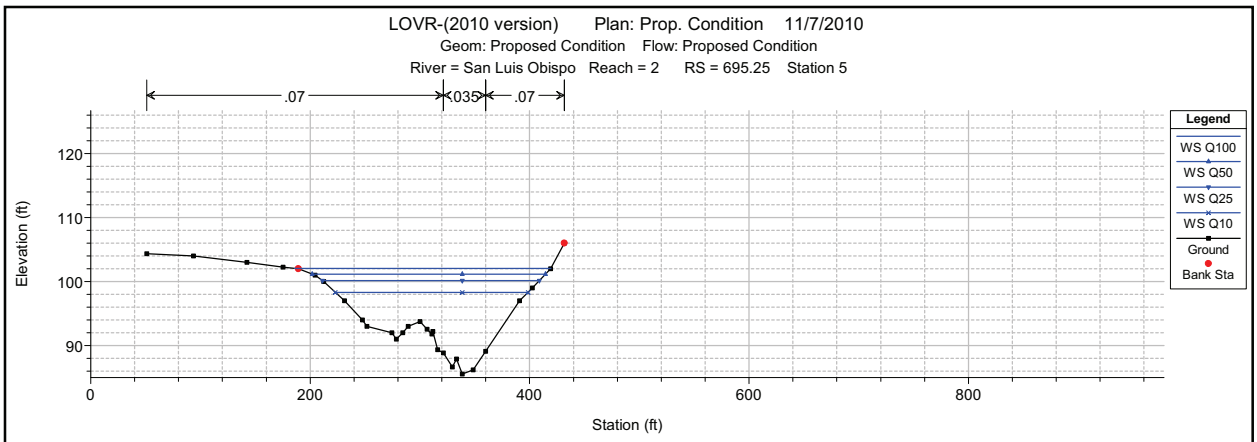


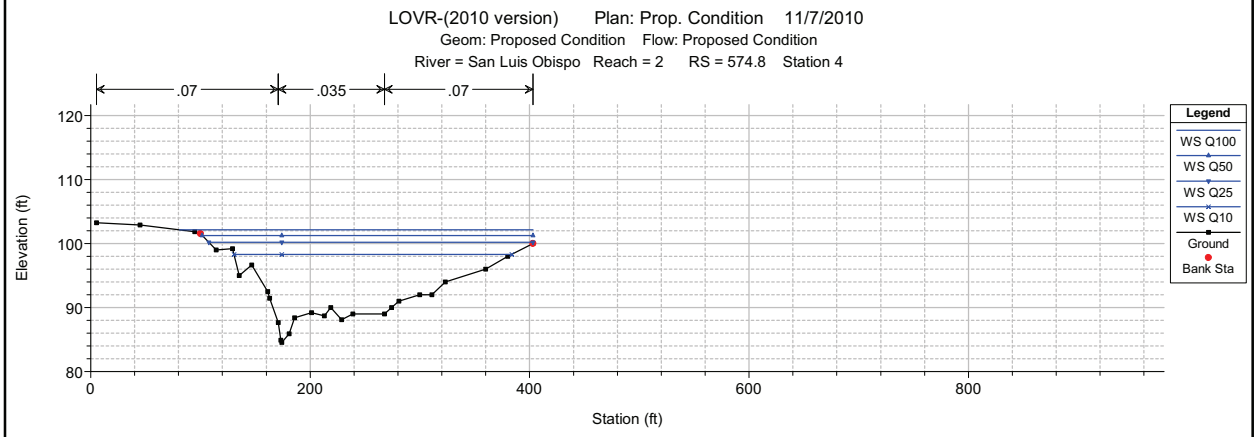


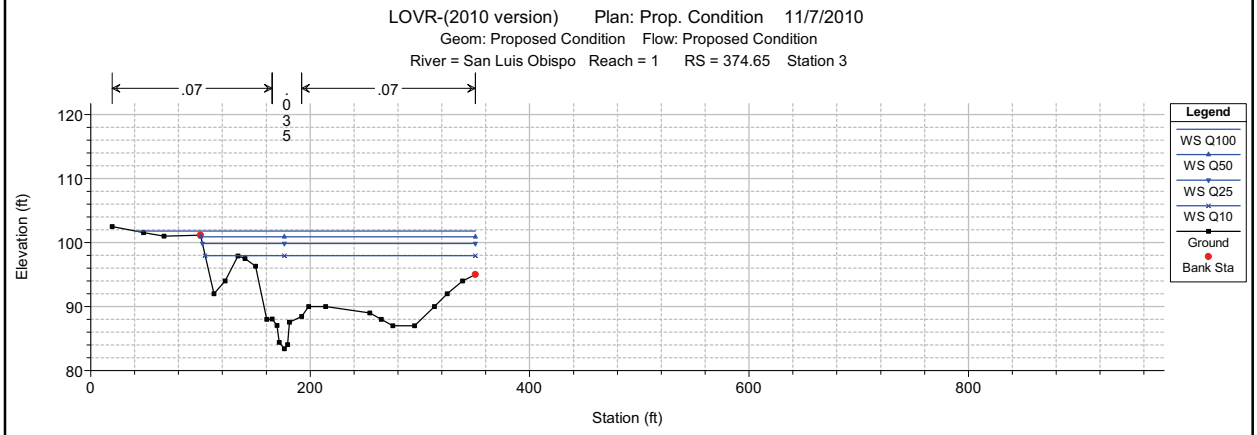


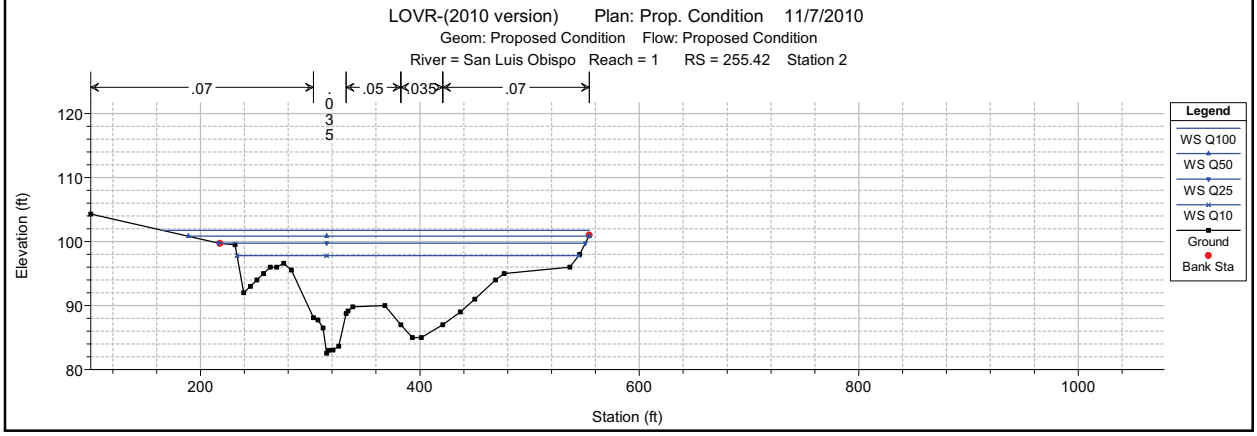


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

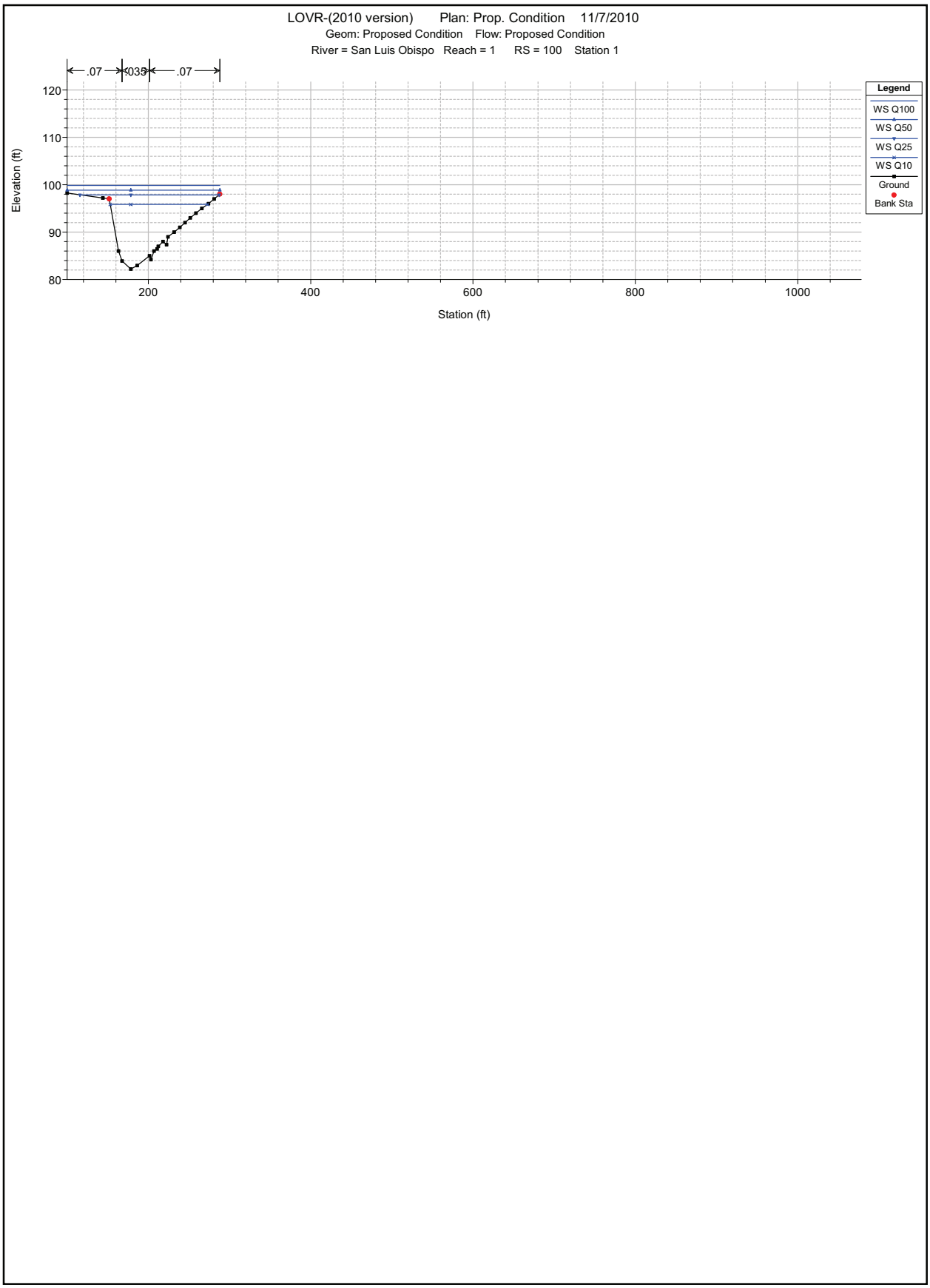






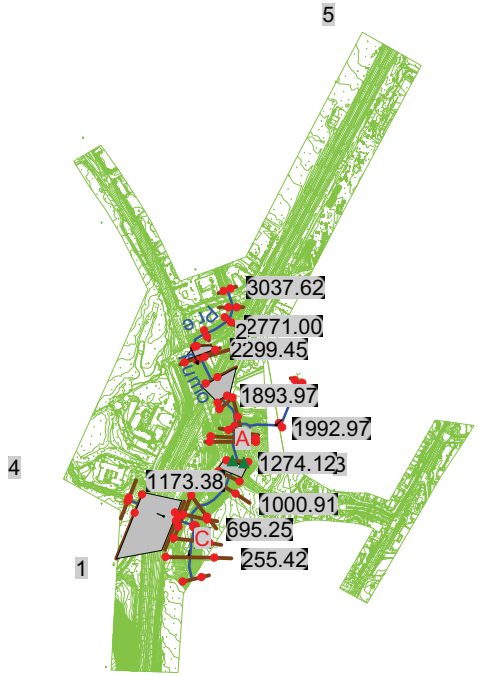


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

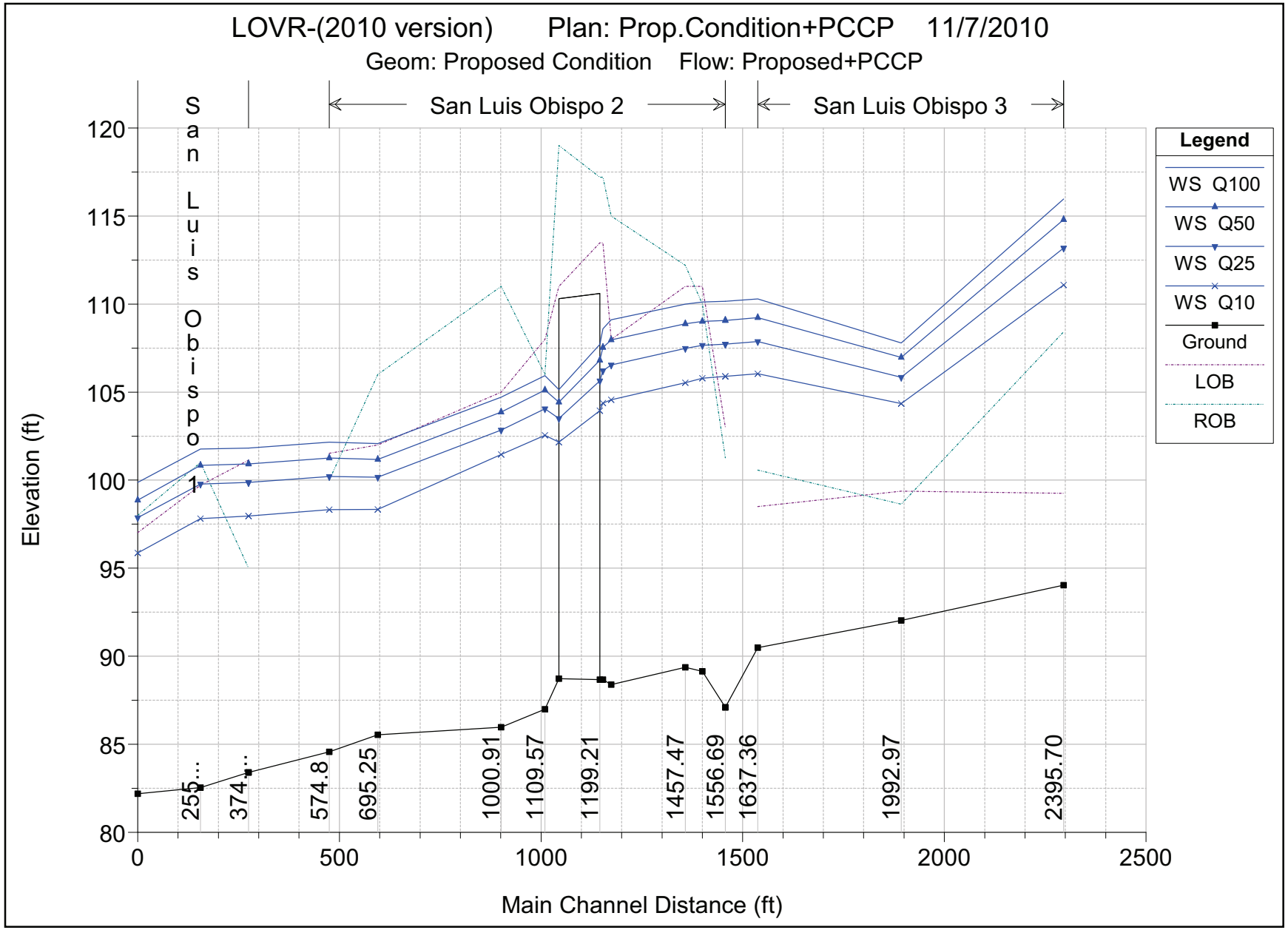


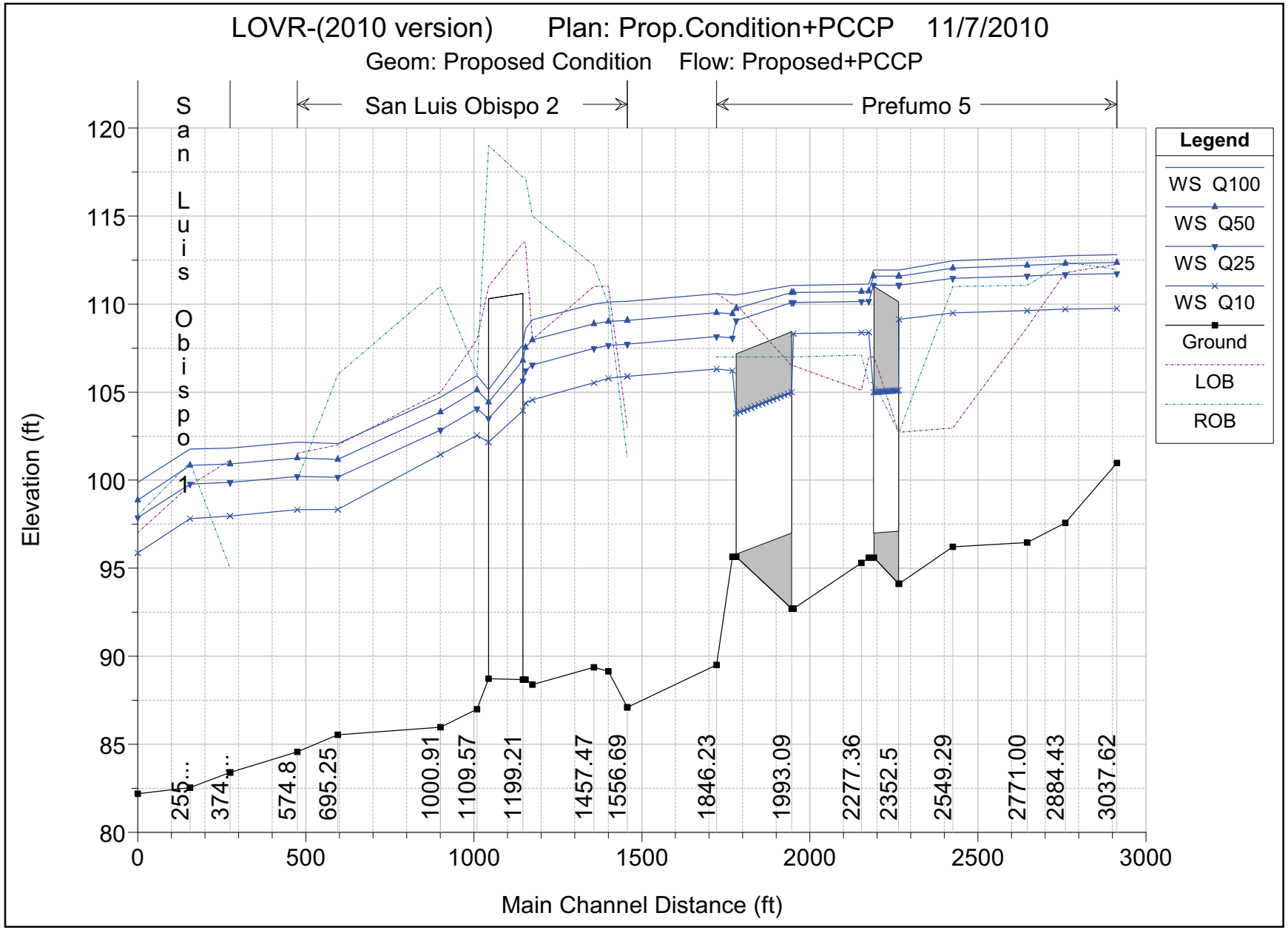
1 in Horiz. = 175 ft 1 in Vert. = 30 ft

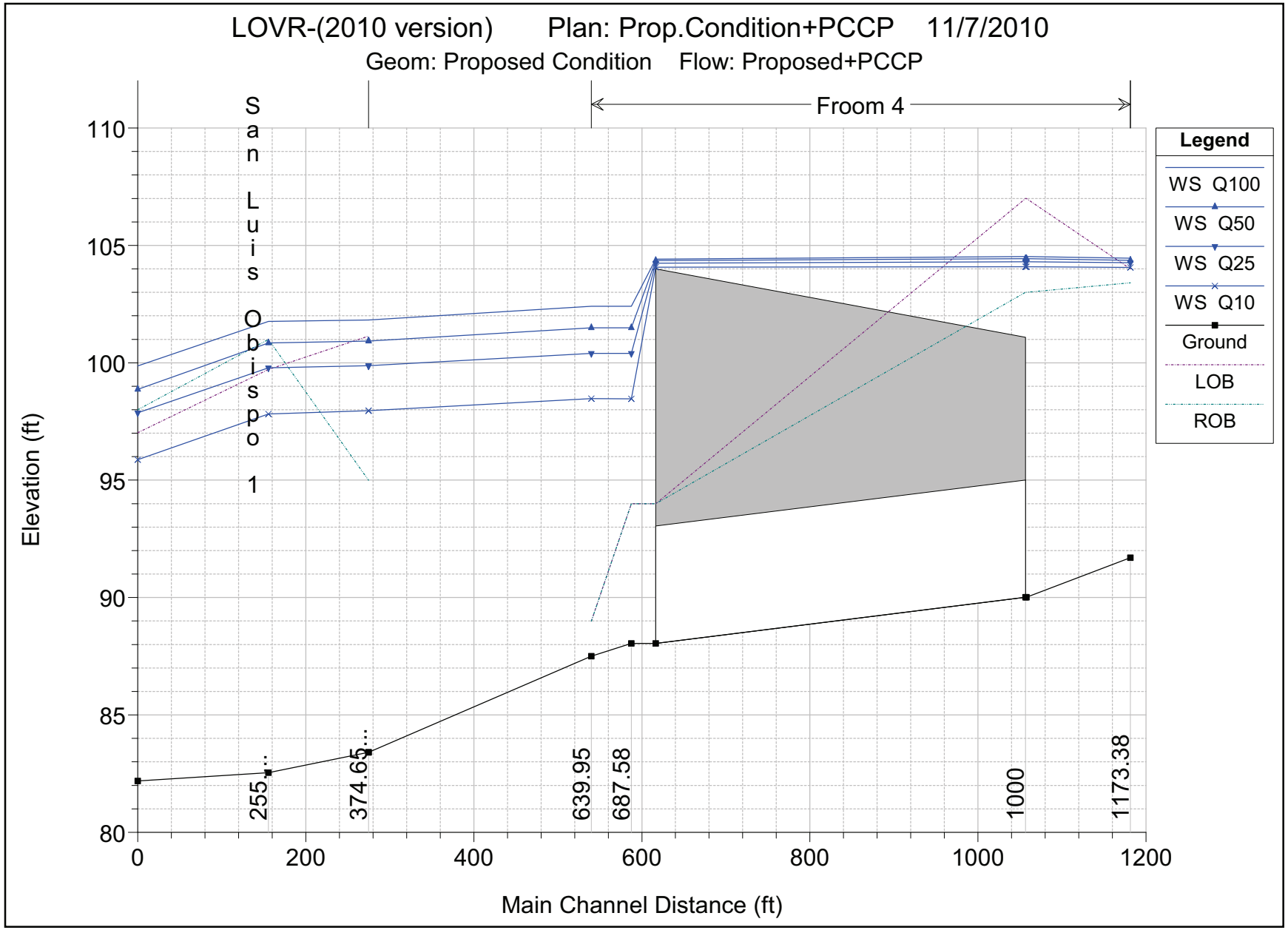
Appendix F.2 Proposed Condition with Prefumo Creek Commons Project



None of the XS's are Geo-Referenced ([Geo-Ref user entered XS][Geo-Ref interpolated XS][Non Geo-Ref user entered XS][Non Geo-Ref interpolated XS])

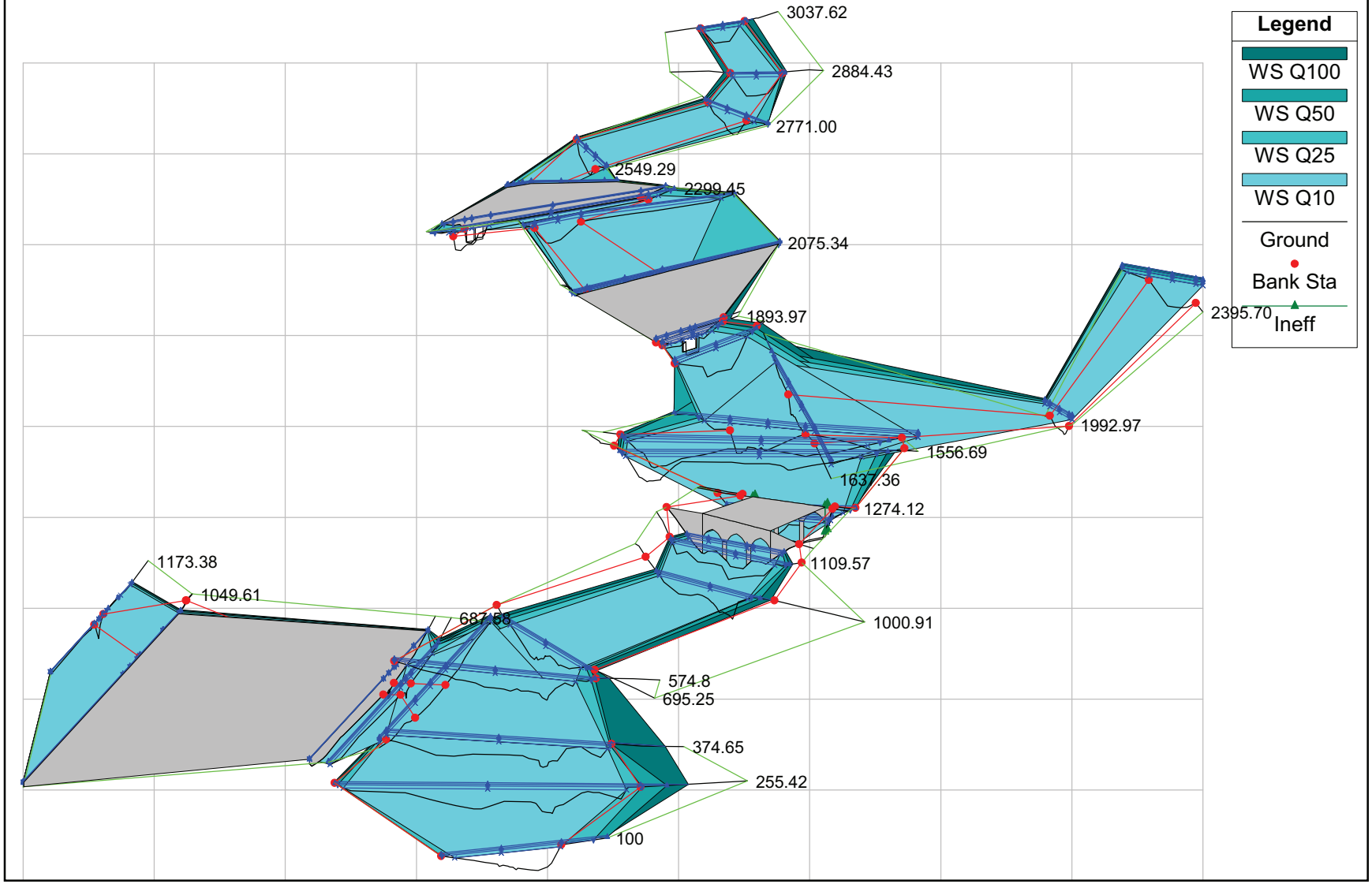

LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
San Luis Obispo 1
San Luis Obispo 2
San Luis Obispo 3
Elevation (ft)
Main Channel Distance (ft)
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
