Preliminary Bridge Hydraulics Report

US6 Bridges Design Build Project
BR 0061-083
Sub Account Number 18838 (CN)

Denver, Colorado

Prepared for
Colorado Department of Transportation

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Olsson Associates Project No. 011-2359

OLSSON ASSOCIATES

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Table of Contents

1.0 Introduction 1
2.0 Hydrology 1
2.1 Previous Studies 1
2.2 Peak Discharges 2
3.0 Existing Structure 2
4.0 Design Discussion 2
4.1 Freeboard Criteria 2
4.2 Hydraulic Analysis and Recommended Design 3
4.3 Design Considerations for Potential Future Projects 4
5.0 Scour Analysis 4
6.0 Floodplain Analysis 4
7.0 Agency Coordination 5
8.0 References 5

Appendix

Bridge Upstream and Downstream Cross Sections

100-year Scour Calculations – 3-span Bridge

FIRM Panel

LOMR Determination Document

LOMR Model HEC-RAS Output

3-span Bridge Model HEC-RAS Output

Figure 1 – 100-Year Floodplains

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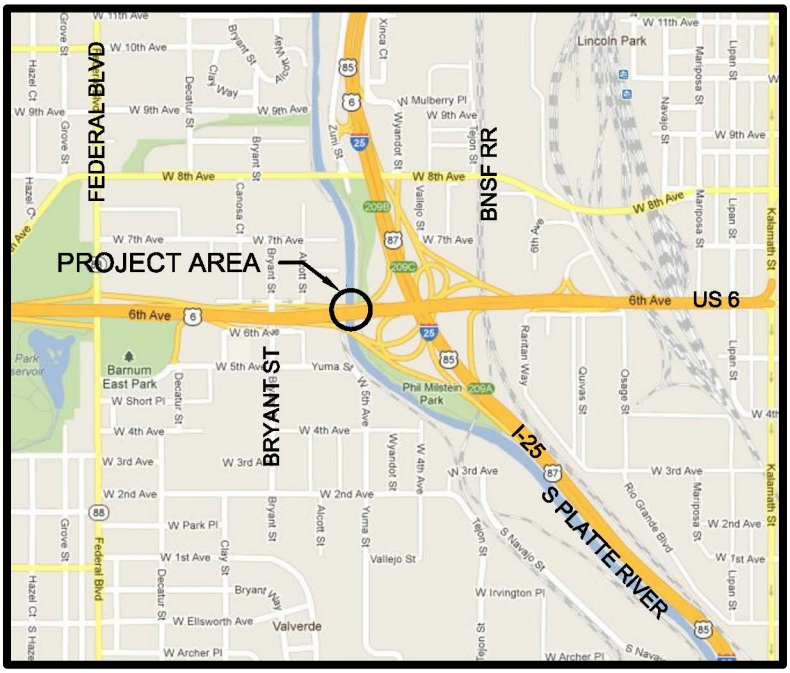
1.0 Introduction

The purpose of this report is to identify the minimum requirements for a new bridge on US6 over the South Platte River and to evaluate the resulting floodplain impacts. The bridge is located in Section 8 Township 4 South Range 68 West in the City and County of Denver, Colorado. The project location is shown in the Vicinity Map.



Vicinity Map

2.0 Hydrology

2.1 Previous Studies

A Flood Hazard Area Delineation (FHAD) was prepared for the South Platter River from Sand Creek to Oxford by Wright Water Engineers in September 1985. A Major Drainageway Plan (MDP) was prepared for the river from Chatfield Dam to Baseline Road by Wright Water Engineers in November 1985.

Urban Drainage and Flood Control District (UDFCD) and City and County of Denver (CCD) have constructed the Zuni and Sun Valley Reach Channel Improvements project, from approximately 100 feet upstream of Spear Boulevard to approximately 360 feet downstream of 3rd Avenue. A Letter of Map Revision (LOMR), Case No. 12-08-0474P, was completed by Matrix Design Group in May 2012 and approved in July 2012 for this work. The LOMR is included in the Appendix. The HEC-RAS model from the approved LOMR was used for the preliminary hydraulic analysis of the new US6 bridge. These improvements reduce the 100-

base flood elevations (BFEs) and flood plain extents on the South Platte River through the subject project area.

2.2 Peak Discharges

Peak discharges at the US6 bridge were obtained from the approved LOMR model and are presented in Table 1.

Table 1 – Peak Discharge at US6 Bridge (cfs)

River Station	10-Year	50-Year	100-Year	500-year
11014 (Downstream of US6)	7,550	15,000	19,200	31,500
11204 (Upstream of US6)	7,550	15,000	19,200	31,500

3.0 Existing Structure

The original existing structures appear to have been constructed around 1955, based on as-built plans. The structure ID Numbers are F-16-EE and F-16-EF for the north and south structures, respectively. The structures appear to have been widened about 1967.

Photo 1 – Existing US6 bridges over the South Platte River

4.0 Design Discussion

4.1 Freeboard Criteria

The CDOT Drainage Design Manual [Rev. 09-02-09] states that the minimum freeboard for a high debris stream should be 4 feet, or more. For low to moderate debris stream, the minimum freeboard, in feet, is calculated with the following equation:

$$\text{Freeboard} = 0.1\ Q^{0.3} + 0.008\ V^2$$

where Q = design discharge, cfs

V = mean velocity of the design flow through the bridge, feet per second (fps)

The freeboard is measured at a water surface elevation 50 to 100 feet upstream of the bridge. The 100-year discharge at the location of the bridge is 19,200 cfs. The average velocity through the existing bridge was 10.5 fps. The initial estimated freeboard was 2.81 feet. The water surface elevation used for the freeboard is at cross section 11204 in the HEC-RAS model obtained from the Letter of Map Revision (LOMR) for the South Platte River Zuni to Sun Valley reach.

At a meeting on December 21, 2011 with representatives from CDOT, UDFCD and CCD, it was decided that the minimum freeboard for the US 6 bridge over the South Platter River would be 3 feet. The freeboard requirement was obtained from Chapter 8 of UDFCD's Urban Storm Drainage Criteria Manual. CCD's Storm Drainage Design and Technical Criteria Manual refers to the UDFCD manual for bridge criteria. The manual states that the distance between the design flow water surface and the bottom of the bridge deck should be a minimum of three feet for the 100-year flood on larger streams or rivers where large floating debris is likely.

Through Denver, the South Platte River was considered to be a low to moderate debris stream. The 3 feet freeboard requirement is greater than the 2.81 feet calculated using the CDOT freeboard equation.

4.2 Hydraulic Analysis and Recommended Design

The HEC-RAS model from the Zuni to Sun Valley Reach Channel Improvements LOMR was used for analysis. HEC-RAS model version 4.1.0 was used for both the LOMR analysis and the bridge analysis for this study.

The 100-year discharge at the location of the bridge is 19,200 cfs. The average velocity through the existing bridge was 10.5 fps. The lowest low chord elevation on the existing bridge was 5204.73, which occurred on the downstream side. The 100-year water surface elevation upstream of the bridge, at cross section 11204 in the HEC-RAS model, was 5207.58, 2.85 feet higher than the low chord.

It was desired that the new bridge opening length should be at least as wide as the floodway downstream of the bridge, which is approximately 156 feet. To achieve 2 horizontal to 1 vertical side slopes (2:1) to the bridge abutments, the lower portion of the South Platte River channel was left intact in the model cross sections. Above the lower flow portion of the channel bottom, the 2:1 slope started and continued to the locations where the abutments might intersect the slopes. The abutments were set so that some vertical distance was available between the low chord and the bank. The vertical distances were 1.5 feet and 2.8 feet. These locations defined the overall length of the bridge opening. If the minimum vertical distance must be greater, the abutments can be moved in, reducing the bridge opening length. Two piers of 4-foot diameter were set to indicate a 3-span bridge. The piers are 67-68 feet apart.

The resulting overall opening was 202.9 feet long. The average velocity through the bridge was 8.4 fps, less than for existing conditions. The water surface elevation at cross section 11204 was 5206.68. The resulting required bridge low chord would be 5209.68. For this level of

analysis, the low chord was set at 5210.0. The bridge opening can be reduced if warranted by additional input on the bridge design parameters. If it does decrease, the low chord elevation of the bridge might need to increase. Upstream and downstream cross sections of the bridge opening are included in the Appendix.

Additional requirements for the bridge over the South Platte River are contained in Book 2, Section 15 - Structures of the Technical Requirements.

An existing 44-inch diameter brick sanitary line is located west of the bridge. The center line of the sanitary line is approximately 31.7 feet away from the proposed west bridge abutment.

4.3 Design Considerations for Potential Future Projects

The 1985 MDP shows the South Platte River channel bottom being lowered by approximately 4 feet in the area of the bridge. The bridge design must take into account the future lowering of the South Platte River. The hydraulic analysis in this report is based on the existing channel bottom elevation.

5.0 Scour Analysis

A preliminary analysis was prepared to evaluate the scour potential at the US6 bridge opening needed to convey the 100-year South Platte River flow and meet freeboard requirements.

Soil boring information near the bridge was provided by RockSol Consulting Group, Inc. The borings indicated the soils are generally sand over sandstone bedrock. Soil boring 10 was located south of the existing bridge in the South Platte River channel. Sandstone bedrock was encountered at a depth of 14 feet. Soil boring 11 was located in the channel north of the bridge. Sandstone bedrock was encountered at a depth of 8 feet.

The HEC-RAS model from the approved LOMR for the South Platte River Zuni to Sun Valley reach was used as the basis of the bridge analysis. A 3-span bridge was evaluated.

Input parameters of d_{50} = 1.0 mm and d_{95} = 2.0 mm were used in the analyses. For the 3-span bridge with two piers, the piers were assumed to have rounded noses. The left abutment scour depth was predicted to be 10.5 feet, and the channel/pier scour depth was predicted to be 12.6 feet at the right bank during the 100-year event. Scour calculations are included in the appendix.

Foundations used in the bridge design should be constructed below the anticipated scour depth. Riprap protection should be used at the abutments and piers. Riprap size and dimensions of protection should be determined as the design progresses.

6.0 Floodplain Analysis

The South Platte River in the project area is channelized. The existing US6 bridge low chord is below the 100-year water surface elevation. Although the bridge is not overtopped, it causes a rise in the 100-year water surface elevation upstream of US6. Upstream of US6, the west bank is not adequate to contain the 100-year discharges. As a result, extensive flooding occurs on the low-lying west side of the South Platte River from Vallejo Street to 6th Avenue, affecting many warehouses, retail stores, and small fabricating shops. In places, the floodplain in this

area is more than 1,500 feet wide. The effective Flood Insurance Rate Map (FIRM) is included in the Appendix.

The South Platte River Zuni to Sun Valley reach LOMR was prepared for improvements along the river downstream of 8th Avenue. Those improvements reduce the 100-year floodplain in the vicinity of this project.

