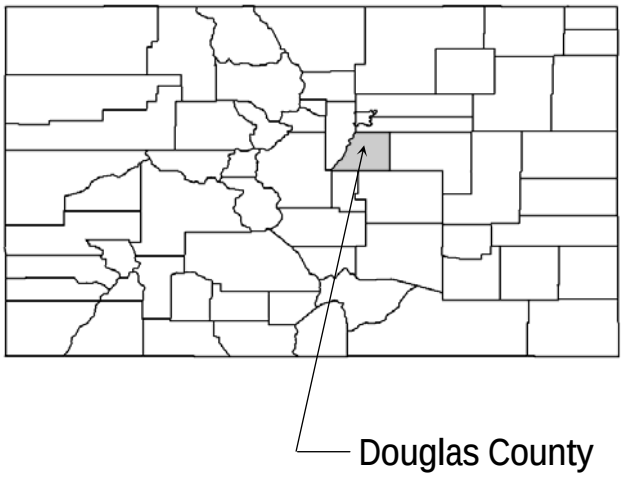
FLOOD INSURANCE STUDY

VOLUME 1 OF 3

DOUGLAS COUNTY, COLORADO
AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
CASTLE ROCK, TOWN OF	080050
DOUGLAS COUNTY (UNINCORPORATED AREAS)	080049
LARKSPUR, TOWN OF	080309
LONE TREE, CITY OF	080319
PARKER, TOWN OF	080310

Notice

This preliminary FIS report includes only revised Flood Profiles and Floodway Data tables. See "Notice to Flood Insurance Study Users" page for additional details.

PRELIMINARY
SEPTEMBER 26, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
08035CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

This FIS was revised on [add new effective date]. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this FIS report should be aware that the information presented in Section 10.0 supersedes information in Sections 1.0 through 9.0 of this FIS report.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 30, 2005

Revised Countywide FIS Dates: XXXXX XX, 2015

The Preliminary FIS report does not include unrevised Floodway Data tables or unrevised Flood Profiles. These unrevised components will appear in the final FIS report.

TABLES OF CONTENTS
Table of Contents – Volume 1 – Revision Date TBD

		Page
1.0	**INTRODUCTION**	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	3
2.0	**AREA STUDIED**	4
	2.1 Scope of Study	4
	2.2 Community Description	12
	2.3 Principal Flood Problems	13
	2.4 Flood Protection Measures	16
3.0	**ENGINEERING METHODS**	16
	3.1 Hydrologic Analyses	16
	3.2 Hydraulic Analyses	32
	3.3 Vertical Datum	37
4.0	**FLOODPLAIN MANAGEMENT APPLICATIONS**	39
	4.1 Floodplain Boundaries	39
	4.2 Floodways	40
5.0	**INSURANCE APPLICATIONS**	48
6.0	**FLOOD INSURANCE RATE MAP**	49
7.0	**OTHER STUDIES**	49
8.0	**LOCATION OF DATA**	52
9.0	**BIBLIOGRAPHY AND REFERENCES**	52
10.0	**REVISIONS DESCRIPTION**	57
	10.1 First Revision	57
	10.2 Second Revision	57
11.0	**MAP REPOSITORIES**	58

Table of Contents – Volume 1 – continued

FIGURES

Figure 1 – Floodway Schematic 42

TABLES

Table 1 – Flooding Sources Studied by Detailed Methods 4-7
Table 2 – Flooding Sources Studied by Approximate Methods 8-9
Table 3 – Letters of Map Revision 10-11
Table 4 – Summary of Discharges 20-31
Table 5 – Manning's "n" Values 35-36
Table 6 – Vertical Datum Offset Table 38
Table 7 – Floodway Data 43-47
Table 8 – Community Map History 50
Table 9 – Map Repositories 58

EXHIBITS

Exhibit 1 – Flood Profiles

Antelope Creek	Panels	01P – 03P
Baldwin Gulch	Panels	04P – 10P
Bayou Gulch	Panels	11P – 20P
Big Dry Creek	Panels	21P – 25P
Big Dry Creek Tributary C	Panels	26P – 28P

Table of Contents – Volume 2 – Revision Date TBD

EXHIBITS

Exhibit 1 – Flood Profiles (Cont'd)

Carpenter Creek	Panels	29P – 31P
Cherry Creek	Panels	32P – 49P
Cottonwood Creek	Panels	50P – 54P
Daniels Park Drain	Panels	55P – 56P
Drainageway 6600-02	Panels	57P
Drainageway 6604-01	Panels	58P
Drainageway 6605-01	Panels	59P
East Plum Creek	Panels	60P – 77P
East Willow Creek	Panels	78P – 80P
Fourmile Creek	Panels	81P – 96P
Glade Gulch	Panels	97P – 98P
Hangmans Gulch	Panels	99P – 107P
Happy Canyon Creek	Panels	108P – 111P

Highlands Gulch	Panels	112P – 113P
Horse Creek	Panels	114P – 118P
Indian Creek	Panel	119P – 124P
Industrial Creek	Panels	125P – 128P
Industrial Creek Tributary	Panels	129P – 130P
Jarre Creek	Panels	131P – 133P

Table of Contents – Volume 3 – Revision Date TBD

EXHIBITS

Exhibit 1 – Flood Profiles (Cont'd)

Lehigh Gulch	Panels	134P – 135P
Little Willow Creek	Panels	136P – 138P
Louviers Gulch	Panels	139P – 140P
McMurdo Gulch	Panels	141P – 147P
McMurdo Gulch Tributary	Panels	148P – 149P
Mitchell Gulch	Panels	150P – 152P
Mitchell Gulch Tributary 1	Panels	153P
Mitchell Gulch Tributary 2	Panels	154P – 155P
Newlin Gulch	Panels	156P – 159P
Omni Creek	Panels	160P – 165P
Oxide Draw	Panels	166P
Piney Creek	Panels	167P – 175P
Plum Creek	Panels	176P – 183P
Plum Creek – Diversion Channel	Panels	184P
Rainbow Creek	Panels	185P – 186P
Section 34 Tributary	Panels	187P – 193P
Sellars Gulch	Panels	194P – 198P
Sellars Gulch Tributary 1	Panels	199P
Sellars Gulch Tributary 2	Panels	200P – 201P
South Platte River	Panels	202P – 216P
Sterling Gulch	Panels	217P – 218P
Sulphur Gulch	Panels	219P – 227P
Tallman Gulch	Panels	228P – 232P
Tributary 6400 East	Panels	233P – 235P
Tributary 6400 West	Panels	236P – 239P
Trout Creek	Panels	240P – 244P
West Creek	Panels	245P – 252P
West Plum Creek	Panels	253P – 259P
Willow Creek	Panels	260P – 265P
Willow Creek (At Lone Tree)	Panels	266P – 268P
6400 South Tributary	Panels	269P - 271P

Exhibit 2 (published separately) – Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Douglas County, Colorado, including: the Towns of Castle Rock, Larkspur, and Parker; the City of Lone Tree; and the unincorporated areas of Douglas County (hereinafter referred to collectively as Douglas County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Douglas County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some States or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared as part of a partial-countywide update to the September 30, 2005 countywide FIS for Douglas County. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Castle Rock, Town of: the hydrologic and hydraulic analyses for the FIS report dated September 30, 1987, were prepared by Howard, Needles, Tammen and Bergendoff, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4016. That work was completed in July 1977. The hydrologic and hydraulic analyses for portions of the streams studied by approximate methods were performed by J. F. Sato and associates Inc., for FEMA, under Contract No. 84-C-1631. That work was

completed in August 1985. Hydrologic information was obtained from the initial Castle Rock FIS, the Douglas County FIS, and previous Urban Drainage and Flood Control District (UDFCD) reports. The major portion of the hydraulic analyses was taken directly from the initial Castle Rock FIS and UDFCD reports. The balance of the analyses was developed by J.F. Sato and Associates, Inc.

Douglas County (Unincorporated Areas): the hydrologic and hydraulic analyses for the January 5 1996, FIS report were prepared by Howard, Needles, Tammen and Bergendoff, for FIA, under Contract No. H-4016. That work was completed in July 1978. The hydrologic and hydraulic analysis for portions of East Plum Creek and Sellars Gulch and for portions of streams studied by approximate methods were performed by J. F. Sato and Associates, Inc., for FEMA, under Contract No. 84-C-1631. That work was completed in August 1985. The major portion of the hydrologic information was obtained from the initial Douglas County FIS, and previous UDFCD reports. The balance of the analyses was developed by J.F. Sato and Associates, Inc.

Larkspur, Town of: the hydrologic and hydraulic analyses for the September 30, 1987, FIS were taken from the FIS for Douglas County.

Parker, Town of: the hydrologic and hydraulic analyses for the February 2, 1996, FIS were taken from the FIS for Douglas County.

The authority and acknowledgments for the City of Lone Tree is not included because there are no previously printed FIS reports for that community.

For the 2005 countywide FIS, the updated and new hydrologic and hydraulic analyses were taken from the following UDFCD, Colorado Water Conservation Board (CWCB), and Douglas County reports:

- "Flood Hazard Area Delineation Big Dry Creek (Arapco) & Tributaries", prepared by WRC Engineering, Inc.
- "Flood Hazard Area Delineation Willow Creek, Little Willow Creek, and East Willow Creek", prepared by Greenhorne & O'Mara, Inc.
- "Flood Hazard Area Delineation Plum Creek Watershed", prepared by WRC Engineering, Inc.
- "Flood Hazard Area Delineation, Cherry Creek Corridor – Reservoir to Scott Road", prepared by URS Corporation

- "Plum Creek and East Plum Creek, Flood Hazard Area Delineation (FHAD), Flood Insurance Study Documentation, Technical Appendix," prepared by ICON Engineering, Inc.
- "Kinney Creek and Fonder Draw Flood Hazard Area Delineation (FHAD), Flood Insurance Study Documentation, Technical Appendix," prepared by WRC Engineering, Inc.
- Post-Wildfire Floodplain Study, Hayman Burn Area, Douglas County, Colorado.

In addition to the reports above, updated hydraulic analysis were performed for Hangmans Gulch using digital topography provided by Douglas County. Floodplain delineations were also revised for detailed streams outside of the UDFCD boundary using digital topography provided by Douglas County.

Base Map information shown on the unrevised 2005 FIRM panels was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2003. Base Map information shown on the FIRM panels revised with this update was provided by the same entities and is current as of 2010.

The coordinate system used for the production of the digital FIRM is Universe Transverse Mercator referenced to North American Datum of 1983 and the GRS 80 spheroid, Western Hemisphere.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

A meeting was held on July 8, 1976, to discuss streams studied in the original study for Douglas County and the methods of study to be used. The meeting was attended by representatives of FEMA; the Douglas County Planning and Zoning Department; the UDFCD; and Howard, Needles, Tammen and Bergendoff, the study contractor. Subsequent meetings and calls to the Douglas County Planning Director provided pertinent zoning and current development information.

For the September 30, 1987, restudy for Douglas County, an initial community coordination meeting was held on April 10, 1984, to set priorities for study reaches. The meeting was attended by representatives of FEMA; CWCB; UDFCD; U.S. Soil Conservation Service (SCS); the Douglas County Planning Department; and J.F. Sato and Associates, Inc., the study contractor. The study area was subsequently modified at the direction of FEMA to include additional reaches to be studied by approximate methods. The final study scope was reviewed with Douglas County Planning Department, Town of Castle Rock, and Engineering Department staff at a meeting on September 17, 1984.

An intermediate community coordination meeting for the Douglas County restudy was held on July 29, 1985, to discuss the findings of the study. Representatives of FEMA, CWCB, UDFCD, Douglas County Planning Department, Town of Castle Rock, and the study contractor attended the meeting.

The following sources were contacted for information during the preparation of the January 5, 1996, FIS for Douglas County.

1. U.S. Soil Conservation Services
2. U.S. Geological Survey (USGS)
3. U.S. Army Corps of Engineers (USACE)
4. Colorado Water Conservation Board
5. Colorado Department of Highways
6. Colorado State Historical Society
7. Douglas County Planning Director
8. M&I, Inc.

For the 2005 countywide FIS, a final CCO meeting was held on March 25, 2005, and was attended by representatives of the state, the study contractor, the community, and FEMA. The final CCO meeting for this partial-countywide update was held on TBD and attended by TBD.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Douglas County, Colorado. All or portions of the flooding sources listed in Table 1 were studied by detailed methods in the January 5, 1996, FIS.

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Stream	Stream Miles
Plum Creek (Sedalia to Chatfield Lake)	8.0
East Plum Creek	21.5
Indian Creek	1.5
West Plum Creek (at Perry Park)	3.0
Hangmans Gulch	2.0
Sellars Gulch	2.7
Carpenter Creek (at Greenland)	1.5
Cherry Creek	16.0
Happy Canyon Creek (at Grandview Estates)	3.5
Newlin Gulch	5.0
Baldwin Gulch	3.5
Sulphur Gulch	5.0
Tallman Gulch	3.0

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS - continued

Stream	Stream Miles
Bayou Gulch	4.0
South Platte River	1.5
Horse Creek	0.5
West Creek	1.5

For the September 30, 2005 countywide FIS, the following streams were either restudied or newly studied by detailed methods:

Stream	Limits of Revised or New Detailed Study
Big Dry Creek	From the Douglas County/Jefferson County border, which is defined along County Line Road, south 5.9 miles
Big Dry Creek – Tributary C	From the confluence with Big Dry Creek to a point approximately 3 miles upstream.
Cherry Creek	From Cherry Creek Reservoir to Scott Road, a point approximately 16.5 miles upstream of the reservoir.
Daniels Park Drain	From the confluence with Plum Creek to a point approximately 1.6 miles upstream.
Drainageway 6600-02	From the confluence with Plum Creek to a point approximately 0.8 miles upstream.
Drainageway 6604-01	From the confluence with Louviers Gulch to a point approximately 0.8 miles upstream.
Drainageway 6605-01	From the confluence with Indian Creek to a point approximately 0.8 miles upstream.
East Plum Creek	From the confluence with Plum Creek to a point approximately 1.2 miles upstream of the confluence with Drainageway 6631.
East Willow Creek	From the confluence with Willow Creek to a point approximately 2.6 miles upstream.
Fourmile Creek	From the confluence with the South Platte River to a point approximately 7.8 miles upstream.

Stream	Limits of Revised or New Detailed Study
Hangmans Gulch	From the confluence with East Plum Creek to a point approximately 2.2 miles upstream.
Highlands Gulch	From the confluence with Plum Creek to a point approximately 1.5 miles upstream.
Horse Creek	From the confluence with South Platte River to a point approximately 4.0 miles upstream.
Indian Creek	From the confluence with Plum Creek to a point approximately 7.2 miles upstream.
Jarre Creek	From the confluence with Plum Creek to a point approximately 2.7 miles upstream.
Lehigh Gulch	From the confluence with Indian Creek to a point approximately 2.2 miles upstream.
Little Willow Creek	From the confluence with Platte Canyon Reservoir to a point 3.5 miles upstream.
Louviers Gulch	From the confluence with Plum Creek to a point approximately 1.9 miles upstream.
Oxide Draw	From the confluence with Plum Creek to a point approximately 0.7 miles upstream.
Plum Creek	From the Highline Canal approximately 8.9 miles upstream to the confluence with East Plum Creek.
Plum Creek – Diversion Channel	From a point approximately 500 feet upstream of the confluence with Plum Creek to a point approximately 0.6 mile upstream of the confluence with East Plum Creek.
Rainbow Creek	From the confluence with Indian Creek to a point approximately 1.5 miles upstream.
Sterling Gulch	from the confluence with Plum Creek to a point 1.7 miles upstream

Stream	Limits of Revised or New Detailed Study
South Platte River	From a point 1,600 feet downstream of County Road 97 (Bridge F-10-A8) to a point 3,200 feet upstream of the bridge. From a point 4.2 miles upstream of County Road 97 (Bridge F-10-A8) to a point 1.6 miles upstream of Road 67 (Bridge E-5-1A)
Trout Creek	From the confluence with the Horse Creek to a point approximately 2.1 miles upstream.
West Creek	From the confluence with Trout Creek to a point approximately 11.5 miles upstream.
West Plum Creek	From the confluence with Plum Creek to a point approximately 2.9 miles upstream.
Willow Creek	From the confluence with the South Platte River to a point 1.9 miles upstream.

For the current, partial-countywide update, all or portions of the following streams were either restudied or newly studied by detailed methods:

East Plum Creek, Hangman's Gulch, Industrial Creek, Industrial Creek Tributary, McMurdo Gulch, McMurdo Gulch Split Flow, Mitchell Gulch, Mitchell Gulch Tributaries 1 and 2, Omni Creek, Sellars Gulch, Sellars Gulch Tributaries 1 and 2, Tributary 6400 East and Tributary 6400 West, and Willow Creek (at Lone Tree).

Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

All or portions of the streams in Table 2 were studied by approximate methods in the January 5, 1996, FIS.

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Stream	Stream Miles
Badger Gulch	1.6
Bear Creek	6.0
Big Dry Creek	5.7
Carpenter Creek	6.0
Cottonwood Creek	4.5
Dad Clark Gulch	6.5
East Plum Creek	23.0
Garber Creek	4.9
Glade Gulch	1.6
Happy Canyon Creek	9.2
Happy Canyon Creek Tributary	1.6
Haskins Gulch	2.0
Hunt Gulch	1.0
Indian Creek	8.0
Jackson Creek	8.0
Jarre Creek	6.0
Jordan Road Tributary	2.0
Kinney Creek	4.0
KOA Tributary	1.7
“Larkspur Butte” Tributary	1.6
Marcy Gulch	4.7
McMurdo Gulch	2.4
Mitchell Gulch	1.6
Newlin Gulch	4.7
North Gulch	1.7
Oak Gulch	1.7
Oakland School Gulch	3.2
Piney Creek	2.4
Section 34 Tributary	1.3
Sellars Gulch	3.6
South Newlin Gulch	1.1
Spring Gulch	5.0
Stark Creek	4.0
Tributary A	1.3
Tributary B	1.0
Tributary C	0.6
Tributary D	3.0
6400 Tributary, East & West Forks	5.1
6400 South Tributary	2.4
West Plum Creek	15.5
Willow Gulch	2.0

For the 2005 countywide FIS, the following streams were either restudied or newly studied by approximate methods:

Stream	Stream Miles
Dad Clark Gulch	3.4
Dad Clark Gulch Tributary 1	0.5
Dad Clark Gulch Tributary 2	0.5
Dad Clark Gulch Tributary 3	0.4
Drainageway 6631	2.4
East Dad Clark Gulch	1.7
East Dad Clark Gulch Tributary 1	0.2
Fonder Draw	2.6
Kinney Creek	8.5
Marcy Gulch	3.1
Marcy Gulch Tributary 1	0.2
Marcy Gulch Tributary 2	0.2
South Platte River	3

Stream	Stream Miles
South Platte River – Unnamed Tributary 1	0.8
South Platte River – Unnamed Tributary 2	0.5
South Platte River – Unnamed Tributary 3	0.4
South Platte River – Unnamed Tributary 4	1
Spring Gulch	1.7

For the 2005 countywide study, the existing FIRM was converted to a Digital FIRM (DFIRM). Detailed analyses were taken from the effective FIRM or from existing UDFCD reports. The existing detailed analysis was originally used in developed areas or areas with a high development potential. The existing approximate analysis was originally used to study those areas that detailed information was not available or those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA, CWCB, UDFCD, and Douglas County.

The 2005 countywide FIS also incorporated the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR]), as shown in Table 3, “Letters of Map Revision.”