255...
374...
574.8
695.25
1000.91
1109.57
1199.21
1457.47
1556.69
1637.36
1992.97
2395.70


LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
San Luis Obispo 1
San Luis Obispo 2
Prefumo 5
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
120
115
110
105
100
95
90
85
80
0
500
1000
1500
2000
2500
3000
255...
374...
574.8
695.25
1000.91
1109.57
1199.21
1457.47
1556.69
1846.23
1993.09
2277.36
2352.5
2549.29
2771.00
2884.43
3037.62


LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
Froom 4
San Luis Obispo 1
Legend
WS Q100
WS Q50
WS Q25
WS Q10
Ground
LOB
ROB
Elevation (ft)
Main Channel Distance (ft)
110
105
100
95
90
85
80
0
200
400
600
800
1000
1200
255...
374.65...
639.95
687.58
1000
1173.38

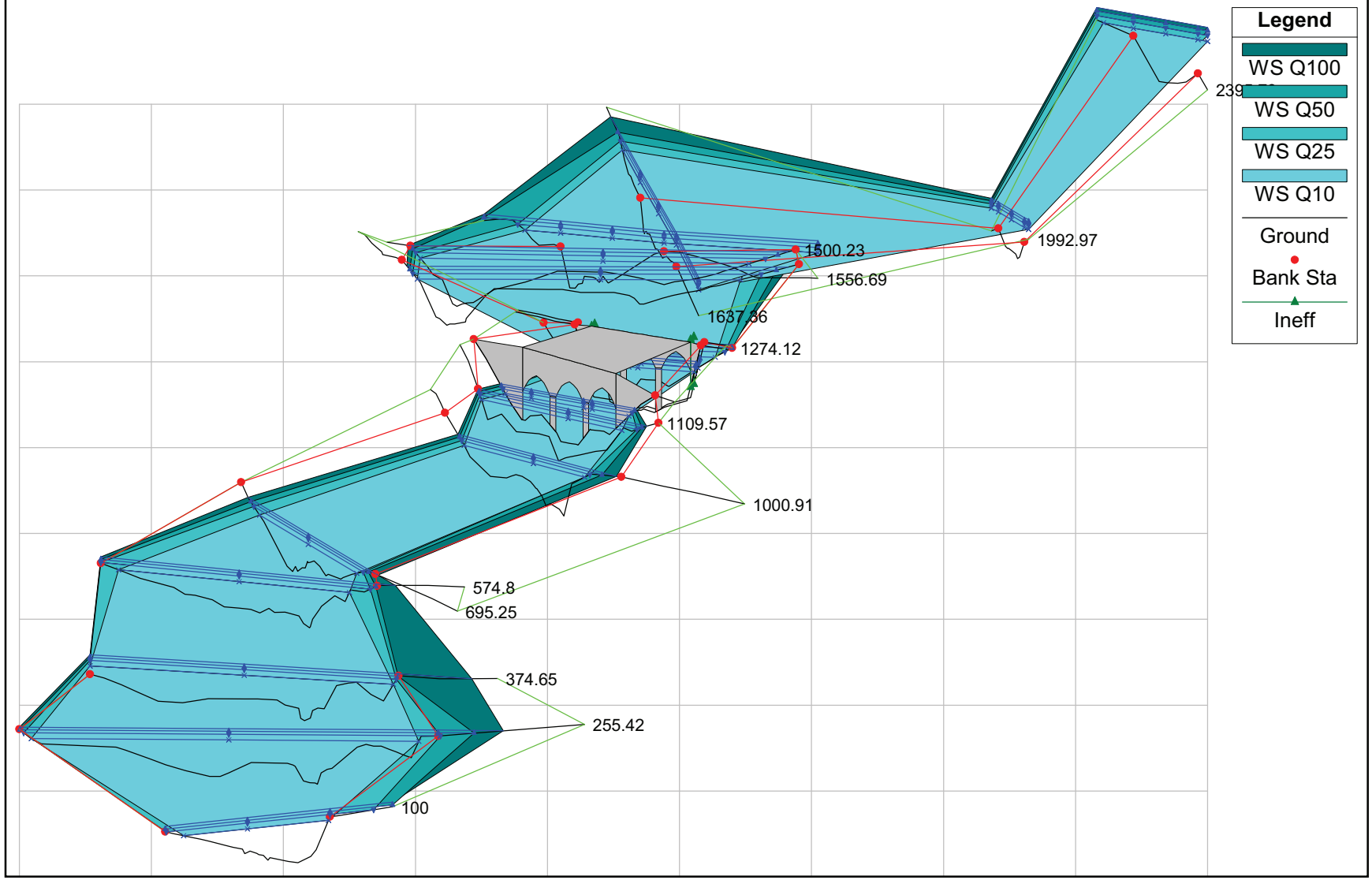
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010

Geom: Proposed Condition Flow: Proposed+PCCP



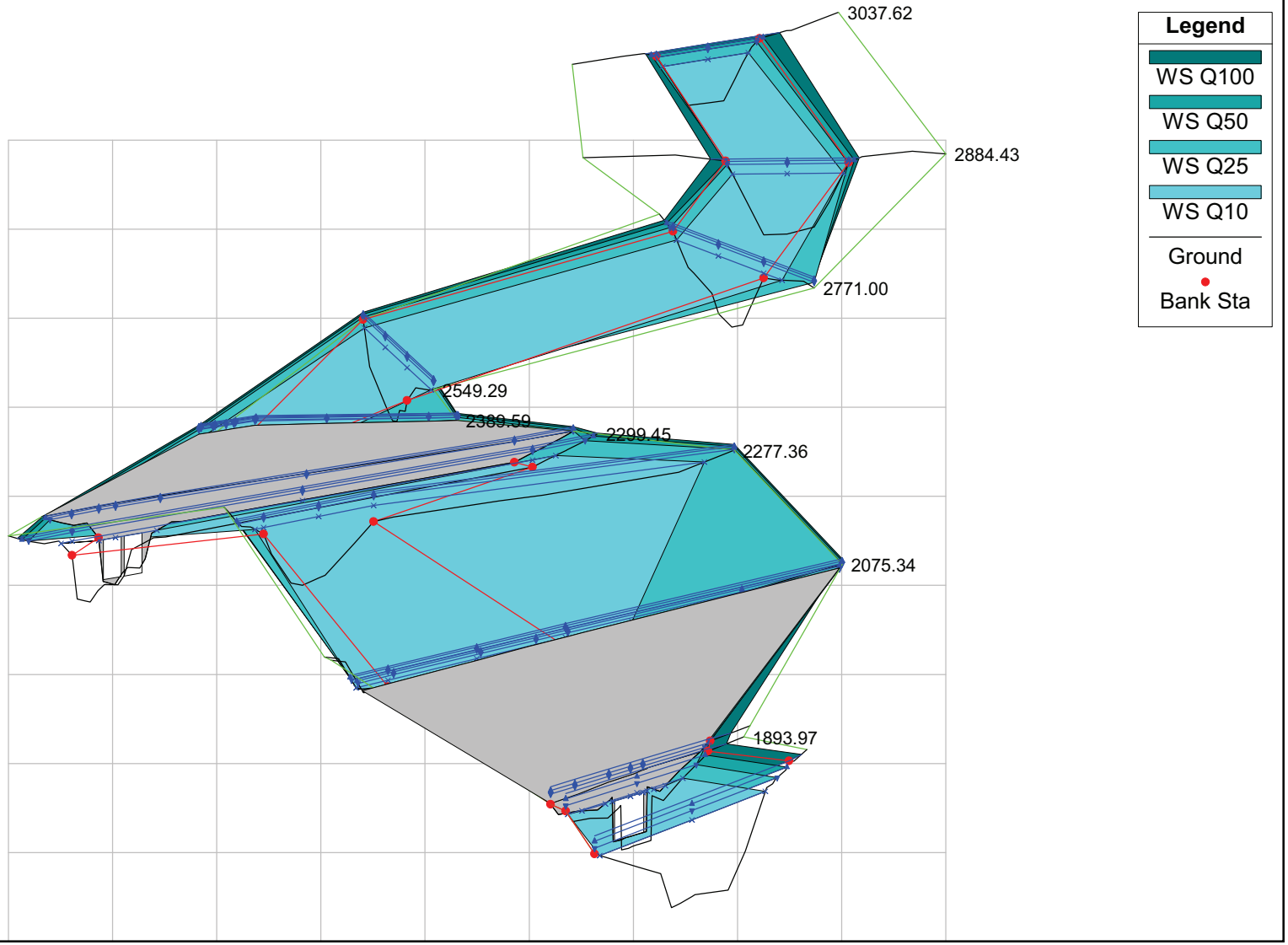
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010