In the proposed preliminary alternative, the South Platte River bridge low chord will be a minimum of 3 feet above the 100-year water surface elevation to meet UDFCD and CCD freeboard requirements, allowing the 100-year flood to pass underneath. Without the obstruction of the bridge, the upstream water surface elevation will be lowered by 0.5 foot to 0.9 foot and the floodplain will be reduced. However, shallow flooding will still exist on the west side of the river, due to the low bank elevations upstream of US6. HEC-RAS output for the original LOMR model and the 3-span bridge are included in the appendix. The floodplain map showing the effective FEMA floodplain, LOMR floodplain and US6 bridge replacement floodplain is shown in Figure 1.

7.0 Agency Coordination

Approvals from UDFCD, CCD, Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers will be needed for the US6 bridge construction over the South Platte River.

8.0 References

Urban Drainage and Flood Control District. April 2008. *Urban Storm Drainage Criteria Manual Vol. 2, Chapter 8: Hydraulic Structures*.

U.S. Army Corps of Engineers Hydrologic Engineering Center. May 2005. Hydrologic Engineering Center River Analysis System (HEC-RAS) Version 3.1.3.

Wright Water Engineers, Inc. November 1985. *Major Drainageway Plan: South Platte River Chatfield Dam to Baseline Road, Phase B – Volume 1: Preliminary Engineering Design*.

Wright Water Engineers, Inc. September 1985. *Flood Hazard Area Delineation: South Platte River Denver Metropolitan Area Sand Creek to Oxford Avenue*.

Appendix

Bridge Upstream and Downstream Cross Sections

100-year Scour Calculations – 3-span Bridge

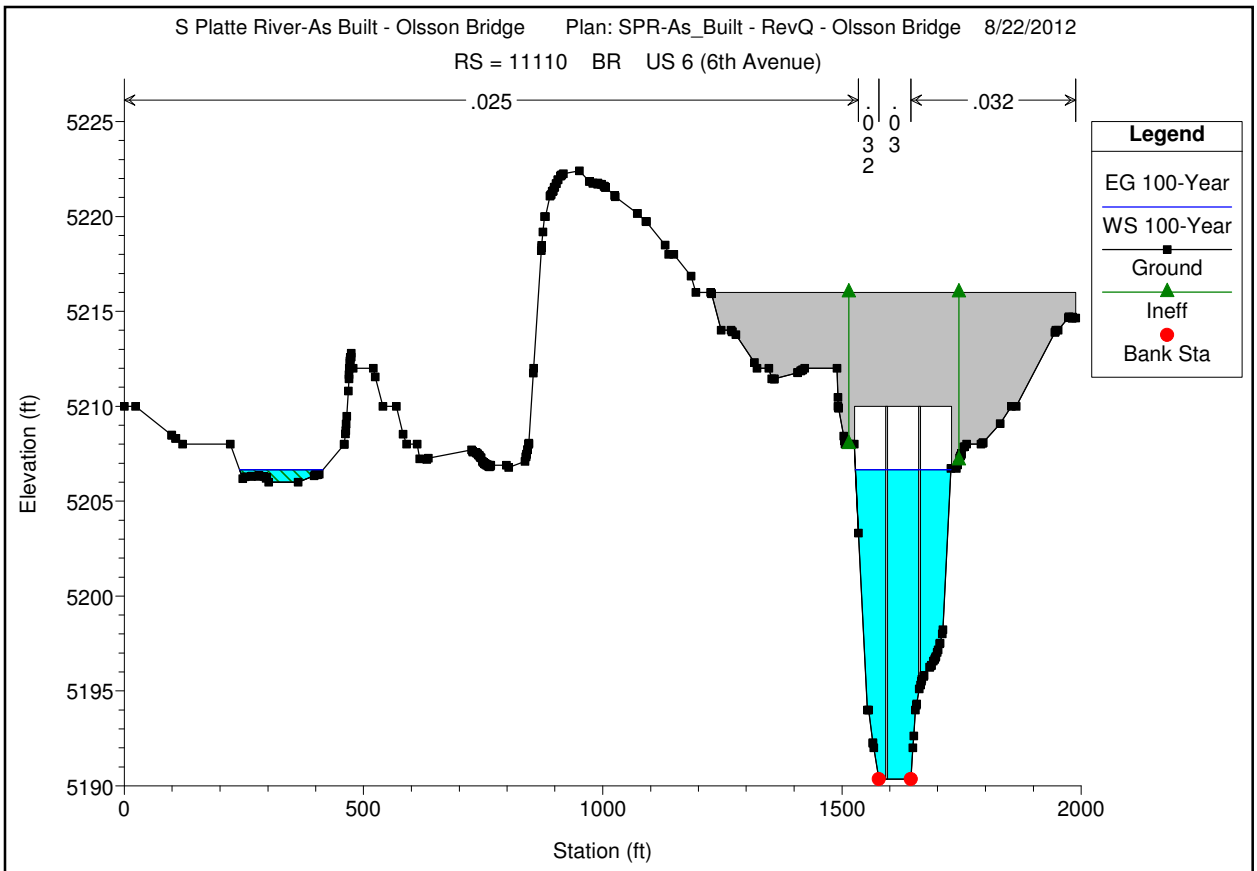
FIRM Panel

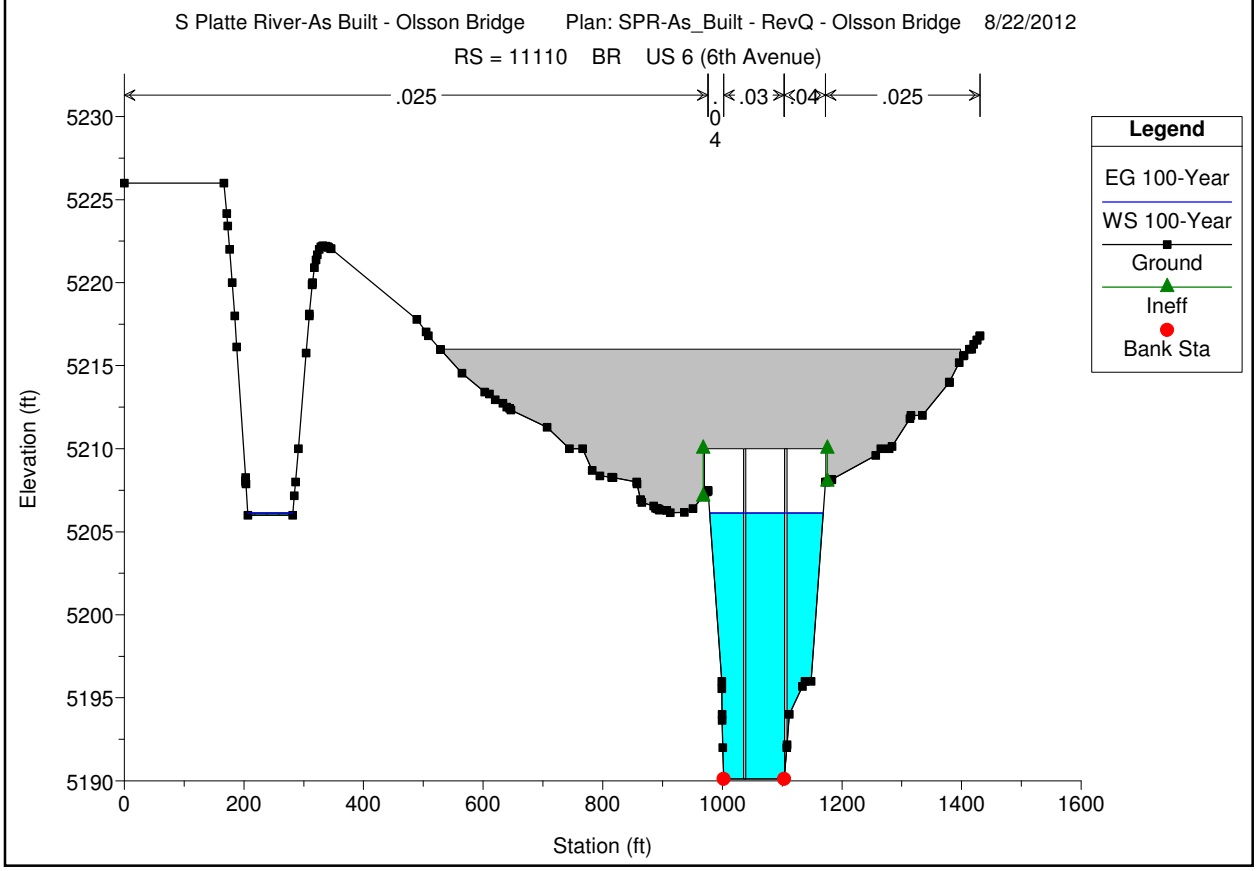
LOMR Determination Document

LOMR Model HEC-RAS Output

3-span Bridge Model HEC-RAS Output

Figure 1 – 100-Year Floodplains


S Platte River-As Built - Olsson Bridge Plan: SPR-As_Built - RevQ - Olsson Bridge 8/22/2012
RS = 11110 BR US 6 (6th Avenue)
.025
.032
Legend
EG 100-Year
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


S Platte River-As Built - Olsson Bridge Plan: SPR-As_Built - RevQ - Olsson Bridge 8/22/2012
RS = 11110 BR US 6 (6th Avenue)
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Legend
EG 100-Year
WS 100-Year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

3-span bridge 100-year scour

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	4.04	16.55	11.03
Approach Velocity (ft/s):	3.22	9.23	4.68
Br Average Depth (ft):	10.25	16.3	9.57
BR Opening Flow (cfs):	4398.47	9653.75	5147.79
BR Top WD (ft):	48.97	63.07	79.59
Grain Size D50 (mm):	1	1	1
Approach Flow (cfs):	692.79	12993.72	5513.49
Approach Top WD (ft):	53.17	85.06	106.77
K1 Coefficient:	0.64	0.64	0.64
Results			
Scour Depth Ys (ft):	10.51	0	2.98
Critical Velocity (ft/s):	2.1	2.66	2.48
Equation:	Live	Live	Live

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Round nose
Pier Width (ft):	4
Grain Size D50 (mm):	1
Depth Upstream (ft):	16.33
Velocity Upstream (ft/s):	9.91
K1 Nose Shape:	1
Pier Angle:	0
Pier Length (ft):	172.58
K2 Angle Coef:	1
K3 Bed Cond Coef:	1.1
Grain Size D90 (mm):	2
K4 Armouring Coef:	1

Results

Scour Depth Ys (ft):	9.6
Froude #:	0.43
Equation:	CSU equation

Pier Scour Limited to Maximum of Ys = 2.4 * a

Combined Scour Depths

Pier Scour + Contraction Scour (ft):

Channel:	9.6
Right Bank:	12.58

MAP SCALE 1" = 500'

250 0 500 1000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0182G

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 182 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DENVER, CITY AND COUNTY OF	080046	0182	G

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 0800460182G

MAP REVISED: NOVEMBER 17, 2005

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

 | **Issue Date: July 31, 2012** | **Effective Date: December 17, 2012** | **Case No.: 12-08-0474P** | LOMR-APP

