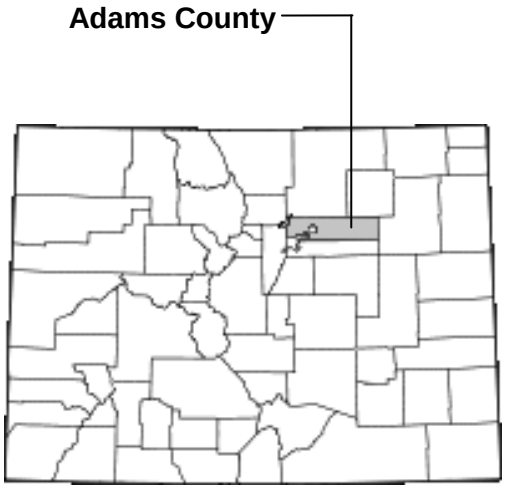
FLOOD INSURANCE STUDY

VOLUME 1 OF 3

ADAMS COUNTY, COLORADO
AND INCORPORATED AREAS

Community Name	Community Number
ADAMS COUNTY (UNINCORPORATED AREAS)	080001
BENNETT, TOWN OF	080003
BRIGHTON, CITY OF	080004
COMMERCE CITY, CITY OF	080006
FEDERAL HEIGHTS, CITY OF	080240
NORTHGLENN, CITY OF	080257
THORNTON, CITY OF	080007



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
08/25/2016

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
08001CV001C

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 may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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

This FIS report was revised on January 20, 2016. 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 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.

Initial FIS Effective Date:	December 15, 1989
Revised FIS Dates:	August 16, 1995 March 5, 2007 January 20, 2016

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.

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EXHIBITS

Exhibit 1 – Flood Profiles

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Flood Insurance Rate Maps (Published Separately)

FLOOD INSURANCE STUDY

ADAMS COUNTY, COLORADO, AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Adams County, including the Cities of Brighton, Commerce City, Federal Heights, Northglenn, and Thornton; the Town of Bennett; and the unincorporated areas of Adams County (referred to collectively herein as Adams County), and 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 community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

The Cities of Arvada, Aurora, and Westminster each fall in more than one county. The technical information for the portions of these communities within Adams County has not been included in this FIS report and Flood Insurance Rate Map (FIRM). Refer to the separately published FIS reports and FIRMs for these communities.

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.

The Digital Flood Insurance Rate Map (DFIRM) and FIS Report for this countywide study have been prepared using digital data. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and geographic information standards and is provided in a digital format so that it can be incorporated into a local Geographic Information System (GIS) and be accessed more easily by the community.

1.2 Authority and Acknowledgments

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

The hydrologic and hydraulic analysis for this partial map revision was completed in January 2012 by Wright Water Engineers, Inc, as part of an update of the Major Drainageway Plan and Flood Hazard Delineation for Big Dry Creek (Reference 93), which updated the analyses for Big Dry Creek.

The hydrologic and hydraulic analyses for the original studies for the unincorporated areas of Adams County and the Cities of Brighton, Commerce City, Northglenn, and Thornton were performed by Gingery Associates, Inc., for the Federal Insurance

Administration (FIA), under Contract No. H-3716. The work for those studies was completed in August 1976, November 1976, March 1977, and April 1979, respectively.

For the unincorporated areas of Adams County, approximate flood boundaries for standing bodies of water greater than 25 acres were arbitrarily determined in February 1977, by Dames & Moore, under contract to the FIA.

The Adams County study was revised on December 15, 1989, to modify the Special Flood Hazard Areas (SFHAs) along a reach of the South Platte River, Approximately 2.3 miles long. The revised reach extended form a point approximately 760 feet downstream of the westbound lane of Interstate Highway 270, upstream to the south boundary of Adams County, at the City and County of Denver corporate limits (Franklin Street).

The basis for the 1989 revision is revised hydraulic analyses conducted by Wright Water Engineers, Inc., Denver, Colorado, under contract to the Urban Drainage and Flood Control District (UDFCD). The revised hydraulic analyses utilized the U.S. Army Corps of Engineers (USACE) HEC-2 hydraulic computer model and were conducted in August 1986 and September 1987. The hydraulic reanalyses modified the 1- and 0.2-percent-annual-chance flood boundaries and increased the base (1-percent-annual-chance) flood elevations (BFEs) along portions of the South Platte River by up to 5 feet.

Additional hydraulic analyses within the City of Commerce City were completed by Simons, Li, and Associates, Inc., in June 1987, to reflect channel modifications for a reach of Sand Creek between Vasquez and Brighton Boulevards. Revised hydraulic analyses were also conducted for a reach of the South Platte River, from approximately 760 feet downstream of westbound Interstate Highway 270 to the upstream corporate limits of Commerce City at Franklin Street, by Wright Water Engineers, Inc., under contract to the UDFCD.

The hydraulic re-analyses for the reach of the South Platte River through Commerce City were completed in September 1987.

The hydrologic and hydraulic analyses for detailed areas in the City of Federal Heights were performed by Greiner Engineering Sciences, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-83-C-1173. That study was completed in July 1984. Additional approximate analyses in that study were performed by the Colorado Water Conservation Board (CWCB) (Reference 1).

The August 16, 1995 revision (Reference 2) combined the FIRMs and FIS reports of the County and incorporated cities into the countywide format. Under the countywide format, FIRM panels have been produced using a single layout format for the entire area within the county instead of separate layout formats for each community.

For the 2007 countywide FIS report, revised hydrologic and hydraulic analyses were taken from reports prepared for the UDFCD on Box Elder Creek, Clear Creek, and the South Platte River. These analyses were completed by Wright Water Engineers, Inc., Ayers Associates, Inc., and Camp Dresser & McKee, Inc., respectively, under contract with the UDFCD. Revised hydraulic analyses along Box Elder Creek were completed from the Weld County Boundary at 168th Avenue to approximately 9,730 feet upstream of East 72nd Avenue. Revised hydraulic analyses along Clear Creek were completed from

the confluence with the South Platte River to the Jefferson County boundary at Sheridan Boulevard. Revised hydraulic analyses along the South Platte River were completed from the Weld County boundary at 168th Avenue to the City and County of Denver boundary at Franklin Street.

The coordinate system used for the production of the digital FIRM is Colorado State Plane North Zone (FIPS Zone 0501) referenced to North American Datum of 1983 and the GRS 80 spheroid, Western Hemisphere.

Base map information shown on the digital FIRM was provided by the Adams County and Commerce City GIS Departments. The coordinate system used for the production of the digital FIRM is Colorado State Plane North Zone (FIPS Zone 0501) referenced to North American Datum of 1983 and the GRS 80 spheroid, Western Hemisphere.

1.3 Coordination

An initial Consultation Coordination Officer (CCO) meeting (also occasionally referred to as the Scoping meeting) is held with representatives of the communities, FEMA, and the study contractors to explain the nature and purpose of the FIS and to identify the streams to be studied by detailed methods. A final CCO (often referred to as the Preliminary DFIRM Community Coordination, or PDCC, meeting) is held with representatives of the communities, FEMA, and the study contractors to review the results of the study.

For this revision of the countywide FIS, the final CCO meeting was held on May 29, 2014 to review and accept the results of this FIS. Those who attended this meeting included representatives of UDFCD, the Study Contractor, FEMA, and the communities. All problems raised at that meeting have been addressed in this study.

The coordination for the original Adams County FIS was completed in multi-agency conferences managed by FEMA.

Officials of the Adams County Planning Commission, the Colorado Highway Department, the CWCB, the UDFCD, the USGS, the U.S. Soil Conservation Service (SCS), the U.S. Bureau of Reclamation, the USACE, Omaha District, the Denver Post newspaper, and local residents were contacted throughout the study; available maps, flood data, and historical information were obtained.

On October 23 and November 28, 1975, public hearings were held by the Adams County Planning Commission to review the floodplains within the county. A final community coordination meeting was held with the public and representatives from Gingery Associates, the Adams County Planning Commission, the UDFCD, and the FIA on August 26, 1976, to present and discuss the flood information prepared for the county. There were no problems raised at that meeting.

The initial coordination meetings for the Cities of Brighton, Commerce City, and Northglenn were held at a meeting attended by personnel of Gingery Associates, Inc., the FIA, and officials of the communities on February 12, 1976. The base map and topographic mapping used for that study were furnished by the communities, and the streams requiring detailed study were identified. On October 26, 1976, a final community

coordination meeting was held with the City of Brighton. On March 7, 1977, a final community coordination meeting was held with the City of Commerce City, where results of the FIS were presented to city officials and residents. On July 25, 1977, a final community coordination meeting was held with the City of Northglenn.

The draft report of the detailed study for the City of Federal Heights was discussed at a coordination meeting attended by representatives of the City of Federal Heights, FEMA, and the study contractor on April 25, 1983. Approximate analyses for Federal Heights were approved by FEMA for use in the FIS. The final community coordination meeting was held on April 2, 1985, and was attended by representatives of FEMA, the study contractor, and the City.

Community based map selection and identification of streams requiring detail study in the City of Thornton were accomplished in an initial coordination meeting attended by personnel of the study contractor, the FIA, and the UDFCD, as well as officials of the City of Thornton on March 11, 1976. A final community coordination meeting was held with the City of Thornton on July 25, 1977.

For the 2007 countywide FIS report, an initial coordination meeting was attended by FEMA; Adams County; the Cities of Commerce City, Northglenn, and Thornton; the Town of Bennett; the CWCB; the UDFCD; Michael Baker, Jr., the National Service Provider; and ICON Engineering, Inc., the study contractor, on October 5, 2004. At that meeting, the communities were notified that their FIS report and FIRM would be converted to a Digital FIRM (DFIRM) format. Additionally, streams to be added as detailed studies and approximate studies were selected, and base mapping and topographic mapping was provided by Adams County along with the City of Commerce City. Additional correspondence was held with the Cities of Brighton and Federal Heights. Base mapping and topographic mapping was also provided by Federal Heights.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Adams County, Colorado, including the incorporated towns and cities, except communities which fall within more than one county as described in Section 1.1. The scope and methods of this study were proposed to, and agreed upon, by FEMA and Adams County. Streams that were studied by detailed methods are listed in Table 1.

Table 1: Streams Studied by Detailed Methods

Stream	Limits of Detailed Study
Basin 4100	From Cypress Drive to approximately 200 feet upstream of Thornton Parkway.
Bear Gulch	From the confluence with Box Elder Creek to City of Aurora boundary located 10,040 feet upstream of 48th Avenue
Bear Gulch Tributary D	From the Adams County boundary, located approximately 440 feet upstream of the confluence with Bear Gulch, to approximately 3,800 feet upstream of the confluence with Bear Gulch.
Bear Gulch Tributary E	From the confluence with Bear Gulch to approximately 1,200 feet upstream of the confluence with Bear Gulch.
Bear Gulch Tributary G	From the confluence with Bear Gulch to approximately 5,600 feet upstream of the confluence with Bear Gulch.
Big Dry Creek*	From the Adams-Weld County boundary to the Adams-Jefferson County Boundary
Box Elder Creek	From the Weld County boundary at 168th Avenue to approximately 9,730 feet upstream of 72nd Avenue.
Brantner Gulch	From approximately 1,400 feet downstream of to approximately 900 feet upstream of Bellaire Drive.
Clear Creek	From the confluence with the South Platte River to the Jefferson County boundary at Sheridan Boulevard.
Comanche Creek	From the Weld County boundary at 168th Avenue to the Arapahoe County boundary at Highway 36.
Grange Hall Creek	From Riverdale Road to Interstate 25.
Grange Hall Creek Tributary	From the confluence with Grange Hall Creek to Union Pacific Railroad.
Hayesmount Creek	From the Weld County boundary at 168th Avenue to the City and County of Denver boundary located 2,720 feet upstream of East 120th Avenue.
Hayesmount Creek East Tributary	From the confluence with Hayesmount Creek to approximately 13,000 feet upstream of the confluence with Hayesmount Creek.
Hayesmount Creek West Tributary	From the confluence with Hayesmount Creek to approximately 11,710 feet upstream of 128th Avenue.

Stream	Limits of Detailed Study
Little Comanche Creek	From the confluence with Comanche Creek to the Arapahoe County boundary at Highway 36.
Little Dry Creek	From West 64th Avenue to Lower Boulevard.
Niver Creek	From the confluence with South Platte River to Washington Street.
Niver Creek Tributary M	From Pecos Street to approximately 300 feet upstream of Elm Court.
Northfield Creek (Downstream of UPPR)	From the confluence with South Platte River to Devonshire Boulevard.
Northfield Creek (Upstream of UPPR)	From Devonshire Boulevard to East 88th Avenue.
North Fork Grange Hall Creek	From the confluence with Grange Hall Creek to Irma Drive.
Sand Creek	From the confluence with south Platte River to approximately 600 feet upstream of East 49th Avenue.
South Fork Grange Hall Creek	From the confluence with Grange Hall Creek to Huron Street.
South Platte River	From the Weld County boundary at 168th Avenue to the City and County of Denver boundary at Franklin Street.
Tanglewood Creek	From the confluence with Big Dry Creek to Interstate 25.
Wolf Creek	From the confluence with Comanche Creek to the Arapahoe County boundary at Highway 36.

*Flooding source was updated as part of this revision

All or portions of the streams in Table 2 were studied by approximate methods in previous FIS for Adams County and Incorporated Areas (References 2 through 5 and 7 through 11).

Table 2: Streams Studied by Approximate Methods

Bijou Creek
Portions of Brantner Gulch
DFA 0054-1
East Bijou Creek
First Creek
Portions of Grange Hall Creek
Grange Hall Tributary Southeast
Hidden Lake
Kiowa Creek
Lost Creek
McKay Lake Drainageway
Morris Creek

Muddy Creek
Mustang Creek
Niver Canal
Portions of Niver Creek
Niver Creek Tributary L
Portions of Niver Creek Tributary M
Portions of Northfield Creek
Preble Creek
Quail Creek
Sack Creek
Second Creek
Shay Ditch
Short Run
South Fork Preble Creek
South Sack Creek
Third Creek
Todd Creek
Tributary 2 to Todd Creek
Tributary 4 to Todd Creek
Tributary to Brantner Gulch
Tributary II to Brantner Gulch
Tributary VII to Brantner Gulch
Wadley North
Wadley South
West Bijou Creek

For the 2007 countywide FIRM, 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 for which 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, Adams County, and the incorporated communities within Adams County.

2.2 Community Description

Adams County is located in central Colorado, just north and east of Denver, the state capital. The general shape of the physical boundary resembles a rectangle that is 18 miles wide by 72 miles long. Extending from near the foothills of the Rocky Mountains easterly to the open plains of the state, Adams County covers approximately 1,180 square miles. It is bordered on the north by Morgan and Weld Counties, on the east by Washington County, on the south by Arapahoe and Denver Counties, and on the west by Jefferson and Broomfield Counties.

The City of Brighton is located in north central Adams County. Brighton has grown from a stagecoach stop in the early 1860s, to a rapidly growing city at the fringe of the Denver metropolitan area. The City originally based its economy on agriculture, which expanded

rapidly after development of an extensive irrigation system in the early 1900s. Today, agriculture still plays a significant role in the economy; however, the pressures of urban growth are currently changing this emphasis. The community has grown steadily over the years since its incorporation, but its pace has dramatically changed since 1970 by an increase in population of over 400 percent, from 8,309 in 1970 to 34,069 in 2010 (Reference 6).

Commerce City is situated in the southwestern corner of Adams County. The City is 15 miles south of Brighton, the county seat. The City and County of Denver, the state capital, and the U.S. Army's Rocky Mountain Arsenal border the City on the east. The City and County of Denver also forms the southern boundary, and Adams County adjoins Commerce City to the north and west.

Commerce City was first incorporated in December of 1952 and named Commerce Town. The population increased 750 percent from 1,200 in 1952 to 9,000 in 1960, at which time Commerce Town became Commerce City. As of 1980, the City had a population of approximately 16,230. In 2010, the population was estimated to be approximately 45,913 (Reference 6).

The City of Federal Heights is located in west-central Adams County, approximately 5 miles north of the City and County of Denver corporate limits and 1.5 miles east of the Jefferson County line. Federal Heights is bordered by the Cities of Thornton on the east, Westminster on the west, and Northglenn on the northeast. Federal Heights experienced much growth between 1970, when the population was 1,502, and 1980, when the population figure was 7,846 (Reference 14). In 2010, the population was estimated to be approximately 11,467 (Reference 6).

The City of Northglenn is located in west-central Adams County, Colorado, and is approximately 6 miles north of Denver. The City is bounded by the City of Thornton to the east, north, and south, and the City of Westminster to the west. Development in the City of Northglenn is mainly residential, except for small areas of retail and service related industry. In 2010, the population of the City of Northglenn was 35,789 (Reference 6).

The City of Thornton is located in the west-central part of Adams County, approximately 6 miles north of Denver. The City is bounded by the City of Northglenn to the northwest, by the Town of Federal Heights to the west, and by the unincorporated areas of Adams County to the east and south. Thornton first became incorporated in 1956. In terms of population, the growth of Thornton has been sporadic. The population from 1960 to 1970 only increased by 1,988; yet, from 1970 to the 1976 estimate, the City had increased by 18,084 to the 1976 estimated population of 31,425 (References 15 and 16). In 2010, the population for the City of Thornton was 118,772 (Reference 6).

The Town of Bennett was incorporated in 1930 with a population of 211. Bennett is located just north of Interstate Highway 70 in Eastern Adams County, 25 miles from the City and County of Denver (Reference 13). The Town is bounded by unincorporated Adams County to the north, west and east, and by unincorporated Arapahoe County to the south. In 2010, the population was 2,308 (Reference 81).

The climate varies slightly from the Denver metropolitan area to the prairie lands in the east; but, generally, it is characteristic of the temperate high plains. The mean annual temperature is 50 degrees Fahrenheit (°F) with a mean annual snowfall of 60.1 inches and rainfall of 15.5 inches. The mean growing season is 166 days (Reference 82).

Adams County was fragmented from Arapahoe County in November 1902, by the state legislature. During the early days of national expansion and exploration, Adams County was visited by many trappers and explorers, including General Zebulon Pike in 1806 and General John C. Fremont in 1853. When gold was discovered along Clear Creek and elsewhere in the Rocky Mountain foothills, extensive growth was experienced, and permanent settlement began. In 1858, Colonel Jack Henderson established the first permanent settlement, called Henderson's Island, near what is now the Town of Henderson. The Kansas Pacific and the Denver Pacific Railroads, in 1871, built lines through what is now the City of Brighton, bringing the impetus for increased cattle production and agricultural development along the South Platte River Valley.

Today, Adams County is one of the richest irrigated and dry land farming areas in the country. The southwestern corner of the county has undergone heavy industrial and residential development. In recent years the county has experienced a rapid growth in population resulting from Denver metropolitan area urbanization and subsequent suburban development. The U.S. Census Bureau lists county population figures for 1970, 1974, and 1980 (projected) as 185,789; 225,600; and 263,827, respectively. In 2004, the population was approximately 398,165 (Reference 6).

The South Platte River flows through the county in shifting channels in a broad, shallow bed with low, flat overbanks. It is a continuous flowing stream, whereas all the tributaries except Clear Creek are intermittent flowing streams. The South Platte River and its tributaries have two major flooding characteristics, snow melt and summer weather fronts or thunderstorms. The tributary basins are narrow, hydraulically steep, and composed of highly erodible clay and loam soils. In the undeveloped portions of the basins, the ground cover is predominantly short grass called buffalo grass and willow and cottonwood trees.

Development has occurred up to the channels on the tributaries. The floodplain on the South Platte River in the past was mostly agricultural, but today commercial, industrial, and residential development has encroached into the floodplain.

2.3 Principal Flood Problems

Major recorded floods have occurred on the South Platte River and its tributaries since 1844 in the Adams County area. During that period, eleven devastating floods have occurred on the South Platte River, three on Clear Creek, and three each on Box Elder, Comanche, and Bijou Creeks.

In 1844 and 1864, reports stated that "bottomlands near Denver were covered with water bluff to bluff' (Reference 20). By 1876, encroachment into the floodplain had developed to such an extent that on May 23, 1876, the Rocky Mountain News reported that, "[The South Platte River] was higher to be sure...several feet higher perhaps in 1864... but it was not able to work such destruction at that time as now. There was not so much town here in 1864, as now, nor as many bridges" (Reference 17).

The most significant floods of recent times on the South Platte River occurred in 1912, 1921, 1933, 1935, 1942, 1965, and 1973. The discharges for these floods were 13,000 cubic feet per second (cfs), 8,790 cfs, 22,000 cfs, 12,320 cfs, 10,200 cfs, 40,300 cfs, and 33,000 cfs, respectively, at the Denver gage. Clear Creek experienced flood discharges of 8,700 cfs, 5,390 cfs, and 5,250 cfs in 1888, 1933, and 1956, respectively recorded at the Golden gage. Citizens interviewed in Watkins, Strasburg, Byers, and Deer Trail recalled severe damage and lives lost in 1905, 1933, 1935, and 1965 floods on Box Elder Creek, Comanche Creek, West Bijou Creek, and East Bijou Creek.

Almost all record floods on the South Platte River have been generated near the river's headwaters on the slopes of Monument Divide, a high ridge located between Castle Rock and Colorado Springs, extending from the Rocky Mountains down to the plains near Limon, Colorado. Past floods have resulted from snowmelt and intensive rain storms over the mountain tributaries, rainstorms over the eastern tributaries, and combinations of these conditions.

In 1965, a unique combination of orthographic effects and meteorological conditions in the South Platte River Basin caused the worst flooding in the region's recorded history. Severe thunderstorms commenced over the headwaters of Plum Creek and Cherry Creek on June 16, and moved northeasterly down the creeks following and augmenting peak flows. More than 14 inches of rain were recorded at Palmer Lake in 4 hours. Overnight, westerly winds moved the storm front to a position over the Kiowa and Bijou Creek Basins where it met with thunderstorms forming just south of Agate. Here, 5.25 inches fell in 45 minutes. The net results of these conditions were six people drowned, two other deaths caused by flood-related activities, and estimated damages of $500 million in the South Platte River Basin, of which $300 million occurred in the Denver area.

Major floods affecting the City of Commerce City area have occurred on the South Platte River and Sand Creek since 1844. During that period, 11 floods occurred on the South Platte and 10 notable floods occurred on Sand Creek.

The major cause of floods on the South Platte River and Sand Creek are cloudbursts of intensive rainstorms which normally occur during the period of May through August. The South Platte River flooding is also aggravated by snowmelt runoff on the tributary streams during the rainstorm period.

There are two areas of shallow sheet flow within Commerce City, both of which are along Sand Creek. The upstream area is on the southwest side of Sand Creek between the corporate limits and east 49th Drive. In this area, the ground slopes away from the channel, and the flow cannot return. The second area is under interstate Highway 270, at the two railroad underpasses to the northwest. During a large flood event, the flood waters will pass under the interstate bridge and flow along the low ground away from the channel, returning to the South Platte River north of East 64th Avenue.

Severe flood runoff is transported through the City of Federal Heights as both overland shallow flow and as channel flow. The steep slope of the land, the close proximity of mobile homes to Tributary M of Niver Creek, and the presence of several culverts that are inadequate to convey major storm runoff combine to create flooding problems.

The runoff upstream of Zuni Street is overland flow that can overtop roads and inundate mobile home trailers. The average slope is 3.5 percent; therefore, excessive velocities occur.

Downstream of Zuni Street, the runoff flows through the culverts and well-defined channels; however, there is some overland flow. Roads and mobile homes can be inundated. The average slope in this area is 1.5 percent.

On June 13, 1984, severe rainfall runoff cause considerable damage to mobile home trailers, to private property, and to the channel. One fatality was directly attributed to the shallow overland flow. Unofficial estimates gave the peak discharge from the storm as 800 to 1,000 cfs at Pecos Street; this was the result of a 4.2-inch rainfall, which fell within 3 hours. The discharge is comparable to a 1-percent-annual-chance event. The extent of inundation shown in this FIS is approximately the same as that which occurred during the June 1984 event.

Similar flooding problems as those outlined above could occur in the floodplains of Niver Creek and Tributary L of Niver Creek in the event of further development.

Much of Niver Creek's floodplain is in park land. However, downstream near Zuni Street, mobile homes are located in the approximate floodplain. At the upstream end of Niver Creek, streets and homes in low areas were affected during the June 1984 flood event.

The main cause of floods in the City of Northglenn is cloudbursts, which usually occur during the months of May through August.

Documentation of historical floods and damage estimates on the streams within corporate limits of Northglenn is sparse. The streams have caused overland inundation of homes and streets, but no discharge or damage estimates have been recorded.

The main cause of floods in the City of Thornton is cloudbursts which normally occur during the period of May through August.

Documentation of historical floods and damage estimates on the streams within the corporate limits of Thornton is sparse. The streams have caused overland inundation of homes and streets, but no recorded discharges or damage estimates exist.

There are also areas in southeast Thornton which experience shallow sheetflow flooding from the South Platte River.

Major flooding in the Town of Bennett has been well documented back to 1875, where a major flood along Kiowa Creek overflowed the channel banks and destroyed the Town. After that flooding event, the Town was moved to its present day location.

2.4 Flood Protection Measures

The first tangible contribution to flood control affecting Adams County streams was made in 1890, when the Castlewood Dam, primarily intended for irrigation storage, was completed by the Denver Land and Water Company on Cherry Creek, 35 miles upstream from Denver in Douglas County. The dam, with a storage capacity of approximately

13,000 acre-feet, was mistakenly regarded by many as protection against deluges. In August 1933, the dam burst under pressure of water from severe thunderstorms in the upper Cherry Creek Basin. Flood control measures on Cherry Creek began in 1936 with the completion of the $800,000, 55-feet high Kenwood Dam, 5 miles from southeast Denver, near Sullivan, Colorado. Despite security, Kenwood Dam was not regarded as the complete answer to flood control on Cherry Creek; therefore, in 1950, the Cherry Creek Dam was constructed just upstream of Kenwood at a cost of $20 million. The dam, 14,300 feet wide and 140 feet high, now serves Denver as a park and water recreation area as well as a retarding barrier for floods much larger than the event of June 1965.