Geom: Proposed Condition Flow: Proposed+PCCP



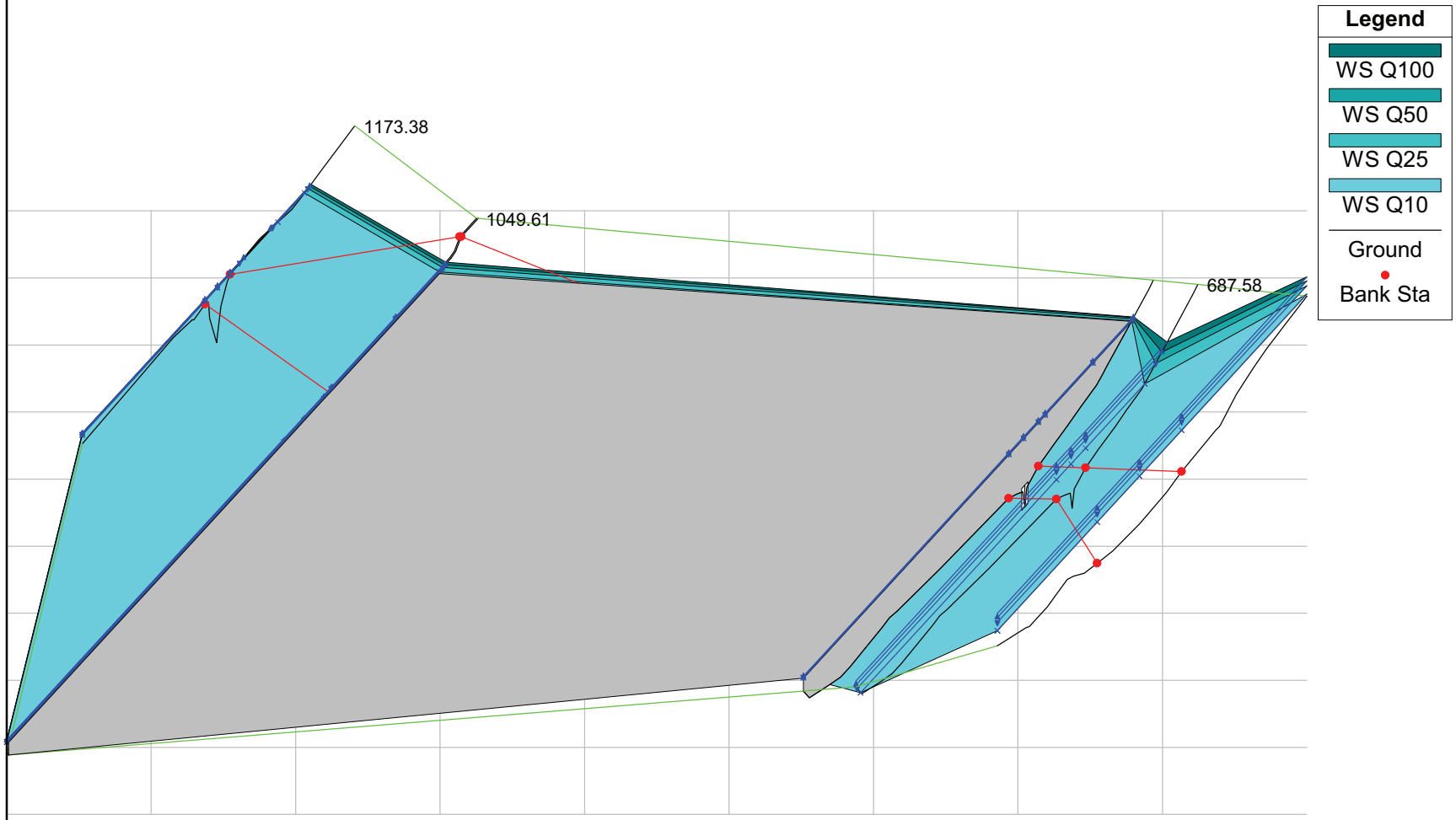
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010

Geom: Proposed Condition Flow: Proposed+PCCP



LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010

Geom: Proposed Condition Flow: Proposed+PCCP



HEC-RAS Plan: Prop-PCCP

River	Reach	River Sta	Profile	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)	
San Luis Obispo	3	2395.70	Q100	13350.00	94.04	115.97		117.21	0.002974	9.41	1680.30	117.73	0.39
San Luis Obispo	3	2395.70	Q50	12043.00	94.04	114.80		115.98	0.003092	9.17	1541.67	117.73	0.39
San Luis Obispo	3	2395.70	Q25	10312.00	94.04	113.19		114.30	0.003258	8.81	1352.29	117.73	0.39
San Luis Obispo	3	2395.70	Q10	8158.00	94.04	111.08		112.07	0.003444	8.22	1106.36	110.52	0.40
San Luis Obispo	3	1992.97	Q100	13350.00	92.03	107.79	107.79	114.17	0.020986	21.14	724.69	60.01	1.03
San Luis Obispo	3	1992.97	Q50	12043.00	92.03	106.98	106.98	112.90	0.021217	20.36	675.68	60.01	1.02
San Luis Obispo	3	1992.97	Q25	10312.00	92.03	105.85	105.85	111.16	0.021572	19.26	607.88	60.01	1.02
San Luis Obispo	3	1992.97	Q10	8158.00	92.03	104.35	104.35	108.86	0.022062	17.69	518.24	60.01	1.00
San Luis Obispo	3	1637.36	Q100	13350.00	90.49	110.30		110.49	0.000529	4.00	4261.95	369.97	0.18
San Luis Obispo	3	1637.36	Q50	12043.00	90.49	109.23		109.41	0.000551	3.90	3880.55	341.47	0.18
San Luis Obispo	3	1637.36	Q25	10312.00	90.49	107.88		108.05	0.000578	3.75	3430.84	330.26	0.18
San Luis Obispo	3	1637.36	Q10	8158.00	90.49	106.04		106.20	0.000635	3.57	2831.79	321.94	0.18
San Luis Obispo	2	1556.69	Q100	15344.00	87.10	110.15		110.43	0.000918	4.91	4080.04	363.33	0.22
San Luis Obispo	2	1556.69	Q50	13785.00	87.10	109.07		109.34	0.000994	4.88	3686.47	363.33	0.22
San Luis Obispo	2	1556.69	Q25	11804.00	87.10	107.73		107.98	0.001049	4.71	3231.93	326.46	0.23
San Luis Obispo	2	1556.69	Q10	9151.00	87.10	105.89		106.13	0.001149	4.47	2640.41	318.43	0.23
San Luis Obispo	2	1500.23	Q100	15344.00	89.14	110.11		110.35	0.001576	3.90	3939.55	406.96	0.22
San Luis Obispo	2	1500.23	Q50	13785.00	89.14	109.02		109.26	0.001796	3.93	3504.15	391.14	0.23
San Luis Obispo	2	1500.23	Q25	11804.00	89.14	107.65		107.90	0.002127	3.96	2980.44	374.64	0.25
San Luis Obispo	2	1500.23	Q10	9151.00	89.14	105.78		106.03	0.002774	3.98	2301.26	351.85	0.27
San Luis Obispo	2	1457.47	Q100	15344.00	89.38	110.00		110.27	0.002015	4.20	3655.47	408.18	0.25
San Luis Obispo	2	1457.47	Q50	13785.00	89.38	108.88		109.17	0.002378	4.30	3208.94	392.58	0.26
San Luis Obispo	2	1457.47	Q25	11804.00	89.38	107.48		107.78	0.002985	4.42	2672.46	372.98	0.29
San Luis Obispo	2	1457.47	Q10	9151.00	89.38	105.54		105.87	0.004423	4.63	1974.57	345.83	0.34
San Luis Obispo	2	1274.12	Q100	15344.00	88.39	109.12		109.78	0.003098	6.53	2348.11	191.15	0.33
San Luis Obispo	2	1274.12	Q50	13785.00	88.39	107.97		108.62	0.003363	6.47	2129.78	188.70	0.34
San Luis Obispo	2	1274.12	Q25	11804.00	88.39	106.54		107.16	0.003505	6.32	1867.93	178.16	0.34
San Luis Obispo	2	1274.12	Q10	9151.00	88.39	104.56		105.12	0.003609	5.98	1530.38	163.89	0.34
San Luis Obispo	2	1253.52	Q100	15344.00	88.67	108.60	100.13	109.69	0.001662	8.38	1831.66	124.61	0.36
San Luis Obispo	2	1253.52	Q50	13785.00	88.67	107.53	99.54	108.53	0.001664	8.03	1716.97	122.71	0.35
San Luis Obispo	2	1253.52	Q25	11804.00	88.67	106.21	98.75	107.09	0.001626	7.49	1575.12	120.36	0.35
San Luis Obispo	2	1253.52	Q10	9151.00	88.67	104.37	97.57	105.06	0.001529	6.64	1377.30	117.08	0.33
San Luis Obispo	2	1199.21		Bridge									
San Luis Obispo	2	1109.57	Q100	15344.00	86.99	105.94		106.83	0.004749	7.58	2023.97	201.60	0.42
San Luis Obispo	2	1109.57	Q50	13785.00	86.99	105.11		105.97	0.004799	7.41	1860.46	194.92	0.42
San Luis Obispo	2	1109.57	Q25	11804.00	86.99	104.05		104.84	0.004816	7.12	1657.65	187.57	0.42

HEC-RAS Plan: Prop-PCCP (Continued)

River	Reach	River Sta	Profile	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)	
San Luis Obispo	2	1109.57	Q10	9151.00	86.99	102.55		103.22	0.004346	6.58	1391.40	168.02	0.40
San Luis Obispo	2	1000.91	Q100	15344.00	85.97	104.71		106.05	0.010387	9.28	1654.26	198.30	0.57
San Luis Obispo	2	1000.91	Q50	13785.00	85.97	103.87		105.19	0.010049	9.22	1495.37	177.98	0.56
San Luis Obispo	2	1000.91	Q25	11804.00	85.97	102.85		104.08	0.009492	8.92	1323.69	160.21	0.55
San Luis Obispo	2	1000.91	Q10	9151.00	85.97	101.45		102.51	0.009402	8.26	1107.64	150.54	0.54
San Luis Obispo	2	695.25	Q100	15344.00	85.54	102.08		103.14	0.008307	8.28	1853.49	234.40	0.51
San Luis Obispo	2	695.25	Q50	13785.00	85.54	101.18		102.26	0.008716	8.33	1654.91	212.95	0.53
San Luis Obispo	2	695.25	Q25	11804.00	85.54	100.16		101.20	0.008985	8.16	1446.26	198.09	0.53
San Luis Obispo	2	695.25	Q10	9151.00	85.54	98.34		99.40	0.011046	8.28	1105.02	175.87	0.58
San Luis Obispo	2	574.8	Q100	15344.00	84.57	102.16		102.64	0.001299	5.57	2759.68	322.78	0.33
San Luis Obispo	2	574.8	Q50	13785.00	84.57	101.26		101.74	0.001388	5.55	2482.09	301.52	0.34
San Luis Obispo	2	574.8	Q25	11804.00	84.57	100.21		100.67	0.001446	5.44	2169.25	295.61	0.35
San Luis Obispo	2	574.8	Q10	9151.00	84.57	98.33		98.81	0.001695	5.55	1649.43	253.38	0.38
San Luis Obispo	1	374.65	Q100	15736.00	83.41	101.82		102.31	0.002125	5.62	2831.89	310.23	0.30
San Luis Obispo	1	374.65	Q50	14108.00	83.41	100.92		101.39	0.002211	5.49	2569.44	250.28	0.30
San Luis Obispo	1	374.65	Q25	12126.00	83.41	99.88		100.30	0.002246	5.25	2308.97	248.88	0.30
San Luis Obispo	1	374.65	Q10	9367.00	83.41	97.96		98.37	0.002630	5.11	1834.71	246.32	0.33
San Luis Obispo	1	255.42	Q100	15736.00	82.54	101.76		102.11	0.000933	4.70	3392.08	389.32	0.26
San Luis Obispo	1	255.42	Q50	14108.00	82.54	100.84		101.18	0.000980	4.66	3044.37	365.34	0.27
San Luis Obispo	1	255.42	Q25	12126.00	82.54	99.78		100.10	0.001004	4.54	2671.94	335.07	0.28
San Luis Obispo	1	255.42	Q10	9367.00	82.54	97.82		98.14	0.001159	4.57	2049.45	311.77	0.31
San Luis Obispo	1	100	Q100	15736.00	82.19	99.87	96.62	101.63	0.009873	10.76	1540.26	188.14	0.59
San Luis Obispo	1	100	Q50	14108.00	82.19	98.87	95.91	100.67	0.011304	10.83	1352.12	188.14	0.62
San Luis Obispo	1	100	Q25	12126.00	82.19	97.87	95.05	99.58	0.012135	10.52	1167.03	171.59	0.64
San Luis Obispo	1	100	Q10	9367.00	82.19	95.87	93.63	97.57	0.013892	10.46	895.12	119.88	0.67
Prefumo	5	3037.62	Q100	2561.00	100.97	112.81		113.24	0.003210	5.24	494.45	80.07	0.33
Prefumo	5	3037.62	Q50	2239.00	100.97	112.36		112.73	0.002989	4.86	461.43	66.98	0.31
Prefumo	5	3037.62	Q25	1847.00	100.97	111.73		112.03	0.002568	4.37	422.23	59.58	0.29
Prefumo	5	3037.62	Q10	1278.00	100.97	109.75		110.01	0.002541	4.08	313.32	51.12	0.29
Prefumo	5	2884.43	Q100	2561.00	97.58	112.74		112.93	0.000909	3.50	736.25	83.53	0.19
Prefumo	5	2884.43	Q50	2239.00	97.58	112.30		112.46	0.000799	3.19	702.08	72.23	0.18
Prefumo	5	2884.43	Q25	1847.00	97.58	111.68		111.80	0.000649	2.80	658.86	67.96	0.16
Prefumo	5	2884.43	Q10	1278.00	97.58	109.72		109.81	0.000536	2.41	530.95	62.36	0.15
Prefumo	5	2771.00	Q100	2561.00	96.46	112.64		112.82	0.001054	3.46	807.22	111.29	0.19
Prefumo	5	2771.00	Q50	2239.00	96.46	112.20		112.36	0.000948	3.19	759.15	109.50	0.18
Prefumo	5	2771.00	Q25	1847.00	96.46	111.60		111.72	0.000818	2.84	693.46	107.00	0.16

HEC-RAS Plan: Prop-PCCP (Continued)

River	Reach	River Sta	Profile	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)	
Prefumo	5	2771.00	Q10	1278.00	96.46	109.63		109.73	0.000835	2.54	508.46	78.46	0.16
Prefumo	5	2549.29	Q100	2561.00	96.21	112.45		112.60	0.000829	3.22	878.31	91.96	0.16
Prefumo	5	2549.29	Q50	2239.00	96.21	112.04		112.16	0.000717	2.94	840.43	91.96	0.15
Prefumo	5	2549.29	Q25	1847.00	96.21	111.46		111.56	0.000585	2.59	787.18	91.96	0.14
Prefumo	5	2549.29	Q10	1278.00	96.21	109.50		109.57	0.000549	2.27	608.43	87.31	0.13
Prefumo	5	2389.59	Q100	2561.00	94.12	111.93	105.48	112.43	0.000911	6.27	704.87	145.50	0.30
Prefumo	5	2389.59	Q50	2239.00	94.12	111.58	104.85	112.01	0.000801	5.78	654.13	145.50	0.28
Prefumo	5	2389.59	Q25	1847.00	94.12	111.08	104.06	111.43	0.000670	5.15	580.83	145.50	0.26
Prefumo	5	2389.59	Q10	1278.00	94.12	109.13	102.82	109.45	0.000680	4.64	343.79	84.66	0.25
Prefumo	5	2352.5		Culvert									
Prefumo	5	2299.45	Q100	2561.00	95.60	111.14		111.18	0.000495	1.52	1767.02	352.77	0.11
Prefumo	5	2299.45	Q50	2239.00	95.60	110.73		110.76	0.000492	1.44	1621.39	347.43	0.11
Prefumo	5	2299.45	Q25	1847.00	95.60	110.16		110.18	0.000498	1.34	1424.94	338.05	0.11
Prefumo	5	2299.45	Q10	1278.00	95.60	108.39		108.43	0.001151	1.50	861.45	299.70	0.15
Prefumo	5	2277.36	Q100	2561.00	95.30	111.13		111.17	0.000265	1.97	1830.78	297.26	0.10
Prefumo	5	2277.36	Q50	2239.00	95.30	110.71		110.75	0.000245	1.85	1708.07	296.28	0.10
Prefumo	5	2277.36	Q25	1847.00	95.30	110.14		110.17	0.000220	1.70	1539.34	294.87	0.09
Prefumo	5	2277.36	Q10	1278.00	95.30	108.38		108.42	0.000269	1.67	1042.24	267.29	0.10
Prefumo	5	2075.34	Q100	2561.00	92.70	111.06	99.66	111.11	0.000306	1.84	1697.76	314.95	0.10
Prefumo	5	2075.34	Q50	2239.00	92.70	110.66	99.25	110.70	0.000281	1.72	1569.36	314.26	0.09
Prefumo	5	2075.34	Q25	1847.00	92.70	110.09	98.63	110.13	0.000248	1.55	1392.48	313.31	0.09
Prefumo	5	2075.34	Q10	1278.00	92.70	108.33	97.61	108.36	0.000260	1.39	942.88	176.40	0.09
Prefumo	5	1993.09		Culvert									
Prefumo	5	1893.97	Q100	2561.00	95.65	110.52		110.71	0.000608	3.49	736.55	110.50	0.23
Prefumo	5	1893.97	Q50	2239.00	95.65	109.44		109.64	0.000753	3.56	628.15	96.46	0.25
Prefumo	5	1893.97	Q25	1847.00	95.65	108.08		108.29	0.000997	3.69	500.52	90.26	0.28
Prefumo	5	1893.97	Q10	1278.00	95.65	106.22		106.44	0.001448	3.73	342.23	79.45	0.32
Prefumo	5	1846.23	Q100	2561.00	89.51	110.58		110.61	0.000137	1.42	1801.58	156.05	0.07
Prefumo	5	1846.23	Q50	2239.00	89.51	109.51		109.54	0.000137	1.36	1643.76	143.67	0.07
Prefumo	5	1846.23	Q25	1847.00	89.51	108.16		108.18	0.000128	1.27	1452.60	136.50	0.07
Prefumo	5	1846.23	Q10	1278.00	89.51	106.31		106.33	0.000095	1.06	1210.87	123.90	0.06
Froom	4	1173.38	Q100	1066.00	91.70	104.45		104.58	0.000828	3.35	606.17	356.47	0.25
Froom	4	1173.38	Q50	939.00	91.70	104.37		104.48	0.000702	3.06	577.06	345.34	0.23
Froom	4	1173.38	Q25	750.00	91.70	104.26		104.34	0.000505	2.56	540.34	330.76	0.20
Froom	4	1173.38	Q10	547.00	91.70	104.06		104.11	0.000336	2.03	476.33	303.69	0.16

HEC-RAS Plan: Prop-PCCP (Continued)

River	Reach	River Sta	Profile	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)	
Froom	4	1049.61	Q100	1066.00	90.01	104.53	98.99	104.53	0.000034	0.66	2680.68	755.63	0.05
Froom	4	1049.61	Q50	939.00	90.01	104.43	98.81	104.44	0.000028	0.60	2609.30	752.49	0.05
Froom	4	1049.61	Q25	750.00	90.01	104.31	98.53	104.31	0.000020	0.50	2513.88	749.21	0.04
Froom	4	1049.61	Q10	547.00	90.01	104.09	98.14	104.09	0.000013	0.39	2351.25	743.67	0.03
Froom	4	1000		Culvert									
Froom	4	687.58	Q100	1066.00	88.05	102.41		102.41	0.000011	0.62	3604.29	535.39	0.03
Froom	4	687.58	Q50	939.00	88.05	101.49		101.49	0.000013	0.63	3113.61	526.25	0.04
Froom	4	687.58	Q25	750.00	88.05	100.40		100.40	0.000016	0.63	2548.38	513.60	0.04
Froom	4	687.58	Q10	547.00	88.05	98.47		98.47	0.000033	0.76	1580.48	488.40	0.06
Froom	4	639.95	Q100	1066.00	87.50	102.41		102.41	0.000001	0.31	5822.35	532.17	0.01
Froom	4	639.95	Q50	939.00	87.50	101.49		101.49	0.000001	0.29	5330.48	532.17	0.01
Froom	4	639.95	Q25	750.00	87.50	100.40		100.40	0.000001	0.26	4752.46	532.17	0.01
Froom	4	639.95	Q10	547.00	87.50	98.47		98.47	0.000001	0.24	3724.75	532.17	0.01

