# FLOOD INSURANCE STUDY

# WAUPACA COUNTY, WISCONSIN
## AND INCORPORATED AREAS

| Community Name | Community Number |
|---|---|
| Big Falls, Village of | 550493 |
| Clintonville, City of | 550494 |
| Embarrass, Village of | 550495 |
| Fremont, Village of | 550496 |
| Iola, Village of | 550497 |
| Manawa, City of | 550498 |
| Marion, City of | 550499 |
| New London, City of | 550308 |
| Ogdensburg, Village of | 550500 |
| Scandinavia, Village of | 550501 |
| Waupaca, City of | 550502 |
| Waupaca County (Unincorporated Areas) | 550492 |
| Weyauwega, City of | 550503 |


January 20, 2010

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
55135CV000A

Waupaca County, Wisconsin
And Unincorporated Areas

# NOTICE TO
# FLOOD INSURANCE STUDY USERS

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

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

Effective Date: January 20, 2010

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# FLOOD INSURANCE STUDY
# WAUPACA COUNTY, WISCONSIN AND INCORPORATED AREAS

## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Waupaca County, Wisconsin, including the Cities of Clintonville, Manawa, Marion, New London, Waupaca, and Weyauwega, the Villages of Big Falls, Embarrass, Fremont, Iola, Ogdensburg, and Scandanavia, and the unincorporated areas of Waupaca County (referred to collectively herein as Waupaca County). Note that the City of Weyauwega and Villages of Big Falls, Embarrass, Iola, Ogdensburg, and Scandinavia did not have previous FIS text.

The flood-hazard information for the portions of the City of Marion that lie in Waupaca County is included in this FIS report. For flood-hazard information for the portions in Shawano County, see separately published FIS report and Flood Insurance Rate Maps (FIRM). The flood-hazard information for the portions of the City of New London that lie in Waupaca County is included in this FIS report. For flood-hazard information for the portions in Outagamie County, see separately published FIS report and Flood Insurance Rate Maps (FIRM).

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

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

### 1.2 Authority and Acknowledgments

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

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, Waupaca County in a countywide format. Information on the

authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

| | |
|---|---|
| Waupaca County, Unincorporated Areas: | For the October 1975 FIS report, the hydrologic and hydraulic analyses were performed by Carl C. Crane, Inc., for the Federal Insurance Administration, under Contract No. H-3681. This work covered all flooding sources affecting the unincorporated areas of Waupaca County.<br><br>Approximate flood boundaries for bodies of water exceeding 25 acres were determined in November 1976 by Dames & Moore under contract to the Federal Insurance Administration.<br><br>For the January 1987 FIS revision, the hydrologic and hydraulic analyses for the Wolf River were performed by the Wisconsin Department of Natural Resources (WDNR). The Federal Emergency Management Agency (FEMA) reviewed and accepted these data for purposes of this revision (Reference 1). |
| Clintonville, City of: | For the March 1984 the FIS report, the hydrologic and hydraulic analyses were obtained from the United States Army Core of Engineers (USACE) Chicago District, flood plain information report for the Pigeon River (Reference 2).<br><br>For the November 1995 FIS revision, the hydrologic and hydraulic analyses were prepared by the United States Geological Survey (USGS) for FEMA, under Contract No. EMW-91-3257. This work was completed in March 1993 (Reference 3). |
| Fremont, Village of: | The hydrologic and hydraulic analyses for this study were performed by Owen Ayres & Associates, Inc., for the Federal Insurance Administration, under Contract No. 3805. This work was completed in April 1976.<br><br>For the January 1987 FIS revision, the hydrologic and hydraulic analyses for the Wolf River were performed by the WDNR. FEMA reviewed and accepted these data for purposes of this revision (Reference 4). |

| | |
|---|---|
| Manawa, City of: | For the May 1988 FIS report, the hydrologic and hydraulic analyses were performed by the United States Department of the Interior, Geological Survey (the Study Contractor) for FEMA, under Inter-Agency Agreement No. EMW-85-1823, Project Order No. 14. This work was completed in May of 1986. (Reference 5). |
| Marion, City of: | For the May 1988 FIS report, the hydrologic and hydraulic analyses were performed by the USGS for FEMA, under Inter-Agency Agreement No. EMW-85-1823. This work was completed in May of 1986. (Reference 6). |
| New London, City of: | For the September 1976 FIS report, the hydrologic and hydraulic analyses were performed by Owen Ayres & Associates, Inc., for the Federal Insurance Administration, under Contract No. H-3705. (Reference 7). |
| Waupaca, City of: | For the August 1989 FIS report, the hydrologic and hydraulic analyses were performed by the USGS, Water Resource Division, for FEMA under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 14. This study was completed in January 1987 (Reference 8). |

For this countywide FIS, detailed study and redelineation of special flood hazard areas was performed by CDM Federal Programs Corporation (CDM), under purchase order NMH00000747. Work was completed April 25, 2008. The digital base mapping information was provided in digital format by WDNR. This information was derived from data compiled in 2005. These data meet or exceed National Mapping Accuracy Standards. Users of this FIS should be aware that minor adjustments may have been made to specific FIRM base map features.

The coordinate system used for the production of the FIRM is Universal Transverse Mercator (UTM) Zone 16, North American Datum of 1983 (NAD 83), GRS 80 spheroid. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

## 1.3 Coordination

An initial Consultation Coordination Officer (CCO) meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS and to identify the streams to be studied by detailed

methods. A final CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to review the results of the FIS.

The dates of the initial and final CCO meetings held for previous FIS for jurisdictions within Waupaca County are shown in Table 1, "Initial and Final CCO Meetings".

**TABLE 1 - INITIAL AND FINAL CCO MEETINGS**

| Community | Initial CCO Date | Final CCO Date |
|---|---|---|
| Clintonville, City of | December 3, 1993 | October 12, 1994 |
| Fremont, Village of | * | May 13, 1976 |
| Manawa, City of | December 1984 | June 1, 1987 |
| Marion, City of | December 1984 | June 1, 1987 |
| New London, City of | * | August 27, 1975 |
| Waupaca, City of | December 13, 1984 | May 11, 1988 |
| Waupaca County, Unincorporated Areas | * | December 17, 1975 |

* Information Not Available

For this countywide FIS, the Scoping meeting was held July 3, 2007 and was attended by representatives of WDNR, FEMA, and the communities of Waupaca County. The results of the study were reviewed at the Open House held on November 19, 2008 and attended by representatives of WDNR, FEMA and the communities. All problems raised at that meeting have been addressed in this study.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This FIS report covers the geographic area of Waupaca County, Wisconsin, 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 and proposed construction.

At the Scoping meeting held on July 3, 2007, potential flood hazard areas of concern were identified by communities. WDNR performed a validation check on all previously effective detailed study areas. While most areas were considered valid or conservative, the Crystal River was identified as a potential need to be restudied. WDNR and the communities determined the Waupaca River to be of highest priority, with a low priority on the Crystal River. The Little Wolf River through the Village of Big Falls was also identified as a higher priority (previously an approximate flood hazard area).

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. For this countywide FIS, new detailed studies were performed on the Waupaca River from its mouth to Anderson Road, and on the Little Wolf River through the Village of Big Falls corporate limits.

All other waterways listed in Table 2 were previously studied by detailed methods and were redelineated on more recent topographic data for this FIS. The limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

**TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS**

| Flooding Source | Limits of Detailed Study |
|---|---|
| Crystal River | From approximately 6000-ft upstream of its confluence with Waupaca River to approximately 4500-ft upstream of State Highway 22. |
| Embarrass River | From approximately 1900-ft upstream of its confluence with the Wolf River to the Outagamie County border. |
| Honey Creek | From its confluence with the Pigeon River to West 1st Street. |
| Little Wolf River | From County Highway X to approximately 2000-ft upstream of State Highway 54. |
| | From approximately 6000-ft downstream of the Manawa Dam to 10,000-ft upstream of the Manawa Dam. |
| | From approximately 2000-ft downstream of State Highway 22 to 2000-ft upstream of State Highway 22. |
| | Approximately 13,500-ft downstream of County Highway C to 16,500-ft upstream of Big Falls Dam. |
| | From approximately 3000-ft downstream of County Highway P to 1000-ft upstream of County Highway P. |
| North Branch Pigeon River | From approximately 6000-ft downstream of Marion Dam to the Marion Dam. |
| Pigeon River | From approximately 14,000-ft downstream of North Lyon Street to 17,500-ft upstream of Hemlock Street. |
| South Branch Little Wolf River | From State Highway 49 to approximately 7000-ft upstream of County Highway Q. |
| Waupaca River | From its confluence with the Wolf River to approximately 500-ft upstream of Anderson Road. |
| Wolf River | From the Winnebago County boundary to the Outagamie County boundary. |

As part of this countywide FIS, updated analyses were included for the flooding sources shown in Table 3, "Scope of Revision."

**TABLE 3 – SCOPE OF REVISION**

| Stream | Limits of Revised or New Detailed Study |
|---|---|
| Little Wolf River | From approximately 1600-ft downstream of the Big Falls Dam to 6700-ft upstream of County Highway G. |
| Waupaca River | From its confluence with the Wolf River to 500-ft upstream of Anderson Road. |
| Wolf River | From the Winnebago County boundary to the Outagamie County boundary. |

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision-based on Fill [LOMR-F], and Letter of Map Amendment [LOMA]) as shown in Table 4, "Letters of Map Correction."

**TABLE 4 – LETTERS OF MAP CORRECTION**

| Community | Flooding Source(s)/Project Identifier | Date Issued | Type |
|---|---|---|---|
| Clintonville | Pigeon River | 9/17/2004 | LOMR |
| New London | Wolf River | 11/30/2007 | LOMR |
| New London | Embarrass River | 5/29/2009 | LOMR |

All or portions of Austin Creek, Basteen Creek, Bear Creek and Tributaries, Blake Creek, Bradley Creek, Brekke Creek, Cedar Lake, Chain O' Lakes, Chapin Lake, Comet Creek and Tributaries, Crystal Lake, Crystal River, Embarrass River and Tributaries, Emmons Creek, Engibretson Creek and Tributaries, Flume Creek and Tributaries, Flynn Lake, Geskey Creek, Goodhal Lake, Grass Lake, Gregerson Lake, Griffin Creek, Gurholt Lake, Hartman Creek, Hartman Lake, Hatch Lake, Hatton Creek and Tributaries, Hydes Creek, Jackson Creek, Johnson Lake, Jones Creek, Leer Creek, Little Creek, Little Wolf River and Tributaries, Long Lake, Maple Creek and Tributaries, Matteson Creek, McLean Creek, Mirror Lake, Mosquito Creek, Mountain Lake, Mouse Creek, Murry Creek, Nace Creek, Nichol Creek and Tributaries, Norby Lake, North Branch Little Wolf River and Tributaries, North Branch Pigeon River and Tributaries, North Fork Blake Creek, Old Taylor Lake, Ottman Lake, Peterson Creek and Tributaries, Pigeon River and Tributaries, Potters Creek, Radley Creek and Tributaries, Rollofson Lake, Sand Lake, Sannes Creek and Tributaries, Shaw Creek and Tributaries, Siemer Lake, Silver Lake, South Branch Little Wolf River and Tributaries, South Branch Pigeon River and Tributaries, South Fork Blake Creek and Tributaries, South Fork Whitcomb Creek, Spaulding Creek, Storm Lake, Vesey Lake, Walla Walla Creek and Tributaries, Waupaca River and Tributaries, Whitcomb Creek and Tributaries, White Lake, and the Wolf River and Tributaries and numerous unnamed streams were studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The Zone A floodplain boundaries for the streams listed above in Waupaca County were developed using approximate study techniques. The scope and methods of study were proposed to, and agreed upon, by FEMA and the WDNR.

## 2.2 Community Description

Waupaca County is located in east-central Wisconsin. Clockwise from the northeast, surrounding counties are Shawano, Outagamie, Winnebago, Waushara, and Portage. In 1990 and 2000, the U.S. Bureau of the Census reported the population of the area to be 46,104, and 51,731, respectively (Reference 9).

The streams studied are spread throughout the county. All are tributaries to the Wolf River, which flows into the Fox River at Lake Poygan, then into Green Bay via Lake Winnebago.

The topography of the county is gently rolling. Its climate is characteristic of the central part of Wisconsin. The average annual maximum and minimum daily temperatures are71.0°F and 16.2°F, respectively. Temperatures have reached as high as 99°F, and as low as -29°F. The average annual precipitation is 30.8 inches.

The southern, eastern, western, and central portions of Waupaca County are devoted to various types of agriculture. The north-central section is partially forested with a wide variety of softwoods and hardwoods.

The flood plains are currently utilized as agriculture, residential, and recreational environments. The residential development is heavier around the incorporated communities of Waupaca, Clintonville, Fremont, and New London; however, rural development is increasing significantly.

The rivers studied in detail are crossed by numerous bridges throughout the county. Significant backwaters are created by County Trunk Highway C and Little Falls footbridge on the Little Wolf River, County Trunk Highway Q on the South Branch of the Little Wolf River, and Parfreyville and Rural Roads on the Crystal River.

## 2.3 Principal Flood Problems

Waupaca County contains six major rivers that are subject to severe flooding. Typical of rivers and streams in Wisconsin, flooding poses the greatest threat in the spring of the year when melting snow, frozen ground, and heavy spring rains combine to swell the basins to flood stage. Most major flooding in the past has been confined to the Wolf, Little Wolf, and Waupaca Rivers; however, if development along the smaller rivers is left unchecked, more extensive property damage could be anticipated.

Large magnitude floods have occurred on the Wolf River five times during the span of record. These floods occurred in 1888, 1922, 1929, 1952, and 1960. The largest

flood occurred in 1922, with an estimated peak discharge of 15,500 cfs, the greatest discharge ever recorded on the Wolf River.

The City of Clintonville is susceptible to flooding from the Pigeon River basin due to its relatively small drainage area. Although the City of Clintonville has experienced many floods on the Pigeon River, four floods considerably exceeded the others. These floods occurred in 1872, 1881, 1912, and 1970. The flood of July 1912 was the largest flood of record (Reference 2).

The Village of Fremont is susceptible to flooding from the Wolf River. Historical accounts indicate that the 1888, 1912, 1922, 1952, 1960, and 1973 floods were the most serious on the Wolf River. The flood of 1973 resulted in extensive damage within the community. Based on the New London gaging records, the 1973 flood was approximately a 25-year frequency flooding event. Ice flows are also a problem. Ice damage along the shoreline of Partridge Lake and the Wolf River has, and can, occur during the spring breakup during flood conditions.

The City of Manawa is susceptible to flooding from the Little Wolf River. The river flows northeast through the northern section of Manawa. Many buildings along the shore of the Manawa Dam millpond will suffer damage in the event of a 1-percent-annual chance flood. Several buildings downstream of the dam will also be flooded. The largest flood recorded at the USGS stream gaging station located on the Little Wolf River at the Town of Royalton occurred on March 28, 1950. The peak discharge at the site was 6,800 cfs, while at Manawa the estimated peak discharge of the flood was 4,600 cfs.

The City of Marion's flooding problems are due primarily to the overflow of the North Branch Pigeon River. The river flows from the west through Marion. In the event of a 1-percent-annual chance flood, the Marion Dam will be overtopped.

The City of New London is susceptible to flooding from both the Wolf and Embarrass Rivers. Historical accounts indicate that the 1888, 1912, 1922, 1952, 1960, and the 1973 floods were the most serious on the Wolf River. The 1973 flood, with a discharge of 14,000 cfs, resulted in extensive damage within the community. Ice flows are also a problem and had to be broken up at the Shawano River Bridge during the 1973 flood.

The City of Waupaca's flooding problems are primarily due to the overflow of the Waupaca and Crystal Rivers. The Waupaca River flows through the city from the northwest to the east. The Crystal River flows west to east near the southern corporate limits. The Crystal River will overflow the Riverside Drive dam in the event of a 1-percent-annual chance flood. Typically the greatest problems occur in the spring when melting snow and heavy rains are combined.

Newspaper accounts of Wolf River and Embarrass River flooding events were documented in the Flood Plain Information report completed by the USACE Chicago District (Reference 10) as follows. Although there have been numerous floods along the Wolf River, newspaper accounts over the years tend to indicate that the floods of

1888, 1912, 1922, 1592, and 1960 were floods of the most serious magnitude. Accounts of the 1888, 1922, and 1952 floods indicate one definite similarity which was exceptionally heavy rainfalls with rising temperatures, causing rapid snow melt, the combination of which produced severe flooding. The floods of 1912 and 1960 were results of heaving and long duration rainfall causing large runoff thereby flooding conditions. The following are excerpts from various newspapers during periods of these floods:

Appleton Daily Post, 29 July 1912 – "The county is now a lake several miles in length."

Press Republican, New London, Wisconsin, 13 April 1922 – "Highest water in history. Crest reached Thursday. Thousands of dollars of damage done in New London. Millions in Wolf and Embarrass Valleys. Green Bay and Western tracks washed out. Pavements caved in. From Saturday night on, when the Embarrass first started overflowing across Shawano Street, the volume of water increased rapidly until Sunday evening when it had reached the depth of about 18 inches on this street near the Wolf River. At this writing Wednesday, there is over three feet of water on some sections of the thoroughfare. The Green Bay and Western Railroad sustained a heavy loss in washout. A strip of road covering three miles between this city and Northport is under from two to six feet of water. Most of the road, it is believed, will have to be rebuilt."

New London Press Republican, 10 April 1952 – "One of the most devastating rains in years struck the area Sunday, causing untold damage. More than an inch of rain fell within about six hours. The rain melted and carried away a heavy layer of ice and snow, bringing the river up about 3.5 feet in three days."

Appleton Post Crescent, 10 May 1960 – "The swollen Wolf River has completely covered Gill's Landing new Weyauwega with better than a foot of water. The water also stood a foot deep in the Wolf River Hotel. Motor boats were the only means of transportation for Shiocton families whose homes were surrounded by waters of the flooding Wolf River."

Appleton Post Crescent, 4 April 1967 – "A rapid rise in temperatures and rain caused a sudden rise in the river. It then went up more than six feet in about ten days. The Wolf River has reached its highest level since 1960. The river held at 10.0 feet."

Three more recent flood events were documented on the National Oceanic and Atmospheric Administration website (Reference 11) as discussed below.

June 16-20, 1996
Heavy rainfall fell across most of Central and East Central Wisconsin, as well as parts of Northeast Wisconsin from June 16th through the 18th. Amounts over the three day period ranged from 2 to 7 inches in most locales. Shawano, Waupaca and Outagamie counties were among the heaviest hit, with several locations receiving between 5 and 7 inches of rain during the three day period. Runoff from the heavy rainfall caused rivers to rise substantially, with several peaking well above flood

stage. Minor flooding was reported on the Little Wolf River at Royalton (Waupaca County), Embarrass River at Embarrass (Waupaca County), and the Pigeon River at Clintonville (Waupaca County). Several streets, parks, campgrounds and county roads were flooded, and a few roads were washed out.

April 1, 1998
The flooding that occurred in early April was a carryover from the excessive precipitation that fell in late March. Four locations along 3 rivers exceeded flood stage during April. The Wolf River at New London (Outagamie and Waupaca counties) also exceeded flood stage. New London peaked at 9.38 feet on April 5. The only significant inconvenience from the floods occurred along the Wolf River. In New London, a few local roads were flooded and closed for a couple of days. The city park along the banks of the river was also flooded.

August 3, 2003
Thunderstorms that developed in unstable air in the vicinity of a low pressure system produced a tornado, large hail, torrential rain and lightning damage. Torrential rains from the storms caused flash flooding in Waupaca (Waupaca County).

## 2.4 Flood Protection Measures

In Waupaca County, flooding on the Wolf River is uncontrolled; however, the Shawano Dam upstream at Shawano, Wisconsin, does provide some relief. Constructed primarily for hydroelectric purposes, its retention characteristics, coupled with the retention characteristics of Shawano Lake, help control the flood waters of the Wolf River downstream.

In the City of Clintonville, a dam is located on the Pigeon River at the mouth of Pigeon Lake. The dam is primarily used to control the level of Pigeon Lake. Presently, the dam is owned and controlled by the city, with the discharge controlled through the use of three sluice gates. Originally, the dam was used to provide water power for feed mills. Presently, the dam is operated to control the reservoir elevations for recreation and not as flood control structures. The dam provides some protection against small floods (Reference 2).

In the City of Manawa, the flow of the Little Wolf River is regulated by the Manawa Dam. There is sufficient millpond storage to significantly reduce the 1-percent-annual chance peak discharge downstream of the dam.

In the City of Marion, the flow of the North Branch Pigeon River is regulated by the Marion Dam. However, it has been ascertained that Marion Dam may not protect the community from a 1-percent-annual chance flood.

Within the commercial district of the City of New London, concrete retaining walls confine the flow of the Wolf River under normal conditions. A bypass channel has been constructed to the Embarrass River between the Green Bay and Western Railroad and State Highway 54 to alleviate flooding due to the Embarrass River.

Historical records indicate that the discharges through this channel are a function of the Wolf River's stage during flood conditions.

In the City of Waupaca, the flow of the Waupaca River is regulated by an operating dam at Washington Street (Lighting Plant Dam). Two other dams were previously located near Water Street and Shearer Street but both have been removed. The Crystal River is regulated by the Little Hope Dam, located approximately four miles upstream of the corporate limits, and by the Riverside Drive dam.

## 3.0 ENGINEERING METHODS

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

### 3.1 Hydrologic Analyses

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

A new hydrologic analysis was performed by the Wisconsin Department of Natural Resources (WDNR) in 2007 for the entire Waupaca River watershed. Discharges were computed using the Hydrologic Engineering Center's *Hydrologic Modeling System (HEC-HMS)* computer software, version 2.2.2 (Reference 20). For each subbasin, runoff Curve Numbers (CNs) were estimated using 1992 WISCLAND landuse data and SSURGO soils data. Times of concentration were estimated using the TR-55 flowpath segment method. The rainfall distribution used was developed by the WDNR and is based on recorded storms 2 inches and larger from 1975 to 2003 at the Madison NWS gage (474961). Floodplain storage was taken into account where permanent water bodies existed, such as ponds, lakes, or manmade detention structures, or where there were significant wetlands identified in the Wisconsin Wetland Inventory. The Chain O' Lakes have a significant storage

capacity, which helps to reduce discharges through the Crystal River. It is assumed that no major construction or filling will occur in these areas that would reduce the amount of available storage volume. USGS Streamgage 4081000 is located on the Waupaca River, just downstream from the City of Waupaca. There are 57 years of record at this gage between 1917 through 1985. The results of the HEC-HMS analysis compared well to the statistical Log Pearson Type III analysis at the gage, coming within 8% (higher) of that value.

For the 1987 revisions of the Waupaca County and Village of Fremont FIS, the WDNR restudied the reach of the Wolf River from the City of New London, Wisconsin, to the Village of Fremont, Wisconsin, taking floodplain storage into account, to determine the reduction in the 1-percent-annual chance peak discharge. The March-April 1952 and May 1960 flood hydrographs at the New London stream gaging station were routed downstream to Fremont using the Modified Plus technique for storage reservoir routing outlined in the HEC-1 Flood Hydrograph Package (Reference 19). The WDNR compared the 1952 and 1960 flood events with regard to routing an approximate technique outlined in the Conger report (Reference 17).

Each incorporated community within, and the unincorporated areas of, Waupaca County, with the exception of the City of Weyauwega and the Villages of Big Falls, Embarrass, Iola, Ogdensburg, and Scandinavia, have a previously printed FIS report. The hydrologic analyses described in those reports have been compiled by waterway and summarized below.

Crystal River – In the City of Waupaca, the 1-percent-annual chance flood equation for streams in northeastern Wisconsin was used to estimate the 1-percent chance flood. Equations have been developed by the USGS for estimating magnitude and frequency of floods for streams in Wisconsin (Reference 17).

The Crystal River discharges in unincorporated Waupaca County were evaluated using multiple regression equations outlined by the USGS (Reference 14).

Embarrass River – The discharges for the Embarrass River were developed from data gathered at gages along the entire length of the river and submitted by the Chicago District of the USACE. These discharges were then coordinated with studies for the City of New London (Reference 7).

Embarrass River Bypass Channel – In the City of New London, to evaluate the amount of water flowing through the bypass channel and in the main Embarrass River channel during flood stage, an analysis was made of historical records to evaluate the expected stage on the Wolf River. The stage on the Wolf River significantly affects the carrying capacity of the bypass channel. As the stage of the Wolf River rises, the bypass channel capacity decreases. However, the Embarrass River has the maximum influence on the Bypass Channel; therefore, the Embarrass River flooding was used to designate the zone boundaries along the Bypass Channel.

Honey Creek – In the City of Clintonville, the 10-, 2-, 1-, and 0.2-percent-annual chance floods for Honey Creek were determined using the USACE HEC-1 flood hydrograph package (Reference 16).

Little Wolf River – In the City of Manawa, the 1-percent annual chance flood for the Little Wolf River was determined by statistical analysis of the records for the stream gage at Royalton (Reference 17). The Royalton gage has 56-years of annual peak flow data. The discharge at the gage was projected upstream to Manawa by means of a drainage area relationship.

The Little Wolf River discharges in unincorporated Waupaca County were evaluated using multiple regression equations outlined by the USGS (Reference 14).

North Branch Pigeon River – In the City of Marion, the Conger equation for central Wisconsin was used to estimate the 1-percent-annual chance discharge (Reference 17).

Pigeon River – The Pigeon River discharges in unincorporated Waupaca County were evaluated using multiple regression equations outlined by the USGS (Reference 14), and closely agreed with the values used by the USACE in their Pigeon River Study (Reference 2). The values used in the USACE study were also used.

In the City of Clintonville, the 10-, 2-, 1-, and 0.2-percent-annual chance floods for the Pigeon River were determined using a regional regression method as outlined by the USGS publication, Flood-Frequency Characteristics of Wisconsin Streams (Reference 15).

South Branch Little Wolf – Discharges were evaluated using multiple regression equations outlined by the USGS (Reference 14).

Wolf River – The discharge-frequency analyses for unincorporated Waupaca County along the Wolf River were provided by the USACE, Chicago District. The log-Pearson Type III analysis for the flow records at the New London gage was used (Reference 12). Records were analyzed for this gage from 1896 to 1975 (Reference 13).

In the Village of Fremont, the peak discharge-frequency analyses for the Wolf River were provided by the USACE, Chicago District (Reference 10). The Wolf River drainage area at Fremont is 3,425 square miles. These discharges were correlated with the statistical analysis of the New London USGS gaging station records (Drainage Area = 2,240 square miles). The New London gage was analyzed using the log-Pearson Type III method (Reference 12) for the gaging records which are available from 1896. Historical documents and records were also researched for information concerning past floods to supplement gaging station records.

In the City of New London, the peak discharge-frequency analyses for the Wolf River were provided by the USACE, Chicago District. The log-Pearson Type III analysis for the flow records at New London was used. Records utilized for this

gage for this analysis were from 1896 through 1976 (Reference 13). The discharges for the Embarrass River were those used in the FIS for Waupaca County (Reference 18). The peak discharges on the Wolf and Embarrass Rivers are not expected to occur simultaneously.

In the City of Marion, the 1-percent-annual chance elevation for Marion Pond is 853.9 feet NAVD.

A summary of the drainage area-peak discharge relationships for all of the streams studied by detailed methods is shown in Table 5, "Summary of Discharges".

**TABLE 5 - SUMMARY OF DISCHARGES**

| | | PEAK DISCHARGES (cfs) | | | |
|---|---|---|---|---|---|
| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq.miles) | 10-PERCENT ANNUAL-CHANCE | 2-PERCENT ANNUAL-CHANCE | 1-PERCENT ANNUAL-CHANCE | 0.2-PERCENT ANNUAL-CHANCE |
| CRYSTAL RIVER | | | | | |
| At Sanders Road | 96.0 | 900 | 1,600 | 1,900 | 2,700 |
| At U.S. Highway 10 | 84.6 | * | * | 1,180 | * |
| EMBARRASS RIVER | | | | | |
| Main Channel Below the Bypass Channel | * | 2,800 | 5,650 | 7,300 | 11,150 |
| At New London – total flow | 676.0 | 5,400 | 8,800 | 10,600 | 15,000 |
| EMBARRASS RIVER BYPASS CHANNEL | | | | | |
| Discharge in bypass channel and overland flow | * | 2,600 | 3,150 | 3,300 | 3,850 |
| HONEY CREEK | | | | | |
| Downstream of West 1st Street to confluence with Pigeon River | 2.8 | 175 | 295 | 350 | 490 |
| LITTLE WOLF RIVER | | | | | |
| At Royalton | 514.0 | 6,100 | 8,000 | 9,350 | 10,100 |
| At Manawa | 311.0 | 4,500 | 5,900 | 7,420 | 8,000 |
| At Symco | 250.0 | 3,900 | 5,200 | 5,700 | 7,000 |

## TABLE 5 - SUMMARY OF DISCHARGES (continued)

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq.miles) | PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL-CHANCE | 2-PERCENT ANNUAL-CHANCE | 1-PERCENT ANNUAL-CHANCE | 0.2-PERCENT ANNUAL-CHANCE |
|---|---|---|---|---|---|
| LITTLE WOLF RIVER (continued) | | | | | |
| At Big Falls | 190.0 | 3,300 | 4,200 | 4,400 | 5,950 |
| At Norske | 53.0 | 1,500 | 2,000 | 2,150 | 2,900 |
| NORTH BRANCH PIGEON RIVER | | | | | |
| At Main Street in Marion | 19.3 | * | * | 560 | * |
| PIGEON RIVER | | | | | |
| At Klemp Road Bridge | 116.0 | 2,400 | 3,500 | 4,000 | 5,200 |
| SOUTH BRANCH LITTLE WOLF RIVER | | | | | |
| At State Highway 49 | 76.0 | 1,900 | 2,500 | 2,700 | 3,400 |
| WAUPACA RIVER | | | | | |
| At confluence with Wolf River | 237.5 | 1,330 | 2,120 | 2,870 | 5,070 |
| Approximately 1,000 feet upstream of River Road | 233.2 | 1,330 | 2,120 | 2,870 | 5,070 |
| Approximately 2,500 feet upstream of Reek Road | 220.3 | 1,140 | 2,120 | 2,870 | 5,070 |
| Downstream of confluence with Crystal River | 201.7 | 800 | 2,120 | 2,870 | 5,070 |
| Anderson Road | 119.7 | 690 | 1,800 | 2,430 | 4,140 |
| WOLF RIVER | | | | | |
| At U.S. Highway 10 | 3,210.0 | 13,400 | 18,100 | 20,200 | 25,400 |
| Upstream of Soo Line Railroad | 2,860.0 | 13,300 | 18,000 | 20,000 | 25,200 |
| Upstream of confluence of Little Wolf River | 2,270.0 | 12,100 | 16,300 | 18,190 | 22,900 |
| Above confluence with Embarrass River Bypass | 1,564.0 | 9,400 | 12,700 | 14,150 | 17,800 |
| WOLF RIVER BYPASS CHANNEL | | | | | |
| Discharge in bypass channel and overland flow | * | 2,500 | 3,500 | 3,850 | 4,700 |

* Information Not Available

## 3.2 Hydraulic Analyses

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

For the Little Wolf River revision, cross sections were developed using the countywide 2-foot contours dated February 2005. Field survey information was obtained in January 2008 for the Big Falls Dam and County Trunk Highway G bridge and incorporated into the hydraulic model. Water-surface elevations were computed through the use of the USACE HEC-RAS 3.1.3 program (Reference 31). As no survey information was available downstream of the Big Falls Dam, the 1987 effective Unincorporated profile was used to set the bottom of channel in this area. The Big Falls Dam was modeled with the 12-foot tall tainter gate fully open for all flood events. Modeling indicated that the dam is overtopped for all modeled events above the 10-percent-annual chance occurrence. The downstream boundary condition for the Little Wolf River model was cross section AC from the effective FIS for all events.

