Federal Emergency Management Agency

Washington, D.C. 20472

October 16, 2013

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 13-08-0266P

The Honorable Sam Susuras
Mayor, City of Grand Junction
250 North 5th Street
Grand Junction, CO 81501

Community Name: City of Grand Junction, CO
Community No.: 080117
FIRM Panel Affected: 08077C0828F

116

Dear Mayor Susuras:

In a Letter of Map Revision (LOMR) dated May 30, 2013, you were notified of proposed flood hazard determinations affecting the Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) report for the City of Grand Junction, Mesa County, CO. These determinations were for Lewis Wash - from approximately 600 feet downstream of D 1/2 Road to approximately 30 feet downstream of E Road. The 90-day appeal period that was initiated on June 14, 2013, when the Department of Homeland Security's Federal Emergency Management Agency (FEMA) published a notice of proposed Flood Hazard Determinations in *The Daily Sentinel* has elapsed.

FEMA received no valid requests for changes to the modified flood hazard information. Therefore, the modified flood hazard information for your community that became effective on October 14, 2013, remains valid and revises the FIRM and FIS report that were in effect prior to that date.

The modifications are pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. The community number(s) and suffix code(s) are unaffected by this revision. The community number and appropriate suffix code as shown above will be used by the National Flood Insurance Program (NFIP) for all flood insurance policies and renewals issued for your community.

FEMA has developed criteria for floodplain management as required under the above-mentioned Acts of 1968 and 1973. To continue participation in the NFIP, your community must use the modified flood hazard information to carry out the floodplain management regulations for the NFIP. The modified flood hazard information will also be used to calculate the appropriate flood insurance premium rates for all new buildings and their contents and for the second layer of insurance on existing buildings and their contents.

If you have any questions regarding the necessary floodplain management measures for your community or the NFIP in general, please contact the Mitigation Division Director, FEMA Region VIII, in Denver, Colorado, either by telephone at (303) 235-4800, or in writing at Denver Federal Center, Building 710, Box 25267, Denver, Colorado, 80225-0267.

If you have any questions regarding the LOMR, the proposed flood hazard determinations, or mapping issues in general, please call the FEMA Map Information eXchange, toll free, at (877) 336-2627 (877-FEMA MAP).

Sincerely,

Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

cc: The Honorable Steven Acquafresca
Chairman, Mesa County
Board of Commissioners

Mr. Bret Guillory, P.E., CFM
Utility Engineer, Floodplain Manger
City of Grand Junction

Mr. Robert Krehbiel, P.E.
Project Engineer
Matrix Design Group, Inc.

Mr. Peter Baier
Public Works Director
Mesa County

Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

MAP SCALE 1" = 500'

250 0 500 FEET

150 0 150 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0828F

FIRM

FLOOD INSURANCE RATE MAP

MESA COUNTY,

COLORADO

AND INCORPORATED AREAS

PANEL 828 OF 1725

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MESA COUNTY	080115	0828	F
GRAND JUNCTION, CITY OF	080117	0828	F

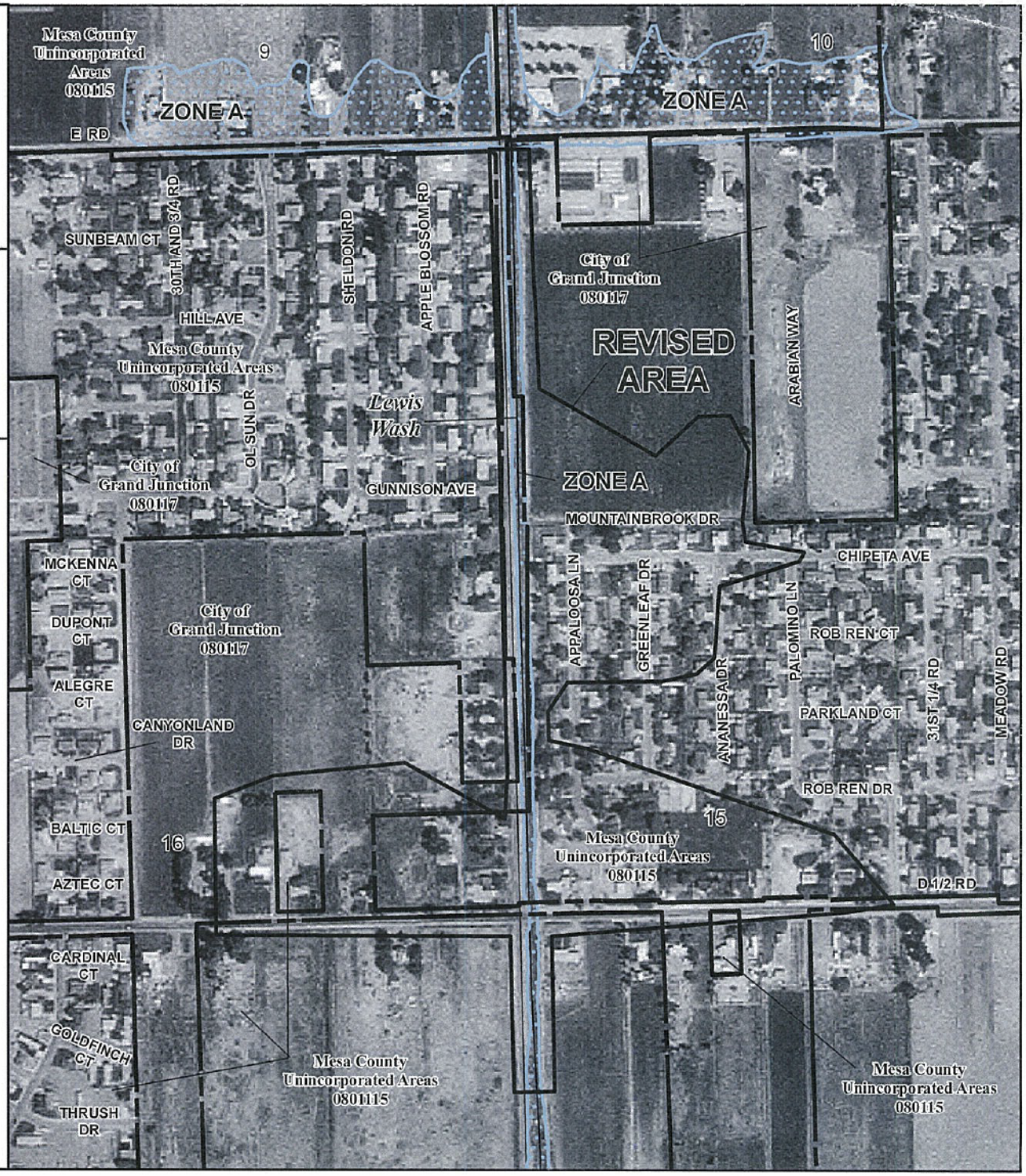
REVISED TO REFLECT LOMR EFFECTIVE: October 14, 2013

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

MAP NUMBER 08077C0828F

EFFECTIVE DATE JULY 6, 2010

Federal Emergency Management Agency



Federal Emergency Management Agency

Washington, D.C. 20472

May 30, 2013

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Sam Susuras
Mayor, City of Grand Junction
250 North 5th Street
Grand Junction, CO 81501

IN REPLY REFER TO:

Case No.:	13-08-0266P
Community Name:	City of Grand Junction, CO
Community No.:	080117
Effective Date of This Revision:	**October 14, 2013**

Dear Mayor Susuras:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Erin E. Cobb

Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

For: Luis Rodriguez, P.E., Chief
Engineering Management Branch
Federal Insurance and Mitigation Administration

List of Enclosures:
Letter of Map Revision Determination Document
Annotated Flood Insurance Rate Map

cc: The Honorable Steven Acquafresca
Chairman, Mesa County
Board of Commissioners

Mr. Bret Guillory, P.E., CFM
Utility Engineer, Floodplain Manger
City of Grand Junction

Mr. Robert Krehbiel, P.E.
Project Engineer
Matrix Design Group, Inc.

Mr. Peter Baier
Public Works Director
Mesa County

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Grand Junction Mesa County Colorado	BRIDGE CHANNELIZATION	HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080117		
IDENTIFIER	D 1/2 Road Bridge Replacement and Channel Improvement	APPROXIMATE LATITUDE & LONGITUDE: 39.074, -108.478 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08077C0828F DATE: July 6, 2010	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Lewis Wash - from approximately 600 feet downstream of D 1/2 Road to approximately 30 feet downstream of E Road

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Lewis Wash	Zone A	Zone A	NONE	YES

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Erin E. Cobb

Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

132942 PT202.BKR.13080266P.H20 102-D

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER COMMUNITIES AFFECTED BY THIS REVISION

CID Number: 080115 **Name:** Mesa County, Colorado

AFFECTED MAP PANELS	AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM* NO.: 08077C0828F DATE: July 6, 2010	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Erin E. Cobb

Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the base (1-percent-annual-chance) flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Erin E. Cobb

Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

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Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp.

LOCAL NEWSPAPER Name: *The Daily Sentinel*
Dates: June 7, 2013 and June 14, 2013

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination information presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Erin E. Cobb

Erin E. Cobb, CFM, Program Specialist
Engineering Management Branch
Federal Insurance and Mitigation Administration

Letter of Map Revision

Lewis Wash

D ½ Road to E Road

Mesa County, Colorado

Prepared For:

Mesa County Department of Public Works
200 South Spruce Street
PO Box 20,000
Grand Junction, CO 81502

Prepared By:

Matrix Design Group, Inc.
1601 Blake St., Suite 200
Denver, Colorado 80202
(303) 572-0200

December 21, 2012

This **LOMR** of Colorado River at 32 1/4 Road Pedestrian Bridge in Mesa County, Colorado was prepared under the supervision and direction of the undersigned Professional Engineer:

COLORADO LICENSED
ROBERT D. KRETBIEL
29113
PROFESSIONAL ENGINEER

12/21/12

Matrix DESIGN GROUP

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LIST OF TABLES AND FIGURES

TABLES

FIGURES

LIST OF APPENDIX

1.0 Introduction

This Letter of Map Revision (LOMR) request on behalf of Mesa County is prepared for Lewis Wash to document the change to the Zone A regulatory floodplain as a result of the reconstruction of D½ Road Bridge and channel improvements upstream and downstream of the bridge. The work lowered the floodplain in all cases; therefore a CLOMR to document proposed hydraulic conditions prior to construction was neither required nor submitted.

The Lewis Wash drainage basin originates to the north at the top of the Book Cliffs at an elevation of 6,600 feet and outfalls into the Colorado River at elevation 4,610 feet. The Lewis Wash watershed is comprised of 10.1 square miles. I-70 at elevation 4,780 feet divides the basin into two distinct portions: upper steep cliffs, and lower flat cultivated or developed lands. 6.4 square miles lie above I-70, and 3.7 square miles lie between the interstate and the Colorado River.

Lewis Wash is a manmade channelized drainageway paralleling 31 Road through the City of Grand Junction and through unincorporated portions of Mesa County, Colorado. The average slope of the channel through the developed region is approximately 0.64%. There are numerous bridge and culvert crossings along the wash. Most of these crossing structures cannot pass the 100-year flood, and consequently, there are many break-outs from the channel. Since the wash is a manmade channel, the surrounding area does not typically drain back towards the wash. Once water breaks out of the banks, it frequently flows away from the channel. The floodplain in many areas is broad and shallow outside of the formal channel banks. This made hydraulic modeling of existing conditions for the FIS challenging and complicated for a one-dimensional model. Tracking the shallow sheet flow leaving the channel was beyond the scope of work of the FIS study, so the regulatory floodplain was designated as a Zone A even though a detailed study of the mainstem was completed and had base floodplain elevations computed.

2.0 Purpose of Study

The purpose of this LOMR is to document changes to the regulatory floodplain due to the construction of the D½ Road bridge and channel improvements. This study was completed on behalf of Mesa County with the support of the City of Grand Junction for Lewis Wash for the reach between D ½ Road and E Road to evaluate the reduced flood hazards to the community.

Reconstruction of the D½ Road Bridge efficiently passes the 100-year discharge, which removed 20.72 acres of property and 41 structures from the 100-year floodplain due to the bridge replacement alone. In addition, excavation and reshaping of the Lewis Wash channel between D½ Road and E Road bridges removed an additional 12.4 acres of property and 60 structures from the 100-year floodplain.

The channel between D ½ Road and E Road fully contains the 100-year flood. This LOMR is being submitted to Federal Emergency Management Agency (FEMA) through a LOMR to take approximately 101 existing structures and 33.12 acres out of the regulatory floodplain.

3.0 Location

The Vicinity Map, Figure 1, illustrates the project area in Mesa County, Colorado. Lewis Wash runs north to south along 31 Road. The area of concern for this study is between D ½ Road and E Road.

Figure 1 - Vicinity Map

4.0 Topographic Mapping and Data Gathering

Base mapping was obtained from the Mesa County and was supplemented with an as-built site survey. This study utilized Mesa's 2001 topographic mapping with a 2- foot contour interval which was the same mapping used to complete the effective floodplain map. The following outlines the base mapping specifications:

Mapping

Existing Topography - Mesa County, 2001, 2' Contour Interval
As-built Survey Topography November 30, 2012 As-built, 2' Contour Interval
As-built Survey D½ Road Bridge Dimensions and Elevations May 7, 2012

Deliverables

As-built floodplain extents in GIS format
As-built flood profile in CAD format

Datum / Units

Coordinate System and Horizontal Datum - Colorado State Plane Coordinate System, Central Zone, North American Datum of 1983 (NAD-'83), U.S. Feet
Vertical Datum – North American Vertical Datum of 1988 (NAVD '88)
Units – U.S. feet

Field surveys were performed on May 7, 2012 and November 30, 2012 to collect the as-built dimensions and elevations for the new D½ Road Bridge structure. In addition, 14 cross sections were surveyed. Figure D-1 – LOMR Work Map shows the surveyed cross section locations. The purpose of the field survey was to incorporate the new data into the effective FEMA floodplain model.

Base mapping with existing topography was obtained from Mesa County, 2001, 2-foot contour interval. Coordinate system and horizontal datum is UTM Zone 12, North American Datum of 1983 (NAD-'83), meters. Vertical datum is the North American Vertical Datum of 1988 (NAVD '88), U.S. feet.

FEMA's effective hydraulic model was acquired from the Floodplain Information Report Lewis Wash Mesa County, Colorado, Revised January 7, 2008, by Matrix Design Group, Inc.

The design for the D½ Road Bridge over Lewis Wash was taken from the Preliminary Design Report, Alternative 3 Pre-stressed Concrete Slab Bridge Plan, by Schmueser/Gordon/Meyer Engineers & Surveyors.

The geotechnical investigation for D½ Road Bridge over Lewis Wash, Grand Junction, Colorado, was provided by Mesa County from Huddleston-Berry Engineering and Testing, LLC, January 18, 2011.

4.1 Bridge Criteria

The Mesa County/City of Grand Junction Stormwater Management Manual (SWMM), December 2007 was used as design guidelines and the minimum requirements for hydraulic structure and channel include:

1. Bridge structures must pass the full 100-year event through the structure.
2. Bridge freeboard below the low chord shall be a minimum of 1 foot above the 100-year flood elevation.
3. Single (clear) span bridge is desired.
4. No significant rise in the flood elevation (especially in residential areas) shall occur by the construction of the bridge. The floodplain rise shall be 1 foot or less in rural areas as long as houses are not influenced.
5. Velocities shall be within reasonable limits to maintain channel stability (SWMM Table 805).
6. Minimum thalweg longitudinal gradient of 0.5% for the channel.
7. Channel bank side slopes shall be 2:1 (H: V) or flatter
8. Manning's ***n*** within reasonable range (SWMM Table 802A, 802B, 802C & 802D)
9. Channel flow depth desired to be less than 7 feet outside the low flow section.
10. Channel freeboard shall be 1 foot minimum.

4.2 Site Photos

The following three Pictures 2-1, 2-2 and 2-3 were taken May 7, 2012 of the Lewis Wash channel after construction of the new bridge, but prior to any channel improvements. The Picture 2-4 shows the pre-project D ½ Road culvert.

Figure 2-1 Lewis Wash Bridge As-built for the D ½ Road Bridge Crossing

Figure 2-2 Lewis Wash Channel Pre-Construction Conditions

Figure 2-3 Lewis Wash Channel with Eroded Banks Pre-Construction

Figure 2-4 Old D½ Road Bridge prior to Reconstruction as modeled in FEMA's Effective Model

Figure 2-5 New D½ Road Bridge as modeled in this LOMR

5.0 Hydrology

The upper portion, north of I-70, consists primarily of arid badlands with very little vegetation. Steep slopes and lack of urban development characterize this area. The area at the base of the slopes is positioned on a highly erosive alluvial fan, and has historically generated large sediment loads during peak events. The upper basin consists almost entirely of 'D' classification soils. These soils are generally characterized by low permeability and high runoff.

The lower portion of the watershed, south of I-70, consists of a mixture of low-density subdivisions. This lower portion is characterized by flatter slopes and contains a number of smaller tributary channels. Soils in the lower basin primarily belong to the 'B' hydrologic classification, as defined by the Natural Resource Conservation Service. These soils are generally characterized by relatively high permeability and low runoff. Small, scattered pockets of 'C' and 'D' classifications also exist.

No new hydrologic analysis was performed for this study. The hydrology from the 2008 Floodplain Information Report was incorporated into this report as listed below in Table 1.

Table 1 - Summary of Discharges
From approved Floodplain Information Report Dated January 7, 2008

Flooding Source and Location Lewis Wash	Drainage Area (Square Miles)	Peak Discharges (cfs)				
		Irrigation	10-Year	50-Year	100-Year	500-Year
Upstream of Interstate 70	3.79	32	1,295	2,168	2,618	3,609
Upstream of Interstate 70	4.19	32	1,340	2,262	2,739	3,800
Upstream of Government Highline Canal	6.86	32	1,055	1,377	1,786	2,714
Upstream of F½ Road	6.97	32	1,060	1,386	1,794	2,726
Upstream of Price Ditch	7.30	32	1,093	1,444	1,862	2,818
Upstream of F Road	7.44	32	1,096	1,457	1,857	2,810
Upstream of E½ Road	7.89	32	1,126	1,510	1,920	2,899
Upstream of Interstate 70 Business	7.98	32	1,230	1,517	1,929	2,911
Upstream of Union Pacific Rail Road	8.96	32	1,228	1,675	2,117	3,173
Upstream of Grand Valley Canal	9.49	32	1,235	1,721	2,157	3,221
Upstream of E Road	9.57	32	1,239	1,727	2,163	3,231
Between E Road and D.5 Road	9.71	32	1,253	1,750	2,194	3,278
Upstream of D½ Road	9.85	32	1,173	1,689	2,094	3,127
Between D½ Road and D Road	9.92	32	1,175	1,694	2,100	3,136
Upstream of D Road	10.10	32	1,190	1,718	2,130	3,184
Upstream of Confluence with Colorado River	10.14	32	1,190	1,720	2,132	3,187

6.0 Hydraulic Analysis

The improvements to the Lewis Wash in this study reach were finished with two stages. The first stage, a new 100-year capacity D½ Road Bridge with span length of 28.5 feet was constructed to replace the existing undersized culvert. The second stage, the capacity of the existing channel between E Road and D½ Road was investigated with the new D½ Road Bridge in place and a channel improvement was designed to remove the residual breakout due to the deficient channel sections.

6.1 Replacement of D½ Road Bridge

The new D½ Road Bridge with span length of 28.5' and maximum opening height of 9.3' has the capacity to pass through 100-year flood with 1.2' of freeboard. The improved D½ Road Bridge reduced the extents of the regulatory floodplain upstream of D½ Road.

The following Tables and Figures describe the existing conditions hydraulics of Lewis Wash after the construction of the new D½ Road Bridge:

Table 2 – Lewis Wash As-built HEC-RAS Hydraulic Output for the subject cross section locations in 10-, 50-, 100-, and 500-year flood conditions
Table 3 – Lewis Wash As-built D ½ Rd Bridge HEC-RAS Hydraulic Output Parameters at the structure for a 100-year flood
Figure 3 - Lewis Wash 100-year Flood Profile, FEMA effective model from 2008 (dashed line), and As-built condition with the new bridge 2012 (blue line)
Figure 4 - Lewis Wash As-built Cross Sections showing the 100-year flood results for the existing condition hydraulic analysis
Figure 5 - Annotated FEMA Floodplain Map showing the change in the approximate 100-year floodplain before and after the bridge construction.

The overbank flooding at approximately 800 feet to 1,700 feet upstream of D½ Road was not reduced by the bridge improvement. The conveyance capacity was restricted by the mildly sloped reach (approximately average slope 0.4%) and narrow channel cross sections at approximately 1,100 feet to 1,500 feet upstream of D½ Road. To remove the left overbank flooding and protect the community from 100-year flood, a channel modification project was implemented for this reach to establish appropriate thalweg slope and cross section size.

