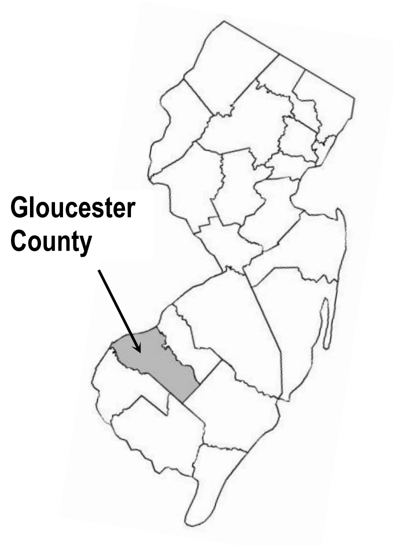
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 2



GLOUCESTER COUNTY, NEW JERSEY

(ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER
BOROUGH OF CLAYTON	340198
TOWNSHIP OF DEPTFORD	340199
TOWNSHIP OF EAST GREENWICH	340200
TOWNSHIP OF ELK	340201
TOWNSHIP OF FRANKLIN	340202
BOROUGH OF GLASSBORO	340203
TOWNSHIP OF GREENWICH	340204
TOWNSHIP OF HARRISON	340205
TOWNSHIP OF LOGAN	340206
TOWNSHIP OF MANTUA	340207
TOWNSHIP OF MONROE	340208
BOROUGH OF NATIONAL PARK	340209
BOROUGH OF NEWFIELD	340549
BOROUGH OF PAULSBORO	340210
BOROUGH OF PITMAN	340211
TOWNSHIP OF SOUTH HARRISON	340212
BOROUGH OF SWEDESBORO	340519
TOWNSHIP OF WASHINGTON	340213
BOROUGH OF WENONAH	340503
TOWNSHIP OF WEST DEPTFORD	340214
BOROUGH OF WESTVILLE	340215
CITY OF WOODBURY	340216
BOROUGH OF WOODBURY HEIGHTS	340550
TOWNSHIP OF WOOLWICH	340217

REVISED:

AUGUST 17, 2016

FLOOD INSURANCE STUDY NUMBER

34015CV001B

FEMA

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.

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

Initial Countywide FIS Effective Date: January 20, 2010

Revised Countywide FIS Date: August 17, 2016 – to update corporate limits, to change Base Flood Elevations, to change Special Flood Hazard Areas, to incorporate new detailed coastal flood hazard analysis, to update roads and road names, to reflect updated topographic information, and to add floodway.

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FLOOD INSURANCE STUDY
GLOUCESTER COUNTY, NEW JERSEY (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Gloucester County, New Jersey, including: Boroughs of Clayton, Glassboro, National Park, Newfield, Paulsboro, Pitman, Swedesboro, Wenonah, Westville, Woodbury Heights; the City of Woodbury; and the Townships of Deptford, East Greenwich, Elk, Franklin, Greenwich, Harrison, Logan, Mantua, Monroe, South Harrison, Washington, West Deptford, and Woolwich (hereinafter referred to collectively as Gloucester County).

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 Gloucester 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 Title 44 of the Code of Federal Regulations (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 are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include all jurisdictions within Gloucester County into 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.

Deptford, Township of:	The hydrologic and hydraulic analyses from the FIS report dated May 17, 1982, were prepared by URS Company, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4808. That work was completed in February 1981.

East Greenwich, Township of:	The hydrologic and hydraulic analyses from the FIS report dated June 1, 1982, were prepared by URS Company, Inc., for FEMA, under contract No. H-4808. That work was completed in February 1981.
Franklin, Township of:	The hydrologic and hydraulic analyses from the FIS report dated August 3, 1981, were prepared by Richard Browne Associates for FEMA, under Contract No. H-4806. That work was completed in January 1980.
Glassboro, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated February 16, 1982, were prepared by URS Company, Inc., for FEMA under Contract No. H-4808. That work was completed in February 1981.
Greenwich, Township of:	The hydrologic and hydraulic analyses from the FIS report dated November 18, 1988, represent a revision of the original analyses by URS Company, Inc., for FEMA, under Contract No. H-4808. The work for the original study was completed in March 1981. The coastal analysis in this study was revised as a result of a reassessment by FEMA of the potential hazards from wave action. That work was completed in December 1987.
Logan, Township of:	The hydrologic and hydraulic analyses from the FIS report dated July 6, 1982, were prepared by the New Jersey Department of Environmental Protection (NJDEP) for FEMA, under Contract No. S-90022. That work was completed in July 1980. The hydrologic and hydraulic analyses for this study were conducted by Tippetts-Abbett-McCarthy-Stratton under subcontract to the NJDEP.
Mantua, Township of:	The hydrologic and hydraulic analyses from the FIS report dated May 3, 1982, were performed by URS Company, Inc., for FEMA, under Contract No. H-4808. That work was completed in February 1981.

Monroe, Township of:	The hydrologic and hydraulic analyses from the FIS report dated July 20, 1981, were prepared by the NJDEP, Division of Water Resources, for FEMA, under Contract No. H-4546. That work was completed in April 1980. The hydrologic and hydraulic analyses for that study were conducted by Gannett, Fleming, Corddry, and Carpenter, Inc., under subcontract to the State of New Jersey.
National Park, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated March 2, 1982, were prepared by URS Company, Inc., for FEMA, under Contract No. H-4808. That work, which was completed in February 1981, covered all significant flooding sources in the Borough of National Park.
Newfield, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated June 17, 1991, were prepared by the U.S. Geological Survey (USGS) for FEMA, under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 23. That work was completed in December 1988.
Paulsboro, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated March 2, 1982, were prepared by URS Company, Inc., for FEMA under Contract No. H-4808. That work was completed in February 1981.
South Harrison, Township of:	The hydrologic and hydraulic analyses from the FIS report dated December 17, 1991, were prepared by the USGS for FEMA, under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 23. That work was completed in May 1989.
Swedesboro, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated January 5, 1982, were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management, for FEMA, under Contract No. S-90022. That work was completed in August 1980. The hydrologic and hydraulic analyses for this study were performed by Tippetts-Abbett-McCarthy-Stratton, under subcontract to the NJDEP.

Washington, Township of:	The hydrologic and hydraulic analyses from the FIS report dated May 17, 1982, were prepared by URS Company, Inc., for FEMA, under Contract No. H-4808. That work was completed in February 1981.
West Deptford, Township of:	The hydrologic and hydraulic analyses from the FIS report dated December 1, 1981, were prepared by URS Company, Inc., for FEMA, under Contract No. H-4808. That work, which was completed in February 1981, covered all significant flooding sources in the Township of West Deptford.
Westville, Borough of:	The hydrologic and hydraulic analyses from the FIS report dated November 1, 1979, were performed by the U.S. Army Corps of Engineers (USACE), Philadelphia District, for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-10-77, Project Order No. 9. That work, which was completed in July 1978, covered all significant flooding sources affecting the Borough of Westville.
Woolwich, Township of:	The hydrologic and hydraulic analyses from the FIS report dated March 2, 1982, were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management, for FEMA, under Contract No. S-90022. That work was completed in August 1980. The hydrologic and hydraulic analyses for this study were performed by Tippetts-Abbett-McCarthy-Stratton, under subcontract to the NJDEP.

There are no previous FISs for the Boroughs of Clayton, Pitman, Wenonah, and Woodbury Heights; the City of Woodbury; and the Townships of Elk and Harrison; therefore, the previous authority and acknowledgment information for these communities is not included in this FIS.

For the January 20, 2010, countywide FIS, the hydrologic and hydraulic analyses for Little Ease Run, Mantua Creek, Raccoon Creek Reach 2, Scotland Run Reach 1 and Reach 2, South Branch Raccoon Creek, Still Run #2, and Woodbury Creek were performed by Leonard Jackson Associates for FEMA. This work was completed in August 2008.

Floodplains for the streams studied by detailed methods, but not revised in the January 20, 2010 countywide study, have been redelineated using updated topographic data provided to FEMA by Terrapoint USA, Inc. This work was completed in August 2008.

Flood hazard areas previously assessed using approximate methods were reanalyzed throughout the county and results were then mapped using the Gloucester County topographic data. This work was completed in July 2008.

Base map information for the January 20, 2010 FIRMs was developed from digital orthoimagery provided by the Delaware Valley Regional Planning Commission. This information was derived from digital orthophotos produced at a scale of 1:2,400 with a 1-foot pixel resolution from photography dated April 2005.

For this August 17, 2016 revision, a storm surge analysis on the Delaware River was studied as part of a FEMA Region III project to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The study replaces outdated coastal storm surge stillwater elevations for all FIS reports in the study area, including Region II Counties in New Jersey along the Delaware River such as Gloucester County and serves as the basis for updated FIRMs. Study efforts were initiated in 2008 and concluded in 2012.

The storm surge study was conducted for FEMA by the USACE and its project partners under Project HSFE03-06-X-0023, “NFIP Coastal Storm Surge Model for Region III” and Project HSFE03-09-X-1108, “Phase II Coastal Storm Surge Model for FEMA Region III”. The work was performed by the Coastal Processes Branch (HF-C) of the Flood and Storm Protection Division (HF), U.S. Army Engineer Research and Development Center – Coastal & Hydraulics Laboratory (ERDC-CHL).

Base map information shown on these August 17, 2016 FIRMs was provided in digital format by the New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS). The aerial photography was captured at a scale of 1:2,400 with a 1 foot pixel resolution in March and April of 2012.

The coordinate system used in the preparation of this FIRM was New Jersey State Plane FIPS Zone 2900. The horizontal datum was NAD83, GRS80 spheroid. Flood elevations on this FIRM are referenced to the North American Vertical Datum of 1988. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

1.3 Coordination

Consultation Coordination Officer’s (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial 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 study.

The dates of the initial and final CCO meetings held for jurisdictions within Gloucester 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
Borough of Clayton	*	*
Township of Deptford	May 9, 1978	January 6, 1982
Township of East Greenwich	May 16, 1978	January 6, 1982
Township of Elk	*	*
Township of Franklin	June 7, 1978	February 26, 1981
Borough of Glassboro	*	October 19, 1981
Township of Greenwich	May 16, 1978	September 15, 1981
Township of Harrison	*	*
Township of Logan	November 29, 1977	February 8, 1982
Township of Mantua	May 16, 1978	December 15, 1981
Township of Monroe	June 1977	February 4, 1981
Borough of National Park	May 4, 1978	October 19, 1981
Borough of Newfield	June 27, 1985	June 8, 1990
Borough of Paulsboro	May 4, 1978	October 19, 1981
Borough of Pitman	*	*
Township of South Harrison	June 27, 1985	January 30, 1991
Borough of Swedesboro	January 24, 1978	August 3, 1981
Township of Washington	May 17, 1978	January 6, 1982
Borough of Wenonah	*	*
Township of West Deptford	May 4, 1978	June 19, 1981
Borough of Westville	September 15, 1976	November 20, 1978
City of Woodbury	*	*
Borough of Woodbury Heights	*	*
Township of Woolwich	January 24, 1978	October 19, 1981

*Data not available

For the January 20, 2010 FIS, a final CCO meeting was held on December 2, 2008, and was attended by Leonard Jackson Associates, FEMA, NJDEP, Dewberry, and Gloucester County.

For this August 17, 2016 revision, the final CCO meeting was held on January 13, 2015, and was attended by representatives of the communities, FEMA, the State, and RAMPP.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Gloucester County, New Jersey.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction. All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. 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

Big Timber Creek
Burnt Mill Branch
Clonmell Creek
Delaware River
Duffield Run
Edwards Run
Fourmile Branch
Hospitality Branch
Little Ease Run
London Branch
Mantua Creek
Nehonsey Brook
Oldmans Creek Reach 1
Oldmans Creek Reach 2
Oldmans Creek Reach 2 Tributary 3
Pargey Creek
Raccoon Creek Reach 1
Raccoon Creek Reach 2
Repaupo Creek
Scotland Run Reach 1
Scotland Run Reach 2
South Branch Big Timber Creek
South Branch Raccoon Creek
Still Run #1
Still Run #2
White Sluice Race
Woodbury Creek

Table 3, "Stream Name Changes," lists streams that have names in this countywide FIS other than those used in previously printed FISs for the communities in which they are located.

TABLE 3 – STREAM NAME CHANGES

Community	Old Name	New Name
Borough of Swedesboro	Raccoon Creek	Raccoon Creek Reach 1
Township of Woolwich	Raccoon Creek	Raccoon Creek Reach 1
Township of Logan	Raccoon Creek	Raccoon Creek Reach 1
Township of Harrison	Raccoon Creek	Raccoon Creek Reach 2
Township of Elk	Raccoon Creek	Raccoon Creek Reach 2
Township of Logan	Oldmans Creek	Oldmans Creek Reach 1
Township of South Harrison	Oldmans Creek	Oldmans Creek Reach 2
Township of Greenwich	Still Run	Still Run #1
Township of Franklin	Still Run	Still Run #2
Township of Elk	Still Run	Still Run #2
Borough of Clayton	Still Run	Still Run #2
Borough of Clayton	Scotland Run	Scotland Run Reach 2
Township of Franklin	Scotland Run	Scotland Run Reach 1

Riverine flooding sources throughout the county have been studied by detailed methods at different times and, prior to this countywide FIS, often on a community-by-community basis. Table 4, "Model Dates for Riverine Flooding Sources" below represents the hydraulic modeling dates for the detailed study flooding sources in the county.

TABLE 4 – MODEL DATES FOR RIVERINE FLOODING SOURCES

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Big Timber Creek	Borough of Westville	July 1978
Big Timber Creek	Township of Deptford, Township of West Deptford	February 1981
Burnt Mill Branch	Borough of Newfield, Township of Franklin	December 1988
Clonmell Creek	Township of Greenwich	December 1987
Delaware River	Borough of National Park, Borough of Paulsboro, Township of Greenwich, Township of Logan, Township of West Deptford	January 1980

TABLE 4 – MODEL DATES FOR RIVERINE FLOODING SOURCES - continued

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Duffield Run	Township of Washington	February 1981
Edwards Run	Township of East Greenwich	February 1981
Fourmile Branch	Township of Monroe	April 1980
Hospitality Branch	Township of Monroe	April 1980
Little Ease Run	Borough of Clayton	August 2008
Little Ease Run	Township of Franklin	January 1980
London Branch	Township of Greenwich	December 1987
Mantua Creek	Borough of Glassboro, Borough of Paulsboro, Borough of Pitman, Borough of Wenonah, Township of Deptford, Township of East Greenwich, Township of Mantua, Township of Washington, Township of West Deptford	August 2008
Nehonsey Brook	Township of Greenwich	December 1987
Oldmans Creek Reach 1	Township of Logan	July 1980
Oldmans Creek Reach 2	Township of South Harrison	May 1989
Oldmans Creek Tributary 3	Township of South Harrison	May 1989
Pargey Creek	Township of Greenwich	December 1987
Raccoon Creek Reach 1	Township of Logan, Township of Woolwich	August 1980
Raccoon Creek Reach 2	Township of Harrison, Township of Elk, Township of Woolwich	August 2008
Repaupo Creek	Township of Greenwich	December 1987
Scotland Run Reach 1	Township of Franklin	January 1980
Scotland Run Reach 2	Borough of Clayton	August 2008
South Branch Big Timber Creek	Township of Deptford, Township of Washington	February 1981
South Branch Raccoon Creek	Township of Harrison, Township of South Harrison	August 2008
Still Run #1	Township of Greenwich	December 1987
Still Run #2	Township of Franklin	January 1980
Still Run #2	Township of Franklin, Township of Elk, Township of Clayton	August 2008
White Sluice Race	Township of Greenwich	December 1987
Woodbury Creek	Township of West Deptford, Borough of National Park, City of Woodbury	August 2008

For the January 20, 2010 countywide FIS, a number of flooding sources studied using detailed methods were revised to reflect the most up-to-date hydrologic and hydraulic data. These sources were identified by FEMA after coordinating with the NJDEP Bureau of Dam Safety and Floodplain Management and other available resources to address the principal flooding sources in Gloucester County. As part of this countywide FIS, updated analyses were included for the flooding sources shown in Table 5, "Scope of Revision for January 20, 2010 FIS."

