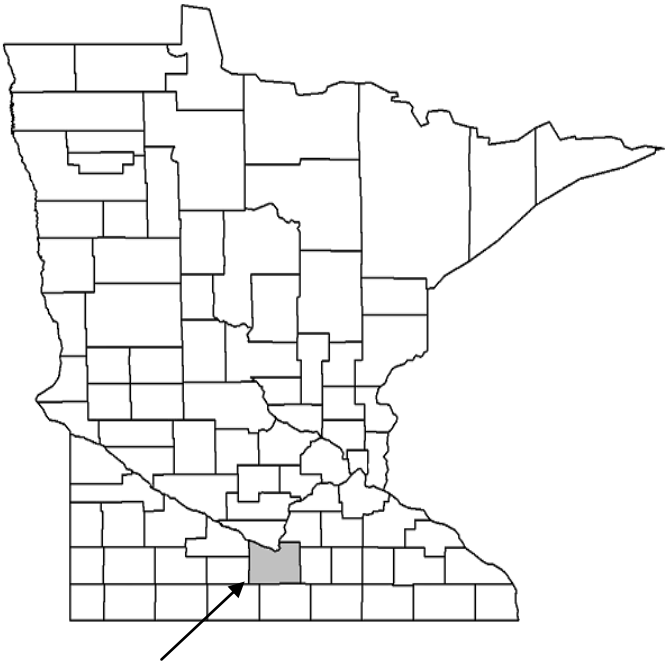
# FLOOD INSURANCE STUDY

# BLUE EARTH COUNTY, MINNESOTA

## AND INCORPORATED AREAS

| *Community Name* | *Community Number* |
|---|---|
| *AMBOY, CITY OF | 270309 |
| BLUE EARTH COUNTY (UNINCORPORATED AREAS) | 275231 |
| EAGLE LAKE, CITY OF | 270316 |
| *GOOD THUNDER, CITY OF | 270768 |
| LAKE CRYSTAL, CITY OF | 270030 |
| *MADISON LAKE, CITY OF | 270130 |
| MANKATO, CITY OF | 275242 |
| *MAPLETON, CITY OF | 270032 |
| MINNESOTA LAKE, CITY OF | 270122 |
| *PEMBERTON, CITY OF | 275331 |
| SKYLINE, CITY OF | 270672 |
| ST. CLAIR, CITY OF | 270033 |
| VERNON CENTER, CITY OF | 270608 |

*NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED




Revised Preliminary:
September 12, 2018

Federal Emergency Management Agency

**FLOOD INSURANCE STUDY NUMBER**
**27013CV000A**

**NOTICE TO**
**FLOOD INSURANCE STUDY USERS**

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

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

| Old Zone(s) | New Zone |
|---|---|
| Al through A30 | AE |
| B | X |
| C | X |

Initial Countywide FIS Effective Date: To Be Determined

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Exhibit 1 - Flood Profiles

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Exhibit 2 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

**FLOOD INSURANCE STUDY**
**BLUE EARTH COUNTY, MINNESOTA AND INCORPORATED AREAS**

# 1.0 INTRODUCTION

## 1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Blue Earth County, including the Cities of Amboy, Eagle Lake, Good Thunder, Lake Crystal, Madison Lake, Mankato, Mapleton, Minnesota Lake, Pemberton, Skyline, St. Clair, and Vernon Center; and the unincorporated areas of Blue Earth County (referred to collectively herein as Blue Earth County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the City of Mankato is geographically located in Blue Earth, Le Sueur, and Nicollet Counties. Only the Blue Earth County portion of the City of Mankato will be included in this FIS report.

Please note that the City of Minnesota Lake is geographically located in Blue Earth and Faribault Counties. Only the Blue Earth County portion of the City of Minnesota Lake is included in this FIS report.

Please note that the Cities of Amboy, Good Thunder, Madison Lake, Mapleton, and Pemberton have no mapped special flood hazard areas.

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

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

## 1.2 Authority and Acknowledgments

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

**Precountywide Analyses**

Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, are shown below:

| | |
|---|---|
| Blue Earth County (Unincorporated Areas): | For the March 5, 1990, FIS (FEMA, 1990), the hydrologic and hydraulic analyses for Cobb, Watonwan, Blue Earth, and Le Sueur Rivers were performed by the U.S. Army Corps of Engineers (USACE), St. Paul District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1. The work was completed in September 1986.<br><br>For the July 21, 1999, FIS, the hydraulic analyses for the Minnesota River were prepared by the USACE, St. Paul District, for FEMA, under Inter-Agency Agreement No. EMW-89-E-2978, Project Order No. 5. The work was completed in October 1994. |
| City of Mankato: | For the November 20, 2000, FIS (FEMA, 2000), the hydraulic analyses for the Minnesota River were taken from data prepared by the USACE, St. Paul District, for the FIS for Nicollet County, Minnesota and Incorporated Areas (FEMA, 1999c), under Inter-Agency Agreement No. EMW-89-E-2978, Project Order No. 5. The work was completed in October 1994. The hydrologic and hydraulic analyses for the Blue Earth River were taken from the FIS for the unincorporated areas of Blue Earth County (FEMA, 1999a). |

No previous FIS reports exist for the Cities of Amboy, Eagle Lake, Good Thunder, Lake Crystal, Madison Lake, Mapleton, Minnesota Lake, Pemberton, Skyline, St. Clair, and Vernon Center.

**This Countywide FIS Report**

For this countywide study, the hydrologic and hydraulic analyses for the limited detail study of the upper reach of the Minnesota River were taken from a study

done in Brown County, Minnesota. The analyses were performed by Black & Veatch and the USACE, under Contract No. EMC-2001-CO-0057. The work was completed in February 2004.

A revised hydraulic model was provided by the Minnesota Department of Natural Resources (MNDNR) for the detailed portion of Minnesota River from approximately 31,300 feet downstream of U.S. Highway 14 / State Highway 60 to approximately 12,110 feet upstream of U.S. Highway 169. This work was completed in August 2009.

The hydrologic and hydraulic analyses for this study, including a portion of Le Sueur River studied by limited detailed methods and the redelineation of all detailed flooding sources, were performed by Post, Buckley, Schuh and Jernigan, Inc. (PBS&J), for FEMA. The work was completed in March 2009, under Contract No. HSFE05-05-D-0023, Task Order Nos. 011 and 016.

Base map information shown on the Flood Insurance Rate Map (FIRM) was provided for Blue Earth County by Optimal Geomatics, Inc., dated 2005 and captured at a resolution of six inches (Optimal Geomatics, 2005). The projection used in the preparation of this map is Universal Transverse Mercator (UTM) Zone 15, and the horizontal datum used is National American Datum (NAD) 83, Geographic Reference System (GRS) 1980 spheroid.

## 1.3 Coordination

An initial meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied or restudied. A final meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

The initial and final meeting dates for the previous FIS reports for Blue Earth County and its communities are listed in the following table:

| Community | FIS Date | Initial Meeting | Final Meeting |
|---|---|---|---|
| Blue Earth County<br>(Unincorporated Areas) | March 5, 1990<br>July 21, 1999 | October 18, 1984<br>June 6, 1988 | March 1, 1989<br>November 13, 1996 |
| City of Mankato | November 20, 2000 | June 6, 1988 | January 7, 1997 |

For this countywide FIS, a scoping meeting was held on August 17, 2006, with representatives from Blue Earth County, the Cities of Lake Crystal, Minnesota Lake, St. Clair, Vernon Center, Minnesota DNR, FEMA, and PBS&J. The purpose of this meeting was to discuss the scope of the FIS.

The results of the study were reviewed at the open house held on _____, and attended by representatives of _____. All problems raised at that meeting have been addressed in this study.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This FIS covers the geographic area of Blue Earth County, Minnesota, 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 following streams are studied by detailed methods in this FIS report:

| | |
|---|---|
| Blue Earth River | Minnesota River |
| Cobb River | Watonwan River |
| Le Sueur River | |

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

For this countywide FIS, reaches of streams that have been studied by detailed methods were selected for redelineation based on more recent topography. Blue Earth County provided PBS&J with countywide digital GIS topographic data dated 2006 (Optimal Geomatics, 2005). The following streams were redelineated as part of this countywide revision:

| | |
|---|---|
| Blue Earth River | From the confluence with Minnesota River to approximately 5,360 feet upstream of Hemlock Road/County Highway 33 |
| Cobb River | From the confluence with Le Sueur River to Juniper Road/County Highway 16 |
| Le Sueur River | From the confluence with Blue Earth River to just downstream of 598th Avenue/County Highway 41 |
| Minnesota River | From approximately 31,300 feet downstream of U.S. Highway 14 / State Highway 60 to approximately 12,110 feet upstream of U.S. Highway 169 |
| Watonwan River | From approximately 17,600 feet downstream of U.S. Highway 169 to just upstream of Chicago and North Western Railroad |

A limited detail study, similar to the traditional approximate study, produces a 1-percent-annual-chance floodplain delineation, but also produces an estimated 1-percent-annual-chance flood elevation or Base Flood Elevation (BFE) for use by the community. The areas studied by limited detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction. The following streams were studied by limited detailed methods as part of this countywide revision:

| | |
|---|---|
| Le Sueur River | Within corporate limits of the City of St. Clair |
| Minnesota River | From approximately 12,110 feet upstream of U.S. Highway 169 to approximately 15,150 feet upstream of Blue Earth County Road 45 |

For this countywide study, all areas studied by approximate methods were newly studied based on updated hydrologic and hydraulic models.

For this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county, including both incorporated and unincorporated areas, is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD) to the North American Vertical Datum of 1988 (NAVD). In addition, the Universal Transverse Mercator coordinates, previously referenced to the North American Datum of 1927, are now referenced to the North American Datum of 1983.

Approximate analyses were used to study those areas having low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA and the communities.

## 2.2 Community Description

Blue Earth County is located in south-central Minnesota, approximately 75 miles southeast of the City of Minneapolis. It is bordered by Nicollet and Le Sueur Counties and the City of North Mankato on the north; Waseca County on the east; Martin and Faribault Counties on the south; and Watonwan and Brown Counties on the west. The Minnesota River forms the northern boundary of the county, and stream flow within the county is generally oriented south to north. Blue Earth County is served by U.S. Highways 14 and 169, State Highways 60, and the Chicago and North Western Railroad.

According to the U.S. Census Bureau, in 2010 the population for Blue Earth County was 64,013. (U.S. Census Bureau, 2010).

Blue Earth County has a humid continental climate that is characterized by large seasonal temperature variations. Mean temperatures vary from 3 degrees Fahrenheit (˚F) in January to 82˚F in July. The average annual precipitation is approximately 33 inches. The majority of the precipitation falls in late spring and summer (The Weather Channel, 2009).

The majority of the county is elevated plain, draining northward toward the City of Mankato, where the continuity of the plain breaks into rather sharp, deep valleys. Most valley surfaces are flat and marked by numerous broad, shallow depressions, although the larger valleys are also characterized by a series of terraces.

### 2.3 Principal Flood Problems

The Minnesota and Blue Earth Rivers have flooded frequently in the vicinity of the City of Mankato. The largest floods of record on the Minnesota River, measured at the U.S. Geological Survey (USGS) gage at Mankato, occurred in 1951, 1965, 1969, 1993, 1997, and 2001 (USGS, 1974b, 1993, and 2009). The 1965 flood was the largest, with an estimated discharge of 94,100 cubic feet per second (cfs). The 1997 and 2001 flood events had estimated discharges of 79,800 and 73,700 cfs, respectively. Other major flooding occurs in the spring due to a combination of snowmelt and rain, although floods of 1908, 1968, and 1993 were due only to heavy rains. Streams in Blue Earth County are also susceptible to ice jams, which threaten bridges and cause backwater flooding (USACE, 1973).

### 2.4 Flood Protection Measures

The USACE has constructed levees along the Blue Earth River and Minnesota River, which provide the county with protection against 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. Levees that do not protect against the 1-pecent-annual-chance flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain. For the Mankato Levee System LAMP analysis (National Levee Database Number 5705000009), the resulting inundation from the Natural Valley and Overtopping and Sound Reach procedures is combined to form a composite floodplain landside of the levee. The Natural Valley procedure, which defines the maximum extent of impacted area of the 1-percent annual chance flood on the landside of the levee is mapped as Zone D while the inundation area resulting from the Overtopping and Sound Reach procedure is mapped as Zone AE.

