FLOOD INSURANCE STUDY

PERRY COUNTY, INDIANA
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
CANNELTON, CITY OF	180196
PERRY COUNTY (UNINCORPORATED AREAS)	180195
TELL CITY, CITY OF	180197
TROY, TOWN OF	180198

Preliminary: December 18, 2015

Revised: To Be Determined

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
18123CV000B

NOTICE TO FLOOD INSURANCE STUDY USERS

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

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

Initial Countywide FIS Effective Date: August 17, 2015

Revised Countywide FIS Effective Date: To Be Determined

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FLOOD INSURANCE STUDY

PERRY COUNTY, INDIANA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports and Flood Insurance Rate Maps (FIRMs) in the geographic area of Perry County, Indiana, including the City of Cannelton and Tell City, the Town of Troy, and the unincorporated areas of Perry County (hereinafter referred to collectively as Perry County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. This information will also be used by Perry County to update existing floodplain regulations as part of the Regular Phase of the NFIP, and 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.

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

1.2 Authority and Acknowledgments

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

Precountywide Analyses

Information of the authority and acknowledgements for each of the new studies and previously printed FIS reports and FIRMs for communities within Perry County was compiled and is shown below:

Perry County (Unincorporated Areas)	No previous FIS.
Cannelton, City of:	The hydrologic and hydraulic analyses for this study were prepared by the U.S. Army Corps of Engineers, (USACE) as reported in "Ohio River Profiles" for the FEMA. This study, which was completed in January 1981, covered all significant flooding sources affecting the City of Cannelton.
Tell City, City of:	The hydrologic and hydraulic analyses for this study were prepared by the USACE, as reported in "Ohio River Profiles" for the FEMA. This study, which was completed in January 1981, covered all significant flooding sources affecting the City of Tell City.
Troy, Town of:	The hydrologic and hydraulic analyses for this study were prepared by the USACE, as reported in "Ohio River Profiles" for the FEMA. This study, which was completed in January 1981, covered all significant flooding sources affecting the Town of Troy.
New Studies:	The hydrologic and hydraulic analyses for approximate stream reaches of Perry County were performed by Morley and Associates, Inc., on behalf of the Indiana Department of Natural Resources (IDNR), under Indiana Public Works Project Number E060020. The IDNR managed the production of this study as part of their Cooperating Technical Partner agreement with the Federal Emergency Management Agency dated April 29, 2004, which was defined by the IDNR Mapping Activity Statement 08-01 dated July 7, 2008, and funded under agreement number EMC-2005-GR-7022.

Initial Countywide FIS Report

For the initial countywide FIS report, redelineation of the previously effective flood hazard information, correction to the North American Vertical Datum of 1988, and conversion of the unincorporated and incorporated areas of Perry County into the Countywide format was performed by Morley and Associates, Inc., on behalf of the IDNR, under Indiana Public Works Project Number E060020. The IDNR managed the production of this study as part of their Cooperating Technical Partner agreement with the Federal Emergency Management Agency dated April 29, 2004, which was defined by the IDNR Mapping Activity Statement 08-01 dated July 7, 2008, and funded under agreement number EMC-2005-GR-7022.

This Physical Map Revision

For this Physical Map Revision (PMR), updated hydrologic analyses for the interior drainage of the City of Tell City South Levee System was developed by the USACE, Louisville District. Incorporation of this revised study area was performed by the Strategic Alliance for Risk Reduction (STARR) for FEMA, under Contract Number HSFEHQ-09-D-0370, Task Order HSFE05-11-J-0080. The work was completed in September 2014.

Base map information shown on the revised FIRM was derived from the Farm Services Administration, produced at a scale of 1:12,000, from aerial photography dated 2012 or later.

1.3 Coordination

The purpose of an initial Consultation Coordinated Officer's (CCOs) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

Precountywide Analyses

The dates of the initial and final CCO meetings held for the previously effective FIS reports covering the geographic area of Perry County, Indiana are shown in Table 1. The initial and final CCO meetings were attended by the study contractor, FEMA (or the Federal Insurance Administration), the IDNR, and the affected communities.

Table 1: CCO Meeting Dates for Pre-Countywide FIS

Community Name	Initial CCO Date	Final CCO Date
Cannelton, City of	*	September 7, 1982
Tell City, City of	*	*
Troy, Town of	*	August 18, 1982

*No dates given in previous FIS.

Initial Countywide FIS Report

For the initial countywide FIS, a CCO meeting was held on July 20, 2005, and was attended by IDNR, NRCS, the Perry County Plan Commission, the Perry County Surveyor, the Perry County Engineer, the Perry County Soil and Water Conservation District, Perry County Emergency Management Agency, the Town of Cannelton and the City of Troy.

The results of the countywide study were reviewed at the final CCO meeting held on November 28, 2012, and attended by representatives of FEMA, IDNR, Tell City, Cannelton, and Perry County. All problems raised at that meeting have been addressed.

This Physical Map Revision

For this PMR, an initial letter dated October 29, 2014, was sent to the City of Tell City to notify the city that FEMA was accepting a request for accreditation of the City of Tell South Levee System.

The City of Tell City was able to provide FEMA with documentation that the Tell City South Levee System complies with 44 CFR Section 65.10, therefore, per FEMA guidance, the levee system is shown on the revised countywide FIRM as providing protection from the 1-percent annual chance flood.

The results of the study were reviewed at the final meeting held on _____, and attended by representatives of _____. All issues and/or concerns raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Perry County, Indiana, including the incorporated communities listed in Section 1.1.

Precountywide Analyses

The Ohio River, within the Cities of Cannelton and Tell City, and the Town of Troy, was studied by detailed methods.

Initial Countywide FIS Report

All FIRM panels for Perry County have been revised, updated, and republished in countywide format as a part of this FIS. The FIRM panel index, provided as Exhibit 2, illustrates the revised FIRM panel layout.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards as identified during the initial CCO meeting. For this study, twelve new stream reaches were studied using approximate methods (Table 3). The scope and methods of new approximate studies were proposed and agreed upon by FEMA, the IDNR, and Perry County.

The areas studied by detailed methods were selected with priority given to all known flood hazards areas and areas of projected development of proposed construction. This study incorporates detailed studies of Ohio River and Windy Creek, performed for and approved by IDNR (Table 2).

The initial countywide FIS update also incorporated the determination of letters issued by FEMA resulting in map changes (Letters of Map Change, or LOMCs). No LOMCs have been incorporated into the mapped changes. No Letters of Map Revision (LOMRs) have been issued for Perry County. Letters of Map Amendment (LOMAs) revalidated for this study are summarized in the Summary of Map Actions (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update. Copies of the TSDN may be obtained from the Community Map Repository.