With a history of major flooding on the South Platte River through 1933, and with the culmination of planning, design, and construction of Cherry Creek Reservoir in 1950, the Denver metropolitan area saw an additional need for a flood control structure on the South Platte River just downstream of the Plum Creek confluence. During the 1950s, planning and design for the Chatfield Dam flood control reservoir was completed. At that time, however, funding was not available to initiate and complete construction. Three hundred million dollars in property damages suffered in 1965 flooding changed the minds of many and led to project funding and construction. In 1973, final closure of the dam was made, and the facility became capable of storing tributary floodwaters. Chatfield Dam is located approximately 0.5 mile above the City of Littleton, Colorado, in Douglas and Jefferson Counties.

In addition to the Cherry Creek, Mt. Carbon, and Chatfield Dams, one additional flood control measure, the Bear Creek Dam, was envisioned in the early 1940s. Authorization for funding and design of the dam did not occur until 1968. Construction on the $68 million earthfill structure was started in July 1974, and was completed in 1982. The dam is over 170 feet high and approximately 7,000 feed wide, having a storage capacity of 75,000 acre-feet.

Throughout the study segment of the South Platte River in Adams County, levees have also been constructed as a flood protection measure. However, past evidence shows these levees to be ineffective against 1-percent-annual-chance floods. On large segments of the South Platte River, historical records indicate that the 1965 and 1973 floods were of the 1-percent-annual-chance magnitude or greater.

A major drainageway planning report has been completed for Big Dry Creek (Reference 20). That report designates various structural measures and nonstructural actions which would be appropriate to alleviate potential flood damage along this stream.

In the City of Federal Heights, a detention pond was constructed near Elm Court, at the upstream limit of study for Tributary M of Niver Creek. This pond is designated to attenuate the peak 1-percent-annual-chance flow from 226 cfs to 200 cfs.

Nonstructural measures of flood protection are also used to aid in the prevention of future flood damage. These are the result of regulations of the UDFCD, located in Denver, Colorado.

The City of Thornton has completed improvements on Niver Creek to reduce or eliminate future flood damages. The effects of these improvements were considered in the study for Thornton.

The City has also made improvements on the Northfield Creek (Hoffman Drainageway) which have alleviated potential flood damages. These improvements were considered in the study.

The other flood protection measures which are presently in existence are local floodplain management measures. The City of Thornton passed the Storm Drainage and Flood Control Ordinance, Ordinance No. 693, on July 28, 1975, which requires any new development to provide detention storage so that the runoff rate before and after anticipated development will not increase flows.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that is 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 that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); 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 community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the county.

Big Dry Creek

For Big Dry Creek, synthetically developed hydrographs were computed to determine potential flood magnitudes. The area was divided into 517 sub-basins, which ranged from 0.01 to 1 square mile. Hydrographs for each of the sub-basins were developed with the U.S. Environmental Protection Agency Storm Water Management Model (SWMM; Reference 90). The SWMM models were first developed for each of the tributary watersheds, and the main stem model was developed by linking the tributary outfalls together and routing the discharge hydrographs downstream in Big Dry Creek.

South Platte River

Data used in the hydrologic analyses include synthetically developed storm runoff records, and information from the USACE study of the South Platte River (Reference 21). These discharge profiles were keyed to the 1-percent-annual-chance flood values computed from the Denver and Henderson gaging records, which were adjusted for the

regulating effects of Chatfield, Mt. Carbon, and Cherry Creek Reservoirs. The Denver gage operated from May to October 1889, from June to October 1890, and from July 1895 to the present. The Henderson gage has been in operation since 1926. Values above and below these gaging stations were based on the USACE analysis using their hydrologic computer model for the South Platte River (Reference 21). That study was revised to use the final versions of the discharge profiles, covering the segment downstream of the Henderson Gaging Station (Reference 22).

Little Dry Creek, Hidden Lake, Niver Creek, and Northfield Creek

For Little Dry Creek, Hidden Lake, Niver Creek, and Northfield Creek, synthetically developed hydrographs were computed to determine potential flood magnitudes. Rainfall data used in the development of these hydrographs were taken from the Denver Regional Council of Governments' Urban Storm Drainage Criteria Manual (USDCM) (Reference 23). Synthetic hydrograph procedures used in the study include the Colorado Urban Hydrograph Procedure (CUHP), outlined in the USDCM and the USACE HEC-1 Computer Hydrograph Package (Reference 24). The discharges computed for this stream varied only slightly from those computed in the previous study. Therefore, the original information was used.

Tributary M of Niver Creek

Peak discharges for the 10- and 1-percent-annual-chance floods for Tributary M of Niver Creek were developed using the CUHP (Reference 31) and USACE HEC-1 (Reference 24) computer models. The watershed was subdivided into six subbasins. For each subbasin, peak flow hydrographs were developed using the CUHP model. Parameters for the hydrograph development include rainfall data (Reference 32), soil type, land use, basin area, and basin geometry (References 33, 34, and 35). The outflow hydrographs derived for the subbasins were then used for the HEC-1 model, which was channel and storage routing capability using the Modified Puls methods.

The result from the HEC-1 analysis shows that the upper pond near Elm Circle attenuates the 1-percent-annual-chance peak flow from 226 cfs to 200 cfs. The flows vary from 200 cfs upstream to 1,086 cfs at Pecos Street.

Grange Hall Creek, South Fork Grange Hall Creek, Grange Hall Creek Tributary, Basin 4100, and Brantner Gulch

Synthetically developed hydrographs were computed to determine the 10-, 2-, and 1-percent-annual-chance discharges. Rainfall data used in the development of these hydrographs were taken from the USDCM (Reference 36). The 0.2-percent-annual-chance discharge on all streams was obtained from a straight-line plot on log probability paper.

The 10-, 2-, and 1-percent-annual-chance values for Grange Hall Creek, South Fork Grange Hall Creek, and Grange Hall Creek Tributary were provided by the UDFCD (Reference 37).

The 10-, 2-, and 1-percent-annual-chance values for Basin 4100 and Brantner Gulch were computed by the study contractor.

Tanglewood Creek

Since no stream gage data were available for Tanglewood Creek, a rainfall runoff analysis was conducted on the watershed to determine the flood discharges. This was accomplished by using the UDFCD CUHP rainfall-runoff computer program to develop the storm hydrographs (Reference 31) and the USACE HEC-1 flood hydrograph package computer program for the stream and reservoir routings (Reference 38). For the analysis, basin characteristics which define the size, shape and runoff characteristics of the watershed as well as rainfall amounts based on the selected recurrence intervals (obtained from the National Oceanic and Atmospheric Administration atlas of precipitation — Reference 32) are used to compute flood hydrographs for various design points in the basin. All stream and reservoir routings were accomplished using the Modified Puls Method.

Since there was a lack of 500-year precipitation data, the 500-year frequency storm runoff values at each design point were calculated. The logarithmic values of the 10-, 2-, and 1-percent-annual-chance peak discharges were fit to a regression line by method of least squares. The 0.2-percent-annual-chance discharges were analytically extrapolated from the regression line based upon a log-normal probability relationship.

Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E and G

Peak discharges for Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G were developed using the CUHPF/PC (Reference 83) and UDSWM 95 (Reference 84) computer programs. The watershed was subdivided into four major sub-watersheds encompassing smaller subbasins. Parameters for each subbasin include rainfall data, soil type, land use, basin area, and basin geometry (Reference 23). The outflow hydrographs derived for the CUHP models were then routed downstream in UDSWM, which utilizes the kinematic wave rating approach.

Other Areas

For the larger drainage basins east of the Denver metropolitan area, discharge versus drainage area relationships were developed. These determinations were based on the standard log-Pearson Type III statistical analysis (Reference 25) of flood discharge records from several streams adjacent to the study area as well as in eastern Colorado. The discharge records for the steams considered covered periods from 10 to 74 years. The data used in making these determinations were recorded at 18 gaging stations by the USGS (References 27 and 29) and compared to the USACE Standard Project Flood data when available (References 12, 21, and 30).

Peak discharge-drainage area relationships for streams studied by detailed methods are shown in Table 3, "Summary of Discharges."

Table 3: Summary of Discharges

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
BASIN 4100					
At Mouth	1.8	240	340	380	500
BEAR GULCH					
At Confluence with Box Elder Creek	19.8	1,400	4,400	6,300	10,300
BEAR GULCH TRIBUTARY D					
At Confluence with Bear Gulch	1.2	265	690	938	1,391
BEAR GULCH TRIBUTARY E					
At Confluence with Bear Gulch	0.8	230	538	699	1,009
BEAR GULCH TRIBUTARY G					
At Confluence with Bear Gulch	2.4	507	1,298	1,754	2,587
BIG DRY CREEK					
At 168th Avenue	66.6	4,530	8,260	10,000	13,460
Confluence with Morris Creek	56.8	4,590	8,350	10,060	13,400
3000 feet upstream of 160th Avenue	55.7	4,620	8,390	10,090	13,400
Confluence with Sack Creek	54.2	4,640	8,430	10,120	13,430
1000 feet downstream of E-470 Westbound Ramp	52.9	4,630	8,410	10,090	13,330
Upstream of Confluence with Wadley North	52.8	4,670	8,460	10,130	13,330
Upstream of Confluence with Mustang Run	50.3	4,660	8,440	10,100	13,280
Upstream of Confluence with West Bijou Creek	48.0	4,680	8,470	10,120	13,260
At 144th Avenue	46.3	4,830	8,580	10,210	13,530
1000 feet upstream of 144th Avenue	45.0	4,870	8,620	10,230	13,440
At Washington Street	42.2	4,820	8,570	10,170	13,380
900 feet downstream of 136th Avenue	41.7	4,720	8,420	10,000	12,990
At 136th Avenue	41.0	4,730	8,410	9,970	12,930

Table 3: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
BIG DRY CREEK (CONTINUED)					
350 feet downstream of confluence with Tanglewood Creek	39.7	4,700	8,360	9,920	12,830
Upstream of confluence with Tanglewood Creek	34.5	4,640	8,280	9,760	12,630
Upstream of confluence with Quail Creek	33.6	4,510	7,930	9,220	11,690
At Willow Run Parkway	32.5	4,460	7,860	9,130	11,640
BOX ELDER CREEK					
At 168th Avenue	243.0	1,100	7,400	11,500	20,600
Downstream of Confluence with Bear Gulch	227.0	1,100	6,900	10,400	17,600
Upstream of the Confluence with Bear Gulch	207.0	1,000	5,600	8,900	15,300
At Interstate 70	202.0	1,246	5,741	9,140	15,618
BRANTNER GULCH					
At the City of Thornton Corporate Limits	1.3	480	720	830	1,100
CLEAR CREEK					
At South Platte Confluence	–[1]	–[1]	–[1]	23,100	–[1]
At Interstate 76	–[1]	–[1]	–[1]	10,079[2]	–[1]
At Sheridan Boulevard Bridge	–[1]	–[1]	–[1]	20,590	–[1]
CLEAR CREEK NORTH OVERFLOW					
At Lowell Street	–[1]	–[1]	–[1]	11,609	–[1]
COMANCHE CREEK					
At Weld County Line	245.2	–[1]	–[1]	48,864[3]	–[1]
Below Confluence with Wolf Creek	224.3	–[1]	–[1]	23,187	–[1]

[1] Data not available

[2] Reflects flow spills to Clear Creek North Overflow

[3] Includes discharge from Kiowa Creek

Table 3: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
COMANCHE CREEK (CONTINUED)					
Above Confluence with Wolf Creek	124.0	–[1]	–[1]	12,049	–[1]
At 26th Avenue	94.4	1,103	4,773	9,640[4]	12,704
At Adams/Arapahoe County Limit (U.S. Highway 36)	84.0	1,000	2,400[5]	4,112[5]	6,618[5]
COMANCHE CREEK RT. BANK OVERFLOW					
Just downstream of 56th Avenue	–[1]	–[6]	–[6]	4,996	–[6]
At U.S. Highway 36	–[1]	–[7]	–[7]	1,500	–[6]
COYOTE RUN					
At Interstate 70/U.S. Highway 36	17	1,680	4,960	6,940	10,800
GRANGE HALL CREEK					
At Riverdale Road	7.1	1,700	2,067	2,214	2,600
At Colorado Boulevard	6.3	1,616	1,798	1,943	2,000
Downstream of Confluence with North Fork Grange Hall Creek	4.7	1,058	1,161	1,204	1,600
Downstream of Confluence with South Fork Grange Hall Creek	3.4	1,166	1,582	1,769	2,200
Downstream of Washington Street Pond	1.3	642	868	976	1,200
At Washington Street Pond	1.3	957	1,195	1,283	1,450
GRANGE HALL CREEK TRIBUTARY					
At Mouth	1.2	644	865	959	1,200
At 112th Avenue	1.1	594	799	887	1,140

[1] Data not available

[4] Upstream of 26th Avenue, 275 CFS overtops into Comanche Creek Overflow

[5] Just upstream of Highway 36, discharge from Comanche Creek and Little Comanche Creek converge and then split at Highway 36

[6] Not computed for overflow

[7] 10-percent and 2-percent contained in channel of Little Comanche Creek and Comanche Creek

Table 3: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
GRANGE HALL CREEK TRIBUTARY (CONTINUED)					
Downstream Union Pacific Railroad	0.6	466	635	693	900
HAYESMOUNT CREEK					
At 168th Avenue	30.4	530	1,600	2,400	3,900
HAYESMOUNT CREEK EAST TRIBUTARY					
At Confluence with Hayesmount Creek	5.4	290	863	1,247	2,038
HAYESMOUNT CREEK WEST TRIBUTARY					
At Confluence with Hayesmount Creek	6.8	477	1,469	2,109	3,322
LITTLE COMANCHE CREEK					
At U.S. Highway 36	10.4	500	2,400[2]	5,800[2]	6,618[2]
LITTLE DRY CREEK					
At Confluence with Clear Creek	13.1	2,200	3,030	3,370	4,200
Downstream of Federal Boulevard	12.2	2,160	2,950	3,270	4,000
Upstream of Federal Boulevard	12.2	2,590	3,430	3,790	4,630
NIVER CREEK					
At Confluence with South Platte River	6.6	1,850	2,860	3,250	4,350
At York Street	6.3	1,800	2,780	3,150	4,260
At North Washington Street	5.4	1,450	2,160	2,760	3,900
NORTH FORK GRANGE HALL CREEK					
At Confluence with Grange Hall Creek	1.1	490	539	560	600

[2] Reflects flow spills to Clear Creek North Overflow

Table 3: Summary of Discharges (continued)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent	2-percent	1-percent	0.2-percent
NORTHFIELD CREEK					
At Union Pacific Railroad	1.2	680	1,050	1,240	1,850
At East 88th Avenue	0.8	490	580	680	1,000
SAND CREEK					
At Confluence with S. Platte River	196.0	11,000	24,200	30,500	36,200
At Quebec Street	189.0	10,500	23,300	30,000	33,000
SOUTH FORK GRANGE HALL CREEK					
At Mouth	1.7	639	797	856	1,100
SOUTH PLATTE RIVER [8]					
At Confluence with Todd Creek	5,026.0	11,400	25,500	33,600	59,450
At Confluence with Clear Creek	4,572.0	12,700	27,500	37,600	66,710
TANGLEWOOD CREEK					
At Confluence w/ Big Dry Creek	1.12	340	758	934	1,655
At Upstream Study Limit	0.11	105	217	253	424
TRIBUTARY M OF NIVER CREEK					
At Pecos Street	0.92	490	–[1]	1,050	–[1]
At Bryant Drive	0.49	450	–[1]	925	–[1]
At Upstream Limit of Study Near Elm Circle	0.18	88	–[1]	200	–[1]
WOLF CREEK					
Above Confluence with Comanche Creek	100.3	–[1]	–[1]	12,408	–[1]

[1] Data not available

[8] Assuming Chatfield and Cherry Creek Dam Gates closed when flow at gage reached 5,000 cfs

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. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

The hydraulic analysis for Big Dry Creek was performed using the United States Corps of Engineers Hydrologic Engineering Center's River Analysis System, or HEC-RAS, version 4.0 (Reference 91). Cross section data was obtained from previous Flood Hazard Area Delineation studies from 1986/1988 (Reference 92) and revised using 2008 LiDAR topography with 2-ft contour intervals (Reference 94). Channel roughness factors (Manning's "n") for these computations were determined through field observations and typically ranged from 0.030 to 0.045 within the channel banks and 0.050 to 0.060 in the overbank areas. Starting water surface elevations were computed using step-backwater with normal depth as the starting condition.

Unless otherwise noted, for all streams studied by detailed methods, the water-surface elevations for floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 39).

Little Dry Creek, Northfield Creek, and Niver Creek

Cross section data for Little Dry Creek, Northfield Creek, and Niver Creek were field surveyed and were located at close intervals above and below culverts, bridges, and drop structures in order to compute the effects of backwater. When necessary, USGS topographic maps at a scale of 1:24,000, with a contour interval of 10 feet (Reference 34) were used to supplement the field-surveyed data.

Channel roughness factors (Manning's "n") for these computations were assigned on the basis of field inspection of the floodplain areas and engineering judgment. Bridge geometry and elevation information was obtained from the Colorado State Highway Department, when available, or measured in the field.

Starting water-surface elevations for the tributaries of the South Platte River were taken from previously computed stage-discharge relationships when available (Reference 21). In many cases, control elevations were shifted upstream to bridges or culverts. Where no other information or control structures were available, the starting water-surface elevations were computed by the slope-area method option of the HEC-2 program (Reference 39).

These analyses indicate that flood flow from Little Dry Creek is divided into two flow paths in the area downstream of the Colorado and Southern Railroad crossing. The Little Dry Creek profiles show the individual elevations for both of these separate flow paths.

Flooding from Northfield Creek above Devonshire Boulevard does not necessarily follow the natural stream channel. For this area, flood profiles were developed using hydraulic flow lines, labeled as base line of flow on the maps and profiles.

The reach of Sand Creek between Vasquez and Brighton Boulevards within Commerce City was revised to reflect a hydraulic analysis carried out by Simons, Li and Associates, Inc., based on new topographic information (Reference 41).

Tributary M of Niver Creek

Cross sections for the backwater analyses for Tributary M of Niver Creek were obtained from topographic maps, provided by the City, at a scale of 1:1,200, with a contour interval of 2 feet (Reference 35). All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the stream and floodplain areas. Roughness values for the main channel ranged from 0.02 to 0.04, and overbank roughness values ranged from 0.02 to 0.07.

The starting water-surface elevation was derived from hand computations for the peak flow at Pecos Street. The computation derived rating curves for pressure and weir flow at Pecos Street crossing. The culverts at Holiday Glen and Holiday Circle were included in the HEC-2 models. However, three long culverts that have limited capacity of fully contain the 10- and 1-percent-annual-chance peak flows were not included. These culverts extend from the east branch of Holiday Circle to 100 feet downstream of Holiday Vale; from the east branch of Holiday Terrace downstream 200 feet; and from Holiday Parkway downstream 200 feet. The culvert under Holiday Parkway is submerged due to backwater from Pecos Street for the 10- and 1-percent-annual-chance floods.

Grange Hall Creek, South Fork Grange Hall Creek, Grange Hall Creek Tributary, Basin 4100, and Brantner Gulch

Cross section data for Grange Hall Creek, South Fork Grange Hall Creek, and Grange Hall Creek Tributary were taken from aerial mapping at a scale of 1:6,000, with a contour interval of 2 feet (Reference 42). The cross section information on Basin 4100 and Brantner Gulch was obtained by field measurements. Field measurements were also taken to obtain elevation data and structural geometry of all bridges and culverts.

Roughness coefficients (Manning's "n") were estimated by field inspection. Values used ranged from 0.025 to 0.040 for the channel and from 0.035 to 0.070 for the overbank.

Starting water-surface elevations were determined for Brantner Gulch by normal depth analysis and for Basin 4100 by inspection of the culvert at the downstream study limit.

The water-surface elevations for Grange Hall Creek and tributaries were computed using a step-backwater model similar to HEC-2, developed by the USACE (Reference 39). The starting water-surface elevations were provided by the UDFCD (Reference 37).

Tanglewood Creek

Cross sections used in the backwater analyses were obtained by aerial photogrammetry (Reference 43). The below water sections of all cross sections were obtained by field measurement. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Roughness factors (Manning's "n") used in the hydraulic computations for the study areas were chosen by engineering judgment and based on field observations of the flooding sources and floodplain areas. Roughness values for the main channels of the streams studied range from 0.020 to 0.065 with floodplain roughness values ranging form 0.020 to 0.100.

Starting water-surface elevations were based on hand calculations at control sections; obtained by the slope area method, or determined for a tributary to a major stream from the major stream at concurrent flows.

Niver Creek, Tributary L of Niver Creek, Tributary M of Niver Creek, and Northfield Creek

In the City of Federal Heights, an approximate floodplain analysis was carried out for Niver Creek and Tributary L of Niver Creek using assumed depths based on a review of the Tributary M profile and available hydrologic information, extensive field reconnaissance, and engineering judgment.

Through the City of Thornton, the approximate 1-percent-annual-chance flood elevation of Niver Creek and Tributaries L and M were based on the Phase B report, Water and Drainage at Niver Creek (Reference 44), and supplemental data provided by the City of Thornton. The approximate 1-percent-annual-chance flood elevations along Northfield Creek (Hoffman Drainageway) were based on the Interim Drainage Study of Hoffman Way (Reference 45), the Adams County FIS (Reference 2), and additional data provided by the engineering department of the City of Thornton.

Hidden Lake

Approximate 1-percent-annual-chance flooding along portions of Hidden Lake Drainageway was taken from the UDFCD study for that drainage system (Reference 46). For the remaining approximate studies, elevations were determined by normal depth calculations using approximate cross sections taken from USGS maps (Reference 34).

South Platte River

Cross-section data for the hydraulic analysis along the South Platte River were obtained from 2-foot contour mapping, provided by Adams County, and supplemented with field survey cross-sections obtained by Camp Dresser & McKee, Inc. and the UDFCD (Reference 85). Roughness factors were based on current field information in addition to roughness factors used in previous hydraulic modeling studies for the South Platte River (Reference 86). Water surface elevations for the selected recurrence intervals along the South Platte River were developed using the USACE River Analysis System computer

program (Reference 87). Split flow and divided flow were considered in the hydraulic analysis of the South Platte River.

In several reaches of the study area, embankments adjacent to the main channel act as levees. Since the stability of these embankments is unknown, and they are not certified by the USACE, the levees were modeled both as intact and as failing in order to determine the water surface elevations along the main channel at overbank areas accordingly.

Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G

Cross-sections for Box Elder Creek, Hayesmount Creek, Hayesmount Creek East Tributary, Hayesmount Creek West Tributary, Bear Gulch, and Bear Gulch Tributaries D, E, and G were obtained from digital mapping provided by the UDFCD (Reference 88), at a map scale of 1" = 200-feet and a contour interval of 2-feet. Roughness coefficients were determined through field observation, review of the USACE recommended values, and consultation with UDFCD staff. For Hayesmount Creek, roughness coefficients ranged from 0.035 to 0.06, and the overbank roughness values were generally 0.035 for both the channel and overbanks, except in areas of significant vegetation, where the channel roughness value was increased to 0.04. Water surface elevations for the selected recurrence intervals was developed using the USACE River Analysis System computer program (Reference 87).

Comanche Creek, Little Comanche Creek, and Wolf Creek

Water surface elevations of floods of the selected recurrence intervals were developed using the USACE River Analysis System computer program (Reference 87) for Comanche Creek, Little Comanche Creek, and Wolf Creek.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this study 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.

3.3 Vertical Datum

All FIS reports 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 used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. It is important to note that adjacent counties may be referenced to NGVD29.

This may result in differences in base flood elevations across the corporate limits between communities.

As noted above, the elevations shown in the FIS report and on the FIRM for Adams County and Incorporated Areas are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a standard conversion factor.

The conversion from NGVD29 to NAVD88 ranged between 2.60 and 3.06 for this county. Accordingly, due to the range in conversion factors, an average conversion factor was established for the entire county. The elevations shown in the FIS report and on the FIRM were, therefore, converted to NAVD88 using a countywide approach in which an average conversion was established for the county. The conversion factor for NGVD 29 to NAVD 88 of 2.87 feet was used for each flooding source in the community.

The BFEs shown in the FIRM represent whole-foot rounded values. For example, a BFE of 5202.4 will appear as 5202 on the FIRM and 5202.6 will appear as 5203. Therefore, users who wish to convert the elevations in this FIS to NGVD29 should apply the stated conversion factor 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 the publication entitled, *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).

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 NGS bench marks shown on the FIRM, please contact the Information Services Branch of the NGS at (301) 7133242, 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.

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 the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

For information on additional control points maintained by Adams County that are not shown on the FIRM, please visit www.co.adams.co.us.

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 report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report 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 flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed or limited detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:24,000; 1:2,400; 1:6,000; and 1:1,200; with contour intervals of 10 and 2 feet (References 34, 35, 40, 42, 43, 47, and 48).

The 1- and 0.2-percent-annual-chance floodplain boundaries for streams studied by detailed methods are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones AH, AO, AR and A99), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance 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 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

Within the City of Commerce City, areas of shallow sheet flow outside the aerial photo mapping limits were delineated using a topographic map at a scale of 1:24,000, with a contour interval of 10 feet (Reference 34).

Approximate 1-percent-annual-chance floodplain boundaries within the City of Federal Heights were delineated using topographic maps at a scale of 1:1,200, with a contour interval of 2 feet (Reference 49).