## 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 are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) 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.

**Precountywide Analyses**

A statistical analysis developed using the procedures outlined in Water Resources Council (WRC) Bulletin No. 17B and the USACE's Hydrologic Engineering Center (HEC) computer program, "Flood Flow Frequency Analysis," was applied to gage data from the Blue Earth, Le Sueur, and Watonwan Rivers (WRC, 1982; HEC, 1982).

On the Blue Earth River, statistical analyses were performed on data from the USGS gage near Rapidan. The flows from this station were combined with flows measured at the Northern States Power Company plant located approximately 0.2 mile upstream. The mean daily flow measured at the plant was converted to an instantaneous flow. The resulting discharges were then transferred to a point just upstream of the confluence of the Le Sueur River using a ratio of drainage areas. Downstream of the confluence of the Le Sueur River, the highest discharge combination resulting from the addition of the instantaneous peak flow and coincidental mean daily flow measured at the Blue Earth River and Le Sueur River gages was used for the peak-discharge analysis. The data were then correlated with data from the USGS Rapidan gage on the Blue Earth River, resulting in an equivalent record of 67 years.

On the Cobb River, discharges at the mouth were developed using the HEC-1 computer program (HEC, 1990). The 10-, 2-, 1-, and 0.2-percent frequency, 10-day hypothetical precipitation values were obtained from the National Weather Service publication TP-40 and TP-49 (NWS, 1961 and 1964). Loss rates and unit hydrograph parameters were obtained from a Minnesota watershed study and a calibrated HEC-1 model that was developed for the Le Sueur River gage at Rapidan (Bowers and Pabst, 1968; HEC, 1990). The resulting discharges were then transferred to the Cobb River at the County Highway 16 bridge using a ratio of drainage areas. Other methods used as a check include USGS regression equations, Minnesota Department of Transportation design discharge curves, and the general relations method (USGS, 1977; MDOT, undated).

Data for the Le Sueur River recorded at the USGS gage at Rapidan, Minnesota (No. 05320500) with 40 years of record, was correlated with data form another

gage (No. 05320000) on the Blue Earth River near Rapidan, resulting in 55 years of equivalent records. The discharges were then transferred to the mouth of the Le Sueur River and to a point just downstream of the confluence if the Cobb River. Discharges just upstream of the confluence of the Cobb River and at the County Highway 41 bridge were determined using USGS regression equations (USGS, 1977). Additional methods used as a check include drainage area ratio transfer, general relations, and HEC-1 computer program (HEC, 1990).

There are gages on the Minnesota River at New Ulm, Mankato, Montevideo, Delhi, and Judson. In 1966, a discharge-frequency relationship for the Mankato gage site was developed with zero skew using the log-Pearson Type III method by the USACE, St. Paul District, based on 63 years of record, from 1093 to 1965 (Water Resources Council, 1967). The USGS also developed a slightly different discharge-frequency curve for the same gage site, as well as curves for Montevideo and Judson, using the same method, but with a skew of -0.15. In 1966, the USACE developed discharge-frequency curves for Delhi, Judson, and New Ulm on the basis of general relationship curves that it had developed in 1958. The curve developed for Judson was extended by correlation with the Mankato site curve. Under an agreement made prior to this study, the USGS and USACE adopted, as a common 1-percent-annual-chance peak discharge estimate at Judson, a number halfway between the values for the event that each agency had estimated. The USACE later developed revised estimates for peak-discharges for the 10-, 2-, and 0.2-percent-annual-chance floods at Judson, based on the revised 1-percent-annual-chance value.

The discharge-frequency relationship for the reach of the Minnesota River between Mankato and the Le Sueur County line was established by the USGS. The discharge-frequency relationship was based on 40 years of record, from 1934 to 1973, of the gage at Jordan, Minnesota, and 69 years of record from 1905 to 1973, of the gage at Mankato. The discharges used in the analysis of the Minnesota River were based on the drainage area ratio between the Jordan and Mankato gages (USGS, 1974b).

Data for the Watonwan River were obtained from the USGS gage at Garden City, Minnesota, and were correlated with data from the gage on the Blue Earth River at Rapidan, resulting in 46 years of equivalent record. The discharges were then transferred to the mouth of the Watonwan River and to a point approximately 1 mile east of the intersection of County Highway 128 and County Highway 20 using a ratio of drainage areas.

**Countywide Analyses**

A study prepared in October 2001 by the USACE, "Section 22 Study: Minnesota River Main Stem Hydrologic Analysis" (USACE, 2001), to present the hydrologic analyses for development of a consistent set of frequency distributions for discharge elevation for the main stem of the Minnesota River from Ortonville,

Minnesota to its confluence with the Mississippi River at Mendota Heights, Minnesota. These analyses were performed as part of a joint funding effort between the Minnesota Department of Natural Resources Development Act of 1974 (Public Law 93-251). Past analyses on the Minnesota River main stem had been conducted on a fragmentary basis as part of the FIS program for individual communities and counties throughout the watershed and had resulted in inconsistent frequency distributions when viewing the river in its entirety. Also, some of the currently published FIS reports were based on obsolete study methods and at some locations do not include flood events that have occurred during the last 30 years. The methodology used in that report is in accordance with the general guidelines for hydrological analyses as provided by FEMA in "Guidelines and Specifications for Study Contractors" (FEMA, 1995). The updated analyses presented in that report were conducted prior to the spring runoff event of 2001 and generally include period of record flows through 1999. However, subsequent analyses performed at some of the stream flow gaged sites demonstrated that the frequency distributions were not sensitive to the inclusion of peak flow data for the years 2000 and 2001.

For the limited detailed study for Minnesota River from approximately 12,110 feet upstream of U.S. Highway 169 to approximately 15,150 feet upstream of County Highway 45, peak flows were estimated at eight structures. The main source of data used in this study was the Section 22 Study Report that was prepared jointly by the MNDNR and the USACE, St. Paul District (MNDNR, 2001). Other sources included as-built plans furnished by the Nicollet County Highway Department and the Minnesota Department of Transportation, USGS 1991 aerial photographs (USGS, 1991), and field measurements. Peak discharges were estimated using the published USGS regional regression equations (USGS, 1997). Regression equations estimate peak discharges for ungaged streams based on characteristics of nearby gaged streams. All streams were modeled using the rural regression equations.

For the limited detailed study for Le Sueur River within the corporate limits of the City of St. Clair, and all streams studied by approximate methods, peak discharges were estimated by using the published USGS regional regression equations for Minnesota (USGS, 1997). The following equation was used to estimate the 1-percent-annual-chance flood peak flows:

$$Q100 = 42.5DA^{0.790}\, SL^{0.522}\, (LK+1)^{-0.416}$$

DA = drainage area, in square miles;
SL = slope, in feet per mile;
LK = area covered by lakes, in percent of drainage area.

Peak discharge-drainage area relationships for streams studied in detail in Blue Earth County are shown in Table 1.

Table 1 – Summary of Discharges

| 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 |
|---|---|---|---|---|---|
| Blue Earth River | | | | | |
| Just downstream of the confluence of Le Sueur River | 3,553 | 24,400 | 42,500 | 52,000 | 76,000 |
| Just upstream of the confluence of Le Sueur River | 2,444 | 16,600 | 28,800 | 34,700 | 50,100 |
| At the limit of detailed study | 2,430 | 16,500 | 28,700 | 34,600 | 49,900 |
| Cobb River | | | | | |
| At confluence with Le Sueur River | 297 | 2,840 | 5,200 | 6,550 | 9,550 |
| At County Highway 16 | 291 | 2,800 | 5,130 | 6,460 | 9,720 |
| Le Sueur River | | | | | |
| Approximately 4,620 feet upstream of Soo Line Railroad | 1,100 | 10,300 | 18,700 | 23,000 | 34,200 |
| Minnesota River | | | | | |
| Approximately 1,900 feet downstream of U.S. Highway 14 | * | 44,700 | 76,000 | 90,700 | 127,000 |
| Aproximately 300 feet upstream of U.S. Highway 14 | * | 44,700 | 76,000 | 90,700 | 127,000 |
| Approximately 200 feet upstream of the confluence with the Blue Earth River | * | 30,000 | 59,000 | 73,000 | 106,000 |
| Watonwan River | | | | | |
| At confluence with Blue Earth River | * | 8,990 | 17,400 | 21,800 | 34,000 |

*Data not avilable

## 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 Table 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 report in conjunction with the data shown on the FIRM.

**Precountywide Analyses**

Cross sections for the flooding sources studied by detailed methods were obtained from field surveys. Overbank data for the Minnesota River were taken from topographic maps (USGS, 1974a). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

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

Water surface elevations (WSELs) of floods of the selected recurrence intervals were computed using the USACE's HEC-2 step-backwater computer program (HEC, 1991). Starting WSELs for Blue Earth River were determined using the coincidental frequency discharges on the Minnesota River and a discharge rating curve for the Minnesota River at the confluence of Blue Earth River. Starting WSELs for Le Sueur River were determined using coincidental frequency discharges and a discharge rating curve for the Blue Earth River at the confluence of Le Sueur River. Starting WSELs for the Minnesota River were obtained using established ratings from the appropriate gaging stations. The rating curve was developed from the HEC-2 model that was developed for the hydraulic design of the USACE flood control project at Mankato, Minnesota (HEC, 1991). For the portion of the Minnesota River within the City of Mankato, the Scott County Minnesota River HEC-2 WSELs near the Scott County line were used as starting WSELs (FEMA, 1987). Starting WSELs for Watonwan River and Cobb River were based on the slope/area option of HEC-2 (HEC, 1991). Flood profiles were drawn showing computed WSELs for floods of the selected recurrence intervals.

**This Countywide FIS Report**

For the portion of Minnesota River studied by limited detailed methods, cross sections were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevations of floods of the selected recurrence intervals. Hydraulic analyses were performed using the USACE's HEC-RAS computer program version 3.1.2 (HEC, 2004) and version 3.1.3 (HEC, 2005). The HEC-RAS model geometry was developed using GIS applications within the USACE's program HEC-GeoRAS (HEC, 2002). Using the digital contour maps, stream centerlines, cross section locations, and lines representing downstream reach lengths were digitized. The USACE HEC-GeoRAS program was used to extract the data and export it into a format compatible with HEC-RAS, version 3.1.2 (HEC, 2004).

For the limited detailed study for Le Sueur River within the corporate limits of the City of St. Clair, cross section data was obtained from the topography. The

North Park Street/North County Road 28 bridge was surveyed in the field. Hydraulic analyses were performed using the USACE's HEC-RAS computer program version 3.1.3 (HEC, 2005).

For the limited detailed study for Le Sueur River within the corporate limits of the City of St. Clair, and all streams studied by approximate methods, cross section data was obtained from the topography. Roads were modeled as weirs, using elevations from the topography. Hydraulic analyses were performed using the USACE's HEC-RAS computer program, version 3.1.3 (HEC, 2005).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by field observation and engineering judgment. For the portion of the Minnesota River studied by limited detailed methods, Manning's "n" values were adjusted to calibrate the HEC-2 models based on observed high water elevation data from previous flood events. The Manning's "n" values for all detailed studied streams are listed in the following table:

Manning's "n" Values

| Stream | Channel "n" | Overbank "n" |
|---|---|---|
| Blue Earth River | 0.038-0.040 | 0.100-0.120 |
| Cobb River | 0.040-0.044 | 0.090-0.099 |
| Le Sueur River | 0.040-0.045 | 0.090 |
| Minnesota River | 0.025-0.035 | 0.055-0.420 |
| Watonwan River | 0.040-0.041 | 0.090 |

The profile baselines depicted on the FIRM represent the hydraulic modeling baselines that match the flood profiles on this FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

The Minnesota River LeHillier Levee and the Mankato Levee along the Minnesota River are the accredited levees, where the flood hazard is modeled with the "with-levee" analysis. The North Mankato Levee along the Minnesota River is not accredited and used LAMP (Levee Analysis and Mapping Procedures) analysis. The HEC-2 hydraulic model for the Minnesota River was updated to a 2-Dimensional (2-D), unsteady HEC-RAS hydraulic model for the Overtopping and Sound Reach Procedure of non-accredited North Mankato Levee. Please refer to North Mankato LAMP report for details. The Natural Valley procedure, which defines the maximum extent of impacted area of the 1-percent annual chance flood on the landside of the levee is mapped as Zone D SFHA while the inundation area resulting from the Overtopping and Sound Reach procedure is mapped as Zone AE for the non-accredited North Mankato Levee.