Table 2: Streams Studied by Detailed Methods for Initial Countywide FIS

Ohio River	Windy Creek

Table 3: Streams Studied by Approximate Methods for Initial Countywide FIS

Anderson River	Little Dear Creek
Bear Creek	Little Oil Creek
Brushy Fork	Little Windy Creek
Deer Creek	Middle Fork Anderson
Hurricane Creek	Hurricane Creek
Krauss Creek	Poison Creek

Table 4: Scope of Study for Initial Countywide FIS

Stream	Limits of Approximate Study
Anderson River	Mouth to Dubois County Line
Bear Creek	Mouth to Tumbler Road
Brushy Fork	Mouth to Sagebrush Road
Deer Creek	Mouth to Thistle Road
Hurricane Creek	Spencer Co. Line to Dubois Co. Line
Krauss Creek	Mouth to Abbott Road
Little Deer Creek	Mouth to Shellflower Road
Little Oil Creek	Mouth to Mount Pleasant Road
Little Windy Creek	Mouth to State Road 37
Middle Fork Anderson River	Mouth to Crawford County Line
Oil Creek	Mouth to Orchid Road
Poison Creek	Mouth to Urban Road

Stream	Limits of Detailed Study
Ohio River	Spencer Co. Line to Crawford Co. Lin

This Physical Map Revision

The purpose of this PMR is to adjust the Tell City South Levee System from Provisionally Accredited to Accredited which incorporates interior drainage behind the levee.

2.2 Community Description

Perry County is located in southern Indiana and is bordered by Dubois County to the northwest, Crawford County to the northeast, Meade County, Kentucky to the east, Breckinridge County, Kentucky to the southeast, Hancock County, Kentucky to the southwest, and Spencer County to the west. The total land area within the county is approximately 381.4 square miles. The largest city and the county seat is Tell City which is located approximately 130 miles south of Indianapolis and 55 miles north of Louisville Kentucky. Perry County is served by Interstate 64, US Highway 50, and State Routes 37, 62, 66, 70, 145, 166 and 237.

The climate in Perry County ranges from hot and humid in the summertime to cold during the winter season. Average daytime temperatures during the summer fall around 84.5°F, while winter temperatures average at 48.3°F. Precipitation for Perry County totals an annual amount of 52.9 inches (Reference 20).

According to U.S. Census Data from the year 2010, the population of Perry County was reported to be 19,338. Table 5 lists the population of the incorporated areas in Perry County (Reference 21).

Table 5: Population of Incorporated Cities and Towns in Perry County 2010 Census

Community	Population
Cannelton, City of	1,563
Tell City, City of	7,272
Troy, Town of	385

2.3 Principal Flood Problems

Major flooding in Perry County primarily occurs along the Ohio River, Windy Creek, and the tributaries to those streams. The flood of January-February 1937 was the most disastrous for the Ohio River Basin. Excessive and almost continuous rainfall most of January caused the river to swell to maximum recorded stages. This flood interrupted communications and transportation for up to a month. The flood of 1913 was the second largest in the area, due to large storms following each other very closely. Floods principally occur during the winter and spring months, but can occur during any season. Generally, two types of storm events cause flooding. During the winter and spring, storms of moderate intensity and long duration, coupled with frozen ground, cause flooding to occur. During the summer, thunderstorms which have high intensities and relatively short durations can cause floods. Localized flood problems in the incorporated areas are summarized below:

Cannelton, City of: Subject to flooding from the Ohio River. The discharges and frequencies of the river are as follows:

Table 6: Flood Crest Elevations
USGS gage for the Ohio River at the Cannelton Dam

Date	Discharge Cubic Feet per Second (CFS)	Elevation (feet, gage datum)
March 8, 1997	735,000	52.42
December 15, 1978	617,000	23.84
January 13, 2005	588,000	46.05
February 22, 2000	572,000	46.85
January 27, 1996	566,000	44.69
February 21, 1989	555,000	46.03

Tell City, City of: Subject to flooding from the Ohio River, Windy Creek, and the backwater to the Ohio River.

Troy, Town of: Subject to flooding from the Ohio River.

Table 7: Flood Crest Elevations
USGS gage for Sigler Creek Tributary at Uniontown

Date	Discharge Cubic Feet per Second (CFS)	Elevation (feet, gage datum)
July 26, 1979	170	10.68
April 30, 1983	130	9.05
March 16, 1984	130	9.07
May 30, 1974	125	9.05
September 1, 1982	110	8.59
July 13, 1987	96	8.11

Table 8: Flood Crest Elevations
USGS gage for the Middle Fork Anderson River at Bristow

Date	Discharge Cubic Feet per Second (CFS)	Elevation (feet, gage datum)
January 21, 1959	15,000	20.00
March 9, 1964	6,360	19.18
April 3, 1989	4,290	17.98
April 28, 1970	4,120	18.87
January 22, 1962	3,400	16.84
March 17, 1963	3,110	16.65

2.4 Flood Protection Measures

The Tell City South Levee System provides 1-percent annual chance flood protection from overflow of the Ohio River in the City of Tell City. In addition to the levee, the city also has a pumping station. The City of Cannelton has a levee system that is provisionally accredited and provides protection from the 1-percent annual-chance flood from the Ohio River. The Town of Troy does not have any flood control measures.

The state of Indiana has also set regulations concerning development in a flood plain. The Indiana Flood Control Act of 1945, as amending, requires that the channels and that portion of the flood plain known as the floodway be kept free and clear of interference or obstructions which could restrict the flow rate in a significant manner. The Act stipulates that the Indiana Flood Plain Management Act of 1973 further requires that flood plain management regulations adopted after July 1, 1974, meet a minimum set of standards for the delineation and regulation of flood hazard areas.

3.0 ENGINEERING METHODS

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

3.1 Hydrologic Analyses

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

Precountywide Analyses

Frequency data for the Ohio River were supplied by the USACE, Ohio River Division Office. Natural maximum annual frequency curves were developed by the USACE in accordance with the method in "Statistical Methods in Hydrology" (Reference 16).

The computed natural statistics (mean, standard deviation, coefficient of skew) for the entire period of record were adjusted by reconciling adjacent points and comparison on drainage area proportions, to produce consistent statistics throughout the length of the main stem. Stage frequency curves were developed by converting flows to stage though the use of crest stage-maximum discharge relations plotted from historical data, and extended rating curves prepared in connection with the Ohio River Standard Project Flood (SPF) Study.

To determine modified flood peaks on the Ohio River, 12 historical floods, plus three hypothetical ones of greater magnitude, were used in the analyses of flow modification. The flows of these 15, considered representative of the basin, were modified by the operation of USACE reservoirs, completed or under construction.

Initial Countywide FIS Report

Table 9 contains a summary of peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance floods, where applicable, for each flooding source studied in detail in Perry County. Peak discharges for Windy Creek in the table were compiled from previously effective FIS reports for Perry County and incorporated areas. Peak discharges for the Ohio River are from the new detailed study.