TABLE 5 - SCOPE OF REVISION FOR JANUARY 20, 2010 FIS

Stream	Limits of Revised or New Detailed Study
Little Ease Run	From approximately 500 feet downstream of Washington Avenue to approximately 2.1 miles upstream of County Route 610.
Mantua Creek	From confluence with the Delaware River to approximately 40 feet above Fish Pond Road (County Route 634).
Raccoon Creek Reach 2	From approximately 0.7 miles downstream of Tomlin Station Road (County Route 607) to approximately 0.5 miles upstream of Richwood Road (County Route 609).
Scotland Run Reach 1	
Scotland Run Reach 2	From approximately 400 feet downstream of East Academy Street (County Route 610) to approximately 1.1 miles above East Academy Street (County Route 610).
South Branch Raccoon Creek	From confluence with Raccoon Creek Reach 2 to approximately 650 feet upstream of County Route 581.
Still Run #2	From approximately 1,200 feet downstream of State Route 55 to approximately 1 mile upstream of County Route 608.
Woodbury Creek	From confluence with Delaware River to approximately 1.5 miles above Interstate Highway 295.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards, or where resources were unavailable to conduct more refined and detailed analyses. For the January 20, 2010 FIS all areas of approximate flood hazard analyses were updated using the topography provided by Gloucester County and Special Report 38 (U.S. Department of the Interior, 1974).

For this August 17, 2016 revision, the Delaware River has been restudied and the resultant coastal flood hazards have been remapped. Flood profiles for Big Timber Creek/South Branch Big Timber Creek, Edwards Run, Mantua Creek, Oldmans Creek Reach 1, Pargey Creek, Raccoon Creek Reach 1, Repaupo Creek, and Woodbury Creek were included in the January 20, 2010 FIS, however all or portions of these profiles have been omitted from this August 17, 2016 revision because the coastal flooding from the Delaware River controls these riverine flooding reaches.

2.2 Community Description

Gloucester County is located in the southern part of New Jersey, south of Philadelphia and northwest of Atlantic City. It is bordered on the north by Philadelphia County, Pennsylvania; on the northeast by Camden County; on the southeast by Atlantic County; on the south by Cumberland County; on the southwest by Salem County; on the west by New Castle County, Delaware; and on the northwest by Delaware County, Pennsylvania (U.S. Census Bureau, 2010).

According to the U.S. Census Bureau, the estimated population for Gloucester County as of 2010 was 288,288 and the land area was 324.72 square miles (U.S. Census Bureau, 2010).

Generally, the climate of south-central New Jersey is mild due to the influence of Gulf Stream currents along the Atlantic coast. The average high temperature in July is 87 degrees Fahrenheit (ºF), and in January is 40ºF. The average low temperature in July is 69ºF and in January is 26ºF. The annual precipitation averages approximately 42 inches (The Weather Channel, 2014). Flood-related storms often are a result of hurricanes moving up the Atlantic coast.

2.3 Principal Flood Problems

Because New Jersey lies within the major North American storm tracks, flooding from various sources in Gloucester County can be experienced in any season. Flooding during the winter is infrequent, and spring flooding compounded by ice and snowmelt has occurred. The most extensive floods have occurred in late summer and early fall and are usually associated with tropical disturbances moving north along the Atlantic Coast.

Major floods were recorded at a USGS gauging station (number 01411500) on the Maurice River on the following dates: September 2, 1940; September 14, 1960; August 29, 1971; June 15, 1975; February 28, 1979; August 20 1989; and April 17, 2007.

There was a large storm to hit Gloucester County that was in September 1940, with an estimated recurrence interval of over 0.2-percent annual chance (500 years). Countywide, numerous dams failed, 15 major roads and bridges were washed out and several people died.

The Mantua Creek basin has suffered the greatest flood damages of any area of Gloucester County. The 1940 storm caused severe damage in the Villages of Mantua, Barnsboro, and Sewell. In the Villages of Mantua and Mantua Terrace (located in the neighboring Township of West Deptford), 72 bungalows were flooded to the roof of their porches and a dozen were swept away. In the 0.25-mile floodplain of Mantua Creek, 200 people were left homeless in the Village of Mantua alone. In Sewell, the new electric pumping station on Glassboro Road was flooded to a depth of 7 feet. Pennsylvania Railroad trains were stranded in Sewell by numerous roadbed and bridge washouts. In Barnsboro, several homes near Tyler's Mill were flooded. Countywide dams on most lakes were breached and there were 15 major road washouts. Based on USGS gauge No. 01475001 at Pitman, New Jersey, on Mantua Creek, the storm of 1940 had an estimated discharge of 4,200 cubic feet per second (cfs).

Although the Township of Deptford is subject to both tidal and fluvial flooding from Big Timber Creek and South Branch Timber Creek, there has been only minor flood damage reported.

In August 1933, tide conditions on the Delaware River, in conjunction with local heavy rains, resulted in the highest recorded tidal flood along Big Timber Creek. The estimated tidal stage of this flood at the mouth of Big Timber Creek was 7.4 feet NAVD88 as compared to a statistical 1-percent annual chance (100-year) stillwater elevation of 9.1 feet NAVD88. Other major floods occurred in the basin in August 1955 and November 1950.

In the Township of East Greenwich, historically, the community of Mount Royal has been subject to the worst flooding. During the flood of September 1940, five dwellings were swept away and 20 other bungalows were flooded to their eaves. Today, only a few dwellings are within the floodplain of Mantua Creek and Edwards Run. These are located off of North Street and adjacent to the Kings Highway bridge over Mantua Creek.

In the Township of Franklin, aside from extremely large storms, the major flooding problem is located along Little Ease Run at the railroad crossing. In February 1979, the floodwaters came within six inches of overtopping the railroad bridge.

Flooding in the Borough of Glassboro is caused by the overflow of Mantua Creek, Raccoon Creek, and Still Run #1. Historically, flooding has been confined to undeveloped lands and fruit orchards. Only a few isolated residences are within the floodplain.

In the Township of Greenwich, with the exception of the Gibbstown residential area, the residential area adjacent to Paulsboro, and the oil storage facilities on Clonmell Road, much of the township is marshland which is subject to tidal flooding. Included in the flood-prone area are the DuPont explosives complex, and residential streets at the outskirts of Gibbstown. These include Willow Street, Allen Drive, Morse Street, Memorial Avenue, and those side streets which intersect these roads. In addition, the dead end streets between Ladner Avenue and Clonmell Creek in the Paulsboro area are subject to flooding. All major roads including state and interstate highways have sections which would be impassable during times of major flooding.

Low-lying areas of the Township of Logan are subject to inundation by high tides from the Delaware River. Extreme high tides flood these lowlands to the same elevation as reached in the Delaware River. Flooding in Logan is most likely to occur in the late summer and fall when hurricanes are prevalent. Floods in the nearby Mantua Creek watershed have occurred in 1938, 1940, 1945, 1952, 1960, 1967, 1968, and 1971 (USACE, 1972).

According to Township of Monroe officials, the township has experienced no riverine-associated flooding problems. Damage from storms comes mainly from high water table seepage. Residents along the lakeside area have reported that they have never seen the lake water surface rise significantly.

Because the floodplains of Fourmile Branch are uninhabited, little information on past flooding is available. However, the poor drainage characteristics as evidenced by the marshlands adjacent to the stream indicate that wide inundation will occur with moderate increases in water-surface elevation.

In the Borough of National Park, several blocks are in an area with the potential to flood from tidal, riverine, or a combination of both flows. Areas susceptible to flooding from the 1-percent annual chance flood are: Riverview Avenue, Grove Street (south of Woodlawn Avenue), Temple Avenue, Jefferson Avenue, and Belmont Avenue. Most flooding in these areas would be tidal and therefore would have a low velocity.

Major floods occurred on Oldmans Creek on the following dates: August 23, 1933; September 6, 1935; June 27, 1938; September 1, 1940; January 26, 1978; and April 16, 1983. The most severe of these was the flood of September 1, 1940, which was estimated to have a less than 1-percent annual chance recurrence interval (U.S. Department of the Interior, 1989). The U.S. Department of Commerce, Weather Bureau, reported 24 inches of rain in 9 hours at Ewan, New Jersey, located just east of South Harrison (U.S. Department of Commerce, 1958).

Low-lying areas of the Borough of Swedesboro in the vicinity of Raccoon Creek Reach 1 are subject to being inundated by high tidal flooding from the Delaware River. Extreme high tides would flood these lowlands to the same elevation as reached in the Delaware River. It should be noted that tidal flooding and winds associated with storms can be quite destructive. Floods in the nearby Mantua Creek watershed have occurred in 1938, 1940, 1945, 1952, 1960, 1967, 1968, and 1971 (USACE, 1976).

Washington Township is subject to fluvial flooding from Mantua Creek and South Branch Big Timber Creek, and their tributaries. Despite the numerous streams which traverse the township, flooding has been relatively minor. This is due to the fact that, until recently, development within Washington has been minimal.

In the Township of West Deptford, during the flood of 1967, a storm estimated to have a greater than 5-percent annual chance recurrence interval, several homes were flooded to the second story. The flood of 1960, with an estimated greater than 50- percent annual chance recurrence interval, lead to the evacuation of a few homes.

Several other areas along Mantua Creek are also in the floodplain. They include the River Drive Road and Heppard Road area. In addition, a trailer park at the intersection of Paradise Road and Crown Point Road is partially inundated by tidal flow along Little Mantua Creek.

Most of the industries between Mantua Creek and Woodbury Creek which lie in the tidal flats have been built on fill. However, a repeat of the 1940 storm has the potential to inundate most of them.

Several areas in the eastern portion of the township are susceptible to flooding from Woodbury Creek and its tributaries, Matthews Branch and Hessian Run. A trailer park between Hessian Run and Woodbury Creek is vulnerable to flooding from tides as low as the 1- percent annual chance recurrence interval. Parts of Watson Street, Edwin Street, Ellwood Avenue, Atkins Avenue, and Miller Avenue are all subject to flooding from Hessian Run. Homes on Lancing Road and Lynn Avenue are just out of the 1- percent annual chance recurrence interval floodplain of Woodbury Creek, however, three industrial structures at the end of Frances Avenue would be vulnerable to flooding. There is minor flooding along Matthews Branch at Myrtle Avenue and Queen Street, and an unnamed tributary to the Delaware River causes flooding along the streets between the river and Belmont Avenue (Red Bank Avenue).

August 1933 marks the date of the highest flood in the Borough of Westville reach of Big Timber Creek. An elevation of 7.4 feet NAVD88 was primarily the result of tidal conditions on the Delaware River augmented by heavy rain.

The November 1950 flood resulted from high tidal conditions on the Delaware River producing a stage of 7.3 feet NAVD88 at the confluence with Big Timber Creek. Rising water levels during this flood forced evacuation of residents in 40 homes along Timber Avenue, where the water rose above first-floor levels. Many residents were rescued by rowboat.

Low-lying areas of the Township of Woolwich in the vicinity of Raccoon Creek are subject to being inundated by high tidal flooding from the Delaware River. Extreme high tides would flood these lowlands to the same elevation as reached in the Delaware River. Flooding in this area would most likely occur in the late summer and early fall during the hurricane season. It should be noted that tidal flooding and winds associated with storms can be quite destructive.

On September 16, 1999, with Hurricane Floyd there was heavy rainfall throughout Delaware River basin causing extensive damage along the tributaries in the lower portion of the basin (http://state.nj.us.drbc/flood_website/events.htm).

There were two early spring rainstorms in 2005, the first on March 28-29 and a second on April 2-3, 2005 combined with snow melt to cause major flooding on the Delaware River Basin. Bridge and road closures and extensive damages were observed (http://state.nj.us.drbc/flood_website/events.htm).

On April 16, 2007 a large storm dumped more than 5 inches of rain in a two-day period causing more than $2.2 million in damage. Franklinville Lake overflowed into the stream and covered the parking area on the community center which was closed. Damage was seen countywide but severely affected areas include

Franklin, West Deptford, and East Greenwich Township. The storm developed over Texas on April 13, 2007 and moved off the coast of Virginia on late Sunday, April 15. The storm moved slowly northward reaching the New York City area Monday morning, April 16. Peak wind gusts were generally in the 40 to 50mi/hr range in New Jersey. Colder air wrapped around the storm as it moved past New Jersey on Monday morning. Many locations in New Jersey, South and East of Philadelphia, as well as parts of northern and central New Jersey, received anywhere from a trace to an inch of snow on Monday morning. Flood peaks were the highest ever recorded (at that time) at ten USGS gauging stations throughout New Jersey, in the Hackensack, Hudson, Raritan, Mullica and lower Delaware River basins. Flood frequencies for this flood ranged from greater than a less than 1-percent annual chance recurrence interval event on the mainstem of the Hackensack River to a greater that 50- percent annual chance recurrence interval event on some streams in southern New Jersey on the outer coastal plain (USGS, 2007).

Gloucester County was significantly affected by Hurricane Irene (2011). In Mullica Hill, the US Route 322 Bridge over Mullica Pond was washed out, while Raccoon Creek had its highest crest on record in Swedesboro. Also in 2011, a strong southeast wind up the Delaware Bay and River combined with the already high astronomical tides associated with the full moon and fresh water runoff from heavy rain to produce severe tidal flooding in Gloucester County along the Delaware River and tidal sections of its tributaries (April 16-17, 2011). Forty homes and seven businesses suffered major damage and another forty homes suffered minor damage as flooding occurred along the Woodbury, Mantua, Big Timber and Repaupo Creeks. (NOAA, 2014)

2.4 Flood Protection Measures

There are several dams in the Maurice River Basin. These include Willow Grove Lake dam on the Maurice River, Malaga Lake dam on Scotland Run and Iona Lake dam on Still Run #1. Scotland Run and Still Run #1 are both tributaries of the Maurice River. While the purpose of these dams is not for flood control, they do have the effect of reducing flooding downstream of them. This is especially true if the dams are not full when a storm hits.

In the Township of Greenwich, for protection against storm surge, flood gates have been installed on Repaupo Creek, White Sluice Race, Clonmell Creek, and Sand Ditch. The tops of these gates are at a high enough elevation to protect against a 2-percent annual chance storm surge, however, low spots in the berm between the gates will allow a 10-percent annual chance storm surge (6.6 feet) to inundate the area.