HEC-RAS Plan: Prop-PCCP

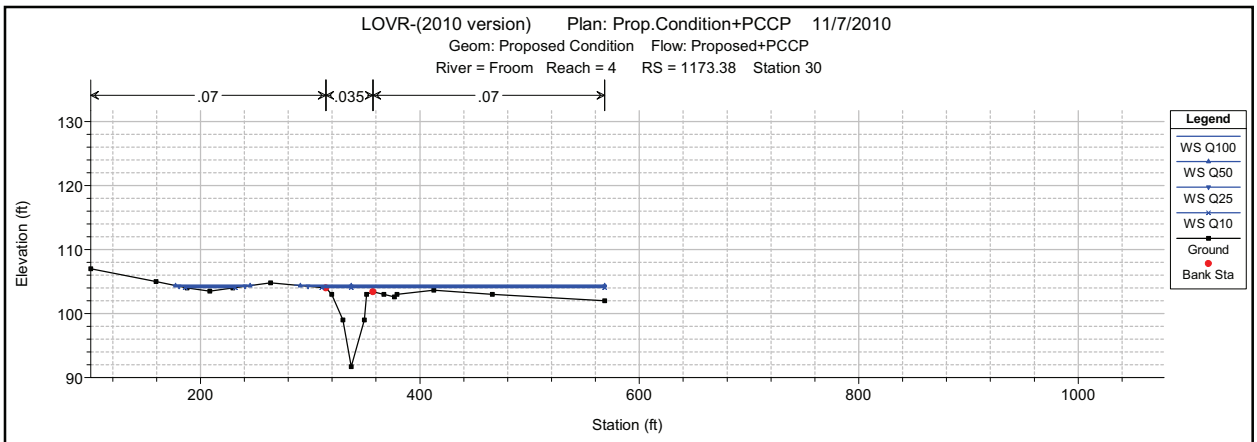
River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
				(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
San Luis Obispo	2	1274.12	Q100	109.78	109.12		0.05	0.04	191.15		15344.00		6.53
San Luis Obispo	2	1274.12	Q50	108.62	107.97		0.05	0.04	188.70		13785.00		6.47
San Luis Obispo	2	1274.12	Q25	107.16	106.54		0.05	0.03	178.16		11804.00		6.32
San Luis Obispo	2	1274.12	Q10	105.12	104.56		0.05	0.01	163.89		9151.00		5.98
San Luis Obispo	2	1253.52	Q100	109.69	108.60	100.13	0.02	0.20	124.61		15344.00		8.38
San Luis Obispo	2	1253.52	Q50	108.53	107.53	99.54	0.02	0.16	122.71		13785.00		8.03
San Luis Obispo	2	1253.52	Q25	107.09	106.21	98.75	0.02	0.13	120.36		11804.00		7.49
San Luis Obispo	2	1253.52	Q10	105.06	104.37	97.57	0.02	0.09	117.08		9151.00		6.64
San Luis Obispo	2	1199.21 BR U	Q100	109.47	107.72	101.23	0.95	0.38	62.13		15344.00		10.62
San Luis Obispo	2	1199.21 BR U	Q50	108.35	106.81	100.59	0.85	0.35	72.36		13785.00		9.96
San Luis Obispo	2	1199.21 BR U	Q25	106.94	105.65	99.73	0.74	0.32	82.94		11804.00		9.13
San Luis Obispo	2	1199.21 BR U	Q10	104.95	103.95	98.48	0.62	0.27	94.35		9151.00		8.03
San Luis Obispo	2	1199.21 BR D	Q100	108.14	105.14	102.75	0.25	1.05	84.77		15344.00		13.91
San Luis Obispo	2	1199.21 BR D	Q50	107.15	104.43	102.10	0.25	0.94	91.03		13785.00		13.24
San Luis Obispo	2	1199.21 BR D	Q25	105.88	103.50	101.24	0.24	0.79	94.26		11804.00		12.37
San Luis Obispo	2	1199.21 BR D	Q10	104.05	102.16	100.02	0.22	0.61	94.26		9151.00		11.06
San Luis Obispo	2	1109.57	Q100	106.83	105.94		0.73	0.04	201.60		15344.00		7.58
San Luis Obispo	2	1109.57	Q50	105.97	105.11		0.73	0.05	194.92		13785.00		7.41
San Luis Obispo	2	1109.57	Q25	104.84	104.05		0.71	0.04	187.57		11804.00		7.12
San Luis Obispo	2	1109.57	Q10	103.22	102.55		0.67	0.04	168.02		9151.00		6.58
San Luis Obispo	2	1000.91	Q100	106.05	104.71		2.83	0.08	198.30		15344.00		9.28
San Luis Obispo	2	1000.91	Q50	105.19	103.87		2.86	0.07	177.98		13785.00		9.22
San Luis Obispo	2	1000.91	Q25	104.08	102.85		2.82	0.06	160.21		11804.00		8.92
San Luis Obispo	2	1000.91	Q10	102.51	101.45		3.11	0.00	150.54		9151.00		8.26

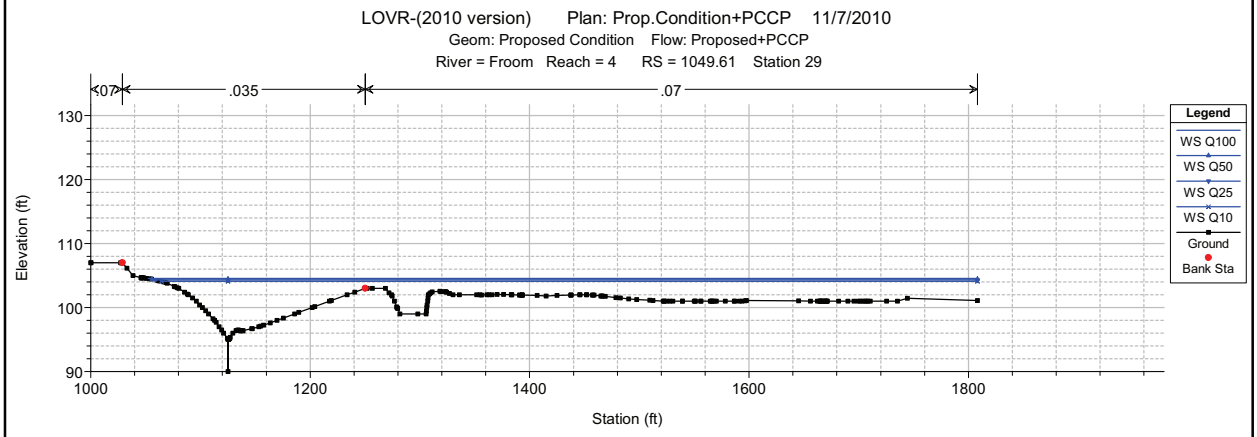
HEC-RAS Plan: Prop-PCCP

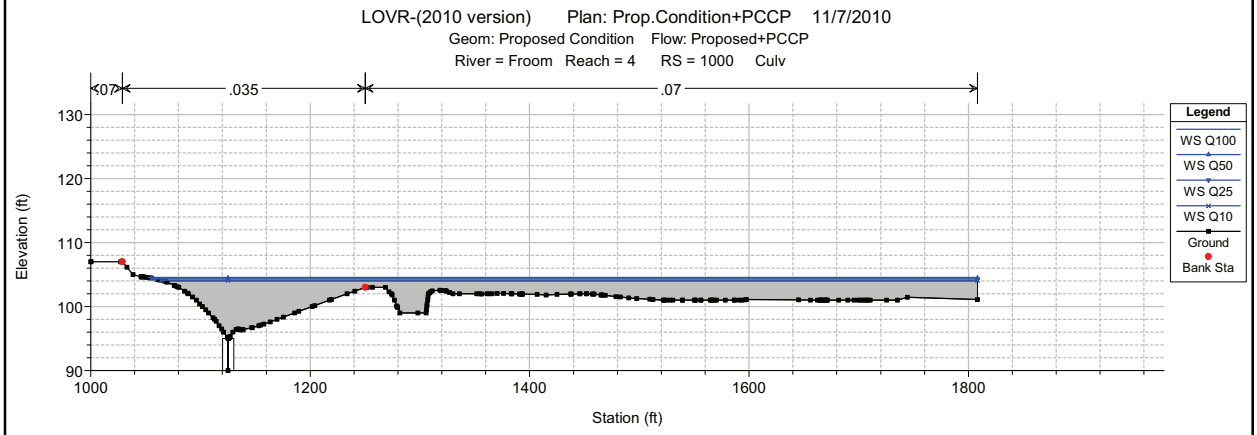
River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Prefumo	5	2549.29	Q100	112.60	112.45	0.15	0.14	0.04	303.47	2257.53		91.96
Prefumo	5	2549.29	Q50	112.16	112.04	0.12	0.12	0.03	247.29	1991.71		91.96
Prefumo	5	2549.29	Q25	111.56	111.46	0.10	0.10	0.03	181.55	1665.45		91.96
Prefumo	5	2549.29	Q10	109.57	109.50	0.08	0.10	0.02	67.24	1210.76		87.31
Prefumo	5	2389.59	Q100	112.43	111.93	0.50			399.95	2069.02	92.04	145.50
Prefumo	5	2389.59	Q50	112.01	111.58	0.43			301.70	1856.99	80.31	145.50
Prefumo	5	2389.59	Q25	111.43	111.08	0.36			189.56	1591.75	65.69	145.50
Prefumo	5	2389.59	Q10	109.45	109.13	0.32			25.61	1214.63	37.75	84.66
Prefumo	5	2352.5		Culvert								
Prefumo	5	2299.45	Q100	111.18	111.14	0.03	0.01	0.00	69.42	2438.72	52.87	352.77
Prefumo	5	2299.45	Q50	110.76	110.73	0.03	0.01	0.00	51.37	2148.51	39.12	347.43
Prefumo	5	2299.45	Q25	110.18	110.16	0.03	0.01	0.00	32.92	1789.86	24.22	338.05
Prefumo	5	2299.45	Q10	108.43	108.39	0.03	0.01	0.00	5.47	1264.23	8.30	299.70
Prefumo	5	2277.36	Q100	111.17	111.13	0.04	0.06	0.00	947.73	1591.22	22.05	297.26
Prefumo	5	2277.36	Q50	110.75	110.71	0.04	0.05	0.00	781.53	1441.76	15.71	296.28
Prefumo	5	2277.36	Q25	110.17	110.14	0.03	0.05	0.00	583.48	1254.58	8.94	294.87
Prefumo	5	2277.36	Q10	108.42	108.38	0.04	0.05	0.00	244.60	1032.53	0.88	267.29
Prefumo	5	2075.34	Q100	111.11	111.06	0.05			251.92	2247.72	61.36	314.95
Prefumo	5	2075.34	Q50	110.70	110.66	0.04			173.14	2018.10	47.76	314.26
Prefumo	5	2075.34	Q25	110.13	110.09	0.04			88.69	1726.19	32.13	313.31
Prefumo	5	2075.34	Q10	108.36	108.33	0.03			2.52	1270.55	4.93	176.40
Prefumo	5	1993.09		Culvert								
Prefumo	5	1893.97	Q100	110.71	110.52	0.19	0.01	0.08	0.66	2560.34		110.50
Prefumo	5	1893.97	Q50	109.64	109.44	0.20	0.01	0.08		2239.00		96.46
Prefumo	5	1893.97	Q25	108.29	108.08	0.21	0.01	0.09		1847.00		90.26
Prefumo	5	1893.97	Q10	106.44	106.22	0.22	0.01	0.10		1278.00		79.45
Prefumo	5	1846.23	Q100	110.61	110.58	0.03	0.16	0.02	0.34	2560.66		156.05
Prefumo	5	1846.23	Q50	109.54	109.51	0.03	0.17	0.02		2239.00		143.67
Prefumo	5	1846.23	Q25	108.18	108.16	0.03	0.18	0.02		1847.00		136.50
Prefumo	5	1846.23	Q10	106.33	106.31	0.02	0.18	0.02		1278.00		123.90

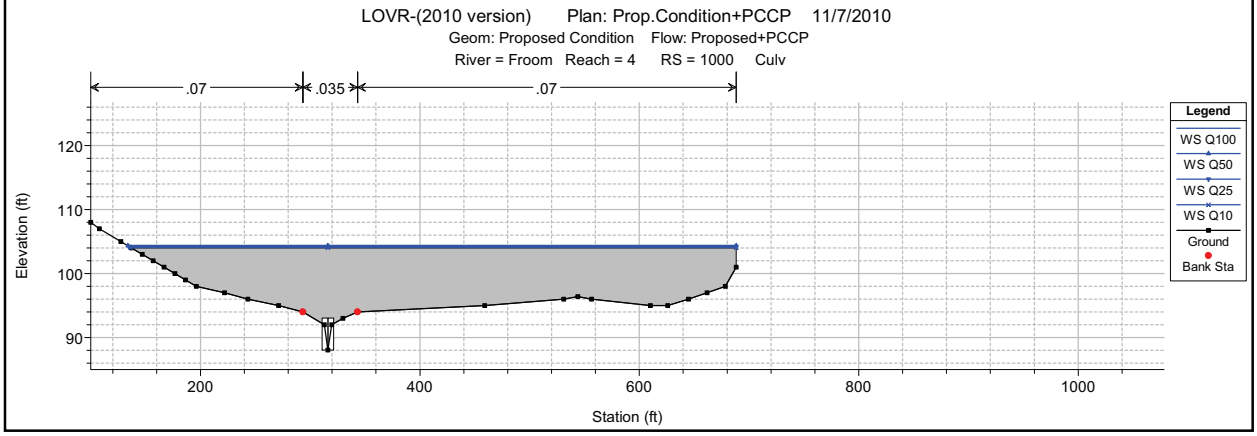
HEC-RAS Plan: Prop-PCCP (Continued)

River	Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
				(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Froom	4	1173.38	Q100	104.58	104.45	0.13	0.01	0.04	15.39	780.91	269.70	356.47
Froom	4	1173.38	Q50	104.48	104.37	0.11	0.01	0.03	10.90	701.16	226.94	345.34
Froom	4	1173.38	Q25	104.34	104.26	0.08	0.01	0.02	6.31	574.23	169.46	330.76
Froom	4	1173.38	Q10	104.11	104.06	0.05	0.00	0.02	2.18	438.71	106.12	303.69
Froom	4	1049.61	Q100	104.53	104.53	0.00				596.83	469.17	755.63
Froom	4	1049.61	Q50	104.44	104.43	0.00				531.74	407.26	752.49
Froom	4	1049.61	Q25	104.31	104.31	0.00				430.99	319.01	749.21
Froom	4	1049.61	Q10	104.09	104.09	0.00				322.97	224.03	743.67
Froom	4	1000		Culvert								
Froom	4	687.58	Q100	102.41	102.41	0.00	0.00	0.00	149.69	299.89	616.41	535.39
Froom	4	687.58	Q50	101.49	101.49	0.00	0.00	0.00	124.74	279.27	535.00	526.25
Froom	4	687.58	Q25	100.40	100.40	0.00	0.00	0.00	91.67	241.97	416.36	513.60
Froom	4	687.58	Q10	98.47	98.47	0.00	0.00	0.00	51.66	220.21	275.13	488.40
Froom	4	639.95	Q100	102.41	102.41	0.00	0.05	0.05	213.04	637.58	215.38	532.17
Froom	4	639.95	Q50	101.49	101.49	0.00	0.05	0.05	179.21	573.63	186.16	532.17
Froom	4	639.95	Q25	100.40	100.40	0.00	0.05	0.04	133.70	471.74	144.56	532.17
Froom	4	639.95	Q10	98.47	98.47	0.00	0.06	0.04	81.17	368.03	97.80	532.17



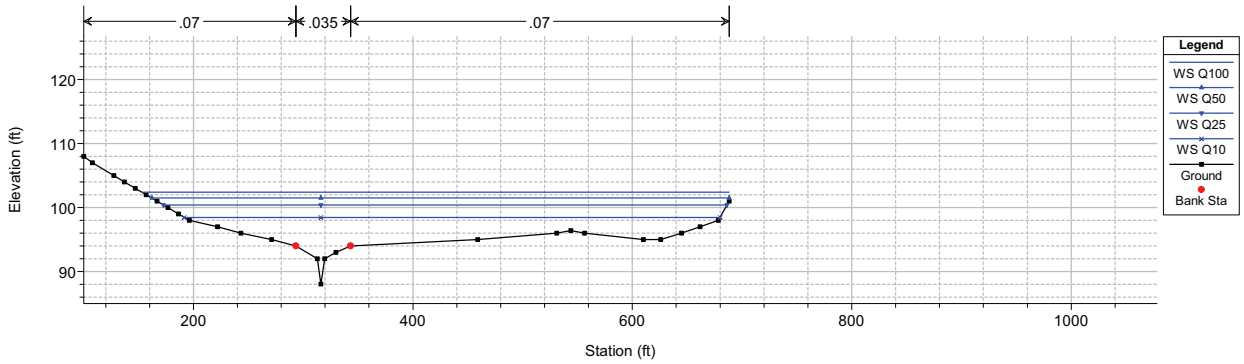




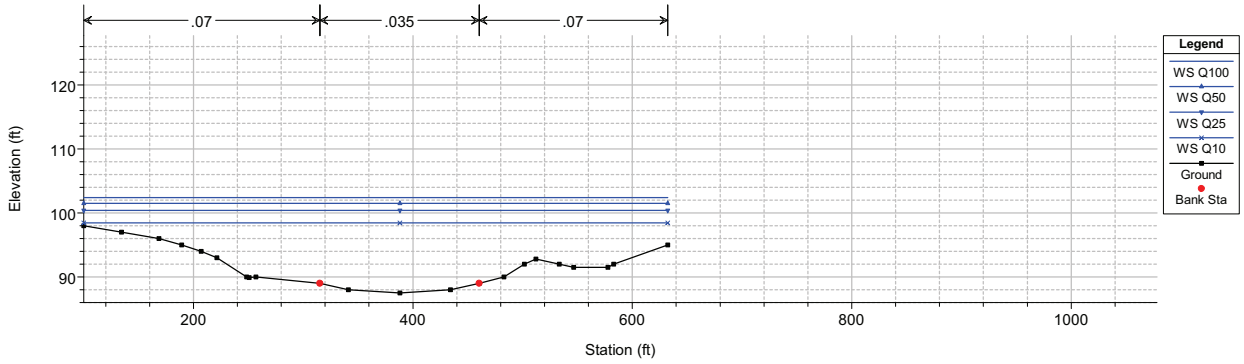


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

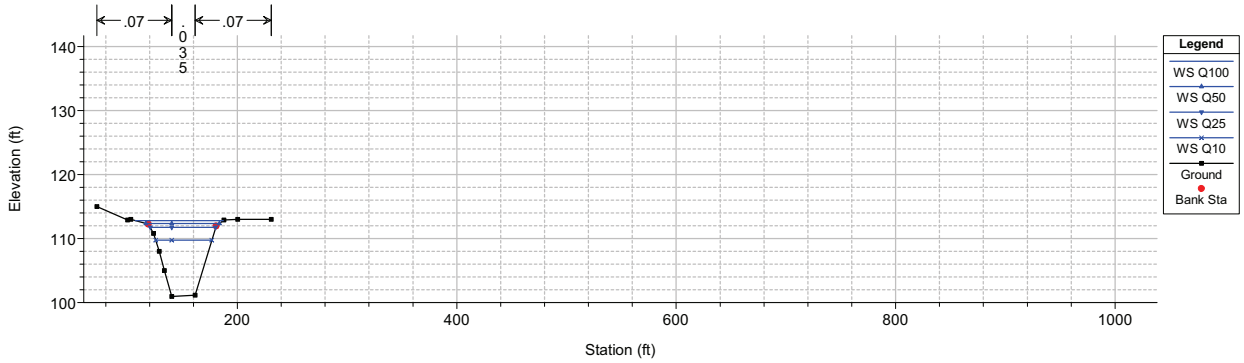
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Froom Reach = 4 RS = 687.58 Station 28