Table 2 – Lewis Wash _ D ½ Road As-built Hydraulics Output
(New D ½ Road Bridge with Surveyed Existing Condition Channel between D ½ Road and E Road)

HEC-RAS Plan: LW_D0.5 Rd_AB River: RIVER-1 Reach: Reach-1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	13	1173.00	4629.10	4635.17		4635.54	0.001616	4.84	242.51	43.86	0.36
Reach-1	13	1689.00	4629.10	4636.64		4637.11	0.001650	5.48	308.23	45.75	0.37
Reach-1	13	3127.00	4629.10	4637.81	4635.04	4638.94	0.004054	8.54	366.22	55.56	0.59
Reach-1	13.5	2094.00	4630.08	4638.15	4638.15	4640.53	0.012260	12.39	171.18	43.79	0.98
Reach-1	13.5	1173.00	4630.08	4635.97	4635.97	4637.98	0.014136	11.38	103.09	26.00	1.01
Reach-1	13.5	1689.00	4630.08	4637.28	4637.28	4639.54	0.013423	12.06	140.09	31.27	1.00
Reach-1	13.5	3127.00	4630.08	4640.10	4640.10	4642.32	0.008553	12.32	292.47	71.42	0.85
Reach-1	14	2094.00	4631.35	4640.37		4641.62	0.002158	8.98	239.18	56.83	0.66
Reach-1	14	1173.00	4631.35	4638.29		4639.19	0.002406	7.61	154.06	34.39	0.63
Reach-1	14	1689.00	4631.35	4639.59		4640.68	0.002218	8.38	201.63	40.02	0.65
Reach-1	14	3127.00	4631.35	4641.53	4640.45	4643.35	0.002821	10.92	316.68	72.16	0.76
Reach-1	14.3	2094.00	4631.53	4640.30	4638.40	4641.81	0.001856	9.86	212.39	28.66	0.64
Reach-1	14.3	1173.00	4631.53	4638.40	4638.63	4639.26	0.001431	7.42	158.02	28.60	0.56
Reach-1	14.3	1689.00	4631.53	4639.59	4637.65	4640.79	0.001638	8.80	191.97	28.64	0.60
Reach-1	14.3	3127.00	4631.53	4641.18	4640.11	4643.87	0.002954	13.15	237.71	56.50	0.81
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4632.57	4640.75	4639.20	4642.41	0.002310	10.35	202.31	28.73	0.69
Reach-1	14.7	1173.00	4632.57	4638.71	4637.45	4639.75	0.002061	8.15	143.99	28.64	0.64
Reach-1	14.7	1689.00	4632.57	4639.96	4638.47	4641.33	0.002155	9.40	179.76	28.69	0.66
Reach-1	14.7	3127.00	4632.57	4645.08	4640.91	4646.40	0.001152	9.34	388.71	74.80	0.49
Reach-1	15	2094.00	4632.47	4641.44		4642.61	0.001968	8.70	240.68	44.52	0.66
Reach-1	15	1173.00	4632.47	4638.74		4639.86	0.003171	8.48	138.25	33.15	0.73
Reach-1	15	1689.00	4632.47	4640.26		4641.45	0.002420	8.77	192.63	38.44	0.69
Reach-1	15	3127.00	4632.47	4645.92		4646.61	0.000537	6.79	535.96	78.70	0.38
Reach-1	15.5	2194.00	4632.77	4641.81	4641.81	4644.13	0.013210	12.24	179.22	38.92	1.01
Reach-1	15.5	1253.00	4632.77	4640.02	4640.02	4641.84	0.014569	10.85	115.53	32.25	1.01
Reach-1	15.5	1750.00	4632.77	4641.03	4641.03	4643.14	0.013678	11.85	150.26	36.04	1.01
Reach-1	15.5	3278.00	4632.77	4645.85		4647.06	0.003513	8.92	394.06	73.50	0.57
Reach-1	16	2194.00	4634.11	4644.06		4645.90	0.003756	7.78	281.87	48.89	0.57
Reach-1	16	1253.00	4634.11	4642.95		4643.81	0.003663	6.56	191.14	41.85	0.54
Reach-1	16	1750.00	4634.11	4644.08		4644.90	0.003717	7.27	240.86	45.53	0.56
Reach-1	16	3278.00	4634.11	4646.82		4647.95	0.003432	8.61	400.99	73.02	0.56
Reach-1	16.5	2194.00	4636.24	4645.87		4647.02	0.004488	8.80	256.41	46.54	0.62
Reach-1	16.5	1253.00	4636.24	4643.88		4644.68	0.004378	7.18	174.63	37.76	0.59
Reach-1	16.5	1750.00	4636.24	4645.02		4646.01	0.004497	7.98	219.30	41.00	0.61
Reach-1	16.5	3278.00	4636.24	4647.58		4649.05	0.004428	9.80	355.22	74.59	0.64
Reach-1	17	2194.00	4640.00	4648.80	4648.80	4651.24	0.011638	12.55	177.61	432.63	0.96
Reach-1	17	1253.00	4640.00	4648.86	4648.86	4648.87	0.013544	11.36	110.25	27.09	0.99
Reach-1	17	1750.00	4640.00	4647.81	4647.81	4650.13	0.012958	12.22	143.26	30.42	0.99
Reach-1	17	3278.00	4640.00	4651.01	4651.01	4651.09	0.000713	3.83	2059.97	1682.07	0.25
Reach-1	17.5	2194.00	4641.54	4651.99	4650.13	4653.14	0.004542	8.72	273.56	67.54	0.62
Reach-1	17.5	1253.00	4641.54	4649.86		4650.76	0.004926	7.58	165.25	34.75	0.61
Reach-1	17.5	1750.00	4641.54	4651.10		4652.16	0.004778	8.28	215.70	51.90	0.62
Reach-1	17.5	3278.00	4641.54	4652.14	4652.14	4654.55	0.009360	12.66	283.41	67.77	0.89
Reach-1	18	2194.00	4642.15	4653.46	4651.39	4654.04	0.002652	6.84	570.03	560.06	0.47
Reach-1	18	1253.00	4642.15	4651.06	4649.45	4651.98	0.005004	7.71	162.52	33.91	0.62
Reach-1	18	1750.00	4642.15	4652.29	4650.58	4653.36	0.004946	8.35	237.39	165.04	0.63
Reach-1	18	3278.00	4642.15	4655.14	4653.79	4655.36	0.001057	5.04	1267.60	2038.69	0.31
Reach-1	18.5	2163.00	4643.09	4654.19		4655.29	0.004394	8.41	257.20	42.78	0.60
Reach-1	18.5	1239.00	4643.09	4652.57		4653.21	0.003095	6.42	192.87	38.81	0.49
Reach-1	18.5	1727.00	4643.09	4653.63		4654.62	0.003294	7.14	241.96	41.45	0.52
Reach-1	18.5	3231.00	4643.09	4654.92	4653.68	4656.85	0.006879	11.14	298.48	65.01	0.77
Reach-1	19	2163.00	4644.68	4655.20	4653.28	4656.21	0.004344	8.07	268.11	47.76	0.60
Reach-1	19	1239.00	4644.68	4653.27	4651.64	4653.98	0.004222	6.80	182.32	41.21	0.57

Surveyed Existing Condition Cross Sections

As-built D ½ Road Cross Sections

Surveyed Existing Condition Cross Sections

Table 2 – Lewis Wash _ D ½ Road As-built Hydraulics Output
(New D ½ Road Bridge with Surveyed Existing Condition Channel between D ½ Road and E Road)
(Continued)

HEC-RAS Plan: LW_D0.5 Rd_AB River: RIVER-1 Reach: Reach-1 (Continued)

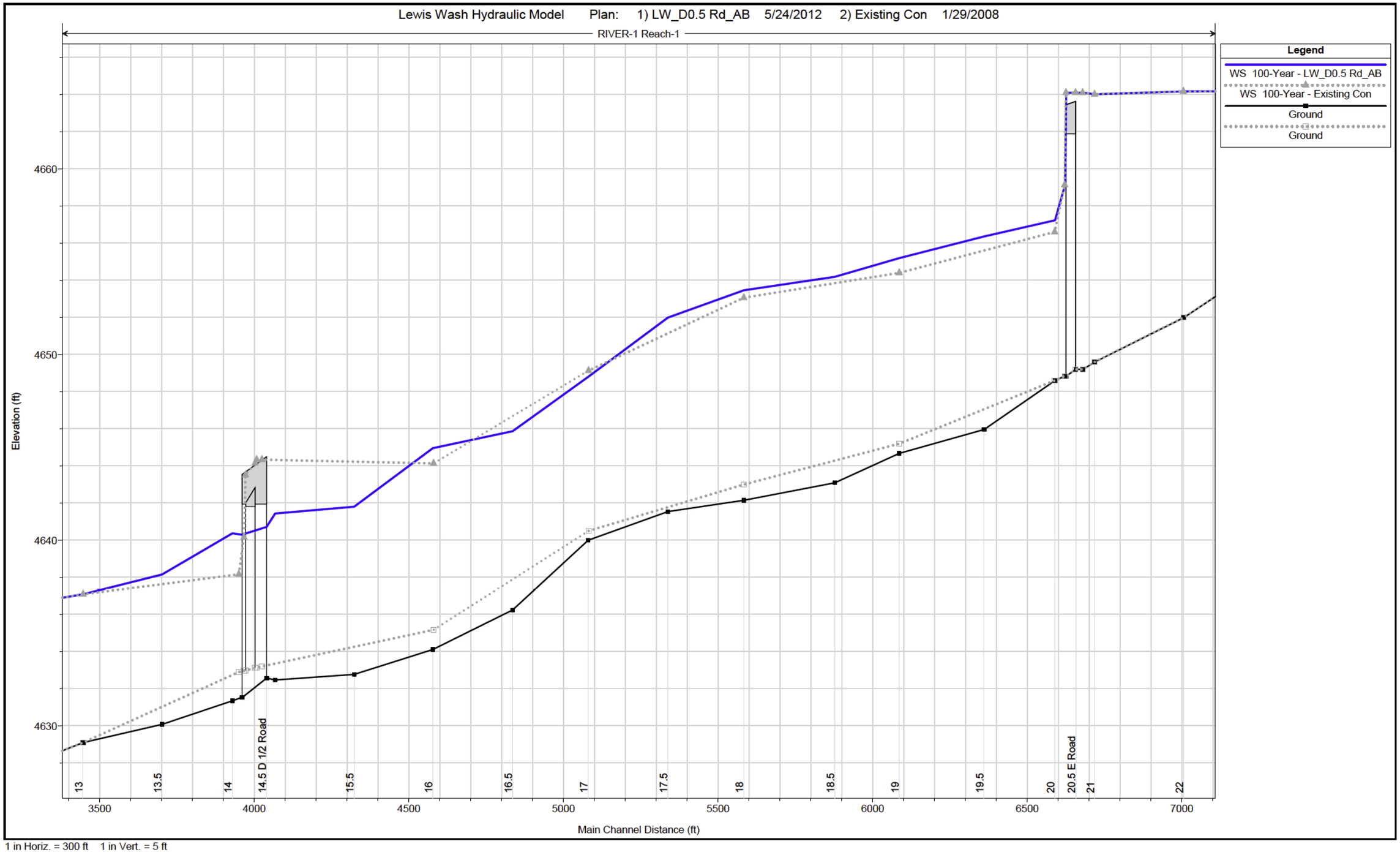
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	19	1727.00	4644.68	4654.55	4652.55	4655.37	0.003866	7.26	237.98	45.57	0.56
Reach-1	19	3231.00	4644.68	4657.08	4654.77	4657.82	0.002715	7.48	681.48	1346.91	0.49
Reach-1	19.5	2163.00	4645.96	4656.36		4657.49	0.004757	8.51	254.15	45.15	0.63
Reach-1	19.5	1239.00	4645.96	4654.39		4655.10	0.004400	7.17	172.90	37.41	0.59
Reach-1	19.5	1727.00	4645.96	4655.59		4656.54	0.004441	7.83	220.53	42.12	0.60
Reach-1	19.5	3231.00	4645.96	4657.49		4659.20	0.006367	10.51	307.44	49.58	0.74
Reach-1	20	2163.00	4648.60	4657.23	4655.86	4658.80	0.005629	10.07	215.26	37.96	0.70
Reach-1	20	1239.00	4648.60	4655.34	4653.89	4656.37	0.005328	8.11	152.70	31.40	0.65
Reach-1	20	1727.00	4648.60	4656.48	4655.01	4657.76	0.005420	9.10	190.00	35.07	0.67
Reach-1	20	3231.00	4648.60	4658.49	4657.39	4660.95	0.006934	12.58	257.59	42.70	0.80
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99
Reach-1	20.3	1239.00	4648.84	4656.83	4656.83	4659.11	0.014362	12.13	102.18	22.21	1.00
Reach-1	20.3	1727.00	4648.84	4658.14	4658.14	4660.75	0.013743	12.95	133.36	25.22	0.99
Reach-1	20.3	3231.00	4648.84	4663.18	4663.18	4663.57	0.001978	6.50	1555.00	1789.48	0.40

Table 3 – Lewis Wash _ D ½ Road Bridge As-built Hydraulics Output

Plan: LW_D0.5 Rd_AB RIVER-1 Reach-1 RS: 14.5 Profile: 100-Year

E.G. US. (ft)	4642.41	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	4640.75	E.G. Elev (ft)	4642.41	4641.82
Q Total (cfs)	2094.00	W.S. Elev (ft)	4640.72	4640.30
Q Bridge (cfs)	2094.00	Crit W.S. (ft)	4639.21	4638.41
Q Weir (cfs)		Max Chl Dpth (ft)	8.15	8.77
Weir Sta Lft (ft)		Vel Total (ft/s)	10.42	9.87
Weir Sta Rgt (ft)		Flow Area (sq ft)	200.88	212.10
Weir Submerg		Froude # Chl	0.64	0.59
Weir Max Depth (ft)		Specif Force (cu ft)	1401.03	1452.18
Min El Weir Flow (ft)	4644.52	Hydr Depth (ft)	7.05	7.44
Min El Prs (ft)	4641.95	W.P. Total (ft)	39.46	39.97
Delta EG (ft)	0.60	Conv. Total (cfs)	25237.1	27395.3
Delta WS (ft)	0.45	Top Width (ft)	28.50	28.50
BR Open Area (sq ft)	236.02	Frctn Loss (ft)	0.50	0.01
BR Open Vel (ft/s)	10.42	C & E Loss (ft)	0.09	0.00
Coef of Q		Shear Total (lb/sq ft)	2.19	1.94
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Figure 3 - Lewis Wash Flood Profile _ D 1/2 Road As-Built Condition
(New D 1/2 Road with Surveyed Existing Condition Channel between D 1/2 Road and E Road)



1 in Horiz. = 300 ft 1 in Vert. = 5 ft

Note: WS 100-Year - Exisitng Condition is the effective profile.

Figure 4 - Lewis Wash _ Cross Sections
(As-built D 1/2 Road Cross Sections with Surveyed Existing Condition Channel between D 1/2 Road and E Road)

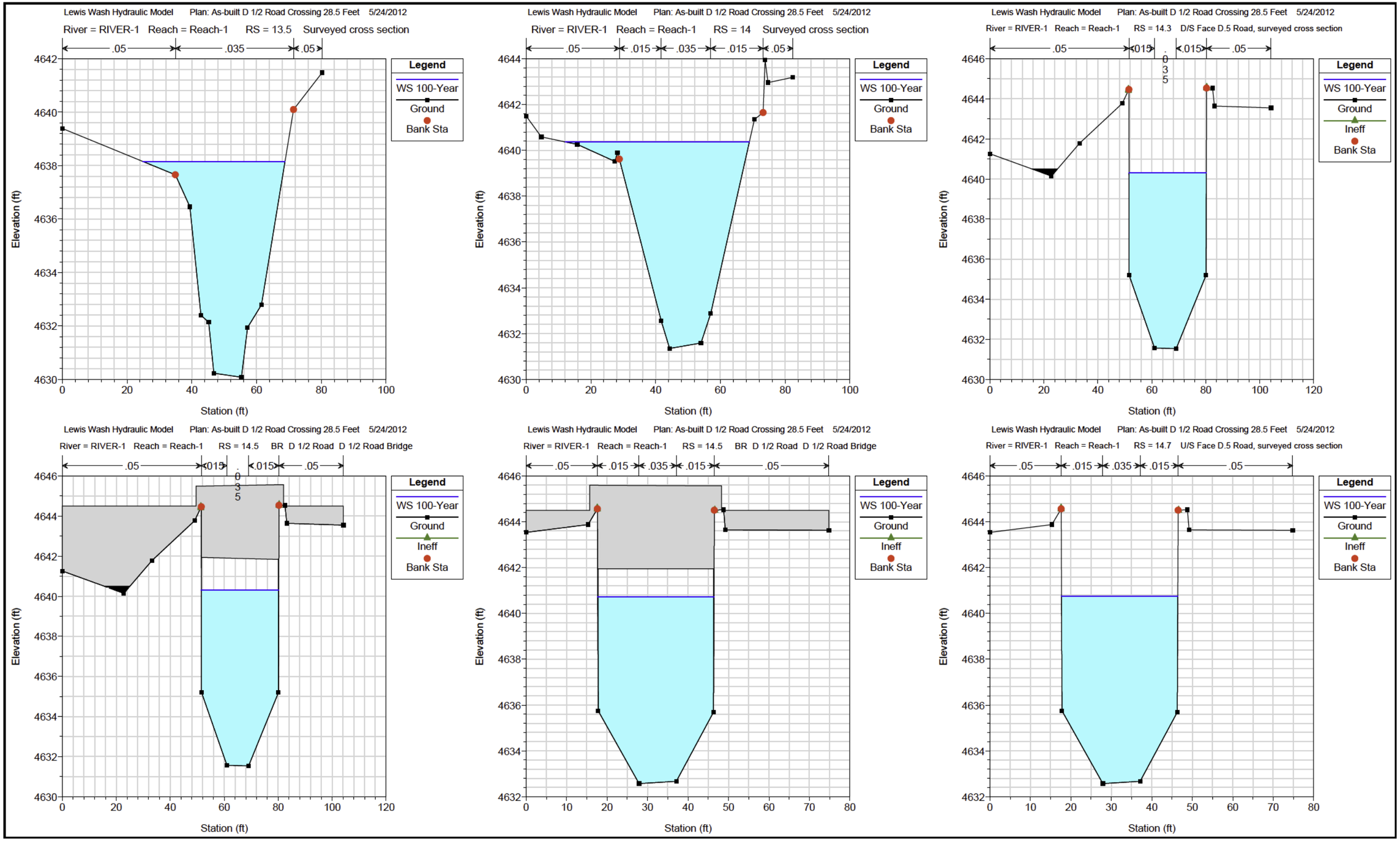


Figure 4 - Lewis Wash _ Cross Sections
(As-built D 1/2 Road Cross Sections with Surveyed Existing Condition Channel between D 1/2 Road and E Road)

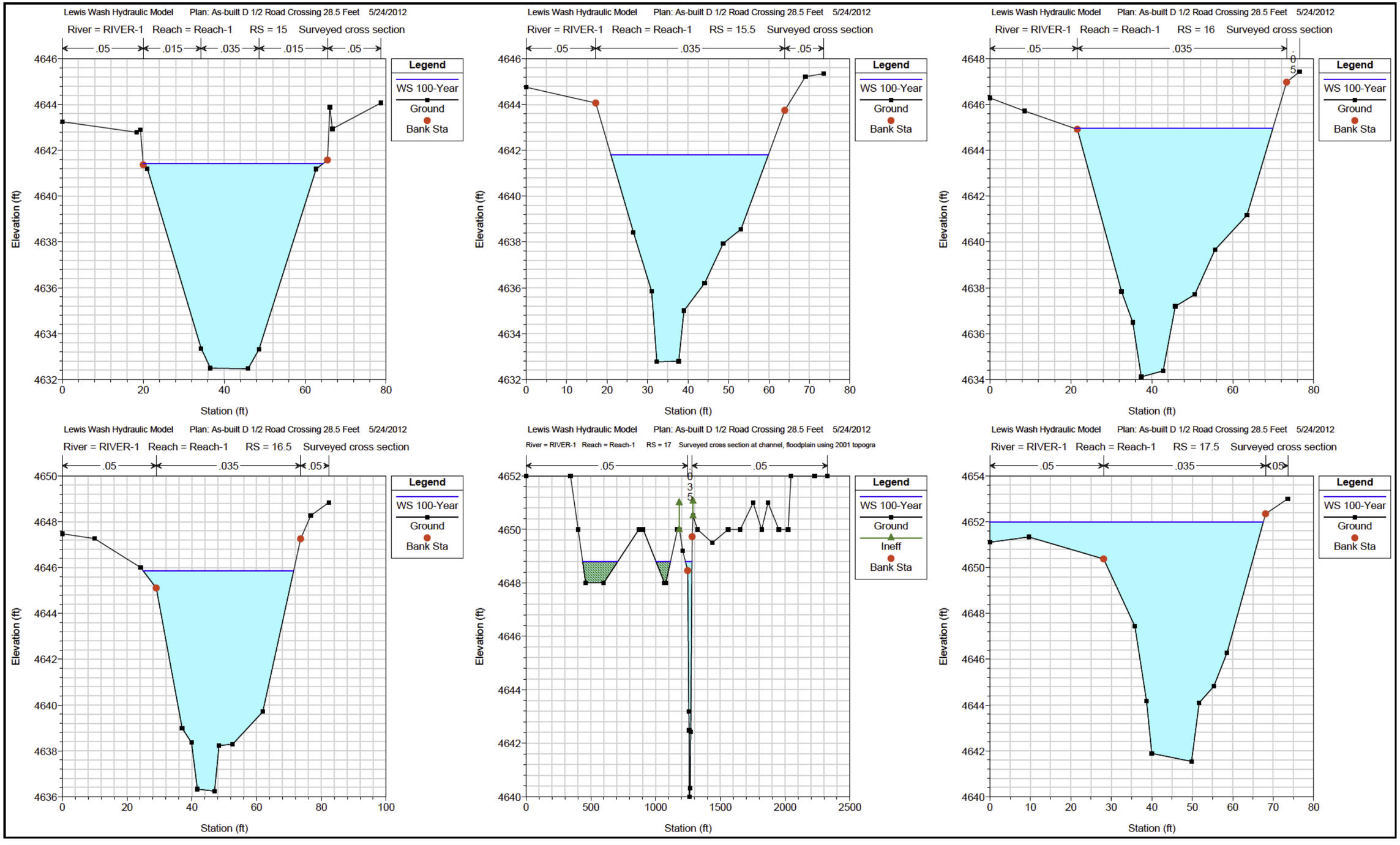


Figure 4 - Lewis Wash _ Cross Sections
(As-built D 1/2 Road Cross Sections with Surveyed Existing Condition Channel between D 1/2 Road and E Road)

