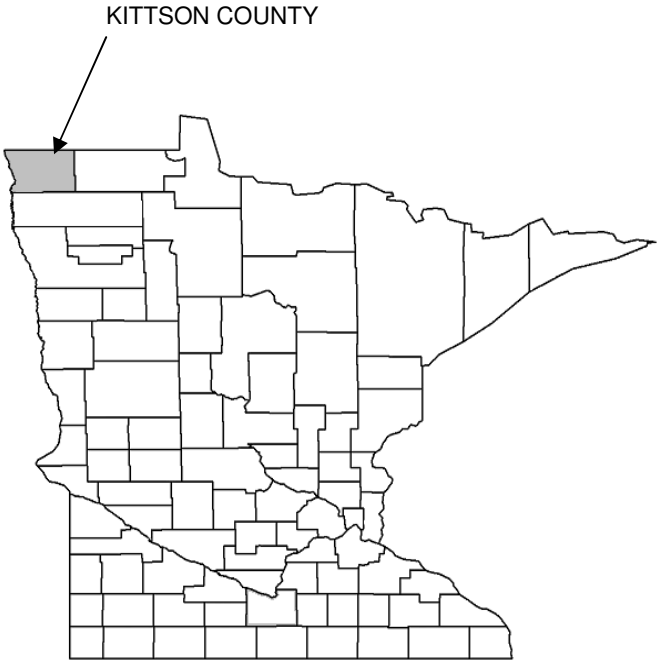
FLOOD INSURANCE STUDY

KITTSON COUNTY, MINNESOTA

AND INCORPORATED AREA



Community Name	*Community Number*
*DONALDSON, CITY OF	270225
HALLOCK, CITY OF	270226
*HALMA, CITY OF	270227
HUMBOLDT, CITY OF	270228
*KARLSTAD, CITY OF	270857
KENNEDY, CITY OF	270686
KITTSON COUNTY (UNINCORPORATED AREAS)	270224
LAKE BRONSON, CITY OF	270230
LANCASTER, CITY OF	270231
ST. VINCENT, CITY OF	270232

*NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

Preliminary: **July 20, 2012**

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
27069CV000A

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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Red River of the North	Panels	09P-14P
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Flood Insurance Rate Map

FLOOD INSURANCE STUDY
KITTSON 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 Kittson County, including the Cities of Donaldson, Hallock, Halma, Humboldt, Karlstad, Kennedy, Lake Bronson, Lancaster, and St. Vincent; and the unincorporated areas of Kittson County (referred to collectively herein as Kittson 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 Cities of Donaldson, Halma, and Karlstad 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, is shown below:

Hallock, City of:	The hydrologic and hydraulic analyses for South Branch Two Rivers and Two Rivers for the July 1979, FIS report were performed by Barr Engineering Co., for the Federal Insurance Administration (FIA), under Contract No. H-3982. The work was completed in June 1978 (FIA, 1979).
Kennedy, City of	The hydrologic and hydraulic analyses for County Ditch No. 4 for the August 5, 1986, FIS report were performed by the U.S. Army Corps of Engineers (USACE), St. Paul District, for FEMA, under Interagency Agreement No. EMW-E-1153, Project Order No. 1. The work was completed in March 1985 (FEMA, 1986).
Kittson County (Unincorporated Areas):	The hydrologic and hydraulic analyses for Joe River, Middle Branch Two Rivers, North Branch Two Rivers, Red River of the North, Roseau River, Salt Coulee, South Branch Two Rivers, and Two Rivers, for the August 4, 1980, FIS report were performed by Barr Engineering Company, for the FIA, under Contract No. H-3982. The work was completed in June 1978 (FIA, 1980).
St. Vincent, City of	The hydrologic and hydraulic analyses for Red River of the North for the March 2, 1982, FIS report were performed by Edwards and Kelcey, Inc., for FEMA, under Contract No. EMW-C-0322. The work was completed in March 1981 (FEMA, 1982).

The Cities of Donaldson, Halm, Humboldt, Karlstad, Kennedy, Lake Bronson, and Lancaster have no previously printed FIS reports.

This Countywide FIS Report

The hydrologic and hydraulic analyses for this study were performed by Strategic Alliance for Risk Reduction (STARR) for FEMA, under Contract No. HSFEHQ-

09-D-0370, Task Order No. HSFE05-09-J-0001. The work was completed in September 2011.

Base map information shown on the FIRM was provided in digital format by the Farm Services Administration. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2010 or later. The projection used in the preparation of this map is Universal Transverse Mercator (UTM) zone 14, and the horizontal datum used is North American Datum of 1983 (NAD83), Geodetic Reference System 1980 (GRS80).

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.

Precountywide Analyses

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

Community	FIS Date	Initial Meeting	Final Meeting
Hallock, City of	July 1979	March 1976	February 1, 1979
Kennedy, City of	August 5, 1986	November 28, 1984	September 24, 1985
Kittson County (Unincorporated Areas)	August 4, 1980	March 1976	January 22, 1980
St. Vincent, City of	March 2, 1982	June 1979	October 7, 1981

This Countywide FIS Report

The initial meeting was held on December 11, 2009, and attended by representatives of FEMA, Minnesota Department of Natural Resources (MNDNR), STARR, and community representatives.

The results of the study were reviewed at the final meeting held on **[Month Day, Year]**, and attended by representatives of **[list all communities and parties that were in attendance – typically list FEMA first, followed by any state organizations, contractors, and communities]**. All issues and/or concerns raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Kittson 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 through September 2011.

The following streams were studied by detailed methods in this FIS report:

County Ditch No. 4	South Branch Two Rivers
Middle Branch Two Rivers	Two Rivers
Red River of the North	

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

All streams studied by detailed methods were restudied for this countywide FIS report and all streams studied by approximate methods were either newly studied or revised 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 (NAD 27), are now referenced to the NAD83.

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 Kittson County.

2.2 Community Description

Kittson County, located in the northwest corner of Minnesota, is bordered by North Dakota on the west; Canada on the north; Roseau County, Minnesota on the east; and Marshall County, Minnesota on the south. The major transportation route through Kittson County, U.S. Highway 75, passes south to northwest on the western third of the county and runs parallel with the Burlington Northern Railroad to Noyes, Minnesota at the United States-Canada border. U.S. Highway 59 runs parallel to the Soo Line railroad. East-west transportation is concentrated on State Highway 11 in the southern part of Kittson County and State Highway 175 in the central part of the county. Except for the City of St. Vincent, the communities in Kittson County are located along the railroad and the U.S.

Highway routes. Covering 1,124 square miles, Kittson County's 2010 population estimate was 4,552 (U.S. Census Bureau, 2011).

Kittson County has an average annual precipitation of 19.5 inches. There is a large variation in temperature with season. In summer the temperature high average is 78 degrees Fahrenheit (˚F) and the average low is -5.6 ˚F. In the winter, the average high is 14.4 ˚F and the average low is -16 ˚F (WorldClimate, 2011).

Kittson County is located in the lakebed of glacial Lake Agassiz. This history created the poorly drained, nearly level lake clays (Soil Conservation Service (SCS), 1974), which are characteristics of soils of the county. The topography is flat with elevation ranging from 790 feet to 1,080 feet. The primary crops of this agricultural county are sugar beets, potatoes and wheat. An extensive ditch system throughout the region provides drainage for the cropland. Development in floodplains is primarily residential.

2.3 Principal Flood Problems

Flooding occurs primarily because of snowmelt runoff, although flooding has resulted from the occurrence of short-duration, high intensity rainstorms. Flood data collection on the Red River dates from 1882. Major flood since that time have occurred in 1882, 1897, 1950, 1965, 1966, 1969, 1975, 1997, 2009, and 2011.

Along the Red River in Kittson County, the greatest flood of record occurred in 1950 and was approximately a 10-percent-annual-chance event.

Since 1897, flooding has occurred on Two Rivers in 1948, 1950, 1966, 1969, 1970, 1974, 1975, and 1978. Except for 1975, all of these flooding occurrences resulted from snowmelt runoff. The highest stage, approximately a 1.67-percent-annual-chance frequency, was reached in 1966. The most recent flooding occurred in 1978 and approximated a 10-percent-annual-chance event. Damages from flooding included washouts, bridge damage, damage to personal property, and water in basements and first floors. Ice jams have aggravated the flooding problems during snowmelt runoff flooding (Kittson County Civil Defense, undated).

2.4 Flood Protection Measures

Levees existing in the study area provide the community with some degree of protection against flooding. However, 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. These levees are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain and are not accredited on the DFIRM as providing protection from a flood with a 1-percent-annual-chance occurrence.

An emergency earthen levee was constructed by the USACE in response to a flood threat in 1966. The emergency structure was left in-place and protected the City of St. Vincent during the 1979 flood event. This ring levee surrounds the developed area of the city. The dike has not been certified for protection against the 1-percent-annual-chance flood event by the USACE.

Dikes have been constructed near Holly Avenue and near the residential area north of State Highway 175 and west of Two Rivers within the City of Hallock. Neither dike has been certified by the USACE as being adequate to provide protection from a 1-percent-annual-chance flood.

Other levees may exist within Kittson County. Levees not identified in this section are not known to have the necessary features to provide protection from a flood with a 1-percent-annual-chance occurrence.

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.

For the Red River of the North, revised discharge-frequency curves provided by the USACE were used (USACE, 2001). The discharge-frequency curves, revised to include floods of record since the USACE Regional Flood Analysis (USACE, 1977), and the MNDNR Red River of the North Main Stem Hydrologic Data report, were used to arrive at the final discharge-frequency relationships (MNDNR and North Dakota State Water Commission, 1971).

For all other streams studied by detailed methods, the USACE, Hydrologic Engineering Center's (HEC) computer program HEC-HMS, version 3.0 (HEC, 2009) was used to estimate the peak rate and volume of runoff for the study area watersheds. The watersheds were divided into sub-basins for the analysis. The sub-basins were delineated using automated GIS routines and a 30-meter cell size Digital Elevation Model (DEM) obtained from the National Elevation Dataset (NED). Light Detection and Ranging (LiDAR) data in the areas contiguous to the studied streams was also incorporated. The sub-basins were manually modified to allow for modeling of storage areas. The drainage areas were calculated in square miles.

The input rainfall depths were based on the Illinois Water Survey and the Midwestern Climate Center Bulletin 71 (Illinois State Survey and the Midwestern Climate Center, 1992). The total rainfall depths were distributed following a frequency distribution. The 0.2-percent-annual-chance rainfall depth was derived from more frequent storm events. The rainfall depths are based on a 10-day duration spring rainfall event.

Rainfall losses were estimated using the SCS soil cover complex curve number methodology (SCS, 1972). A curve number was determined for each sub-basin based on the soil type, hydrologic soil group, and land use.

Sub-basin response was estimated using the Clark unit hydrograph. The time of concentration and storage parameters were calculated based on guidance from the MNDNR guidance document flowchart (Natural Resource Conservation Service (NRCS), 2010). The time of concentration was based on the Engineering Field Handbook methodology (SCS, 2003).

Sub-basin reach routings were estimated using the Muskingum-Cunge method.

Ten reservoir storage areas were modeled in the analysis. The storage areas were routed based on stage-discharge outlet relationships and stage-storage relationships.

The rainfall-runoff model was verified by comparison to the U.S. Geological Survey (USGS) regional regression equations (USGS, 2010), and USGS stream gage data.

For the approximate analyses streams, peak discharges typically were estimated using the published USGS regional regression equation results (USGS, 2010). Regression equations estimate peak discharges for ungaged streams based on characteristics of nearby gauged streams. Drainage areas were developed from USGS 30-meter DEMs.

For drainage areas less than 2.81 square miles, the peak discharges were determined based on guidelines from the MNDNR guidance document flowchart (NRCS, 2010). The guidance requires the use of the SCS National Engineering Handbook, Part 650 (SCS,1972).

Peak discharges for South Branch Two Rivers, were developed using the drainage area ratio methodology based on a log-Pearson Type III probability distribution of the annual peak discharges recorded at the USGS stream gage 05094000, using the USGS computer program, PeakFQ.

Peak discharges for North Branch Two Rivers, Roseau River, and South Branch Two Rivers, were developed using the drainage area ratio methodology based on a log-Pearson Type III probability distribution analysis, following the procedures outlined in the Water Resource Council (WRC) Bulletin #17B (WRC, 1981). The analysis was performed using the USGS computer program, PeakFQ, for USGS stream gage stations 05093000, 5096000, and 05112000.

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 1.

Table 1 - Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
COUNTY DITCH NO. 4					
Approximately 840 feet Downstream of Burlington Northern & Sante Fe Railway	48	1,126	1,899	2,332	3,123
MIDDLE BRANCH TWO RIVERS					
At the confluence with Two Rivers/South Branch Two Rivers	78	1,114	1,965	2,375	3,234
Approximately 4,300 feet downstream of State Highway 175	50	483	865	1,049	1,427
RED RIVER OF THE NORTH					
At the Kittson County/Canadian border	40,200	54,000	95,900	117,000	176,000
SOUTH BRANCH TWO RIVERS					
At the confluence with Two Rivers	597	3,997	5,984	6,780	8,499
TWO RIVERS					
At Broadway Street/State Highway 175	676	4,405	6,596	7,472	9,373

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.