For the Waupaca River revision, cross sections were developed using the countywide 2-foot contours dated February 2005. Field survey information was obtained in January 2008 for the twelve bridge structures and two dams and incorporated into the hydraulic model. Water-surface elevations were computed through the use of the USACE HEC-RAS 3.1.3 program (Reference 31). The Waupaca Lighting Plant Dam was modeled with a constant upstream reservoir elevation for all events. This elevation was 6-inches above the top of the two 10-foot tall tainter gates and at the top of the three 5-foot tall tainter gates (867.6 feet NAVD). The Weyauwega Dam was modeled with a constant reservoir elevation for the 10-, 2-, and 1-percent-annual chance events. This elevation was the normal high water elevation (770.3 feet NAVD) controlled by three 10-foot tall tainter gates. For the 0.2-percent-annual chance event, the three gates for the Weyauwega Dam were set fully open and the upstream reservoir elevation was determined to be 771.0 feet NAVD. The downstream boundary condition for the Waupaca River model was the 10-percent-annual chance elevation on the Wolf River at its confluence with the Waupaca River (752.7 feet NAVD).

The Wolf River 1987 effective model was converted to HEC-RAS by the WDNR. The converted model was updated to match the effective FIRM for floodway widths and distances between cross sections. WDNR provided a profile baseline and extended the downstream end of the model to the Winnebago County line using a HEC-RAS conversion of an October 1988 analysis completed by the WDNR. One LOMR in New London was incorporated into the HEC-RAS model as noted in Table 4.

Each incorporated community within, and the unincorporated areas of Waupaca County, with the exception of the City of Weyauwega and Villages of Big Falls, Embarrass, Iola, Ogdensburg, and Scandinavia, have a previously printed FIS report. The hydraulic analyses described in those reports have been compiled by waterway and summarized below.

In unincorporated Waupaca County, water-surface elevations of floods for the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program (Reference 21). Cross sections for the backwater analyses of the streams were field-surveyed and were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. Other cross sections were determined from USGS topographic maps. Starting elevations for the rivers were established by a normal depth analysis of the first cross section of the reach.

Crystal River – In the City of Waupaca, cross sections were obtained both from a field survey and by synthesized methods for the backwater analysis of the Crystal River. The synthesized cross sections were estimated from adjacent surveyed cross sections and topographic maps. Structural geometry and elevations for bridges were obtained from the field survey. Water-surface elevations for the 1-percent-annual-chance flood for streams were computed using WSPRO (Reference 25). The starting water-surface elevation was determined by the slope-conveyance method.

Embarrass River – In the City of New London, water-surface elevations were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 21). The water-surface elevation in the bypass channel of the Embarrass River is influenced by the backwater of the Wolf River and/or the flood stage of the Embarrass River. The anticipated upper limit elevations in this area are expected to be from 760 feet to 761 feet NAVD.

Honey Creek – In the City of Clintonville, cross sections for the flooding sources studied by detailed methods were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 22).

A 10-percent-annual-chance flood event starting water-surface elevation of 806.1 feet NAVD at the entrance of the 6th Street culvert was determined using "Hydraulic Charts for the Selection of Highway Culverts" (Reference 23). In using this chart, it was assumed that the event on the Pigeon River would be lower than the culvert exit elevation for a similar event. In addition, inlet control to the culvert was assumed, rendering roughness and culvert length as non-factors in its capacity to pass flow.

Little Wolf River – For the backwater analyses of the Little Wolf River in the City of Manawa, two cross sections were obtained from a field survey and two were synthesized. The synthesized sections were developed from adjacent surveyed sections and topographic maps. Structural geometry and elevations for one dam and

one bridge with a road section were also obtained from the field surveys. Cross sections were located above and below the bridge in order to compute the backwater effects of this structure.

In Manawa, water-surface elevations for the 1-percent annual chance flood were computed by WSPRO, a step-backwater computer program (Reference 25). The water-surface elevation at the corporate limits was determined by the slope-conveyance method. The water surface at the dam was obtained from the FIS for Waupaca County (Reference 26).

A dam breach analysis for Manawa Dam was completed by the WDNR. The National Weather Service model DMBRK (Reference 27) was used. The dam was assumed to breach at the time of overtopping of the earthen dike. The six gates on the left side of the concrete section of the dam were assumed to fail. The analysis showed that the flooding that would result from a dam breach would occur before the 1-percent-annual chance flood peak discharge and the resulting elevation would be less than the flood elevation caused by the 1-percent-annual chance discharge.

North Branch Pigeon River – In the City of Marion, cross sections for the North Branch Pigeon River hydraulic analysis were obtained from field surveys of the channel and topographic maps (Reference 28). Elevations and structural geometry for structures were also obtained by field survey. Water-surface elevations for the 1-percent-annual-chance flood were computed by WSPRO (Reference 25). The starting water-surface elevation for the section of the river downstream of Marion Dam was determined by the slope-conveyance method. The starting water-surface elevation at the dam is based on a discharge curve developed for the spillway. This study assumes four of the five gates of Marion Dam are blocked.

Pigeon River – In the City of Clintonville, cross sections for the flooding sources studied by detailed methods were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 22).

A spilt-flow modeling alternative was chosen on one reach of the Pigeon River in Clintonville. It assumed three segments of flow: through Lyons Street bridge, its culverts, and over Lyons Street. The culverts were modeled with the HEC-2 special culvert routine, assuming outlet control. The culverts were not modeled as being skewed due to the orientation of their openings as compared to the bridge opening. Water overtopping the river bank passes over Lyons Street north of the bridge, it then turns and flows south between the old railroad grade and the Lyons Street embankment to join the rest of the flow.

Through hydraulic analyses on the Pigeon River in Clintonville, the tainter gates at the dam were found to have the capacity to maintain normal pool (806.6 feet NAVD) during the 10-percent annual-chance flood. A split-flow analysis using the HEC-2 special bridge routine was run, assuming the tainter gates fully open. The results confirmed the capacity of the dam. For this model, an X5 card was used to force a

water-surface elevation at the upstream face of the dam. Some increases above normal pool would be expected due to delay in opening the gates; therefore, an elevation of 806.9 feet NAVD was chosen to reflect this condition. The starting water-surface elevation at the exit section for Klemp Street Bridge was determined by slope/area method (normal depth). An energy slope was estimated by computing the slope of the water surface. This was determined by using water-surface elevations obtained on April 7, 1992 at the Klemp Street Bridge.

Upon the City of Clintonville's implementation of the Dam Action Plan, it is assumed that during the event of a flood, all of the gates on the dam will work properly and remain fully open to pass maximum flow.

Wolf River – In the Village of Fremont, water surface elevations were computed utilizing the USACE HEC-2 step-backwater computer program with modification number 58 (Reference 21). Several surveyed cross sections were taken downstream and upstream of the corporate limits. The upstream sections were provided by Carl C. Crane, Inc. (Reference 18).

Stream mileages for the Wolf River in the Village of Fremont were matched with the published Flood Plain Information Report and the FIS in Waupaca County (Reference 18). All distances were measured on recent topographic maps (Reference 24).

In Fremont the 1973 historical flood was used as the basis for constructing the hydraulic computer model. High-water marks from 1976 checked favorably with the computed 10-percent-annual-chance flood event. The old U.S. Highway 10 Bridge was incorporated in this model but, in subsequent and final computations, the superstructure and piers of this structure were removed and the new structure was utilized. Although the actual discharge is an estimate, the "n" values and flow areas compared closely to expected values. Elevations for Partridge Lake are directly related to the Wolf River.

In the City of New London, water-surface elevations were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 21). Stream mileages for the Wolf River were matched with the published Flood Plain Information Report (Reference 10) and the FIS in Waupaca County (Reference 18). All distances were measured on recent topographic maps (Reference 29). All computed elevations on the Wolf River were compared with the USGS Survey gage. The 1973 historical flood was used as the basis for constructing the hydraulic model.

For the 1987 revisions of the Waupaca County and Village of Fremont FIS, the WDNR input the new 1-percent-annual chance peak discharges into the HEC-2 step-backwater computer program (Reference 30) used for the original FIS. The WDNR made no other changes to the original HEC-2 model as all previous assumptions were still considered valid. A revised 1-percent-annual chance flood profile was drawn as a result of the updated HEC-2 analysis.

Roughness factors (Manning's "n" values) used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 6, "Manning's “n” Values."

**TABLE 6 - MANNING'S “n” VALUES**

| Stream | Channel “n” | Overbank “n” |
|---|---|---|
| Crystal River | 0.030 – 0.080 | * |
| Honey Creek | 0.035 | 0.030 – 0.060 |
| Embarrass River | * | * |
| Little Wolf River | 0.035 – 0.045 | 0.030 – 0.100 |
| North Branch Pigeon River | 0.030 – 0.045 | 0.030 – 0.045 |
| Pigeon River | 0.036 – 0.064 | 0.032 – 0.092 |
| South Branch Little Wolf River | * | * |
| Waupaca River | 0.030 – 0.045 | 0.030 – 0.150 |
| Wolf River | 0.028 – 0.040 | 0.030 – 0.150 |

* Information Not Available

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 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 used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Waupaca County is -0.1 feet. This translates in Waupaca County to (NGVD – 0.1) = NAVD. WISCON was used to determine the conversion factor (build v2.2 (06/01/2003)).

For additional information regarding conversion between the NGVD29 and NAVD88, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey 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. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1-percent-annual chance and 0.2-percent-annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

### 4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance 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 this countywide study, the 1- and 0.2-percent annual chance floodplain boundaries were delineated using a digital terrain model that meets the National Map Accuracy Standards for mapping at a scale of 1:4,800 (Reference 32).

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-perent 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 base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, Wisconsin has established a more strict policy and does not allow any increase in the regional flood height for flood fringe developments (Reference 33).

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 7, “Floodway Data”). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Please note portions of the floodway for the Embarrass River extend beyond the county boundary.

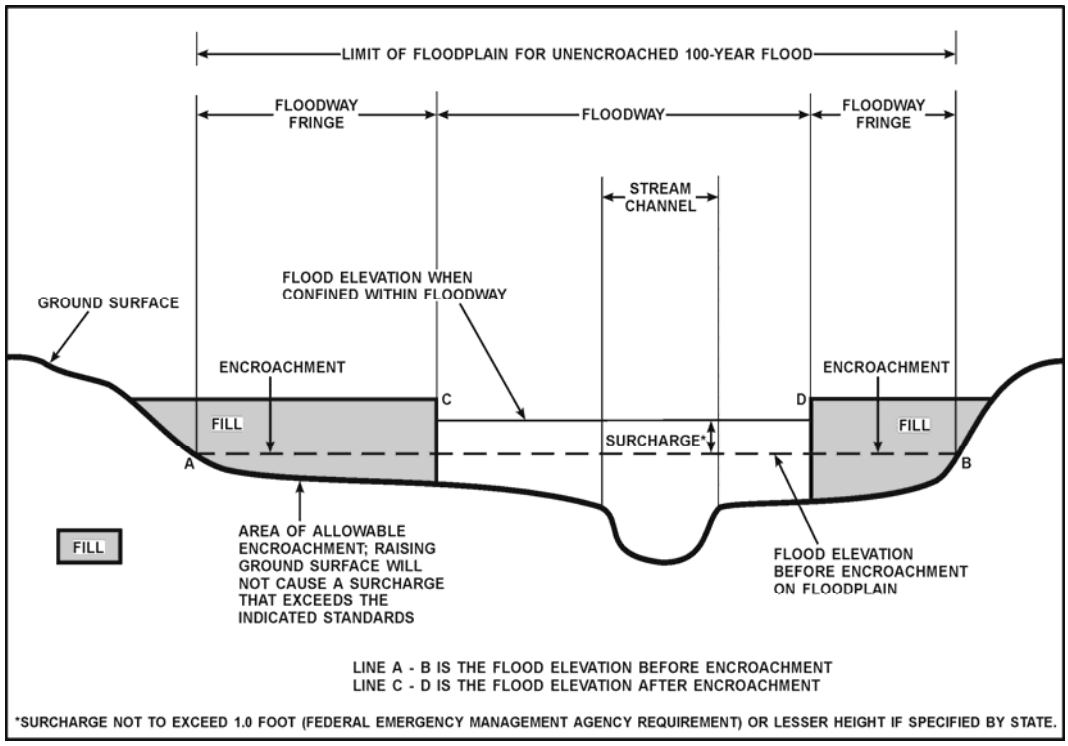
The following stream reaches have detailed flooding, but do not have floodways in Waupaca County: Honey Creek downstream of cross section A, Little Wolf River between cross sections M and P, North Branch Pigeon River upstream of Main Street, and the Pigeon River between cross sections Q and U.

In the redelineation efforts, the floodways were not recalculated. As a result, there were areas where the previous floodway did not fit within the boundaries of the redelineated 1-percent-annual chance floodplain. In these areas, the floodway was

reduced. Water surface elevations, with and without a floodway, the mean velocity in the floodway, and the location and area at each surveyed cross section as determined by the hydraulic methods can be seen in Table 7. The width of the floodway depicted by the FIRM panels and the amount of reduction to fit the floodway inside the 1-percent annual chance floodplain, if necessary, is also listed.

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

FIGURE 1 - FLOODWAY SCHEMATIC



| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| CRYSTAL RIVER | | | | | | | | | |
| A | 6,992 | 99 | 656 | 1.8 | 85 | 809.9 | 809.9 | 809.9 | 0.0 |
| B | 8,583 | 47 | 213 | 5.6 | 0 | 812.9 | 812.9 | 812.9 | 0.0 |
| C | 9,719 | 350 | 2,507 | 0.5 | 0 | 826.8 | 826.8 | 826.8 | 0.0 |
| D | 11,588 | 322 | 1,960 | 0.6 | 0 | 826.8 | 826.8 | 826.8 | 0.0 |
| E | 13,014 | 149 | 728 | 1.6 | 0 | 827.0 | 827.0 | 827.0 | 0.0 |
| F | 13,160 | 98 | 589 | 2 | 0 | 828.0 | 828.0 | 828.0 | 0.0 |
| G | 14,445 | 466 | 2,636 | 0.5 | 0 | 828.4 | 828.4 | 828.4 | 0.0 |
| H | 15,613 | 620 | 2,927 | 0.3 | 0 | 828.5 | 828.5 | 828.5 | 0.0 |
| I | 21,232 | 375 | 1,320 | 2.8 | 25 | 828.5 | 828.5 | 828.5 | 0.0 |
| J | 24,755 | 330 | 2,190 | 1.8 | 0 | 829.5 | 829.5 | 829.5 | 0.0 |
| K | 27,634 | 130 | 790 | 3.9 | 0 | 830.9 | 830.9 | 830.9 | 0.0 |
| L | 32,828 | 181 | 1,310 | 2.6 | 39 | 835.3 | 835.3 | 835.3 | 0.0 |
| M | 35,521 | 70 | 200 | 9.5 | 0 | 836.8 | 836.8 | 836.8 | 0.0 |
| N | 38,031 | 80 | 750 | 3.1 | 0 | 841.4 | 841.4 | 841.4 | 0.0 |
| O | 38,180 | 86 | 780 | 3.3 | 44 | 841.5 | 841.5 | 841.5 | 0.0 |
| P | 40,634 | * | * | * | * | 848.4 | 848.4 | * | 0.0 |
| Q | 42,647 | 80 | 3,780 | 0.9 | 0 | 849.2 | 849.2 | 849.2 | 0.0 |
| R | 44,526 | 150 | 1,090 | 3.5 | 0 | 852.1 | 852.1 | 852.1 | 0.0 |
| S | 45,369 | 140 | 180 | 10.2 | 0 | 852.4 | 852.4 | 852.4 | 0.0 |
| T | 46,283 | 52 | 730 | 2.9 | 38 | 855.6 | 855.6 | 855.6 | 0.0 |
| U | 48,690 | 180 | 620 | 3.7 | 0 | 858.7 | 858.7 | 858.7 | 0.0 |
| V | 50,593 | 90 | 490 | 3.9 | 0 | 860.0 | 860.0 | 860.0 | 0.0 |
| W | 52,670 | 63 | 550 | 3.7 | 37 | 865.8 | 865.8 | 865.8 | 0.0 |
| X | 55,857 | 85 | 830 | 3.6 | 0 | 872.3 | 872.3 | 872.3 | 0.0 |
| Y | 56,621 | 30 | 220 | 7.5 | 50 | 873.7 | 873.7 | 873.7 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WAUPACA RIVER; *DATA NOT APPLICABLE, CROSS SECTION LOCATED IN AREA OF BACKWATER FROM MAN-MADE IMPOUNDMENT

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## CRYSTAL RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| CRYSTAL RIVER (CONTINUED) | | | | | | | | | |
| Z | 57,694[1] | 230 | 540 | 3.0 | 0 | 876.1 | 876.1 | 876.1 | 0.0 |
| AA | 61,906[1] | 120 | 340 | 8.6 | 0 | 885.4 | 885.4 | 885.4 | 0.0 |
| EMBARRASS RIVER | | | | | | | | | |
| A | 2,870[2] | 1,670 | 4,465 | 1.6 | 0 | 760.6[3] | 760.5[5] | 760.5[5] | 0.0 |
| B | 3,604[2] | 1,235 | 3,290 | 2.2 | 25 | 760.7 | 760.7 | 760.7 | 0.0 |
| C | 3,683[2] | 1,200 | 5,185 | 1.4 | 0 | 760.9 | 760.9 | 760.9 | 0.0 |
| D | 3,789[2] | 1,200 | 3,645 | 2.0 | 0 | 760.9 | 760.9 | 760.9 | 0.0 |
| E | 5,110[2] | 230 | 1,985 | 3.7 | 0 | 761.1 | 761.1 | 761.1 | 0.0 |
| F | 5,197[2] | 180 | 2,040 | 3.6 | 0 | 761.4 | 761.4 | 761.4 | 0.0 |
| G | 5,263[2] | 220 | 2,483 | 2.9 | 0 | 761.4 | 761.4 | 761.4 | 0.0 |
| H | 6,624[2] | 650 | 5,070 | 1.5 | 0 | 761.8 | 761.8 | 761.8 | 0.0 |
| HONEY CREEK | | | | | | | | | |
| A | 1,836[4] | 110 | 320 | 1.3 | 0 | 811.9 | 811.9 | 811.9 | 0.0 |
| B | 2,172[4] | 40 | 225 | 1.7 | 0 | 812.0 | 812.0 | 812.0 | 0.0 |
| C | 2,403[4] | 110 | 1,230 | 0.5 | 0 | 815.7 | 815.7 | 815.7 | 0.0 |
| D | 2,697[4] | 200 | 1,380 | 0.4 | 0 | 815.7 | 815.7 | 815.7 | 0.0 |
| E | 3,621[4] | 200 | 840 | 0.5 | 0 | 815.7 | 815.7 | 815.7 | 0.0 |
| F | 4,240[4] | 110 | 330 | 1.2 | 0 | 815.7 | 815.7 | 815.7 | 0.0 |
| LITTLE WOLF RIVER | | | | | | | | | |
| A | 10,454[2] | 141 | 2,020 | 3.3 | 39 | 759.9 | 759.9 | 759.9 | 0.0 |
| B | 12,704[2] | 243 | 1,080 | 5.6 | 47 | 760.9 | 760.9 | 760.9 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WAUPACA RIVER; [2]FEET ABOVE CONFLUENCE WITH WOLF RIVER; [3]FLOODING CONTROLLED BY WOLF RIVER

[4]FEET ABOVE CONFLUENCE WITH PIGEON RIVER; [5]ELEVATION COMPUTED WITHOUT CONSIDERATION OF FLOODING CONTROLLED BY WOLF RIVER

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

**CRYSTAL RIVER - EMBARRASS RIVER - HONEY CREEK - LITTLE WOLF RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| LITTLE WOLF RIVER (CONTINUED) | | | | | | | | | |
| C | 15,860 | 220 | 1,090 | 5.6 | 0 | 765.1 | 765.1 | 765.1 | 0.0 |
| D | 17,837 | 140 | 1,770 | 3.5 | 0 | 770.6 | 770.6 | 770.6 | 0.0 |
| E | 19,732 | 156 | 1,000 | 6.2 | 74 | 771.4 | 771.4 | 771.4 | 0.0 |
| F | 23,277 | 219 | 1,240 | 4.9 | 41 | 775.4 | 775.4 | 775.4 | 0.0 |
| G | 27,678 | 430 | 1,320 | 4.6 | 0 | 778.1 | 778.1 | 778.1 | 0.0 |
| H | 29,602 | 200 | 2,020 | 3.2 | 0 | 778.8 | 778.8 | 778.8 | 0.0 |
| I | 31,203 | 160 | 564 | 10.8 | 0 | 778.9 | 778.9 | 778.9 | 0.0 |
| J | 31,975 | 139 | 1,190 | 5.4 | 31 | 782.6 | 782.6 | 782.6 | 0.0 |
| K | 34,062 | 280 | 1,500 | 4.6 | 0 | 784.0 | 784.0 | 784.0 | 0.0 |
| L | 71,883 | 619 | 2,985 | 2.1 | 0 | 808.0 | 808.0 | 808.0 | 0.0 |
| M | 72,439 | 184 | 2,055 | 3.1 | 0 | 808.7 | 808.7 | 808.7 | 0.0 |
| N | 75,187 | * | * | * | * | 814.5 | 814.5 | * | 0.0 |
| O | 78,764 | * | * | * | * | 814.6 | 814.6 | * | 0.0 |
| P | 82,365 | * | * | * | * | 814.8 | 814.8 | * | 0.0 |
| Q | 99,264 | 177 | 875 | 9.2 | 33 | 814.7 | 814.7 | 814.7 | 0.0 |
| R | 100,461 | 250 | 1,000 | 5.7 | 0 | 819.2 | 819.2 | 819.2 | 0.0 |
| S | 100,953 | 100 | 1,015 | 5.6 | 0 | 820.1 | 820.1 | 820.1 | 0.0 |
| T | 101,890 | 260 | 1,640 | 5.0 | 0 | 822.5 | 822.5 | 822.5 | 0.0 |
| U | 102,863 | 1,202 | 5,153 | 1.9 | 48 | 823.3 | 823.3 | 823.3 | 0.0 |
| V | 155,126 | 223 | 1,090 | 4.9 | 47 | 854.8 | 854.8 | 854.8 | 0.0 |
| W | 156,803 | 220 | 1,570 | 3.5 | 40 | 855.6 | 855.6 | 855.6 | 0.0 |
| X | 162,749 | 280 | 890 | 5.6 | 0 | 859.3 | 859.3 | 859.3 | 0.0 |
| Y | 166,029 | 250 | 1,780 | 3.2 | 0 | 860.5 | 860.5 | 860.5 | 0.0 |
| Z | 168,157 | 140 | 2,500 | 3.5 | 0 | 864.6 | 864.6 | 864.6 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WOLF RIVER; *DATA NOT APPLICABLE, CROSS SECTION LOCATED IN AREA OF BACKWATER FROM MAN-MADE IMPOUNDMENT

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## LITTLE WOLF RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| LITTLE WOLF RIVER (CONTINUED) | | | | | | | | | |
| AA | 168,672[1] | 130 | 560 | 8.6 | 0 | 867.9 | 867.9 | 867.9 | 0.0 |
| AB | 170,338[1] | 153 | 700 | 10.5 | 97 | 870.6 | 870.6 | 870.6 | 0.0 |
| AC | 170,870[1] | 290 | 1,290 | 4.5 | 0 | 873.3 | 873.3 | 873.3 | 0.0 |
| AD | 173,273[1] | 174 | 967 | 5.3 | 76 | 875.5 | 875.5 | 875.5 | 0.0 |
| AE | 175,846[1] | 409 | 1,510 | 2.9 | 0 | 878.5 | 878.5 | 878.5 | 0.0 |
| AF | 176,800[1] | 199 | 2,326 | 3.2 | 0 | 880.0 | 880.0 | 880.0 | 0.0 |
| AG | 177,470[1] | 145 | 2,904 | 2.1 | 0 | 905.8 | 905.8 | 905.8 | 0.0 |
| AH | 177,950[1] | 428 | 5,427 | 0.8 | 0 | 907.1 | 907.1 | 907.1 | 0.0 |
| AI | 179,895[1] | 536 | 3,303 | 1.3 | 0 | 907.8 | 907.8 | 907.8 | 0.0 |
| AJ | 182,398[1] | 315 | 2,064 | 2.1 | 0 | 909.0 | 909.0 | 909.0 | 0.0 |
| AK | 187,276[1] | 300 | 2,670 | 2.5 | 0 | 923.7 | 923.7 | 923.7 | 0.0 |
| AL | 191,077[1] | 250 | 1,720 | 3.3 | 0 | 925.0 | 925.0 | 925.0 | 0.0 |
| AM | 194,303[1] | 240 | 2,160 | 4.0 | 0 | 927.7 | 927.7 | 927.7 | 0.0 |
| AN | 253,440[1] | 190 | 820 | 9.1 | 50 | 1,050.4 | 1,050.4 | 1,050.4 | 0.0 |
| AO | 255,782[1] | 660 | 880 | 3.6 | 0 | 1,056.8 | 1,056.8 | 1,056.8 | 0.0 |
| AP | 256,331[1] | 140 | 1,020 | 4.5 | 0 | 1,057.8 | 1,057.8 | 1,057.8 | 0.0 |
| AQ | 257,448[1] | 530 | 2,200 | 4.1 | 0 | 1,058.5 | 1,058.5 | 1,058.5 | 0.0 |
| NORTH BRANCH PIGEON RIVER | | | | | | | | | |
| A | 25,030[2] | 218 | 295 | 1.9 | 0 | 834.0 | 834.0 | 834.0 | 0.0 |
| B | 25,912[2] | 93 | 393 | 1.4 | 197 | 834.7 | 834.7 | 834.7 | 0.0 |
| C | 26,998[2] | 182 | 172 | 3.2 | 27 | 836.3 | 836.3 | 836.3 | 0.0 |
| D | 27,657[2] | 144 | 372 | 1.5 | 88 | 837.4 | 837.4 | 837.4 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WOLF RIVER; [2]FEET ABOVE CONFLUENCE WITH PIGEON RIVER

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## LITTLE WOLF RIVER - NORTH BRANCH PIGEON RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| NORTH BRANCH PIGEON RIVER (CONTINUED) | | | | | | | | | |
| E | 27,923[1] | 88 | 438 | 1.3 | 168 | 841.0 | 841.0 | 841.0 | 0.0 |
| F | 28,351[1] | 107 | 459 | 1.2 | 28 | 841.1 | 841.1 | 841.1 | 0.0 |
| PIGEON RIVER | | | | | | | | | |
| A | 10,138[2] | 240 | 1465 | 3.6 | 0 | 794.2 | 794.2 | 794.2 | 0.0 |
| B | 12,239[2] | 750 | 3,850 | 1.8 | 0 | 794.8 | 794.8 | 794.8 | 0.0 |
| C | 15,115[2] | 480 | 2,230 | 2.9 | 0 | 795.7 | 795.7 | 795.7 | 0.0 |
| D | 18,102[2] | 800 | 21,750 | 3.2 | 70 | 797.6 | 797.6 | 797.6 | 0.0 |
| E | 20,995[2] | 453 | 2,328 | 2.6 | 0 | 799.3 | 799.3 | 799.3 | 0.0 |
| F | 22,107[2] | 657 | 3,904 | 1.7 | 36 | 800.1 | 800.1 | 800.1 | 0.0 |
| G | 23,759[2] | 463 | 1,511 | 3.8 | 0 | 800.6 | 800.6 | 800.6 | 0.0 |
| H | 24,099[2] | 468 | 2,566 | 1.8 | 0 | 802.3 | 802.3 | 802.3 | 0.0 |
| I | 25,454[2] | 989 | 4,300 | 1.2 | 41 | 802.7 | 802.7 | 802.7 | 0.0 |
| J | 26,109[2] | 550 | 2,250 | 2.5 | 0 | 802.7 | 802.7 | 802.7 | 0.0 |
| K | 26,833[2] | 100 | 690 | 6.2 | 0 | 803.6 | 803.6 | 803.6 | 0.0 |
| L | 27,138[2] | 134 | 700 | 6.4 | 36 | 804.9 | 804.9 | 804.9 | 0.0 |
| M | 27,459[2] | 130 | 1,560 | 2.6 | 0 | 805.9 | 805.9 | 805.9 | 0.0 |
| N | 27,527[2] | 94 | 1,130 | 3.5 | 41 | 806.9 | 806.9 | 806.9 | 0.0 |
| O | 27,891[2] | 190 | 1,940 | 2.1 | 0 | 808.4 | 808.4 | 808.4 | 0.0 |
| P | 28,852[2] | 430 | 1,960 | 2.1 | 0 | 808.6 | 808.6 | 808.6 | 0.0 |
| Q | 30,084[2] | 302 | 2,790 | 1.5 | 118 | 808.9 | 808.9 | 808.9 | 0.0 |
| R | 34,060[2] | * | * | * | * | 808.9 | 808.9 | * | 0.0 |
| S | 36,813[2] | * | * | * | * | 808.9 | 808.9 | * | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH PIGEON RIVER; [2]FEET ABOVE CONFLUENCE WITH EMBARRASS RIVER; *DATA NOT APPLICABLE, CROSS SECTION LOCATED IN AREA OF BACKWATER FROM MAN-MADE IMPOUNDMENT