Table 9: Summary of Discharges

Flooding Source And Location	Drainage Area (Square Miles)	Peak Discharge (CFS) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
OHIO RIVER					
Cannelton Lock & Dam (River Mile 720.5)	96,700	640,000	800,000	865,000	1,010,000
WINDY CREEK					
Washington Street Bridge (River Mile 4.425)	1.01	1,390	1,540	1,680	3,320
19th Street Bridge (River Mile 3.30)	4.0	2,570	2,850	3,120	6,330

Standard and accepted hydrologic methods were used to develop discharge data on the study streams in Perry County. These data were coordinated with the IDNR, the Natural Resources Conservation Service (NRCS)

(formerly the Soil Conservation Service), the U. S. Geological Survey (USGS) and the Louisville District of the USACE, through a Memorandum of Understanding dated May 6, 1976. Discharge curves for the 10-, 2-, 1-, and 0.2- percent annual chance floods were developed for each study stream using several different procedures and compared for consistency.

The hydrologic analyses for the Ohio River were performed by the USACE. Frequency discharge data for the entire length of the Ohio River are available based on an analysis conducted by the Ohio River Division of the Corps of Engineers in Cincinnati, Ohio. Natural discharge-frequency curves for the Ohio River were developed in accordance with methods presented in papers by Leo R. Beard, Statistical Methods in Hydrology. Modified discharge-frequency curves, for the Ohio River, resulted from routing twelve representative floods for the Ohio River modified by an upstream Corps of Engineers reservoir system. That system included reservoirs completed or near completion in 1976 and is considered current in 2002. Data were plotted opposite original flood data on a grid containing a referenced flow reduction of natural flow and a new best-fit curve drawn. Total reductions were read from the new curve at selected natural flow frequencies, and subtracted from natural flows at those frequencies to obtain new modified-flow values.

For Windy Creek a one hour unit hydrograph was developed at a power substation near the end of Twelfth Street, Windy Creek mile 1.9, for a drainage area of 5.3 square miles. The one hour unit hydrograph was developed by synthetic methods due to the absence of observed flow records on Windy Creek. Unit hydrograph values thus derived were for peak discharge, time of peak, the discharge at twice the time of peak, and base time. These values were related to the slope of the valley and the size of the area for the conditions of uniform distribution of rainfall.

Rainfall data for the 10-, 2-, 1-, and 0.2- percent annual chance floods were developed for Windy Creek. Rainfall data for the Windy Creek watershed were taken from Technical Paper No. 40, “Rainfall Frequency Atlas of the United States,” dated May 1961. The 0.2% annual chance frequency rainfall data were determined by the method outlined in Civil Engineer Bulletin No. 52-8, Corps of Engineers, dated 26 March 1952.

Discharge-frequency data on Windy Creek were based on applications of rainfall- excess to the one hour unit hydrograph mentioned previously. A curve of drainage area versus stream mileage was plotted from the mouth of Windy Creek to State Route 66 (mile 5.3). Flow distribution along Windy Creek was by drainage area proportion.

The equations used to determine the discharges in the majority of the cases are taken from Estimation of Peak Discharges of Indiana Streams by using log Pearson (iii) distribution. The equations presented in the report are also included in the latest version of the National Flood Frequency (NFF) program by the USGS, and are included in the USGS StreamStats

application. In some cases, the discharges for a stream have been coordinated with the IDNR, the NRCS (formally the Soil Conservation Service), the USGS and the USACE, through a Memorandum of Understanding dated May 6, 1976.

This Physical Map Revision

The interior drainage analysis for the Tell City South Levee System was modeled using the USACEs, Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS), computer program. Subbasins were delineated within the interior side of the levee and the methods outlined in the USACE Engineering Manual 1110-2-1413 were used to determine the interior 1-percent annual chance ponding elevation through a coincident frequency analysis.

To perform the coincident frequency analysis, several pieces of information are needed:

Exterior elevation duration curve – needed to determine the percent of time the exterior elevation is at or above a given elevation. This was obtained through the City of Tell City.

Hypothetical rainfall depths were obtained from NOAA Atlas 14 for the City of Tell City and were used to generate runoff hydrographs for the interior sub-basins. The hydrographs were computed based on the NRCS soil-cover-complex curve number (CN) and dimensionless unit graph.

Along with gravity structure/pump plant locations data, HEC-HMS was used to calculate the interior drainage ponding elevation. The stillwater elevation for the interior drainage ponding is shown in Table 10.

Table 10 - Summary of Stillwater Elevations

	Water Surface Elevations (Feet NAVD[1])			
Flooding Source	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Interior Drainage Ponding	*	*	387.7	*

[1] North American Vertical Datum of 1988
*Data 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 table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

Precountywide Analyses

Cross sections for the precountywide analyses were obtained by topographic surveying and hydrologic surveys.

Initial Countywide Analyses

Cross sections for the backwater analyses were obtained from a variety of sources including: physical survey data, IDNR contour mapping, USGS topographic mapping and local contour mapping. 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. Cross sections for the Ohio River were determined from detailed mapping with bathymetry (1" = 600' with 5-foot contour intervals), developed for Corps of Engineers - Ohio River navigation studies.

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program. For the new approximate study reaches, the USACE HEC-River Analysis System (RAS) program was used. HEC- RAS is an updated version of the HEC-2 program used to perform step-backwater analyses. Water-surface elevations of floods of the selected recurrence intervals were computed in April 1984 through the use of the USACE HEC-2 step-backwater computer program. For the new approximate study reaches and the Ohio River, the USACE HEC-RAS (Version 3.1.3 & 3.1.1, respectively) program was used. The Windy Creek detailed study was computed using the USACE HEC-2 program.

Flood profiles were prepared for all streams studied by detailed methods and show computed water-surface elevations to an accuracy of 0.5 feet for floods of the selected recurrence intervals. For this countywide FIS, flood profiles and approved LOMRs have been consolidated into continuous stream reaches and adjusted to reflect the current vertical datum as described in Section 3.3. New profiles have been prepared for the new detailed studies and for the purposes of incorporating the LOMRs described in Section 2.1 above.

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

estimated by field inspection with the aid of "n" value tables and equations. Channel and overbank roughness factors used in the detailed studies are summarized by stream in Table 11.

Table 11: Channel and Overbank Roughness Factors

	Roughness Coefficients		
Stream	Main Channel	Left Overbank	Right Overbank
Ohio River	0.023-0.034	0.050-0.055	0.050-0.055
Windy Creek	0.020-0.040	0.030-0.150	0.030-0.100

For new approximate study areas, analyses were based on field inspection and modeling of the stream reaches using simplified HEC-RAS models. Structural measurements or field surveying was not performed. Cross section geometry was derived from topographic mapping from the 2005 statewide orthophotography project. Starting elevations were assumed to be normal depth. Starting water-surface elevations for the Ohio River were obtained using gaged data and known elevation- discharge relationships at those locations.

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.

This Physical Map Revision

No hydraulic analyses were performed for this PMR.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the North American Vertical Datum of 1988 (NAVD88), many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities.

For the initial countywide FIS, a vertical datum conversion of -0.33 feet was calculated at the centroid of the county and used to convert all elevations in Perry county from NGVD29 to NAVD88 using the National Geologic Survey's VERTCON online utility (VERTCON, 2005).