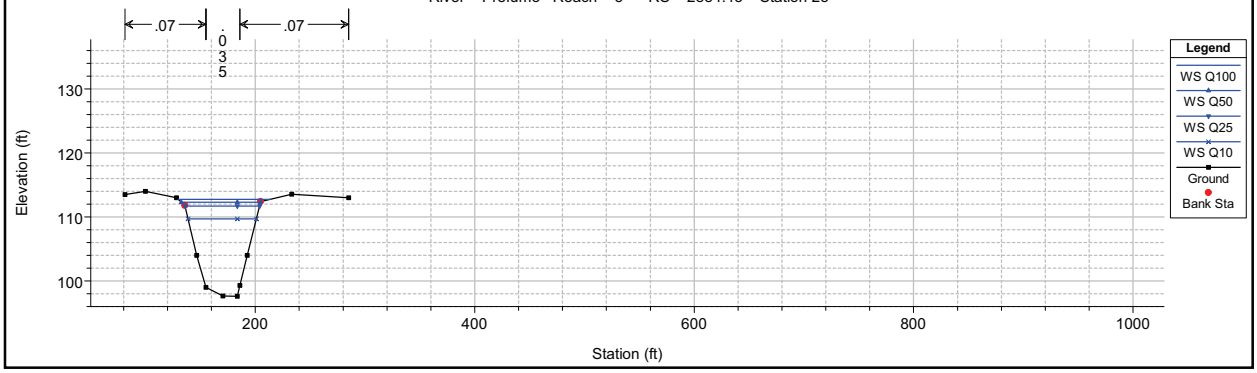
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Froom Reach = 4 RS = 639.95 Station 27



LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 3037.62 Station 26

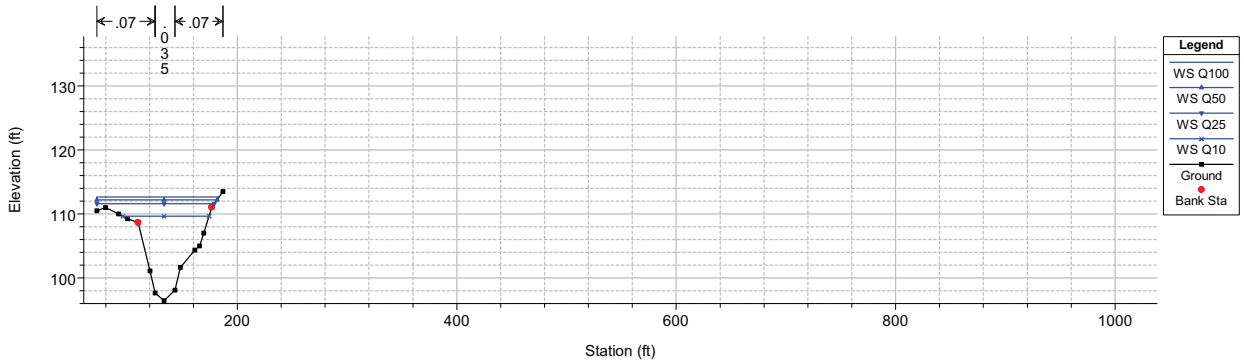


LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2884.43 Station 25

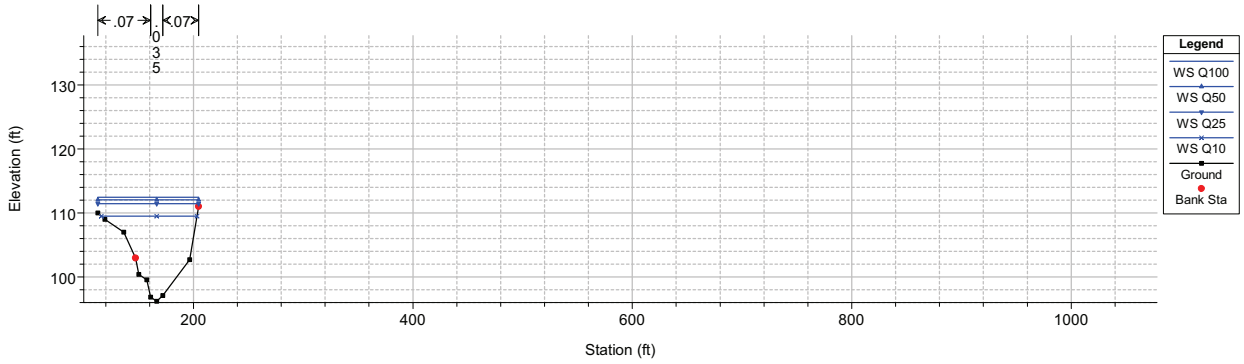


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

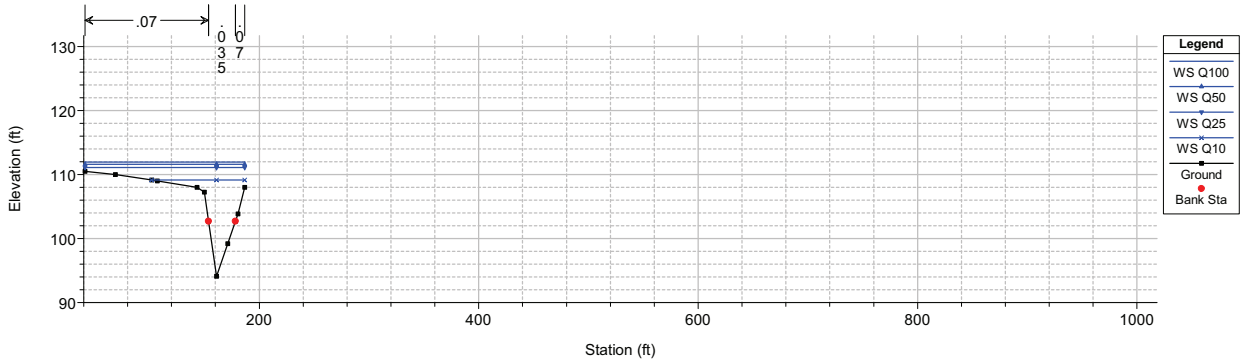
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2771.00 Station 24



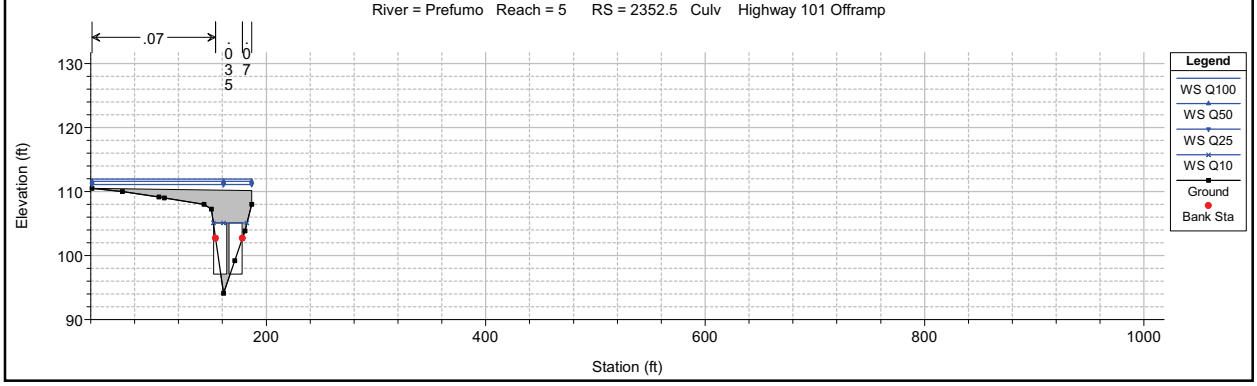
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2549.29 Station 23



LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2389.59 Station 22

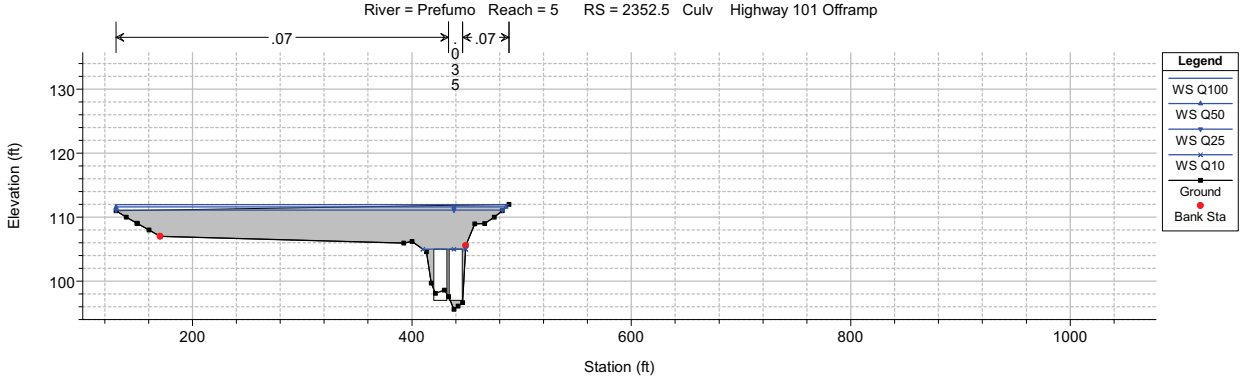


LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2352.5 Culv Highway 101 Offramp

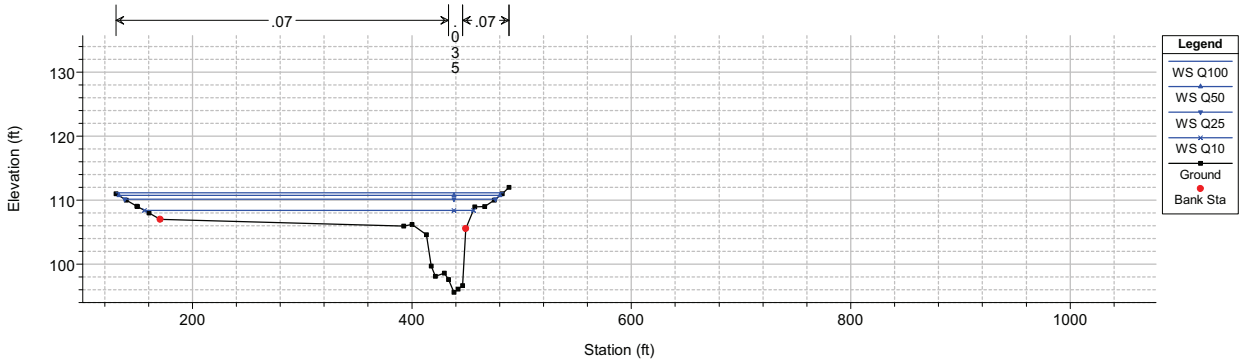


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

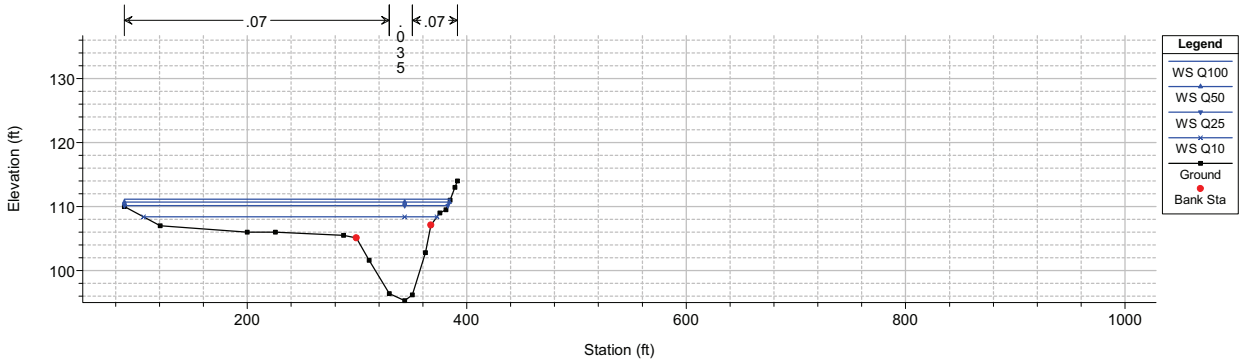
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2352.5 Culv Highway 101 Offramp



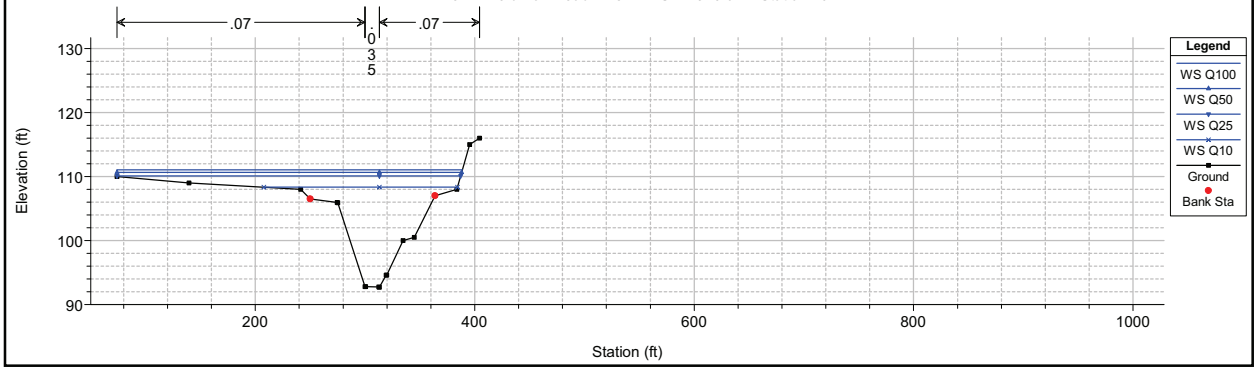
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2299.45 Station 21



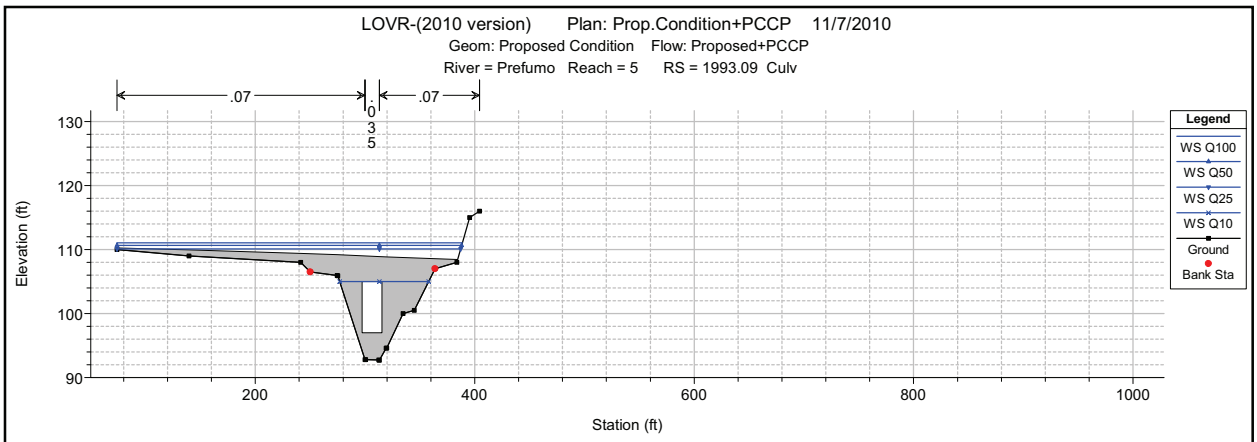
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2277.36 Station 20

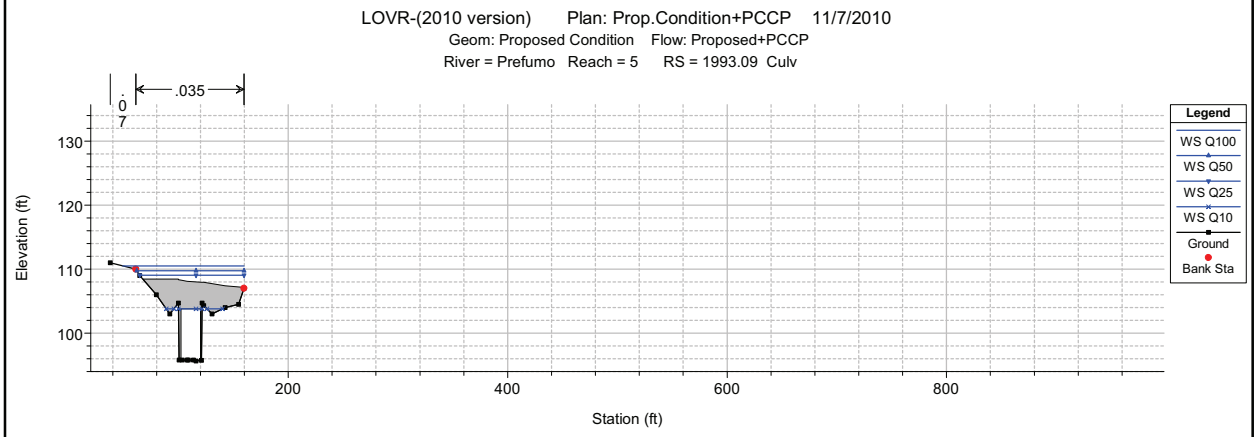


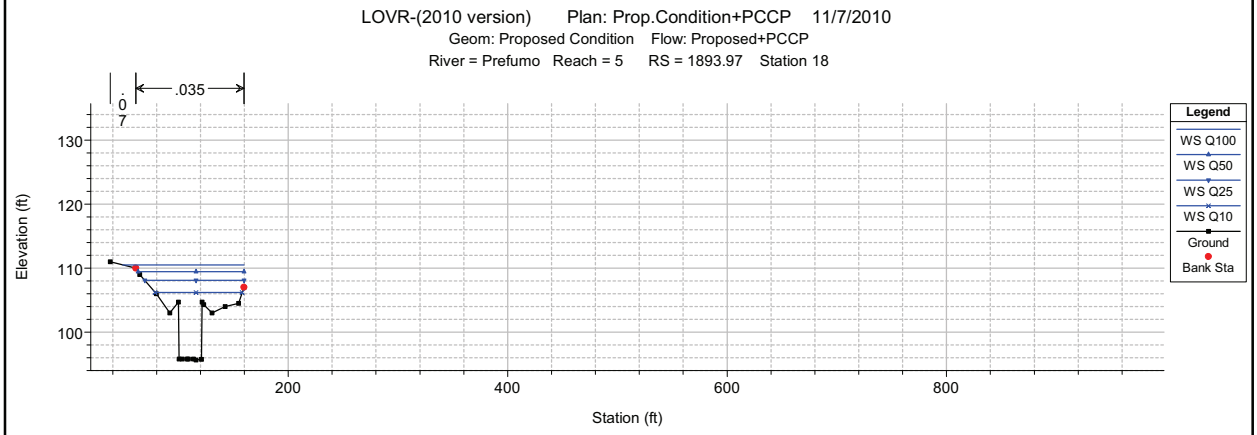
LOVR-(2010 version) Plan: Prop.Condition+PCCP 11/7/2010
Geom: Proposed Condition Flow: Proposed+PCCP
River = Prefumo Reach = 5 RS = 2075.34 Station 19