Follows Conditional Case No.: 09-08-0632R

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 and County of Denver Colorado**	**BRIDGE** **CHANNELIZATION** **EXCAVATION** **FILL**	**FLOODWAY** **HYDRAULIC ANALYSIS** **NEW TOPOGRAPHIC DATA**
	COMMUNITY NO.: 080046		
IDENTIFIER	Upper Central Platte Valley	**APPROXIMATE LATITUDE & LONGITUDE: 39.737, -105.018** **SOURCE:** Other **DATUM:** NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 0800460182G DATE: November 17, 2005 TYPE: FIRM* NO.: 0800460069G DATE: November 17, 2005 TYPE: FIRM* NO.: 0800460184G DATE: November 17, 2005	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: November 17, 2005 PROFILES: 14P, 24P, 74P, 91P, & 92P DELETED PROFILES: 98P FLOODWAY DATA TABLE: 3 SUMMARY OF DISCHARGES TABLE: 2

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) **See Page 2 for Additional Flooding Sources**

South Platte River - from approximately 320 feet downstream of North Speer Boulevard to approximately 500 feet upstream of West 3rd Avenue

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
South Platte River	Zone AE	Zone AE	YES	YES
	Zone X (shaded)	Zone X (shaded)	YES	YES
	Zone AE	Zone AH	YES	NONE
	No Floodway	Floodway	YES	NONE

* 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

125360 PT202.BKR.12-08-0474P.H17 102-I-A-C

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Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER FLOODING SOURCES AFFECTED BY THIS REVISION

FLOODING SOURCE(S) & REVISED REACH(ES)

South Platte River - from approximately 320 feet downstream of North Speer Boulevard to approximately 500 feet upstream of West 3rd Avenue
Lakewood Gulch - from the confluence with the South Platte River to approximately 220 feet upstream
Lakewood Gulch Overflow - from the confluence with the South Platte River to approximately 780 feet upstream
Weir Gulch - from the confluence with the South Platte River to approximately 870 feet upstream
Sloans Lake - from the confluence with the South Platte River to approximately 770 feet upstream

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
South Platte River	BFEs*	BFEs	NONE	YES
Lakewood Gulch	Floodway	Floodway	YES	NONE
	BFEs	BFEs	NONE	YES
Lakewood Gulch Overflow	Floodway	Floodway	YES	YES
	Zone AE	Zone AE	NONE	YES
	Zone X (shaded)	Zone X (shaded)	NONE	YES
	BFEs	BFEs	NONE	YES
Weir Gulch	Floodway	Floodway	YES	NONE
	Zone AE	Zone AE	YES	NONE
	BFEs	BFEs	NONE	YES
Sloans Lake	Zone A	Zone A	YES	NONE

* BFEs - Base Flood Elevations

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

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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.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

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

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Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

This revision has met our criteria for removing an area from the base floodplain to reflect the placement of fill. However, we encourage you to require that the lowest adjacent grade and lowest floor (including basement) of any structure placed within the subject area be elevated to or above the Base Flood Elevation.

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
Post Office Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We are processing a revised FIRM and FIS report for the City and County of Denver in our countywide format; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the countywide FIRM and FIS report, which present information from the effective FIRMs and FIS reports for your community, were submitted to your community for review on March 15, 2012. We will incorporate the modifications made by this LOMR into the countywide FIRM and FIS report before they become effective.

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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LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

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 Denver Post*
Dates: August 10, 2012 and August 17, 2012

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.

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Table 2. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Sq. Miles)	Peak Discharges (Cubic Feet per Second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Sanderson Gulch					
At South Sheridan Boulevard (State Highway 95)	5.3	1,030	1,400	1,550	1,900
At West South Platte River Drive	7.6	1,650	2,200	2,450	3,000
Weir Gulch					
At Mouth	--[1]	1,850	2,340	2,530	3,190
First Avenue Tributary					
At Mouth	1.5	410	670	740	1,030
Dakota Avenue Tributary					
At Mouth	0.7	200	300	355	465
Sand Creek					
Downstream of Confluence with Westerly Creek	184.0	10,000	22,400	30,000	33,000
Sand Creek Overflow					
1,030 Feet Above Confluence with Sand Creek	--[1]	--[1]	3,948	7,770	9,394
South Platte River (Main Channel Only)					
At West Dartmouth Avenue	--[1]	6,400	12,700	16,500	31,500
At Alameda Avenue	--[1]	7,550	15,000	19,200	31,500
At 15th Street	--[1]	9,700	17,600	22,300	35,000
Westerly Creek					
At Mouth	--[1]	3,680	5,780	6,790	9,150
At Colfax Avenue	--[1]	570	870	1,000	1,320
Westerly Creek Overflow					
At Confluence with Westerly Creek	--[1]	--[1]	--[1]	471	--[1]
South Monaco Street Parkway Overflow					
At Intersection of South Monaco Street Parkway and Florida Avenue	--[1]	24	158	262	456

[1]Data Not Available

DATA REVISED BY LOMR EFFECTIVE OCTOBER 5, 2012

REVISED DATA

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Platte River								
A[2]-AO[2]								
AP	125,953	268	2335	8.3	5186.0	5186.0	5186.0	0.0
AQ	126,771	336	2847	6.8	5186.9	5186.9	5186.9	0.0
AR	127,558	313	2743	7.1	5187.5	5187.5	5187.5	0.0
AS	128,108	300	2654	7.3	5187.9	5187.9	5187.9	0.0
AT	129,121	259	2291	8.5	5188.4	5188.4	5188.4	0.0
AU	129,893	215	2123	9.1	5189.2	5189.2	5189.2	0.0
AV	130,338	153	1489	13.0	5189.8	5189.8	5189.8	0.0
AW	130,563	164	1594	12.1	5191.2	5191.2	5191.2	0.0
AX	131,218	156	1801	10.7	5192.9	5192.9	5192.9	0.0
AY	131,467	149	1700	11.4	5193.4	5193.4	5193.4	0.0
AZ	131,617	142	1668	11.6	5193.5	5193.5	5193.5	0.0
BA	132,553	137	1608	11.9	5196.0	5196.0	5196.0	0.0
BB	132,672	142	2149	8.9	5197.2	5197.2	5197.2	0.0
BC	133,037	220	2610	7.4	5198.1	5198.1	5198.1	0.0
BD	133,459	164	1753	11.0	5198.1	5198.1	5198.1	0.0
BE	133,859	171	1869	10.3	5198.5	5198.5	5198.5	0.0
BF	134,114	196	1916	10.0	5198.9	5198.9	5198.9	0.0
BG	134,507	196	1933	9.9	5199.5	5199.5	5199.5	0.0
BH	135,285	165	1933	9.9	5200.7	5200.7	5200.7	0.0
BI	135,412	182	2101	9.1	5201.1	5201.1	5201.1	0.0
BJ	135,807	156	1668	11.5	5203.3	5203.3	5203.3	0.0
BK	136,340	202	1974	9.7	5204.7	5204.7	5204.7	0.0

[1] Feet above Adams/Weld county line
[2] Floodway not determined

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

SOUTH PLATTE RIVER

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Platte River (Cont'd)								
BL	136,922	157	2249	8.5	5,206.1	5206.1	5206.1	0.0
BM	137,112	181	2527	7.6	5,207.6	5207.6	5207.6	0.0
BN	137,566	199	2589	7.4	5,208.0	5208.0	5208.0	0.0
BO	138,335	214	2134	9.0	5,208.4	5208.4	5208.4	0.0
BP	138,838	179	1993	9.6	5,209.0	5209.0	5209.0	0.0
BQ	139,104	181	1492	14.7	5,210.5	5210.5	5210.5	0.0
BR	139,669	154	4191	10.6	5,214.2	5214.2	5214.2	0.0
BS	139,914	195	6812	10.1	5,215.7	5215.7	5215.7	0.0
BT[2]-DJ[2]								

[1] Feet above Adams/Weld county line
[2] Floodway not determined

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

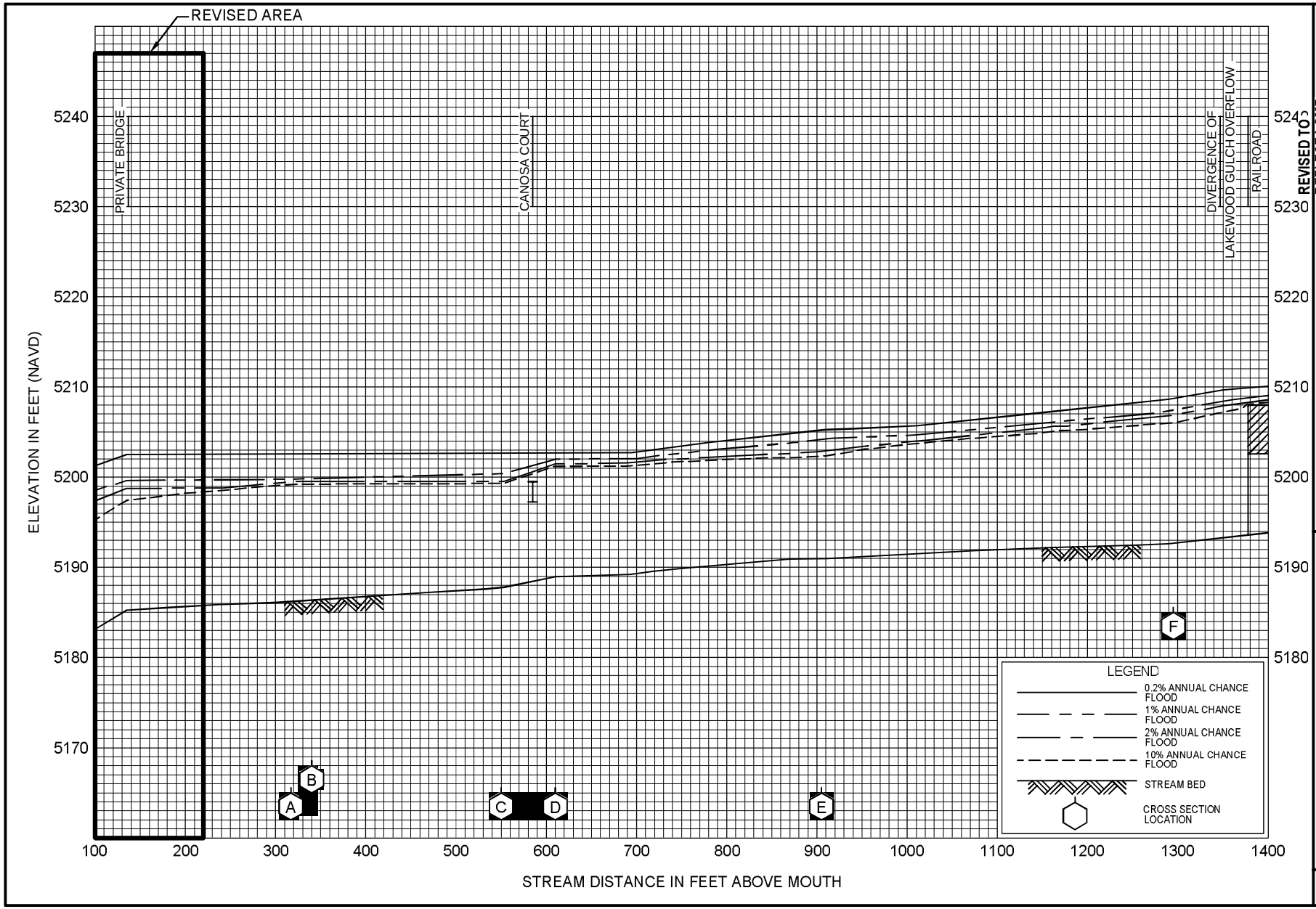
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, CO