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## NORTH BRANCH PIGEON RIVER - PIGEON RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| PIGEON RIVER (CONTINUED) | | | | | | | | | |
| T | 38,947[1] | * | * | * | * | 808.9 | 808.9 | * | 0.0 |
| U | 42,524[1] | 278 | 760 | 10.8 | 132 | 809.4 | 809.4 | 809.4 | 0.0 |
| V | 45,419[1] | 372 | 2950 | 4.0 | 48 | 813.4 | 813.4 | 813.4 | 0.0 |
| SOUTH BRANCH LITTLE WOLF RIVER | | | | | | | | | |
| A | 122,232[2] | 39 | 1,860 | 2.7 | 261 | 899.3 | 899.3 | 899.3 | 0.0 |
| B | 124,580[2] | 120 | 3,440 | 1.1 | 0 | 906.1 | 906.1 | 906.1 | 0.0 |
| C | 126,955[2] | 200 | 1,000 | 3.2 | 0 | 908.9 | 908.9 | 908.9 | 0.0 |
| D | 128,795[2] | 26 | 690 | 4.1 | 114 | 909.5 | 909.5 | 909.5 | 0.0 |
| E | 131,177[2] | 140 | 600 | 7.2 | 0 | 912.7 | 912.7 | 912.7 | 0.0 |
| WAUPACA RIVER | | | | | | | | | |
| A | 20,257[3] | 662 | 1,797 | 1.6 | 0 | 756.0 | 756.0 | 756.0 | 0.0 |
| B | 25,847[3] | 207 | 1,079 | 2.7 | 0 | 758.2 | 758.2 | 758.2 | 0.0 |
| C | 30,806[3] | 119 | 749 | 3.8 | 0 | 760.5 | 760.5 | 760.5 | 0.0 |
| D | 34,504[3] | 2,101 | 22,089 | 0.1 | 0 | 770.8 | 770.8 | 770.8 | 0.0 |
| E | 41,100[3] | 77 | 469 | 6.1 | 0 | 771.2 | 771.2 | 771.2 | 0.0 |
| F | 47,345[3] | 771 | 2,431 | 1.2 | 0 | 776.3 | 776.3 | 776.3 | 0.0 |
| G | 51,391[3] | 838 | 2,539 | 1.1 | 0 | 778.2 | 778.2 | 778.2 | 0.0 |
| H | 54,316[3] | 164 | 632 | 4.5 | 0 | 778.7 | 778.7 | 778.7 | 0.0 |
| I | 55,914[3] | 402 | 1,220 | 2.4 | 0 | 781.1 | 781.1 | 781.1 | 0.0 |
| J | 59,107[3] | 954 | 2,037 | 1.4 | 0 | 782.3 | 782.3 | 782.3 | 0.0 |
| K | 64,210[3] | 197 | 969 | 3.0 | 0 | 785.1 | 785.1 | 785.1 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH EMBARRASS RIVER; [2]FEET ABOVE CONFLUENCE WITH LITTLE WOLF RIVER; [3]FEET ABOVE CONFLUENCE WITH WOLF RIVER

*DATA NOT APPLICABLE, CROSS SECTION LOCATED IN AREA OF BACKWATER FROM MAN-MADE IMPOUNDMENT

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

**PIGEON RIVER - SOUTH BRANCH LITTLE WOLF RIVER - WAUPACA RIVER**

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WAUPACA RIVER (CONTINUED) | | | | | | | | | |
| L | 70,819 | 154 | 955 | 3.0 | 0 | 788.5 | 788.5 | 788.5 | 0.0 |
| M | 75,529 | 595 | 1,898 | 1.5 | 0 | 790.7 | 790.7 | 790.7 | 0.0 |
| N | 79,549 | 305 | 827 | 3.5 | 0 | 792.9 | 792.9 | 792.9 | 0.0 |
| O | 83,886 | 394 | 1,072 | 2.7 | 0 | 796.9 | 796.9 | 796.9 | 0.0 |
| P | 86,224 | 498 | 1,066 | 2.3 | 0 | 799.5 | 799.5 | 799.5 | 0.0 |
| Q | 89,741 | 337 | 934 | 2.6 | 0 | 804.2 | 804.2 | 804.2 | 0.0 |
| R | 92,839 | 156 | 379 | 6.4 | 0 | 809.1 | 809.1 | 809.1 | 0.0 |
| S | 95,053 | 400 | 1,254 | 1.9 | 0 | 814.3 | 814.3 | 814.3 | 0.0 |
| T | 97,319 | 180 | 566 | 4.3 | 0 | 816.0 | 816.0 | 816.0 | 0.0 |
| U | 100,608 | 549 | 1,238 | 2.0 | 0 | 821.1 | 821.1 | 821.1 | 0.0 |
| V | 103,426 | 765 | 2,584 | 1.4 | 0 | 825.2 | 825.2 | 825.2 | 0.0 |
| W | 105,964 | 170 | 709 | 3.4 | 0 | 831.4 | 831.4 | 831.4 | 0.0 |
| X | 106,855 | 190 | 1,029 | 2.4 | 0 | 835.4 | 835.4 | 835.4 | 0.0 |
| Y | 108,317 | 235 | 882 | 2.8 | 0 | 837.3 | 837.3 | 837.3 | 0.0 |
| Z | 109,324 | 64 | 314 | 7.7 | 0 | 843.7 | 843.7 | 843.7 | 0.0 |
| AA | 110,000 | 139 | 585 | 4.2 | 0 | 845.5 | 845.5 | 845.5 | 0.0 |
| AB | 111,317 | 424 | 3,498 | 0.7 | 0 | 867.6 | 867.6 | 867.6 | 0.0 |
| AC | 112,803 | 218 | 672 | 3.6 | 0 | 870.8 | 870.8 | 870.8 | 0.0 |
| AD | 113,816 | 492 | 1,361 | 1.8 | 0 | 872.5 | 872.5 | 872.5 | 0.0 |
| AE | 115,336 | 447 | 915 | 2.7 | 0 | 875.5 | 875.5 | 875.5 | 0.0 |
| AF | 117,606 | 465 | 1,108 | 2.2 | 0 | 878.2 | 878.2 | 878.2 | 0.0 |
| AG | 119,315 | 267 | 512 | 5.8 | 0 | 882.4 | 882.4 | 882.4 | 0.0 |
| AH | 121,209 | 769 | 3,145 | 0.8 | 0 | 888.4 | 888.4 | 888.4 | 0.0 |
| AI | 124,809 | 1,204 | 3,897 | 0.6 | 0 | 889.5 | 889.5 | 889.5 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WOLF RIVER

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## WAUPACA RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WAUPACA RIVER (CONTINUED) | | | | | | | | | |
| AJ | 126,293[1] | 456 | 1,832 | 1.3 | 0 | 892.8 | 892.8 | 892.8 | 0.0 |
| WOLF RIVER | | | | | | | | | |
| A | 37,440[2] | 944 | 10,159 | 2.4 | 0 | 753.6 | 753.6 | 753.6 | 0.0 |
| B | 38,940[2] | 849 | 5,868 | 3.4 | 0 | 753.8 | 753.8 | 753.8 | 0.0 |
| C | 39,940[2] | 390 | 6,397 | 3.5 | 0 | 754.0 | 754.0 | 754.0 | 0.0 |
| D | 40,460[2] | 475 | 7,248 | 2.8 | 47 | 754.2 | 754.2 | 754.2 | 0.0 |
| E | 40,826[2] | 439 | 6,855 | 3.1 | 0 | 754.2 | 754.2 | 754.2 | 0.0 |
| F | 42,676[2] | 400 | 13,631 | 3.3 | 0 | 754.4 | 754.4 | 754.4 | 0.0 |
| G | 42,913[2] | 400 | 13,715 | 3.3 | 0 | 754.4 | 754.4 | 754.4 | 0.0 |
| H | 43,238[2] | 375 | 9,279 | 3.5 | 0 | 754.5 | 754.5 | 754.5 | 0.0 |
| I | 45,070[2] | 2,123 | 23,804 | 1.0 | 0 | 754.8 | 754.8 | 754.8 | 0.0 |
| J | 82,783[2] | 4,000 | 46,460 | 0.6 | 0 | 756.1 | 756.1 | 756.1 | 0.0 |
| K | 96,383[2] | 5,650 | 44,476 | 0.5 | 0 | 756.2 | 756.2 | 756.2 | 0.0 |
| L | 119,783[2] | 6,300 | 77,572 | 0.3 | 0 | 756.3 | 756.3 | 756.3 | 0.0 |
| M | 132,633[2] | 1,347 | 11,788 | 2.3 | 0 | 756.3 | 756.3 | 756.3 | 0.0 |
| N | 139,233[2] | 4,100 | 32,741 | 0.6 | 0 | 757.2 | 757.2 | 757.2 | 0.0 |
| O | 151,553[2] | 300 | 5,214 | 4.4 | 0 | 758.5 | 758.5 | 758.5 | 0.0 |
| P | 158,915[2] | 3,282 | 23,697 | 0.8 | 0 | 759.2 | 759.2 | 759.2 | 0.0 |
| Q | 162,415[2] | 3,900 | 31,419 | 0.8 | 0 | 759.3 | 759.3 | 759.3 | 0.0 |
| R | 166,565[2] | 1,250 | 28,599 | 2.3 | 0 | 759.7 | 759.7 | 759.7 | 0.0 |
| S | 166,665[2] | 1,135 | 6,453 | 2.2 | 0 | 759.7 | 759.7 | 759.7 | 0.0 |
| T | 167,075[2] | 760 | 5,445 | 2.7 | 0 | 759.8 | 759.8 | 759.8 | 0.0 |
| U | 167,445[2] | 478 | 4,578 | 3.2 | 0 | 759.8 | 759.8 | 759.8 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH WOLF RIVER; [2]FEET ABOVE CONFLUENCE WITH LAKE POYGAN

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## WAUPACA RIVER - WOLF RIVER

| FLOODING SOURCE | | FLOODWAY | | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88) | | | |
|---|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | WIDTH REDUCED FROM PRIOR STUDY (FEET) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| WOLF RIVER (CONTINUED) | | | | | | | | | |
| V | 168,150 | 370 | 7,417 | 3.3 | 0 | 759.9 | 759.9 | 759.9 | 0.0 |
| W | 169,510 | 280 | 5,055 | 3.4 | 0 | 760.1 | 760.1 | 760.1 | 0.0 |
| X | 169,629 | 240 | 5,608 | 3.4 | 0 | 760.1 | 760.1 | 760.1 | 0.0 |
| Y | 169,780 | 240 | 5,390 | 3.8 | 0 | 760.1 | 760.1 | 760.1 | 0.0 |
| Z | 170,310 | 205 | 4,254 | 3.9 | 0 | 760.1 | 760.1 | 760.1 | 0.0 |
| AA | 170,900 | 218 | 4,244 | 3.7 | 0 | 760.2 | 760.2 | 760.2 | 0.0 |
| AB | 171,164 | 205 | 4,263 | 3.9 | 0 | 760.2 | 760.2 | 760.2 | 0.0 |
| AC | 171,355 | 250 | 3,365 | 4.6 | 0 | 760.2 | 760.2 | 760.2 | 0.0 |

[1]FEET ABOVE CONFLUENCE WITH LAKE POYGAN

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACACOUNTY, WI**

**AND INCORPORATED AREAS**

# FLOODWAY DATA

## WOLF RIVER

## 5.0 INSURANCE APPLICATION

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

Zone A

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

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the FIS by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, and to 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 base flood elevations or depths are shown within this zone.

## 6.0 FLOOD INSURANCE RATE MAP

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

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

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

The countywide FIRM presents flooding information for the entire geographic area of Waupaca 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 (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 8, "Community Map History."

| COMMUNITY NAME | INITIAL IDENTIFICATION | FLOOD HAZARD BOUNDARY MAP REVISION DATE(S) | FLOOD INSURANCE RATE MAP EFFECTIVE DATE | FLOOD INSURANCE RATE MAP REVISION DATE(S) |
|---|---|---|---|---|
| Big Falls, Village of | August 30, 1974 | May 28, 1976 | N/A | None |
| Clintonville, City of | July 30, 1976 | None | September 19, 1984 | November 16, 1995 |
| Embarrass, Village of | December 17, 1973 | May 21, 1976 | June 17, 1986 | None |
| Fremont, Village of | November 30, 1973 | None | June 15, 1977 | January 2, 1987 |
| Iola, Village of | June 7, 1974 | May 14, 1976 | September 4, 1985 | None |
| Manawa, City of | November 30, 1973 | May 28, 1976 | May 4, 1988 | None |
| Marion, City of | June 7, 1974 | July 2, 1976 | May 4, 1988 | None |
| New London, City of | November 9, 1973 | None | March 15, 1977 | None |
| Ogdensburg, Village of | August 23, 1974 | May 28, 1976 | N/A | None |
| Scandinavia, Village of | January 20, 2010 | None | January 20, 2010 | None |
| Waupaca County (Unincorporated Areas) | August 15, 1977 | None | February 17, 1978 | January 2, 1987 |
| Waupaca, City of | December 28, 1973 | None | August 3, 1989 | None |
| Weyauwega, City of | December 17, 1973 | September 3, 1976 | July 1, 1987 | None |

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI AND INCORPORATED AREAS**

**COMMUNITY MAP HISTORY**

## 7.0 OTHER STUDIES

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

The Countywide studies for Outagamie, Winnebago, and Portage County, Wisconsin, are in progress and might impact the information presented in this countywide FIS report.

## 8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting Federal Insurance and Mitigation Division, FEMA Region V, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605.

## 9.0 BIBLIOGRAPHY AND REFERENCES


1. Federal Emergency Management Agency, Flood Insurance Administration. (1987). Flood Insurance Study, Waupaca County, Unincorporated Areas, Wisconsin.

2. U.S. Army Corps of Engineers, Chicago District. (1971). Flood Plain Information Report, Pigeon River, Clintonville, Wisconsin.

3. Federal Emergency Management Agency, Flood Insurance Administration. (1995). Flood Insurance Study, City of Clintonville, Wisconsin .

4. Federal Emergency Management Agency, Flood Insurance Administration. (1987). Flood Insurance Study, Village of Fremont, Wisconsin.

5. Federal Emergency Management Agency, Flood Insurance Administration. (1988). Flood Insurance Study, City of Manawa, Wisconsin.

6. Federal Emergency Management Agency, Flood Insurance Administration. (1988). Flood Insurance Study, City of Marion, Wisconsin.

7. Federal Emergency Management Agency, Flood Insurance Administration. (1976). Flood Insurance Study, City of New London, Wisconsin.

8. Federal Emergency Management Agency, Flood Insurance Administration. (1989). Flood Insurance Study, City of Waupaca, Wisconsin.

9. U.S. Department of Commerce, Bureau of the Census. (1990, 2000). Census of Population, Wisconsin, Washington, D.C.

10. U. S. Army Corps of Engineers, Chicago District. (1969). Flood Plain Information: Wolf River, Lake Poygan to Shawano, Wisconsin.

11. National Climatic Data Center, National Oceanic and Atmospheric Administration Satellite and Information Service (2008). http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms.

12. U.S. Water Resources Council, Bulletin No. 15. (1967). A Uniform Technique for Determining Flood Flow Frequencies.

13. U.S. Geological Survey. (1968-1973). Water Resources Data for Wisconsin.

14. U.S. Geological Survey. (1971). Estimating Magnitude and Frequency of Floods in Wisconsin.

15. Krug, W. R., Conger, D. H., Gebert, W. A. (1991). Flood Frequency Characteristics of Wisconsin Streams. U.S. Geological Survey Water Resources Investigation Report 91-4128.

16. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1990). HEC-1 Computer Program, Flood Hydrograph Package. Davis, California.

17. Conger, D.H. (1981). Techniques for Estimating Magnitude and Frequency of Floods for Wisconsin Streams, U.S. Geological Survey, Water Resources Investigations Report 80-1214.

18. Carl C. Crane, Inc. (1975). Flood Insurance Study, Waupaca County, Wisconsin.

19. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1973). HEC-1 Computer Program 823-X6-L2610. Davis, California.

20. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (2003). Hydrologic Modeling System Version 2.2.2. Davis, California.

21. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1973). HEC-2 Water Surface Profiles, Generalized Computer Program. Davis, California.

22. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1991). HEC-2 Water Surface Profiles, Generalized Computer Program. Davis, California.

23. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1990). HEC-2 Water Surface Profiles, Users Manual. Davis, California.

24. U.S. Geological Survey. (1969). 7.5 Minute Series, Topographic Maps, Readfield, Wisconsin and Weyauwega, Wisconsin.

25. J.O. Shearman, W.H. Kirby, V.R Snyder, and H.N. Flippo. (1986). Bridge Waterways Analysis Model: Research Report. U.S. Department of Transportation, Federal Highway Administration Report No. FHWA/RD-86/108.

26. U.S. Department of Housing and Urban Development, Federal Insurance Administration. (1977). Flood Insurance Study, Waupaca County, Unincorporated Areas, Wisconsin.

27. U.S. Department of Commerce, National Weather Service. (1984). DMBRK. Silver Spring, Maryland.

28. U.S. Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 feet: Tigerton N.W., Wisconsin (1970); Tigerton, Wisconsin (1970); Manawa, Wisconsin (1969); Marion, Wisconsin (1970); Clintonville, Wisconsin (1970); Clintonville South, Wisconsin (1970); Embarrass, Wisconsin (1969); Lunds, Wisconsin (1969); Idla, Wisconsin (1971); Big Falls, Wisconsin (1970); Symco, Wisconsin (1970); Clintonville South, Wisconsin (1970); Bear Creek, Wisconsin (1969); Leeman, Wisconsin (1969); Scandinavia, Wisconsin (1969); New London, Wisconsin (1969); King, Wisconsin (1969); Waupaca, Wisconsin (1969); Weyauwega, Wisconsin (1969); Readfield, Wisconsin (1969); Hortonville, Wisconsin (1969); Northport, Wisconsin (1969).

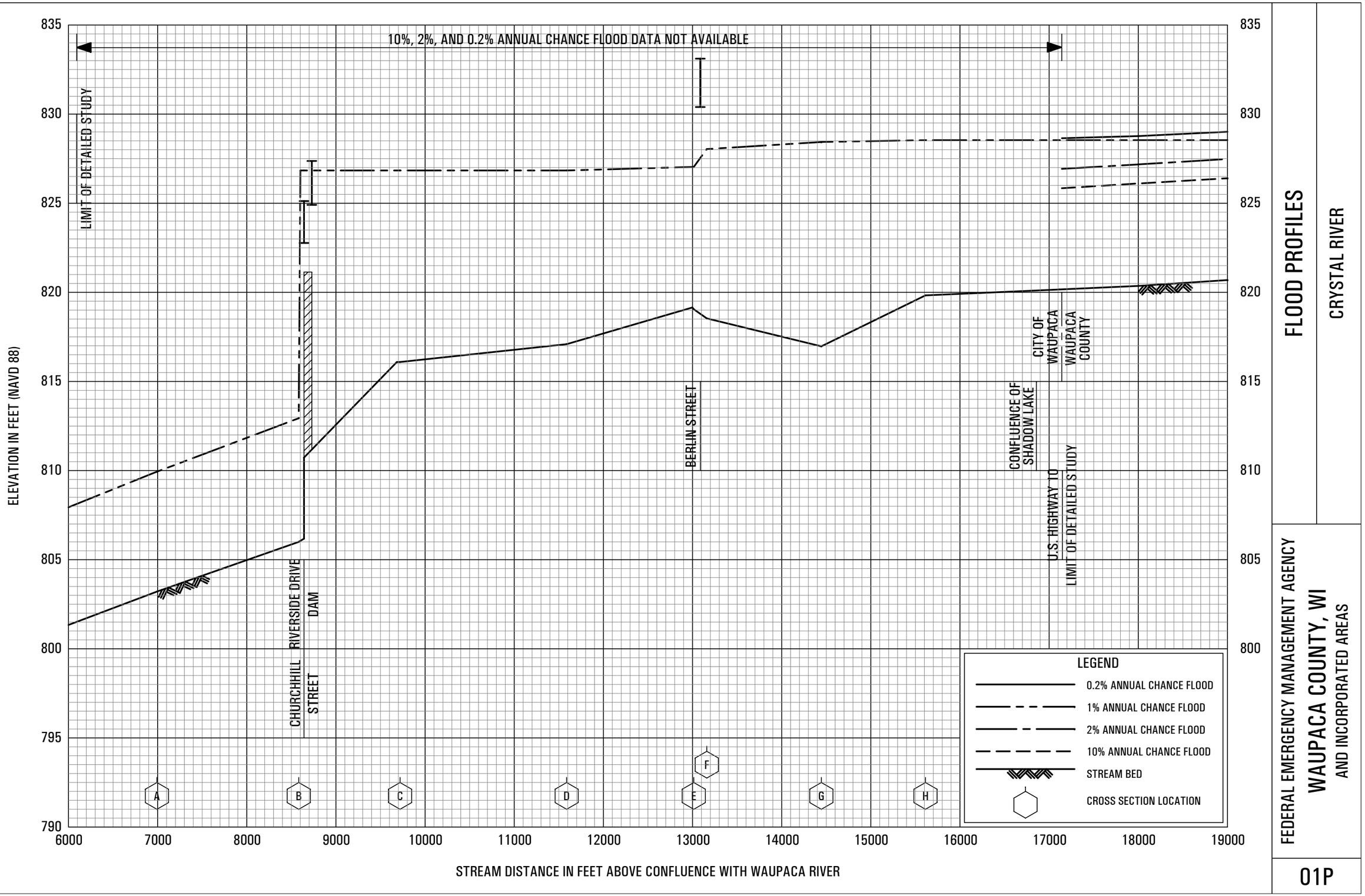
29. Mark Hurd Aerial Surveys, Inc. (1974). Topographic Map for the City of New London, Wisconsin. Scale 1:4800, Contour Interval 2 feet.

30. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1984). HEC-2 Water Surface Profiles, Generalized Computer Program. Davis, California.

31. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (2005). HEC-RAS River Analysis System Version 3.1.3. Davis, California.

32. Waupaca County Land Information Office. (2005). 2-foot Interval Contours, Scale 1:4,800, Contour Interval 2 feet, Waupaca County, Wisconsin.

33. Wisconsin Department of Natural Resources. (2004). Wisconsin's Floodplain Management Program. Chapter NR 116, Register No. 584.




FLOOD PROFILES

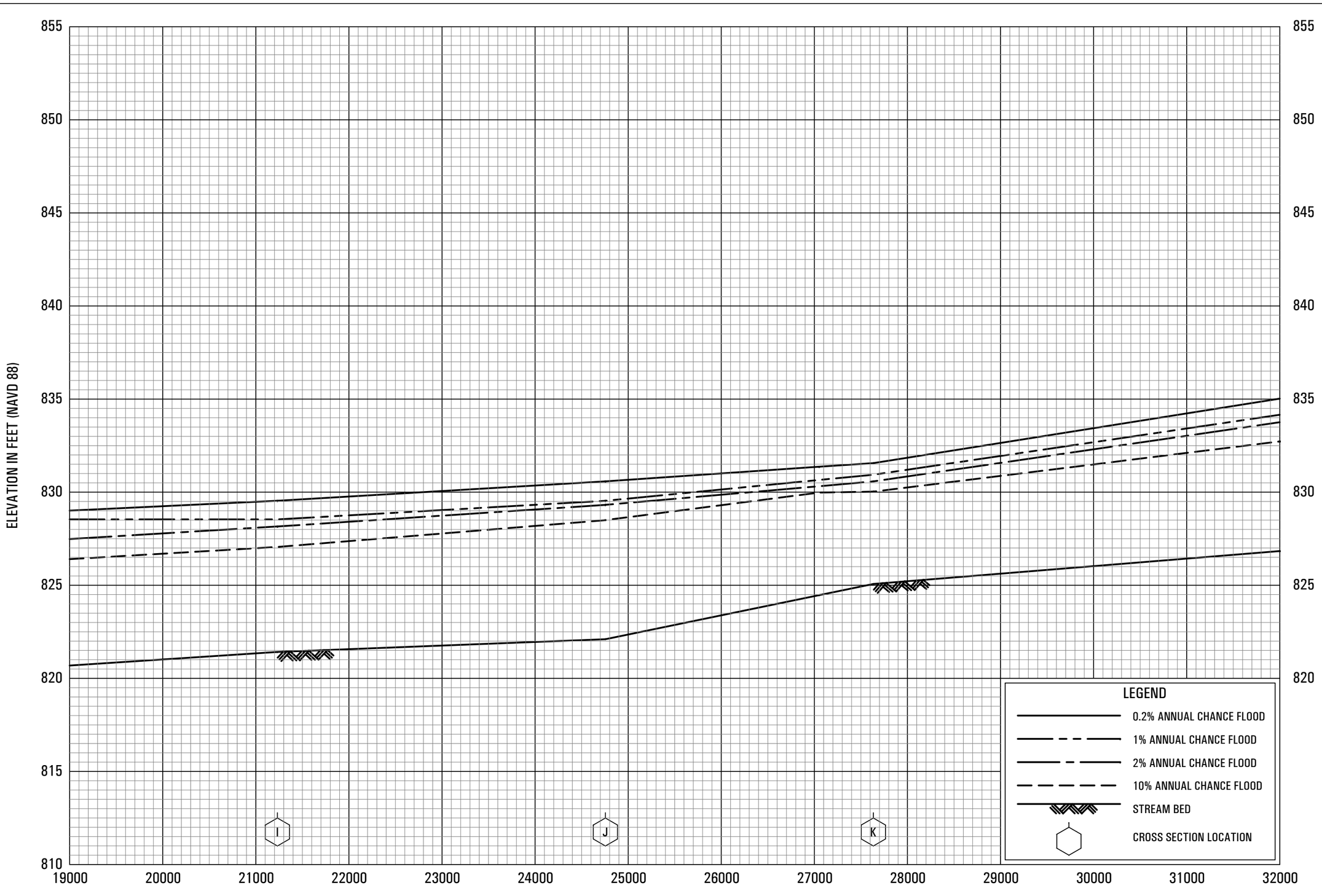
CRYSTAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

01P




FLOOD PROFILES

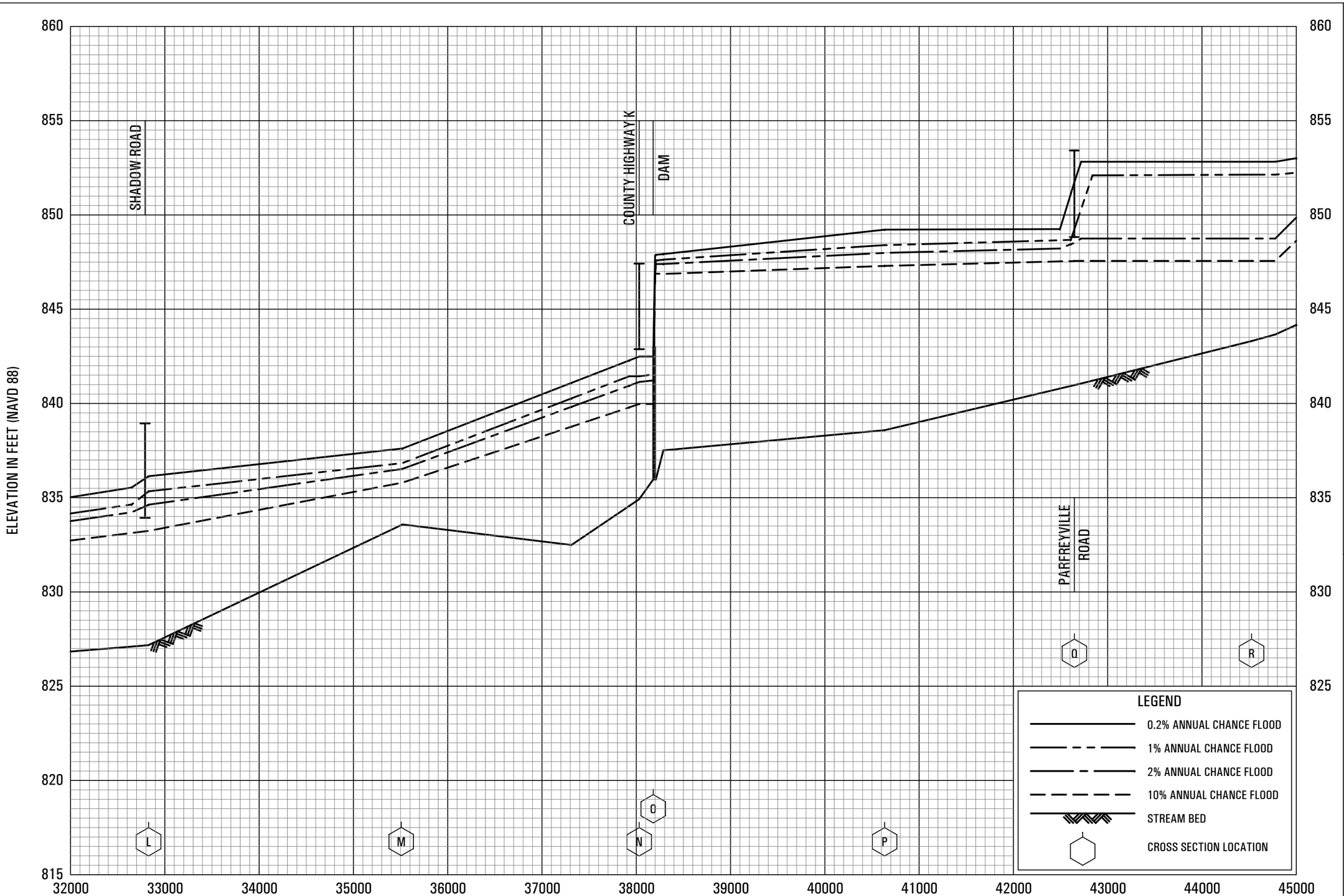
CRYSTAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