For the Red River of the North, USGS 7.5-minute series topographic quadrangle maps were used to extend existing cross sections in order to capture effective flow limits for the 1997 flood.

For all streams studied by detailed methods, other than Red River of the North, floodplain cross sections were placed at representative locations, approximately 500 feet apart along the stream centerline. Cross sections were spaced at closer intervals along the upper reaches of the streams and at locations of sudden changes in stream geometry or direction. The cross sectional geometries were comprised of field collected survey data and the LiDAR data that was collected by CWE. Surveyed channel sections were obtained at the bridge and culvert faces. Additional survey was also provided on an "as-needed" basis at bridge approach sections and at long stretches of stream between structures. The detailed survey data are presented in Appendix A. Surveyed channel sections were transferred upstream and downstream to non-surveyed cross sections and were blended with the LiDAR data to create a consistent channel profile.

Survey was performed for 21 bridge/culverts crossing and 43 riverine cross sections over approximately 26 miles of stream in Kittson County. At each of the structures, channel cross sections immediately upstream and downstream of the crossing were surveyed along with road grade elevations. Sketches and digital photos were taken at each bridge, culvert, and dam in order to document the dimensions of the hydraulic structures.

For all streams studied by detailed methods, other than Red River of the North, the steady state one dimensional models were set at normal depth as the starting conditions.

Water surface elevations (WSEL) for the selected recurrence intervals for all streams studied by detailed methods, except Red River of the North, were calculated using the USACE, HEC computer program, HEC-RAS, version 4.0.0 (HEC, 2008).

For Red River of the North, WSELs were calculated using the USACE, HEC computer program, HEC-RAS, version 3.0.1 (HEC, 2001). Starting WSELs for the Red River of the North were determined by high water data and rating curves established at the Town of Emerson, Manitoba (USACE, 2003).

For the streams studied by approximate methods, cross section data was obtained from the topography. Roads were modeled as weirs with cross-sections upstream and downstream of the structure. The studied streams were modeled using the USACE, HEC computer program, HEC-RAS version 4.1.0 (HEC, 2010).

Channel roughness factors (Mannings "n") used in the hydraulic computations were chosen by engineering judgment and field observations of the floodplain area. The Manning's "n" values for all detailed studied streams are listed in the following tabulation:

Manning's "n" Values

Stream	Channel "n"	Overbank "n"
County Ditch No. 4	0.035	0.040-0.080
Middle Branch Two Rivers	0.04-0.1	0.045-0.100
Red River of the North	0.030	0.035-0.150
South Branch Two Rivers	0.035	0.035-0.110
Two Rivers	0.035	0.035-0.110

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).

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.

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 NGVD. With the finalization of 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 Base Flood Elevations (BFEs) across the corporate limits between the communities. Some of the data used in this study were taken from the prior effective FIS reports and adjusted to NAVD. 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 (NGS) VERTCON online utility (NGS, 2011). 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 NGVD29 to NAVD88
Bathgate NE	SE	48.875	-97.250	1.345
Bathgate NE OE N	SE	49.000	-97.250	1.378
Bowesmont	SE	48.625	-97.125	1.204
Caribou	SE	48.875	-96.375	1.365
Caribou OE N	SE	49.000	-96.375	1.365
Enok	SE	48.625	-96.750	1.276
Hallock	SE	48.750	-96.875	1.270
Hallock NE	SE	48.875	-96.750	1.352
Hallock NE OE N	SE	49.000	-96.750	1.339
Halma	SE	48.625	-96.500	1.394
Hill Siding	SE	48.750	-97.000	1.257
Humboldt	SE	48.875	-97.000	1.181
Humboldt OE N	SE	49.000	-97.000	1.227
Joliette	SE	48.750	-97.125	1.263
Juneberry Ridge	SE	48.750	-96.375	1.375
Kennedy	SE	48.625	-96.875	1.201
Lake Bronson	SE	48.625	-96.625	1.345
Lancaster	SE	48.750	-96.750	1.385
Mattson	SE	48.625	-97.000	1.188
Orleans	SE	48.875	-96.875	1.286
Orleans OE N	SE	49.000	-96.875	1.293
Pelan	SE	48.625	-96.375	1.391
Pembina	SE	48.875	-97.125	1.237
Pembina OE N	SE	49.000	-97.125	1.224
Skull Lake	SE	48.875	-96.625	1.368
Skull Lake NE	SE	48.875	-96.500	1.371
Skull Lake NE OE N	SE	49.000	-96.500	1.362
Skull Lake OE N	SE	49.000	-96.625	1.358
Skull Lake SE	SE	48.750	-96.500	1.381
			Average:	**1.311**

For additional information regarding conversion between NGVD and NAVD, visit the 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 3
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.

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. Between cross sections, the boundaries were interpolated using 3-meter raster grids with an accuracy equivalent to a contour interval of 2-feet (International Water Institute, 2010).

For each stream studied by approximate methods, the 1-percent-annual-chance floodplain boundies were delineated using 3-meter raster grids with an accuracy equivalent to a contour interval of 2-feet (International Water Institute, 2010).

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 0.5-foot surcharge were delineated for this FIS. The floodway 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.

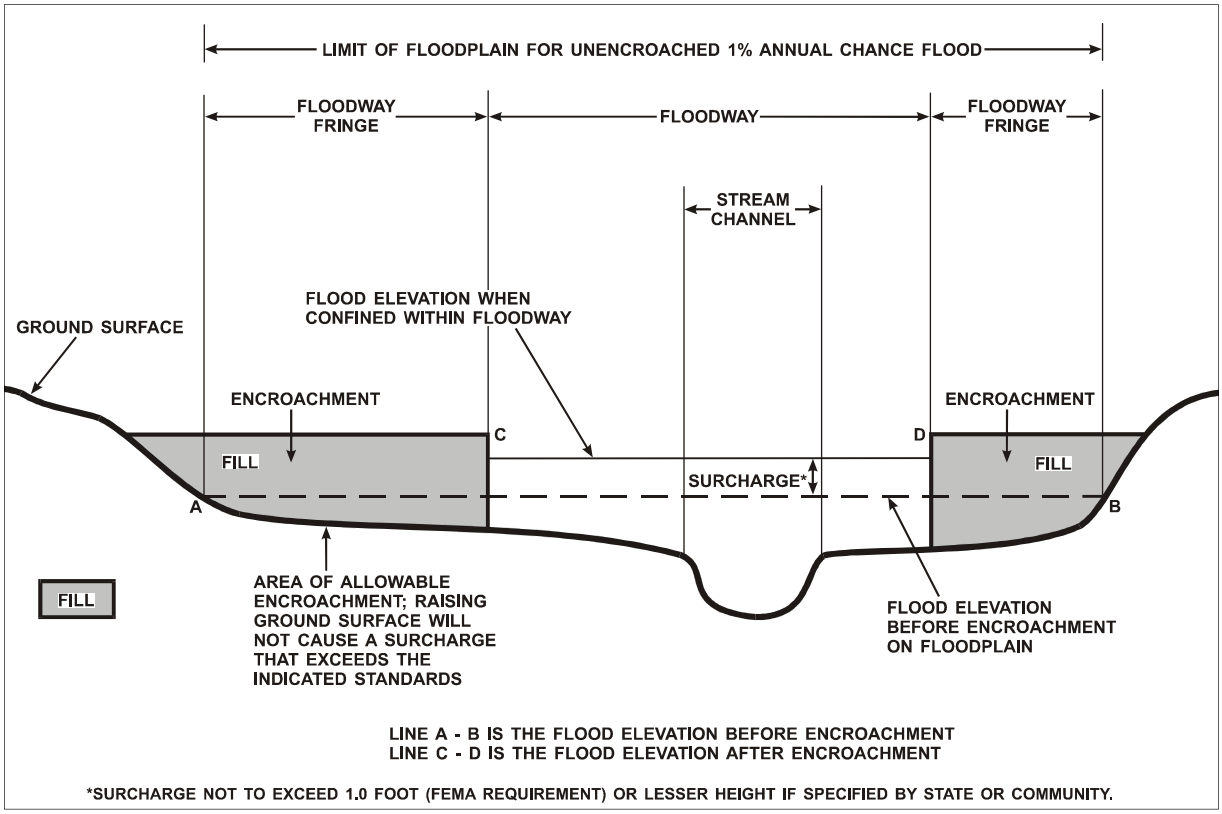

Figure 1 - Floodway Schematic

No floodways were computed for Red River of the North from 4.04 miles upstream of State Highway 171 to approximately 10.60 miles downstream of State Highway 11 per the request of Kittson County.

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
COUNTY DITCH 4								
A	481	77	439	5.3	823.2	823.2	823.7	0.5
B	938	98	564	4.1	824.0	824.0	824.5	0.5
C	1,117	79	640	3.6	825.4	825.4	825.4	0.0
D	2,240	90	494	4.0	826.1	826.1	826.3	0.2
E	2,339	99	700	2.9	826.5	826.5	826.7	0.2
F	2,836	99	637	3.1	826.8	826.8	827.1	0.3
G	3,565	258	1,203	1.7	827.9	827.9	828.2	0.3
H	4,536	111	461	4.3	827.9	827.9	828.3	0.4
I	5,246	390	1,825	1.1	828.4	828.4	828.9	0.5

[1]Feet above Limit of Detailed Study (Limit of Detailed Study is approximately 965 feet downstream of Burlington Northern & Sante Fe Railway)

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

COUNTY DITCH 4

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MIDDLE BRANCH TWO RIVERS								
A	1,785	178	1549	1.5	812.2	810.1[2]	810.6[2]	0.5
B	4,545	213	1799	1.3	812.2	810.5[2]	811.0[2]	0.5
C	7,348	188	1258	1.9	812.2	810.9[2]	811.3[2]	0.4
D	9,716	245	1802	1.3	812.2	811.5[2]	812.0[2]	0.5
E	11,440	186	1142	1.3	812.2	811.9[2]	812.3[2]	0.4
F	12,373	183	1077	1.4	812.2	812.0[2]	812.5[2]	0.5
G	15,788	150	667	2.2	812.8	812.8	813.3	0.5
H	17,607	150	734	2.0	813.7	813.7	814.2	0.5
I	19,746	77	637	2.3	814.8	814.8	815.2	0.4
J	22,574	179	815	1.8	816.3	816.3	816.7	0.4
K	24,805	78	573	2.6	817.4	817.4	817.9	0.5
L	26,512	89	544	2.7	818.0	818.0	818.4	0.4
M	27,141	72	570	2.6	818.4	818.4	818.8	0.4
N	28,411	64	354	4.2	819.2	819.2	819.5	0.3
O	29,070	77	374	3.9	820.2	820.2	820.4	0.2
P	32,940	80	414	3.6	825.0	825.0	825.2	0.2
Q	35,697	54	418	2.5	827.3	827.3	827.6	0.3
R	38,872	47	319	3.3	828.8	828.8	829.2	0.4
S	39,752	45	303	3.5	829.3	829.3	829.7	0.4
T	43,262	50	289	3.6	833.7	833.7	833.9	0.2

[1]Feet above confluence with Two River/South Branch Two Rivers

[2]Elevation computed without consideration of backwater effects from Two Rivers/South Branch Two Rivers

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

MIDDLE BRANCH TWO RIVERS

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
MIDDLE BRANCH TWO RIVERS (CONTINUED)								
U	44,913	67	328	3.2	835.7	835.7	836.2	0.5
V	45,487	58	296	3.5	836.3	836.3	836.7	0.4
W	49,417	52	276	3.8	840.6	840.6	840.8	0.2
X	54,168	49	290	3.6	847.4	847.4	847.9	0.5
Y	57,047	51	280	3.8	851.5	851.5	851.7	0.2
Z	57,367	51	302	3.5	852.4	852.4	852.5	0.1
AA	60,699	58	296	3.5	856.8	856.8	857.0	0.2
AB	64,027	69	308	3.4	861.6	861.6	861.7	0.1
AC	64,198	58	335	3.1	863.1	863.1	863.1	0.0
AD	66,068	52	247	4.3	864.5	864.5	864.9	0.4
AE	68,828	80	292	3.6	868.6	868.6	868.7	0.1
AF	69,600	49	298	3.5	869.8	869.8	870.0	0.2
AG	73,237	69	377	2.8	873.3	873.3	873.6	0.3
AH	76,097	42	211	5.0	876.9	876.9	877.1	0.2
AI	78,561	95	427	2.5	881.0	881.0	881.4	0.4
AJ	79,524	65	329	3.2	882.1	882.1	882.4	0.3