(NGVD29 – 0.33 = NAVD88)

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (FEMA, June 1992), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Spring, Maryland 20910. (Internet address http://www.ngs.noaa.gov.)

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

The horizontal coordinate system used for the production of the digital FIRMs is the Transverse Mercator projection, Indiana State Plane coordinate system, referenced to the North American Datum of 1983 and the GRS 1980 spheroid.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

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

4.1 Floodplain Boundaries

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

interpolated using topographic mapping from the 2005 statewide orthophotography flight.

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, AE, V, and VE); and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the Tell City South Levee interior drainage, the 1-percent annual chance floodplain boundaries were provided by the USACE, Louisville District.

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

4.2 Floodways

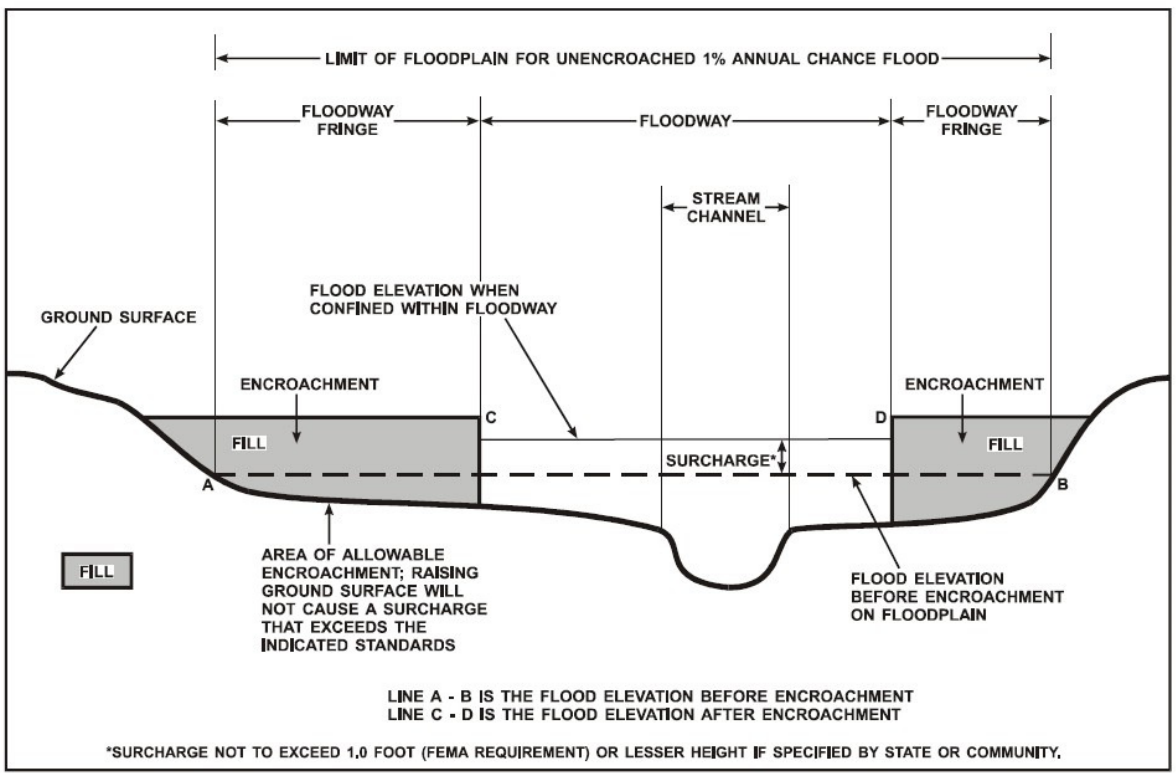
Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The State of Indiana, however, per Indiana Code IC 14-28-1 and Indiana Administrative Code 312 IAC 10, has designated that encroachment in the floodplain is limited to that which will cause no significant increase in flood height. As a result, floodways for this study are delineated based on a flood surcharge of less than 0.15 feet. The floodways in this study were approved by the IDNR, and are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 12). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood more than 0.14 feet at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

Figure 1: Floodway Schematic



FLOODING SOURCE		FLOODWAY			1- PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FT/SEC)	REGULATORY (FEET, NAVD)	WITHOUT FLOODWAY (FEET, NAVD)	WITH FLOODWAY (FEET, NAVD)	INCREASE (FEET)
OHIO RIVER								
A	731.00	8,066/321	170,661	5.1	397.4	397.4	397.5	0.1
B	730.50	8,228/303	181,822	4.8	397.7	397.7	397.8	0.1
C	730.00	8,845/1,086	219,961	3.9	398.1	398.1	398.2	0.1
D	729.25	9,834/3,097	226,989	3.8	398.3	398.3	398.4	0.1
E	728.50	9,194/2,193	223,879	3.9	398.6	398.6	398.7	0.1
F	728.00	8,657/718	197,048	4.4	398.7	398.7	398.8	0.1
G	727.50	7,588/799	183,693	4.7	398.9	398.9	399.0	0.1
H	727.00	8,036/148	175,404	4.9	399.0	399.0	399.1	0.1
I	726.25	7,603/106	182,949	4.7	399.3	399.3	399.4	0.1
J	725.25	6,994/169	176,201	4.9	399.8	399.8	399.9	0.1
K	724.25	2,518/163	131,519	6.6	400.0	400.0	400.1	0.1
L	723.50	1,614/369	103,916	8.3	400.0	400.0	400.1	0.1
M	722.25	3,295/1,332	138,135	6.3	401.1	401.1	401.2	0.1
N	721.50	2,740/346	137,425	6.3	401.4	401.4	401.5	0.1
O	720.50	2,287/230	117,863	7.3	402.1	402.1	402.2	0.1
P	719.50	4,815/246	147,395	5.9	402.8	402.8	402.9	0.1
Q	719.00	5,856/420	161,584	5.4	403.1	403.1	403.2	0.1
R	718.00	6,350/250	147,233	5.9	403.4	403.4	403.5	0.1
S	717.25	7,643/283	202,023	4.3	404.3	404.3	404.4	0.1
T	716.50	6,208/467	173,958	5.0	404.5	404.5	404.6	0.1
U	715.50	2,552/207	126,703	6.8	404.8	404.8	404.9	0.1
V	714.50	2,637/1,404	111,242	7.8	405.1	405.1	405.2	0.1
W	712.50	4,595/3,139	148,140	5.8	406.6	406.6	406.7	0.1
X	711.00	3,734/1,474	153,946	5.6	407.3	407.3	407.4	0.1
Y	709.50	2,969/1,516	122,165	7.1	407.8	407.8	407.9	0.1
Z	708.00	3,440/1,895	154,682	5.6	408.9	408.9	409.0	0.1
AA	707.00	1,914/212	111,795	7.7	409.0	409.0	409.1	0.1
AB	705.75	2,725/114	110,199	7.9	409.6	409.6	409.7	0.1
AC	704.50	3,614/148	143,909	6.0	410.7	410.7	410.8	0.1