With the expanded overbank flow area on the landside of the levee, the 1-percent annual chance elevations were lower for the Natural Valley analysis. The lower water surface profile resulting from the Natural Valley analysis is mapped for the 1-percent annual chance flood on the landside of the levee. The water surface profile and Zone AE flood hazard on the riverside of the levee remains consistent with the "with-levee" analysis.

Along the Mankato Levee, Honeymead, ndian` Creek and arren` Creek are the identified interior drainage ponding areas mapped as Zone AE with static FEs.` Along the Minnesota River LeHillier Levee, LeHillier East is the identified interior drainage ponding area mapped as Zone AE with a static BFE.

For the North Mankato Levee LAMP analysis, the resulting inundation from the Natural Valley and Overtopping and Sound Reach procedures is combined to form a composite floodplain landside of the levee. The HEC-2 hydraulic model for the Minnesota River was updated to a 2-Dimensional (2-D), unsteady HEC-RAS hydraulic model for the Overtopping and Sound Reach analysis. Please refer to North Mankato LAMP report for details. The Natural Valley procedure, which defines the maximum extent of impacted area of the 1-percent annual chance flood on the landside of the levee is mapped as Zone D while the inundation area resulting from the Overtopping and Sound Reach procedure is mapped as Zone AE.

## 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 in use for newly created or revised FIS reports and FIRMs was the NGVD. With the finalization of the NAVD, many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in BFEs across the corporate limits between the communities. The average conversion factor that was used to convert the data in this FIS report to NAVD was calculated using the National Geodetic Survey's VERTCON online utility (NGS, 2006). The data points used to determine the conversion are listed in Table 2.

Table 2 – Vertical Datum Conversion

| Quad Name | Corner | Latitude | Longitude | Conversion from NGVD to NAVD |
|---|---|---|---|---|
| New Ulm | SE | 44.250 | -94.375 | 0.240 |
| Courtland | SE | 44.250 | -94.250 | 0.226 |
| North Star | SE | 44.250 | -94.000 | 0.118 |
| Saint Peter | SE | 44.250 | -93.875 | 0.151 |
| Cleveland | SE | 44.250 | -93.750 | 0.161 |
| Hanska | SE | 44.125 | -94.375 | 0.217 |
| Cambria | SE | 44.125 | -94.250 | 0.180 |
| Judson | SE | 44.125 | -94.125 | 0.141 |
| Mankato West | SE | 44.125 | -94.000 | 0.115 |
| Mankato East | SE | 44.125 | -93.875 | 0.118 |
| Madison Lake | SE | 44.125 | -93.750 | 0.131 |
| Madelia | SE | 44.000 | -94.375 | 0.174 |
| Perth | SE | 44.000 | -94.250 | 0.164 |
| Lake Crystal | SE | 44.000 | -94.125 | 0.154 |
| Good Thunder | SE | 44.000 | -94.000 | 0.128 |
| Beauford | SE | 44.000 | -93.875 | 0.118 |
| Saint Clair | SE | 44.000 | -93.750 | 0.112 |
| Lewisville | SE | 43.875 | -94.375 | 0.171 |
| Willow Creek | SE | 43.875 | -94.250 | 0.177 |
| Amboy | SE | 43.875 | -94.125 | 0.171 |
| Sterling Center | SE | 43.875 | -94.000 | 0.161 |
| Mapleton | SE | 43.875 | -93.875 | 0.157 |
| Mapleton NE | SE | 43.875 | -93.750 | 0.141 |
| | | | **Average:** | **0.158** |

For additional information regarding conversion between NGVD and NAVD, visit the NGS website at www.ngs.noaa.gov.

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.

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data Table, and Summary of Stillwater Elevations Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

### 4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For each stream studied by detailed, limited detailed, and approximate methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated

using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:100, with a contour interval of 2 feet (Optimal Geomatics, Inc., 2005).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

## 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 1-percent-annual-chance 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. In Minnesota, however, floodplain encroachment is limited by Minnesota Regulations to that which would cause a 0.5-foot increase in flood heights above pre-floodway conditions at any point (MNDNR, 1977). Floodways having no more than a 0.5-foot surcharge were delineated for this FIS. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS report and on the FIRM 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 have been tabulated for selected cross sections

(Table 3). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

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

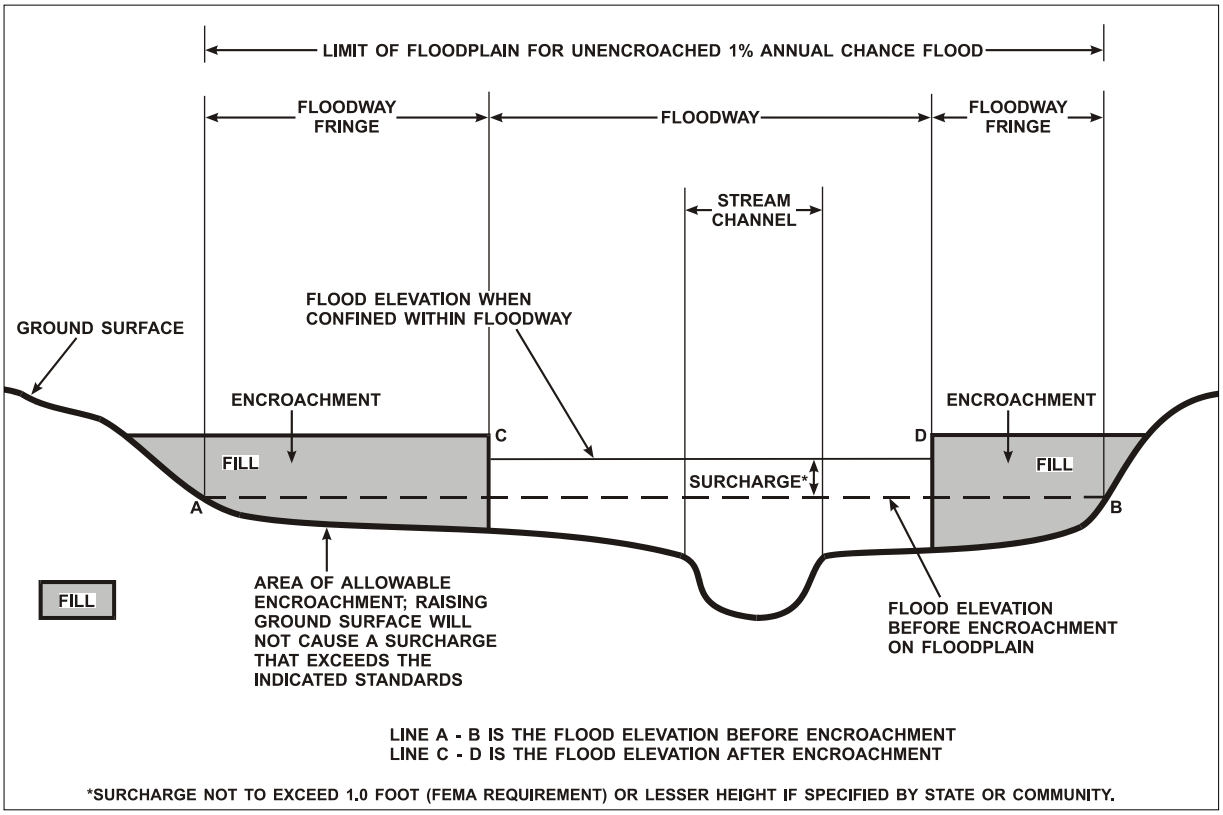


Figure 1 – Floodway Schematic

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| BLUE EARTH RIVER | | | | | | | | | |
| A | 3,302 | 496[2] | 7,863 | 6.5 | | 782.5 | 780.2[3] | 780.6 | 0.4 |
| B | 3,852 | 388[2] | 7,724 | 6.7 | | 782.5 | 780.5[3] | 780.9 | 0.4 |
| C | 4,369 | 358[2] | 5,890 | 8.7 | | 782.5 | 781.4[3] | 781.8 | 0.4 |
| D | 5,944 | 978[2] | 17,243 | 3.0 | 7 | 783.2 | 783.2 | 783.5 | 0.3 |
| E | 7,519 | 972 | 12,804 | 4.0 | | 783.6 | 783.6 | 783.9 | 0.3 |
| F | 9,094 | 1,340 | 19,320 | 2.7 | | 784.4 | 784.4 | 784.7 | 0.3 |
| G | 10,544 | 1,467 | 20,557 | 2.5 | | 784.8 | 784.8 | 785.1 | 0.3 |
| H | 11,995 | 1,653 | 19,779 | 2.6 | 33 | 785.2 | 785.2 | 785.4 | 0.2 |
| I | 12,845 | 1,218 | 13,764 | 3.7 | | 785.6 | 785.6 | 785.8 | 0.2 |
| J | 14,170 | 903 | 13,294 | 3.9 | | 785.8 | 785.8 | 786.1 | 0.3 |
| K | 15,445 | 992 | 12,438 | 4.1 | | 786.3 | 786.3 | 786.6 | 0.3 |
| L | 16,620 | 590 | 6,796 | 7.6 | | 786.4 | 786.4 | 786.6 | 0.2 |
| M | 21,020 | 263 | 5,528 | 6.3 | 17 | 788.9 | 788.9 | 789.4 | 0.5 |
| N | 21,420 | 321 | 7,271 | 4.8 | | 789.8 | 789.8 | 790.3 | 0.5 |
| O | 22,150 | 310 | 6,223 | 5.6 | | 789.9 | 789.9 | 790.4 | 0.5 |
| P | 23,450 | 290 | 5,712 | 6.1 | | 790.4 | 790.4 | 790.9 | 0.5 |
| Q | 25,422 | 279 | 5,803 | 6.0 | 11 | 791.7 | 791.7 | 792.1 | 0.4 |
| R | 26,620 | 316 | 6,270 | 5.5 | 41 | 792.4 | 792.4 | 792.9 | 0.5 |

[1]Feet above confluence with Minnesota River

[2] These widths consider adjustments made to ensure compliance with FEMA policy regarding the mapping of floodways on levees

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

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**BLUE EARTH RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| COBB RIVER | | | | | | | | | |
| A | 750 | 1,045 | 1,598 | 4.1 | 85 | 826.6 | 820.2[2] | 820.7 | 0.5 |
| B | 3,310 | 278 | 1,469 | 4.5 | 142 | 826.6 | 824.8[2] | 824.8 | 0.0 |
| C | 4,755 | 327 | 1,819 | 3.6 | | 826.6 | 826.2[2] | 826.2 | 0.0 |
| D | 7,310 | 213 | 1,152 | 5.7 | | 830.9 | 830.9 | 830.9 | 0.0 |
| E | 8,435 | 271 | 740 | 8.8 | | 835.2 | 835.2 | 835.2 | 0.0 |
| F | 9,497 | 120 | 694 | 9.4 | | 842.7 | 842.7 | 842.7 | 0.0 |
| G | 10,435 | 179 | 1,215 | 5.4 | | 847.2 | 847.2 | 847.2 | 0.0 |
| H | 12,344 | 963 | 1,964 | 3.3 | 38 | 850.5 | 850.5 | 850.5 | 0.0 |
| I | 13,860 | 261 | 1,041 | 6.3 | | 854.4 | 854.4 | 854.4 | 0.0 |
| J | 15,335 | 233 | 1,322 | 5.0 | | 858.7 | 858.7 | 858.7 | 0.0 |
| K | 16,435 | 239 | 1,370 | 4.8 | 333 | 861.1 | 861.1 | 861.1 | 0.0 |
| L | 18,660 | 163 | 857 | 7.6 | 330 | 869.3 | 869.3 | 869.3 | 0.0 |
| M | 21,910 | 269 | 1,698 | 3.9 | | 879.1 | 879.1 | 879.1 | 0.0 |
| N | 22,590 | 198 | 1,597 | 4.1 | 66 | 879.8 | 879.8 | 879.8 | 0.0 |
| O | 23,740 | 445 | 2,832 | 2.3 | 314 | 881.0 | 881.0 | 881.0 | 0.0 |
| P | 27,035 | 264 | 906 | 7.2 | | 886.3 | 886.3 | 886.3 | 0.0 |
| Q | 27,434 | 337 | 1,604 | 4.1 | | 889.2 | 889.2 | 889.2 | 0.0 |
| R | 29,309 | 198 | 1,309 | 5.0 | 217 | 891.9 | 891.9 | 892.3 | 0.4 |