02P




# FLOOD PROFILES

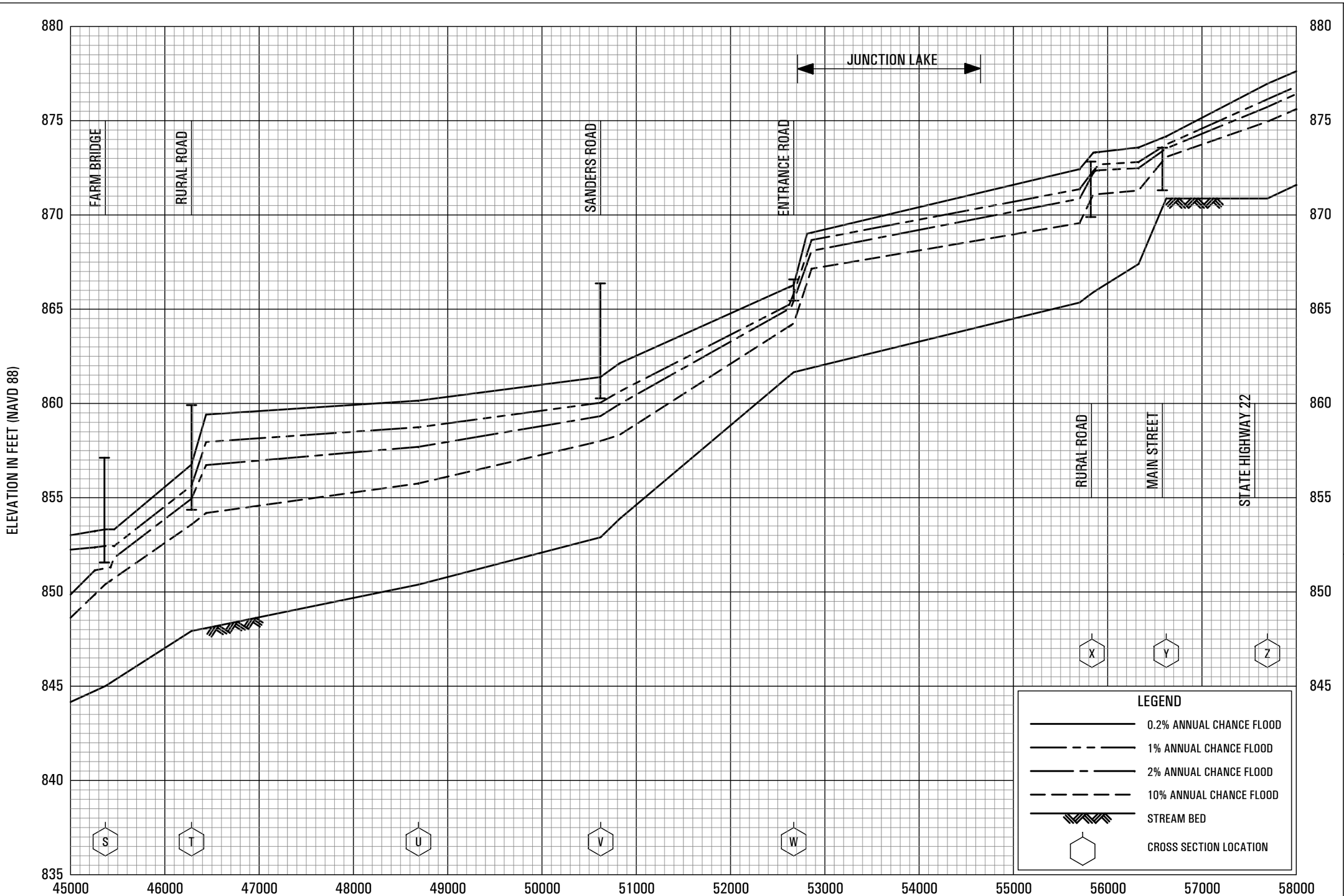
## CRYSTAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

03P



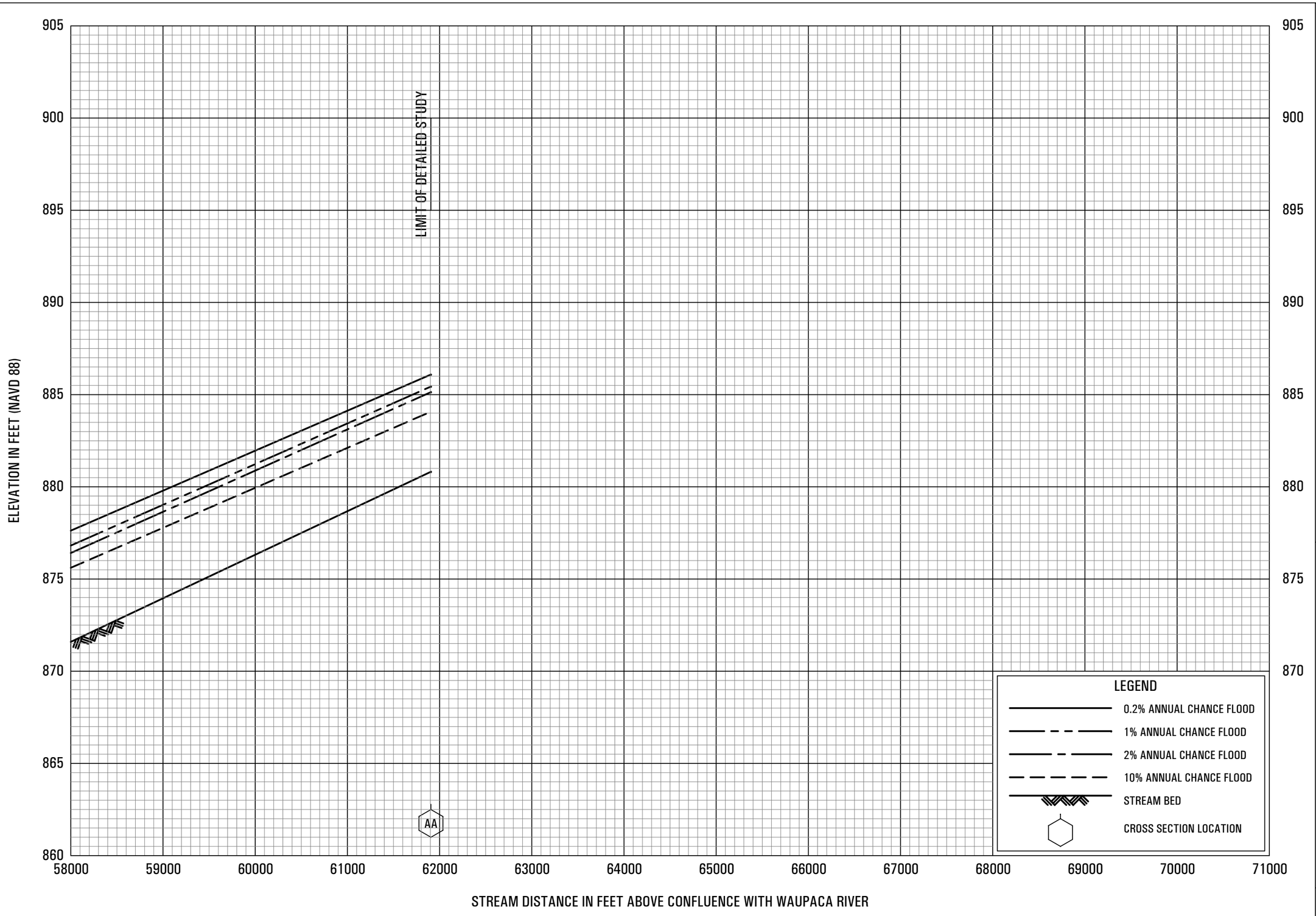

# FLOOD PROFILES

CRYSTAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS




# FLOOD PROFILES

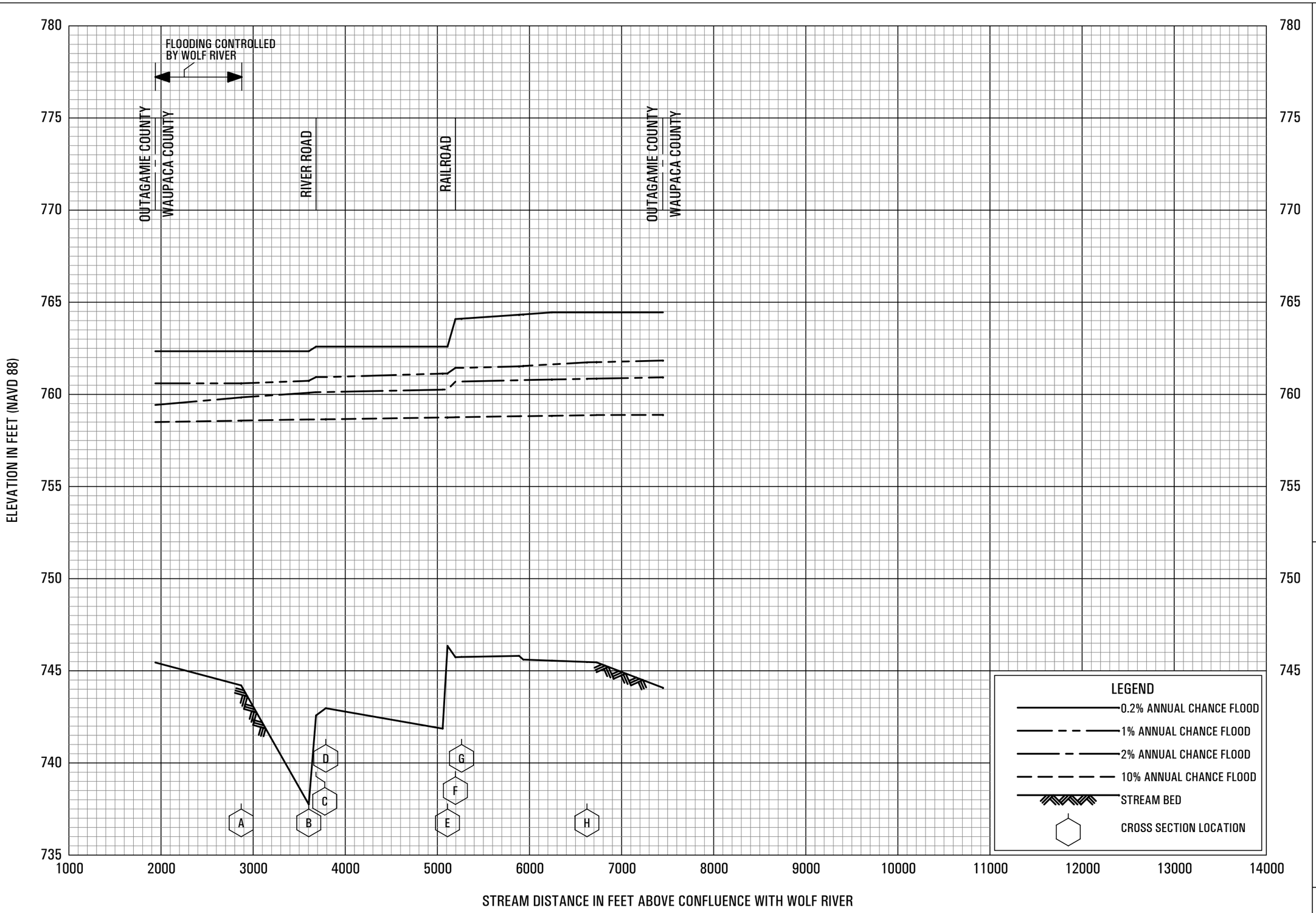
CRYSTAL RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

05P




# FLOOD PROFILES

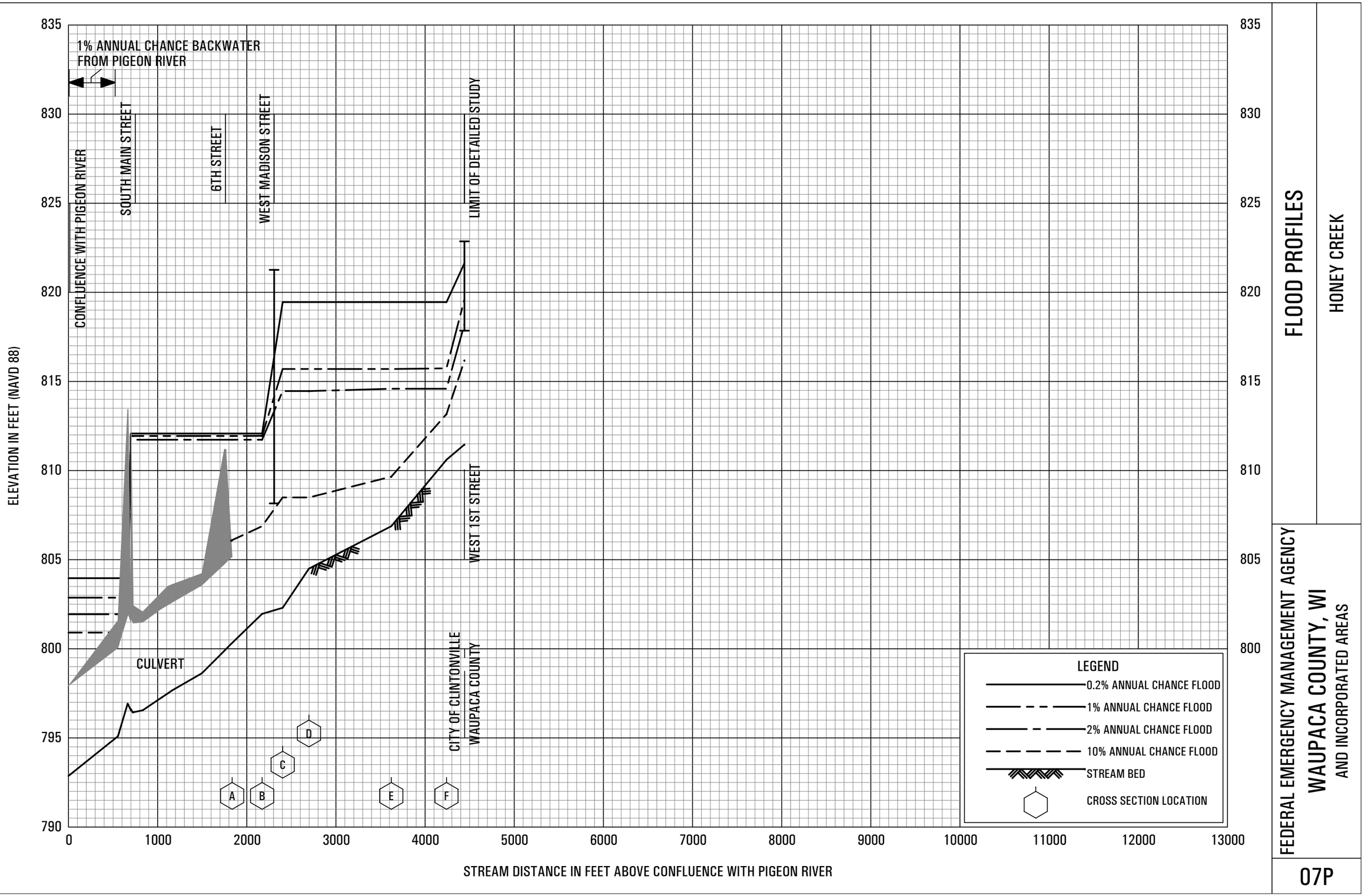
## EMBARRASS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

06P




# FLOOD PROFILES

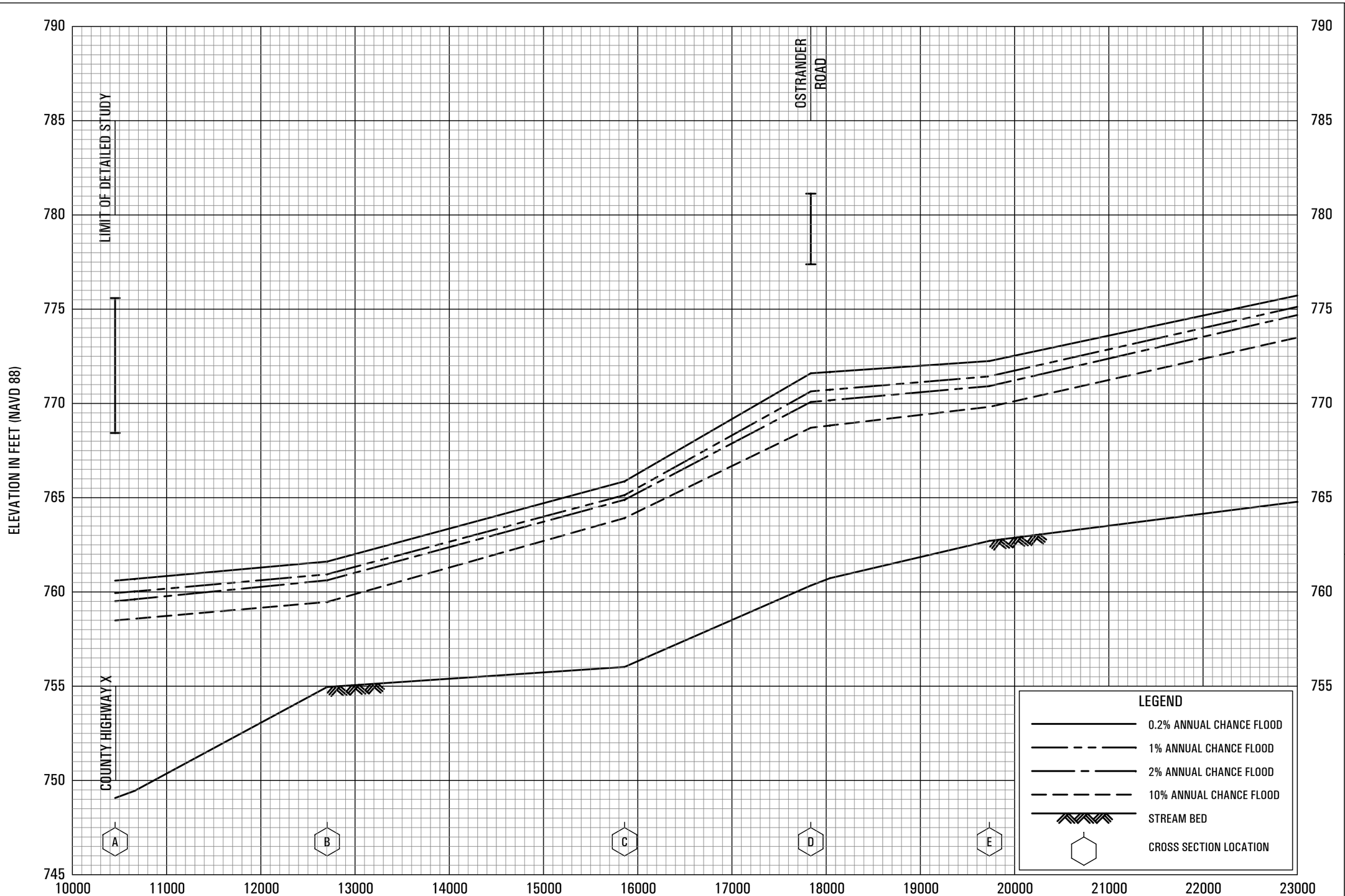
HONEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

07P




FLOOD PROFILES

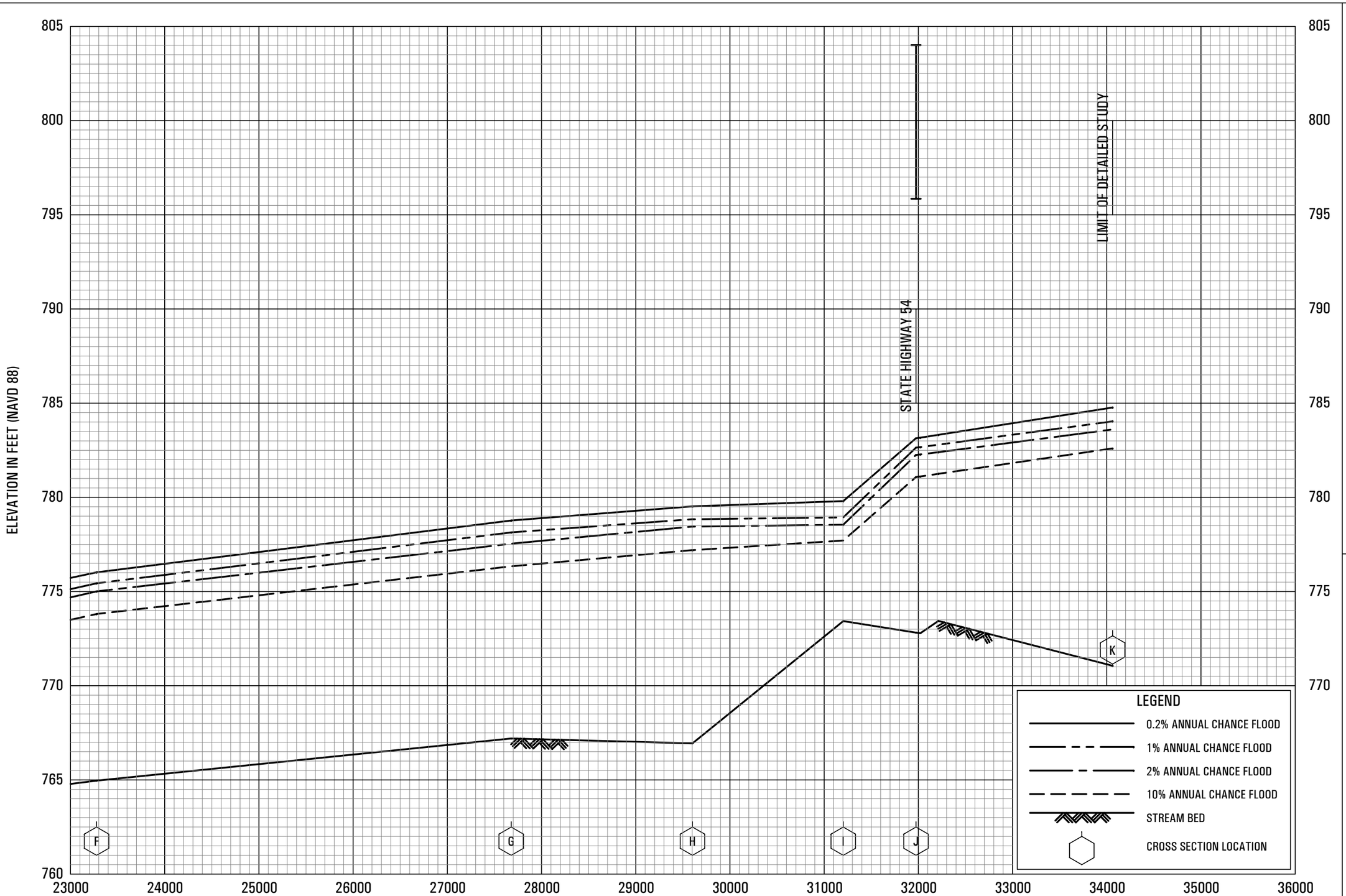
LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

08P




FLOOD PROFILES

LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

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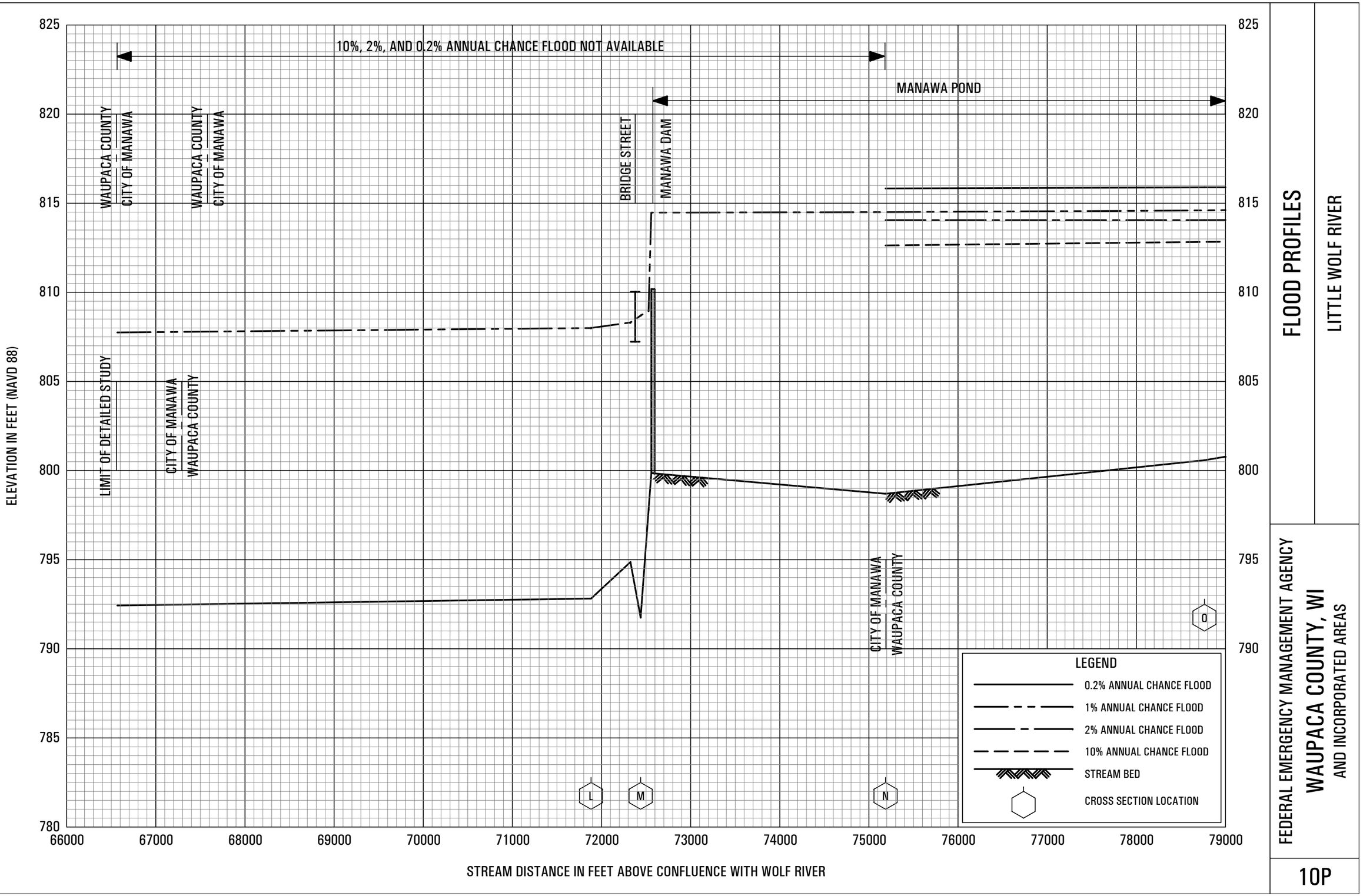


FLOOD PROFILES

LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

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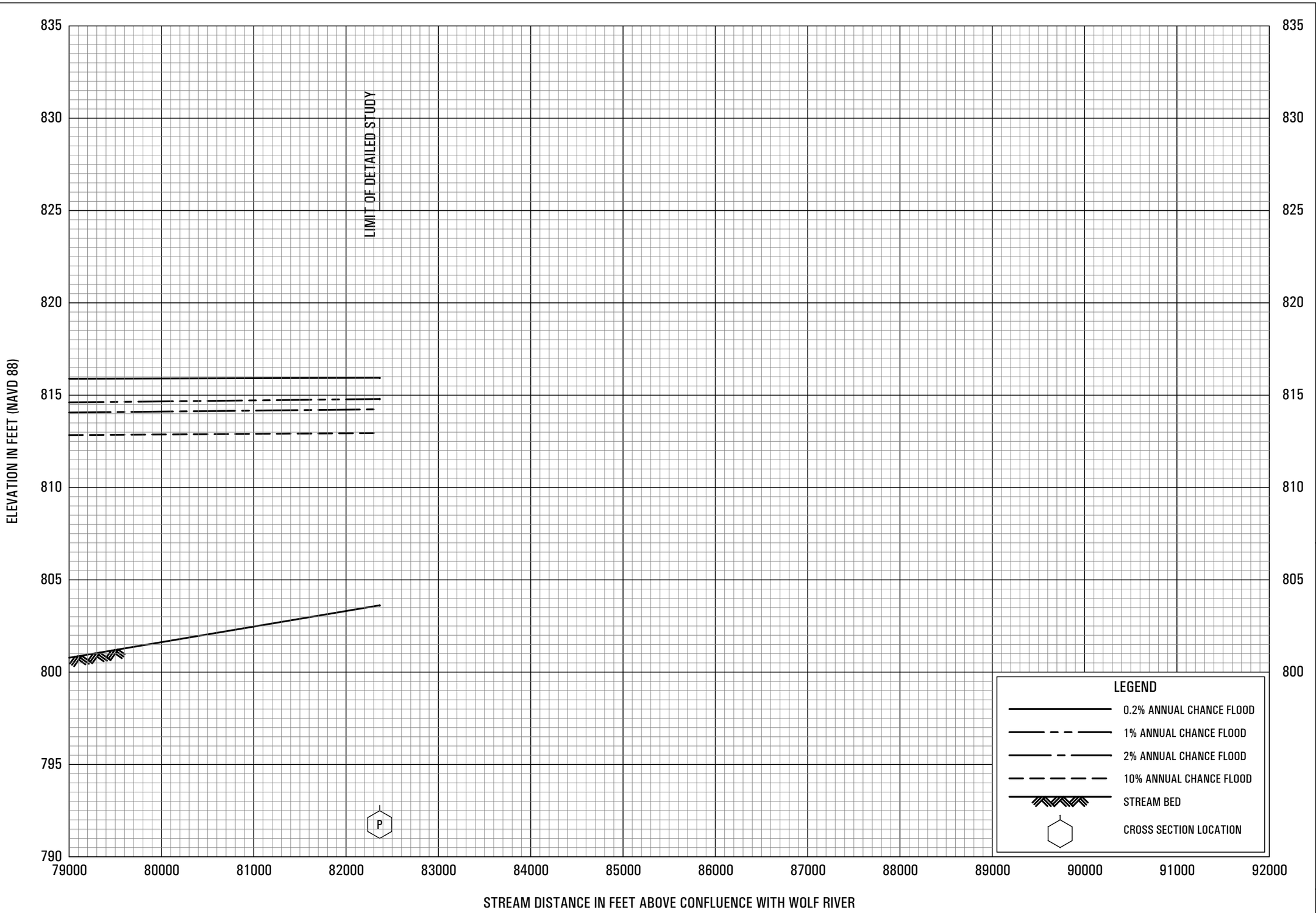