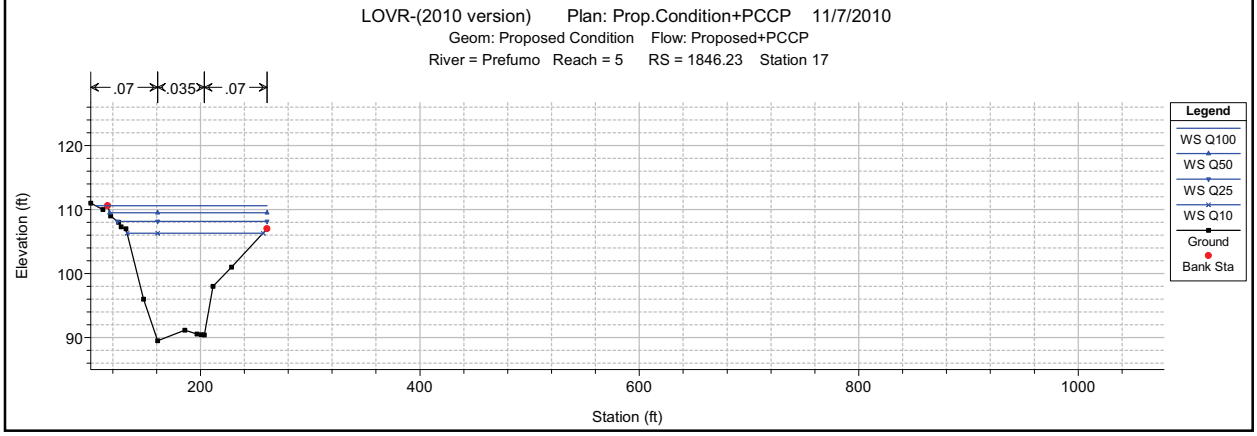


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

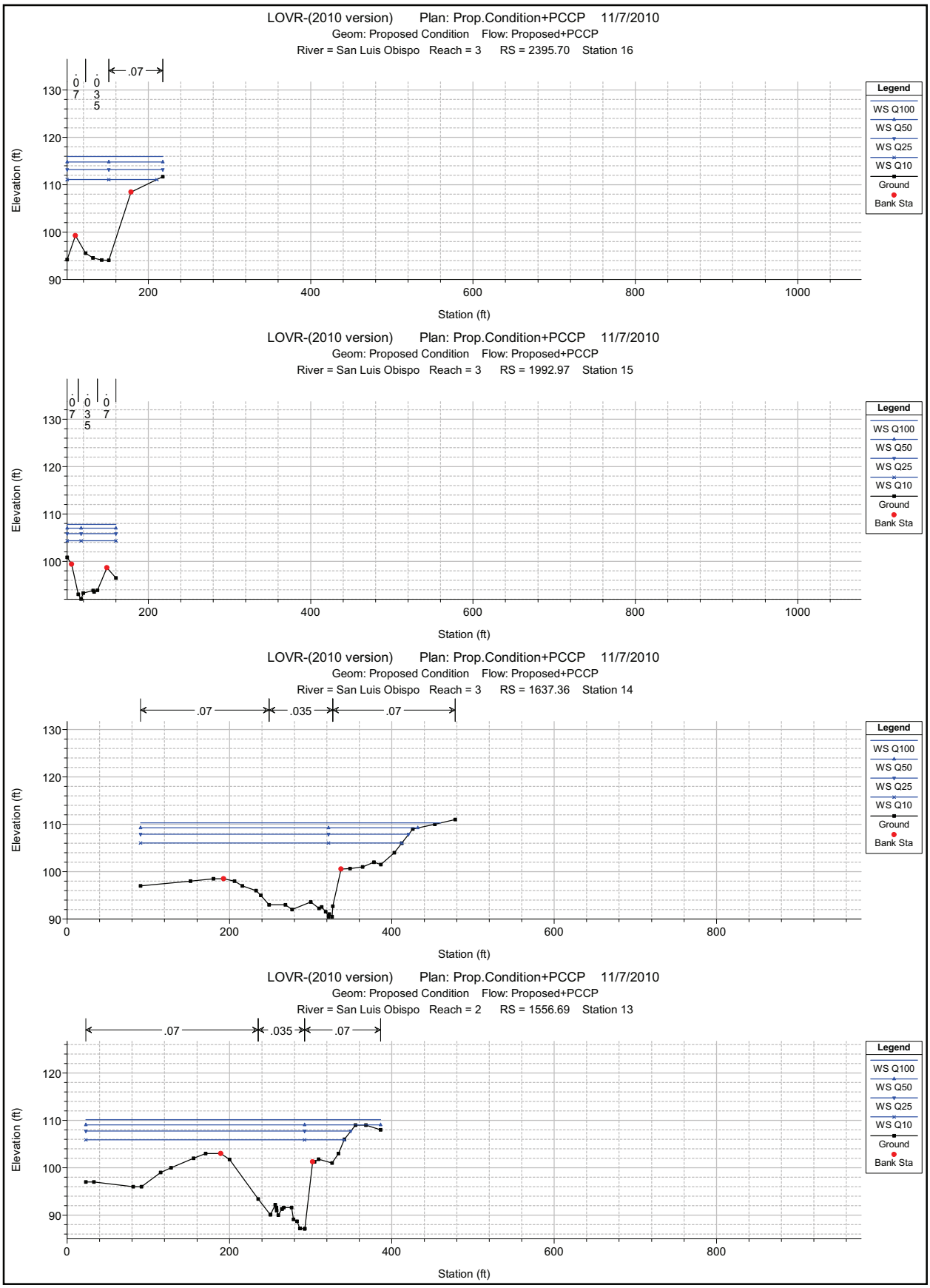




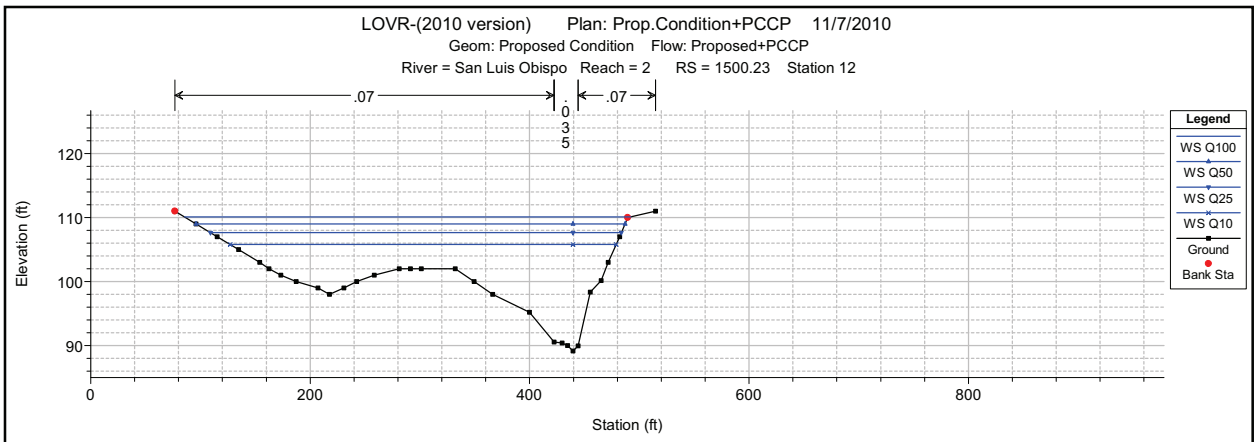


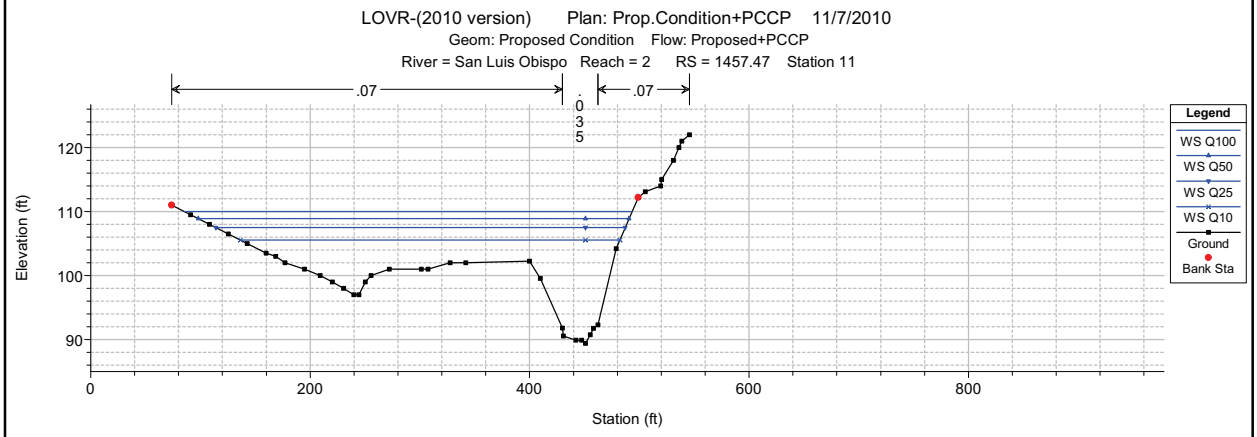


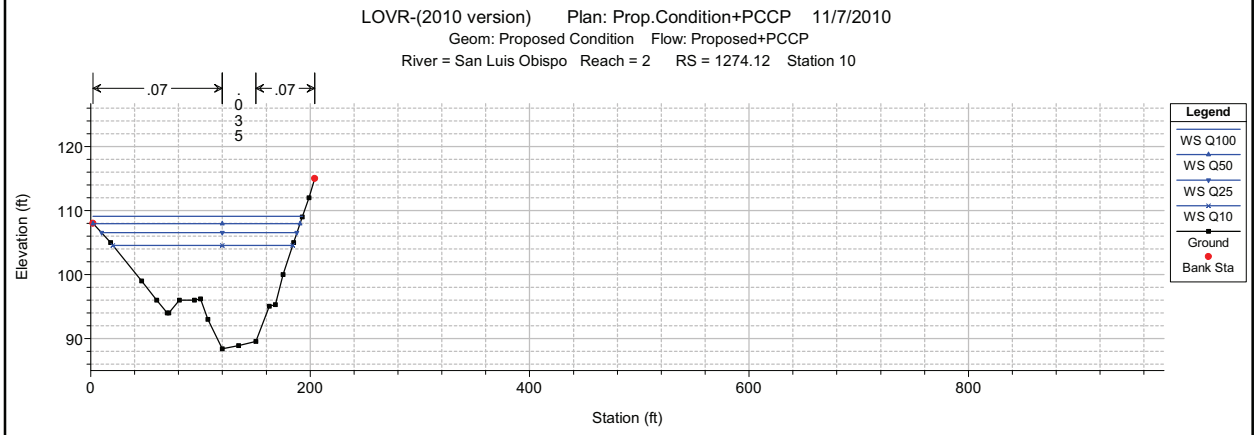
1 in Horiz. = 175 ft 1 in Vert. = 30 ft

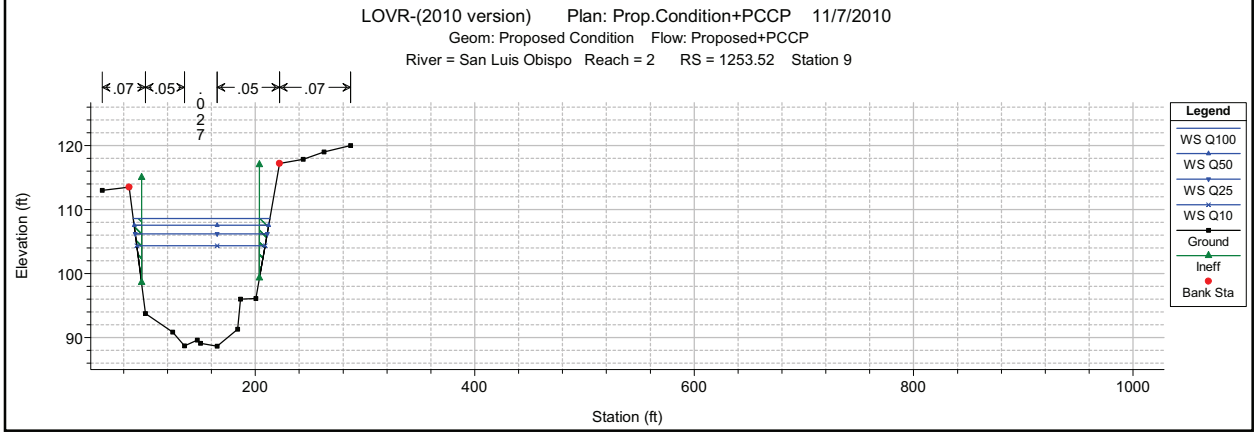


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

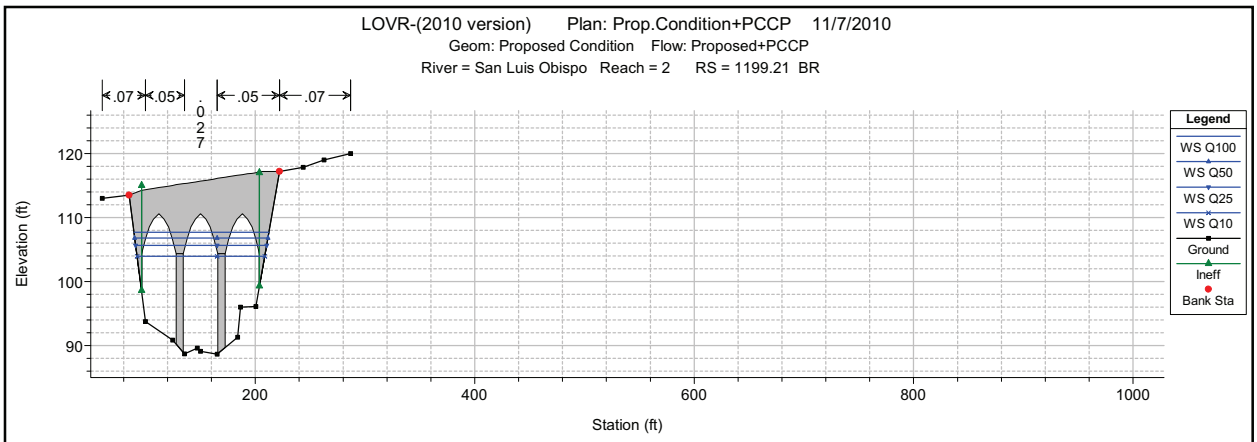


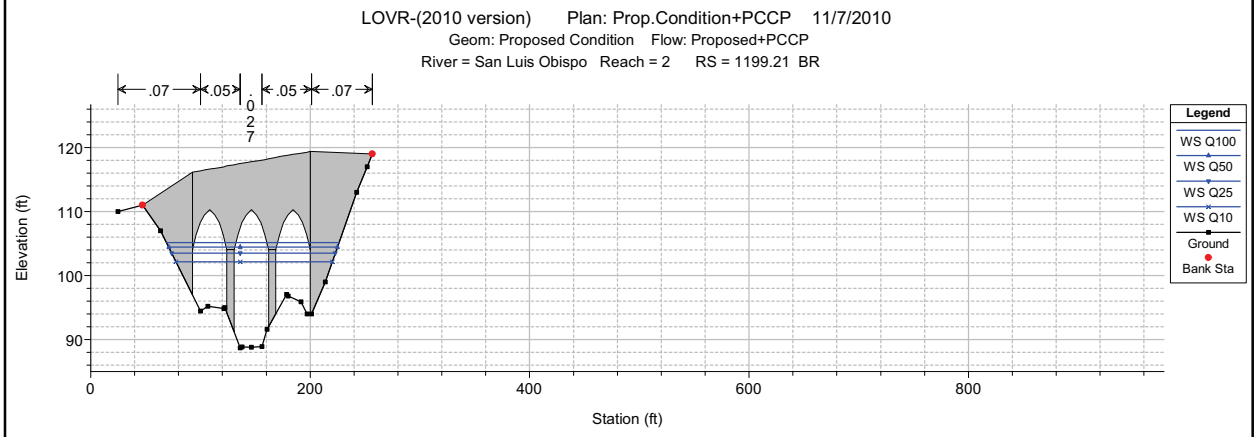


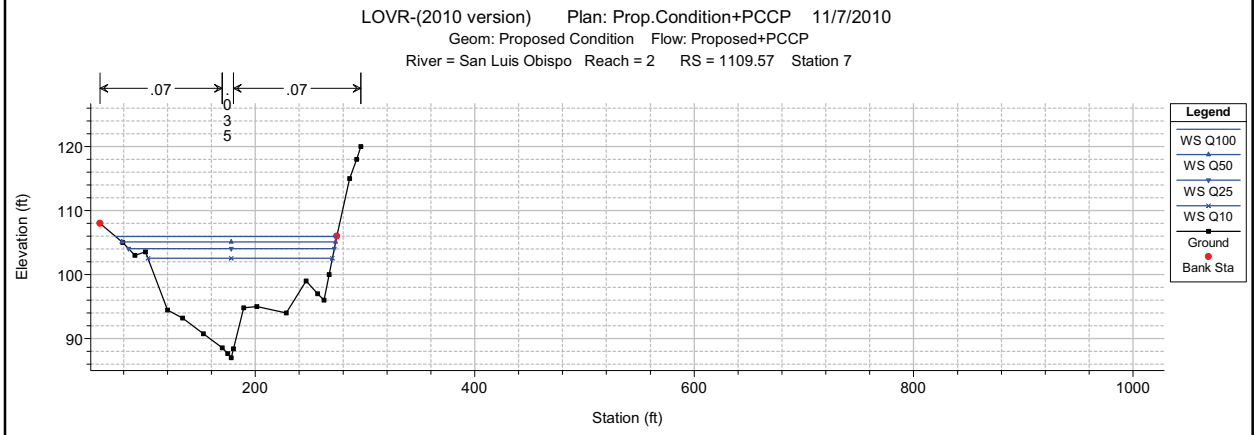


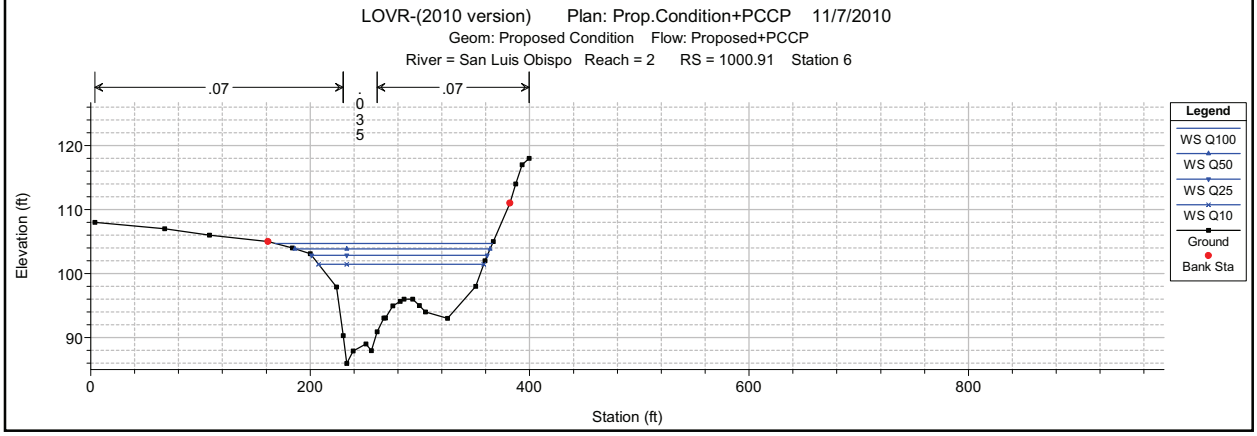


1 in Horiz. = 175 ft 1 in Vert. = 30 ft

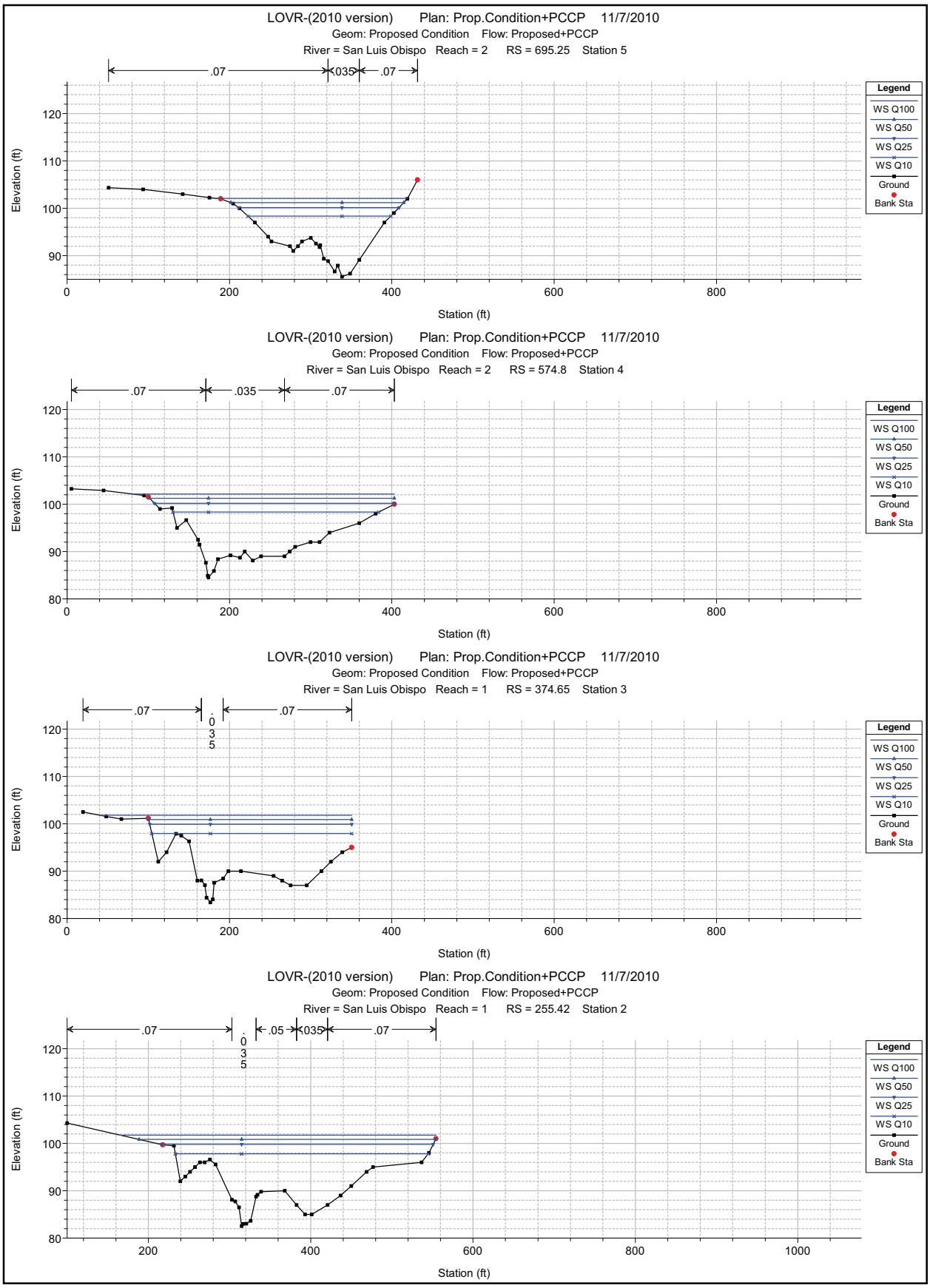




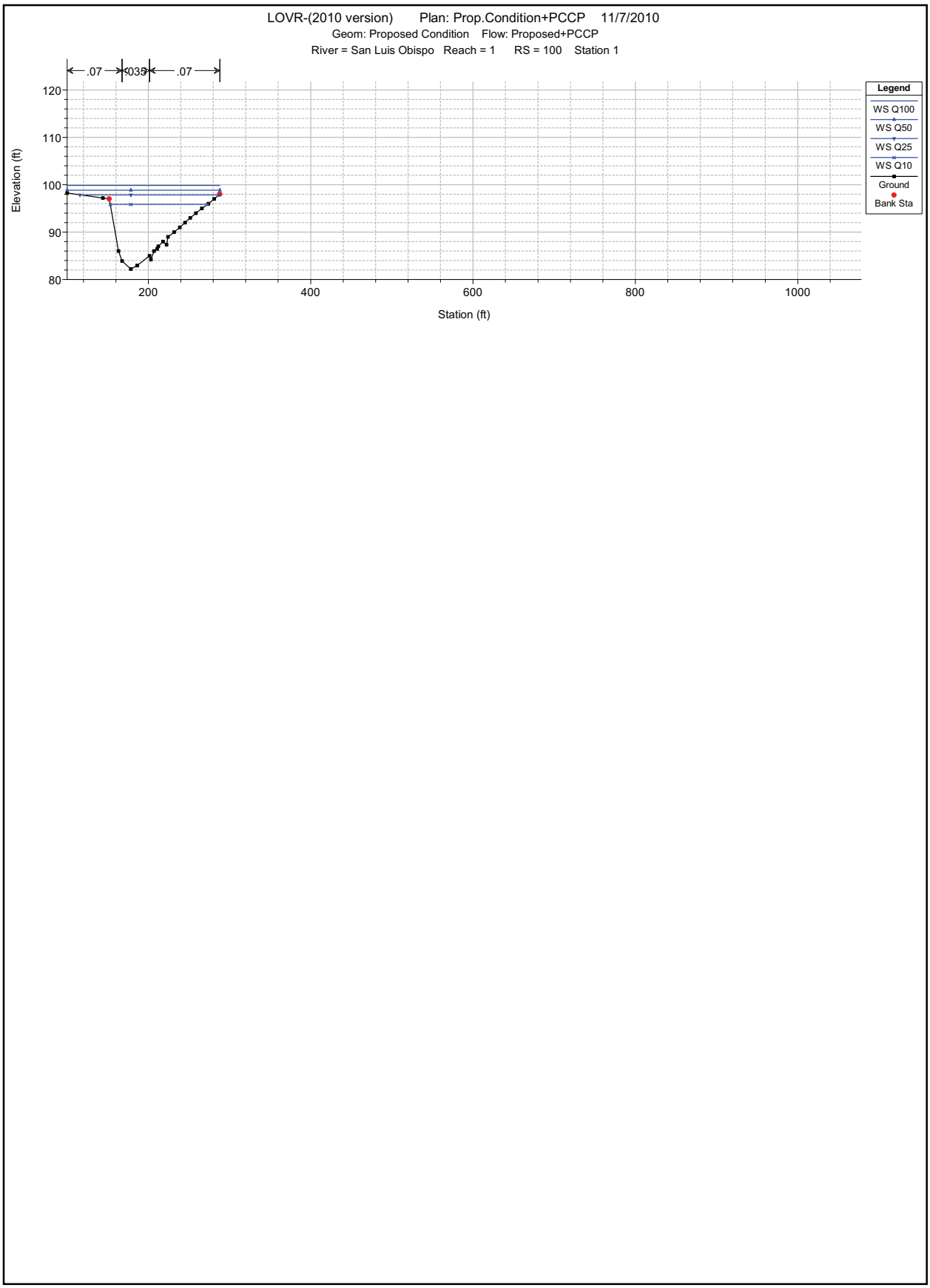




1 in Horiz. = 175 ft 1 in Vert. = 30 ft



1 in Horiz. = 175 ft 1 in Vert. = 30 ft



1 in Horiz. = 175 ft 1 in Vert. = 30 ft

Appendix G Communication Records

City of San Luis Obispo
Public Works Department • 919 Palm Street • San Luis Obispo, CA 93401-3218

October 1, 2010

Richard Krumholz
District Director
California Department of Transportation
50 Higuera Street
San Luis Obispo, CA 93401-5415

RE: Los Osos Valley Road / US-101 Interchange Prefumo Creek Culverts at US-101 Design Criteria

Dear Mr. Krumholz:

This letter is to inform you of the City of San Luis Obispo's decision to modify the scope of the Los Osos Valley Road / US-101 Interchange improvement project. We have determined that due to cost increases associated with construction methods and additional permitting conditions of approval established by Caltrans and other agencies, we are deleting the proposed installation of the additional drainage culverts beneath the mainline US 101 facility from the project. We have calculated that the benefits associated with the improvements do not justify the significant cost and impacts that would result from construction of the culverts. A revised Location Hydraulic Study is currently being prepared by our consultant team of Dokken Engineering and Wreco, Inc. for submittal to Caltrans for review and processing.

We will be informing our Council of this decision as part of a study session on the Interchange project on November 16, 2010. As part of that meeting we will be giving an update on the project, including informing them of the remaining issues as we pursue project completion. I would like to request your attendance at that meeting to discuss the Caltrans role in the project and how we plan to work together regarding environmental processing and other design consistency issues that are yet unresolved.

Sincerely,

Jay D. Walter, PE
Director of Public Works

CC: Timothy Scott Bochum/City of San Luis Obispo, Doug Heumann/Caltrans, Matt Griggs/Dokken Engineering

G:\Transportation-Data\Interchanges\Los Osos Valley at 101\PA-ED Environmental\Culvert Deletion\10-01-10 Culvert letter.doc

The City of San Luis Obispo is committed to include the disabled in all of its services, programs and activities.
Telecommunications Device for the Deaf (805) 781-7410.

DOKKEN ENGINEERING
www.dokkenengineering.com

MEMORANDUM

Project:	**Los Osos Valley Road / US-101 Interchange**
Attention:	**Mr. Tim Bochum, Han-Bin Liang**
From:	**Matthew Griggs, PE**
Subject:	**Hydraulic Options for Prefumo Creek at US-101**
Date:	**Original July 17, 2007, Updated September 15, 2010**

The purpose of this memorandum is to present the City with a range of options in considering capacity improvements to Prefumo Creek at US-101. A matrix of options with associated cost and benefits is presented with this memorandum for City consideration and design direction.

This memorandum was originally prepared in 2007 and has been revised to include information obtained in 2009 related to requirements from NOAA Fisheries, State utility protection requests, and results of geotechnical investigations at the site.

Background

Currently, Prefumo Creek at US-101 is identitfied in the City Waterway Master Plan as having capacity to pass approximately the 15 year storm. With current sediment and fish baffle conditions, this capacity is estimated to be closer to a 10-year capacity in the Location Hydraulic Study prepared for the project by Wreco.

The existing Prefumo Creek box culvert at US-101 measures 18' x 8'. This culvert is identified as Caltrans Bridge Number 49-0062. The existing Prefumo Creek box culvert under the US-101 southbound off-ramp is a double 12'x8', Bridge Number 49-0062k (30% larger than under US-101).

Froom Creek passes under US-101 in a double 5'x5' reinforced concrete box culvert. This box culvert does not have a Caltrans Bridge Number. This box culvert has the capacity to handle a greater storm than the Prefumo Creek culverts, but still falls short of handling the 25-year storm without overtopping US-101.