TABLE 3 – LETTERS OF MAP REVISION

Community	Flooding Source(s) and Project Identifier	Date Issued	Type
Town of Castle Rock	East Plum Creek Tributary D	May 22, 2003	LOMR
	Tributary B Castle Rock Factory Store Expansion	September 12, 2002	LOMR
	Tributary B to East Plum Creek	October 2, 2000	LOMR
	6400 Tributary East Fork	January 24, 2003	LOMR
	Tributary D to East Plum Creek	September 12, 2000	LOMR
	Tributary B to East Plum Creek	December 3, 1999	LOMR
	Hangmans Gulch	June 18, 1996	LOMR
	Tributary C to East Plum Creek West Fork of Tributary 6400	August 7, 1995	LOMR
	Village No. Diversion Channel	April 5, 1995	LOMR
	Unnamed Tributary to Sellars Gulch	November 21, 1994	LOMR
	Omni Drainageway	March 10, 1994	LOMR
	Tributary 6400 East Fork and Tributary 6400 West Fork	January 14, 1994	LOMR
Douglas County (Unincorporated Areas)	Newlin Gulch	July 30, 2003	LOMR
	Bayou Gulch / Cherry Creek	July 23, 2003	LOMR
	Sulpher Gulch	June 25, 2003	LOMR
	East Plum Creek Tributary D	May 22, 2003	LOMR
	Happy Canyon Creek	April 24, 2003	LOMR
	Tributary A	January 24, 2003	LOMR
	Sulpher Gulch	January 16, 2003	LOMR
	Tributary B to East Plum Creek	September 12, 2002	LOMR
	Newlin Gulch	June 22, 2001	LOMR
	Green Acres Tributary	March 14, 2001	LOMR
	Tributary B to East Plum Creek	October 2, 2000	LOMR
	Tributary A of East Plum Creek	September 11, 2000	LOMR
	Big Dry Creek	June 29, 2000	LOMR
	Tributary B to East Plum Creek	December 3, 1999	LOMR
	Tallman Gulch	March 29, 1999	LOMR
	Sulpher Gulch	May 4, 1998	LOMR
	Willow Creek	April 17, 1998	LOMR
	Newlin Gulch	August 27, 1997	LOMR
	Jordan Road Tributary	March 3, 1997	LOMR
	Tributary C to East Plum Creek	August 7, 1995	LOMR
	Village No. Diversion Channel	April 5, 1995	LOMR
	East Plum Creek	November 18, 1994	LOMR
	Jordan Road Tributary	August 29, 1994	LOMR
	Tributary 6400 East Fork and Tributary 6400 West Fork	January 14, 1994	LOMR
Town of Parker	Unnamed Tributary D	December 5, 2003	LOMR
	Cherry Gulch / Newlin Gulch	July 30, 2003	LOMR
	Sulpher Gulch	June 25, 2003	LOMR

For the current partial-countywide update, the following LOMRs were incorporated:

TABLE 3 – LETTERS OF MAP REVISION - continued

Community	Flooding Source(s) and Project Identifier	Date Issued	Type
Town of Castle Rock	6400 Tributary East Fork	July 11, 2007	LOMR
	6400 Tributary West Fork	October 1, 2007	LOMR
	6400 South Tributary	January 16, 2008	LOMR
	6400 South Tributary	September 19, 2008	LOMR
	East Plum Creek Tributary C	August 4, 2011	LOMR
	East Plum Creek	January 13, 2012	LOMR
Douglas County (Unincorporated Areas)	Plum Creek	April 10, 2006	LOMR
	Baldwin Gulch	July 26, 2006	LOMR
	Happy Canyon Creek & Badger Gulch	January 18, 2007	LOMR
	Scott Gulch & Scott Gulch Tributary B	May 29, 2007	LOMR
	Cherry Creek	May 22, 2008	LOMR
	Baldwin Gulch	August 21, 2008	LOMR
	Newlin Gulch	January 9, 2009	LOMR
	Newlin Gulch	February 6, 2009	LOMR
	Newlin Gulch	April 23, 2009	LOMR
	Cherry Creek	September 25, 2009	LOMR
	Cottonwood Creek	September 25, 2009	LOMR
	Tributary A of East Plum Creek	September 30, 2009	LOMR
	Badger Gulch	November 19, 2009	LOMR
	Newlin Gulch	October 29, 2010	LOMR
	Cherry Creek	April 29, 2011	LOMR
	Newlin Gulch	June 30, 2011	LOMR
	East Plum Creek	January 13, 2012	LOMR
	Stonegate Tributary	January 11, 2013	LOMR
City of Lone Tree	Happy Canyon Creek & Badger Gulch	January 18, 2007	LOMR
	Happy Canyon Creek & Badger Gulch	November 22, 2011	LOMR
Town of Parker	Tallman Gulch	March 8, 2006	LOMR
	Oak Gulch	July 12, 2006	LOMR
	Baldwin Gulch	July 26, 2006	LOMR
	Newlin Gulch	January 9, 2009	LOMR
	Newlin Gulch	February 6, 2009	LOMR
	Baldwin Gulch & Cherry Creek	March 6, 2009	LOMR
	Newlin Gulch	April 23, 2009	LOMR
	Cherry Creek	September 25, 2009	LOMR
	Newlin Gulch	October 29, 2010	LOMR
	Cherry Creek	April 29, 2011	LOMR

2.2 Community Description

Douglas County is located slightly northeast of the geographic center of Colorado, south of the City and County of Denver. The county seat is Castle Rock, located approximately 30 miles south of Denver. The 2010 population of Castle Rock was 51,348 (Reference 1). The 2010 population figures for the remainder of Douglas County are Larkspur (245), Lone Tree (11,852), Parker (47,169), and the unincorporated areas of Douglas County (120,950) (Reference 1). Douglas County is bordered on the north by Arapahoe County, on the west by Jefferson County, on the south by Teller and El Paso Counties, and on the east by Elbert County.

Castle Rock, Parker, and Lone Tree and the northern portion of Douglas County have developed as residential areas with more development planned. Business and industrial activities in Denver support much of these areas working population. The result has been extensive growth, with a loss of agricultural land use. Most agricultural land use in the county is centered around livestock production; the remainder is cultivation.

Douglas County is in the South Platte River watershed. The study areas of the South Platte River, Horse Creek at Deckers, and West Creek are within Pike National Forest. All the other study areas are part of two subbasins, Plum Creek and Cherry Creek. East Plum Creek originates in Pike National Forest and joins West Plum Creek near Sedalia. Plum Creek flows northerly and joins the South Platte River at Chatfield Lake.

The climate of the plains area of the county is high inland continental, modified by the Rocky Mountains immediately to the west and Palmer Lake Divide to the south. Precipitation is light with an annual average of 15 to 18 inches. Totals vary substantially for individual years because a large part of the yearly total is from summer thunderstorms. Temperatures in the area range from a high slightly more than 100 degrees Fahrenheit (^{o}F) to a low of approximately –35^{o}F. The mean annual air temperature is 47^{o}F, and the mean summer air temperature is 66^{o}F.

The northern one half of the plains area of the county consists of three basic soil types. Loamy and sandy soils exist on the floodplains and terraces. Terrain in these areas is nearly level to gently sloping to moderately steep, with sandy and gravelly soils on the uplands. Vegetation is mainly grass, with some Gambel oak, mountain mahogany, and ponderosa pine trees (Reference 2). Most of the remaining area is gently sloping to moderately steep, with loamy soils on the uplands.

The southern portion of the plains area is gently sloping to the steep, with sandy soils on the uplands and loamy soils on the tablelands. Vegetation on the uplands is mainly mid-size and talk grasses, with Gambel oak and ponderosa pine trees. The tablelands vegetation is mainly western wheatgrass, junigrass, mountain meehley, and Gambel oak.

2.3 Principal Flood Problems

Douglas County is located in an area that is prone to very intense rainfall, sometimes of cloudburst magnitude. Floods have resulted from storms covering large areas with heavy general rainfall as wet as from storms covering small area with extremely intense rainfall. Floods generally occur from May through August. The upland areas are characterized by dissected topographic relief with steep stream slopes. Rapid rises, high maximum discharges, short durations, and comparatively low volumes of total runoff characterize the floods.

The roadways that cross the streams and obstruct flood flows are the most significant factor affecting flooding in the area. Other manmade objects, such as building, cars, and fences, as well as the natural vegetation of the flood plains, cause flow obstruction.

The following accounts of flooding on the South Platte River, Plum Creek, and Cherry Creek area are representative of typical floods for which information is available.

Three separate floods occurred during May and June 1864. The first originated in the Cherry Creek and Plum Creek basins, occurring during the night of May 19-20, 1864, and was caused primarily by a cloudburst in the upper part of those basins. On the morning of May 20, the flood inundated the lower portions of Denver at a depth of 1 to 5 feet, leaving great deposits of sand and gravel.

Records indicate that 2.08 inches of rain occurred during a 2-hour period on July 14, 1912. The heaviest precipitation occurred between Franktown and a point about 5 miles north of Denver; the center was located near Parker. The rainfall started around 3pm and continued until around 5pm. Cherry Creek crested around 10pm and had a peak discharge of 25,000 cubic feet per second (cfs) in Denver. The Cherry Creek Flood Commission estimated that runoff occurred from an area of approximately 200 square miles. Flood damages in the reach between Franktown and the site of the existing Cherry Creek Dam and Reservoir totaled $554,000.

In June 1921, the rainfall extended east of the mountains for a considerable distance, and the plains tributaries as well as those in the mountains contributed flow into the South Platte River. No gaging stations were being maintained at the mouths of the tributaries. This flood caused the South Platte River to rise approximately 7 feet in Denver. The local press estimated that approximately 500 houses were inundated and many families were forced to seek higher ground. Three large packing plants and practically all of the lower feeding pens at the Denver Union Stockyards were flooded. Ten acres of railroad yards were flooded to a depth of 1-foot (Reference 3).

A severe storm centered over the Bayou Gulch Basin, a tributary to Cherry Creek, during the afternoon of July 28, 1922. Heavy rainfall was reported to have occurred in a line bounded by lines 3 miles north of Parker, 4 miles west of Cherry Creek, and 1 mile south of Franktown, and by the Douglas-Elbert County

line on the east. Unofficial rainfall amounts varied from 1 inch and 3.5 inches and occurred in approximately 2 hours. An estimated peak flow of 8,700 cfs discharged out of Bayou Gulch. The discharge on Cherry Creek, 3 miles north of Parker, was estimated to be 17,000 cfs. Although no damage was experienced in Denver, this was considered a major flood for the upstream part of the basin.

The storm of August 2 and 3, 1933, occurred over a 175 square mile area upstream from Franktown. Unofficial rainfall amounts varied from 3 to 9 inches and occurred over a 9-hour period between 6pm on August 2 and 3am on August 3. The most intense activity of the storm occurred between 9pm and 10pm. Waters in the existing Castlewood Dam and Reservoir reached the spillway crest around 11pm. The inflow was estimated at 35,000 cfs. Water overtopped the crest of the dam and the structure failed around 12am. The sudden release of water caused a flood wave to move down the valley. The peak discharge is estimated to have ranged from 126,000 cfs downstream of the dam to approximately 16,500 cfs near the confluence with the South Platte River. The Cherry Creek Flood Commission estimated the damages to be approximately $1 million; approximately $200,000 of this total occurred upstream from Denver. This flood caused additional economic damage to the Cherry Creek basin. Loss of the dam cut off water supply to approximately 3,000 acres of land. The basin suffered a severe recession and many families moved from the area.

On September 9 and 10, 1933, a flood was caused by heavy rain on the divide separating Cherry Creek from Plum Creek, Big Dry, and Little Dry Creeks, which enter the South Platte River between the mouth of the South Platte River canyon and Denver. In an investigation of this flood, the office of the State Engineer made a slope-area determination of the flow in Plum Creek and found it to be 5,500 cfs.

A large storm front moved into southeastern Colorado on August 25, 1945, and extended over the Cherry Creek Basin. Unofficial rainfall amounts varied from 2 to 5 inches. Severe flooding occurred along Cherry Creek in the Franktown-Parker area. The gaging station at Melvin recorded a peak discharge of 10,700 cfs. Total damages were estimated at $200,000.

High intensity, heavy rains occurred at three locations in the Plum Creek Basin on the afternoon of June 16, 1965. Over 12 inches fell near Castle Rock and over 14 inches fell near Palmer Lake and near Larkspur in approximately 4 hours. East and West Plum Creeks crested at 126,000 cfs and 38,000 cfs, respectively, during the afternoon. The unit run off above the site on East Plum Creek just downstream from Castle Rock was 1,170 cfs per square mile for a drainage area of approximately 108 square miles. Western tributaries of West Plum Creek and all tributaries of Plum Creek downstream of Sedalia were out of the high rainfall areas and contributed little or no runoff during the flood.

The combination of steep slopes, sand and gravel streambed, and relatively open and straight reaches of Plum Creek near Louviers was conductive to high velocities and standing waves. The computed mean velocities in seven cross sections surveyed after the flood were near 15 cfs, which implies maximum

velocities of approximately 20 to 22 cfs. The amount of scour and fill, the size of the cottonwood trees that were uprooted or bent over, and the matted condition of the debris on trees confirmed the computed velocities.

The damage in rural areas of Plum Creek basin was extensive. The heavy runoff deposited all kinds of debris, from sand to huge boulders and trees, on fields and pastures. Road embankments were severely eroded and bridges on County, State and Interstate highways were destroyed. Large-cut banks, particularly along East Plum Creek, were left after land had been washed away. Much of the Town of Castle Rock was inundated, and service to approximately 100 telephones in town was disrupted. Seven homes, a church, the Grand Hall, and the lower part of the main street in Sedalia vanished during the flood.

The Denver and Rio Grande Western Railroad between Denver and Palmer Lake, built in 1871 –72, had never been damaged as extensively as it was in 1965. Five bridges, many culverts, and about 4 miles of track were damaged. The track was out of service for approximately 6 weeks after the flood. Repairs to the facilities cost $468,000. The Atchison, Topeka, and Santa Fe Railway also follows the South Platte River and Plum Creek, and repairs, primarily to one bridge, cost approximately $500,000. Although the Plum Creek gaging station near Louviers was destroyed, observations indicated that the flow increased from about 150 to 154,000 cfs in less than 3 hours. The recurrence interval of this flood was estimated as greater than 500 years. Prior to the 1965 event, the maximum discharge was 7,700cfs, in August 1945 (Reference 4).

Peak discharges along Cherry Creek were 1,000 cfs upstream from Franktown, 39,900 cfs near Melvin, and 58,000 cfs at Cherry Creek Dam. An estimated peak flow of 14,000 cfs discharged from Piney Creek, a right bank tributary of Cherry Creek. During the evening and night of June 16, the Cherry Creek Reservoir impounded a flood that had a volume of 116,000 acre-feet. Three of the 18 small dams constructed by the SCS in the upper Cherry Creek Basin between Franktown and Parker were filled. Two of these were subsequently overtopped and sustained erosion damage. The remaining 15 structures were out of the area of high intensity rainfall and received only moderate runoff. The heavy runoff caused major flooding along the main stem of Cherry Creek from the vicinity of Franktown to the Cherry Creek Reservoir. Approximately 2,720 acres were flooded. Most of the bridges across Cherry Creek were either damaged or destroyed. One life was lost during the flood on Cherry Creek. Flood damages totaled $1,306,000. No floods of consequence have occurred since 1965.

In the summer of 2002, severe drought conditions in the western United States contributed to an unusually large number of wildfires in Colorado. The Hayman Fire burned approximately 138,000 acres (216 sq. mi.) in the South Platte River Basin (Reference 5), or approximately 10 percent of the basin upstream of the confluence with the North Fork South Platte River, near the community of South Platte. The fire was located in the southwestern corner of Douglas County, and included portions of Jefferson, Park, Teller and El Paso Counties.

2.4 Flood Protection Measures

The possibility of flood damage in the upper Cherry Creek area has been reduced somewhat by the construction of 32 floodwater retarding structures. The SCS completed construction of these structures in 1965 as part of an overall plan. The plan is presented in two watershed work plans (References 6 and 7). These structures were designed for a rural agricultural community with design floods having a 25-year recurrence interval.

Chatfield Dam, completed in 1976, provides flood protection, recreation, and water supply facilities for the City of Denver and its environs. The dam is located downstream of the mouth of Plum Creek. The effects on the dam have been taken into consideration in this FIS.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

For each community within Douglas County that has a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

Pre-countywide Analyses

For the January 5, 1996, FIS, the synthetic hydrograph method was used to obtain peak discharge for Plum Creek, East Plum Creek, West Plum Creek (at Perry

Park), Hangmans Gulch, Sellars Gulch, Unnamed Tributary to Sellars Gulch, Carpenter Creek, Happy Canyon Creek, Newlin Gulch, Baldwin Gulch, Sulphur Gulch, Tallman Gulch, Bayou Gulch, and West Creek. The analysis was based on a 24-hour storm with a Type IIA distribution, as described in the SCS National Engineering Handbook (U.S. Department of Agriculture, 1972). The amount of rainfall was obtained from a precipitation frequency-atlas (U.S. Department of Commerce, 1973) and a real adjustment was applied to convert the point precipitation values to average precipitation over the entire watershed area. Hydrologic soil cover complexes and associated Runoff Curve Numbers were obtained from field investigations, a soil survey of Castle Rock (U.S. Department of Commerce, 1973), an unpublished SCS study of the area, and land use and natural plant coverage maps of Douglas County (U.S. Department of Agriculture, 1971; U.S. Department of Agriculture, 1974; U.S. Department of Agriculture, 1973). Values of 10-, 50-, 100- and 500- year peak discharges were obtained using the computer program developed by the SCS (U.S. Department of Agriculture, 1976). The computed peak discharges compare favorably with the peak discharges estimated using the USGS Technical Manual No. 1 (U.S. Department of the Interior, Technical Manual No.1, 1976).

Discharge magnitudes for floods in Cherry Creek analyzed in the 1996 FIS were based on an analysis of stream gaging data at the USGS stream gages located approximately 2.5 miles south of Franktown and 6 miles northwest of Parker. This information was obtained from a USACE Flood Plain Information report (USACE, 1976). Discharge-frequency relationships for the upstream and downstream limits of the study reach were developed using data from the Franktown and Parker stream gages, respectfully. The presence of 32 flood retarding structures in the Cherry Creek Basin constructed by the SCS was taken into consideration.

A continuous record of flows at stream gaging station No. 0670500, located on the South Platte River at South Platte, is available from 1900 to the present, and stream gaging station No. 06701500, below Cheesman Lake, has a continuous record of flows from 1925 to the present.

Discharge magnitudes for floods analyzed in the 1996 FIS detailed study of the South Platte River and Horse Creek were based on statistical analyses of the previously mentioned stream gaging records, as explained in U.S. Water Resources Counsel Bulletin 17 (U.S. Water Resources Council, 1976).

Discharge-probability relationships for the upstream and downstream study limits were developed using data from the gaging stations below Cheesman Lake and at South Platte, respectively.

Hydrologic information for the streams studied by approximate methods, for the 1996 FIS, was obtained from various sources. Existing UDFCD reports were used directly for Badger Gulch, Big Dry Creek, Cottonwood Creek, Dad Clark Gulch, Happy Canyon Creek, Marcy Gulch, McMurdo Gulch, and Piney Creek (Howard, Needles, Tammen & Bergendoff, 1977; VTN Engineers, Architects, Planners, 1973; Gingery Associates, Inc., Piney Creek, 1975). A drainage area

versus discharge curve was developed using UDFCD information for Happy Canyon Creek Tributary, Jordan Road Tributary, KOA Tributary, Newlin Gulch, South Newlin Gulch, and Oak Gulch. A procedure that was developed by the SCS was used for the 6400 Tributaries (U.S. Department of Agriculture, 1980), the computer model SWWM was used for Tributary A (U.S. Environmental Protection Agency, Computer Model SWWM) and the SCS TR-20 computer program was used to develop hydrologic information for Glade Gulch and Section 34 Tributary (U.S. Department of Agriculture, 1976). Technical Manual No. 1 (U.S. Department of Agriculture, Technical Manual No. 1, 1976) was used for all other approximate-study reaches.

Countywide Analyses

Peak discharges for Big Dry Creek, and Big Dry Creek Tributary C were obtained using version CUHPE/PC of the Colorado Urban Hydrograph Procedure (CUHP) by UDFCD (WRC Engineering, Inc., 1996; Urban Drainage and Flood Control District, 1984). A modified 2-hour design storm distribution recommended by the Urban Storm Drainage Criteria Manual (USDCM) (Urban Drainage and Flood Control District, 1984) was used within CUHP to produce runoff hydrographs required for the flow routing required in the UDFCD Stormwater Management Model (SWMM) (Urban Drainage and Flood Control District, 1989). Values of 10-, 50-, 100, and 500-year peak discharges were obtained using the SWMM computer program.

Peak discharges for Willow Creek, Little Willow Creek, and East Willow Creek were obtained using version CUHPF/PC of the CUHP by UDFCD (Urban Drainage and Flood Control District, 1996). One-hour rainfall depths were developed using criteria from the Douglas County Drainage Criteria Manual (Greenhorne & O'Mara, 1996; Douglas County, 1986) and the USDCM. One-hour rainfall depths distributed over a two-hour design storm were used within CUHP to produce runoff hydrographs required for the flow routing required in the UDFCD Stormwater Management Model (UDSWM386) (Urban Drainage and Flood Control District, 1985). Values of 10-, 50-, and 100-year peak discharges were obtained using the SWMM computer program.

Discharge magnitudes for Daniels Park Drain, Drainageways 6600-02, 6604-01, 6605-01, Highlands Gulch, Indian Creek, Jarre Creek, Lehigh Gulch, Louviers Gulch, Oxide Draw, Plum Creek, Rainbow Creek, Sterling Gulch, and West Plum Creek (near the Plum Creek Confluence) were obtained using version CUHP98 (WRC Engineering, Inc., 2001; Urban Drainage and Flood Control District, 1985) of the CUHP by UDFCD. Design storm distributions were developed using criteria from the Douglas County Drainage Criteria Manual and the USDCM. These storm distributions were used within CUHP to produce runoff hydrographs required for the flow routing required in the UDFCD Stormwater Management Model (UDSWM98) (Urban Drainage and Flood Control District, 1989). Values of 10-, 50-, and 100-year peak discharges were obtained for all of the streams listed above using the SWMM computer program. In addition, peak discharges for the 500-year event were obtained for Plum Creek.

Peak discharges for Cherry Creek were obtained from the 1996 FIS for Douglas County (FEMA, 1996) after these discharges were verified using version CUHP2000 of CUHP and UDSWM (URS Corporation, 2003; Urban Drainage and Flood Control District, Colorado Urban Hydrograph Procedure, CUHP2000, Version 1.1; Urban Drainage and Flood Control District, 2001).

With the exception of the 0.9-mile reach of the South Platte River at the community of South Platte, the hydrologic information for the South Platte River, Horse Creek, Trout Creek, and West Creek was obtained from the report, "Analysis of Post-Fire Hydrologic Hazards for the 2002 Hayman, Coal Seam and Missionary Ridge Wildfires, Colorado" (U.S. Geological Survey, 2004). For the South Platte River the discharge profile used for the current hydraulic analysis for both the main detailed study reach and the approximate study reach was prepared by correlating peak flows at specific nodes within the USGS hydrologic model to physical locations along the South Platte River.