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Map for the City of Thornton (Reference 50).

Approximate flood boundaries in some portions of the City of Northglenn were taken from the FIA's Flood Hazard Boundary Map (Reference 51); others were taken from USGS Flood Prone Area Maps (Reference 52).

For streams studied by approximate methods in other areas of Adams County, the boundaries of the 1-percent-annual-chance flood were delineated using the determined elevations and topographic maps (Reference 34), and were reconciled with USGS Flood Prone Area Maps (Reference 52), and concurrent studies completed on Second and Third Creeks for the UDFCD (Reference 53). The boundary of the 1-percent-annual-chance flood for portions of Hidden Lake Drainageway was taken from the UDFCD study for that drainage system (Reference 46).

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 1-percent-annual-chance 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 base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The City of Brighton, the City of Thornton, and Adams County have ordinances which limit the increase in flood heights to 0.5 foot above the pre-floodway elevation; therefore floodways having no more than a 0.5-foot surcharge have been delineated for these communities.

Floodways were not computed along Tributary M of Niver Creek through the City of Federal Heights because they were not within the scope of this study.

The floodways presented in this study 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 and provided in Table 4, "Floodway Data." The computed floodway is shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown on the FIRM.

Portions of the floodway for Big Dry Creek extend beyond the county limits for Adams County identified in this FIS report.

The area between the floodway and 1-percent-annual-chance 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 (WSEL) of the base flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

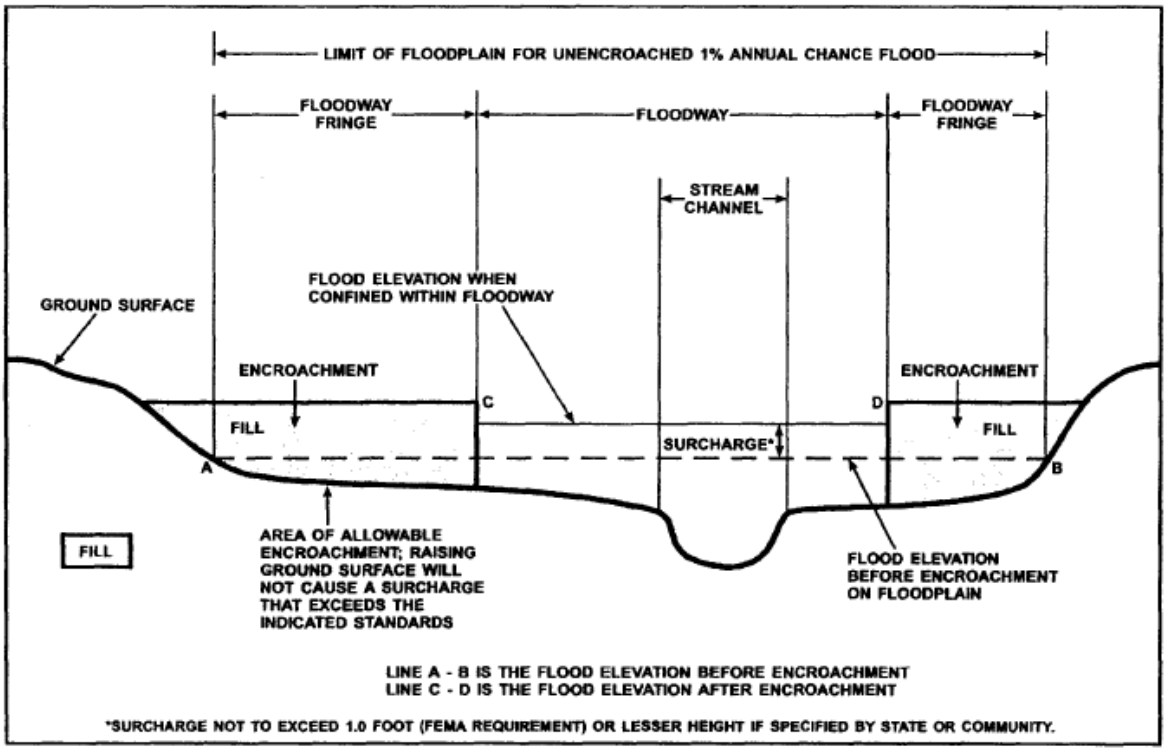

Figure 1. Floodway Schematic

Example of Floodway Data Table using lettered cross-sections

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BEAR GULCH								
A	1,533	180	875	7.2	5,284.1[2]	5,283.0	5,283.6	0.6
B	3,834	301	1,344	4.7	5,285.4	5,285.4	5,286.0	0.6
C	5,613	190	812	7.7	5,286.6	5,286.6	5,286.8	0.2
D	8,561	360	723	8.0	5,289.7	5,289.7	5,290.0	0.3
E	11,012	229	899	6.3	5,296.1	5,296.1	5,296.7	0.6
F	12,931	236	996	5.3	5,303.4	5,303.4	5,304.2	0.8
G	14,754	330	925	5.7	5,307.3	5,307.3	5,307.9	0.6
H	17,474	375	1,108	4.4	5,316.0	5,316.0	5,316.8	0.8
I	19,081	655	1,272	3.7	5,323.0	5,323.0	5,323.9	0.9
J	21,073	200	687	6.8	5,329.8	5,329.8	5,330.4	0.6
K	23,852	202	609	6.6	5,339.7	5,339.7	5,340.6	0.9
L	25,987	216	537	7.3	5,349.3	5,349.3	5,349.8	0.5
M-O[3]	-	-	-	-	-	-	-	-
P	33,268	170	1,322	2.3	5,388.2	5,388.2	5,389.1	0.9
Q-U[3]	-	-	-	-	-	-	-	-
V	45,489	47	178.0	10.5	5,490.8	5,490.8	5,490.8	0.0
W	46,544	51	143.0	9.4	5,508.2	5,508.2	5,508.6	0.4
X[3]	-	-	-	-	-	-	-	-

[1]Feet above confluence with Box Elder Creek
[2]Flooding controlled by Box Elder Creek
[3]Cross sections are outside of Adams County

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

BEAR GULCH

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Box Elder Creek								
A	193,597	941	4,665	3.5	5,058.9	5,058.9	5,059.3	0.4
B	195,951	827	2,567	4.9	5,063.4	5,063.4	5,063.6	0.2
C	197,041	550	1,597	7.8	5,065.9	5,065.9	5,066.1	0.2
D	198,229	759	2,353	5.3	5,070.8	5,070.8	5,071.0	0.2
E	199,212	725	1,711	7.3	5,072.9	5,072.9	5,073.1	0.2
F	200,806	1,075	3,529	3.7	5,093.9	5,093.9	5,094.0	0.1
G	202,932	695	2,257	5.6	5,098.9	5,098.9	5,099.0	0.1
H	204,830	1,184	2,530	5.0	5,104.0	5,104.0	5,104.2	0.2
I	206,878	1,055	4,812	5.5	5,114.2	5,114.2	5,114.2	0.0
J	209,071	716	2,792	4.5	5,116.3	5,116.3	5,116.6	0.3
K	210,827	1,133	3,126	4.0	5,120.3	5,120.3	5,120.4	0.1
L	211,854	749	3,049	4.1	5,125.7	5,125.7	5,125.7	0.0
M	213,862	990	3,082	4.1	5,130.6	5,130.6	5,130.7	0.1
N	215,738	710	2,077	6.1	5,134.0	5,134.0	5,134.1	0.1
O	218,990	810	2,679	4.7	5,141.4	5,141.4	5,141.6	0.2
P	221,016	727	2,640	4.8	5,147.5	5,147.5	5,147.5	0.0
Q	222,317	705	2,595	4.9	5,151.1	5,151.1	5,151.2	0.1
R	224,146	715	2,863	4.4	5,157.2	5,157.2	5,157.4	0.2
S	225,733	890	3,746	3.4	5,161.0	5,161.0	5,161.3	0.3
T	227,675	672	1,885	6.7	5,165.7	5,165.7	5,165.7	0.0
U	229,098	655	2,648	4.8	5,173.3	5,173.3	5,173.4	0.1

[1]Feet above confluence with South Platte River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

BOX ELDER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Box Elder Creek								
V	230,171	535	2,168	5.9	5,175.8	5,175.8	5,175.9	0.1
W	231,496	699	2,820	4.5	5,181.2	5,181.2	5,181.5	0.3
X	232,627	912	3,929	3.2	5,183.5	5,183.5	5,183.6	0.1
Y	235,511	660	2,242	9.0	5,195.8	5,195.8	5,195.9	0.1
Z	235,662	1,414	6,900	4.2	5,199.2	5,199.2	5,199.2	0.0
AA	237,341	671	3,074	4.2	5,201.8	5,201.8	5,201.8	0.0
AB	239,954	774	2,091	6.1	5,208.2	5,208.2	5,208.3	0.1
AC	242,051	270	1,129	11.3	5,216.2	5,216.2	5,216.2	0.0
AD	242,664	379	2,242	5.7	5,220.4	5,220.4	5,220.6	0.2
AE-AJ[2]								
AK	253,306	534/182[3]	2,423	5.3	5,256.6	5,256.6	5,256.6	0.0
AL	254,204	1,104/546[3]	3,319	3.9	5,259.6	5,259.6	5,259.6	0.0
AM	258,383	1,348	1,501	7.5	5,267.1	5,267.1	5,267.2	0.1
AN	260,579	1,920	3,962	2.8	5,275.9	5,275.9	5,276.0	0.1
AO	263,188	985/393[4]	2,028	5.5	5,284.1	5,284.1	5,284.1	0.0
AP	263,664	561/211[4]	2,748	4.1	5,285.8	5,285.8	5,285.8	0.0
AQ	265,296	1,150	2,780	4.0	5,295.0	5,295.0	5,295.0	0.0
AR	267,707	598	1,986	9.1	5,302.7	5,302.7	5,302.7	0.0
AS	268,305	674	4,246	4.1	5,308.5	5,308.5	5,308.5	0.0
AT	268,900	391	2,216	5.1	5,309.5	5,309.5	5,309.5	0.0
AU	271,089	608	1,970	5.7	5,315.0	5,315.0	5,315.3	0.3

[1]Feet above confluence with South Platte River

[2]Cross Sections are outside of Adams County

[3]Total floodway width/width within jurisdiction

[4]Modeled includes Box Elder/Bear Gulch floodway

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

BOX ELDER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Box Elder Creek								
AV	272,990	605	1,951	5.7	5,322.0	5,322.0	5,322.4	0.4
AW	274,475	1,304/219[3]	2,241	5.0	5,328.7	5,328.7	5,328.9	0.2
AX-BB[2]								
BC	282,442	966	3,587	3.8	5,360.7	5,360.7	5,360.9	0.2
BD-BR[2]								
BS	297,514	939/811[3]	2,100	5.3	5,423.8	5,423.8	5,423.8	0.0
BT	300,100	904	2,053	5.4	5,435.2	5,435.2	5,435.2	0.0
BU	301,791	1,507/1,061[3]	2,539	4.4	5,441.5	5,441.5	5,441.5	0.0
BV-CG[2]								
CH	316,634	1,022/619[3]	2,049	5.4	5,505.1	5,505.1	5,505.1	0.0
CI	317,980	889/609[3]	2,228	5.0	5,512.4	5,512.4	5,512.4	0.0
CJ	319,349	781	2,192	5.1	5,518.9	5,518.9	5,518.9	0.0
CK	320,889	1,364	2,679	4.8	5,525.6	5,525.6	5,525.6	0.0
CL	322,297	3,239/127[3]	5,281	3.6	5,532.5	5,532.5	5,532.5	0.0
CM	322,931	3,151/363[3]	4,550	4.3	5,534.8	5,534.8	5,534.8	0.0
CN	323,521	2,585/468[3,4]	5,443	4.0	5,537.8	5,537.8	5,537.8	0.0
CO	324,137	1,924/348[3]	4,216	5.9	5,540.9	5,540.9	5,540.9	0.0

[1]Feet above confluence with South Platte River

[2]Cross Sections are outside of Adams County

[3]Total floodway width/width within jurisdiction

[4]Width excludes dry ground between encroachments

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

BOX ELDER CREEK

LOCATION		FLOODWAY			1% ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/ SEC)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Coyote Run								
F	6,210	378	1,803	4.7	5,415.8	5,415.8	5,416.0	0.2
G	9,384	497	1,216	6.9	5,421.8	5,421.8	5,421.9	0.1
H	11,106	541	1,327	6.4	5,431.3	5,431.3	5,431.4	0.1
I-S[2]								
T	40,351	108	672	10.4	5,508.4	5,508.4	5,508.5	0.1
U	40,463	144	1,834	3.9	5,515.4	5,515.4	5,515.4	0.0
V	40,973	1,335	4,342	1.6	5,515.7	5,515.7	5,515.7	0.0
W	41,602	815	3,425	1.9	5,515.8	5,515.8	5,515.8	0.0
X	41,973	895	3,757	1.6	5,516.6	5,516.6	5,516.6	0.0
Y	42,484	1,175	4,782	3.3	5,516.6	5,516.6	5,516.6	0.0

[1]Feet above confluence with Box Elder Creek

[2]Cross sections are outside of Adams County

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

COYOTE RUN

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. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs 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 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs 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 areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot base flood depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Zone AR is the flood insurance risk zone that corresponds to an area of special flood hazard formerly protected from the 1-percent-annual-chance flood event by the 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-percent-annualchance or greater flood event.

Zone A99

Zone A99 is the flood insurance risk zone that corresponds to areas of the 1-percent-annual-chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No BFEs or depths are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Zone X (Future Base Flood)

Zone X (Future Base Flood) is the flood insurance risk zone that corresponds to the **1**-percent-annual-chance floodplains that are determined based on future-conditions hydrology. No BFEs or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance risk 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 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use zones and BFEs 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 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Adams County, excluding those communities which fall within more than one county as described in Section 1.1. Previously, separate FIRMs were prepared for each identified floodprone incorporated community and the unincorporated areas of the county. Historical data relating to the maps prepared for each community are presented in Table 5, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Adams County, (Unincorporated Areas)	February 1, 1979	---	February 1, 1979	December 15, 1989 August 16, 1995 March 5, 2007
Bennett, Town of	November 22, 1974	---	August 16, 1995	March 5, 2007
Brighton, City of	February 22, 1974	October 15, 1976	November 16, 1977	August 16, 1995 March 5, 2007
Commerce City, City of	June 28, 1974	July 11, 1975	February 15, 1978	October 6, 1978 January 19, 1982 September 30, 1988 December 5, 1989 August 16, 1995 March 5, 2007
Federal Heights, City of	July 11, 1975	---	April 15, 1986	August 16, 1995 March 5, 2007

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Northglenn, City of	August 22, 1975	---	September 15, 1978	March 31, 1981 August 16, 1995 March 5, 2007
Thornton, City of	November 1, 1974	October 1, 1976	June 15, 1978	January 19, 1982 August 16, 1995 March 5, 2007

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This FIS supersedes all previous FIS reports and FIRMs covering the unincorporated areas of Adams County and the incorporated areas of the Cities of Brighton, Commerce City, Federal Heights, Northglenn, and Thornton, and the Town of Bennett (References 2, 5, 7, 8, 9, and 10, respectively). For these areas, it should be considered authoritative for the purposes of the NFIP. The Cities of Arvada, Aurora, and Westminster have individual, separately published FIS (References 3 and 4) that are not superseded by this countywide FIS.

There are past published reports on flooding throughout Adams County. The 1963 USACE Denver Metropolitan Region Flood Plain Information (FPI) report, Volume **I,** (Reference 21) was adopted by the Colorado Water Conservation Board (CWCB) in 1967 as the official floodplain study for the South Platte River. Following the 1965 flood and other, more recent, flood experiences, as well as the construction of Chatfield Dam, the USACE considers the 1963 FPI for the South Platte River to be outdated. In September of 1977, the UDFCD published a Flood Hazard Area Delineation of the South Platte River.

The UDFCD published an updated Flood Hazard Area Delineation Report of the South Platte River in April of 2005 (Reference 85). This report was incorporated into this FIS.

An FPI report (Reference 30) was prepared in 1968 by the USACE, Omaha District, which included Little Dry Creek in Adams County. Minor discrepancies occurred because the USACE assumed blockage at culverts and bridges during flooding stages, and the present study is based on unobstructed flow.

The UDFCD published a report on Big Dry Creek (Reference 20) in March 1973 and was incorporated into the FIS.

The UDFCD published a Flood Hazard Area Delineation report for the Lower Box Elder Creek Watershed in September 2001 (Reference 89). This report identified flood hazard information on Box Elder Creek, Hayesmount Creek, and Bear Gulch. This report was incorporated into this FIS.

An FPI report was published in January 1966 by the USACE, Omaha District, regarding flooding along Clear Creek (Reference 12). Peak discharges for Clear Creek were recomputed by the UDFCD, and the revised floodplain boundaries were incorporated as an approximate Special Flood Hazard Area. The FIS study report was later revised to reflect updated hydrologic and hydraulic analyses prepared in a 1979 UDFCD report (Reference 59) for Clear Creek. The revised flooding was included as a detailed analysis. Floodway and 0.2-percent-annual-chance floodplain boundaries were not determined.

The UDFCD published a report on Niver Creek in February 1974 (Reference 54). The report contained two 1-percent-annual-chance profiles, one reflected existing conditions and a fully developed basin, and the second reflected channel improvements with discharges based on a fully developed basin. Since the publication, some of the channel improvements have been made. Also, this FIS report reflects only present basin development. Therefore, no comparison can be made between profiles.

A report on Northfield Creek, prepared by Hogan & Olhausen for the City of Thornton (Reference 55), was published in March 1976. When compared, the 1-percent-annual-chance discharges in this study were found to be different from those determined for the present FIS study. This difference is due to the different methods used to determine discharges. A meeting was held on April 16, 1976, with the UDFCD, the City of Thornton, Hogan & Olhausen, and Gingery Associates in order to resolve the difference in discharges. The main reason for the discrepancy was because Hogan & Olhausen considered residential areas as being 25 percent impervious while the present study used a 50 percent impervious figure, the figure recommended by the UDFCD in their USDCM for use in the Denver metropolitan area. At this meeting, a resolution was never confirmed; therefore, the FIA was contacted for a final ruling. The FIA decided to use the 50 percent impervious figure.

Approximate flood boundaries were adopted from studies on First Creek (Reference 56), Second and Third Creeks (Reference 57), and Grange Hall Creek (Reference 58).

Zone A approximate flooding has been added to the FIRM for Brantner Gulch, Tributary VIII Northern to Brantner Gulch, Direct Flow Area 0054-1, McKay Lake Drainageway, Morris Creek, Mustang Run, Preble Creek, South Fork Preble Creek, Quail Creek, Sack Creek, Sack Creek South, Shay Ditch, Short Run, Todd Creek, Tributary 2 to Todd Creek, Tributary 4 to Todd Creek, Wadley Creek North, and Wadley Creek South. The source of the flood data for the identified streams was UDFCD Flood Hazard Area Delineation reports (References 60-64).

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, CO 80225-0267.

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10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original FIS was printed. Future revisions may be made that do not result in the republishing of the FIS report. All users are advised to contact the community repositories of flood hazard data to obtain the most up-to-date flood hazard information.

10.1 First Revision (Pre-countywide December 15, 1989)

South Platte River

The study was revised on December 15, 1989, to modify the SFHAs in the unincorporated areas of Adams County along a reach of the South Platte River. The revised reach extended from a point approximately 760 feet downstream of the westbound lane of Interstate 270, upstream to the south boundary of Adams County, at the City and County of Denver corporate limits (Franklin Street).

The basis for that revision is revised hydraulic analyses conducted by Wright Water Engineers, Inc., Denver, Colorado, under contract to the Urban Drainage and Flood Control District. The revised hydraulic analyses utilized the USACE HEC-2 hydraulic computer model and were conducted in August 1986 and September 1987. The hydraulic analyses modified the 1-percent-annual-chance and 0.2-percent-annual-chance flood boundaries and increased the base (1-percent-annual-chance) flood elevations (BFEs) along portions of the South Platte River by up to 5 feet. A floodway was not analyzed for this reach due to the split flow situations along the South Platte's floodplain.

Third Creek

The study was revised to incorporate a LOMR issued on September 28, 1988 for Third Creek in the unincorporated areas of Adams County. The purpose of the LOMR was to reflect channel modification and lot grading through Third Creek Estates Subdivision downstream of East 132'[1] Avenue.

Hidden Lakes Drainageway

The study was revised to reflect a LOMR issued on July 21, 1987, for the completion of a flood control project in the vicinity of Hidden Lakes Drainageway, in unincorporated areas of Adams County. Based on data submitted with the LOMR, the 1-percent-annual-chance flood boundaries were revised to reflect approximately 0.8-mile of channel modifications along Lowell Boulevard, located south of West 67th Avenue.

10.2 Second Revision (Countywide August 16, 1995)

Countywide Update

The second revision combined the FIS reports and FIRMs of the County and incorporated cities into the countywide format.

Under the countywide format, FIRM panels have been produced using a single layout format for the entire area within the county instead of separate layout formats for each community. The single layout format facilitates the matching of adjacent panels and depicts the flood hazard area within the entire panel border, even in areas beyond a community corporate boundary line. In addition, under the countywide format, this single FIS report provides all FIS information and data for the entire county area.

The mapping for the countywide conversion was prepared using digital TIGER files obtained from the U.S. Department of Commerce, Bureau of the Census. Previously published FIRM data produced manually was converted to vector digital data by a digitization process. These vector digital data were fit to raster digital images of the USGS quadrangle maps of the county area to provide horizontal positioning.

The 1995 revision also incorporated revisions to the flooding along Clear Creek to reflect the hydrologic and hydraulic analyses prepared in a 1979 UDFCD report (Reference 59). The revised flooding was included as a detailed analysis and updates the flooding shown on the previous effective maps. Floodway and 0.2-percent-annual-chance floodplain

boundaries were not determined. The revisions to Clear Creek are reflected in the profiles and on the FIRMS.

For Brantner Gulch, the study replaced existing Zone A flooding shown previously and added new Zone A Special Flood Hazard Areas (SFHAs). The LOMR issued to the City of Thornton on December 16, 1992, to revise the Zone A SFHA along Brantner Gulch between 123"I and 124th Avenues and Colorado Boulevard and Monroe Street, was superseded by the information presented for Brantner Gulch (Reference 63). The existing detailed flooding show from Colorado Avenue to approximately 2,600 feet downstream of Colorado Avenue was not revised.

A new Zone A SFHA was added for Direct Flow Area 0054-1 from its confluence with the South Platte River upstream to Holly Street. The LOMR issued to the City of Thornton on January 19, 1989, to revise the Zone A SFHA from Holly Street upstream to East 112th Avenue was not superseded by this study. The SFHA was continued north of East 112th Avenue.

New SFHAs were also added for: McKay Lake Drainageway, Morris Creek, Mustang Run, North Tributary VII to Brantner Gulch, Preble Creek, South Fork Preble Creek, Quail Creek, Sack Creek, Sack Creek South, Shay Ditch, Short Run, Tributary 4 to Todd Creek, Wadley North Creek, and Wadley South Creek.

Flooding was revised and added to Todd Creek and Tributary 2 to Todd Creek.

The flood information was provided by the U.S. Department of the Interior, Bureau of Reclamation, under Inter-Agency Agreement No. EMW-90-E-3456, as part of the Limited Map Maintenance Program. The source of the flood data for the identified stream was UDFCD Flood Hazard Area Delineation reports (References 60 through 64).

Letters of Map Revision (LOMRs)

The following LOMRs were included in the second update.

The LOMR issued January 19, 1989, for the City of Thornton, revised the Zone A SFHA delineations along East 112th Avenue and the area southeast of East 112th Avenue to Holly Street, reflecting major drainage improvements completed.

The LOMR issued June 9, 1992, for the City of Commerce City, incorporates modifications to the floodway along Sand Creek in the vicinity of East 49th Street.

The LOMR issued June 21, 1994, for the City of Thornton incorporates modifications to the floodplain boundary delineations along Niver Creek from Washington Street upstream to Interstate Highway 25.

The LOMR issued July 14, 1994, for the City of Northglenn, revised the FIRM to reflect elevation by the placement of fill along North Fork Grange Hall Creek.

10.3 Third Revision (March 5, 2007)

The study was revised as part of a DFIRM conversion for Adams County and incorporated areas. That study incorporated the new countywide DFIRM conversion prepared by the UDFCD. The UDFCD contracted ICON Engineering, Inc. to digitize the flood data from various sources and to prepare the data in conformance with the FEMA DFIRM specifications.

Flood information used for the DFIRM conversion came from four sources: the UDFCD's Flood Hazard Area Determination studies; the work maps from the original FIS; and the work maps from several LOMRs.

Box Elder Creek

The UDFCD published a Flood Hazard Area Delineation report (Reference 89) for the Lower Box Elder Creek watershed in September 2001. This report identified flood hazard information on Box Elder Creek, Hayesmount Creek, and Bear Gulch. This report was incorporated into this FIS.

South Platte River

The UDFCD published a Flood Hazard Area Delineation report for the South Platte River in April 2005 (Reference 85). This report was incorporated into this FIS.

Letters of Map Revision (LOMRs)

The LOMR issued March 13, 1997 for the City of Thornton revised the FIRM to reflect changes along Grange Hall Creek and Grange Hall Creek Tributary due to the construction of a floodwall at Colorado Boulevard. Revisions occurred along Grange Hall Creek from approximately 500 feet downstream of East 108th Avenue to approximately 600 feet upstream of the confluence with Grange Hall Creek Tributary. Revisions along Grange Hall Creek Tributary occurred from the confluence with Grange Hall Creek to approximately 800 feet upstream of the confluence.