In December 2009 a project was completed to rebuild the floodgate and levee along Repaupo Creek by the Gloucester County Improvement Authority. However, the repaired system does not provide protection against the 1-percent annual chance flood.

In the Township of Logan, near the coastline of the Delaware River levees have been built to protect areas inland from some degree of coastal flooding from the Delaware River. However, these levees do not provide protection against the 1-percent annual chance flood.

In the Township of Monroe, the dams which impound water to form Diamond Lake and Timber Lake will act to dampen the peak flood discharges downstream. This effect was considered in the hydrologic analysis.

Within the Townships of Greenwich, Logan, and Pennsauken, existing levees along the Delaware River do not protect against the 1-percent annual chance flood.

Non-structural measures of flood protection are being utilized to aid in the prevention of future flood damage. These measures are in the form of land-use regulations which control building within areas that have a high risk of flooding.

In an effort to reduce impacts from flooding, the NJDEP, Division of Land Use Regulation (DLUR) has created regulations for development within floodplains. The most recent regulations can be found on the NJDEP website at www.state.nj.us/dep/landuse/fha_main.html.

A number of man-made structures commonly called agricultural or salt-hay levees have been identified in this county. The inventory of these structures is detailed in a report (South Jersey Levee Inventory, 2010) developed by the United States Department of Agriculture (USDA), National Resource Conservation Service (NRCS) for the NJDEP (Reference 34).

These structures do not meet the definition of a levee (Code of Federal Regulations, Title 44, Section 59.1 (CFR 44§59.1)) for the purpose of the NFIP. These structures were studied and found to not provide protection from the 1-percent-annual-chance flood or base flood elevations (BFEs). There is a potential that these structures may increase local flood hazard due to higher velocity flows during a large flood event as they overtop, and may lead to increased time of inundation by retaining flood waters for an extended period. Local conditions should be assessed for this potential for increased flood hazard and appropriate mitigation measures are recommended.

More information on the non-levee structures located in this county may be found in the "South Jersey Levee Inventory" published in November, 2010 by the NRCS and the NJDEP, Bureau of Dam Safety and Flood Control.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 2-, 1-, and 0.2-percent-annual-chance flood 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, probabilistic 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 which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, 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 Riverine Hydrologic Analyses

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

For each jurisdiction within Gloucester County that had a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

Precountywide Analyses

The hydrologic analysis for Big Timber Creek and South Branch Timber Creek was developed using the two USGS gauges located in the Big Timber Creek basin. USGS gauge No. 01467330 is located along South Branch Big Timber Creek at Blackwood, New Jersey. This gauge has a drainage area of 19 square miles and has been in operation since 1964. USGS gauge No. 01467351 is located along North Branch Big Timber Creek at Laurel Springs, New Jersey. This gauge has a drainage area of 7.2 square miles and has been in operation since 1975. Because of the period of record for both gauges, a USACE regional-frequency analysis utilizing the Generalized Skew Study for the State of New Jersey was used to develop frequency-discharge curves at the gauge locations (USACE, 1977). In conjunction with these data, frequency-discharge curves for other locations within the basin were generated by a rainfall-runoff model of Big Timber Creek using the USACE HEC-1 computer program (USACE, 1973). The 0.2-percent annual chance peak discharges were determined from a linear extrapolation of a log-probability curve of flood discharges computed for frequencies up to 100 years (1-percent annual chance).

The peak discharges for Still Run #1, Little Ease Run, and Scotland Run Reach 1 were calculated using the USACE HEC-1 flood hydrograph computer package. A HEC-1 model of the Maurice River Basin was developed by the USACE Hydrologic Engineering Center (HEC) for the Philadelphia District in 1976 (USACE, April 1976). This model was prepared to develop discharges for the Maurice River; consequently, Still Run No. 1, Little Ease Run, and Scotland Run Reach 1 were modeled as single subbasin tributaries.

To more accurately determine discharges on the streams of interest, FEMA approval was obtained to modify this HEC-1 model; this was accomplished by further subdividing the drainage basins in Franklin. The HEC-1 package was then used to develop flood hydrographs for each subbasin, route the hydrographs downstream to the Union Lake Dam in Vineland through stream reaches and lakes, and combining these hydrographs where appropriate. The entire model was calibrated by reproducing the hydrograph of the August 1971 storm as recorded at the USGS stream gauge (No. 01411500) at Norma, New Jersey. Peak discharges for the 10-, 2-, 1-, and 0.2-percent annual chance storms were then determined using the HEC-1 package by calibrating the model to discharges calculated by a statistical analysis of peak discharges at the Norma stream gauge. This statistical analysis was prepared by the USGS in May 1979, and involved a log-Pearson Type III analysis of 45 years of continuous record (U.S. Department of the Interior, unpublished).

Flood-flow frequency data for Raccoon Creek Reach 1 and Oldmans Creek Reach 1 were based on statistical analysis of streamflow records from gauges located on the streams. The analysis of each gauge followed the standard log-Pearson Type III procedure outlined by the Water Resources Council (Water Resources Council, 1976). Peak discharges for floods of 10-, 2-, 1-, and 0.2-percent annual chance recurrence intervals were developed using the method in Special Report 38 (State of New Jersey, 1974).

The gauge on Raccoon Creek (gauging station No. 01477120) had a 12-year period of record (at the time of publication of the FIS for the Township of Logan), and the gauge on Oldmans Creek (gauging station No. 01477500) has a 9-year period of record, from 1931 to 1939. Since both these gauges have short periods of record, the discharges obtained were weighted with values from Special Report 38 using the technique developed by S. J. Stankowski. The weighted data represent peak discharge-frequency floods of 10-, 2-, 1-, and 0.2-percent annual chance recurrence intervals, and was plotted on log-probability paper for the two creeks. Discharges for the 0.2-percent annual chance flood were estimated by straight-line extrapolation of the previously mentioned graphs.

Peak discharge-frequency values at various points within each respective basin were obtained by transposing the corresponding weighted data, using the following discharge drainage area relationship:

$$Q = kA^n$$

Where k is a constant of proportionality, A is the drainage area, and n is an exponent representative of the hydrologic characteristics of the basin. The value of the exponent used was 0.81, which was recommended by the USACE in Special Projects Memo No. 480 (USACE, 1977).

Peak flood discharges for Hospitality Branch and Fourmile Branch were determined using the USGS Special Report 38 (State of New Jersey, 1974). This method of estimating flood-peak magnitudes was developed through a regression analysis of 103 gauging stations in New Jersey using the log-Pearson Type III methodology (Water Resources Council, 1976). This method relates basin characteristics such as drainage area, slope, storage and impervious cover to peak discharges for various frequencies through empirical equations. The peak flows determined by this method are suppressed by a factor related to the amount of water storage available in the drainage basin.

Peak discharges for Burnt Mill Branch were calculated using regional regression equations developed by the NJDEP in cooperation with the USGS (State of New Jersey, 1974). This report is based on a regression analysis of 103 stream gauges throughout the State of New Jersey. They are used to estimate peak flood magnitudes of selected recurrence intervals for drainage basins larger than 1.0 square mile that have various degrees of urban and suburban development. Drainage basin characteristics used in this method are basin size, channel slope, surface storage, and population density.

For Oldmans Creek Reach 2, discharges were based on stream gauge records from two gauges and regional regression equations. Values for the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were calculated at the Woodstown gauge, and the Harrisonville gauge, using a log-Pearson Type III flood-frequency analysis of annual peak flow data (U.S. Department of the Interior, 1981). Flows calculated at the gauge were transposed to specific locations according to the drainage area-discharge formula:

$$Q_1 = Q_2(A_1/A_2)^T$$

where Q_1 is the discharge at a specific location and A_1 is the drainage area at that location, Q_2 is the discharge at the gauge and A_2 is the drainage area at the gauge with T being the transfer exponent (D. C. Johnstone, 1949). For Oldmans Creek, a value of 0.70 was considered to be representative for the transfer exponent (T).

The discharges obtained from the flood-frequency analysis were transferred from the Oldmans Creek gauges to ungauged sites using the previously mentioned drainage area-discharge formula and then were combined with estimates made using New Jersey Special Report 38 using equivalent years of records (State of New Jersey, 1974; U.S. Department of the Interior, 1971). The equivalent years of records for the transferred gauge data were determined using the following equations:

Gauge Upstream from Site

$$N_s - N_g \frac{PA_g - A_s}{A_g(P-1)}$$

Gauge Downstream from Site

$$N_s - N_g \frac{A_s - pA_g}{A_g(1-p)}$$

The weight applied to T-year discharges computed from gauge records in the study reach is N_g, the equivalent years of record at the gauge. At the ungauged site the weight is N_s. A_g is the drainage area at the gauge; A_s is the drainage area at the ungauged site. Above and below the zone of application (defined as ½ to 2 times gauged area, p and P) the weight is zero. At points within the zone, assuming linear variation of weight from N_g at the gauge to zero at the limits, equivalent years of record for a transferred value can be estimated.

For each ungauged site, three separate estimates of the T-year discharge were made. The first two estimates were transfers of data from the two gauges using the drainage area-discharge formula. The third estimate was computed using regional equation (Special Report 38) (State of New Jersey, 1974). The three estimates were combined into a final estimate by weighing the individual estimates with their respective equivalent years of record. For the two gauged sites, the above equations were used to determine the equivalent years of record (N_s). For the discharges from the regional equations, the equivalent years of record (N_T) were selected from the following: for recurrence intervals of 50-, 20-, 10-, 4-, 2-, 1-, and 0.2-percent annual chance; N_T of 1, 2, 4, 5, 7, 8, and 12 years, respectively. On Oldmans Creek Tributary 3, discharges were based on regional regression equations.

For Mantua Creek, the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were developed using a weighted average of discharges from Special Report 38 and discharges from the Pitman gauge No. 01475000 as determined by a log-Pearson Type III distribution (State of New Jersey, 1974; U.S. Department of the Interior, 1978). The gauge was located on Mantua Creek and was in operation from 1926 to 1977. Gauge values were transposed using the drainage area proportioning formula, $Q_1/Q_2 = (A_1/A_2)^{.75}$, where Q_1 and Q_2 represent discharges for the respective drainage areas, A_1 and A_2 (D. C. Johnstone, 1949). The weighting formula employed follows:

$$\text{Log } Q = N_1 \text{ Log } Q_1 + Nr(\text{Log } Qr)/(N_1 + Nr)$$

where N_1 is the years of record for gauge discharges, Nr is the equivalent years of record for Special Report 38, Q_1 is the transposed gauge discharges, Qr is the Special Report 38 discharges, and Q is the discharge.

For Duffield Run, Edwards Run, Pargey Creek, Repaupo Creek, Woodbury Creek, White Sluice Race, London Branch, Nahonsey Brook, and Clonmell Creek, the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were developed using drainage area proportions employing discharges calculated for Mantua Creek at two locations. The choice of which location to utilize was dependent on the slope of the stream. The hydrology was developed using two USGS stream gauging stations in the basin and the Generalized Skew Study for the State of New Jersey report (USACE, undated). In addition, frequency-discharge curves for other locations within the basin were generated by a rainfall-runoff model.

Countywide Analyses

For the January 20, 2010 countywide FIS, the base data for hydrologic analyses were developed from USGS Quads and NJDEP GIS data (Wetland, Ponds, and Land-Use). The impervious areas in the watershed were calculated from NJDEP Land-Use data and NRCS – TR-55 guidelines for average impervious cover by Land-Use characteristics. The slope of the main channel at 10% and 85% of its length was calculated from USGS 10M DEM for Gloucester County, New Jersey. Population densities were obtained from Census 2000 tracts shape files for Gloucester County.

For ease of use, information on the methodology used to study different streams is organized based on 11-digit Hydrologic Unit Code (HUC). The USGS has developed the 8 digit HUC system as a hierarchical classification system of hydrologic drainage basin in the United States. The HUC hierarchy corresponds to codes with 2, 4, 6, 8, and 11 digits. In decreasing area (increasing number of digits in HUC) order each is made up by several of the contiguous watersheds of lower hierarchy .The first two digits of the HUC are the Regional Code. The first four digits of the HUC are the Subregional Code. The first six digits of the HUC are the Accounting Unit Code. The additional next two digits of the HUC identify the Cataloging Unit. The last three digits of the HUC are the code for the NRCS watershed Boundary.

For Little Ease Run, Mantua Creek, and Raccoon Creek Reach 2 with Gauge Analysis, PeakFQ software by USGS was used to perform gauge analyses based on Bulletin #17B guidelines. The weighted skew coefficient of 0.27 and a standard error of 0.44 for the Coastal Plains of New Jersey, developed by USGS, New Jersey, were used for gauge analyses (U.S. Department of the Interior, 1982).

To transfer peak discharges obtained from Gauge Analyses, the following formula was used.

$$Q_1/Q_2 = (A_1/A_2)^n$$

Where, Q_1: discharge at the transposed point
Q_2: discharge at the gauge
A_1: drainage area at the transposed point
A_2: drainage area at the gauge
n: 0.88 for 10 year recurrence interval
n: 0.85 for 50 year recurrence interval
n: 0.84 for 100 year recurrence interval
n: 0.82 for 500 year recurrence interval

For Scotland Run Reach 2, South Branch Raccoon Creek, Still Run #2, and Woodbury Creek without USGS gauges and points of interest outside the drainage area transfer range, regression equations from USGS Special Report 38, “Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization”, were used to generate peak discharges. Special Report 38 is based on a regression analysis of 103 gauges in the State of New Jersey and is used to estimate peak-flood magnitudes having selected recurrence intervals for drainage basins larger than 0.61 square mile with various degrees of urban or suburban development. Parameters used in this method are basin size, channel slope, surface storage and population density.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 6, "Summary of Discharges."