[1]Feet above confluence with Two River/South Branch Two Rivers

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

MIDDLE BRANCH TWO RIVERS

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED RIVER OF THE NORTH								
A	816,783	9,975/8,440[2]	109,347	1.1	794.9	794.9	795.7	0.8
B	820,493	6,100/5,059[2]	80,512	1.8	795.2	795.2	795.9	0.7
C	823,098	4,975/4,458[2]	92,061	1.5	795.4	795.4	796.1	0.7
D	828,323	11,125/6,225[2]	116,037	1.0	795.6	795.6	796.3	0.7
E	837,323	11,100/6,028[2]	90,606	1.3	796.1	796.1	796.7	0.6
F	843,653	N/A	N/A	N/A	796.4	796.4	N/A	N/A
G	849,983	N/A	N/A	N/A	796.7	796.7	N/A	N/A
H	854,738	N/A	N/A	N/A	796.9	796.9	N/A	N/A
I	867,193	N/A	N/A	N/A	797.3	797.3	N/A	N/A
J	876,358	N/A	N/A	N/A	797.6	797.6	N/A	N/A
K	886,668	N/A	N/A	N/A	797.9	797.9	N/A	N/A
L	894,853	N/A	N/A	N/A	798.1	798.1	N/A	N/A
M	901,753	N/A	N/A	N/A	798.2	798.2	N/A	N/A
N	918,413	N/A	N/A	N/A	798.4	798.4	N/A	N/A
O	940,103	N/A	N/A	N/A	798.4	798.4	N/A	N/A
P	940,948	N/A	N/A	N/A	798.5	798.5	N/A	N/A
Q	952,573	N/A	N/A	N/A	798.5	798.5	N/A	N/A
R	959,433	N/A	N/A	N/A	798.6	798.6	N/A	N/A

[1]Feet above confluence with Lake Winnipeg
[2]Total width/Width within Kittson County
N/A - Data not available

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

RED RIVER OF THE NORTH

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
RED RIVER OF THE NORTH (CONTINUED)								
S	966,173	N/A	N/A	N/A	798.7	798.7	N/A	N/A
T	974,623	N/A	N/A	N/A	798.8	798.8	N/A	N/A
U	982,633	N/A	N/A	N/A	798.9	798.9	N/A	N/A
V	992,763	N/A	N/A	N/A	799.1	799.1	N/A	N/A
W	995,488	N/A	N/A	N/A	799.1	799.1	N/A	N/A
X	1,007,633	N/A	N/A	N/A	799.4	799.4	N/A	N/A
Y	1,017,148	N/A	N/A	N/A	799.6	799.6	N/A	N/A
Z	1,026,898	N/A	N/A	N/A	799.8	799.8	N/A	N/A
AA	1,035,528	14,025/5,109[2]	137,002	0.8	799.9	799.9	800.1	0.2
AB	1,050,173	9,300/1,432[2]	88,423	1.3	800.2	800.2	800.4	0.2
AC	1,063,953	6,400/3,481[2]	76,940	1.5	800.6	800.6	800.9	0.3
AD	1,074,243	4,600/1,407[2]	64,755	1.7	800.9	800.9	801.2	0.3
AE	1,084,868	4,550/547[2]	70,682	1.6	801.3	801.3	801.7	0.4
AF	1,086,016	4,800/328[2]	56,003	2.0	801.4	801.4	801.7	0.3
AG	1,094,171	4,750/4,367[2]	84,148	1.3	801.7	801.7	802.1	0.4
AH	1,104,601	8,695/540[2]	125,788	0.9	801.9	801.9	802.3	0.4
AI	1,115,301	6,400/5,165[2]	78,273	1.4	802.1	802.1	802.5	0.4

[1]Feet above confluence with Lake Winnipeg
[2]Total width/Width within Kittson County
N/A - Data not available

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

RED RIVER OF THE NORTH

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)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
TWO RIVERS/SOUTH BRANCH TWO RIVERS								
A	359	427	3,170	2.4	798.6	798.6	799.0	0.4
B	2,388	273	1,846	4.1	799.2	799.2	799.6	0.4
C	4,710	372	2,576	2.9	800.9	800.9	801.3	0.4
D	7,582	255	2,427	3.1	801.8	801.8	802.3	0.5
E	14,746	612	3,716	2.0	804.3	804.3	804.7	0.4
F	19,159	473	4,080	1.9	805.7	805.7	806.1	0.4
G	21,890	558	4,407	1.7	806.5	806.5	806.9	0.4
H	30,688	363	3,024	2.5	808.7	808.7	809.2	0.5
I	34,210	506	2,772	2.7	809.9	809.9	810.3	0.4
J	36,009	535	4,163	1.8	810.8	810.8	811.2	0.4
K	39,245	408	2,904	2.6	812.1	812.1	812.5	0.4
L	41,038	312	1,794	3.8	812.8	812.8	813.2	0.4
M	47,060	315	2,124	3.2	816.7	816.7	817.1	0.4
N	50,727	503	3,650	1.9	817.8	817.8	818.2	0.4
O	54,415	501	3,937	1.7	819.8	819.8	820.1	0.3
P	62,047	150	1,713	4.0	823.0	823.0	823.4	0.4

[1]Feet above Unnamed Road

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

FLOODWAY DATA

TWO RIVERS/SOUTH BRANCH TWO RIVERS

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.

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 Kittson County. Previously, FIRMs were prepared for each incorporated community and

the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 4.

7.0 OTHER STUDIES

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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COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
*Donaldson, City of	N/A	None	N/A	None
Hallock, City of	May 17, 1974	May 14, 1976	January 2, 1980	None
*Halma, City of	N/A	None	N/A	None
Humboldt, City of	To Be Determined	None	To Be Determined	None
*Karlstad, City of	N/A	None	N/A	None
Kennedy, City of	September 24, 1976	None	August 5, 1986	None
Kittson County (Unincorporated Areas)	November 4, 1977	None	February 4, 1981	None
Lake Bronson, City of	To Be Determined	None	To Be Determined	None
Lancaster, City of	To Be Determined	None	To Be Determined	None
St. Vincent, City of	August 9, 1974	July 9, 1976 August 5, 1977	September 2, 1982	None

*No special flood hazard areas identified

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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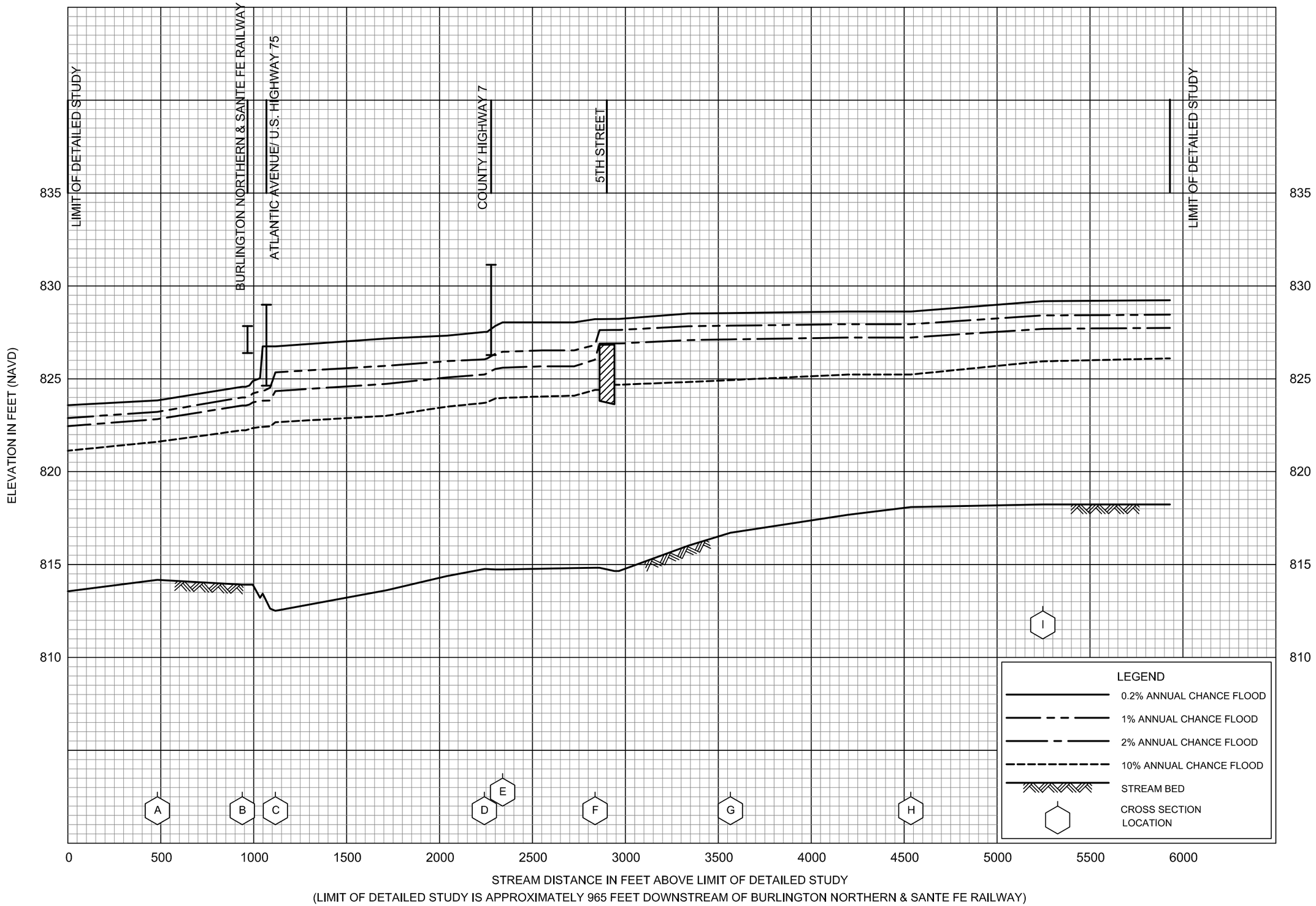


FLOOD PROFILES

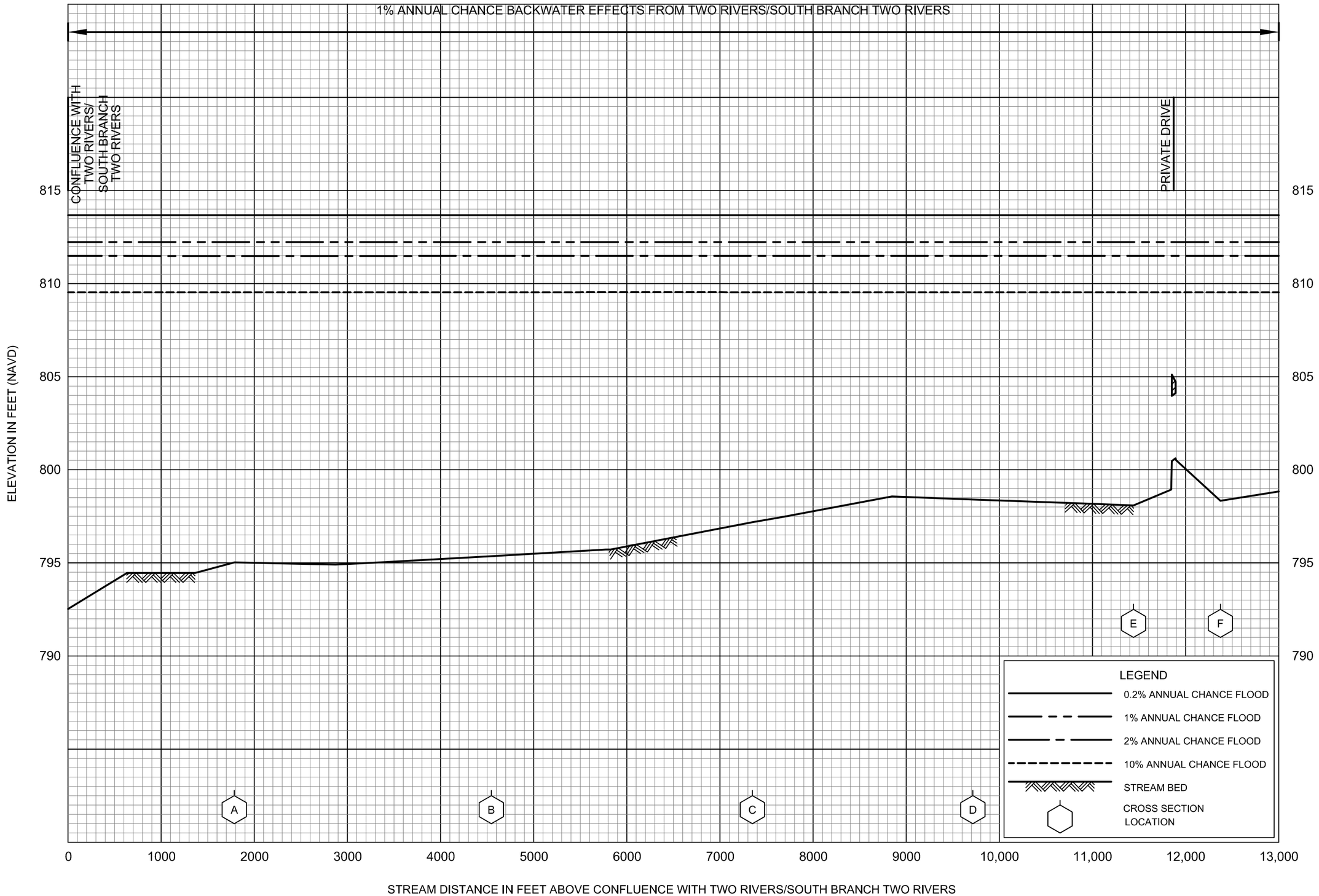
COUNTY DITCH 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