FLOOD PROFILES

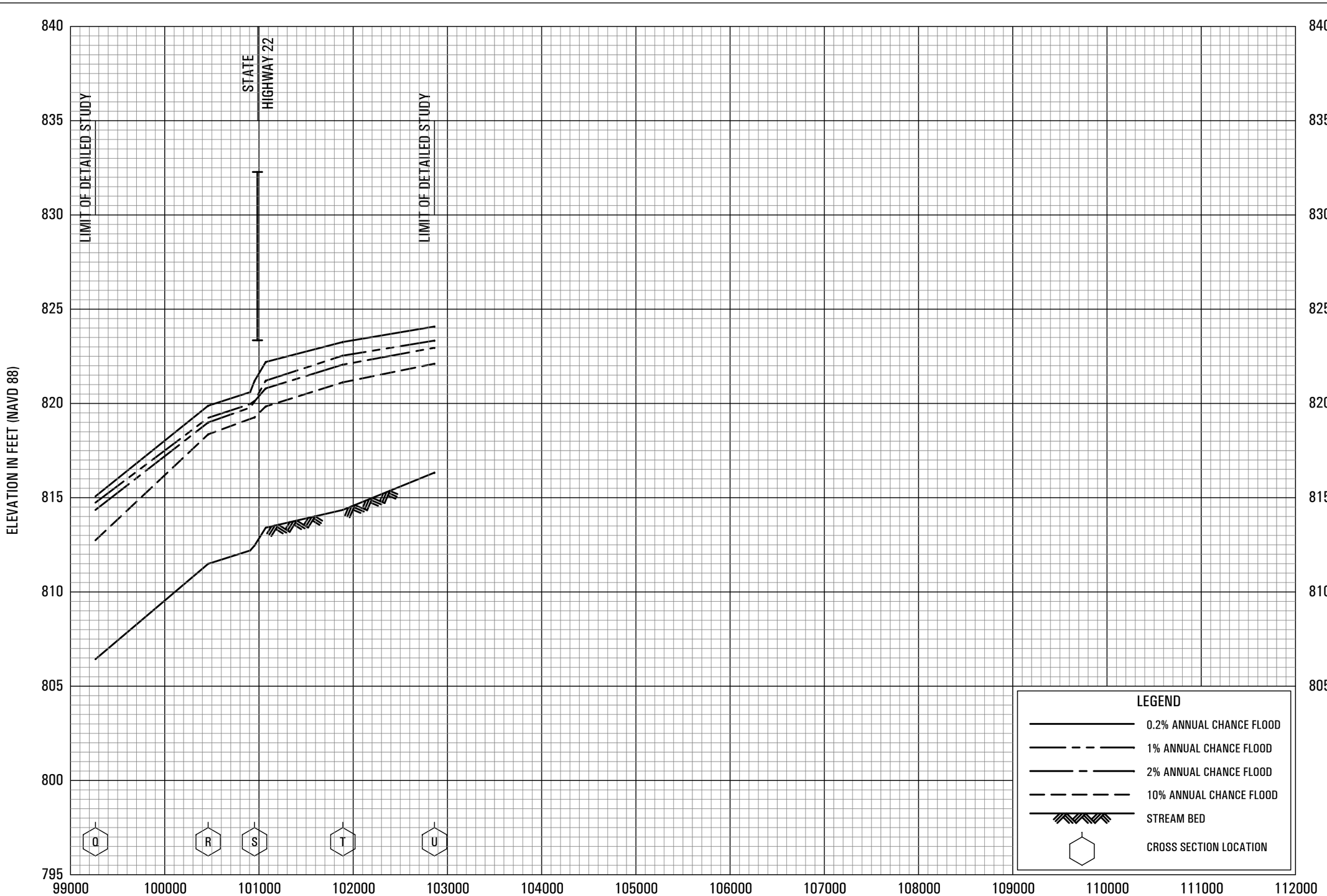
LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

11P




# FLOOD PROFILES

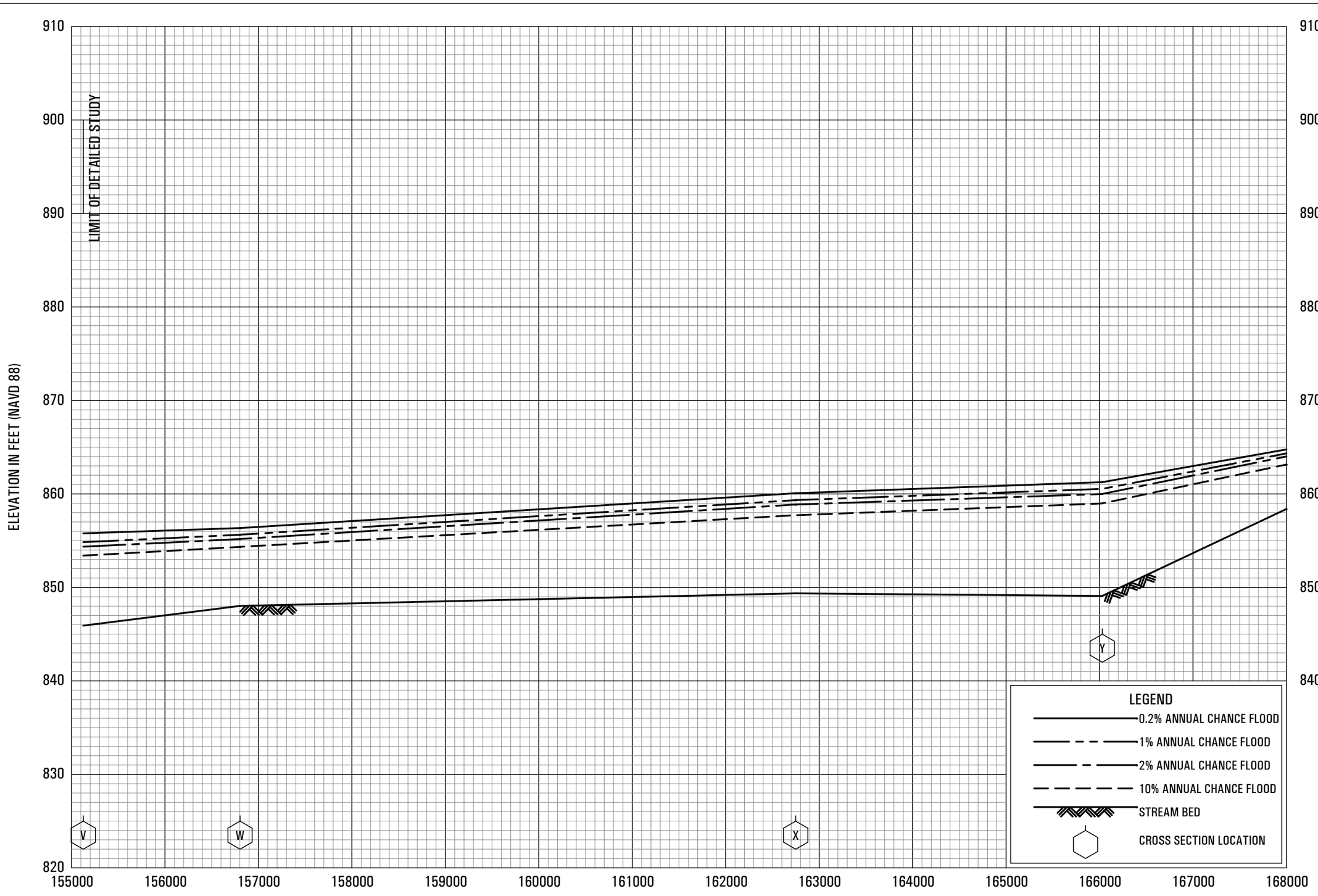
## LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

12P




# FLOOD PROFILES

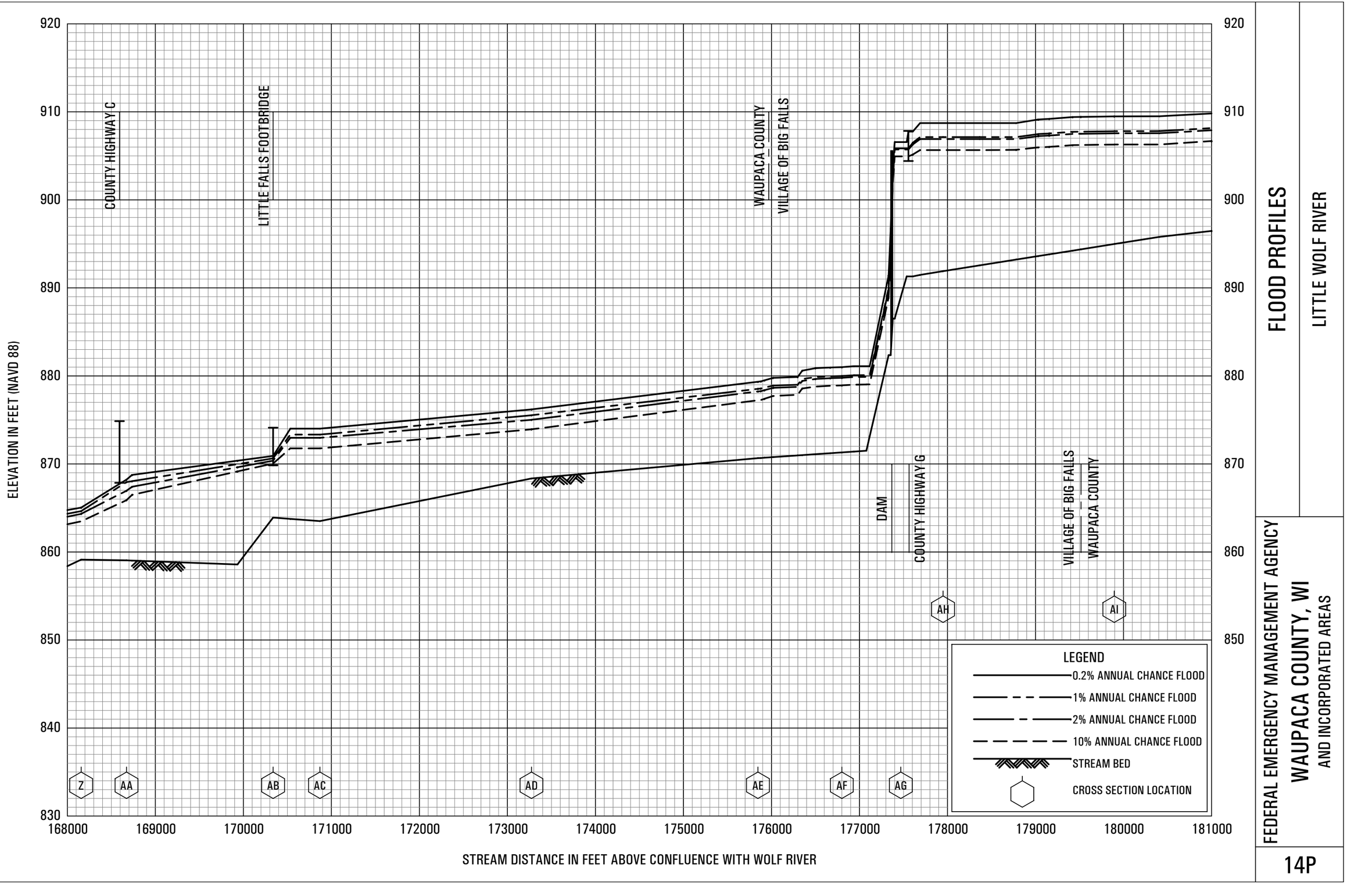
LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

13P



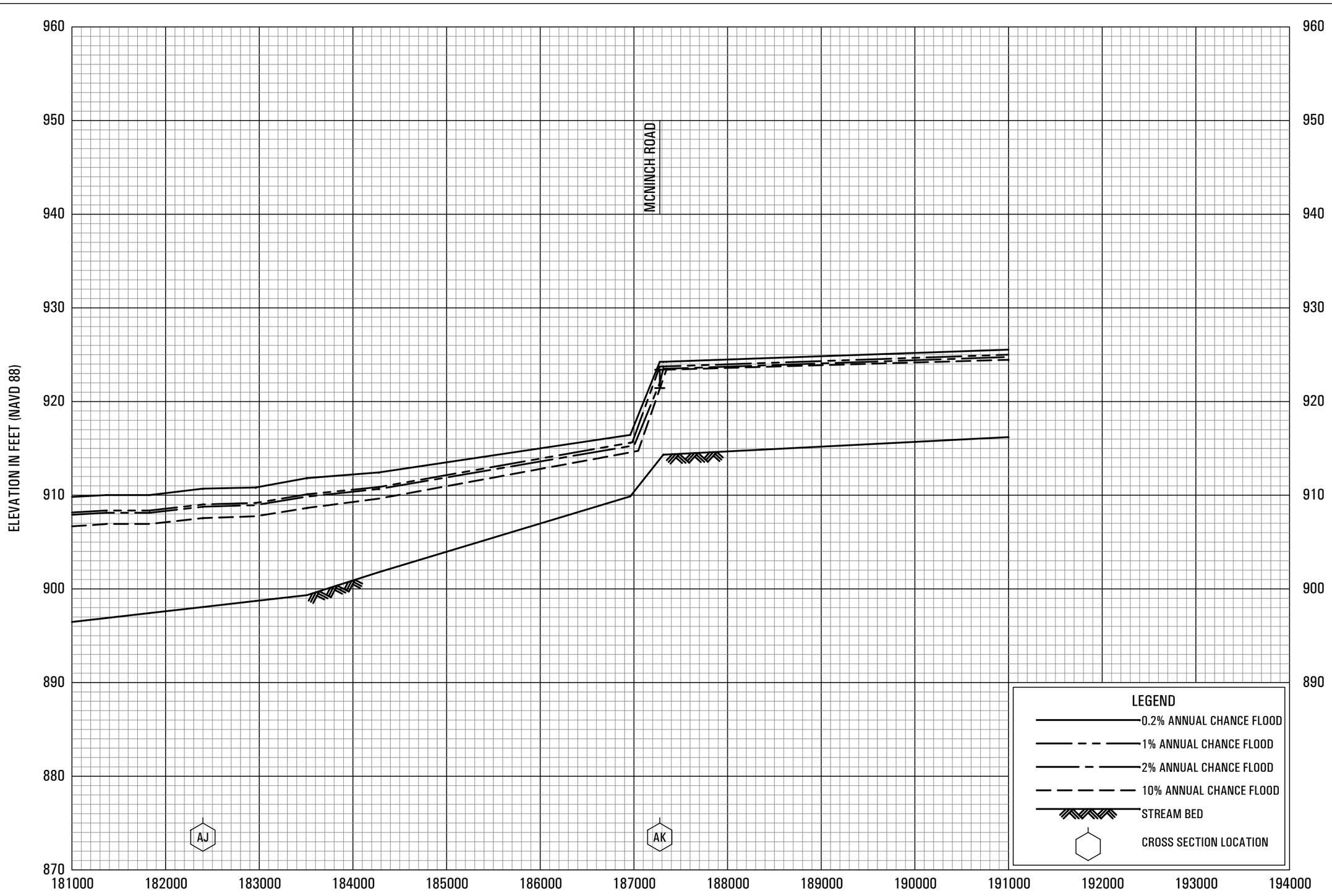

# FLOOD PROFILES

## LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS




FLOOD PROFILES

LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

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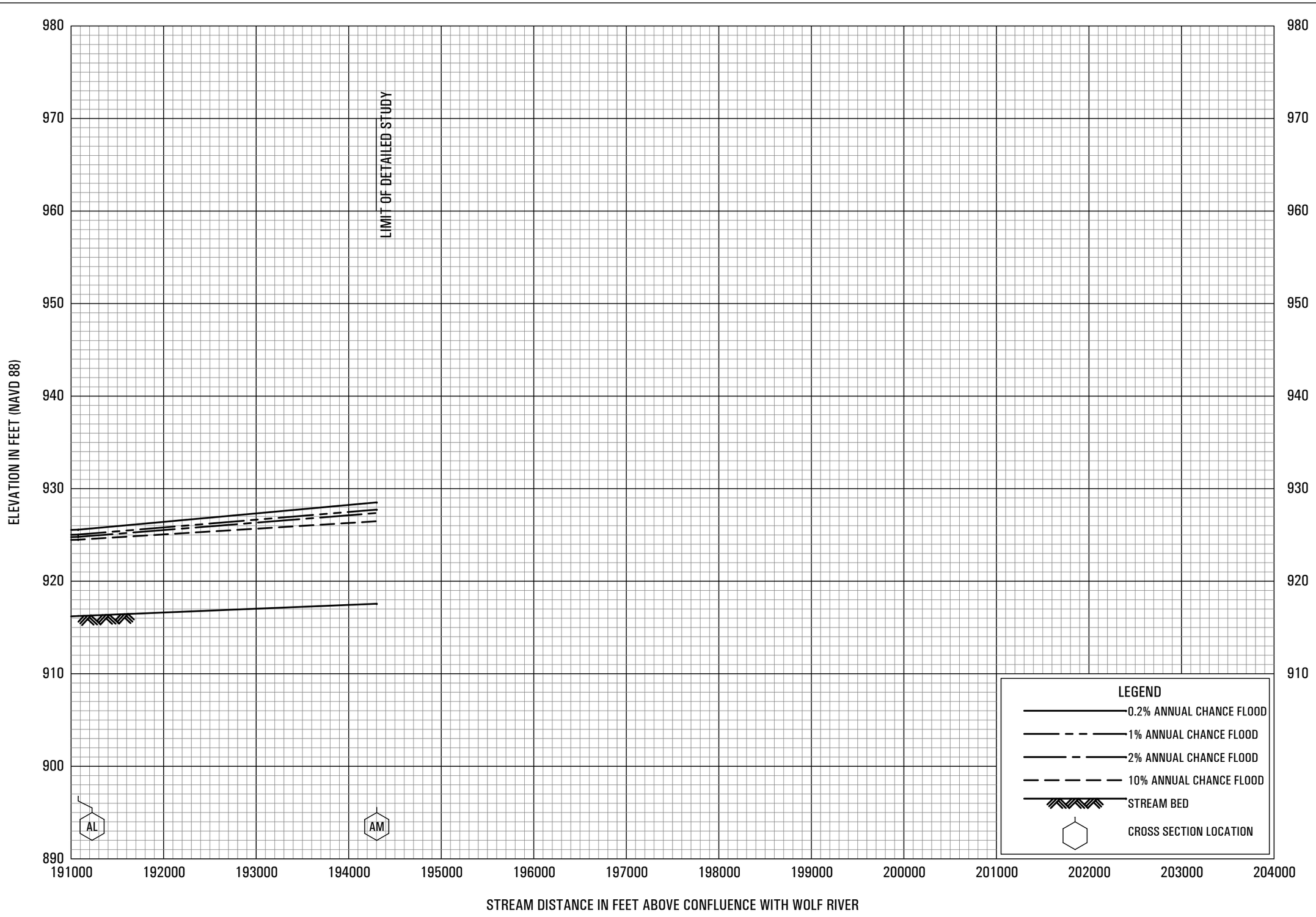



# FLOOD PROFILES

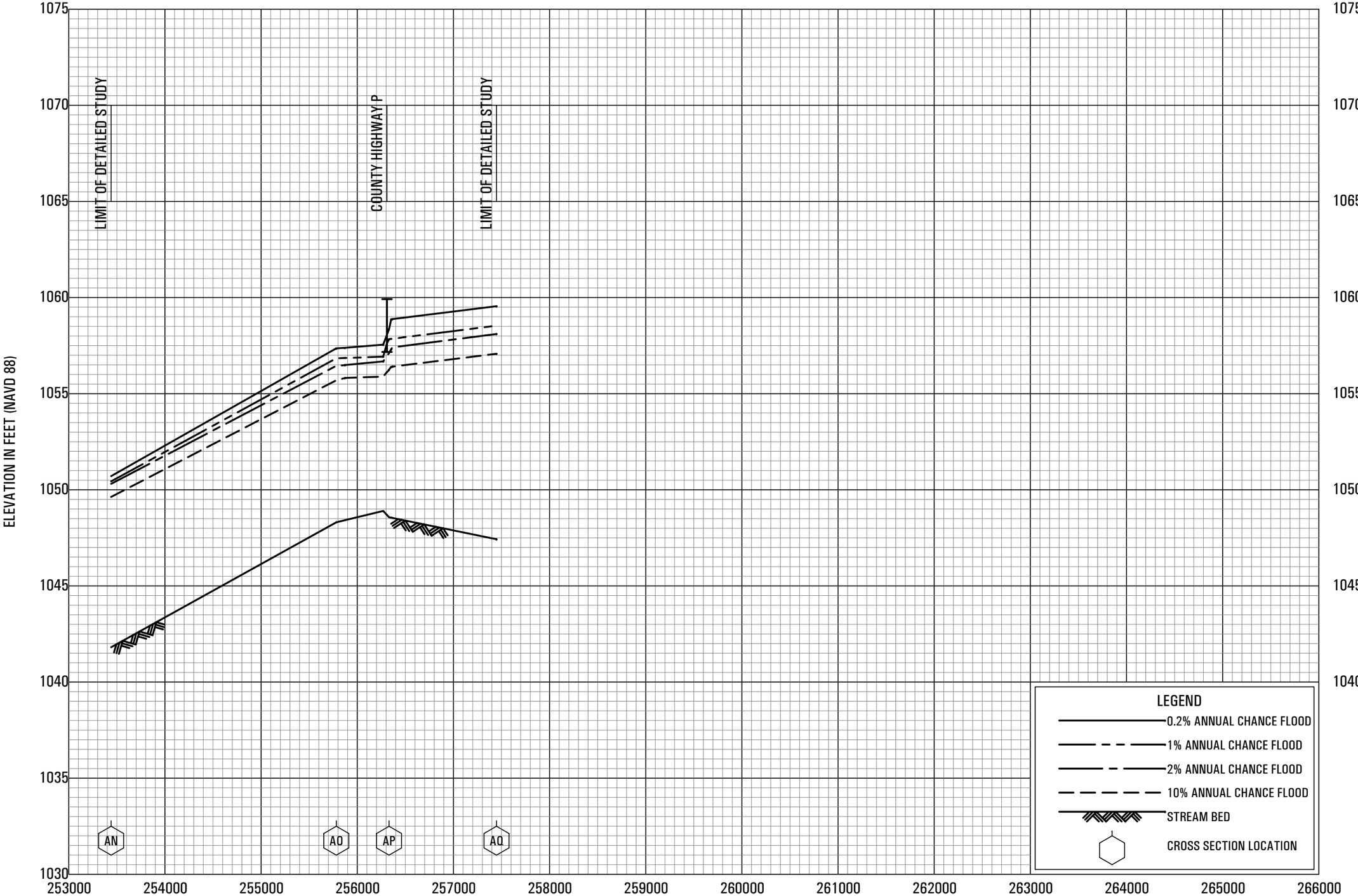
LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

16P




# FLOOD PROFILES

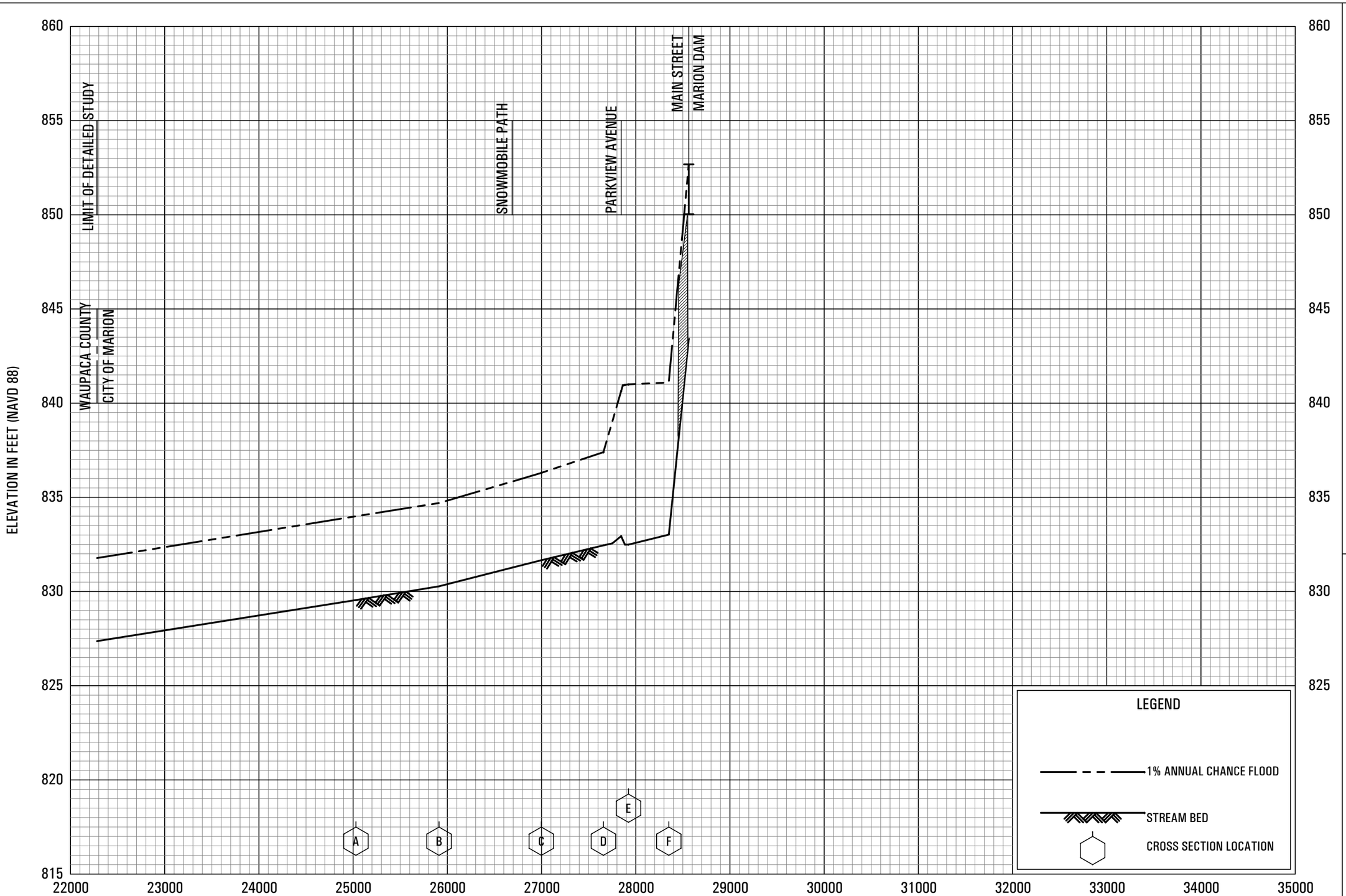
LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