TABLE 6 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BIG TIMBER CREEK					
Downstream of the confluence with North Branch Big Timber Creek	44.5	2,400	4,460	5,580	7,800
BURNT MILL BRANCH					
At downstream Borough of Newfield corporate limits	3.72	330	570	700	1,130
Upstream of West Boulevard	2.81	285	490	610	980
Approximately 680 feet upstream of West Boulevard	2.70	275	484	604	945
Approximately 1,580 feet upstream of West Boulevard	2.26	260	440	550	890
CLONMELL CREEK					
At confluence with Delaware River	4.0	320	830	1,190	2,630
At Interstate Route 295	0.9	100	260	375	840
DUFFIELD RUN					
At the confluence with Mantua Creek	3.7	200	510	730	1,635
EDWARDS RUN					
At the confluence with Mantua Creek	10.1	645	1,670	2,390	5,290
Upstream of Berkley Road	10.0	640	1,655	2,370	5,240
At a point approximately 760 feet south of the New Jersey Turnpike bridge	8.8	580	1,500	2,150	4,755
FOURMILE BRANCH					
At confluence with Great Egg Harbor River	7.61	221	384	475	770
Upstream Township of Monroe corporate limits	1.61	109	193	242	405
HOSPITALITY BRANCH					
Centerline of Sharps Road bridge	18.6	539	908	1,114	1,750
At confluence of Oakland Brook	7.07	335	571	707	1,130
LITTLE EASE RUN					
Approximately 560 feet downstream of East Washington Avenue	10.88	190	303	357	497

TABLE 6 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
LITTLE EASE RUN (continued)					
Upstream of East Academy Street at Gauge Station 01411456	9.63	171	274	322	450
Approximately 4,450 feet upstream of Gauge Station 01411456	7.40	135	219	258	362
LONDON BRANCH					
At confluence with Still Run	1.6	165	425	610	1,355
At Swedesboro Avenue	1.1	115	300	430	965
MANTUA CREEK					
Upstream of confluence with Delaware River	49.38	1,464	2,288	2,709	3,896
Upstream of Interstate Route 295	47.60	1,549	2,413	2,857	4,096
Upstream of railroad	45.17	1,623	2,522	2,987	4,272
Upstream of confluence with Edwards Run	33.38	1,266	1,983	2,356	3,390
Upstream of New Jersey Turnpike	33.04	1,278	2,000	2,375	3,412
Upstream of State Route 45	30.75	1,247	1,951	2,318	3,328
Upstream of confluence with Mantua Creek Tributary 71264	28.94	1,189	1,865	2,218	3,189
Upstream of confluence with Chestnut Branch	19.36	809	1,290	1,542	2,244
Upstream of confluence with Monongahela Brook	15.38	665	1,067	1,279	1,867
Salina Gauging Station 01475019	14.08	637	1,022	1,224	1,783
Upstream of confluence with Bees Branch	12.79	586	1,035	1,277	1,986
Upstream of confluence with Bethel Run	10.08	475	846	1,046	1,634
Upstream of confluence with Porch Branch	7.70	375	673	834	1,310
Upstream of Lambs Road	7.58	370	664	823	1,293
Pitman Gauging Station (approximately 300 feet upstream of Route 47)	6.12	306	553	688	1,085
Upstream of Greentree Road	2.66	147	273	341	548
Upstream of Fish Pond Road	1.26	90	154	189	285

TABLE 6 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
NEHONSEY BROOK					
At confluence with White Sluice Race	3.9	320	825	1,180	2,610
At Tomlin Station Road	3.3	295	715	1,025	2,265
At Swedesboro Avenue	1.9	185	480	690	1,520
OLDMANS CREEK REACH 1					
At confluence with the Delaware River	45.80	2,800	5,200	6,600	10,300
At upstream Township of Logan corporate limits	30.90	2,030	3,750	4,790	7,470
At gauge near Woodstown (No. 01477500)	19.30	1,390	2,560	3,270	5,100
OLDMANS CREEK REACH 2					
At a point approximately 100 feet downstream from CONRAIL bridge	18.6	1,960	4,450	6,130	12,200
At a point approximately 120 feet downstream from Woodstown-Swedesboro Road	18.5	1,950	4,430	6,120	12,200
At confluence of Oldmans Creek Tributary 1	17.2	1,590	3,970	5,480	10,900
At confluence of Oldmans Creek Tributary 2	13.8	1,410	3,090	4,230	8,250
At a point approximately 520 feet downstream from State Route 45 bridge	12.6	1,250	2,660	3,630	6,950
At a point approximately 80 feet downstream from State Route 45 bridge	10.6	1,000	2,010	2,680	4,850
OLDMANS CREEK REACH 2 TRIBUTARY 3					
At confluence with Oldmans Creek	1.93	320	560	715	1,180
At a point approximately 40 feet downstream from Marl Road	1.76	310	540	690	1,150
At a point approximately 1,900 feet upstream from Marl Road	1.51	280	485	620	1,030
At a point approximately 2,120 feet upstream from Marl Road	1.08	210	365	470	785

TABLE 6 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
OLDMANS CREEK REACH 2 TRIBUTARY 3 (continued)					
At a point approximately 0.58 mile upstream from Marl Road	1.03	140	245	320	530
PARGEY CREEK					
At Swedesboro Avenue	4.5	355	910	1,305	2,890
RACCOON CREEK REACH 1					
At the upstream Borough of Swedesboro corporate limits	39.8	2,680	4,780	5,950	9,060
At the USGS gauge near Swedesboro	29.9	2,130	3,790	4,720	7,190
RACCOON CREEK REACH 2					
At Township of Harrison/ Township of Woolwich corporate limits	26.73	1,667	2,706	3,208	4,517
Upstream of Tomlin Station Road (Swedesboro Gauging Station 01477120)	25.85	1,618	2,630	3,119	4,395
Upstream of confluence with South Branch Raccoon Creek	16.57	1,076	1,957	2,420	3,718
Upstream of Mill Road at Mullica Hill Gauging Station 01477110	14.89	979	1,787	2,212	3,406
Downstream of Mullica Hill Pond	13.82	917	1,677	2,077	3,204
Approximately 5,100 feet upstream of Mullica Hill Road	12.58	844	1,548	1,920	2,967
Upstream of Miery Run	10.67	730	1,346	1,672	2,592
Upstream of Glems Run	6.81	216	375	463	724
Upstream of Main Street	6.30	200	348	430	674
Upstream of Ellis Mill Road	4.47	153	272	340	545
Upstream of Richwood Road	1.22	43	80	101	167
REPAUPO CREEK					
At confluence with the Delaware River	7.0	495	1,275	1,825	4,030
At CONRAIL	6.0	435	1,120	1,600	3,540

TABLE 6 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SCOTLAND RUN REACH 1					
Upstream of Willow Grove Lake	36.40	399	969	124	2,499
Downstream of reservoir	17.51	364	564	654	1,999
At Washington Avenue	11.87	274	394	489	949
SCOTLAND RUN REACH 2					
Approximately 430 feet downstream of East Academy Street	9.28	232	394	481	735
Upstream of East Academy Street	9.25	232	394	481	735
SOUTH BRANCH BIG TIMBER CREEK					
Upstream of the confluence with North Branch Big Timber Creek	25.4	1,400	2,580	3,250	5,400
At Good Intent Road	19.2	1,210	2,220	2,810	4,400
At the confluence of Little Lebanon Brook	3.7	395	735	920	1,470
SOUTH BRANCH RACCOON CREEK					
Upstream of confluence with Raccoon Creek Reach 2	8.27	271	463	568	877
Upstream of High Street	8.20	271	463	568	877
Upstream of Woodstown Road	6.87	234	404	500	781
Upstream of Unnamed Tributary	5.22	167	293	364	575
STILL RUN #1					
At confluence with London Branch	5.6	415	1,070	1,535	3,400
At Swedesboro Avenue	4.9	375	965	1,385	3,060

TABLE 6 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
STILL RUN #2					
At county boundary	46.78	1,074	1,519	1,899	3,649
Downstream of confluence of Little Ease Run	40.52	969	1,379	1,689	3,299
Upstream of confluence of Little Ease Run	26.16	584	919	1,174	2,249
Upstream of confluence of Reed Branch	12.37	324	494	624	1,119
At Township of Franklin/ Borough of Clayton corporate limits	10.20	274	424	524	969
WHITE SLUICE RACE					
At confluence with Aunt Debs Ditch	12.0	735	1,905	2,725	6,025
At confluence of Nehonsey Brook	7.6	520	1,350	1,930	4,270
At CONRAIL	7.5	515	1,330	1,905	4,220
WOODBURY CREEK					
Upstream of confluence with Delaware River	12.25	522	842	1,009	1,486
Upstream of confluence with Hessian Run	9.82	466	754	905	1,331
Upstream of confluence with Matthew Branch	6.09	295	484	583	858
At corporate boundary of City of Woodbury	5.23	279	459	554	816

3.2 Riverine Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that riverine 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. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

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.

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). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

For each jurisdiction within Gloucester County that has a previously printed FIS report, the hydraulic analyses described in those reports have been compiled and are summarized below.

Pre-Countywide Analyses

Hydraulic analyses of the shoreline characteristics of the Delaware River were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Tidal analyses for the Delaware River were taken directly from the FIS for the City of Philadelphia (FEMA, 1978).

Water-surface elevations of floods of the selected recurrence intervals for Big Timber Creek, Burnt Mill Branch, Clonmell Creek, Duffield Run, Edwards Run, Little Ease Run, London Branch, Mantua Creek, Nehansey Brook, Oldmans Creek Reach 1, Oldmans Creek Reach 2, Oldmans Creek Tributary 3, Pargey Creek, Raccoon Creek Reach 1, Repaupo Creek, Scotland Run Reach 1, South Branch Big Timber Creek, Still Run #1, Still Run #2, White Sluice Race, and Woodbury Creek were computed through the use of the USACE HEC-2 step-backwater computer program (USACE, 1980). Starting water-surface elevations for Big Timber Creek, Mantua Creek, and Woodbury Creek were obtained from the one-year tidal elevation of the Delaware River. Starting water-surface elevations for South Branch Big Timber Creek were determined using coincident flood peaks at its confluence with Big Timber Creek. Starting water-surface elevations for Duffield Run, Edwards Run, Little Ease Run, Oldmans Creek Reach 1, and Raccoon Creek were determined using the slope/area method.

Starting water-surface elevations for Still Run #1 were taken from the elevations computed at Willow Grove Lake Dam, in the City of Vineland, by the Philadelphia District of the USACE (USACE, August 1977). Scotland Run Reach 1 calculations were started at the downstream corporate limits using elevations taken from the FIS for the City of Vineland (FEMA, 1982).

Starting water-surface elevations for Repaupo Creek, White Sluice Race, and Clonmell Creek, which all have flood gates, were taken from normal depth at the upstream face of the gate. Normal depth was obtained through the slope/area method. The starting water-surface elevations for Pargey Creek were taken from the profile for Repaupo Creek at the point of confluence, and London Branch, Still Run #1, and Nehonsey Brook starting water-surface elevations came from the profile for White Sluice Race at the respective points of confluence. These hydraulic analyses have determined that tidal flooding from the Delaware River is higher than the computed riverine flood elevations; as a result, flood profiles were not prepared for these streams.

For Repaupo Creek, Pargey Creek, White Sluice Race, London Branch, Still Run, Nehonsey Brook, and Clonmell Creek, channel cross sections and partial overbank cross sections were obtained through field surveys. The overbanks were extended using topographic maps compiled from aerial photographs at a scale of 1:2,400. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Starting water-surface elevations for Burnt Mill Branch were calculated using weir-formula and flow-over-embankment computation at the dam just upstream of State Route 47 in the City of Vineland (U.S. Department of the Interior, 1967).

Starting water-surface elevations for Oldmans Creek Reach 2 were taken directly from the USGS rating for Oldmans Creek near the Woodstown gauge. Starting water-surface elevations for Fourmile Branch, Hospitality Branch, and Oldmans Creek Tributary 3 were taken from normal depth.

These hydraulic analyses have determined that tidal flooding from the Delaware River is higher than the computed riverine flood elevations; as a result, flood profiles were not prepared for Clonmell Creek, London Branch, Nehonsey Brook, Still Run #1, and White Sluice Race within the Township of Greenwich.

Countywide Analyses

For the January 20, 2010 countywide FIS, for ease of use, information on the methodology used to study different stream is organized based on 11- digit HUC. See Section 3.1 for more explanation on the HUC system. In Gloucester County, revised analyses were performed in some portions of following HUC 11 Units.

02040202150- Raccoon Creek Reach 2, South Branch Raccoon Creek
02040202130- Mantua Creek
02040202120- Woodbury Creek
02040206120- Little Ease Run, Still Run #2
02040206130- Scotland Run Reach 2

For all detailed study streams, field survey was obtained for both natural stream cross sections as well as hydraulic obstructions such as bridges, culverts, dams and weirs. This information was combined with topographic data provided by Gloucester County in the form of bare earth mass points to create a bare earth surface for the stream corridor. This information was preprocessed using the HEC GeoRAS interface for ArcGIS 9.0. The interface prepared the geometry file for HEC-RAS and was eventually used to visualize results from the simulations.

Water-surface elevations of flood profiles of the selected recurrence intervals for all revised detailed streams were computed using the USACOE HEC-RAS computer program, Version 3.1.3(USACE, 2005).

02040202150-
Starting water surface elevations for Raccoon Creek Reach 2 and South Branch Raccoon Creek were obtained using normal depth.

02040202130-
The stillwater elevations computed by the USACE for the recent Camden County, New Jersey FIS were used as starting water-surface elevations for Mantua Creek.

02040202120-
The stillwater elevations computed by the USACE for the recent Camden County, New Jersey FIS were used as starting water-surface elevations for Woodbury Creek.

02040206120-
Starting water-surface elevations for Little Ease Run and Still Run #2 were obtained from the effective FIS of the Township Franklin. Water-surface elevations at the boundary of the Township of Franklin and Borough of Clayton from the FIS of the Township of Franklin were in NGVD 29 datum. A datum conversion was performed to convert NGVD 29 elevations (existing FIS) to NAVD88 (new FIS) using guidelines of NGS Height Conversion Methodologies and VECTCON 2.0 model

02040206130-
Starting water-surface elevations for Scotland Run Reach 2 were obtained using normal depth.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Roughness factors (Manning's "n") 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 7, "Manning's "n" Values."

TABLE 7 - MANNING'S "n" VALUES

Stream	Channel “n”	Overbank “n”
Big Timber Creek	0.035 - 0.045	0.070 - 0.090
Burnt Mill Branch	0.030 - 0.040	0.035 - 0.160
Clonmell Creek	0.019 - 0.028	0.080 - 0.110
Duffield Run	0.025 - 0.035	0.070 - 0.080
Edwards Run	0.028	0.060 - 0.100
Fourmile Branch	0.050 - 0.070	0.100 - 0.110
Hospitality Branch	0.030 - 0.040	0.040 - 0.100

TABLE 7 - MANNING'S "n" VALUES - continued

Stream	Channel “n”	Overbank “n”
Little Ease Run	0.035 – 0.040	0.035 – 0.100
London Branch	0.020 - 0.028	0.060 - 0.120
Mantua Creek	0.015 – 0.035	0.015 – 0.100
Nehonsey Brook	0.020 - 0.028	0.100 - 0.125
Oldmans Creek Reach 1	0.022 - 0.035	0.050 - 0.120
Oldmans Creek Reach 2	0.030 - 0.040	0.060 - 0.080
Oldmans Creek Reach 2 Tributary 3	0.030 - 0.040	0.060 - 0.080
Pargey Creek	0.019 - 0.030	0.050 - 0.125
Raccoon Creek Reach 1	0.022 - 0.040	0.050 – 0.120
Raccoon Creek Reach 2	0.026 – 0.045	0.020 – 0.100
Repaupo Creek	0.019 - 0.030	0.050 - 0.125
Scotland Run Reach 1		
Scotland Run Reach 2	0.030 – 0.040	0.030 – 0.080
South Branch Big Timber Creek	0.020 - 0.070	0.070 - 0.150
South Branch Raccoon Creek	0.034 – 0.035	0.033 – 0.100
Still Run #1	0.014 – 0.028	0.600 – 0.160
Still Run #2	0.014 - 0.040	0.033 - 0.160
White Sluice Race	0.020 - 0.028	0.060 - 0.120
Woodbury Creek	0.029 – 0.035	0.016 – 0.070

3.3 Coastal Analysis

For the August 17, 2016 countywide revision, the storm surge analysis on the Delaware River was studied as part of a FEMA Region III project to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The study replaces outdated coastal storm surge stillwater elevations for all FIS reports in the study area, including Region II Counties in New Jersey along the Delaware River such as Gloucester County and serves as the basis for updated FIRMs. Study efforts were initiated in 2008 and concluded in 2012.