As the USGS report did not provide any specific hydrologic information for the South Platte River near the community of South Platte, the peak flows used for the hydraulic analysis of this lower reach were developed by analyzing historical gage data both on the South Platte River downstream of South Platte, and on the North Fork South Platte River which confluences with the South Platte River at the community of South Platte. This analysis assumed that the timing of the 100-year (1-percent annual chance) peak discharges from the various sources in the study area would be nearly concurrent, thereby allowing for direct addition of the peak flows (Anderson Consulting Engineers, 2004).

Hydrologic information for the streams studied by approximate methods, for this revision, was obtained from various sources. Existing UDFCD reports were used directly for Dad Clark Gulch, East Dad Clark Gulch, Marcy Gulch, and their respective tributaries, and Spring Gulch (Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Highlands Ranch). Hydrologic information for Drainageway 6631, Plum Creek, East Plum Creek, and the South Platte River and its four unnamed tributaries was obtained from the FIRMs for Douglas County, Colorado (FEMA, 1987).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 4, "Summary of Discharges."

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
BAYOU GULCH					
At Confluence With Cherry Creek	22.5	3,930	7,620	9,340	13,800
At State Highway 83	22.4	3,940	7,640	9,400	13,850
At Upstream Limit of Detailed Study	10.0	1,880	3,660	4,510	6,690
BIG DRY CREEK					
At County Line Road	11.43	1,700	2,900	3,550	6,390
At C-470	11.22	1,300	2,350	2,950	5,310
At Gleneagles Village Parkway	9.64	1,250	2,100	2,550	4,590
At S. University Blvd.	8.59	579	741	800	1,440
At Confluence With Tributary C	7.95	1,800	4,400	6,000	10,800
At S. Quebec Street	3.86	950	2,350	3,250	5,850
At Quarry Road	2.45	600	1,550	2,100	3,780
At Mcarthur Drive	1.85	450	1,250	1,700	3,060
At Valley Road	1.70	450	1,200	1,650	2,970
At Upstream Limit of Detailed Study	1.43	450	1,100	1,500	2,700
BIG DRY CREEK TRIBUTARY C					
At Confluence with Big Dry Creek	3.07	*	*	2,400	*
At McArthur Ranch Road	1.63	*	*	1,350	*
At Upstream Limit of Detailed Study	0.12	*	*	250	*

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CARPENTER CREEK					
At Denver & Rio Grande Western Railroad	10.1	1,220	2,510	3,350	5,570
At County Road 74	9.4	1,300	2,660	3,530	5,840
CHERRY CREEK					
At County Limits	*	8,950	26,800	43,710	133,200
At Cottonwood Drive	*	8,670	25,940	42,200	129,700
At E-470	*	8,480	25,360	41,200	129,700
At Lincoln Avenue	*	8,100	24,200	39,190	122,740
At West Parker Road	*	7,730	23,040	37,180	118,100
At Stroh Avenue	*	6,610	19,570	31,510	104,200
At Scott Road	*	6,000	17,500	27,120	100,000
At State Highway 86	*	5,500	12,600	19,080	79,000
COTTONWOOD CREEK					
At Inverness Drive South	*	1,293	1,963	2,498	3,662
At Inverness Drive South	*	1,214	1,830	2,336	3,466
At Liberty Boulevard	*	1,214	1,830	2,336	3,466
At E-470 Off Ramp	*	1,123	1,695	2,149	3,179
At E-470	2.4	1,123	1,695	2,149	3,179
At E-470 On Ramp	*	1,123	1,695	2,149	3,179
At Meridian Boulevard	*	1,298	2,177	2,657	3,451
At Pedestrian Bridge	*	304	514	665	1,022
At Golf Cart Bridge	*	304	514	665	1,022
At Meridian Boulevard	*	304	514	665	1,022
At Lincoln Avenue	0.8	304	514	665	1,022
At I-25 (Upstream Limit of Detailed Study)	0.7	185	416	541	863

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
DANIELS PARK DRAIN					
At Confluence with Plum Creek	5.05	820	2,780	4,200	*
At Cement Plant Road (Station 1465)	5.05	820	2,780	4,200	*
At D&RGW Railroad	5.05	820	2,780	4,200	*
At Lavaun Way	5.01	820	2,780	4,200	*
At AT&SF Railroad	5.01	800	2,720	4,100	*
At U.S. Hwy 85	5.01	800	2,720	4,100	*
At Upstream Limit of Detailed Study	4.36	800	2,720	4,100	*
DRAINAGEWAY 6600-02					
At Confluence With Plum Creek	0.71	190	470	660	*
At D&Rgw Railroad	0.66	140	360	500	*
At Lavaun Way	0.46	120	300	420	*
At At&Sf Railroad	0.46	90	210	300	*
At U.S. Hwy 85	0.46	90	210	300	*
At Upstream Limit of Detailed Study	0.39	90	210	300	*
DRAINAGEWAY 6604-01					
At Confluence with Louviers Gulch	0.83	240	510	675	*
At Moore Road	0.58	120	330	460	*
At Upstream Limit of Detailed Study	0.58	120	330	460	*
DRAINAGEWAY 6605-01					
At Confluence with Indian Creek	0.39	70	160	220	*
At Upstream Limit of Detailed Study	0.09	70	160	220	*

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
EAST PLUM CREEK					
At Confluence with Plum Creek	142.4	6,020	12,460	16,650	27,730
At Haskins Gulch	122.4	9,379	13,795	18,631	27,763
At confluence of Unnamed Zone A near Castle Gate Drive	116.0	8,113	13,488	18,234	27,129
At Confluence of Hangmans Gulch	106.1	7,718	13,332	18,048	26,850
At Park Street, In Castle Rock	85.6	7,248	12,548	16,954	25,192
At Crystal Valley Pkwy, In Castle Rock	*	6,533	11,261	15,164	22,402
At I-25, In Larkspur	61.6	5,300	11,000	14,800	24,800
At County Road 18	61.2	5,340	11,100	14,900	25,000
At Perry Park Avenue	57.2	5,670	11,600	15,400	25,600
At Spruce Mountain Road	29.1	3,100	6,480	8,660	14,550
EAST WILLOW CREEK					
At Confluence With Willow Creek	1.37	399	934	1,281	*
At Highline Canal	1.37	399	934	1,281	*
At Rampart Range Road	1.29	399	934	1,281	*
At Roxborough Park Road	0.96	432	909	1,176	*
At Upstream Limit of Detailed Study	0.10	300	620	797	*
FOURMILE CREEK					
Just upstream of Confluence with South Platte River	8.4	*	*	312	*
Just upstream of YMCA Camp	7.4	*	*	306	*
At river station 410+00	5.7	*	*	261	*

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
GLADE GULCH					
At confluence with East Plum Creek	1.2	*	*	750	*
HANGMANS GULCH					
Downstream of I-25	1.26	305	774	1,008	1,293
At the Confluence of Tributary B	*	229	591	778	933
At Upstream Limit of Detailed Study	0.05	95	209	273	370
HAPPY CANYON CREEK					
At Dogwood Avenue	13.7	2,350	4,450	5,610	8,660
At Birch Avenue	12.5	2,310	4,340	5,460	8,340
At Upstream Limit of Detailed Study	9.0	1,860	3,340	4,160	6,270
HIGHLANDS GULCH					
At Confluence with Plum Creek	2.48	290	1,150	1,890	*
At D&RWG Railroad	2.43	290	1,150	1,890	*
At AT&SF Railroad	2.28	290	1,150	1,890	*
At U.S. HWY 85	2.28	290	1,150	1,770	*
At Upstream Limit of Detailed Study	1.91	290	1,150	1,720	*
HORSE CREEK					
At Confluence with the South Platte River	214.1	*	*	2,873	*
Just downstream of West Creek and Trout Creek Confluence	204.4	*	*	2,679	*

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
INDIAN CREEK					
At Louviers Road	16.69	1,550	4,520	6,550	*
At Airport Road	16.20	1,500	4,450	6,500	*
At Confluence with Lehigh Gulch	15.33	1,200	3,400	4,800	*
At Private Road (Station 17997)	12.29	1,200	3,400	4,800	*
At Lambert Road	12.11	1,100	3,200	4,400	*
At Rainbow Creek Road	10.97	1,050	2,920	4,100	*
At Confluence with Rainbow Creek	10.44	1,050	2,920	4,100	*
At Cherokee Drive	7.40	1,050	2,920	4,100	*
At Upstream Limit of Detailed Study	6.40	1,050	2,920	4,100	*
INDUSTRIAL CREEK					
At Confluence with East Plum Creek	*	590	962	1,162	1,540
Upstream of Plum Creek Parkway	*	196	430	540	733
At Upstream Limit of Detailed Study	*	50	118	149	200
INDUSTRIAL CREEK TRIBUTARY					
At Confluence with Industrial Creek	*	91	191	237	319
At Upstream Limit of Detailed Study	*	41	94	117	160
JARRE CREEK					
At Confluence with Plum Creek	5.23	450	1,330	1,890	*
At U.S. HWY 67	5.17	450	1,330	1,890	*
At Private Bridge (Station 2805)	5.12	440	1,320	1,880	*
At Private Bridge (Station 6147)	4.33	360	1,070	1,520	*
At Private Bridge (Station 8128)	4.09	320	960	1,370	*
At Upstream Limit of Detailed Study	3.58	320	960	1,370	*

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LEHIGH GULCH					
At Confluence with Indian Creek	2.41	510	1,350	1,900	*
At Horse Trail Road (Station 8371)	1.27	380	1,000	1,400	*
At Upstream Limit of Detailed Study	0.97	380	1,000	1,400	*
LITTLE WILLOW CREEK					
At Waterton Road	3.11	805	1,517	1,881	*
At Village Circle West Road	3.00	754	1,485	1,844	*
At Roxborough Village Detention Pond	3.00	826	1,723	2,293	*
At Rampart Range Road	2.57	726	1,526	2,034	*
At Roxborough Road	2.06	604	1,386	1,840	*
LOUVIERS GULCH					
At Confluence with Plum Creek	2.90	560	1,390	1,960	*
At Dismantled Railroad Bridge	2.77	560	1,390	1,960	*
At Dupont Road	2.59	500	1,320	1,870	*
At Upstream Limit of Detailed Study	1.45	280	830	1,150	*
MCMURDO GULCH					
At Confluence with Cherry Creek	*	1,880	4,449	5,967	8,201
At Confluence with Unnamed Stream	*	1,394	3,124	4,144	5,637
At McMurdo Gulch Tributary 5 Confluence	*	838	1,474	1,821	2,387
At State Highway 86	*	409	634	762	965
MCMURDO GULCH SPLIT FLOW					
Entire Reach	*	188	402	514	691
MITCHELL GULCH					
At Mitchell Gulch Tributary 2 Confluence	*	583	1,133	1,447	1,947
At Mitchell Gulch Tributary 1 Confluence	*	155	295	370	494

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
MITCHELL GULCH TRIBUTARY 1					
At Confluence with Mitchell Gulch	*	225	381	462	602
At Ridge Road	*	78	165	211	287
MITCHELL GULCH TRIBUTARY 2					
At Confluence with Mitchell Gulch	*	263	519	661	884
At Enderud Boulevard South Crossing	*	95	185	233	314
NEWLIN GULCH					
At Jordan Road	13.8	1,920	3,520	4,690	8,150
At West Parker Road	11.8	1,890	3,450	4,590	7,920
At Upstream Limit of Detailed Study	10.2	2,020	3,640	4,820	8,300
OMNI CREEK					
At Confluence with East Plum Creek	*	373	767	932	1,227
Downstream of Plum Creek Parkway	*	240	593	758	1,045
OXIDE DRAW					
At Confluence with Plum Creek	4.66	630	2,400	3,530	*
At D&RGW Railroad	4.66	630	2,400	3,530	*
At AT&SF Railroad	4.58	630	2,400	3,530	*
At U.S. HWY 85	4.58	630	2,400	3,645	*
At Upstream Limit of Detailed Study	4.47	630	2,400	3,650	*
PINEY CREEK					
At Arapahoe/Douglas County Line	5.89	684	2,072	2,861	4,967
At Confluence of Tenderfoot Gulch	3.38	409	1,252	1,744	3,003
At Piney Lake Road	1.09	209	670	930	1,604

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PLUM CREEK					
At Downstream Limit of Detailed Study	317.00	14,190	28,730	38,590	69,460
At Titan Road	314.00	14,150	28,800	38,710	69,680
At Louviers Avenue	302.00	14,430	29,130	39,100	70,380
At Confluence of Indian Creek	300.00	14,430	29,130	39,100	70,380
At Airport Road	278.00	14,430	29,130	39,100	70,380
PLUM CREEK – DIVERSION CHANNEL					
At mouth	2.8	*	*	2,180	*
RAINBOW CREEK					
At Cherokee Drive	2.70	550	1,470	2,060	*
SECTION 34 TRIBUTARY					
At confluence with East Plum Creek	1.9	*	*	1,280	*
At Bell Mountain Drive	0.3	*	*	610	*
SELLARS GULCH					
At Confluence with Sellars Gulch Tributary 2	15.4	1,075	3,461	5,118	5,692
At East Haystack Road	12.2	856	3,234	4,807	5,337
At Confluence with Sellars Gulch Tributary 1	8.7	785	2,968	4,373	4,872
SELLARS GULCH TRIBUTARY 1					
At Detention Pond	*	770	1,431	1,746	1,874
At Upstream Limit of Detailed Study	*	136	270	358	368
SELLARS GULCH TRIBUTARY 2					
At Oman Road	*	774	1,608	2,019	2,184
At Miller Boulevard	*	199	426	580	588
At Upstream Limit of Detailed Study	*	125	241	313	317

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SOUTH PLATTE RIVER					
Downstream of the Community of South Platte	*	*	*	12,150	*
At the Confluence with the North Fork of the South Platte River	*	*	*	9,630	*
At Deckers	*	*	*	5,750	*
Downstream of Cheesman Reservoir	*	*	*	5,220	*
STERLING GULCH					
At Confluence with Plum Creek	2.52	528	1,350	18,090	*
At Titan Road	2.47	528	1,350	18,090	*
At Unnamed Tributary	2.31	528	1,350	18,090	*
At Upstream Limit of Detailed Study	0.22	170	400	550	*
SULPHUR GULCH					
At Private Road (Station 890)	16.8	2,400	5,000	6,340	10,310
At Parker Road	16.6	2,450	5,080	6,440	10,530
At Pikes Peak Drive	16.5	2,450	5,070	6,430	10,530
At Stonehenge Way	9.6	1,820	3,680	4,640	7,450
At County Road 9	3.4	1,030	1,960	2,460	3,960
TALLMAN GULCH					
At Seibert Circle (Station 520)	5.8	670	1,310	1,660	2,700
At Siebert Circle (Station 2,475)	4.6	430	1,060	1,390	2,340
At Unnamed Road (Station 5,175)	4.5	430	1,060	1,390	2,370
TRIBUTARY 6400 EAST					
At the Confluence with Tributary 6400 West	*	379	785	974	1,219
At Cherokee Drive	*	313	619	783	1,158
At Upstream Limit of Detailed Study	*	198	692	1,098	1,405

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
TRIBUTARY 6400 WEST					
At the Confluence with Tributary 6400 East	*	221	441	638	794
At Morningview Drive	*	47	70	79	157
TROUT CREEK					
Just Upstream of Confluence with Horse Creek	135.0	*	*	1,339	*
Just upstream of Rainbow Falls	125.7	*	*	1,305	*
WEST CREEK					
Just Upstream of Confluence with Horse Creek	69.3	*	*	1,653	*
Just downstream of Town of West Creek	60.1	*	*	1,338	*
Just Downstream of Little Creek	54.4	*	*	1.240	*
WEST PLUM CREEK (Near the Plum Creek Confluence)					
At Confluence with East Plum Creek	134.90	2,450	11,740	19,210	*
At U.S. HWY 67	134.90	2,450	11,740	19,210	*
At Farm Road (Station 12445)	132.18	2,440	11,730	19,190	*
At Upstream Limit of Detailed Study	130.86	2,440	11,730	19,190	*
WEST PLUM CREEK (at Perry Park)					
At Perry Park Road (Station 85)	26.8	2,770	5,910	8,320	14,790
At Perry Park Road (Station 90400)	25.5	2,840	6,200	8,730	16,180
At Red Rock Drive	20.7	2,660	5,740	7,900	14,500
At Private Road (Station 101,050)	8.1	1,210	2,680	3,620	6,170

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WILLOW CREEK					
At Confluence with East Willow Creek	9.87	2,844	6,003	7,930	*
At Highline Canal	8.04	1,577	3,690	5,071	*
At Rampart Range Road	7.67	1,577	3,690	5,071	*
At Roxborough Park Road	6.05	1,244	3,114	4,308	*
At Unnamed Dirt Road (Station 21720)	5.61	1,197	2,998	4,164	*
At Unnamed Dirt Road (Station 27364)	4.01	997	2,419	3,302	*
At Unnamed Reservoir (Station 31600)	3.74	947	2,319	3,116	*
At Unnamed Tributary (Station 33671)	3.32	839	2,047	2,770	*
At Upstream Limit of Detailed Study	2.78	724	1,774	2,419	*
WILLOW CREEK (AT LONE TREE)					
Upstream of C-470	*	2,149	3,502	4,236	5,622
At Lone Tree Parkway	*	520	1,014	1,145	1,578
At East Lincoln Avenue	*	454	810	968	1,249
6400 SOUTH TRIBUTARY	1.4	331	846	1,129	*

*Data not available

The stillwater elevation of 5,539.2 feet North American Vertical Datum of 1988 has been determined for the 1% annual chance flood for the entire shoreline of the Platte Canyon Reservoir.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals.
The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Pre-countywide Analyses

Cross sections for the flooding sources studied by detailed methods were obtained from field surveys except for portions of East Plum and Happy Canyon Creeks, Sellars, Newlin, Baldwin, Sulphur, and Tallman Gulches. These areas were photographed and mapped, then digitized cross sections were obtained from the contour plans. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Water-surface elevations of floods of the selected recurrence intervals were computed for the 1996 FIS using the SCS WSP-2 computer program (U.S. Department of Agriculture, 1976), for Plum Creek; the portions of East Plum Creek where it flows through the Towns of Larkspur, Castle Rock, and Sedalia; West Plum Creek (at Perry Park); Indian Creek; Hangmans Gulch; the portion of Sellars Gulch through the Town of Castle Rock; Unnamed Tributary to Sellars Gulch; Sulphur Creek; Happy Canyon Creek; Newlin Gulch; Baldwin Gulch; Sulphur Gulch; Tallman Gulch, Bayou Gulch; South Platte River; Horse Creek; and West Creek. These profiles and elevations were compared with historic floods and the flood stages then determined.

The water surface profiles for the selected recurrence intervals were developed using the USACE HEC-2 step backwater computer program (USACE, 1973) for portions of East Plum Creek between the Towns of Larkspur and Castle Rock, and between the Towns of Castle Rock and Sedalia; and the portion of Sellars Gulch upstream of the Town of Castle Rock.

The water-surface profiles for Cherry Creek utilized in the 1996 FIS were obtained from a USACE Flood Plain Information report (U.S. Water Resources Council, 1976), and were developed using the USACE HEC-2 step-backwater

computer program (USACE, 1973). The computations were based on channel and flood plain conditions as represented by the survey data gathered in April 1975 and as supplemented by later field investigations.

The methods used in estimating elevations of streams studied by approximate methods included the direct use of UDFCD information, calculation of normal depth from field cross sections with an estimation of top width, and direct use of drainage area versus discharge and drainage area versus depth in channel curves from USGS Technical Manual No. 1 (U.S. Department of the Interior, Technical Manual No.1, 1976).

Generally, roughness factors (Manning's "n") used in the hydraulic computations were estimated by field investigation and from pictures of the stream and its floodplain using Roughness Characteristics of Natural Channels (VTN Engineers, Architects, Planners, 1973), Open-Channel Hydraulics (Gingery Associates, Inc., 1975), and Handbook of Applied Hydraulics (Jack G. Raub Company, 1981). Table 3 shows the channel and overbank "n" values for the streams studied by detailed methods.

Countywide Analyses

Cross sections for Big Dry Creek, Big Dry Creek Tributary C, Willow Creek, Little Willow Creek, East Willow Creek, Daniels Park Drain, Drainageways 6600-02, 6604-01, and 6605-01, Highlands Gulch, Indian Creek, Jarre Creek, Lehigh Gulch, Louviers Gulch, Oxide Draw, Plum Creek (from the downstream limits upstream to 0.7 miles upstream of Airport Road), Rainbow Creek, Sterling Gulch, and West Plum Creek, all of which were studied by detailed methods were digitized from digital topographic mapping (WRC Engineering, Inc., 1996; Greenhorne & O'Mara, Inc. 1996; WRC Engineering, Inc., 2001).

Water-surface elevations of floods of the selected recurrence intervals were developed using the USACE HEC-RAS River Analysis System computer program (USACE, 1997), for Daniels Park Drain, Drainageways 6600-02, 6604-01, and 6605-01, Highlands Gulch, Indian Creek, Jarre Creek, Lehigh Gulch, Louviers Gulch, Oxide Draw, Plum Creek, Rainbow Creek, Sterling Gulch, and West Plum Creek (near the Plum Creek Confluence).