[1]Feet above confluence with Le Sueur River

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

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

# FLOODWAY DATA

## COBB RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| LE SUEUR RIVER | | | | | | | | | |
| A | 450 | 860 | 12,102 | 1.9 | | 788.1 | 787.2[2] | 787.7 | 0.5 |
| B | 2,660 | 1,810 | 10,075 | 2.3 | | 788.3 | 787.6[3] | 788.1 | 0.5 |
| C | 4,310 | 2,162 | 8,177 | 2.8 | 47 | 788.3 | 788.3 | 788.7 | 0.4 |
| D | 5,420 | 1,340 | 10,054 | 2.3 | | 788.9 | 788.9 | 789.2 | 0.3 |
| E | 6,860 | 346 | 4,359 | 5.3 | | 789.4 | 789.4 | 789.7 | 0.3 |
| F | 7,500 | 202 | 3,041 | 7.6 | | 790.0 | 790.0 | 790.2 | 0.2 |
| G | 7,760 | 231 | 3,131 | 7.4 | | 790.5 | 790.5 | 790.7 | 0.2 |
| H | 8,790 | 231 | 3,771 | 6.1 | 38 | 791.8 | 791.8 | 792.0 | 0.2 |
| I | 10,360 | 400 | 4,014 | 5.8 | 56 | 793.3 | 793.3 | 793.4 | 0.1 |
| J | 12,020 | 328 | 3,214 | 7.2 | | 795.2 | 795.2 | 795.3 | 0.1 |
| K | 12,570 | 213 | 3,385 | 6.8 | | 796.4 | 796.4 | 796.4 | 0.0 |
| L | 13,900 | 396 | 3,505 | 6.6 | | 797.7 | 797.7 | 797.7 | 0.0 |
| M | 14,900 | 241 | 2,967 | 7.8 | | 799.0 | 799.0 | 799.0 | 0.0 |
| N | 16,370 | 323 | 3,753 | 6.1 | | 801.2 | 801.2 | 801.2 | 0.0 |
| O | 17,720 | 448 | 4,452 | 5.2 | 123 | 802.6 | 802.6 | 802.6 | 0.0 |
| P | 19,220 | 336 | 6,822 | 3.4 | 84 | 803.9 | 803.9 | 803.9 | 0.0 |
| Q | 20,260 | 338 | 6,043 | 3.8 | 145 | 804.2 | 804.2 | 804.2 | 0.0 |
| R | 21,550 | 350 | 6,346 | 3.6 | | 804.8 | 804.8 | 804.8 | 0.0 |
| S | 23,600 | 562 | 4,632 | 5.0 | 497 | 805.3 | 805.3 | 805.4 | 0.1 |
| T | 24,780 | 585 | 3,522 | 6.5 | 215 | 806.8 | 806.8 | 807.1 | 0.3 |
| U | 25,870 | 510 | 2,994 | 7.7 | | 808.6 | 808.6 | 809.0 | 0.4 |
| V | 26,960 | 747 | 4,997 | 4.6 | | 811.0 | 811.0 | 811.3 | 0.3 |
| W | 28,260 | 470 | 5,918 | 3.9 | | 812.5 | 812.5 | 812.7 | 0.2 |
| X | 30,680 | 670 | 4,906 | 4.7 | | 814.4 | 814.4 | 814.7 | 0.3 |
| Y | 31,900 | 900 | 6,924 | 3.3 | | 815.8 | 815.8 | 816.2 | 0.4 |

[1]Feet above confluence with Blue Earth River

[2]Elevation computed without consideration of control by Blue Earth River

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

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**LE SUEUR RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| LE SUEUR RIVER (CONTINUED) | | | | | | | | | |
| Z | 33,050 | 766 | 7,329 | 2.4 | | 816.8 | 816.8 | 817.2 | 0.4 |
| AA | 34,280 | 773 | 4,966 | 3.6 | 28 | 817.3 | 817.3 | 817.7 | 0.4 |
| AB | 36,100 | 635 | 4,501 | 4.0 | | 819.6 | 819.6 | 819.7 | 0.1 |
| AC | 37,100 | 489 | 3,771 | 4.7 | | 820.6 | 820.6 | 820.7 | 0.1 |
| AD | 39,040 | 185 | 2,491 | 7.2 | | 822.9 | 822.9 | 823.0 | 0.1 |
| AE | 39,530 | 689 | 7,672 | 2.3 | | 824.3 | 824.3 | 824.3 | 0.0 |
| AF | 40,950 | 330 | 2,702 | 6.6 | | 824.7 | 824.7 | 824.7 | 0.0 |
| AG | 41,810 | 769 | 5,929 | 3.0 | | 826.4 | 826.4 | 826.5 | 0.1 |
| AH | 43,275 | 670 | 4,019 | 4.0 | | 827.6 | 827.6 | 827.8 | 0.2 |
| AI | 45,530 | 1,369 | 8,153 | 2.0 | | 829.8 | 829.8 | 830.1 | 0.3 |
| AJ | 46,770 | 513 | 3,640 | 4.4 | | 830.6 | 830.6 | 830.8 | 0.2 |
| AK | 47,100 | 466 | 5,119 | 3.1 | | 831.5 | 831.5 | 831.6 | 0.1 |
| AL | 49,590 | 926 | 4,777 | 3.4 | | 833.1 | 833.1 | 833.3 | 0.2 |
| AM | 50,790 | 350 | 2,836 | 5.7 | | 834.3 | 834.3 | 834.8 | 0.5 |
| AN | 51,350 | 370 | 2,644 | 6.1 | | 835.3 | 835.3 | 835.8 | 0.5 |
| AO | 53,360 | 364 | 3,242 | 4.9 | | 839.4 | 839.4 | 839.5 | 0.1 |
| AP | 55,220 | 582 | 4,783 | 3.4 | 44 | 841.5 | 841.5 | 841.5 | 0.0 |
| AQ | 56,710 | 1,238 | 6,862 | 2.3 | | 842.9 | 842.9 | 842.9 | 0.0 |
| AR | 58,550 | 618 | 4,200 | 3.8 | 48 | 844.5 | 844.5 | 844.5 | 0.0 |
| AS | 61,550 | 563 | 3,519 | 4.6 | 203 | 849.5 | 849.5 | 849.5 | 0.0 |
| AT | 63,020 | 510 | 3,799 | 4.2 | | 851.5 | 851.5 | 851.5 | 0.0 |
| AU | 65,820 | 381 | 3,672 | 4.4 | 31 | 854.4 | 854.4 | 854.4 | 0.0 |
| AV | 71,370 | 307 | 3,142 | 5.0 | 30 | 859.8 | 859.8 | 859.8 | 0.0 |
| AW | 72,080 | 371 | 3,709 | 4.2 | | 861.8 | 861.8 | 861.8 | 0.0 |
| AX | 73,290 | 1,134 | 8,468 | 1.8 | | 862.6 | 862.6 | 862.9 | 0.3 |

[1]Feet above confluence with Blue Earth River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**LE SUEUR RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| LE SUEUR RIVER (CONTINUED) | | | | | | | | | |
| AY | 74,680 | 499 | 4,311 | 3.6 | | 863.2 | 863.2 | 863.5 | 0.3 |
| AZ | 75,840 | 167 | 1,598 | 9.8 | | 863.6 | 863.6 | 863.8 | 0.2 |
| BA | 78,300 | 590 | 3,440 | 4.5 | | 870.5 | 870.5 | 870.6 | 0.1 |
| BB | 80,000 | 492 | 4,188 | 3.7 | 55 | 872.6 | 872.6 | 872.8 | 0.2 |
| BC | 81,540 | 287 | 2,727 | 5.7 | | 874.1 | 874.1 | 874.4 | 0.3 |
| BD | 82,390 | 278 | 2,733 | 5.7 | | 875.5 | 875.5 | 875.6 | 0.1 |
| BE | 83,440 | 1,250 | 3,433 | 4.5 | 81 | 877.1 | 877.1 | 877.4 | 0.3 |
| BF | 84,540 | 194 | 2,175 | 7.2 | 407 | 878.2 | 878.2 | 878.4 | 0.2 |
| BG | 86,170 | 300 | 2,067 | 7.5 | | 881.4 | 881.4 | 881.5 | 0.1 |
| BH | 87,110 | 210 | 2,507 | 6.2 | | 883.7 | 883.7 | 883.8 | 0.1 |
| BI | 88,680 | 374 | 3,373 | 4.6 | | 887.1 | 887.1 | 887.1 | 0.0 |
| BJ | 90,040 | 540 | 2,941 | 5.3 | | 889.7 | 889.7 | 889.7 | 0.0 |
| BK | 91,470 | 360 | 3,175 | 4.9 | | 892.8 | 892.8 | 892.8 | 0.0 |
| BL | 92,530 | 320 | 2,343 | 6.7 | | 894.2 | 894.2 | 894.2 | 0.0 |
| BM | 94,230 | 300 | 3,003 | 5.2 | | 896.9 | 896.9 | 896.9 | 0.0 |
| BN | 96,130 | 252 | 2,679 | 5.8 | | 900.1 | 900.1 | 900.2 | 0.1 |
| BO | 97,290 | 294 | 2,095 | 7.3 | | 902.1 | 902.1 | 902.4 | 0.3 |
| BP | 98,420 | 784 | 5,735 | 2.7 | | 904.7 | 904.7 | 905.0 | 0.3 |
| BQ | 99,410 | 494 | 3,955 | 3.9 | | 905.3 | 905.3 | 905.6 | 0.3 |
| BR | 100,170 | 469 | 4,530 | 3.4 | | 906.4 | 906.4 | 906.6 | 0.2 |
| BS | 102,050 | 224 | 1,999 | 7.7 | | 908.5 | 908.5 | 908.7 | 0.2 |
| BT | 103,330 | 411 | 2,683 | 5.7 | | 912.4 | 912.4 | 912.4 | 0.0 |
| BU | 104,170 | 325 | 3,046 | 5.0 | | 914.4 | 914.4 | 914.4 | 0.0 |
| BV | 104,825 | 325 | 3,572 | 4.3 | | 915.5 | 915.5 | 915.5 | 0.0 |

[1]Feet above confluence with Blue Earth River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**LE SUEUR RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| MINNESOTA RIVER | | | | | | | | | |
| A | 130,152 | 4,000/1,360[2] | 53,669 | 4.2 | | 769.2 | 769.2 | 769.2 | 0.0 |
| B | 133,002 | 3,556/609[2] | 41,066 | 7.9 | | 769.6 | 769.6 | 769.7 | 0.1 |
| C | 142,977 | 2,546/2,309[2] | 30,631 | 7.9 | 52 | 771.6 | 771.6 | 771.6 | 0.0 |
| D | 145,527 | 2,269/246[2] | 35,810 | 5.1 | | 772.5 | 772.5 | 772.7 | 0.2 |
| E | 147,197 | 2,139/632[2] | 32,652 | 6.6 | | 772.7 | 772.7 | 772.9 | 0.2 |
| F | 150,397 | 1,595/252[2] | 32,543 | 6.0 | | 774.2 | 774.2 | 774.7 | 0.5 |
| G | 152,597 | 911/547[2] | 18,389 | 7.2 | | 774.5 | 774.5 | 774.9 | 0.4 |
| H | 154,657 | 798 | 15,889 | 7.3 | | 775.2 | 775.2 | 775.5 | 0.3 |
| I | 156,227 | 404/194[2] | 11,000 | 8.6 | | 775.5 | 775.5 | 775.8 | 0.3 |
| J | 157,977 | 449/251[2] | 11,249 | 8.8 | | 776.3 | 776.3 | 776.7 | 0.4 |
| K | 159,647 | 465/252[2,4] | 11,438 | 8.5 | | 777.2 | 777.2 | 777.6 | 0.4 |
| L | 161,147 | 474/297[2,4] | 13,008 | 7.5 | | 778.3 | 778.3 | 778.6 | 0.3 |
| M | 162,697 | 523/280[2,4] | 13,900 | 7.0 | | 778.9 | 778.9 | 779.2 | 0.3 |
| N | 163,827 | 429/163[2,4] | 10,632 | 9.2 | | 778.9 | 778.9 | 779.2 | 0.3 |
| O | 165,771 | 634/470[2,4] | 16,998 | 5.8 | | 780.6 | 780.6 | 780.8 | 0.2 |
| P | 167,956 | 546/325[2,4] | 15,927 | 6.2 | | 781.4 | 781.4 | 781.6 | 0.2 |
| Q | 169,826 | 473/370[3] | 11,631 | 9.0 | | 781.6 | 781.6 | 781.8 | 0.2 |
| R | 170,726 | 1,304/974[2] | 28,444 | 5.6 | | 782.9 | 782.9 | 783.1 | 0.2 |
| S | 175,506 | 3,348/310[2] | 69,513 | 2.8 | 109 | 783.8 | 783.8 | 784.2 | 0.4 |
| T | 176,996 | 2,988/154[2] | 61,341 | 2.8 | | 783.9 | 783.9 | 784.2 | 0.3 |