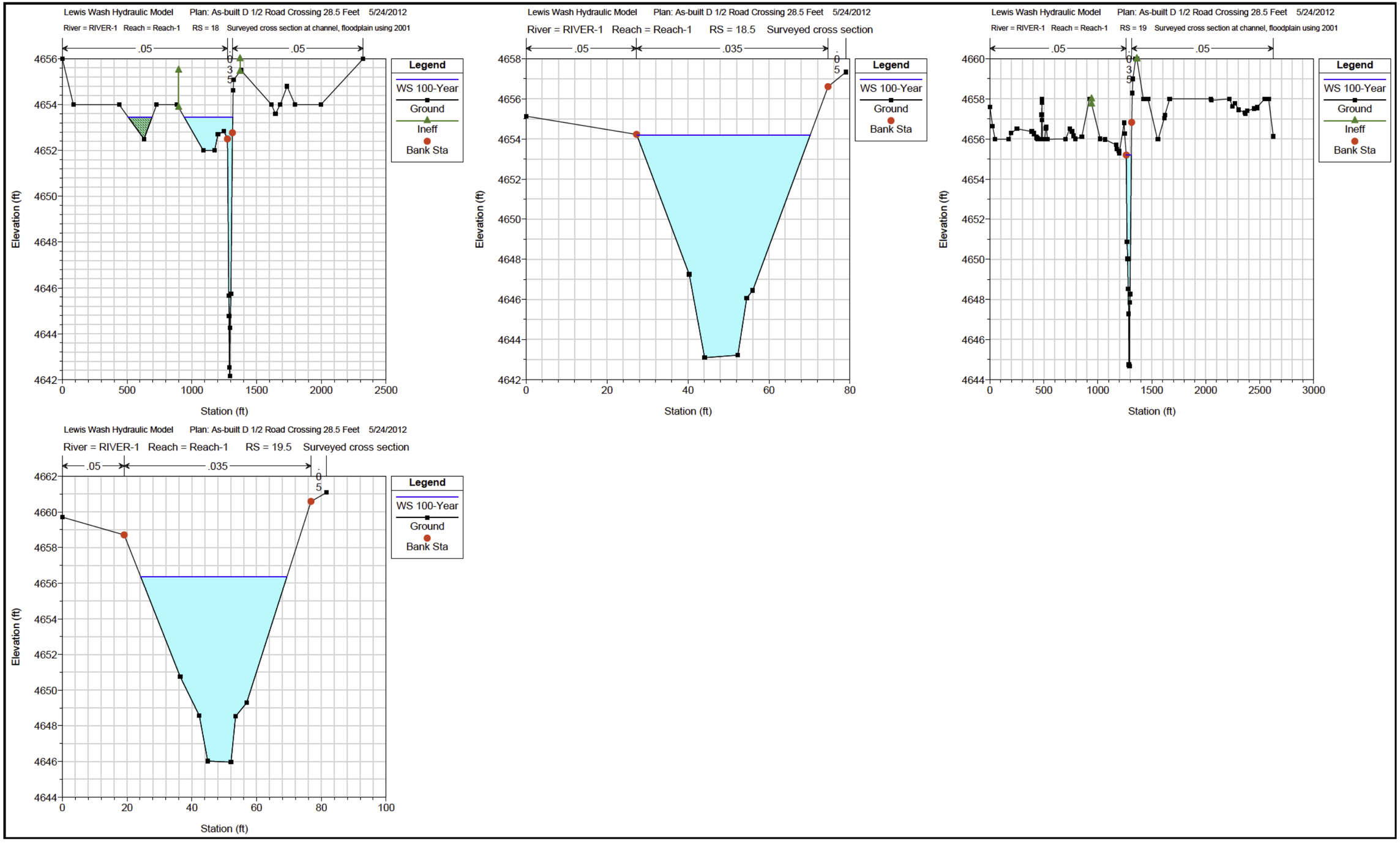
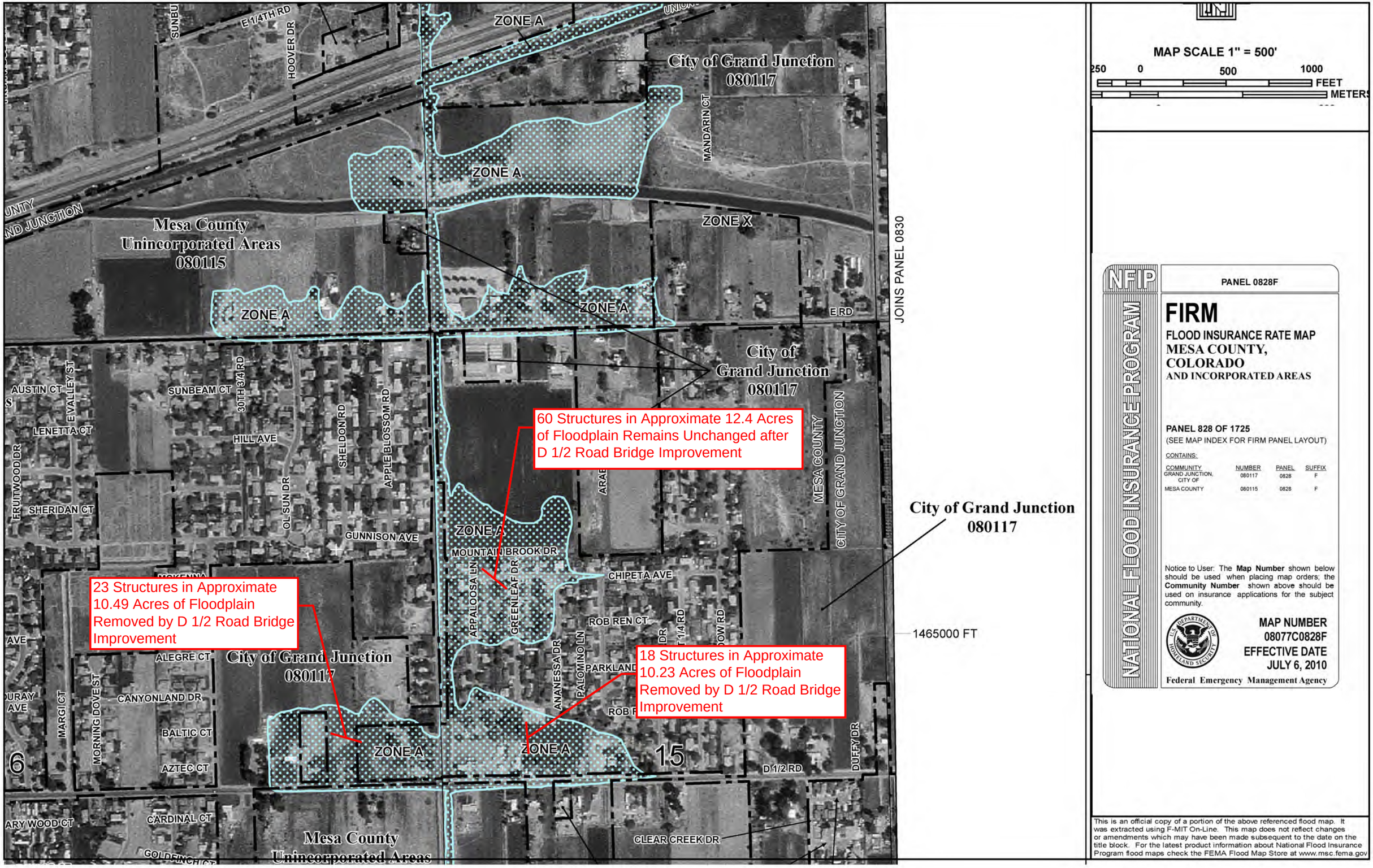


Figure 5 - Annotated Floodplain Map



6.2 Improved Channel Hydraulics

The existing condition HEC-RAS model with new D½ Road Bridge was used as the base model for channel improvement analysis. T he Manning's ***n*** value was determined using SWMM Table 802C. A new geometry file was created in the HEC-RAS model after input of all the required parameters for the proposed channel.

The existing longitudinal slope of the Lewis Wash between D½ Road and E Road was analyzed as shown in Table 4. The average slope is 0.64% from E Road to D½ Road. The pre-construction thalweg had an average slope 0.4% for the reach with deficient conveyance capacity. The improved channel thalweg slope is 0.69% and starts at cross section 16 to end at cross section 18.5 in the hydraulic model.

Table 4 - Lewis Wash - Channel Thalweg Elevation

HEC-RAS Cross Section	Q Total	Channel Thalweg Elevation	As-built W.S. Elevation	Reach Length between Cross Sections	Accumulated Reach Length	Channel Thalweg Slope between Cross	Average Slope between D 1/2 Road and E Road	Average slope between XS 16 to XS 18.5	Note
	(cfs)	(ft)	(ft)	(ft)	(ft)	(%)	(%)	(%)	
20	2163	4648.60	4657.23	229	3143	1.15	0.64	-	D/S of E Road
19.5	2163	4645.96	4656.36	274	2914	0.47		-	
19	2163	4644.68	4655.20	209	2640	0.76		-	
18.5	2163	4643.09	4654.19	294	2431	0.32		0.69	Proposed reach for channel modification
18	2194	4642.15	4653.46	246	2137	0.25			
17.5	2194	4641.54	4651.99	258	1891	0.60			
17	2194	4640.00	4648.80	245	1634	1.54			
16.5	2194	4636.24	4645.87	258	1389	0.83			
16	2194	4634.11	4644.96	255	1131	0.53			
15.5	2194	4632.77	4641.81	256	877	0.12		-	
15	2094	4632.47	4641.44	27	621	-0.38		-	U/S of D 1/2 Road

The proposed channel modification is a minimum 1533-foot section of channel from the projection of Ouray Avenue to Palomino Way that needs to be reshaped with a trapezoidal cross section with a 5 feet bottom width and 2:1 (H:V) side slopes. The parameters of right-of-way, construction and maintenance requirements were considerations in the design of the cross section. Flatter side slopes were used where there was adequate land area and easements for a wider channel section. Figure 6 shows the trapezoidal cross sections pre- and proposed-construction conditions.

The channel was excavated to fully contain the 100-year flood. In some areas, the channel was lowered by as much as 2.2 feet. With this excavation, the 100-year floodplain is contained within the channel section. The reconstructed channel has a minimum 1 foot of freeboard during a 100-year flood. The results of the post-construction conditions channel are shown in the following figures and tables:

Table 5 – Lewis Wash Hydraulic Output parameters by cross section for the improved reach for the 10-, 50-, 100-, and 500-year flood conditions
Figure 7 - Lewis Wash 100-year Flood Profile, pre- construction (dashed) and post-construction (solid)
Figure 8 - Lewis Wash Cross Sections show the results of post-construction hydraulic analysis for a 100-year flood

The downstream limit of the floodplain hydraulic analysis is Cross Section 13 from the effective HEC-RAS model. This cross section is located approximately 500 feet from downstream face of the new D½ Road Bridge. FEMA Cross Section 20.3 is the most upstream cross section for this studied reach. This cross section is located downstream of the E Road Bridge. The FEMA Flood Insurance Rate Map (FIRM) is included in Appendix B and it illustrates the location of all FEMA Cross sections in the project area.

The average post-construction longitudinal slope along the study reach is 0.0062 feet per foot. The channel characteristics are uniform throughout the study reach as a canal-like channel clean of vegetation and debris with an average Manning's roughness coefficient of 0.035.

Table 5 - Lewis Wash LOMR
(As-built D 1/2 Road Bridge and Channel between D 1/2 Road and E Road)

HEC-RAS Plan: AB Road Channel River: RIVER-1 Reach: Reach-1

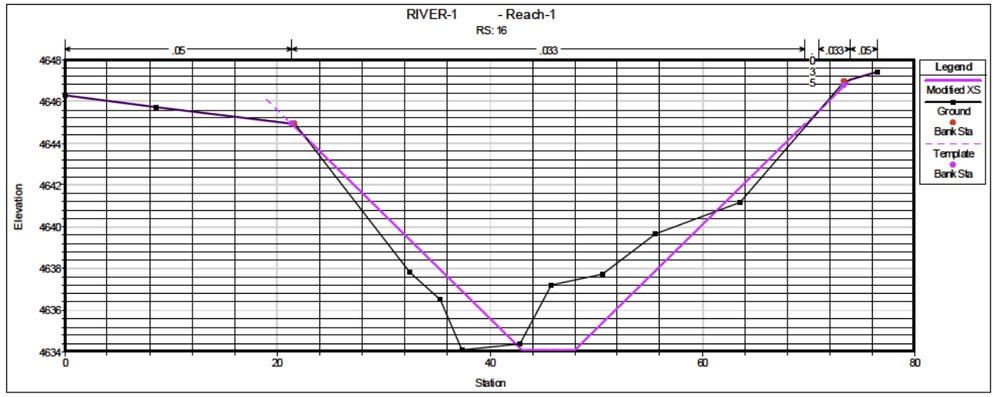
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	13	1173.00	4629.10	4635.17		4635.54	0.001616	4.84	242.51	43.86	0.36
Reach-1	13	1689.00	4629.10	4636.64		4637.11	0.001650	5.48	308.23	45.75	0.37
Reach-1	13	3127.00	4629.10	4637.81	4635.04	4638.94	0.004054	8.54	366.22	55.56	0.59
Reach-1	13.5	2094.00	4630.00	4637.83	4637.83	4640.36	0.012871	12.76	164.06	32.82	1.01
Reach-1	13.5	1173.00	4630.00	4635.88	4635.88	4637.81	0.013776	11.15	105.19	27.49	1.00
Reach-1	13.5	1689.00	4630.00	4637.04	4637.04	4639.33	0.013223	12.16	138.92	30.66	1.01
Reach-1	13.5	3127.00	4630.00	4640.03	4640.03	4642.43	0.008625	12.63	275.58	70.52	0.86
Reach-1	14	2094.00	4631.35	4640.21		4641.53	0.002366	9.25	230.33	52.03	0.68
Reach-1	14	1173.00	4631.35	4638.11		4639.09	0.002714	7.92	148.07	33.79	0.67
Reach-1	14	1689.00	4631.35	4639.37		4640.55	0.002521	8.75	193.12	38.08	0.68
Reach-1	14	3127.00	4631.35	4641.75	4640.45	4643.42	0.002361	10.51	332.35	73.23	0.73
Reach-1	14.3	2094.00	4631.53	4640.15	4638.40	4641.72	0.001976	10.07	208.01	28.66	0.66
Reach-1	14.3	1173.00	4631.53	4638.28	4636.63	4639.17	0.001533	7.59	154.52	28.60	0.58
Reach-1	14.3	1689.00	4631.53	4639.38	4637.65	4640.66	0.001799	9.07	186.15	28.63	0.63
Reach-1	14.3	3127.00	4631.53	4641.38	4640.11	4643.95	0.002751	12.84	243.48	59.37	0.78
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4632.57	4640.63	4639.20	4642.35	0.002435	10.53	198.83	28.72	0.71
Reach-1	14.7	1173.00	4632.57	4638.62	4637.45	4639.69	0.002192	8.31	141.16	28.63	0.66
Reach-1	14.7	1689.00	4632.57	4639.80	4638.47	4641.24	0.002336	9.65	175.08	28.69	0.69
Reach-1	14.7	3127.00	4632.57	4645.08	4640.91	4646.40	0.001154	9.34	388.42	74.80	0.49
Reach-1	15	2094.00	4632.47	4641.33		4642.55	0.002066	8.87	236.16	43.56	0.67
Reach-1	15	1173.00	4632.47	4638.64		4639.81	0.003414	8.69	134.94	32.79	0.76
Reach-1	15	1689.00	4632.47	4640.09		4641.37	0.002681	9.07	186.16	37.85	0.72
Reach-1	15	3127.00	4632.47	4645.92		4646.61	0.000537	6.79	535.77	78.70	0.38
Reach-1	15.5	2194.00	4633.00	4641.65	4641.65	4644.07	0.013175	12.49	175.71	36.69	1.01
Reach-1	15.5	1253.00	4633.00	4639.79	4639.79	4641.68	0.014189	11.02	113.73	30.23	1.00
Reach-1	15.5	1750.00	4633.00	4640.83	4640.83	4643.03	0.013697	11.92	146.85	33.83	1.01
Reach-1	15.5	3278.00	4633.00	4645.81		4647.08	0.003619	9.11	384.04	71.94	0.57
Reach-1	16	2194.00	4634.50	4644.89		4645.84	0.003753	7.83	280.35	47.81	0.57
Reach-1	16	1253.00	4634.50	4642.79		4643.49	0.003828	6.70	186.92	41.17	0.55
Reach-1	16	1750.00	4634.50	4643.98		4644.82	0.003760	7.34	238.35	44.94	0.56
Reach-1	16	3278.00	4634.50	4646.85		4647.99	0.003471	8.61	389.62	72.12	0.57
Reach-1	16.5	2194.00	4636.90	4645.81		4647.07	0.005239	9.00	243.75	43.84	0.67
Reach-1	16.5	1253.00	4636.90	4643.78		4644.72	0.005382	7.76	161.47	37.45	0.66
Reach-1	16.5	1750.00	4636.90	4644.93		4646.05	0.005287	8.48	206.38	41.06	0.67
Reach-1	16.5	3278.00	4636.90	4647.62		4649.17	0.004890	9.99	332.03	65.78	0.67
Reach-1	17	2194.00	4638.30	4646.92	4646.61	4649.11	0.010590	11.88	184.69	35.74	0.92
Reach-1	17	1253.00	4638.30	4645.11	4644.71	4646.67	0.010177	10.05	124.66	30.34	0.87
Reach-1	17	1750.00	4638.30	4646.13	4645.80	4648.05	0.010450	11.12	157.35	33.39	0.90
Reach-1	17	3278.00	4638.30	4648.46	4648.30	4651.28	0.011168	13.48	243.22	324.47	0.97
Reach-1	17.5	2194.00	4641.00	4649.75		4651.36	0.006944	10.20	215.20	38.54	0.76
Reach-1	17.5	1253.00	4641.00	4647.69		4648.90	0.007191	8.83	141.87	32.81	0.75
Reach-1	17.5	1750.00	4641.00	4648.85		4650.29	0.007026	9.62	181.89	36.05	0.75
Reach-1	17.5	3278.00	4641.00	4651.60	4650.31	4653.56	0.006649	11.22	297.53	66.58	0.76
Reach-1	18	2194.00	4642.16	4651.48	4650.63	4653.22	0.007973	10.59	207.14	38.45	0.80
Reach-1	18	1253.00	4642.16	4649.49	4648.73	4650.79	0.008004	9.14	137.14	31.97	0.78
Reach-1	18	1750.00	4642.16	4650.61	4649.80	4652.17	0.008022	10.00	175.01	35.62	0.80
Reach-1	18	3278.00	4642.16	4654.11	4653.59	4654.64	0.002517	7.00	861.97	1550.49	0.47
Reach-1	18.5	2163.00	4643.73	4654.00		4654.96	0.003560	7.90	273.86	43.87	0.56
Reach-1	18.5	1239.00	4643.73	4651.73		4652.44	0.003440	6.76	183.22	36.33	0.53
Reach-1	18.5	1727.00	4643.73	4653.02		4653.88	0.003515	7.42	232.67	40.62	0.55
Reach-1	18.5	3231.00	4643.73	4654.58		4656.38	0.006226	10.77	300.07	45.88	0.74
Reach-1	19	2163.00	4645.29	4654.69	4653.11	4655.94	0.005243	8.96	241.27	43.17	0.67
Reach-1	19	1239.00	4645.29	4652.45	4651.27	4653.46	0.005912	8.09	153.20	35.22	0.68
Reach-1	19	1727.00	4645.29	4653.72	4652.32	4654.87	0.005480	8.59	201.04	39.74	0.67
Reach-1	19	3231.00	4645.29	4656.06	4654.72	4657.74	0.006683	10.49	348.49	661.56	0.76
Reach-1	19.5	2163.00	4646.34	4656.15		4657.52	0.006054	9.38	230.67	42.38	0.71
Reach-1	19.5	1239.00	4646.34	4654.07		4655.11	0.006069	8.19	151.19	33.88	0.68

HEC-RAS Plan: AB Road Channel River: RIVER-1 Reach: Reach-1 (Continued)

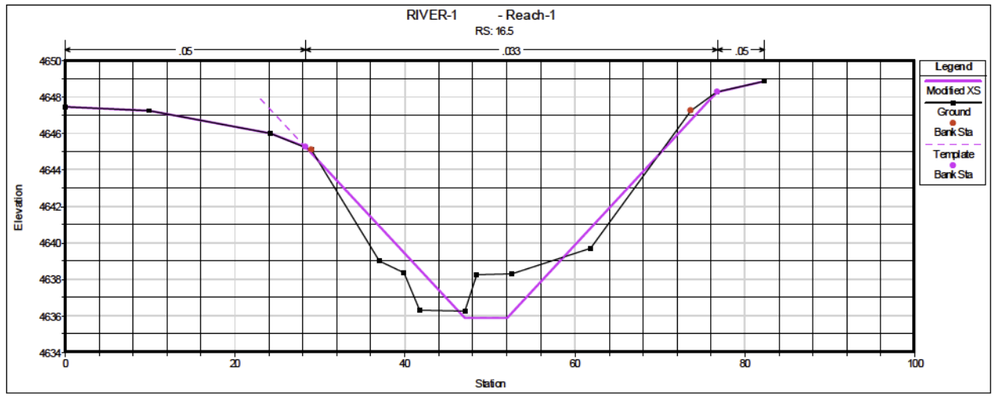
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	19.5	1727.00	4646.34	4655.25		4656.48	0.006107	8.90	193.96	38.69	0.70
Reach-1	19.5	3231.00	4646.34	4657.82		4659.54	0.006343	10.53	306.72	49.15	0.74
Reach-1	20	2163.00	4648.60	4657.35	4655.86	4658.86	0.005313	9.89	219.07	38.38	0.68
Reach-1	20	1239.00	4648.60	4655.40	4653.89	4656.40	0.005164	8.02	154.47	31.55	0.64
Reach-1	20	1727.00	4648.60	4656.52	4655.01	4657.79	0.005280	9.03	191.51	35.25	0.66
Reach-1	20	3231.00	4648.60	4658.87	4657.39	4661.10	0.005923	12.00	270.14	44.11	0.74
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99
Reach-1	20.3	1239.00	4648.84	4656.83	4656.83	4659.11	0.014362	12.13	102.18	22.21	1.00
Reach-1	20.3	1727.00	4648.84	4658.14	4658.14	4660.75	0.013743	12.95	133.36	25.22	0.99
Reach-1	20.3	3231.00	4648.84	4663.18	4663.18	4663.57	0.001978	6.50	1555.00	1789.48	0.40