Caltrans hydraulics design unit has requested the project try to improve the flow capacity through this interchange. It is Caltrans' desire to correct or improve deficiencies when a major project such as this one is proposed. However, it is important to recognize, the proposed interchange improvements do not increase the flows or water surface elevations in San Luis Obispo, Prefumo or Froom Creeks by more than 0.5% or 0.1 feet respectively.

Criteria

The Highway Design Manual addresses this type of Cross Drainage under Topic 821.3.2 "Selection of Design Floods (2) Culverts". There are two primary design criteria:

- A 10% probability flood (10-year) without causing headwater elevation to rise above the inlet top of culvert and,

- A 1% probability flood (100-year) without headwaters rising above an elevation that would cause objectionable backwater depths.

The Highway Design Manual further discusses reducing the second demand based upon a cost/benefit ratio of the improvements. However, the manual advises that for highways of major importance, a minimum design flood of 4% probability of exceedance (25-year) should be applied for freeways. It is this criteria which one of our alternatives proposed to meet for Prefumo Creek. However, this level of flood capacity cannot be reached with the interchange project due to limitations on the project work imposed by NOAA.

Discusssion of Prefumo Creek

The design team has developed and evaluated 3 alternatives to increase the capacity in Prefumo Creek under US-101. Prefumo Creek under the US-101 southbound off-ramp currently performs better than the US-101, as it is a larger box culvert. By improving the capacity under US-101 per the options in the table below and providing some removal of deposits around the southbound off-ramp, the off ramp culvert will pass the 25-year event without overtopping the off-ramp.

Table 1. Prefumo Creek at US-101 Capacity Improvement Matrix

Proposed Action	Storm Event Capacity	Impacts	Cost	Benefits
No Improvements	10-15 year	None	$0	None
1) Add 2 84" Culverts	25-year	Major – jacking pits and relocation of creek between ramp and mainline Construction risk is high with hydrocarbins, groundwater and jacking operation	$1.7 million	Hydraulic capacity improved to Caltrans minimum standard, enhances high flow conditions for existing fish ladder
2) Replace Box Culvert w/ 70' slab bridge	100-year	Major – traffic staging of US-101, staged bridge construction and removal of old culvert Must relocate oil and gas lines onto bikeway bridge Construction risk is moderate for staging of	$2.2 million	Eliminates flooding of US-101 at Prefumo, restores natural creek, stops sediment deposition *Note: The alternative can only eliminate the flooding of US-101 at Prefumo if other improvements are made downstream on San Luis Obispo Creek to reduce the backwater effects.*

		traffic		

The first alternative includes adding a pair of 84 inch reinforced concrete pipes under US-101 via the bore and jack method. This alternative (in conjunction with sediment removal resisted by NOAA) will provide capacity to handle the 25-year storm without overtopping. The bore and jack method of construction is feasible based upon the soil type in this area, adequate spacing for a jacking pit, and sufficient clearance to US-101 subgrade. This work can be accomplished without impacts to the mainline traffic on US-101. However, it is considered the highest risk construction element of the project due to groundwater handling, presence of hydrocartons in the boring logs and the tremendous jacking force necessary to push an 8 foot diameter pipe 180 feet through clayey soil strata.

Another alternative is to replace the existing box culvert with a slab bridge that would carry the US-101 mainline. This alternative provides the greatest benefits, but is also the highest cost. The slab bridge would allow full restoration of the creek bed for fish passage and pass the 100-year event without overtopping US-101. However, directly upstream, Prefumo Creek would remain in a box culvert and overtop the southbound US-101 offramp for any event greater than the 25-year. This alternative is especially appealing if the existing southbound offramp was being relocated (as in project alternative 6) and the southbound off-ramp box culvert were being removed.

The current Project Report Cost Estimate has made an allowance of $1.1 million for these activities.

Recommendations:

Prepare a Revised Location Hydraulic Study to seek approval from Caltrans District 5 to elimate the jacked concrete pipes based on the cost benefit analysis herein.

Support development of a new project to improve the flood capacity of Prefumo and San Luis Obispo Creek, focussed on creek modifications. Support replacement of the US-101 Prefumo Box Culvert with a new 70' slab bridge to restore the creek with a natural bottom for fish passage as part of the new project.