Water-surface elevations of floods of the selected recurrence intervals were developed using the USACE HEC-RAS River Analysis System computer program (USACE, 2008), for the new or revised studies along East Plum Creek, Hangman's Gulch, Industrial Creek, Industrial Creek Tributary, McMurdo Gulch, McMurdo Gulch Split Flow, Mitchell Gulch, Mitchell Gulch Tributaries 1 and 2, Omni Creek, Sellars Gulch, Sellars Gulch Tributaries 1 and 2, Tributary 6400 East and Tributary 6400 West, and Willow Creek (at Lone Tree).

The water surface profiles for the selected recurrence intervals were developed using the USACE HEC-2 step backwater computer program (USACE, 1990) for Big Dry Creek, Big Dry Creek Tributary C, Willow Creek, Little Willow Creek, and East Willow Creek.

Water-surface elevations for Cherry Creek, Plum Creek (from approximately 0.7 miles upstream of Airport Road upstream to the confluence West Plum Creek), and East Plum Creek (from the confluence with Plum Creek upstream to approximately 1.2 miles upstream of Drainageway 6631) were obtained from the UDFCD Flood Hazard Area Delineation (URS Corporation, 2003; ICON Engineering, Inc., 2004), and were developed using the USACE HEC-RAS computer program, using the HEC-GeoRAS extension for ArcView (USACE, 2001; USACE, 2000).

The water-surface elevations for Hangman's Gulch were revised using HEC-RAS, digital topography provided by Douglas County, and the existing hydraulic structure information from the effective FIS (FEMA, 1996).

Hydraulic analyses for the South Platte River included three distinct reaches: (a) detailed floodplain mapping was defined for a 0.9-mile reach in the vicinity of South Platte, at the confluence with the North Fork South Platte River; (b) detailed floodplain mapping was also defined for a 13.4-mile reach from Nighthawk to just below Wigwam; and (c) an approximate floodplain was delineated for a 1.7-mile reach starting at the upstream end of the main detailed study reach and continuing upstream through the Wigwam area.

For the South Platte River study, three hydraulic models were prepared using the USACE HEC-RAS River Analysis System (USACE, 2004). The first (a) hydraulic model analyzed the 100-year (1-percent annual chance) flood and the 1-foot rise floodway for the 0.9-mile reach of the South Platte River in the vicinity of the community of South Platte. The second (b) hydraulic model analyzed the 100-year flood and the 1-foot rise floodway for the 13.4-mile reach of the South Platte River from Nighthawk to just downstream of the Wigwam area. The third (c) hydraulic model evaluated the 100-year flood for the 1.7-mile reach of the South Platte River in the vicinity of Wigwam. Although the third reach was studied using a detailed model, the floodplain is defined as approximate primarily due to the lack of data for the three private bridges located within this reach (Anderson Consulting Engineers, 2004).

Analyses of the hydraulic characteristics of flooding from Horse Creek, Trout Creek, West Creek, and Fourmile Creek were carried out to provide estimates of the elevations of flooding for the 100-year recurrence interval event. The slope-area method was used for determination of the starting water-surface elevations for all streams. Water-surface profiles for the 100-year event were developed using the USACE HEC-RAS River Analysis System (USACE, 2004). Due to the relatively steep channel slope of the streams, the mixed-flow procedure (sub-critical and supercritical analyses) was used within HEC-RAS to establish the water surface profile.

Cross section data for Horse Creek, Trout Creek, West Creek, and Fourmile Creek was obtained from LIDAR mapping obtained January 9, 2004. The

below-water sections were obtained by field measurement. All bridges and culverts were measured to obtain elevation data and structure geometry.

Manning's n values for the following streams were based on photographic documentation, field visits, and engineering judgment: Daniels Park Drain, Drainageways 6600-02, 6604-01, and 6605-01, East Plum Creek, Highlands Gulch, Indian Creek, Jarre Creek, Lehigh Gulch, Louviers Gulch, Oxide Draw, Plum Creek, Rainbow Creek, Sterling Gulch, and West Plum Creek (near the Plum Creek Confluence), Big Dry Creek, Big Dry Creek Tributary C, Willow Creek, Little Willow Creek, East Willow Creek, Cherry Creek, South Platte River, Horse Creek, West Creek, Trout Creek, and Fourmile Creek.

Roughness coefficients for all other streams were taken from the analyses used in the 1996 FIS for Douglas County. Roughness coefficients for the 1996 FIS were estimated by field investigation and from pictures of the stream and its floodplain using USGS water Supply Paper 1849 (U.S. Department of the Interior, 1967;), Open Channel Hydraulics (Ven Te Chow, 1959) and Handbook of Applied Hydraulics (Davis Sorenson, 1969).

Roughness factors for all streams studies by detailed methods are shown in Table 5, "Manning's "n" Values."

TABLE 5 – MANNING'S "n" VALUES

STREAM	CHANNEL "n"	OVERBANK "n"
Plum Creek	0.03 – 0.06	0.04 – 0.12
East Plum Creek	0.03 – 0.06	0.04 – 0.12
West Plum Creek (at Perry Park)	0.03 – 0.06	0.04 – 0.12
Indian Creek	0.03 – 0.06	0.04 – 0.12
Hangmans Gulch	0.013 – 0.08	0.04 – 0.12
Sellars Gulch	0.042 – 0.061	0.04 – 0.071
Carpenter Creek	0.03 – 0.06	0.04 – 0.12
Happy Canyon Creek	0.03 – 0.05	0.03 – 0.12
Newlin Gulch	0.03 – 0.05	0.03 – 0.12
Baldwin Gulch	0.03 – 0.05	0.03 – 0.12
Sulphur Gulch	0.03 – 0.05	0.03 – 0.12
Tallman Gulch	0.03 – 0.05	0.03 – 0.12
Bayou Gulch	0.03 – 0.05	0.03 – 0.12
South Platte River	0.03 – 0.045	0.016 – 0.12
Fourmile Creek	0.045 – 0.050	0.045 – 0.120
Horse Creek	0.045 – 0.050	0.045 – 0.120
Trout Creek	0.045 – 0.050	0.045 – 0.120
West Creek	0.045 – 0.050	0.045 – 0.120

TABLE 5 – MANNING'S "n" VALUES – continued

STREAM	CHANNEL "n"	OVERBANK "n"
Daniels Park Drain	0.03	0.04
Drainageway 6600-02	0.03	0.04
Drainageway 6604-01	0.03	0.04
Drainageway 6605-01	0.03	0.04
Highlands Gulch	0.03	0.04
Indian Creek	0.03	0.04
Jarre Creek	0.03	0.04
Lehigh Gulch	0.03	0.04
Louviers Gulch	0.03	0.04
Oxide Draw	0.03	0.04
Plum Creek	0.03	0.04
Plum Creek – Diversion Channel	0.035	0.05
Rainbow Creek	0.03	0.04
Sterling Gulch	0.03	0.04
West Plum Creek	0.03	0.04
Big Dry Creek	0.03 – 0.05	0.03 – 0.05
Big Dry Creek Tributary C	0.035 – 0.04	0.035 – 0.04
Willow Creek	0.035 – 0.06	0.035 – 0.04
Little Willow Creek	0.035 – 0.08	0.03 – 0.1
East Willow Creek	0.035 – 0.04	0.035 – 0.04
Willow Creek (At Lone Tree)	0.014 - 0.084	0.035 - 0.15
Cherry Creek	0.04 – 0.055	0.061 – 0.095
Industrial Creek	0.033 – 0.05	0.045 – 0.06
Industrial Creek Tributary	0.04	0.05
McMurdo Gulch	0.035 – 0.04	0.06
McMurdo Gulch Split Flow	0.04	0.06
Mitchell Gulch	0.028 – 0.101	0.028 – 0.101
Mitchell Gulch Tributary 1	0.028	0.028
Mitchell Gulch Tributary 2	0.039 – 0.068	0.039 – 0.092
Omni Creek	0.013 – 0.045	0.035 – 0.07
Sellars Gulch Tributary 1	0.035 – 0.056	0.05 – 0.059
Sellars Gulch Tributary 2	0.042 – 0.062	0.055 – 0.071
Tributary 6400 East	0.04 – 0.045	0.04 – 0.045
Tributary 6400 West	0.035 – 0.04	0.04 – 0.045

Qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Bench marks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g. concrete bridge abutments)

- Stability C: Monuments which may be affected by surface ground movements (e.g. concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

To obtain up-to-date elevation information on National Geodetic Survey (NGS) bench marks shown on the FIRM (Exhibit 2), please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS monument elevations when using these elevations for construction or floodplain management purposes.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

For information on additional control points maintained by Douglas County that are not shown on the FIRM (Exhibit 2), please visit: www.publicstaging.douglas.co.us/website/control/viewer.htm.

3.3 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

As noted above, the elevations shown in the FIS report and on the FIRM for Douglas County and Incorporated Areas are referenced to NAVD 88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor.

The conversion from NGVD 29 to NAVD 88 ranged between 3.10 and 3.97 for this county. Accordingly, due to the statistically significant range in conversion factors, an average conversion factor could not be established for the entire county. The elevations shown in the FIS report and on the FIRM were, therefore, converted to NAVD 88 using a stream-by-stream approach. In this method, an average conversion was established for each flooding source and applied accordingly. The conversion factor for each flooding source in the community may be found in the following table as well as on the FIRM.

The vertical datum offset values used for this countywide are include in Table 6, "Vertical Offset Table".

The flooding sources partially or completely restudied in detail as part of this partial-countywide update were referenced to NAVD 1988 at the time of study and therefore, they do not require a vertical datum offset. These sources include East Plum Creek, Hangman's Gulch, Industrial Creek, Industrial Creek Tributary, McMurdo Gulch, McMurdo Gulch Split Flow, Mitchell Gulch, Mitchell Gulch Tributaries 1 and 2, Omni Creek, Sellars Gulch, Sellars Gulch Tributaries 1 and 2, Tributary 6400 East and Tributary 6400 West, and Willow Creek (at Lone Tree).

TABLE 6 – VERTICAL DATUM OFFSET TABLE

Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Baldwin Gulch	3.10	Newlin Gulch	3.14
Bayou Gulch	3.22	Plum Creek, Cross Section A to D	3.12
Big Dry Creek	3.15	South Platte River	3.67
Big Dry Creek, Tributary C	3.15	Sulphur Gulch	3.13
Carpenter Creek	3.93	Tallman Gulch	3.16
Cherry Creek, Cross Section BR to CU	3.23	West Creek	3.97
East Plum Creek, Cross Section CO to CZ	3.49	West Plum Creek, Cross Section W to AM	3.68
East Plum Creek, Cross Section DA to EM	3.71		
Happy Canyon Creek	3.12		
Horse Creek	3.67		
Example: To convert Baldwin Gulch elevations to NAVD 88, 3.10 feet were added to the NGVD 29 elevations.			

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 6202.4 will appear as 6202 on the FIRM and 6202.6 will appear as 6203. Therefore, users that wish to convert the elevations in this FIS to NGVD29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For more information on NAVD88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey,

Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 100-year floodplain data, which may include a combination of the following: 10-, 50-, 100-, and 500-year flood elevations; delineations of the 100-year and 500-year floodplains; and 100-year floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the streams studied in detail, the 100-year floodplains have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:1,200 with contour intervals of 2 feet (WRC Engineering, Inc., 1996; Greenhorne & O'Mara, Inc., 1996; WRC Engineering, Inc., 2001; URS Corporation, 2003) for areas within the UDFCD. In addition, the 500-year floodplain was also delineated for Plum Creek, East Plum Creek, Big Dry Creek, and Big Dry Creek Tributary C.

For areas south of the UDFCD boundary the 100- and 500-year floodplains have been delineated using the flood elevations determined at each cross section, as represented on the 1996 FIS (FEMA, 1996). Between cross sections, the boundaries were interpolated using Douglas County topographic maps with a contour interval of 5 feet, or site specific topography from a Letter of Map Revision, with the exception of West Plum Creek. The floodplain boundary for West Plum Creek was taken directly from the effective FIRM for Douglas County (Reference 33).

Floodplains for the 100-year (1-percent annual chance) event for the South Platte River, Trout Creek, Fourmile Creek, West Creek, and Horse Creek were delineated on ortho-rectified aerial photograph and contours at a 2-foot interval. The topography was prepared based on aerial photography taken on January 8, 2004. The above-water LiDAR data provided by the County was supplemented with bathymetric field survey data provided by Douglas County and prepared by ICON Engineering, Inc.

The 100- and 500-year floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the

areas of special flood hazards (Zones A AE, AH, AO, AR, and D), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary is shown on the FIRM (Exhibit 2).

Approximate 100-year floodplain boundaries for Dad Clark Gulch, East Dad Clark Gulch, and Marcy Gulch and their respective tributaries, and Spring Gulch were taken directly from UDFCD information (Urban Drainage and Flood Control District, Flood Hazard Area Delineation, Highlands Ranch). Approximate 100-year flood plain boundaries for Drainageway 6631, East Plum Creek, and the South Platte River and its 4 unnamed tributaries were obtained from the effective FIRM for Douglas County (FEMA, 1987).

All other approximate 100-year flood plain boundaries were delineated on USGS topographic maps (U.S. Department of the Interior, 1965 et cetera) using elevations estimated by the hydraulic analyses described previously. In some portions of the study area the boundaries were taken directly from the effective FIRM for Douglas County (FEMA, 1986).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 7). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

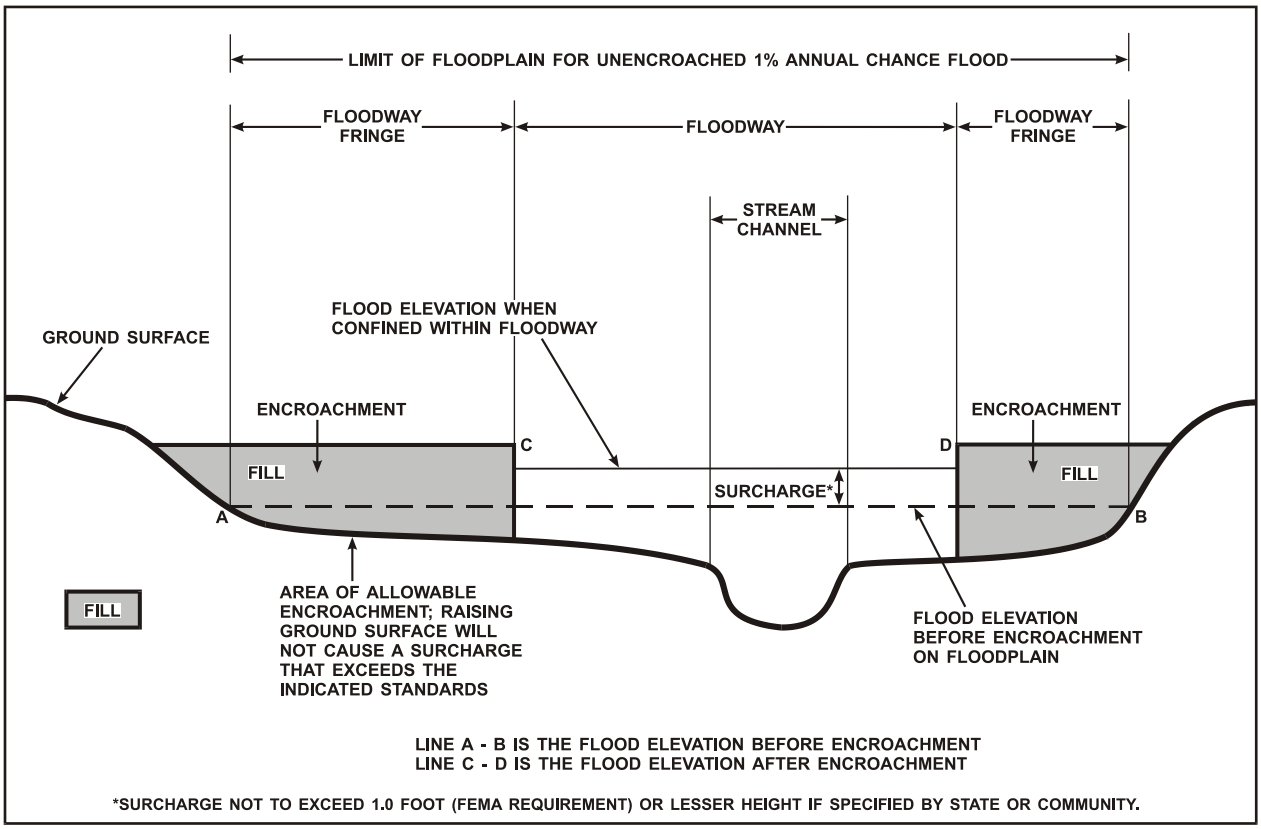
Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 7, "Floodway Data." To reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 7 for certain downstream cross sections of Jarre Creek and West Plum Creek are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

Portions of the floodways for South Platte River extend beyond the county boundary.

No floodways were computed for Fourmile Creek, Trout Creek, West Creek, and Plum Creek – Diversion Channel.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1, "Floodway Schematic."



FLOODWAY SCHEMATIC Figure 1

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
Antelope Creek								
A	17,612	54	66	6.0	6,057.3	6,057.3	6,057.3	0.0
B	18,057	127	99	4.0	6,065.9	6,065.9	6,065.9	0.0
C	18,519	69	70	5.7	6,078.8	6,078.8	6,079.1	0.3
D	18,907	70	854	0.5	6,094.0	6,094.0	6,094.2	0.2
E	19,499	91	244	0.9	6,094.0	6,094.0	6,094.2	0.2
F	19,775	95	460	0.5	6,101.7	6,101.7	6,101.7	0.0
G	20,206	38	88	2.5	6,101.7	6,101.7	6,101.7	0.0
H	20,664	45	42	5.2	6,114.0	6,113.9	6,113.9	0.0
I	21,125	82	53	4.2	6,124.8	6,124.8	6,124.8	0.0

[1] Stream distance in feet above confluence with Piney Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

ANTELOPE CREEK

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
Cottonwood Creek								
A	29,904	129	558	4.5	5,788.9	5,788.9	5,788.9	0.0
B	30,742	93	293	8.8	5,794.6	5,794.6	5,794.6	0.0
C	31,730	118	328	7.7	5,807.5	5,807.5	5,807.5	0.0
D	32,649	139	428	5.5	5,814.9	5,814.9	5,814.9	0.0
E	33,536	299	633	3.7	5,831.1	5,831.1	5,831.1	0.0
F	34,298	44	225	11.4	5,841.9	5,841.9	5,841.9	0.0
G	35,232	391	1,722	1.4	5,850.2	5,850.2	5,850.2	0.0
H	36,095	417	1,432	1.9	5,857.3	5,857.3	5,857.3	0.0
I	36,941	107	318	8.4	5,866.0	5,866.0	5,866.0	0.0
J	37,806	120	198	4.7	5,874.9	5,874.9	5,874.9	0.0
K	38,614	99	166	5.5	5,883.0	5,883.0	5,883.0	0.0
L	39,426	75	134	5.0	5,900.6	5,900.6	5,900.6	0.0
M	40,199	61	114	5.8	5,912.2	5,912.2	5,912.2	0.0
N	40,687	78	229	2.9	5,916.9	5,916.9	5,916.9	0.0
O	41,447	66	132	5.0	5,926.9	5,926.9	5,926.9	0.0
P	42,485	31	83	6.5	5,943.1	5,943.1	5,943.1	0.0
Q	43,355	31	67	8.0	5,954.9	5,954.9	5,954.9	0.0
R	44,141	63	86	6.3	5,974.8	5,974.8	5,974.8	0.0
S	44,691	34	74	7.3	5,983.1	5,983.1	5,983.1	0.0

[1] Stream distance in feet above mouth

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

COTTONWOOD CREEK

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
Piney Creek								
A	49,499	187	581	4.1	6,032.2	6,032.2	6,032.6	0.4
B	49,802	160	1,327	1.8	6,043.9	6,043.9	6,044.2	0.3
C	50,530	128	283	8.5	6,046.0	6,046.0	6,046.1	0.1
D	51,150	140	470	4.3	6,051.4	6,051.4	6,051.7	0.3
E	51,418	120	504	4.0	6,054.1	6,054.1	6,054.6	0.5
F	51,737	55	191	10.6	6,055.5	6,055.5	6,055.7	0.2
G	52,170	85	364	5.6	6,060.3	6,060.3	6,060.7	0.4
H	52,592	63	200	10.1	6,063.7	6,063.7	6,063.9	0.2
I	52,941	124	425	4.8	6,067.3	6,067.3	6,067.7	0.4
J	53,390	77	209	9.3	6,071.2	6,071.2	6,071.2	0.0
K	53,816	98	307	6.3	6,076.8	6,076.8	6,077.3	0.5
L	54,131	92	225	8.6	6,081.1	6,081.1	6,081.1	0.0
M	54,417	438	2,857	0.4	6,092.4	6,092.4	6,092.4	0.0
N	54,645	175	827	1.5	6,092.4	6,092.4	6,092.4	0.0
O	55,034	79	156	7.8	6,092.6	6,092.6	6,092.6	0.0
P	55,502	96	220	5.6	6,098.9	6,098.9	6,098.9	0.0
Q	55,963	109	188	6.5	6,104.1	6,104.1	6,104.1	0.0
R	56,401	89	210	5.8	6,109.2	6,109.2	6,109.2	0.0
S	56,829	66	161	7.6	6,113.7	6,113.7	6,113.7	0.0
T	57,265	132	187	5.6	6,120.5	6,120.5	6,120.5	0.0
U	57,741	111	181	5.8	6,126.5	6,126.5	6,126.5	0.0
V	58,184	63	136	7.7	6,132.7	6,132.7	6,132.7	0.0
W	58,650	292	213	4.9	6,144.9	6,144.9	6,144.9	0.0
X	59,388	309	1,754	0.6	6,159.8	6,159.8	6,159.8	0.0
Y	59,804	323	2,438	0.3	6,168.3	6,168.3	6,168.3	0.0
Z	60,137	360	2,253	0.4	6,168.3	6,168.3	6,168.3	0.0

