FLOOD INSURANCE STUDY

LINCOLN COUNTY, MISSOURI
AND INCORPORATED AREAS

Community Name	Community Number
CAVE, TOWN OF	290448
CHAIN OF ROCKS, VILLAGE OF	290750
ELSBERRY, CITY OF	290209
FOLEY, CITY OF	290210
FOUNTAIN N'LAKES, VILLAGE OF*	290459
HAWK POINT, CITY OF*	290201
LINCOLN COUNTY (UNINCORPORATED AREAS)	290869
MOSCOW MILLS, CITY OF	290546
OLD MONROE, CITY OF	290211
SILEX, VILLAGE OF	290212
TROY, CITY OF	290641
TRUXTON, VILLAGE OF*	290206
WHITESIDE, VILLAGE OF*	290470
WINFIELD, CITY OF	290213

*NON-FLOODPRONE

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
29113CV000B

PRELIMINARY
September 30, 2016

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
B	X
C	X

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

Initial Countywide Effective: September 29, 2010

Revised Countywide FIS Date: TBD

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FLOOD INSURANCE STUDY
LINCOLN COUNTY, MISSOURI AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 PURPOSE OF STUDY

This FIS revises and updates information about the existence and severity of flood hazards in the geographic area of Lincoln County, including the Cities of Elsberry, Foley, Hawk Point, Moscow Mills, Old Monroe, Troy, and Winfield; the Town of Cave; the Villages of Chain of Rocks, Fountain N'Lakes, Silex, Truxton, and Whiteside and the unincorporated areas of Lincoln County (referred to collectively herein as Lincoln 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 NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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

In addition, the City of Hawk Point; and the Villages of Fountain N'Lakes, Truxton, and Whiteside are non-floodprone communities.

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 analyses for the Mississippi River were performed by the US Army Corps of Engineers (USACE) as part of the Upper Mississippi River System Flow Frequency Study (UMRSFFS). This study was a collaboration of effort between the Rock Island, St. Louis, Kansas City, Omaha, and St. Paul districts and was completed in 2003. The floodway computations on the Mississippi River were performed for the Federal Emergency Management Agency (FEMA) under Contract No. EMW-2002-IA-0114 by the St. Paul, Rock Island, and St. Louis districts and were completed in 2004.

The floodplain mapping for the Mississippi River was performed by Watershed Concepts for FEMA under Contract No. HSFE07-07-C-0022.

This map modernization study was performed by Fuller, Mossbarger, Scott and May Engineers, Inc. for FEMA under Contract No. EMC-2001-CO-2018, Task Order No. EMC-2001-TO-06. This work was completed in June 2004.

Table 1 contains a chronological summary of the most recent analyses of flooding sources studied by detailed methods within Lincoln County, the study contractor, and the communities affected.

Table 1: Summary of Flooding Sources Presented in Current Study

Flooding Source	Completion Date	Study Contractor	Communities Affected
Butcher Creek	July 2014	USACE, St. Louis District	Lincoln County (Unincorporated Areas)
Crooked Creek	July 2014	USACE, St. Louis District	Lincoln County (Unincorporated Areas), City of Moscow Mills, & City of Troy
Meister Branch	July 2014	USACE, St. Louis District	Lincoln County (Unincorporated Areas)
Unnamed Tributary to Cuivre River	January 30, 2014	*	Lincoln County (Unincorporated Areas), & City of Moscow Mills
Unnamed Tributary to Unnamed Tributary to Cuivre River	January 30, 2014 November 2007	*	Lincoln County (Unincorporated Areas), & City of Moscow Mills
Whitcomb Branch	January 30, 2014	*	Lincoln County (Unincorporated Areas) & City of Troy
Cuivre River	July 31, 2008 August 1981	* USACE, St. Louis District	Lincoln County (Unincorporated Areas), & City of Old Monroe
Mississippi River	2003	USACE, St. Louis District	City of Elsberry, City of Winfield, & Lincoln County (Unincorporated Areas)
Bobs Creek	March 1988	Fox & Cole, Inc.	Lincoln County (Unincorporated Areas)
Brushy Fork Creek	March 1988	Fox & Cole, Inc.	Lincoln County (Unincorporated Areas)
Lost Creek	March 1988	Fox & Cole, Inc.	City of Elsberry & Lincoln County (Unincorporated Areas),
Sandy Creek	March 1988	Fox & Cole, Inc.	City of Foley & Lincoln County (Unincorporated Areas)
Big Creek	August 1981	USACE, St. Louis District	Lincoln County (Unincorporated Areas)
Buchanan Creek	August 1981	USACE, St. Louis District	Lincoln County (Unincorporated Areas) & City of Troy
McLean Creek	August 1981	USACE, St. Louis District	Lincoln County (Unincorporated Areas) & City of Winfield

*Data not available, incorporated from LOMRs

Table 1: Summary of Flooding Sources Presented in Current Study (cont'd)

Flooding Source	Completion Date	Study Contractor	Communities Affected
Mill Creek	August 1981	USACE, St. Louis District	Lincoln County (Unincorporated Areas) & Village of Silex
North Fork Cuivre River	August 1981	USACE, St. Louis District	Lincoln County (Unincorporated Areas) & Village of Silex
Town Branch	August 1981	USACE, St. Louis District	City of Elsberry City of Troy Lincoln County (Unincorporated Areas)

This initial countywide FIS report incorporates study data within the communities listed in Table 2, which had previously been published as separate community based studies, to create a comprehensive countywide product.

Table 2: Summary of Community Studies Used to Compile Initial Countywide FIS

Community Name	Study Contractor	Contract or Inter-Agency Agreement Number	Completion Date
Elsberry, City of (Reference 1)	Black and Veatch Consulting Engineers	H-3801	March 1976
Foley, City of (Reference 2)	USACE, St. Louis District	IAA-H-16-75, Project Order No. 15 IAA-H-7-76, Project order No. 13	August 1976
Lincoln County (Reference 3)	Fox & Cole, Inc. USACE, St. Louis District	EMW-89-C-2837 H-9-79, Project Order No. 36 and the First Amendment	March 1988 August 1981
Old Monroe, City of (Reference 4)	R.W. Booker & Associates, Inc.	R.W. Booker & Associates, Inc. H-4028	June 1977
Silex, Village of (Reference 5)	USACE, St. Louis District	IAA-H-9-79, Project Order No. 36 and the Second Amendment	January 1981
Troy, City of (Reference 6)	Booker Associates, Inc.	H-4730	July 1979
Winfield, City of (Reference 7)	USACE, St. Louis District	IAA-H-9-79, Project Order No. 36 and the Second Amendment	November 1980

1.3 COORDINATION

The purpose of an initial Consultation Coordination Officer (CCO) meeting is to discuss the scope of the FIS. An intermediate meeting is sometimes held to discuss the study procedures. The results of a study are reviewed at the Final CCO meeting. The following tabulation shows the dates of the CCO meetings for each incorporated community within Lincoln County.

Table 3: History of CCO Meetings Held for Lincoln County FISs

Community Name/FIS	Initial CCO Date	Intermediate Meeting Date	Final CCO Date
Elsberry, City of	March 11, 1975 June 11, 1975	October 1, 1975	March 9, 1976
Foley, City of	December 6, 1974	**	January 25, 1977
Lincoln County (Unincorporated Areas)	April 21, 1988	**	**
Old Monroe, City of	December 19, 1978	**	June 21, 1982
Silex, Village of	November 28, 1978	March 31, 1981	October 13, 1981
Troy, City of	April 1978	**	June 9, 1980
Winfield, City of	November 28, 1978	May 1, 1980	October 13, 1981
Lincoln County and Incorporated Areas*	**	**	May 9, 2009

*Countywide Compilation
**Data Not Available

2.0 AREA STUDIED

2.1 SCOPE OF STUDY

This FIS report covers the geographic area of Lincoln County, Missouri, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction. The scope and methods of study were proposed to, and agreed upon, by FEMA, the community, and the study contractor. "Streams Studied by Detailed Methods" are presented in Table 4.

Table 4: Streams Studied by Detailed Methods

Flooding Source	Reach Length (miles)	Study Area
Big Creek	14.6	From the confluence with the Cuivre River to a point approximately 5,390 feet upstream of County Route J
Bobs Creek	9.9	From a point approximately 200 feet downstream of State Route 79 to State Route 47
Brushy Fork Creek	5.2	From the confluence with Bobs Creek to County Route 691
Buchanan Creek	4.1	From the confluence with the Cuivre River to a point approximately 7,290 feet upstream of U.S. Highway 61
Butcher Creek	2.9	From the confluence with Crooked Creek to approximately 2.9 miles upstream
Crooked Creek	13.7	From the confluence with the Cuivre River to approximately 13.66 miles upstream
Cuivre River	27.0	From the confluence with the Mississippi River to a point approximately 220 feet upstream of the confluence of Big Creek and from a point approximately 2,200 feet downstream of County Route 814 to a point approximately 11,300 feet upstream of State Route 47
Lost Creek	3.8	From a point approximately 100 feet downstream of State Route 79 to a point approximately 19,800 feet upstream of State Route 79
McLean Creek	1.1	From the confluence with the Mississippi River to a point approximately 2,090 feet upstream of State Route 79
Meister Branch	1.4	From the confluence with the Crooked Creek to approximately 245 feet downstream of Witte Road.
Mill Creek	1.4	From the confluence with the North Fork Cuivre River to a point approximately 1,060 feet upstream of County Route E
Mississippi River	26.0	From a point approximately 2.8 miles downstream of the confluence of the Cuivre River to a point approximately 23.2 miles upstream of the confluence of the Cuivre River
North Fork Cuivre River	1.1	From a point approximately 980 feet downstream of the confluence of Mill Creek to a point approximately 1,110 feet upstream of County Route E
Sandy Creek	7.0	From a point approximately 450 feet downstream of State Route 79 to a point approximately 12,900 feet upstream of County Route 645
Town Branch	2.4	From the confluence with Buchanan Creek to a point approximately 2,900 feet upstream of Lincoln Drive
Unnamed Tributary to the Cuivre River*	2.0	From the confluence with the Cuivre River to approximately 900 feet downstream of U.S. 61
Unnamed Tributary to Unnamed Tributary to the Cuivre River*	0.6	From the confluence with the Unnamed Tributary to the Cuivre River to approximately 3,150 feet upstream
Whitcomb Branch*	4.5	From the confluence with the Cuivre River to approximately 2,250 FT upstream of South Camelot Road

* LOMR incorporation

Approximate methods of analysis were used to study all remaining areas having a potential flood hazard that did not have available scientific or technical data. All or portions of numerous flooding sources in the county were studied by approximate methods.

Mapping for Lincoln County, Missouri, and Incorporated Areas has been prepared using digital data. Previously published FIRM and FBFM data produced manually have been converted to vector digital data by a digitizing process.

There are four Letters of Map Change that have been incorporated into this countywide study, as shown in Table 5.

Table 5: Letters of Map Change

Community	Case Number	Flooding Source(s)	Effective Date	Status
Lincoln County (Unincorporated Areas) & City of Troy	01-07-201P	Buchanan Creek	09/24/2001	Incorporated
City of Troy	03-07-102P	Town Branch	05/19/2004	Incorporated
Lincoln County (Unincorporated Areas)	06-07-BA52P	Unnamed Tributary to the Cuivre River, Unnamed Tributary to Unnamed Tributary to the Cuivre River	11/28/2007	Superseded by 13-07-1368P
Lincoln County (Unincorporated Areas)	07-07-1516P	Cuivre Creek, Crooked Creek, Butcher Creek	07/31/2008	Incorporated
Lincoln County (Unincorporated Areas) & City of Troy	13-07-1363P	Whitcomb Branch	01/30/2014	Incorporated
Lincoln County (Unincorporated Areas) & City of Moscow Mills	13-07-1368P	Unnamed Tributary to the Cuivre River, Unnamed Tributary to Unnamed Tributary to the Cuivre River	01/30/2014	Incorporated

2.2 COMMUNITY DESCRIPTION

Lincoln County is located on the eastern border of central Missouri. It is bordered by Pike County to the north; St. Charles and Warren Counties to the south; Montgomery County to the west; and by the Mississippi River and Calhoun County, Illinois to the east. The county encompasses approximately 625 square miles of land. The population in 2000 was 38,944 and was estimated at 50,123 in 2006 (Reference 8). The major transportation routes through the county are U.S. Highway 61 and State Highways 47 and 79. The Burlington Northern Railroad also passes through the county.

Lincoln County was organized in 1818 and was named in memory of General Benjamin Lincoln of Massachusetts, an officer and friend of George Washington (Reference 9). Today, Lincoln County is growing at a modest rate. There are 12 manufacturing facilities in the county and four of them employ more than 20 workers each (Reference 10).

The following tabulation shows temperature averages for Lincoln County in degrees Fahrenheit (°F):

Season	Average High (°F)	Average Low (°F)
Winter	46	25
Spring	67	44
Summer	86	64
Fall	69	47

Temperature extremes have ranged from -20°F to 110°F. Annual precipitation averages approximately 37 inches and is distributed fairly evenly throughout the year. Monthly precipitation will vary from approximately 1.5 inches per month in December, January, and February, to approximately 4.5 inches per month in May, June, and September (Reference 11).

Soils in the upland are moderately to steeply sloping, moderately to well-drained silt loam. They are of the Keswick-Findley association, which consists of deep soils formed in glacial till. The Keswicks are found on ridgetops and side slopes. They are moderately well-drained silt loam underlain by clay. The Findley soils are moderately steep to steep, well-drained loam found on more dissected side slopes below the Keswick Soils. They are underlain by clay loam. Soils in the uplands are suitable for pasture, woodland, and wildlife, with cultivation on the moderate slopes (Reference 12).

The land in Lincoln County varies from wide valleys and steep hillsides to rolling uplands. Along the Mississippi River is a floodplain averaging approximately three miles wide. It is bounded on the west by rock bluffs that vary from 50 to 200 feet in elevation. These bluffs are cut in several places by narrow valleys through which flow the streams that lie east of the dividing ridge. The main ridge is nearly parallel with the Mississippi River. The eastern half of the county has an uneven surface with ridges rising in places more than 100 feet above the adjacent valleys. The western half of the county is mostly high rolling prairie, cut through in several places with tributaries to the Cuivre River. The prairie land comprises one fourth to one third of the area in the county (Reference 9).

The eastern edge of the county is in the Mississippi River alluvial floodplain. Surface soils in the area consist of 10 to 20 feet of silty clay (loess). This is underlain by fine to medium sand, which generally becomes coarser with depth. Bedrock is located at a depth of 70 to 80 feet. Due to good vertical permeability of loess and the underlying sand, the area is well drained with moderately to gently sloping topography. The area is underlain by Mississippian age limestones of the St. Louis, Salem, and Warsaw formations.

The City of Elsberry is located in Lincoln County, approximately 60 miles north of St. Louis, Missouri, on State Highway 79. The city is neatly tucked into the hillside that borders the western floodplain of the Mississippi River, whose channel is about 3 1/2 miles east of Elsberry.

The population of Elsberry is 2,047 according to the 2000 Census (Reference 8). Elsberry serves as a trade center which provides goods and services for the surrounding farming community. Experimental farming operations are conducted by the U.S. Department of Agriculture on government-owned river bottom land south of the city.

The corporate boundaries of Elsberry encompass an area of approximately 350 acres. The Mississippi River floodplain extends into the eastern and southern part of the city, where the land is fairly flat, having an elevation of approximately 450 feet above mean sea level. The adjoining upland is moderately hilly, rising to an elevation of approximately 560 feet in the extreme northwest section of town. Stormwater runoff from approximately 0.43 square mile of

upland area contributes to the flow in Town Branch, which runs south through the city to a confluence with Lost Creek just south of the city limits. Lost Creek flows east along the south city boundary and has a contributing area of approximately 14.5 square miles (Reference 13).

The City of Foley is located approximately 40 miles north of St. Louis, Missouri on State Highway 79. The city is located in the western floodplain of the Mississippi River and opposite river miles 244 to 245 above the mouth of the Ohio River. The Mississippi River channel is approximately 1.5 miles east of Foley. The Burlington Northern Railroad and State Highway 79 pass through the community in a north-south direction. The community is laid out on a grid street pattern, paralleling the railroad and the riverfront. Foley, Missouri, was incorporated as a city on May 15, 1900.

The population of Foley is 178, as listed in the 2000 census (Reference 8).

The corporate boundaries of Foley encompass an area of approximately 380 acres. The land is fairly flat at an elevation of approximately 440 feet. The upland to the west is moderately hilly, rising to an elevation of approximately 540 feet.

Sandy Creek, located outside the corporate limits, flows around the community on the west and north sides and empties into the Mississippi River at river mile 245.

The City of Foley is underlain by thick deposits of sand, gravel, till (boulder clay), and loess (wind-blown silt). During earlier geologic periods, the area was submerged, resulting in the deposition of thick limestone beds, shale, and sandstone. The area's dominant vegetation includes species of maple, elm, cottonwood, and pin oak trees, small shrubs, and urban lawns.

The City of Old Monroe is located in the eastern portion of Lincoln County. The community lies on the north bank of the Cuivre River along the western fringe of the Mississippi River floodplain. The community, which has a population of 250 by the 2000 census, (Reference 8), encompasses some 20 acres and is entirely urbanized.

Missouri State Highway 79 runs through the community and provides access to employment and commercial centers located in St. Charles and St. Louis. Old Monroe also serves as a junction point on the Burlington Northern Railway, with the main line and small transfer yard passing through the community and running parallel to Highway 79.

The Village of Silex is located in the northwestern quarter of Lincoln County. It is located about five miles west of U.S. Highway 61 and is about 12 miles northwest of Troy, the county seat. The Village of Silex is completely surrounded by the unincorporated areas of Lincoln County. The Village of Silex was laid out and platted in 1882, by Mr. Portus B. Weare. The village consisted of only two stores until 1884, when the Moseley Hotel was begun. In the early days, the village was serviced by the St. Louis and Keokuk Railroad. The Village of Silex was then the principal outlet for a large tract of good agricultural lands, especially in the western part of Lincoln County. By the later 1880s, there were nearly 300 inhabitants in the village. By 1960, the population had dwindled to 176 people; however, by 2000, the population was at 206 (Reference 8).

The topography at the Village of Silex is gentle to moderately sloping and surficial soils consist of sandy clay of glacial origin. Mississippian age rocks of the Chouteau group are exposed in the Village of Silex area. They consist of sandstone of the Bachelor Formation, shale and siltstone of the Hannibal Formation, and an unnamed limestone unit. Structurally, the Village of Silex area lies approximately five miles west of the north-south extension of the Cape au Gris fault system. Vegetation consists of a few native hardwood trees and other landscaping trees and scrubs.

Development within the community is a combination of agricultural and residential. Within the floodplain, the development is mostly residential.

The City of Troy, Missouri is located in southern Lincoln County, and serves as the county seat. The community, which encompasses an area of approximately 2.2 square miles, had a population of 6,737 in 2000 (Reference 8). Troy is bordered on all sides by unincorporated areas of Lincoln County.

The topography of the community is characterized by gently to moderately rolling terrain. Runoff from the entire community drains into the three creeks, which were studied in detail. They run in a west to east direction. Runoff enters the creeks either directly or by one of their tributaries. The majority of these tributaries were studied by approximate methods.

Soils in Troy are a moderately to steeply sloping, moderately to well-drained silt loam. They are of the Keswick-Findley Associates, which are deep soils formed in glacial till. The Keswicks are found on the ridgetops and side slopes. They are a moderately well-drained silt loam underlain by clay. The Findley soils are a moderately steep to steep, well-drained loam found on more dissected side slopes below the Keswick soils. They are underlain by clay loam. Some Sharon soils are found in the narrow floodplains. Soils in Troy are suitable for pasture, woodland and wildlife, with cultivation on the more moderate slopes (Reference 12).

The community's major thoroughfares are State Highway 47, which runs east and west, and U.S. Highway 61, which runs north and south. Commercial and industrial development is concentrated in the downtown area and on Lincoln Drive east of town. Residential development, which constitutes the major land use, is found throughout the remainder of the community. The floodplain of Town Branch Creek has been developed primarily as residential and commercial areas, whereas the Buchanan Creek and Whitcomb Branch floodplains are primarily agricultural lands.

The City of Winfield is located in southeastern Lincoln County. About 48 miles northwest of St. Louis, the community encompasses an area of approximately a quarter of a square mile. Winfield is bordered on all sides by unincorporated areas of Lincoln County. State Highway 79 provides access to Winfield from the north or south and State Highway 47 provides access from the west. The Burlington Northern railroad provides rail transportation to Winfield. The industrial and commercial development is generally within one block of State Highway 79. The population is 723 by the 2000 census (Reference 8).

The City of Winfield was founded in 1879 by David T. Killam and named after his father, Winfield Scott Killam. The area where the city is now located was first settled by Sac Indians; then came explorers, fur trappers and traders, and finally, pioneers. A flour mill was built in Winfield in 1883, a tile factory was added in 1890, and later, a tomato canning factory was put into operation. The city was incorporated in February 1892 (Reference 14). The only industry now in Winfield is a cap-making factory.

The topography of Winfield is flat in the eastern half of the city, but rises about 100 feet from State Highway 79 to the western corporate limits. Runoff from the community either drains into McLean Creek or flows into the Mississippi River floodplain east of the city. White Oak and Walnut timber is natural to this area. The city now contains some hardwood trees and other landscaping shrubs and plants.

Winfield lies on the edge of the Mississippi River alluvial floodplain. Surficial soils in the Winfield vicinity consist of 10-20 feet of silty clay loess. This is underlain by fine to medium sand which, in general, becomes coarser with depth. Depth to bedrock is 70 to 80 feet. Due to good vertical permeability of loess and the underlying sand, the area is well drained with moderately to gently sloping topography.

The area is underlain by Mississippian age limestones of the St. Louis, Salem and Warsaw formations. This area is located on the northern limb of the Troy-Brussels Syncline and the southern flank of the Cap au Gres Faulted Flexure. This geologic structure produces dips of 10

to 20 degrees toward the south (Reference 12).

McLean Creek, a tributary to Bob's Creek, flows east to west on the north side of the city. Development within the floodplain is primarily commercial and residential.

2.3 PRINCIPAL FLOOD PROBLEMS

Flooding in Lincoln County is a result of overflow from the Mississippi River, the Cuivre River, and various tributary streams throughout the county.

Flooding from the Mississippi River in Lincoln County primarily consists of backwater flooding along tributary streams. Many creeks running through the county are subject to flash flooding and flooding from backwater at their outlets on the two previously described rivers. Flash flooding results from the intense thunderstorm activity associated with the Midwest, where large masses of cold and warm air collide. This type of flooding is usually restricted to several hours. Flooding occurs frequently to varying degrees, but only for short periods, except in those areas subject to river backwater. Most damage is caused by backwater flooding.

The largest flood on record occurred in 1973 on the Mississippi River, and had an elevation of 444.2 NAVD (North American Vertical Datum of 1988) at Lock and Dam No. 25; it was higher than the 2-percent-annual-chance flood in Lincoln County.

Flooding in Elsberry has occurred in the past from high water on the Mississippi River. During the flood of 1973, river levees were overtopped, allowing the spread of water across the floodplain and into the low areas of Elsberry. This same area is also subject to flooding from Lost Creek and Town Branch overflows. The extent and depth of flooding from these two streams is potentially greater than flooding from the Mississippi River. The drainage areas contributing to Lost Creek and Town Branch are small and as such, flooding on these streams is usually the result of thunderstorms of high intensity and short duration. Obstructions to flow due to heavy vegetation and poorly maintained drainage structures along these streams increase the flood potential (Reference 15).

The City of Foley is subject to flood damage primarily from the adjacent Mississippi River. The community has experienced several floods over the last150 years. USACE data reveals that the 1973 flood, with an estimated frequency of 1-percent-annual-chance, was the highest since 1844, the earliest flood for which significant records are available. The third flood of record at Foley occurred in 1947. Other major floods of record occurred in 1851, 1929, 1951, 1960, 1965, and 1969.

Sandy Creek, also adjacent to the community, floods the western part of the city more frequently than does the Mississippi River.

The Cuivre River and the Mississippi River are the major sources of flooding in the City of Old Monroe. The Cuivre River, which forms part of the community's southern boundary, experienced a large flood in 1881. That flood record held until 1941, when it was surpassed by several feet. Another large flood occurred in 1969. Although the aforementioned are the three largest floods, the Cuivre River frequently reaches bankfull stage. Between 1922 and 1970, there were only 14 years during which the Cuivre River did not reach flood stage, with many years experiencing several floods. Newspaper accounts of the 1969 flood cited that the floodwaters had isolated the town and in 1970 thousands of dollars damage to dozens of farms and summer cottages was caused by flooding (Reference 16).

The Mississippi River backwater is also a major source of flooding in the community. In 1973, flooding occurred along the eastern and northern boundaries and through the low-lying area near the center of town.

Flooding in the Village of Silex is a result of overflow from the North Fork Cuivre River and Mill Creek.

Large floods are known to have occurred in 1941 and 1970 as a result of overflows from the North Fork Cuivre River. The flood that occurred in 1941 was the largest flood of record and was estimated to have a recurrence probability of about 0.2-percent-annual-chance. The flood that occurred in 1970 was estimated to have a recurrence probability of approximately 1-percent-annual-chance. Both floods were determined from the gage reading at the Troy gage (No. 05514500) which has been in service since February 1922. Flooding has occurred at various times from Mill Creek overflow, but no records of these floods are available.

Town Branch, Buchanan Creek, and Whitcomb Branch are the major sources of flooding in the City of Troy. Flooding along these streams is generally caused by flash flooding from localized storms. Flash flooding results from the intense thunderstorm activity associated with the Midwest where large masses of cold and warm air collide. This type of flooding is characterized by a rapid rise in stream levels with durations usually restricted to several hours.

Moderate flooding occurred in Troy in late Spring 1979 when a 4-inch rainfall resulted in Town Branch overflowing. The result was about one foot of water in the 600 and 700 blocks of Main Street.

The worst flooding in Troy was in the late 1930s, which also resulted from Town Branch overflowing.

Past flooding in Winfield resulted from overflow of the Mississippi River and/or McLean Creek. In Spring 1973, flood waters from the Mississippi River covered the community east of the railroad tracks to about elevation 444.3 feet NAVD. The water was several feet deep in portions of this part of the city. This flood elevation was about 1.5 feet less than the 1-percent-annual-chance flood at this location. The city has also experienced flooding from McLean Creek overflows.

2.4 FLOOD PROTECTION MEASURES

Levees exist in the study area that provides the community with some degree of protection against flooding. Lincoln County is partially protected from Mississippi River flooding by a riverfront levee between Bryant's Creek, which is north of Lincoln County, and the Cuivre River, the southern boundary of the county.

Flank levees extend up the creeks to the bluff on the west. The levees were initially constructed over 60 years ago by local residents and have been raised periodically. The levees are irregular in both height and cross section. The existing substandard system is estimated to provide protection from floods with recurrence intervals up to approximately 5--percent-annual chance, with two feet of freeboard (Reference 17). FEMA specifies that all levees must have a minimum of 3 foot freeboard against 1-percent-annual chance flooding to be shown as providing protection from the 1-percent-annual-chance flood event. It has been ascertained that some of these levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are: 1) adequate design, including

freeboard; 2) structural stability; and 3) proper operation and maintenance.

An existing levee system along the west bank of the Mississippi River protects the City of Elsberry from minor and medium floods on the river. The levees were topped by the flood of 1973, which was between a 2-percent and 1-percent-annual-chance flood. USACE, St. Louis District, is presently studying the feasibility of raising the level of protection provided by this levee system. Existing flood protection on Lost Creek consists of a system of flood retarding dams in the upper basin and a low levee along the north bank of the stream adjacent to Elsberry. This system provides only minimal protection and has little effect in reducing the magnitude of the 1-percent-annual-chance flood. Two flood gates have been provided through the Lost Creek levee to prevent backup of floodwater along Town Branch; however, poor maintenance prevents the proper operation of these gates. USACE is presently considering feasibility studies for improved flood protection along Lost Creek.

The City of Foley is provided protection from floods up to approximately 5-percent-annual chance on the Mississippi River by non-federal levees. The city also receives some protection from three reservoirs: Coralville, Redrock, and Clarence Canyon, located along the Mississippi River, upstream of Foley. Foley has no flood protection from Sandy Creek floods.

A private levee has existed for several years to keep flood waters out of the City of Winfield. It was overtopped during the 1973 flood. The levee has recently been raised approximately three feet above the level of the 1973 flood. The levee top is approximately 1.5 feet above the Base (1-percent-annual-chance) Flood Elevation (BFE); however it does not provide the required three feet of freeboard above the 1-percent-annual chance flood.

There is no flood protection for the Village of Silex and the Cities of Old Monroe and Troy that protects from the 10-percent-annual chance or larger flood.

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-year, 50-year, 100-year, 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-year, 50-year, 100-year, and 500-year floods, have a 10-percent, 2-percent, 1-percent, 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 community. Peak discharge-drainage area relationships for streams studied by detailed methods are shown in Table 7, ―Summary of Discharges.‖

3.1.1 Upper Mississippi River System Flow Frequency Study Methodology

Major Upper Mississippi River Basin flooding during the 1990s resulted in significant losses and raised questions, regarding the frequency of the associated flood events. Reevaluation of the Upper Mississippi River System became necessary to address the questions resulting from the Great Flood of 1993, and was facilitated based on the availability of new topographic data, new computational techniques, and about 20 more years of recorded hydrologic data since the previous study of the Mississippi River had been performed in 1979. This is generally true for the Missouri River as well. The last major effort to comprehensively determine Missouri River flow frequencies was in 1962. The additional record of more than 35 years included the major events of 1993 downstream of Nebraska City and the 1997 large volume flood in the upper reaches of the Missouri River.

The UMRSFFS was undertaken starting in 1998 with the purpose to update the discharge-frequency relationships and associated water-surface profiles for the Mississippi River from St. Paul, Minnesota to the confluence of the Ohio River; for the Illinois River from Lockport, Illinois to its mouth; and for the Missouri River from Gavins Point Dam to its mouth. Five USACE Districts participated in the study: Rock Island, St. Louis, St. Paul, Kansas City, and Omaha. The study was completed in 2003.

The hydrologic analysis for the UMRSFFS utilized a combination of the following methods and approaches to determine discharge-frequency relationships: 100 years of record from 1898 to 1998; the log-Pearson Type III distribution for unregulated flows at gages; main stem flows between gages determined by interpolation of the mean and standard deviation for the annual flow distribution based on drainage area in conjunction with a regional skew; flood control reservoir impacts defined by developing regulated versus non-regulated relationships for discharges; extreme events determined by factoring up major historic events; HEC-HMS and/or HEC-1 models for the main tributaries; and the UNET unsteady flow program to address hydraulic impacts. In situations where historic records were not adequate or appropriate to develop discharge-frequency relationships or to verify the results; hydrologic modeling was used to create synthetic flows based on rainfall. Gage records for all streams were carefully evaluated. The computation of unregulated flow frequency relationships on the Missouri River upstream of the Kansas River required special consideration due to the combination of the two historic peak flow periods consisting of the plains snowmelt of the early spring and the mountain snowmelt and plains rainfall of the late spring/early summer. An additional concern related to the Missouri River was flow depletion due to irrigation and reservoir evaporation. Historic depletions were added to the observed flow

record to help obtain unregulated flows, while historic depletions were adjusted to present level depletions for computation of the regulated flow record. The result of the hydrologic aspects of the study was a discharge and related frequency of occurrence for stations or given cross section located along each of the principle main stem rivers. For more detailed information on each of the hydrologic methodologies used to determine discharges on the Mississippi River, the reader is encouraged to consult the report cited as (Reference 18) in Section 9.0 of this FIS.

3.1.2 Methods for Existing Studies

Peak discharges for Lost Creek, Big Creek, the Cuivre River, Bobs Creek, Brushy Creek, and Sandy Creek were developed from regional frequency equations as developed by the USACE in 1981 (Reference 19). Discharges from this updated frequency analysis focused on streams in the St. Louis District, and were much more specialized than those produced using the statewide regression equations used by Hauth (Reference 20). Because of the USACE focus, it was determined that these equations would be more applicable than the lower and more general Hauth equations.

Peak discharge values for McLean Creek, Mill Creek, Town Branch, the North Fork Cuivre River, and Buchanan Creek were developed by hydrologic basin modeling using the HEC-1 computer program (Reference 21). The computer program uses frequency rainfall amounts obtained from the U.S. National Weather Service (NWS) Technical Paper No. 40, unit hydrographs, and storage routing (Reference 22). Discharges for the 0.2-percent-annual-chance floods for these five streams were obtained by using extrapolated rainfall data.

Discharges for the Cuivre River near the City of Troy were determined by statistical analyses of streamflow records from February 1922 to July 1972 for the Troy gage (USGS No. 5-5145.00) at River Mile 39.9. These analyses of recorded data provided the basis for selection of peak discharges of the recurrence intervals used in the original study. The Troy gage discharges on the Cuivre River were proportioned to the downstream study limit at River Mile 30.7. Discharge values for Big Creek and the downstream 18.8 miles of the Cuivre River were obtained from the FIS for St. Charles County (Reference 23).

USACE, St. Louis District, has performed a hydrologic analysis of the Cuivre River in conjunction with a Flood Plain Information Report for St. Charles County, Missouri (Reference 16). A log-Pearson Type III frequency analysis was made for the only stream gaging station on the Cuivre River, which was formerly located at Troy, Missouri. Discharge frequencies for major sub-areas were also developed by rainfall analysis (Reference 24) and the two methods compared favorably for the 1-percent-annual chance or Intermediate Regional Flood. Discharges for the Intermediate Regional Flood, which has an average frequency of occurrence of 1-percent-annual-chance, and the 0.2-percent-annual-chance or Standard Project Flood were estimated for the reach applicable to the City of Old Monroe.

Using the 1-percent-annual-chance discharge developed by USACE as the control value, the 10-percent and 2-percent-annual-chance discharges were

estimated as being proportioned to Troy gaging station data developed by U.S. Geological Survey (USGS) in their Open-File Report ―Technique for Estimating the Magnitude and Frequency of Missouri Floods‖ (Reference 25). Discharge for the 0.2-percent-annual-chance flood was determined by straight line extrapolation of a log-probability graph of flood discharges computed for frequencies up to 1-percent-annual-chance.

Peak discharge values for Mill Creek and North Fork Cuivre River were developed by hydrologic basin modeling using Computer Program HEC-1 ―Flood Hydrograph Package‖ (Reference 24) and/or by using regional equations (Reference 16). The computer program utilizes frequency rainfall amounts obtained from the NWS Technical Paper No. 40 (Reference 26), unit hydrographs, and storage routing. Discharges for the 0.2-percent-annual-chance floods for these two streams were obtained by using rainfall data extrapolated from that published in Technical Paper No. 40.

Flood-discharge data for the 10-percent, 2-percent, and 1-percent-annual-chance floods for Whitcomb Branch were determined by the empirical relationships presented in the USGS, Water Resource Investigation Technique for Estimating the Magnitude and Frequency of Missouri Floods (Reference 25). For Town Branch and Buchanan Creek, the discharge data for the 10-percent, 2-percent, and 1-percent-annual-chance floods were determined by the empirical relationships presented in an Open-File Report (Reference 27). The selection of parameters for watershed development were based on field reconnaissance and interpretation of aerial photographs (Reference 28).

The flood discharges for Buchanan Creek are affected by the Trojan Lake Reservoir. A rainfall runoff model was developed using the USACE HEC-1, ―Flood Hydrograph Package,‖ to route the flows through the reservoir (Reference 24). Inflow hydrographs to the lake were calibrated to the flood discharges determined by the empirical relationships discussed above. Storage-discharge parameters were determined by field surveys and aerial photogrammetry (Reference 28).

Peak discharge values for McLean Creek were developed by hydrologic basin modeling using Computer Program HEC-1 ―Flood Hydrograph Package‖ (Reference 24). The computer program utilizes frequency rainfall amounts obtained from the NWS Technical Paper No. 40 (Reference 26), unit hydrographs and storage routing. Discharges for the 0.2-percent-annual-chance flood for McLean Creek were obtained by using rainfall extrapolated from that published in Technical Paper No. 40.

Table 6: Summary of Discharges

*DATA NOT AVAILABLE

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent annual-chance	2-percent annual-chance	1-percent annual-chance	0.2-percent annual-chance
BIG CREEK					
At confluence of Coon Creek	91.1	*	*	23,000	*
BOBS CREEK					
At State Highway 79	40.4	6,220	11,100	13,300	20,200
At confluence of Brushy Fork Creek	39.9	6,210	11,000	13,300	20,200
Approximately 5 miles upstream of County Highway 861	24.6	4,600	8,210	9,900	15,100
Approximately 8 miles upstream of County Highway 845	19.8	4,240	7,600	9,170	13,800
BRUSHY FORK CREEK					
At confluence with Bobs Creek	13.2	2,140	5,840	7,060	10,700
At confluence of Birkhead Branch Creek	11.3	3,190	5,750	6,960	10,500
BUCHANAN CREEK					
At mouth	2.8	1,330	2,840	3,240	4,070
Upstream of U.S. Highway 61	1.85	1,350	2,000	2,250	3,150
About 920 feet downstream of Moscow Mills Road	1.56	1,050	1,550	1,750	2,500
Moscow Mills Road	1.47	900	1,350	1,550	2,200
Below Trojan Lake	1.12	650	1,100	1,300	1,950

Table 6: Summary of Discharges (Cont.)