Figure 6 - Proposed Channel Cross Section Modification

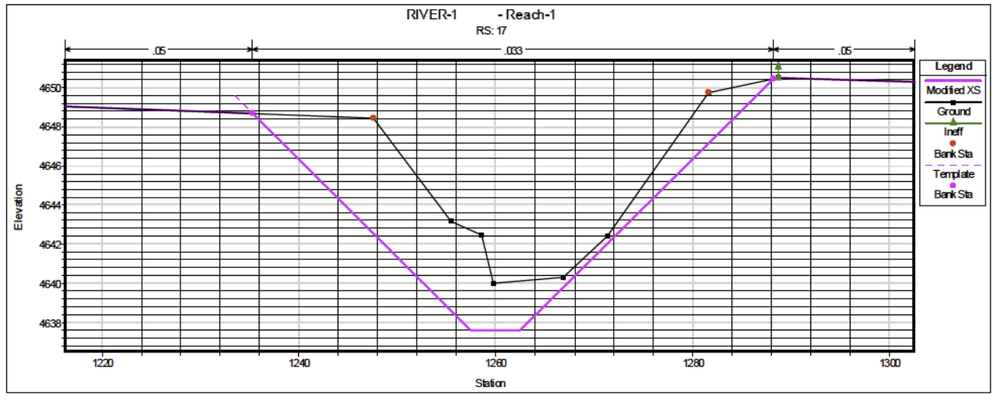
Cross Section 16



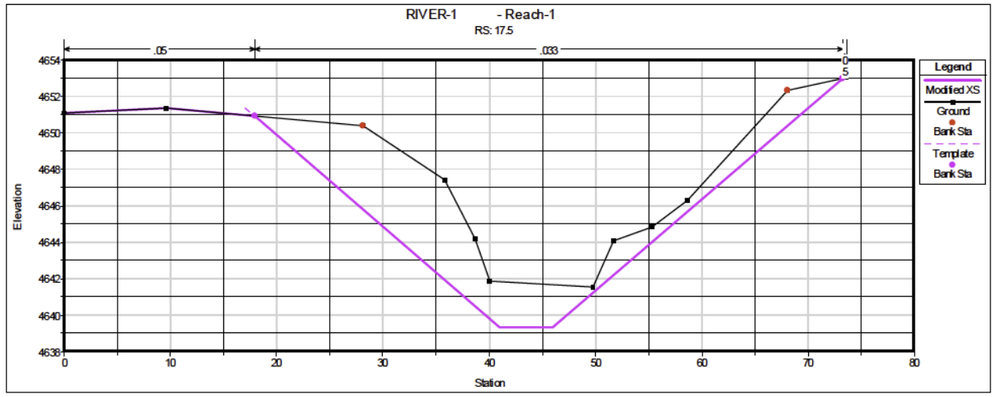
Cross Section 16.5



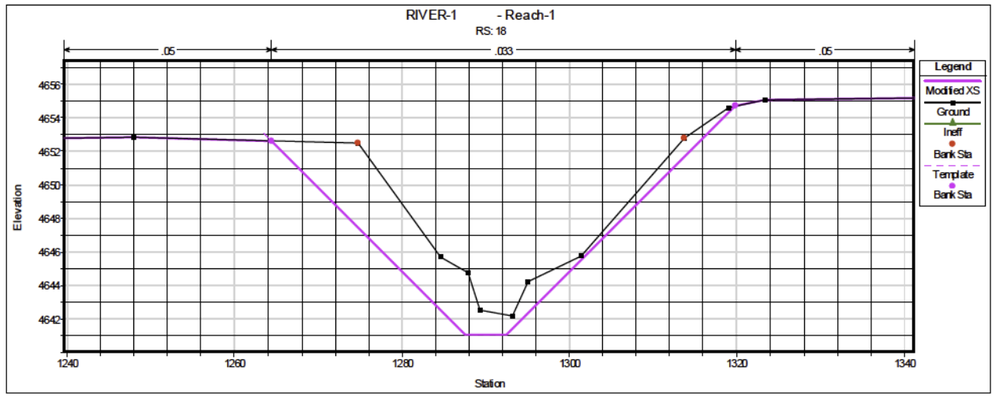
Cross Section 17



Cross Section 17.5



Cross Section 18



Cross Section 18.5

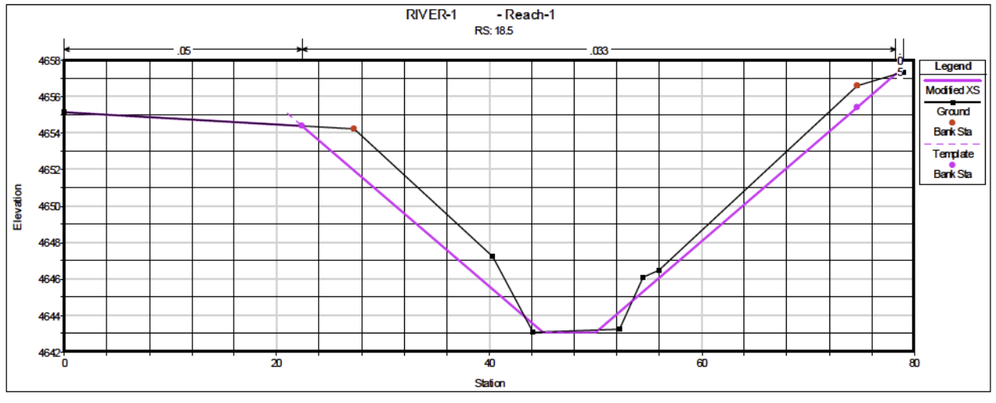
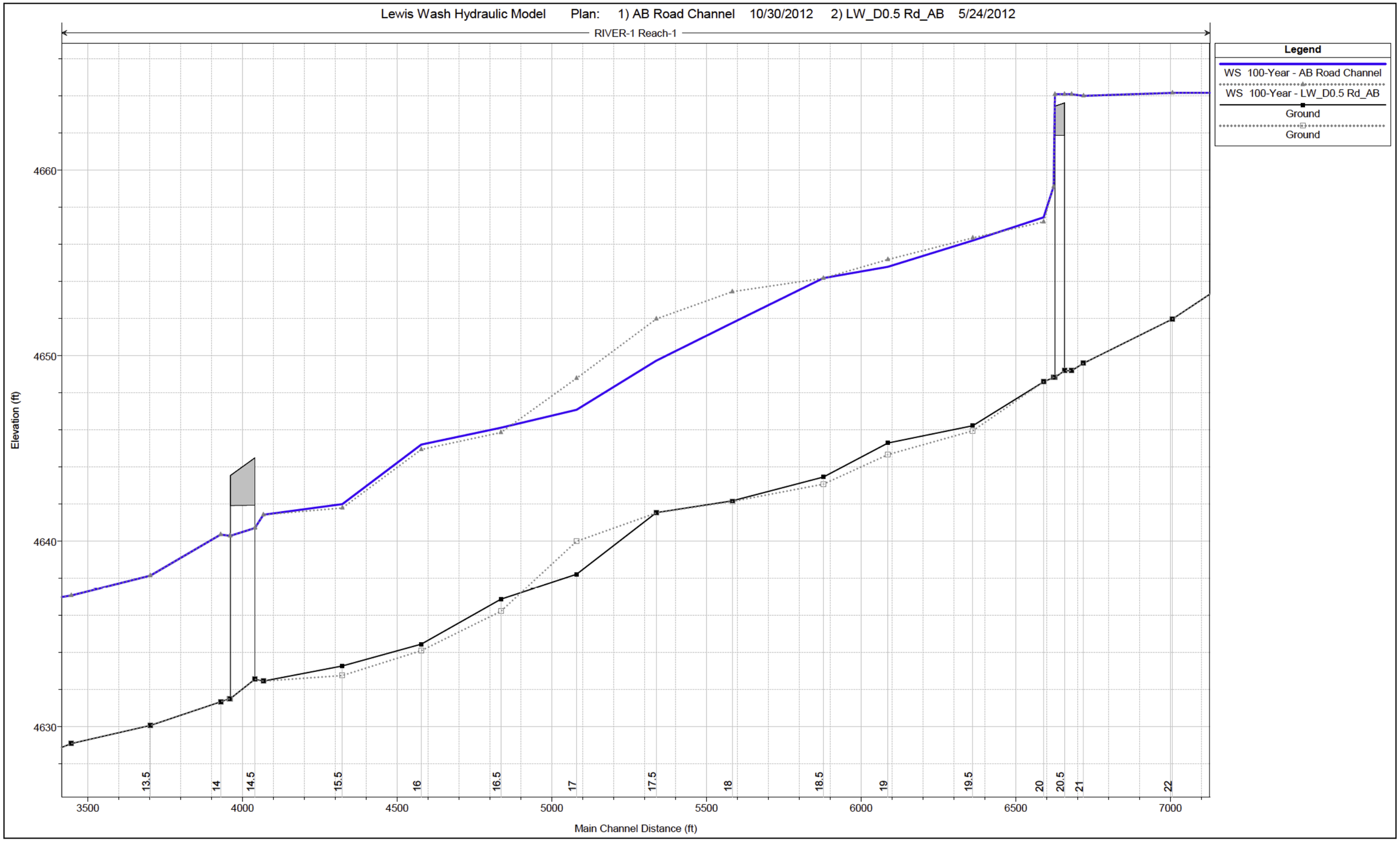


Figure 7 - Lewis Wash 100-year Flood Profile, Pre-construction (dashed) and Post-construction (solid)



1 in Horiz. = 300 ft 1 in Vert. = 5 ft

Figure 8 - Lewis Wash _ Post-construction Cross Sections
D 1/2 Road to E Road

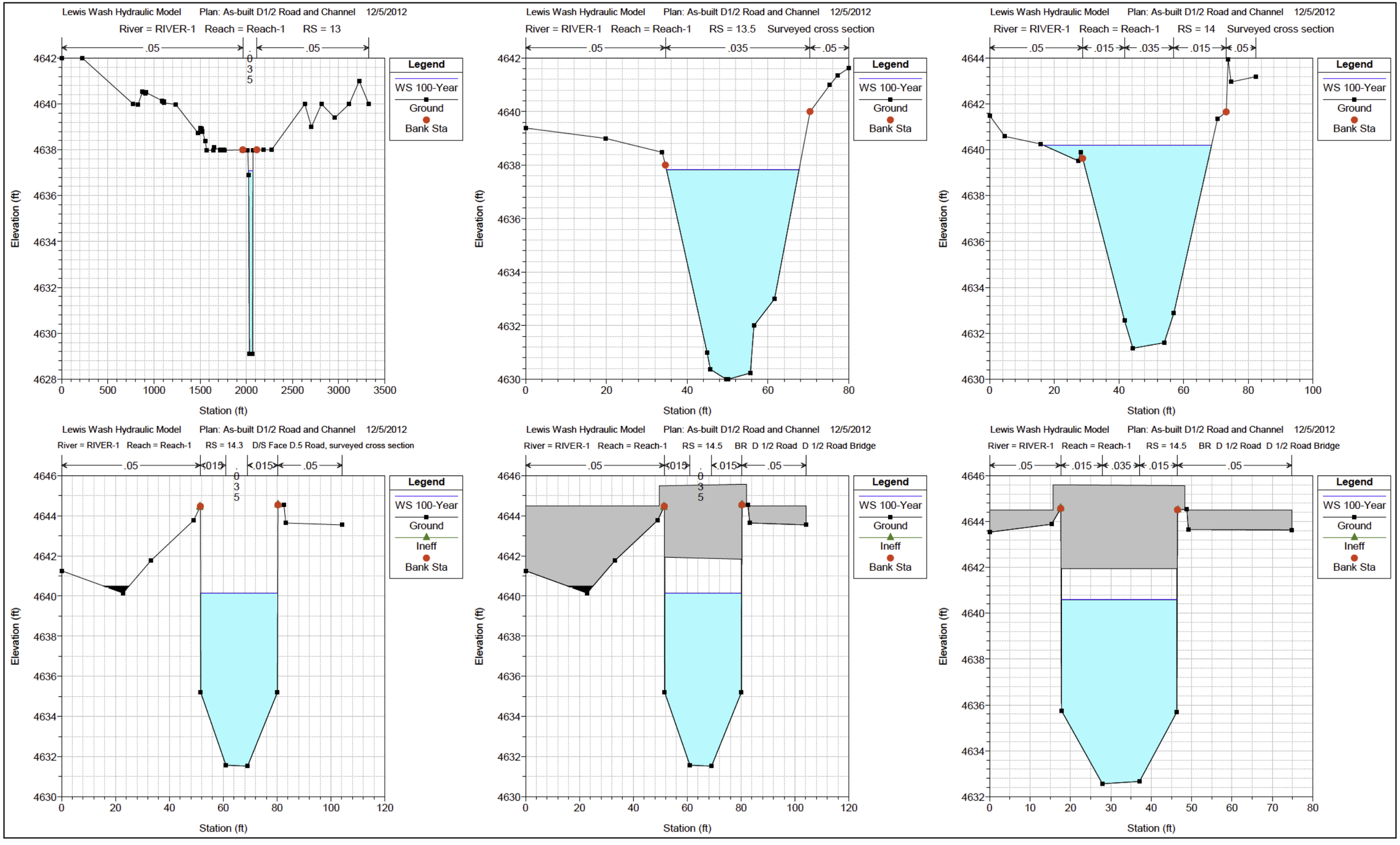


Figure 8 - Lewis Wash _ Post-construction Cross Sections
D 1/2 Road to E Road

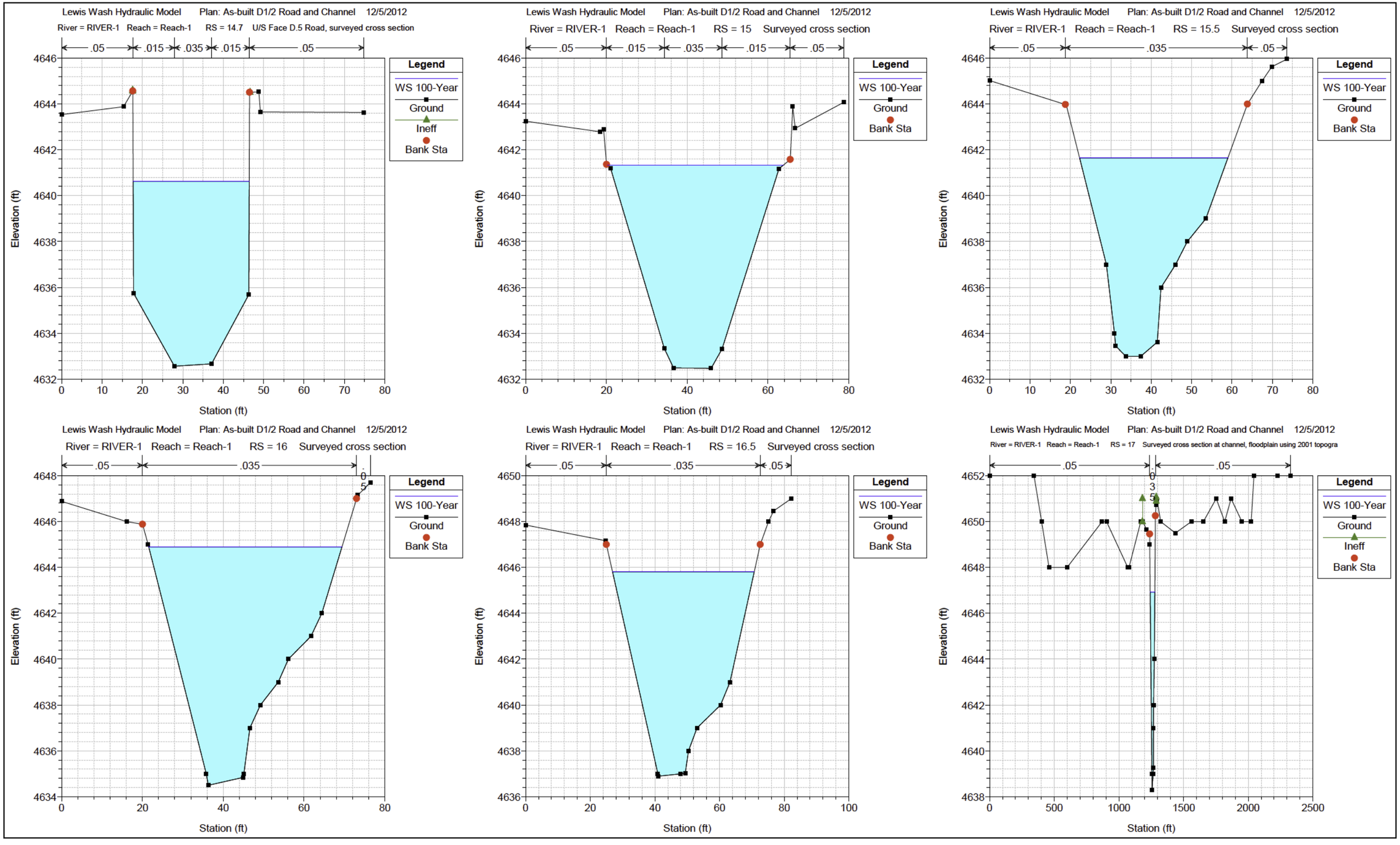
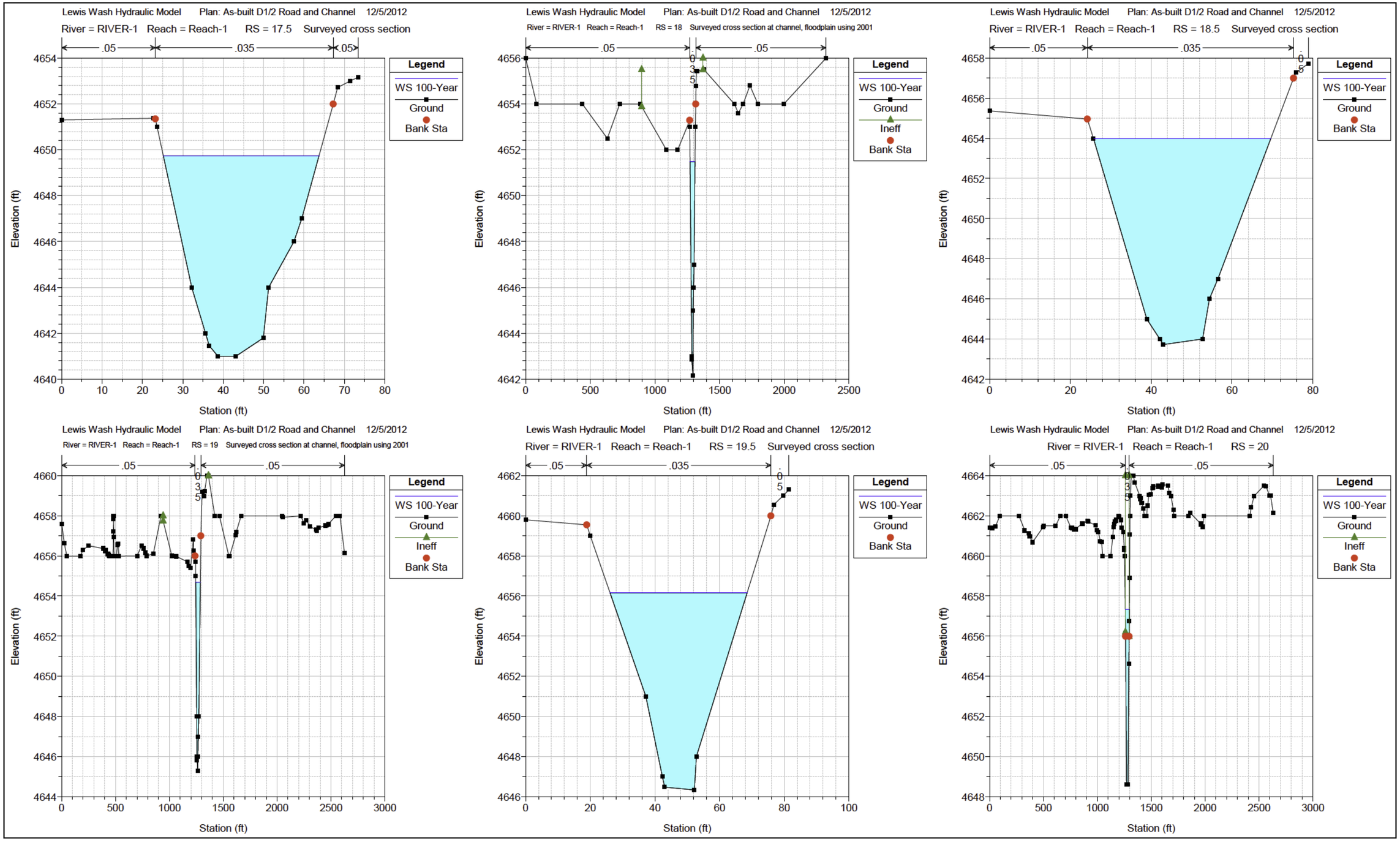


Figure 8 - Lewis Wash _ Post-construction Cross Sections
D 1/2 Road to E Road



6.3 Survey Information

As-built information was surveyed by Matrix Design Group, Inc. on May 7, 2012 and November 30, 2012 as described in Section 4.0.

6.4 Modeling

The U.S. Army Corp of Engineers HEC-RAS program version 4.1.0 was used to calculate the water surface elevations for the pre-project condition and post-project condition. The HEC-RAS hydraulic analysis that was completed for Lewis Wash is presented below.

Effective Model

The effective condition HEC-RAS model was provided by Mesa County which was previously run using the older version of HEC-RAS 3.1.0. The HEC-RAS output for the model is included in Appendix C and a copy of HEC-RAS input and output digital file in included in the compact disc.

Duplicate Effective Model

The effective model was reproduced in HEC-RAS 4.1.0 to ensure that the effective model's input data was transferred correctly and to ensure that the revised data will be integrated in the effective data to provide a continuous FIS model upstream and downstream of the revised reach. The duplicated model using HEC-RAS 4.1.0 generated exactly the same output compared with the effective model output. Table 6 shows the water surface comparison.

Manning's "n" values used in the duplicated effective model were 0.035 for the channel and 0.050 for the over-banks. These are the same Manning's "n" values that were used in the FEMA Effective model. A copy of the duplicated model input and output was included in Appendix C.

Table 6 - Output Comparison
(Duplicated Effective vs. Regulatory Effective Model)

Model Cross Section ID	$Q_{100\text{-year}}$ Total (cfs)	Channel Thalweg (ft)	W.S. Elevation (NAVD 88) (ft)		W.S. Elevation Discrepancy (ft)
			Effective Model HEC-RAS 3.1.0 Output	Duplicated Effective Model HEC-RAS 4.1.0 Output	
13	2,094	4629.1	4637.1	4637.1	**0.0**
14	2,094	4632.9	4638.2	4638.2	**0.0**
14.3	2,094	4633.0	4640.2	4640.2	**0.0**
14.5	D 1/2 Road Bridge				
14.7	2,094	4633.1	4644.3	4644.3	**0.0**
15	2,094	4633.2	4644.3	4644.3	**0.0**
16	2,194	4635.2	4644.1	4644.1	**0.0**
17	2,194	4640.5	4649.1	4649.1	**0.0**
18	2,194	4643.0	4653.1	4653.1	**0.0**
19	2,163	4645.2	4654.4	4654.4	**0.0**
20	2,163	4648.6	4656.6	4656.6	**0.0**
20.3	2,163	4648.8	4659.1	4659.1	**0.0**

Corrected Effective (Existing Condition) Model

A corrected effective/existing condition model was established and used as base model for this study. Four effective cross sections (FEMA Cross Sections16, 17, 18 & 19) were updated with surveyed information. Six new cross sections were inserted in between the effective cross sections to reduce the average cross section spacing from approximately 500 feet down to approximately 250 feet. The corrected effective/existing condition model offered more and better detailed hydraulic information which facilitated the hydraulic analysis for D½ Road design study and channel improvement study between D½ Road and E Road. The corrected effective also offered a base for comparison of the hydraulics changes physically on a cross section by cross section basis. The Table 7 shows the model output comparison between effective model and corrected effective model and Figure 9 shows the flood profiles comparison.