[1] Stream distance in feet above confluence with Cherry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

PINEY CREEK

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
Piney Creek								
AA	60,667	165	497	1.7	6,168.3	6,168.3	6,168.3	0.0
AB	60,963	103	168	4.9	6,168.5	6,168.5	6,168.5	0.0
AC	61,287	499	3,695	0.2	6,182.9	6,182.9	6,182.9	0.0
AD	61,749	309	1,874	0.4	6,182.9	6,182.9	6,182.9	0.0
AE	62,176	102	186	5.5	6,183.3	6,183.3	6,183.3	0.0
AF	62,653	207	160	3.4	6,190.3	6,190.3	6,190.3	0.0
AG	63,116	97	97	5.6	6,197.1	6,197.1	6,197.1	0.0
AH	63,545	116	157	3.5	6,202.2	6,202.2	6,202.2	0.0
AI	64,038	76	90	6.1	6,207.8	6,207.8	6,207.8	0.0
AJ	64,529	87	116	4.7	6,215.8	6,215.8	6,215.8	0.0
AK	64,959	75	82	5.9	6,223.2	6,223.2	6,223.2	0.0
AL	65,374	56	95	5.0	6,229.3	6,229.3	6,229.3	0.0
AM	65,860	45	50	5.7	6,237.8	6,237.8	6,237.8	0.0
AN	66,275	37	52	5.6	6,245.5	6,245.5	6,245.5	0.0
AO	66,678	37	46	6.3	6,254.9	6,254.9	6,254.9	0.0
AP	67,084	25	40	7.2	6,264.7	6,264.7	6,264.7	0.0
AQ	67,426	24	45	6.5	6,271.2	6,271.2	6,271.2	0.0
AR	67,646	54	52	5.5	6,278.7	6,278.7	6,278.7	0.0

[1] Stream distance in feet above confluence with Cherry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

PINEY CREEK

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
Willow Creek (At Lone Tree)								
AD	19,936	91	727	5.8	5,725.5	5,725.5	5,725.5	0.0
AE	21,744	68	346	12.2	5,739.6	5,739.6	5,739.6	0.0
AF	23,161	85	535	4.7	5,757.5	5,757.5	5,757.5	0.0
AG	25,944	74	273	6.3	5,786.3	5,786.3	5,786.3	0.0
AH	28,394	56	221	5.2	5,814.5	5,814.5	5,814.5	0.0
AI	32,245	87	329	4.5	5,872.0	5,872.0	5,872.0	0.0
AJ	35,173	86	123	4.4	5,931.1	5,931.1	5,931.1	0.0

[1] Stream Distance In Feet Above Confluence With Little Dry Creek

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO AND INCORPORATED AREAS

FLOODWAY DATA

WILLOW CREEK (AT LONE TREE)

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of the 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the area of the 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1% annual chance flood event 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 event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. On selected FIRM panels, floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

The current FIRM presents flooding information for the entire geographic area of Douglas County. Previously separate Flood Hazard Boundary Maps (FHBMs) and/or FIRMs were prepared for each identified floodprone incorporated community within the county. This countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each floodprone community, up to and including the September 30, 2005, countywide FIS are presented in Table 8, "Community Map History.'

7.0 OTHER STUDIES

Several other flood studies have been completed for Douglas County streams. Flood hazard area delineations for Piney, Cottonwood, Lane Tree, and Murphy Creeks (Gingery Associates, Inc., 1975; Gingery Associates, Inc., Piney Creek; Gingery and Associates, Inc., Flood Hazard Area Delineations, 1975) were completed by Gingery Associates in October 1975 for UDFCD. The 10- and 50-year flood discharges are calculated and the 100-year profile and floodplain limits are shown.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Castle Rock, Town of	March 29, 1974	None	August 15, 1978	September 30, 1987 September 30, 2005
Douglas County (Unincorporated Areas)	February 7, 1975	September 6, 1977	September 3, 1980	September 30, 1987 March 15, 1993 January 5, 1996 September 30, 2005
Larkspur, Town of	September 30, 1987	None	September 30, 1987	September 30, 2005
Lone Tree, City of	September 30, 2005	None	September 30, 2005	
Parker, Town of	September 30, 1987	None	September 30, 1987	July 4, 1989 March 2, 1993 February 2, 1996 September 30, 2005

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

Flood Hazard Area Delineation Big Dry Creek (Arapco) (WRC Engineering, Inc., 1996), prepared for UDFCD by WRC Engineering, Inc, was completed in November 1996 and shows the 100-year floodplain boundary and water surface profile.

Flood Hazard Area Delineation Willow Creek, Little Willow Creek, and East Willow Creek (Greenhorne & O'Mara, Inc., 1996), prepared for UDFCD by WRC Engineering, Inc, was completed in December 1996 and shows the 100-year floodplain boundary and water surface profile.

Flood Hazard Area Delineation Plum Creek Watershed (WRC Engineering, Inc., 2001), prepared for UDFCD by WRC Engineering, Inc, was completed in November 2001 and shows the 100-year floodplain boundary and water surface profile.

Flood Hazard Area Delineation, Cherry Creek Corridor – Reservoir to Scott Road, (URS Corporation, 2003) was prepared for UDFCD by URS Corporation, was completed in May 2003 and shows the 100-year floodplain boundary and water surface profile.

Plum Creek and East Plum Creek Flood Hazard Area Delineation (ICON Engineering, Inc., 2004), prepared for the UDFCD by ICON Engineering, Inc., was completed in May 2004 and shows the 100-year and 500-year floodplain boundaries and water surface profiles from approximately 0.7 miles upstream of Airport Road on Plum Creek upstream to 1.2 miles upstream of Drainageway 6631 on East Plum Creek.

Flood Hazard Area Delineation, Highlands Ranch, an unpublished study was prepared by UDFCD and shows the approximate 100-year floodplain boundary.

Major Drainageway Planning, Little Dry Creek (McCall-Ellingson and Morrill, Inc., 1974), prepared for UDFCD by McCall-Ellingson and Morrill, Inc, was completed in February 1974 and shows the 100-year floodplain boundary and water surface profile.

Major Drainage Master Plan, Big Dry Creek, completed by VTN Colorado, Inc. in June 1975, shows the 100-year flood plain boundary and water surface profile (VTN Colorado, Inc., 1975). This study was also prepared for UDFCD.

A USACE Flood Plain information report on Cherry Creek (USACE, 1976) prepared for UDFCD includes determinations of 10-, 50-, 100-, and 500-year flood discharges and water surface profiles. The 1996 FIS included verification of the USACE hydrologic and hydraulic analysis. One area of disagreement was noted. At the confluence of Happy Canyon and Cherry Creeks, a significant difference in existing terrain was observed when the comparison of the mapping was made. The stream channel was relocated subsequent to the USACE mapping when a change in land use occurred. The 1996 FIS was based on more recent conditions and utilizes COE data to show flood plain limits in this area.

Howard, Needles, Tammen & Bergendoff completed a report (Howard, Needles, Tammen & Bergendoff, 1977) in November 1977 for UDFCD. The 10-, 50-, 100-, and 500-year flood discharges were calculated for future flood conditions and the 100-year profile and flood plain boundaries are shown.

The Jack G. Raub Company completed Flood Hazard Area Delineations reports for Dad Clark Gulch in May 1981 and for Marcy Gulch in February 1983 (Jack G. Raub Company, 1981; Jack G. Raub Company, 1983). The 100-year flood plain boundaries and profiles are shown. The 1996 FIS includes these streams, but is based on the present condition of the study area. The study results are necessarily different.

USGS Flood-Prone Area Maps for Douglas County (U.S. Department of the Interior, 1973) were used for general information and reference purposes. These maps, however, reflect approximate flood hazard area boundaries and are superseded by this FIS.

This is a multi-volume FIS. Each volume may be revised separately, in which case it supersedes the previously printed volume. Users should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Douglas County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Douglas County.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Mitigation Division, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

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10.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the Community Map Repository. Please reference the FIRM Index Map for a listing of repositories in Douglas County.

10.1 First Revision

This study was revised on _____ to incorporate new hydrologic and hydraulic study data and recent Letters of Map Revision (LOMRs).

This revision was completed by the UDFCD under its May 17, 1999 agreement with FEMA, entitled "Cooperating Technical Partners Mapping Activity Statement No. 21." The final community meeting was held _____ at _____. UDFCD contracted ICON Engineering, Inc., to incorporate the flood hazard data from various sources, to prepare the data in conformance with FEMA's DFIRM specifications, and to produce the revised DFIRM panels. Specifically, new hydraulic and hydrologic studies resulted in new or revised detailed studies along East Plum Creek, Hangman's Gulch, Industrial Creek, Industrial Creek Tributary, McMurdo Gulch, McMurdo Gulch Split Flow, Mitchell Gulch, Mitchell Gulch Tributaries 1 and 2, Omni Creek, Sellars Gulch, Sellars Gulch Tributaries 1 and 2, Tributary 6400 East and Tributary 6400 West, and Willow Creek (at Lone Tree), which were incorporated into the county's flood hazard information. Finally, several LOMRs issued since the original countywide FIS became effective were incorporated into the revised DFIRM panels.

With the exception of the Willow Creek FHAD within and near the City of Lone Tree, the new studies were generated by the Town of Castle Rock, Colorado as updates to many of the drainageways affecting its jurisdiction. The new studies are known as Flood Hazard Area Delineation (FHAD) studies and additional information on their development is available from the Town of Castle Rock, and in the case of Willow Creek, from UDFCD.

10.2 Second Revision

This study was revised on _____ to incorporate two Flood Hazard Delineation Reports from the Urban Drainage and Flood Control District (UDFCD). The final community coordination meeting for this study was held _____ at _____ and attended by _____.

The UDFCD published a Flood Hazard Delineation report (Reference 58) for Cottonwood Creek and its tributaries in August 2011. The analysis was conducted by Muller Engineering Company, Inc., and identified flood hazard information on Cottonwood Creek. This report was incorporated into this FIS and the DFIRM.

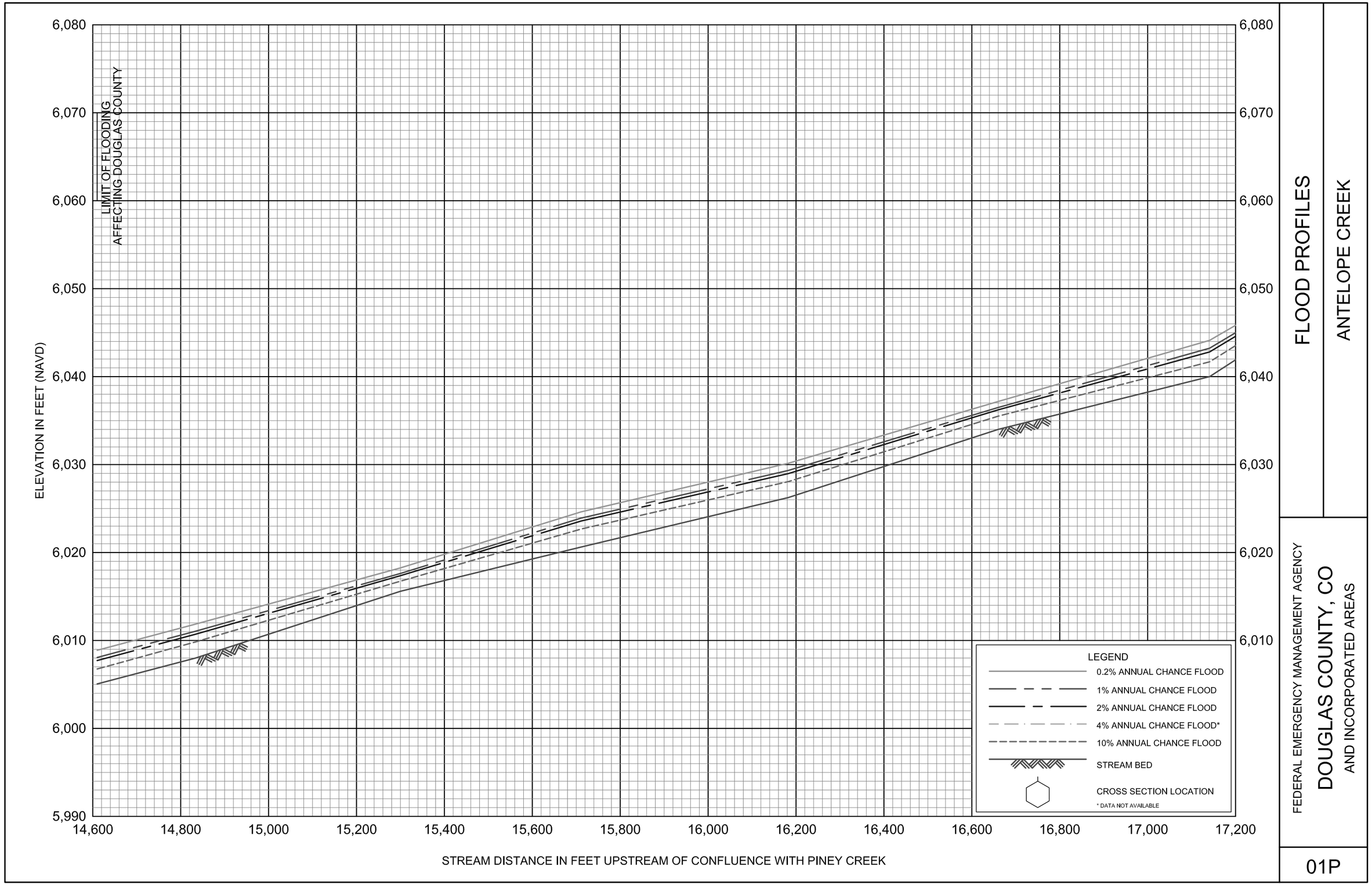
The UDFCD published a Flood Hazard Delineation report (Reference 59) for Piney Creek and Antelope Creek in December 2011. The analysis was conducted by WRC Engineering, Inc., and identified flood hazard information on Piney Creek and Antelope Creek. This report was incorporated into this FIS and DFIRM.

11.0 MAP REPOSITORIES

For previous versions of the FIRM Index, the Map Repository information was included on the FIRM Index itself. The map repositories are listed in Table 6 in the FIS.

TABLE 9 – MAP REPOSITORIES

Community	Address	City	State	Zip Code
Town of Castle Rock	175 Kellogg Court	Castle Rock	CO	80109
Douglas County, Unincorporated Areas	100 Third Street	Castle Rock	CO	80104
Town of Larkspur	9524 South Spruce Mountain Road	Larkspur	CO	80118
Town of Lone Tree	9222 Teddy Lane	Lone Tree	CO	80124
Town of Parker	20120 East Main Street	Parker	CO	80138



FLOOD PROFILES

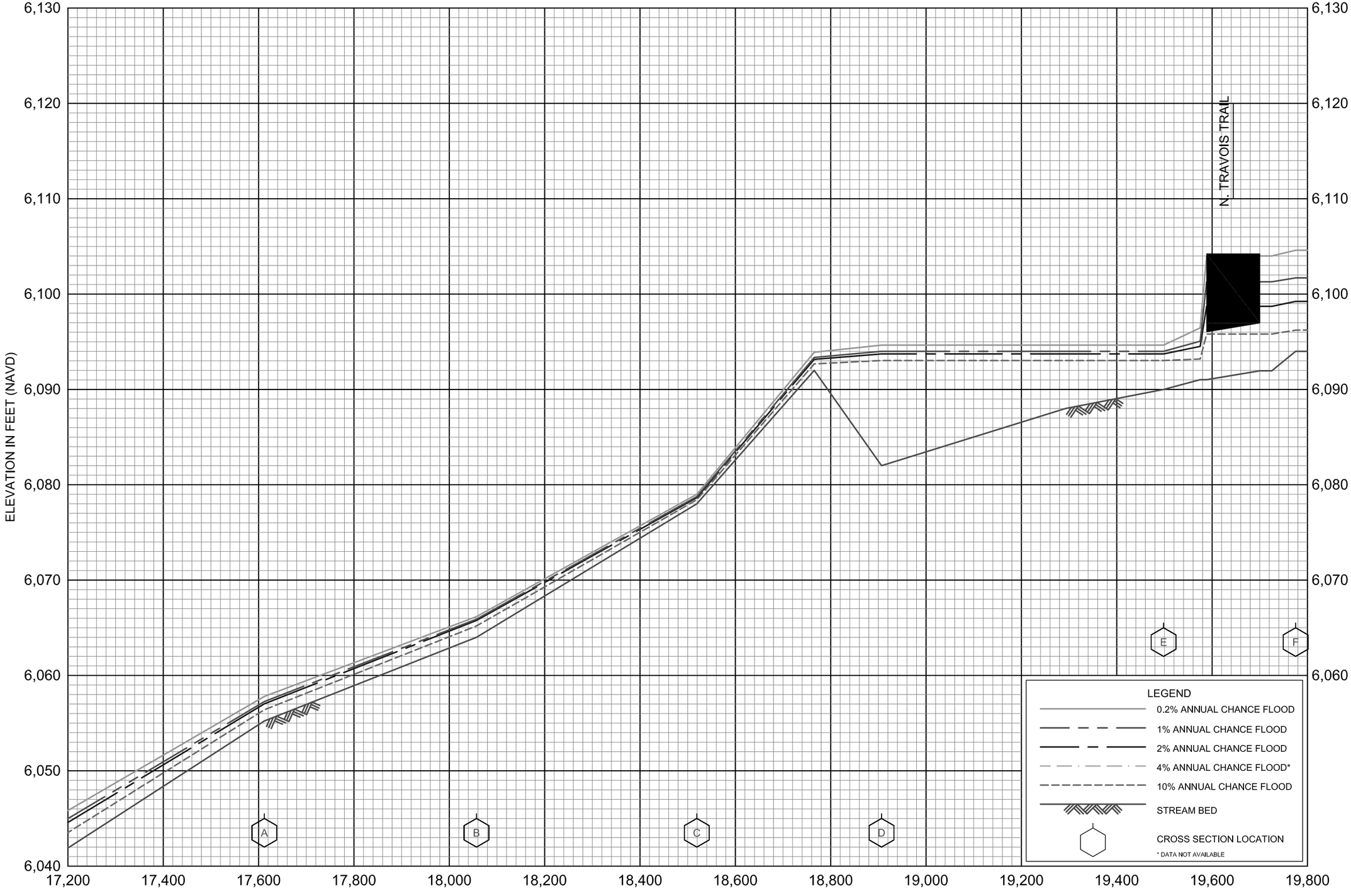
ANTELOPE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