*DATA NOT AVAILABLE

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent annual-chance	2-percent annual-chance	1-percent annual-chance	0.2-percent annual-chance
BUTCHER CREEK					
Approximately 654 feet upstream of confluence	3.51	1,415	2,455	3,115	4,465
Approximately 4,621 feet upstream of confluence	2.63	1,273	2,120	2,620	3,640
14,495 feet upstream of confluence	0.44	310	490	601	810
CROOKED CREEK					
Approximately 2,044 feet upstream of confluence	19.82	3,650	5,875	7,365	11,715
Approximately 3,773 feet upstream of confluence	19.37	3,620	5,835	7,345	11,620
Approximately 6,351 feet upstream of confluence	15.85	3,465	5,620	7,045	10,835
Approximately 21,616 feet upstream of confluence	14.18	3,890	6,005	7,515	11,180
Approximately 24,853 feet upstream of confluence	13.8	3,475	6,075	7,500	11,140
Approximately 44,390 feet upstream of confluence	8.77	3,575	5,830	7,060	9,540
Approximately 59,086 feet upstream of confluence	5.24	2,465	4,055	4,995	6,855
Approximately 65,989 feet upstream of confluence	1.57	885	1,435	1,755	2,385
Approximately 72,121 feet upstream of confluence	0.91	590	930	1,135	1,530
CUIVRE RIVER (UPPER REACH)					
At the point approximately 2.37 miles upstream of Burlington Northern Railroad	976.6	48,800	74,570	85,900	114,400

Table 6: Summary of Discharges (Cont.)

*DATA NOT AVAILABLE

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent annual-chance	2-percent annual-chance	1-percent annual-chance	0.2-percent annual-chance
LOST CREEK					
Approximately 1.2 miles upstream of State Highway 79	12.6	*	*	8,540	*
At confluence of major tributary approximately 3.1 miles upstream of State Highway 79	8.6	*	*	7,140	*
At confluence of major tributary approximately 3.6 miles upstream of State Highway 79	6.2	*	*	5,890	*
MCLEAN CREEK					
At State Highway 79	6.9	2,500	5,500	6,200	7,800
At confluence of major tributary approximately 1.63 miles upstream of State Highway 79	5.4	1,900	4,100	4,600	5,700
MEISTER BRANCH					
Approximately 102 feet upstream of confluence	2.71	1,200	1,955	2,440	3,350
Approximately 5,566 feet upstream of confluence	2	850	1,390	1,710	2,370
Approximately 7,240 feet upstream of confluence	1.35	590	955	1,165	1,615
MILL CREEK					
At County Highway E	17.5	6,300	14,000	15,000	19,000
Upstream of confluence of Dry Branch	13.3	4,600	10,100	11,500	14,200

Table 6: Summary of Discharges (Cont.)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent annual-chance	2-percent annual-chance	1-percent annual-chance	0.2-percent annual-chance
MISSISSIPPI RIVER					
Downstream of the confluence of Cuivre River	142,000	312,000	406,000	445,000	547,000
Downstream of the confluence of Salt River	140,700	310,000	404,000	443,000	545,000
NORTH FORK CUIVRE RIVER					
At confluence of Mill Creek	292.0	25,000	52,000	58,000	76,000
SANDY CREEK					
At Burlington Northern Railroad Bridge	22.5	5,600	8,300	9,715	13,500
At confluence of Upper Sandy Creek	15.7	4,370	7,890	9,530	14,500
At confluence of Little Sandy Creek	9.9	3,240	5,880	7,110	10,700
TOWN BRANCH					
At Mouth	2.8	1,330	2,840	3,240	4,070
1,220 feet downstream from corporate limits	1.84	1,275	2,035	2,392	3,181
At State Highway 47	1.37	1,020	1,363	972[1]	1,002[1]
At East Cherry Street	1.37	1,020	1,620	1,620[2]	1,620[2]
At abandoned bridge	1.20	1,020	1,620	1,800	2,527
At upstream corporate limits	1.03	923	1,462	1,712	2,276

[1]Reflects change of discharge due to lateral weir flow at on-ramp to U.S. Highway 61 South

[2]Reflects change of discharge due to overflow of Lincoln Drive

Table 6: Summary of Discharges (Cont.)

Flooding Source and Location	Drainage Area (Square miles)	Peak Discharges (Cubic Feet per Second) 10-percent annual-chance	2-percent annual-chance	1-percent annual-chance	0.2-percent annual-chance
UNNAMED TRIBUTARY TO THE CUIVRE RIVER					
At its confluence with Cuivre River	1.6	701	813	1,084	2,516
Approximately 450 feet downstream of Tropicana Village Drive	0.26	269	349	477	736
UNNAMED TRIBUTARY TO UNNAMED TRIBUTARY TO THE CUIVRE RIVER					
At its confluence with Unnamed Tributary to Cuivre River	0.66	146	176	664	957
Approximately 500 feet downstream of U.S. 61	0.3	120	155	542	772
WHITCOMB BRANCH					
At Main Street	2.06	665	876	1,221	1,897

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.

3.2.1 Upper Mississippi River System Flow Frequency Study Methodology

The main hydraulic tool used to determine flood elevations along the Mississippi River was the UNET unsteady flow computer modeling program (Reference 29). Included in the UNET model were the main stem of the Mississippi River, several of its main tributaries, navigation dams, and the levees and levee systems. Hydrographic surveys were assembled from navigation channel maintenance surveys, dam periodic inspection surveys, and environment management project surveys. These surveys date from 1997 or later. For areas where no digital hydrographic surveys were available, such as in some side channels and chutes, depths were estimated from the most current printed surveys available. Bluff-to-bluff digital terrain data collected in 1995 and 1998 were used to supplement the channel survey data (Reference 30). Model development consisted of constructing HEC-RAS models from the original cross sections, adding in ineffective flow areas or obstructions as necessary, and then converting the models to UNET.

The UNET model was calibrated to reproduce recorded flood hydrographs for a selected period of record. The UNET model was calibrated to both stage and discharge at gaging locations primarily by adjusting roughness coefficients and estimated lateral inflows. Annual peak flows and peak stages from the period of record run of the calibrated UNET model were used to develop rating curves for each cross section location. Using these station rating curves and the station frequency flows developed during the hydrology phase, frequency elevation points were obtained for each cross section location. Connecting the corresponding points resulted in flood frequency profiles. These profiles were coordinated among the computational teams and appropriate adjustments were made to assure consistency.

Some special considerations and techniques were required to address especially complex flow reaches and levee failure impacts. The confluences of the Missouri and Illinois Rivers with the Mississippi relied primarily on development of graphical stage-probability relationships for backwater-impacted cross sections. These were created using a graphical Weibull approach. The graphical period-of-record stage-probability curves were combined to blend a consistent and reasonable profile for each probability flood. Confluences of many other smaller streams with the mainstem also exhibited backwater effects resulting in discontinuities in the profiles. A computer routine was developed to smooth the profile in these reaches so as to form a consistent, reasonable transition through

the zone of backwater. The Illinois Waterway presented special problems related to backwater due to the very flat profile in the lower reaches. As a result, the general technique based on rating curves was abandoned. Profiles upstream of La Grange Lock and Dam are based on UNET modeling of pattern hydrographs based on historic records adjusted to represent various frequency events. UNET modeling of overtopped mainstem levees accounted for storage, flow through the levee cells, and/or conversion of the levee cells area to increased cross-sectional conveyance.

This study is based on the most current topographic mapping, the most up-to-date hydrologic data, and state-of-the-art computational techniques. It represents a large worthwhile investment of resources and provides the best estimate at this time related to future flooding. Additional data from future years of record and improved modeling techniques based on future technology will likely justify a future restudy of these vitally important relationships. However, at this time, this study answers the pertinent questions related to Upper Mississippi River Basin flooding and should serve as the basis for future related water resource planning in the basin (Reference 18).

The 1-percent-annual-chance flood water-surface elevation (WSEL) profile was calculated using the HEC-RAS 3.1.3 Computer Program (Reference 31). HEC-RAS was chosen to model the 1-percent-annual chance flood so that encroachments and a floodway could be calculated, as the UNET model does not offer that capability.

The cross section stationing used in the Mississippi River model was based on existing U.S. Army Corps of Engineers River Mile markers of 1960 (Reference 46). The reach length between cross sections is based on a model centerline developed for the HEC-RAS converted model of the Upper Mississippi River System Flow Frequency Study (UMRSFFS) (Reference 47). The distances between cross sections shown in the floodway data table and flood profile were created using the cross section stations based on the 1960 River Miles. While the calculated distance between cross sections using the 1960 River Miles are similar to the measured distance along the model centerline, some differences may occur. This difference in distance does not affect the calculated water surface elevation at each cross section shown on the floodway data table and flood profile, nor does it affect the placement of the BFEs on the map.

3.2.2 Methods for Existing Studies

Cross sections were obtained by field survey. The locations and extent of cross sections were determined in field inspections by hydraulic engineers. Supplemental cross section information was obtained from topographic maps. All bridges and culverts were field checked to obtain elevation data and structural geometry.

Channel and valley cross sections for the North Fork Cuivre River and Mill Creek were obtained by photogrammetric methods. The photogrammetry was used to draw four-foot contour lines for delineating flood limits on the work maps (Reference 32). However, the mapping was done to a contour interval accuracy of two feet, which provided data for the valley cross sections to plus or minus one foot of the actual elevations.

Channel and valley cross sections for the backwater analyses of McLean Creek were obtained by photogrammetric methods. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Starting WSELs for Lost Creek, Sandy Creek, Bobs Creek, and Brushy Creek, were calculated using the slope/area method. For Big Creek, the starting WSEL was obtained from a previous flood study performed by the St. Louis District of the USACE. In the original study, starting WSELs for McLean Creek, Town Branch, Buchanan Creek, the Cuivre River, and the North Fork Cuivre River were calculated using the slope/area method. For Mill Creek, starting WSELs in the original study were obtained from rating curves of known WSELs.

Water-surface profiles were developed using the HEC-2 step-backwater computer program (Reference 33). These profiles were drawn to an accuracy of 0.5 foot (Exhibit 1). Starting elevations for Lost Creek were taken from studies conducted by USACE, St. Louis District. Starting elevations for Town Branch were taken from the Lost Creek profile.

Starting WSELs for the Cuivre River were dictated by backwater effects of the Mississippi River.

The 1-percent-annual-chance flood profile for the Cuivre River upstream of the Highway 79 Bridge was computed through the use of the USACE HEC-2 Step Backwater computer program (Reference 33). Normal depth analysis was used to adjust the 1-percent-annual-chance profiles to the revised backwater elevations and to establish the 10-percent, 2-percent, and 0.2-percent-annual-chance profiles. Bridge losses were estimated using the U.S. Department of Transportation publication entitled ―Hydraulics of Bridge Waterways‖ (Reference 34).

The starting WSELs were determined by the slope-area method for the North Fork Cuivre River. The starting WSELs were determined for Mill Creek by using peak discharges and rating curves from the known WSELs on the North Fork Cuivre River. WSELs of the 10-percent, 2-percent, 1-percent and 0.2-percent-annual-chance floods were computed using the HEC-2 computer program developed by USACE (Reference 33).

Starting WSELs were computed by assuming normal depths at a point downstream of the beginning of the study. WSELs of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program (Reference 33).

The detail study conducted for Town Branch included a comprehensive analysis of out-of-bank flow. In several locations, flow is restricted by roadway crossings and is forced to bypass the primary drainage system. This bypass occurs over roadways and along highway medians, and tends to seek its lowest level as it flows downstream to eventually recombine with the main channel. The bypass volumes were manually calculated using standard techniques for each frequency flood, and the results were incorporated into the HEC-2 computer analysis to obtain final results (Reference 33). Hydraulic analysis of the overflow of Town Branch at the U.S. Highway 61 and State Highway 47 interchange was treated as weir flow, and because of critical flow, hand calculations were used for determining the flood elevations. It was decided that the overflow would be shown as sheet flow.

Starting WSELs for McLean Creek were computed using slope-area method.

WSELs of floods of the selected recurrence intervals for McLean Creek were computed through use of the USACE HEC-2 step backwater computer program (Reference 33).

The existing levee on McLean Creek does not provide a three-foot freeboard; therefore it has been considered to fail upon 1-percent-annual-chance flooding and has not been considered in the modeling.

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen based on engineering judgment and field observations of the streams and floodplain areas.

Channel and overbank "n" values for the streams studied by detailed methods are shown in Table 7, "Summary of Roughness Coefficients."

Table 7: Summary of Roughness Coefficients

Flooding Source	Roughness Coefficients	
	Channel "n"	Overbanks "n"
Big Creek	0.060	0.050-0.100
Bobs Creek	0.065	0.070-0.100
Brushy Fork Creek	0.060	0.060-0.100
Buchanan Creek	0.050-0.065	0.050-0.085
Cuivre River (Lower Reach)	0.060	0.065
Cuivre River (Upper Reach)	0.060	0.065
Lost Creek	0.045-0.050	0.060-0.070
McLean Creek	0.055-0.065	0.045-0.080
Mill Creek	0.050-0.060	0.060-0.075
Mississippi River	0.020-0.040	0.035-0.150
North Fork Cuivre River	0.050-0.065	0.050-0.085
Sandy Creek	0.060	0.060-0.100
Town Branch	0.050-0.065	0.050-0.085
Whitcomb Branch	0.012-0.12	0.015-0.150

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 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.

For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey (NGS) website at www.ngs.noaa.gov, or contact the NGS at the following address:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center Three
1315 East-West Highway
Silver Spring, Maryland 20910
((301) 713-3191

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.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

3.3.1 Methods for the Mississippi River

The studied reach of the Mississippi River spans multiple counties in multiple states, and the river forms the actual border between adjacent counties. The UMRSFFS was originally performed using the NGVD vertical datum. Applying an average countywide datum shift to convert to NAVD would have resulted in a mismatch of elevations between counties. Therefore, in order to perform the most accurate vertical datum conversion possible, and to maintain consistency in approach across county lines, the datum conversion for the Mississippi River was performed on a cross-section by cross-section basis, rather than by applying an average county-wide or stream-wide value.

3.3.2 Methods for Existing Studies

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The average datum conversion factor from NGVD to NAVD in Lincoln County is -0.1 feet.

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-percent, 2-percent, 1-percent, and 0.2-percent-annual-chance flood elevations; delineations of the 1-percent 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

4.1.1 Methods for the Mississippi River

Between cross sections along the Mississippi River, the boundaries were interpolated using a digital terrain model (DTM) created from photogrammetric-derived mass points and break lines, with a post spacing of 15 feet and vertically accurate enough to support the creation of 4-foot contours (Reference 30).

4.1.2 Methods for Existing Studies

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 methods, the 1-percent and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections of all flooding sources except Whitcomb Creek, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with contour intervals of 5, 10, and 20 feet (Reference 35). For Whitcomb Creek, the boundaries were interpolated between cross sections using aerial photography at a scale of 1:4800 with a contour interval of four feet (Reference 36).

For the flooding sources studied by approximate methods, the boundaries of the 1-percent annual-chance floodplain were taken from the Flood Hazard Boundary Map for the unincorporated areas of Lincoln County (Reference 37).

The 1-percent and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the Special Flood Hazard Areas (Zones A, AE, AH, and AO), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1-percent 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.

Small areas within the flood boundaries may lie above the flood elevations, and, therefore, not be subject to flooding. Owing to limitations of the map scale, such areas are not shown.

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 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 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.

4.2.1 Methods for the Mississippi River

Upon completion of the UMRSFFS, FEMA funded USACE to compute a floodway for the studied reach of the Mississippi River. This floodway determination consisted of converting the hydraulic data from UNET to HEC-RAS, calibrating the HEC-RAS steady-state models to the UMRSFFS results, and performing the floodway computations.

4.2.2 Methods for Existing Studies

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 (see Table 8, ―Floodway Data Table‖ of this FIS report). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown. No floodway was computed for Lost Creek.

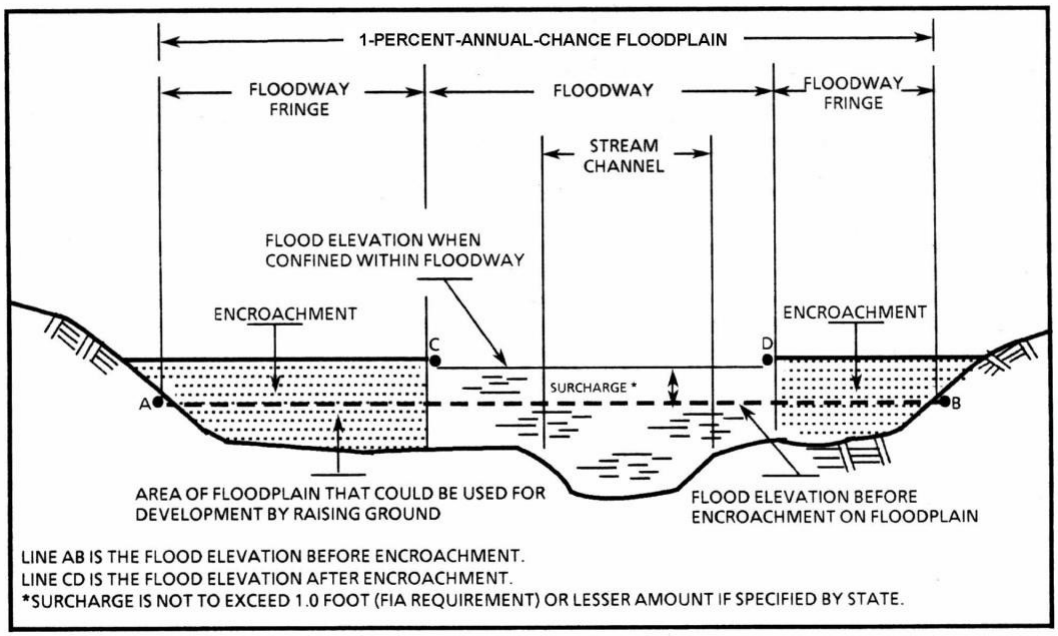

Figure 1: Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BIG CREEK								
A	898	993/850	10,920	2.9	455.9	452.8[3]	453.8	1.0
B	5,280	1,863/1,700	27,608	1.0	455.9	453.2[3]	454.2	1.0
C	8,448	1,814/200	24,362	1.1	455.9	453.3[3]	454.3	1.0
D	10,824	1,778/175	22,308	1.2	455.9	453.4[3]	454.4	1.0
E	16,104	2,332/170	22,769	1.2	455.9	453.7[3]	454.7	1.0
F	18,374	2,013/965	14,874	1.8	455.9	453.8[3]	454.8	1.0
G	20,856	1,077/830	5,997	4.6	455.9	454.6[3]	455.6	1.0
H	23,337	1,176/1,060	6,690	4.1	459.1	459.1	460.1	1.0
I	25,291	1,338/980	8,180	3.3	461.8	461.8	462.8	1.0
J	28,987	1,290/290	8,993	3.0	464.8	464.8	465.8	1.0
K	31,996	1,354/275	10,413	2.6	467.1	467.1	468.1	1.0
L	35,323	1,730/1,300	17,113	1.6	468.5	468.5	469.5	1.0
M	39,916	1,022/330	8,758	2.6	470.9	470.9	471.9	1.0
N	42,451	993/460	7,844	2.9	473.3	473.3	474.3	1.0
O	43,824	985/380	7,520	3.1	475.0	475.0	476.0	1.0
P	45,355	1,479/510	11,658	2.0	476.2	476.2	477.2	1.0
Q	46,992	1,562/1,000	11,125	2.1	477.4	477.4	478.4	1.0
R	53,275	*	*	*	482.8	482.8	*	*
S	59,450	*	*	*	488.9	488.9	*	*
T	69,590	*	*	*	499.4	499.4	*	*
U	79,640	*	*	*	514.1	514.1	*	*

[1]Feet above confluence with Cuivre River

[2]Total width/width within county boundary

[3]Elevation computed without consideration of backwater effects from Cuivre River

*No floodway data

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

BIG CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BOBS CREEK								
A	755	530	4,266	3.1	449.7	449.7	450.4	0.7
B	5,505	349	3,318	3.1	454.0	454.0	454.9	0.9
C	10,240	380	3,828	2.7	458.1	458.1	459.0	0.9
D	13,680	440	3,386	2.9	460.8	460.8	461.7	0.9
E	19,470	338	2,966	3.2	466.7	466.7	467.6	0.9
F	23,070	312	3,219	3.0	470.8	470.8	471.7	0.9
G	31,820	259	2,348	4.1	483.5	483.5	484.5	1.0
H	37,680	491	2,869	3.2	492.2	492.2	493.1	0.9
I	41,570	235	2,075	4.1	502.8	502.8	503.8	1.0
J	43,400	285	2,458	3.4	508.0	508.0	509.0	1.0
K	48,690	249	1,804	4.7	523.4	523.4	524.3	0.9

[1]Feet above Burlington Northern Railroad

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

BOBS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BRUSHY FORK CREEK								
A	5,060	970	5,641	1.2	454.0	454.0	455.0	1.0
B	12,570	283	1,863	3.8	461.4	461.4	462.2	0.8
C	16,460	228	1,851	3.8	468.4	468.4	469.3	0.9
D	21,560	245	2,403	1.9	480.9	480.9	481.5	0.6
E	23,570	244	1,480	3.1	482.9	482.9	483.7	0.8
F	27,330	54	523	8.6	497.7	497.7	497.7	0.0

[1]Feet above confluence with Bobs Creek

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

BRUSHY FORK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
BUCHANAN CREEK								
A	8,173	400	1,560	0.0	472.1	467.7[2]	468.1	0.4
B	9,800	100	329	4.1	474.2	474.2	475.0	0.8
C	11,489	150	355	3.3	478.5	478.5	478.8	0.3
D	12,640	139	440	3.7	483.3	483.3	484.2	0.9
E	13,902	96	373	6.0	489.7	489.7	489.7	0.0
F	15,404	52	342	6.6	500.0	500.0	500.9	0.9
G	16,647	90	333	5.3	506.1	506.1	507.1	1.0
H	17,692	119	875	1.8	516.3	516.3	517.3	1.0
I	19,240	88	432	3.0	527.0	527.0	527.8	0.8

[1]Feet above confluence with Cuivre River
[2]Elevations computed without consideration of backwater effects from Cuivre River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Butcher Creek								
A	1,544	225	932	3.3	456	450.8[2]	451.8	1.0
B	3,131	345	1,291	2.0	456	455.1[2]	455.9	0.8
C	5,041	288	917	2.9	459.9	459.9	460.6	0.7
D	7,170	21	83	5.1	465.8	465.8	466.3	0.5
E	9,720	29	104	4.1	474.0	474.0	474.4	0.4
F	12,043	29	104	4.1	483.9	483.9	484.2	0.3
G	13,255	27	84	5.1	490.7	490.7	491.0	0.3
H	15,385	29	94	4.5	505.3	505.3	505.4	0.1

[1] Feet above confluence with Crooked Creek

[2] Elevation computed without consideration of backwater effects from Cuivre River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

BUTCHER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Crooked Creek								
A	2,044	800	2,500	2.9	456	449.5[2]	450.5	1.0
B	10,084	729	5,366	1.4	462.2	462.2	462.7	0.6
C	20,639	955	3,089	2.4	471.2	471.2	472.0	0.8
D	31,060	397	1,895	3.7	489.3	489.3	490.0	0.7
E	41,170	321	1,375	5.1	508.7	508.7	509.6	0.9
F	50,056	171	928	5.4	536.1	536.1	536.2	0.2
G	60,359	47	284	6.2	570.3	570.3	571.1	0.9
H	71,557	114	319	3.2	628.7	628.7	629.7	0.9

[1] Feet above confluence with Cuivre River

[2] Elevation computed without consideration of backwater effects from Cuivre River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CUIVRE RIVER								
A	62,198[1]	1,748/1,150[3]	22,237	4.5	448.5	448.5	449.0	0.5
B	66,370[1]	1,700/300[3]	29,677	3.4	449.8	449.8	450.6	0.8
C	69,168[1]	1,653/700[3]	27,924	3.6	450.1	450.1	450.9	0.8
D	71,861[1]	1,600/150[3]	24,359	4.1	450.4	450.4	451.1	0.7
E	74,237[1]	1,600/200[3]	22,091	4.5	451.0	451.0	451.7	0.7
F	75,293[1]	1,800/150[3]	27,127	3.7	451.5	451.5	452.3	0.8
G	77,405[1]	2,080/1,900[3]	29,995	3.4	452.0	452.0	452.7	0.7
H	84,058[1]	1,329/550[3]	22,207	4.5	453.1	453.1	453.9	0.8
I	87,173[1]	1,033/400[3]	16,406	6.1	453.9	453.9	454.7	0.8
J	0[2]	2,825	28,534	3.0	458.2	458.2	459.2	1.0
K	897[2]	2,852	28,639	3.0	460.6	460.6	461.6	1.0
L	3,907[2]	3,917	12,833	6.7	462.6	462.6	463.5	0.9
M	8,712[2]	4,380	48,371	1.8	465.7	465.7	466.7	1.0
N	18,533[2]	4,120	42,300	2.0	469.1	469.1	470.1	1.0
O	23,285[2]	3,147	34,791	2.5	469.7	469.7	470.6	0.9
P	26,769[2]	4,645	46,497	1.8	470.3	470.3	471.2	0.9
Q	31,997[2]	2,647	31,952	2.7	471.2	471.2	472.1	0.9
R	34,426[2]	3,450	41,492	2.1	475.7	475.7	476.6	0.9
S	38,544[2]	3,606	48,516	1.7	476.9	476.9	477.9	1.0
T	43,982[2]	1,498	18,201	4.5	478.2	478.2	479.1	0.9

[1]Feet above confluence with Mississippi River
[2]Feet above Burlington Northern Railroad
[3]Total width/width within county boundary

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

CUIVRE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MCLEAN CREEK								
A	15,470	529	3,479	1.8	453.0	453.0	454.0	1.0

[1]Feet above confluence with Mississippi River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

MCLEAN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Meister Branch								
A	103	70	412	5.9	566.5	564.6[2]	565.6	1.0
B	1,161	49	339	5.1	567.7	567.7	568.1	0.4
C	2,134	34	240	7.2	573.3	573.3	573.9	0.6
D	3,100	36	197	8.7	578.8	578.8	579.5	0.7
E	4,044	125	326	5.3	585.5	585.5	585.6	0.1
F	5,158	188	480	3.6	591.0	591.0	591.7	0.7
G	6,887	60	262	4.5	596.7	596.7	597.2	0.5

[1] Feet above confluence with Crooked Creek

[2] Elevation computed without consideration of backwater effects from Crooked Creek

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MILL CREEK								
A	2,661	700	3,683	4.1	511.4	507.3[2]	507.9	0.6
B	3,548	700	4,574	3.3	512.6	512.6	512.8	0.2
C	4,229	700	5,939	2.5	513.2	513.2	513.6	0.4
D	5,338	700	3,848	3.0	514.1	514.1	515.1	1.0
E	7,471	500	2,598	4.4	520.0	520.0	520.8	0.8

[1]Feet above confluence with North Fork Cuivre River
[2]Elevations computed without consideration of backwater effects from North Fork Cuivre River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

MILL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MISSISSIPPI RIVER								
A	237.00	17,374	299,921	1.5	443.8	443.8	444.4	0.6
B	239.09	13,539	265,138	1.7	444.4	444.4	445.0	0.6
C	241.23	13,052	248,810	1.8	445.0	445.0	445.7	0.7
D	243.22	11,088	211,131	2.1	445.6	445.6	446.4	0.8
E	245.39	11,709	198,762	2.2	445.8	445.8	446.6	0.8
F	247.09	16,955	283,602	1.6	446.2	446.2	447.0	0.8
G	249.50	17,194	281,443	1.6	446.8	446.8	447.6	0.8
H	251.22	16,706	270,666	1.6	447.4	447.4	448.2	0.8
I	253.21	19,688	311,099	1.4	448.0	448.0	448.8	0.8
J	255.26	16,297	261,233	1.7	448.7	448.7	449.6	0.9
K	257.57	15,496	235,251	1.9	449.5	449.5	450.3	0.8

[1]Miles above confluence of Ohio River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
NORTH FORK CUIVRE RIVER								
A	51.980	1,800	25,772	2.3	510.7	510.7	511.6	0.9
B	52.325	1,800	19,776	2.9	511.8	511.8	512.6	0.8
C	52.578	1,800	20,061	2.9	512.4	512.4	513.1	0.7
D	52.774	1,300	14,948	3.9	513.5	513.5	514.0	0.5

[1]Miles above confluence with Cuivre River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
SANDY CREEK								
A	19,100	989	6,593	1.5	471.7	471.7	472.2	0.5
B	24,140	200	1,046	5.2	476.9	476.9	477.8	0.9
C	27,610	123	991	5.5	493.5	493.5	494.2	0.7
D	32,580	165	1,184	4.3	520.8	520.8	521.5	0.7
E	35,110	181	881	5.8	541.3	541.3	541.8	0.5
F	38,050	115	658	7.8	562.2	562.2	563.0	0.8
G	40,100	111	543	9.4	581.4	581.4	581.4	0.0

[1]Feet above Burlington Northern Railroad (Downstream side)

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
TOWN BRANCH								
A	2,439	3,450[2]	41,492	2.1	475.7	467.8[3]	468.3	0.5
B	4,303	197	1,069	3.0	476.6	469.5[3]	470.1	0.6
C	5,634	300	1,464	1.9	476.6	476.6	477.4	0.8
D	7,260	111	203	1.7	482.6	482.6	482.6	0.0
E	8,999	131	572	2.8	490.1	490.1	490.1	0.0
F	9,947	162	399	1.2	498.6	498.6	498.6	0.0
G	11,427	97	279	4.2	506.2	506.2	506.2	0.0
H	12,442	90	161	7.0	515.1	515.1	515.2	0.1

[1]Feet above confluence with Buchanan Creek
[2]Combined Cuivre River/Town Branch floodway
[3]Elevations computed without consideration of backwater effects from Cuivre River

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Unnamed Tributary to Cuivre River								
A	1,824	185	1,223	1.3	465.1	458.4[2]	458.9	0.5
B	3,850	180	1,119	1.3	465.1	458.6[2]	459.4	0.8
C	5,883	87	283	3.2	465.1	462.4[2]	463.4	0.9
D	7,855	46	223	2.1	473.8	473.8	474.6	0.8
E	9,932	48	149	3.2	484.7	484.7	484.8	0.0

[1] Feet above confluence with Cuivre River

[2] Elevation computed without consideration of backwater effects from Cuivre River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED TRIBUTARY TO CUIVRE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Unnamed Tributary to Unnamed Tributary to Cuivre River								
A	1,590	153	227	2.4	465.1	459.8[2]	460.2	0.4
B	2,385	35	103	5.8	465.1	464.2[2]	464.2	0.0

[1] Feet above confluence with Unnamed Tributary to Cuivre River

[2] Elevation computed without consideration of backwater effects from Cuivre River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED TRIBUTARY TO UNNAMED TRIBUTARY TO CUIVRE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE [1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Whitcomb Branch								
A	3,021	144	586	4.6	467.0	458.2[2]	458.7	0.5
B	4,721	424	1225	1.9	467.0	461.4[2]	462.4	1.0
C	6,778	53	243	8.0	469.0	469.0	469.6	0.6
D	9,396	50	224	7.5	480.1	480.1	480.9	0.8
E	11,680	38	205	8.2	493.5	493.5	494.0	0.5
F	13,557	60	302	5.6	503.9	503.9	504.9	1.0
G	15,384	38	171	7.1	514.9	514.9	515.4	0.5
H	17,195	25	98	7.2	523.1	523.1	523.6	0.5
I	19,894	46	176	4.0	542.4	542.4	542.5	0.1
J	21,915	61	240	2.9	554.2	554.2	554.3	0.1
K	23,970	62	130	5.5	571.2	571.2	571.2	0.1

[1] Feet above confluence with Cuivre River

[2] Elevation computed without consideration of backwater effects from Cuivre River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

FLOODWAY DATA

WHITCOMB BRANCH

5.0 INSURANCE APPLICATION

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 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 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, and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

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-percent and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Lincoln County. Previously, FIRMs were prepared for each incorporated community identified as flood-proneand for the unincorporated areas of the County. This countywide FIRM also includes flood-hazard information that was presented separately on FBFMs, where applicable. Historical data relating to the maps prepared for each community are presented in Table 10, “Community Map History.”

7.0 OTHER STUDIES

A previous FIS report was prepared for the City of Elsberry, dated November 4, 1988.

A previous FIS report was prepared for the City of Foley, dated July, 1977.

A previous FIS report was prepared for the City of Old Monroe, dated June 5, 1985.

A previous FIS report was prepared for the Village of Silex dated, March 16, 1982.

A previous FIS report was prepared for the City of Troy, dated November 5, 1980.

A previous FIS report was prepared for the City of Winfield, dated May 17, 1982.

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA Region VII, Mitigation Division, Federal Office, 9221 Ward Parkway, Suite 300, Kansas City, Missouri 64114-3372.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Cave, Town of [1]	December 30, 1980	N/A	March 15, 1984	N/A
Chain Rocks, Village of [1]	December 30, 1980	N/A	March 15, 1984	N/A
Elsberry, City of	May 10, 1974	November 21, 1975	May 2, 1977	November 4, 1988
Foley, City of	November 29, 1974	June 4, 1976	March 1, 1978	N/A
Fountain N' Lakes, Village of [2]	N/A	N/A	N/A	N/A
Hawk Point, City of [2]	N/A	N/A	N/A	N/A
Lincoln County (Unincorporated Areas)	December 30, 1980	N/A	March 15, 1984	April 2, 1993
Moscow Mills, City of	September 29, 2010	N/A	September 29, 2010	N/A
Old Monroe, City of	November 8, 1974	N/A	August 15, 1978	June 5, 1985
Silex, Village of	November 22, 1974	December 5, 1975	September 16, 1982	N/A
Troy, City of	October 29, 1976	N/A	May 5, 1981	N/A
Truxton, Village of [2]	N/A	N/A	N/A	N/A
Whiteside, Village of [2]	N/A	N/A	N/A	N/A
Winfield, City of	December 28, 1973	May 7, 1976	November 17, 1982	N/A

[1]This community did not have its own FIRM prior to this countywide FIS. The land area for this community was previously shown on the FIRM for the unincorporated areas of Lincoln County, but was not identified as a separate NFIP community. Therefore, the dates for this community were taken from the Lincoln County FIRM.

[2] This community is non-floodprone.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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10.0 REVISIONS DESCRIPTION

This section has been added to provide information regarding revisions made since the original FIS report and FIRM were 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 Map Repository at the address found on the Flood Insurance Rate Map Index to obtain the most up-to-date flood hazard data. All digital data can be found on FEMAs Map Service Center website.

10.1 First Revision (TBD)

a. Introduction

Identifier:	Crooked Creek Watershed Study
Flooding Sources:	Crooked Creek, Butcher Creek, and Meister Branch
FIRM Panels Affected:	29113C0360E, 29113C0378E, 29113C0379E, 29113C0383E, 29113C0386E, 29113C0387E, 29113C0391E, and 29113C0392E

Lincoln County and US Army Corps of Engineers (USACE) entered into an agreement to update the FEMA floodplains within the Crooked Creek Watershed (Reference 46). Around July 2014 the USACE submitted a new floodplain management study for potential incorporation via the LOMR route. In December 2014 the data submitted met the FEMA technical and scientific data requirements, however due to the size of the updates (8 FIRM panels) a Physical Map Revision (PMR – 16-07-1461S) was necessary in order to incorporate the updated models.

In March 2016, the PMR study was initiated by the Strategic Alliance for Risk Reduction (STARR II) Production Technical Staff (PTS) FEMA contractor to prepare all necessary deliverables and move forward with Preliminary Distribution and then Effective.

This floodplain management study covers Crooked Creek Watershed, which contains the three creeks: Butcher Creek, Meister Branch, and Crooked Creek. Butcher Creek and Meister Branch are both tributaries to Crooked Creek, which is a tributary to the Cuivre River. The Crooked Creek watershed drains a portion of the Cities of Troy and Moscow Mills, along with a portion of Unincorporated Lincoln County, Missouri. Hydrologic and hydraulic models were utilized to study the Crooked Creek Watershed which begins at Missouri Highway 47 and continues southeast to where it joins the Cuivre River. In addition to mapping the 0.2 percent and 1 percent chance exceedance floodplains, the 2 percent and 10 percent chance exceedance floodplains were mapped to assist the county in managing the floodplain. A Federal Emergency Management Agency (FEMA) floodway for the three creeks was also determined.

b. Coordination & Scope of Study

An initial Community Coordination Officers (CCO) meeting may be conducted if community is interested. The following communities have been notified of the potential changes and updates: City of Moscow Mills, City of Troy, and Lincoln County.