The storm surge study was conducted for FEMA by the USACE and its project partners under Project HSFE03-06-X-0023, “NFIP Coastal Storm Surge Model for Region III” and Project HSFE03-09-X-1108, “Phase II Coastal Storm Surge Model for FEMA Region III”. The work was performed by the Coastal Processes Branch (HF-C) of the Flood and Storm Protection Division (HF), U.S. Army Engineer Research and Development Center – Coastal & Hydraulics Laboratory (ERDC-CHL).

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics (Luettich et. al, 2008). ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating Waves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (USACE, 2012.). The resulting model system is typically referred to as SWAN+ADCIRC (USACE, 2012). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from three major flood events for the Region III domain: Hurricane Isabel, Hurricane Ernesto, and extratropical storm Ida. Model skill was accessed by quantitative comparison of model output to wind, wave, water level and high water mark observations.

Gloucester County shows stretches of natural shoreline but it is also characterized by a hardened shoreline composed of seawalls and riprap revetments. Erosion was not computed as the county does not show any erodible features and is sheltered with a fetch less than 5 miles.

Coastal analysis, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Users of the FIRM should be aware that coastal flood elevations are provided in Table 8, “Summary of Coastal Stillwater Elevations” table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

The storm-surge elevations for the 10-, 2-, 1-, and 0.2- percent annual chance floods were determined for Delaware Bay and are shown in Table 8, “Summary of Coastal Stillwater Elevations.” The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects.

TABLE 8 - SUMMARY OF COASTAL STILLWATER ELEVATIONS

	ELEVATION (feet) NAVD88			
FLOODING SOURCE AND LOCATION	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
DELAWARE RIVER				
At boundary between Salem and Gloucester Counties	6.9	7.6-7.8	8.3-8.4	10.9-11
At boundary between Gloucester and Camden Counties	7.6	8.5-8.6	9.1-9.2	11.5-11.7

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS, 1977). This method is based on three major concepts. First, depth-limited waves in shallow water reach maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in NAS Report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

This coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave height analysis and wave runup analysis.

Wave heights were computed across transects that were located along the shoreline at the Delaware River of Gloucester County, as illustrated on the FIRMs. The transects were laid out with consideration given to existing transect locations and to the physical and cultural characteristics of the land so that they would closely represent conditions in the locality.

Each transect was taken perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The stillwater elevations for a 1% annual chance event were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the Zone VE (area with velocity wave action) was computed at each transect.

Wave height calculation methodologies used in this flood study are described in the FEMA guidance for coastal mapping (FEMA, 2007a). Wave setup is the increase in mean water level above the still water level due to momentum transfer to the water column by waves that are breaking or otherwise dissipating their energy (Dean et. al., 2005). For the Gloucester County study, total stillwater elevation was determined directly from the ADCIRC+SWAN model. The total stillwater elevation (SWEL) was then used for simulations of inland wave propagation conducted using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model Version 4.0 (FEMA, 2007b). WHAFIS is a one-dimensional model that was applied to each transect in the study area. The model uses the specified SWEL and the starting wave conditions as input. Simulations of wave transformations were then conducted with WHAFIS taking into account the storm-induced erosion and overland features of each transect. Output from the model includes the combined SWEL and wave height along each cross-shore transect allowing for the establishment of base flood elevations (BFEs) and flood zones from the shoreline to points inland within the study area.

Wave runup is defined as the maximum vertical extent of wave uprush on a beach or structure. FEMA's "Atlantic Ocean and Gulf of Mexico Coastal Guidelines" require the top 2% of 1% storm wave runup level be computed for the coastal feature being evaluated (cliff, coastal bluff, dune, or structure) (FEMA, 2007a). The 2-percent runup level is the elevation exceed by 2-percent of incoming waves affecting the shoreline during the 1-percent-annual-chance flood event. Each transect defined within the Region II study area was evaluated for the applicability of wave runup, and if necessary, the appropriate runup methodology was selected and applied to each transect. Runup elevations were then compared to WHAFIS results to determine the dominant process affecting BFEs and associated flood hazard levels. Based on wave runup rates, wave overtopping was computed, where applicable, following FEMA's "Atlantic Ocean and Gulf of Mexico Coastal Guidelines."

Figure 1, "Transect Location Map," illustrates the location of each transect. Along each transect, wave envelopes were computed considering the combined effects of changes in ground elevation, vegetation and physical features. Between transects, base flood elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the aerial extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergoes major changes. The flood hazard zone and base flood elevations for each transect flooding source is provided in Table 9, "Transect Data", along with the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations for the respective flooding source.

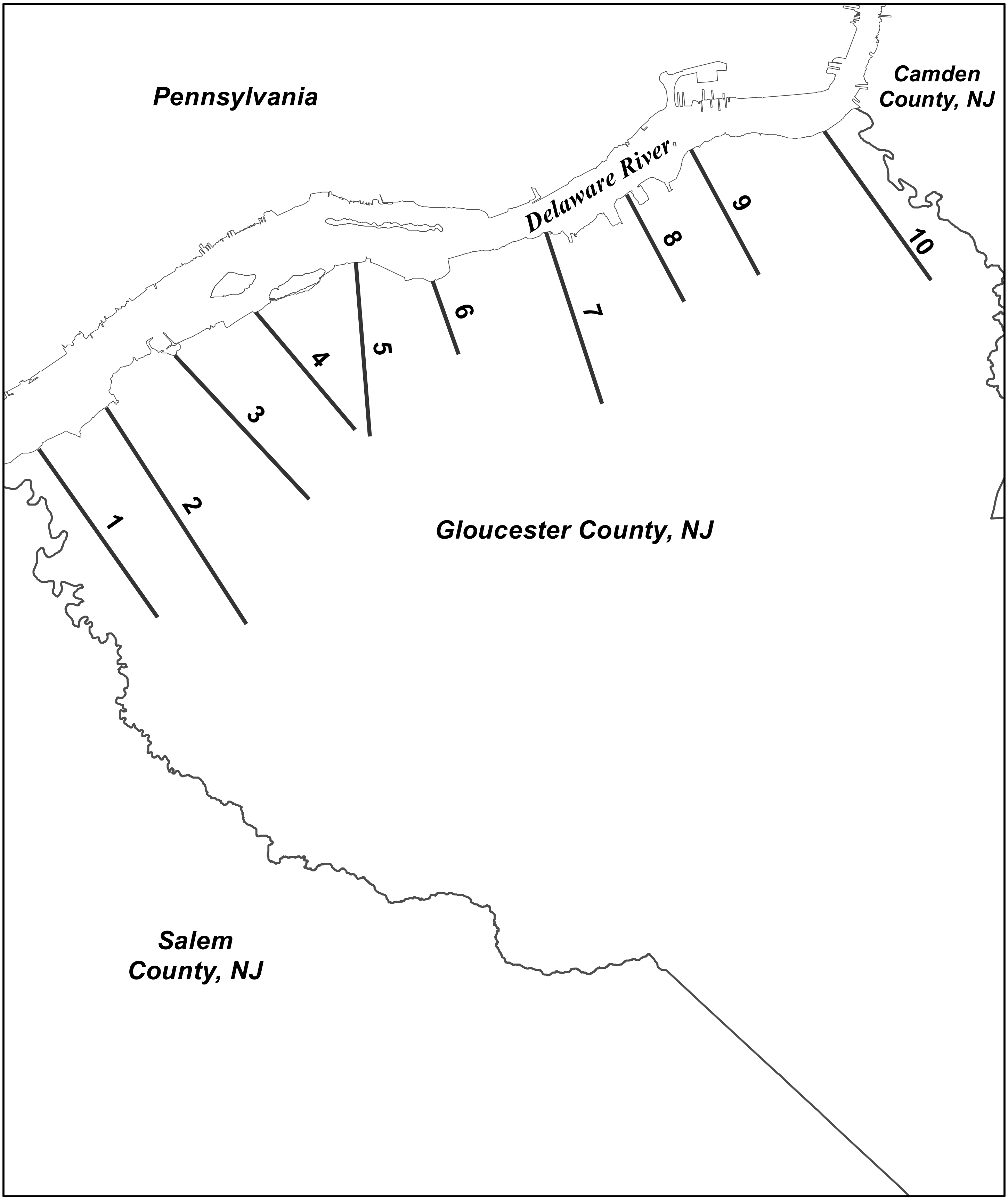


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NEW JERSEY

(ALL JURISDICTIONS)

Approximate Scale

0 1.5 3 Miles

TRANSECT LOCATION MAP

TABLE 9 - TRANSECT DATA

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (feet NAVD88) Range of Stillwater Elevations* (feet NAVD88)			
		Coordinates	Significant Wave Height (feet)	Peak Wave Period (sec)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Delaware River	1	N 39.795433 W 75.404544	2.36	2.96	6.9	7.6 7.6 - 7.8	8.4 8.3 - 8.4	11 10.9 - 11
Delaware River	2	N 39.806175 W 75.382282	2.31	2.73	7 6.9 - 7	7.7 7.7 - 7.8	8.4 8.3 - 8.4	11.1 11 - 11.1
Delaware River	3	N 39.819815 W 75.359473	2.09	2.64	7 6.9 - 7	7.7 7.7 - 7.8	8.4	11 10.9 - 11.1
Delaware River	4	N 39.831139 W 75.332796	1.90	2.53	7 6.2 - 7.1	7.8 7.2 - 7.8	8.4 7.8 - 8.5	11 10.9 - 11
Delaware River	5	N 39.844139 W 75.299593	3.10	3.34	7.1 6.2 - 7.1	7.9 7.2 - 7.9	8.5 7.8 - 8.5	11.1 10.8 - 11.1
Delaware River	6	N 39.839492 W 75.273879	2.34	2.83	7.2 7.1 - 7.2	8 7.9 - 8	8.6	11.1 11.1 - 11.2
Delaware River	7	N 39.852341 W 75.236116	2.17	2.79	7.3	8.2 8.1 - 8.2	8.7 8.6 - 8.7	11.2 11.2 - 11.3
Delaware River	8	N 39.862117 W 75.209462	2.34	2.80	7.4	8.2 8.2 - 8.3	8.8	11.3
Delaware River	9	N 39.873837 W 75.188173	2.38	3.00	7.5 7.4 - 7.5	8.3 8.3 - 8.4	8.9	11.4 11.4 - 11.5
Delaware River	10	N 39.878810 W 75.143566	1.87	2.51	7.6	8.5 8.5 - 8.6	9.1 9.1 - 9.2	11.5 11.5 - 11.7

*For Transects with a constant stillwater elevation, only one number is provided to represent both the starting value and the range.

Areas of coastline subject to significant wave attack are referred to as Coastal High Hazard Areas (CHHA). The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard areas (USACE, 1975). The 3-foot wave has been determined to be the minimum size wave capable of causing major damage to conventional wood frame of brick veneer structures. The CHHA is depicted on the FIRMs as Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet. Zone AE is depicted on the FIRMs where the delineated flood hazard includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 2, "Transect Schematic".

Post-storm field visits and laboratory tests have confirmed that, in Zone AE, wave heights as small as 1.5 feet can still cause damage to structures when designed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. The LiMWA also identifies a specific regulatory area for users of the International Building Code. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE (see Figure 2).

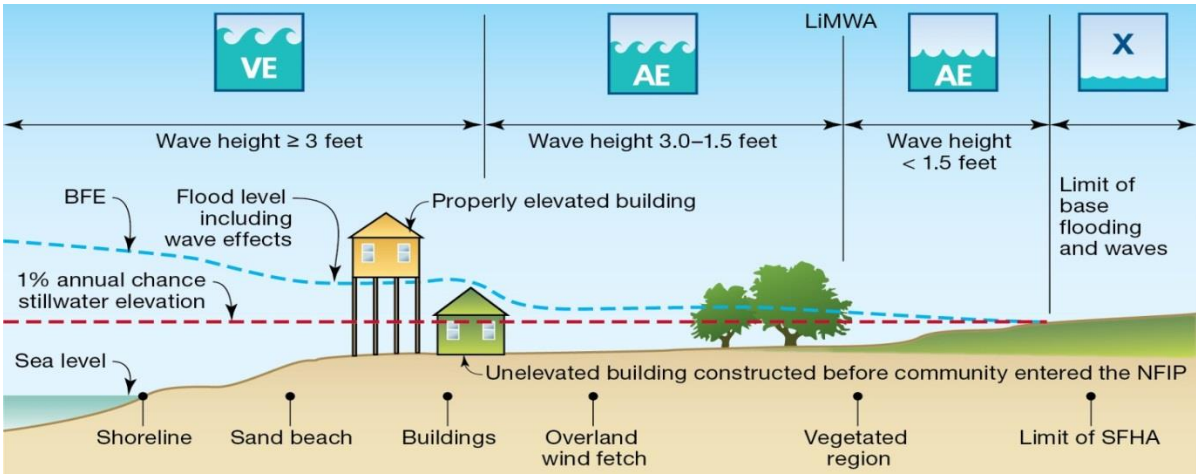


FIGURE 2: TRANSECT SCHEMATIC

3.4 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 NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. The datum conversion from NGVD29 to NAVD88 in Gloucester County can be expressed as the following equation:

$$\text{NGVD29} - 1.177 \text{ feet} = \text{NAVD88}$$

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:

NGS Information Services,
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Qualifying benchmarks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical Survey Control Points and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6-character NSRS Permanent Identifier.

Benchmarks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g.; mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g.; concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g.; concrete monument below frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g.; concrete monument above frost line, or steel witness post)

In addition to NSRS benchmarks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

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

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control.

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- 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 county. For the streams studied in detail, 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 bare earth digital elevation data. The topographic data was composed of bare earth mass points. The point elevation data is comprised mostly of LiDAR. Water-surface elevation triangular irregular networks (TINs) were created from the model cross sections and intersected with the bare earth ground TIN to produce the floodplain corridor. The resulting floodplains were smoothed and incorporated in the DFIRM.

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

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

For this August 17, 2016 revision, new floodplain boundaries were developed and mapped for the Delaware River coastal study using 10 foot resolution Digital Elevation Models (DEMs). The DEMs were created from 2007 LiDAR acquired by Terrapoint USA.

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, however, the State of New Jersey standards limit such increases to 0.2 feet, provided that hazardous velocities are not produced. The floodways in this FIS 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 floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 10). 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.