[1]Feet above the Nicollet-Sibley County boundary
[2]Total width / Width within county
[3]The floodway shown on the FIRM has been widened beyond this value for administrative purposes
[4]These widths consider adjustments made to ensure compliance with FEMA policy regarding the mapping of floodways on levees

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

# FLOODWAY DATA

## MINNESOTA RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY (FEET NAVD) | WITHOUT FLOODWAY (FEET NAVD) | WITH FLOODWAY (FEET NAVD) | INCREASE (FEET) |
| WATONWAN RIVER | | | | | | | | | |
| A | 7,270 | 492 | 4,039 | 5.4 | | 887.7 | 887.7 | 880.2 | 0.5 |
| B | 8,410 | 882 | 7,093 | 3.1 | 45 | 889.2 | 889.2 | 889.5 | 0.3 |
| C | 9,760 | 465 | 3,928 | 5.5 | 16 | 890.3 | 890.3 | 890.5 | 0.2 |
| D | 11,140 | 400 | 3,586 | 6.1 | 22 | 892.4 | 892.4 | 892.5 | 0.1 |
| E | 12,060 | 262 | 4,041 | 5.4 | | 893.7 | 893.7 | 893.7 | 0.0 |
| F | 13,180 | 760 | 7,193 | 3.0 | | 894.7 | 894.7 | 894.8 | 0.1 |
| G | 14,100 | 516 | 4,941 | 4.4 | | 894.9 | 894.9 | 895.0 | 0.1 |
| H | 15,500 | 488 | 3,686 | 5.9 | | 896.3 | 896.3 | 896.4 | 0.1 |
| I | 16,750 | 276 | 2,861 | 7.6 | 29 | 897.7 | 897.7 | 897.8 | 0.1 |
| J | 17,750 | 233 | 3,240 | 6.7 | 38 | 899.7 | 899.7 | 899.8 | 0.1 |
| K | 18,690 | 574 | 7,593 | 2.9 | 86 | 901.3 | 901.3 | 901.3 | 0.0 |
| L | 19,740 | 216 | 2,821 | 7.7 | | 902.3 | 902.3 | 902.3 | 0.0 |
| M | 21,390 | 227 | 3,420 | 6.4 | | 905.1 | 905.1 | 905.4 | 0.3 |
| N | 22,440 | 211 | 3,306 | 6.6 | | 906.0 | 906.0 | 906.3 | 0.3 |
| O | 23,115 | 300 | 4,006 | 5.4 | | 907.2 | 907.2 | 907.5 | 0.3 |
| P | 24,460 | 700 | 8,110 | 2.7 | | 908.3 | 908.3 | 908.7 | 0.4 |
| Q | 25,170 | 400 | 4,999 | 4.4 | | 909.2 | 909.2 | 909.5 | 0.3 |
| R | 26,130 | 306 | 3,501 | 6.2 | | 910.1 | 910.1 | 910.3 | 0.2 |
| S | 27,400 | 318 | 3,810 | 5.7 | 39 | 911.8 | 911.8 | 912.0 | 0.2 |
| T | 29,035 | 337 | 3,514 | 6.2 | | 913.1 | 913.1 | 913.6 | 0.5 |
| U | 30,060 | 399 | 3,857 | 5.7 | 19 | 914.4 | 914.4 | 914.8 | 0.4 |
| V | 31,360 | 200 | 2,655 | 8.2 | | 916.1 | 916.1 | 916.3 | 0.2 |

[1]Feet above confluence with Blue Earth River

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**FLOODWAY DATA**

**WATONWAN RIVER**

## 5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

Zone AE is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, 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 risk 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 1-percent-annual-chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone D

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

## 6.0 FLOOD INSURANCE RATE MAP

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

For flood insurance applications, the map designates flood insurance risk 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 the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide FIRM presents flooding information for the entire geographic area of Blue Earth County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. Historical data relating to the maps prepared for each community are presented in Table 4.

## 7.0 OTHER STUDIES

Previous FIS reports have been prepared for Faribault County, Minnesota (Unincorporated Areas) (FIA, 1981), Le Sueur County, Minnesota and Incorporated Areas (FEMA, 1999b), and a FIRM has been created for Martin County, Minnesota (Unincorporated Areas) (FEMA, 1988), Waseca County, Minnesota (Unincorporated Areas) (FEMA, 1985a), and Watonwan County, Minnesota (Unincorporated Areas) (FEMA, 1985b).

This report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for 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, Federal Insurance and Mitigation Division, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605.

## 9.0 BIBLIOGRAPHY AND REFERENCES

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Federal Emergency Management Agency, Flood Insurance Study, Scott County, Minnesota (Unincorporated Areas), February 19, 1987.

| COMMUNITY NAME | INITIAL IDENTIFICATION | FLOOD HAZARD BOUNDARY MAP REVISION DATE | FIRM EFFECTIVE DATE | FIRM REVISION DATE |
|---|---|---|---|---|
| * Amboy, City of | N/A | None | N/A | None |
| Blue Earth County (Unincorporated Areas) | November 25, 1972 | None | November 25, 1972 | July 1, 1974<br>May 7, 1976<br>June 18, 1982<br>March 5, 1990<br>July 21, 1999 |
| Eagle Lake, City of | To Be Determined | None | To Be Determined | None |
| * Good Thunder, City of | N/A | None | N/A | None |
| Lake Crystal, City of | July 30, 1976 | None | July 3, 1985 | None |
| * Madison Lake, City of | N/A | None | N/A | None |
| Mankato, City of | December 22, 1972 | None | December 22, 1972 | July 1, 1974<br>March 12, 1976<br>June 17, 1977<br>July 16, 1982<br>November 20, 2000 |
| * Mapleton, City of | N/A | None | N/A | None |
| Minnesota Lake, City of | To Be Determined | None | To Be Determined | None |
| * Pemberton, City of | N/A | None | N/A | None |
| Skyline, City of | June 27, 1975 | None | To Be Determined | None |
| St. Clair, City of | To Be Determined | None | To Be Determined | None |
| Vernon Center, City of | January 3, 1975 | None | To Be Determined | None |

*No special flood hazard areas identified

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

**BLUE EARTH COUNTY, MN**
**AND INCORPORATED AREAS**

**COMMUNITY MAP HISTORY**

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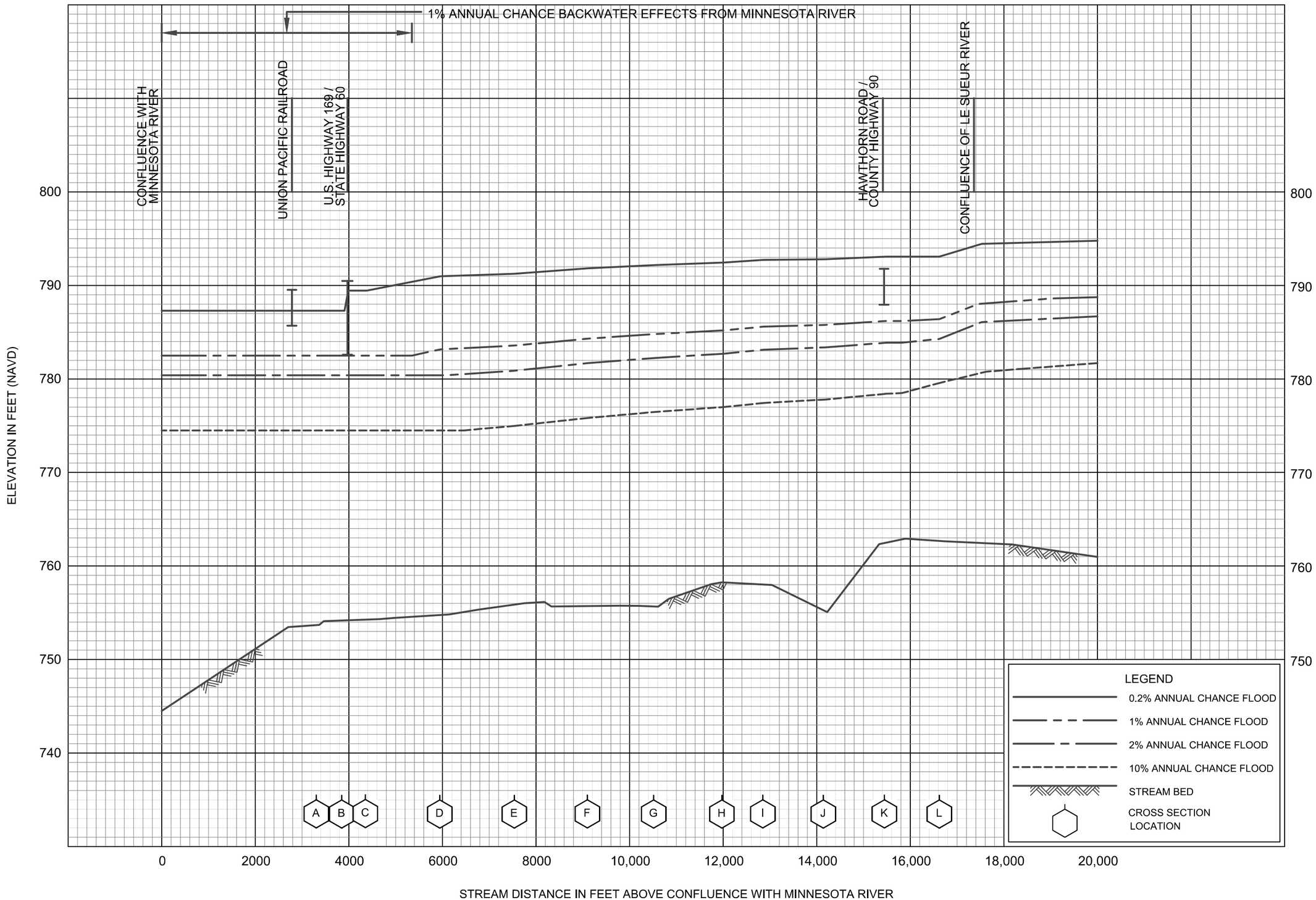