17P



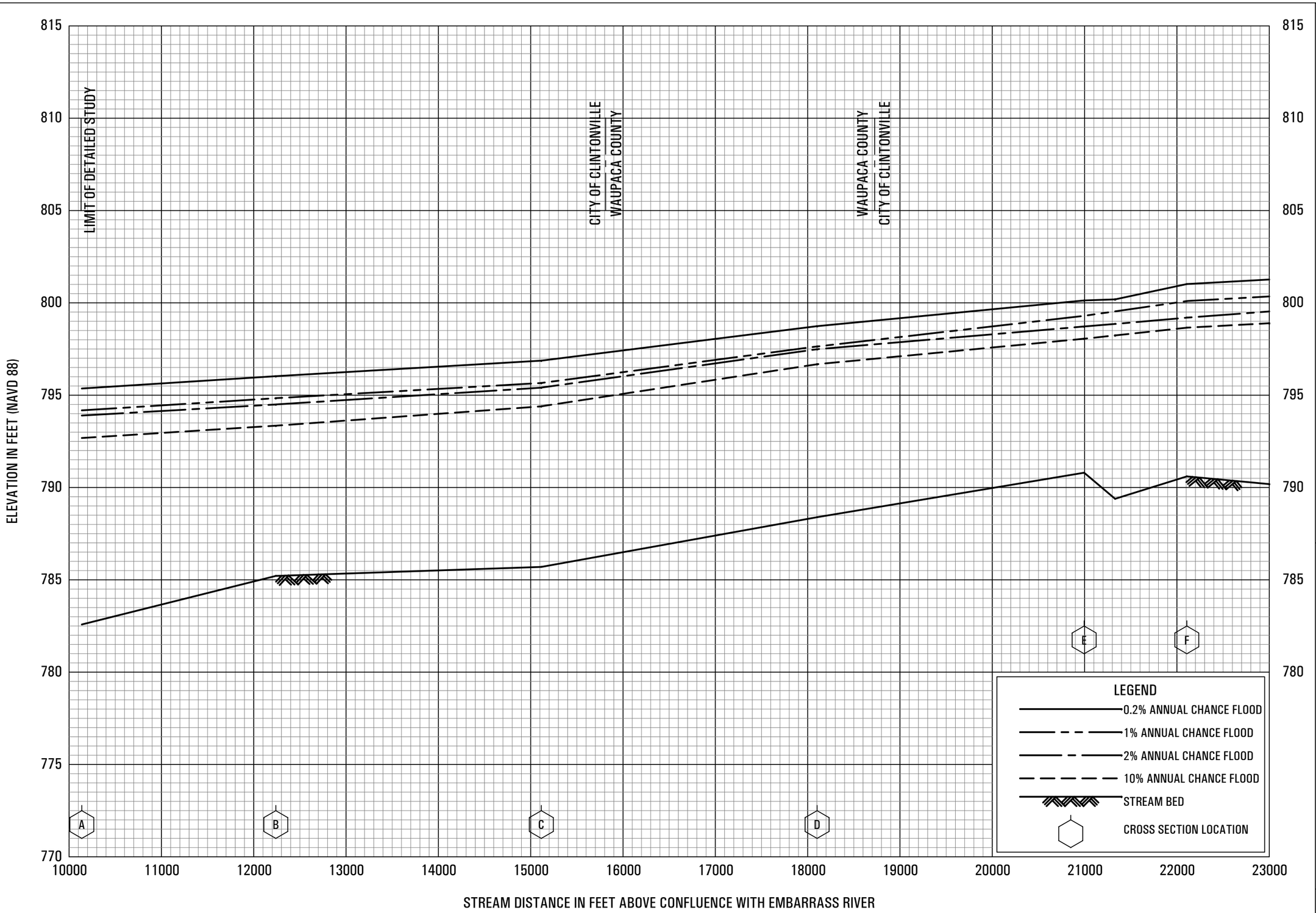

# FLOOD PROFILES

## NORTH BRANCH PIGEON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS




FLOOD PROFILES

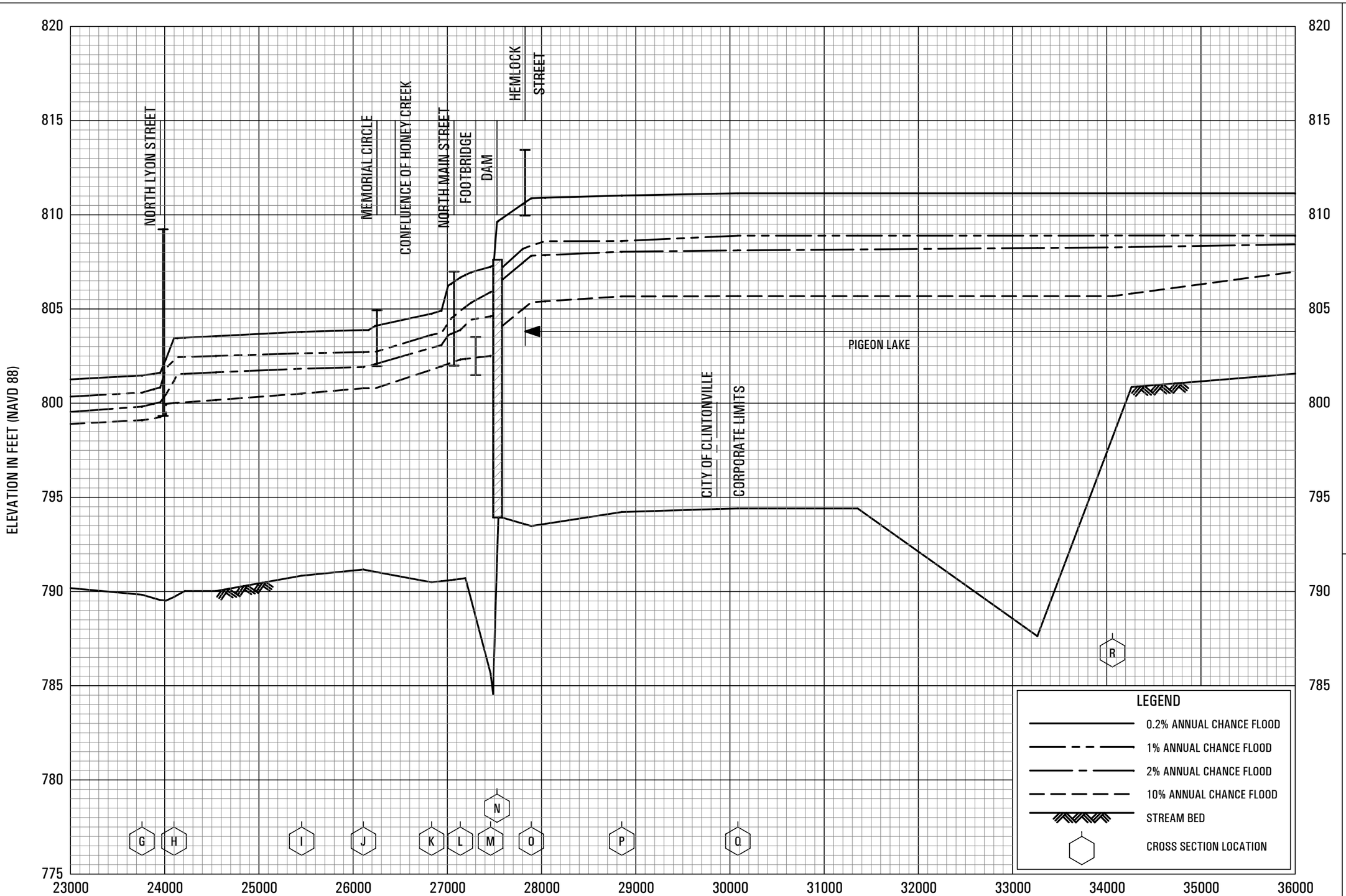
PIGEON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

19P



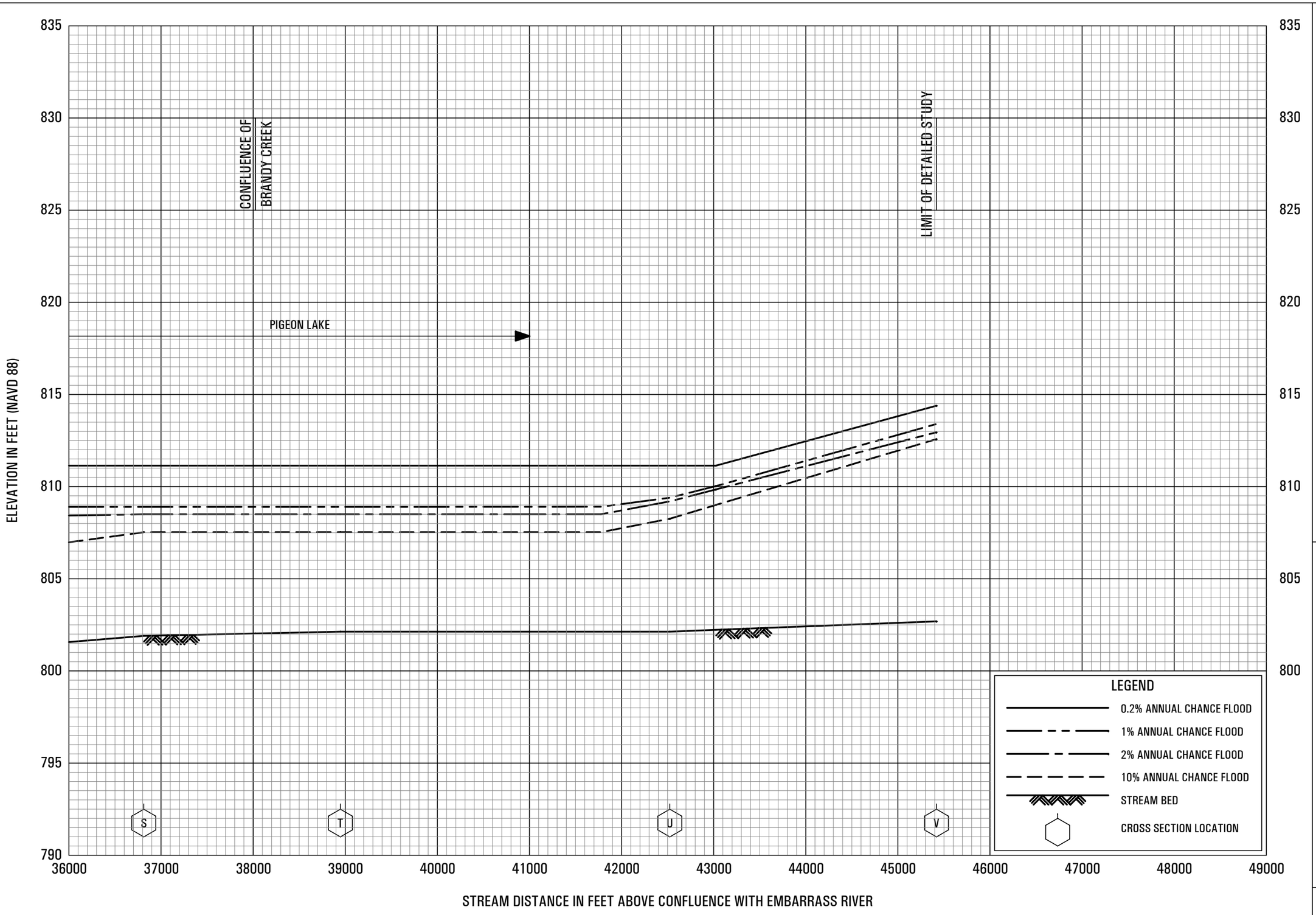

# FLOOD PROFILES

PIGEON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS



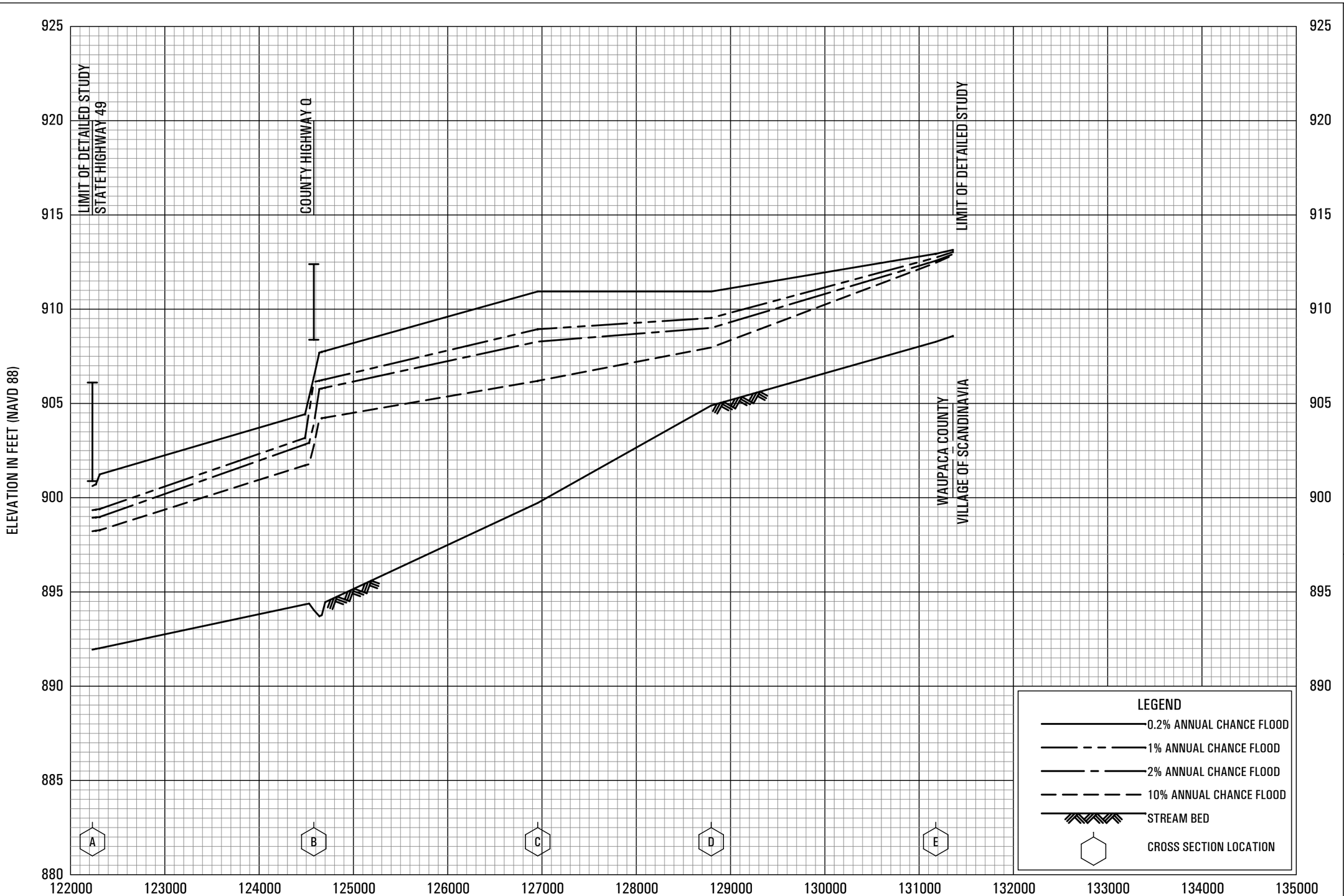

# FLOOD PROFILES

PIGEON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS



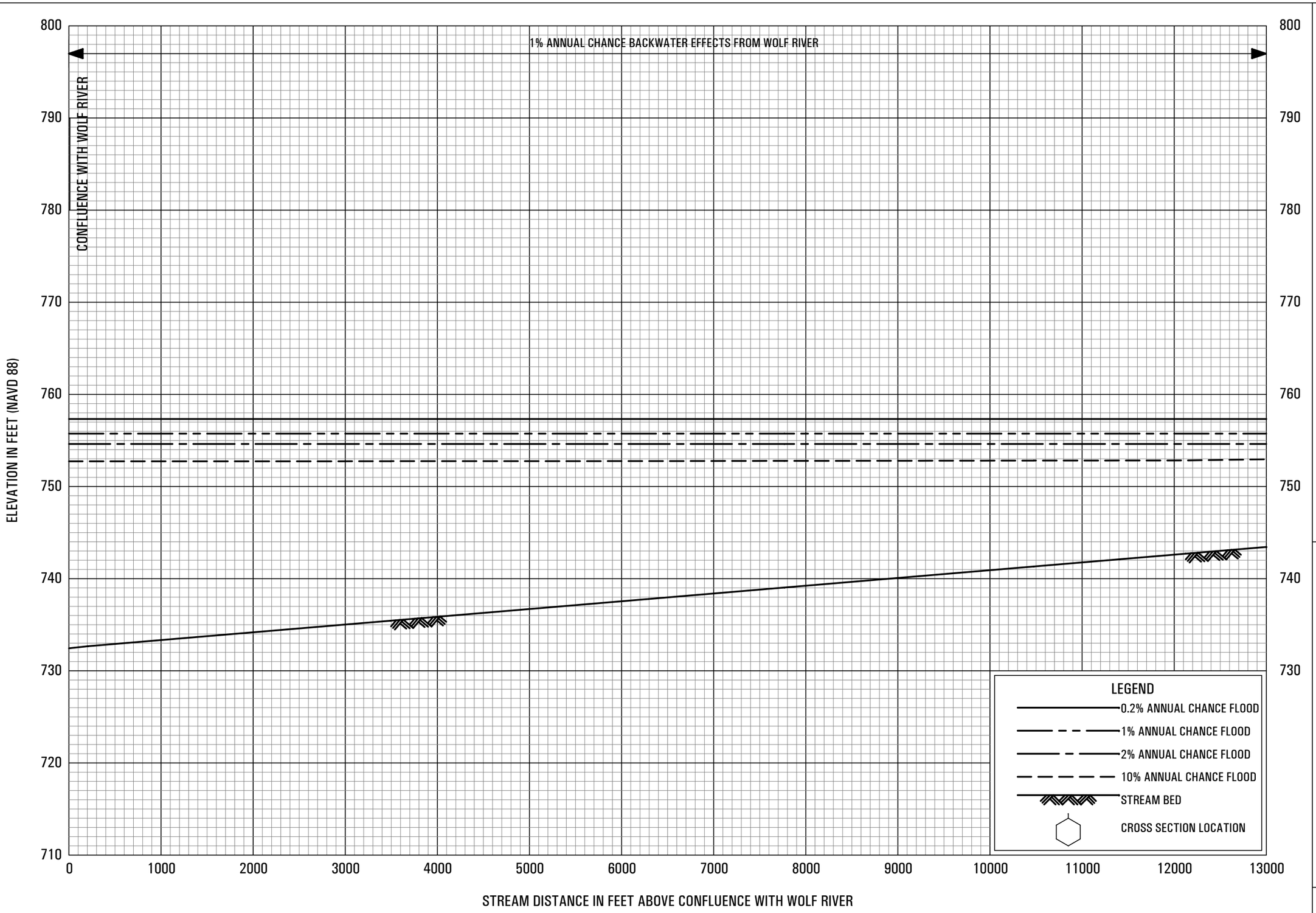

# FLOOD PROFILES

## SOUTH BRANCH LITTLE WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS




# FLOOD PROFILES

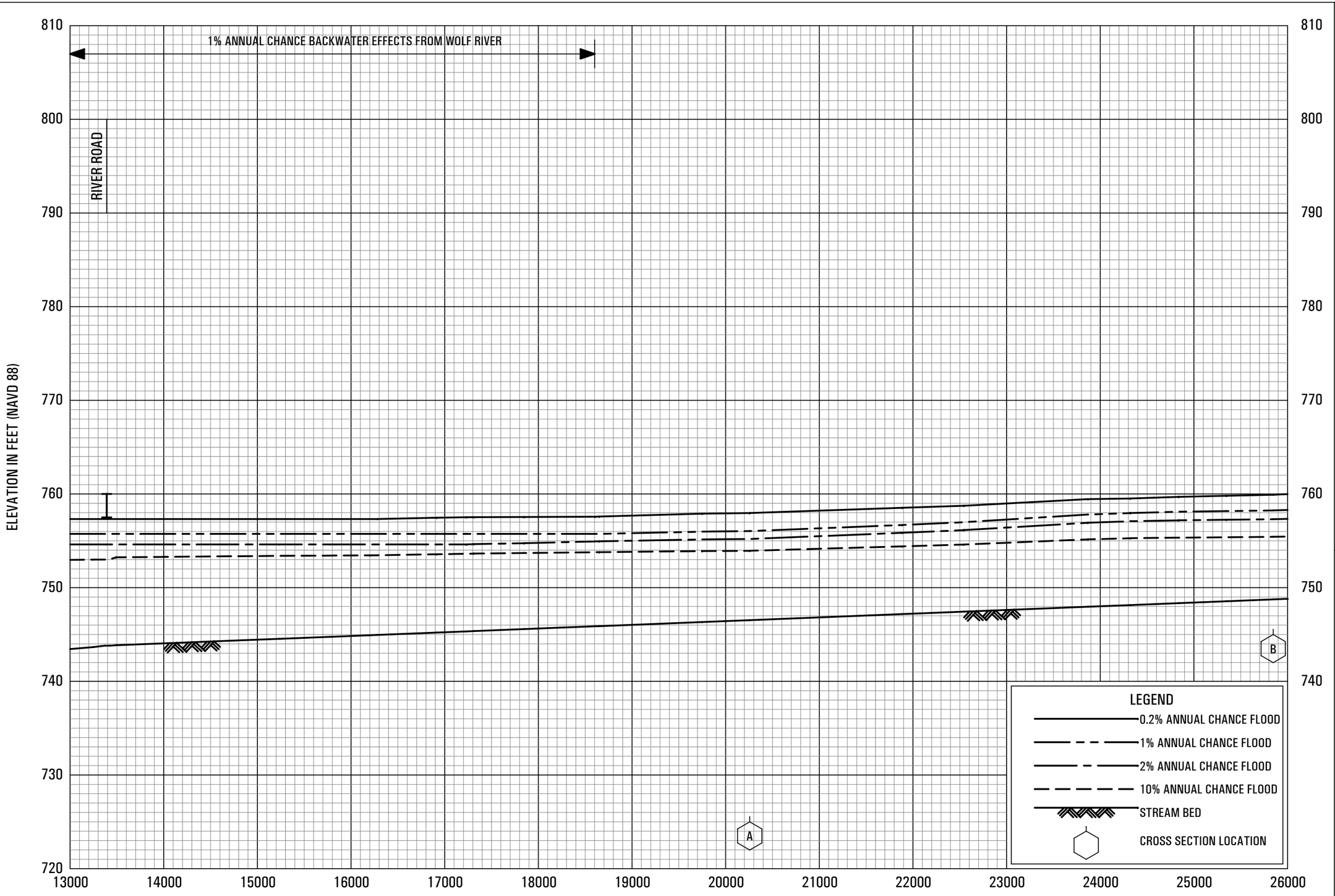
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

23P




FLOOD PROFILES

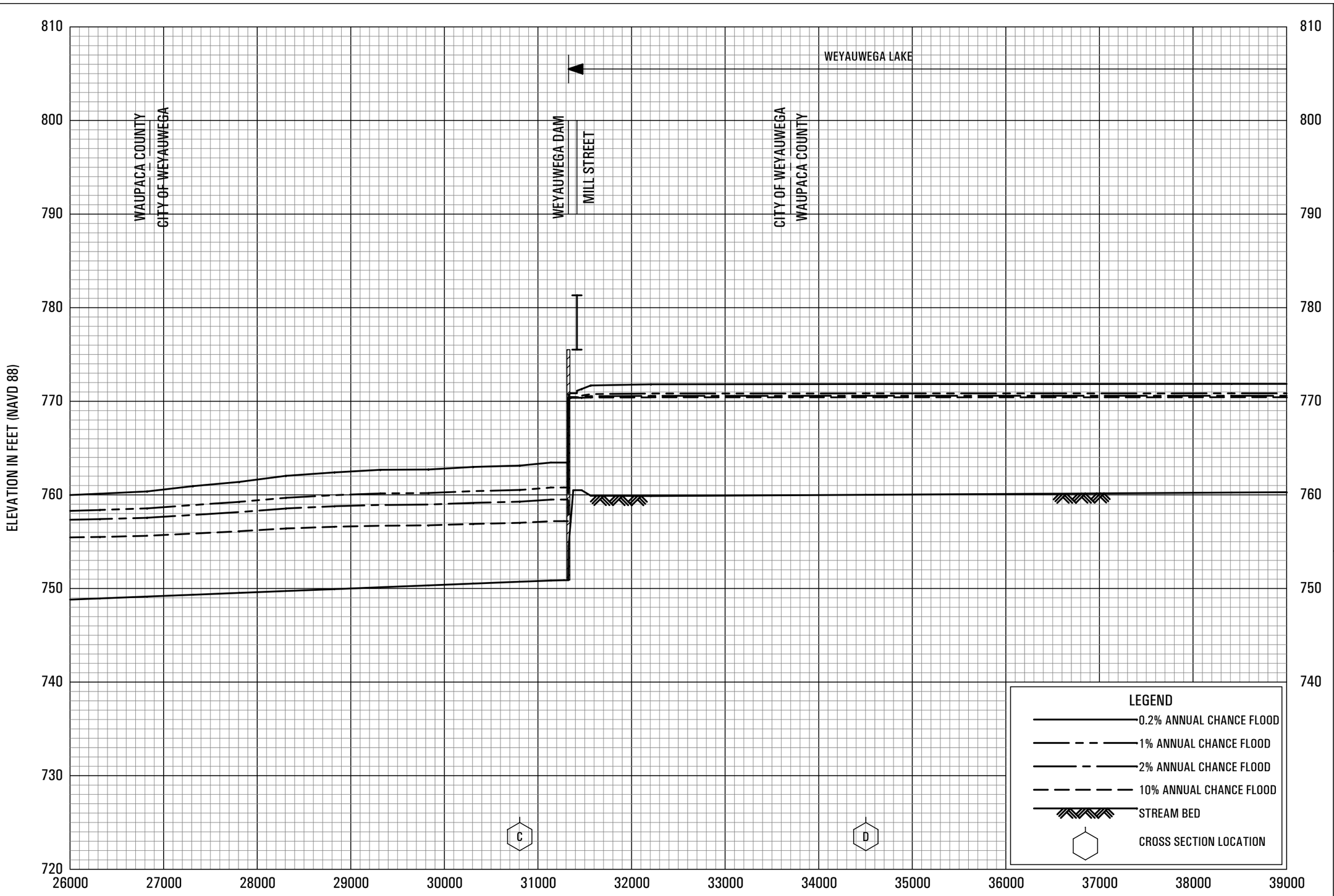
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

24P




FLOOD PROFILES

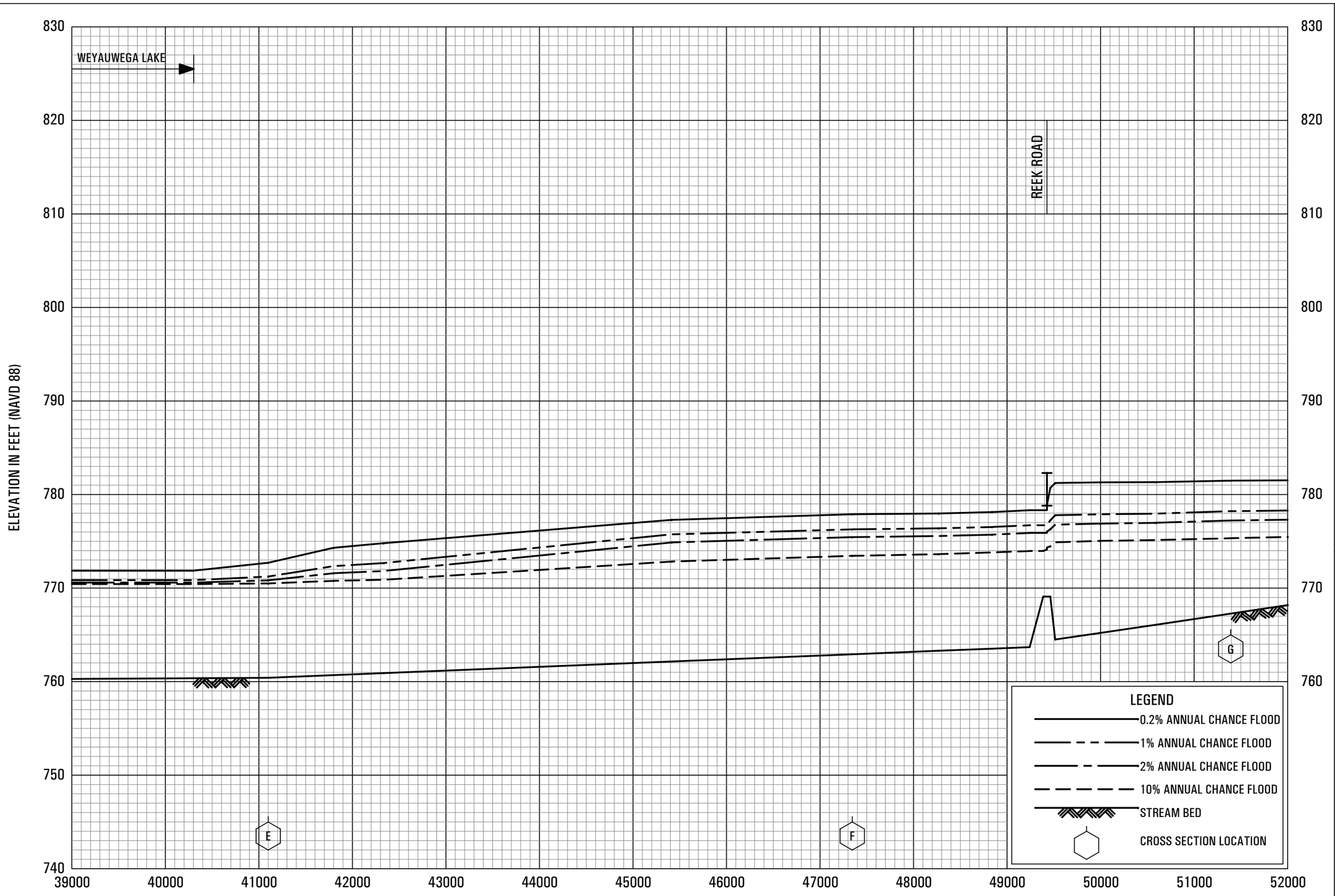
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

25P




FLOOD PROFILES

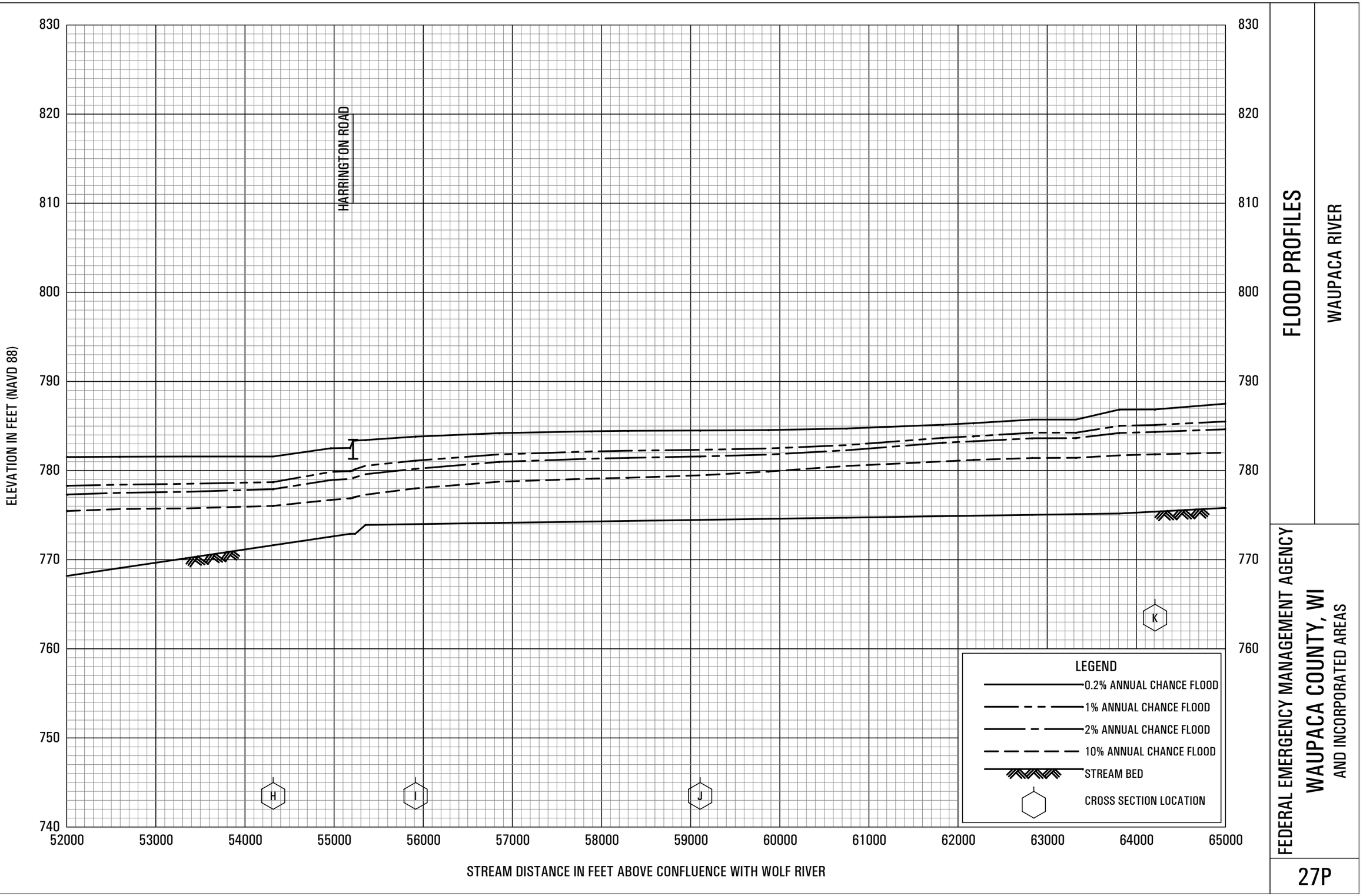
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