New floodplain and floodway mapping for the Crooked Creek Watershed Floodplain Management Study was performed by USACE for incorporation in the FIS and the countywide DFIRM.

c. Hydrologic Analyses

The Crooked Creek watershed is mostly farm land and wooded area with some newer land development. Land uses include open space, meadow, and wooded areas. Developed areas include residential, commercial, and industrial areas. Soil types within the watershed include B, C, D, and C/D hydrologic soil groups, with the majority being C and D. Small portions of the watershed are drained by a curb and gutter system. The majority is drained overland or through roadside ditches. The watershed boundary for the Crooked Creek watershed follows natural boundaries, with a few areas included or excluded by curb and gutter drainage systems. The watershed delineation can be seen in Figure 2.

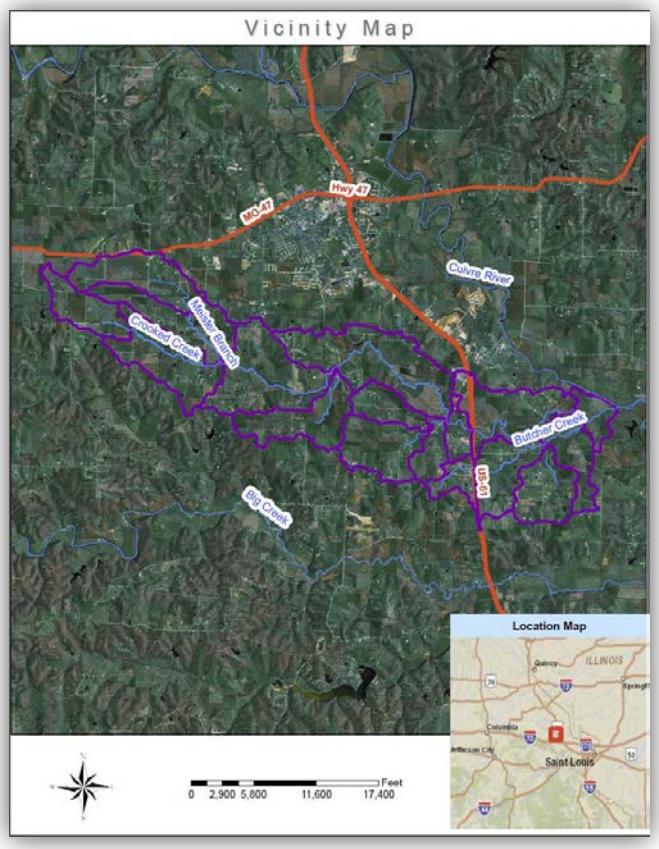


Figure 2 – Crooked Creek Watershed

Natural Resources Conservation Service (NRCS) methods were used to calculate rainfall loss in the model. The Clark Unit Hydrograph was used to transform rainfall to runoff in the model. Curve numbers were determined using NRCS soils data, aerial photography, and published tables of curve number values. ArcMap was utilized in determining composite curve numbers for each watershed.

A land cover layer was developed based on aerial photography (National Agriculture Imagery Program (NAIP), 2012). Each land cover polygon was assigned a cover type with its associated curve numbers for various soil types. Land cover types, the soil layer, and the sub watershed boundaries were intersected in ArcMap to develop shapes with one cover and soil type. Areas were computed for these shapes and a curve number was assigned. Composite

curve numbers for each watershed were then computed. The composite curve numbers were calculated by using ArcMap to merge the land cover, soil types, and basin area.

Time of concentration (T_c) was computed with the assistance of ArcMap. Longest flow paths were delineated based upon LiDAR and NAIP imagery. These flow paths were then divided into segments representing sheet, shallow, and channel flow. Slopes of the segments were determined using the elevation values at the ends of the segments. For channel flow segments that ended on a road surface at a culvert, the lowest channel elevation near the culvert was used. Other parameters such as Manning's n values needed for the travel time calculations were estimated based upon 2012 aerial imagery.

For the Clark Unit Hydrograph, the capital letter R denotes the storage coefficient. According to the HEC-HMS User Manual, many studies have found that the ratio of storage coefficient divided by the sum of time of concentration and storage coefficient is reasonably constant over a region. For this study, the ratio that was used was 0.44 and is based on an average regional value found in a report conducted by the US Army Corps of Engineers in 2009 for the nearby Salt River Basin. Therefore, the ratio R/(Tc+R)=0.44 was used to calculate R for both conditions. See Table 1 within Reference 46 for a summary of basin hydrologic parameters for existing conditions.

In the HEC-HMS model, Modified Puls routing was used for all three creeks. Storage-outflow relationships that are required for Modified Puls routing were developed with data from the HEC-RAS model. The storage-outflow relationships were developed by running a series of increasing flowrates in HEC-RAS to develop a smooth curve for each reach. These curves were then exported to HEC-DSS where they were referenced by HEC-HMS to complete the routing for each reach.

Frequency rainfall data were determined through the use of the National Oceanic and Atmospheric Administration Atlas 14. The five-minute through 24-hour precipitation depths for each return period are presented in Table 2 within Reference 46.

A storm with duration of three days was simulated with the HEC-HMS model. The average time of concentration for each the basin was near 1.5 hours, so the three-day storm duration used ensured the peak of the rainfall and flow could be routed through the whole system. The calculated flow rates for each of the four exceedance storms examined are presented in Table 6: Summary of Discharges within section 3.1 of this report.

A comparison was performed between peak flow rates calculated from HEC-HMS at the watershed outlet for Butcher Creek, Meister Branch and Crooked Creek and United States Geological Survey (USGS) regression equations for both urban and rural areas. The results of this comparison are given in Tables 6-8 within Reference 46. USGS regression equation values were determined through the use of the USGS National Streamflow Statistics program. The results of the HMS modeling represent flows that closely match the USGS Rural Regression Equation and are in the middle to the upper end of the USGS Urban Regression Equations.

d. Hydraulics

HEC-RAS, Version 4.1.0, was used to develop water surface profiles for all three creeks. Cross section data across the floodplain were taken from the LiDAR surface developed for this study using the HEC-GeoRAS toolbar for ArcMap. Channel cross sections were surveyed by a contractor of the United States Army Corps of Engineers (USACE). Surveyed sections were located near bridges and culverts as well as at other locations along the stream. Cross sections taken from the LiDAR surface and those that were surveyed were merged to create the cross

section geometry within the model. The bridges and culverts were also surveyed to obtain road deck elevation, low chord on bridges, bridge pier data, and culvert invert elevations. Steady flow data was taken from the HEC-HMS model. Peak flow rates were entered at inflow locations along the stream for each of the frequency storms modeled.

Manning's n values for the channel varied from 0.03 to 0.05. Overbank n values ranged from 0.05 to 0.10. The n values were selected based on 2012 Aerial Imagery.

Contraction and expansion and exit loss coefficients were set to standard values at all road crossings. Contraction and expansion coefficients are set to 0.3 and 0.5 respectively. Flow contraction occurs between the two cross sections upstream of the bridge, while flow expansion occurs between the two cross sections downstream of the bridge.

Floodway computations were started with a surcharge of 1.0 foot at the downstream boundary. It was reasonable to assume that Crooked Creek, Butcher Creek and Meister Branch could be encroached to the full 1.0 foot of surcharge. All other floodway calculations followed standard practice.

FEMA's CheckRAS program was used to check the model for errors. The NT, XS and Structure checks were run on the ten, two, one and 0.2 percent chance exceedance profiles. The Floodway checks were run on the floodway profiles, and the profile checks were run on all profiles. The reports are included with the DVD delivered with this report. Responses were included with each message as needed to explain the use of nonstandard values, etc.

e. Floodplain Boundaries

Flooded outlines were developed using the RAS Mapper utility included in the HEC-RAS program. These outlines were plotted over aerial photography. The outlines were inspected for reasonableness. Modification of the floodplain was performed in the area of the dry detention basin at the upstream end of the model to ensure the proper area was shown as inundated. ArcMap was used to accomplish this task. This line was then added to the floodplain area.

Mapping of the floodway was accomplished by utilizing the post processing tools of the HEC-GeoRAS toolbar for ArcMap. This toolbar was used to import the bounding polygon for the floodway to identify the floodway extents on the cross sections. The floodway outline was then manually adjusted to follow the stream centerline and to remain within the 100-year floodplain.

f. Other Considerations

When modeling Meister Branch, Butcher and Crooked Creek only non-backwater conditions were taken into consideration Floodplains were also mapped based on local flow from the Crooked Creek watershed. The floodways were only based on local flow from the Crooked Creek watershed.

Backwater conditions were mapped by taking mapping contour elevations at the confluence of the creeks and the contours were merged to create the backwater inundation mapping. The backwater conditions on effective FEMA maps did not have data available for the 0.2 percent-annual-chance-floodplain. The 0.2 percent-annual-chance-floodplain was not mapped for the backwater conditions.

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 3 contains the full list of these notes.

Figure 3: 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 Flood Map Service Center website at 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 Flood 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 Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 9 in this FIS Report.

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.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

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 Non-Coastal Stillwater Elevations 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.

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.

Figure 3. FIRM Notes to Users

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" 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 State Plane Missouri East, FIPS 2401. 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 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 in Section 3.3 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on this FIRM was provided in digital format by the United States Geological Survey (USGS), Missouri Department of Transportation, U.S. Army Corps of Engineers (USACE), and Federal Emergency Management Agency (FEMA). Other information was derived from digital orthophotography at a 1-meter resolution dated 2014 from U.S. Department of Agriculture National Aerial Imagery Program (NAIP).

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 Lincoln County, MO, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report 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.

Figure 3. FIRM Notes to Users

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Lincoln County, MO, effective TBD.

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.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 4 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Lincoln County.

Figure 4: 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.

Figure 4: Map Legend for FIRM

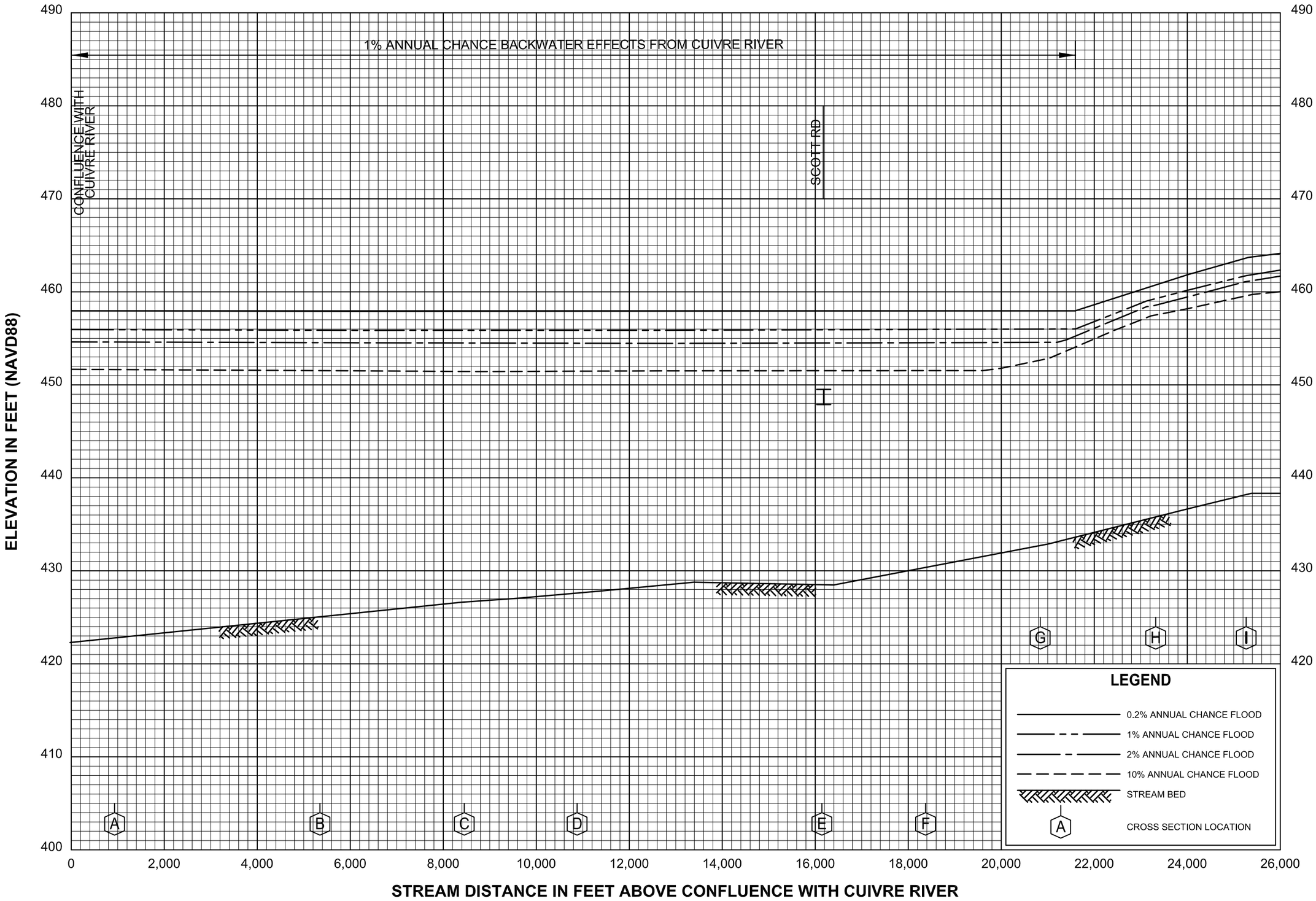
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate 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.
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.
NO SCREEN	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

Figure 4: Map Legend for FIRM

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.*	
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

Figure 4: Map Legend for FIRM

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

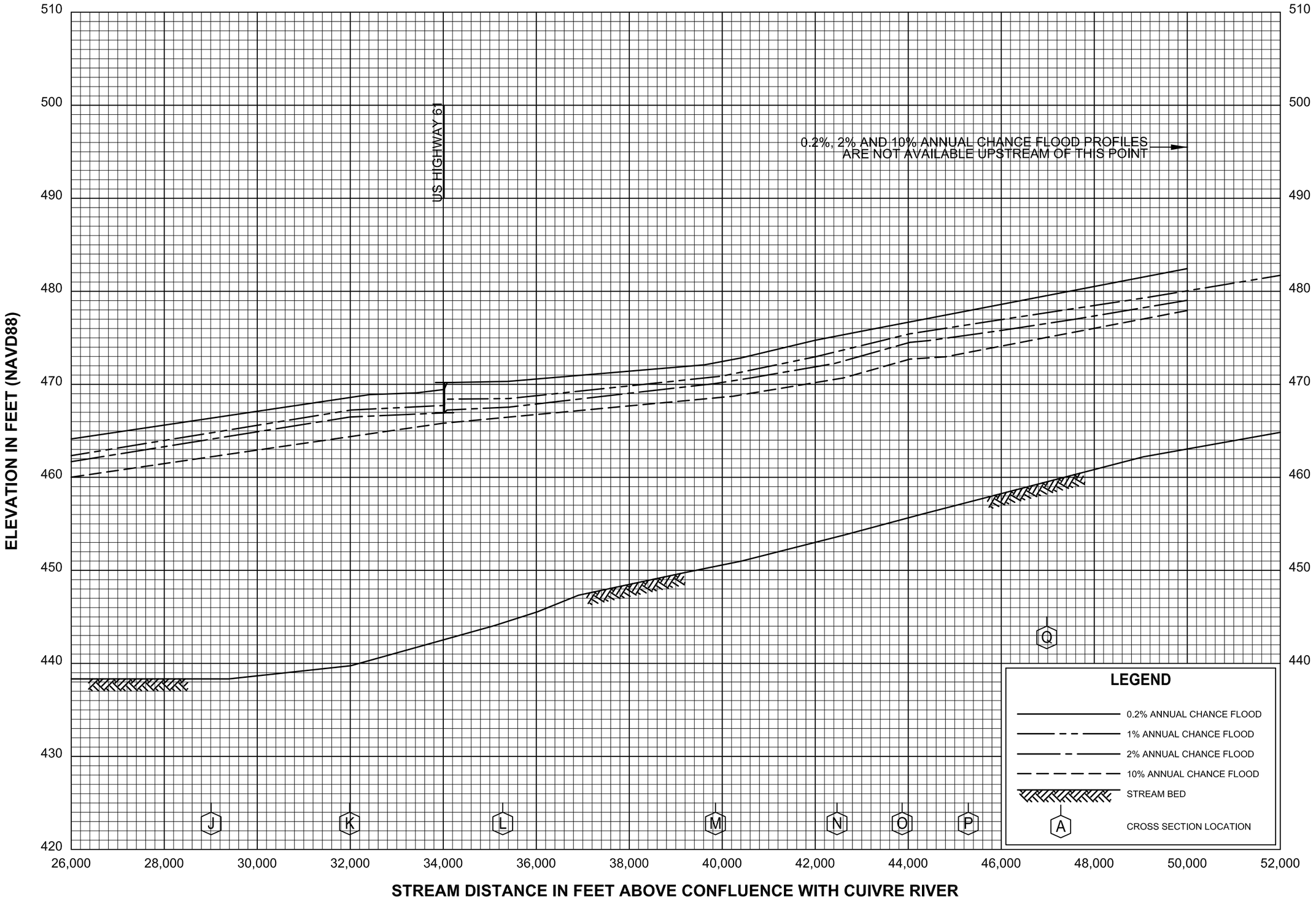
BIG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

01P



FLOOD PROFILES

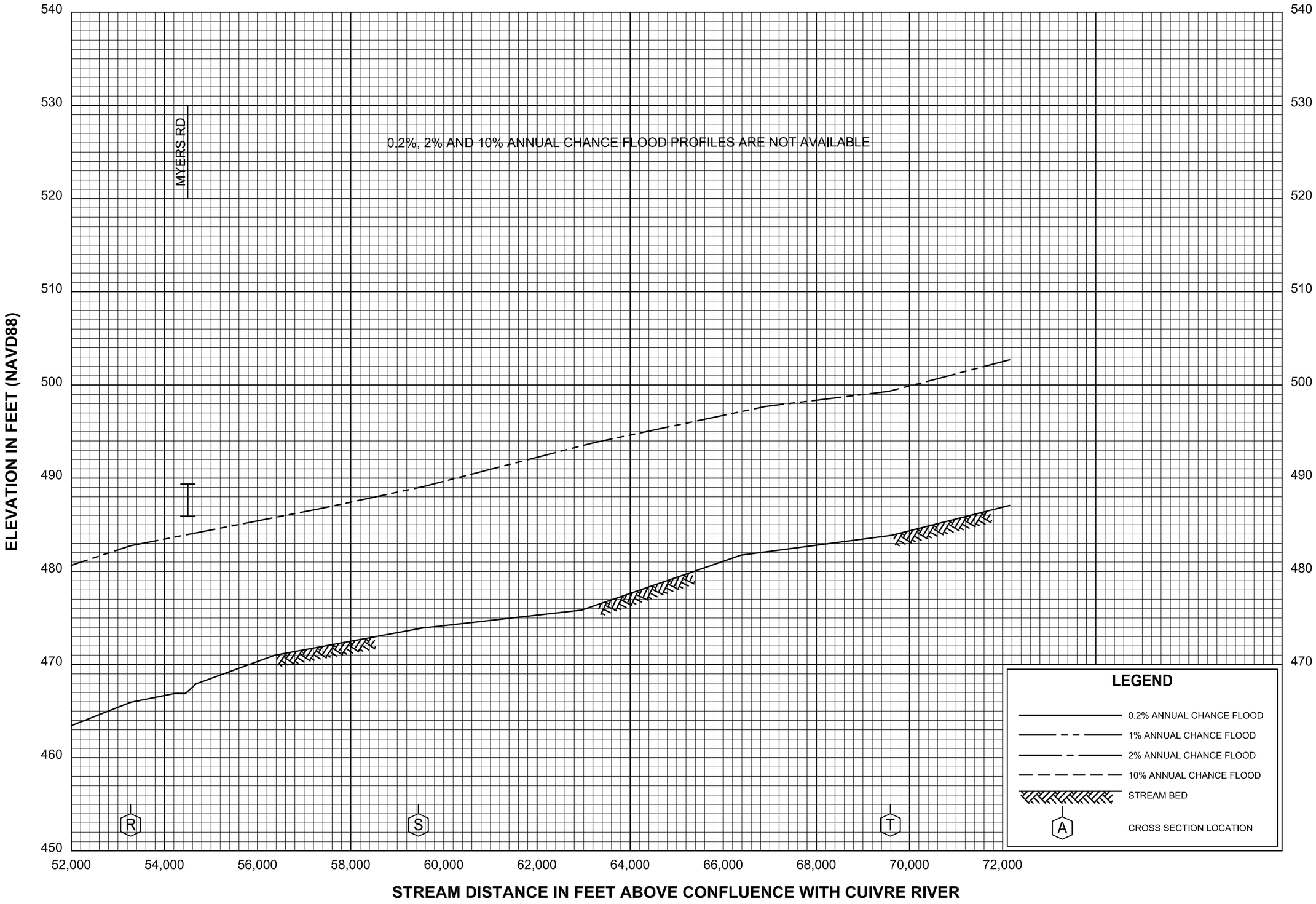
BIG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

02P



FLOOD PROFILES

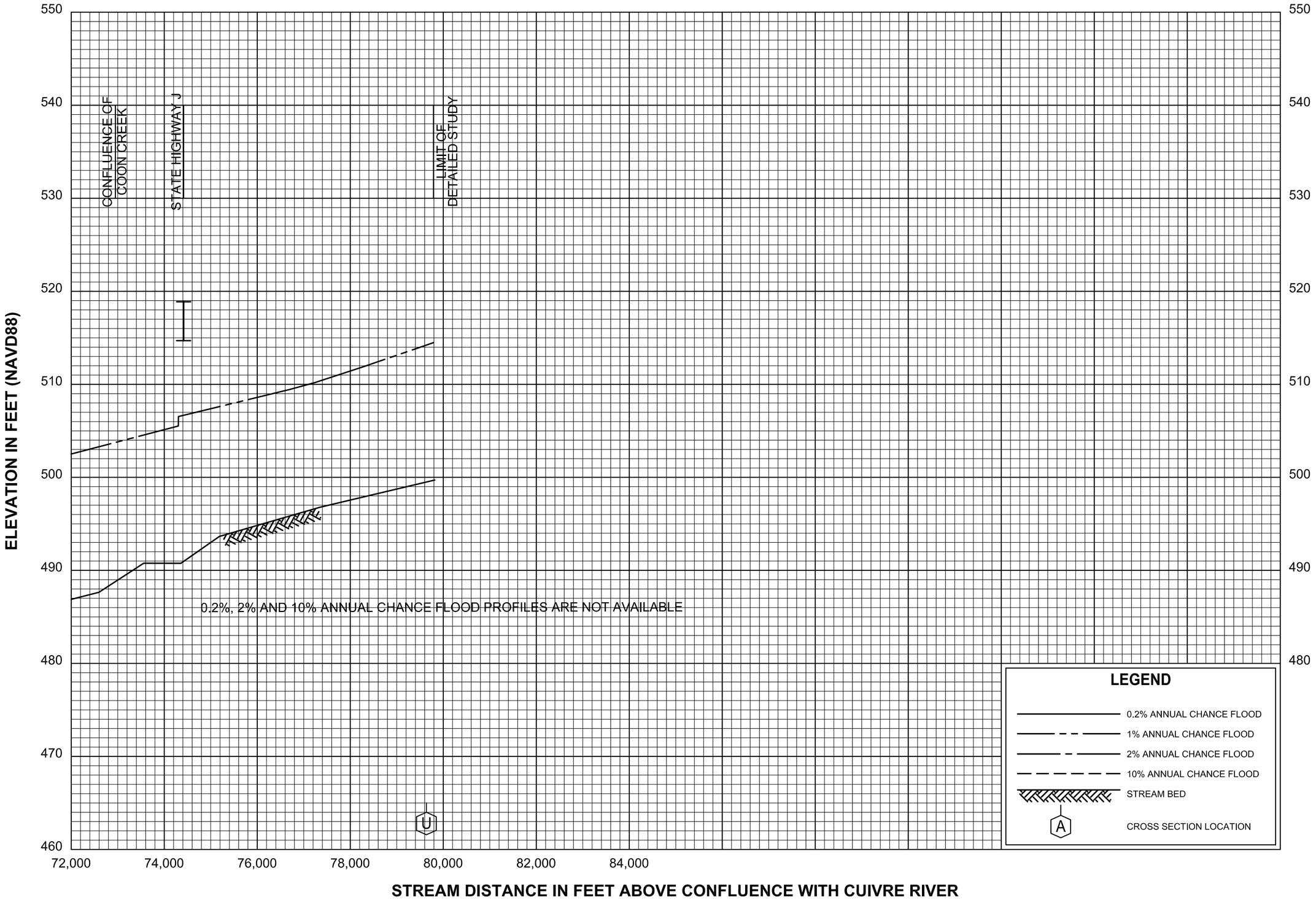
BIG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

03P



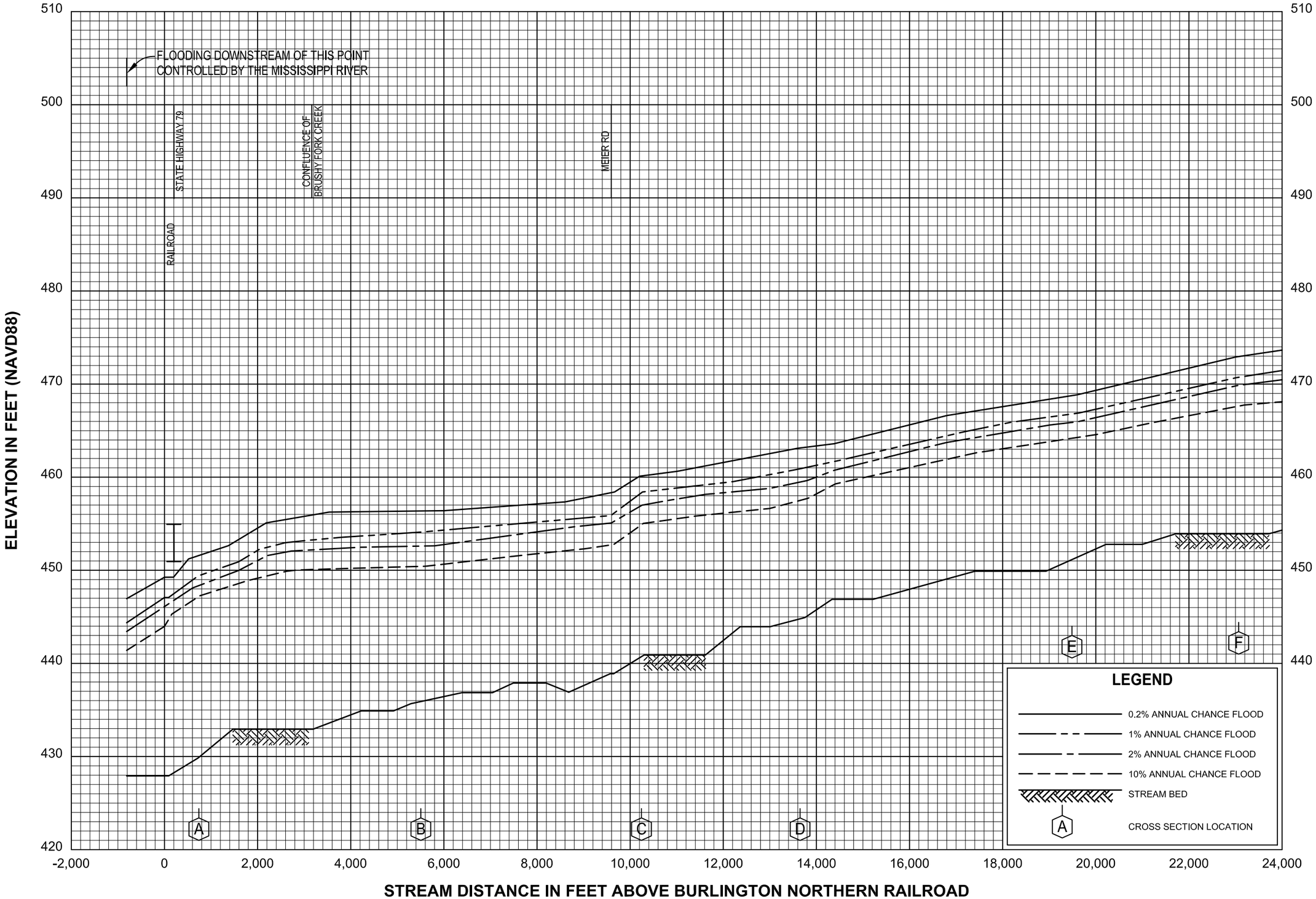
FLOOD PROFILES

BIG CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



FLOOD PROFILES

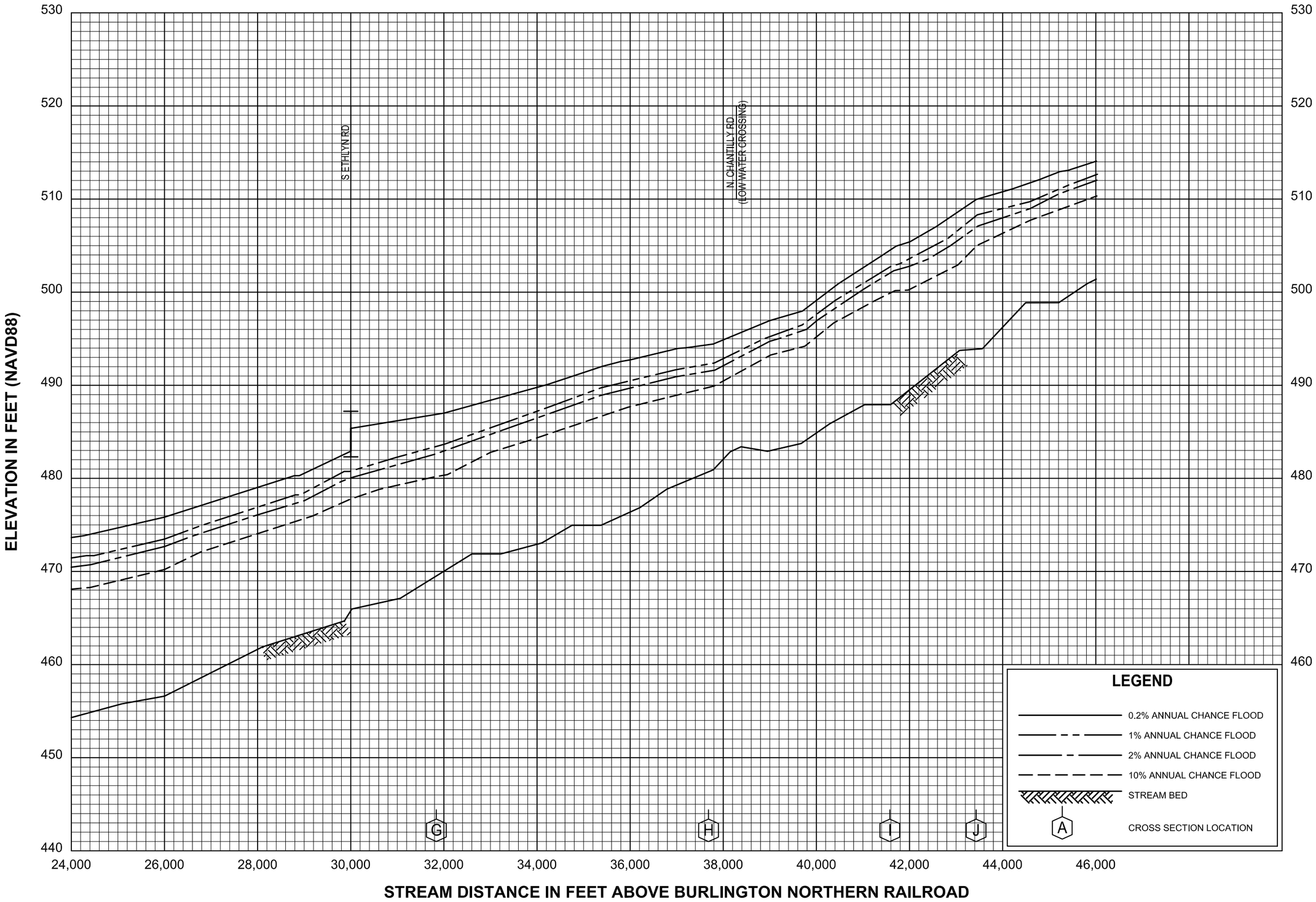
BOBS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

05P



FLOOD PROFILES

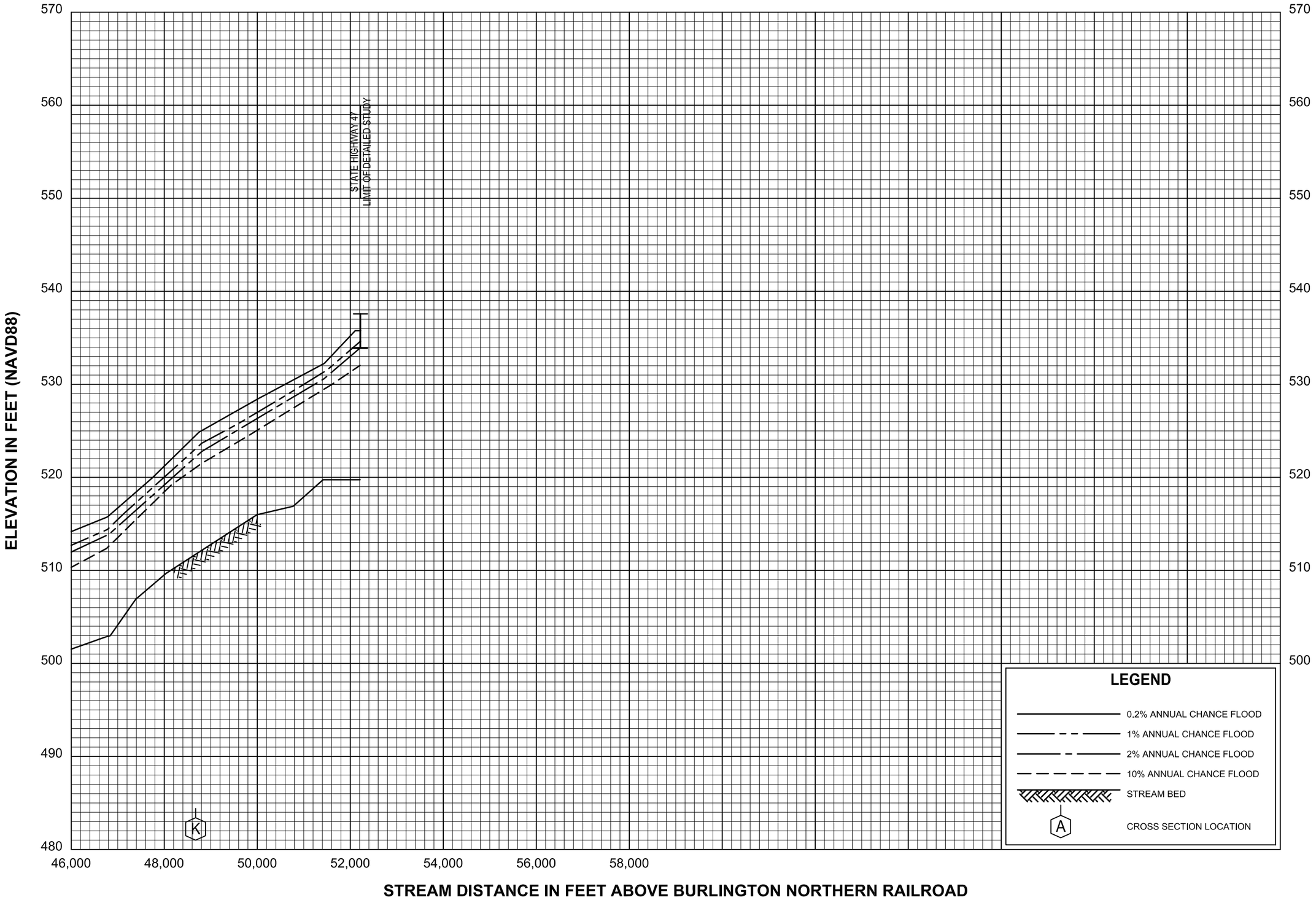
BOBS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