[1] Miles Below Pittsburgh
[2] Total Width / Width Within County Boundary

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN AND INCORPORATED AREAS

FLOODWAY DATA

OHIO RIVER

FLOODING SOURCE		FLOODWAY			1- PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FT/SEC)	REGULATORY (FEET, NAVD)	WITHOUT FLOODWAY (FEET, NAVD)	WITH FLOODWAY (FEET, NAVD)	INCREASE (FEET)
OHIO RIVER								
AD	704.00	4,025/519	153,991	5.6	411.0	411.0	411.1	0.1
AE	703.25	2,733/803	148,220	5.8	411.3	411.3	411.4	0.1
AF	702.75	2,394/718	121,178	7.1	411.3	411.3	411.4	0.1
AG	701.75	2,179/754	124,301	7.0	411.9	411.9	412.0	0.1
AH	700.75	2,382/744	127,465	6.8	412.3	412.3	412.4	0.1
AI	699.50	2,331/1,719	122,305	7.1	413.0	413.0	413.1	0.1
AJ	698.50	2,990/329	130,849	6.6	413.4	413.4	413.5	0.1
AK	697.75	2,424/203	115,695	7.5	414.1	414.1	414.2	0.1
AL	697.25	2,674/1,507	140,770	6.1	414.4	414.4	414.5	0.1
AM	696.75	3,556/1,954	152,462	5.7	414.6	414.6	414.7	0.1
AN	695.75	3,978/1,742	154,639	5.6	415.0	415.0	415.1	0.1
AO	695.00	3,505/2,184	147,816	5.9	415.5	415.5	415.6	0.1
AP	694.50	4,321/2,396	165,484	5.2	415.6	415.6	415.7	0.1
AQ	694.00	4,268/1,141	160,637	5.4	415.8	415.8	415.9	0.1
AR	693.25	2,914/280	143,614	6.0	416.0	416.0	416.1	0.1
AS	692.00	1,812/191	119,621	7.2	416.6	416.6	416.7	0.1
AT	691.50	2,884/444	122,706	7.0	417.4	417.4	417.5	0.1
AU	690.50	3,806/2,142	168,374	5.1	417.7	417.7	417.8	0.1
AV	690.00	4,283/2,456	177,609	4.9	418.0	418.0	418.1	0.1
AW	689.25	4,993/1,592	191,744	4.5	418.2	418.2	418.3	0.1
AX	688.50	5,027/890	190,964	4.5	418.4	418.4	418.5	0.1
AY	688.00	4,237/1,251	169,030	5.1	418.6	418.6	418.7	0.1
AZ	687.25	4,118/1,117	162,904	5.3	418.7	418.7	418.8	0.1
BA	686.25	2,707/591	125,485	6.9	419.2	419.2	419.3	0.1
BB	685.00	2,745/1,052	127,781	6.8	419.7	419.7	419.8	0.1
BC	684.50	2,214/750	116,858	7.4	420.1	420.1	420.2	0.1
BD	684.00	2,139/272	122,176	7.1	420.2	420.2	420.3	0.1
BE	683.25	1,647/142	109,745	7.9	420.5	420.5	420.6	0.1
BF	682.25	1,688/213	101,631	8.5	421.3	421.3	421.4	0.1

[1] Miles Below Pittsburgh
[2] Total Width / Width Within County Boundary

TABLE 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN AND INCORPORATED AREAS

FLOODWAY DATA

OHIO RIVER

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone X

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

6.0 FLOOD INSURANCE RATE MAP

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

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

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

The current FIRM presents flooding information for the entire geographic area of Perry County. Previously, separate FIRMs were prepared for each identified flood prone incorporated community and for the unincorporated areas of the county. Historical data relating to the maps prepared for each community are presented in Table 13.

7.0 OTHER STUDIES

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

8.0 LOCATION OF DATA

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

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Cannelton, City of	November 30, 1973	October 18, 1974 June 25, 1976	July 18, 1983	
Perry County (Unincorporated Areas)	April 24, 1981	N/A	November 1, 1995	
Tell City, City of	January 4, 1974	April 9, 1976	March 1, 1977	
Troy, Town of	May 31, 1974	August 29, 1975 January 14, 1977	July 5, 1983	

TABLE 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN
(AND INCORPORATED AREAS)

COMMUNITY MAP HISTORY

9.0 BIBLIORAPHY AND REFERENCES

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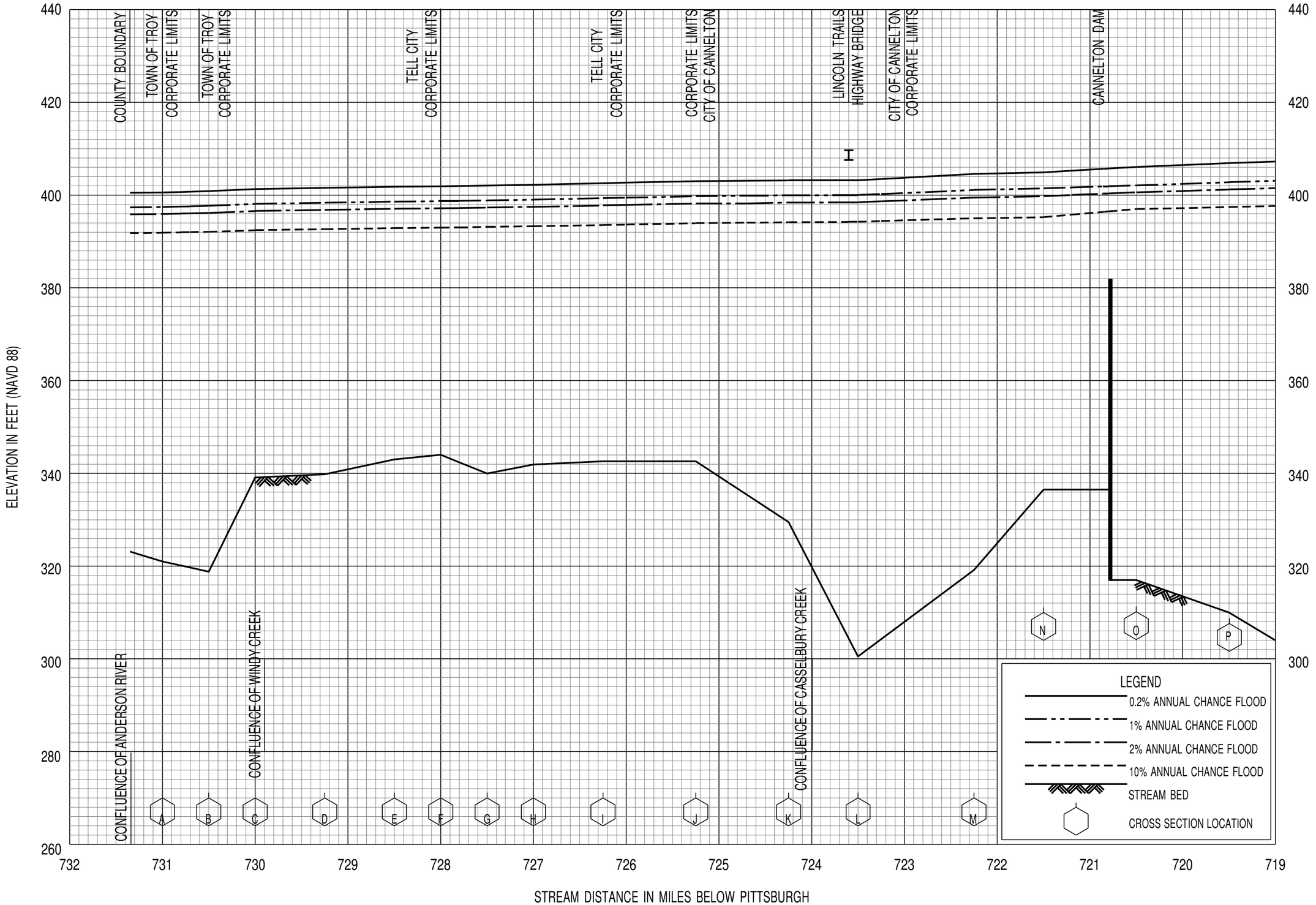