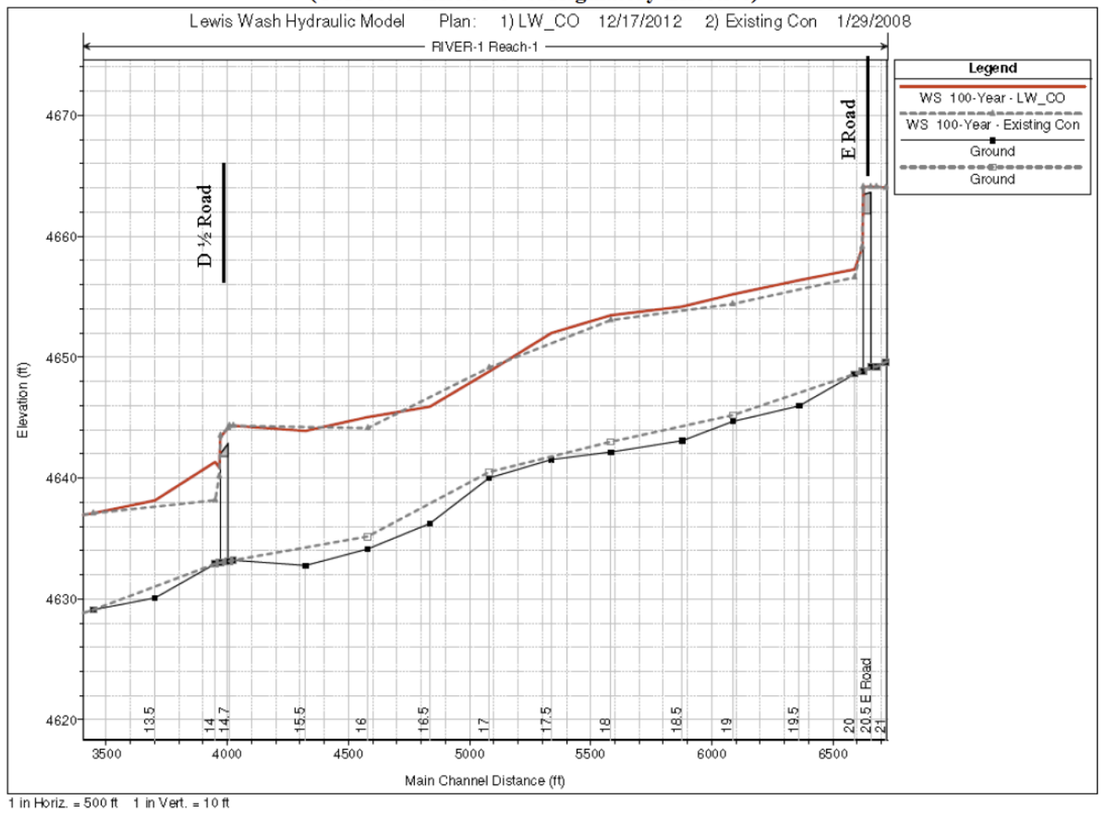
Manning's "n" values used in the corrected effective model were 0.035 for the channel and 0.050 for the over-banks. These are the same Manning's "n" values that were used in the FEMA Effective model. A copy of the corrected effective model input and output was included in Appendix C.

The water surface elevations were seen generally higher than the regulatory effective water surface elevation throughout the study reach. This is usually seen in the HEC-RAS model with more densely spaced cross sections. Especially cross section 14, the effective regulatory model couldn't balance the energy calculation, so forced the water surface elevation to be at the critical depth which showed much lower water depth compared to the corrected model.

Table 7 - Output Comparison
(Corrected Effective vs. Regulatory Effective Model)

Regulatory Effective Model HEC-RAS 3.1.0 Output				Corrected Effective Model HEC-RAS 4.1.0 Output				W.S. Elevation Discrepancy (Corrected - Regulatory) (ft)
Model Cross Section ID	$Q_{100\text{-year}}$ Total (cfs)	Channel Thalweg (ft)	W.S. Elevation (NAVD 88) (ft)	Model Cross Section ID	$Q_{100\text{-year}}$ Total (cfs)	Channel Thalweg (ft)	W.S. Elevation (NAVD 88) (ft)	
13	2,094	4629.1	4637.1	**13**	2,094	4629.1	4637.1	**0.0**
-	-	-	-	**13.5**	2,094	4630.1	4638.2	**-**
14	2,094	4632.9	4638.2	**14**	2,094	4632.9	4641.3	**3.2**
14.3	2,094	4633.0	4640.2	**14.3**	2,094	4633.0	4640.9	**0.7**
14.5	2,094	D 1/2 Road Bridge		**14.5**	2,094	D 1/2 Road Bridge		
14.7	2,094	4633.1	4644.3	**14.7**	2,094	4633.1	4644.3	**0.0**
15	2,094	4633.2	4644.3	**15**	2,094	4633.2	4644.3	**0.0**
-	-	-	-	**15.5**	2,194	4632.8	4643.9	**-**
16	2,194	4635.2	4644.1	**16**	2,194	4634.1	4645.0	**0.9**
-	-	-	-	**16.5**	2,194	4636.2	4645.9	**-**
17	2,194	4640.5	4649.1	**17**	2,194	4640.0	4648.8	**-0.3**
-	-	-	-	**17.5**	2,194	4641.5	4652.0	**-**
18	2,194	4643.0	4653.1	**18**	2,194	4642.2	4653.5	**0.4**
-	-	-	-	**18.5**	2,163	4643.1	4654.2	**-**
19	2,163	4645.2	4654.4	**19**	2,163	4644.7	4655.2	**0.8**
-	-	-	-	**19.5**	2,163	4646.0	4656.4	**-**
20	2,163	4648.6	4656.6	**20**	2,163	4648.6	4657.3	**0.7**
20.3	2,163	4648.8	4659.1	**20.3**	2,163	4648.8	4659.1	**0.0**

Figure 9 – Flood Profile Comparison
(Corrected Effective vs. Regulatory Effective)



Post-Project (As-built Condition) Model

The corrected effective model was then revised to create the as-built condition model. The as-built bridge plan and associated as-built channel improvement grading plan were incorporated into the model. Stamped as-built plans can be found in Appendix A.

A total of fourteen cross sections from 13.5 to 19.5 inside the study reach were updated with the as-built topography. Four cross sections 14, 14.3, 14.7 and 15 were kept the same naming in the post-project model while have been moved to the locations at where the required four cross sections for properly modeling the new D½ Road Bridge were. The rest ten cross sections were at the same station as corrected effective model and were updated with cross sections cut from the as-built topography.

Manning's "n" values used in the post-project model were 0.035 for the channel and 0.050 for the over-banks. These are the same Manning's "n" values that were used in the FEMA Effective model. See

Table 8 for water surface elevation comparison. Figure 10 shows the flood profile comparison. A copy of the post-project condition HEC-RAS input and output was included in Appendix C.

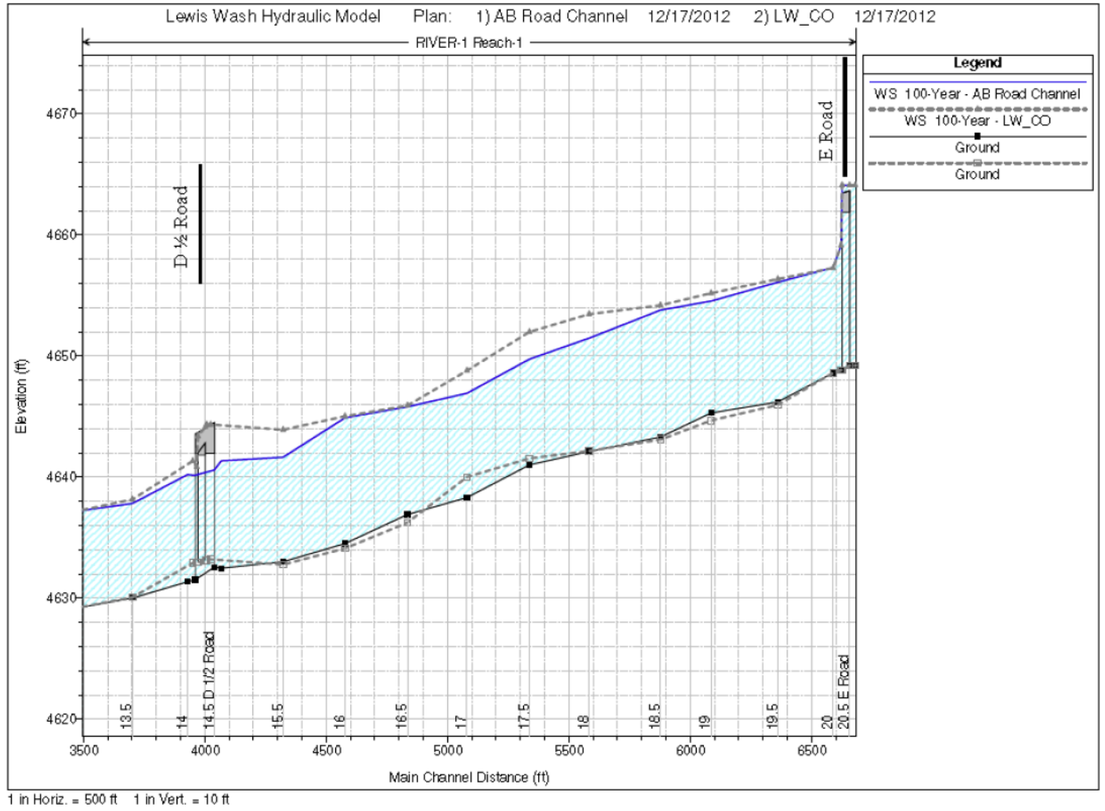
The new 100-year capacity D½ Road Bridge and the channel improvement between D½ Road and E Road lower the 100-year event water surface elevation throughout the study reach with a maximum reduction of 3.7 feet at upstream face of D½ Road. The post-project 100-year discharge was contained in the improved channel cross section for most of the study area except the 100-year floodplain in the left descending overbank at cross section 14 spreads out approximate 5 feet beyond the top of the left bank. This is due to the mild sloped grading in the left overbank area. The slightly wider floodplain does not spread outside of the drainageway easement, so private owned property is not adversely impacted.

Table 8 - Output Comparison
(Post-Project Condition vs. Corrected Effective Model)

Model Cross Section ID	$Q_{100\text{-year}}$ Total (cfs)	Post-Project Model Output		Corrected Effective Model		W.S. Elevation Discrepancy (Post-Project - Corrected) (ft)
		Channel Thalweg (ft)	W.S. Elevation (NAVD 88) (ft)	Channel Thalweg (ft)	W.S. Elevation (NAVD 88) (ft)	
13	2,094	4629.1	4637.1	4629.1	4637.1	**0.0**
13.5	2,094	4630.0	4637.8	4630.1	4638.2	**-0.3**
14	2,094	4631.4	4640.2	4632.9	4641.3	**-1.1**
14.3	2,094	4631.5	4640.2	4633.0	4640.9	**-0.7**
14.5	2,094	D 1/2 Road Bridge				
14.7	2,094	4632.6	4640.6	4633.1	4644.3	**-3.7**
15	2,094	4632.5	4641.3	4633.2	4644.3	**-3.0**
15.5	2,194	4633.0	4641.7	4632.8	4643.9	**-2.3**
16	2,194	4634.5	4644.9	4634.1	4645.0	**-0.1**
16.5	2,194	4636.9	4645.8	4636.2	4645.9	**-0.1**
17	2,194	4638.3	4646.9	4640.0	4648.8	**-1.9**
17.5	2,194	4641.0	4649.8	4641.5	4652.0	**-2.2**
18	2,194	4642.1	4651.5	4642.2	4653.5	**-2.0**
18.5	2,163	4643.3	4653.8	4643.1	4654.2	**-0.4**
19	2,163	4645.3	4654.5	4644.7	4655.2	**-0.7**
19.5	2,163	4646.2	4656.1	4646.0	4656.4	**-0.3**
20	2,163	4648.6	4657.3	4648.6	4657.3	**0.0**
20.3	2,163	4648.8	4659.1	4648.8	4659.1	**0.0**

Note: Both post-project and corrected effective condition were run using HEC-RAS version 4.1.0.

Figure 10 – Flood Profile Comparison
(Post-Project Condition vs. Corrected Effective)



Post-Project (As-built Condition) Floodway Model

Per discussion with Michael Baker staff, the floodway encroachment analysis for this study reach can be omitted because there is not a regulatory floodway defined for the Zone A designation and the post-project floodplain was contained in the improved channel corridor. For all practical purposes, the floodway top width is the same as the floodplain top width.

Hydraulic Output

The 100-year floodplain surface elevations for effective model, pre-project and post-project conditions have been compared in Table 6, 7 and 8. Table 9 shows the floodplain data for the post-project condition. The detailed input and output of the HEC-RAS models are included in Appendix C. The post-project floodplain boundary has been delineated and is included in the work map (Figure D-1) and annotated FIRM (Figure D-2) in the Appendix D.

Table 9 - Floodplain Data Table _ Post-project Condition
Lewis Wash, Mesa County, Colorado

Cross Section Number	Streambed Elevation	100 - Year Flood (NAVD 88)				
		Peak Discharge	Top Width	Flow Area	Average Velocity	Water Surface Elevation
	(feet)	(cfs)	(feet)	(sq ft)	(ft/sec)	(feet)
13	4629.1	2,094	48	329	6.4	4637.1
13.5	4630	2,094	33	164	12.8	4637.8
14	4631.35	2,094	52	230	9.1	4640.2
14.3	4631.53	2,094	29	208	10.1	4640.2
14.5	Bridge					
14.7	4632.57	2,094	29	199	10.5	4640.6
15	4632.47	2,094	44	236	8.9	4641.3
15.5	4633	2,194	37	176	12.5	4641.7
16	4634.5	2,194	92	283	7.8	4644.9
16.5	4636.9	2,194	44	244	9.0	4645.8
17	4638.3	2,194	36	185	11.9	4646.9
17.5	4641	2,194	39	215	10.2	4649.8
18	4642.1	2,194	38	209	10.5	4651.5
18.5	4643.3	2,163	43	268	8.1	4653.8
19	4645.29	2,163	43	235	9.2	4654.5
19.5	4646.2	2,163	42	229	9.4	4656.1
20	4648.6	2,163	38	221	9.9	4657.3
20.3	4648.84	2,163	28	160	13.6	4659.1

7.0 Floodplain Boundaries and Profiles

The 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the Lewis Wash, the 100-year floodplain boundary has been delineated using the flood elevations determined at each cross section. The floodplain boundaries were interpolated between the modeled cross sections using the topographic contours with an interval of 2 feet that were obtained from the 2001 topography for the overbank area outside of the project area and surveyed as-built topography for the project area. The 100-year floodplain boundary is shown on the attached LOMR Work Map (Figure D-1) and the annotated FIRM Panels (Figure D-2) in Appendix D.

The post-project 100-year floodplain ties in the effective regulatory floodplain on the cross section 13 at the downstream study limit and on cross section 20 at the upstream study limit.

There is no published flood profile available for a regulatory Zone A designation floodplain. A copy of the FEMA flood profile-like flood profile (Figure D-3) for Lewis Wash shows the post-construction elevation profiles for the affected reaches is included in Appendix D.

8.0 Sediment Transport

An irrigation base flow of 32 cfs was analyzed in the proposed condition model to evaluate stable channel design, in addition to evaluating the four FEMA regulated discharges of 10-, 50-, 100- and 500-year flood. Table 8 shows the channel hydraulics for the base flow condition. At a flow of 32 cfs, the maximum flow velocity is approximate 4 fps and the maximum shear force in channel is approximately 0.5 lb/sq-ft.

The soils data indicates that that the soils consist of Sagers silty clay loam. (See Appendix B for excerpts from the soils report completed for the bridge design.) Per SWMM Table 805, the maximum permissible mean channel velocity for erosive soils is 3.0 fps. The existing channel contains some erosion areas along the banks. Riprap revetment lining in needed for the improved channel to minimize the scour potential.

The upper banks and the soil on the riprap will be stabilized with vegetation. It is assumed that native grasses can be established without supplemental irrigation during the establishment period. Weed control is also important for disturbed areas.

Table 8 – Irrigation Base Flow Channel Hydraulics

HEC-RAS Plan: PI_BW 5 SS 2 River: RIVER-1 Reach: Reach-1 Profile: Irrigation

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Shear Chan
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/sq ft)
Reach-1	13.5	32.00	4630.08	4631.42	4630.89	4631.53	0.003631	2.60	12.29	10.87	0.43	0.23
Reach-1	14	32.00	4631.35	4632.44		4632.56	0.005848	2.79	11.48	14.00	0.54	0.29
Reach-1	14.3	32.00	4631.53	4632.57	4632.25	4632.70	0.003839	2.88	11.12	13.75	0.56	0.19
Reach-1	14.5	Bridge										
Reach-1	14.7	32.00	4632.57	4633.40	4633.29	4633.59	0.008337	3.50	9.14	14.08	0.77	0.33
Reach-1	15	32.00	4632.47	4633.67		4633.74	0.002470	2.12	15.09	15.47	0.38	0.15
Reach-1	15.5	32.00	4632.77	4634.45		4634.59	0.004426	3.08	10.40	7.08	0.45	0.31
Reach-1	16	32.00	4634.11	4635.55		4635.67	0.004018	2.83	11.29	10.74	0.49	0.25
Reach-1	16.5	32.00	4635.89	4637.02		4637.25	0.009972	3.92	8.17	9.50	0.75	0.51
Reach-1	17	32.00	4637.58	4638.89	4638.54	4639.05	0.005615	3.19	10.02	10.25	0.57	0.32
Reach-1	17.5	32.00	4639.36	4640.56		4640.76	0.007833	3.60	8.90	9.81	0.67	0.42
Reach-1	18	32.00	4641.06	4642.33	4642.01	4642.50	0.006370	3.34	9.58	10.08	0.60	0.36
Reach-1	18.5	32.00	4643.09	4644.32		4644.51	0.007244	3.50	9.15	9.91	0.64	0.39
Reach-1	19	32.00	4644.68	4645.96	4645.67	4646.20	0.009009	3.87	8.27	7.30	0.64	0.53
Reach-1	19.5	32.00	4645.96	4647.48		4647.58	0.003156	2.58	12.39	9.51	0.40	0.22
Reach-1	20	32.00	4648.60	4649.13	4649.13	4649.39	0.023365	4.08	7.84	15.37	1.01	0.73

9.0 Conclusions

The results of this analysis indicate that the as-built bridge and channel improvements reduced the water surface elevations in all areas. The revised floodplain is narrower compared to the regulatory floodplain and contained inside the post-construction channel section. Only downstream of the D½ Road Bridge in the left overbank is the post-construction floodplain slightly wider than the regulatory floodplain. Approximately 33.12 acres of the existing regulatory floodplain which inundated 101 structures was removed by the new D1/2 Road Bridge and channel improvement. There is no adversely affected property owner so no notification letter was required.

10.0 Reference

1. Flood Insurance Study of Mesa County, Colorado and Unincorporated Areas, prepared by Federal Emergency Management Agency, July 6, 2010.
2. Flood Insurance Rate Map 08077C0828F, Effective Date July 6, prepared by Federal Emergency Management Agency, 2010.
3. Matrix Design Group Inc., Certified D ½ Road Bridge as-built elevation, May 7, 2012.
4. Matrix Design Group Inc., Certified As-built Topography Plan, December 21, 2012.
5. Berry Engineering and Testing, LLC, Geotechnical Investigation D1/2 Road Bridge over Lewis Wash Report, January 18, 2011

APPENDIX A

- MT-2 Forms
- Certified As-built D ½ Road Bridge Elevation Plan
- Certified As-built Topography Plan (Included in Figure D-1 Work Map)

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

OVERVIEW & CONCURRENCE FORM

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

PAPERWORK BURDEN DISCLOSURE NOTICE

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

PRIVACY ACT STATEMENT

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

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

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

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

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

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

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

B. OVERVIEW

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

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
080117	Grand Junction City of	CO	08077C	0828F	07/06/10
080115	Mesa County	CO	08077C	0828F	07/06/10

2. a. Flooding Source: Lewis Wash

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

3. Project Name/Identifier: D 1/2 Road Bridge Replacement and Channel Improvements

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

5. Basis for Request and Type of Revision:

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

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

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

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

   Structures: ☒ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert ☐ Dam ☐ Fill ☐ Other (Attach Description)

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

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $5,300 ☐ No, Attach Explanation

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

D. SIGNATURE

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

Name: Peter Baier	Company: Mesa County	
Mailing Address: 200 South Spruce Street, PO Box 20,000 Grand Junction, CO 81502	Daytime Telephone No.: 970-244-1689	Fax No.:
	E-Mail Address: Peter.baier@mesacounty.us	
Signature of Requester (required):	Date:	

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

Community Official's Name and Title: Bill Taylor	Community Name: Mesa County Public Works	
Mailing Address: PO Box 20000 Grand Junction, CO 81502	Daytime Telephone No.: 970-256-1580	Fax No.:
	E-Mail Address: Bill.Taylor@mesacounty.us	
Community Official's Signature (required):	Date:	

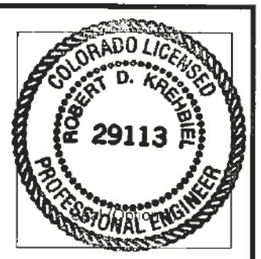
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

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

Certifier's Name: Robert Krehbiel	License No.: 29113	Expiration Date: 10/31/2013	
Company Name: Matrix Design Group, Inc.	Telephone No.: 303-572-0200	Fax No.: 303-572-0202	
Signature: Robert D. Krehbiel	Date: 12/21/12	E-Mail Address: Robert_Krehbiel@matrixdesigngroup.com	

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

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



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

RIVERINE HYDROLOGY & HYDRAULICS FORM

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

PAPERWORK BURDEN DISCLOSURE NOTICE

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

PRIVACY ACT STATEMENT

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

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

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

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

Flooding Source: Lewis Wash

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

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

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

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

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

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

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

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

4. Review/Approval of Analysis

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

5. Impacts of Sediment Transport on Hydrology

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

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

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*	Approxi. 500' from d/s face of D1/2 Road	13	4637.09	4637.09
Upstream Limit*	Approxi. 40' from d/ face of E Road	20	4657.27	4657.31

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

2. Hydraulic Method/Model Used: HEC-RAS 4.1.0

3. Pre-Submittal Review of Hydraulic Models*

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

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: Floodplain.prj	Plan Name: Floodplain.p03	File Name:	Plan Name:	NAVD 88
Corrected Effective Model*	File Name: Floodplain.prj	Plan Name: Floodplain.p04	File Name:	Plan Name:	NAVD 88
Existing or Pre-Project Conditions Model	File Name: Floodplain.prj	Plan Name: Floodplain.p04	File Name:	Plan Name:	NAVD 88
Revised or Post-Project Conditions Model	File Name: Floodplain.prj	Plan Name: Floodplain.p08	File Name:	Plan Name:	NAVD 88
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	

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

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

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

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

Topographic Information: As-buit surveyed topography

Source: Matrix Design Group, Inc. Date: November 30, 2012

Accuracy: 2 foot

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

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

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

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

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

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
      If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

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

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

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

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

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

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

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

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

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

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

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

Flooding Source: Lewis Wash

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

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:
Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: D 1/2 Road Bridge

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

   Location of Structure: D 1/2 Road

   Downstream Limit/Cross Section: 14.3

   Upstream Limit/Cross Section: 14.7

2. Name of Structure: Lewis Wash Channel Improvement

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

   Location of Structure: Between D 1/2 Road and E Road

   Downstream Limit/Cross Section: Approxi. 540' from u/s face of D 1/2 Road/ 16

   Upstream Limit/Cross Section: Appoxi. 1840' from u/s face of D 1/2 Road/ 18.5

3. Name of Structure: _____

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

   Location of Structure: _____

   Downstream Limit/Cross Section: _____

   Upstream Limit/Cross Section: _____

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

B. CHANNELIZATION

Flooding Source: Lewis Wash

Name of Structure: Channel Improvement

1. Hydraulic Considerations

   The channel was designed to carry 2,194 (cfs) and/or the 100-year flood.