01P



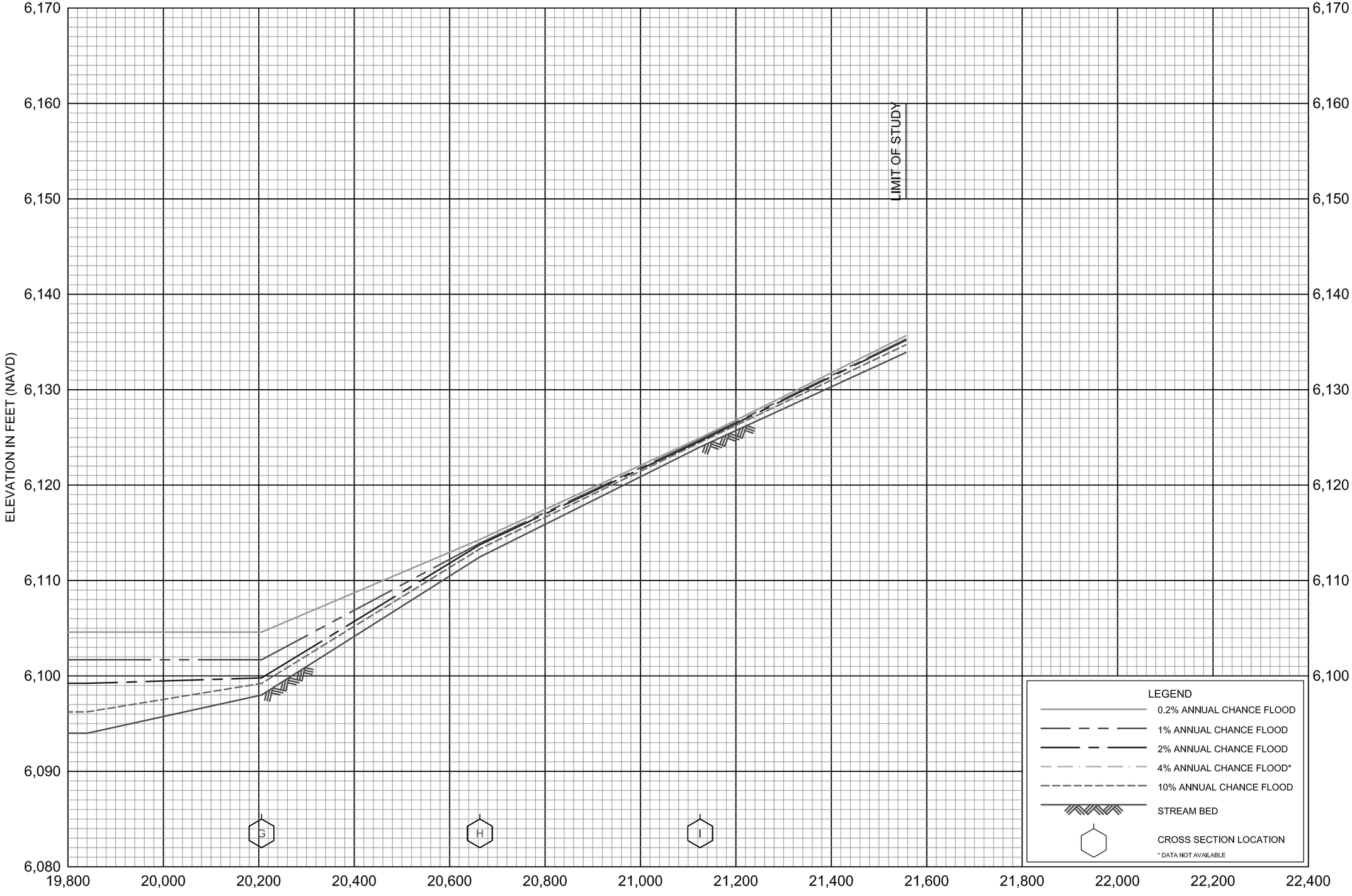
FLOOD PROFILES

ANTELOPE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

02P



FLOOD PROFILES

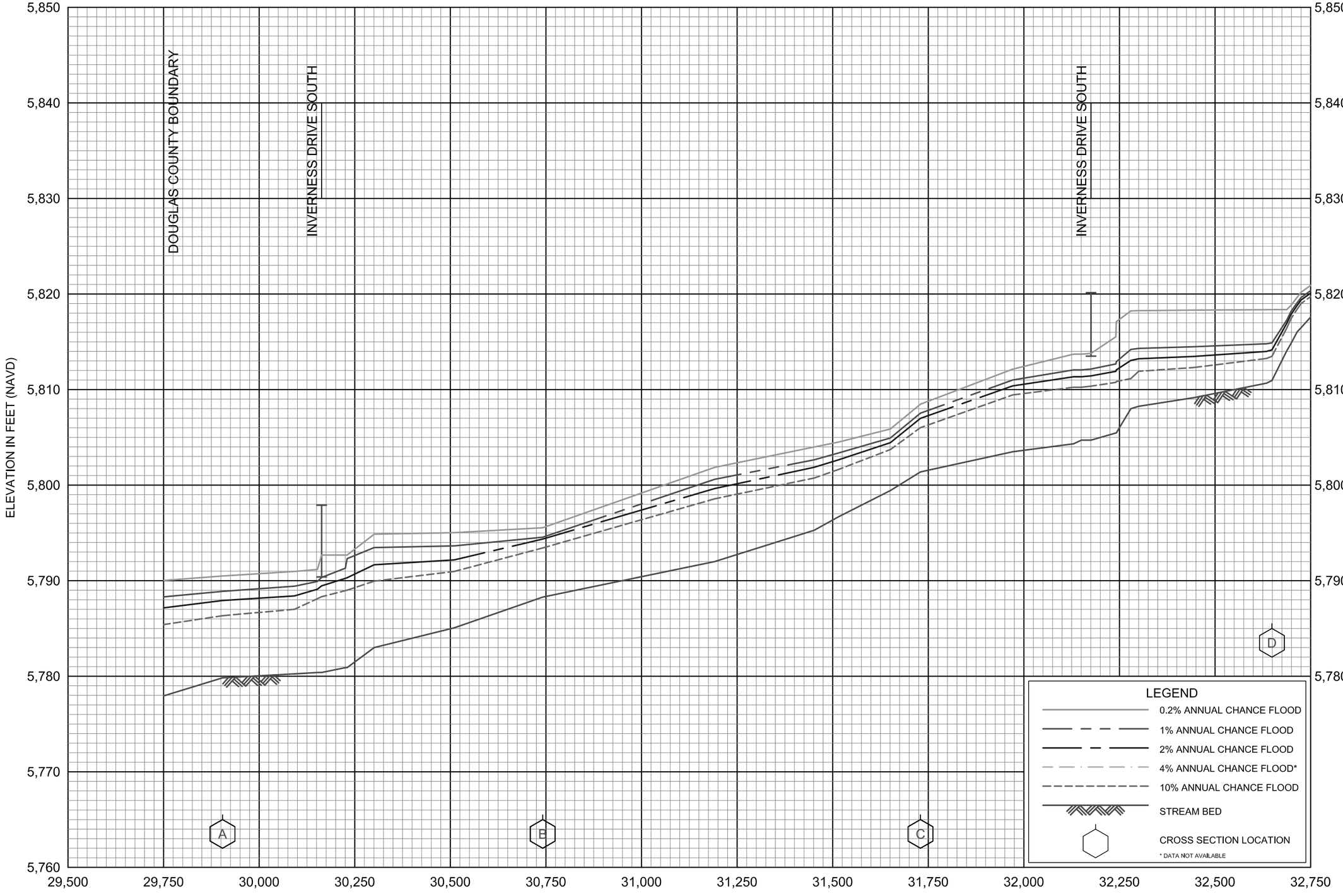
ANTELOPE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

03P



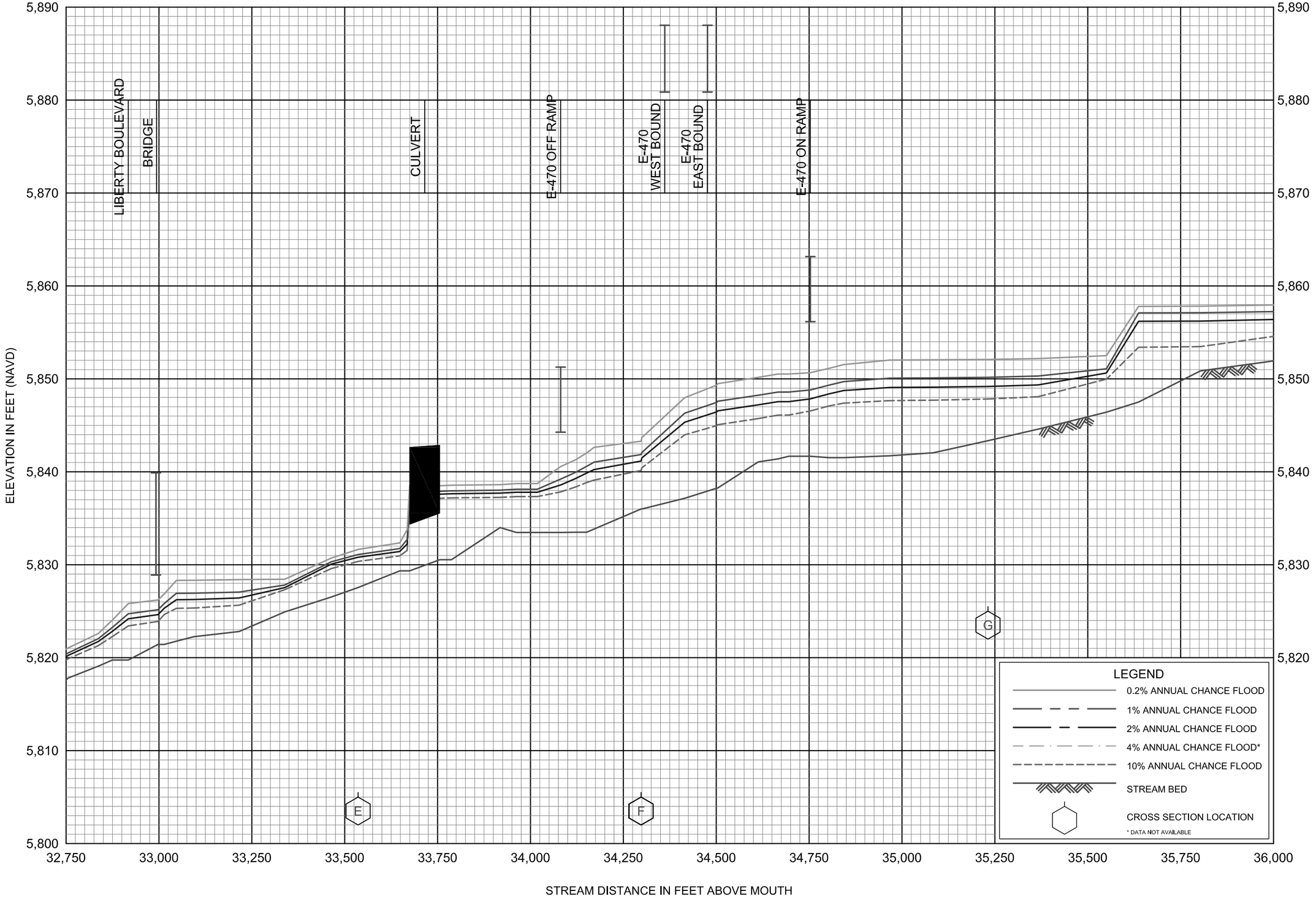
FLOOD PROFILES

COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS



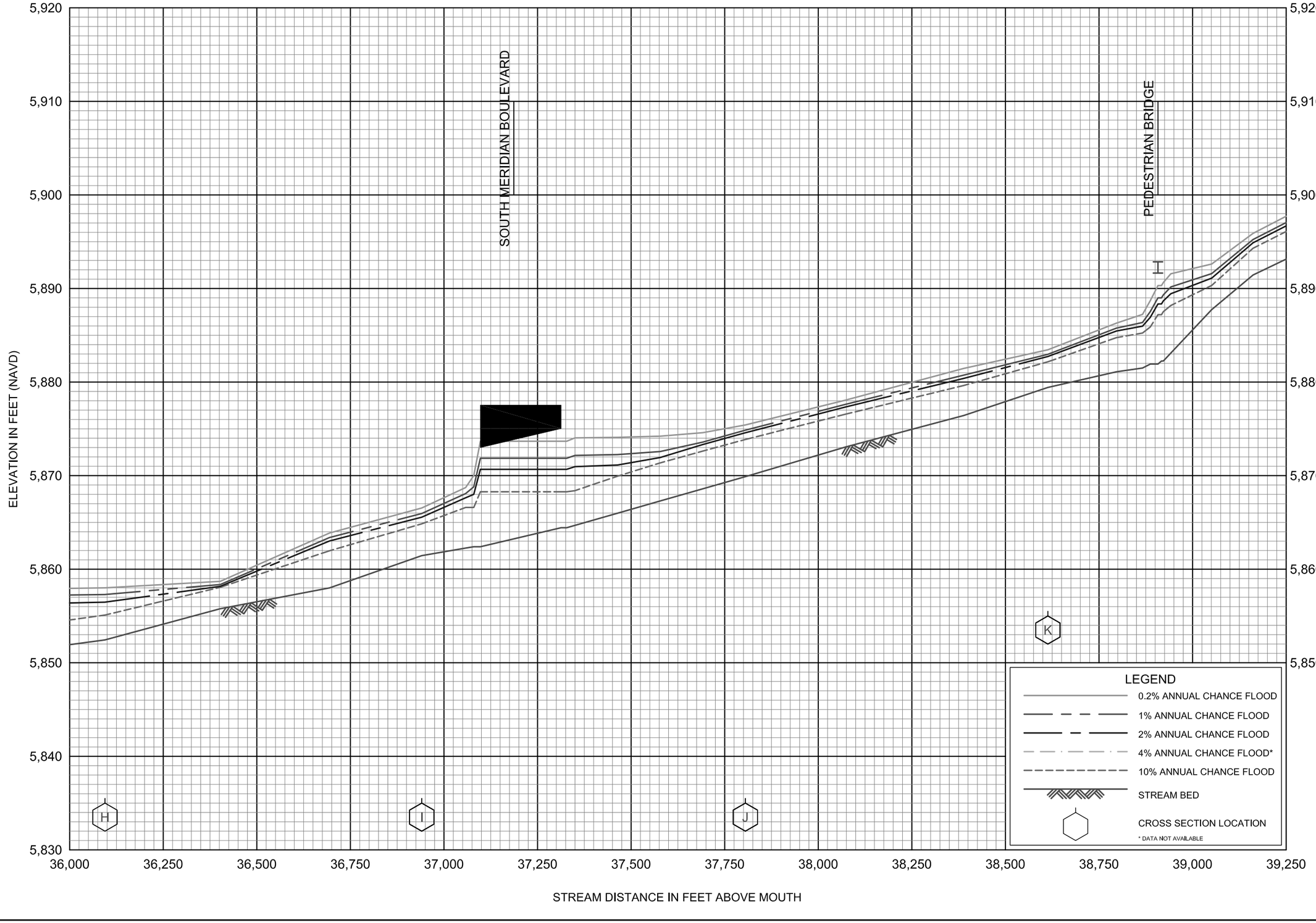
FLOOD PROFILES

COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS



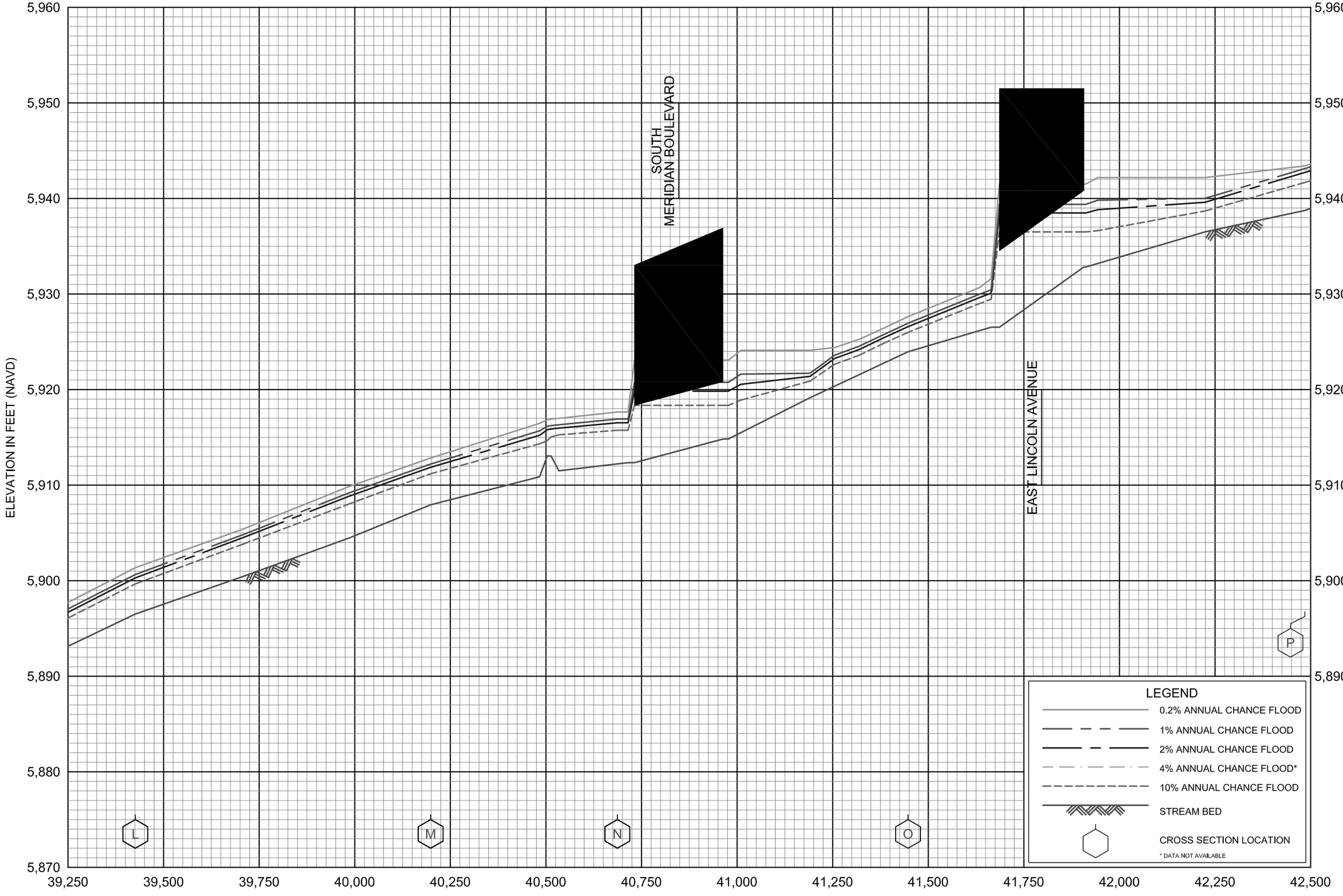
FLOOD PROFILES

COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS



FLOOD PROFILES

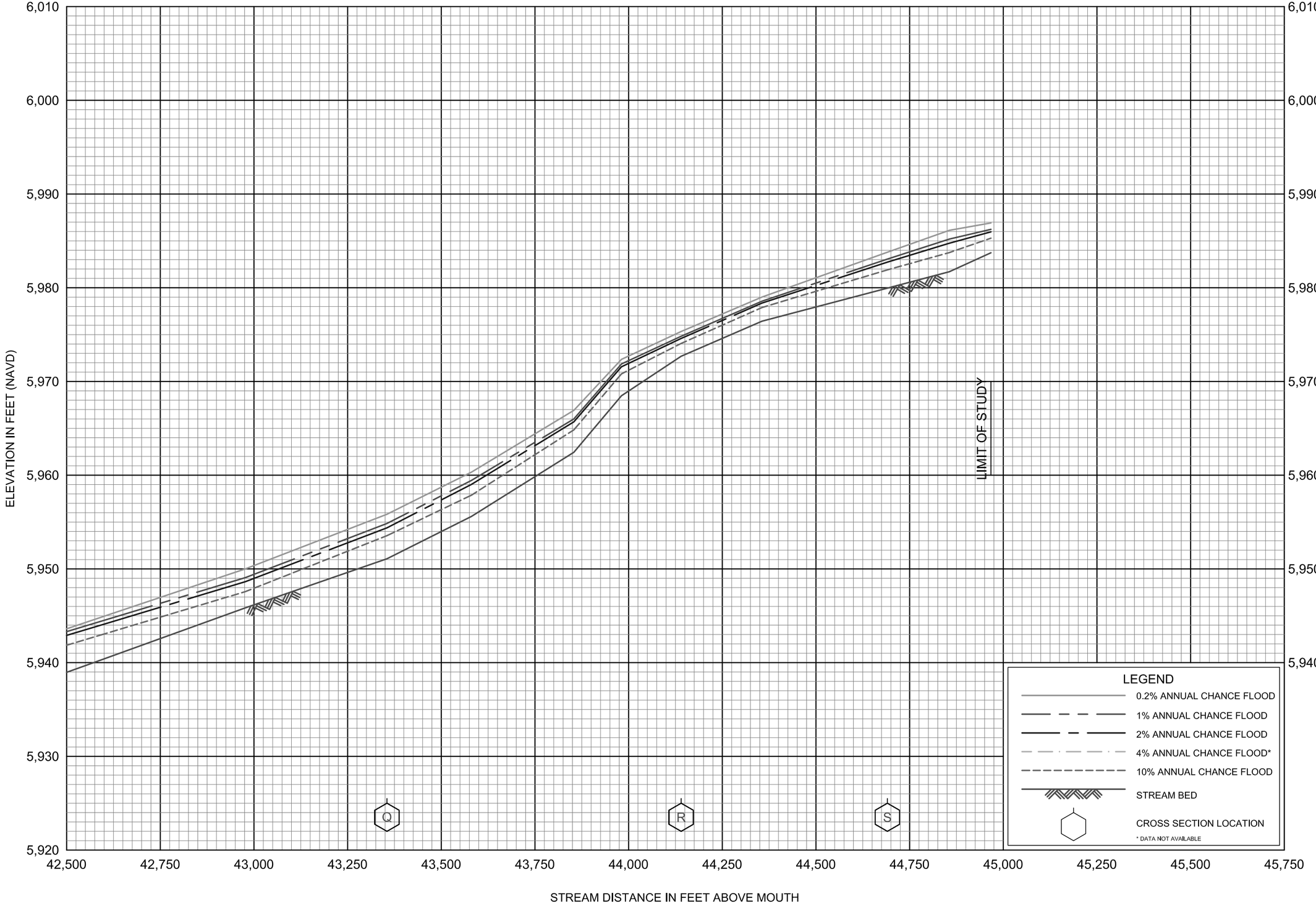
COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