The LOMR issued August 23, 2000 for the Cities of Northglenn and Thornton revised the FIRM to show effects of construction of the Thornton Town Center along South Fork Grange Hall Creek from approximately 950 feet downstream of Grant Street to Melody Drive. The construction of the Thornton Town Center included installation of a new concrete box culvert below Grant Street; construction of a storage pond upstream of Grant Street; and installation of a box culvert between the storage pond and Interstate Highway 25 (1-25). The construction resulted in a realignment of the South Fork Grange Hall Creek from approximately 800 feet downstream of Grant Street to Huron Street.

The LOMR issued December 6, 1999 for unincorporated areas of Adams County, the City of Westminster, and the City of Thornton revised the FIRM to reflect changes along Big Dry Creek from 136th Avenue to Interstate Highway 25 (1-25).

The LOMR issued February 7, 2000 for the City of Federal Heights revised the FIRM to show the effects of placement of fill associated with the Northmoor subdivision

development on the south side of Tributary L to Niver Creek from Huron Street to approximately 1000 feet upstream of Huron Street.

The LOMR issued September 11, 2000 for the City of Federal Heights revised the FIRM to correct an error in streambed elevation used in the effective hydraulic model for Tributary M of Niver Creek. Modifications occurred from approximately 250 feet downstream to approximately 120 feet upstream of Bryant Drive.

The LOMR issued February 8, 2001 for the City of Thornton revised the FIRM to reflect changes along Niver Creek associated with the American Furniture Warehouse development. Modifications occurred along Niver Creek from just upstream of the confluence with Tributary L to Niver Creek to approximately 320 feet downstream of Interstate Highway 25 (I-25).

The LOMR issued September 25, 2001 for the City of Thornton revised the FIRM to reflect changes along Wadley South Creek associated with the Haven at York Street development. Revisions occurred along Wadley South Creek from the confluence with Big Dry Creek for the Union Pacific Railroad.

The LOMR issued November 25, 2002 for the City of Commerce City and Adams County revised the FIRM to reflect changes along First Creek associated with the Belle Creek Filing 1 development from Brighton Road to approximately 400 feet upstream of U.S. Highway 85.

The LOMR issued November 29, 2002 for Adams County and the City of Brighton revised the FIRM to reflect changes along Second Creek associated with construction of the State Highway E-470 Tollway. Modifications occurred along Second Creek for the Union Pacific Railroad to just downstream of East 124 Avenue.

The LOMR issued January 30, 2003 for Adams County, the City of Commerce City, and the City of Thornton revised the FIRM to show the effects of updated topographic information along the South Platte River form approximately 500 feed upstream of 104th Avenue to approximately 3,100 feet downstream of East 88th Avenue.

The LOMR issued May 29, 2003 for Adams County and the City of Westminster revised the FIRM to reflect channel improvements along Big Dry Creek between Interstate Highway 25 and Huron Street.

The LOMR issued July 2, 2003 for the City of Thornton revised the FIRM to reflect changes along an unnamed tributary to Grange Hall Creek due to the construction of Birch Street and 105th Avenue. Modifications occurred along the unnamed tributary to Grange Hall Creek from the confluence with Grange Hall Creek to Colorado Boulevard.

The LOMR issued August 20, 2003 for Adams County revised the FIRM to incorporate updated topographic data, the new Pecos Street bridge, and the widening of the channel along Clear Creek form approximately 3,300 feet downstream of Pecos Street to the Colorado and Southern Railroad.

The LOMR issued August 29, 2003 for Adams County and the City of Thornton revised the FIRM to reflect channel modifications associated with the proposed realignment of 152nd Avenue along Wadley North Creek from the confluence with Big Dry Creek to just downstream of the Union Pacific Railroad.

The LOMR issued August 29, 2003 for the City of Thornton and the City of Northglenn revised the FIRM to reflect modifications to Eastlake Reservoirs Nos. 2 and 3 and channel impacts along Brantner Gulch from the Eastlake reservoirs to Colorado Boulevard.

The LOMR issued December 4, 2003 for Adams County revised the FIRM to reflect modifications along Todd Creek and Tributary 4 to Todd Creek (Tributary 4) associated with the construction of the State Highway E-470 Tollway.

The LOMR issued January 24, 2004 for Adams County, the City of Brighton, and the City of Commerce City revised the FIRM to reflect channel improvements associated with the construction of the State Highway E-470 Tollway along Third Creek from west of Chambers Road upstream to Tower Road. The E-470 Highway construction project incorporated a regional stormwater detention facility south of 120th Avenue, bridge/culvert crossings at 120th Avenue and at the ramp from Highway E-470 to Interstate Highway 76, and relocation/channelization of portions of Third Creek.

The LOMR issued May 14, 2004 for Adams County revised the FIRM to reflect changes in Special Flood Hazard Areas, Base Flood Elevations, and Floodway for Comanche Creek, Little Comanche Creek, and Wolf Creek based on more detailed topographic information. The revised reaches extend along Comanche Creek from the Adams County boundary with Weld County to just downstream of 26th Avenue, along Wolf Creek from the confluence with Comanche Creek to just downstream of U.S. Highway 36 (US 36), and along Little Comanche Creek from the confluence with Comanche Creek to just downstream of US 36.

The LOMR issued May 12, 2004 for Adams County and the City of Brighton revised the FIRM to reflect modifications along the South Platte River and Second Creek resulting from the construction of the State Highway E-470 Tollway (E-470). Modifications along the South Platte River occurred from approximately 760 feet upstream of the confluence with Second Creek to E-470. Modifications along Second Creek occurred at the confluence with the South Platte River.

The LOMR issued July 14, 2004 for Adams County and the City of Commerce City revised the FIRM to reflect changes along First Creek, Tributary Channel A to First Creek, and Tributary Channel B to First Creek, associated with Belle Creek subdivision Filing No. 4. Modifications occurred along First Creek and the tributary channels from approximately 900 feet upstream of Brighton Boulevard to the Union Pacific Railroad.

The LOMRs issued July 16, 2004 for Adams County and the City of Thornton revised the FIRM to reflect modifications along Big Dry Creek and Big Dry Creek North Area Tributaries (Mustang Run, Sack Creek South, and Short Run) associated with the construction of the State Highway E-470 Tollway.

The LOMR issued September 29, 2004 for Adams County and the City of Westminster revised the FIRM to reflect construction of culverts along Little Dry Creek at the Colorado and Southern Railroad at West 64th Avenue. Modifications occurred along Little Dry Creek from West 64th Avenue to just upstream of Federal Boulevard. The base flood elevation along Clear Creek was also affected by this revision.

The LOMR issued May 11, 2005 revised the FIRM to reflect changes in Special Flood Hazard Area, Base Flood Elevation, and Floodway for the South Platte River associated with Tigers Reservoir from approximately 2,350 feet upstream of McKay Road to East 88th Avenue. These changes to the FIRM are the result of revised hydraulic analysis to incorporate the effects of Tigers Reservoir along the South Platte River.

The LOMR issued July 8, 2005 for the City of Thornton revised the FIRM to reflect changes along South Fork Preble Creek associated with the construction of a box culvert at the Larkridge Mall development. The Special Flood Hazard Area for South Fork Preble Creek is contained within the constructed box culvert.

The LOMR issued July 25, 2005 for the City of Thornton revised the FIRM to reflect changes along Big Dry Creek associated with the construction of a new bridge at 136th Avenue.

The LOMR issued March 31, 2006 for Adams County and the City of Aurora revised the FIRM to reflect changes along First Creek associated with the construction of the Prologis Park 70 development.

The LOMR issued May 11, 2006 for Adams County and the City of Thornton revised the FIRM to reflect changes along Grange Hall Creek associated with the construction of box culverts extensions at Holly Street.

The LOMR issued May 26, 2006 for Adams County and the City of Commerce City revised the FIRM to reflect updated topography along Second Creek associated with the Second Creek Farm Filing No. 1 development.

The LOMR issued June 13, 2006 for the City of Thornton revised the FIRM to reflect the changes along South Fork Preble Creek associated with the construction of the Larkridge Retail Center.

The LOMR issued September 26, 2006 for Adams County revised the FIRM to reflect changes along McKay Lake Drainageway associated with the improvements at McKay Lake and the Huntington Trails development.

10.4 Fourth Revision (January 20, 2016)

This revision was initiated by a Physical Map Revision (PMR) request submitted to FEMA by Urban Drainage Flood Control District This revision involved updating the mapping for Big Dry Creek in Adams County, Colorado.

The hydrologic and hydraulic analysis for this partial map revision was completed in January 2012 by Wright Water Engineers, Inc, as part of Flood Hazard Area Delineation, Big Dry Creek (Reference 93), which updated the analyses for Big Dry Creek.

For Big Dry Creek, synthetically developed hydrographs were computed to determine potential flood magnitudes. The area was divided into 517 sub-basins, which ranged from 0.01 to 1 square mile. Hydrographs for each of the sub-basins were developed with the U.S. Environmental Protection Agency Storm Water Management Model (SWMM; Reference 90). The SWMM models were first developed for each of the tributary watersheds, and the main stem model was developed by linking the tributary outfalls together and routing the discharge hydrographs downstream in Big Dry Creek.

The hydraulic analysis for Big Dry Creek was performed using the United States Corps of Engineers Hydrologic Engineering Center's River Analysis System, or HEC-RAS, version 4.0 (Reference 91). Cross section data was obtained from previous Flood Hazard Area Delineation studies from 1986/1988 (Reference 92) and revised using 2008 LiDAR topography with 2-ft contour intervals (Reference 94). Channel roughness factors (Manning's "n") for these computations were determined through field observations and typically ranged from 0.030 to 0.045 within the channel banks and 0.050 to 0.060 in the overbank areas. Starting water surface elevations were computed using step-backwater with normal depth as the starting condition.

10.5 Fifth Revision (TBD)

This revision was initiated by a Physical Map Revision (PMR) request submitted to FEMA by Urban Drainage Flood Control District (UDFCD).

The UDFCD published a Flood Hazard Area Delineation report (Reference 95) for Box Elder Creek (Downstream of Jewell Avenue) and Coyote Run in December 2014. The analysis was conducted by Olsson Associates, and identified flood hazard information on the above stream reaches. This report was incorporated into this revision of the FIS and DFIRM for portions of Box Elder Creek and Coyote Run.

a. Acknowledgments

The Box Elder Creek, Box Elder Spill 4, Box Elder Spill 5, Box Elder Spill 6, Box Elder Split 1, Box Elder Split 2 and Coyote Run study flow path through Adams County, Colorado were performed by Olsson Associates for the Urban Drainage and Flood Control District as part of the "Box Elder Creek (Downstream of Jewell Avenue) and Coyote Run Flood Hazard Area Delineation". FEMA reviewed and accepted this data for the purposes of this revision (Pending).

b. Scope

Detailed hydrologic and hydraulic analyses were conducted for this portion of Box Elder Creek, Box Elder Spill 4, Box Elder Spill 5, Box Elder Spill 6, Box Elder Split 1, Box Elder Split 2 and Coyote Run. This portion of Box Elder Creek

is approximately 30.9 miles long and generally slopes to the north at a slope between 0.3% and 0.5%. Coyote Run is approximately 15.9 miles long and generally slopes to the north at a slope between 0.2% and 1.2%.

c. Hydrology

For Box Elder Creek, Box Elder Spill 4, Box Elder Spill 5, Box Elder Spill 6, Box Elder Split 1, Box Elder Split 2, and Coyote Run, peak discharges for the 1% future, 1%, 2%, and 10% annual chance of occurrence events were analyzed. Hydrology for the Box Elder Creek watershed was completed to update the older CUHP and UDSWM models from previous studies (1995 and 2001 Outfall System Plans) to CUHP 2005 version 1.3.3, and EPA SWMM version 5.0.022.

d. Hydraulic

For Box Elder Creek, Box Elder Spill 4, Box Elder Spill 5, Box Elder Spill 6, Box Elder Split 1, Box Elder Split 2 and Coyote Run, the U.S. Army Corps of Engineer's step backwater program HEC-RAS, Version 4.1.0, was used for the floodplain analysis. Cross sections for HEC-RAS were developed electronically using the 2-foot interval LiDAR data. The survey data collected for all of the major bridges and culverts was used in the model.

e. Manning

For Box Elder Creek, Box Elder Spill 4, Box Elder Spill 5, Box Elder Spill 6, Box Elder Split 1, Box Elder Split 2 and Coyote Run, estimates of channel and overbank roughness were determined using aerial photography and field observation, primarily at road crossings. The channel and bank roughness values ranged from 0.03 to 0.06. Sandy portions of the channel were set at 0.03. Areas that appeared to have short grasses were set at 0.035. Areas with longer grass and scattered trees were set at 0.04 to 0.045. Areas with thick trees and brush were set at 0.06 (Reference 95).

TABLE 1a – FLOODING SOURCES RESTUDIED OR NEWLY STUDIED BY DETAILED METHODS

Stream	**Limits of Revised or New Detailed Study**
Box Elder Creek	From the Adams-Weld county boundary to approximately 5.9 miles upstream of I-70
Box Elder Spill 4	From confluence with Coyote Run to approximately 8,000 feet upstream
Box Elder Spill 5	From confluence with Coyote Run to approximately 9,400 feet upstream
Box Elder Spill 6	From the confluence with Coyote Run to approximately 5,200 feet upstream
Box Elder Split 1	From the confluence with Box Elder Creek to approximately 3,400 feet upstream
Box Elder Split 2	From confluence with Box Elder to approximately 2.7 miles upstream
Coyote Run	From confluence with Box Elder to approximately 7.7 miles upstream of I-70

TABLE 3 – SUMMARY OF DISCHARGES

		Peak Discharges (Cubic Feet per Second)			
Flooding Source/Location	Drainage Area (Square Miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	1% Future Annual Chance
Box Elder Creek					
Confluence with Coyote Run	--[1]	1,681	7,522	11,090	15,998
At I-70	--[1]	1,698	7,597	11,138	12,893
Approximately 5.9 miles upstream of I-70	--[1]	1,709	7,640	11,164	12,933
Box Elder Spill 4					
Approximately 7,100 feet upstream of confluence with Coyote Run	--[1]	0	0	26	108
Approximately 3,700 feet upstream of confluence with Coyote Run	--[1]	133	1,368	2,162	3,035
Box Elder Spill 5					
Approximately 9,000 feet upstream of confluence with Coyote Run	--[1]	0	1,285	3,007	3,967
Box Elder Spill 6					
Approximately 5,200 feet upstream of confluence with Coyote Run	--[1]	170	993	1,493	1,726

[1]Data not available

Flooding Source/Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10% Annual Chance	2% Annual Chance	1% Annual Chance	1% Future Annual Chance
Box Elder Split 1					
Approximately 3,400 feet upstream of confluence with Box Elder Creek	--[1]	0	73	484	3,475
Box Elder Split 2					
Approximately 5,800 feet upstream of confluence with Box Elder	--[1]	572	3,348	4,429	5,439
Approximately 2.6 miles upstream of confluence with Box Elder	--[1]	1,347	7,234	9,680	11,957
Coyote Run					
Approximately 1700 feet upstream of confluence with Box Elder Creek	--[1]	1,920	6,111	8,703	15,349
At I-70	--[1]	1,546	4,190	5,804	6,533
Approximately 7.7 miles upstream of I-70	--[1]	46	109	141	169

[1]Data not available

APPENDIX A

Figure 2. FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

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

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations and/or Transect Data tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Coastal flood elevations are also provided in the Summary of Stillwater Elevations table and Transect Data table in the FIS Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table and Transect Data table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to the "Flood Protection Measures" section of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was

Universal Transverse Mercator (UTM) Zone 13N. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services

NOAA, N/NGS12

National Geodetic Survey

SSMC-3, #9202

1315 East-West Highway

Silver Spring, Maryland 20910-3282

(301) 713-3242

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed on the FIRM Index.

BASE MAP INFORMATION: Base map information shown on this FIRM was provided in digital format by the Adams County GIS Department.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Adams County, CO, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to the FIRM Index to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

ATTENTION: The corporate limits shown on this FIRM Index are based on the best information available at the time of publication. As such, they may be more current than those shown on FIRM panels issued before [most recent FIRM panel date].

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Adams County, CO.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Figure 3. Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)

Zone A — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE — The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.

Zone AH — The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.

Zone AO — The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.

Zone AR — The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

Zone A99 — The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.

Zone V — The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.

Zone VE — Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.

Regulatory Floodway determined in Zone AE.

OTHER AREAS OF FLOOD HAZARD

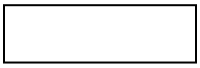
Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.

Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.

Area with Reduced Flood Risk due to Levee: Areas where an accredited levee, dike, or other flood control structure has reduced the flood risk from the 1% annual chance flood. See Notes to Users for important information.

OTHER AREAS

Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.



Unshaded Zone X: Areas of minimal flood hazard.

FLOOD HAZARD AND OTHER BOUNDARY LINES

(ortho) (vector)

Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)

Limit of Study

Jurisdiction Boundary

Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet

GENERAL STRUCTURES

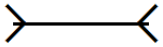
Aqueduct
Channel
Culvert
Storm Sewer

Channel, Culvert, Aqueduct, or Storm Sewer

Dam
Jetty
Weir

Dam, Jetty, Weir

Levee, Dike, or Floodwall



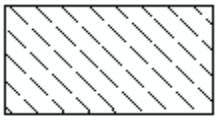
Bridge

Bridge

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*

CBRS AREA
09/30/2009

Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.



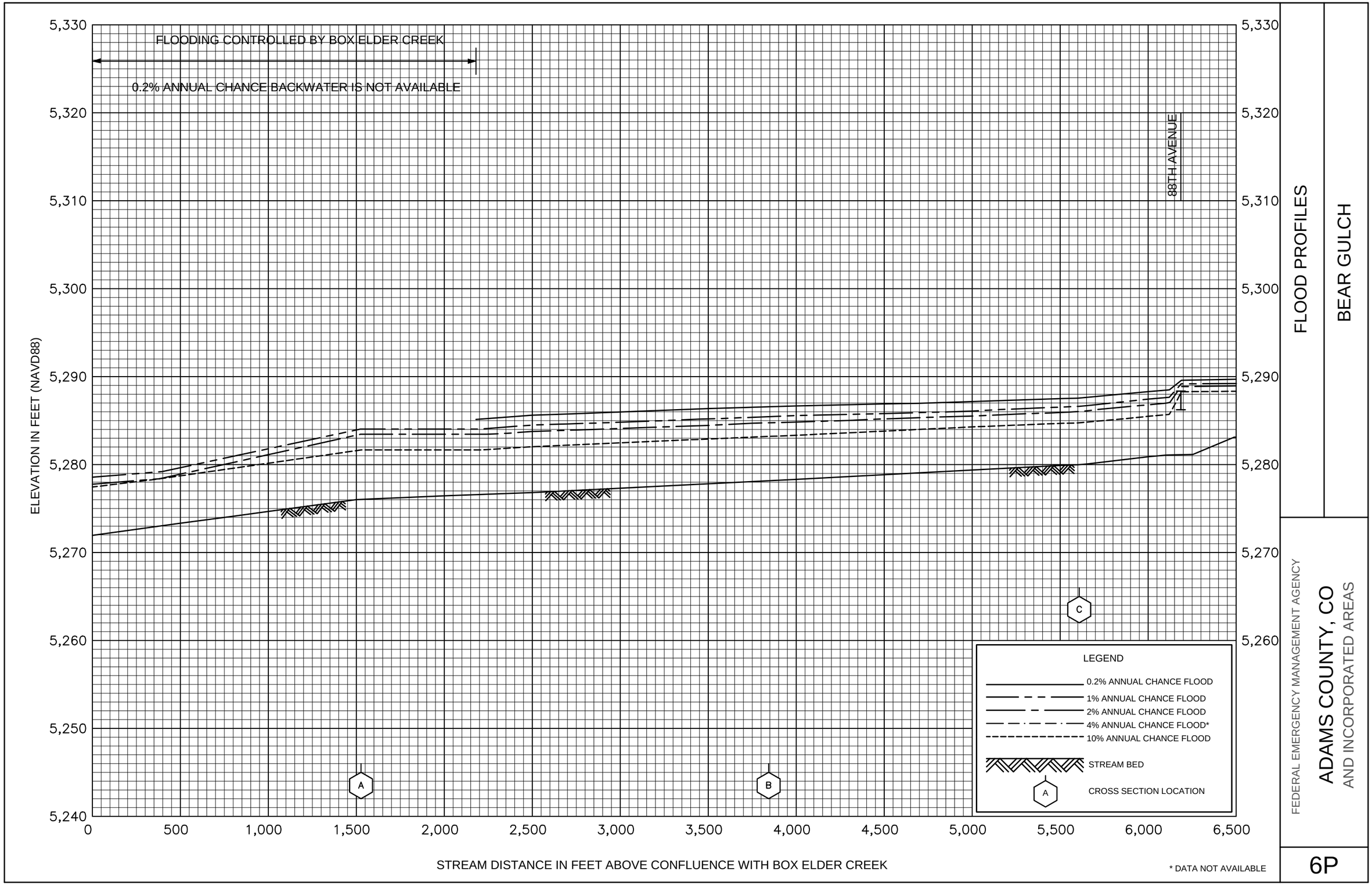
OTHERWISE PROTECTED AREA
09/30/2009

Otherwise Protected Area

REFERENCE MARKERS

22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line
ZONE AE **(EL 16)**	Static Base Flood Elevation value (shown under zone label)
ZONE AO **(DEPTH 2)**	Zone designation with Depth
ZONE AO **(DEPTH 2)** **(VEL 15 FPS)**	Zone designation with Depth and Velocity
BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway

234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)



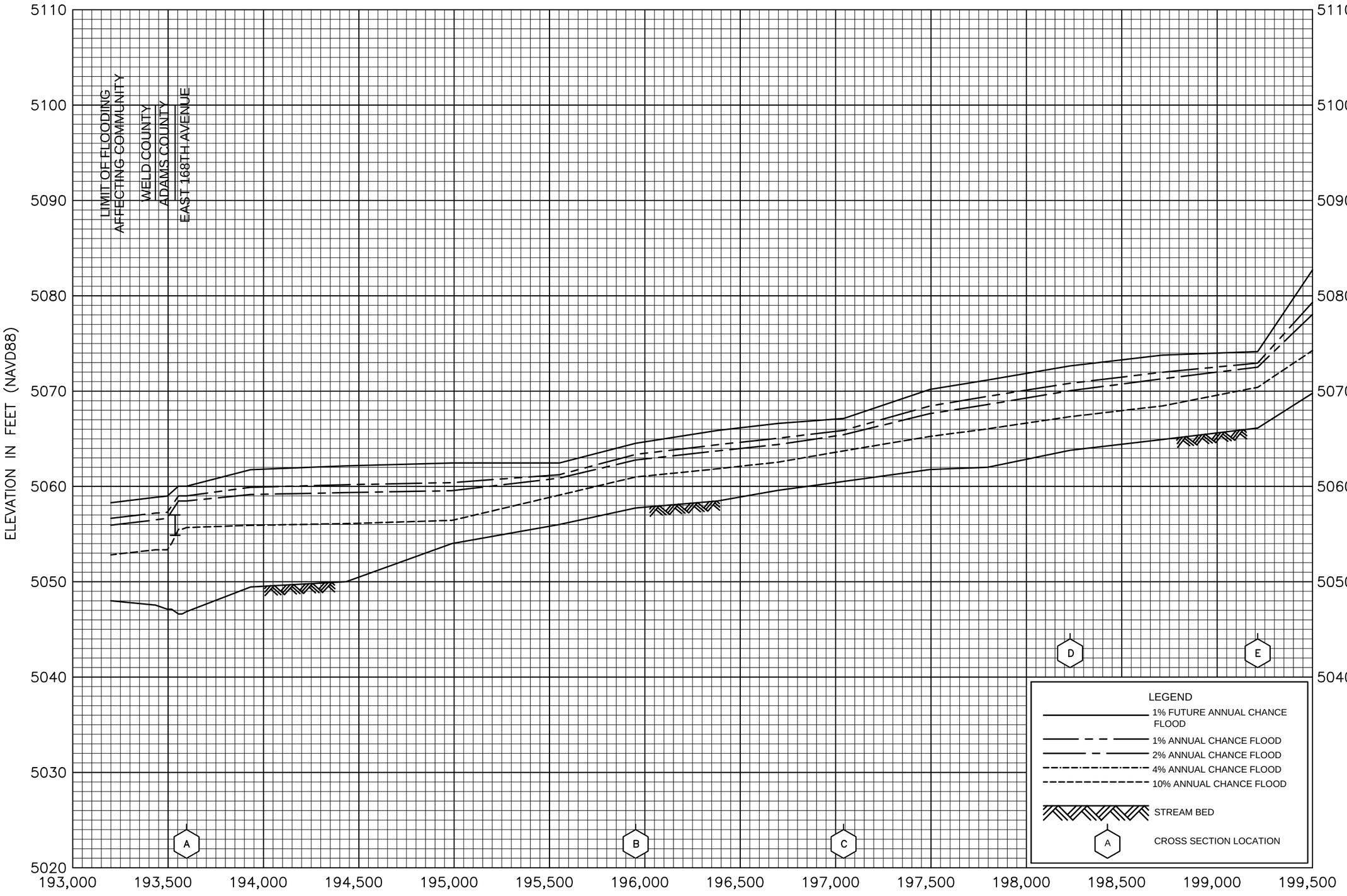
FLOOD PROFILES

BEAR GULCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

6P



FLOOD PROFILES

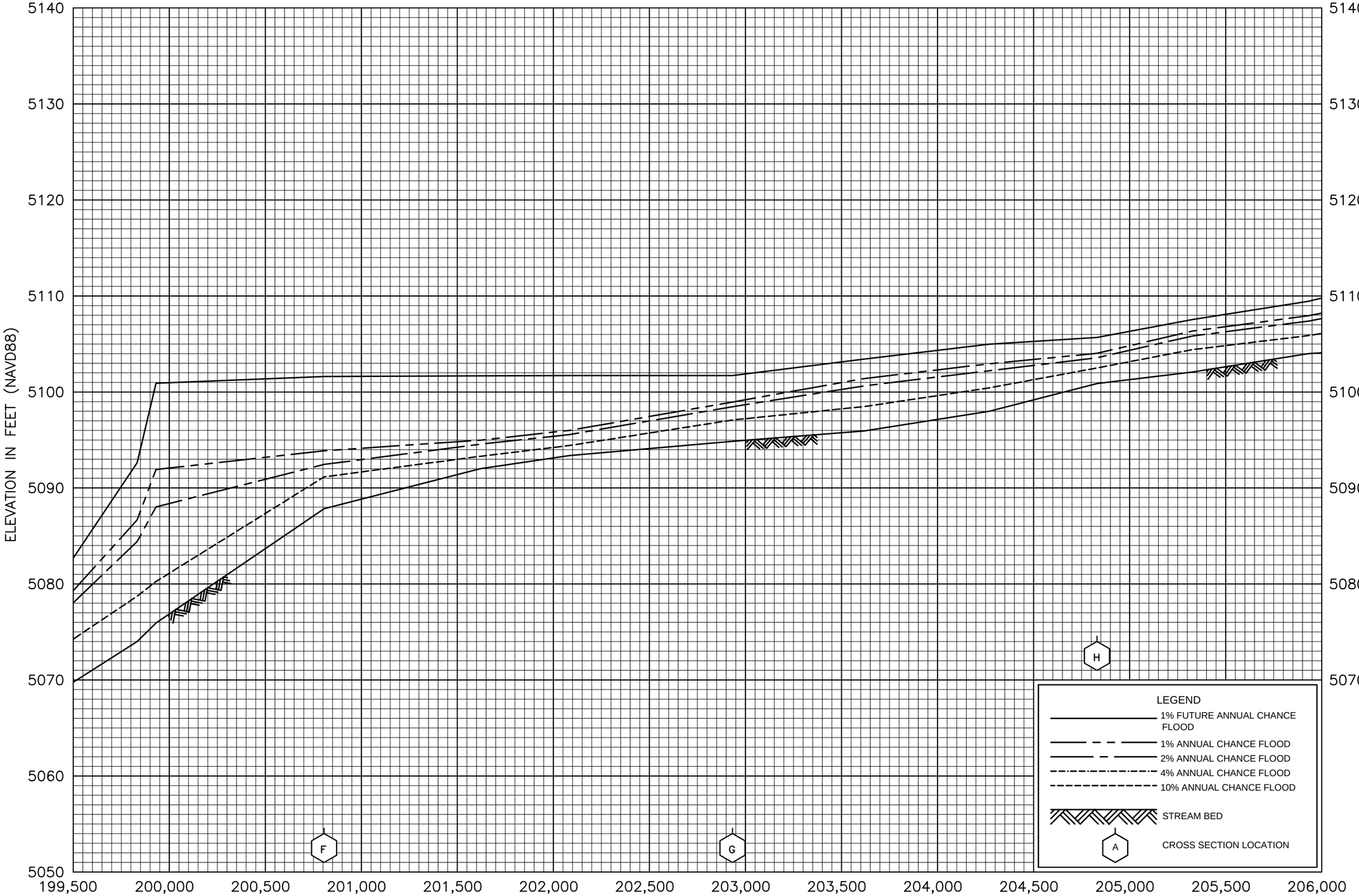
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