06P



FLOOD PROFILES

BOBS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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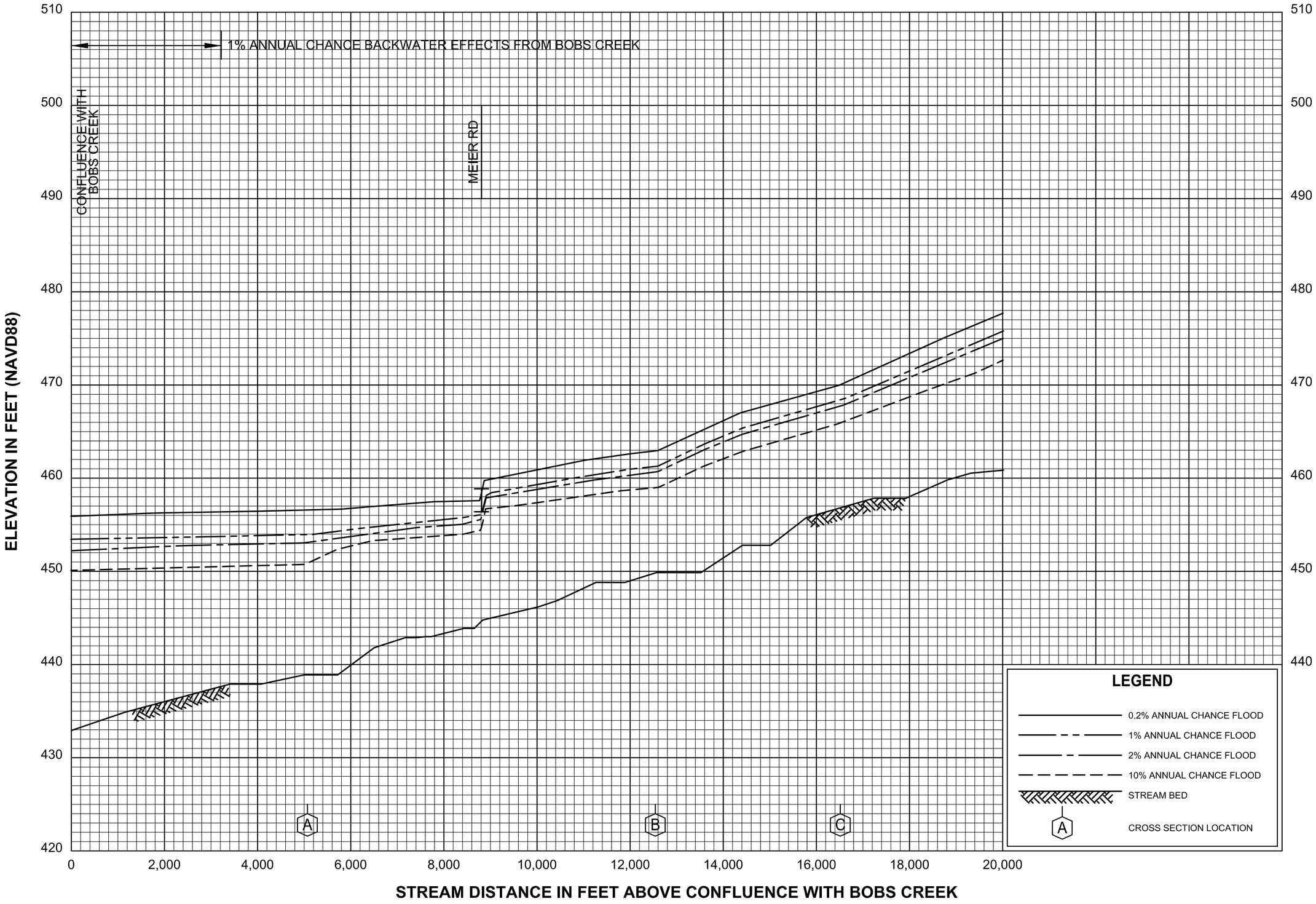

FLOOD PROFILES

BRUSHY FORK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

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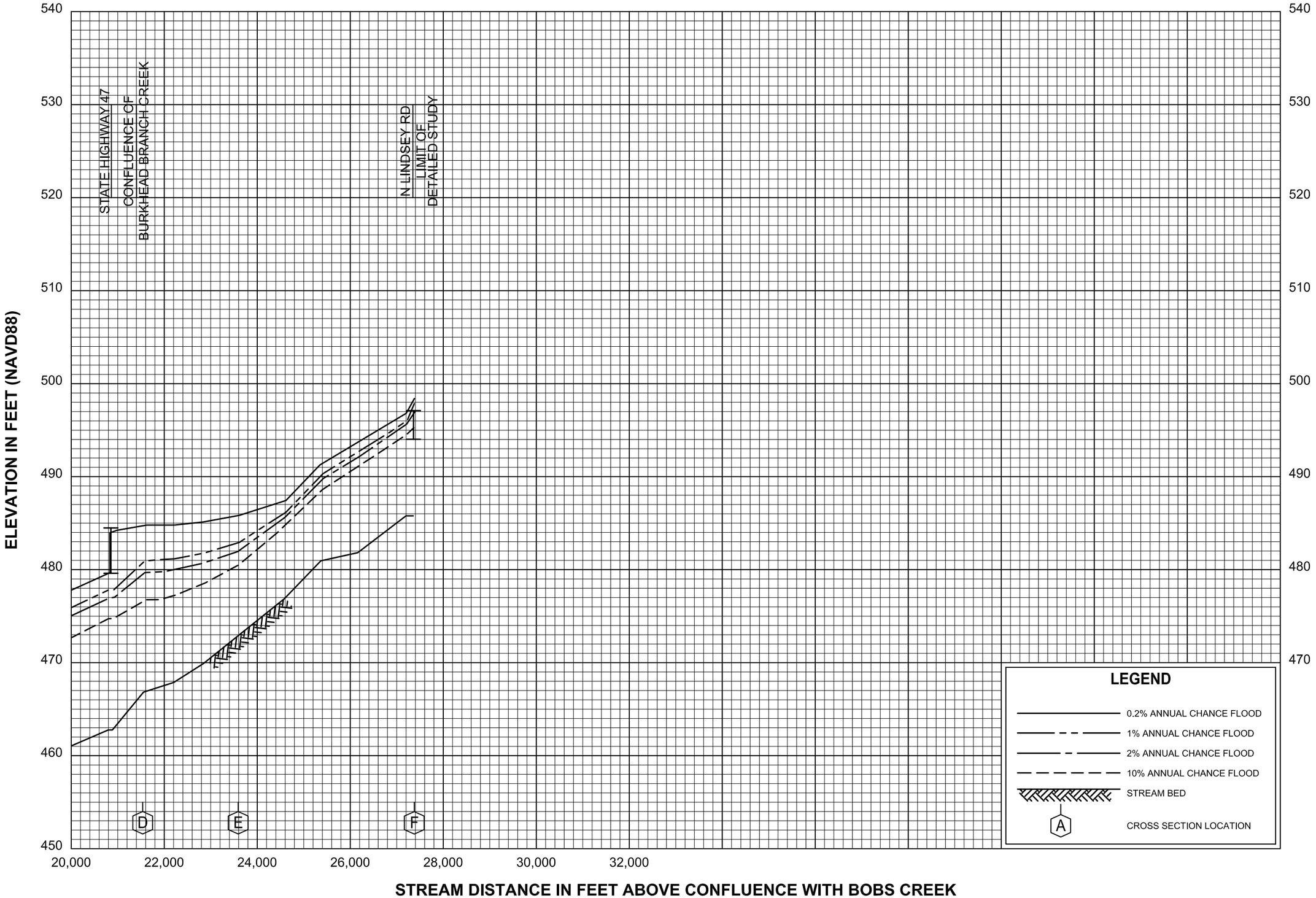

FLOOD PROFILES

BRUSHY FORK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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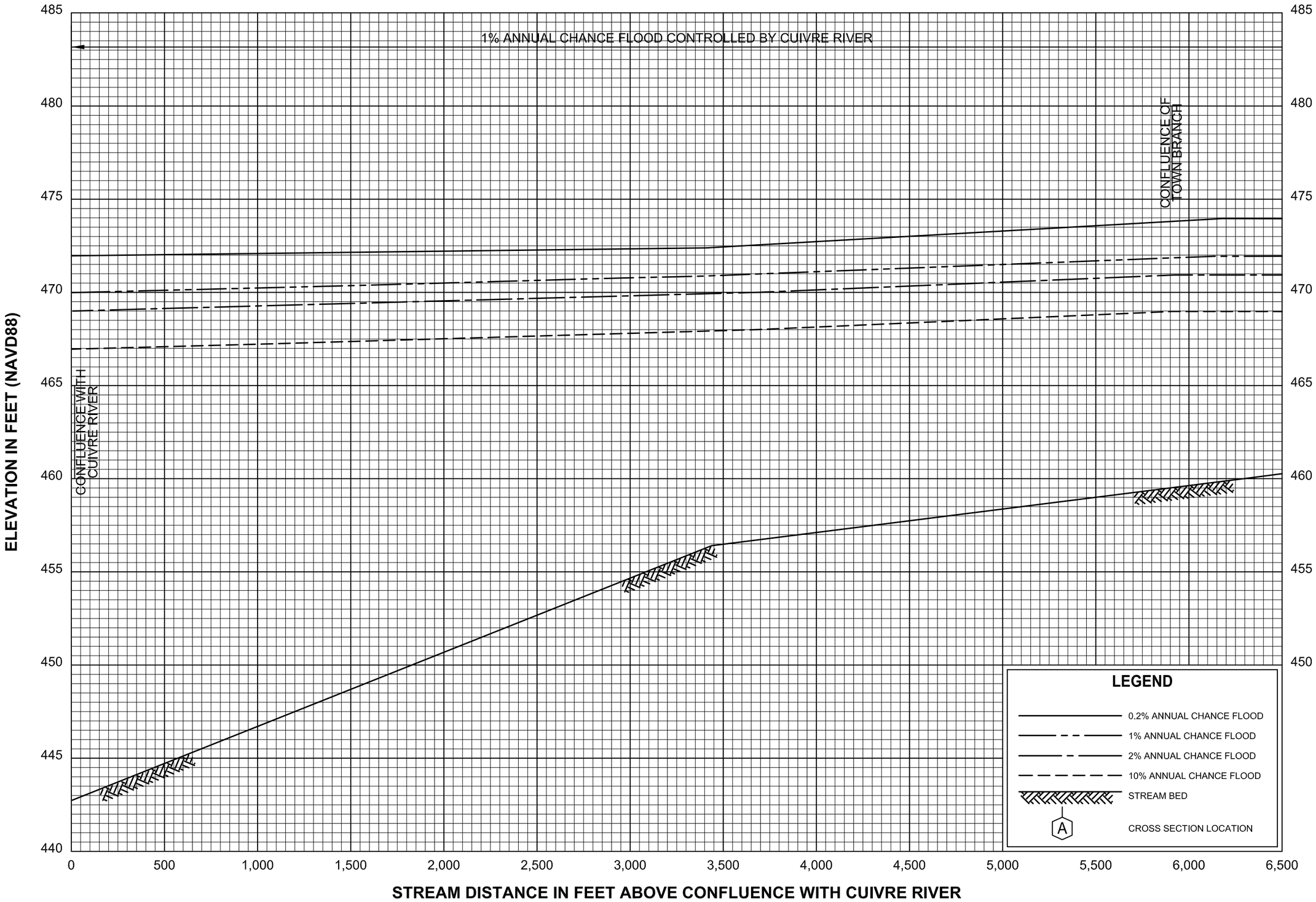
09P



FLOOD PROFILES

BUCHANAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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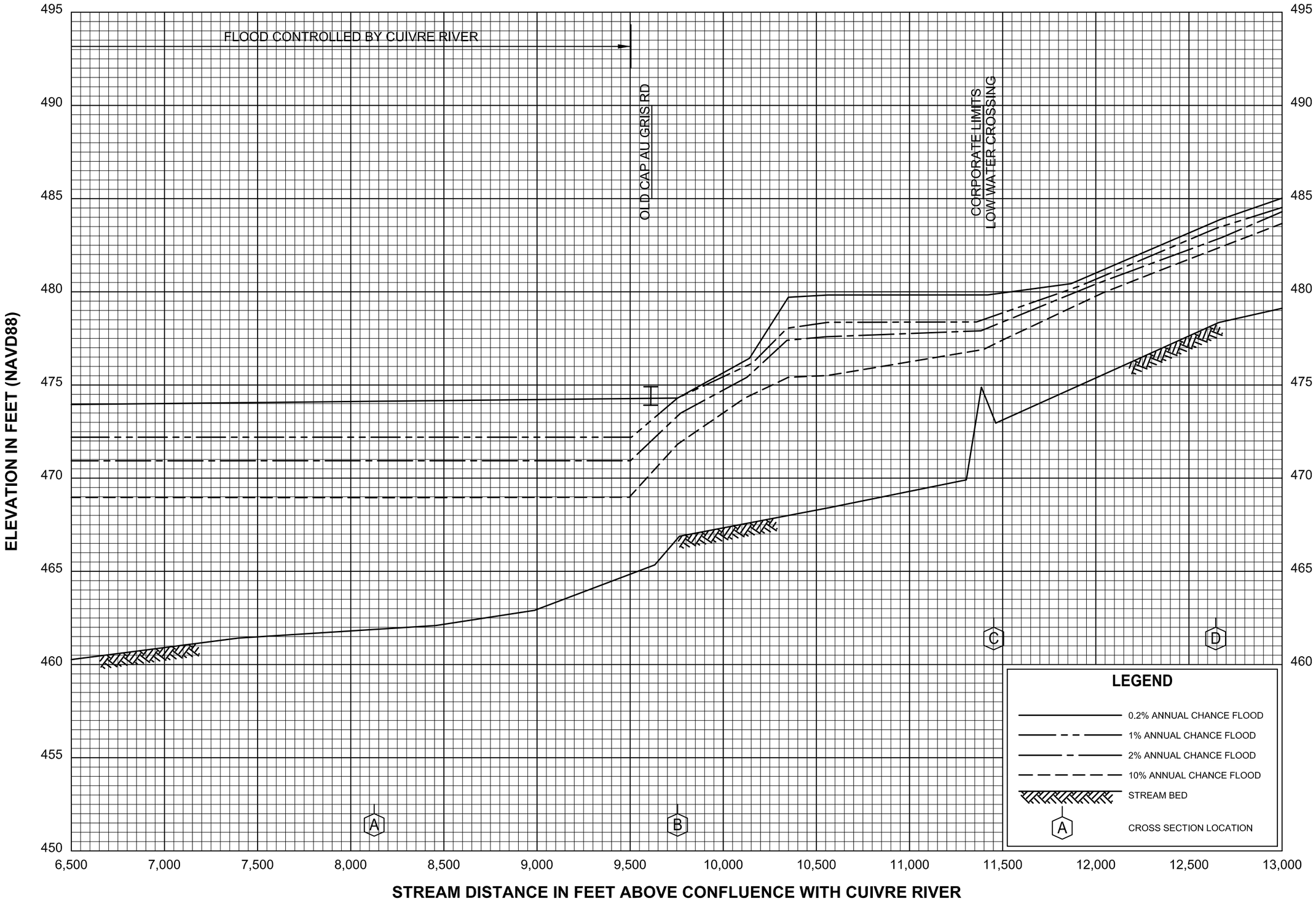

FLOOD PROFILES

BUCHANAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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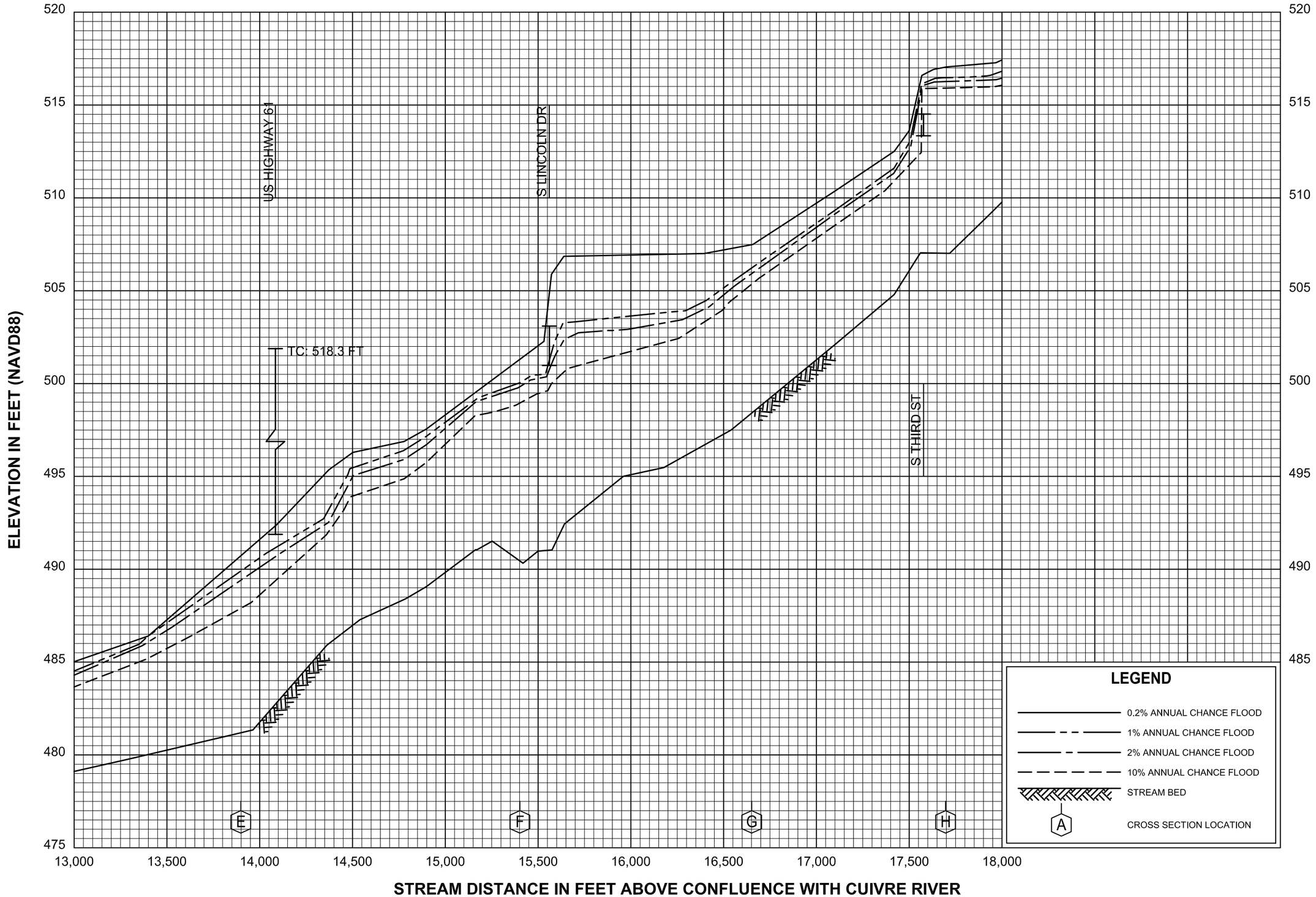

FLOOD PROFILES

BUCHANAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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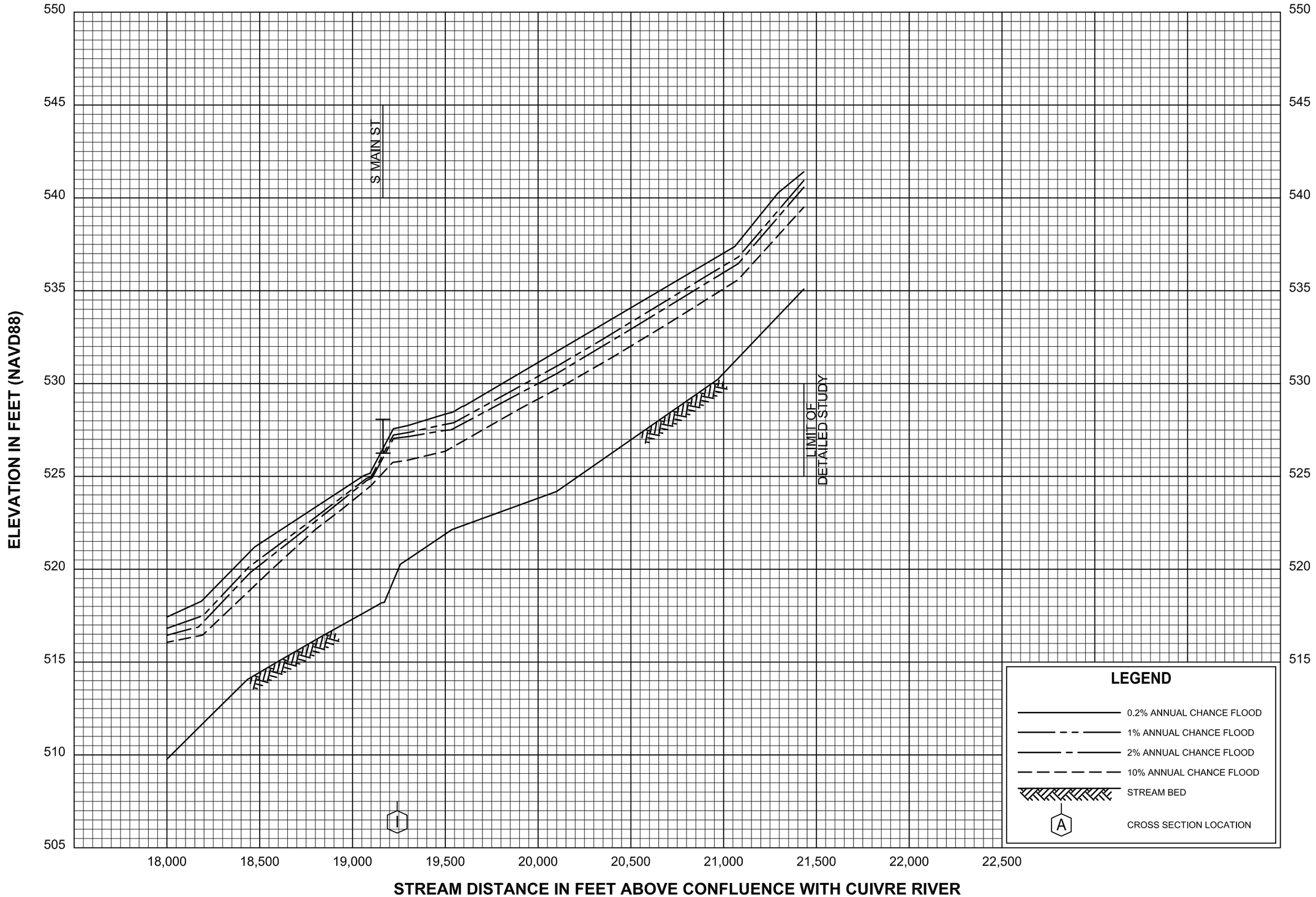

FLOOD PROFILES

BUCHANAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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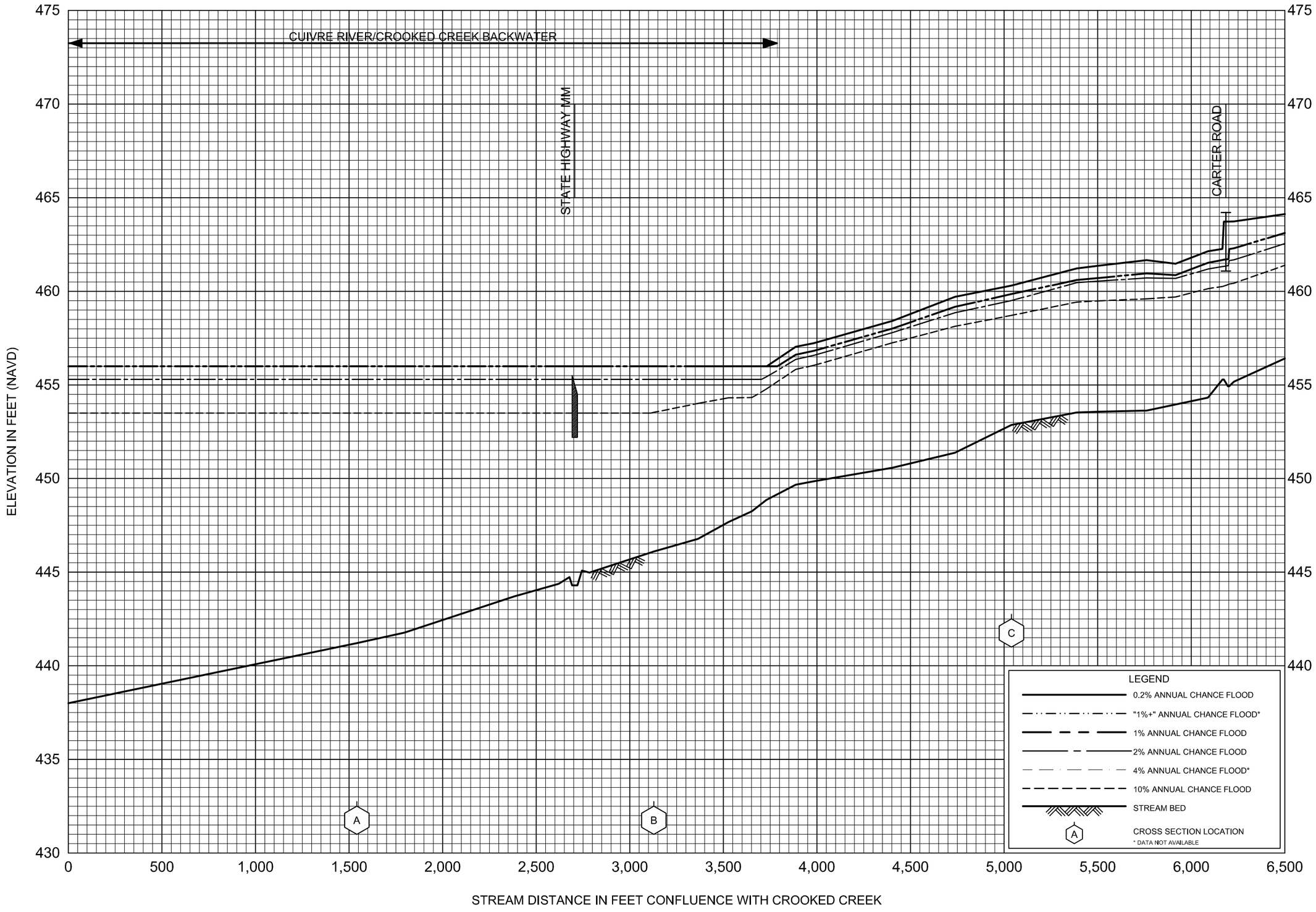

FLOOD PROFILES

BUTCHER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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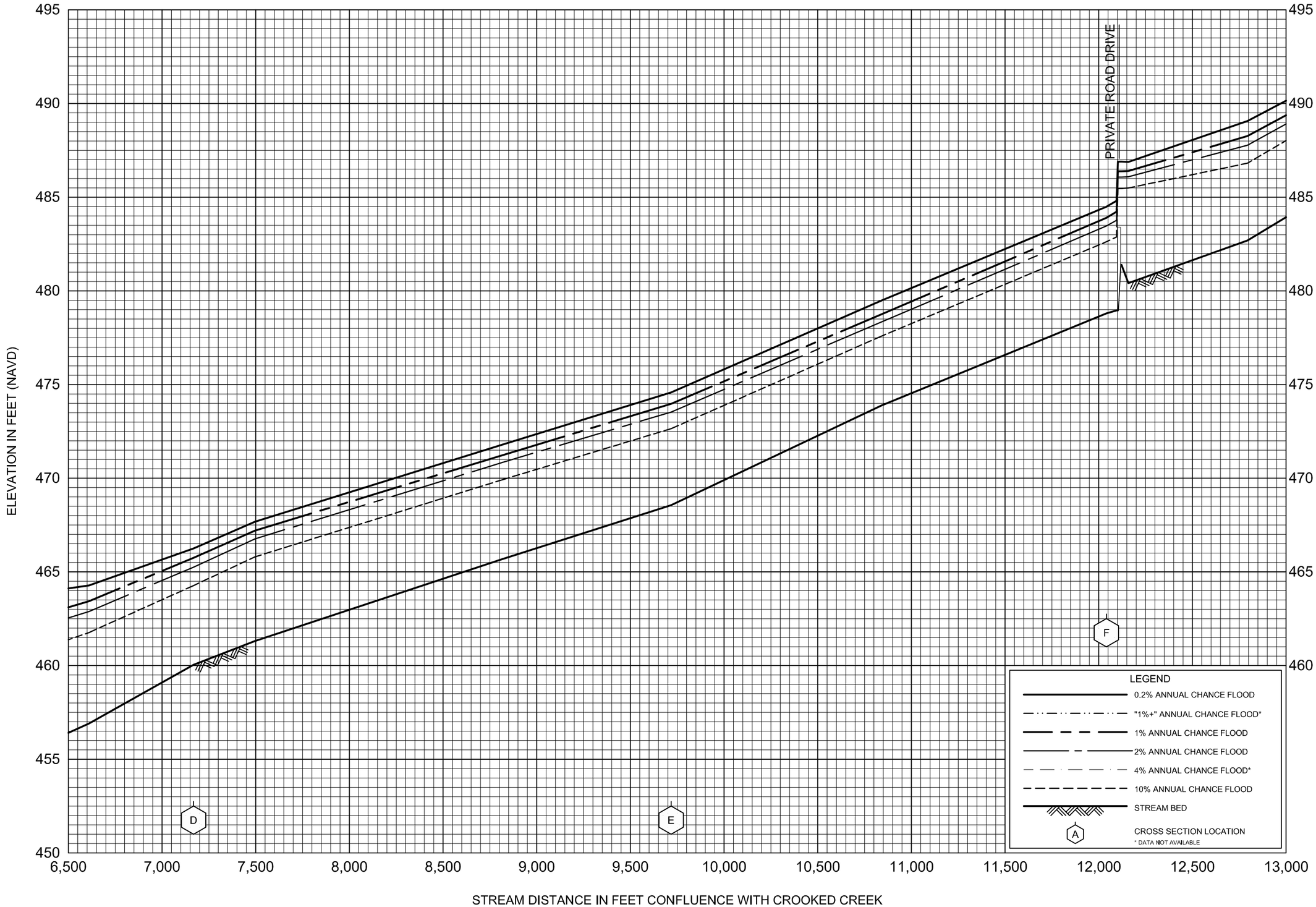

FLOOD PROFILES

BUTCHER CREEK

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LINCOLN COUNTY, MO

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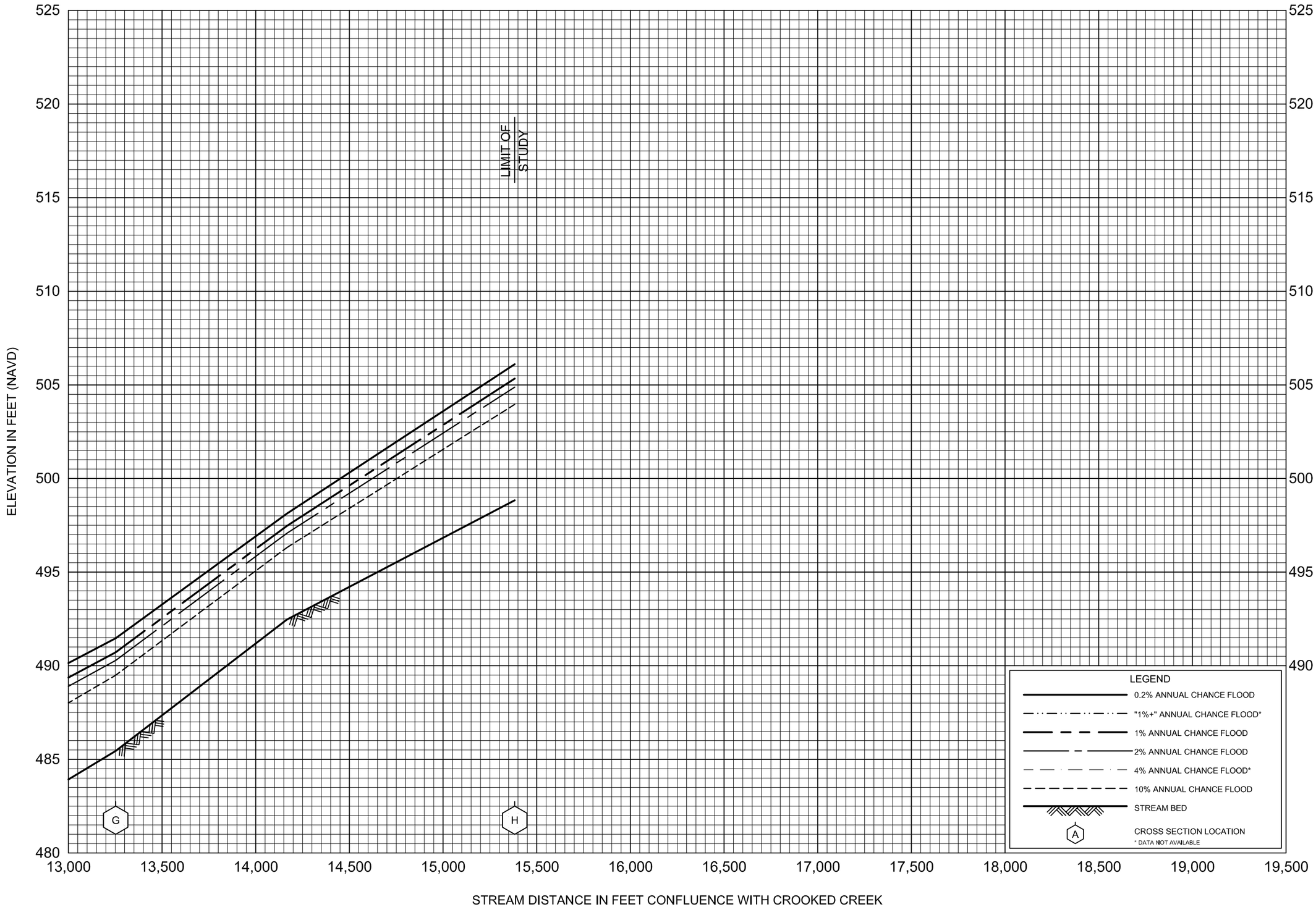

FLOOD PROFILES

BUTCHER CREEK

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LINCOLN COUNTY, MO

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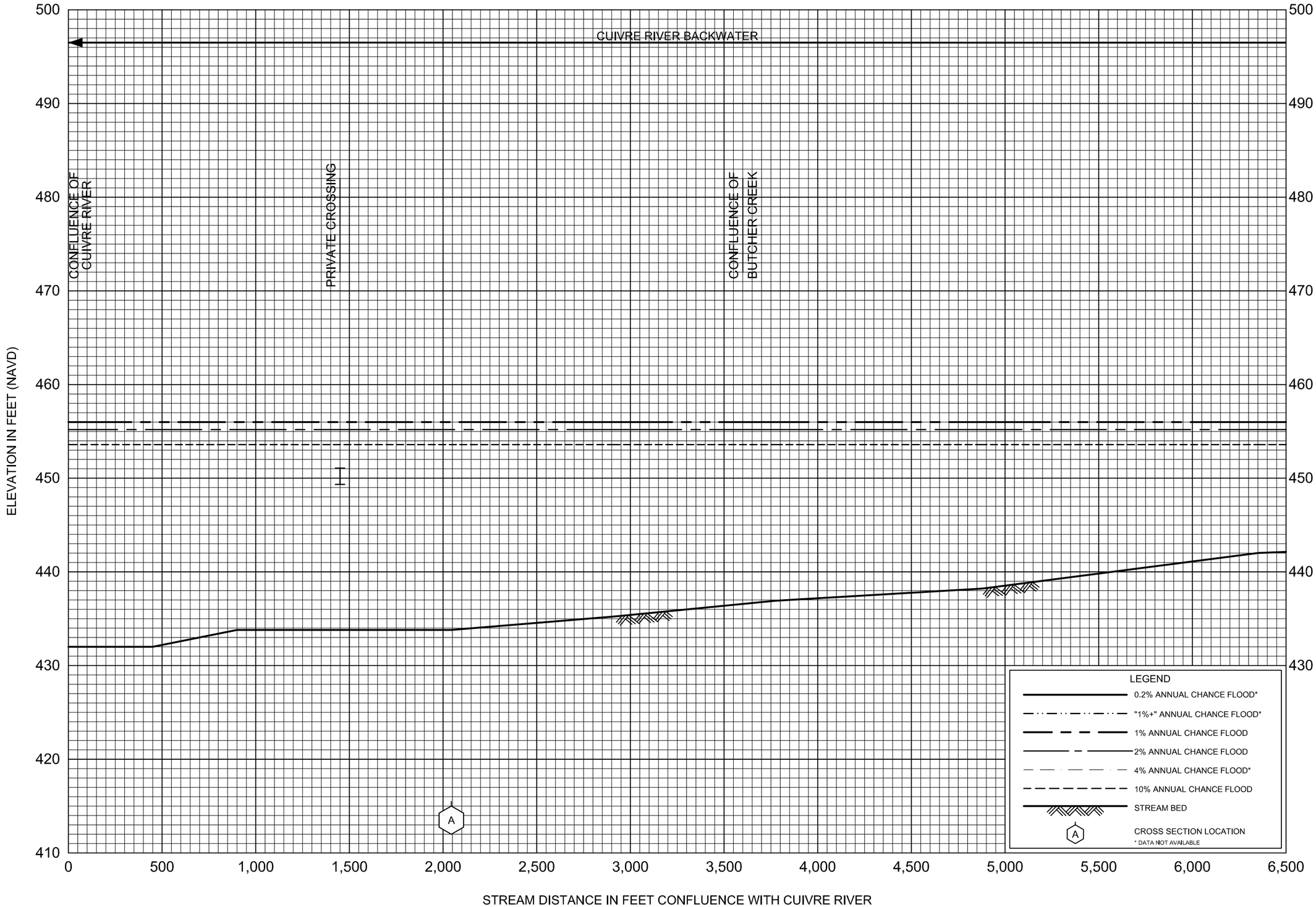