53P



FLOOD PROFILES

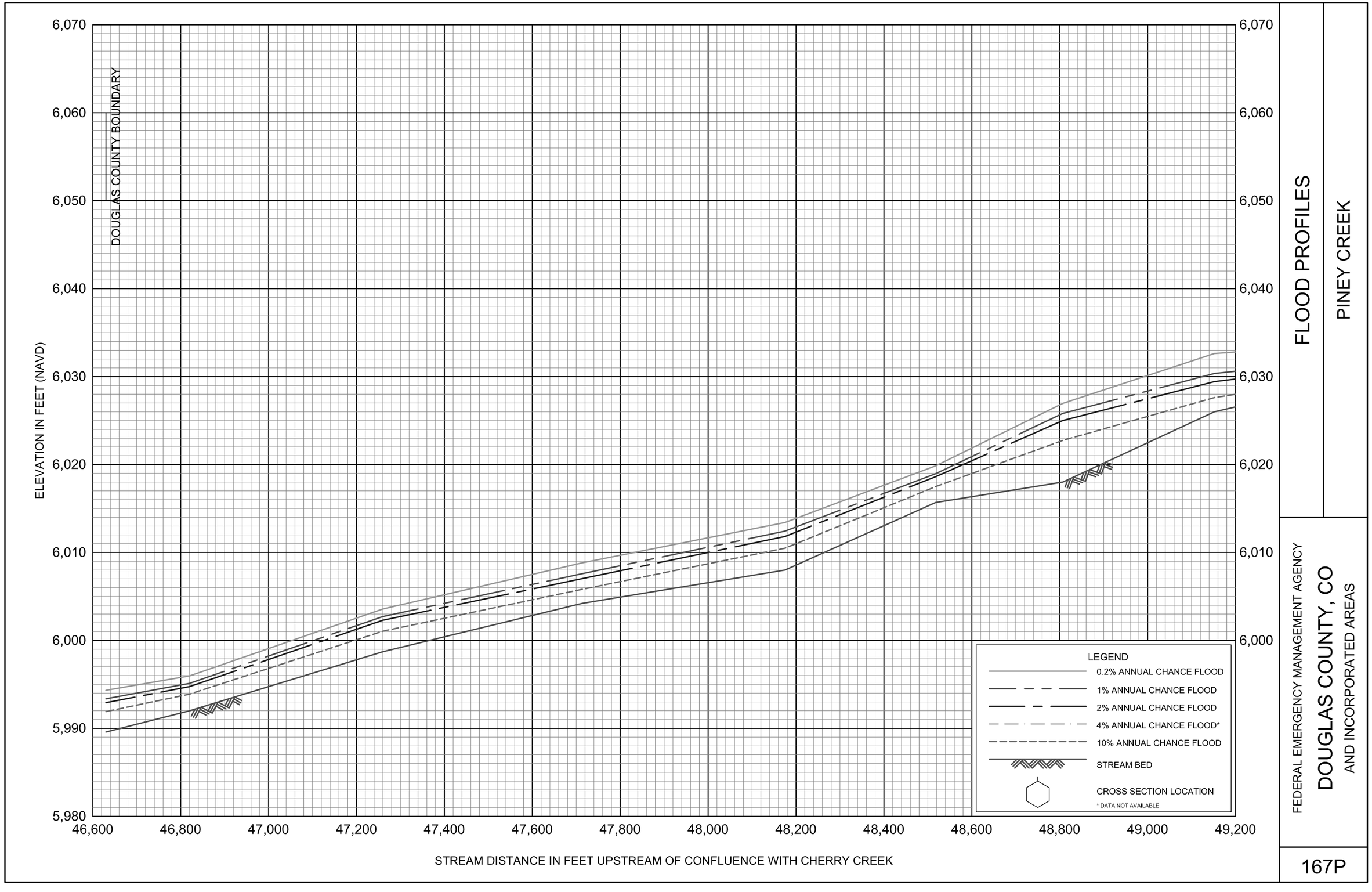
COTTONWOOD CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

54P



FLOOD PROFILES

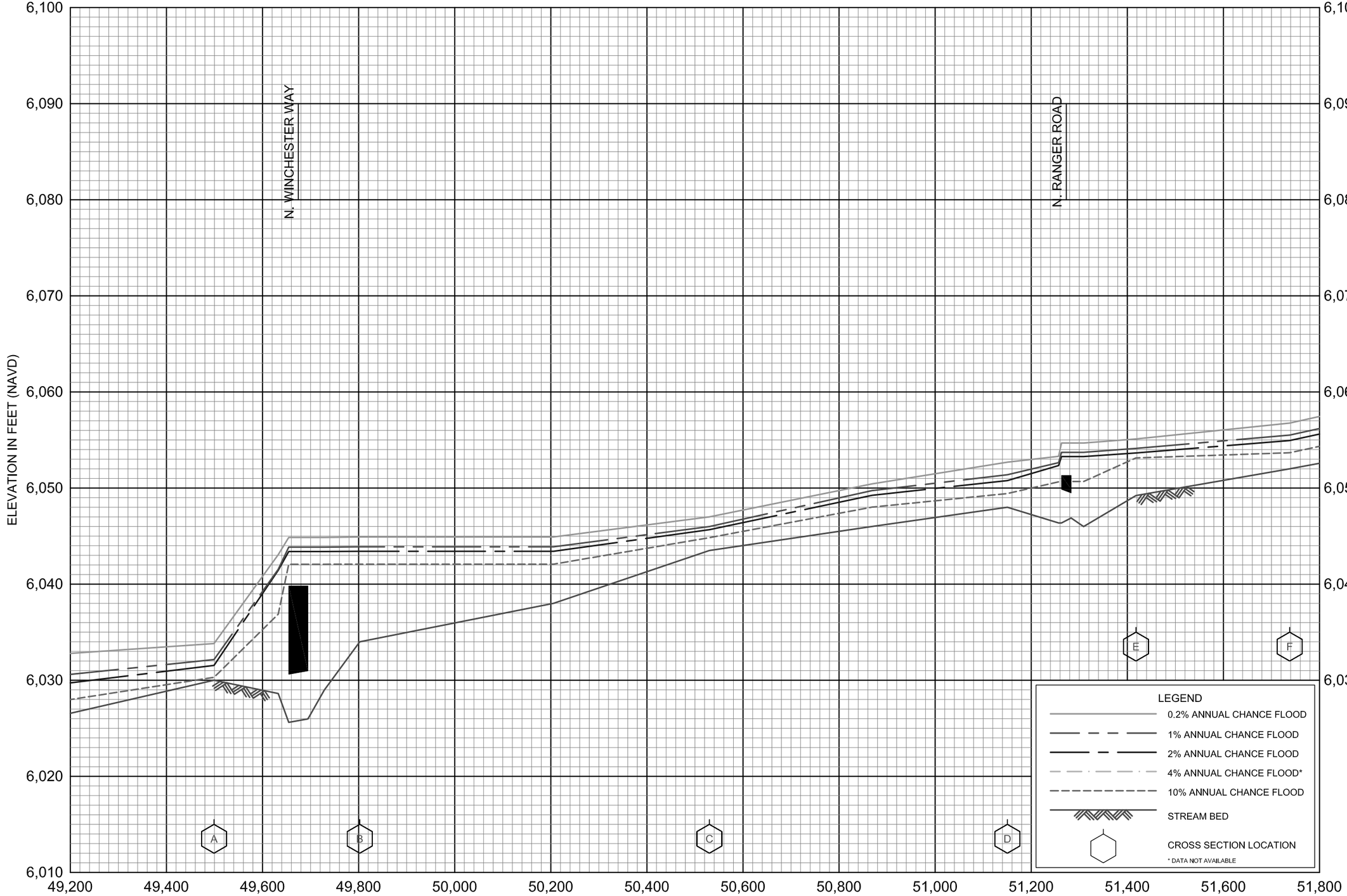
PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

167P



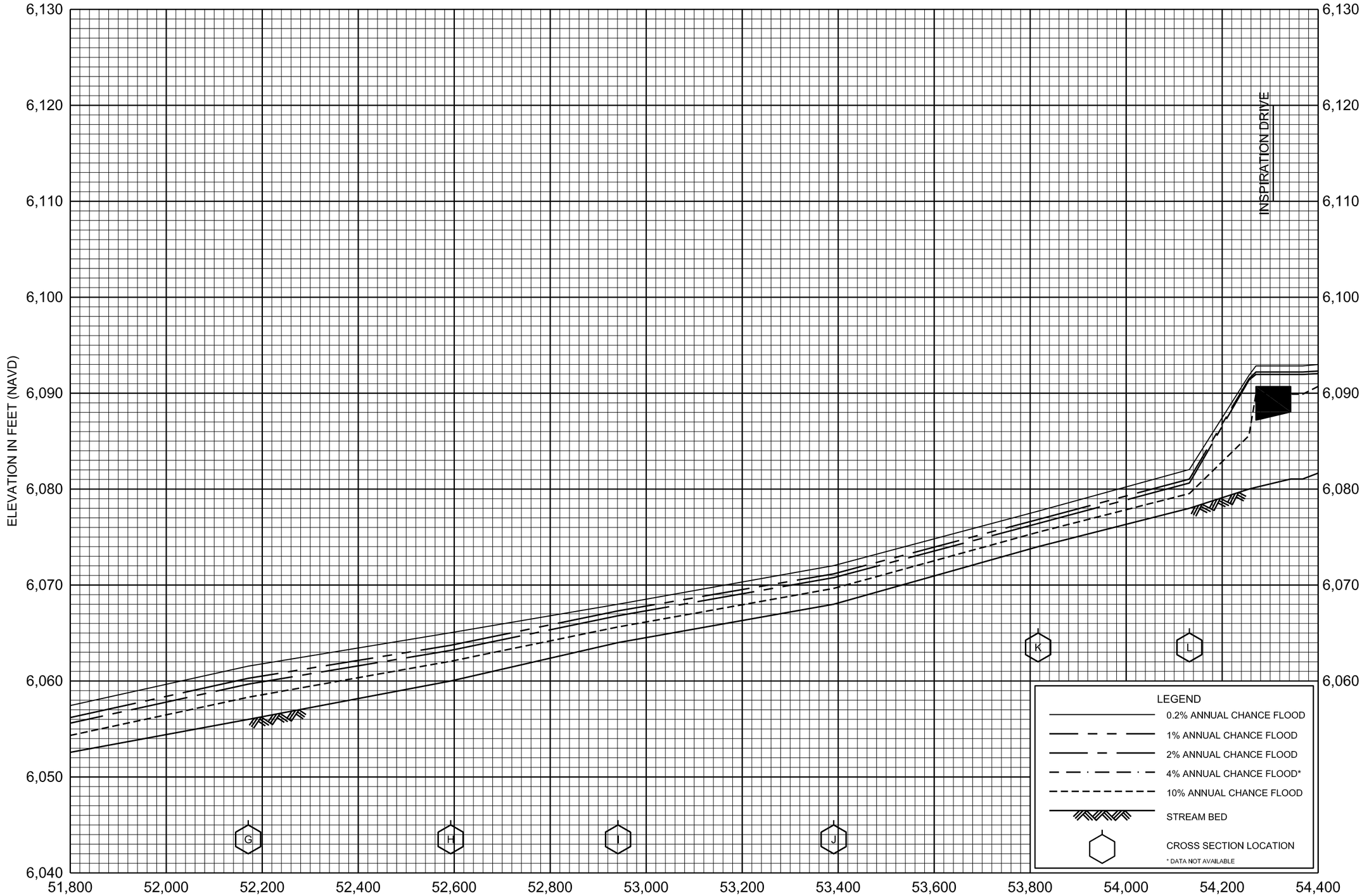
FLOOD PROFILES

PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

168P



FLOOD PROFILES

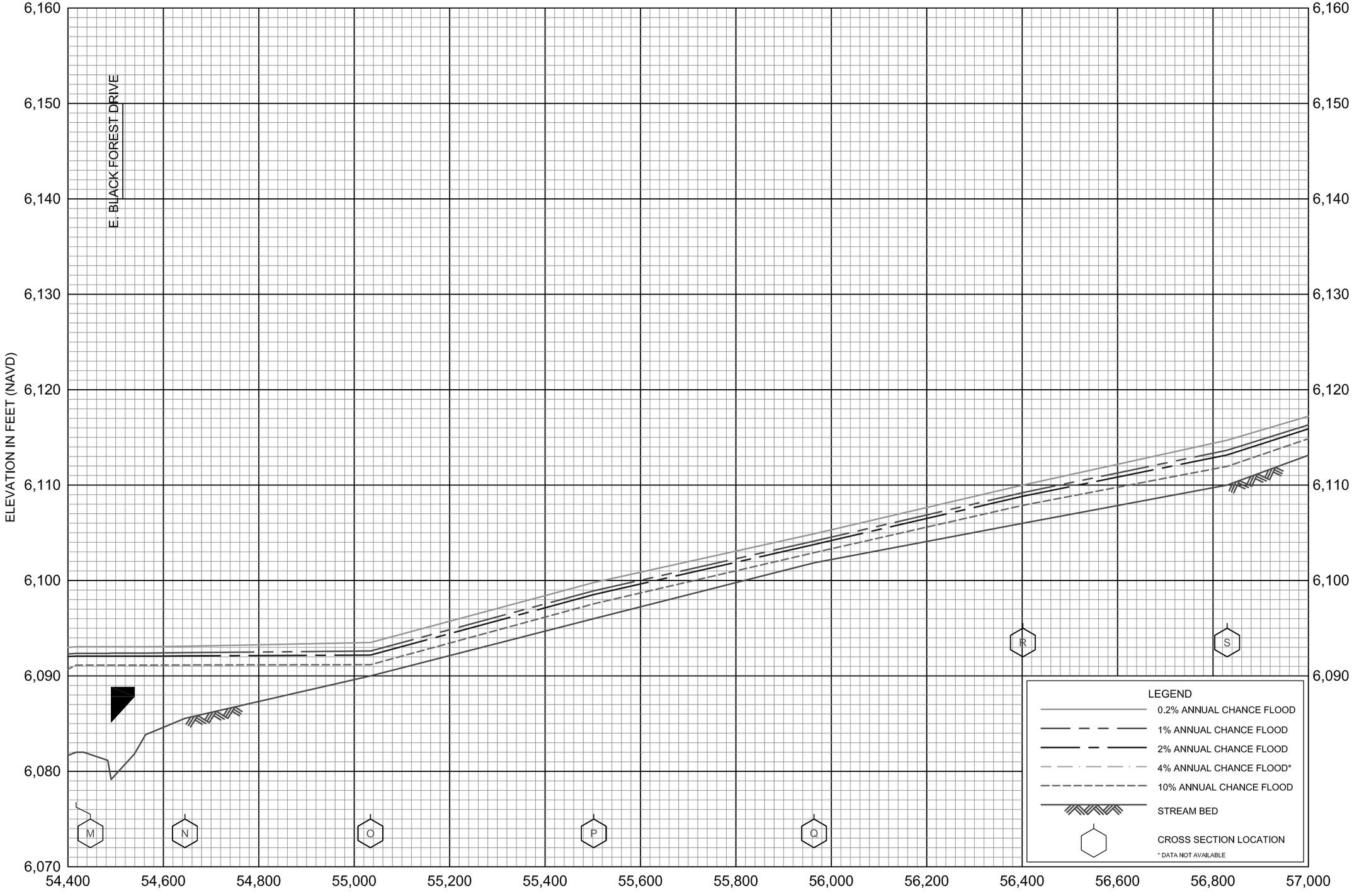
PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

169P



FLOOD PROFILES

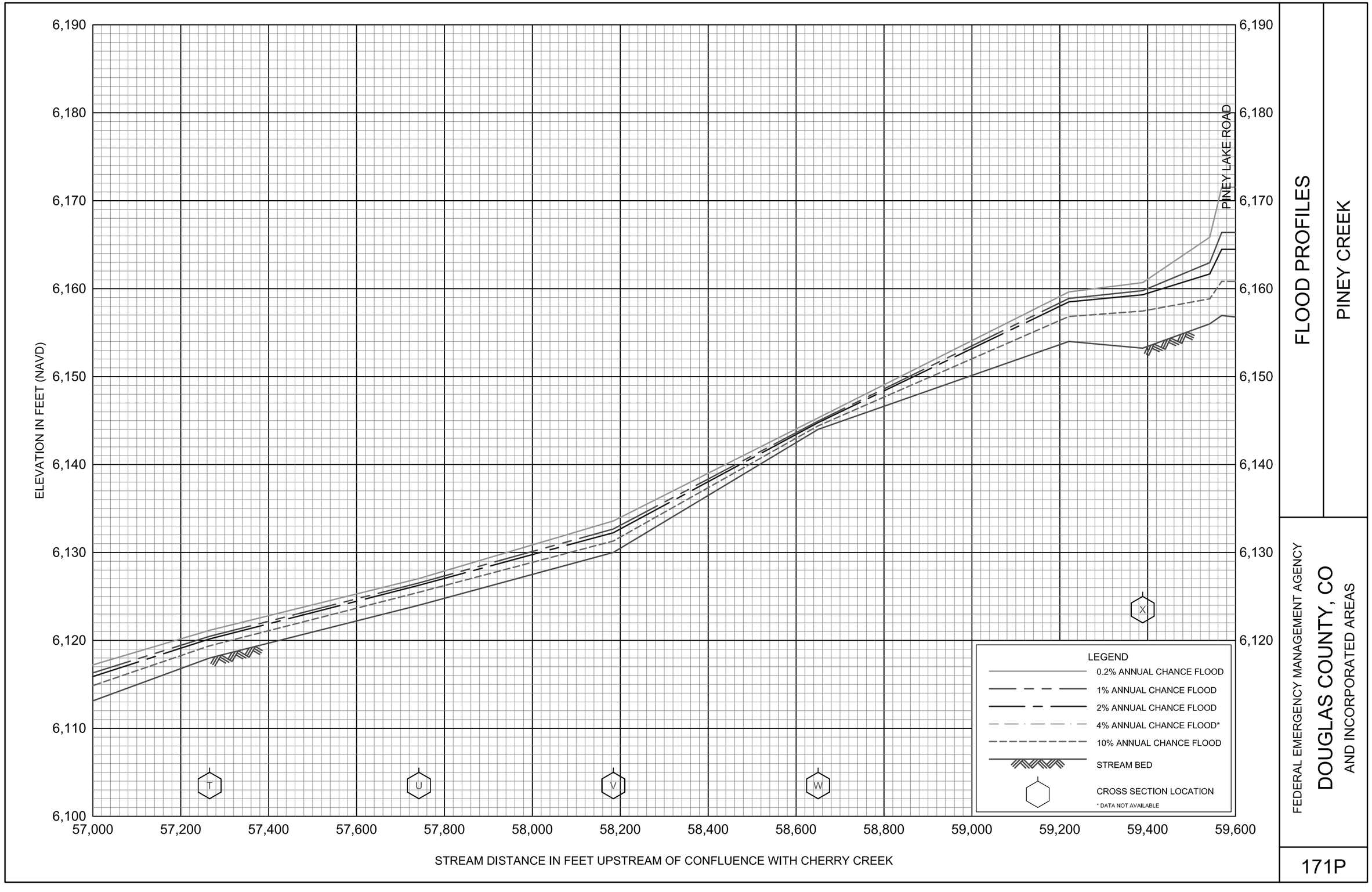
PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

170P



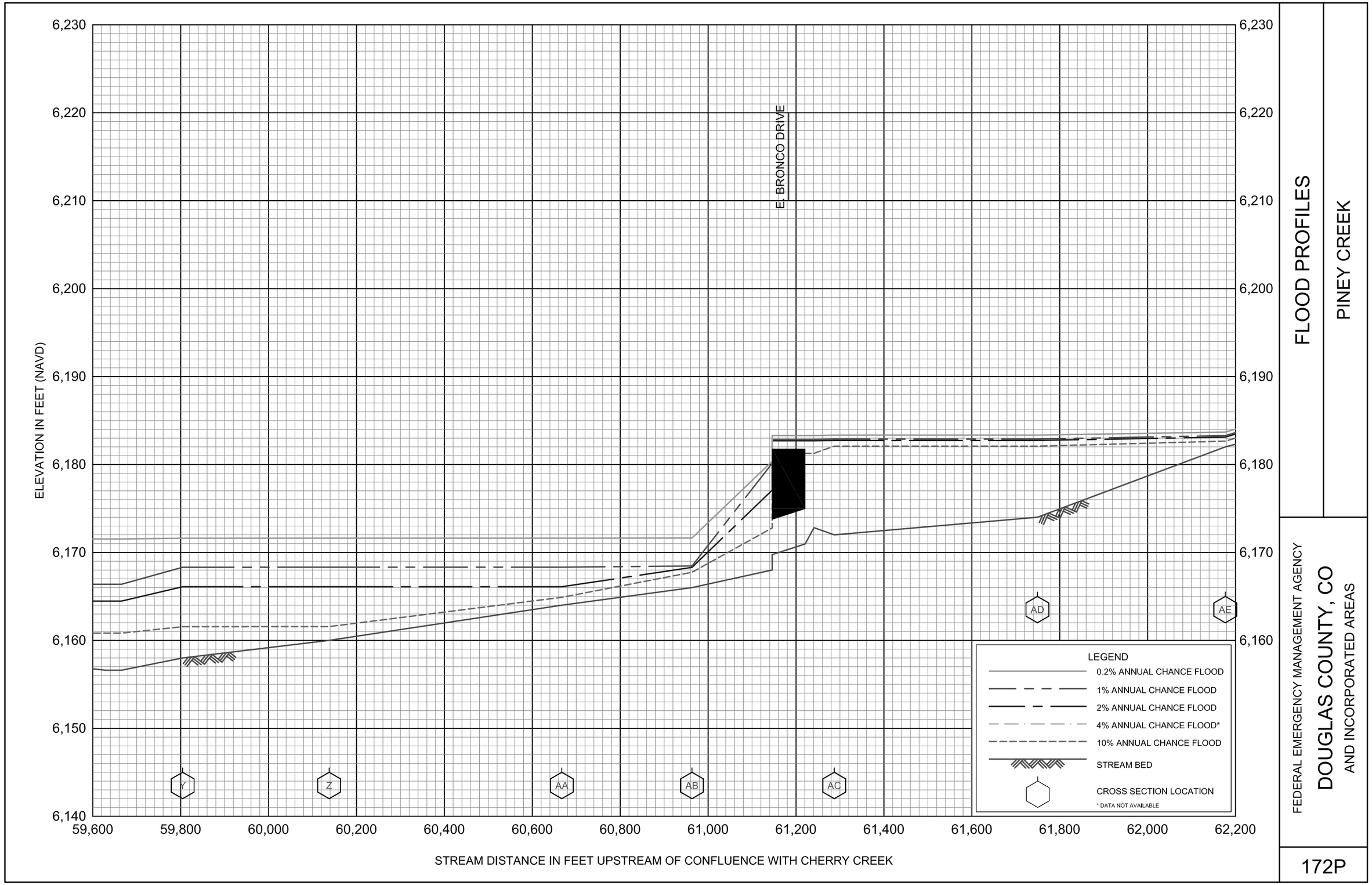
FLOOD PROFILES

PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

171P



FLOOD PROFILES

PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

172P

ELEVATION IN FEET (NAVD)