01P



FLOOD PROFILES

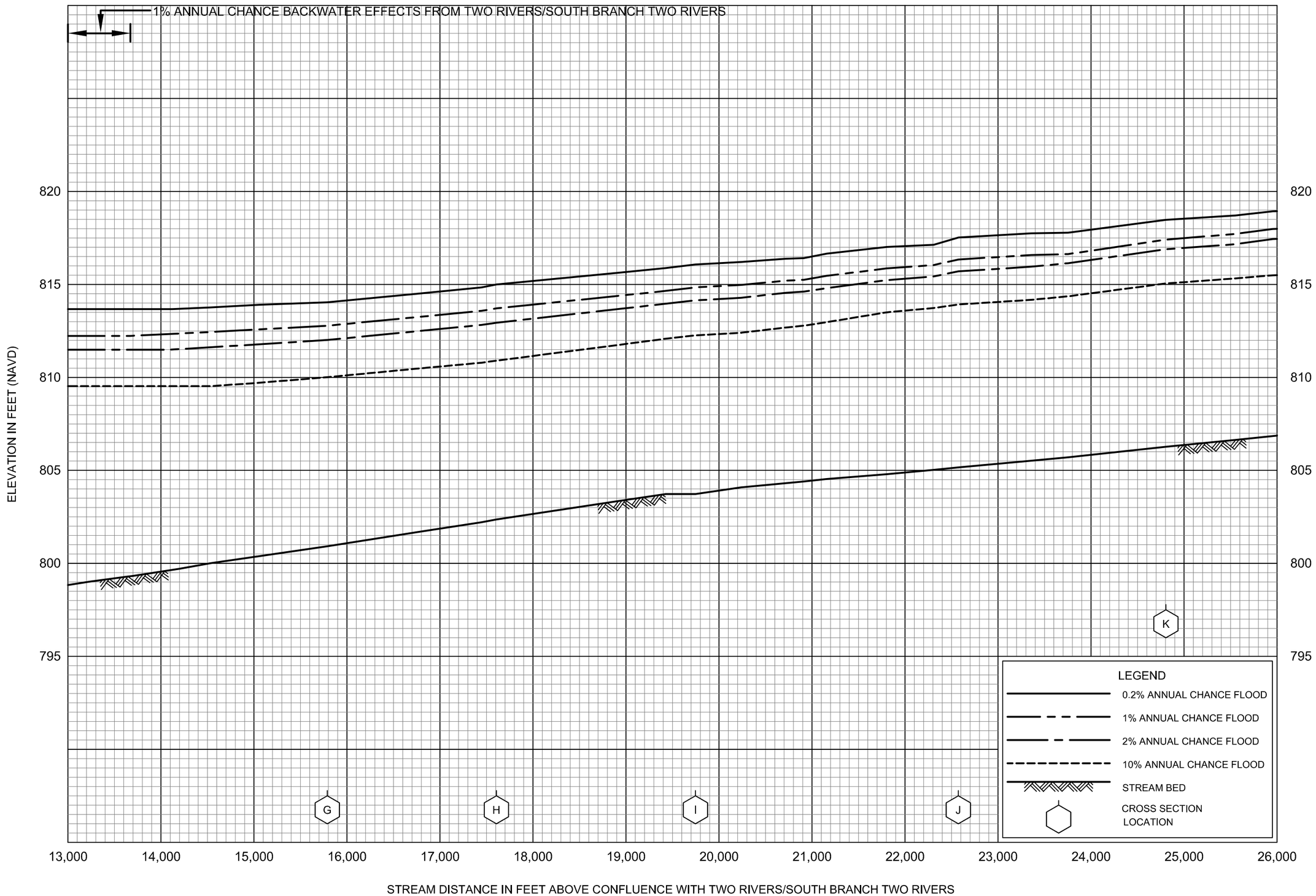
MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

02P



FLOOD PROFILES

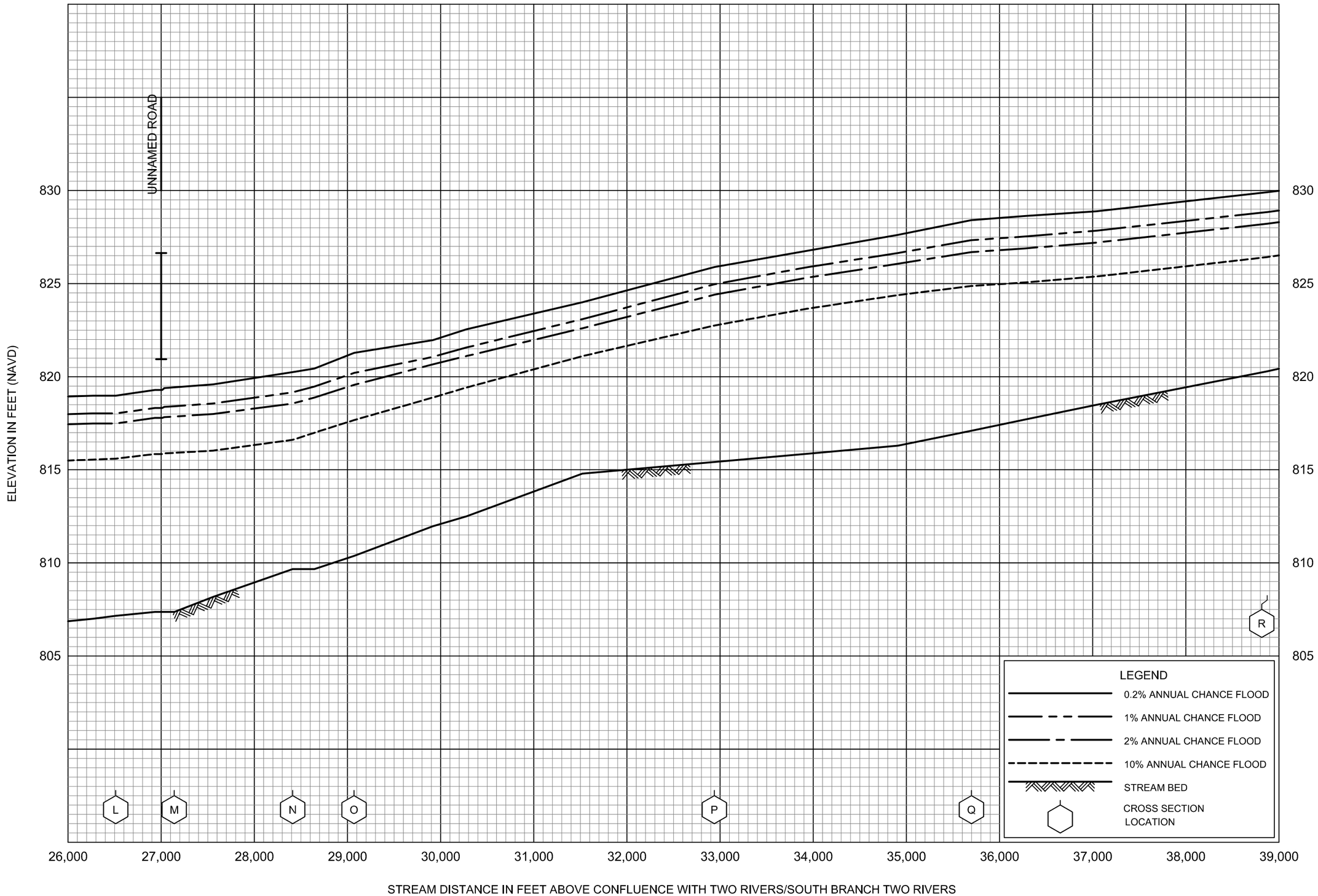
MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