FLOODWAY DATA

SOUTH PLATTE RIVER



REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

FLOOD PROFILES

LAKEWOOD GULCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, COLORADO

14P

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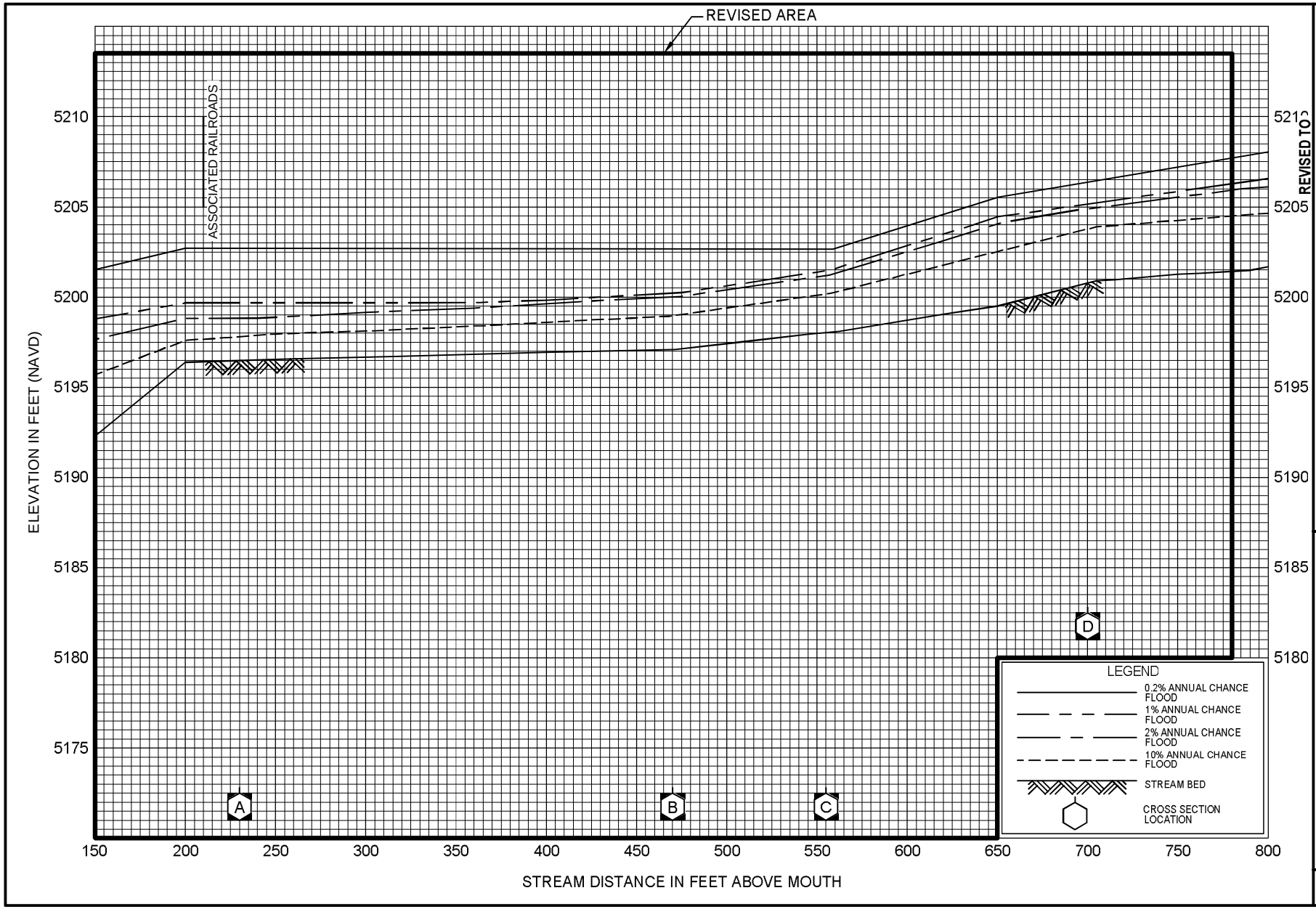


REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

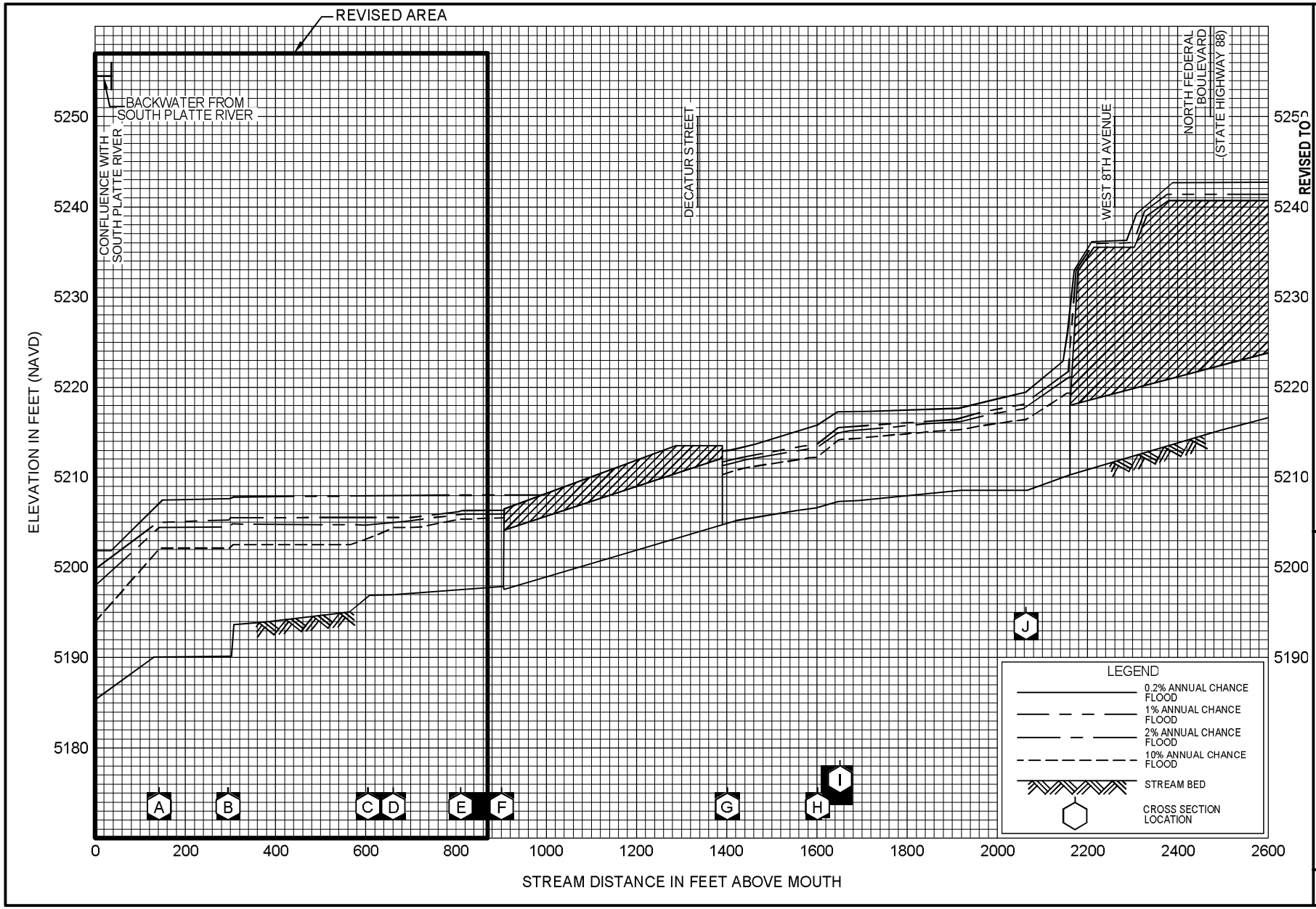
FLOOD PROFILES

LAKEWOOD GULCH OVERFLOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, COLORADO

24P



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FLOOD PROFILES

WEIR GULCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, COLORADO

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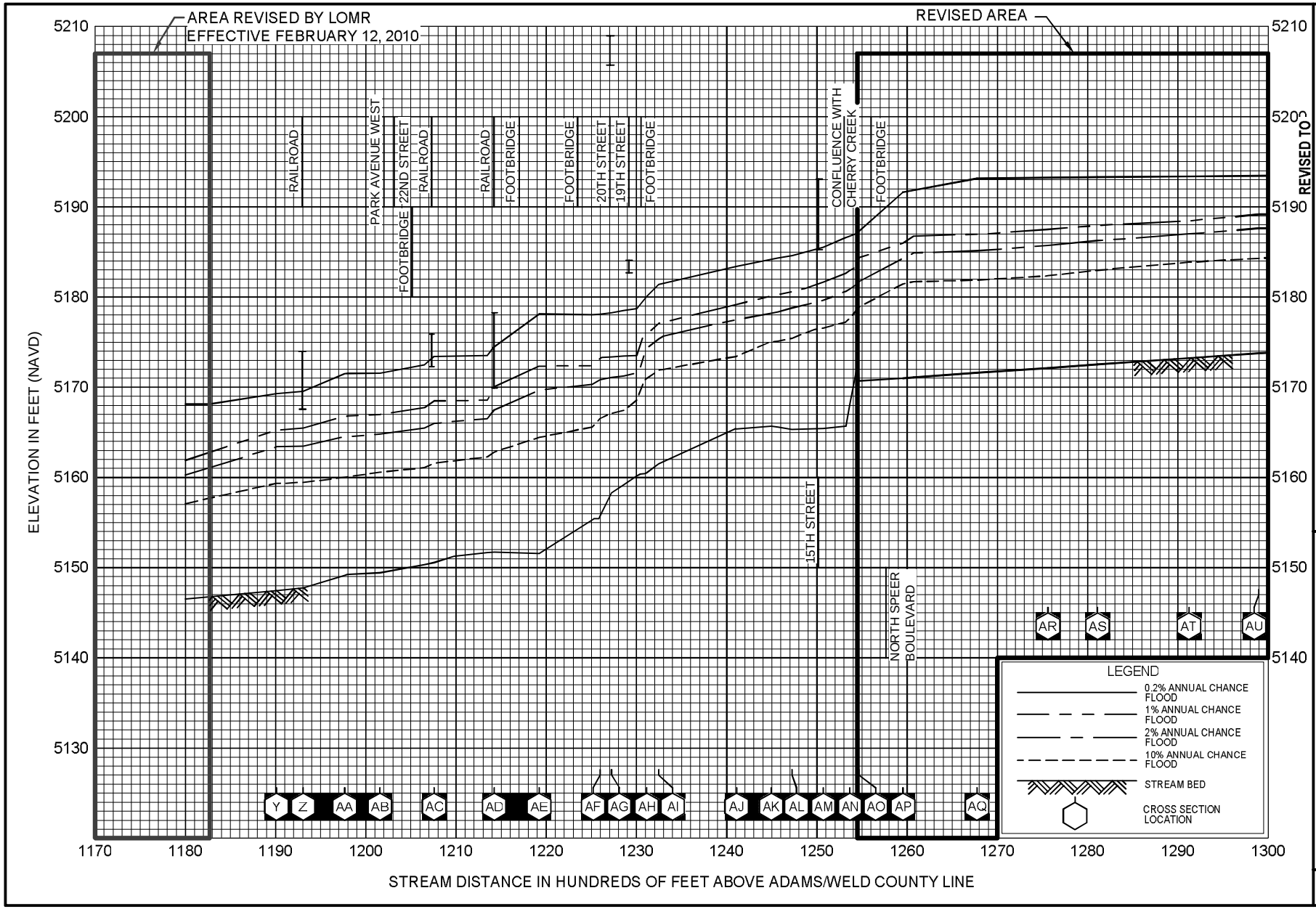