26P




FLOOD PROFILES

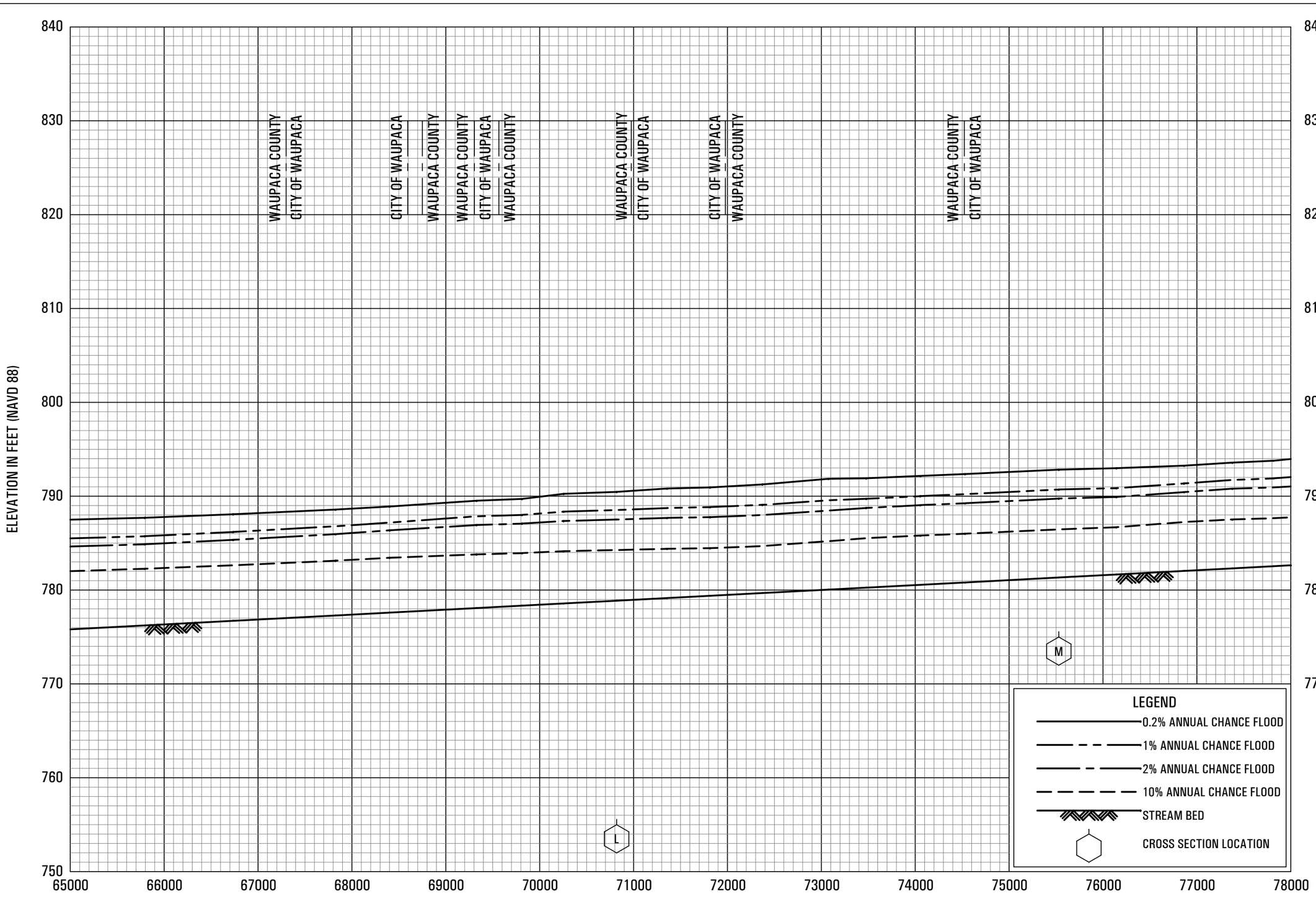
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

27P




# FLOOD PROFILES

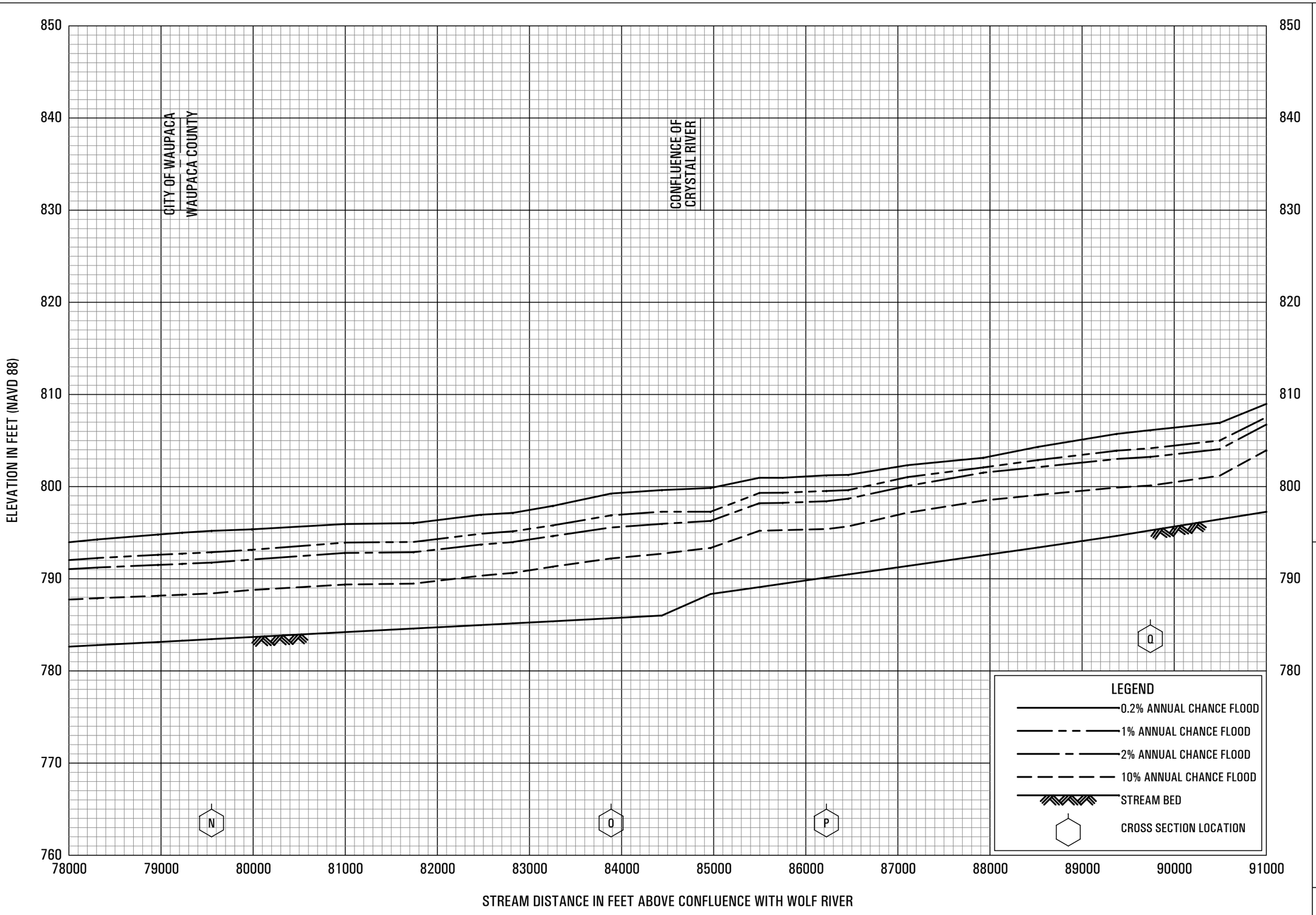
## WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS

28P




FLOOD PROFILES

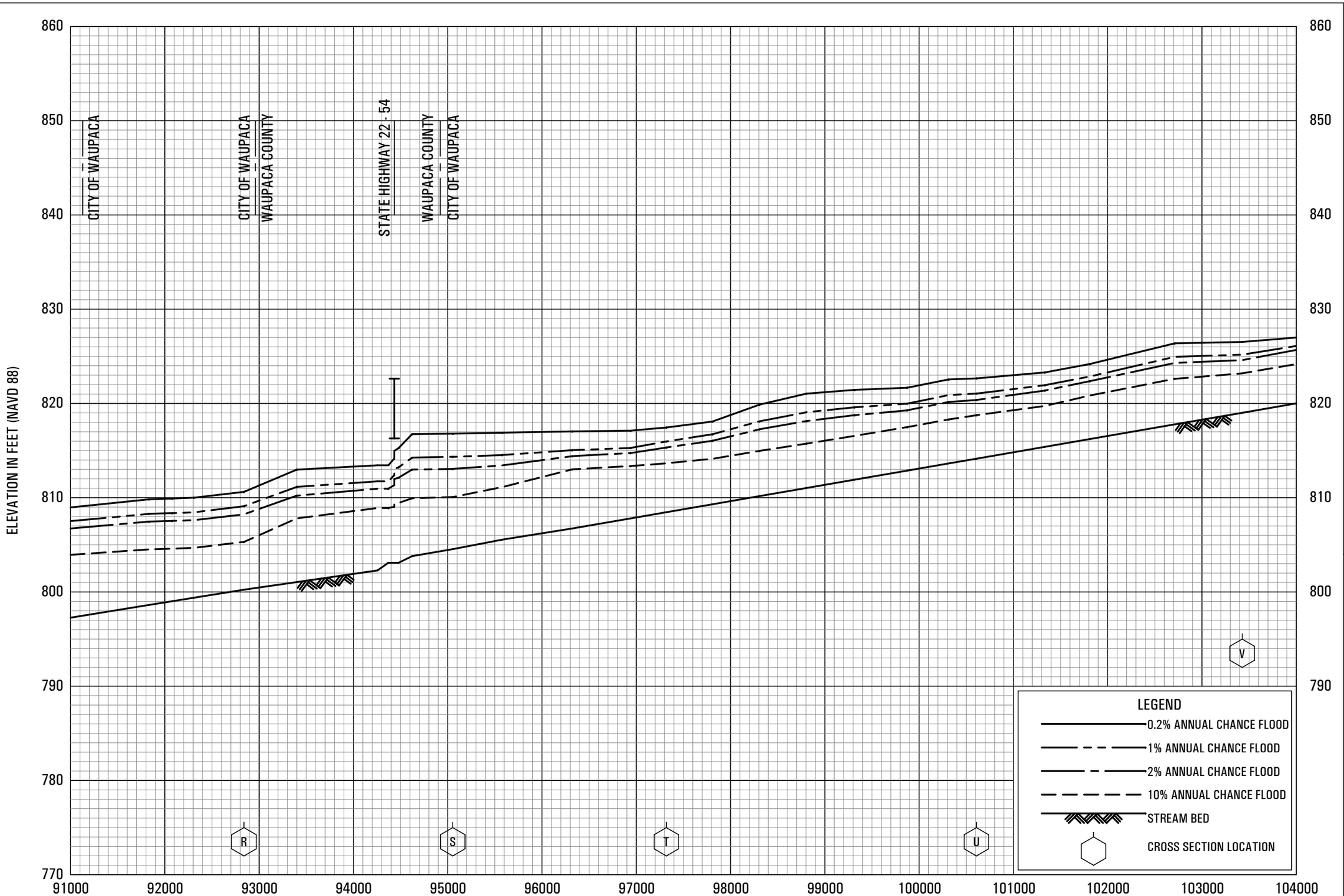
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

29P




FLOOD PROFILES

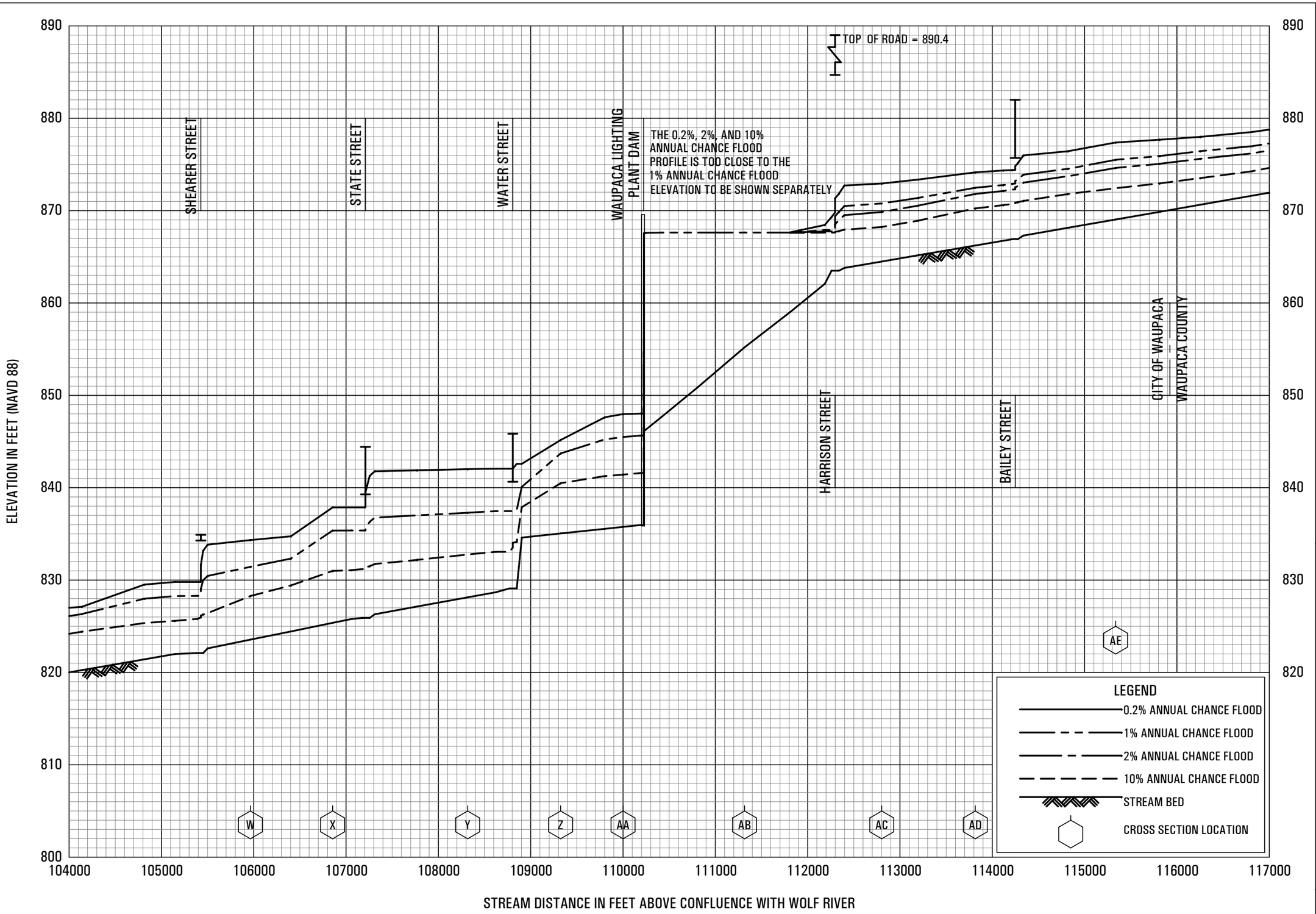
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

30P



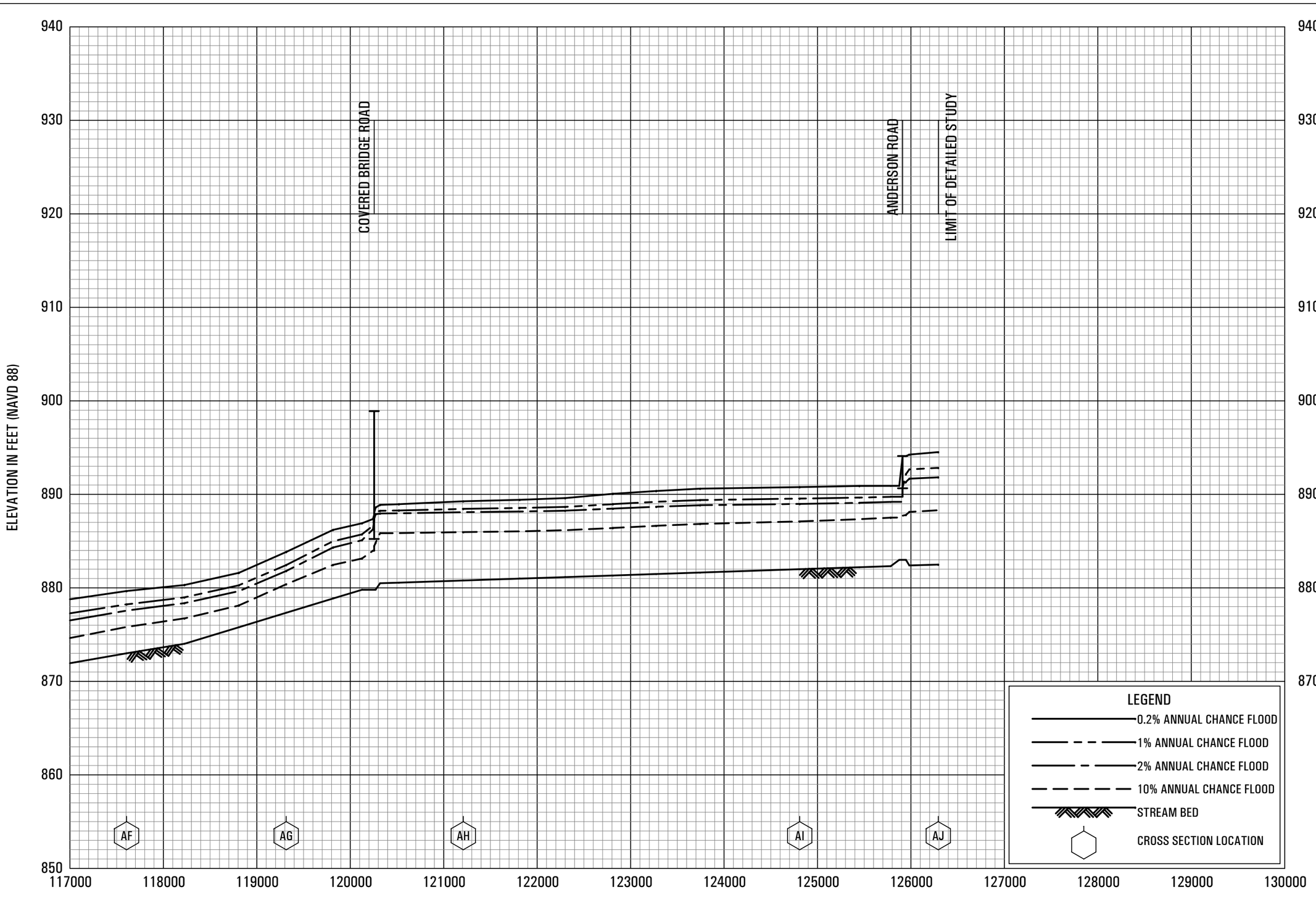

# FLOOD PROFILES

## WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS




# FLOOD PROFILES

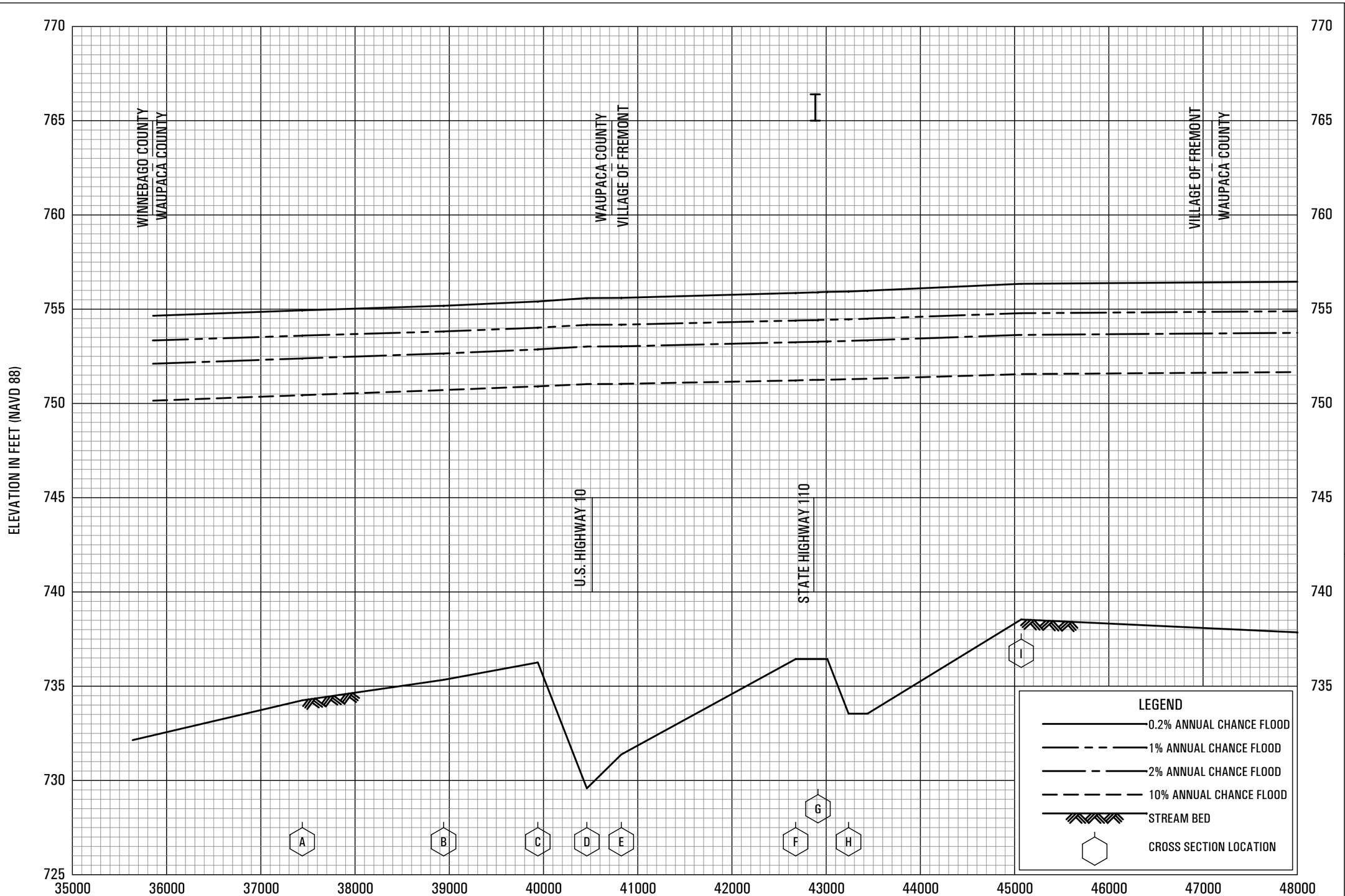
WAUPACA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

32P



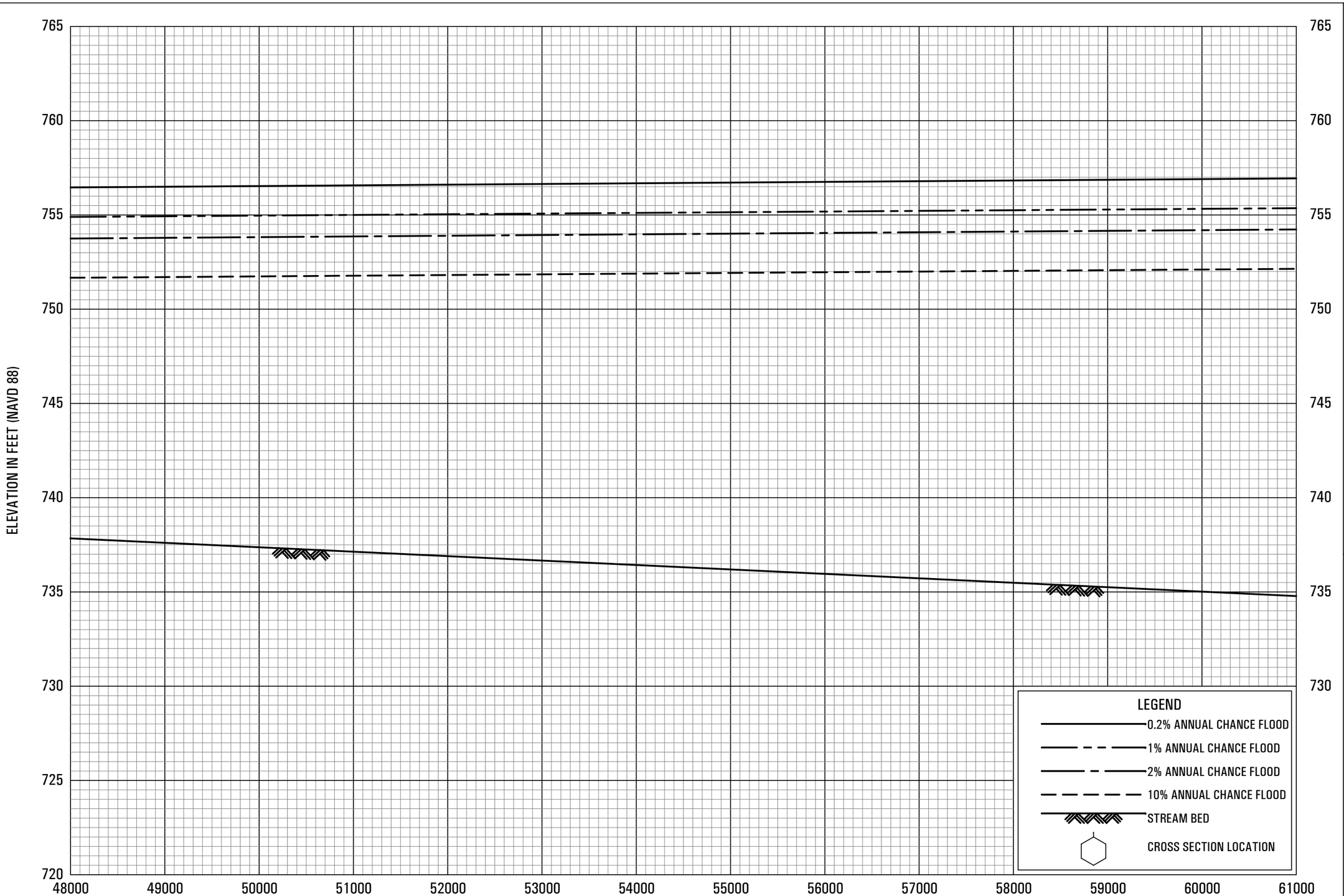

# FLOOD PROFILES

WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS




FLOOD PROFILES

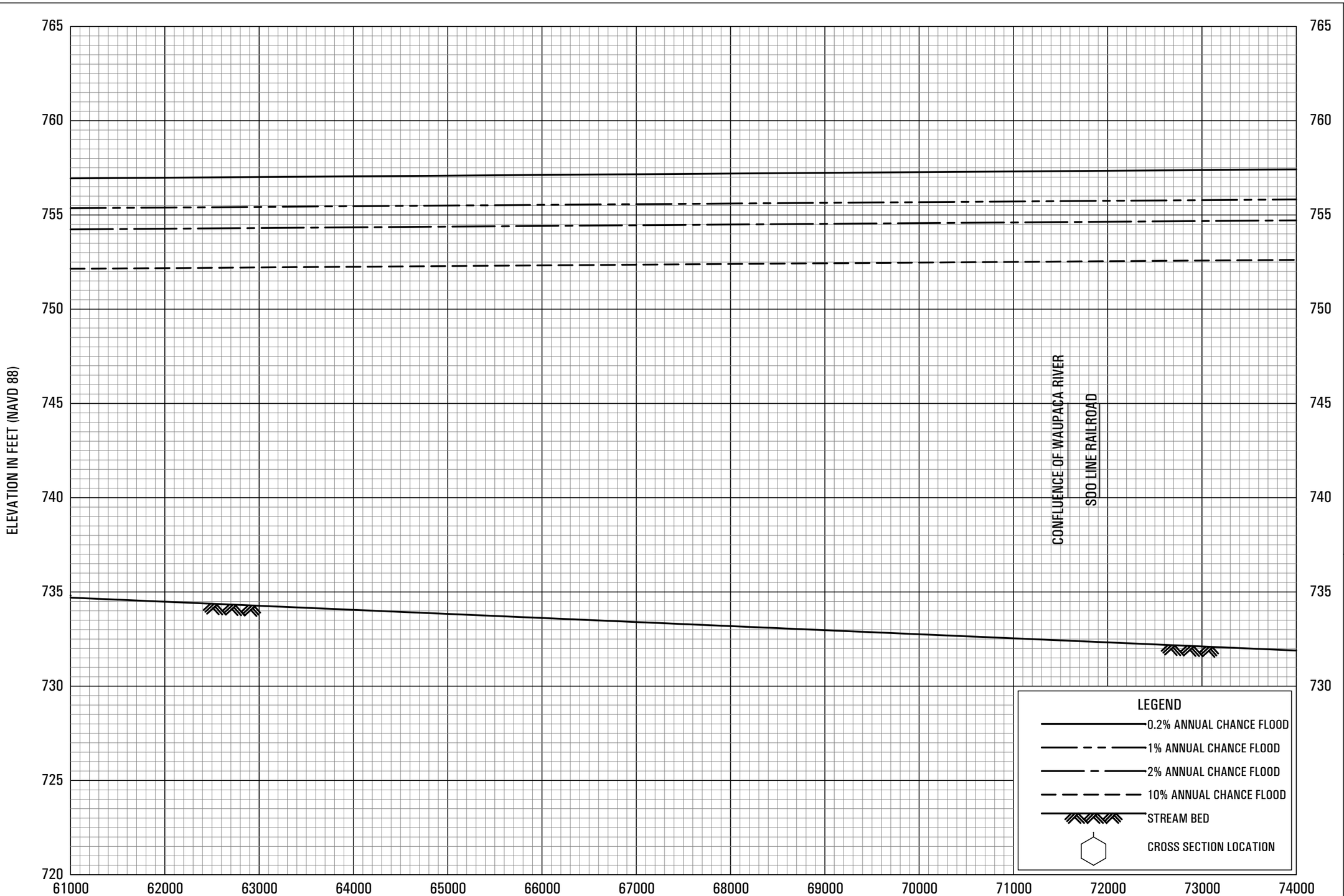
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