03P



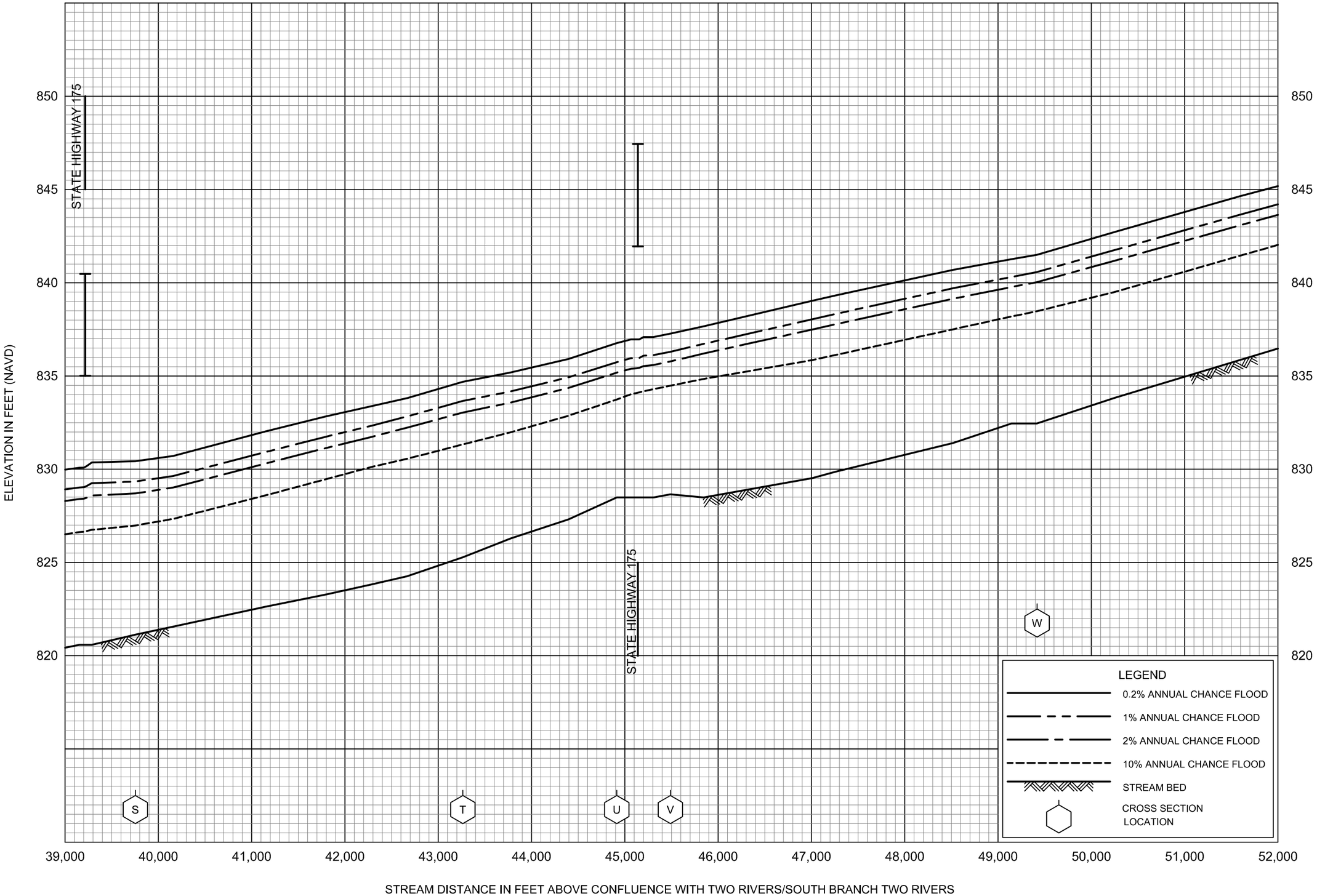
FLOOD PROFILES

MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS



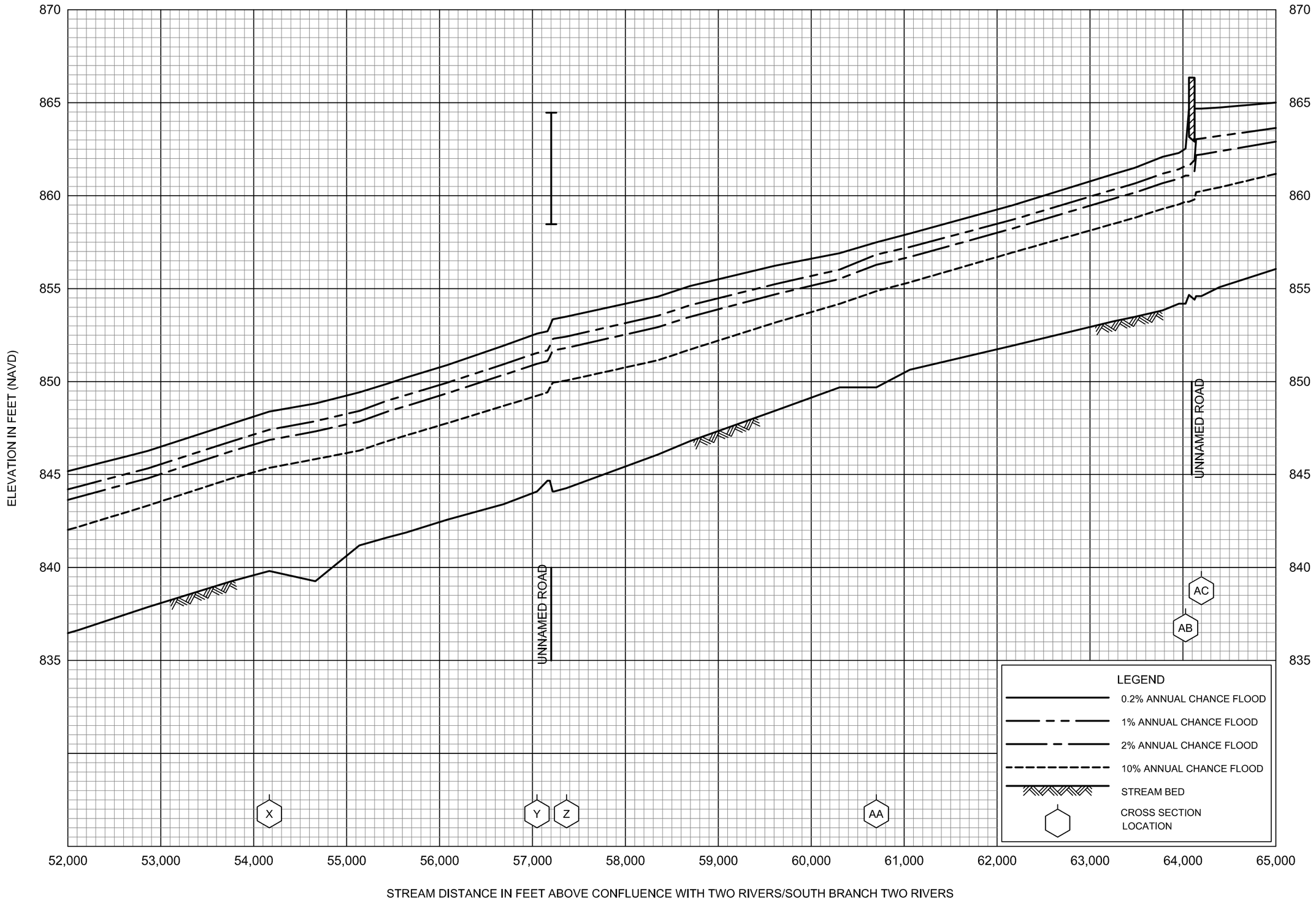
FLOOD PROFILES

MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS



FLOOD PROFILES

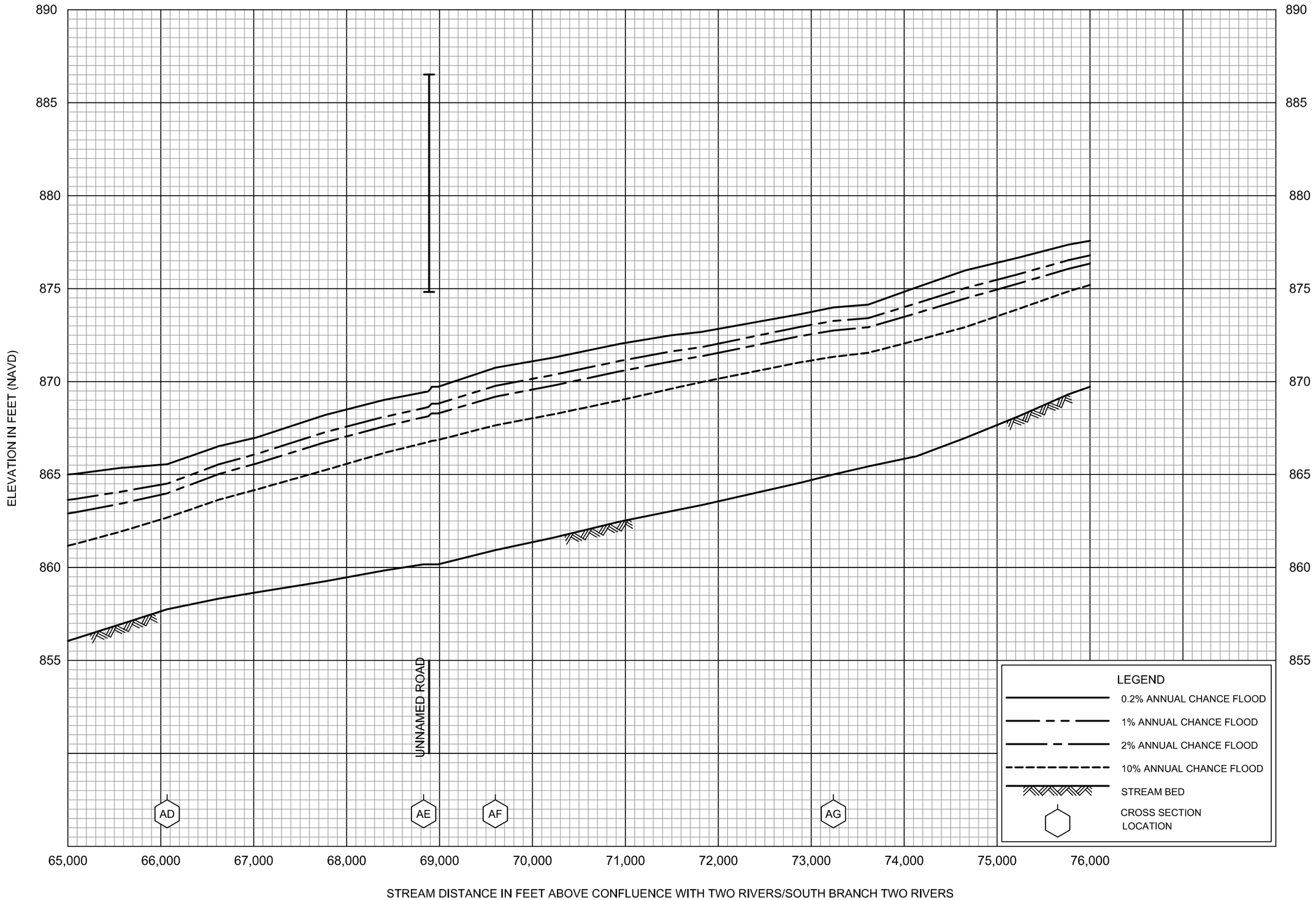
MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

06P



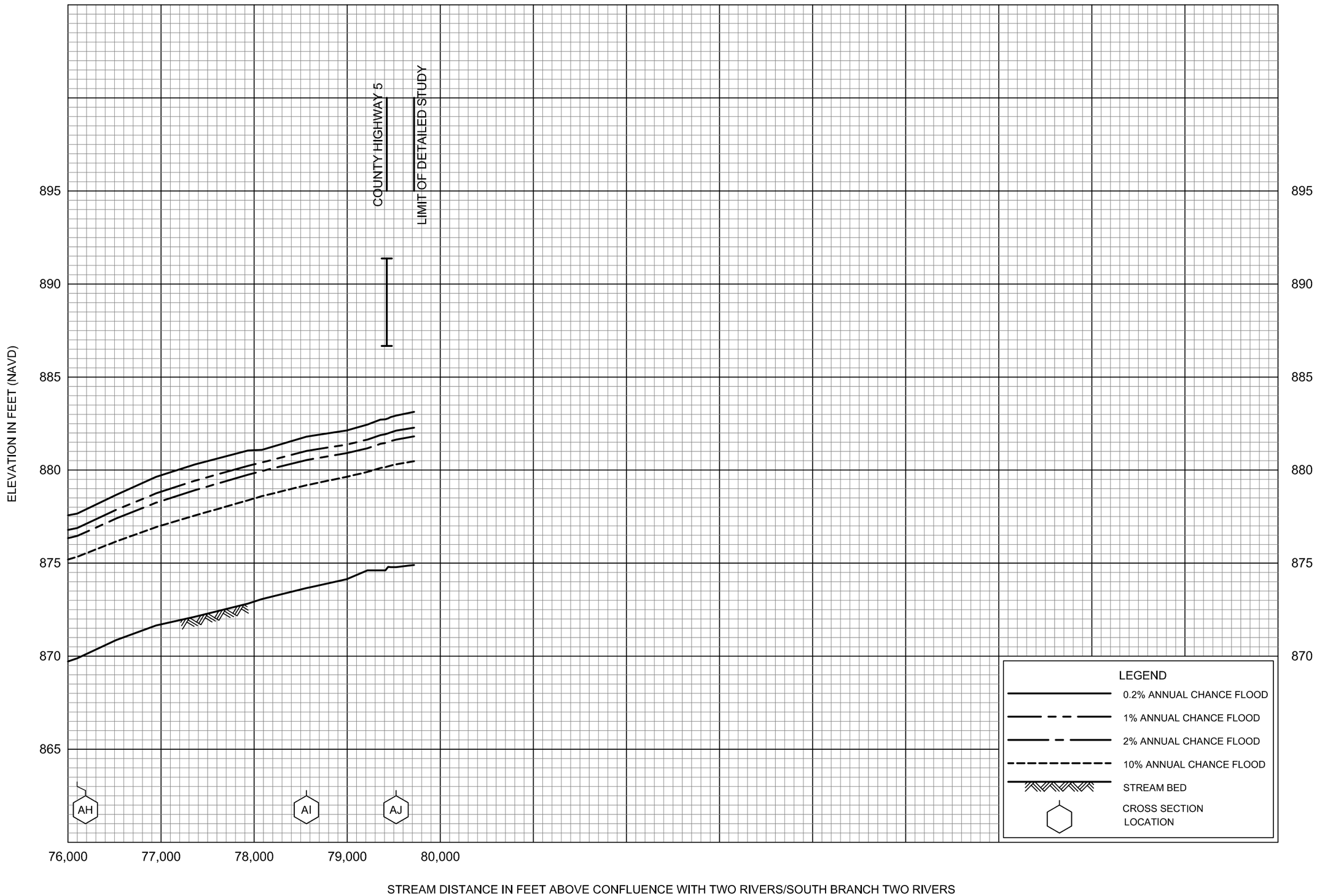
FLOOD PROFILES

MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS



FLOOD PROFILES

MIDDLE BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

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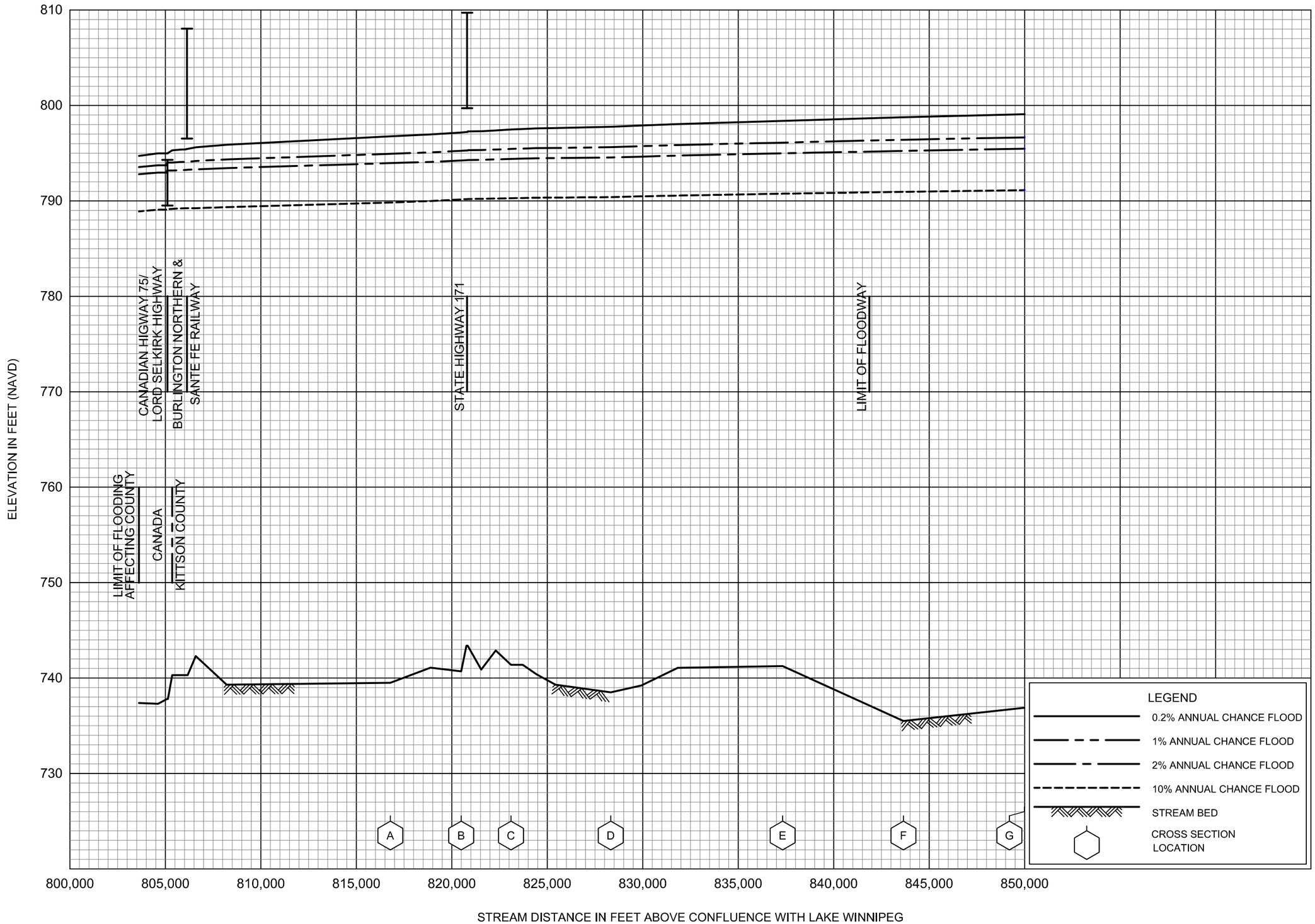