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

FLOOD PROFILES

SOUTH PLATTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, COLORADO

91P

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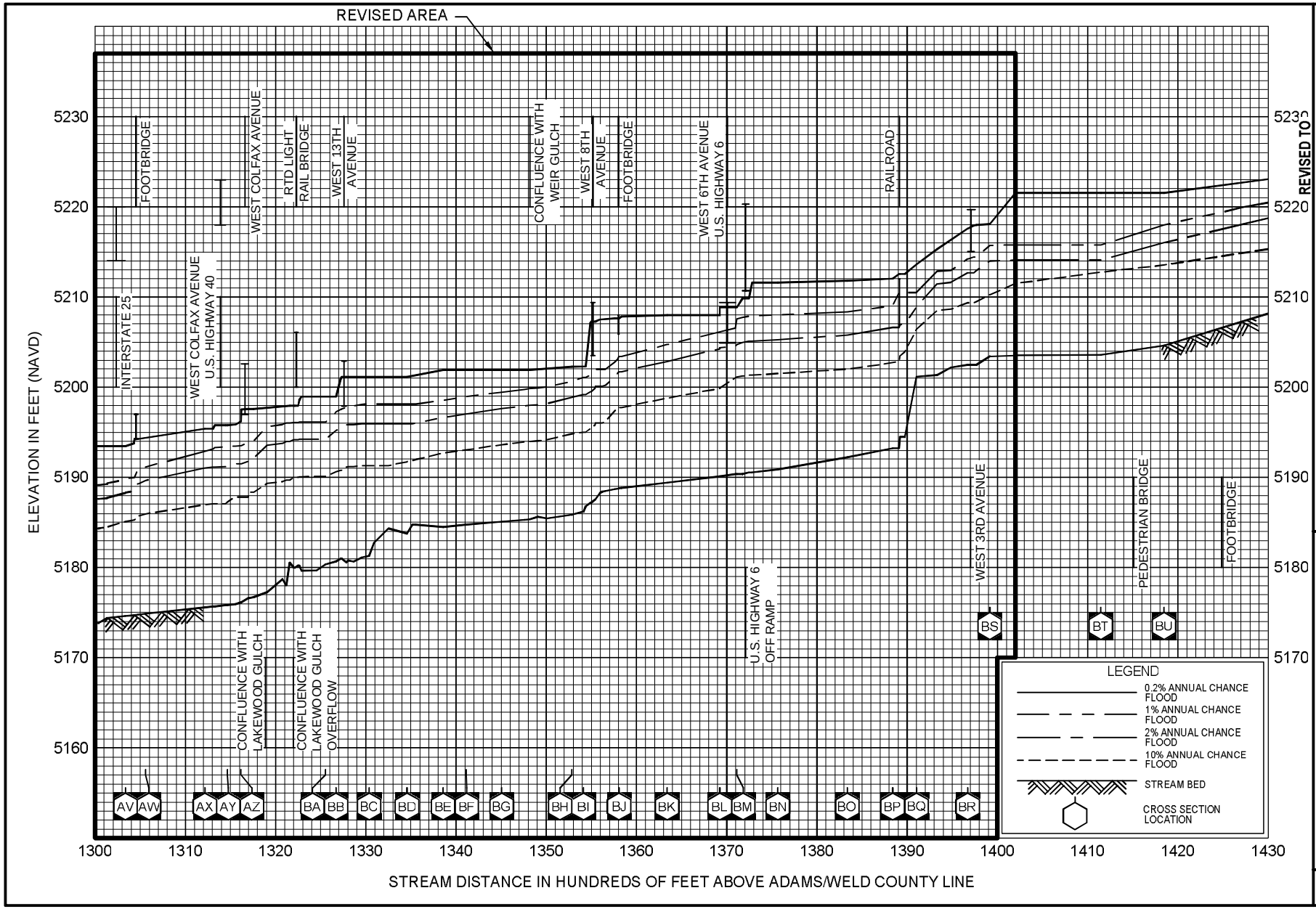

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

FLOOD PROFILES

SOUTH PLATTE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY AND COUNTY OF DENVER, COLORADO

92P

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NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 3 SOUTH, RANGE 68 WEST.

CITY AND COUNTY OF DENVER 080046

REVISED AREA

ZONE AE

ZONE AH (ELEV 5187)

JOINS PANEL 0182

39° 45' 00"

105° 00' 00"

Legend

1% annual chance (100-Year) Floodplain

1% annual chance (100-Year) Floodway

0.2% annual chance (500-Year) Floodplain

MAP SCALE 1" = 500'

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0069G

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 69 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
DENVER, CITY AND COUNTY OF	080046	0069	G

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

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 0800460069G

MAP REVISED: NOVEMBER 17, 2005

Federal Emergency Management Agency

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NOTES TO USERS

s map is for use in administering the National Flood Insurance Program. It does necessarily identify all areas subject to flooding, particularly from local drainage rces of small size. The **community map repository** should be consulted for sible updated or additional flood hazard information.

btain more detailed information in areas where **Base Flood Elevations** (BFEs) /or **floodways** have been determined, users are encouraged to consult the Flood files and Floodway Data and/or Summary of Stillwater Elevations tables shown on FIRM. Users should be aware that BFEs shown on the FIRM represent rounded le-foot elevations. These BFEs are intended for flood insurance rating purposes and should not be used as the sole source of flood elevation information. ordingly, flood elevation data presented in the Flood Profiles and Floodway Data /or Summary of Stillwater Elevations tables should be utilized in conjunction with FIRM for purposes of construction and/or floodplain management.

ndaries of the **floodways** were computed at cross sections and interpolated ween cross sections. The floodways were based on hydraulic considerations with ard to requirements of the National Flood Insurance Program. Floodway widths other pertinent floodway data are provided in the Floodway Data table shown on FIRM.

projection used in the preparation of this map was Universal Transverse cator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 eroid. Differences in datum, spheroid, projection or UTM zones used in the duction of FIRMs for adjacent jurisdictions may result in slight positional erences in map features across jurisdiction boundaries. These differences do not ct the accuracy of this FIRM.

d elevations on this map are referenced to the North American Vertical Datum of 3. These flood elevations must be compared to structure and ground elevations renced to the same **vertical datum**. For information regarding conversion ween the National Geodetic Vertical Datum of 1929 and the North American ical Datum of 1988, visit the National Geodetic Survey website at ://www.ngs.noaa.gov or contact the National Geodetic Survey at the following ress:

S Information Services
AA, N/NGS12
onal Geodetic Survey
MC-3 #9202
5 East-West Highway
er Spring, Maryland 20910-3282
1) 713-3242

btain current elevation, description, and/or location information for **bench marks** wn on this map, please contact the Information Services Branch of the National detic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

e map information shown on this FIRM was derived from U.S. Geological vey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from tography dated 1998 or later.

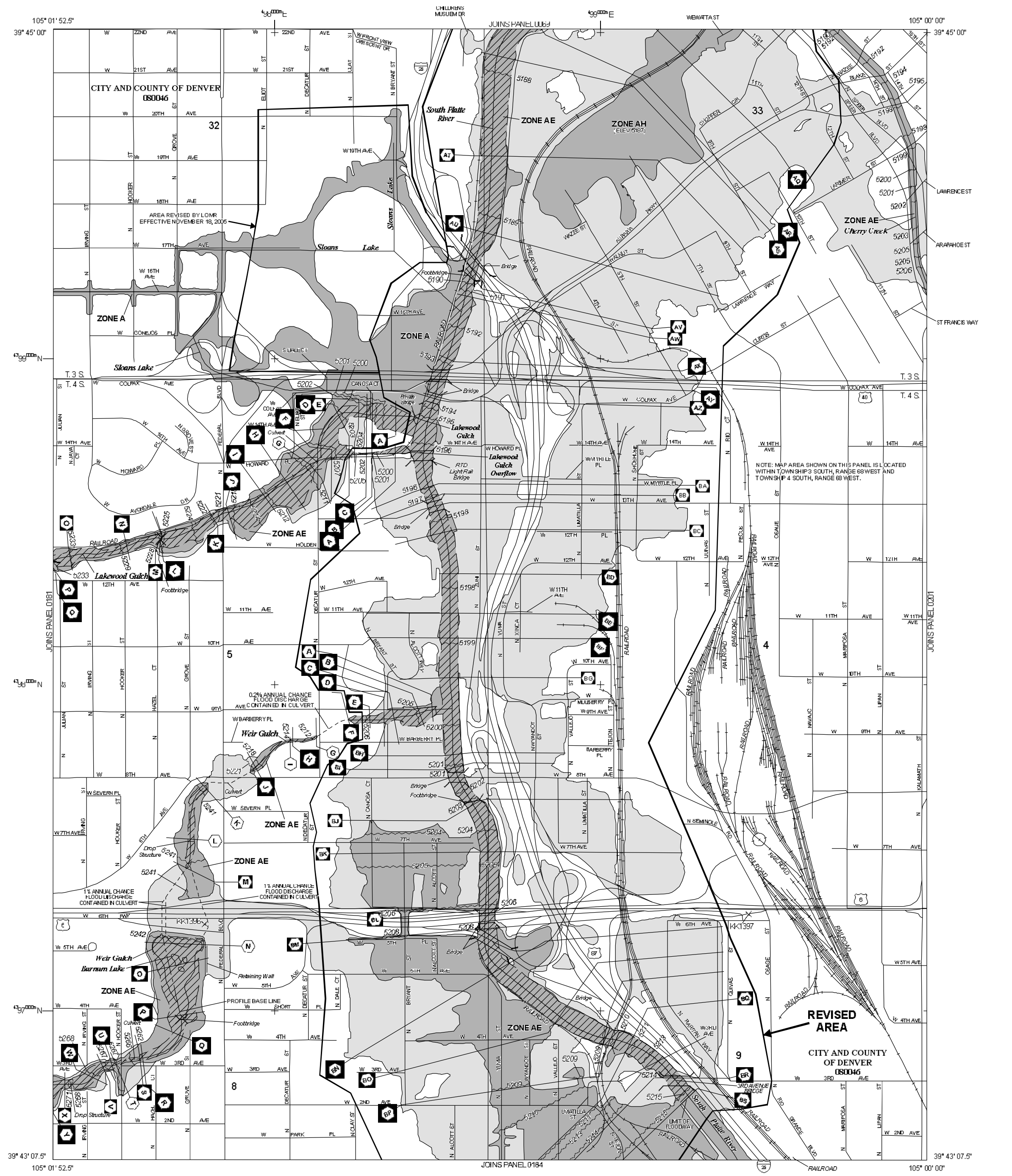
s map reflects more detailed and up-to-date **stream channel configurations** those shown on the previous FIRM for this jurisdiction. The floodplains and dways that were transferred from the previous FIRM may have been adjusted hese new stream channel configurations. As a result, the Flood Profiles Floodway Data tables to conform for multiple streams in the Flood rance Study Report (which contains authoritative hydraulic data) may reflect am channel distances that differ from what is shown on this map.