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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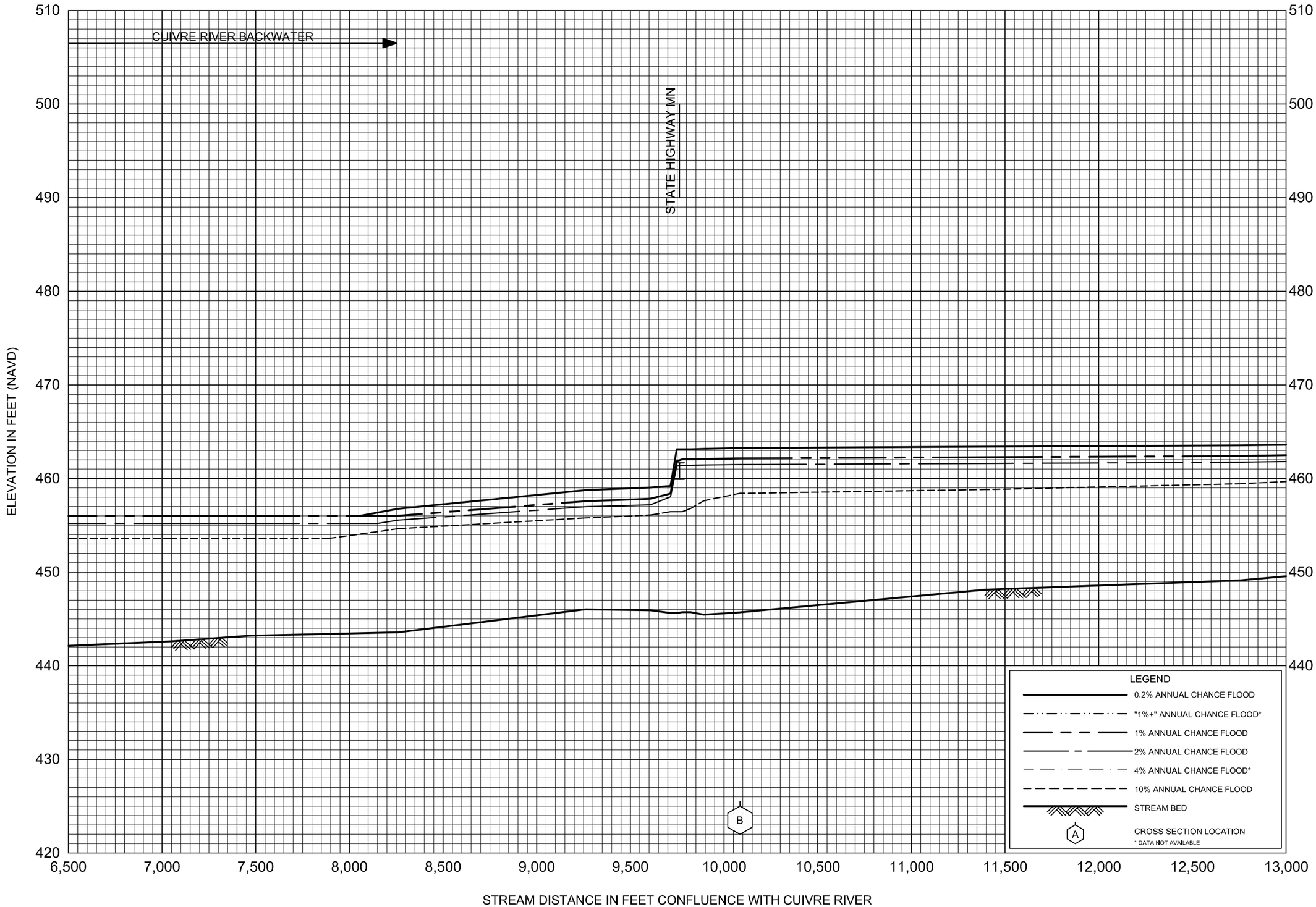

FLOOD PROFILES

CROOKED CREEK

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LINCOLN COUNTY, MO

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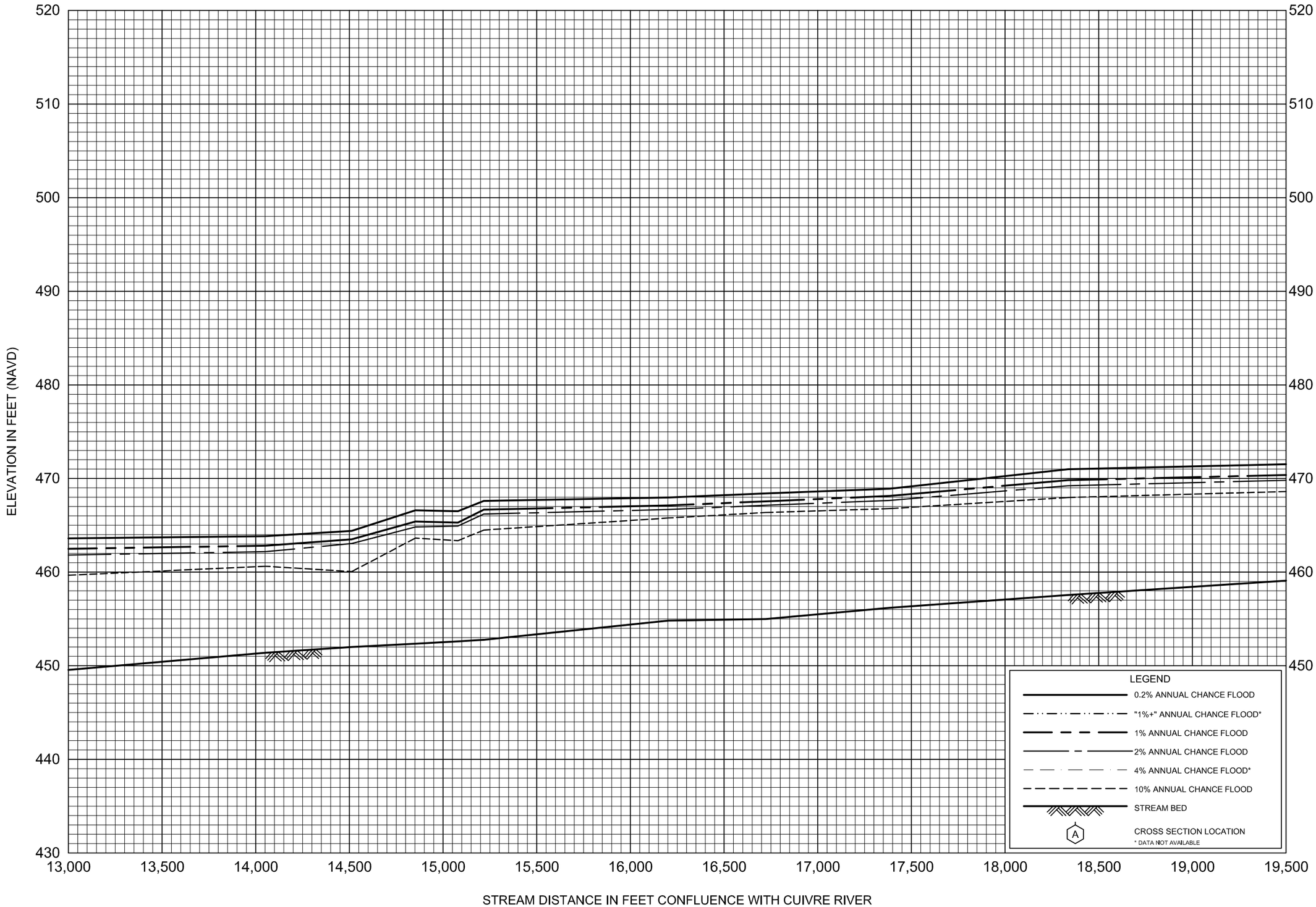

FLOOD PROFILES

CROOKED CREEK

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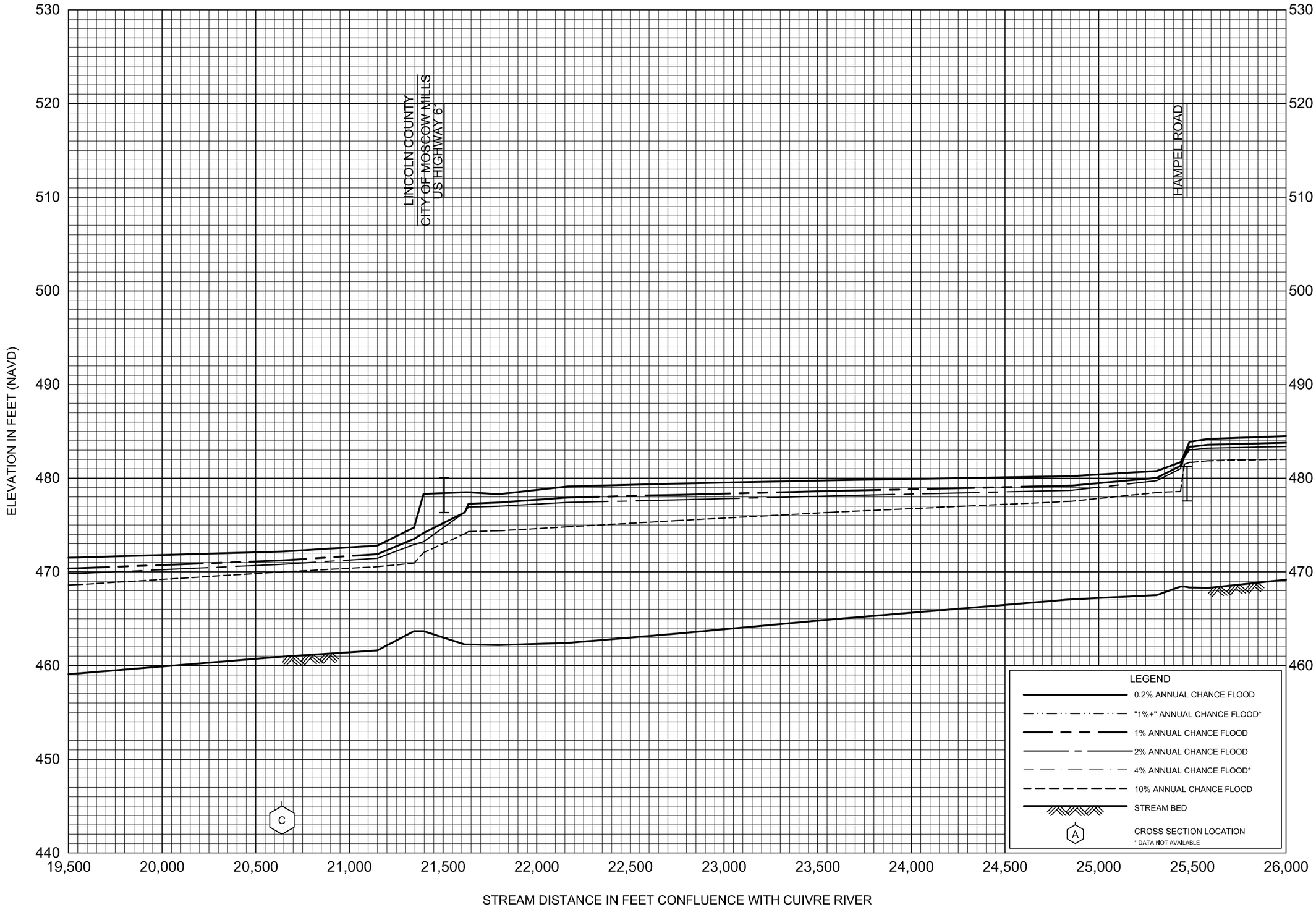

FLOOD PROFILES

CROOKED CREEK

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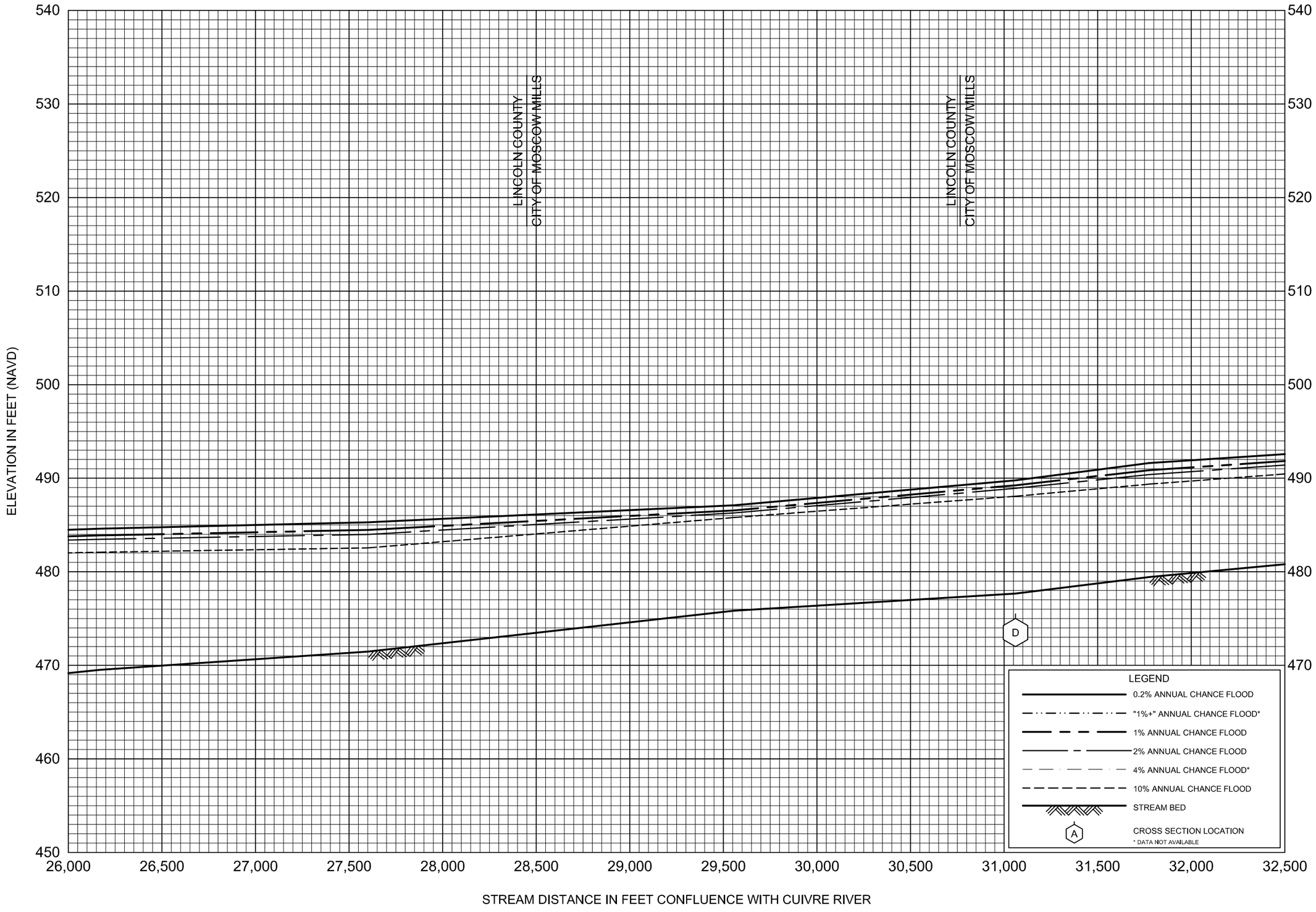

FLOOD PROFILES

CROOKED CREEK

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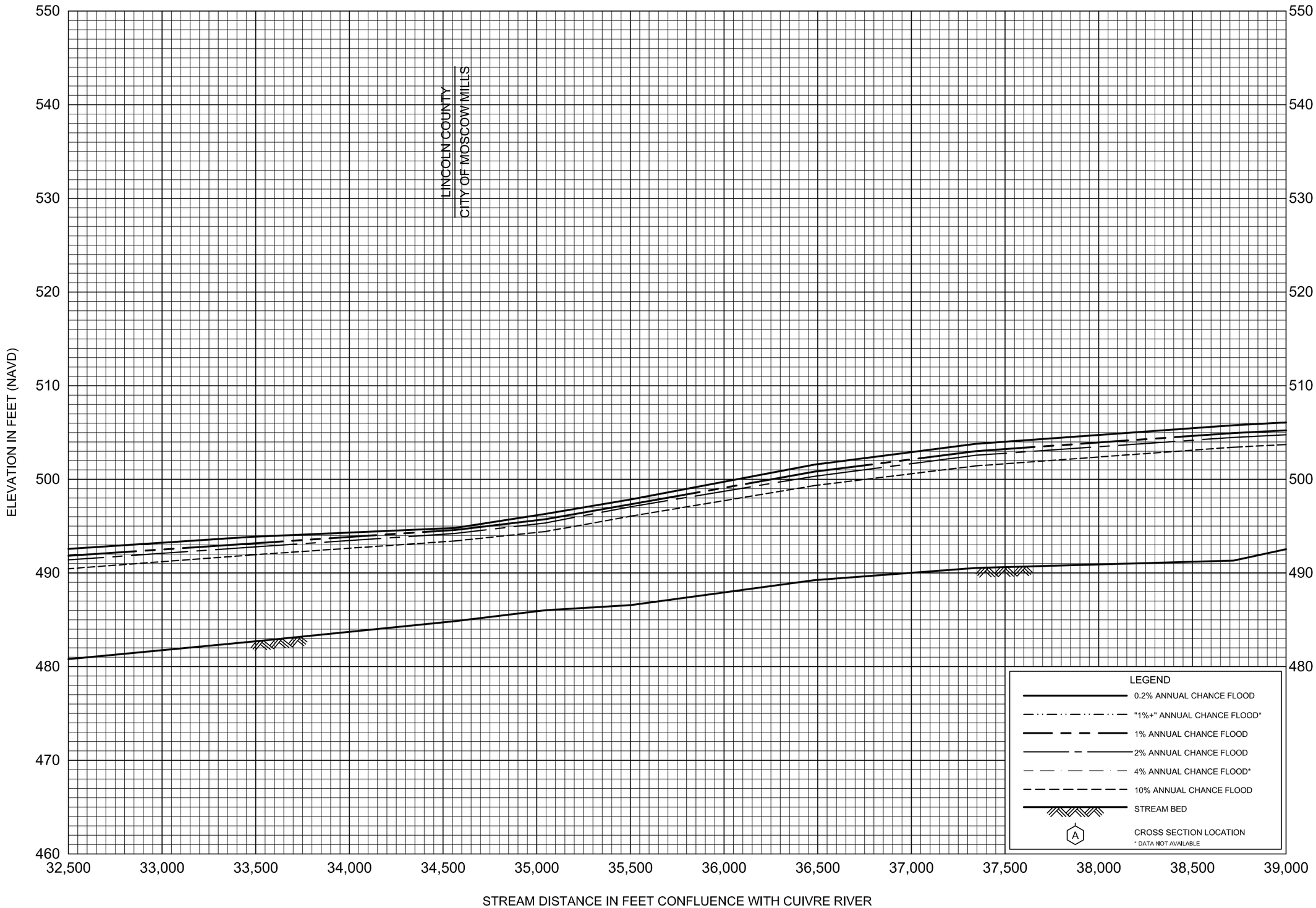

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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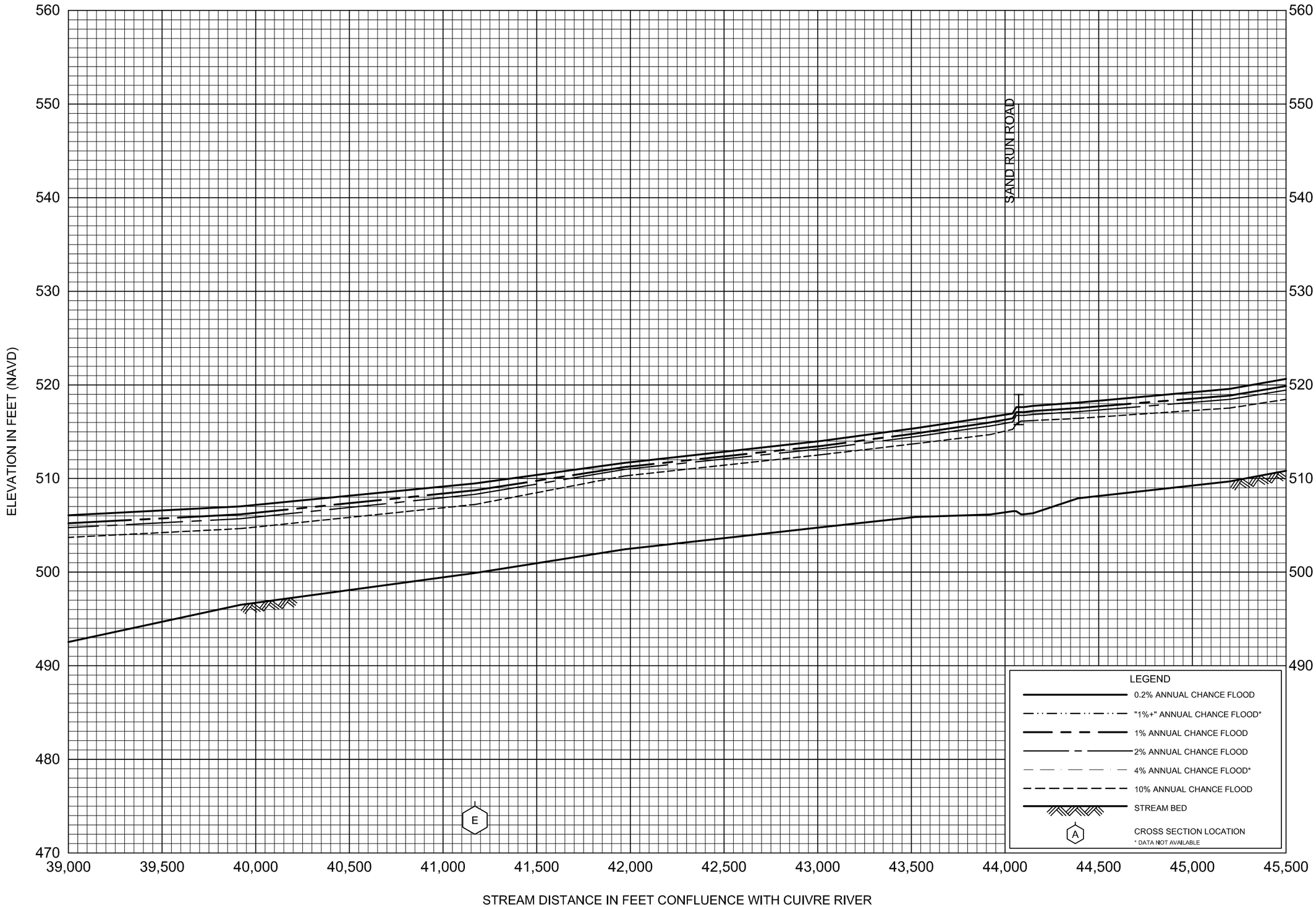

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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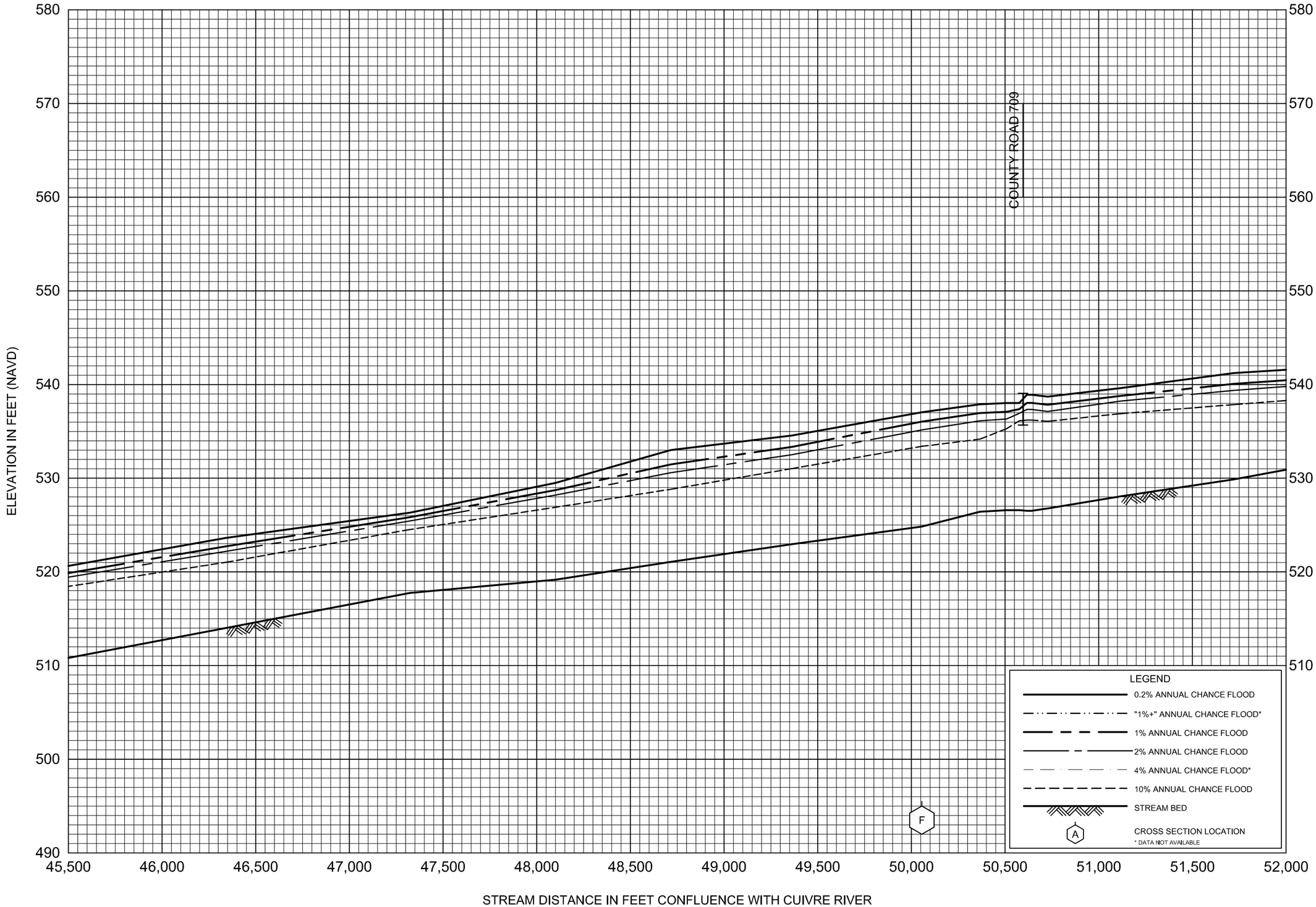

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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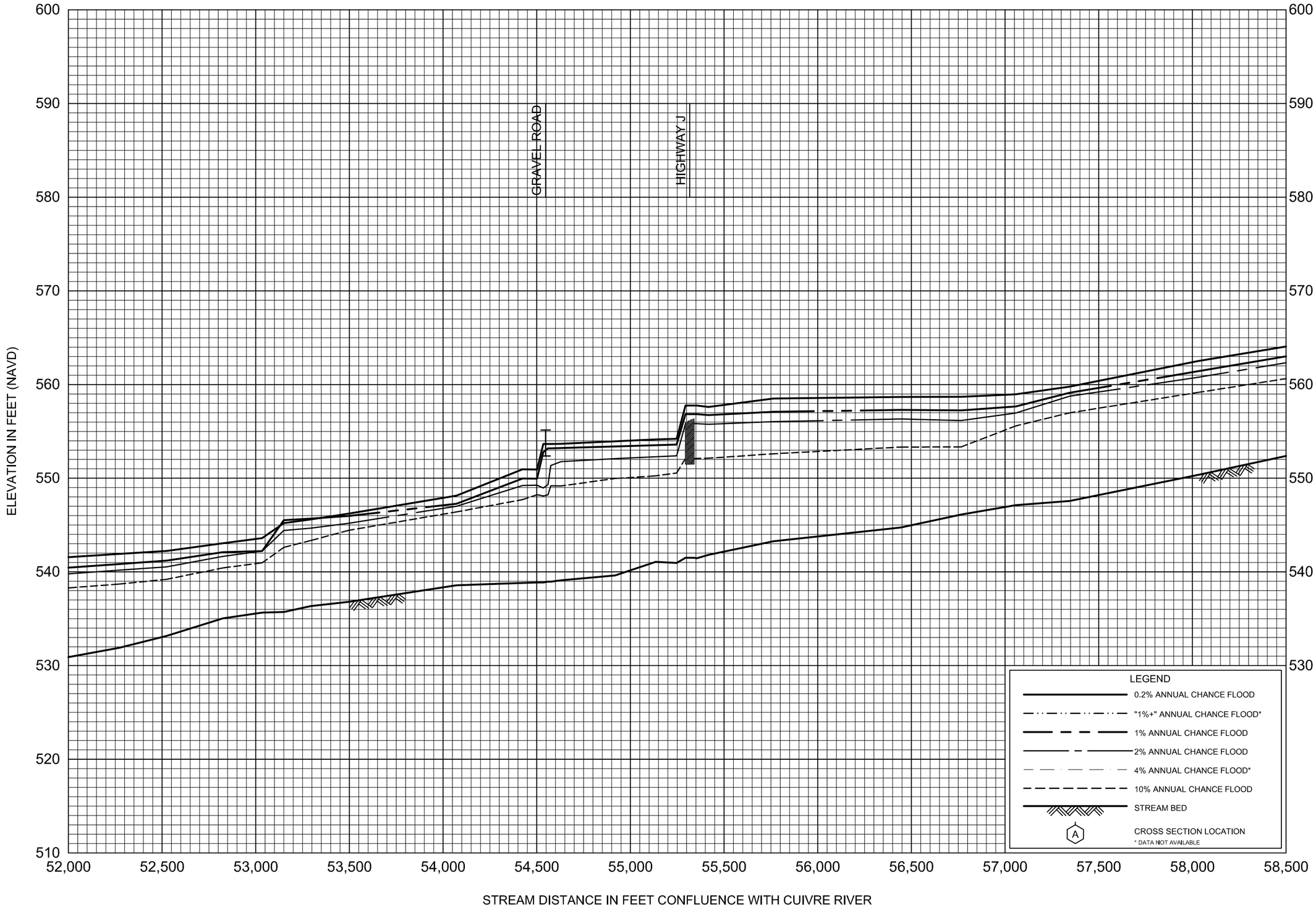

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

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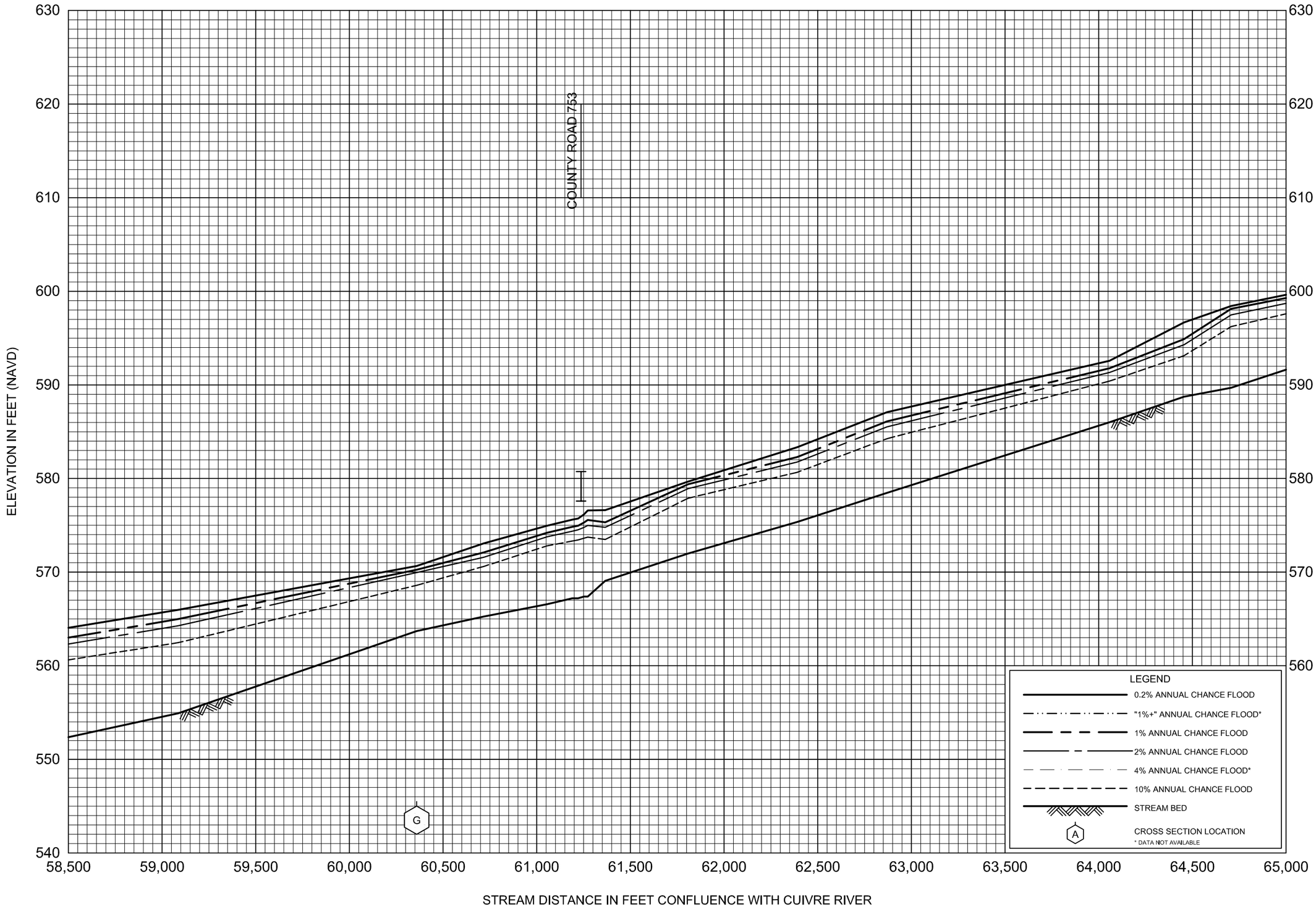

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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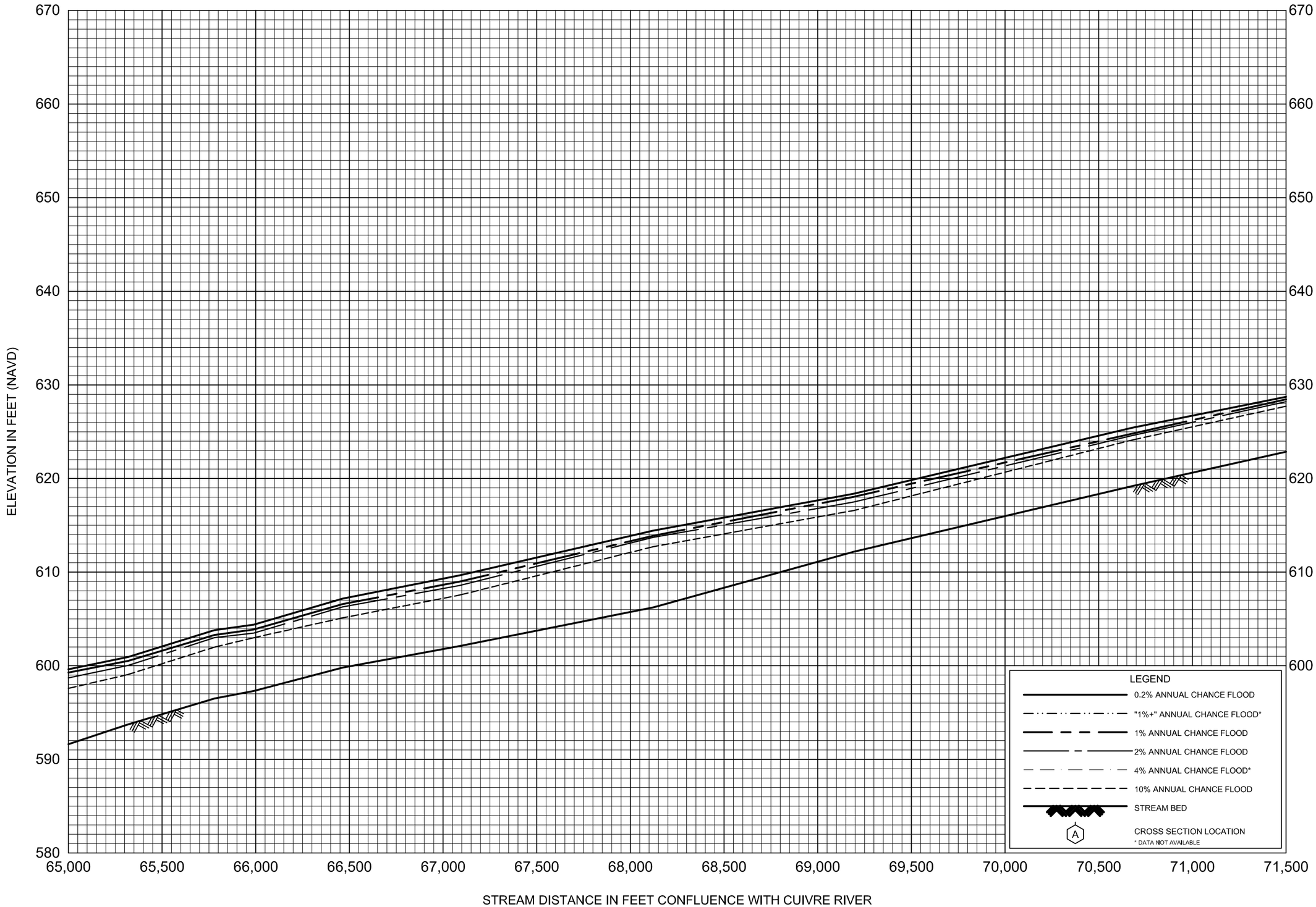