6,260
6,250
6,240
6,230
6,220
6,210
6,200
6,190
6,180
6,170

62,200 62,400 62,600 62,800 63,000 63,200 63,400 63,600 63,800 64,000 64,200 64,400 64,600 64,800

STREAM DISTANCE IN FEET UPSTREAM OF CONFLUENCE WITH CHERRY CREEK

AF AG AH AI AJ

LEGEND
- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD*
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

* DATA NOT AVAILABLE

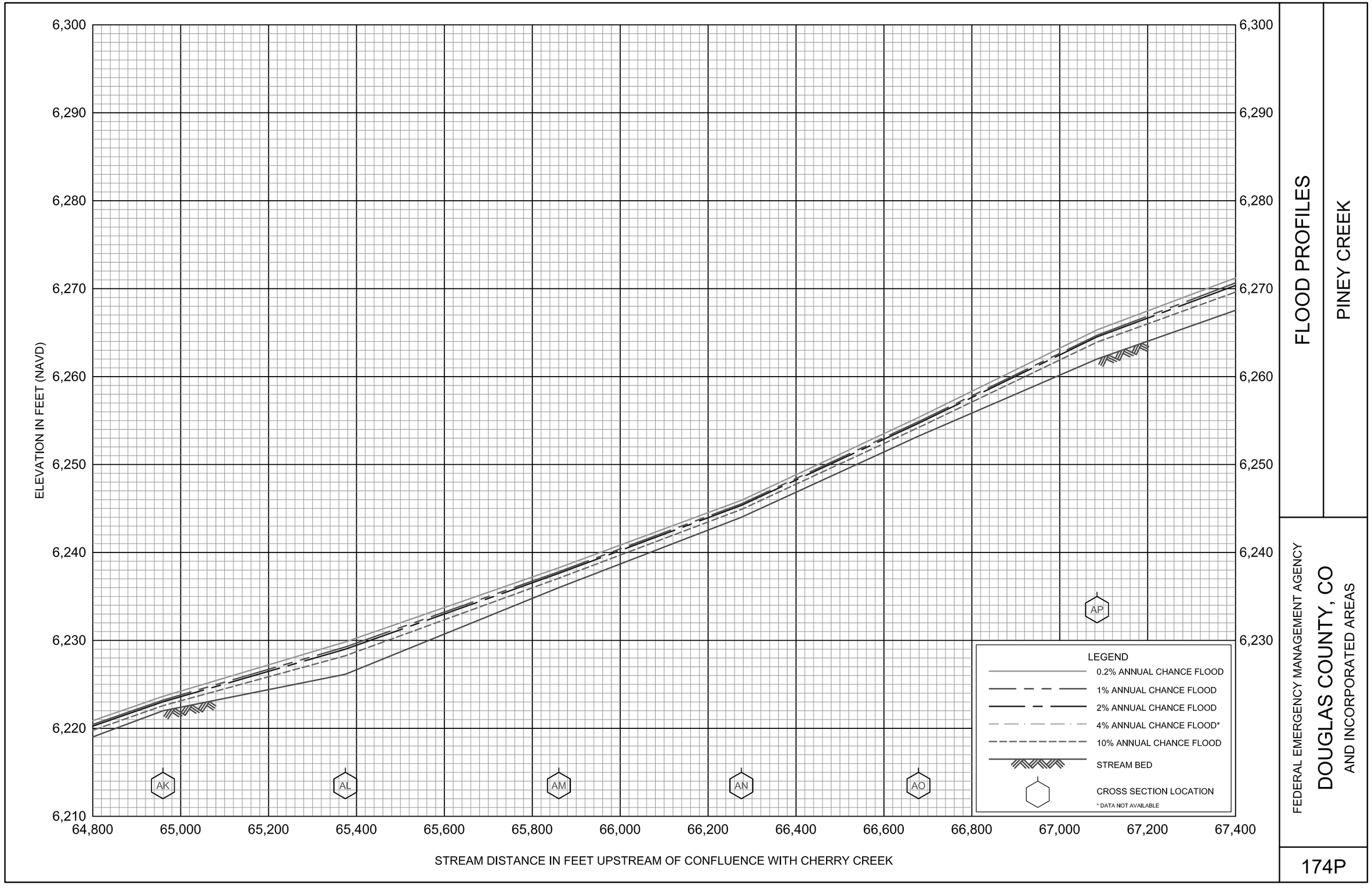
FLOOD PROFILES

PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

173P



FLOOD PROFILES

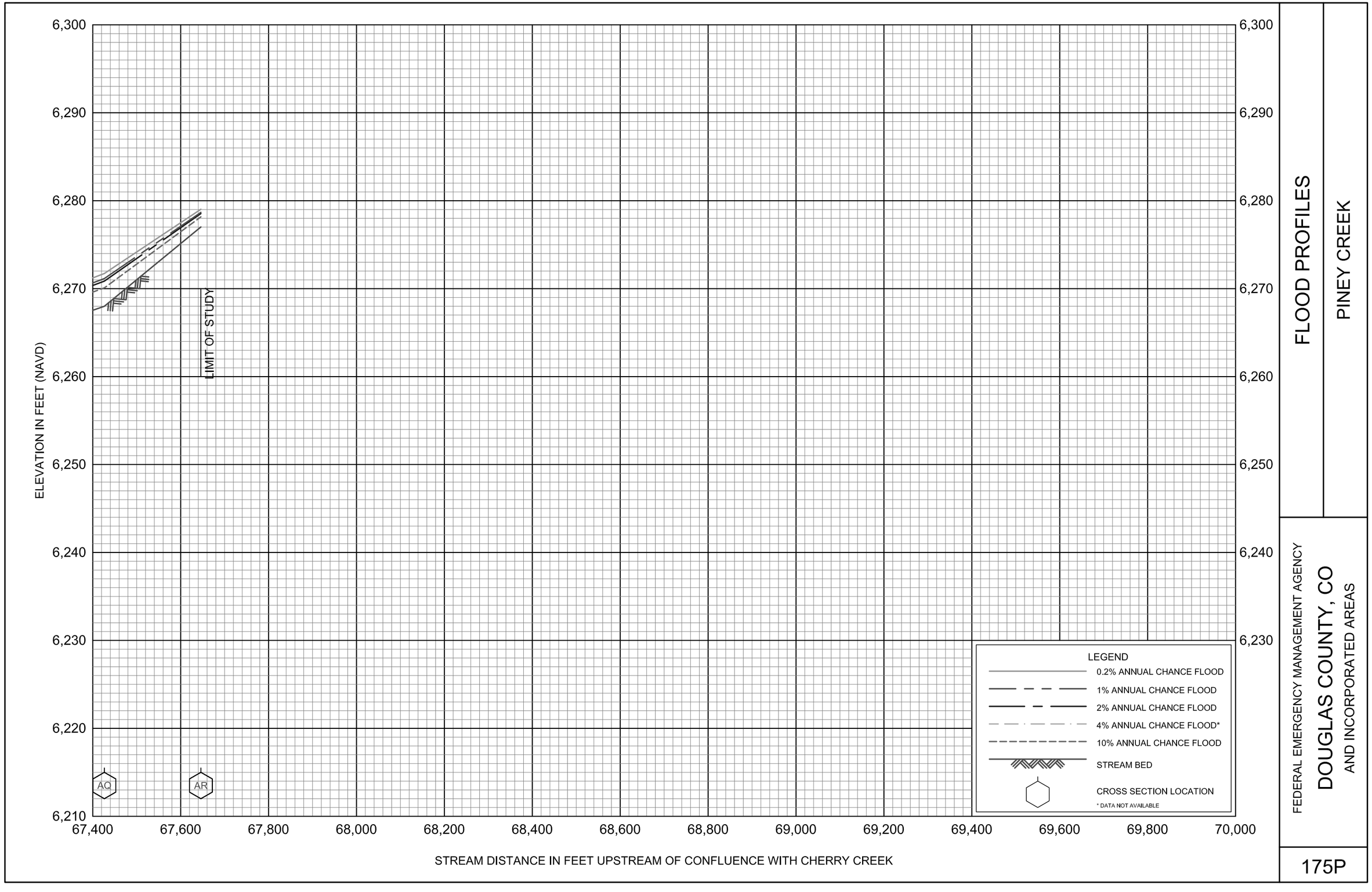
PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

174P



FLOOD PROFILES

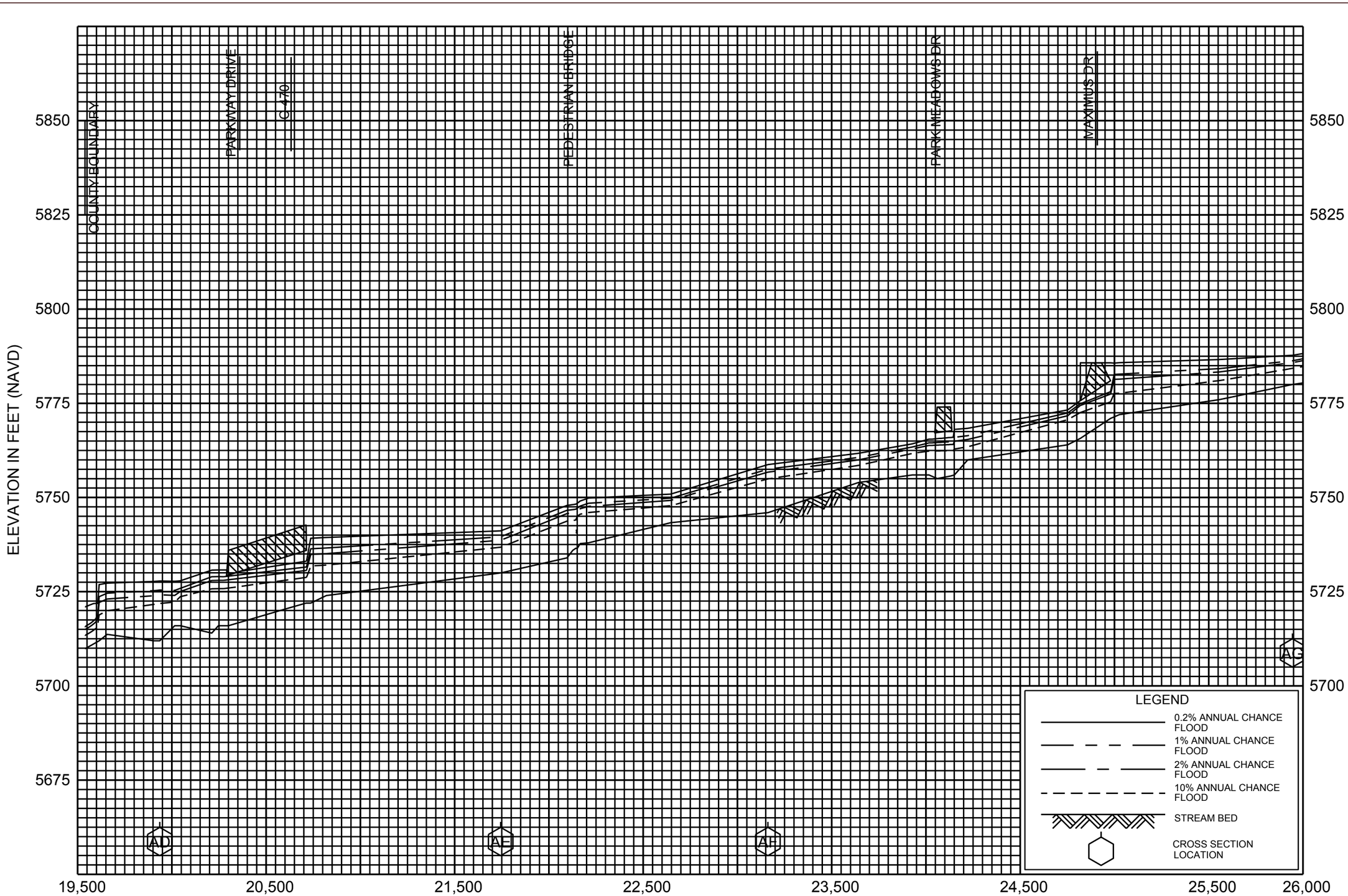
PINEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO

AND INCORPORATED AREAS

175P

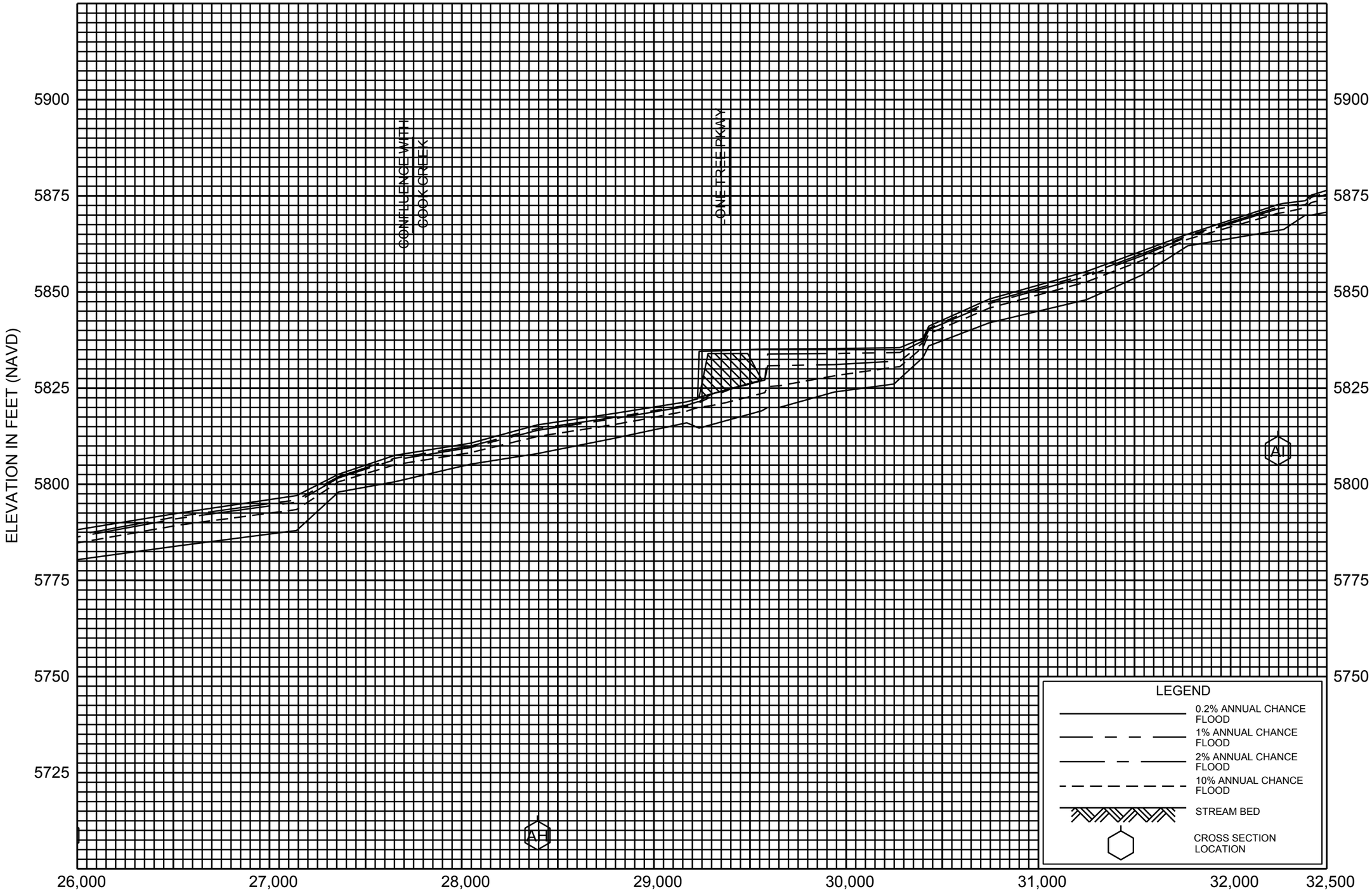


FLOOD PROFILES

WILLOW CREEK (AT LONE TREE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS



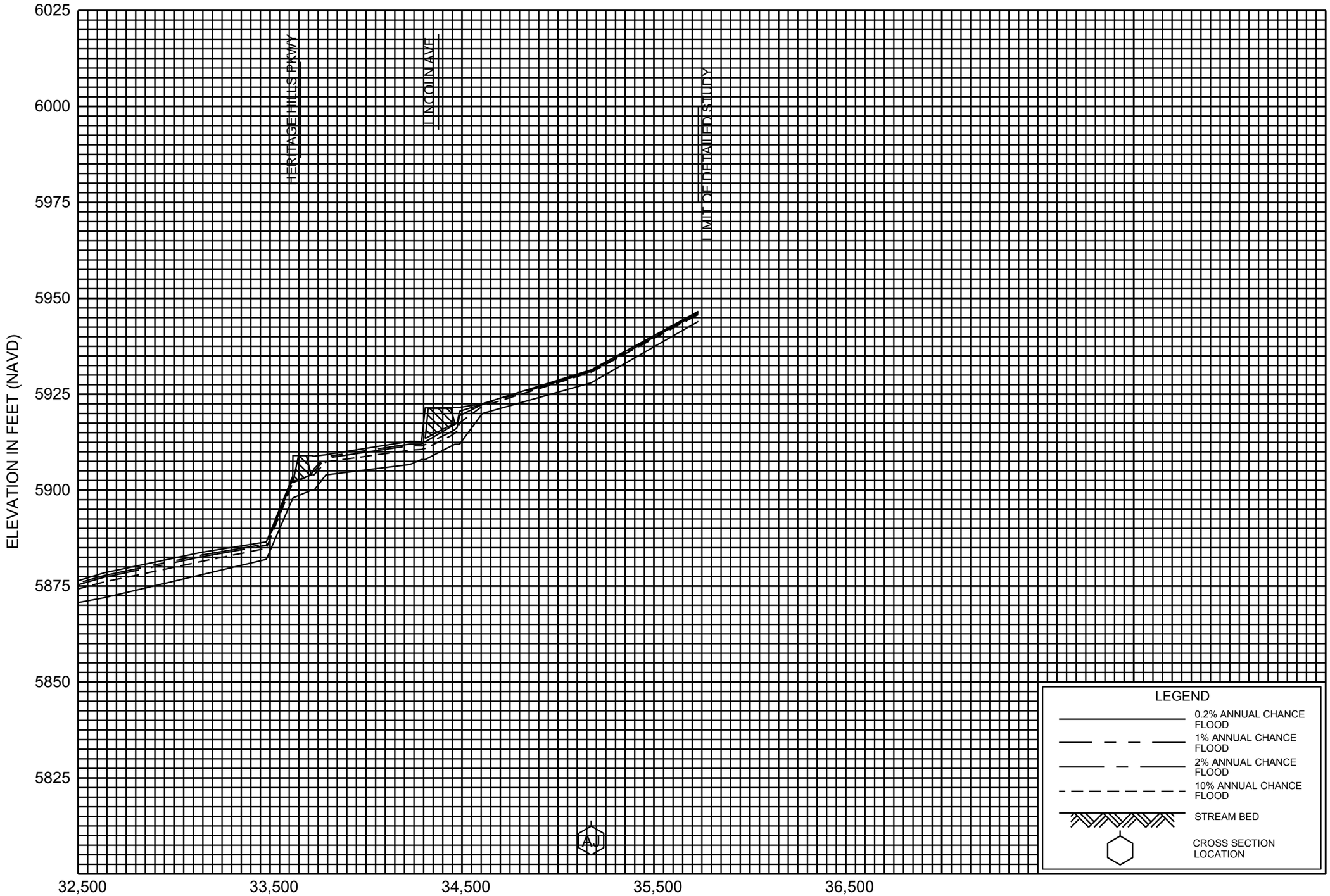
FLOOD PROFILES

WILLOW CREEK (AT LONE TREE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

267P



FLOOD PROFILES

WILLOW CREEK (AT LONE TREE)

FEDERAL EMERGENCY MANAGEMENT AGENCY

DOUGLAS COUNTY, CO
AND INCORPORATED AREAS

268P