porate limits shown on this map are based on the best data available at the time ublication. Because changes due to annexations or de-annexations may have urred after this map was published, map users should contact appropriate munity officials to verify current corporate limit locations.

ase refer to the separately printed **Map Index** for an overview map of the nty showing the layout of map panels; community map repository addresses; a Listing of Communities table containing National Flood Insurance Program s for each community as well as a listing of the panels on which each community cated.

tact the **FEMA Map Service Center** at 1-800-358-9616 for information available products associated with this FIRM. Available products may include viously issued Letters of Map Change, a Flood Insurance Study Report, and/or tal versions of this map. The FEMA Map Service Center may also be reached by at 1-800-358-9620 and its website at http://msc.fema.gov.

u have **questions about this map** or questions concerning the National Flood rance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or the FEMA website at http://www.fema.gov/business/nfip/.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - -(23)	Transect line
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
4989000 N	1000-meter Universal Transverse Mercator grid values, zone 13N
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index
INITIAL IDENTIFICATION
DECEMBER 28, 1975
FLOOD HAZARD BOUNDARY MAP REVISIONS
APRIL 15, 1977
FLOOD INSURANCE RATE MAP EFFECTIVE
APRIL 15, 1986
FLOOD INSURANCE RATE MAP REVISIONS
SEPTEMBER 28, 1990 AUGUST 3, 1992 APRIL 16, 1993 MARCH 4, 1996 SEPTEMBER 7, 1998
NOVEMBER 17, 2005: to update corporate limits, to change special flood hazard areas, to update map format, to add roads and road names, to add special flood hazard areas dated August 16, 1995 from Adams County, Colorado, to reflect updated topographic information, and to incorporate previously issued letters of map revision.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0182G

FIRM
FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 182 OF 300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CITY AND COUNTY OF DENVER	080046	0182	G

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

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
0800460182G

MAP REVISED:
NOVEMBER 17, 2005

Federal Emergency Management Agency

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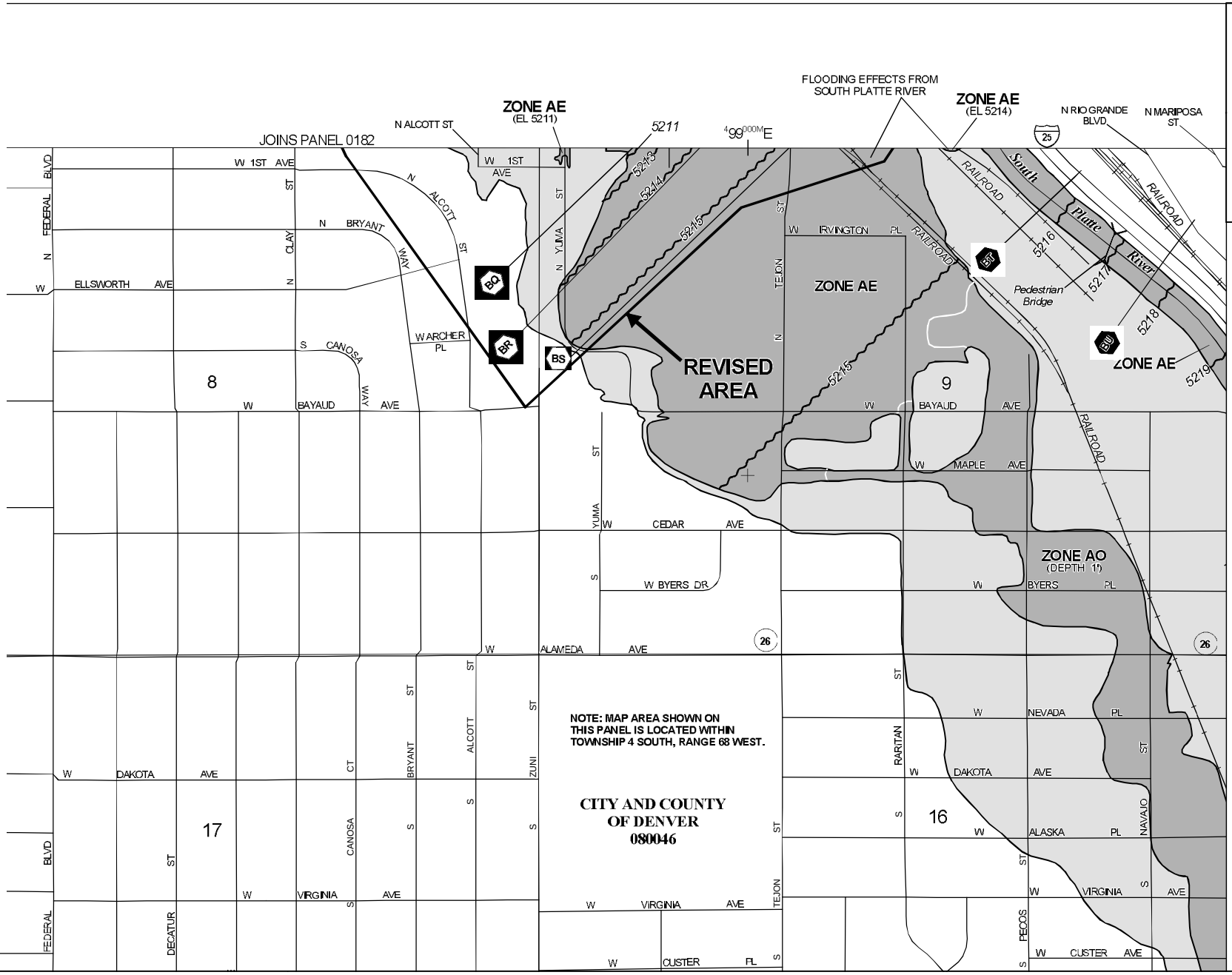

Legend

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

MAP SCALE 1" = 500'

250 0 250 500 750 1,000 Feet

0 75 150 300 Meters

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0184G

FIRM

FLOOD INSURANCE RATE MAP

CITY AND COUNTY OF DENVER, COLORADO

PANEL 184 OF 300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DENVER, CITY AND COUNTY OF	080046	0184	G