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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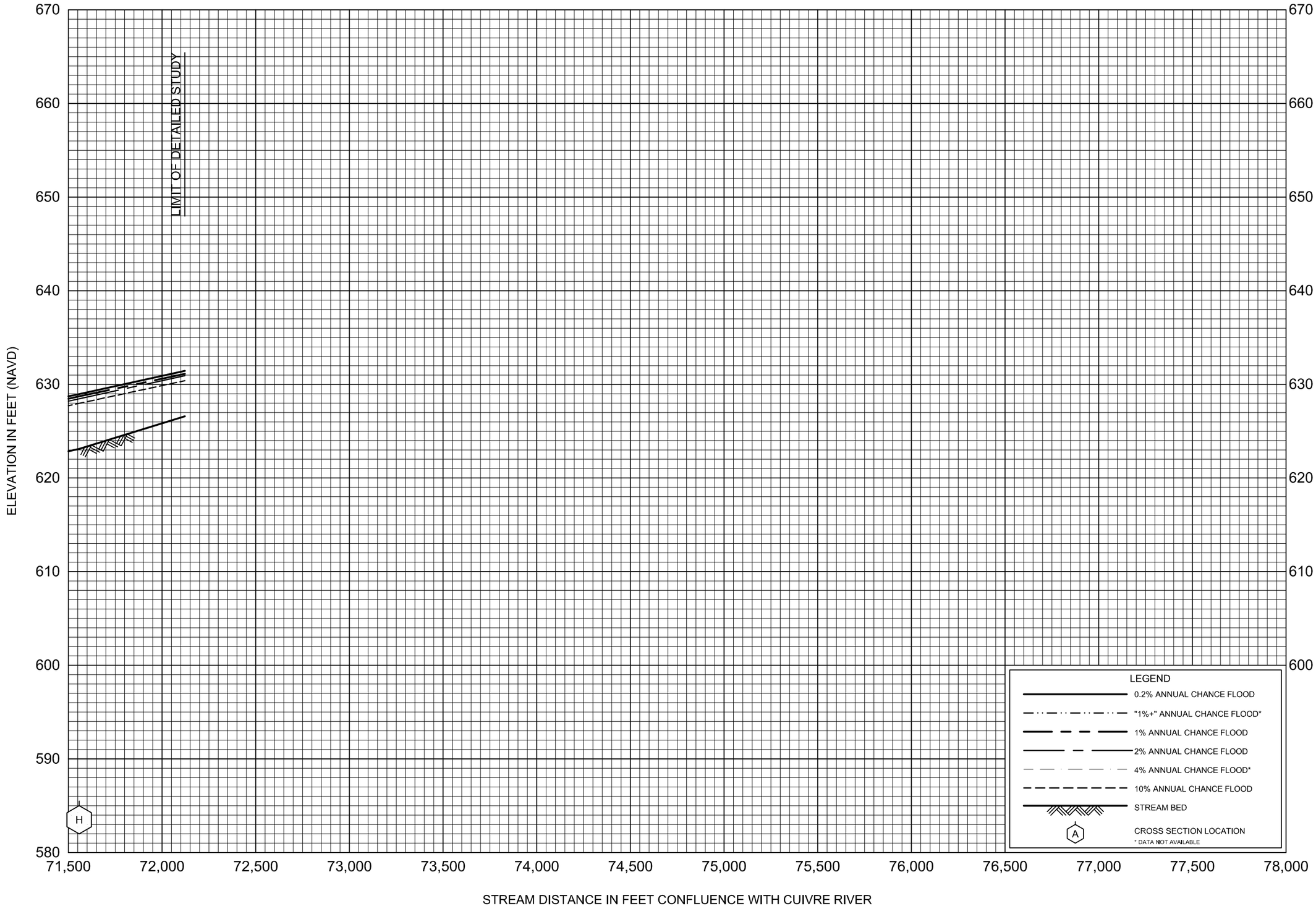

FLOOD PROFILES

CROOKED CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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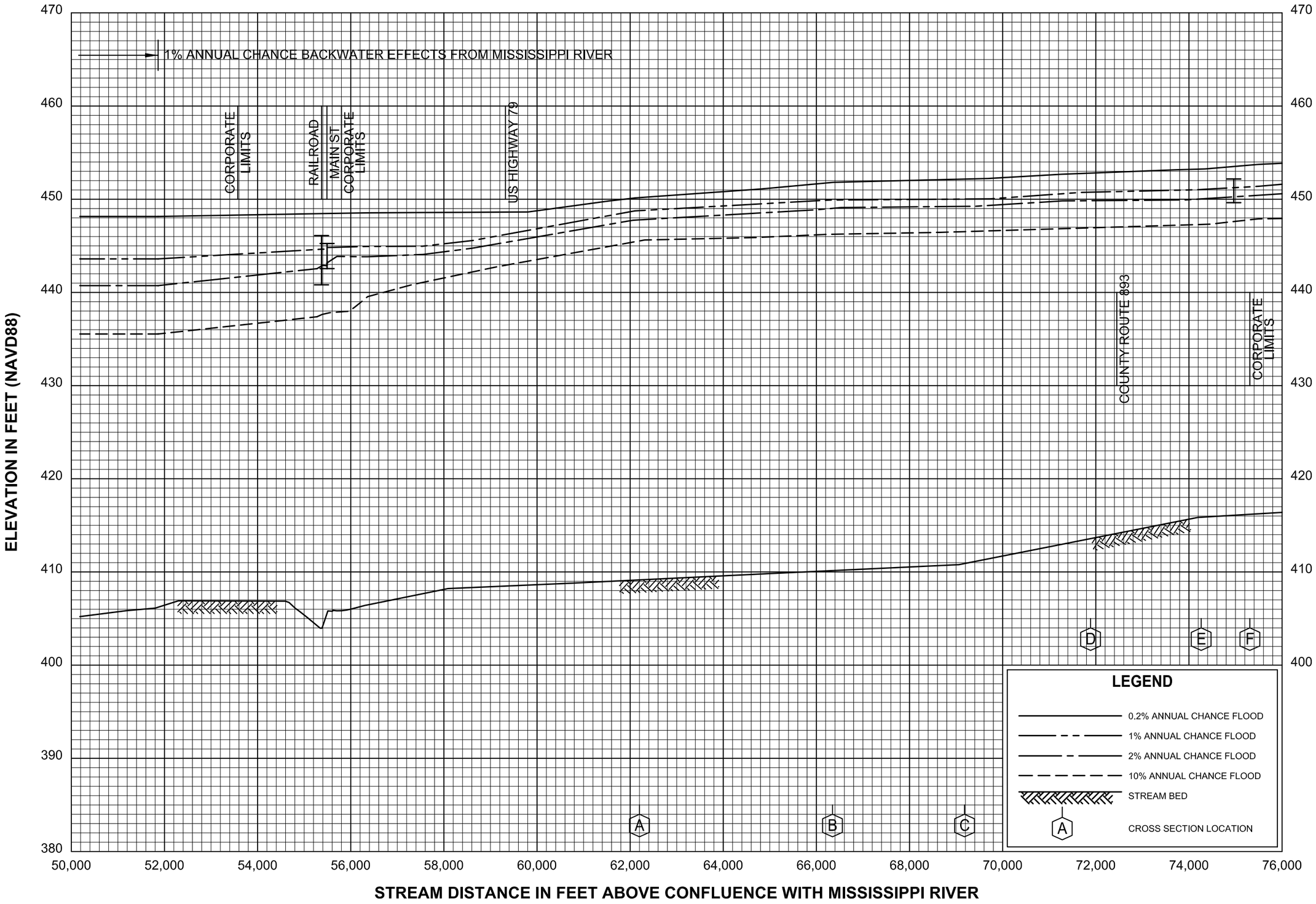


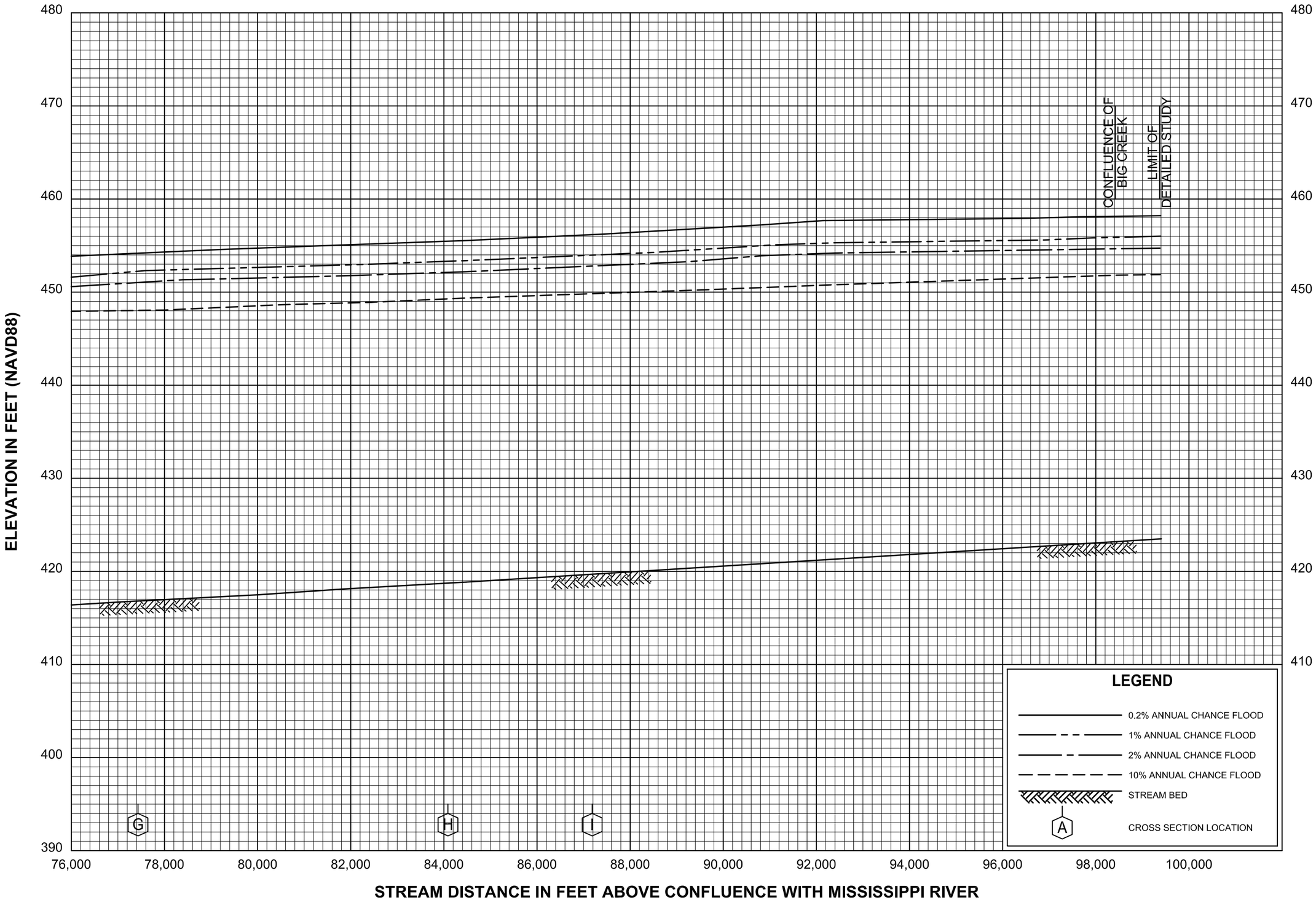
FLOOD PROFILES

CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



FLOOD PROFILES

CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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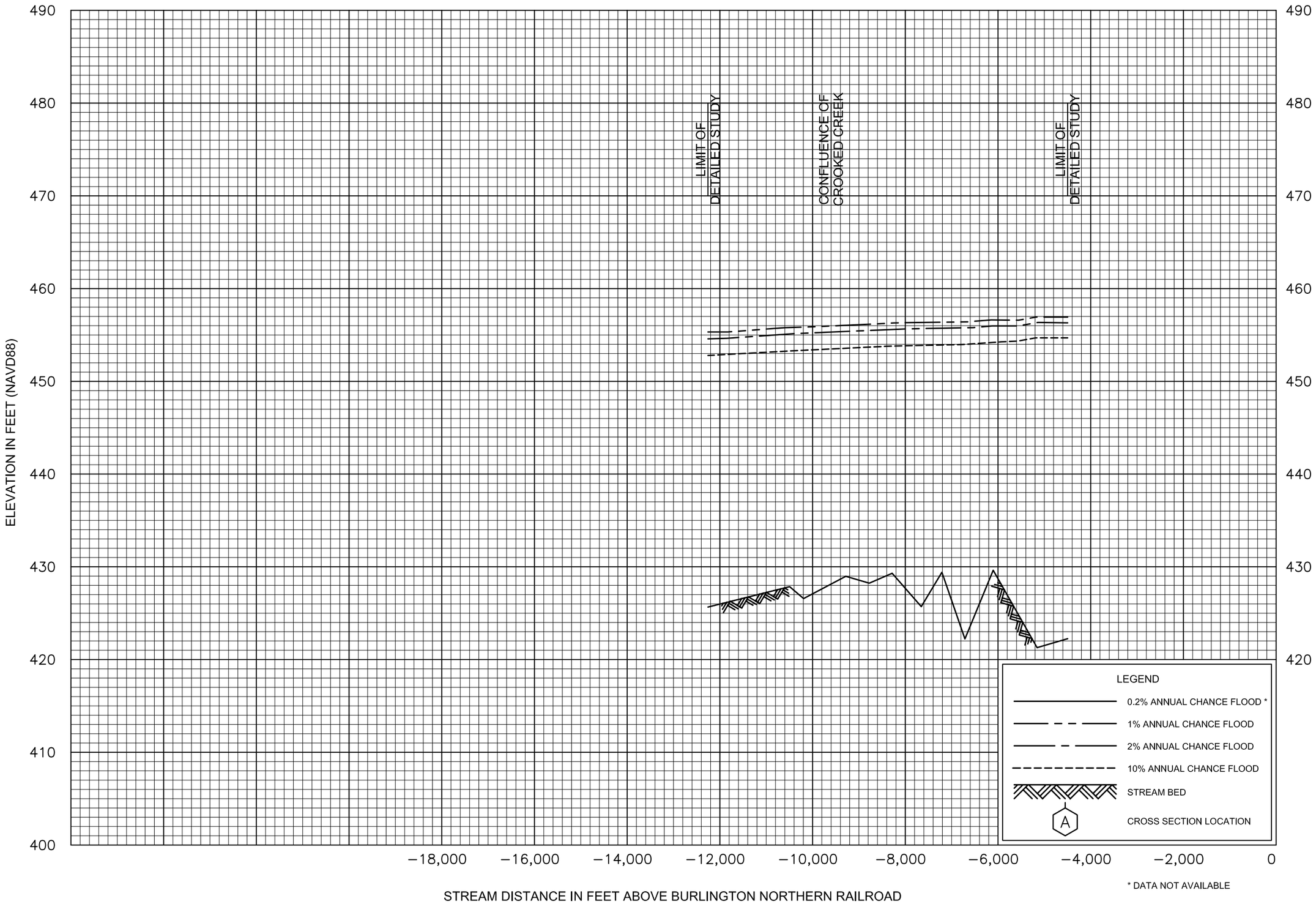