FLOOD PROFILES

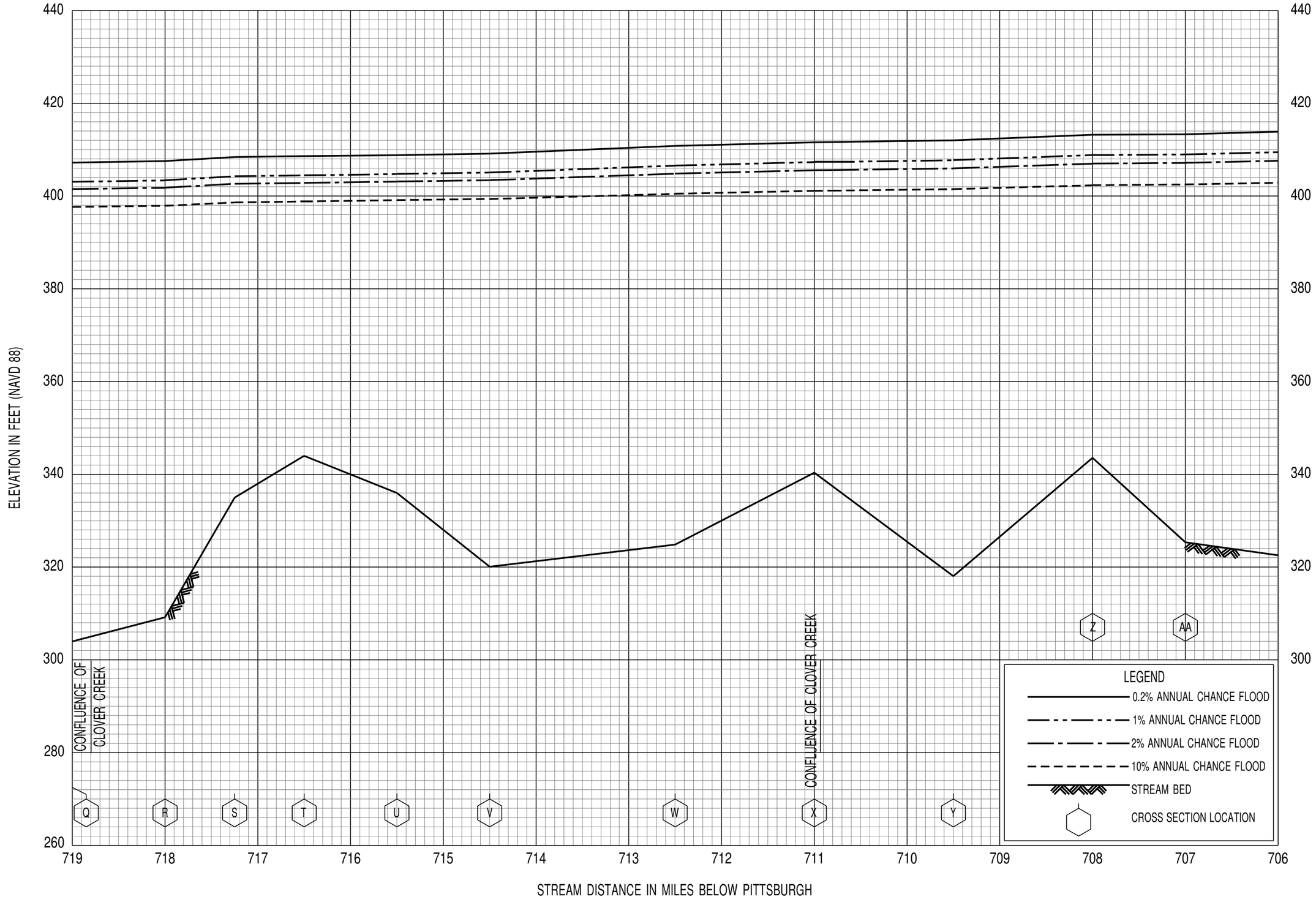
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