FLOOD PROFILES

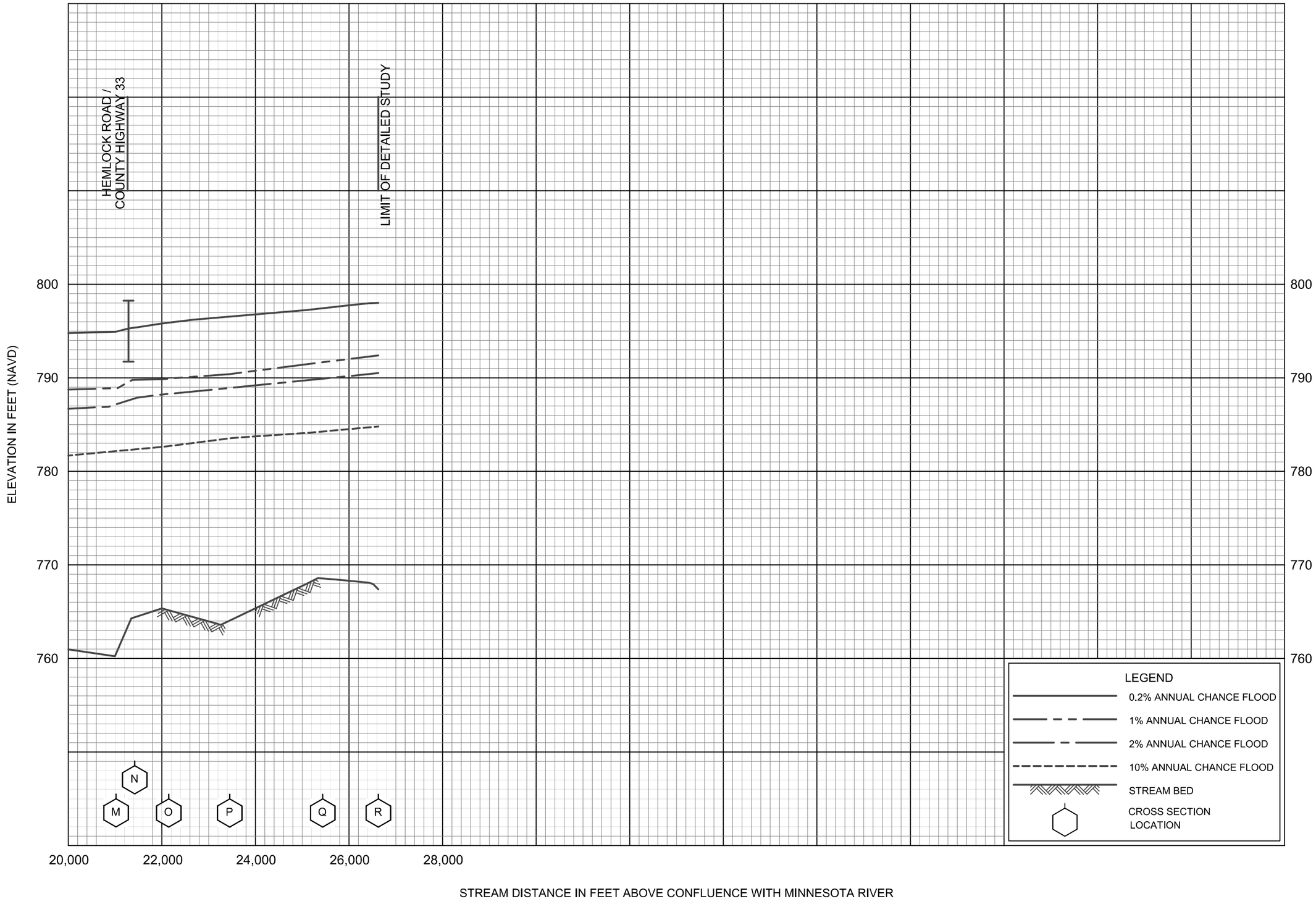
BLUE EARTH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

01P




FLOOD PROFILES

BLUE EARTH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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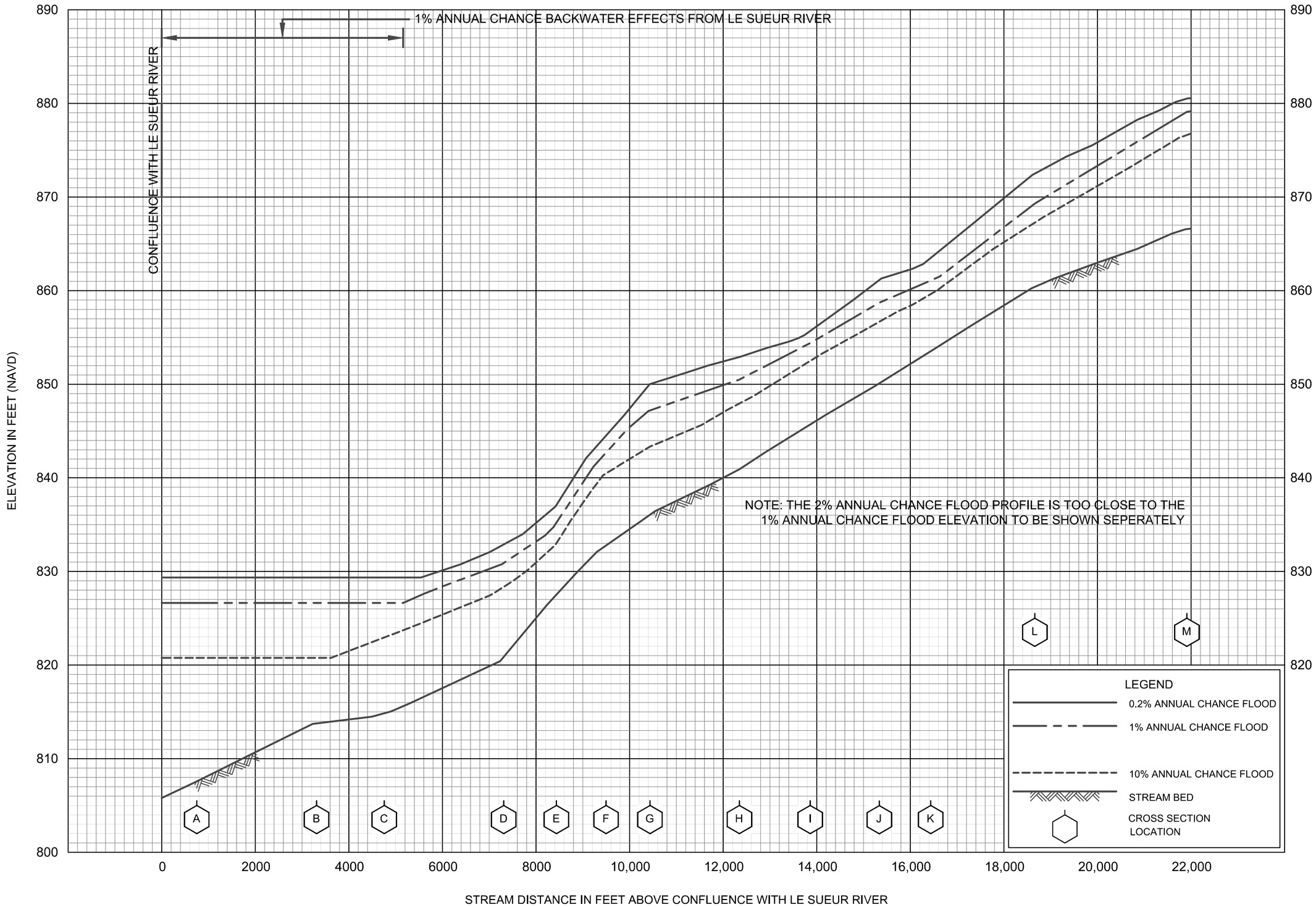


FLOOD PROFILES

COBB RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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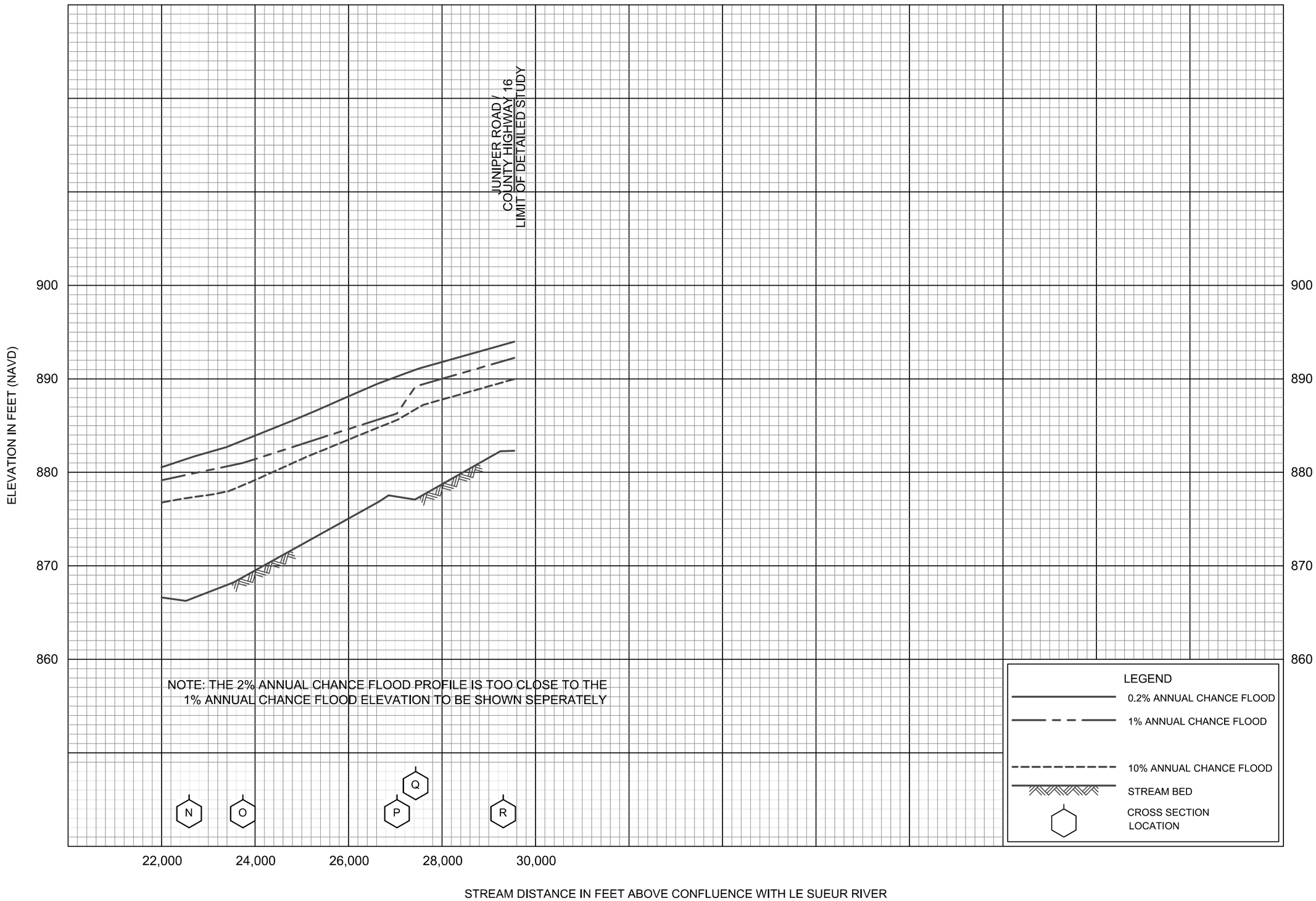


FLOOD PROFILES

COBB RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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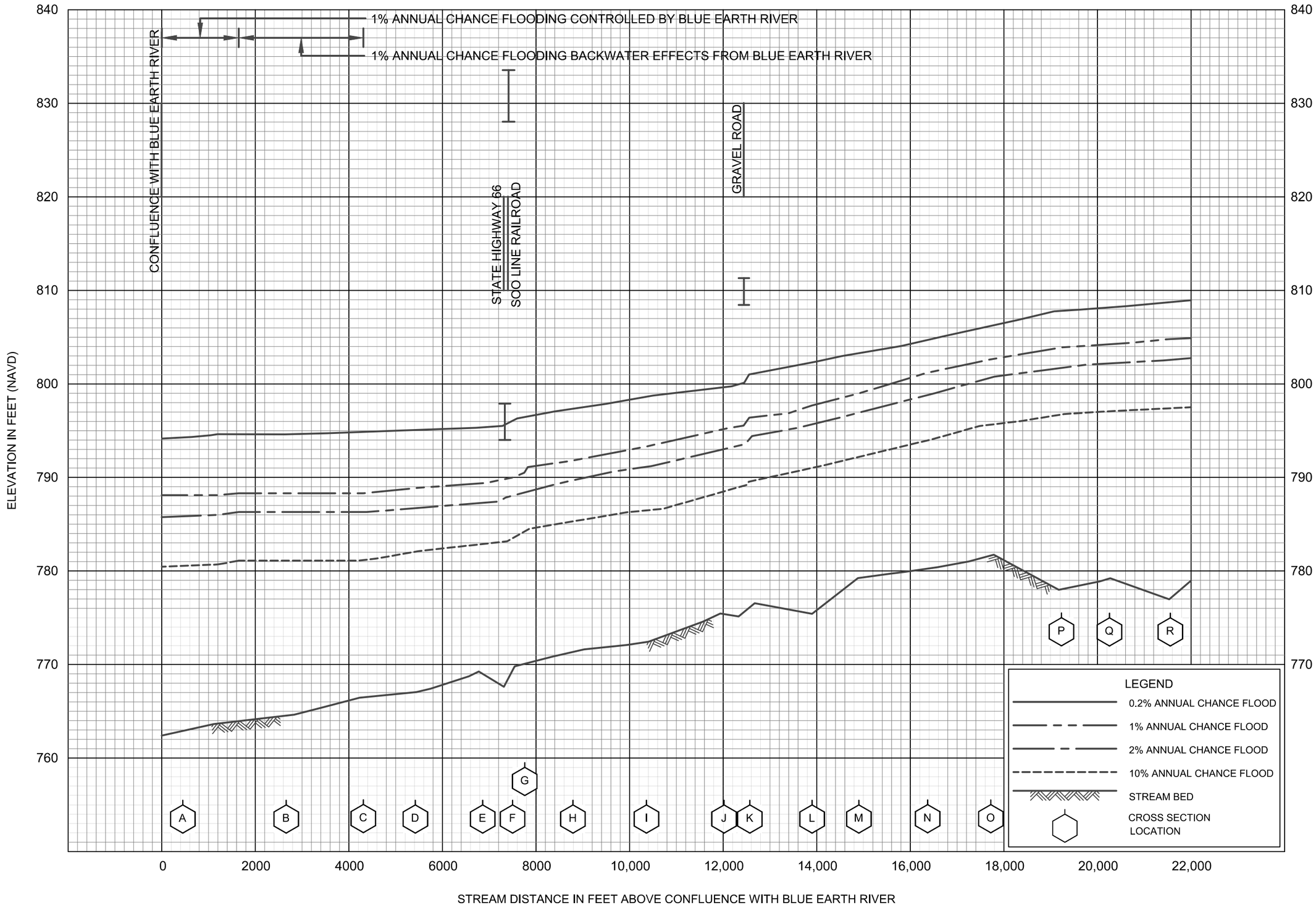