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

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

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

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

   ☐ Other locations (specify): _____

2. Channel Design Plans

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

3. Accessory Structures

   The channelization includes (check one):

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

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

   ☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

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

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

C. BRIDGE/CULVERT

Flooding Source: Lewis Wash

Name of Structure: D 1/2 Road Bridge

1. This revision reflects (check one):

   ☐ Bridge/culvert not modeled in the FIS

   ☒ Modified bridge/culvert previously modeled in the FIS

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

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS 4.1.0
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

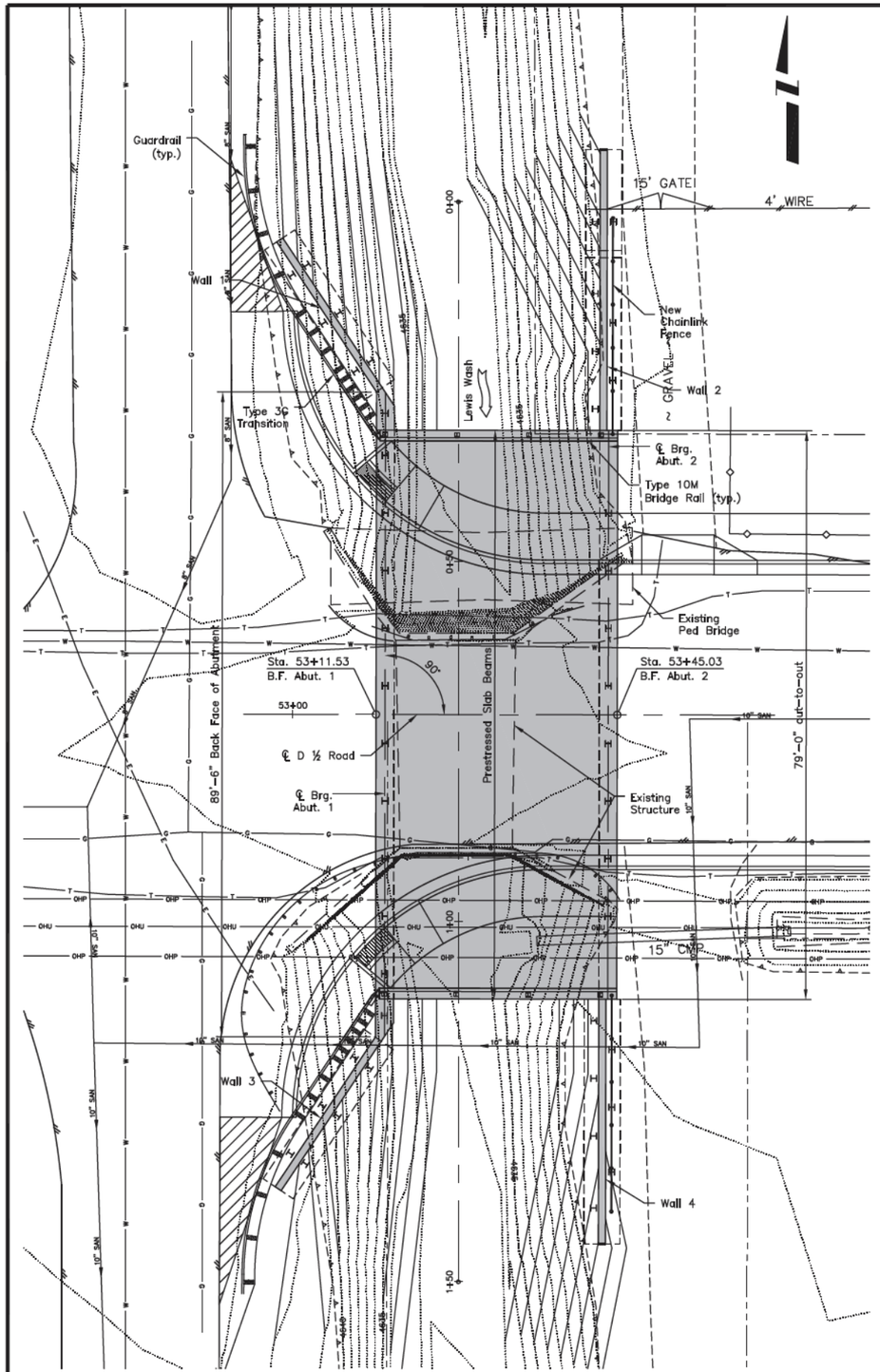
3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

   ☒ Dimensions (height, width, span, radius, length)
   ☐ Shape (culverts only)
   ☒ Material
   ☐ Beveling or Rounding
   ☒ Wing Wall Angle
   ☐ Skew Angle
   ☒ Distances Between Cross Sections
   ☐ Erosion Protection
   ☒ Low Chord Elevations – Upstream and Downstream
   ☒ Top of Road Elevations – Upstream and Downstream
   ☒ Structure Invert Elevations – Upstream and Downstream
   ☒ Stream Invert Elevations – Upstream and Downstream
   ☐ Cross-Section Locations

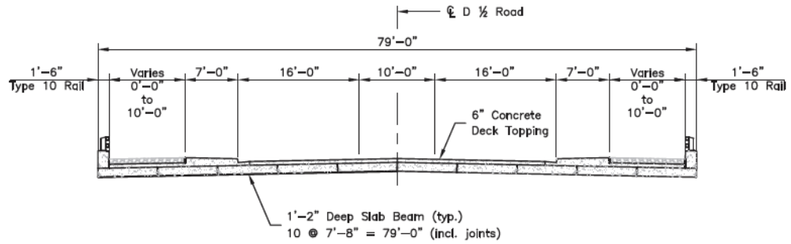
4. Sediment Transport Considerations

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

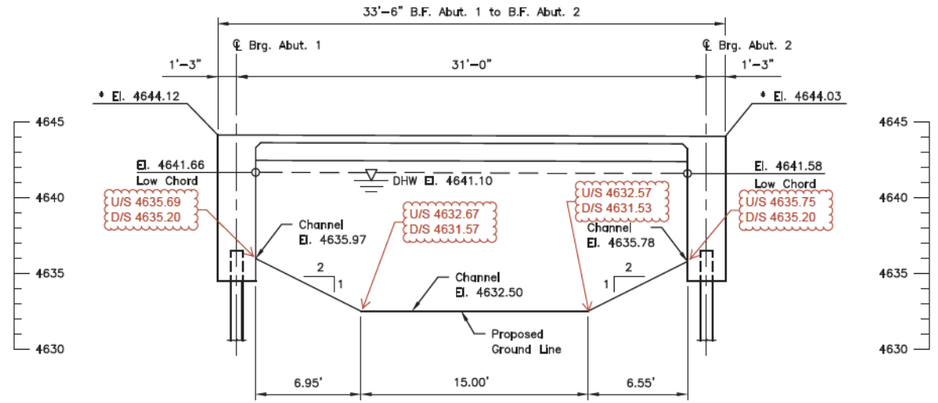
   If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.



PLAN

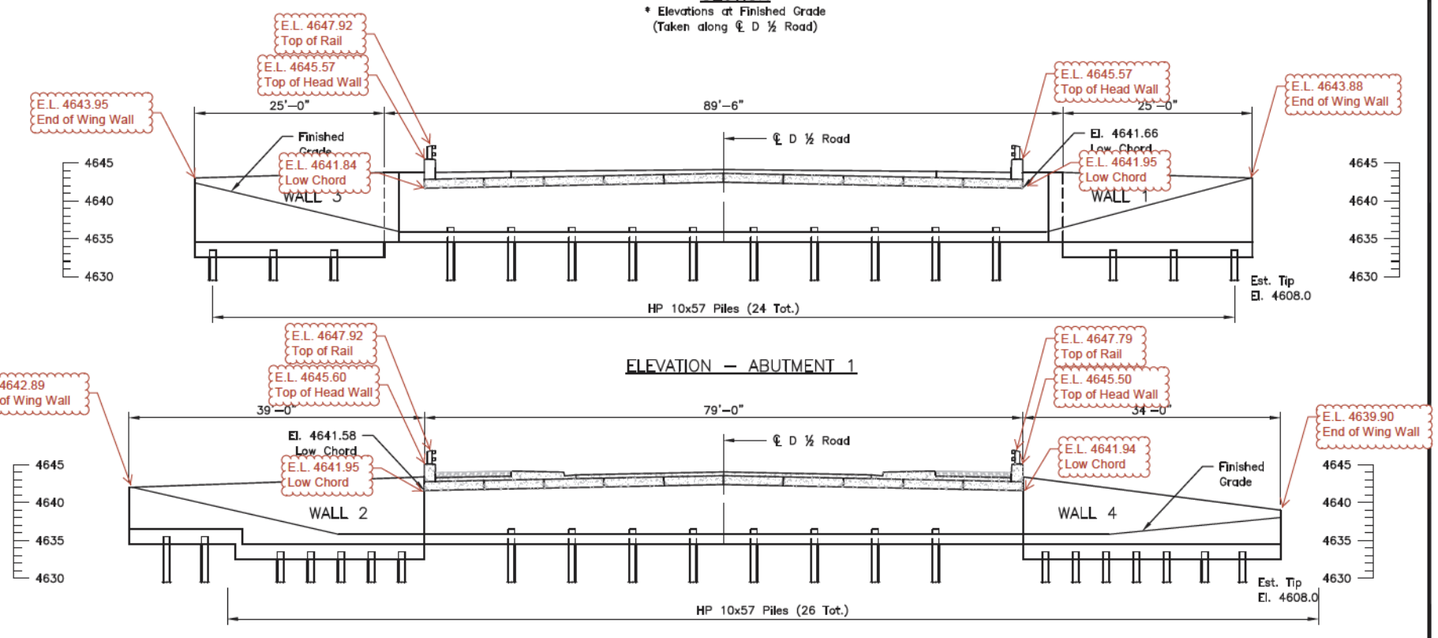


TYPICAL SECTION



SECTION

* Elevations at Finished Grade (Taken along ℄ D ½ Road)



ELEVATION – ABUTMENT 1

ELEVATION – ABUTMENT 2

PROJECT NO. 100-0000701

NOTES

1. See CDOT M-606-1 Sheet 16 for Type 3 Bridge Rail (ref. Headwall Mount)
2. See CDOT M-606-1 Sheet 11 for Type 3J Transition and End Anchorage Type 3K details.
3. End Anchorages at guardrails on 31 Road to be shown in Roadway Plans.
4. Limits of guardrail on 31 Road to be shown in Roadway Plans.
5. Approximate Freeboard = 0.70'

COLORADO REGISTERED ROBERT LEE MEADOWS 34977 PROFESSIONAL ENGINEER

Surveyed Finished Elevation 05/07/2012

DESCRIPTION	DATE
REVISION 1	
REVISION 2	
REVISION 3	
REVISION 4	

DRAWN BY MDF DATE 03-25-11
DESIGNED BY DATE
CHECKED BY DATE
APPROVED BY DATE

SCALES: PLAN HORIZONTAL 0 5 10; PROFILE HORIZONTAL 0 5 10, VERTICAL 0 2.5 5

SCHMUESER | GORDON | MEYER ENGINEERS SURVEYORS
2768 Compass Drive, Suite 102
Grand Junction, CO 81506
(970) 245-2571

City of Grand Junction Colorado

PUBLIC WORKS AND PLANNING ENGINEERING DIVISION

D ½ Road over Lewis Wash
Preliminary Design Alternative 3
Prestressed Concrete Slab Bridge

1

APPENDIX B

- Flood Insurance Rate Map, July 6, 2010
- Excerpts from Geotechnical Investigation D1/2 Road Bridge over Lewis Wash Report

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0828F

FIRM

FLOOD INSURANCE RATE MAP
MESA COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 828 OF 1725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

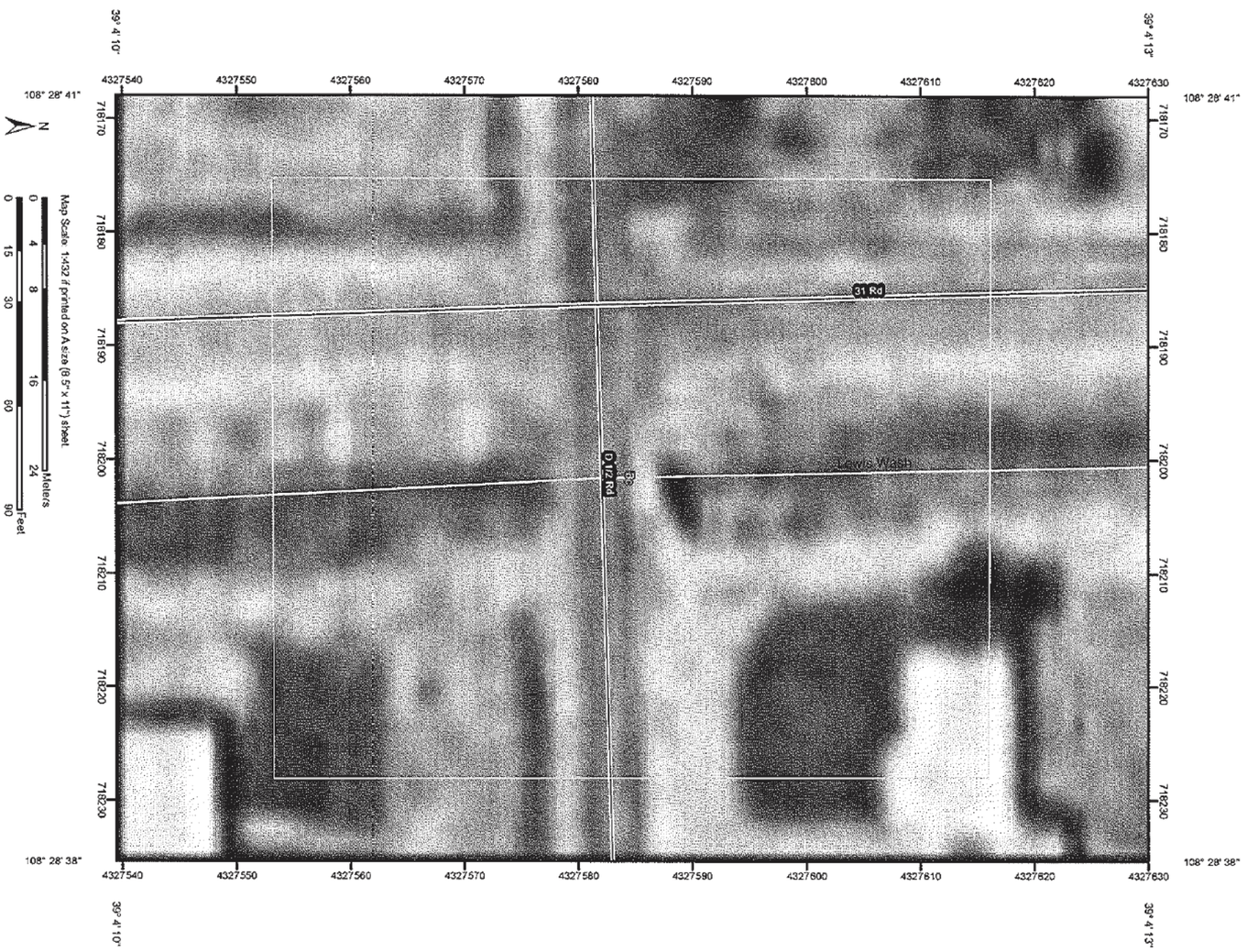
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAND JUNCTION, CITY OF	080117	0828	F
MESA COUNTY	080115	0828	F

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

MAP NUMBER
08077C0828F
EFFECTIVE DATE
JULY 6, 2010

Federal Emergency Management Agency



Soil Map–Mesa County Area, Colorado

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:432 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 12N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Date(s) aerial images were photographed: 9/14/1993

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Mesa County Area, Colorado (CO680)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Bc	Sagers silty clay loam, 0 to 2 percent slopes	0.8	100.0%
Totals for Area of Interest		0.8	100.0%

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Mesa County Area, Colorado

Bc—Sagers silty clay loam, 0 to 2 percent slopes

Map Unit Setting
Elevation: 4,500 to 5,900 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 150 to 190 days

Map Unit Composition
Sagers and similar soils: 90 percent

Description of Sagers

Setting
Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Alluvium and slope alluvium derived from calcareous shale and sandstone

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Nonsaline to slightly saline (2.0 to 8.0 mmhos/cm)
Available water capacity: High (about 9.8 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability (nonirrigated): 7c

Typical profile
0 to 12 inches: Silty clay loam
12 to 25 inches: Silty clay loam
25 to 60 inches: Silty clay loam

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Roads and Streets, Shallow Excavations, and Lawns and Landscaping

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. This table shows the degree and kind of soil limitations that affect local roads and streets, shallow excavations, and lawns and landscaping.

The ratings in the table are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. *Not limited* indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. *Somewhat limited* indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. *Very limited* indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the table indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Information in this table is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this table. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Report—Roads and Streets, Shallow Excavations, and Lawns and Landscaping

[Onsite investigation may be needed to validate the interpretations in this table and to confirm the identity of the soil on a given site. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the potential limitation. The table shows only the top five limitations for any given soil. The soil may have additional limitations]

Roads and Streets, Shallow Excavations, and Lawns and Landscaping– Mesa County Area, Colorado

Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
Bc—Sagers silty clay loam, 0 to 2 percent slopes							
Sagers	90	Somewhat limited		Somewhat limited		Not limited	
		Shrink-swell	0.50	Cutbanks cave	0.10		

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features– Mesa County Area, Colorado

Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	In		In	In			
Bc—Sagers silty clay loam, 0 to 2 percent slopes									
Sagers		—	—		0	—	Low	High	Moderate

Data Source Information

Soil Survey Area: Mesa County Area, Colorado
Survey Area Data: Version 3, Sep 25, 2007

APPENDIX C

- FEMA Effective HEC-RAS Model Output
- Duplicated Effective HEC-RAS Model Output
- Corrected Effective HEC-RAS Model Output
- Post-project Condition HEC-RAS Results

Effective Regulatory HEC-RAS 3.1.0 Model Output
100- Year Floodplain

HEC-RAS Plan: Existing Con River: RIVER-1 Reach: Reach-1 Profile: 100-Year

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	14	2094.00	4632.90	4638.16	4638.16	4640.71	0.014312	12.81	163.43	32.15	1.00
Reach-1	14.3	2094.00	4632.98	4640.16	4640.16	4642.82	0.013321	13.08	160.04	59.22	1.00
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4633.13	4644.34	4643.80	4644.38	0.000822	3.10	2126.50	2163.79	0.22
Reach-1	15	2094.00	4633.20	4644.34	4638.46	4644.39	0.000325	2.69	2451.33	2311.74	0.16
Reach-1	16	2194.00	4635.17	4644.14	4642.35	4645.18	0.004683	8.19	267.77	53.85	0.64
Reach-1	17	2194.00	4640.50	4649.13	4649.13	4650.89	0.010268	10.72	218.68	558.20	0.92
Reach-1	18	2194.00	4643.00	4653.06	4651.59	4653.62	0.003113	6.37	503.68	442.69	0.52
Reach-1	19	2163.00	4645.20	4654.40	4652.68	4655.57	0.003976	8.72	259.36	61.36	0.61
Reach-1	20	2163.00	4648.60	4656.60	4655.86	4658.53	0.007914	11.15	194.17	35.56	0.81
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99

Duplicated Effective HEC-RAS 4.1.0 Model Output
100- Year Floodplain

HEC-RAS Plan: LW_DE River: RIVER-1 Reach: Reach-1 Profile: 100-Year

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	14	2094.00	4632.90	4638.15	4638.15	4640.71	0.014378	12.83	163.18	32.14	1.00
Reach-1	14.3	2094.00	4632.98	4640.16	4640.16	4642.82	0.013321	13.08	160.04	59.22	1.00
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4633.13	4644.34	4643.80	4644.38	0.000822	3.10	2126.50	2163.79	0.22
Reach-1	15	2094.00	4633.20	4644.34	4638.46	4644.40	0.000324	2.69	2452.46	2311.84	0.16
Reach-1	16	2194.00	4635.17	4644.14	4642.35	4645.18	0.004683	8.19	267.77	53.85	0.64
Reach-1	17	2194.00	4640.50	4649.13	4649.13	4650.89	0.010268	10.72	218.68	558.20	0.92
Reach-1	18	2194.00	4643.00	4653.06	4651.59	4653.62	0.003115	6.37	503.51	442.54	0.52
Reach-1	19	2163.00	4645.20	4654.40	4652.68	4655.57	0.003976	8.72	259.36	61.36	0.61
Reach-1	20	2163.00	4648.60	4656.60	4655.86	4658.53	0.007914	11.15	194.17	35.56	0.81
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99