REVISED TO REFLECT LOMR EFFECTIVE: December 17, 2012

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 0800460184G

MAP REVISED: NOVEMBER 17, 2005

Federal Emergency Management Agency

HEC-RAS Plan: AsBuilt - Rev Q River: S_Platte_Prp Reach: 01 Profile: 100-Year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	14006	100-Year	19200.00	5203.42	5215.70	5211.98	5217.50	0.002400	11.07	1897.20	2001.66	0.56
01	13858	100-Year	19200.00	5202.50	5214.15	5211.73	5216.77	0.004839	13.28	1547.34	1527.28	0.69
01	13767		Bridge									
01	13761	100-Year	19200.00	5202.50	5214.21	5210.35	5215.96	0.001731	10.63	1806.64	1145.38	0.55
01	13577	100-Year	19200.00	5202.18	5212.96	5210.68	5215.49	0.002836	12.87	1526.50	911.33	0.69
01	13420	100-Year	19200.00	5201.34	5212.87	5209.75	5214.97	0.002169	11.77	1700.94	1136.90	0.61
01	13196	100-Year	19200.00	5201.14	5210.46	5210.00	5214.06	0.005872	15.31	1305.07	621.72	0.93
01	13064	100-Year	19200.00	5194.50	5210.49	5205.02	5212.10	0.001662	10.99	2186.58	1072.95	0.48
01	12997		Bridge									
01	12930	100-Year	19200.00	5193.22	5209.02	5205.32	5211.12	0.002594	13.15	1992.53	327.46	0.59
01	12427	100-Year	19200.00	5192.20	5208.36	5203.14	5210.03	0.001261	11.24	2135.99	580.57	0.49
01	11658	100-Year	19200.00	5190.90	5207.99	5200.36	5209.09	0.000796	9.27	2579.63	377.01	0.40
01	11372	100-Year	19200.00	5190.55	5207.90	5201.24	5208.77	0.000676	8.63	2997.37	914.88	0.37
01	11288		Bridge									
01	11204	100-Year	19200.00	5190.35	5207.58	5201.13	5208.56	0.000746	9.02	2520.75	646.67	0.38
01	11110		Bridge									
01	11014	100-Year	19200.00	5190.12	5206.13	5200.01	5207.47	0.000995	9.92	2248.38	232.72	0.44
01	10432	100-Year	19200.00	5189.41	5204.71	5200.15	5206.60	0.001524	12.77	1973.43	855.79	0.58
01	9926	100-Year	19200.00	5188.81	5203.32		5205.68	0.002048	12.84	1667.64	155.84	0.61
01	9898	100-Year	19200.00	5188.77	5203.35	5199.20	5205.54	0.001813	12.59	1798.64	161.13	0.58
01	9893		Bridge									
01	9887	100-Year	19200.00	5188.74	5203.11		5205.42	0.001941	12.90	1756.24	161.69	0.60
01	9849	100-Year	19200.00	5188.67	5202.75		5205.25	0.005883	13.29	1555.40	140.06	0.62
01	9749	100-Year	19200.00	5188.48	5201.99		5204.63	0.006321	13.40	1485.79	156.91	0.64
01	9713	100-Year	19200.00	5188.41	5201.83		5204.42	0.004215	13.62	1535.36	155.92	0.66
01	9687	100-Year	19200.00	5188.24	5201.85		5204.24	0.002157	13.11	1639.07	154.68	0.63
01	9637	100-Year	19200.00	5187.53	5201.97	5197.26	5203.71	0.001002	11.16	1997.12	165.06	0.52
01	9611		Bridge									
01	9584	100-Year	19200.00	5187.19	5201.29	5196.76	5202.95	0.000982	10.87	1983.47	162.45	0.51
01	9528	100-Year	19200.00	5186.80	5200.82		5202.80	0.001347	11.91	1822.37	171.70	0.58
01	9504	100-Year	19200.00	5186.20	5201.08		5202.65	0.000883	10.63	2100.52	181.53	0.49
01	9377	100-Year	19200.00	5185.86	5200.65	5196.05	5202.50	0.001050	11.45	1933.46	164.80	0.53
01	9100	100-Year	19200.00	5185.45	5200.03		5202.08	0.002016	12.21	1742.23	168.29	0.57
01	9000	100-Year	19200.00	5185.60	5199.91	5195.88	5201.89	0.001208	11.82	1879.50	668.47	0.56
01	8910	100-Year	19200.00	5185.36	5199.83	5195.58	5201.76	0.001139	11.50	1765.49	237.87	0.55
01	8852	100-Year	19200.00	5185.27	5199.75	5195.34	5201.69	0.001133	11.84	1945.01	167.48	0.55
01	8599	100-Year	19200.00	5185.07	5199.46	5195.17	5201.40	0.001145	11.70	1932.79	196.08	0.55
01	8199	100-Year	19200.00	5184.76	5198.93		5200.93	0.001215	11.97	1916.56	196.00	0.57
01	7951	100-Year	19200.00	5184.49	5198.53		5200.61	0.001255	12.18	1868.79	171.35	0.58
01	7649	100-Year	19200.00	5184.76	5197.91		5200.18	0.001472	12.59	1744.91	159.51	0.62
01	7611	100-Year	19200.00	5184.75	5197.83		5200.13	0.001472	12.55	1723.91	158.83	0.62
01	7551	100-Year	19200.00	5183.80	5197.73		5200.04	0.001496	12.75	1753.06	163.71	0.62
01	7344	100-Year	19200.00	5184.36	5197.36		5199.72	0.001572	12.96	1750.17	169.01	0.64
01	7184	100-Year	19200.00	5182.75	5197.96		5199.22	0.000761	9.57	2357.34	255.48	0.45
01	7129	100-Year	19200.00	5181.30	5198.13		5199.10	0.000485	8.38	2633.85	255.37	0.37
01	7049	100-Year	19200.00	5181.10	5198.08	5190.12	5199.06	0.000446	8.16	2569.21	201.55	0.35
01	6956	100-Year	19200.00	5180.65	5197.93	5190.27	5199.01	0.000490	8.59	2426.14	165.10	0.37
01	6899	100-Year	19200.00	5180.77	5197.95		5198.92	0.000431	8.03	2448.64	157.93	0.35
01	6876	100-Year	19200.00	5180.59	5197.88	5190.19	5198.89	0.000454	8.17	2397.66	154.84	0.36
01	6851		Bridge									
01	6817	100-Year	19200.00	5180.97	5197.54	5189.98	5198.59	0.000464	8.29	2355.09	151.88	0.36
01	6764	100-Year	19200.00	5180.68	5197.24		5198.49	0.000573	9.12	2149.15	141.83	0.40
01	6646	100-Year	19200.00	5180.36	5195.95		5198.29	0.001167	12.37	1607.78	137.39	0.56
01	6545	100-Year	19200.00	5179.67	5196.04	5190.46	5197.83	0.000876	10.94	1883.89	148.50	0.49
01	6381	100-Year	19200.00	5179.64	5196.06		5197.37	0.000662	9.57	2285.65	191.54	0.42
01	6356	100-Year	19200.00	5180.20	5196.12	5189.85	5197.28	0.000596	9.17	2453.23	209.97	0.41
01	6321		Bridge									
01	6295	100-Year	19200.00	5179.98	5196.07	5189.63	5197.23	0.000627	9.47	2468.00	222.89	0.42
01	6251	100-Year	19200.00	5180.55	5196.02	5191.70	5197.18	0.002131	9.26	2324.92	598.27	0.44
01	6214	100-Year	19200.00	5178.01	5196.04	5188.72	5197.12	0.000516	8.96	2658.50	500.78	0.38
01	6169	100-Year	19200.00	5178.71	5195.86	5189.58	5197.08	0.000631	9.76	2440.17	347.01	0.42
01	5999	100-Year	19200.00	5177.30	5195.61	5189.31	5196.96	0.000672	10.22	2280.43	244.70	0.44
01	5849	100-Year	19300.00	5176.72	5194.02		5196.69	0.001418	14.07	1688.63	165.10	0.62
01	5799	100-Year	19300.00	5176.63	5193.92	5190.38	5196.61	0.001395	13.92	1644.78	135.98	0.62
01	5734		Bridge									
01	5709	100-Year	19300.00	5176.16	5193.51		5196.14	0.001351	13.72	1667.29	141.94	0.61
01	5649	100-Year	19300.00	5175.96	5193.46		5196.03	0.001287	13.46	1728.82	146.48	0.59
01	5559	100-Year	19300.00	5175.86	5193.35	5190.07	5195.88	0.001692	13.86	1698.28	148.85	0.61
01	5509		Bridge									
01	5401	100-Year	19300.00	5175.69	5193.15		5195.29	0.001095	12.36	1875.82	172.18	0.55
01	5310	100-Year	19300.00	5175.59	5192.89		5195.15	0.001169	12.69	1801.17	155.68	0.56
01	4655	100-Year	19300.00	5174.87	5191.16	5187.93	5194.17	0.001644	14.41	1593.31	164.14	0.66
01	4573	100-Year	19300.00	5174.78	5190.92	5187.95	5194.01	0.001716	14.63	1490.43	127.72	0.67
01	4554		Bridge									
01	4523	100-Year	19300.00	5174.73	5189.96		5193.72	0.002901	16.35	1329.94	124.36	0.77
01	4430	100-Year	19300.00	5174.62	5189.84	5187.92	5193.32	0.002692	15.69	1488.69	152.93	0.75

HEC-RAS Plan: AsBuilt - Rev Q River: S_Platte_Prp Reach: 01 Profile: 100-Year (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	4327		Bridge									
01	4226	100-Year	19300.00	5174.40	5189.25		5192.58	0.003134	15.53	1425.34	153.48	0.75
01	4135	100-Year	19300.00	5173.86	5189.14		5192.07	0.003607	14.58	1491.71	173.83	0.69
01	3985	100-Year	19300.00	5173.76	5189.15		5191.00	0.000948	11.28	2123.44	215.39	0.54
01	3213	100-Year	19400.00	5173.22	5188.44		5190.22	0.001016	11.64	2291.26	259.33	0.53
01	2200	100-Year	19400.00	5172.51	5187.92		5189.07	0.000888	10.97	2653.95	299.95	0.49
01	1650	100-Year	19400.00	5172.12	5187.50		5188.60	0.000807	10.44	2742.56	313.29	0.47
01	863	100-Year	19400.00	5171.57	5186.94		5188.00	0.000699	9.71	2846.85	335.50	0.44
01	164	100-Year	19400.00	5171.08	5186.74	5180.27	5187.53	0.000451	7.90	3190.30	1459.80	0.35
01	45	100-Year	19400.00	5171.00	5185.95	5180.58	5187.40	0.000822	10.34	2335.09	1262.71	0.47