01P



FLOOD PROFILES

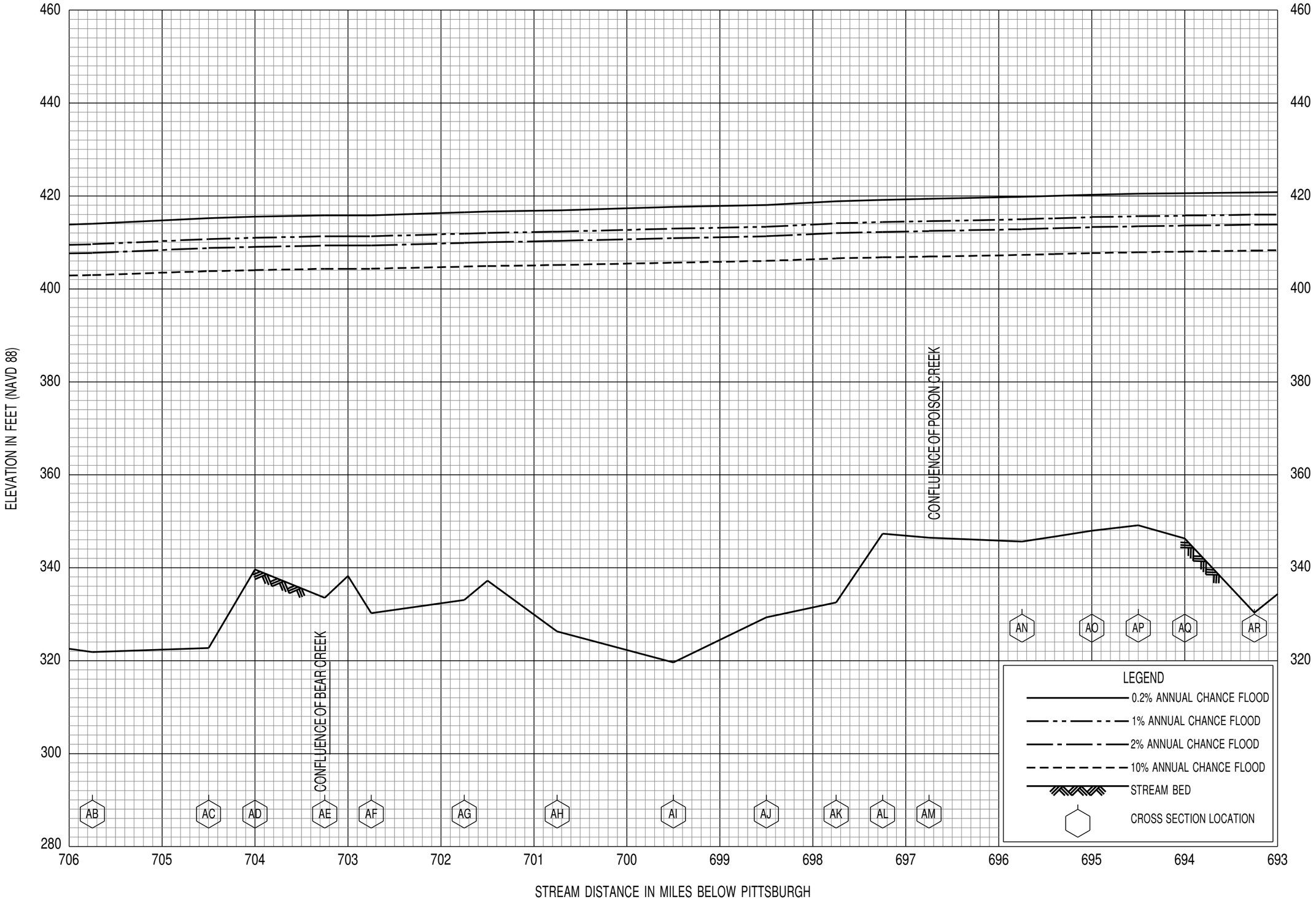
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

02P



FLOOD PROFILES

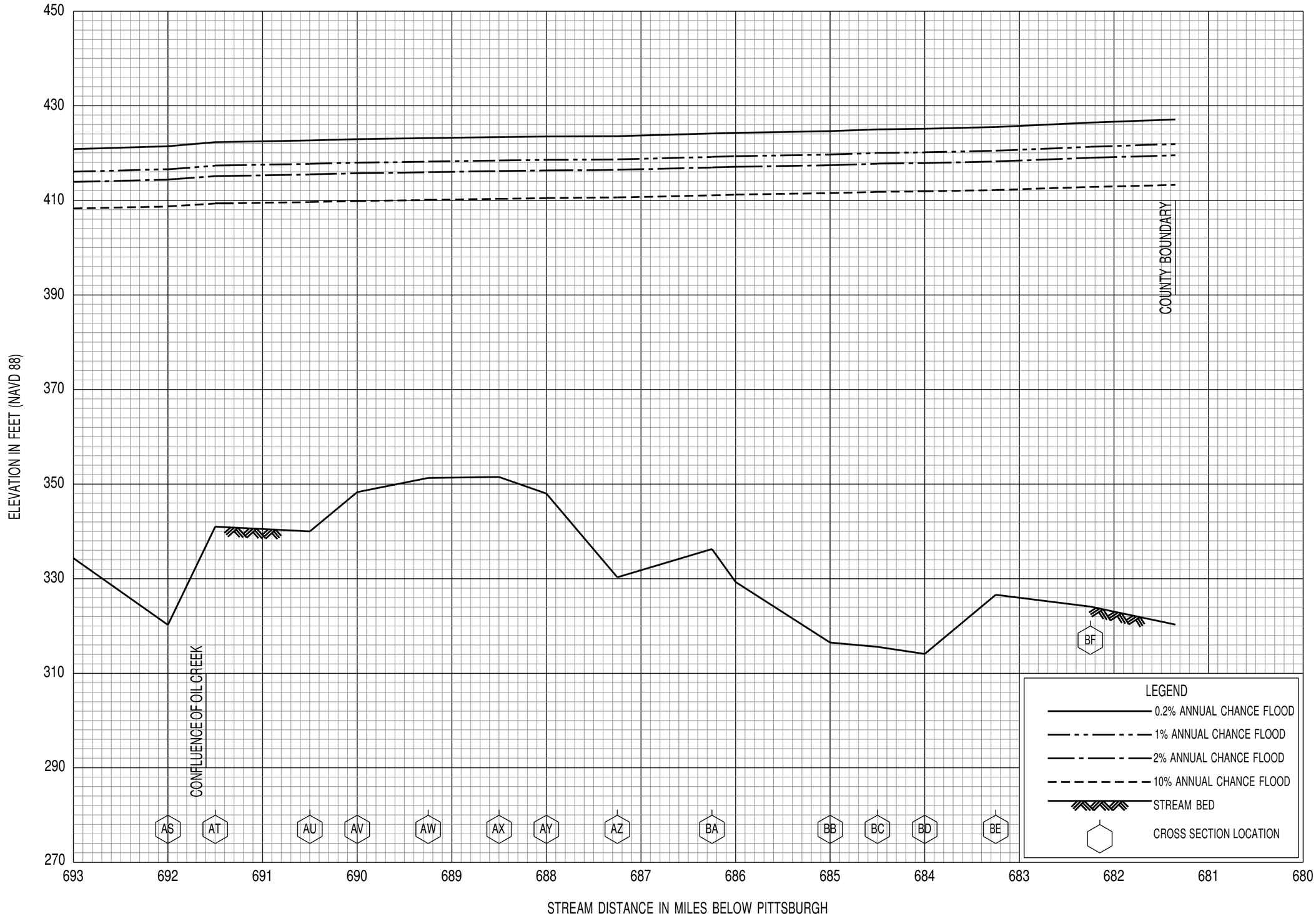
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