FLOOD PROFILES

LE SUEUR RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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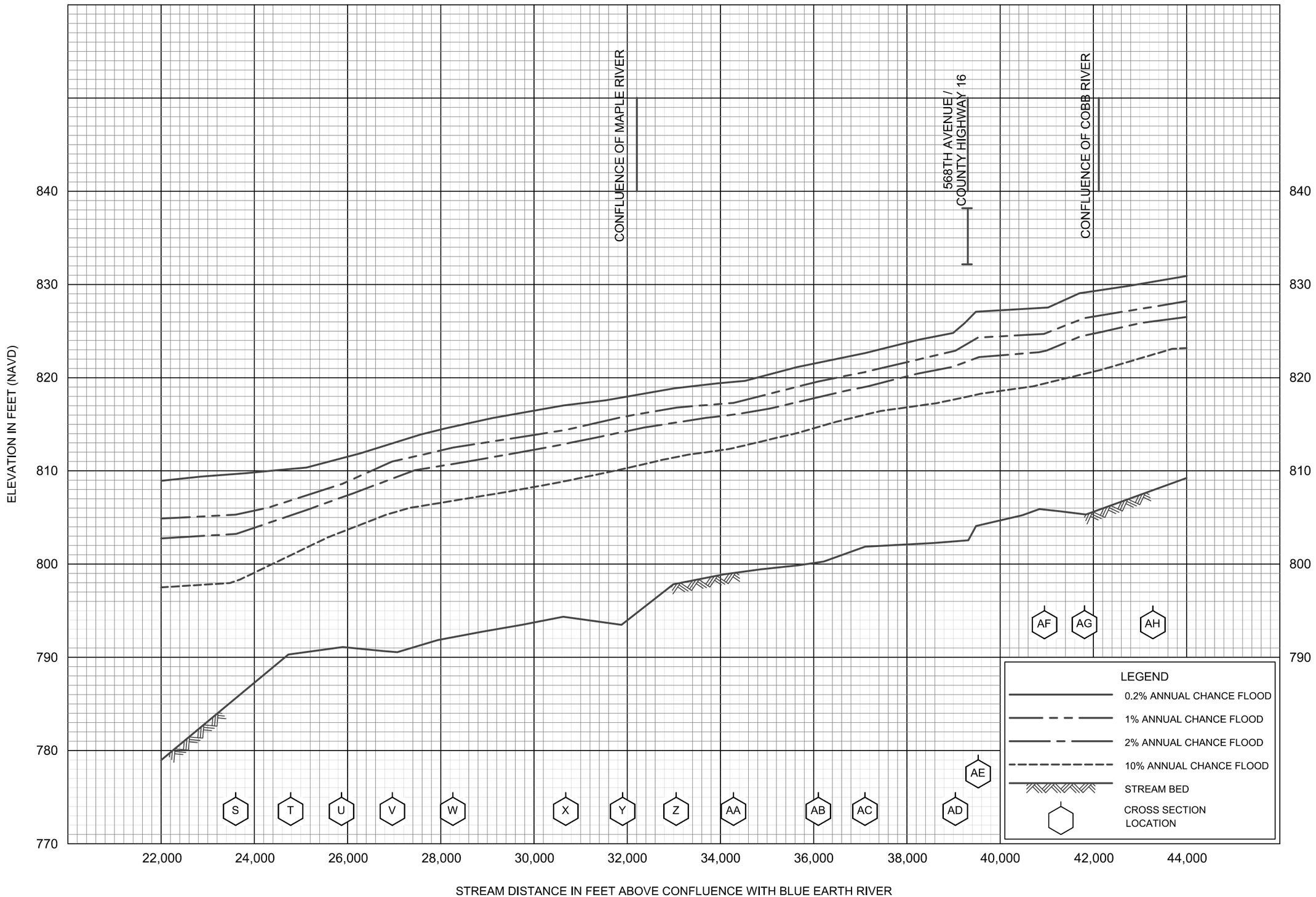


FLOOD PROFILES

LE SUEUR RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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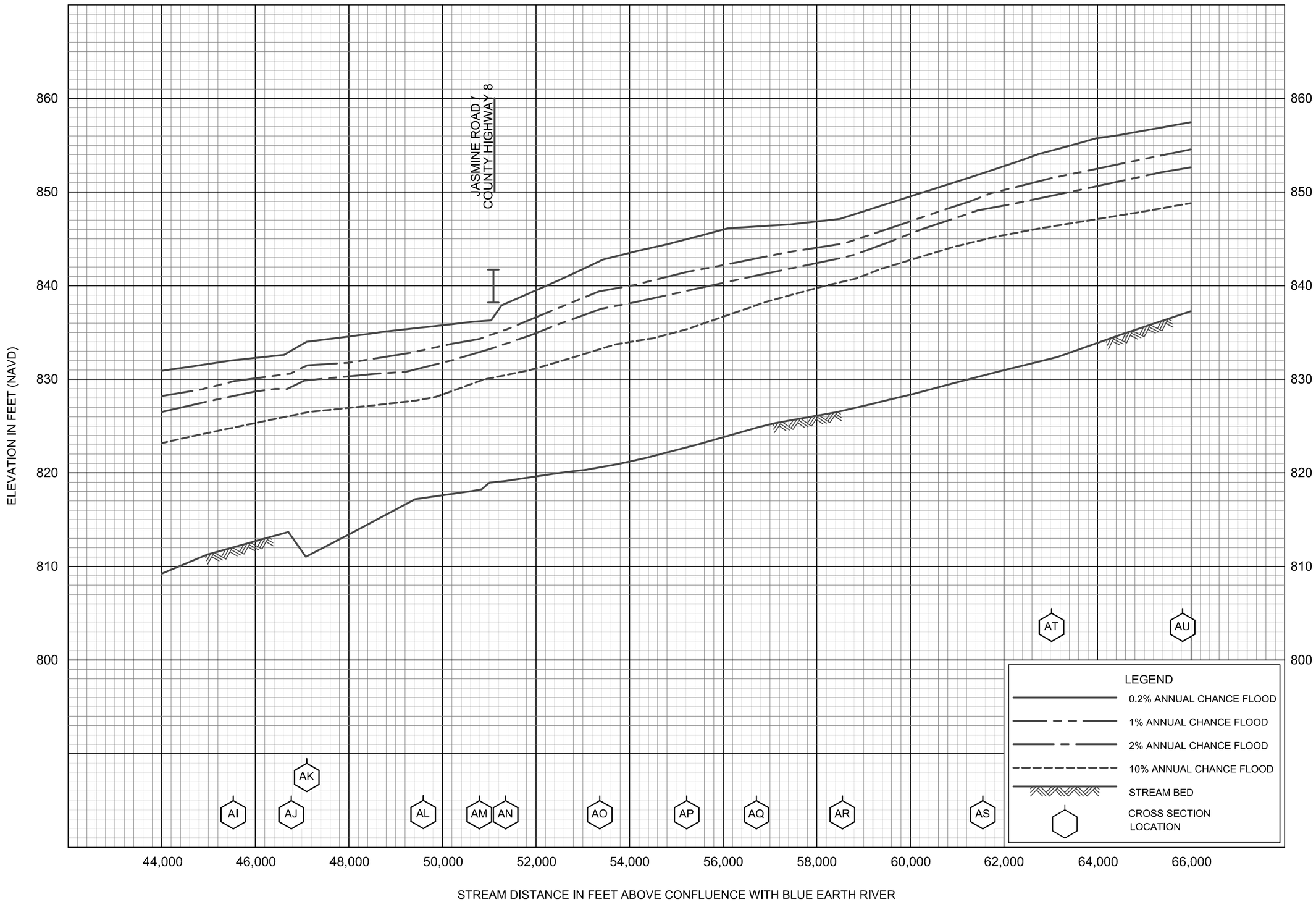