FLOOD PROFILES

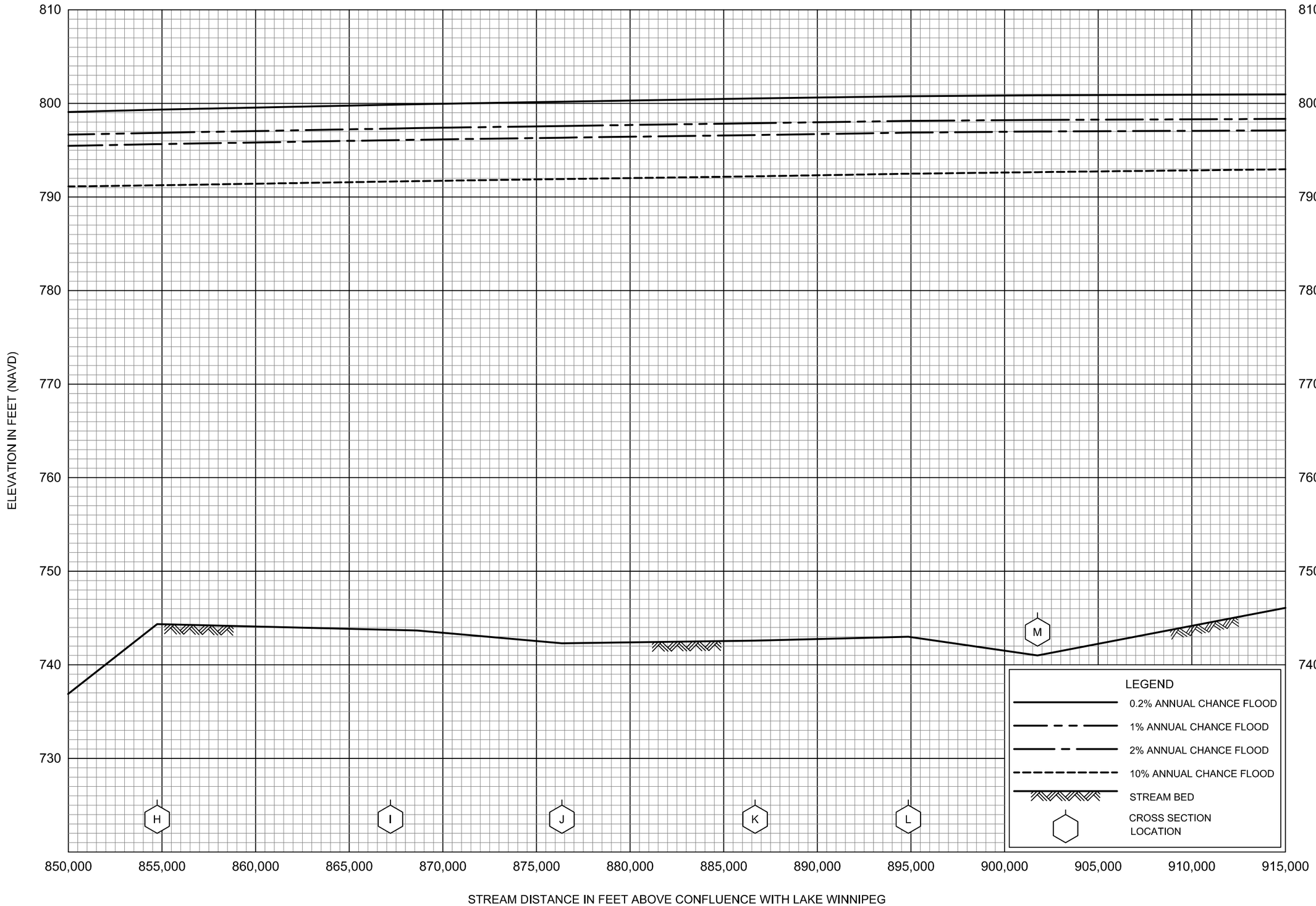
RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

09P



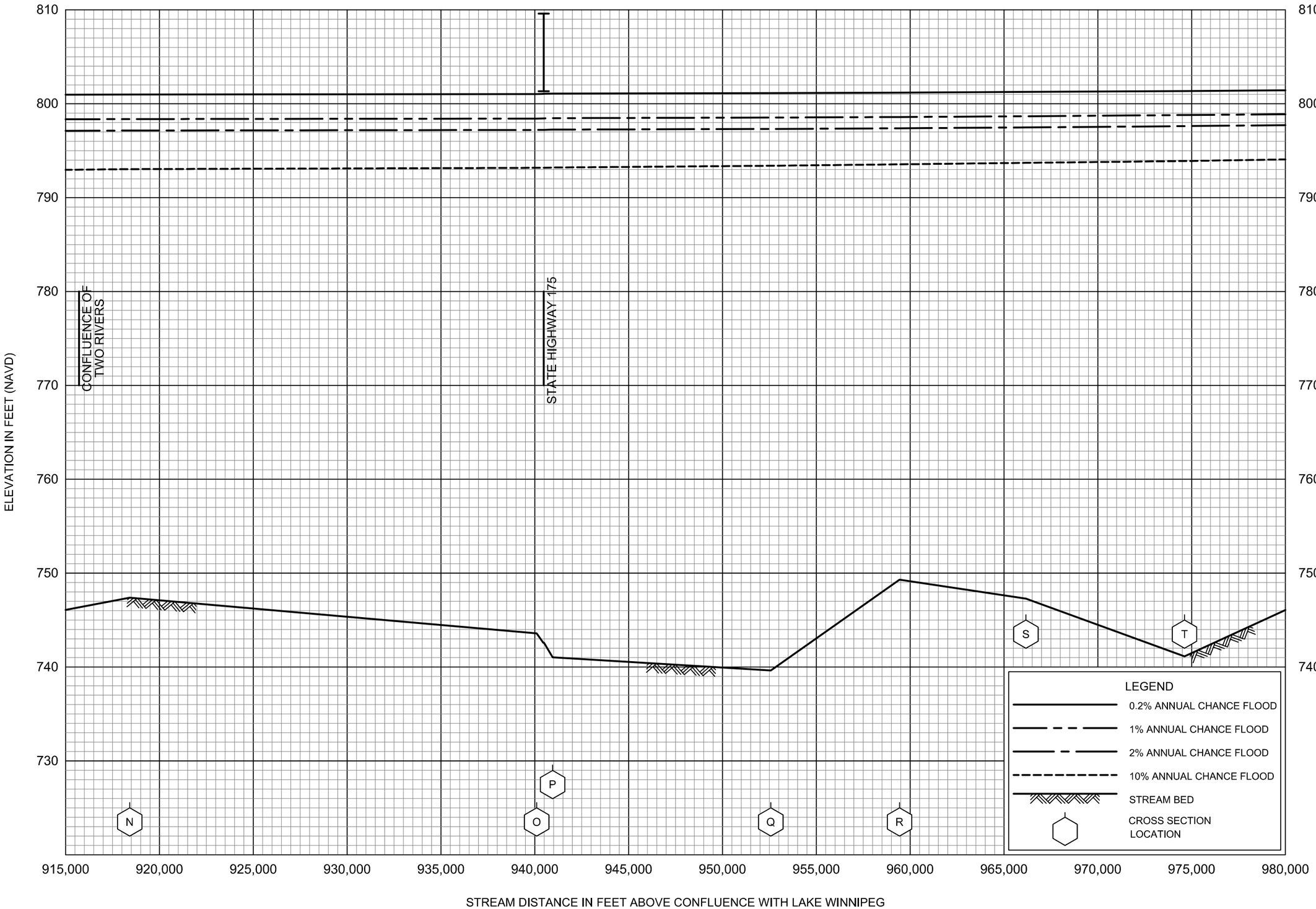
FLOOD PROFILES

RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS



FLOOD PROFILES

RED RIVER OF THE NORTH

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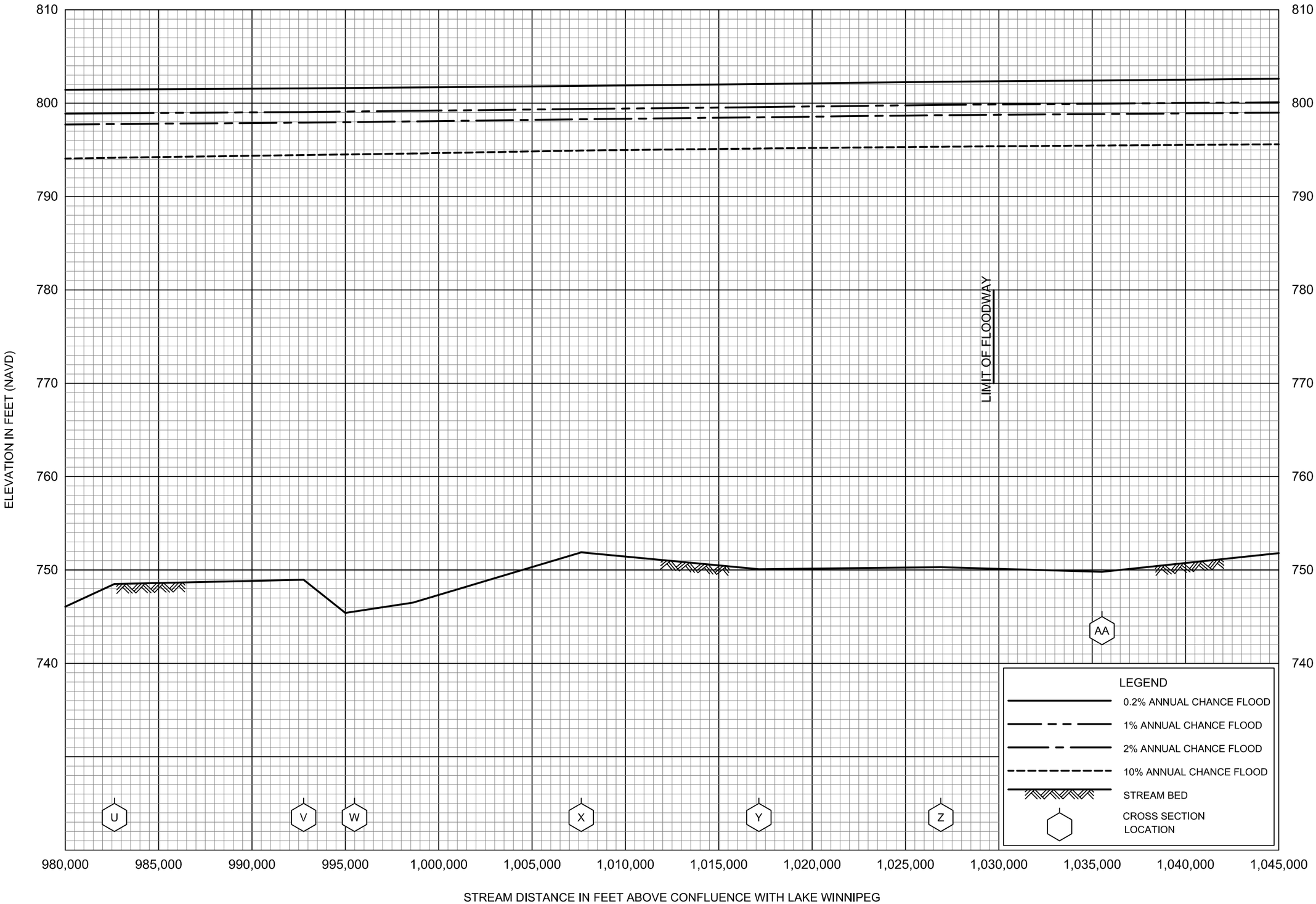
KITTSON COUNTY, MN