030P



FLOOD PROFILES

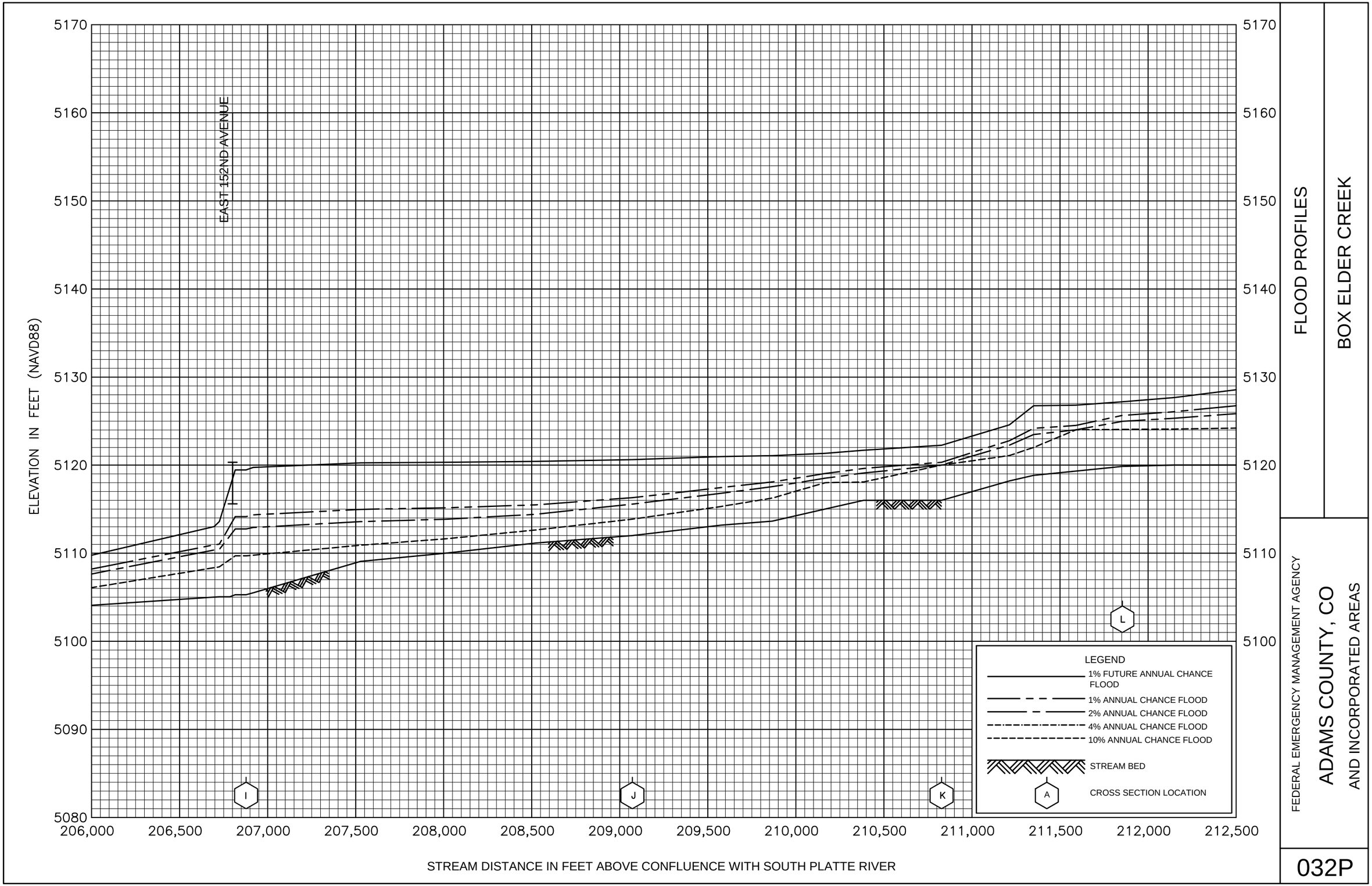
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

031P



FLOOD PROFILES

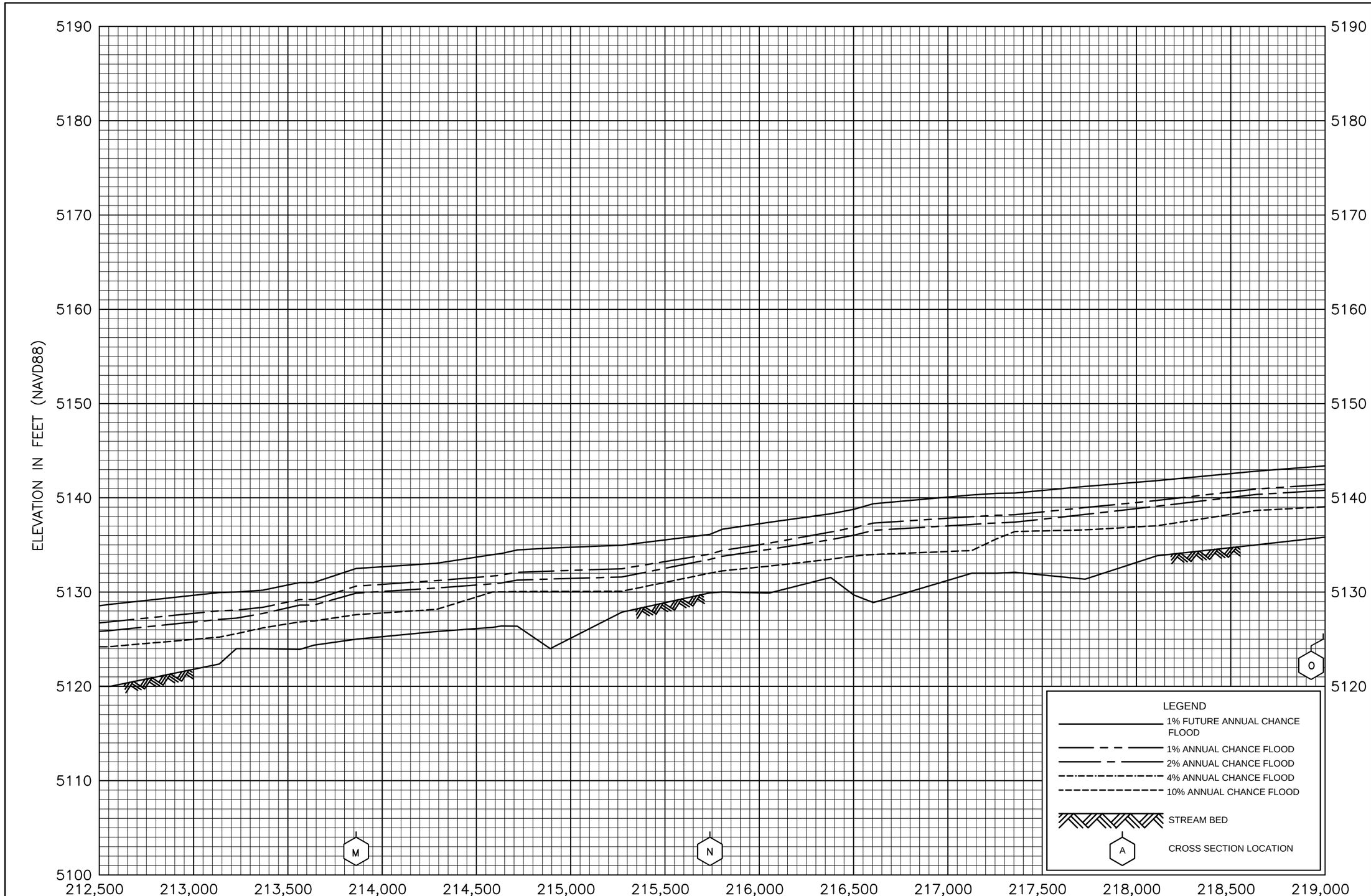
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

032P



STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

FLOOD PROFILES

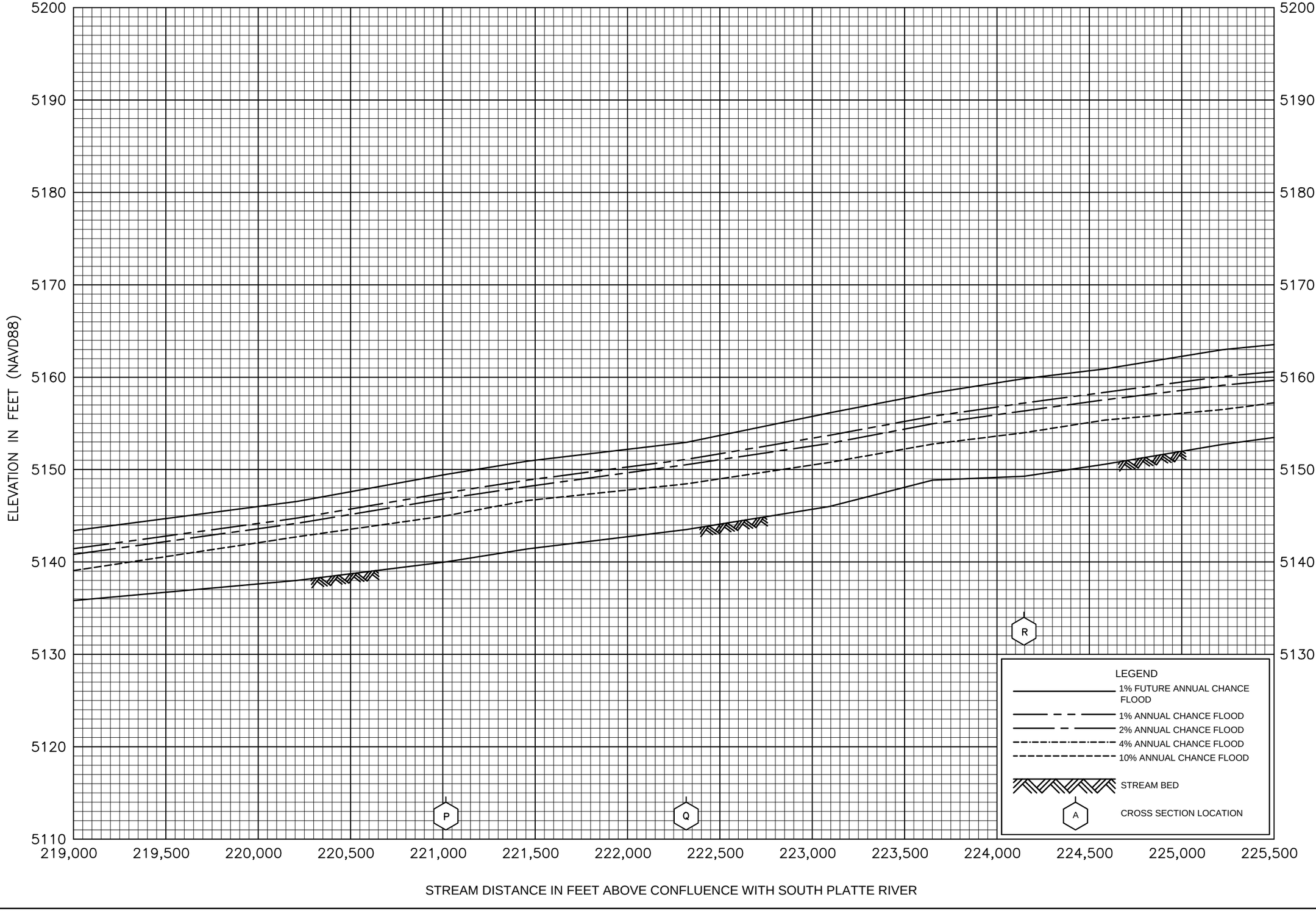
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

033P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

034P

ELEVATION IN FEET (NAVD88)

5220
5210
5200
5190
5180
5170
5160
5150
5140
5130

225,500 226,000 226,500 227,000 227,500 228,000 228,500 229,000 229,500 230,000 230,500 231,000 231,500 232,000

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

S T U V W

LEGEND

- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

FLOOD PROFILES

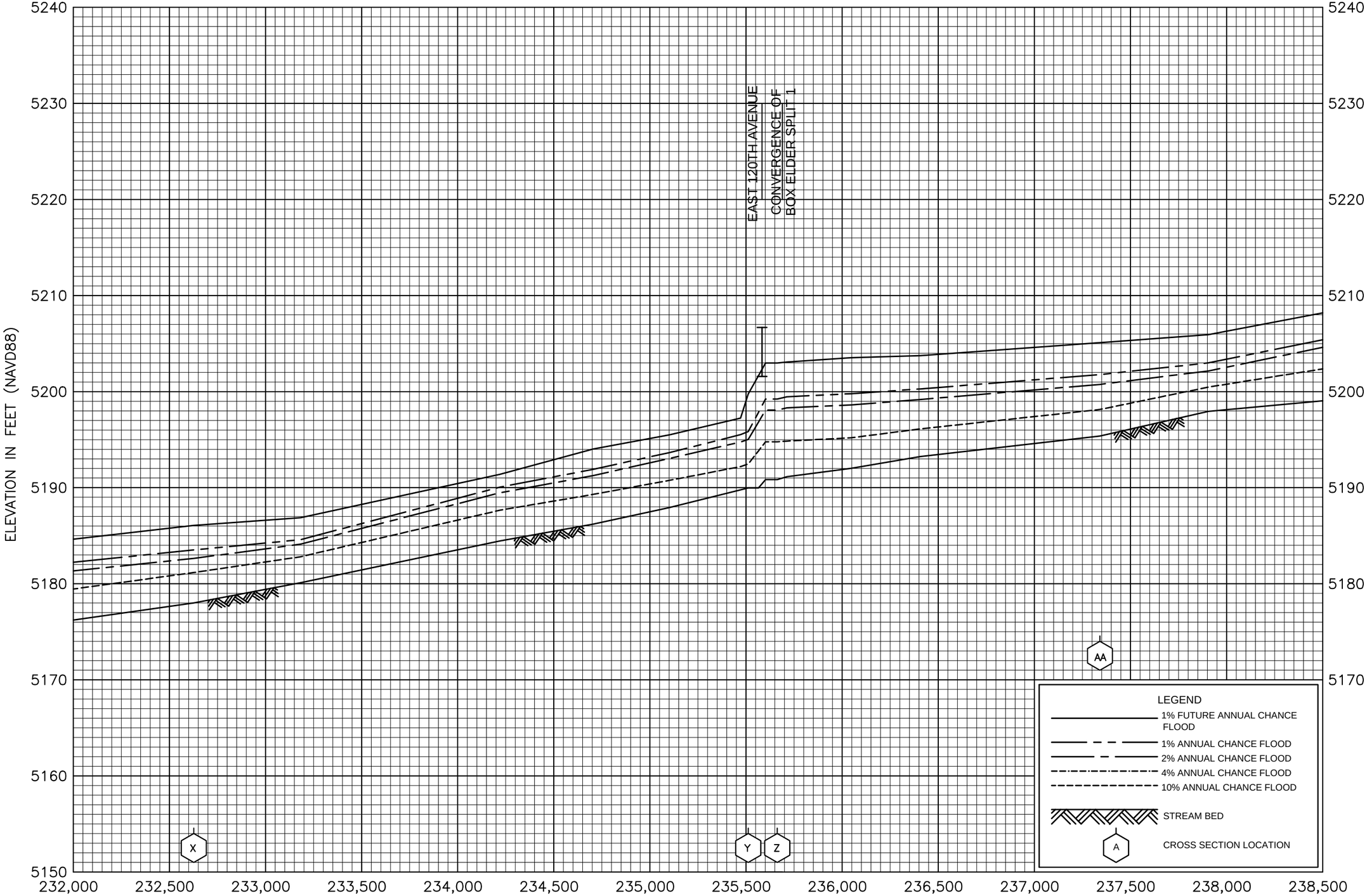
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

035P



FLOOD PROFILES

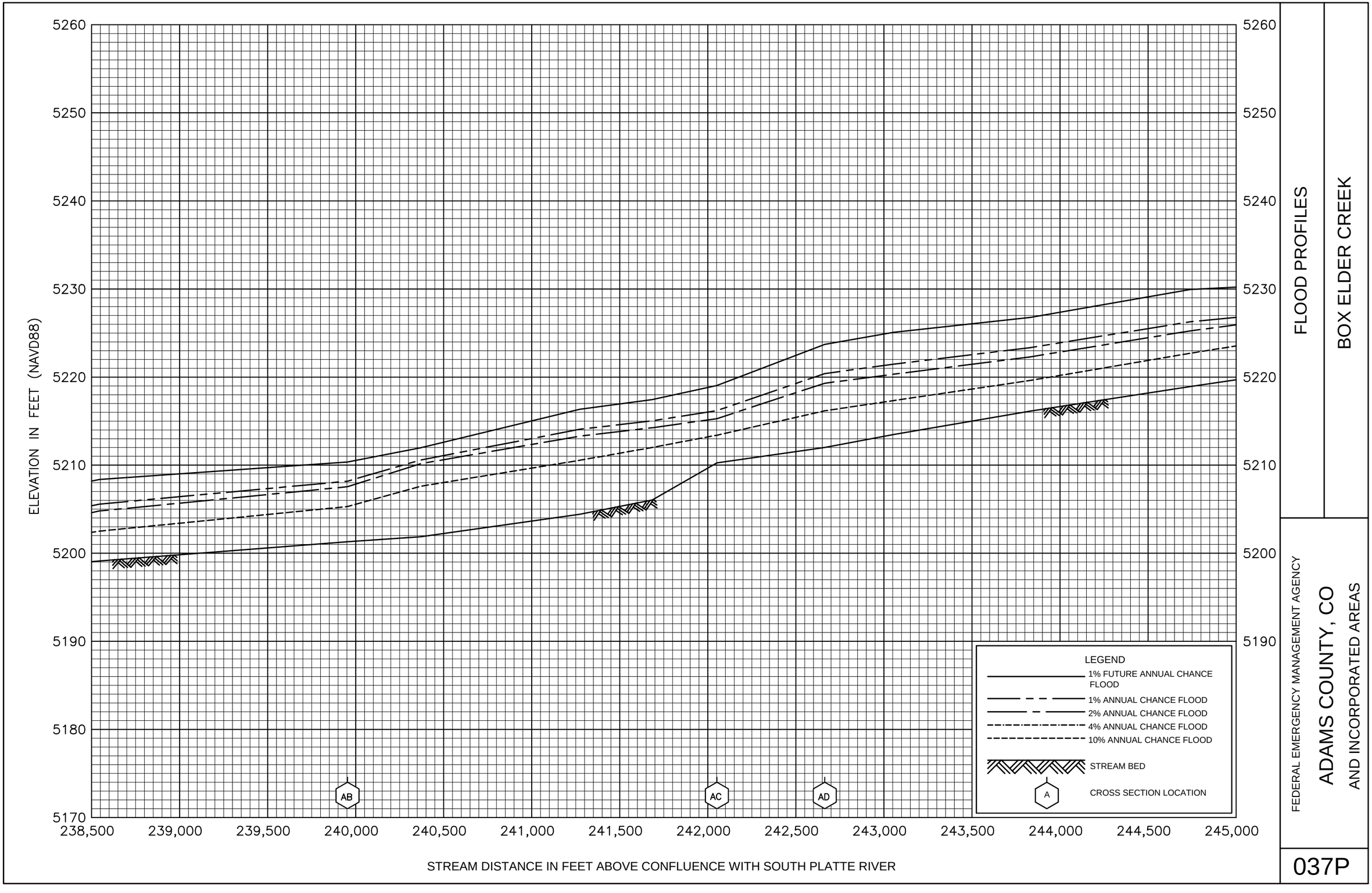
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

036P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

037P

ELEVATION IN FEET (NAVD88)

ADAMS COUNTY
CITY AND COUNTY OF DENVER

5290
5280
5270
5260
5250
5240
5230
5220
5210
5200

245,000 245,500 246,000 246,500 247,000 247,500 248,000 248,500 249,000 249,500 250,000 250,500 251,000 251,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

AE AF AG AH AI

LEGEND
- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

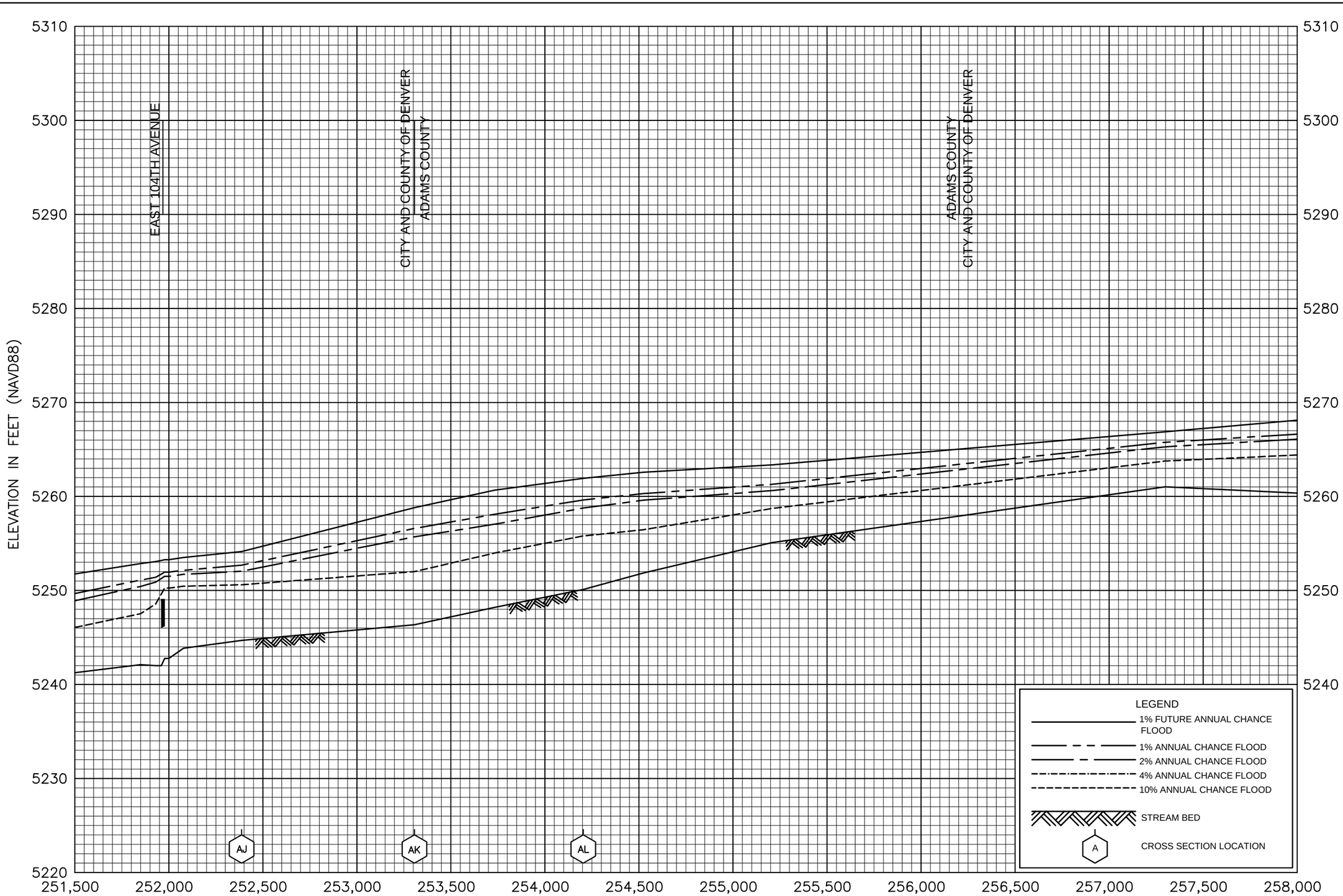
FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