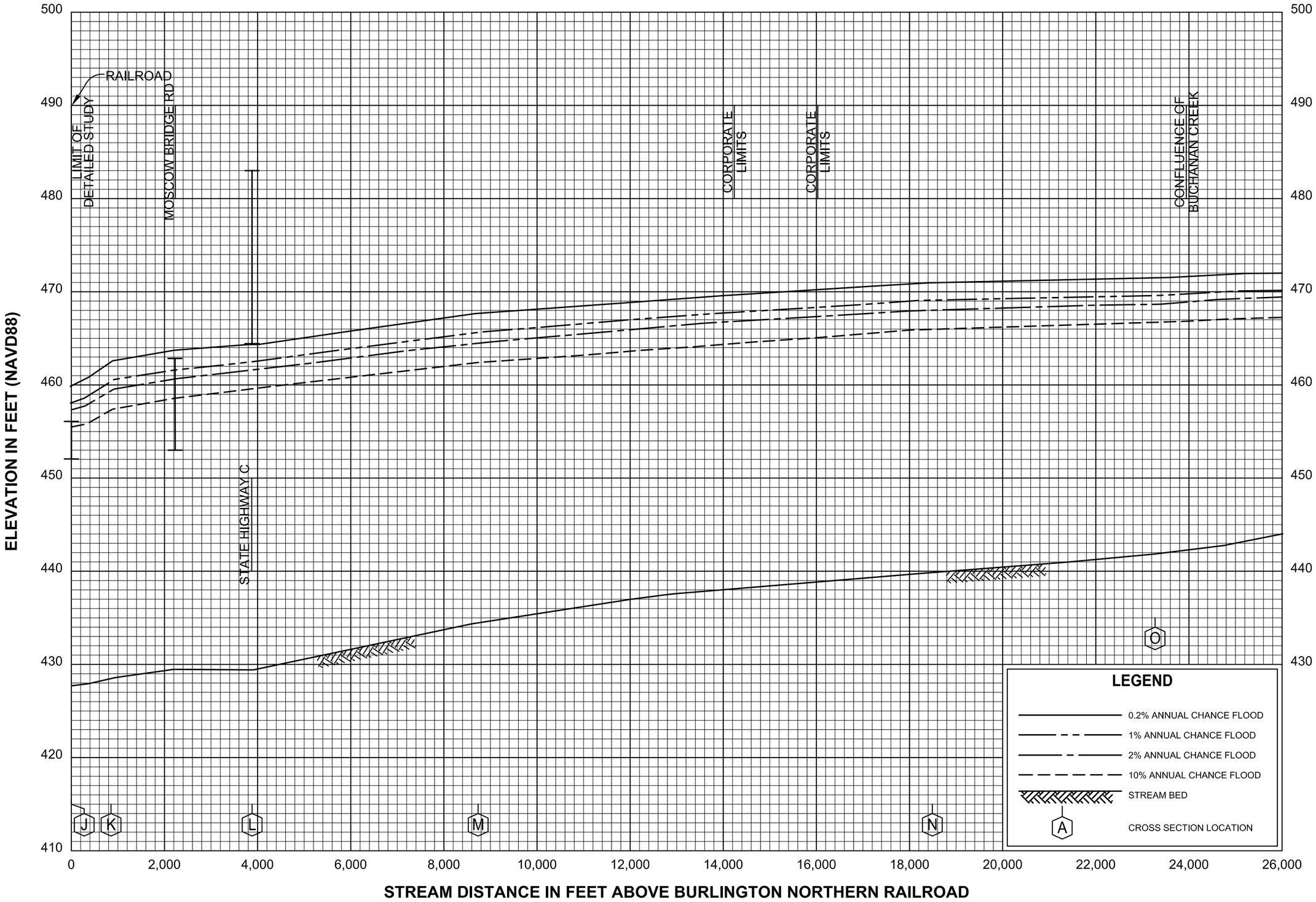
FLOOD PROFILES

CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



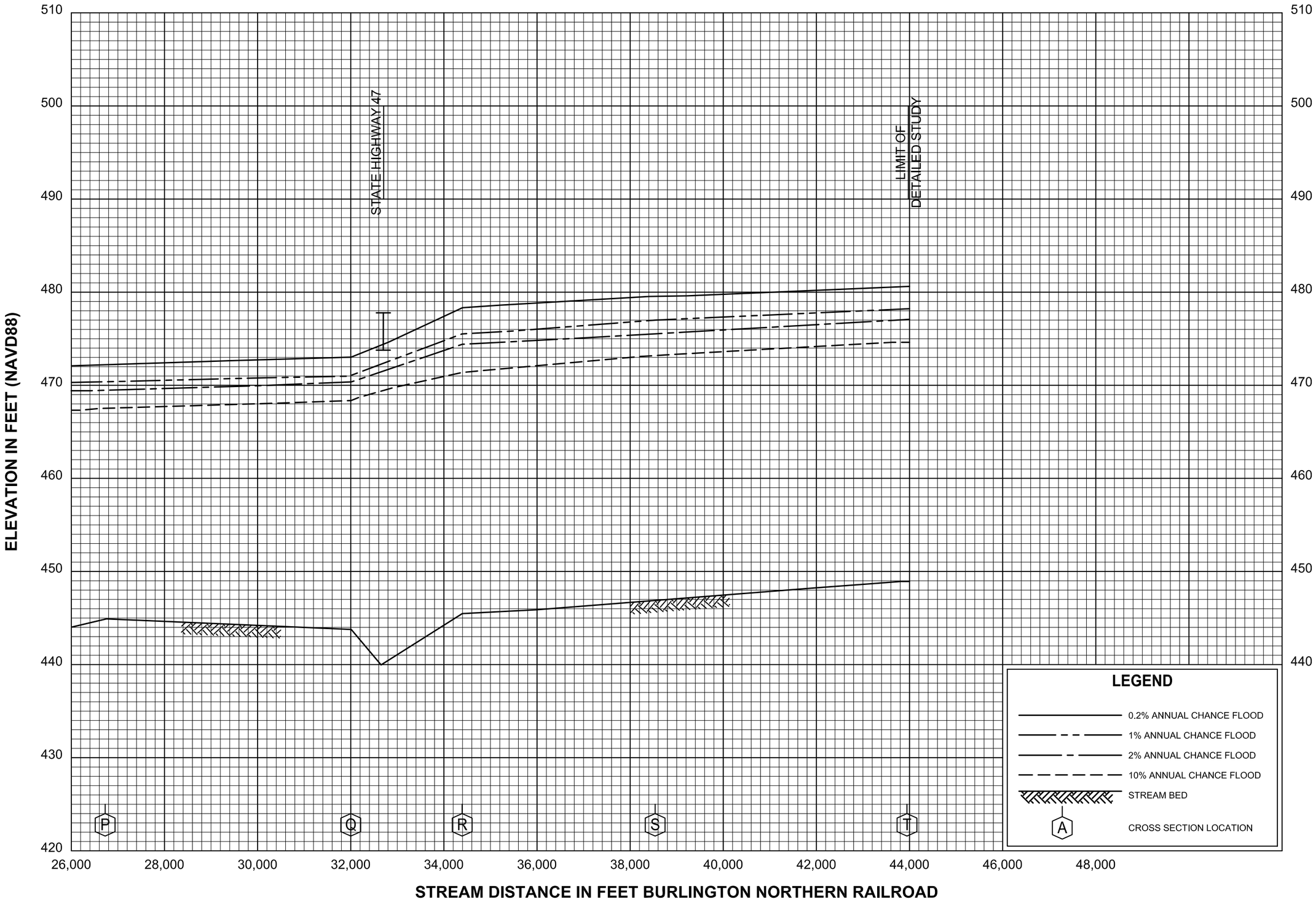
FLOOD PROFILES

CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



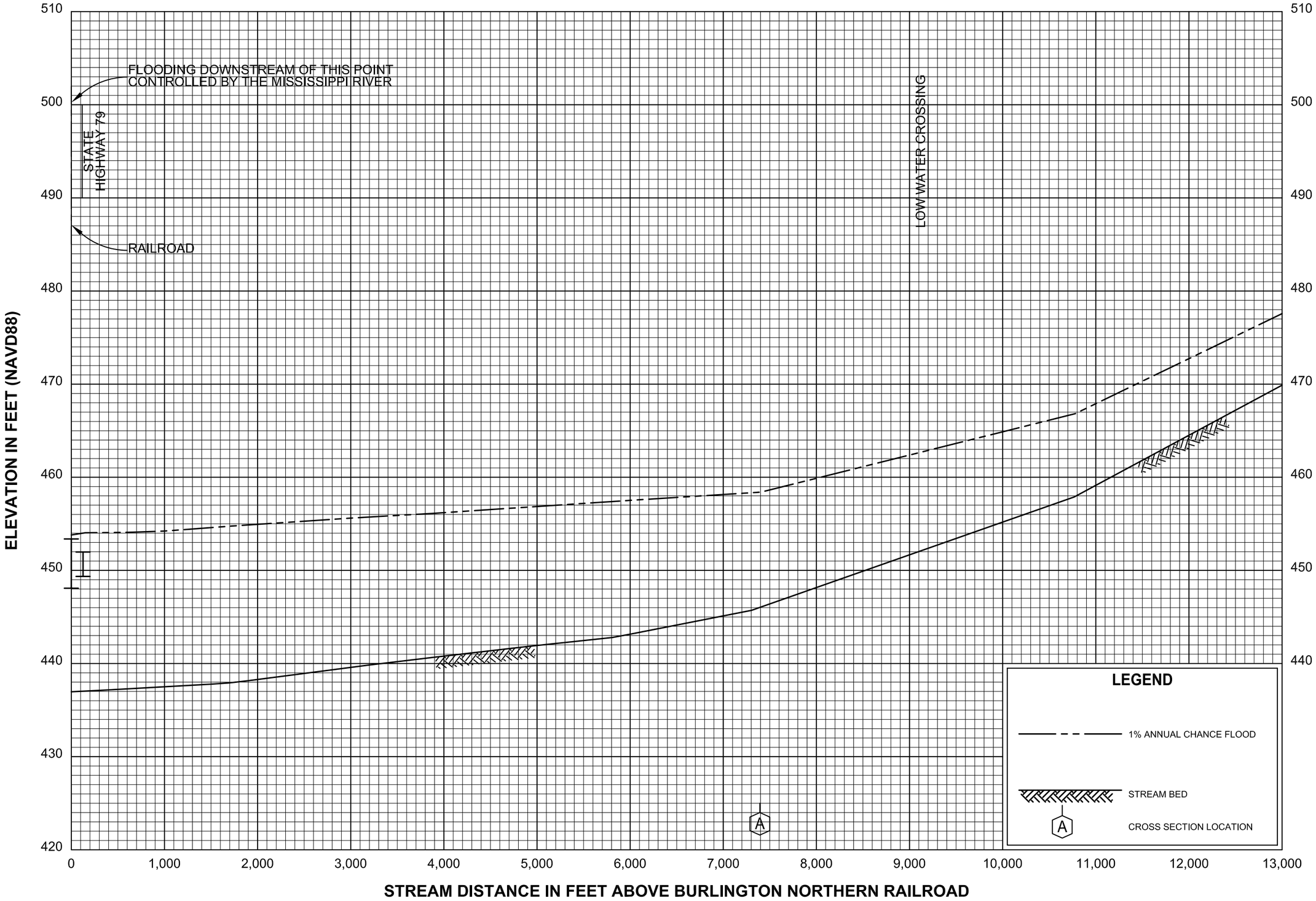
FLOOD PROFILES

CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



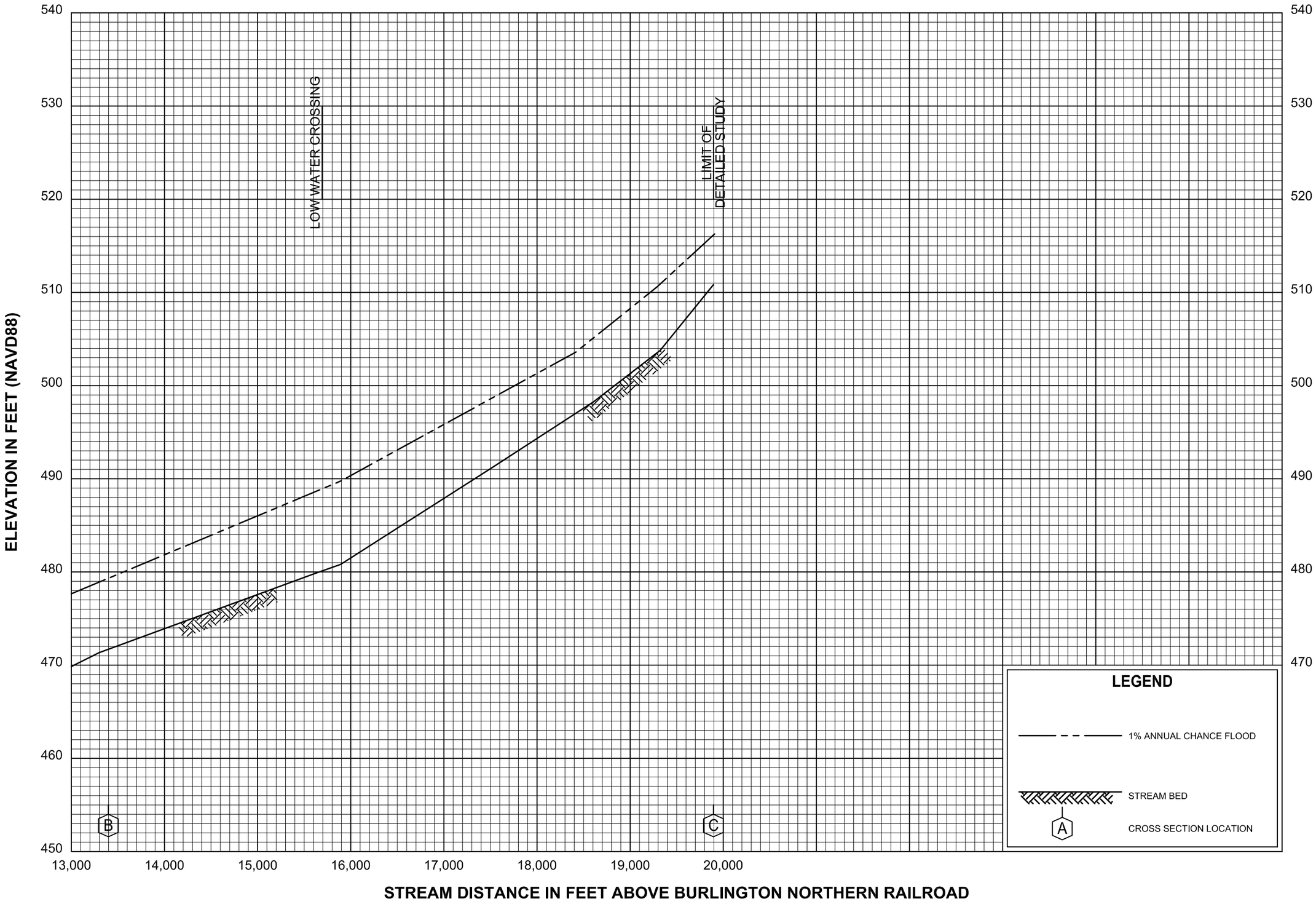
FLOOD PROFILES

LOST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



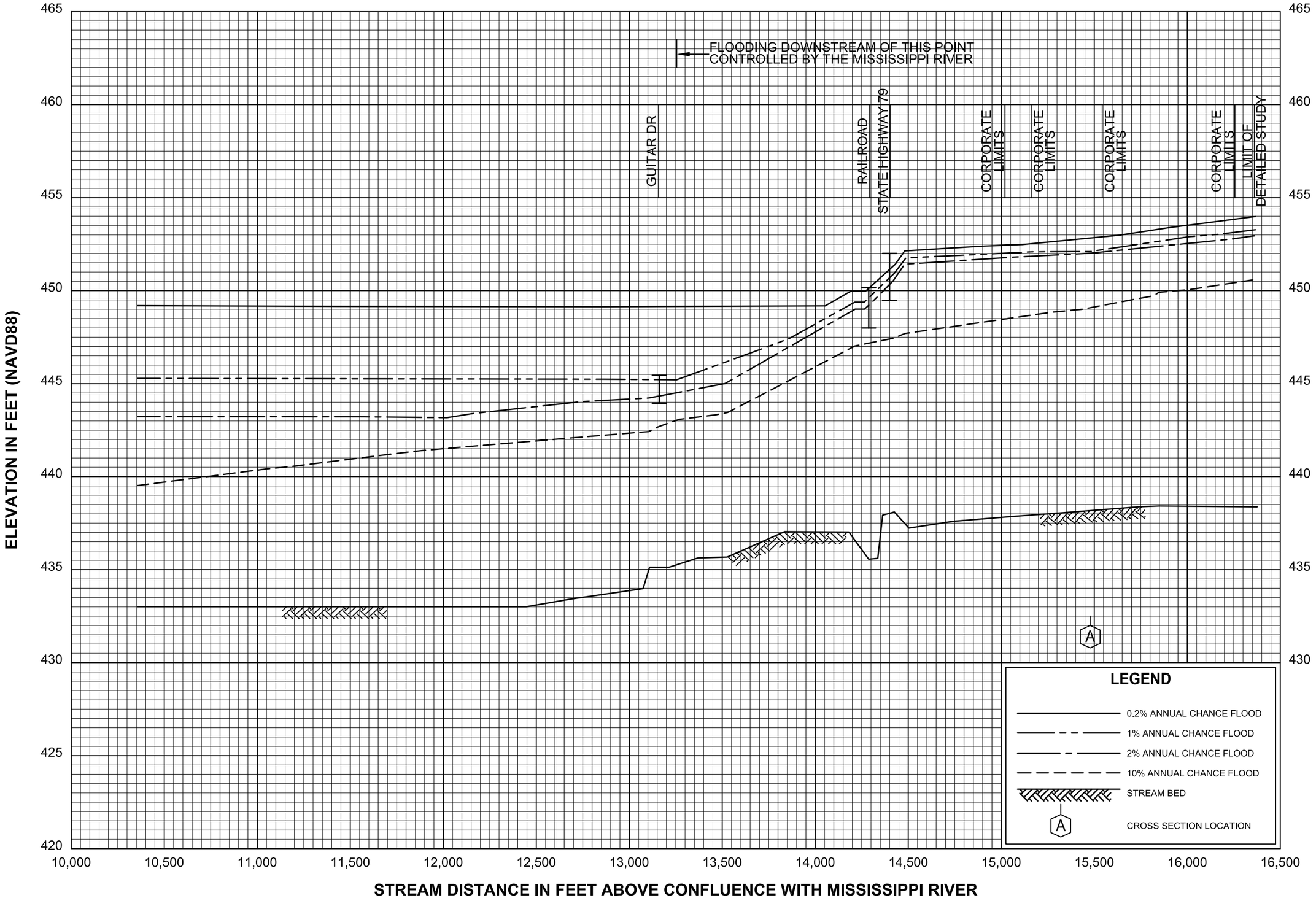
FLOOD PROFILES

LOST CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



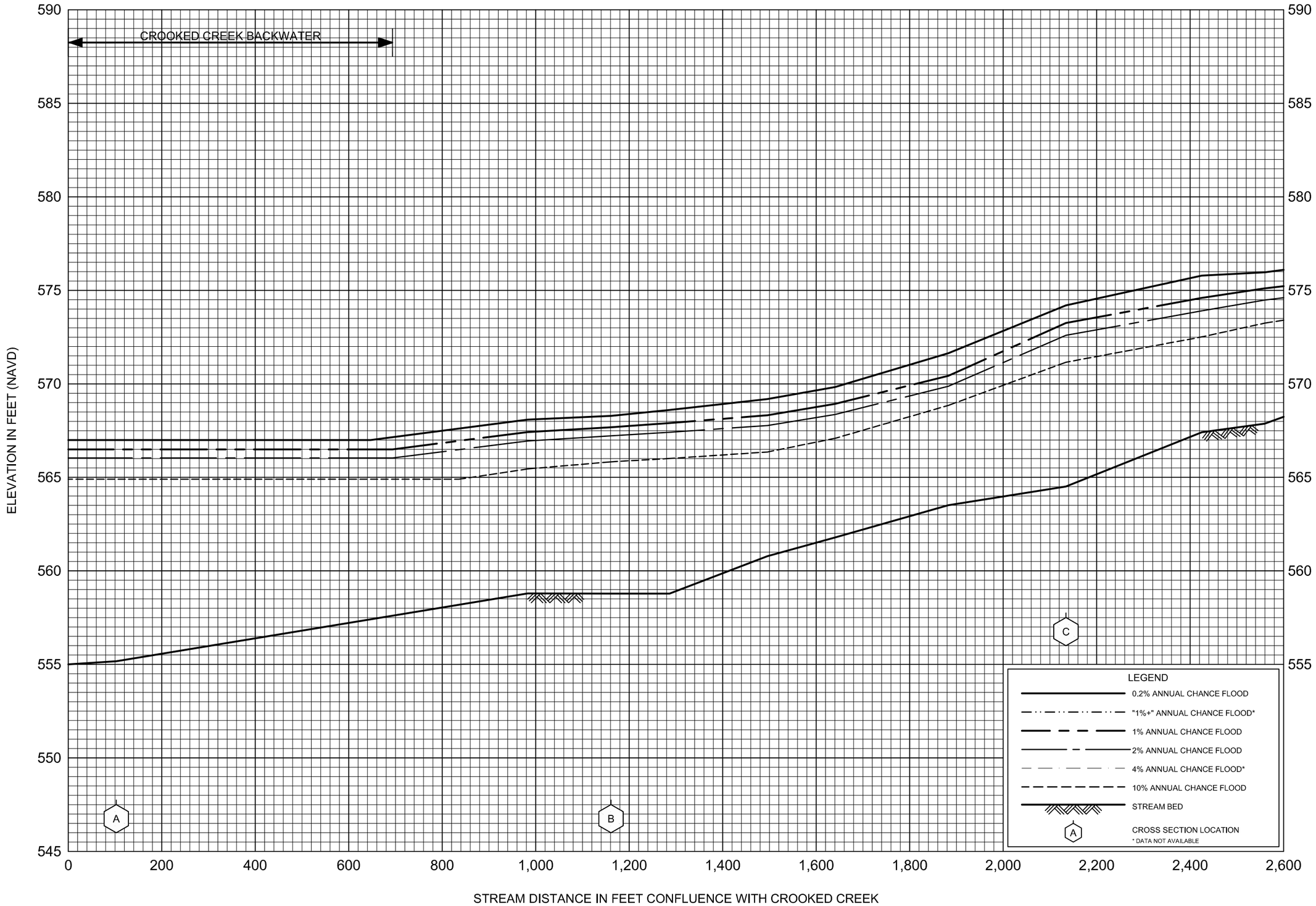
FLOOD PROFILES

MCLEAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



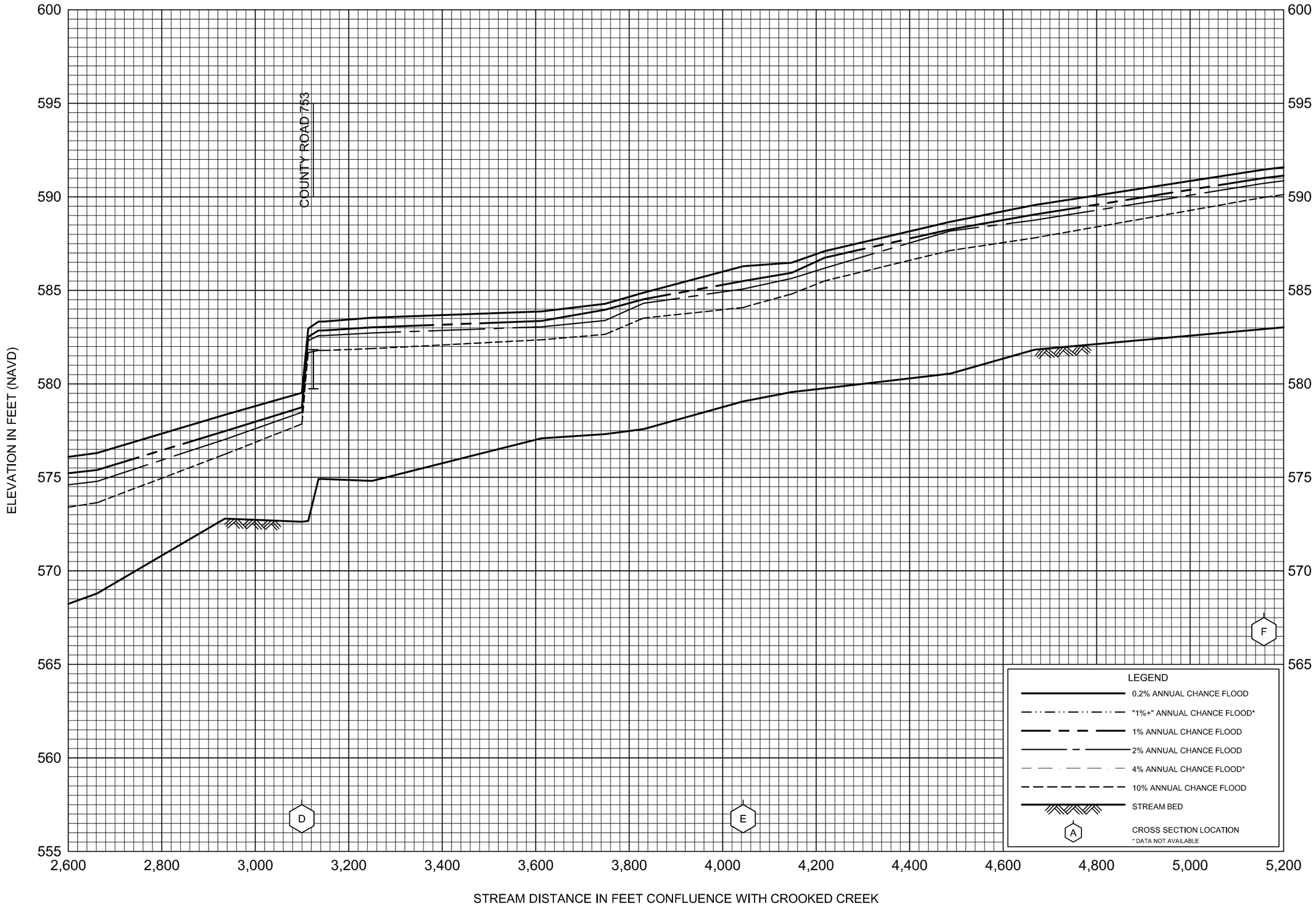
FLOOD PROFILES

MEISTER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



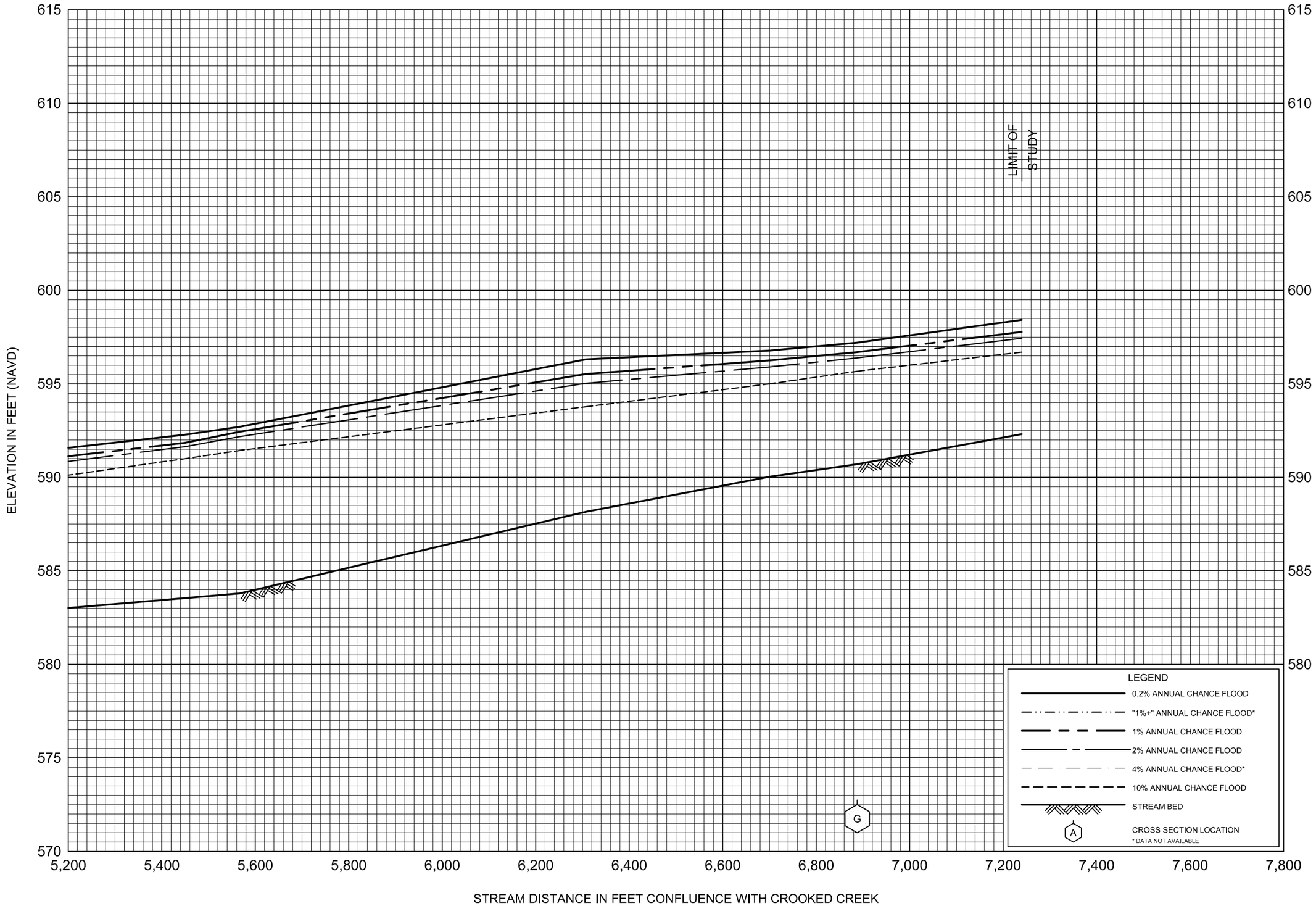
FLOOD PROFILES

MEISTER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



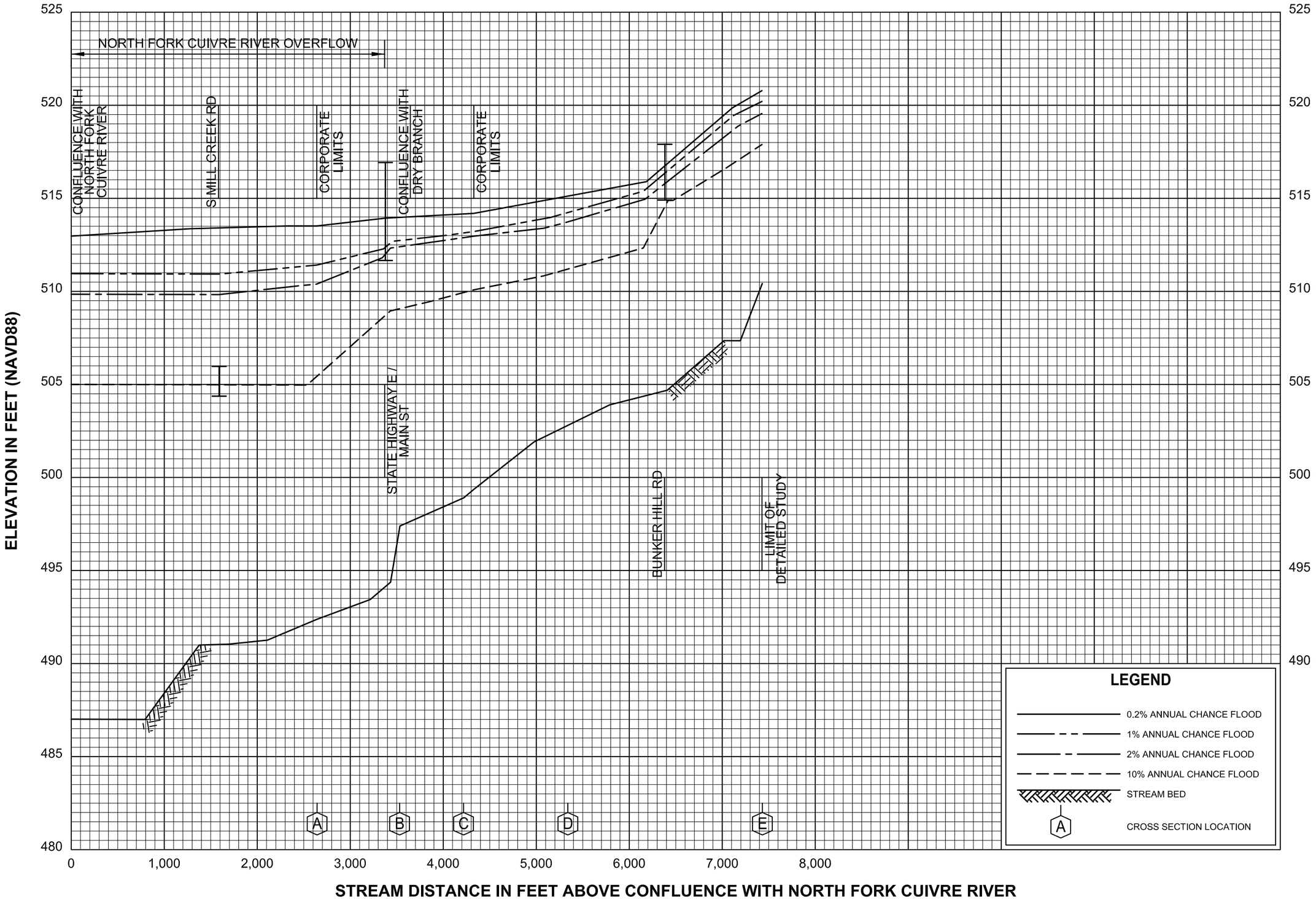
FLOOD PROFILES

MEISTER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



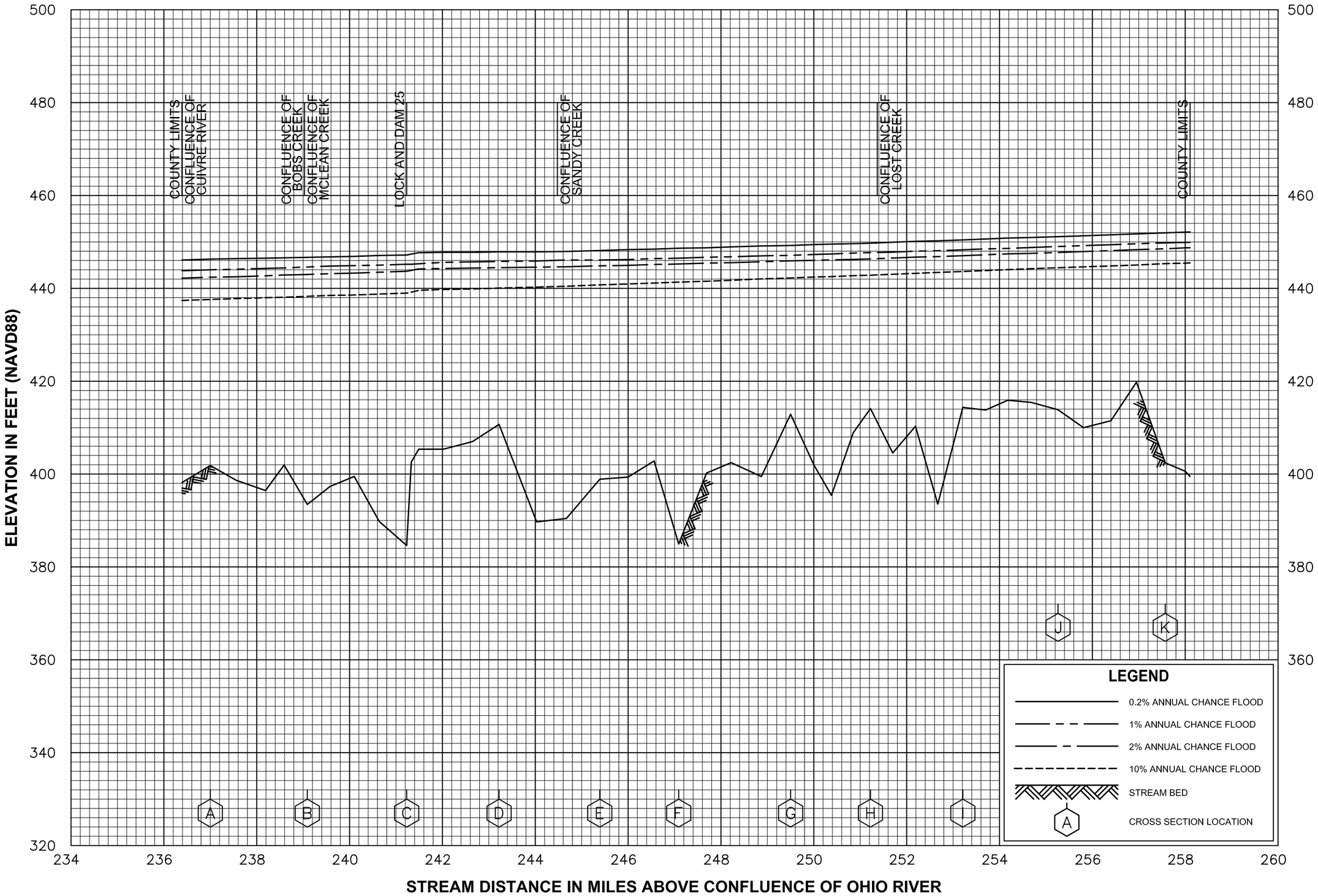
FLOOD PROFILES

MILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



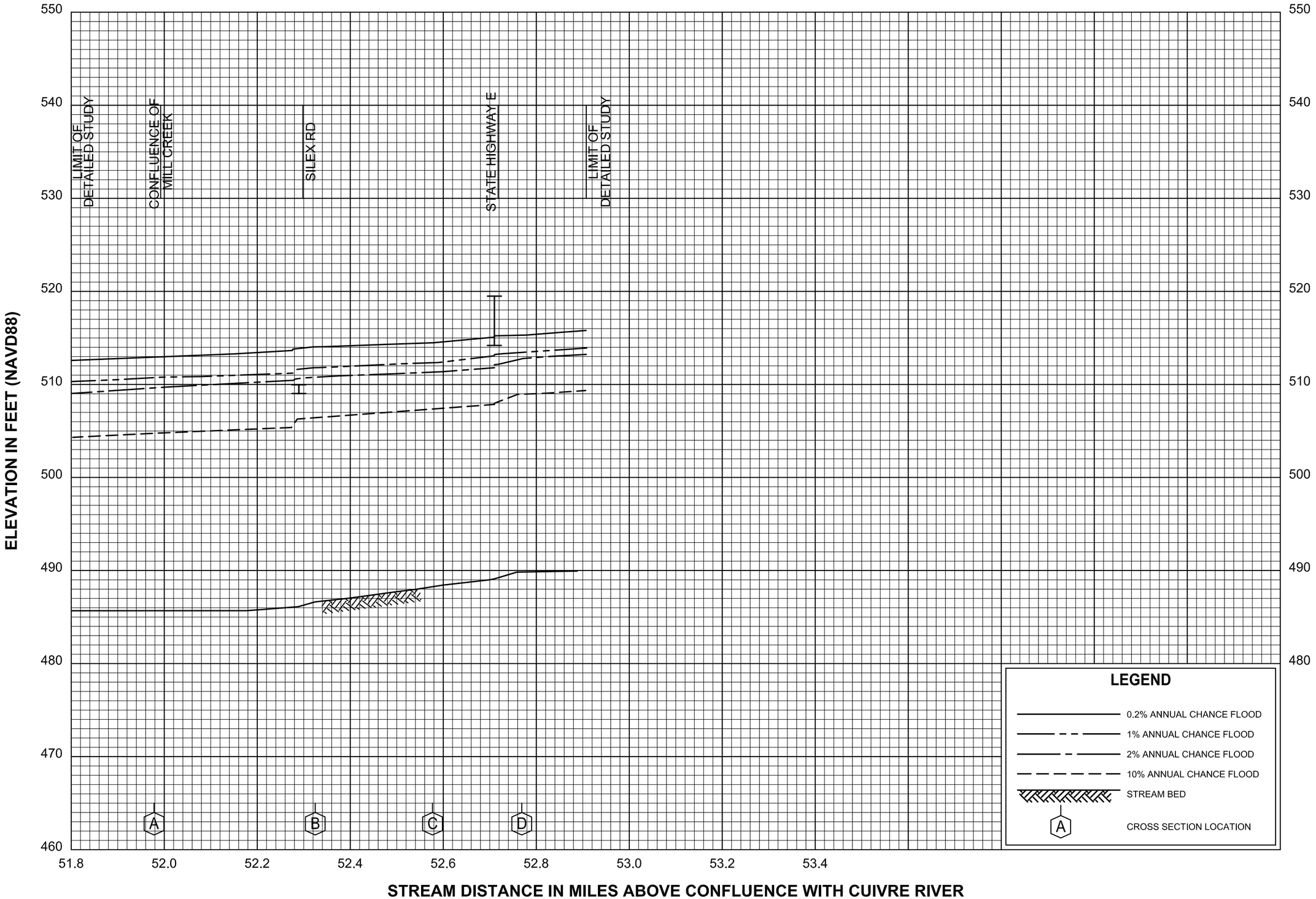
FLOOD PROFILES

MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



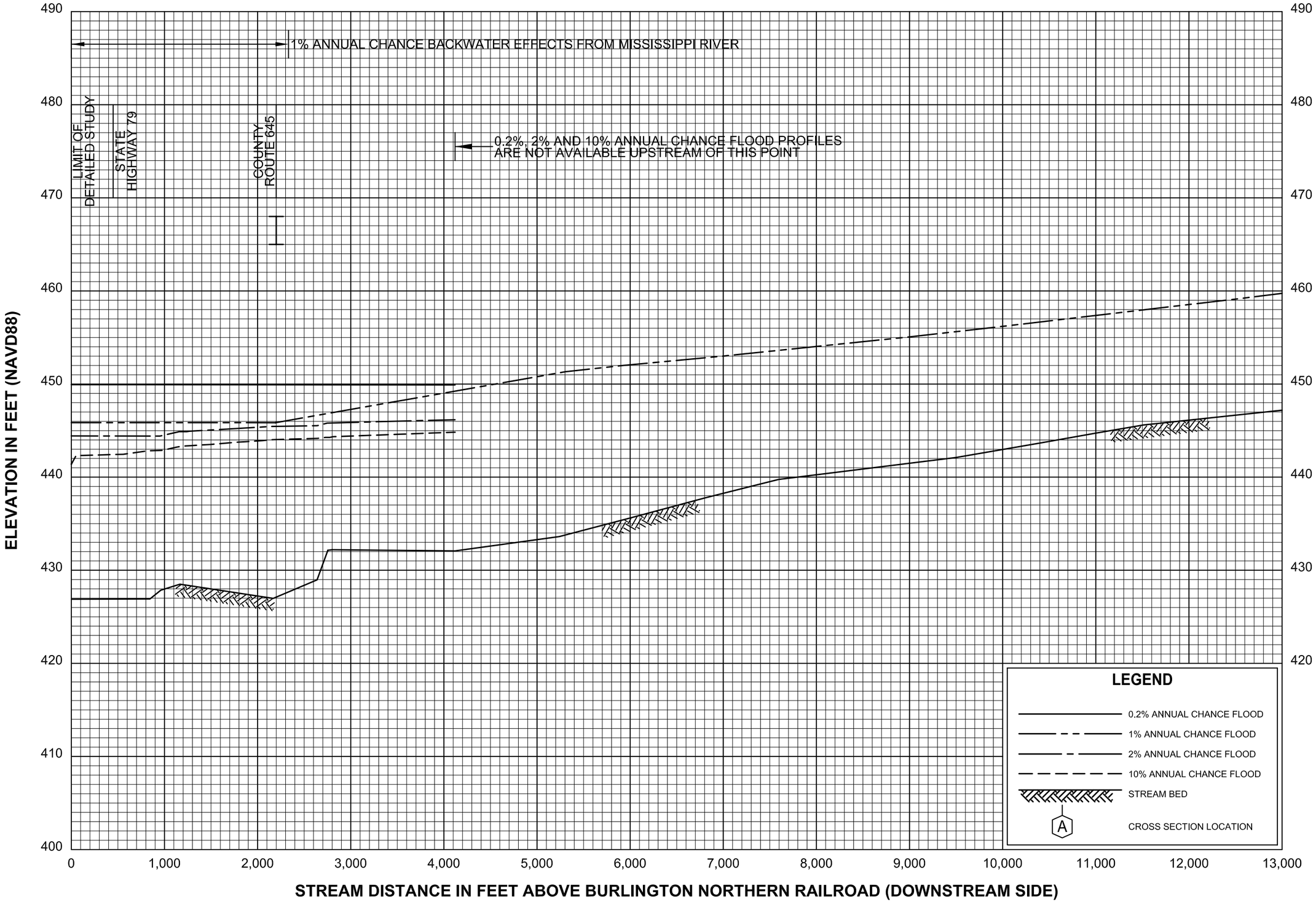
FLOOD PROFILES

NORTH FORK CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



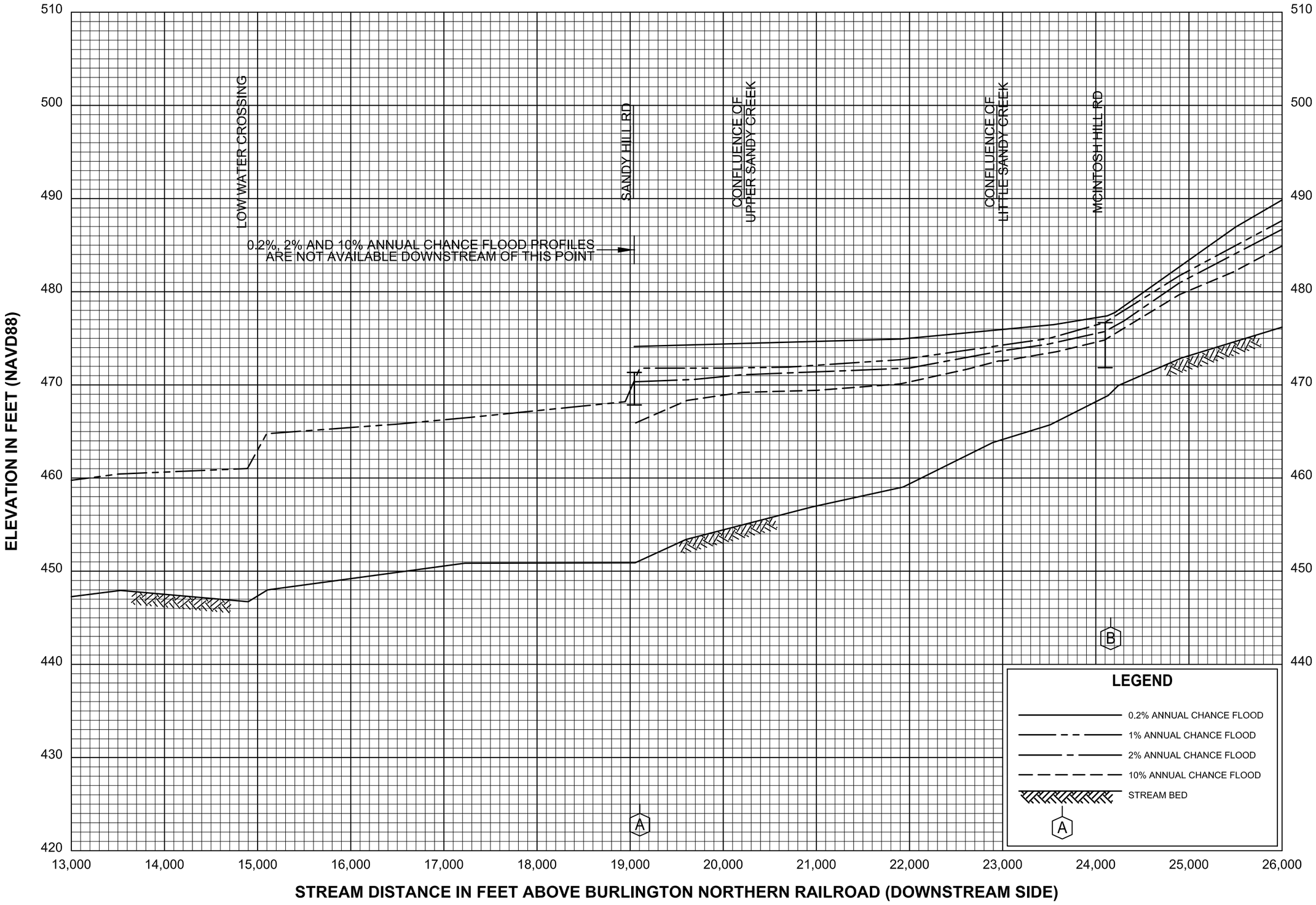
FLOOD PROFILES

SANDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



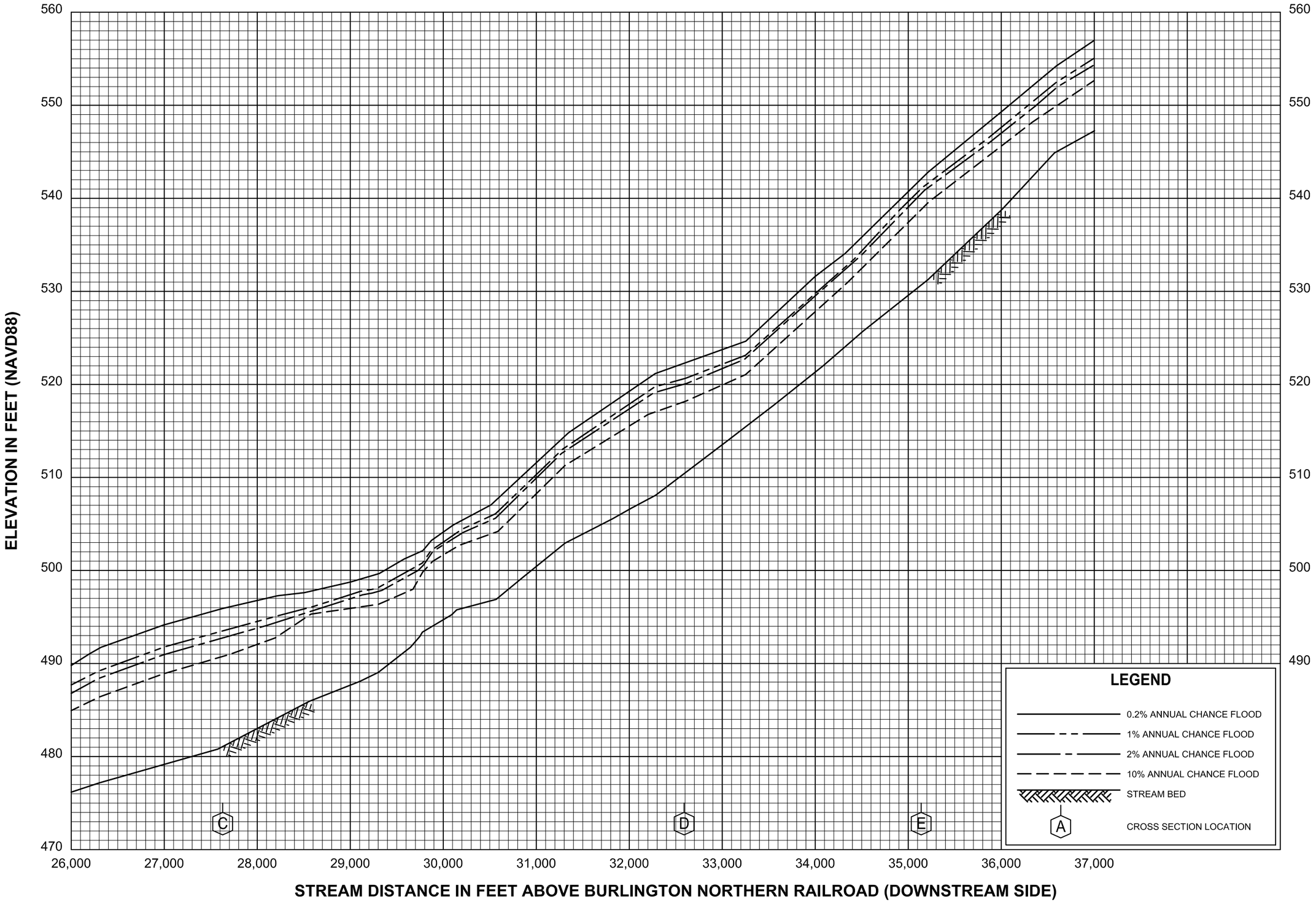
FLOOD PROFILES

SANDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