3-span bridge model HEC-RAS output

HEC-RAS Plan: Olsson River: S_Platte_Prp Reach: 01 Profile: 100-Year

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	14006	100-Year	19200.00	5203.42	5215.70	5211.98	5217.50	0.002400	11.07	1897.20	2001.66	0.56
01	13858	100-Year	19200.00	5202.50	5214.15	5211.73	5216.77	0.004839	13.28	1547.34	1527.28	0.69
01	13767		Bridge									
01	13761	100-Year	19200.00	5202.50	5214.21	5210.35	5215.96	0.001731	10.63	1806.64	1145.38	0.55
01	13577	100-Year	19200.00	5202.18	5212.96	5210.68	5215.49	0.002836	12.87	1526.50	911.33	0.69
01	13420	100-Year	19200.00	5201.34	5212.87	5209.75	5214.97	0.002169	11.77	1700.94	1136.90	0.61
01	13196	100-Year	19200.00	5201.14	5210.46	5210.00	5214.06	0.005872	15.31	1305.07	621.72	0.93
01	13064	100-Year	19200.00	5194.50	5210.49	5205.02	5212.10	0.001662	10.99	2186.58	1072.95	0.48
01	12997		Bridge									
01	12930	100-Year	19200.00	5193.22	5208.50	5205.32	5210.80	0.002963	13.73	1899.59	279.17	0.63
01	12427	100-Year	19200.00	5192.20	5207.69	5203.14	5209.57	0.001484	11.86	2000.05	395.18	0.53
01	11658	100-Year	19200.00	5190.90	5207.22	5200.36	5208.46	0.000953	9.84	2426.64	362.23	0.43
01	11372	100-Year	19200.00	5190.55	5207.10	5201.24	5208.10	0.000824	9.23	2799.87	866.13	0.40
01	11288		Bridge									
01	11204	100-Year	19200.00	5190.35	5206.68	5201.08	5207.82	0.000966	9.91	2393.05	384.79	0.43
01	11110		Bridge									
01	11014	100-Year	19200.00	5190.12	5206.13		5207.47	0.000995	9.92	2248.38	232.72	0.44
01	10432	100-Year	19200.00	5189.41	5204.71	5200.15	5206.60	0.001524	12.77	1973.43	855.79	0.58
01	9926	100-Year	19200.00	5188.81	5203.32		5205.68	0.002048	12.84	1667.64	155.84	0.61
01	9898	100-Year	19200.00	5188.77	5203.35	5199.20	5205.54	0.001813	12.59	1798.64	161.13	0.58
01	9893		Bridge									
01	9887	100-Year	19200.00	5188.74	5203.11		5205.42	0.001941	12.90	1756.24	161.69	0.60
01	9849	100-Year	19200.00	5188.67	5202.75		5205.25	0.005883	13.29	1555.40	140.06	0.62
01	9749	100-Year	19200.00	5188.48	5201.99		5204.63	0.006321	13.40	1485.79	156.91	0.64
01	9713	100-Year	19200.00	5188.41	5201.83		5204.42	0.004215	13.62	1535.36	155.92	0.66
01	9687	100-Year	19200.00	5188.24	5201.85		5204.24	0.002157	13.11	1639.07	154.68	0.63
01	9637	100-Year	19200.00	5187.53	5201.97	5197.26	5203.71	0.001002	11.16	1997.12	165.06	0.52
01	9611		Bridge									
01	9584	100-Year	19200.00	5187.19	5201.29	5196.76	5202.95	0.000982	10.87	1983.47	162.45	0.51
01	9528	100-Year	19200.00	5186.80	5200.82		5202.80	0.001347	11.91	1822.37	171.70	0.58
01	9504	100-Year	19200.00	5186.20	5201.08		5202.65	0.000883	10.63	2100.52	181.53	0.49
01	9377	100-Year	19200.00	5185.86	5200.65	5196.05	5202.50	0.001050	11.45	1933.46	164.80	0.53
01	9100	100-Year	19200.00	5185.45	5200.03		5202.08	0.002016	12.21	1742.23	168.29	0.57
01	9000	100-Year	19200.00	5185.60	5199.91	5195.88	5201.89	0.001208	11.82	1879.50	668.47	0.56
01	8910	100-Year	19200.00	5185.36	5199.83	5195.58	5201.76	0.001139	11.50	1765.49	237.87	0.55
01	8852	100-Year	19200.00	5185.27	5199.75	5195.34	5201.69	0.001133	11.84	1945.01	167.48	0.55
01	8599	100-Year	19200.00	5185.07	5199.46	5195.17	5201.40	0.001145	11.70	1932.79	196.08	0.55
01	8199	100-Year	19200.00	5184.76	5198.93		5200.93	0.001215	11.97	1916.56	196.00	0.57
01	7951	100-Year	19200.00	5184.49	5198.53		5200.61	0.001255	12.18	1868.79	171.35	0.58
01	7649	100-Year	19200.00	5184.76	5197.91		5200.18	0.001472	12.59	1744.91	159.51	0.62
01	7611	100-Year	19200.00	5184.75	5197.83		5200.13	0.001472	12.55	1723.91	158.83	0.62
01	7551	100-Year	19200.00	5183.80	5197.73		5200.04	0.001496	12.75	1753.06	163.71	0.62
01	7344	100-Year	19200.00	5184.36	5197.36		5199.72	0.001572	12.96	1750.17	169.01	0.64
01	7184	100-Year	19200.00	5182.75	5197.96		5199.22	0.000761	9.57	2357.34	255.48	0.45
01	7129	100-Year	19200.00	5181.30	5198.13		5199.10	0.000485	8.38	2633.85	255.37	0.37
01	7049	100-Year	19200.00	5181.10	5198.08	5190.12	5199.06	0.000446	8.16	2569.21	201.55	0.35
01	6956	100-Year	19200.00	5180.65	5197.93	5190.27	5199.01	0.000490	8.59	2426.14	165.10	0.37
01	6899	100-Year	19200.00	5180.77	5197.95		5198.92	0.000431	8.03	2448.64	157.93	0.35
01	6876	100-Year	19200.00	5180.59	5197.88	5190.19	5198.89	0.000454	8.17	2397.66	154.84	0.36
01	6851		Bridge									
01	6817	100-Year	19200.00	5180.97	5197.54	5189.98	5198.59	0.000464	8.29	2355.09	151.88	0.36
01	6764	100-Year	19200.00	5180.68	5197.24		5198.49	0.000573	9.12	2149.15	141.83	0.40
01	6646	100-Year	19200.00	5180.36	5195.95		5198.29	0.001167	12.37	1607.78	137.39	0.56
01	6545	100-Year	19200.00	5179.67	5196.04	5190.46	5197.83	0.000876	10.94	1883.89	148.50	0.49
01	6381	100-Year	19200.00	5179.64	5196.06		5197.37	0.000662	9.57	2285.65	191.54	0.42
01	6356	100-Year	19200.00	5180.20	5196.12	5189.85	5197.28	0.000596	9.17	2453.23	209.97	0.41
01	6321		Bridge									
01	6295	100-Year	19200.00	5179.98	5196.07	5189.63	5197.23	0.000627	9.47	2468.00	222.89	0.42
01	6251	100-Year	19200.00	5180.55	5196.02	5191.70	5197.18	0.002131	9.26	2324.92	598.27	0.44
01	6214	100-Year	19200.00	5178.01	5196.04	5188.72	5197.12	0.000516	8.96	2658.50	500.78	0.38
01	6169	100-Year	19200.00	5178.71	5195.86	5189.58	5197.08	0.000631	9.76	2440.17	347.01	0.42
01	5999	100-Year	19200.00	5177.30	5195.61	5189.31	5196.96	0.000672	10.22	2280.43	244.70	0.44
01	5849	100-Year	19300.00	5176.72	5194.02		5196.69	0.001418	14.07	1688.63	165.10	0.62
01	5799	100-Year	19300.00	5176.63	5193.92	5190.38	5196.61	0.001395	13.92	1644.78	135.98	0.62
01	5734		Bridge									
01	5709	100-Year	19300.00	5176.16	5193.51		5196.14	0.001351	13.72	1667.29	141.94	0.61
01	5649	100-Year	19300.00	5175.96	5193.46		5196.03	0.001287	13.46	1728.82	146.48	0.59
01	5559	100-Year	19300.00	5175.86	5193.35	5190.07	5195.88	0.001692	13.86	1698.28	148.85	0.61
01	5509		Bridge									
01	5401	100-Year	19300.00	5175.69	5193.15		5195.29	0.001095	12.36	1875.82	172.18	0.55
01	5310	100-Year	19300.00	5175.59	5192.89		5195.15	0.001169	12.69	1801.17	155.68	0.56
01	4655	100-Year	19300.00	5174.87	5191.16	5187.93	5194.17	0.001644	14.41	1593.31	164.14	0.66
01	4573	100-Year	19300.00	5174.78	5190.92	5187.95	5194.01	0.001716	14.63	1490.43	127.72	0.67
01	4554		Bridge									
01	4523	100-Year	19300.00	5174.73	5189.96		5193.72	0.002901	16.35	1329.94	124.36	0.77
01	4430	100-Year	19300.00	5174.62	5189.84	5187.92	5193.32	0.002692	15.69	1488.69	152.93	0.75

3-span bridge model HEC-RAS output

HEC-RAS Plan: Olsson River: S_Platte_Prp Reach: 01 Profile: 100-Year (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	4327		Bridge									
01	4226	100-Year	19300.00	5174.40	5189.25		5192.58	0.003134	15.53	1425.34	153.48	0.75
01	4135	100-Year	19300.00	5173.86	5189.14		5192.07	0.003607	14.58	1491.71	173.83	0.69
01	3985	100-Year	19300.00	5173.76	5189.15		5191.00	0.000948	11.28	2123.44	215.39	0.54
01	3213	100-Year	19400.00	5173.22	5188.44		5190.22	0.001016	11.64	2291.26	259.33	0.53
01	2200	100-Year	19400.00	5172.51	5187.92		5189.07	0.000888	10.97	2653.95	299.95	0.49
01	1650	100-Year	19400.00	5172.12	5187.50		5188.60	0.000807	10.44	2742.56	313.29	0.47
01	863	100-Year	19400.00	5171.57	5186.94		5188.00	0.000699	9.71	2846.85	335.50	0.44
01	164	100-Year	19400.00	5171.08	5186.74	5180.27	5187.53	0.000451	7.90	3190.30	1459.80	0.35
01	45	100-Year	19400.00	5171.00	5185.95	5180.58	5187.40	0.000822	10.34	2335.09	1262.71	0.47

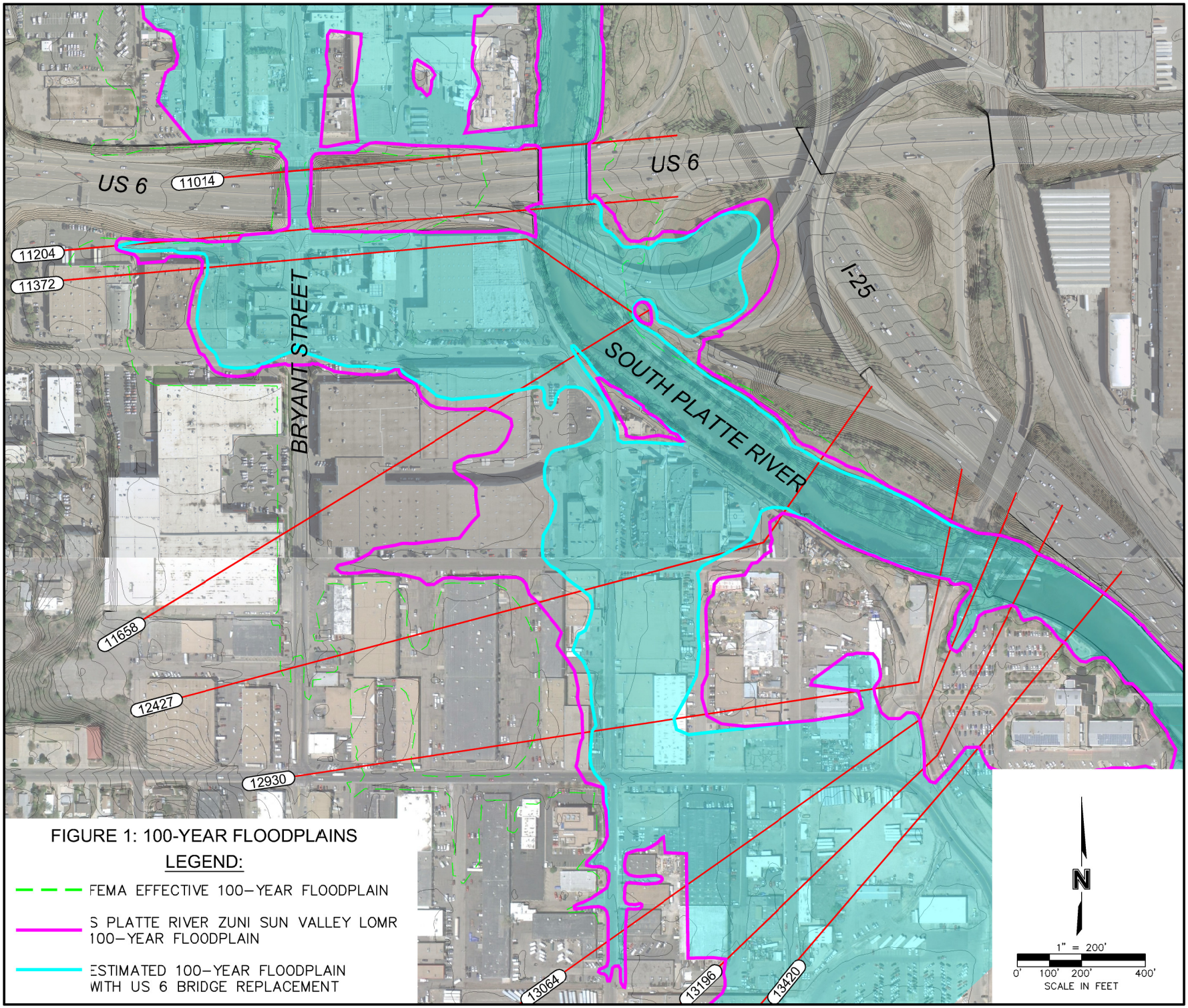

FIGURE 1: 100-YEAR FLOODPLAINS

LEGEND:

- FEMA EFFECTIVE 100-YEAR FLOODPLAIN
- S PLATTE RIVER ZUNI SUN VALLEY LOMR 100-YEAR FLOODPLAIN
- ESTIMATED 100-YEAR FLOODPLAIN WITH US 6 BRIDGE REPLACEMENT