Appendix H Caltrans Comments and Reponses

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: Brent Massey,
Liaison Engineer
Office of Special Funded Projects
Division of Engineering Services

Date: August 26, 2009

File: 05-SLO-101-25.94
Prefumo Creek Bridges
Br. #s. 49-0062, 49-0062K
EA 05-0H7300

From: **Division of Engineering Services**
Structure Design Services
Structure Hydraulics and Hydrology Report

Subject: Consultant Review Los Osos Valley Road / US101 Interchange Improvement Project

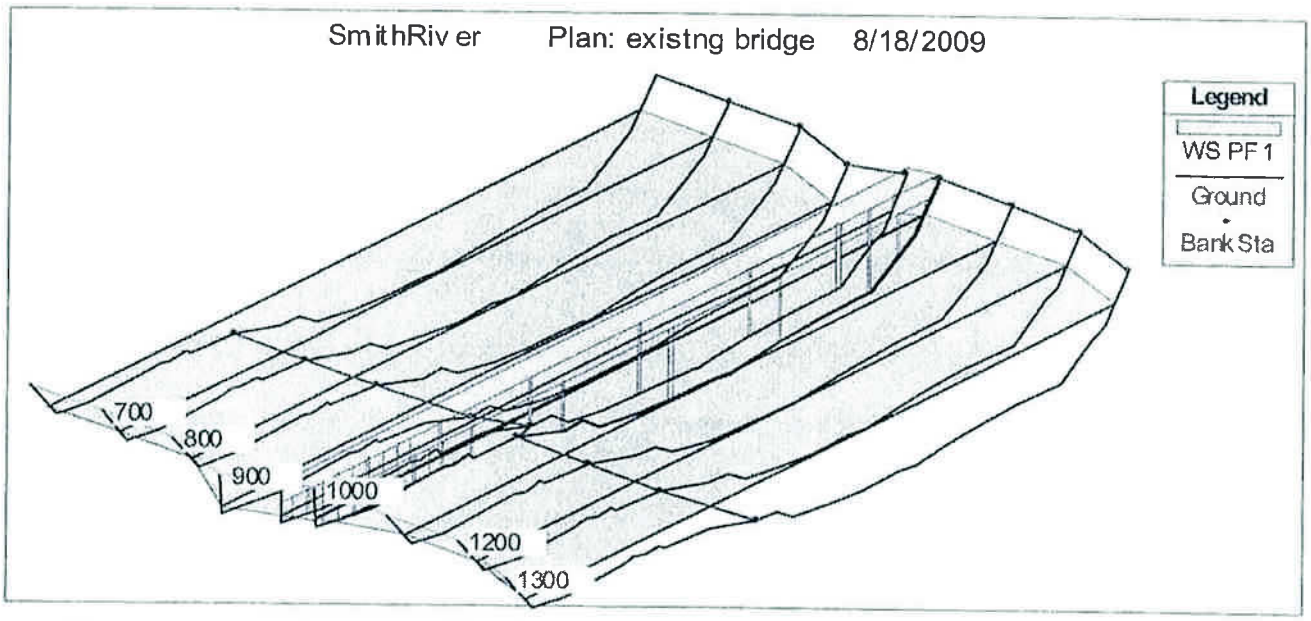
This is an updated hydraulic analysis for the proposed interchange improvements near the Los Osos Valley Road in San Luis Obispo County.

In reviewing the HEC-RAS model that was used to evaluate this report there are several concerns:

- The Location Hydraulic Study Report stated that this model was geo-referenced, however upon review it was not. This makes it very difficult to re-create the location of the cross sections used in the report for checking.
- Since the model was not geo-referenced we were unable to determine an accurate water surface elevation.
- The flow values used (in Bold and Italics in the table below) seem to be too small for Prefumo Creek and too large for San Luis Obispo. Also there was no flow data for Froom Creek. During our preliminary flow checking we determined the values shown in the table.

San Luis Obispo Creek	Drainage Area (mi^2)	Agency or method (cfs)	100-year Q (cfs)	50-year Q (cfs)	25 year Q (cfs)	10-year Q (cfs)
	26.4	FEMA	12,900	9,800	N/A	4,100
		Tr-55	16,366	1,2971	9,634	6,140
		NSS	5,331	4,225	3,138	2,000
		County/City	***15291***	***1,3738***	***1,1760***	***9,111***
Prefumo Creek		Agency or method	100 year Q	50 year Q	25 year Q	10 year Q
	14.3	FEMA	3,100	2,400	N/A	1,000
		Tr-55	9,280	7,726	6,107	4,262
		NSS	3,834	3,192	2,523	1,761
		County/City	***2,507***	***2,190***	***1801***	***1,236***
Froom Creek		Agency or method	100 year Q	50 year Q	25 year Q	10 year Q
	1.6	FEMA	N/A	N/A	N/A	N/A
		Tr-55	1570	1,217	910	572
		NSS	445	345	258	162
		County/City	***N/A***	***N/A***	***N/A***	***N/A***

- A graphic showing the location of the HEC-RAS cross sections on a quadrangle map or an aerial photo in the background needs to be included in the report.
- The HEC-RAS model was reviewed, but could not be cross checked at this time.
- Photos 1 thru 4 shows the culverts and bridges as natural channels, HEC-RAS slows the culverts/bridges with paved inverts, in the summary tables.
- The "six bridge" or "culvert" option should be displayed.
- An optional 3D graphic like the one pictured below would be desirable for each reach of the model.



Since a graphic of the extent of flooding is included, a graphic illustrating the results of the chosen alternative should be included.

The report makes mention of the backwater and flooding potential for the existing condition as calculated by FEMA but flows used in the model were larger than the FEMA flows. Hence it would follow that the flooding extent of flooding for the existing condition would be greater.

Froom Creek should be evaluated for backwater effects as well, especially since it seems to have almost no slope.

For Section V, the Traffic Items 3 and 4 should not be included in the "Other Hydrology" section.

The elevations in this report are not tied to an established datum I e NVGD29 or NAD88.

Possible scour at wing walls, culvert entrances, and exits should be addressed.

Since culverts will be submerged, will the overflow be designed to flow straight over the crossing, or will a portion of the flow travel down the 101 Freeway?

The above evaluation is only preliminary until a final design is proposed for replacement. If there are any questions upon reviewing this information, please contact Ronald McGaugh at 227-8026 or Steve Ng at 227-8018.

PROJECT NAME: Los Osos Valley Road/101 Interchange Improvement Project

COMMENTS BY: Caltrans Division of Engineering Services **ADDRESSED BY: WRECO**

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 10/18/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
1	Gen	Caltrans	The Location Hydraulic Study Report stated that this model was geo-referenced, however upon review it was not. This makes it very difficult to re-create the location of the cross sections used in the report for checking.	A	WRECO	An AutoCAD image attached as a background image for plan view in all HEC-RAS models (see Figure 9, Appendix D, and Appendix E). Appendix C also shows cross section locations.			
2	Gen	Caltrans	Since the model was not geo-referenced we were unable to determine an accurate water surface elevation.	A	WRECO	Please see response to Comment #1.			
3	Gen	Caltrans	The flow values used (in Bold and Italics in the table below) seem to be too small for Prefumo Creek and too large for San Luis Obispo. Also there was no flow data for Froom Creek. During our preliminary flow checking we determined the values shown in the table.	A	WRECO	See Appendix B.2 for design flows from San Luis Obispo Creek Watershed, Waterway Management Plan Volume 1. For Froom Creek, HEC-HMS model provided by the City of San Luis Obispo was used to provide the design peak flows.			

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 10/18/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
4	Gen	Caltrans	A graphic showing the location of the HEC-RAS cross sections on a quadrangle map or an aerial photo in the background needs to be included in the report.	A	WRECO	The general information is provided in Figures 9 and 10. This information can also be found in Appendices C, D, and E.			
5	Gen	Caltrans	The HEC-RAS model was reviewed, but could not be cross checked at this time.	-	-	Comment Noted			
6	Gen	Caltrans	Photos 1 thru 4 shows the culverts and bridges as natural channels, HEC-RAS shows the culverts/bridges with paved inverts, in the summary tables.	A	WRECO	San Luis Obispo Creek has a natural channel underneath LOVR bridge. The n values used for bridge range from 0.027 to 0.070, which are for natural creek conditions. Prefumo Creek and Froom Creek have cross culverts with concrete bottom. The n values used in the inside of the cross culverts range from 0.015 to 0.020. The n values used for the cross sections upstream and downstream of the culverts range from 0.035 to 0.070, which are for natural creek conditions.			

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 10/18/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
7	Gen	Caltrans	The "six bridge" or "culvert" option should be displayed. (In HEC-RAS)	A	WRECO	Six bridge and culvert options are available in Appendices.			
8	Gen	Caltrans	An optional 3D graphic like the one pictured below would be desirable for each reach of the model. (In HEC-RAS)	A	WRECO	The 3-D graphic is provided in Figure 10. For each model, the 3-D graphics are included in Appendices D and E.			
9	Gen	Caltrans	The report makes mention of the backwater and flooding potential for the existing condition as calculated by FEMA but flows used in the model were larger than the FEMA flows. Hence it would follow that the flooding extent of flooding for the existing condition would be greater.	-	-	Comment Noted			
10	Gen	Caltrans	Froom Creek should be evaluated for backwater effects as well, especially since it seems to have almost no slope.	B	WRECO	The Project would not significantly impact the water surface elevation of the Froom Creek. Since there is no significant impact to the floodplain, Froom Creek was not studied in details.			

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 10/18/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
11	Gen	Caltrans	For Section V, the Traffic Items 3 and 4 should not be included in the "Other Hydrology" section.	A	WRECO	It is moved to Sections 1.8 and 1.9, as a part of Section 1, Project Descriptions.			
12	Gen	Caltrans	The elevations in this report are not tied to an established datum I e NVGD29 or NAD88.	A	WRECO	The datum used in the hydraulic analyses is NAVD88.			
13	Gen	Caltrans	Possible scour at wing walls, culvert entrances, and exits should be addressed.	A	WRECO	Scour analyses will be preformed in the final design phase of the Project.			
14	Gen	Caltrans	Since culverts will be submerged, will the overflow be designed to flow straight over the crossing, or will a portion of the flow travel down the 101 Freeway?	A	WRECO	According to the topography of US 101, portion of the overflow would travel down the US 101 freeway towards southwest.			

PROJECT NAME: Los Osos Valley Road/101 Interchange Improvement Project

COMMENTS BY: Caltrans District 5 **ADDRESSED BY: WRECO**

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 11/5/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
1	38 S6.1	Caltrans District 5	Delete the sentence, "The proposed project would implement improvements to alleviate the flooding situation." The project no longer proposes to address the flooding issues since no new culverts will be added on Prefumo Creek. The SLO Creek Bridge widening is not an improvement to help the flooding situation.	A	WRECO	The sentence was deleted from the paragraph according to the comment.			
2	40 S6.6	Caltrans District 5	As we discussed this afternoon, the project no longer includes removal of accumulated sediment. Therefore, no significant encroachments are proposed as part of the project as discussed throughout the LHS. Replace the debris removal discussion with a sentence stating that no significant encroachments are proposed, i.e., a practicable alternative is not necessary since	A	WRECO	The 2nd paragraph in section 6.6 is replaced with: "The Project would not significantly encroach onto the existing floodplain. Therefore, other alternatives were not considered for this Project."			

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 11/5/2010		

Comment No.	**Dwg or Page No.**	**Reviewer/ Entity**	**Reviewer's Comments**	**RESPONSE**			**Final Disposition**		
				Response Code	**By Whom/ Entity**	**Response Text**	**"√"**	**By Whom/ Entity**	**Date**
			no significant encroachment is proposed.						
3	A-3 A-5	Caltrans District 5	Did the project engineer from Dokken help prepare the "Technical Information for Location Hydraulic Study" form? If so, change the signature block for the project engineer to, "Signature - Project Engineer" and include the signature of the project engineer from Dokken. If the entire form was prepared by Han-Bin Liang, remove the project engineer signature block.	A	WRECO	Signature block removed according to the comment.			
4	A-6	Caltrans District 5	Change the hydraulic engineer signature block to "Signature - Hydraulic Engineer".	A	WRECO	Signature block modified according to the comment.			

Kazuya Tsurushita

From: HanBin Liang
Sent: Wednesday, November 03, 2010 6:23 PM
To: Kazuya Tsurushita
Subject: FW: EA 05-0H730_SLO-101/LOVR IC re: Location Hydraulic Study (LHS)

Attachments: pic21527.jpg

pic21527.jpg (18 KB)

-----Original Message-----
From: Doug Heumann [mailto:doug_heumann@dot.ca.gov]
Sent: Wednesday, November 03, 2010 4:01 PM
To: mgriggs@dokkenengineering.com
Cc: tbochum@slocity.org; Kristen K Inkrott; Chuck Cesena; Matt C Fowler; HanBin Liang
Subject: EA 05-0H730_SLO-101/LOVR IC re: Location Hydraulic Study (LHS)

Matt,
District 5 has concluded its review of the revised LHS submitted by Wreco on 10/21/10.

The Revised Location Hydraulic Study (LHS) indicates that the LOVR I/C project will not contribute a significant amount of surface run-off to the
US-101 culverts at Prefumo Creek Therefore, the project does not have a significant impact on the US-101 culverts and no culvert improvement is necessary. Yet, please be advised that should the City decide to modify the culverts, i.e., extend them for the proposed Bob Jones' Bikepath, then the culvert capacity will need to be increased to Caltrans minimum standard of a 25-year storm event conveyance.

Specific comments regarding the revised LHS are as follow:

Page 38, Section 6.1, paragraph 2: Delete the sentence, "The proposed project would implement improvements to alleviate the flooding situation."
The project no longer proposes to address the flooding issues since no new culverts will be added on Prefumo Creek. The SLO Creek Bridge widening is not an improvement to help the flooding situation.

Page 40, Section 6.6, paragraph 2: As we discussed this afternoon, the project no longer includes removal of accumulated sediment. Therefore, no significant encroachments are proposed as part of the project as discussed throughout the LHS. Replace the debris removal discussion with a sentence stating that no significant encroachments are proposed, i.e., a practicable alternative is not necessary since no significant encroachment is proposed.

Pages A-3, A-5: Did the project engineer from Dokken help prepare the "Technical Information for Location Hydraulic Study" form? If so, change the signature block for the project engineer to, "Signature - Project Engineer" and include the signature of the project engineer from Dokken.
If the entire form was prepared by Han-Bin Liang, remove the project engineer signature block.

Page A-6: Change the hydraulic engineer signature block to "Signature - Hydraulic Engineer".

In conclusion, please make all changes enumerated above and send two revised copies for signature.

thanks,

(Embedded image moved to file: pic21527.jpg)

PROJECT NAME: Los Osos Valley Road/101 Interchange Improvement Project

COMMENTS BY: Caltrans District 5 **ADDRESSED BY: WRECO**

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 11/5/2010		

Comment No.	Dwg or Page No.	Reviewer/ Entity	Reviewer's Comments	RESPONSE			Final Disposition		
				Response Code	By Whom/ Entity	Response Text	"√"	By Whom/ Entity	Date
1	38 S6.1	Caltrans District 5	Delete the sentence, "The proposed project would implement improvements to alleviate the flooding situation." The project no longer proposes to address the flooding issues since no new culverts will be added on Prefumo Creek. The SLO Creek Bridge widening is not an improvement to help the flooding situation.	A	WRECO	The sentence was deleted from the paragraph according to the comment.			
2	40 S6.6	Caltrans District 5	As we discussed this afternoon, the project no longer includes removal of accumulated sediment. Therefore, no significant encroachments are proposed as part of the project as discussed throughout the LHS. Replace the debris removal discussion with a sentence stating that no significant encroachments are proposed, i.e., a practicable alternative is not necessary since	A	WRECO	The 2nd paragraph in section 6.6 is replaced with: "The Project would not significantly encroach onto the existing floodplain. Therefore, other alternatives were not considered for this Project."			

Submittal:		**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal
Circulated by: WRECO	Date: 11/5/2010		

Comment No.	**Dwg or Page No.**	**Reviewer/ Entity**	**Reviewer's Comments**	**RESPONSE**			**Final Disposition**		
				Response Code	**By Whom/ Entity**	**Response Text**	**"√"**	**By Whom/ Entity**	**Date**
			no significant encroachment is proposed.						
3	A-3 A-5	Caltrans District 5	Did the project engineer from Dokken help prepare the "Technical Information for Location Hydraulic Study" form? If so, change the signature block for the project engineer to, "Signature - Project Engineer" and include the signature of the project engineer from Dokken. If the entire form was prepared by Han-Bin Liang, remove the project engineer signature block.	A	WRECO	Signature block removed according to the comment.			
4	A-6	Caltrans District 5	Change the hydraulic engineer signature block to "Signature - Hydraulic Engineer".	A	WRECO	Signature block modified according to the comment.			

Floodplain Evaluation Report Summary

Dist. 5 Co. San Luis Obispo Rte. 101 P.M 25.95

Project No. Bridge No. 49-0062K, 49-0062, 49-185

Limit:

Auto Park Way to South Higuera Street
2,500 ft south and 4,300 ft north of the LOVR overcrossing

Floodplain Description:

San Luis Obispo, Prefumo, and Froom Creek contribute to the floodplains within the Project vicinity. Prefumo Creek crosses US 101 and joins with San Luis Obispo Creek immediately upstream of the LOVR crossing. San Luis Obispo Creek flows parallel to the US 101 in the Project vicinity and joins with Froom Creek approximately 1,000 ft downstream of the LOVR crossing over San Luis Obispo Creek.

		Yes	No
1.	Is the proposed action a longitudinal encroachment of the base floodplain?		√
2.	Are the risks associated with the implementation of the proposed action significant?		√
3.	Will the proposed action support probable incompatible floodplain development?		√
4.	Are there any significant impacts on natural and beneficial floodplain values?		√
5.	Routine construction procedures are required to minimize impacts on the floodplain. Area there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values? If yes, explain.		√
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105(q).		√
7.	Are Location Hydraulic Studies that document the above answers on file? If not explain.	√	

Concurrence:

Signature – ~~Matt Griggs, P.E. (Project Engineer)~~ Hydraulic Engineer — Date 11/15/10

Signature – Dist. Environmental Branch Chief — Date

Prepared By:

Signature – Han-Bin Liang, Ph.D., P.E. (Hydraulic Engineer) — Date 11/8/2010

PROJECT NAME: Los Osos Valley Road/101 Interchange Improvement Project

COMMENTS BY: Caltrans District 5 **ADDRESSED BY: WRECO**

Submittal:				**CODE**	**A** - Accept Comment (correct, add, clarify) **B -** Will not incorporate **C** - Resolution of comment in next submittal				
Circulated by: WRECO			Date: 11/22/2010						
Comment No.	**Dwg or Page No.**	**Reviewer/ Entity**	**Reviewer's Comments**	**RESPONSE**			**Final Disposition**		
				Response Code	**By Whom/ Entity**	**Response Text**	**"√"**	**By Whom/ Entity**	**Date**
1	39 S6.2	Caltrans District 5	District 5 received 2 copies of the revised LHS on 11/10/10. The sediment removal, which is no longer a part of this project was removed from Section 6.6, but unfortunately, is still reflected in Section 6.2, paragraph 2. Please remove ANY discussion of sediment removal from this document so that we can go forward with our discussions with NOAA.	A	WRECO	The discussion of sediment removal in section 1.4 shows NOAA's preference of not performing sediment removal for this project. This discussion is not removed from the report. The discussion of sediment removal in sections 6.2 and 6.5 was removed from the report. The words "debris" and "sediment" are only used in section 1.4.			
2	App. A	Caltrans District 5	Please change the signature title of the first line from "Matt Griggs, P.E. (Project Engineer)" to "Hydraulic Engineer."	A	WRECO	The signature page in the Floodplain Evaluation Report Summary was modified according to the comment.			