Corrected Effective HEC-RAS 4.1.0 Model Output
100- Year Floodplain

HEC-RAS Plan: LW_CO River: RIVER-1 Reach: Reach-1 Profile: 100-Year

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	13.5	2094.00	4630.08	4638.15	4638.15	4640.53	0.012260	12.39	171.18	43.79	0.98
Reach-1	14	2094.00	4632.90	4641.33		4642.25	0.003835	7.70	280.67	67.48	0.53
Reach-1	14.3	2094.00	4632.98	4640.85	4640.16	4642.92	0.009449	11.56	181.07	110.27	0.85
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4633.13	4644.34	4643.80	4644.38	0.000822	3.10	2126.50	2163.79	0.22
Reach-1	15	2094.00	4633.20	4644.34	4638.46	4644.40	0.000324	2.69	2452.46	2311.84	0.16
Reach-1	15.5	2194.00	4632.77	4643.90		4644.93	0.004302	8.16	268.97	46.94	0.60
Reach-1	16	2194.00	4634.11	4645.03	4642.79	4645.95	0.003617	7.69	285.45	55.59	0.56
Reach-1	16.5	2194.00	4636.24	4645.91		4647.04	0.004407	8.55	258.10	46.79	0.61
Reach-1	17	2194.00	4640.00	4648.80	4648.80	4651.24	0.011638	12.55	177.61	432.63	0.96
Reach-1	17.5	2194.00	4641.54	4651.99	4650.18	4653.14	0.004543	8.72	273.53	67.54	0.62
Reach-1	18	2194.00	4642.15	4653.46	4651.39	4654.04	0.002654	6.85	569.66	559.77	0.47
Reach-1	18.5	2163.00	4643.09	4654.19		4655.29	0.004394	8.41	257.20	42.78	0.60
Reach-1	19	2163.00	4644.68	4655.20	4653.28	4656.21	0.004344	8.07	268.11	47.76	0.60
Reach-1	19.5	2163.00	4645.96	4656.36		4657.51	0.004892	8.60	251.65	44.98	0.64
Reach-1	20	2163.00	4648.60	4657.27	4655.86	4658.82	0.005526	10.01	216.48	38.09	0.69
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99

Post-project Condition HEC-RAS 4.1.0 Model Output
100- Year Floodplain

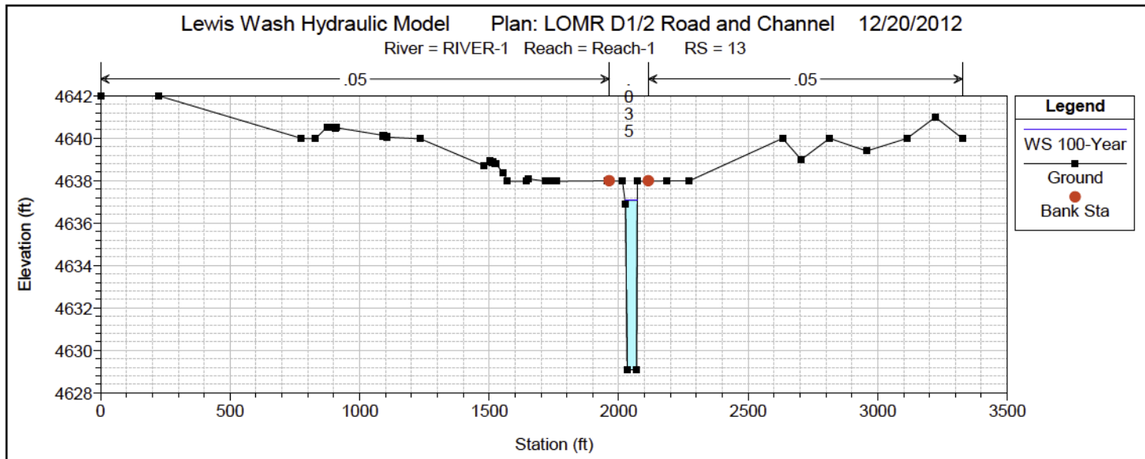
HEC-RAS Plan: LOMR River: RIVER-1 Reach: Reach-1 Profile: 100-Year

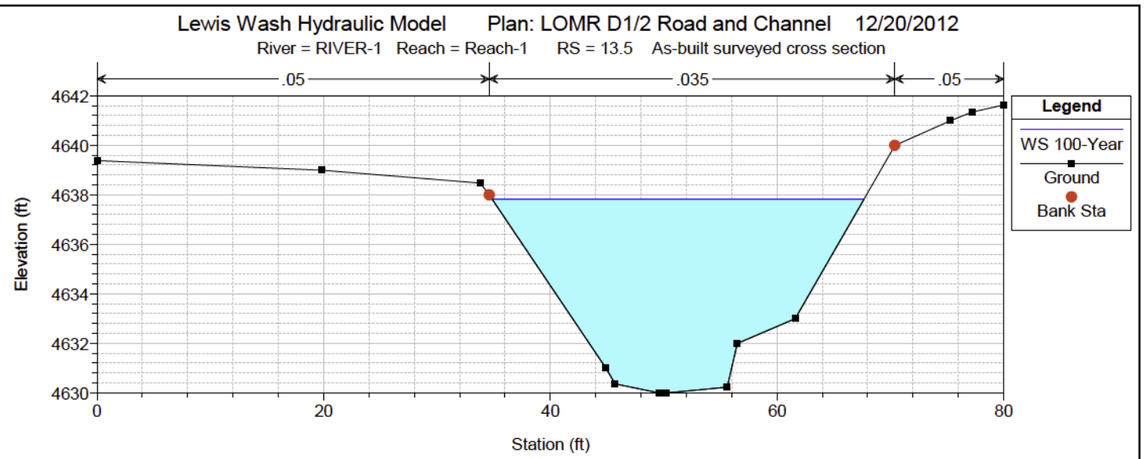
Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach-1	13	2094.00	4629.10	4637.09		4637.72	0.002180	6.37	328.99	48.05	0.43
Reach-1	13.5	2094.00	4630.00	4637.83	4637.83	4640.36	0.012871	12.76	164.06	32.82	1.01
Reach-1	14	2094.00	4631.35	4640.10		4641.49	0.002231	9.44	222.27	45.26	0.70
Reach-1	14.3	2094.00	4631.53	4640.05	4638.40	4641.67	0.002059	10.21	205.17	28.66	0.67
Reach-1	14.5	Bridge									
Reach-1	14.7	2094.00	4632.57	4640.55	4639.20	4642.31	0.002519	10.65	196.63	28.72	0.72
Reach-1	15	2094.00	4632.47	4641.28		4642.53	0.002108	8.95	234.00	42.92	0.68
Reach-1	15.5	2194.00	4633.00	4641.65	4641.65	4644.07	0.013175	12.49	175.71	36.69	1.01
Reach-1	16	2194.00	4634.50	4644.89	4642.71	4645.84	0.003753	7.83	280.35	52.48	0.57
Reach-1	16.5	2194.00	4636.90	4645.81		4647.07	0.005239	9.00	243.75	43.84	0.67
Reach-1	17	2194.00	4638.30	4646.92	4646.61	4649.11	0.010590	11.88	184.69	35.74	0.92
Reach-1	17.5	2194.00	4641.00	4649.75		4651.36	0.006944	10.20	215.20	38.54	0.76
Reach-1	18	2194.00	4642.10	4651.48	4650.57	4653.19	0.007789	10.52	208.62	38.44	0.80
Reach-1	18.5	2163.00	4643.30	4653.80		4654.81	0.003765	8.08	267.76	43.21	0.57
Reach-1	19	2163.00	4645.29	4654.54	4653.06	4655.85	0.005592	9.19	235.41	42.62	0.69
Reach-1	19.5	2163.00	4646.20	4656.09		4657.48	0.006152	9.44	229.04	42.13	0.71
Reach-1	20	2163.00	4648.60	4657.31	4655.86	4658.84	0.005415	9.95	217.81	38.24	0.68
Reach-1	20.3	2163.00	4648.84	4659.14	4659.14	4661.99	0.013295	13.55	159.66	27.50	0.99

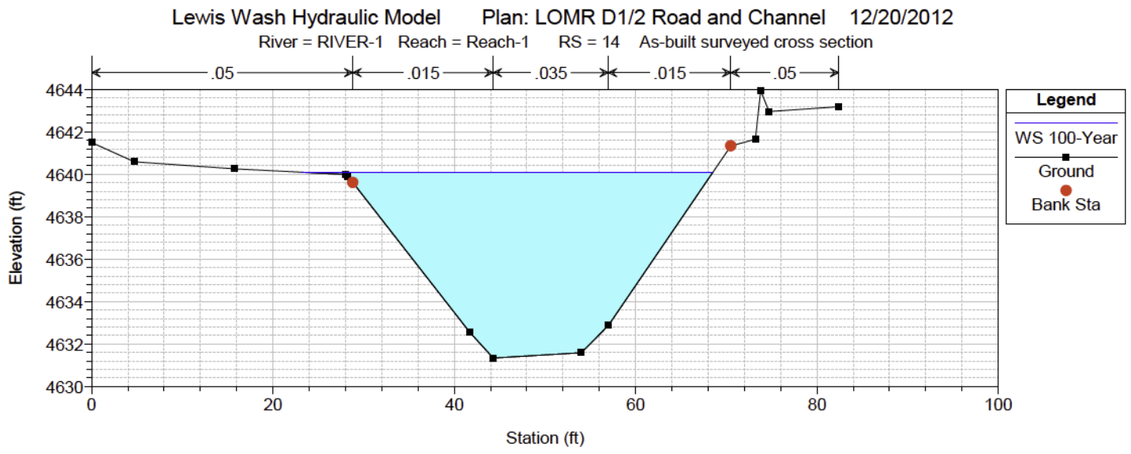
Post-project Condition HEC-RAS 4.1.0 Model Output
100- Year D 1/2 Road Bridge

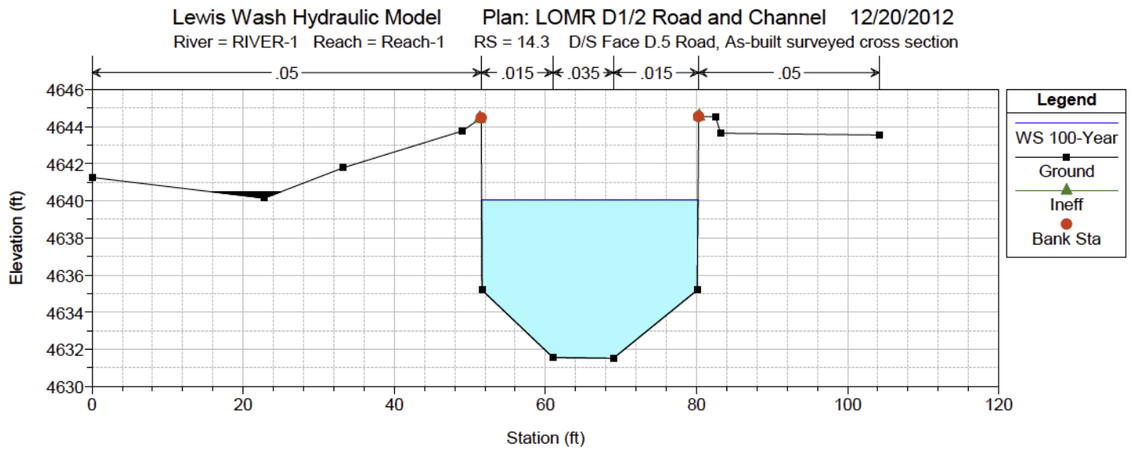
Plan: LOMR RIVER-1 Reach-1 RS: 14.5 Profile: 100-Year

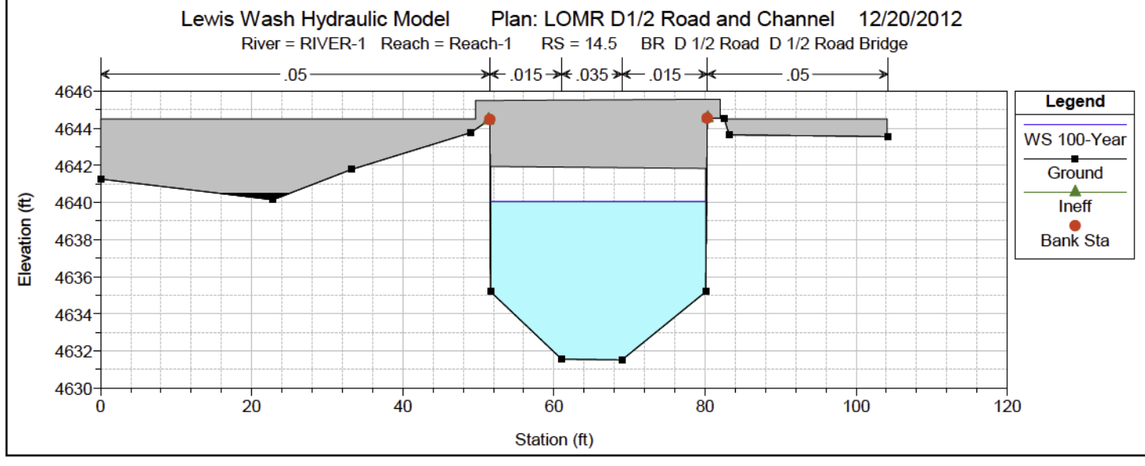
E.G. US. (ft)	4642.31	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	4640.55	E.G. Elev (ft)	4642.31	4641.67
Q Total (cfs)	2094.00	W.S. Elev (ft)	4640.52	4640.05
Q Bridge (cfs)	2094.00	Crit W.S. (ft)	4639.21	4638.41
Q Weir (cfs)		Max Chl Dpth (ft)	7.95	8.52
Weir Sta Lft (ft)		Vel Total (ft/s)	10.73	10.22
Weir Sta Rgt (ft)		Flow Area (sq ft)	195.18	204.96
Weir Submerg		Froude # Chl	0.67	0.62
Weir Max Depth (ft)		Specif Force (cu ft)	1381.20	1422.31
Min El Weir Flow (ft)	4644.52	Hydr Depth (ft)	6.85	7.19
Min El Prs (ft)	4641.95	W.P. Total (ft)	39.06	39.47
Delta EG (ft)	0.65	Conv. Total (cfs)	24217.1	26092.3
Delta WS (ft)	0.50	Top Width (ft)	28.50	28.50
BR Open Area (sq ft)	236.02	Frctn Loss (ft)	0.55	0.01
BR Open Vel (ft/s)	10.73	C & E Loss (ft)	0.08	0.00
Coef of Q		Shear Total (lb/sq ft)	2.33	2.09
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

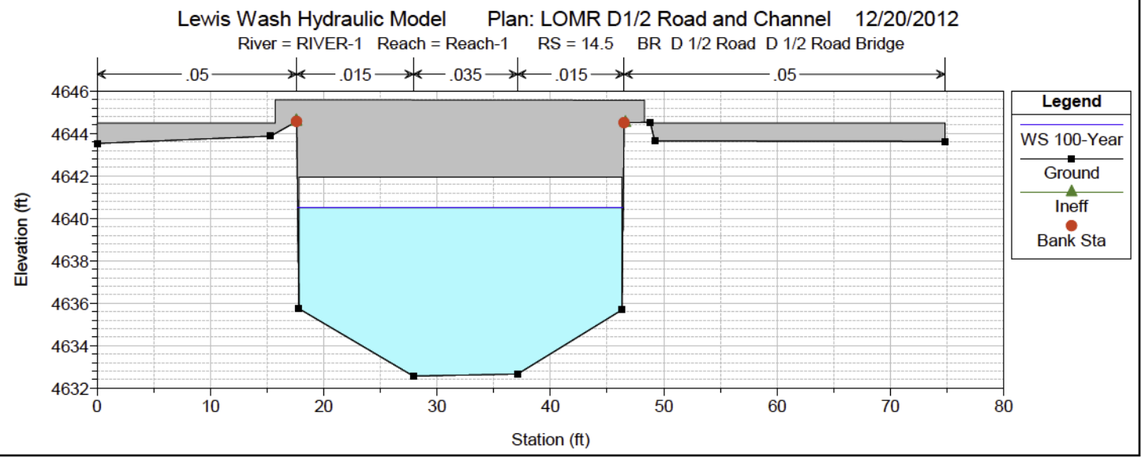

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 13
.05
.035
.05
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

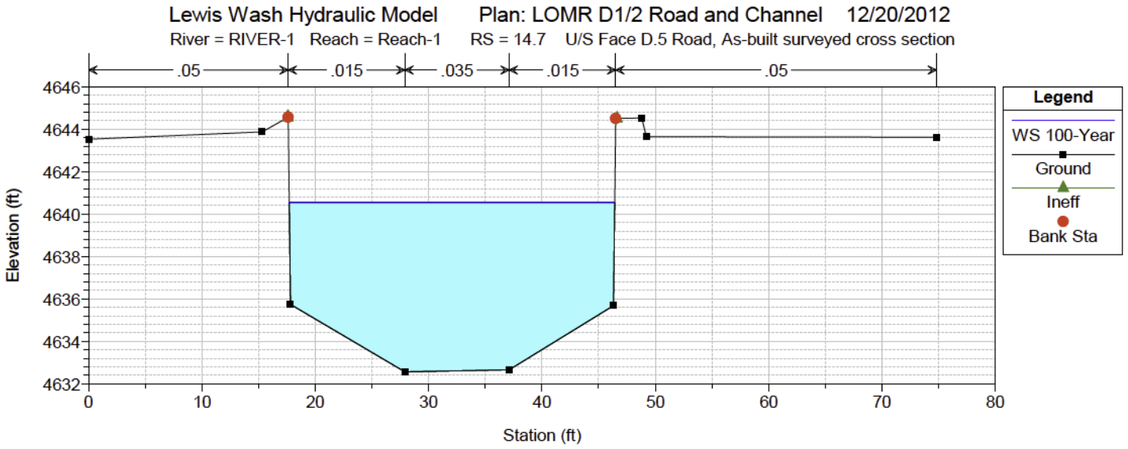

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 13.5 As-built surveyed cross section
.05
.035
.05
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

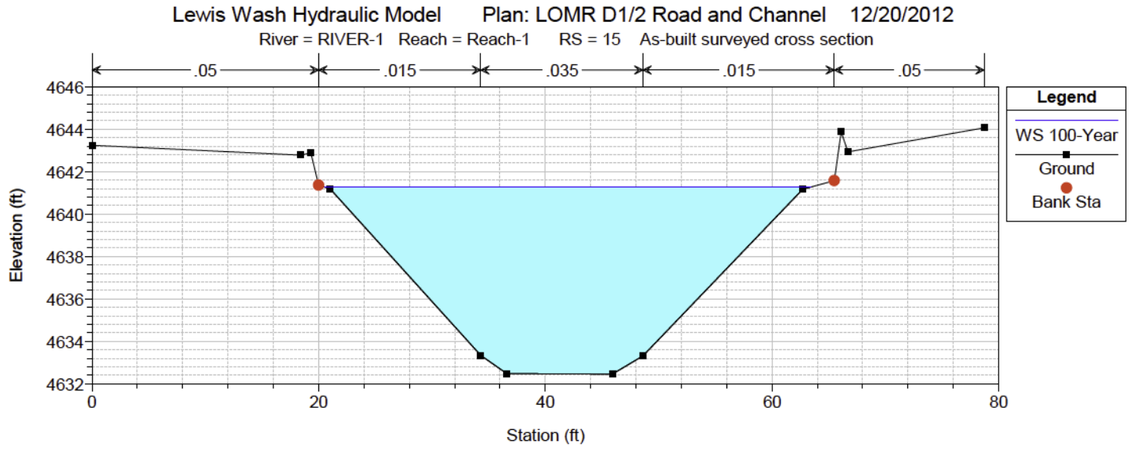

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 14 As-built surveyed cross section
.05
.015
.035
.015
.05
Legend
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)

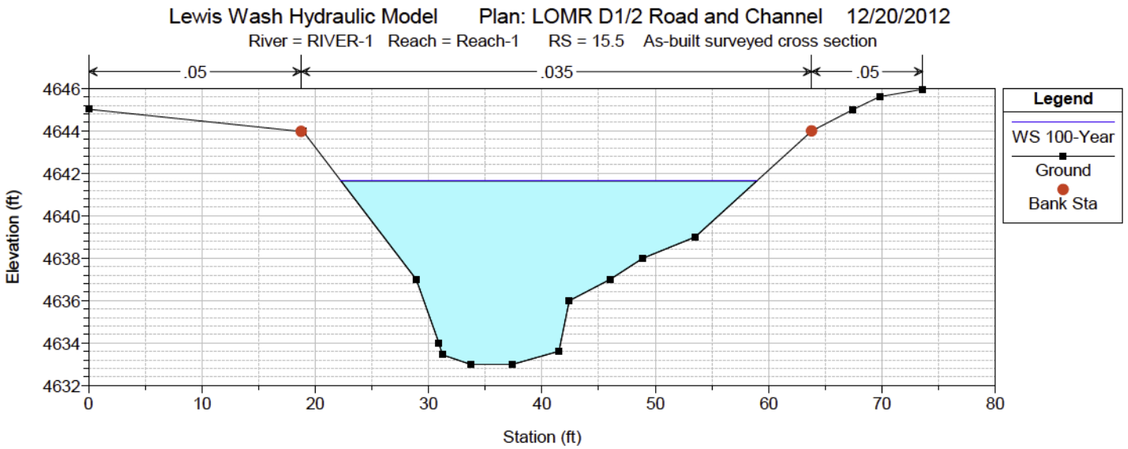

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 14.3 D/S Face D.5 Road, As-built surveyed cross section
.05
.015
.035
.015
.05
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

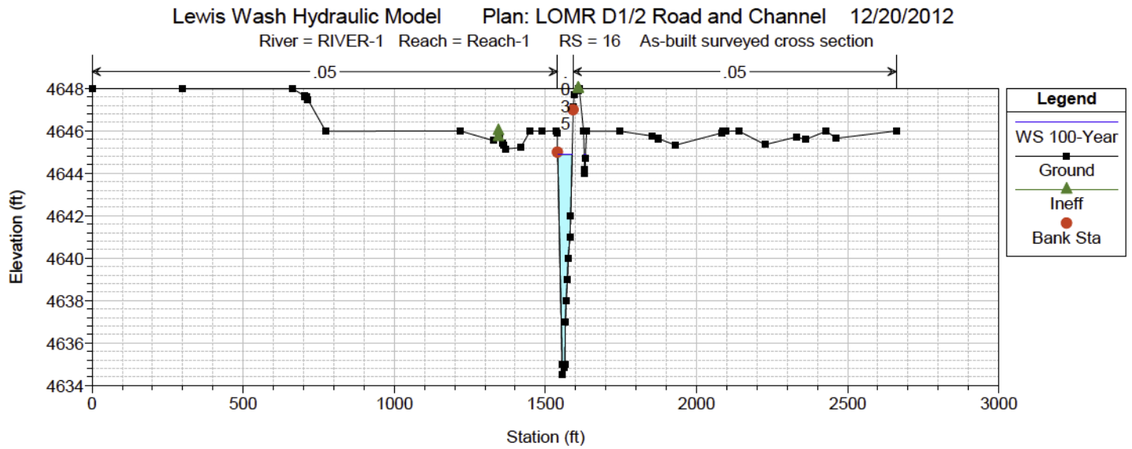

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 14.5 BR D 1/2 Road D 1/2 Road Bridge
.05
.015
.035
.015
.05
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