AND INCORPORATED AREAS



FLOOD PROFILES

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KITTSON COUNTY, MN

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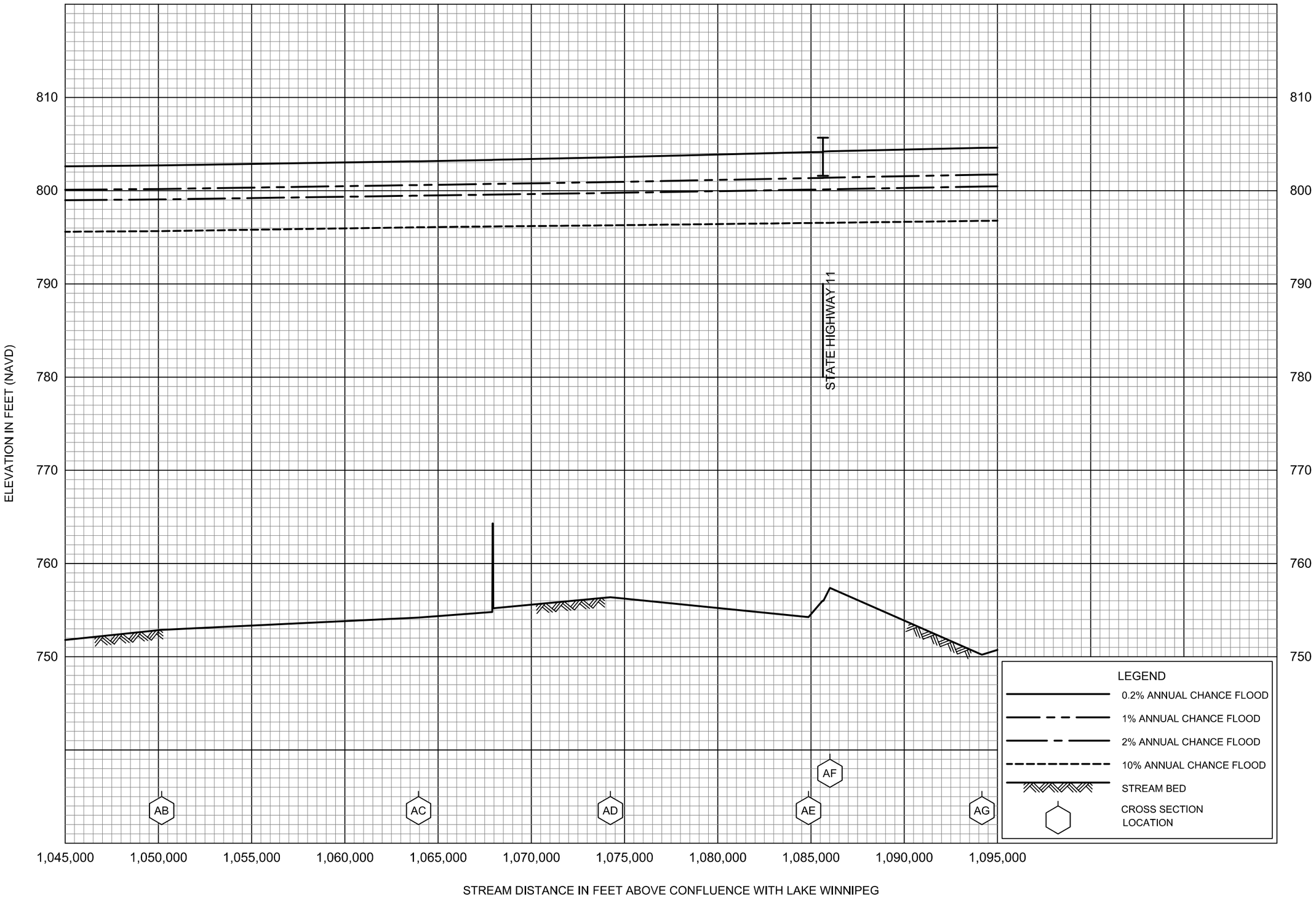

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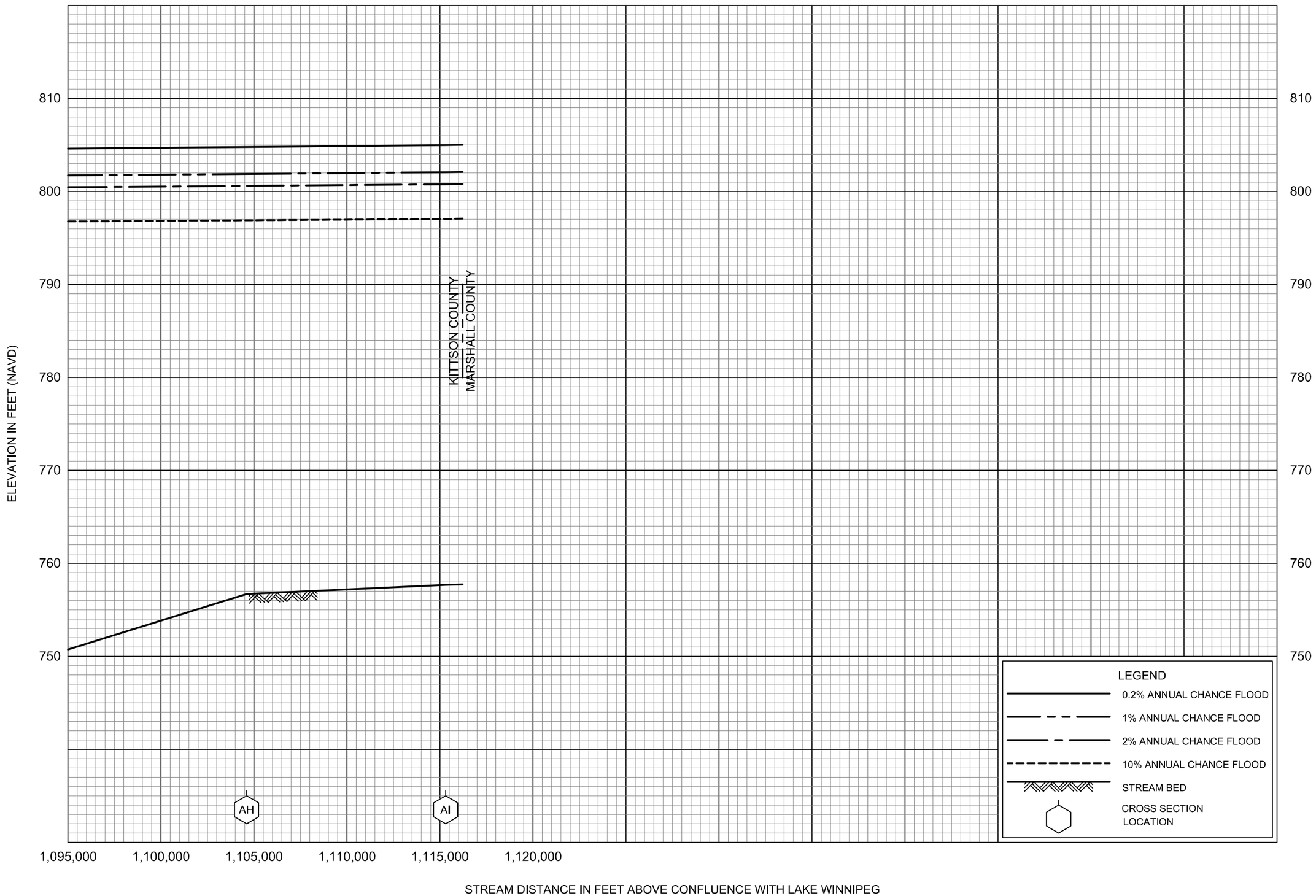

FLOOD PROFILES

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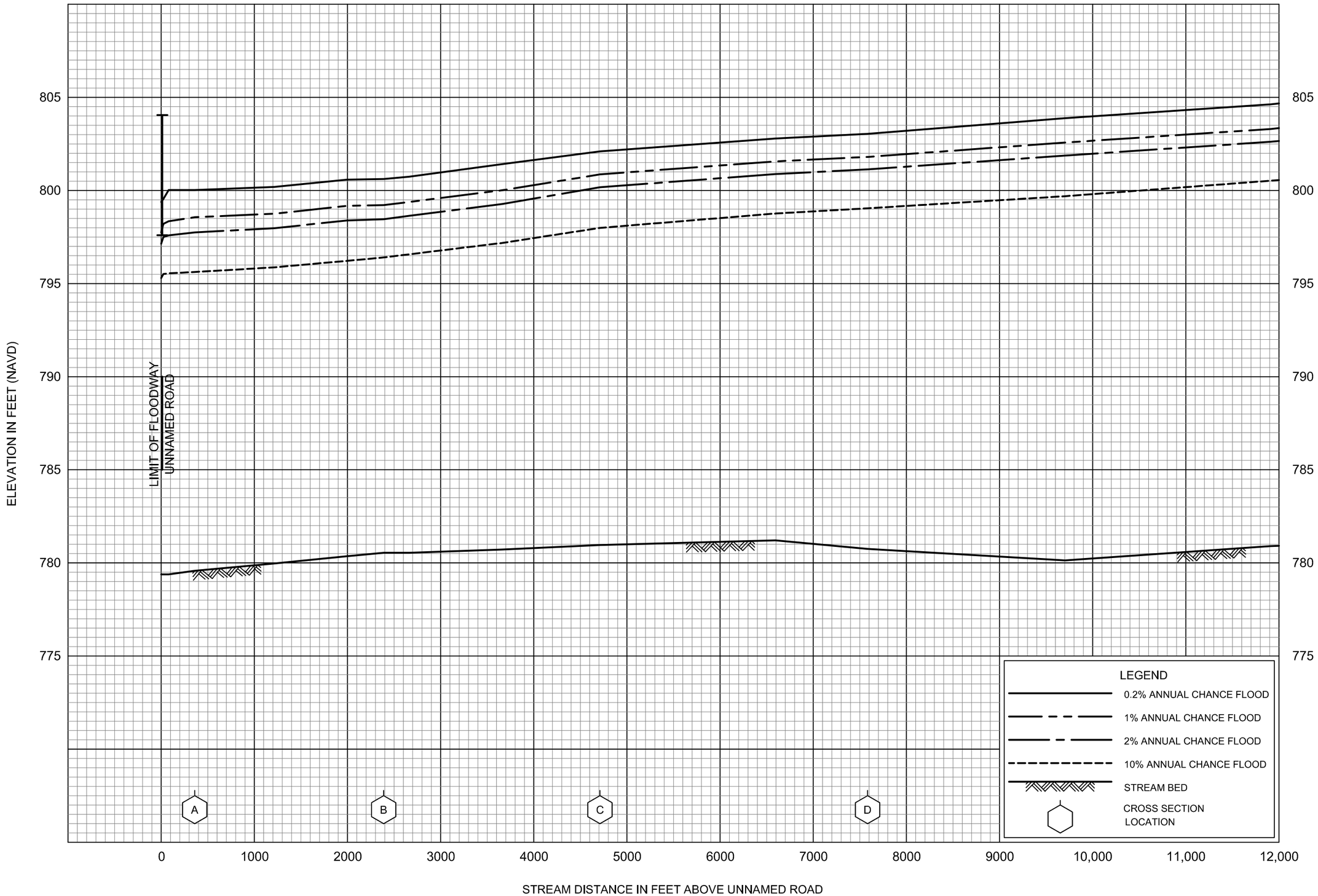


FLOOD PROFILES

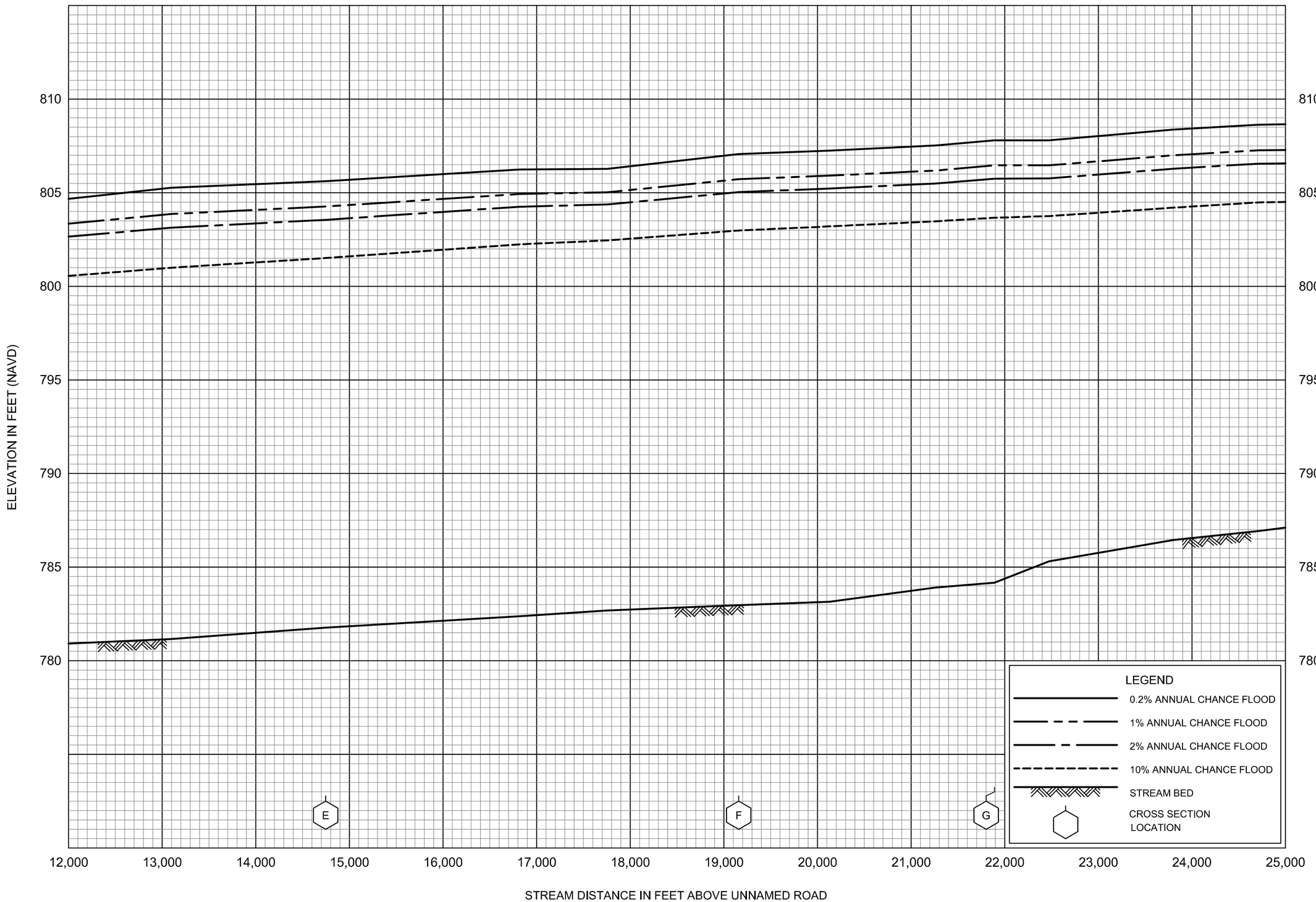
TWO RIVERS/SOUTH BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