Portions of the floodway for Big Timber Creek, Fourmile River, Oldmans Creek Reach 1, and South Branch Big Timber Creek extend beyond the county boundary.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 10, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

No floodway was computed for Burnt Mill Branch, Oldmans Creek Reach 2, and Oldmans Creek Reach 2 Tributary 3.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 10 for certain downstream cross sections of Big Timber Creek, Clonmell Creek, Edwards Run, London Branch, Mantua Creek, Nehonsey Brook, Oldmans Creek Reach 1, Pargey Creek, Raccoon Creek Reach 1, Repaupo Creek, South Branch Big Timber Creek, South Branch Raccoon Creek, Still Run #1, and White Sluice Race are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Big Timber Creek								
A	16,990	270	3,410	2.0	*	6.0[3]	6.1	0.1
B	18,340	270	3,420	2.0	*	6.2[3]	6.2	0.0
C	23,120	670	5,150	1.2	*	6.6[3]	6.6	0.0
D	27,300	200	2,295	2.5	*	7.0[3]	7.0	0.0
E	28,260	133	1,626	3.5	*	7.1[3]	7.2	0.1
South Branch Big Timber Creek								
F	32,960	240	2,068	1.6	*	7.6[3]	7.7	0.1
G	38,660	455	4,071	0.7	*	8.0[3]	8.2	0.2
H	44,240	438	2,143	1.3	*	8.4[3]	8.6	0.2
I	48,102	85	703	4.0	16.2	16.3[3]	16.5	0.2
J	48,760	138	836	3.2	16.8	16.8	17.0	0.2
K	52,240	259	1,602	1.6	23.7	23.7	23.7	0.0
L	60,560	175	681	3.4	31.4	31.4	31.5	0.1
M	69,540	200	1,463	1.1	66.8	66.8	66.8	0.0
N	75,240	135	876	1.4	85.6	85.6	85.8	0.2
O	79,050	105	257	3.6	100.4	100.4	100.6	0.2
P	83,070	85	218	1.4	123.4	123.4	123.5	0.1

[1]Feet above confluence with the Delaware River
[2]Width extends beyond county boundary
[3]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

BIG TIMBER CREEK / SOUTH BRANCH BIG TIMBER CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Clonmell Creek								
A	80	294	568	2.1	*	2.2	2.4	0.2
B	4,320	368	1,231	1.0	*	3.8	3.9	0.1
C	7,300	338	2,030	0.6	*	4.3	4.5	0.2
D	11,020	480	2,544	0.5	*	4.5	4.7	0.2
E	12,700	272	1,401	0.8	*	5.0	5.2	0.2
F	14,280	345	2,789	0.4	*	8.8	9.0	0.2
G	15,770	331	1,461	0.8	*	8.8	9.0	0.2

[1]Feet above confluence with Delaware River
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

CLONMELL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Duffield Run								
A	738	118	1,208	0.6	76.6	76.6	76.6	0.0
B	2,964	146	854	0.9	76.6	76.6	76.6	0.0
C	3,562	190	477	1.5	76.6	76.6	76.7	0.1
D	4,210	105	285	2.6	77.8	77.8	77.8	0.0
E	5,511	50	130	5.6	82.3	82.3	82.4	0.1
F	6,024	156	457	1.6	85.3	85.3	85.3	0.0
G	6,871	139	334	2.2	86.0	86.0	86.2	0.2
H	7,539	46	119	6.1	89.2	89.2	89.4	0.2
I	8,115	104	290	2.5	93.2	93.2	93.4	0.2

[1]Feet above confluence with Mantua Creek

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

DUFFIELD RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Edwards Run								
A	210	67	382	6.3	*	0.4[2]	0.6	0.2
B	1,050	75	405	5.9	*	1.8[2]	1.9	0.1
C	3,040	321	1,337	1.8	*	4.9[2]	5.1	0.2
D	4,270	390	1,348	1.8	*	5.4[2]	5.6	0.2
E	6,900	286	1,065	2.2	*	6.9[2]	7.0	0.1
F	7,840	200	1,078	2.2	9.6	9.6	9.6	0.0

[1]Feet above confluence with Mantua Creek
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

EDWARDS RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Fourmile Branch								
A	10	545	1,010	2.5	102.3	102.3	102.5	0.2
B	1,015	37	119	4.0	106.4	106.4	106.5	0.1
C	2,545	269	603	0.8	109.0	109.0	109.2	0.2
D	4,465	368	668	0.7	110.5	110.5	110.7	0.2
E	6,115	714	1,201	0.4	111.3	111.3	111.5	0.2
F	7,495	535	693	0.7	112.0	112.0	112.2	0.2
G	9,170	489	897	0.5	113.4	113.4	113.6	0.2
H	10,870	45	192	2.4	117.2	117.2	117.4	0.2
I	12,300	313	667	0.6	118.7	118.7	118.9	0.2
J	13,415	421	800	0.5	119.3	119.3	119.5	0.2
K	14,400	77	265	1.5	120.4	120.4	120.6	0.2
L	15,630	631	1,353	0.3	120.8	120.8	121.0	0.2
M	17,250	179	130	2.5	121.5	121.5	121.7	0.2
N	18,500	462	546	0.6	124.6	124.6	124.8	0.2
O	19,735	119	145	1.7	128.4	128.4	128.6	0.2
P	21,375	275	559	0.4	129.7	129.7	129.9	0.2

[1]Feet above limit of detailed study (located approximately 965 feet upstream from confluence with Great Egg Harbor River)
[2]Width extends beyond county boundary

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

FOURMILE BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Hospitality Branch								
A	45	613	5,612	0.2	85.1	85.1	85.3	0.2
B	795	667	4,360	0.3	85.1	85.1	85.3	0.2
C	2,245	303	978	1.1	85.1	85.1	85.3	0.2
D	4,535	252	396	2.5	86.5	86.5	86.7	0.2
E	4,795	921	6,309	0.2	91.7	91.7	91.7	0.0
F	6,020	764	3,559	0.3	91.7	91.7	91.7	0.0
G	8,275	997	2,139	0.5	91.7	91.7	91.7	0.0
H	10,370	449	751	1.3	93.2	93.2	93.4	0.2
I	11,745	550	1,057	0.9	94.8	94.8	95.0	0.2
J	14,475	177	364	2.1	97.2	97.2	97.4	0.2
K	14,975	890	6,082	0.1	99.7	99.7	99.9	0.2
L	16,125	730	3,240	0.2	99.7	99.7	99.9	0.2
M	17,500	1,000	4,439	0.2	103.5	103.5	103.5	0.0
N	18,965	615	3,092	0.2	103.5	103.5	103.5	0.0
O	20,920	376	529	1.3	103.6	103.6	103.6	0.0

[1]Feet above Sharps Road

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

HOSPITALITY BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Little Ease Run								
A	1,800	142	270	1.9	82.1	82.1	82.3	0.2
B	2,530	156	242	2.1	84.4	84.4	84.5	0.1
C	3,410	150	453	1.1	85.2	85.2	85.4	0.2
D	5,630	184	359	1.4	86.2	86.2	86.4	0.2
E	7,600	233	496	1.0	88.9	88.9	89.1	0.2
F	8,890	188	599	0.9	93.3	93.3	93.3	0.0
G	9,820	280	814	0.6	93.5	93.5	93.6	0.1
H	10,590	31	116	4.5	94.2	94.2	94.3	0.1
I	11,680	714	4,033	0.1	97.8	97.8	97.8	0.0
J	13,000	554	2,645	0.2	97.8	97.8	97.8	0.0
K	14,500	510	656	0.9	97.8	97.8	97.8	0.0
L	15,840	154	333	1.8	98.7	98.7	98.9	0.2
M	17,200	185	518	1.1	99.7	99.7	99.9	0.2
N	18,120	214	710	0.8	100.5	100.5	100.7	0.2
O	19,200	181	606	1.0	100.7	100.7	100.9	0.2
P	20,650	117	206	2.8	101.0	101.0	101.1	0.1
Q	22,000	331	793	0.7	102.2	102.2	102.4	0.2
R	23,360	335	678	0.9	102.8	102.8	103.0	0.2
S	23,711	596	1,193	0.3	102.9	102.9	103.1	0.2
T	24,229	271	622	0.6	103.2	103.2	103.4	0.2
U	25,173	391	681	0.5	103.8	103.8	104.0	0.2
V	26,098	224	538	0.7	104.1	104.1	104.3	0.2
W	27,286	53	167	1.9	104.9	104.9	105.1	0.2
X	28,242	29	72	4.5	106.0	106.0	106.1	0.1
Y	29,898	301	414	0.8	110.2	110.2	110.3	0.1
Z	32,427	356	436	0.6	112.9	112.9	113.1	0.2
AA	35,525	568	476	0.5	115.9	115.9	116.1	0.2
AB	37,733	241	376	0.7	118.5	118.5	118.7	0.2

[1]Feet above confluence with Still Run #2

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

LITTLE EASE RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
London Branch								
A	380	223	1,455	0.4	*	4.6	4.8	0.2
B	1,730	192	1,277	0.5	*	4.6	4.8	0.2
C	2,930	320	2,067	0.3	*	4.9	5.1	0.2
D	4,700	159	1,140	0.5	*	5.0	5.2	0.2
E	6,740	68	440	1.4	*	5.0	5.2	0.2

[1]Feet above confluence with White Sluice Race
[2]Elevation computed without consideration of backwater effects from White Sluice Race
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

LONDON BRANCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mantua Creek								
A	2,683	310	4,296	0.6	*	3.3[2]	3.4	0.1
B	6,921	342	5,815	0.5	*	3.3[2]	3.5	0.2
C	8,512	167	2,513	1.1	*	3.3[2]	3.5	0.2
D	11,766	425	3,396	0.8	*	3.4[2]	3.5	0.1
E	14,779	719	4,201	0.7	*	3.5[2]	3.6	0.1
F	16,844	892	3,841	0.7	*	3.5[2]	3.6	0.1
G	17,915	606	2,990	1.0	*	3.5[2]	3.7	0.2
H	20,794	606	2,726	1.1	*	3.6[2]	3.8	0.2
I	22,578	873	2,830	1.0	*	3.7[2]	3.9	0.2
J	25,056	407	1,781	1.6	*	4.0[2]	4.2	0.2
K	27,162	747	3,544	0.8	*	4.2[2]	4.4	0.2
L	30,897	912	3,574	0.7	*	4.3[2]	4.5	0.2
M	32,875	516	2,792	0.9	*	5.3[2]	5.4	0.1
N	34,651	1,099	3,926	0.6	*	5.4[2]	5.5	0.1
O	36,209	421	1,739	1.4	*	5.7[2]	5.8	0.1
P	38,166	117	746	3.2	*	5.9[2]	6.0	0.1
Q	39,995	301	1,459	1.6	*	6.7[2]	6.9	0.2
R	41,150	342	1,721	1.4	*	6.9[2]	7.1	0.2
S	42,849	413	1,959	1.2	*	7.1[2]	7.3	0.2
T	43,890	367	1,571	1.5	*	7.3[2]	7.5	0.2
U	45,407	258	1,178	1.3	*	7.9[2]	8.1	0.2
V	46,515	287	1,312	1.2	*	8.4[2]	8.6	0.2
W	48,371	620	2,162	0.6	8.9	8.9	9.1	0.2
X	49,265	284	766	1.7	9.3	9.3	9.5	0.2
Y	50,822	253	935	1.4	10.8	10.8	11.0	0.2
Z	52,734	230	704	1.8	12.9	12.9	13.0	0.1

[1]Feet above confluence with Delaware River
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

MANTUA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Mantua Creek (continued)								
AA	53,953	343	964	1.3	13.4	13.4	13.6	0.2
AB	55,678	45	199	6.4	16.5	16.5	16.7	0.2
AC	57,027	434	1,550	0.8	18.7	18.7	18.9	0.2
AD	58,108	128	488	2.5	20.1	20.1	20.3	0.2
AE	59,808	217	748	1.7	21.8	21.8	22.0	0.2
AF	61,664	104	433	3.0	24.2	24.2	24.4	0.2
AG	63,345	183	751	1.7	27.0	27.0	27.2	0.2
AH	64,728	144	364	3.5	28.2	28.2	28.4	0.2
AI	65,876	75	280	3.7	31.6	31.6	31.8	0.2
AJ	67,243	140	329	2.5	34.4	34.4	34.6	0.2
AK	68,312	61	199	4.2	37.5	37.5	37.6	0.1
AL	70,364	244	1,455	0.6	52.4	52.4	52.4	0.0
AM	72,372	58	273	3.0	52.5	52.5	52.5	0.0
AN	74,151	149	425	1.9	54.8	54.8	55.0	0.2
AO	75,733	37	139	5.9	59.2	59.2	59.4	0.2
AP	76,750	146	329	2.5	62.3	62.3	62.5	0.2
AQ	78,249	430	2,479	0.3	70.9	70.9	70.9	0.0
AR	80,612	186	459	1.5	74.8	74.8	74.9	0.1
AS	82,111	146	201	3.4	79.3	79.3	79.3	0.0
AT	83,188	99	237	2.9	83.7	83.7	83.9	0.2
AU	85,225	94	181	1.9	88.7	88.7	88.9	0.2
AV	86,682	95	204	1.7	92.5	92.5	92.7	0.2
AW	88,044	36	72	4.7	98.6	98.6	98.7	0.1

[1]Feet above confluence with Delaware River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

MANTUA CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Nehonsey Brook								
A	140	274	1,433	0.8	*	2.2	2.4	0.2
B	2,460	374	1,980	0.6	*	2.4	2.6	0.2
C	5,290	358	2,091	0.6	*	4.0	4.2	0.2
D	7,680	367	2,486	0.4	*	4.1	4.3	0.2
E	11,530	398	2,492	0.4	*	4.3	4.5	0.2
F	13,980	323	2,025	0.5	*	4.4	4.6	0.2
G	16,335	288	1,932	0.5	*	4.9	5.1	0.2
H	18,080	260	2,210	0.5	*	7.4	7.5	0.1

[1]Feet above confluence with White Sluice Race
[2]Elevation computed without consideration of backwater effects from White Sluice Race
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

NEHONSEY BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[3]	WITH FLOODWAY	INCREASE
Oldmans Creek Reach 1								
A	4,190	425	1,431	4.6	*	-1.9	-1.9	0.0
B	8,280	220	1,471	4.5	*	0.3	0.3	0.0
C	10,820	270	1,891	3.5	*	1.0	1.0	0.0
D	12,960	244	2,630	2.5	*	1.4	1.4	0.0
E	16,430	205	1,797	3.2	*	1.6	1.6	0.0
F	19,070	130	895	6.4	*	2.1	2.2	0.1
G	19,160	170	904	6.3	*	2.5	2.7	0.2
H	25,340	1,090	3,771	1.5	*	4.1	4.3	0.2
I	29,260	155	1,107	5.1	*	4.8	5.0	0.2
J	29,430	140	958	5.9	*	5.1	5.3	0.2
K	30,340	140	1,342	4.2	*	5.9	6.0	0.1

[1]Feet above confluence with Delaware River
[2]Width extends beyond county boundary
[3]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

OLDMANS CREEK REACH 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Pargey Creek								
A	80	185	1,486	1.1	*	5.8	5.9	0.1
B	1,980	256	2,004	0.8	*	5.8	5.9	0.1
C	3,620	233	1,870	0.9	*	5.9	6.1	0.2
D	5,148	286	2,733	0.6	*	6.9	7.1	0.2
E	6,708	322	2,910	0.5	*	6.9	7.1	0.2
F	9,888	314	2,419	0.7	*	7.0	7.2	0.2

[1]Feet above confluence with Repaupo Creek
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