038P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

039P

CITY AND COUNTY OF DENVER
ADAMS COUNTY

ELEVATION IN FEET (NAVD88)

5330
5320
5310
5300
5290
5280
5270
5260
5250
5240

258,000 258,500 259,000 259,500 260,000 260,500 261,000 261,500 262,000 262,500 263,000 263,500 264,000 264,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

AM AN AO AP

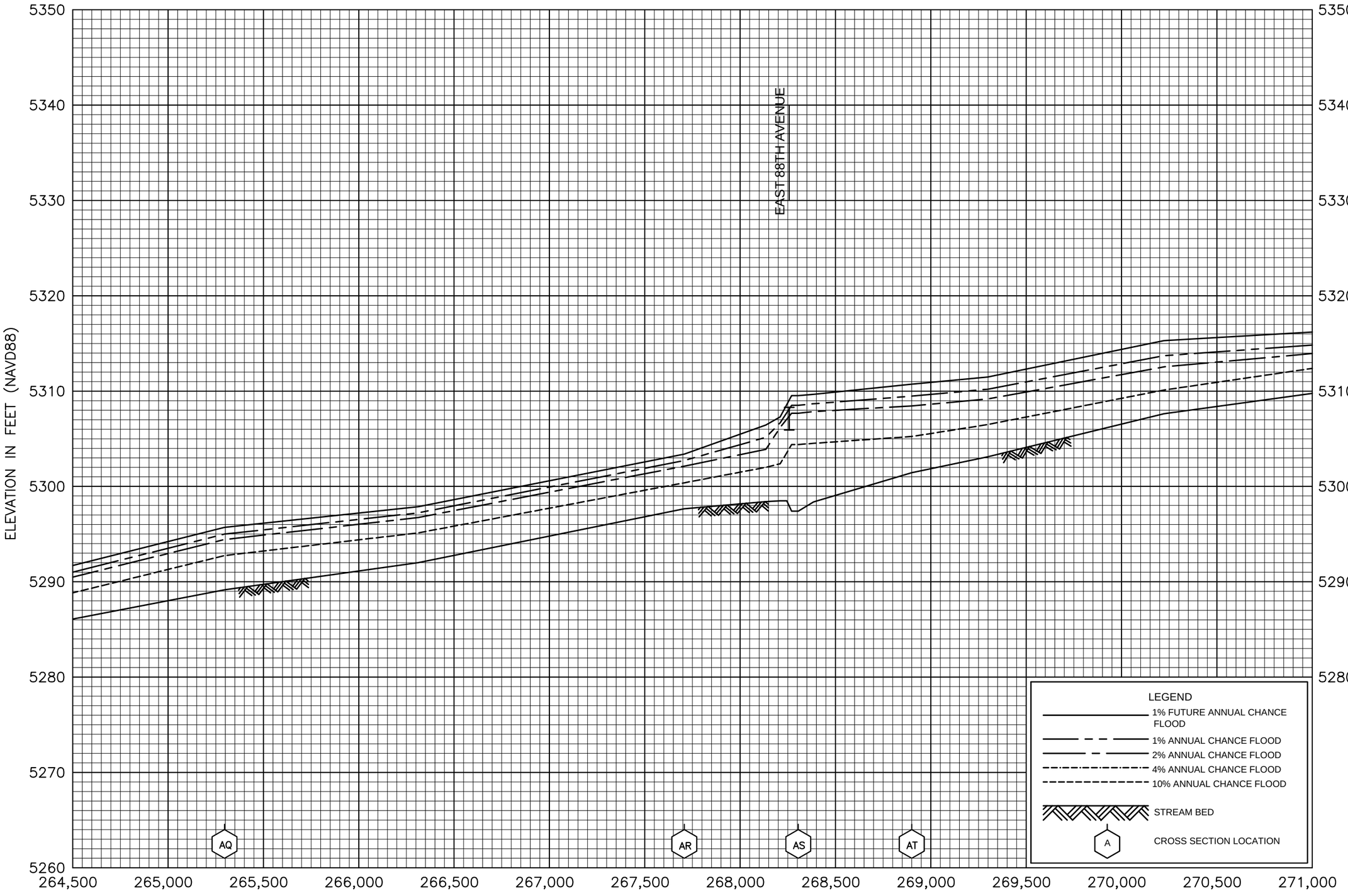
LEGEND
1% FUTURE ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
4% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A CROSS SECTION LOCATION

FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
ADAMS COUNTY, CO
AND INCORPORATED AREAS

040P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

041P

ADAMS COUNTY
CITY AND COUNTY OF DENVER

ELEVATION IN FEET (NAVD88)

5380
5370
5360
5350
5340
5330
5320
5310
5300
5290

271,000 271,500 272,000 272,500 273,000 273,500 274,000 274,500 275,000 275,500 276,000 276,500 277,000 277,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

AU AV AW AX

LEGEND
- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

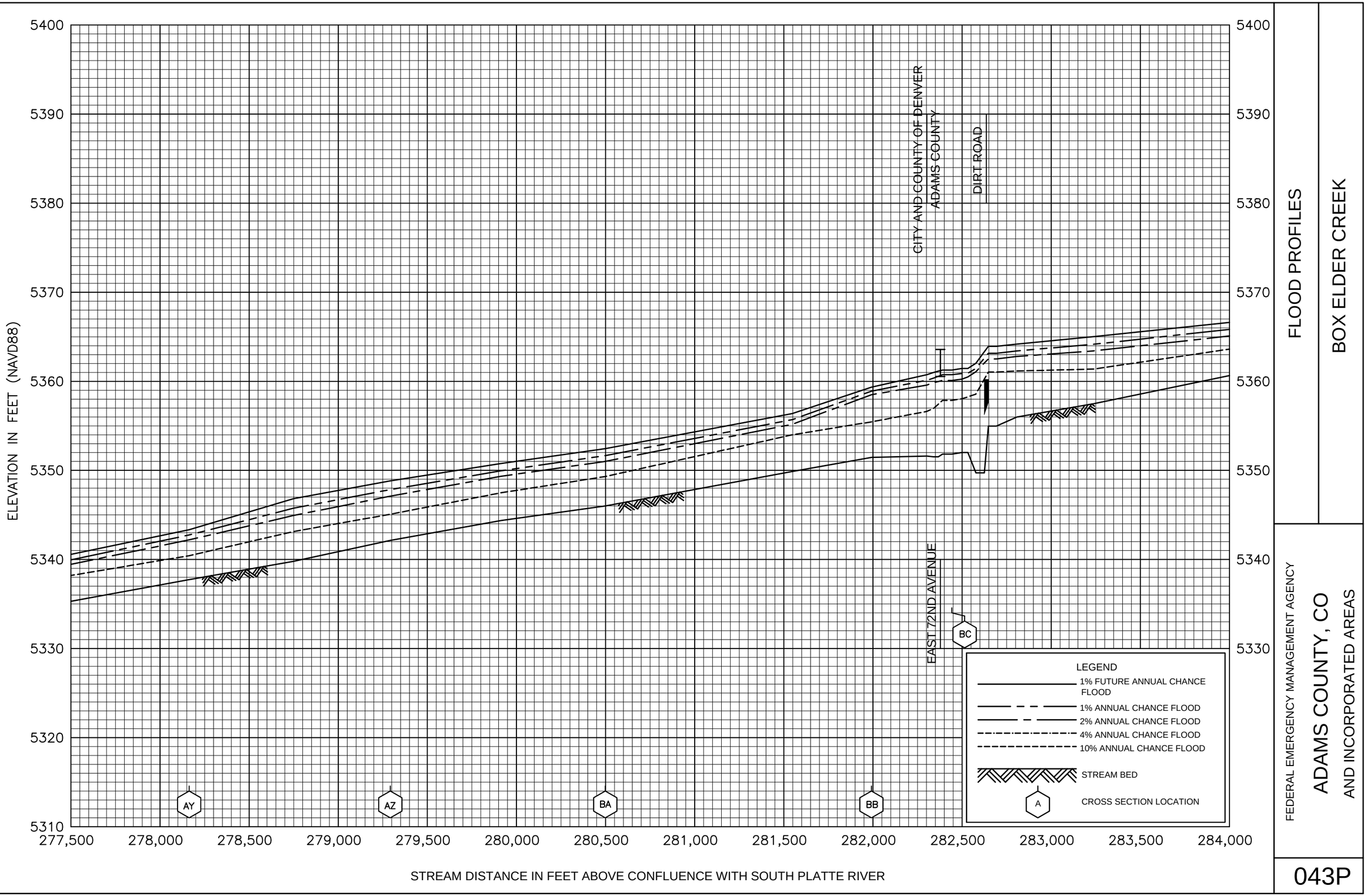
FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

042P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

043P

ADAMS COUNTY
CITY OF AURORA
ARAPAHOE COUNTY

CONVERGENCE OF
BOX ELDER SPLIT 2

CONFLUENCE OF
BOX ELDER SPLIT 2A

ELEVATION IN FEET (NAVD88)

5430
5420
5410
5400
5390
5380
5370
5360
5350
5340

284,000 284,500 285,000 285,500 286,000 286,500 287,000 287,500 288,000 288,500 289,000 289,500 290,000 290,500

BD BE BF BG BH BI BJ BK

LEGEND
1% FUTURE ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
4% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
A CROSS SECTION LOCATION

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

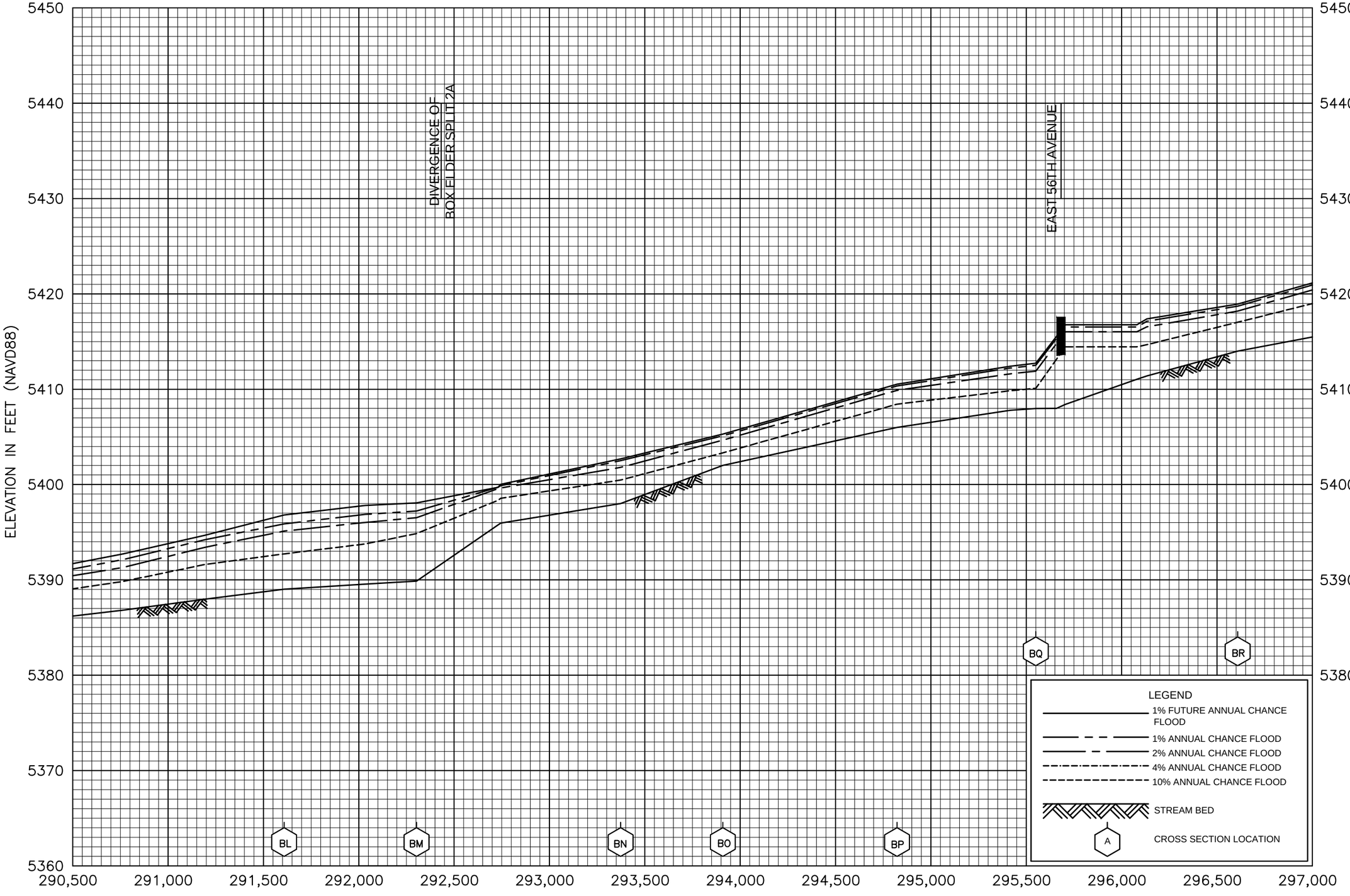
FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

044P



FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

045P

CITY OF AURORA ARAPAHOE COUNTY
ADAMS COUNTY

ELEVATION IN FEET (NAVD88)

5480
5470
5460
5450
5440
5430
5420
5410
5400
5390

297,000 297,500 298,000 298,500 299,000 299,500 300,000 300,500 301,000 301,500 302,000 302,500 303,000 303,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SOUTH PLATTE RIVER

BS BT BU

LEGEND
- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A CROSS SECTION LOCATION

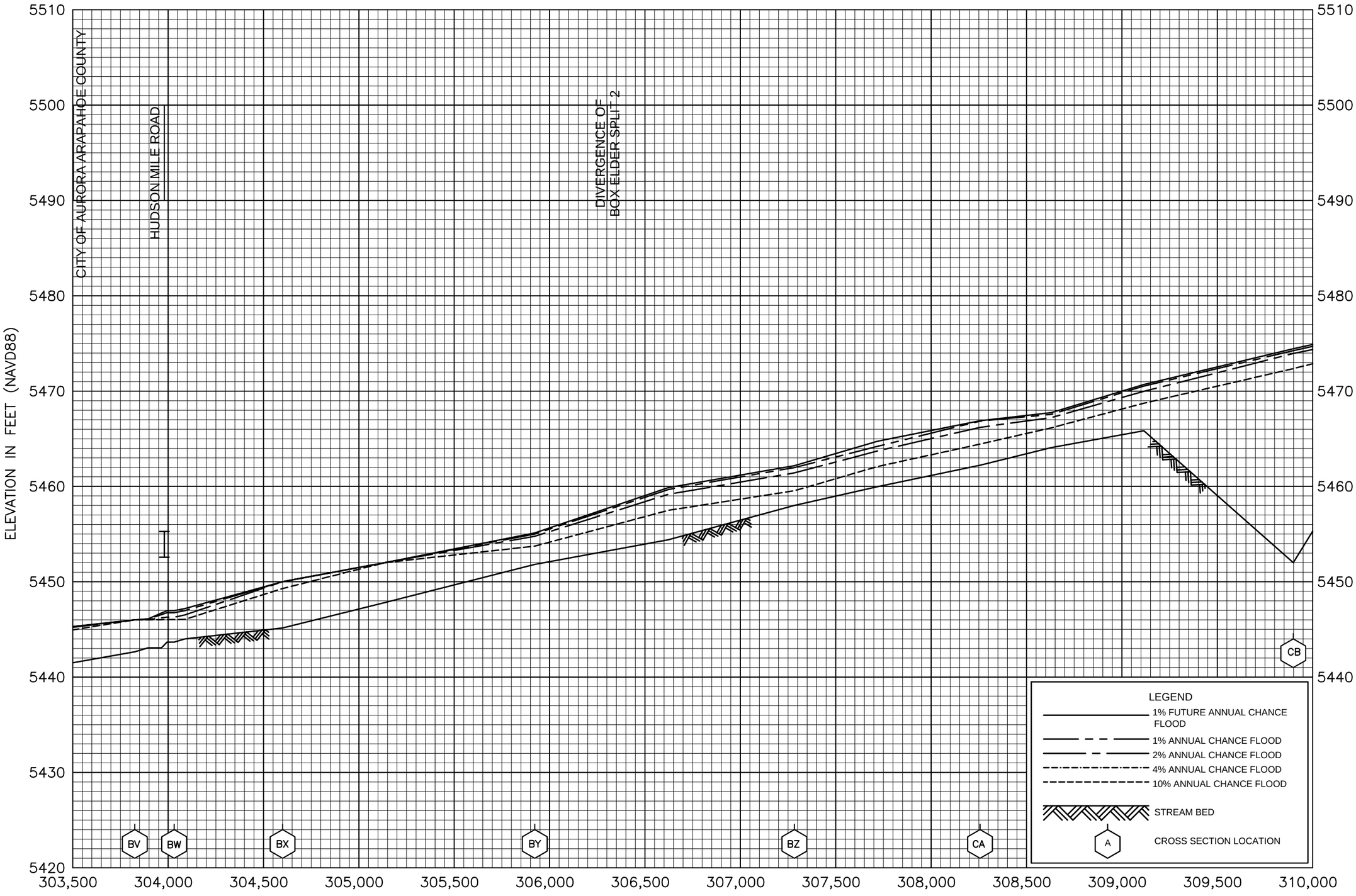
FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

046P



FLOOD PROFILES

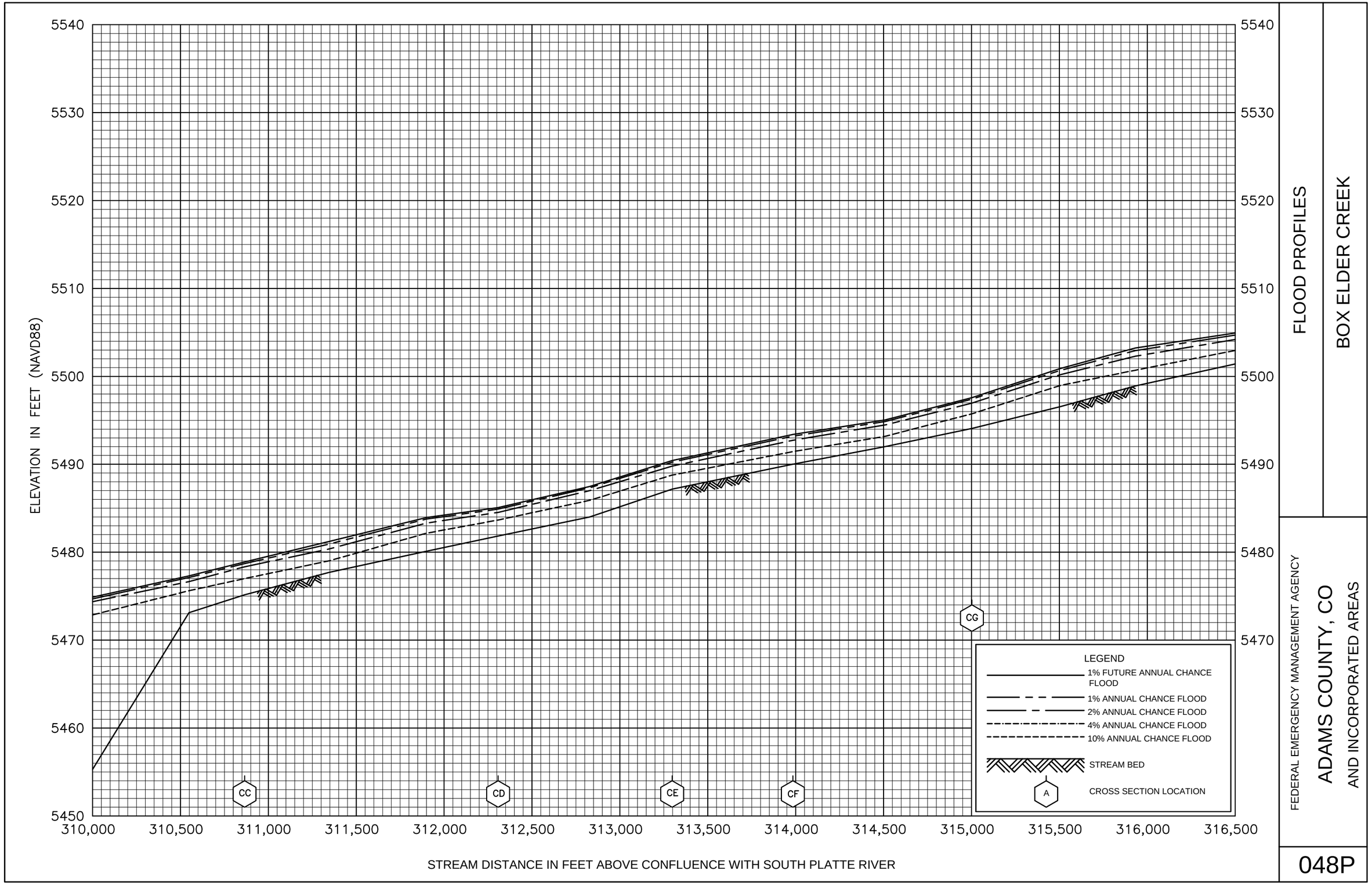
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

047P



FLOOD PROFILES

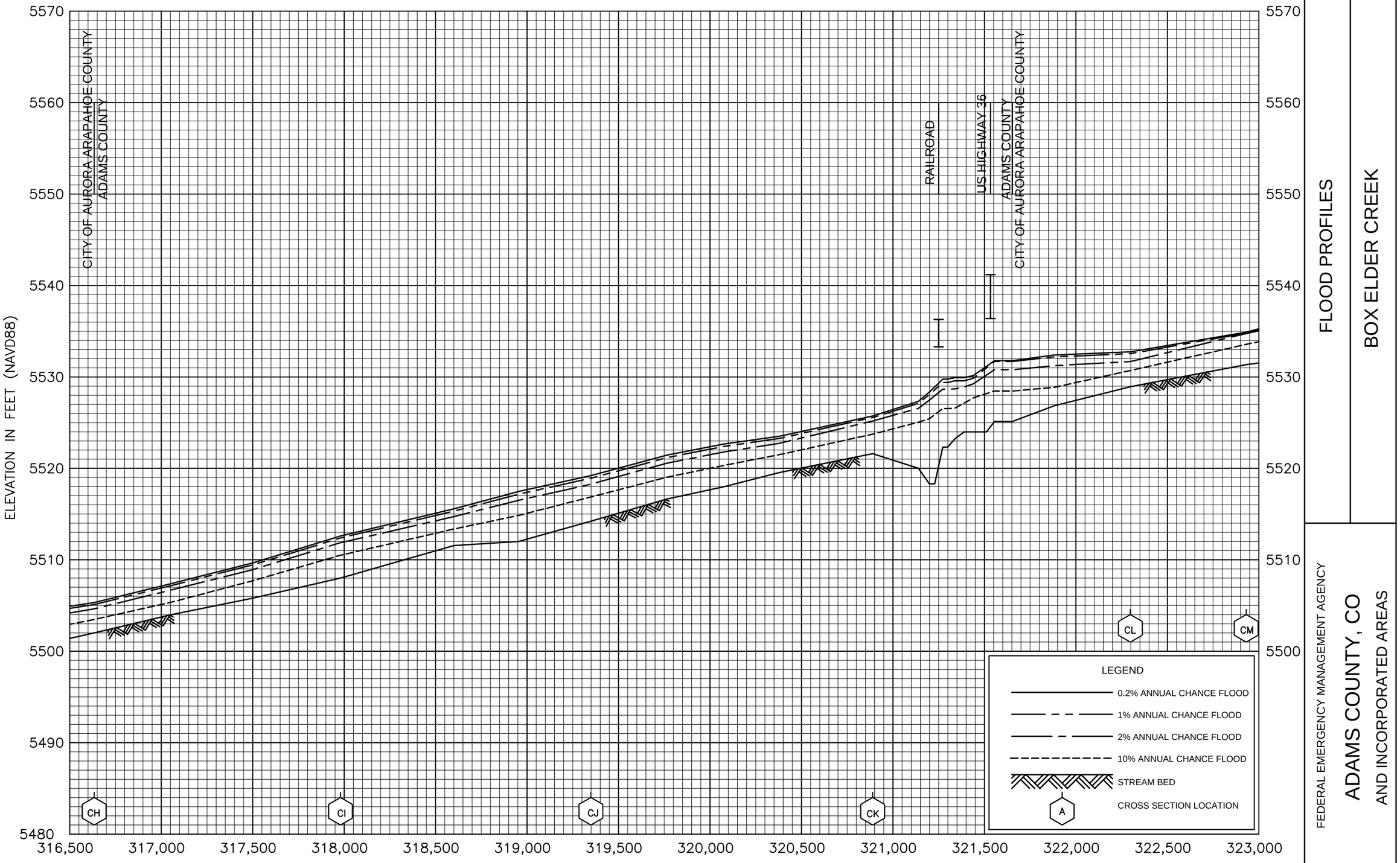
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