AND INCORPORATED AREAS

15P



FLOOD PROFILES

TWO RIVERS/SOUTH BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

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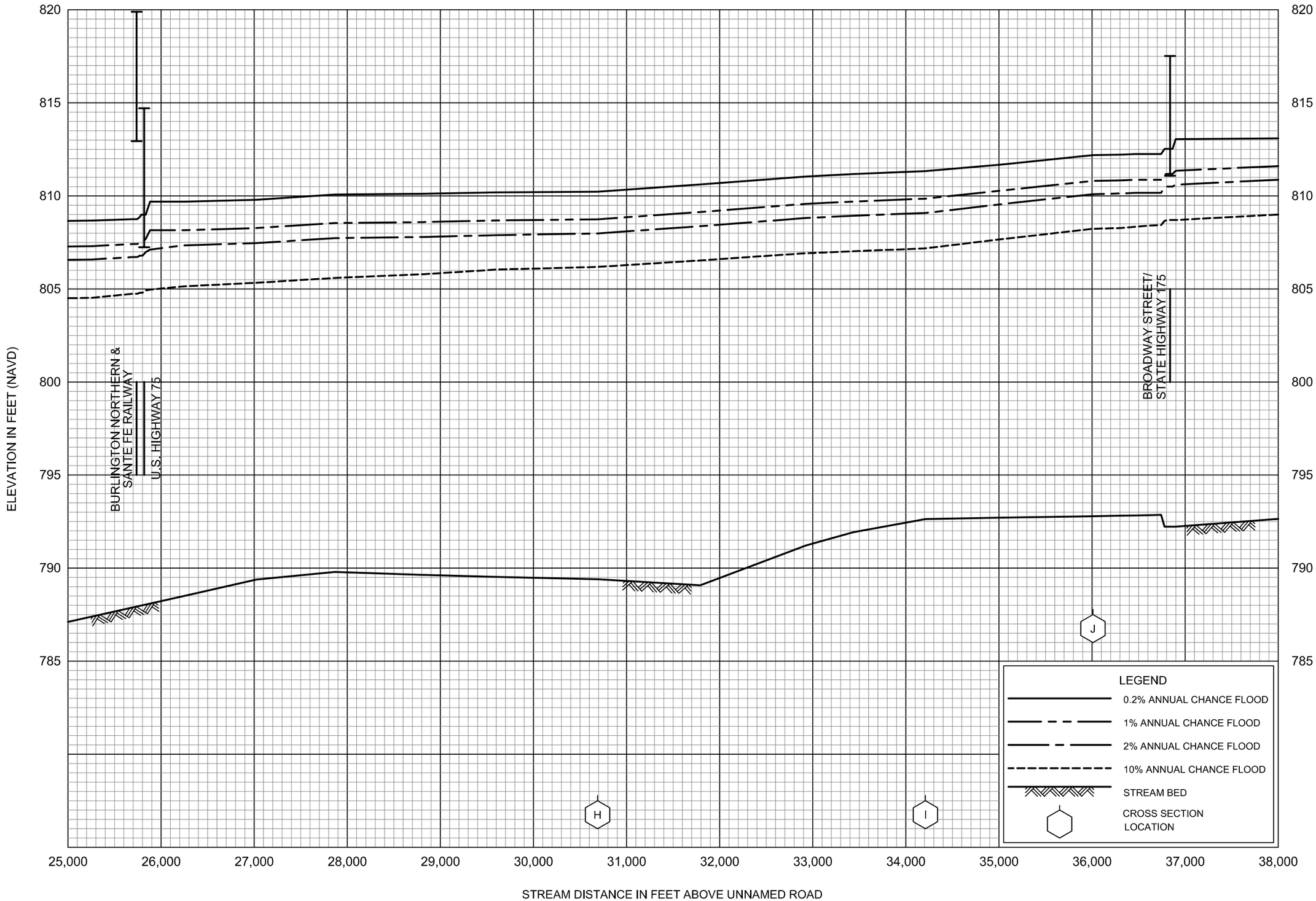

FLOOD PROFILES

TWO RIVERS/SOUTH BRANCH TWO RIVERS

FEDERAL EMERGENCY MANAGEMENT AGENCY

KITTSON COUNTY, MN

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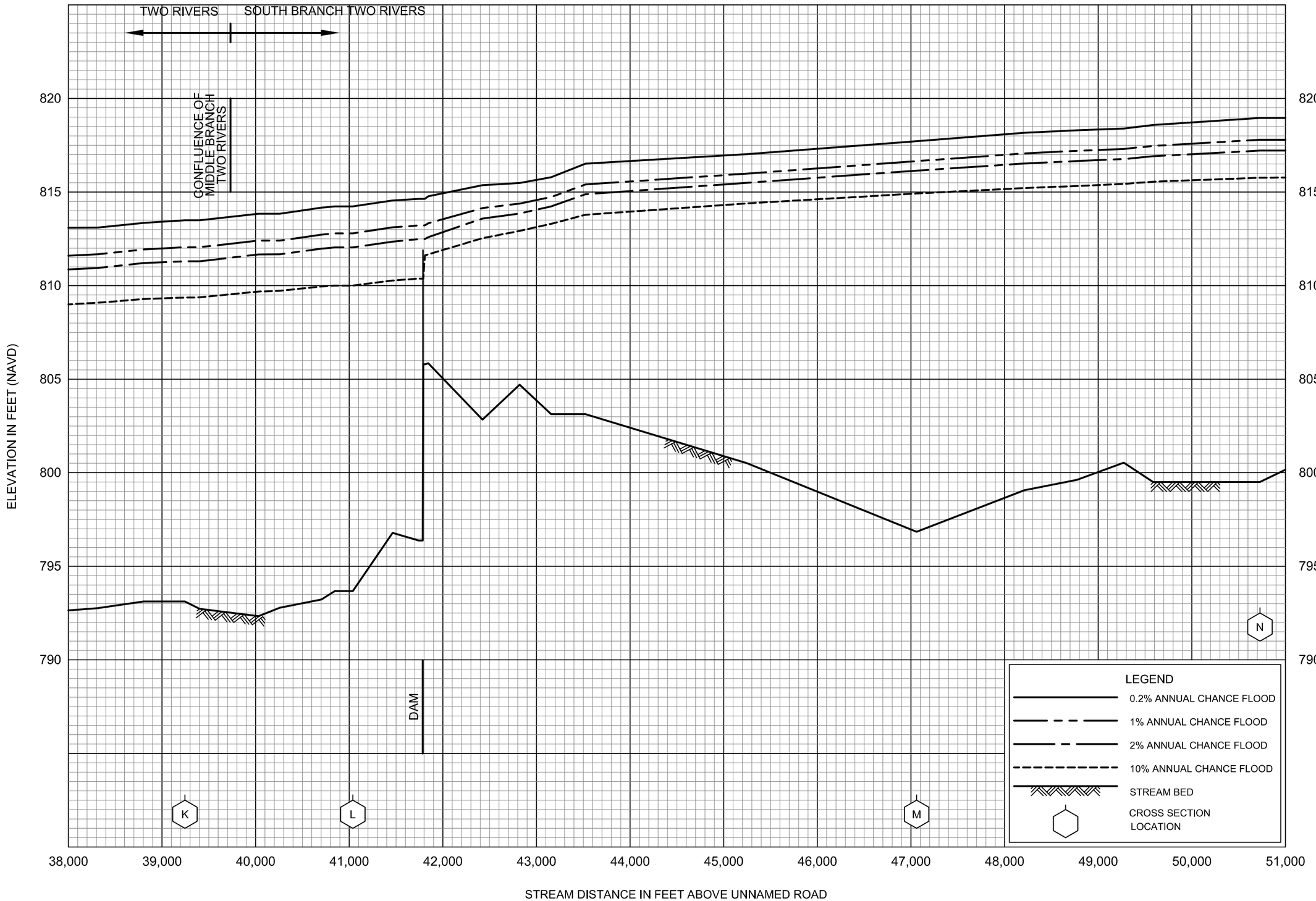

FLOOD PROFILES

TWO RIVERS/SOUTH BRANCH TWO RIVERS

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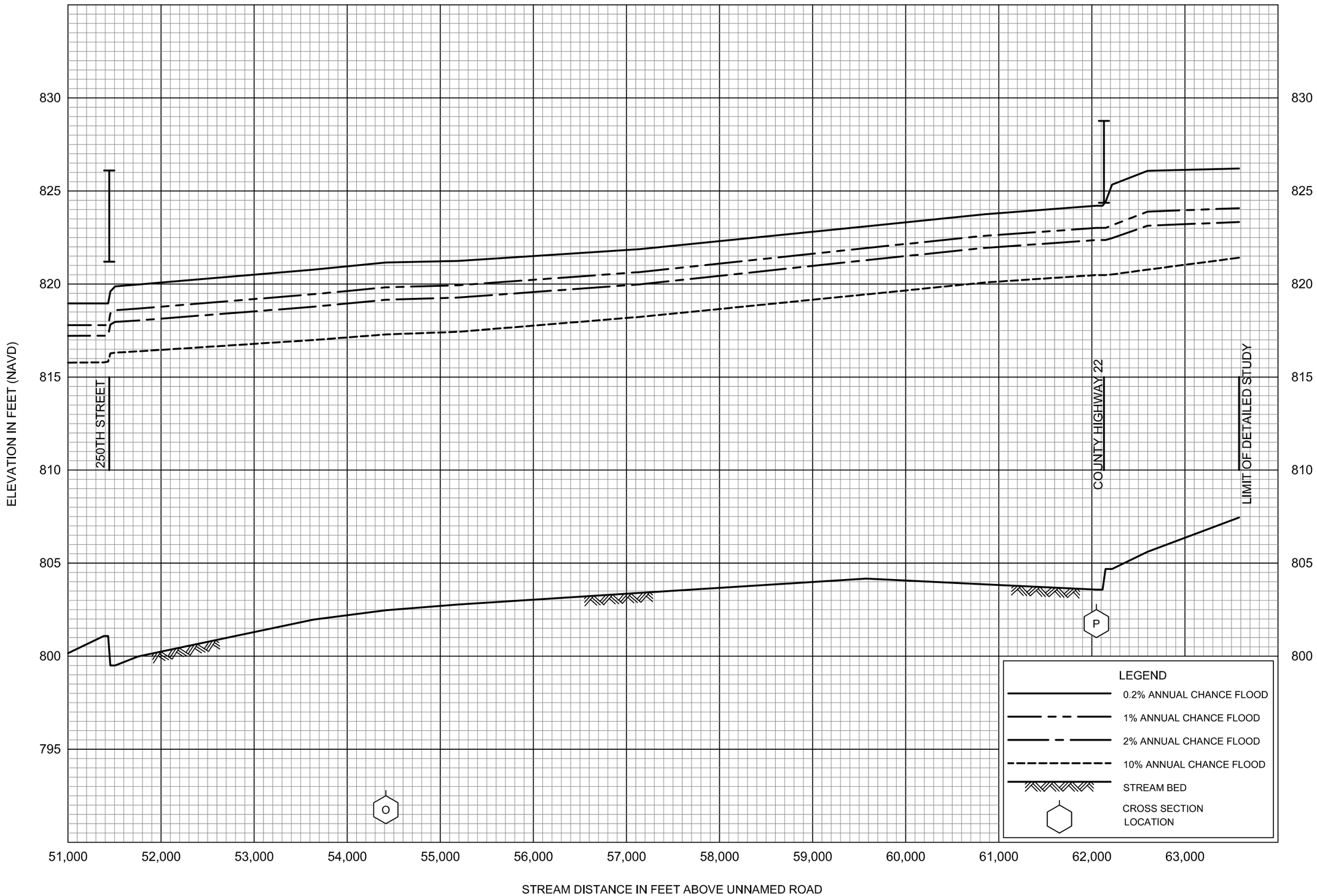

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