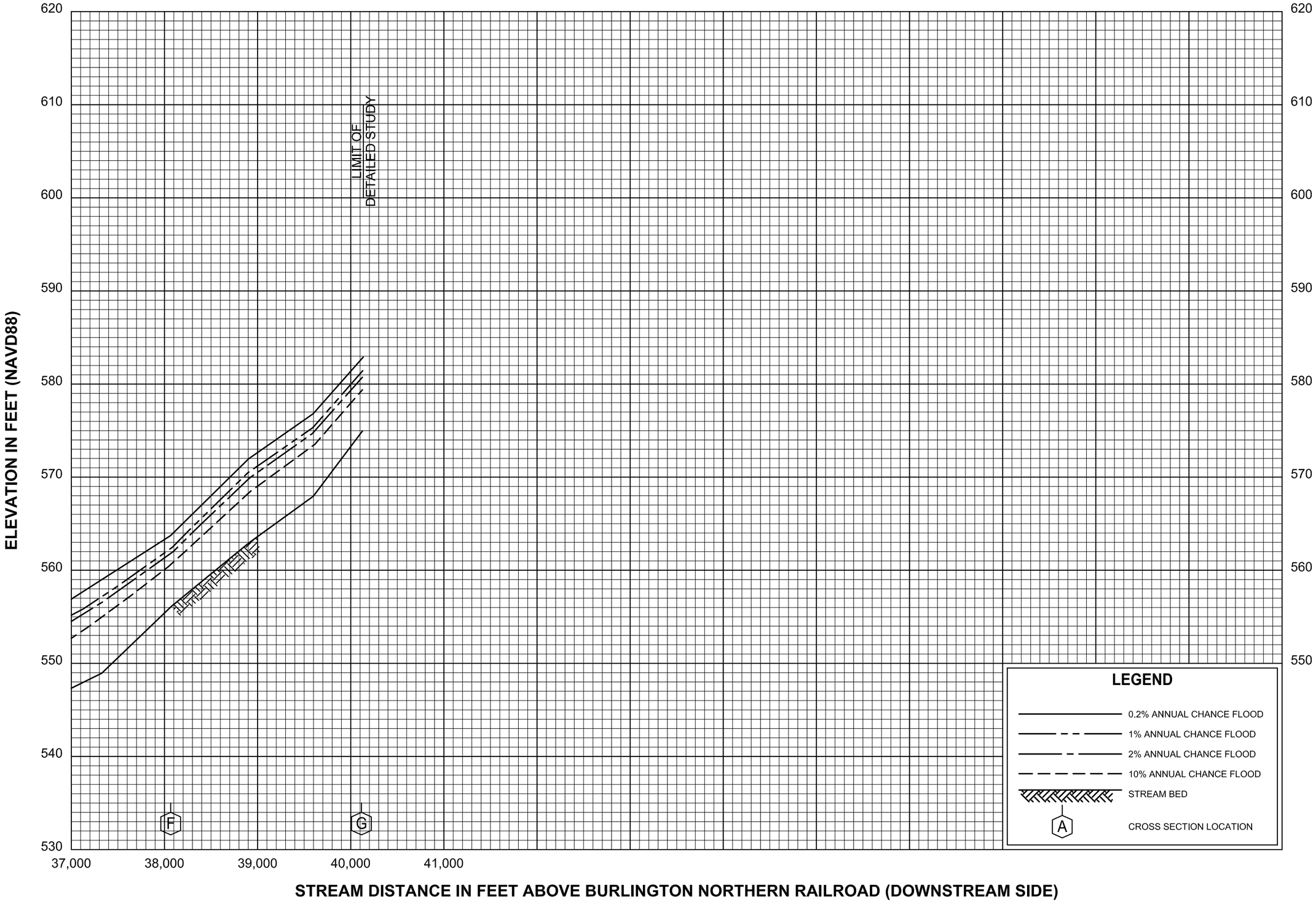
FLOOD PROFILES

SANDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



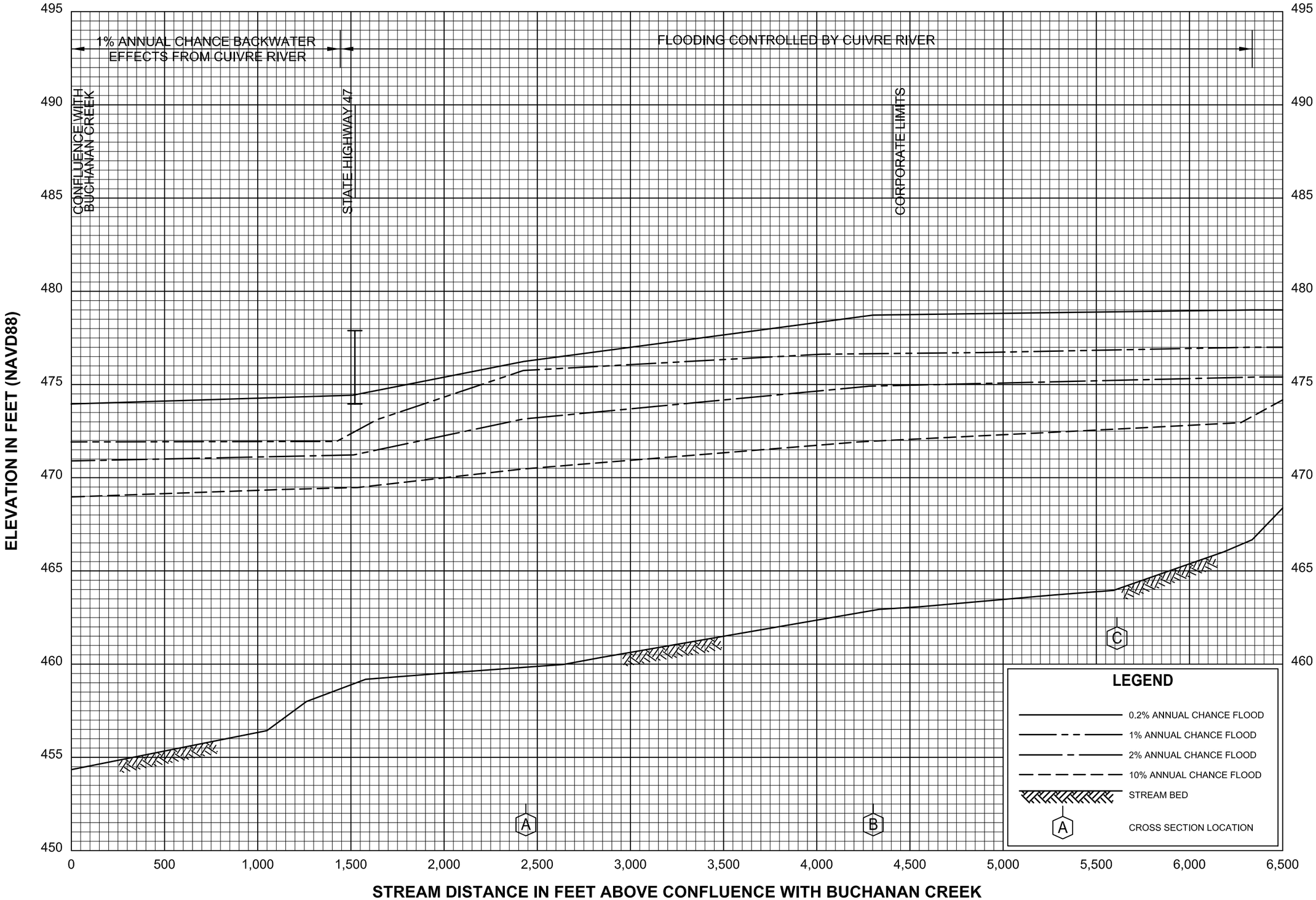
FLOOD PROFILES

SANDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



FLOOD PROFILES

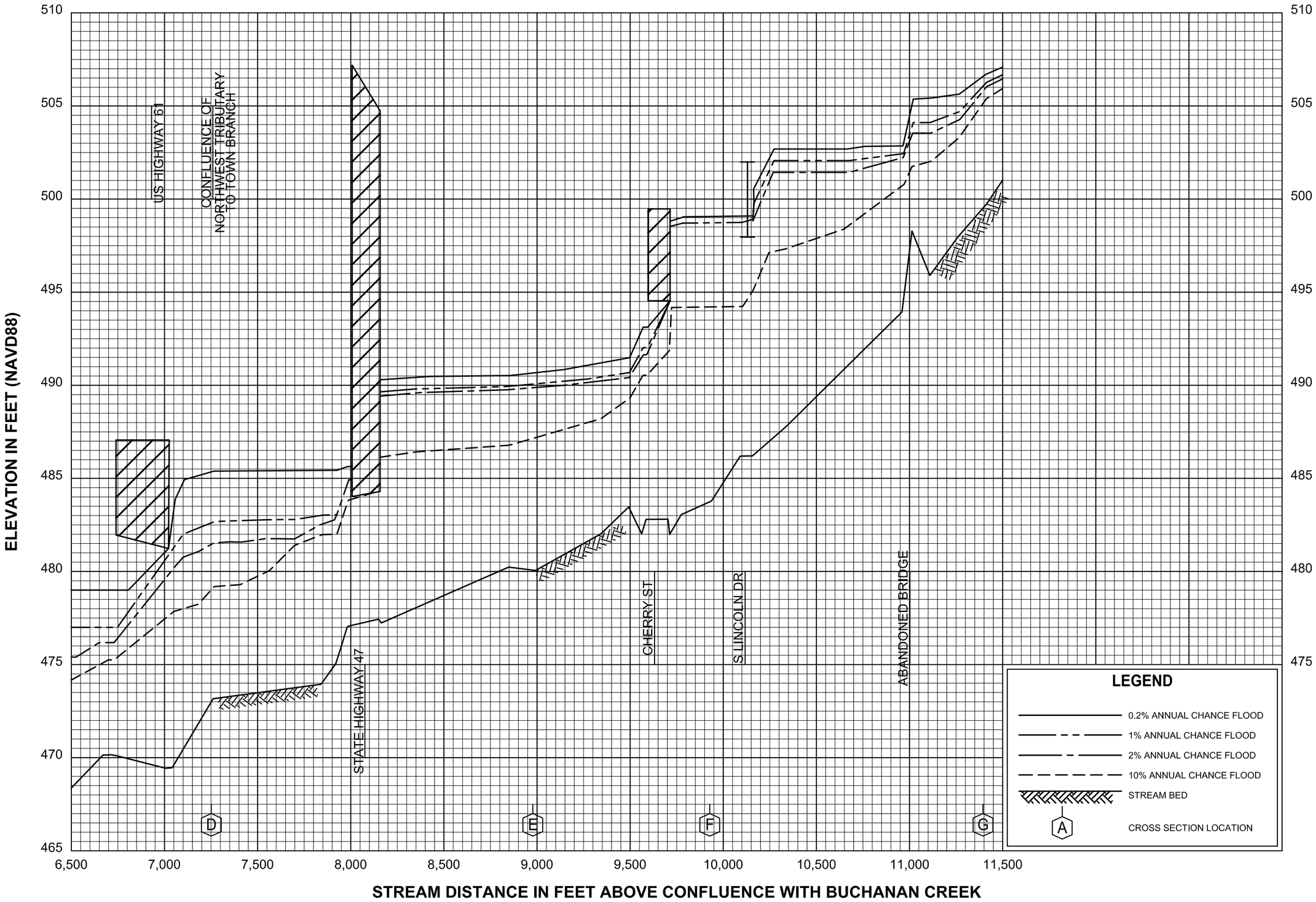
TOWN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS

47P



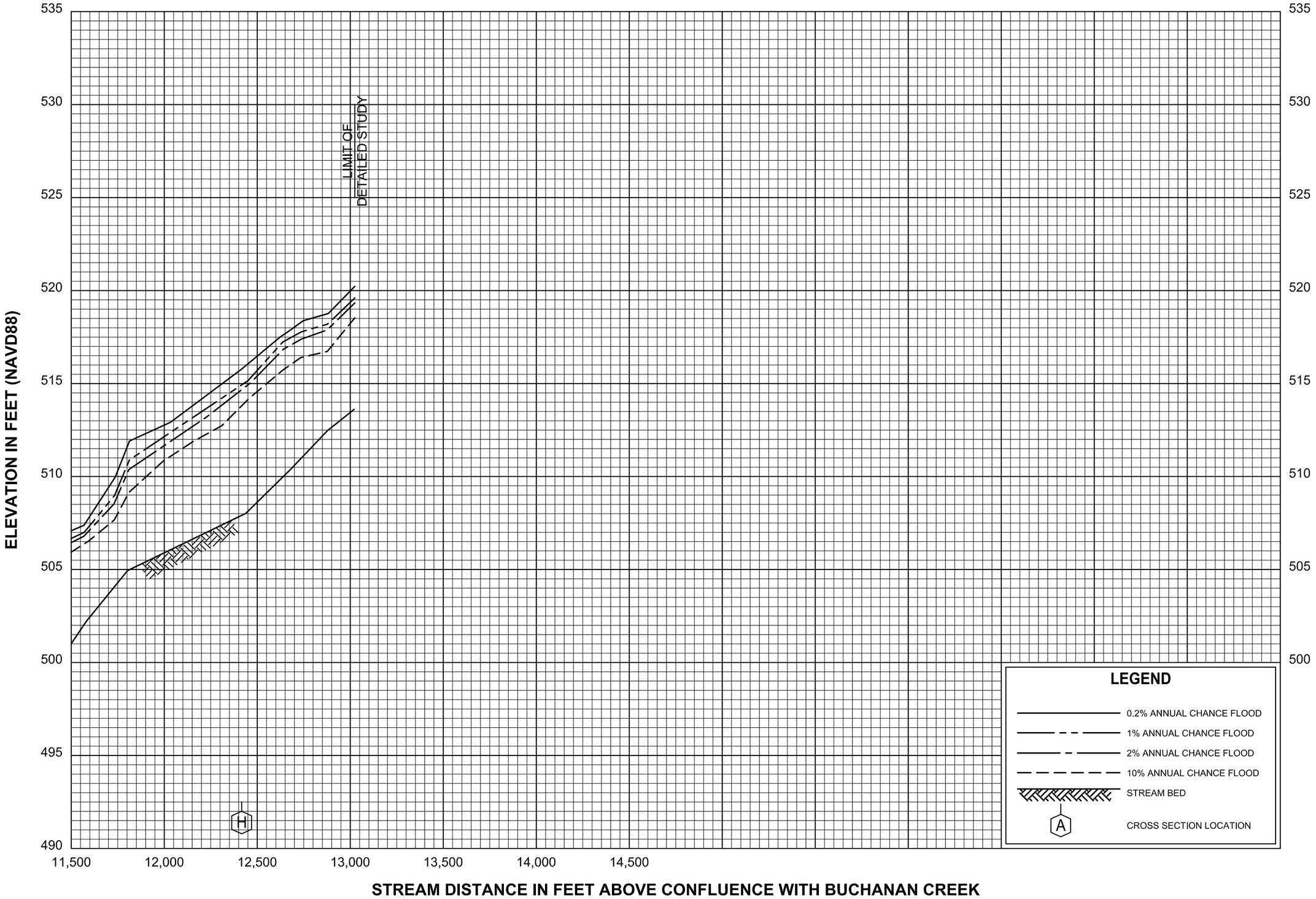
FLOOD PROFILES

TOWN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



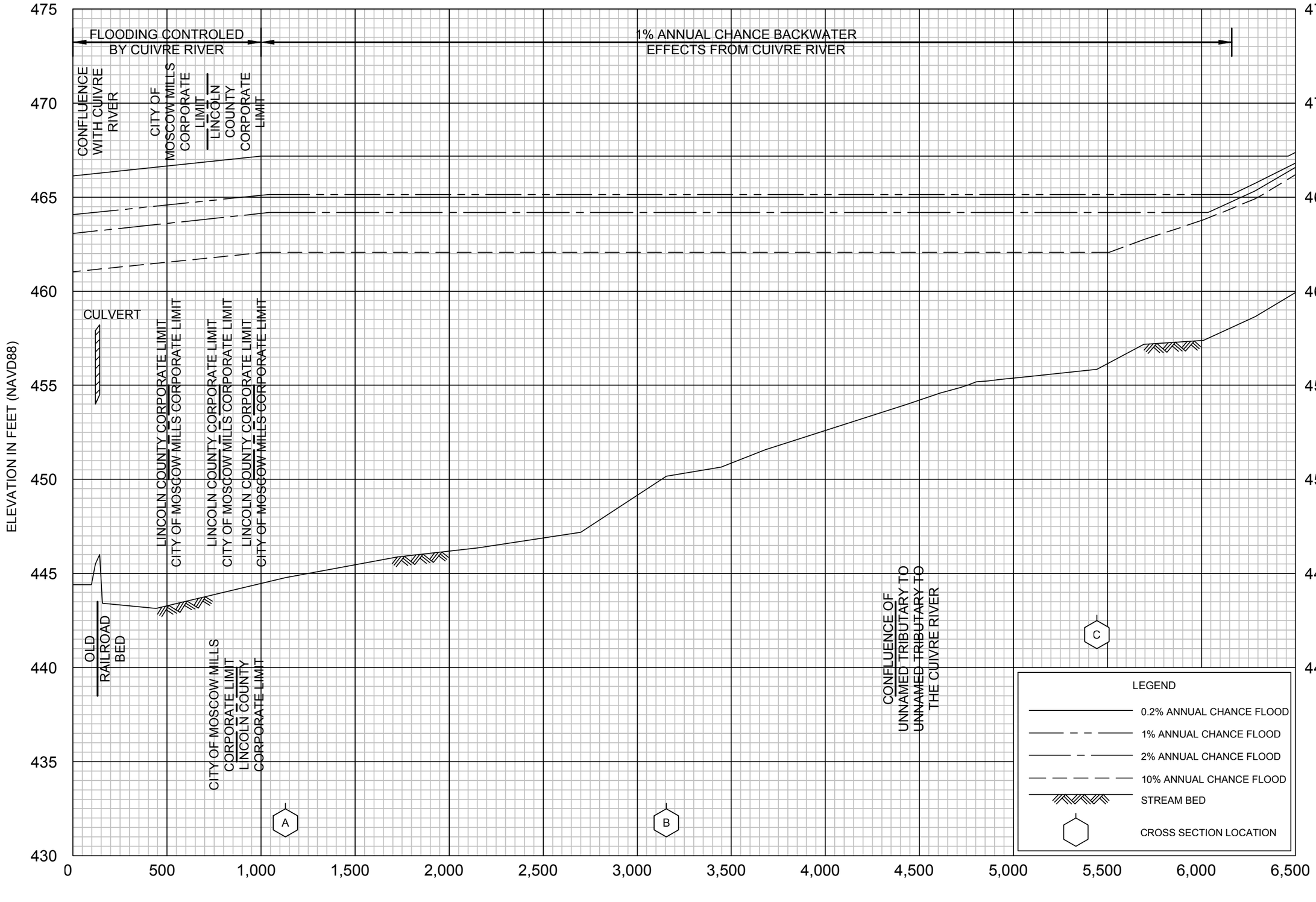
FLOOD PROFILES

TOWN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



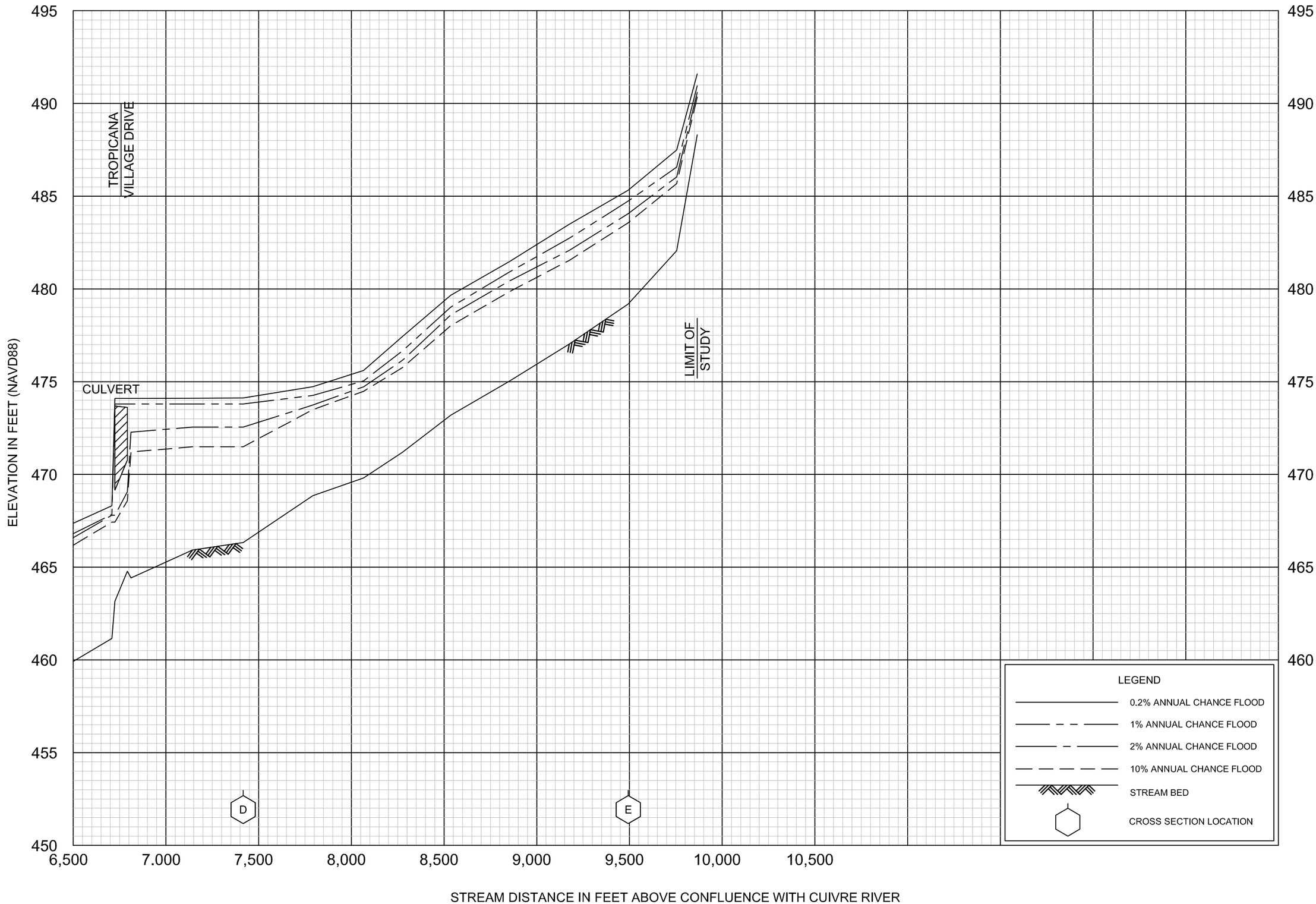
FLOOD PROFILES

UNNAMED TRIBUTARY TO CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPOATED AREAS



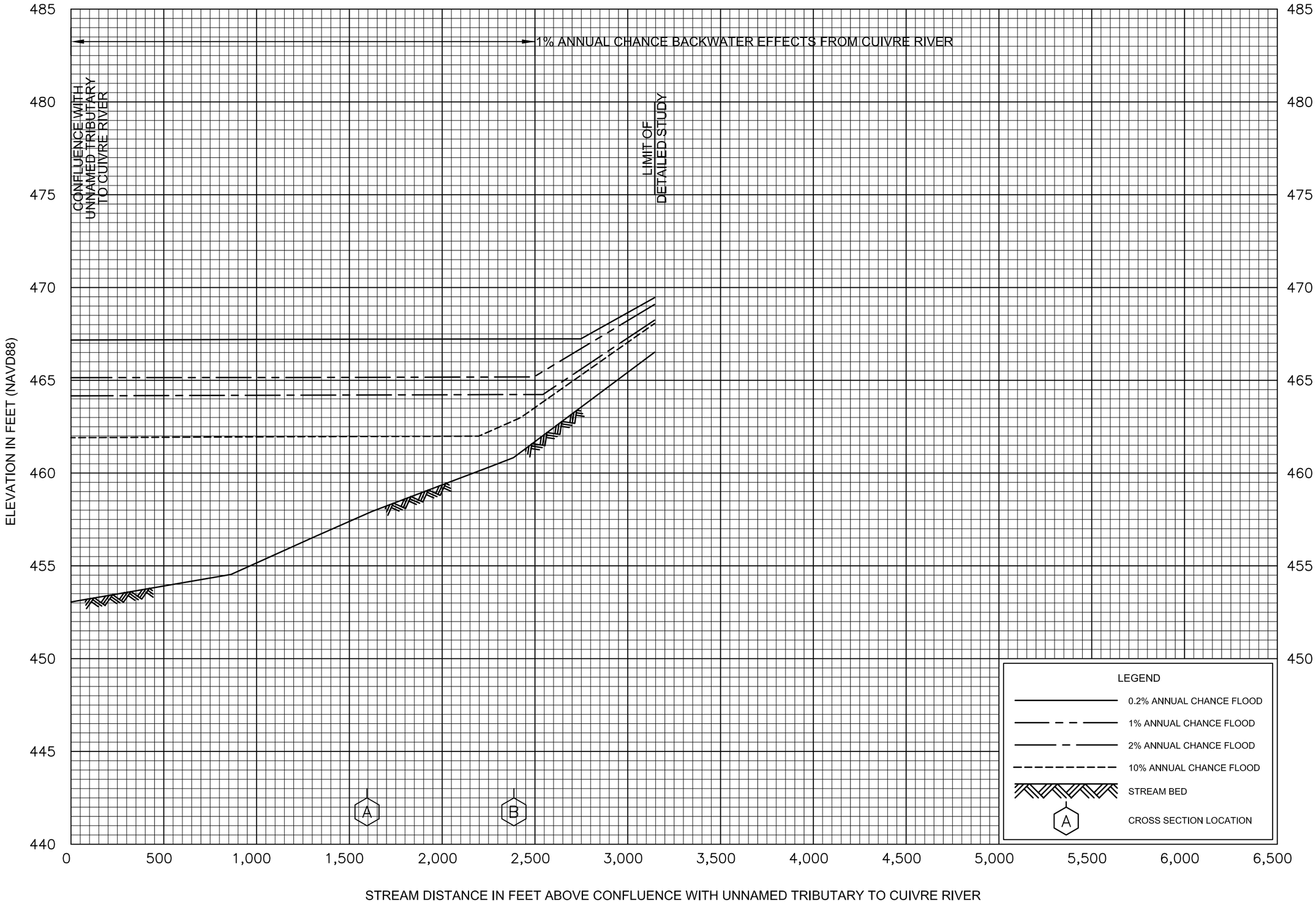
FLOOD PROFILES

UNNAMED TRIBUTARY TO CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO
AND INCORPOATED AREAS

51P



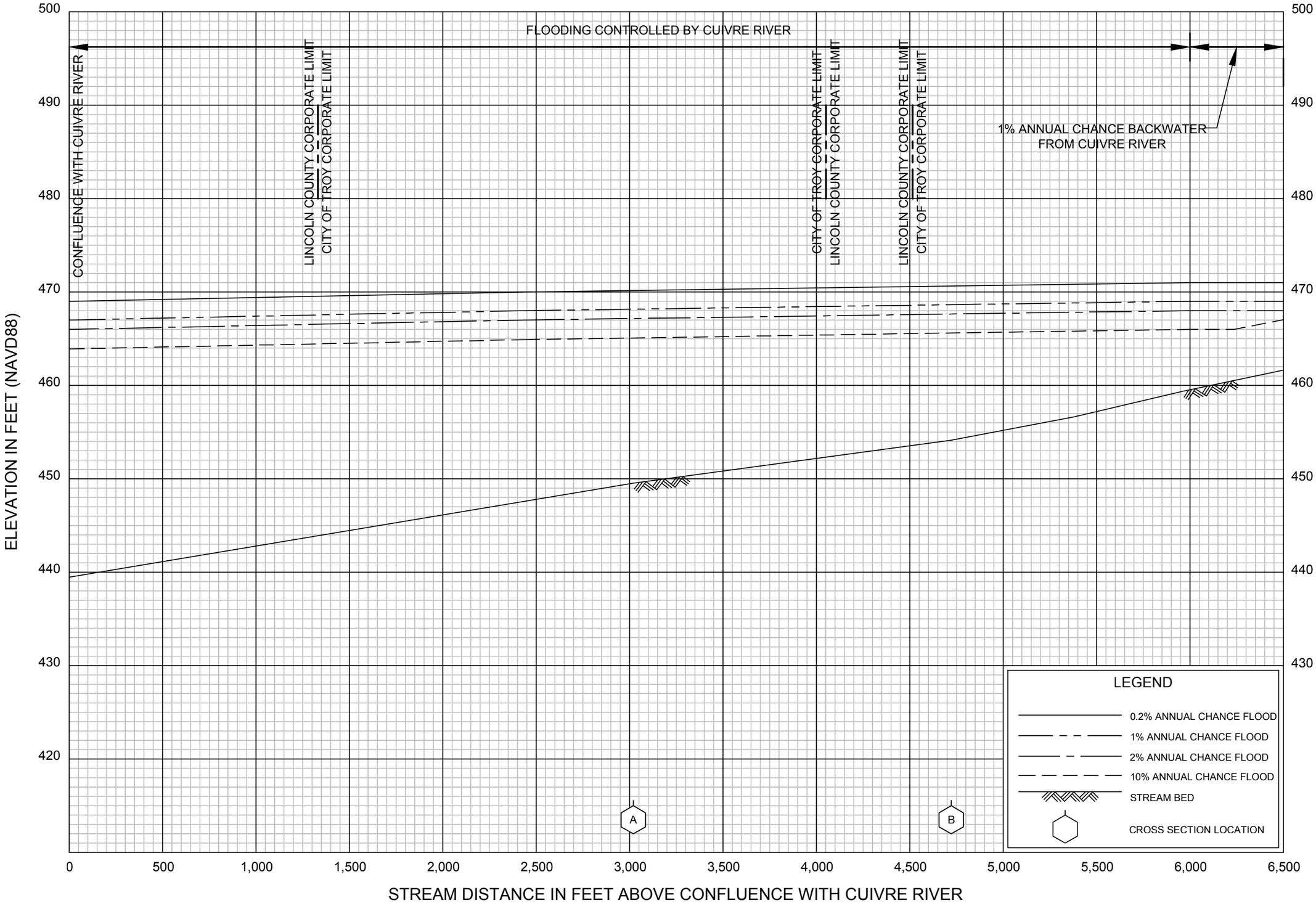
FLOOD PROFILES

UNNAMED TRIBUTARY TO UNNAMED TRIBUTARY TO CUIVRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPORATED AREAS



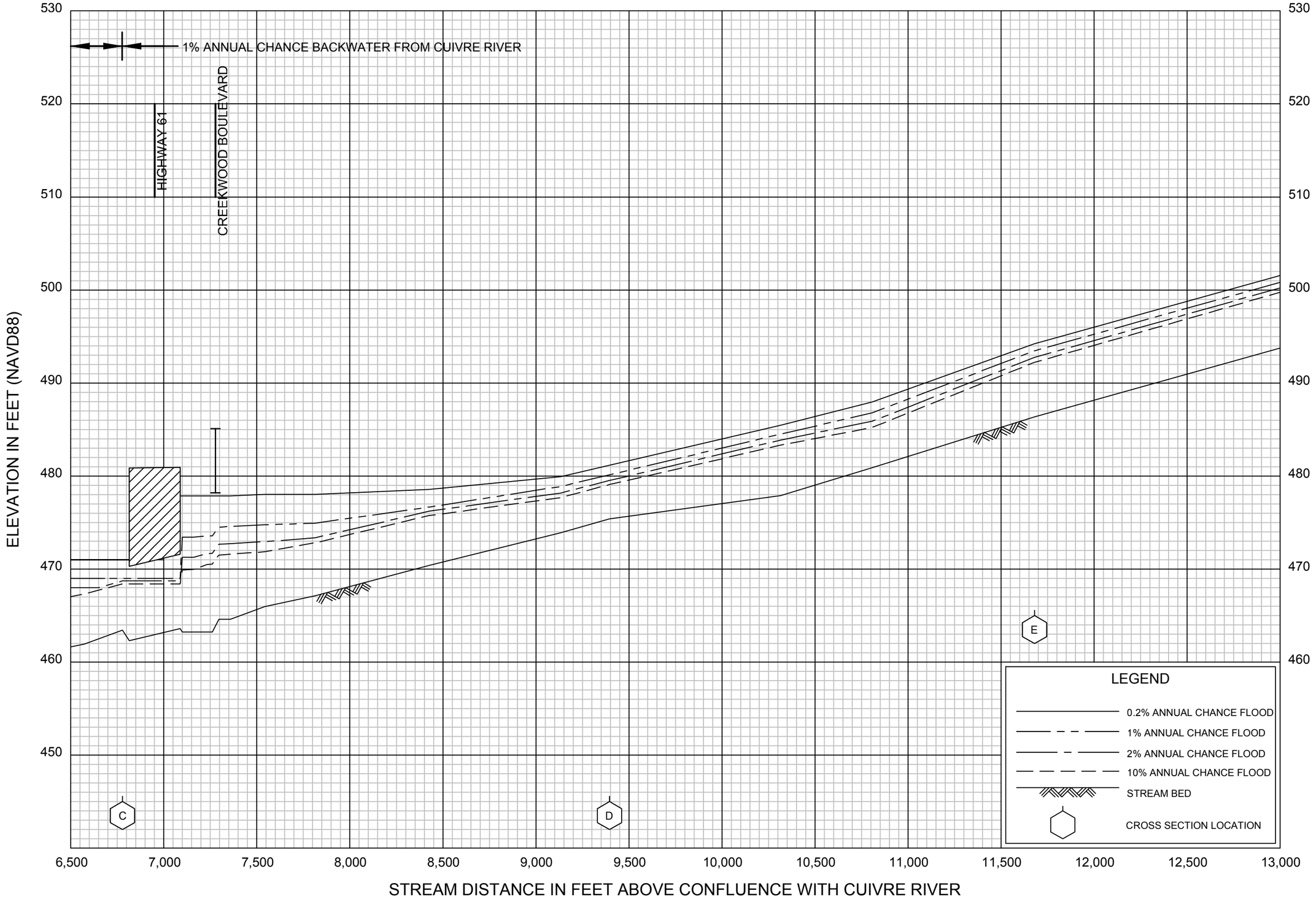
FLOOD PROFILES

WHITCOMB BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPOATED AREAS



FLOOD PROFILES

WHITCOMB BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

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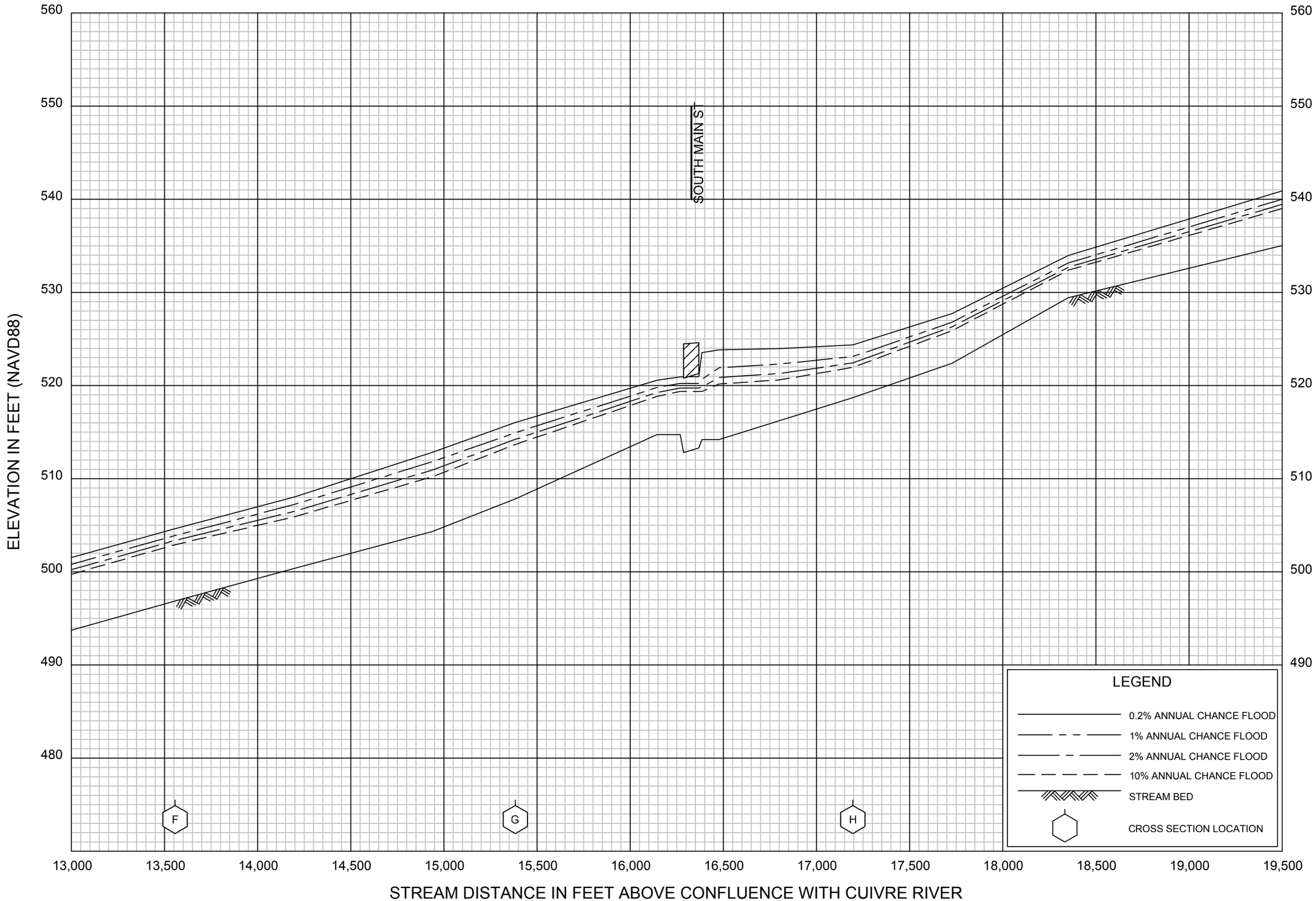


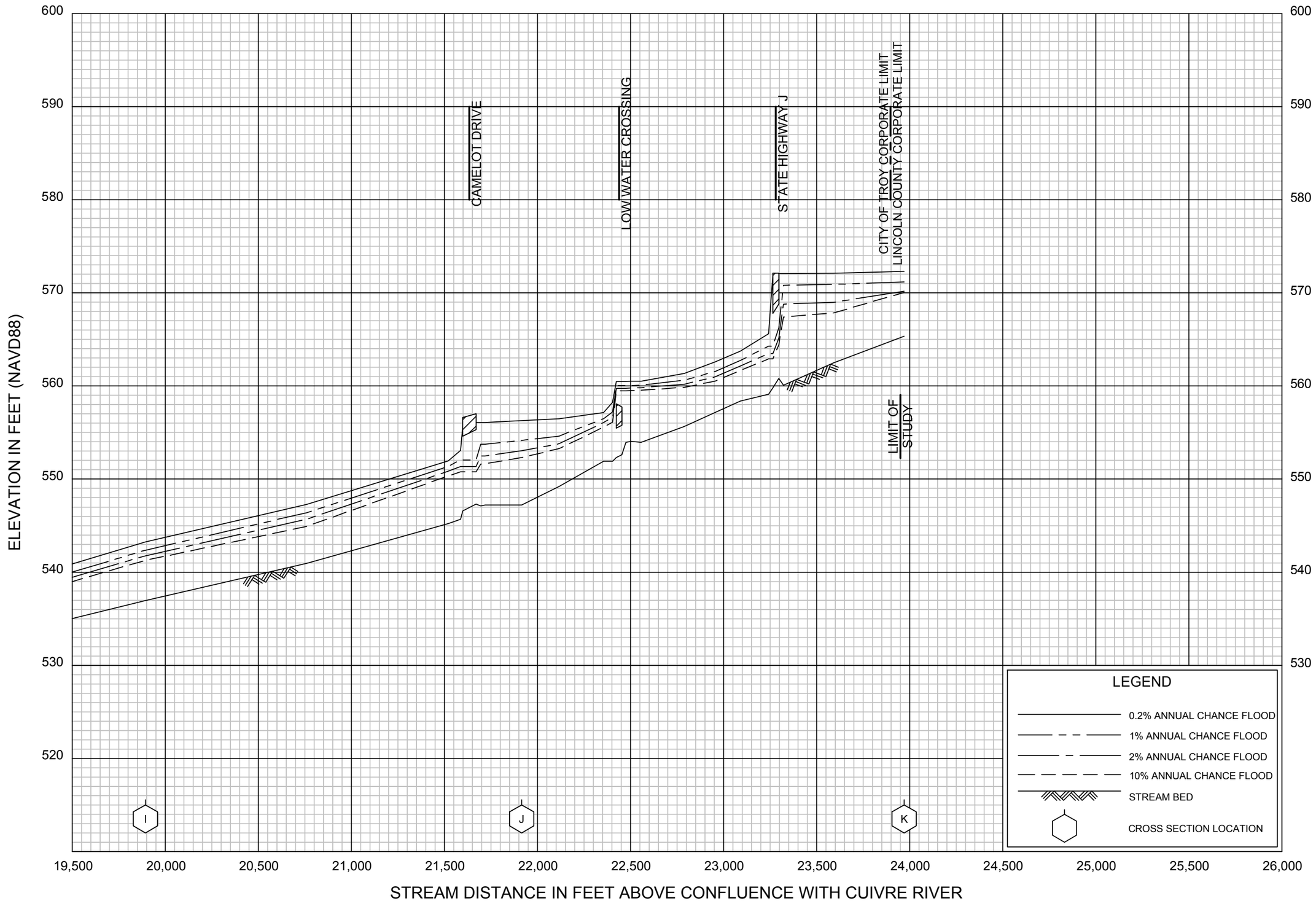
FLOOD PROFILES

WHITCOMB BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPOATED AREAS



FLOOD PROFILES

WHITCOMB BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

LINCOLN COUNTY, MO

AND INCORPOATED AREAS