048P



FLOOD PROFILES

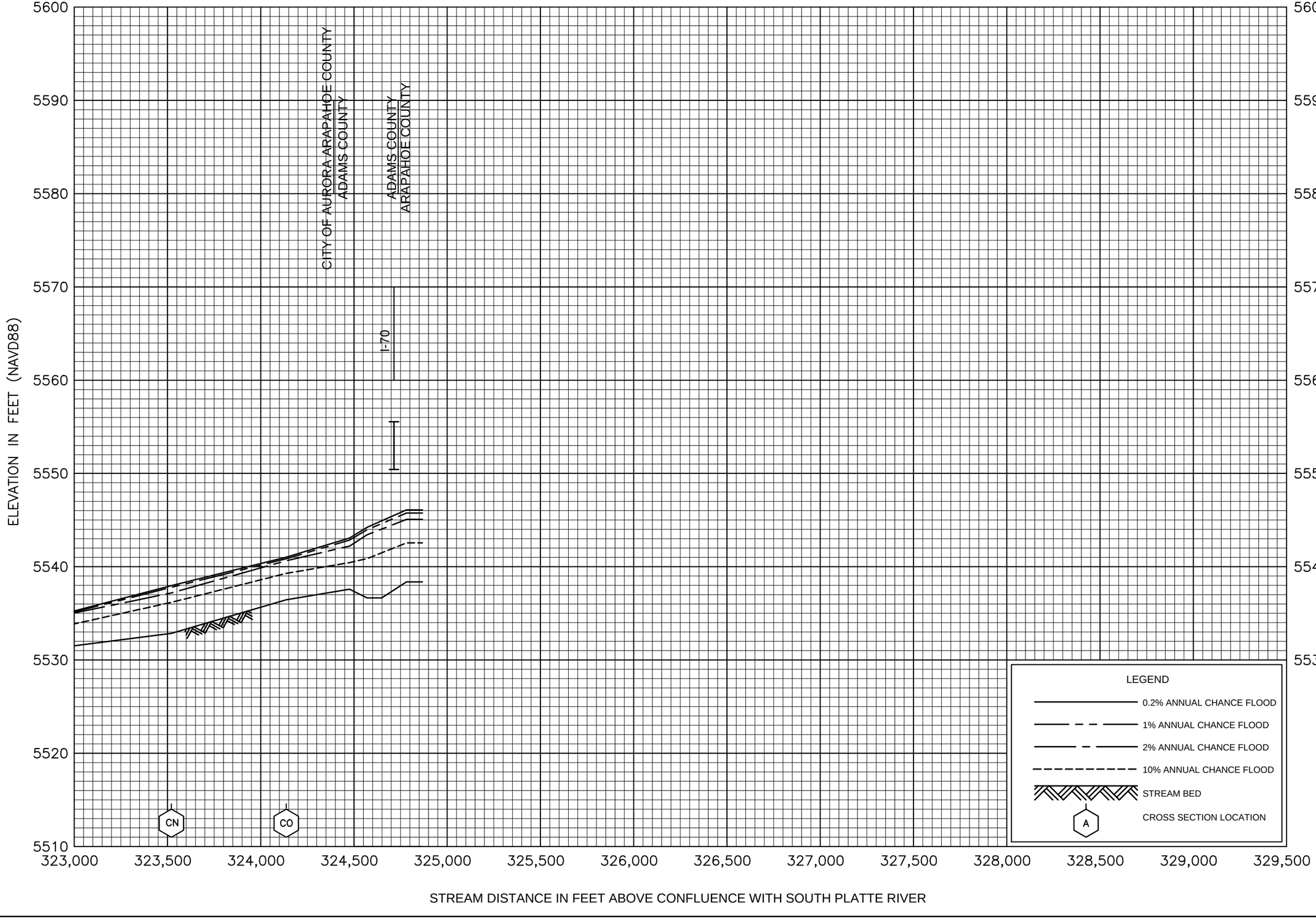
BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

049P



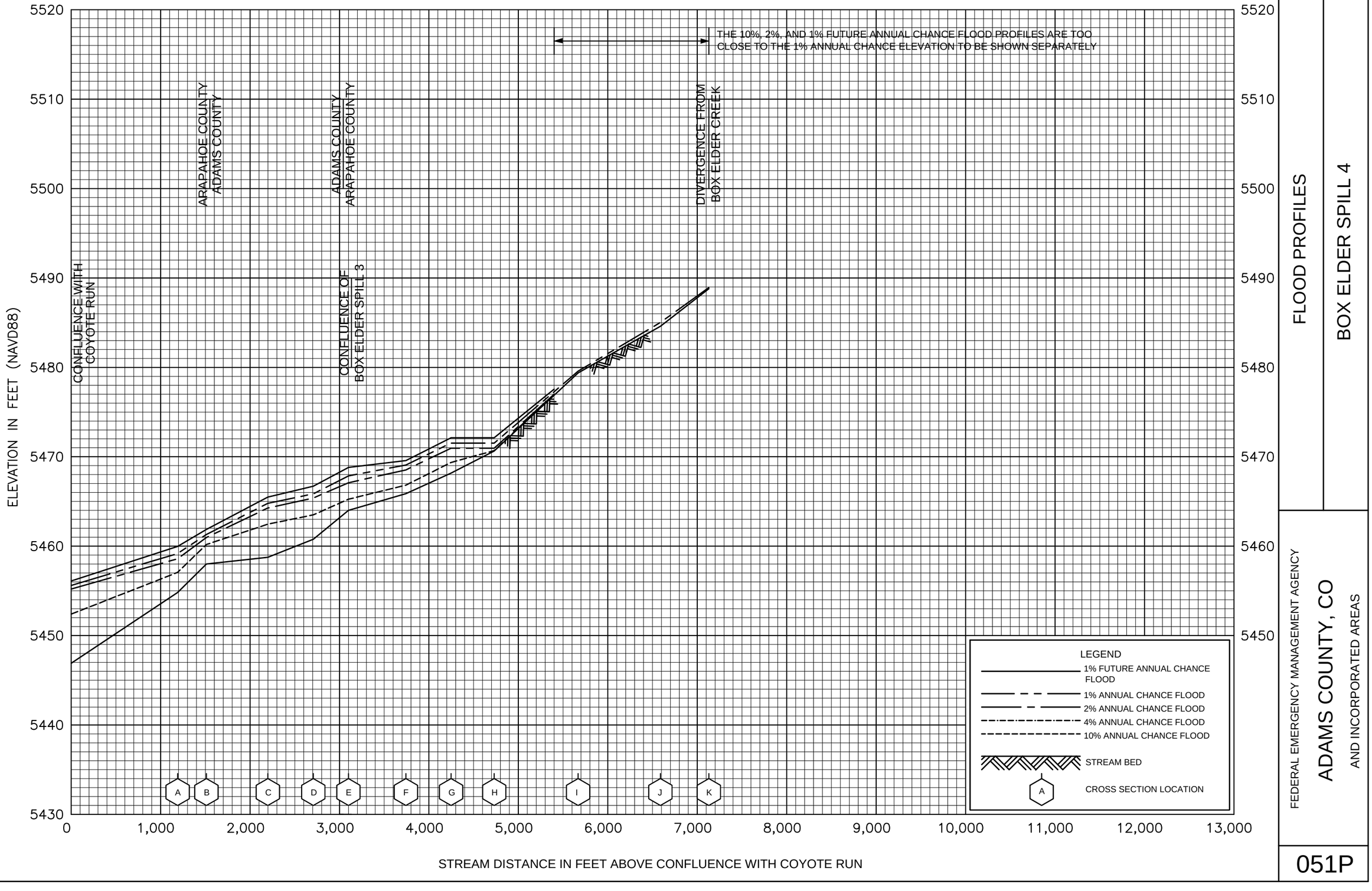
FLOOD PROFILES

BOX ELDER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

050P



FLOOD PROFILES

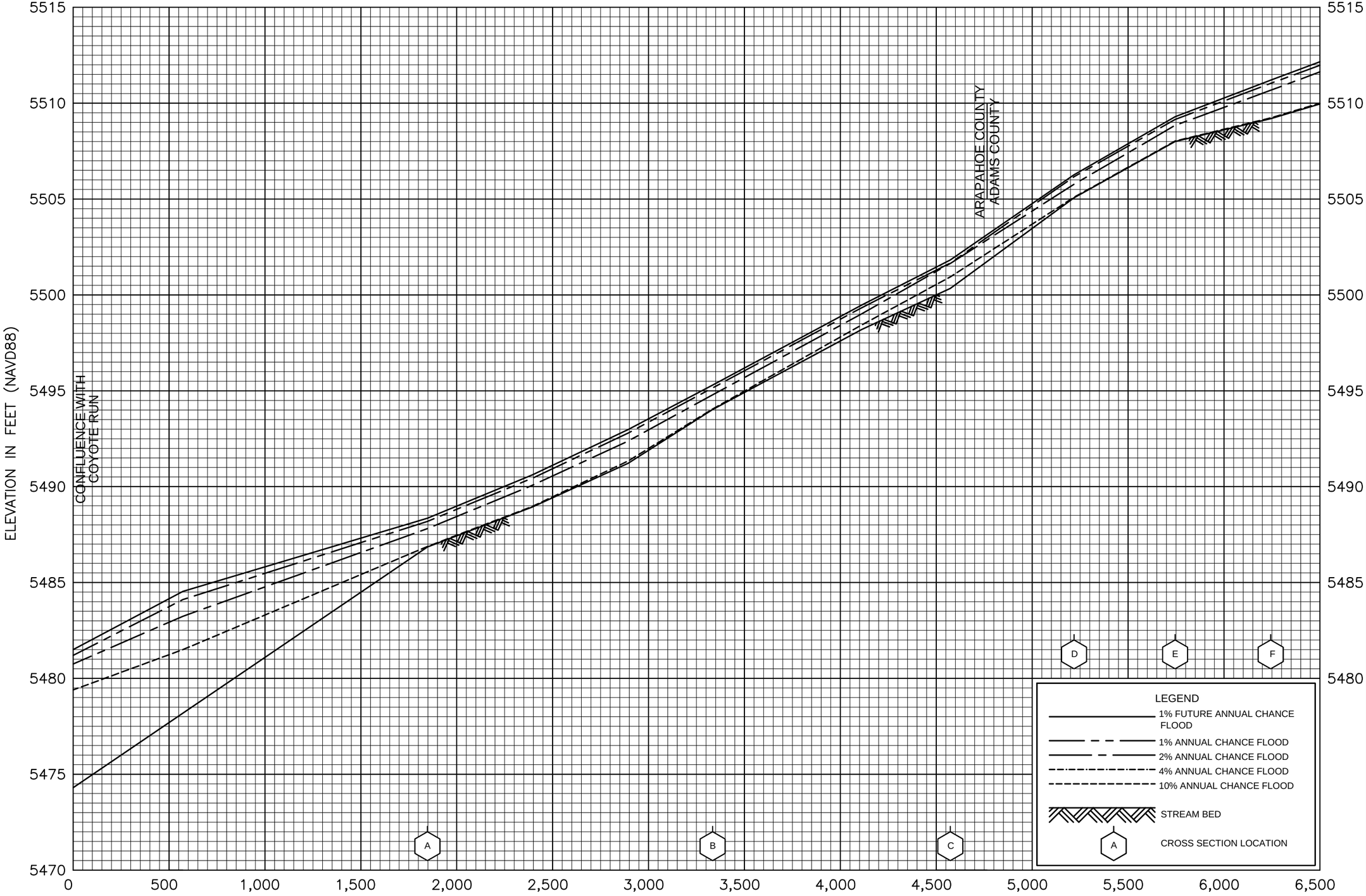
BOX ELDER SPILL 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

051P



FLOOD PROFILES

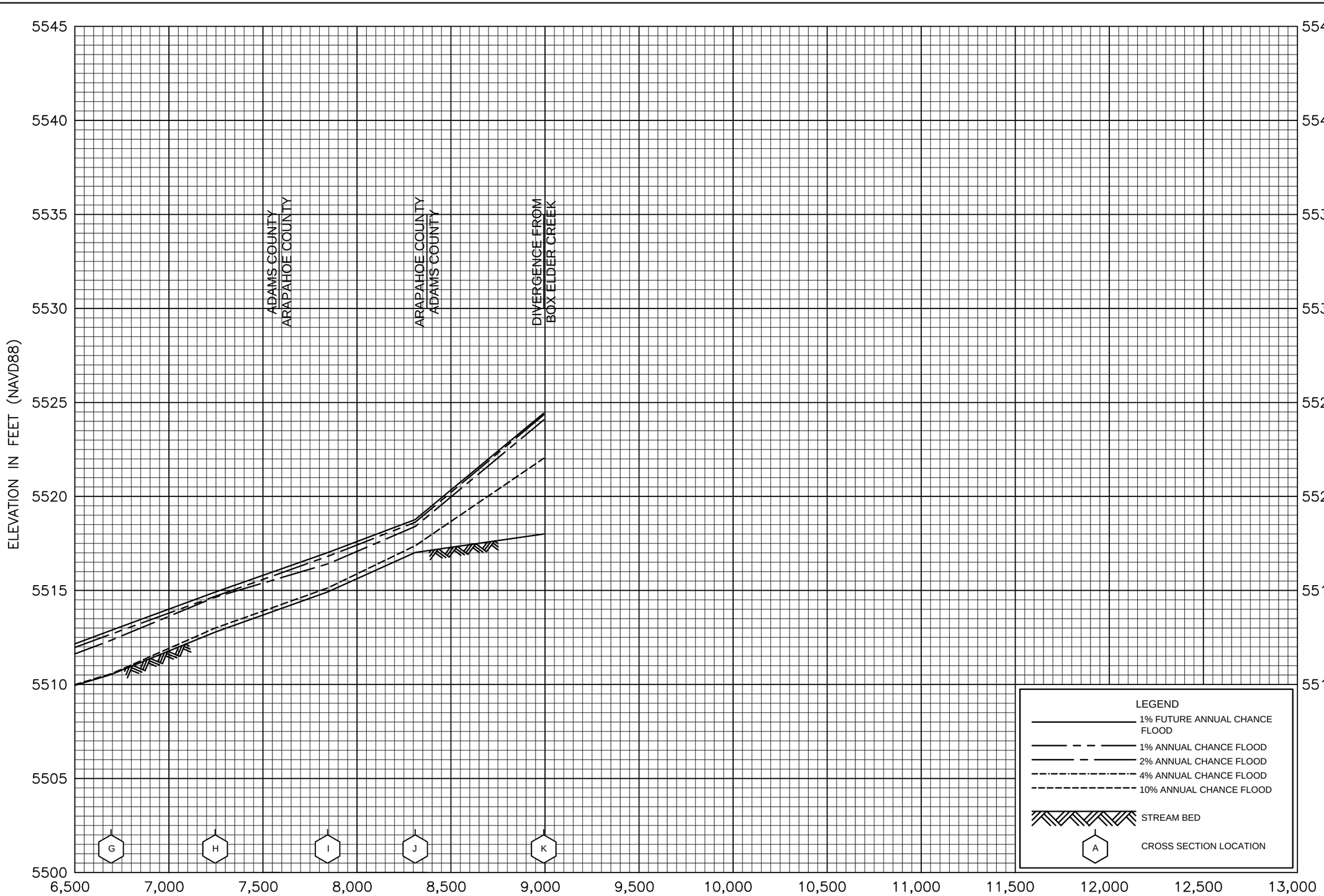
BOX ELDER SPILL 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

052P



FLOOD PROFILES

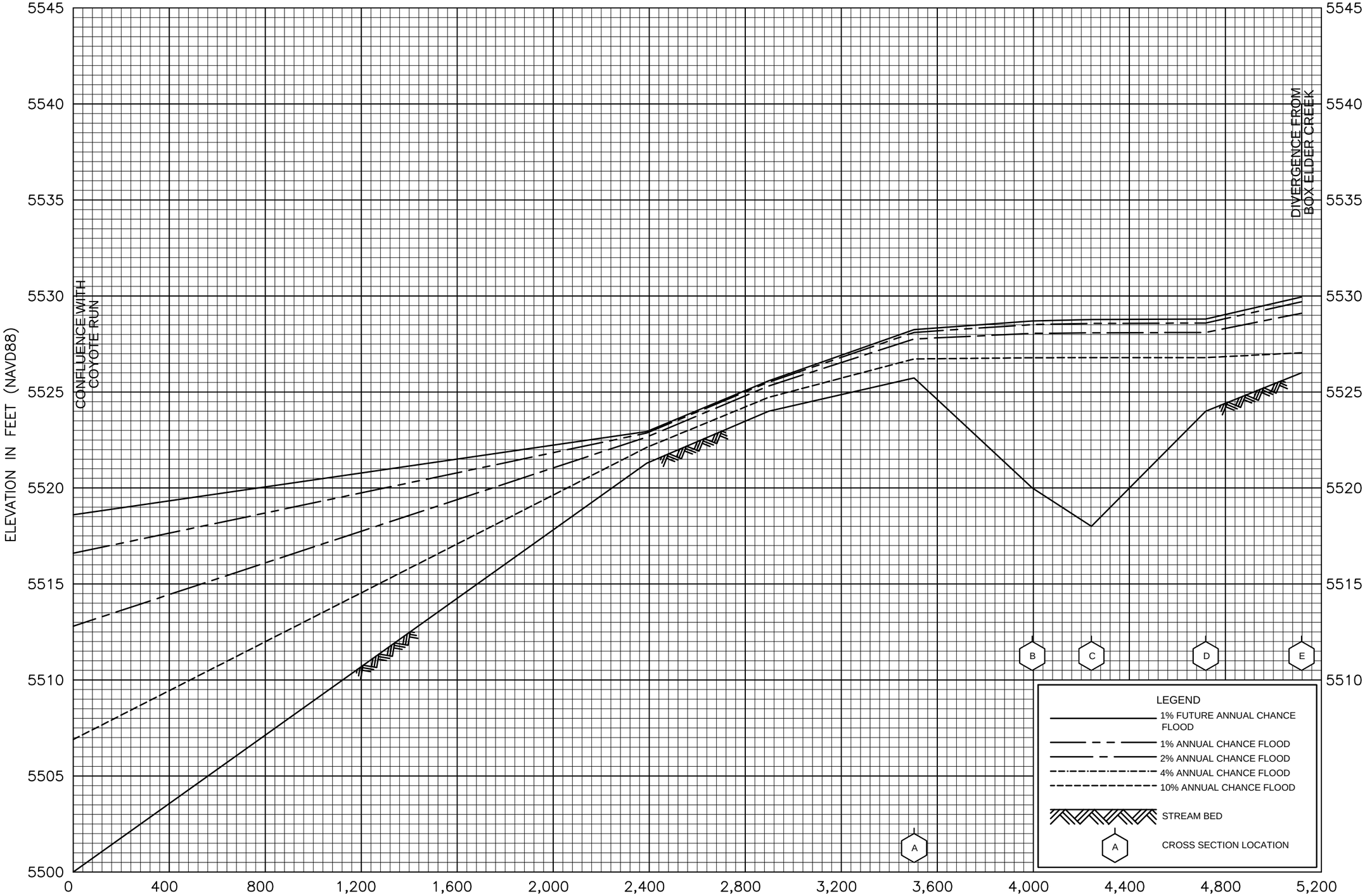
BOX ELDER SPILL 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

053P



FLOOD PROFILES

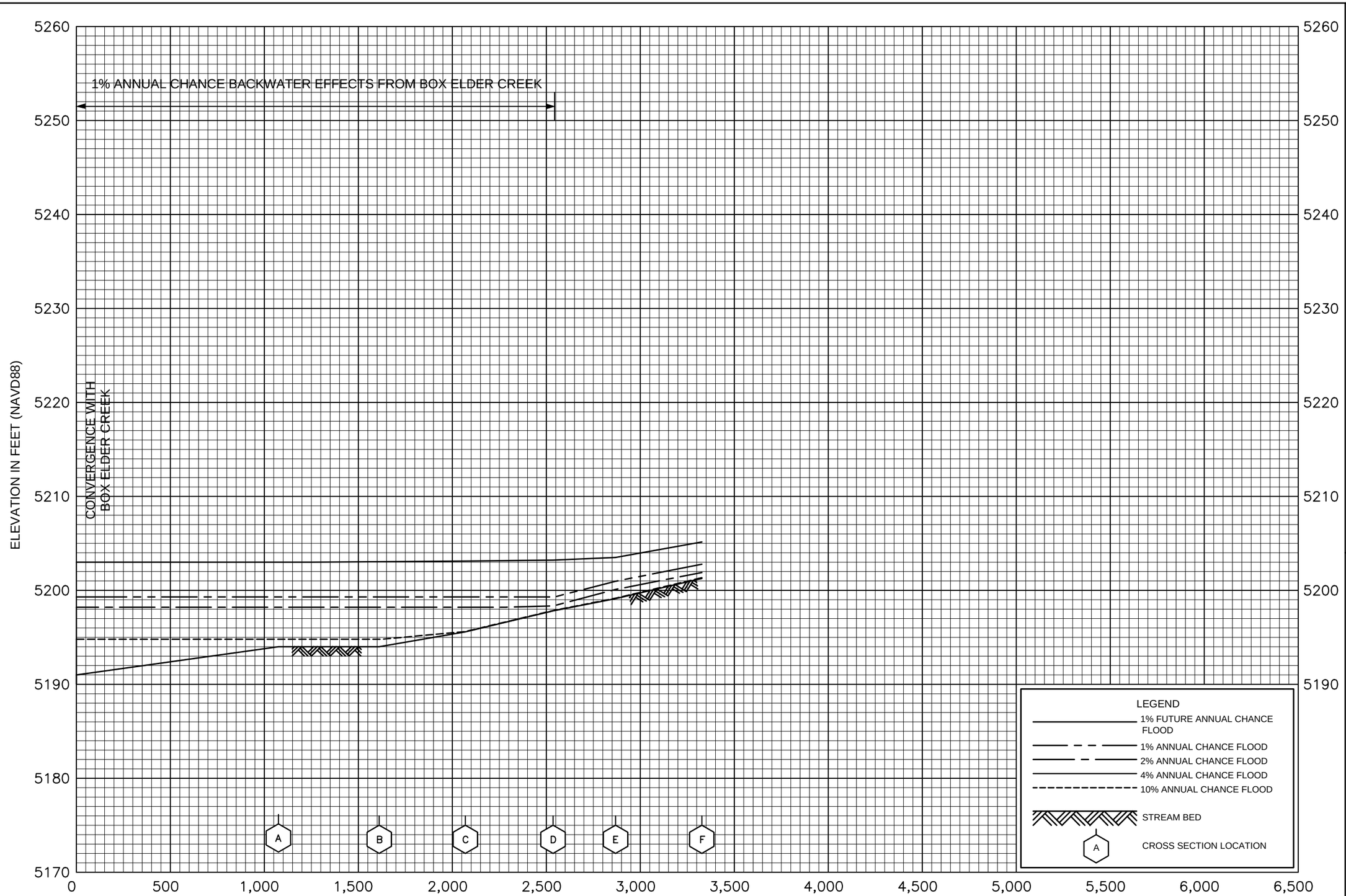
BOX ELDER SPILL 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