34P




FLOOD PROFILES

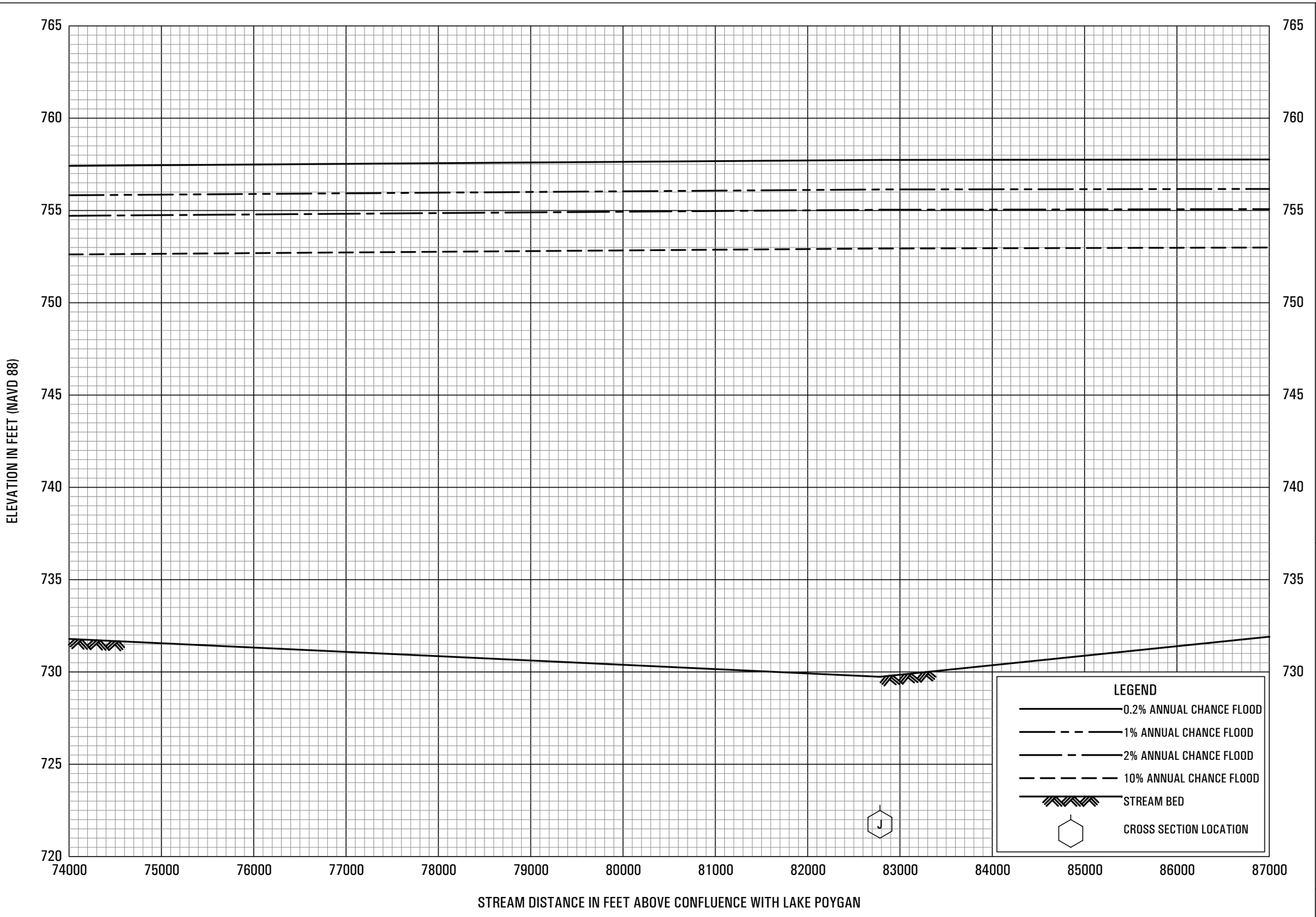
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

35P



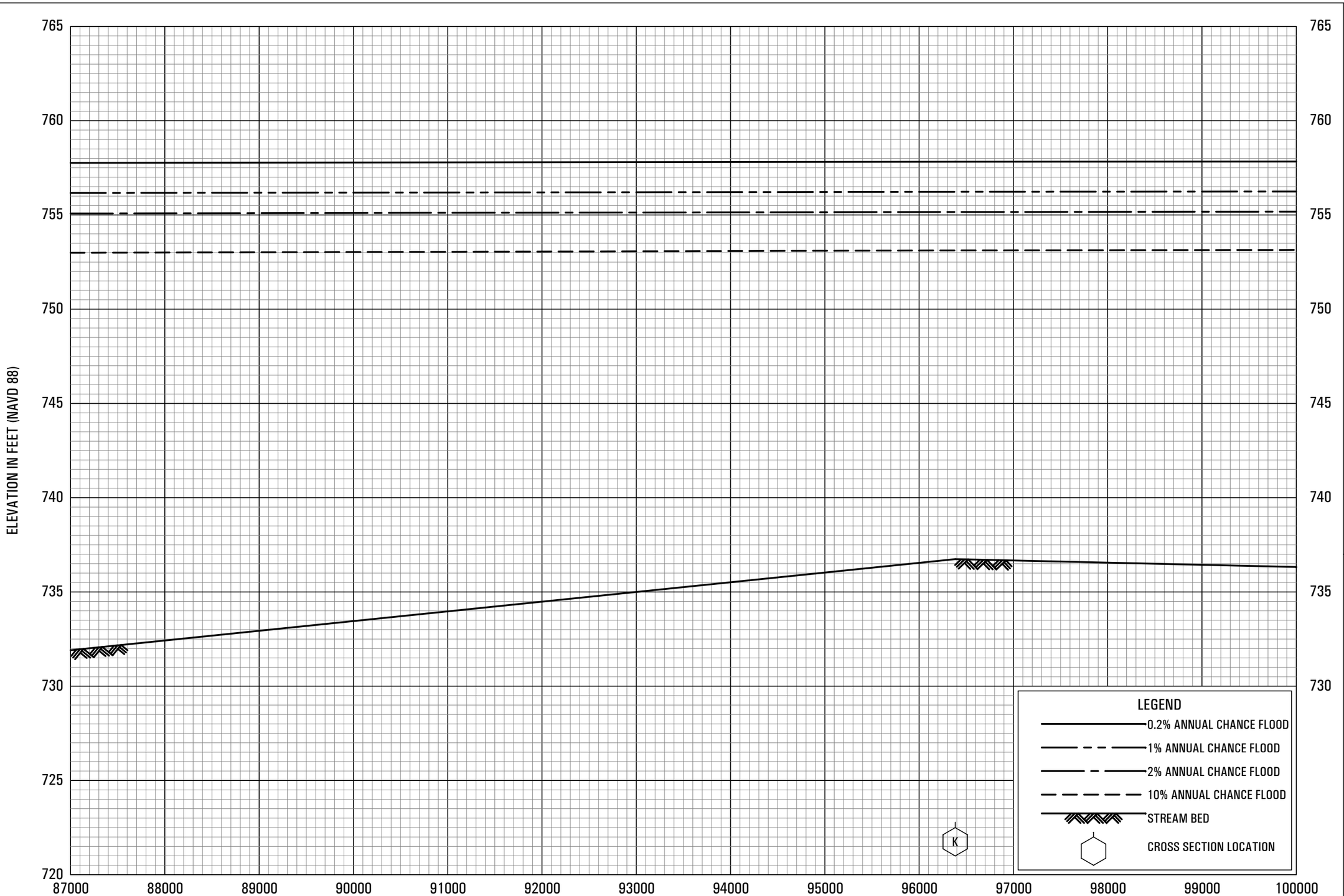

FLOOD PROFILES

WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS




FLOOD PROFILES

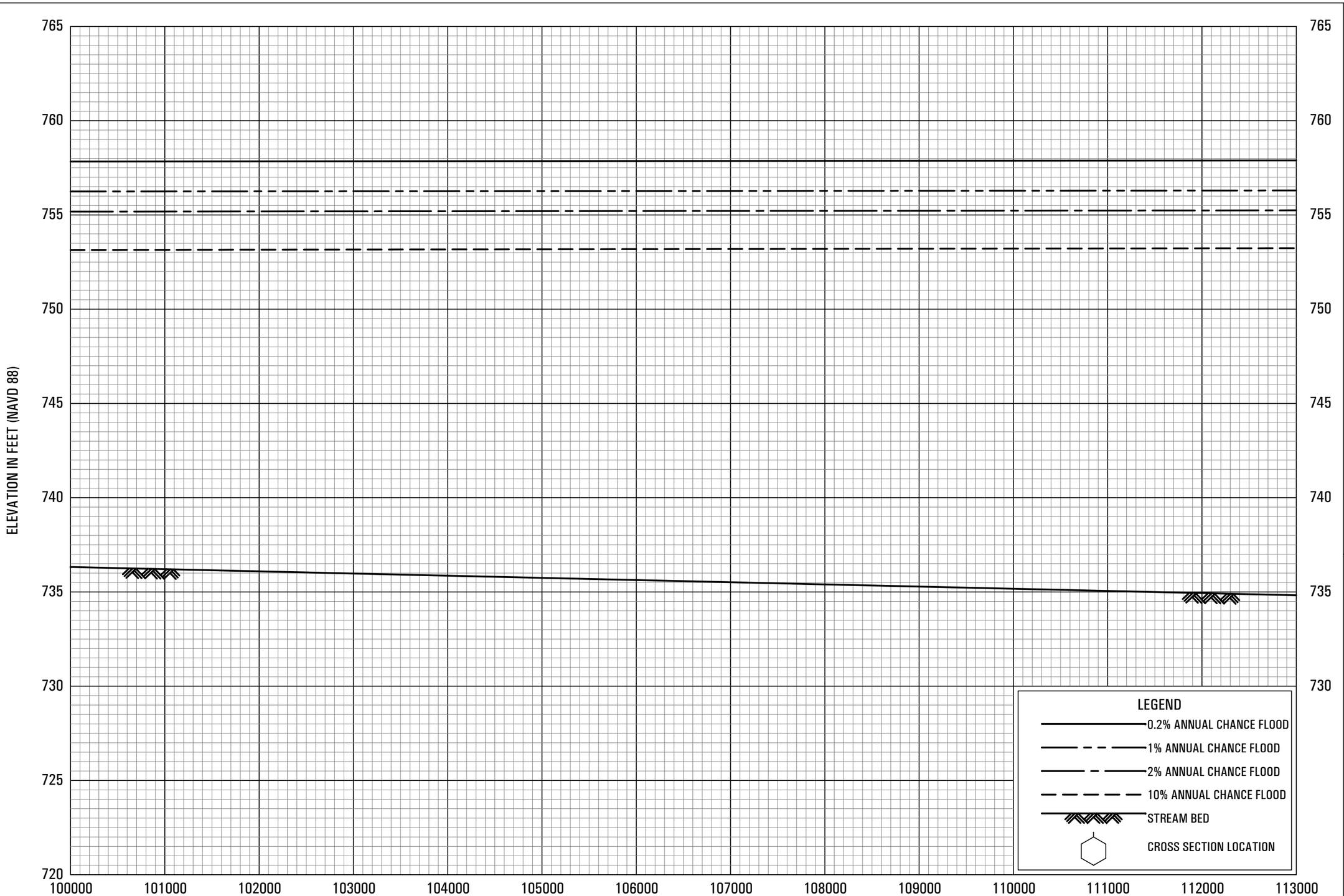
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

37P




FLOOD PROFILES

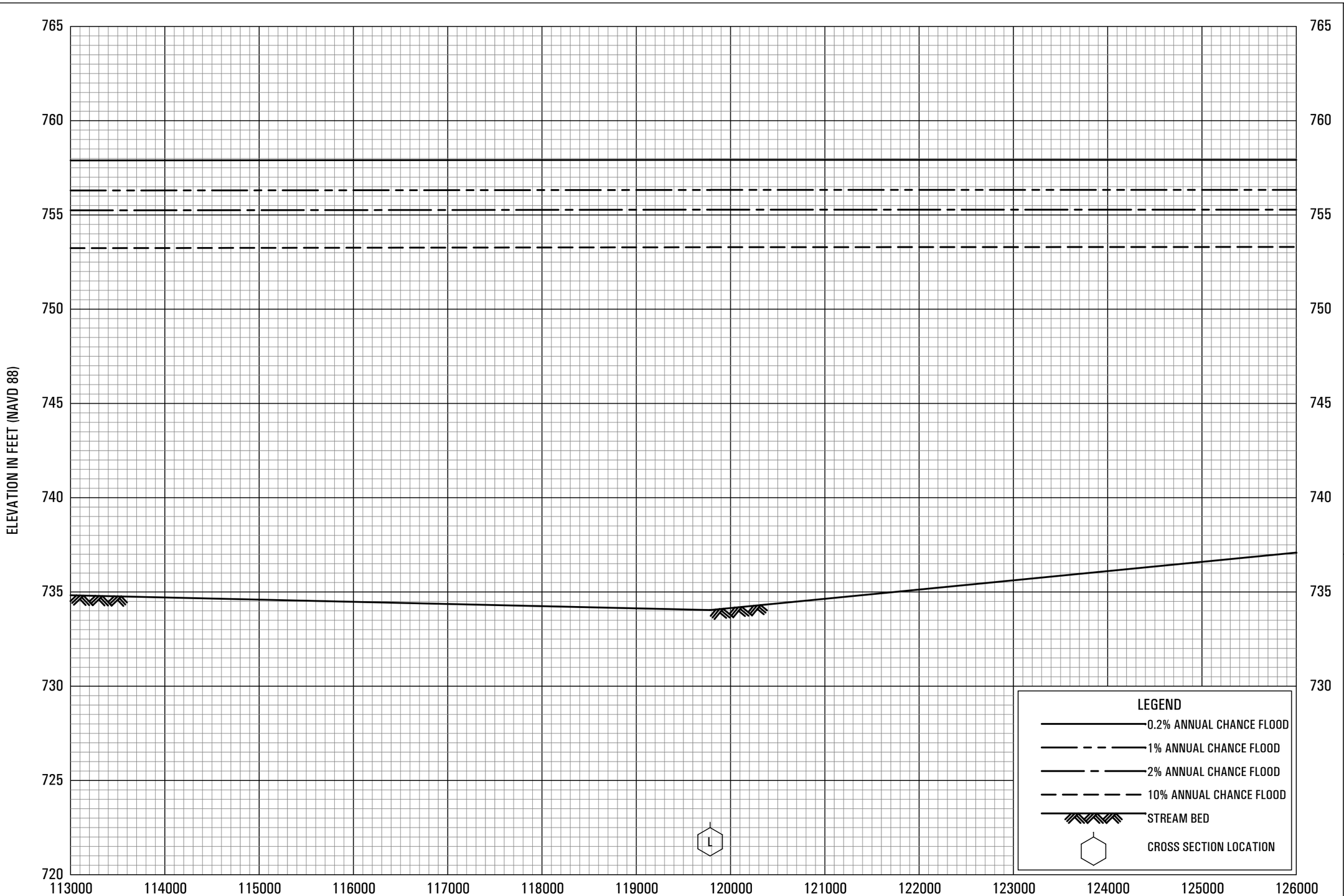
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

38P




FLOOD PROFILES

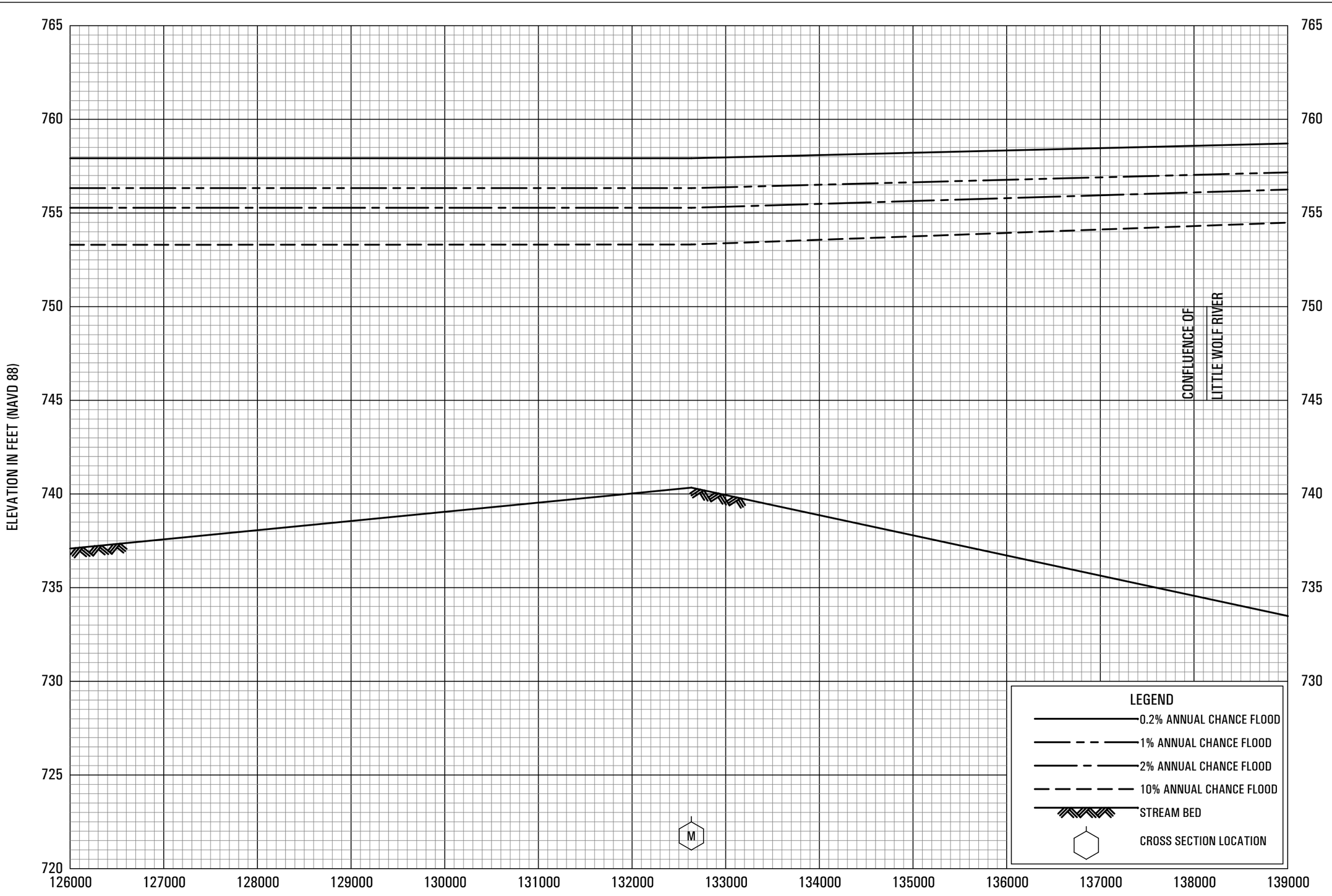
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

39P




FLOOD PROFILES

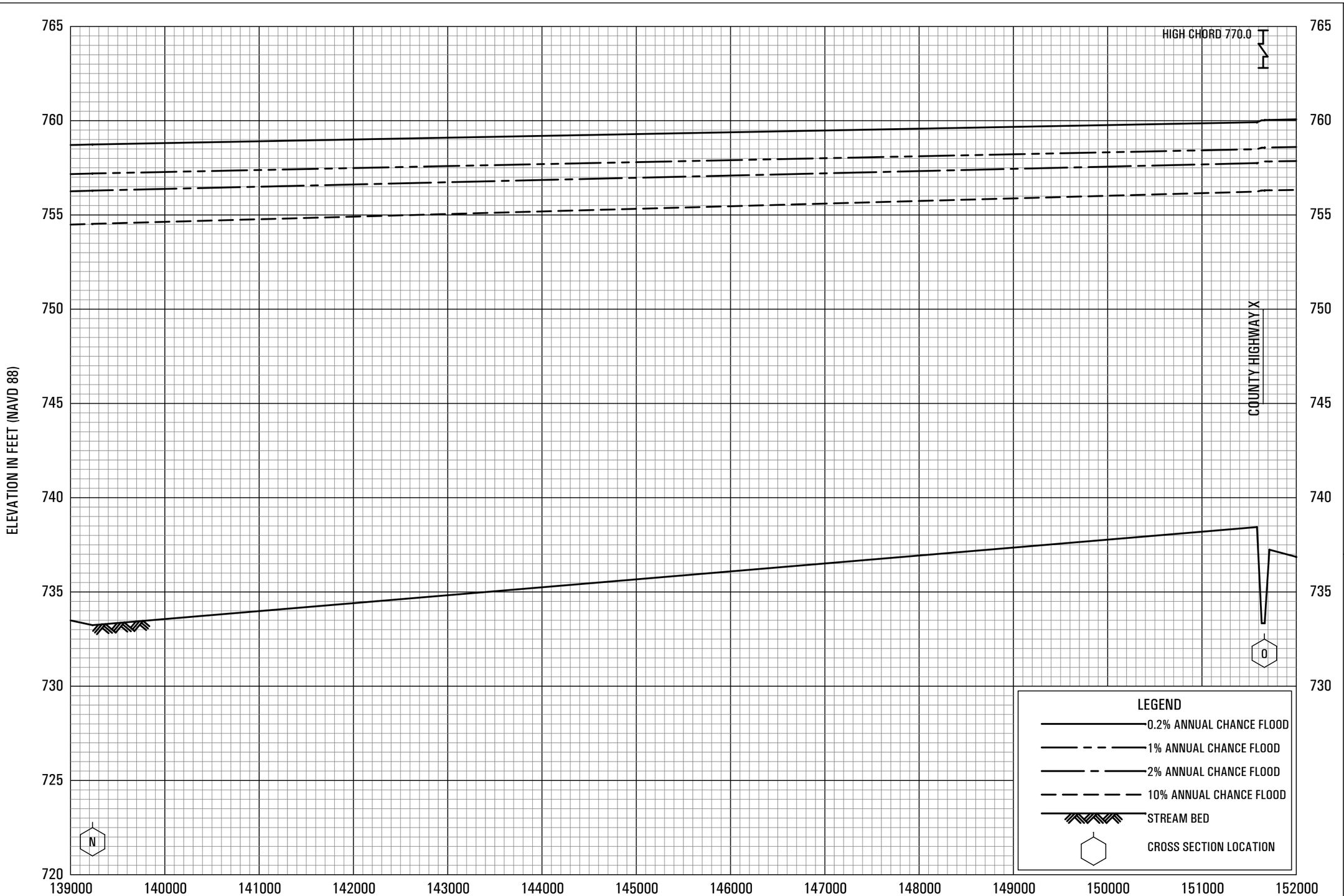
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

40P




FLOOD PROFILES

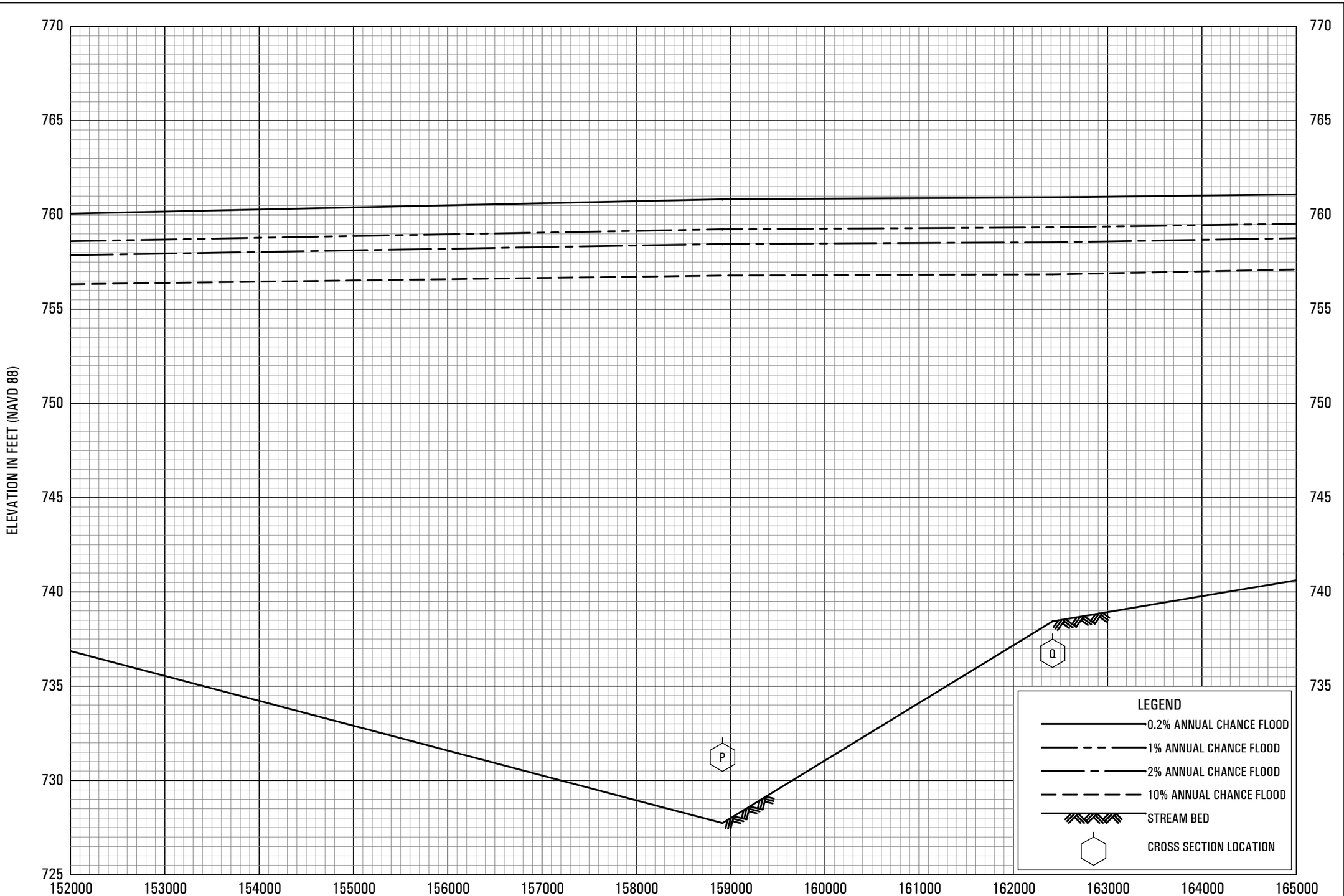
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

41P




FLOOD PROFILES

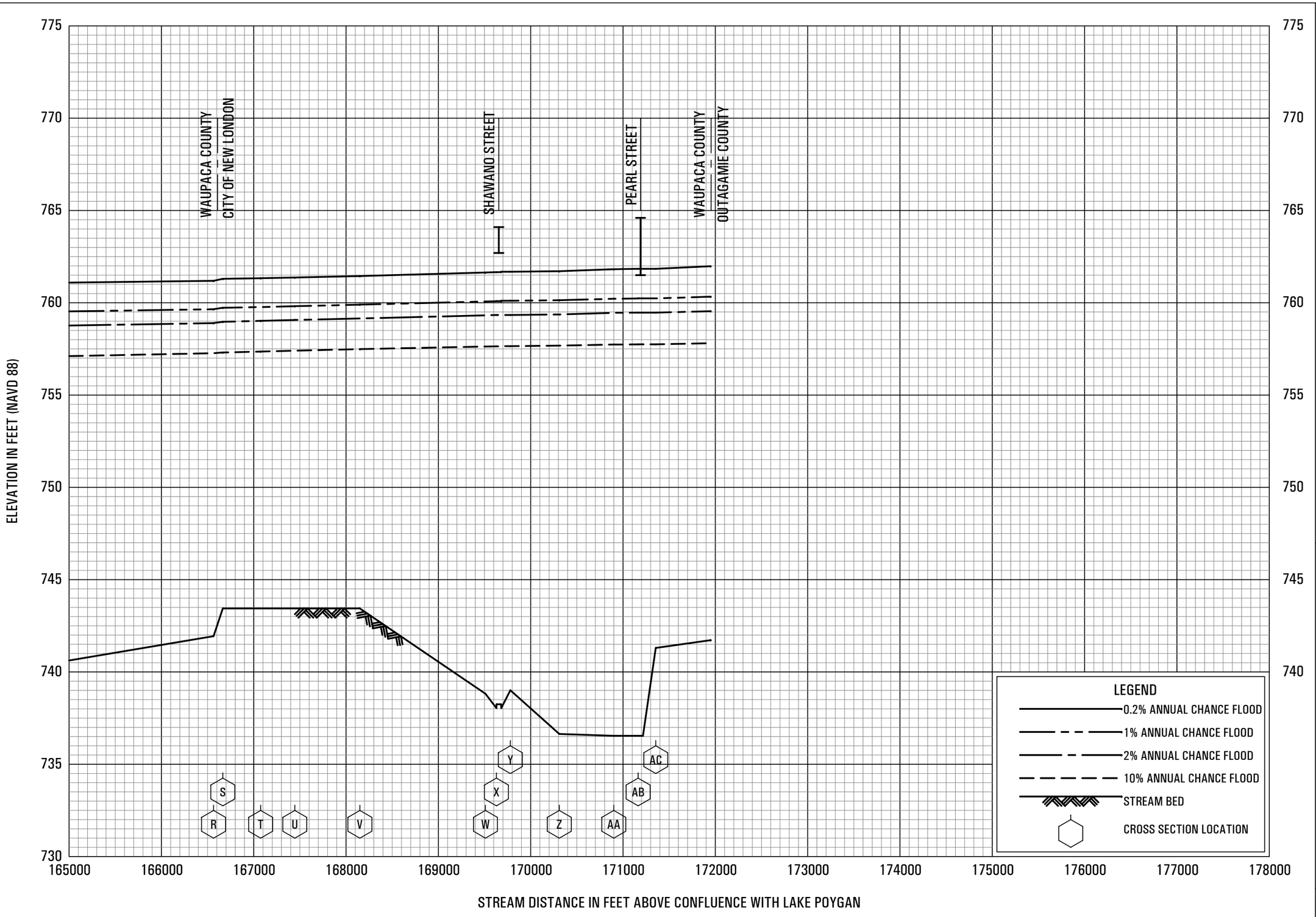
WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WAUPACA COUNTY, WI

AND INCORPORATED AREAS

42P




# FLOOD PROFILES

WOLF RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

**WAUPACA COUNTY, WI**

AND INCORPORATED AREAS