PARGEY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Raccoon Creek Reach 1								
A	2,200	650	1,680	4.2	*	-4.4[2]	-4.4	0.0
B	3,620	720	1,791	4.0	*	-3.6[2]	-3.6	0.0
C	4,740	530	1,932	3.7	*	-3.1[2]	-3.1	0.0
D	6,880	310	1,695	4.2	*	-2.4[2]	-2.4	0.0
E	8,940	315	1,758	4.1	*	-1.6[2]	-1.6	0.0
F	9,480	295	2,031	3.5	*	-1.4[2]	-1.4	0.0
G	10,120	270	2,340	3.0	*	-1.1[2]	-1.1	0.0
H	11,480	310	1,608	4.4	*	-1.0[2]	-1.0	0.0
I	17,470	280	1,496	4.5	*	1.0[2]	1.0	0.0
J	20,900	195	1,621	4.2	*	2.0[2]	2.0	0.0
K	23,840	215	1,807	3.8	*	3.6[2]	3.6	0.0
L	26,020	240	2,525	2.7	*	4.2[2]	4.2	0.0
M	26,580	210	2,175	3.1	*	4.2[2]	4.3	0.1
N	26,800	185	2,223	3.1	*	4.5[2]	4.5	0.0
O	27,800	970	4,446	1.5	*	4.7[2]	4.8	0.1
P	31,070	860	4,451	1.5	*	4.9[2]	5.0	0.1
Q	33,950	720	3,285	2.0	*	5.3[2]	5.4	0.1
R	37,440	500	3,009	2.2	*	6.4[2]	6.5	0.1
S	39,000	220	2,082	3.1	*	6.7[2]	6.9	0.2
T	40,680	215	1,971	3.0	*	7.2[2]	7.4	0.2
U	41,580	215	2,370	2.5	*	8.3[2]	8.5	0.2
V	42,600	810	5,435	1.1	8.5	8.5[2]	8.7	0.2
W	43,390	540	3,391	1.8	9.0	9.0	9.2	0.2

[1]Feet above confluence with Delaware River
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RACCOON CREEK REACH 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Raccoon Creek Reach 2								
A	0	264	1,540	2.1	12.2	12.2	12.3	0.1
B	1,166	454	2,623	1.2	12.9	12.9	13.0	0.1
C	2,427	443	2,291	1.4	13.7	13.7	13.8	0.1
D	3,553	151	763	4.2	14.3	14.3	14.4	0.1
E	3,715	417	2,769	1.1	16.0	16.0	16.2	0.2
F	5,545	342	1,830	1.3	16.5	16.5	16.7	0.2
G	6,463	460	2,460	1.0	16.9	16.9	17.0	0.1
H	7,398	520	2,726	0.9	18.0	18.0	18.2	0.2
I	8,557	603	2,123	1.1	18.4	18.4	18.6	0.2
J	9,761	311	999	2.4	19.5	19.5	19.7	0.2
K	10,527	391	1,353	1.8	20.6	20.6	20.8	0.2
L	11,641	333	985	2.5	21.7	21.7	21.9	0.2
M	12,097	301	826	2.9	22.5	22.5	22.7	0.2
N	12,490	259	787	3.1	23.7	23.7	23.8	0.1
O	12,969	210	709	3.4	24.8	24.8	24.9	0.1
P	13,504	190	779	3.1	25.9	25.8	26.0	0.2
Q	14,085	203	812	3.0	27.0	27.0	27.1	0.1
R	14,658	209	847	2.9	27.7	27.7	27.8	0.1
S	15,182	90	435	5.6	28.4	28.4	28.6	0.2
T	15,347	50	379	6.4	29.9	29.9	30.0	0.1
U	15,895	100	718	3.1	32.4	32.4	32.4	0.0
V	16,752	73	552	4.0	32.7	32.7	32.8	0.1
W	16,924	319	2,525	0.8	38.4	38.4	38.4	0.0
X	18,095	249	1,513	1.4	38.4	38.4	38.5	0.1
Y	19,314	211	1,061	2.0	39.0	39.0	39.1	0.1
Z	19,889	199	890	2.3	39.7	39.7	39.8	0.1

[1]Feet above limit of detailed study (located approximately 3,624 feet downstream of Tomlin Station Road)

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RACCOON CREEK REACH 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Raccoon Creek Reach 2 (continued)								
AA	20,649	181	858	2.4	40.9	40.9	41.1	0.2
AB	21,833	370	1,533	1.3	42.3	42.3	42.5	0.2
AC	22,573	273	948	2.0	43.1	43.1	43.2	0.1
AD	23,471	337	1,090	1.8	44.0	44.0	44.2	0.2
AE	24,260	339	1,147	1.7	45.4	45.4	45.6	0.2
AF	25,011	219	601	3.2	46.6	46.6	46.8	0.2
AG	25,520	271	975	2.0	47.8	47.8	48.0	0.2
AH	26,313	237	950	2.0	49.0	49.0	49.2	0.2
AI	26,918	271	1,059	1.8	50.2	50.2	50.4	0.2
AJ	27,433	245	694	2.8	51.1	51.1	51.3	0.2
AK	27,713	282	838	2.3	51.9	51.9	52.1	0.2
AL	28,305	132	529	3.2	53.0	53.0	53.2	0.2
AM	29,213	235	982	1.7	54.7	54.7	54.9	0.2
AN	30,026	195	701	2.4	55.7	55.7	55.9	0.2
AO	30,721	100	387	4.3	56.9	56.9	57.1	0.2
AP	30,887	151	682	2.5	57.9	57.9	57.9	0.0
AQ	31,509	170	575	0.8	58.7	58.7	58.7	0.0
AR	32,325	95	274	1.7	58.9	58.9	59.1	0.2
AS	32,985	57	93	5.0	59.8	59.8	59.9	0.1
AT	33,435	90	140	3.3	61.2	61.2	61.3	0.1
AU	34,103	67	192	2.4	62.7	62.7	62.9	0.2
AV	34,525	90	140	3.3	64.0	64.0	64.1	0.1
AW	34,943	54	133	3.5	65.1	65.1	65.2	0.1
AX	35,489	89	207	2.2	66.4	66.4	66.5	0.1
AY	35,835	39	130	3.6	67.7	67.7	67.9	0.2
AZ	36,202	291	2,592	0.2	77.0	77.0	77.0	0.0

[1]Feet above limit of detailed study (located approximately 3,624 feet downstream of Tomlin Station Road)

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RACCOON CREEK REACH 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Raccoon Creek Reach 2 (continued)								
BA	39,079	160	317	1.4	77.3	77.3	77.4	0.1
BB	39,790	152	188	2.3	79.2	79.2	79.3	0.1
BC	40,164	132	262	1.6	80.7	80.7	80.8	0.1
BD	40,717	119	253	1.7	82.4	82.4	82.6	0.2
BE	41,080	32	128	3.4	84.0	84.0	84.1	0.1
BF	41,318	379	2,893	0.1	91.0	91.0	91.0	0.0
BG	42,173	162	1,084	0.3	91.0	91.0	91.0	0.0
BH	43,148	20	58	5.9	91.4	91.4	91.5	0.1
BI	43,469	66	227	1.5	96.7	96.7	96.9	0.2
BJ	43,844	148	1,033	0.1	102.0	102.0	102.0	0.0
BK	44,842	118	579	0.2	102.0	102.0	102.0	0.0
BL	45,768	37	44	2.3	103.4	103.4	103.4	0.0
BM	46,105	33	48	2.1	105.1	105.1	105.2	0.1
BN	46,314	18	19	5.4	107.7	107.7	107.8	0.1
BO	46,423	47	118	0.9	109.7	109.7	109.7	0.0

[1]Feet above limit of detailed study (located approximately 3,624 feet downstream of Tomlin Station Road)

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

RACCOON CREEK REACH 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Repaupo Creek								
A	275	198	654	2.8	*	-2.6	-2.4	0.2
B	3,070	90	529	3.4	*	-1.1	-0.8	0.3
C	4,975	123	630	2.9	*	-0.1	0.0	0.1
D	9,100	235	918	2.0	*	1.3	1.4	0.1
E	12,665	166	953	1.9	*	2.3	2.5	0.2
F	14,165	233	1,958	0.8	*	5.7	5.7	0.0

[1]Feet above confluence with Delaware River
[2]Elevation computed without consideration of backwater effects from Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

REPAUPO CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Scotland Run Reach 1								
A	8,970	130	559	2.2	78.8	78.8	78.9	0.1
B	11,145	1,230	11,709	0.1	87.5	87.5	87.5	0.0
C	12,345	935	7,559	0.1	87.5	87.5	87.5	0.0
D	13,960	250	964	0.9	87.6	87.6	87.7	0.1
E	15,220	190	398	2.1	88.2	88.2	88.4	0.2
F	16,540	761	2,552	0.3	88.5	88.5	88.7	0.2
G	18,530	250	964	0.9	88.8	88.8	89.0	0.2
H	19,265	120	515	1.6	91.6	91.6	91.7	0.1
I	19,720	124	696	1.2	92.9	92.9	93.0	0.1
J	20,990	1,200	7,373	0.1	93.6	93.6	93.8	0.2
K	21,430	825	4,065	0.2	93.6	93.6	93.8	0.2
L	22,780	815	2,726	0.2	93.6	93.6	93.8	0.2
M	24,240	652	1,662	0.4	93.7	93.7	93.9	0.2
N	26,680	254	364	1.8	94.8	94.8	94.9	0.1
O	28,000	489	624	1.0	95.9	95.9	96.0	0.1
P	29,015	480	1,228	0.5	97.0	97.0	97.0	0.0
Q	30,310	300	823	0.6	98.5	98.5	98.6	0.1
R	33,000	163	414	0.5	100.8	100.8	101.0	0.2
S	36,200	113	284	1.7	103.6	103.6	103.8	0.2
T	37,000	116	400	1.2	104.2	104.2	104.4	0.2
U	38,430	122	339	1.4	105.2	105.2	105.4	0.2
V	39,150	45	203	2.4	105.7	105.7	105.9	0.2
W	39,910	36	150	3.3	106.3	106.3	106.5	0.2

[1]Feet above confluence with Maurice River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

SCOTLAND RUN REACH 1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Scotland Run Reach 2								
A	0	334	480	1.0	110.8	110.8	110.9	0.1
B	367	49	189	2.5	112.1	112.1	112.2	0.1
C	471	556	1,639	0.3	117.5	117.5	117.5	0.0
D	2,296	674	3,387	0.1	117.5	117.5	117.5	0.0
E	4,302	694	2,744	0.2	117.5	117.5	117.5	0.0
F	5,135	889	2,680	0.2	117.5	117.5	117.5	0.0
G	5,691	596	1,004	0.5	117.5	117.5	117.5	0.0

[1]Feet above limit of detailed study (located approximately 398 feet downstream of East Academy Street)

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

SCOTLAND RUN REACH 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Branch Raccoon Creek								
A	154[1]	24	62	9.2	16.3	12.1[3]	12.1	0.0
B	503[1]	33	171	3.3	16.3	14.1[3]	14.3	0.2
C	909[1]	54	245	2.3	16.3	14.9[3]	15.0	0.2
D	1,311[1]	175	430	1.3	16.3	15.1[3]	15.2	0.1
E	1,551[1]	137	279	2.0	16.3	15.2[3]	15.3	0.1
F	1,659[1]	197	660	0.9	16.3	15.9[3]	16.1	0.2
G	2,161[1]	241	657	0.9	16.3	16.1[3]	16.3	0.2
H	2,859[1]	250	484	1.2	16.8	16.8	17.0	0.2
I	3,567[1]	311	492	1.1	17.6	17.6	17.7	0.1
J	5,381[1]	410	738	0.8	20.7	20.7	20.9	0.2
K	6,657[1]	390	629	0.9	22.6	22.6	22.8	0.2
L	8,384[1]	168	305	1.9	26.4	26.4	26.6	0.2
M	10,263[1]	36	184	2.7	30.4	30.4	30.5	0.1
N	12,432[1]	202	349	1.4	33.6	33.6	33.8	0.2
O	14,196[1]	296	312	1.2	35.6	35.6	35.8	0.2
P	16,117[1]	174	162	2.3	39.5	39.5	39.6	0.1
Q	17,052[1]	26	179	2.0	43.2	43.2	43.3	0.1
R	17,771[1]	221	285	1.3	45.1	45.1	45.2	0.1
Still Run #1								
A	970[2]	355	2,499	0.6	*	4.6[4]	4.8	0.2
B	2,040[2]	355	2,375	0.6	*	4.6[4]	4.8	0.2
C	4,870[2]	300	2,757	0.6	*	6.6[4]	6.8	0.2
D	6,520[2]	298	2,992	0.5	*	6.6[4]	6.8	0.2

[1]Feet above confluence with Raccoon Creek Reach 2
[2]Feet above confluence with White Sluice Race
[3]Elevation computed without consideration of backwater effects from Raccoon Creek Reach 2
[4]Elevation computed without consideration of backwater effects from White Sluice Race
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

SOUTH BRANCH RACCOON CREEK – STILL RUN #1

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Still Run #2								
A	13,920	89	393	4.3	76.8	76.8	77.0	0.2
B	15,480	220	579	2.9	79.4	79.4	79.5	0.1
C	15,980	112	426	4.0	80.0	80.0	80.2	0.2
D	17,950	553	1,910	0.9	81.2	81.2	81.4	0.2
E	19,030	338	1,200	1.0	81.5	81.5	81.7	0.2
F	19,532	137	549	2.1	81.7	81.7	81.9	0.2
G	20,035	137	596	2.0	82.1	82.1	82.3	0.2
H	21,400	710	3,448	0.2	87.0	87.0	87.0	0.0
I	22,820	350	1,643	0.4	87.0	87.0	87.1	0.1
J	24,440	369	546	1.1	87.4	87.4	87.6	0.2
K	26,520	255	560	1.1	89.0	89.0	89.2	0.2
L	27,800	250	492	1.3	90.5	90.5	90.6	0.1
M	28,430	252	755	0.8	91.9	91.9	92.1	0.2
N	30,280	140	358	1.7	93.3	93.3	93.4	0.1
O	30,800	105	356	1.8	94.9	94.9	94.9	0.0
P	32,340	200	553	0.9	95.6	95.6	95.8	0.2
Q	33,950	66	219	2.4	96.4	96.4	96.6	0.2
R	35,710	84	239	2.2	97.8	97.8	98.0	0.2
S	37,980	51	124	4.2	100.4	100.4	100.4	0.0
T	39,700	604	3,271	0.1	106.7	106.7	106.9	0.2
U	40,849	206	811	0.6	106.7	106.7	106.9	0.2
V	40,990	77	294	1.6	106.7	106.7	106.9	0.2
W	41,839	526	2,105	0.2	106.9	106.9	107.0	0.2
X	42,620	729	2,198	0.2	106.9	106.9	107.1	0.2
Y	43,481	481	1,306	0.4	106.9	106.9	107.1	0.2
Z	44,117	580	894	0.5	107.1	107.1	107.2	0.1