03P



FLOOD PROFILES

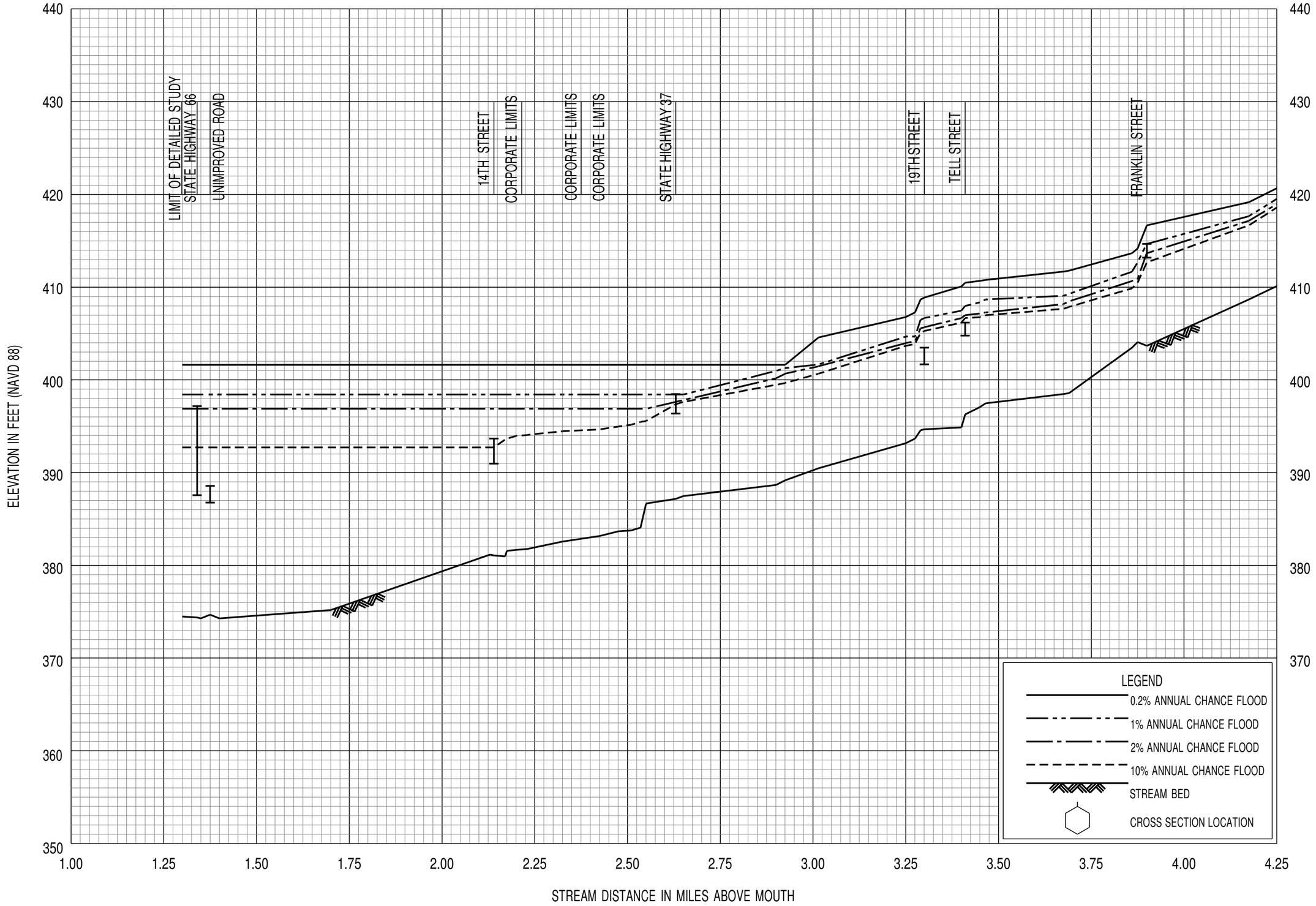
OHIO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

04P



FLOOD PROFILES

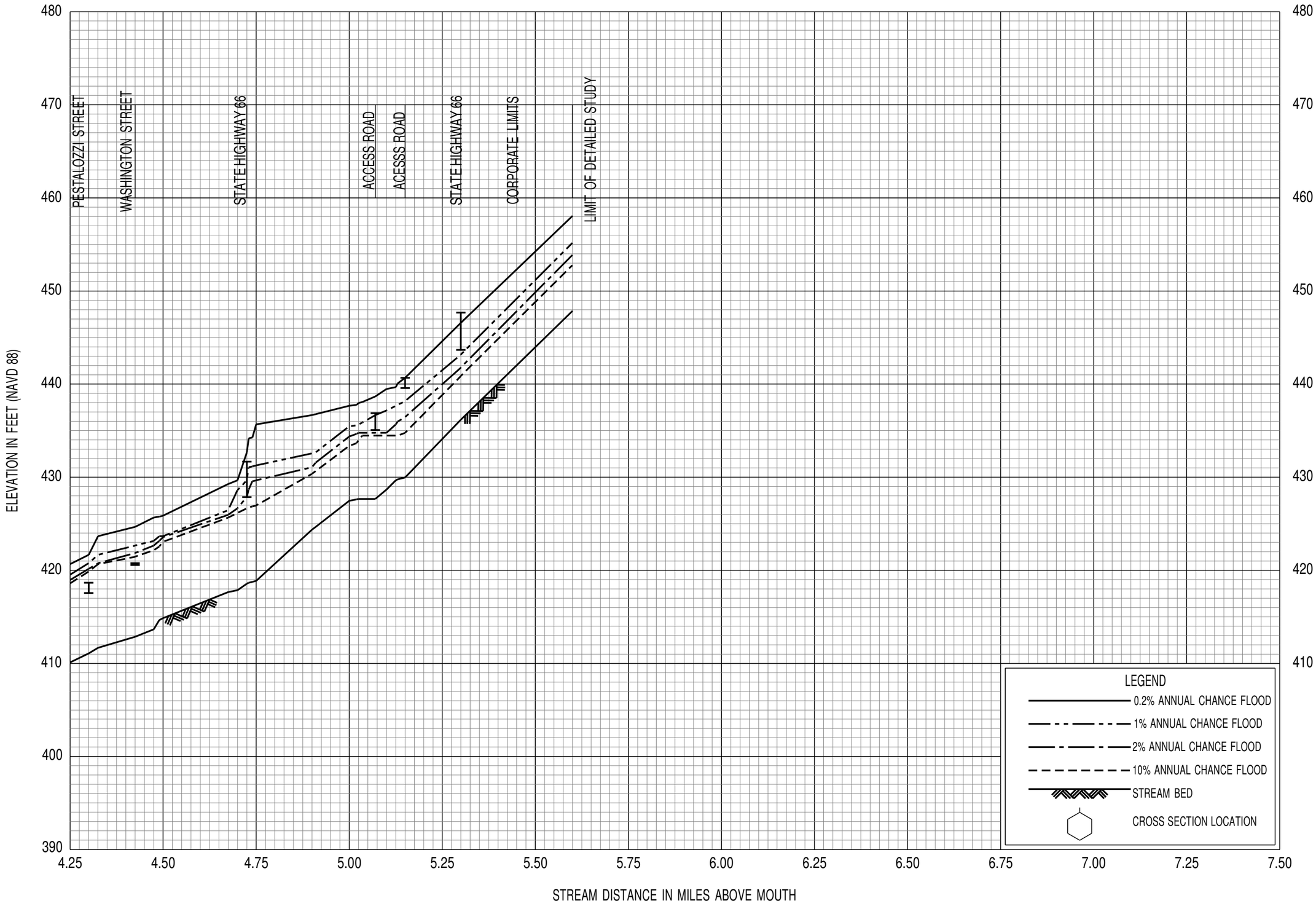
WINDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

05P



FLOOD PROFILES

WINDY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

PERRY COUNTY, IN

AND INCORPORATED AREAS

06P