054P



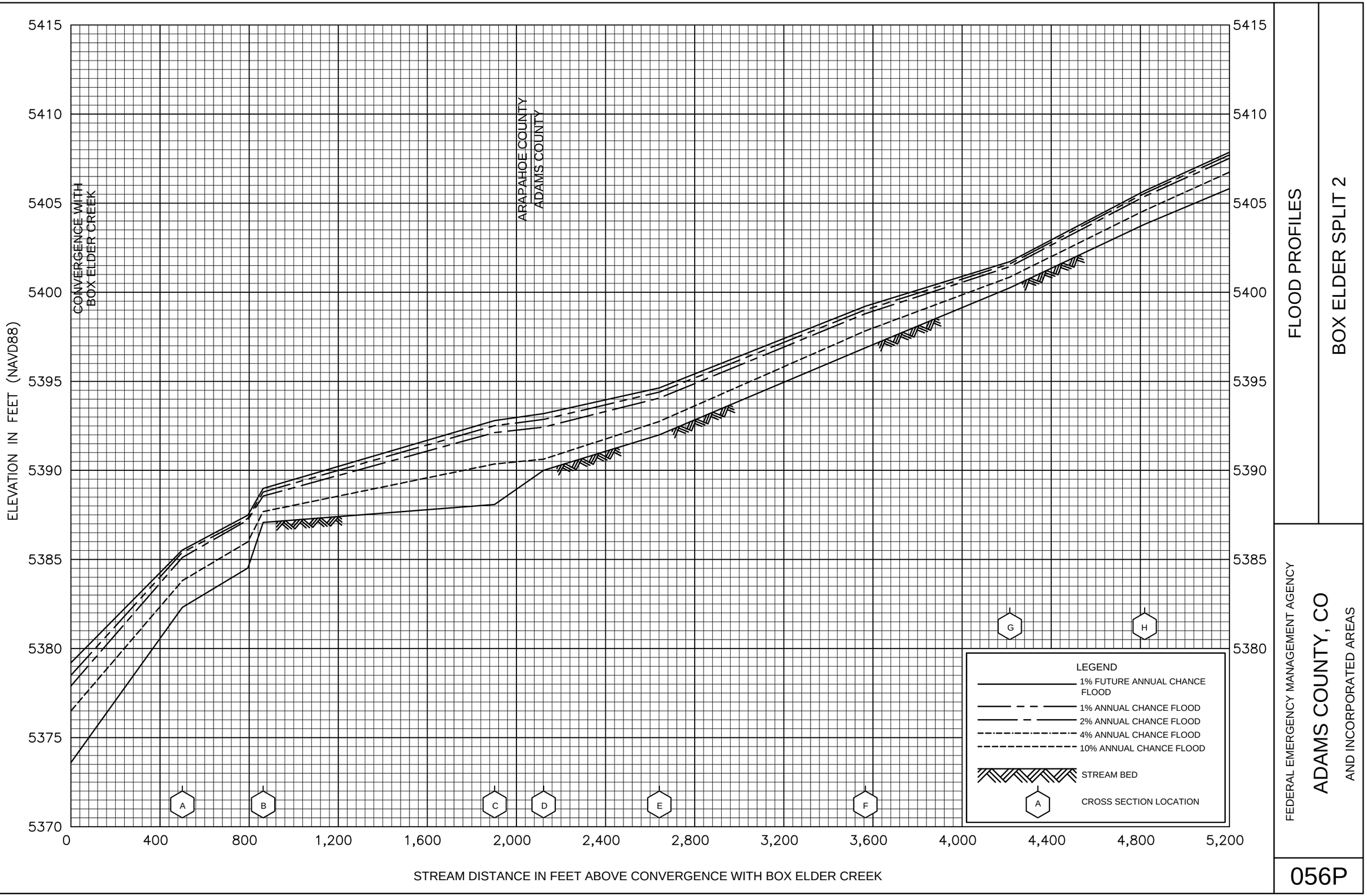
FLOOD PROFILES

BOX ELDER SPLIT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

055P



FLOOD PROFILES

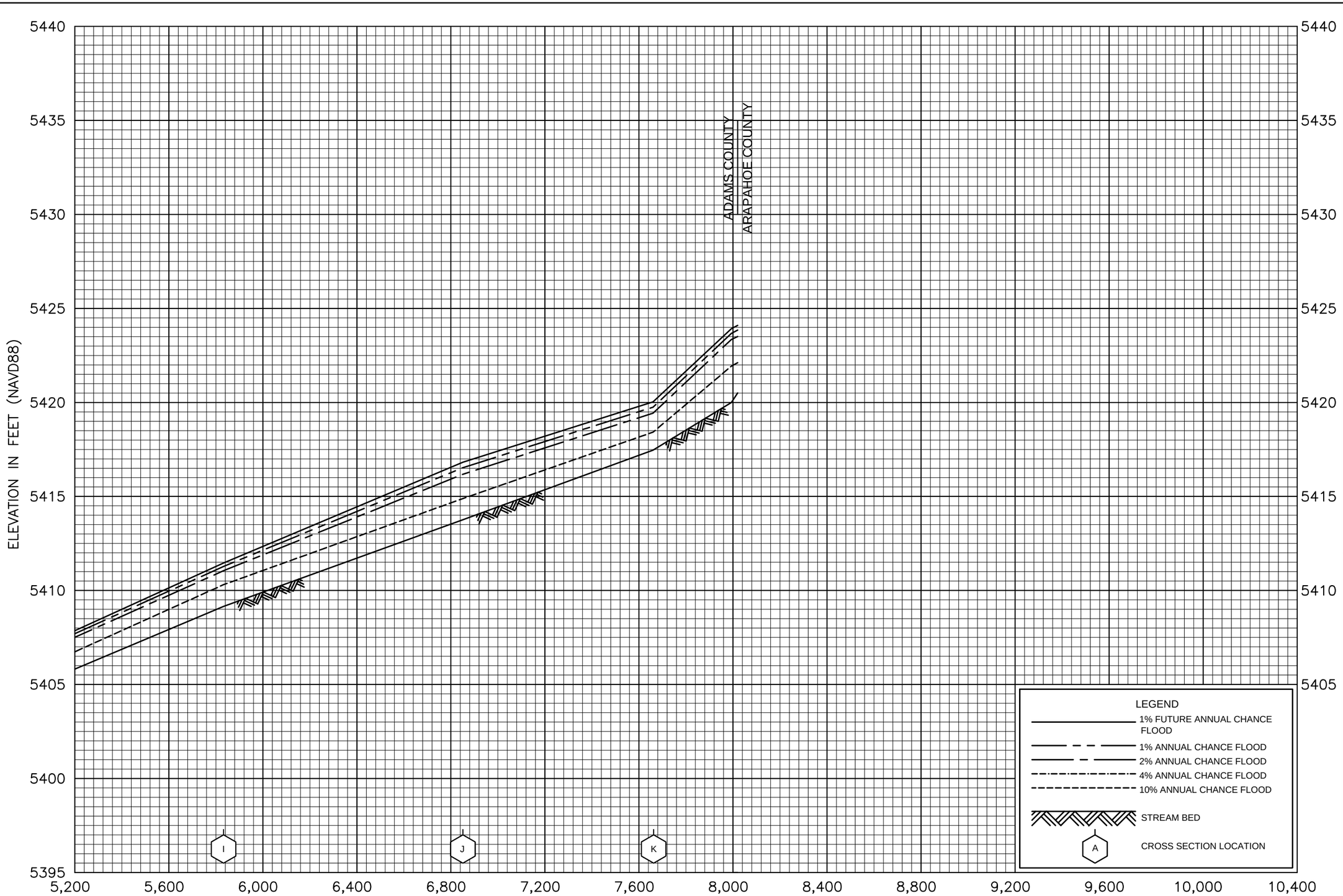
BOX ELDER SPLIT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

056P



FLOOD PROFILES

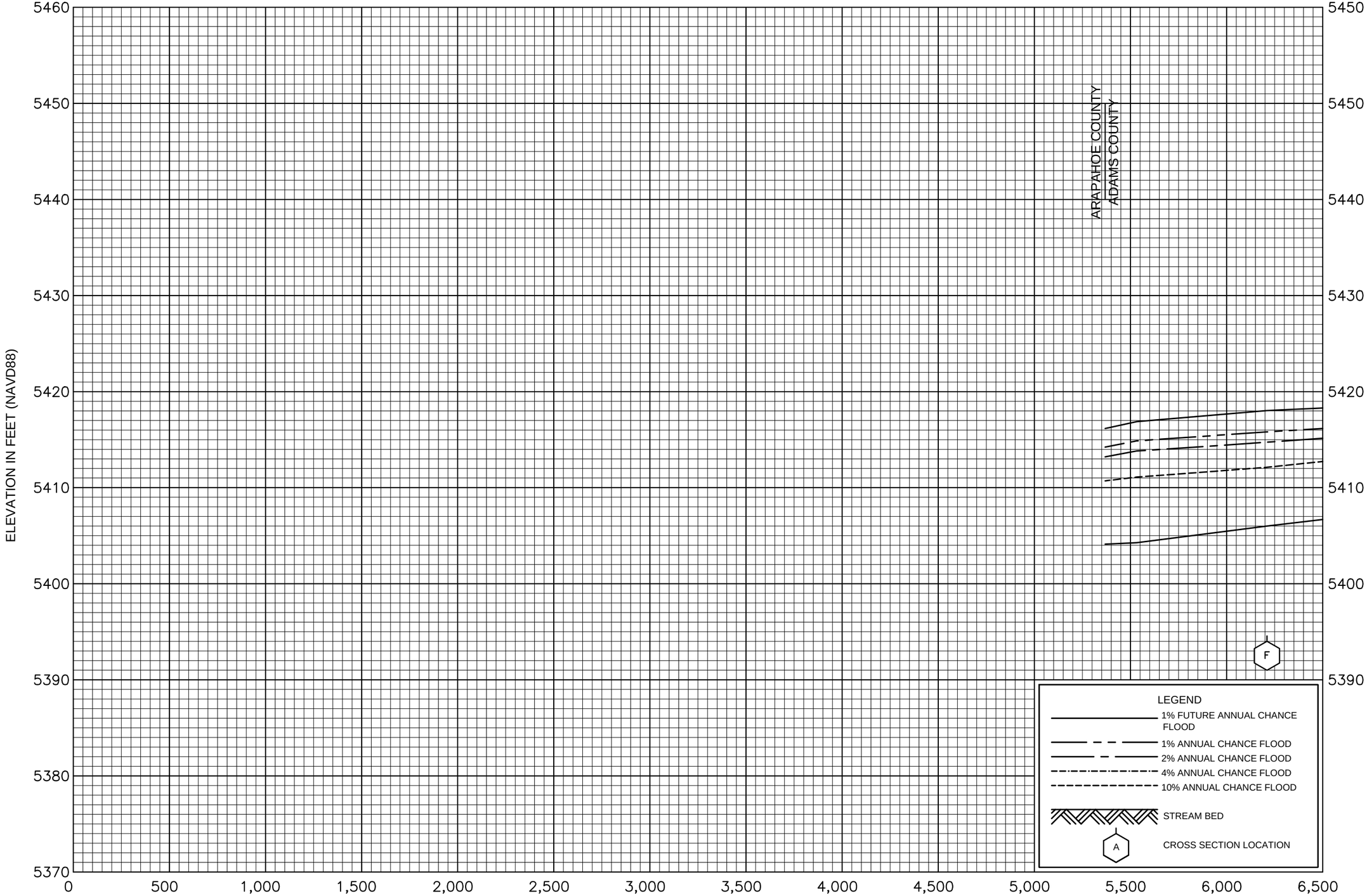
BOX ELDER SPLIT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

057P



FLOOD PROFILES

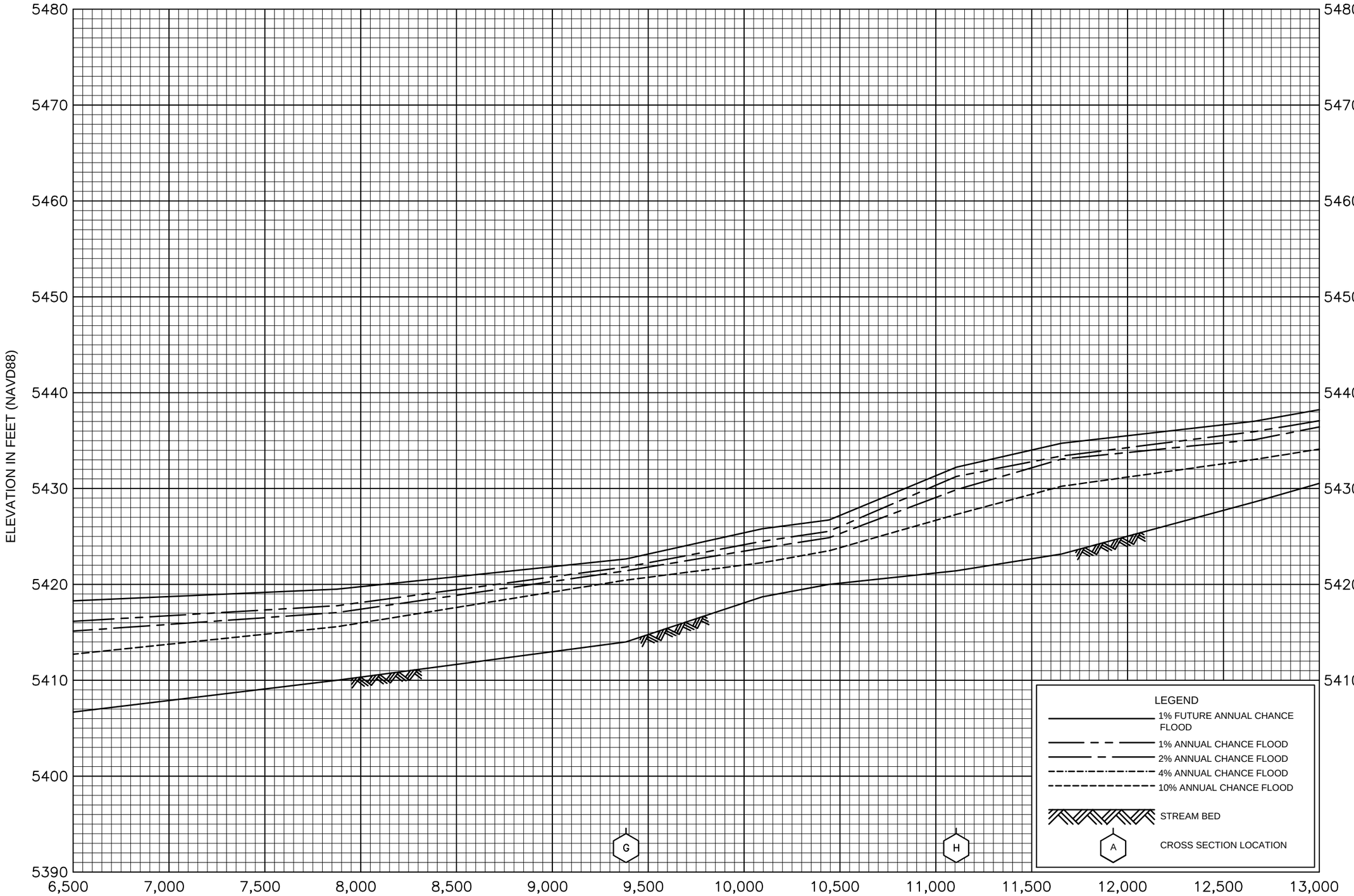
COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

090P



FLOOD PROFILES

COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

091P

ADAMS COUNTY
ARAPAHOE COUNTY

ELEVATION IN FEET (NAVD88)

5500
5490
5480
5470
5460
5450
5440
5430
5420
5410

13,000 13,500 14,000 14,500 15,000 15,500 16,000 16,500 17,000 17,500 18,000 18,500 19,000 19,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH BOX ELDER CREEK

I J K L

LEGEND
- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A — CROSS SECTION LOCATION

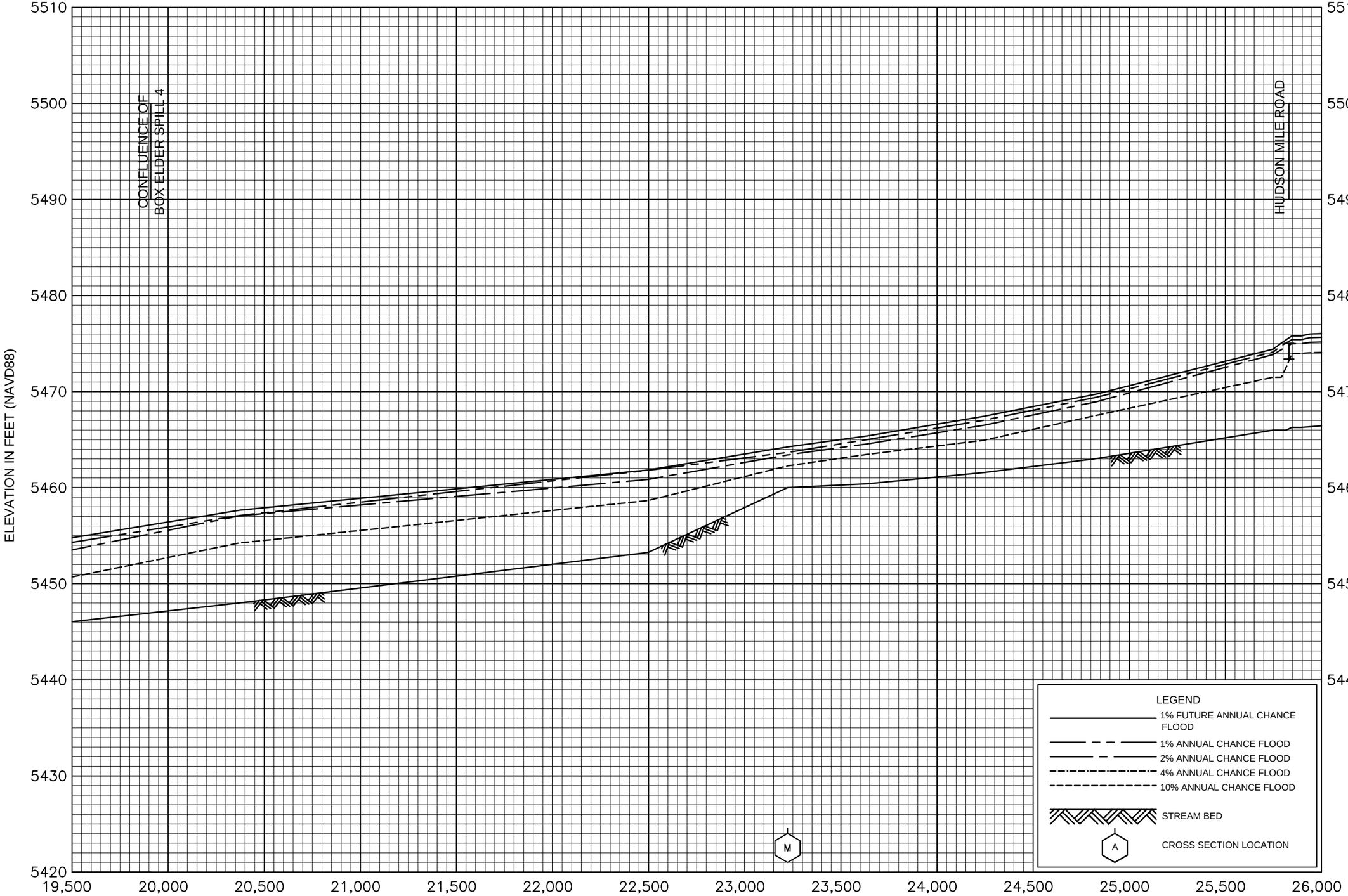
FLOOD PROFILES

COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

092P



FLOOD PROFILES

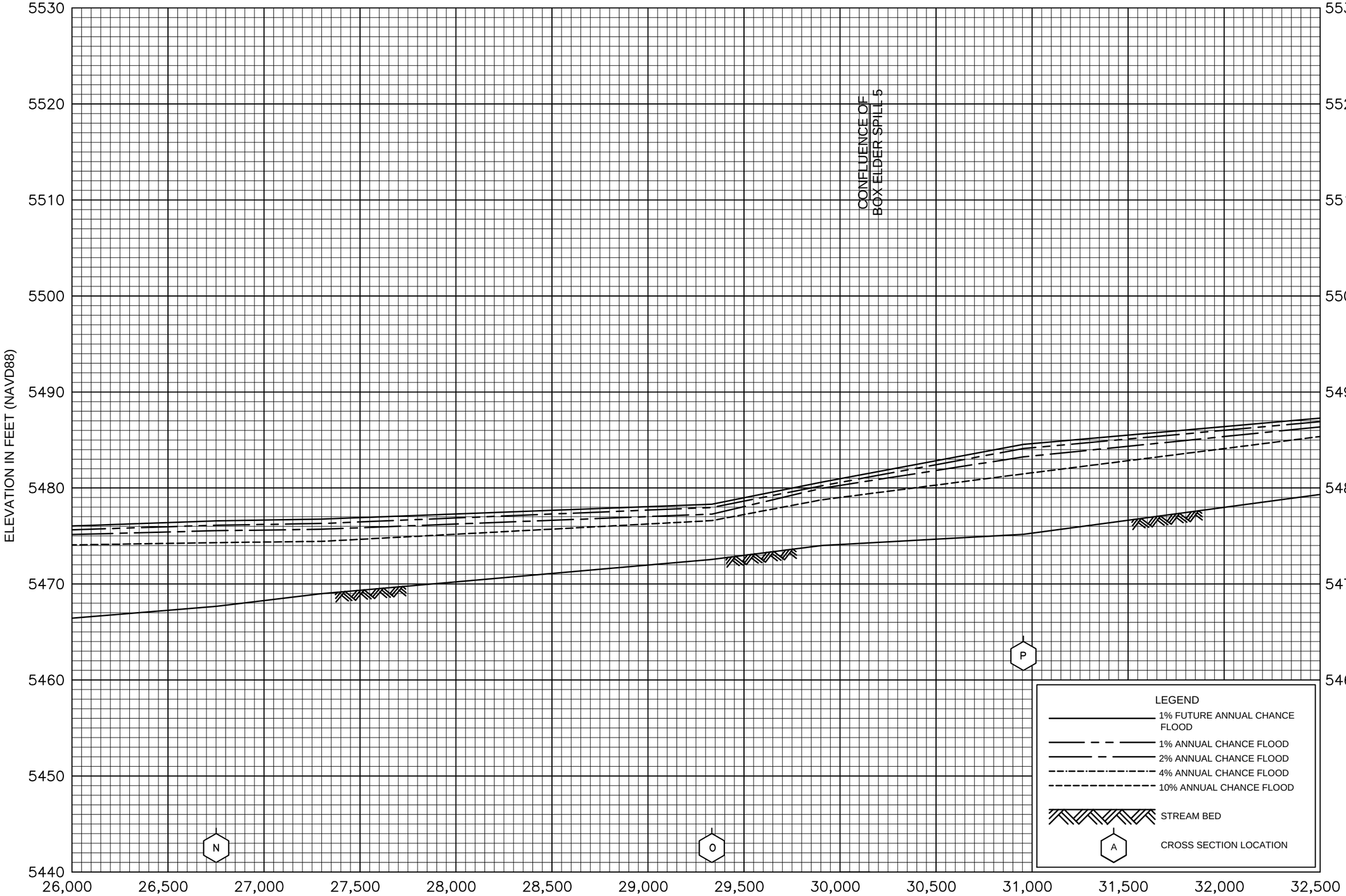
COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

093P



FLOOD PROFILES

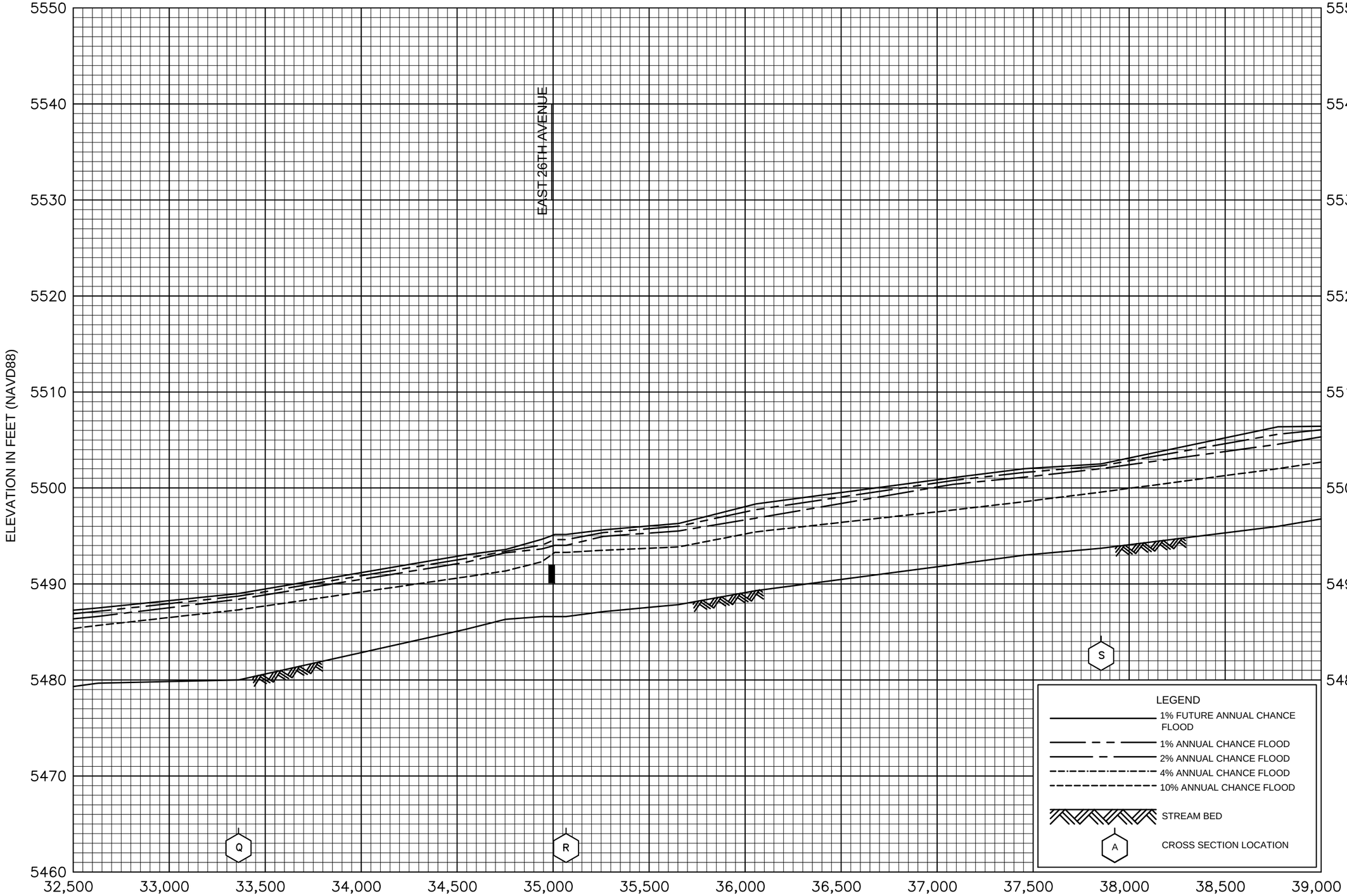
COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

094P



FLOOD PROFILES

COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO

AND INCORPORATED AREAS

095P

ELEVATION IN FEET (NAVD88)

5560
5550
5540
5530
5520
5510
5500
5490
5480
5470

ARAPAHOE COUNTY
ADAMS COUNTY
RAILROAD CROSSING
CONFLUENCE OF BOX ELDER SPILL 6
US HIGHWAY 36
I-70
ADAMS COUNTY
ARAPAHOE COUNTY

T U V W X Y

39,000 39,500 40,000 40,500 41,000 41,500 42,000 42,500 43,000 43,500 44,000 44,500 45,000 45,500

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH BOX ELDER CREEK

LEGEND
- 1% FUTURE ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 4% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- A CROSS SECTION LOCATION

FLOOD PROFILES

COYOTE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

ADAMS COUNTY, CO
AND INCORPORATED AREAS

096P