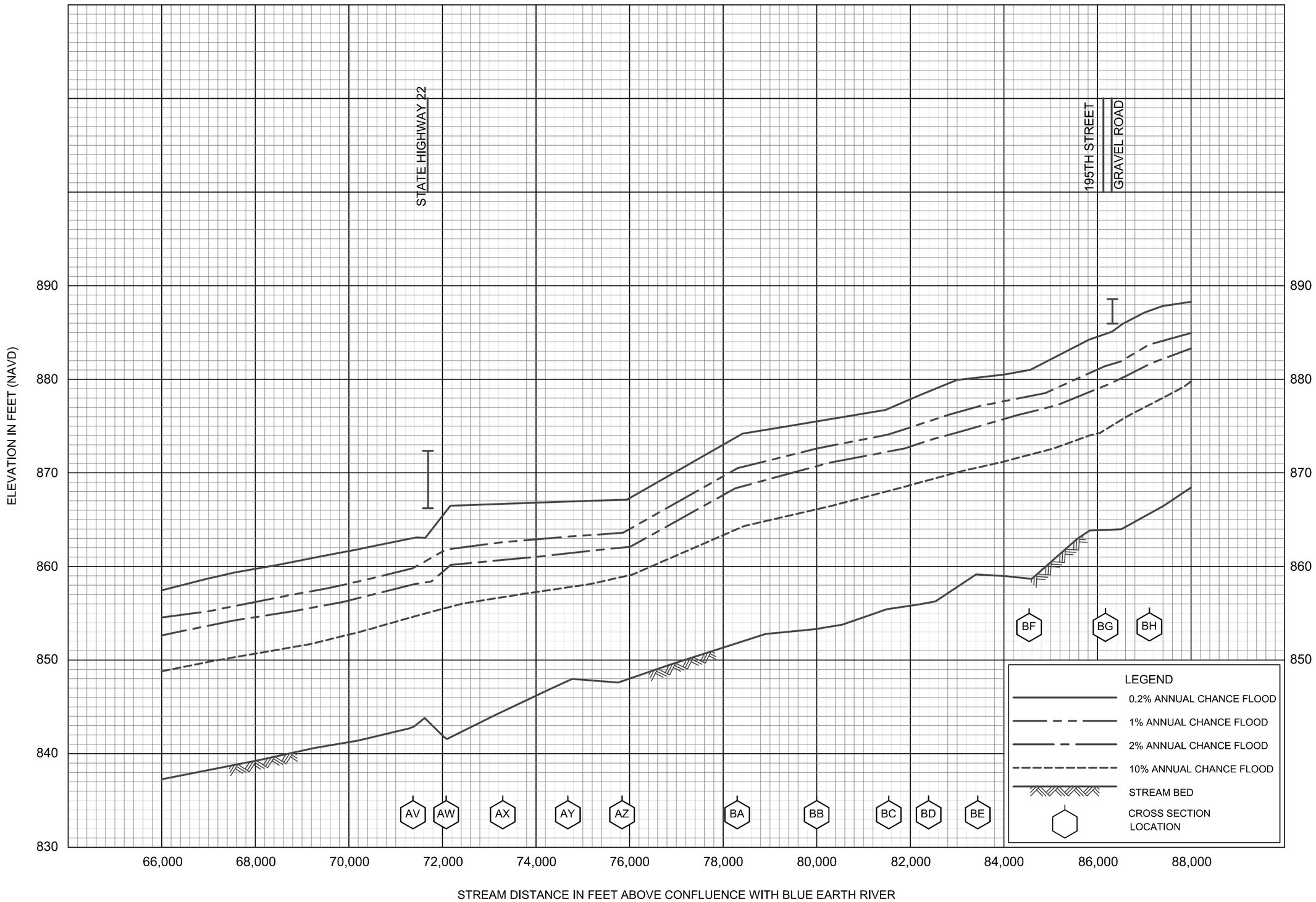

FLOOD PROFILES

LE SUEUR RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS




FLOOD PROFILES

LE SUEUR RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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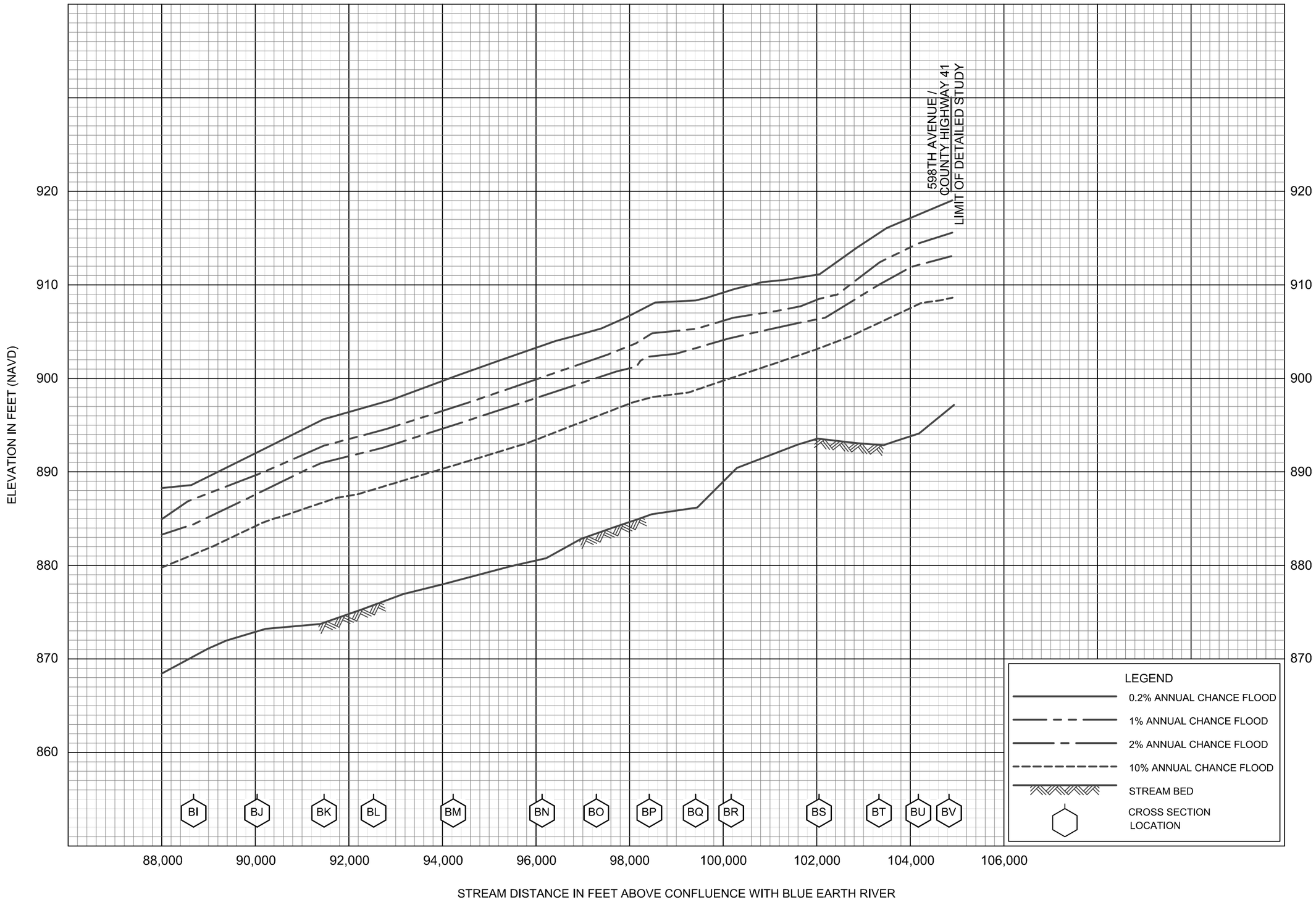


FLOOD PROFILES

LE SUEUR RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS

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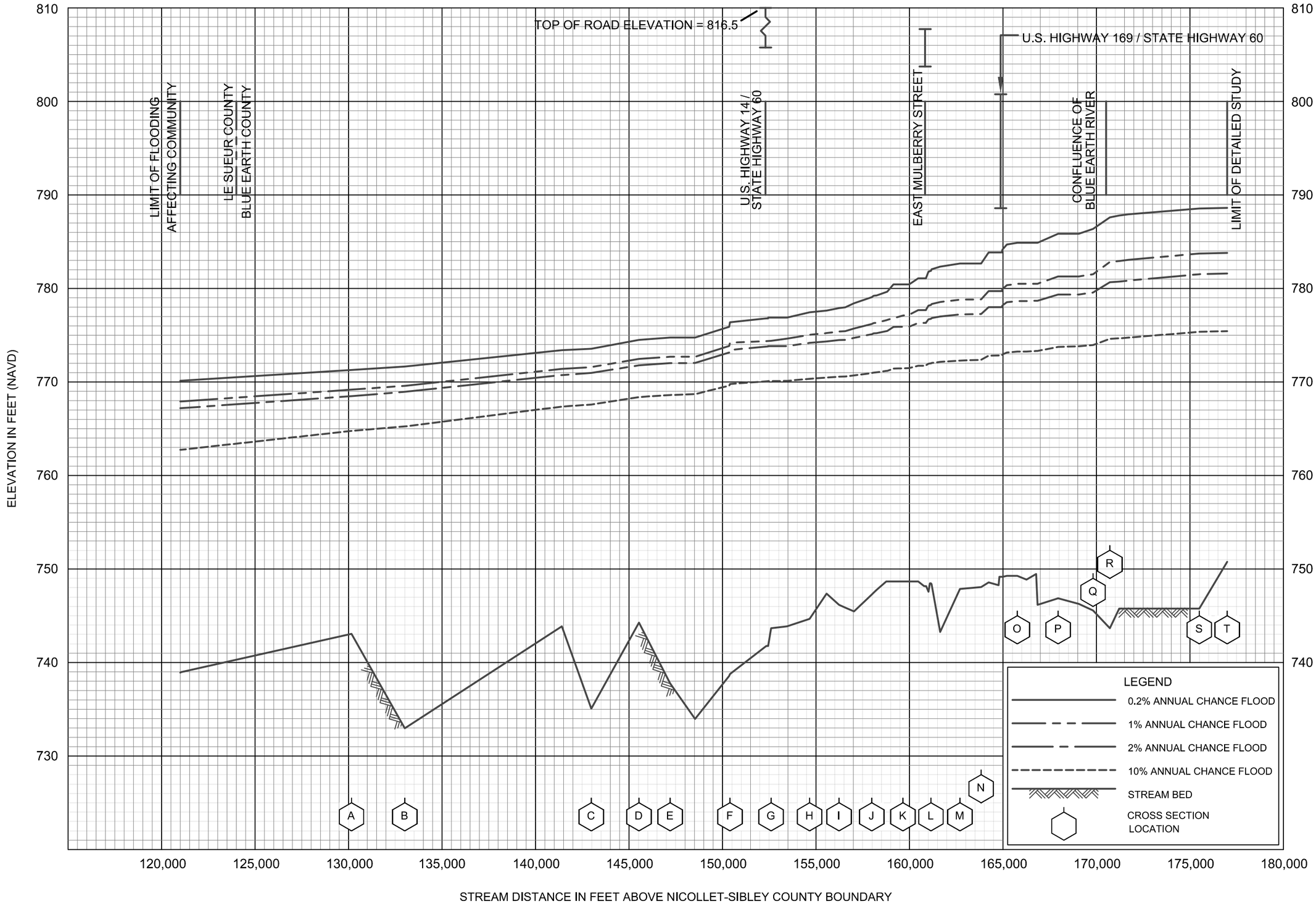


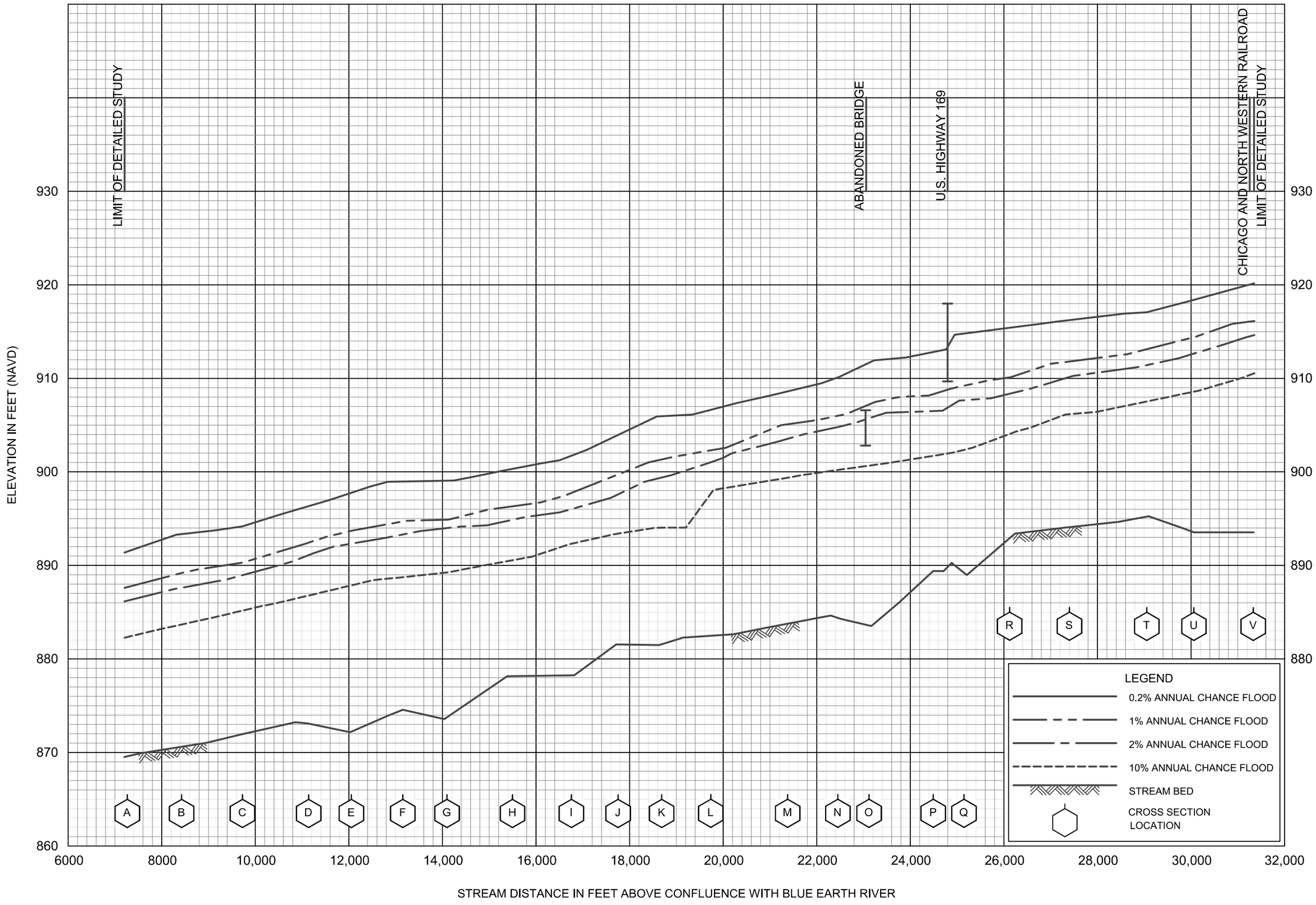

FLOOD PROFILES

MINNESOTA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS




FLOOD PROFILES

WATONWAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BLUE EARTH COUNTY, MN

AND INCORPORATED AREAS