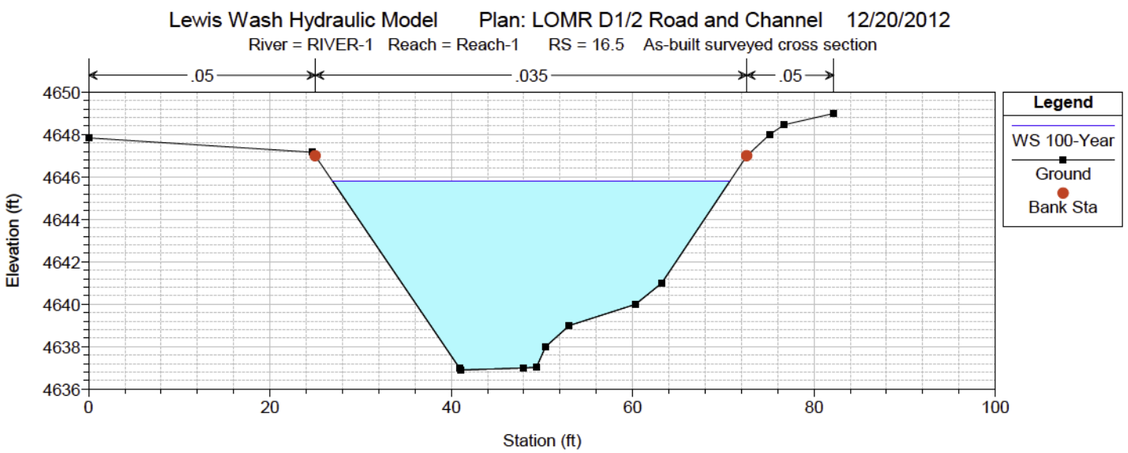

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 14.5 BR D 1/2 Road D 1/2 Road Bridge
.05
.015
.035
.015
.05
Legend
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

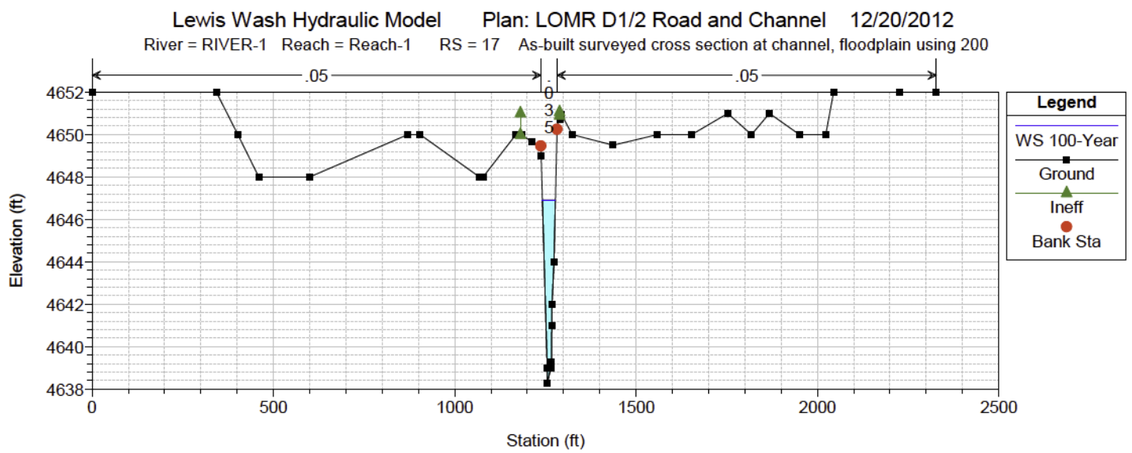

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 14.7 U/S Face D.5 Road, As-built surveyed cross section
.05
.015
.035
.015
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta

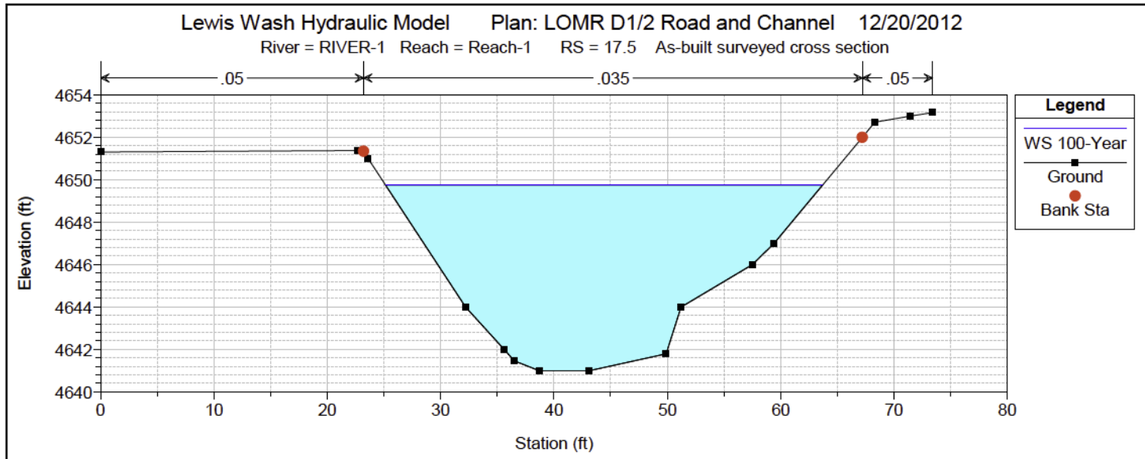

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 15 As-built surveyed cross section
.05
.015
.035
.015
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta

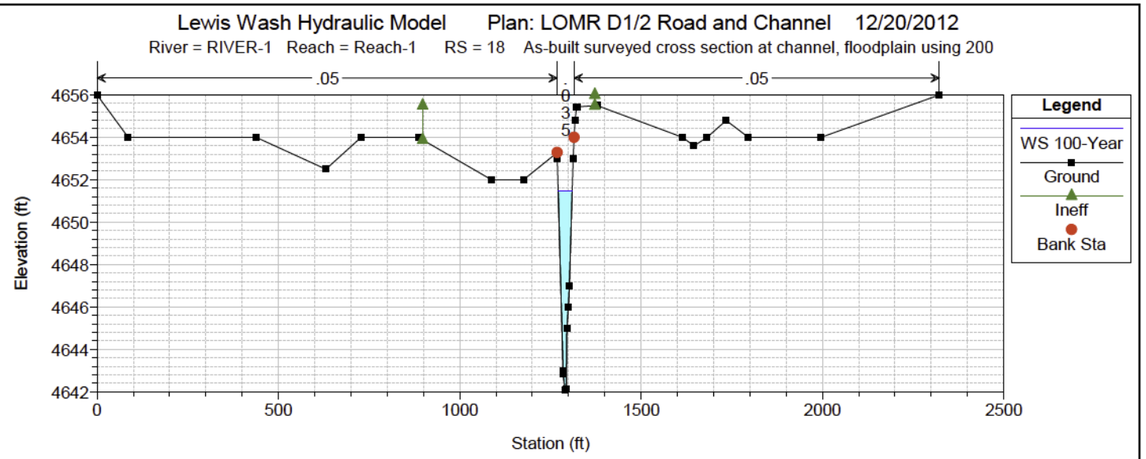

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 15.5 As-built surveyed cross section
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta

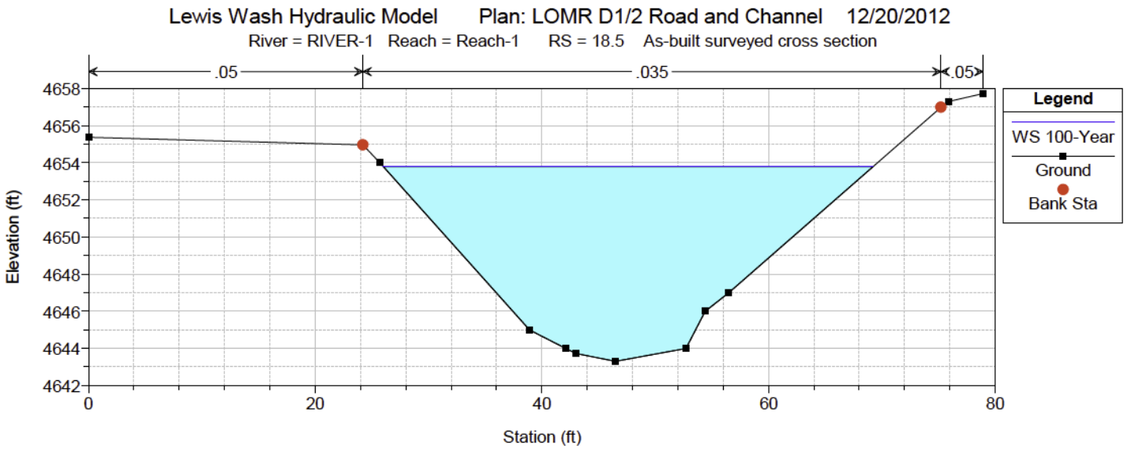

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 16 As-built surveyed cross section
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta

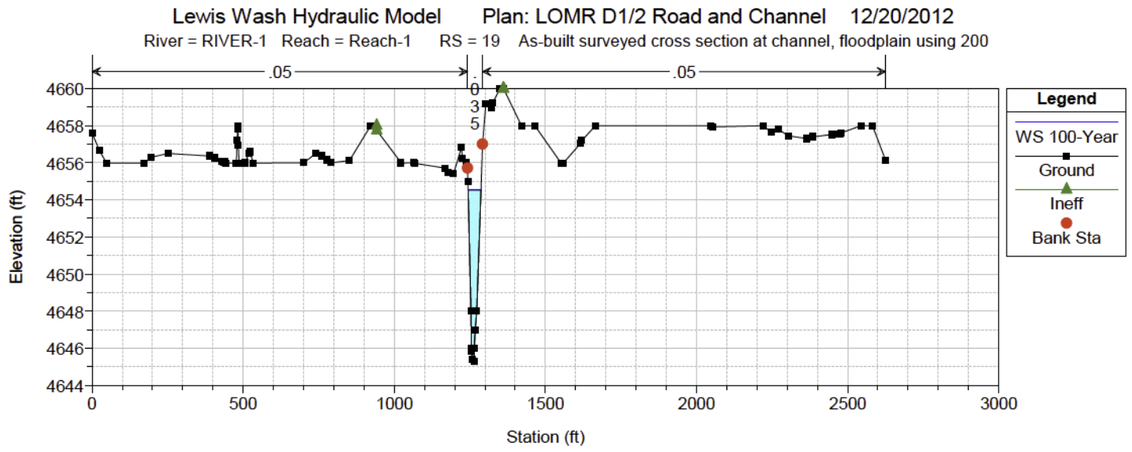

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 16.5 As-built surveyed cross section
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta

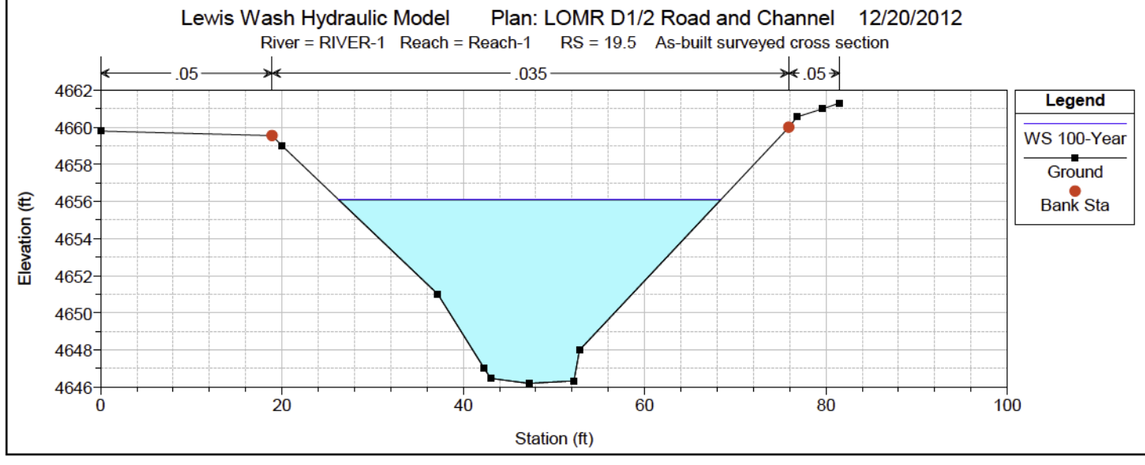

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 17 As-built surveyed cross section at channel, floodplain using 200
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta

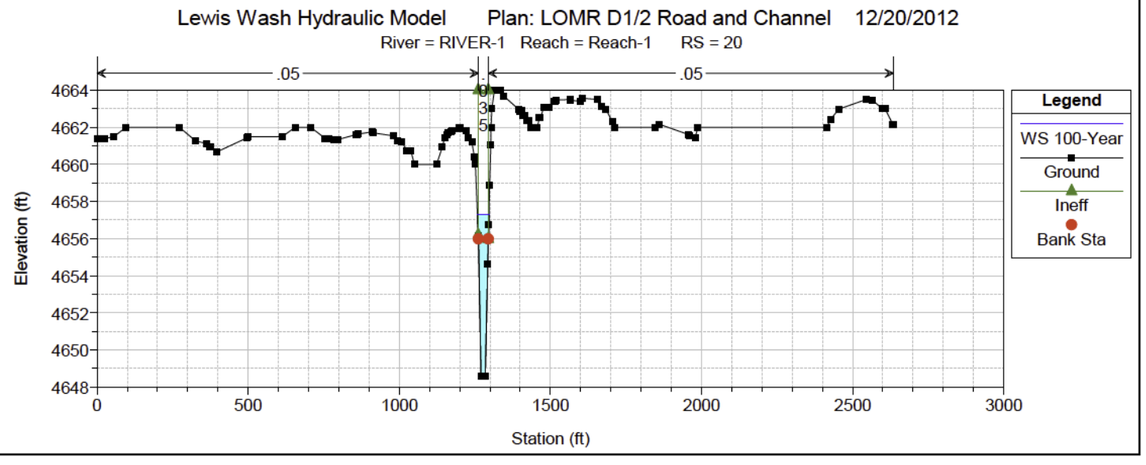

Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 17.5 As-built surveyed cross section
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta


Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 18 As-built surveyed cross section at channel, floodplain using 200
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta


Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 18.5 As-built surveyed cross section
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta


Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 19 As-built surveyed cross section at channel, floodplain using 200
.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta


Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
River = RIVER-1 Reach = Reach-1 RS = 19.5 As-built surveyed cross section
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Bank Sta


Lewis Wash Hydraulic Model Plan: LOMR D1/2 Road and Channel 12/20/2012
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.05
.05
Elevation (ft)
Station (ft)
Legend
WS 100-Year
Ground
Ineff
Bank Sta

APPENDIX D

- Figure D-1 LOMR D½ Road Bridge and Channel Improvements Work Map
- Figure D-2 Annotated Flood Rate Insurance Map
- Figure D-3 Post-project Flood Profile

Legend

- arcel
- S ross Section
- isting loodplain
- ear loodplain

Study Limit (Tie-In)

20.3
20
19.5
19
18.5
18
17.5
17
16.5
16
15.5
15
14.7
14.3
14
13.5
13

4657
4656
4655
4654
4650
4649
4647
4645
4644
4642
4641
4640
4638

E Rd
30 3/4 Rd
31 Rd
31 1/2 Rd
31 1/4 Rd
D 3/4 Rd
D 1/2 Rd
Grand Valley Dr
Foothwood Dr
E Valley St
Austin Ct
Sunbeam Ct
Ol Sun Dr
Sheldon Rd
Apple Blossom Rd
Summit View Dr
Arrowhead Trl
Tahoe St
Arabian Way
Palomino Way
Belford Ave
Sundown Dr
Moonlight Ct
Moonlight Dr
Pear Pond St
Bulla Ct
Chatfield Cir
Chatfield Dr
Odessy Way
Teller Ave
Hill Ave
Sunflower Ct
Sheridan Ct
Gregory Dr
Jaquelle Ln
Evan Ave
Evans Ave
Mountain Brook Dr
D 3/4 Ct
Gunnison Ave
Ute Canyon Ln
Bulla Dr
Mohawk Ave
Seminole Ct
Waigi Ct
Morning Dove Ct
McKenna Ct
Mandan Ln
Chipeta Ave
Shawnee Pl
Seneca Pl
Dupont Ct
Joel Ct
Alegre Ct
N Sun Ct
Jo Alan Ct
Washburn St
Bismarck St
Appaloosa Ln
Greenleaf Dr
Anenessa Dr
Rob Ren Ct
Parkland Ct
Meadow Rd
Larrys Meadow Dr
Cross Canyon Ln
Buck Dr
Open Meadows Ct
Canyon Land Dr
Ouray Ave
Rob Ren Dr
Countryside Ln
Cardinal Ct
Bartlett Pl
Lark Dr
Pearl Ln
Thrush Dr
Grosbeak Ct
Clear Creek Dr
Mountainside Ln

Location ap

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S rveyor ertification

he s b ilt topographic conto rs have been prepared by me or nder my direct s pervision and are correct to the best of my knowledge information and belief

COLORADO REGISTERED PROFESSIONAL ENGINEER 34977

S rveyor's Signat re and ate

ngineer ertification

he revised floodplain information on this topographic work map has been prepared by me or nder my direct s pervision and is correct to the best of my knowledge

COLORADO LICENSED ROBERT D. KRAENZEL 29113 PROFESSIONAL ENGINEER 12/21/12

ngineer's Signat re and ate

Lewis ash L
ecember
esa o nty

MESA COUNTY

Matrix DESIGN GROUP

eet

wilson wheeler
\activeprojects\Lewis ash ridge\ridge ckmap.m d
\projects\esa o nty Lewis ash ridge\

Figure D-2

MAP SCALE 1" = 500'

250 0 500 1000 FEET METERS

ANNOTATED FIRM
LEWIS WASH LOMR
MAY 2012

NFIP

PANEL 0828F

FIRM

FLOOD INSURANCE RATE MAP
MESA COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 828 OF 1725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAND JUNCTION, CITY OF	080117	0828	F
MESA COUNTY	080115	0828	F

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

NATIONAL FLOOD INSURANCE PROGRAM

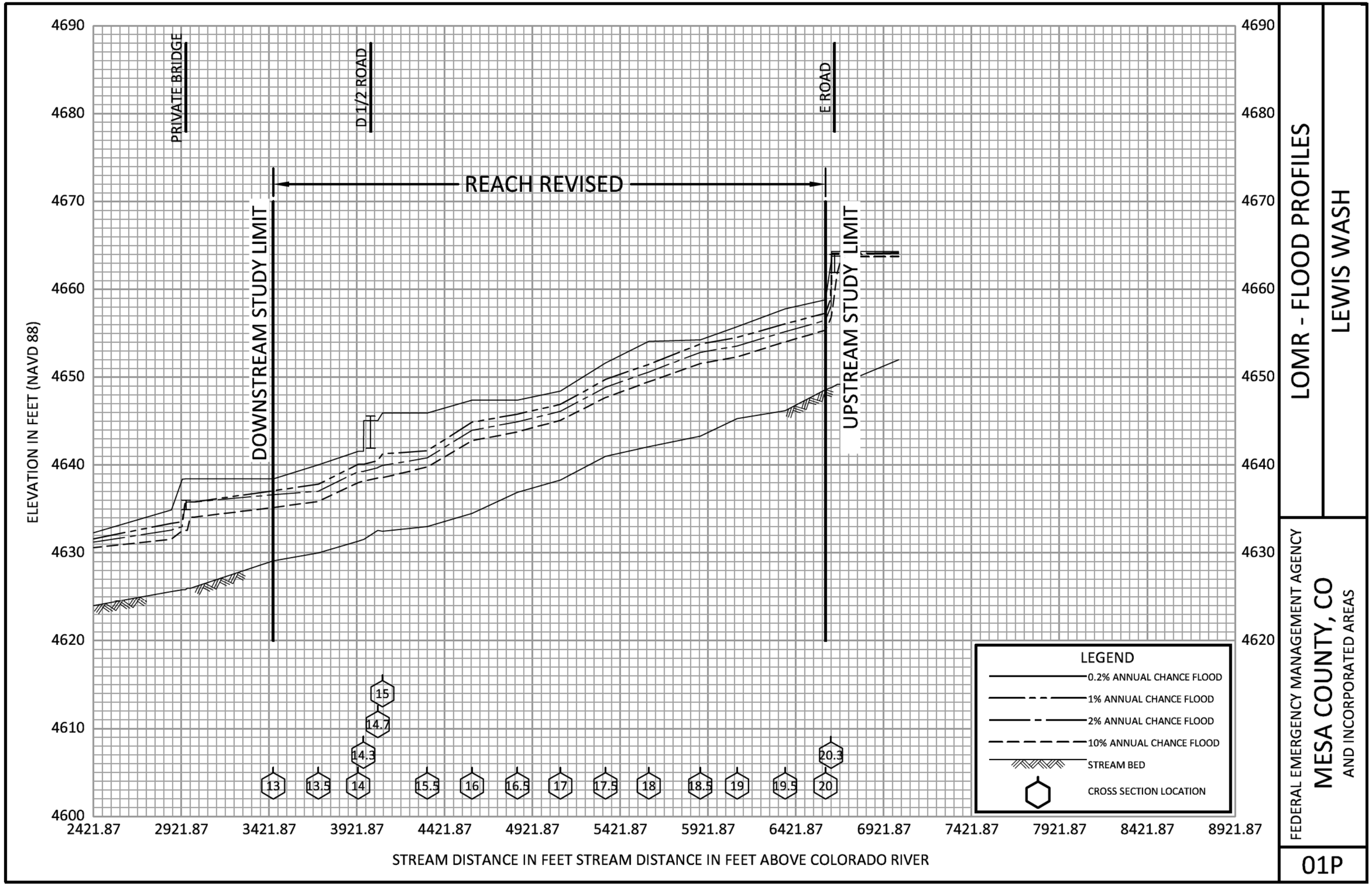
MAP NUMBER
08077C0828F
EFFECTIVE DATE
JULY 6, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

FILE: G:\gis_projects\Mesa_County_Lewis_Wash_D05_Bridge\12.334.006\active\apps\Lewis_Wash_D05_Rd_Bridge_Annotated_FIRM.mxd, 12/21/2012, wilson_wheeler

Figure D-3



LOMR - FLOOD PROFILES

LEWIS WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

MESA COUNTY, CO

AND INCORPORATED AREAS

01P

APPENDIX E

Compact Disk