[1]Feet above confluence with Maurice River

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

STILL RUN #2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Still Run #2 (continued)								
AA	45,103[1]	198	320	1.4	108.6	108.6	108.8	0.2
AB	45,414[1]	43	187	1.8	113.9	113.9	113.9	0.0
AC	46,865[1]	969	6,590	0.1	115.3	115.3	115.4	0.1
AD	48,670[1]	650	2,649	0.1	115.3	115.3	115.4	0.1
AE	49,610[1]	420	1,517	0.2	115.3	115.3	115.4	0.1
AF	50,633[1]	88	156	2.1	115.4	115.4	115.5	0.1
White Sluice Race								
A	250[2]	250	1,287	2.1	*	1.3[3]	1.5	0.2
B	2,670[2]	246	1,200	2.3	*	1.8[3]	2.0	0.2
C	7,170[2]	275	1,402	1.4	*	2.6[3]	2.8	0.2
D	9,790[2]	275	1,808	1.1	*	4.3[3]	4.5	0.2
E	10,870[2]	275	1,859	1.0	*	4.4[3]	4.6	0.2
F	11,795[2]	234	1,929	1.0	*	4.5[3]	4.7	0.2

[1]Feet above confluence with Maurice River
[2]Feet above confluence with Aunt Debs Ditch
[3]Elevation computed without consideration of backwater effects from Aunt Debs Ditch
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

STILL RUN #2 – WHITE SLUICE RACE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY[2]	WITH FLOODWAY	INCREASE
Woodbury Creek								
A	313	300	2,998	0.3	*	3.3	3.5	0.2
B	1,806	411	6,386	0.2	*	3.3	3.5	0.2
C	3,210	187	1,552	0.7	*	3.3	3.5	0.2
D	4,750	136	1,993	0.5	*	3.3	3.5	0.2
E	6,297	551	3,697	0.3	*	3.3	3.5	0.2
F	7,475	236	1,791	0.5	*	3.3	3.5	0.2
G	9,102	154	1,195	0.8	*	3.4	3.6	0.2
H	10,170	163	1,055	0.6	*	3.4	3.6	0.2
I	11,991	168	915	0.6	*	3.4	3.6	0.2
J	13,640	168	839	0.7	*	3.5	3.7	0.2
K	15,211	146	666	0.9	*	3.5	3.7	0.2
L	15,984	125	572	1.0	*	3.6	3.8	0.2
M	16,935	111	534	1.1	*	3.7	3.9	0.2

[1]Feet above confluence with Delaware River
[2]Elevation computed without consideration of backwater effects from the Delaware River
* Controlled by coastal flooding – see Flood Insurance Rate Map for regulatory base flood elevation

TABLE 10

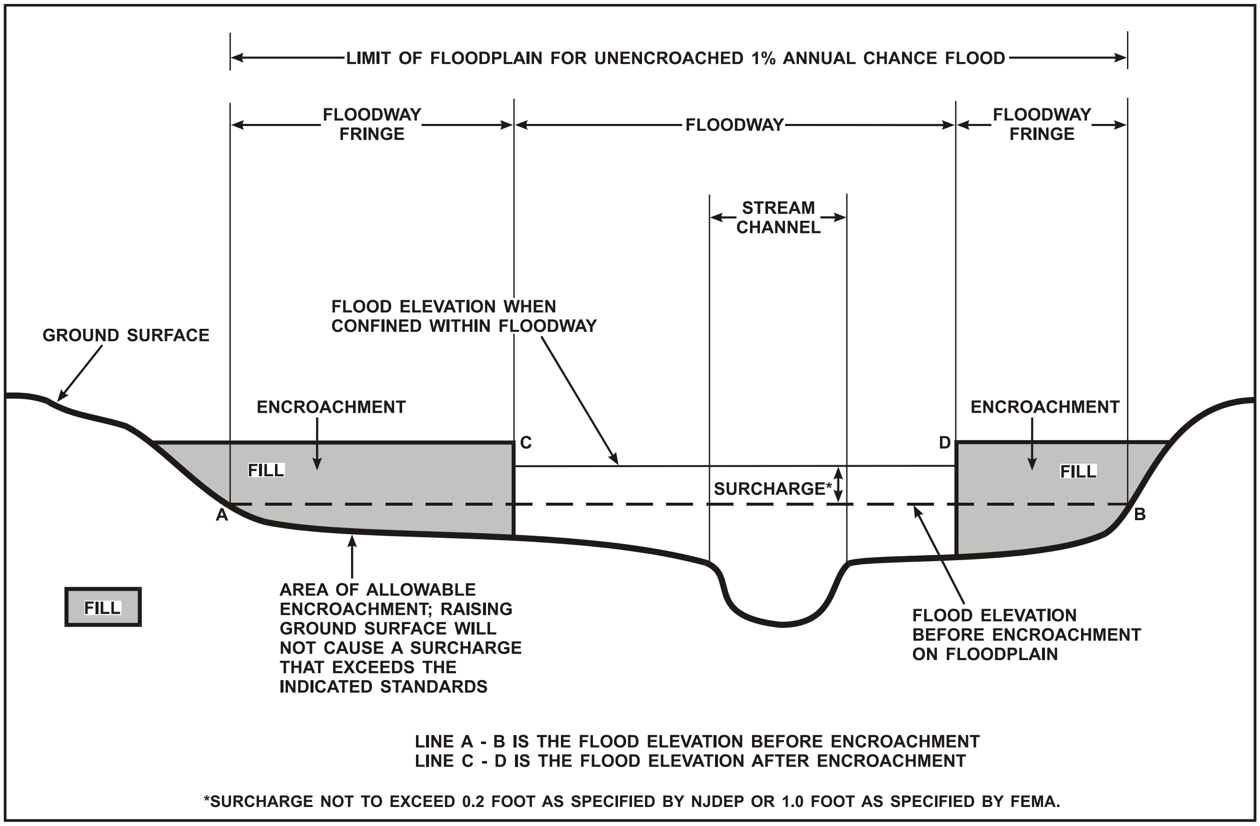
FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

WOODBURY CREEK

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 by more than 0.2 feet at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3.



FLOODWAY SCHEMATIC Figure 3

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. The zones are as follows:

Zone A

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

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. 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.

Zone D

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

6.0 FLOOD INSURANCE RATE MAP

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

For flood insurance applications, the map designates flood insurance 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 the 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 current FIRM presents flooding information for the entire geographic area of Gloucester County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone incorporated community and the unincorporated areas of the county. 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 11, "Community Map History."

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Gloucester County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all of the incorporated areas within Gloucester County.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Clayton, Borough of	August 31, 1973	April 1, 1977	March 11, 1983	
Deptford, Township of	August 9, 1974	July 23, 1976	November 17, 1982	
East Greenwich, Township of	September 6, 1974	July 23, 1976	December 1, 1982	
Elk, Township of	June 28, 1974	September 24, 1976	October 21, 1983	
Franklin, Township of	September 13, 1974	August 13, 1976	February 3, 1982	
Glassboro, Borough of	June 28, 1974	July 23, 1976	August 16, 1982	
Greenwich, Township of	January 23, 1974	November 25, 1977	September 16, 1982	February 15, 1984 November 18, 1988
Harrison, Township of	July 26, 1974	October 3, 1975	April 1, 1983	
Logan, Township of	September 13, 1974	November 28, 1975 December 30, 1977	January 6, 1983	
Mantua, Township of	March 22, 1974	August 6, 1976	November 3, 1982	
Monroe, Township of	September 20, 1974	June 25, 1976	January 20, 1982	
National Park, Borough of	April 12, 1974	June 25, 1976 June 3, 1977	September 2, 1982	
Newfield, Borough of	July 1, 1977	None	June 17, 1991	

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Paulsboro, Borough of	August 9, 1974	July 23, 1976	September 2, 1982	
Pitman, Borough of	March 15, 1974	June 18, 1976	April 1, 1983	
South Harrison, Township of	June 28, 1974	July 2, 1976	December 17, 1991	
Swedesboro, Borough of	November 1, 1974	May 28, 1976	July 5, 1982	
Washington, Township of	May 31, 1974	June 11, 1976	November 17, 1982	
Wenonah, Borough of	March 29, 1974	None	May 11, 1979	
West Deptford, Township of	March 8, 1974	July 15, 1977	June 1, 1982	
Westville, Borough of	March 8, 1974	August 6, 1976	May 1, 1980	
Woodbury, City of	July 16, 1976	None	May 11, 1979	
Woodbury Heights, Borough of	February 21, 1975	None	May 18, 1979	
Woolwich, Township of	April 5, 1974	September 3, 1976	September 2, 1982	

TABLE 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting the Flood Insurance and Mitigation Division of the Federal Emergency Management Agency, Region II Office, 26 Federal Plaza, Room 1337, New York, New York 10278.

9.0 BIBLIOGRAPHY AND REFERENCES

D. C. Johnstone and W. P. Cross. (1949). Elements of Applied Hydrology. New York, New York. Ronald Press Company.

Dean, R., Collins, I., Divoky, D., Hatheway, D., and Scheffner, N. (2005) FEMA Coastal Flood Hazard Analysis and Mapping Guidelines Focused Study Report: Wave Setup. FEMA.

Delaware River Basin Commission. Recent Flooding Events in the Delaware River Basin.

Dennis G. Milbert, Ph.D. (May 12, 1999). National Geodetic Survey (NGS) Height Conversion Methodology. U.S. Geological Survey.

Federal Emergency Management Agency. (February 2007). Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update, Final Draft. Washington, D.C.

Federal Emergency Management Agency. (December 17, 1991, Flood Insurance Rate Map; December 17, 1991, Flood Insurance Study report). Flood Insurance Study, Township of South Harrison, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (June 17, 1991, Flood Insurance Rate Map; June 17, 1991, Flood Insurance Study report). Flood Insurance Study, Borough of Newfield, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (November 18, 1988, Flood Insurance Rate Map; November 18, 1988, Flood Insurance Study report). Flood Insurance Study, Township of Greenwich, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (October 21, 1983, Flood Insurance Rate Map). Flood Insurance Study, Township of Elk, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (April 1, 1983, Flood Insurance Rate Map). Flood Insurance Study, Township of Harrison, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (April 1, 1983, Flood Insurance Rate Map). Flood Insurance Study, Borough of Pitman, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (March 11, 1983, Flood Insurance Rate Map). Flood Insurance Study, Borough of Clayton, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (January 6, 1983, Flood Insurance Rate Map; July 6, 1982, Flood Insurance Study report). Flood Insurance Study, Township of Logan, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (December 1, 1982, Flood Insurance Rate Map; June 1, 1982, Flood Insurance Study report). Flood Insurance Study, Township of East Greenwich, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (November 17, 1982, Flood Insurance Rate Map; May 17, 1982, Flood Insurance Study report). Flood Insurance Study, Township of Deptford, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (November 17, 1982, Flood Insurance Rate Map; May 17, 1982, Flood Insurance Study report). Flood Insurance Study, Township of Washington, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (November 3, 1982, Flood Insurance Rate Map; May 3, 1982, Flood Insurance Study report). Flood Insurance Study, Township of Mantua, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (September 2, 1982, Flood Insurance Rate Map; March 2, 1982, Flood Insurance Study report). Flood Insurance Study, Borough of National Park, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (September 2, 1982, Flood Insurance Rate Map; March 2, 1982, Flood Insurance Study report). Flood Insurance Study, Borough of Paulsboro, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (September 2, 1982, Flood Insurance Rate Map; March 2, 1982, Flood Insurance Study report). Flood Insurance Study, Township of Woolwich, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (August 16, 1982, Flood Insurance Rate Map; February 16, 1982, Flood Insurance Study report). Flood Insurance Study, Borough of Glassboro, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (July 5, 1982, Flood Insurance Rate Map; January 5, 1982, Flood Insurance Study report). Flood Insurance Study, Borough of Swedesboro, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (July 5, 1982, Flood Insurance Rate Map; January 5, 1982, Flood Insurance Study report). Flood Insurance Study, City of Vineland, Cumberland County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (June 1, 1982, Flood Insurance Rate Map; December 1, 1981, Flood Insurance Study report). Flood Insurance Study, Township of West Deptford, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (February 3, 1982, Flood Insurance Rate Map; August 3, 1981, Flood Insurance Study report). Flood Insurance Study, Township of Franklin, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (January 20, 1982, Flood Insurance Rate Map; July 20, 1981, Flood Insurance Study report). Flood Insurance Study, Township of Monroe, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (May 1, 1980, Flood Insurance Rate Map; November 1, 1979, Flood Insurance Study report). Flood Insurance Study, Borough of Westville, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (May 18, 1979, Flood Insurance Rate Map). Flood Insurance Study, Borough of Woodbury Heights, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (May 11, 1979, Flood Insurance Rate Map). Flood Insurance Study, Borough of Wenonah, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency. (May 11, 1979, Flood Insurance Rate Map). Flood Insurance Study, City of Woodbury, Gloucester County, New Jersey. Washington, D.C.

Federal Emergency Management Agency, Federal Insurance Administration. (December 15, 1978). Flood Insurance Study, City of Philadelphia, Philadelphia County, Pennsylvania. Washington, D.C.

Federal Emergency Management Agency, Federal Insurance Administration. (Unpublished). Flood Insurance Study, City of Vineland, Cumberland County, New Jersey.

Federal Emergency Management Agency. (2007). Supplementary WHAFIS Documentation, WHAFIS 4.0. Atlanta, Georgia.

Luettich, R.A. and Westerink, J.J. (February 6, 2008). A (Parallel) Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC). Version 45.12. University of North Carolina at Chapel Hill, Institute of Marine Sciences. Morehead City, North Carolina.

Maintenance of Variance Extension (MOVE.2).

National Academy of Sciences. (1977). Methodology for Calculating Wave Action Effects Associated with Storm Surges. Washington, D.C.

National Oceanic and Atmospheric Administration, Storm Events Database, Version 3.0, National Climatic Data Center (March 2014) http://www.ncdc.noaa.gov/stormevents/

New Jersey Department of Environmental Protection. (August 1, 2003). Census Tracts in New Jersey.

Robert M. Hirsch. (March 22, 1982). "A Comparison of Four Streamflow Record Extension Techniques. U.S. Geological Survey.

Soil Conservation Service. (1986). TR 55 "Urban Hydrology for Small Watersheds."

State of New Jersey, Department of Environmental Protection, Division of Water Resources, in cooperation with the U.S. Geological Survey. (1974). Special Report 38, Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization. Stephen J. Stankowski (author). Trenton, New Jersey.

U.S. Army Corps of Engineers, Engineer Research and Development Center, Coastal and Hydraulics Laboratory (ERDC/CHL). (July 2012). FEMA Region III Storm Surge Study, Coastal Storm Surge Analysis: Storm Surge Results, Intermediate Data Submittal No. 3 in Draft Form. Vicksburg, Mississippi.

U.S. Army Corps of Engineers, Galveston District. (June 1975). Guidelines for Identifying Coastal Hazard Areas.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (November 1976, Updated April 1980). HEC-2 Water-Surface Profiles, Generalized Computer Program. Davis, California.

U.S. Army Corps of Engineers, Philadelphia District. (undated). Generalized Skew Study for the State of New Jersey. Philadelphia, Pennsylvania.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (October 1977). Special Projects Memo 480, Generalized Skew Study for the State of New Jersey. Davis, California.

U.S. Army Corps of Engineers, Philadelphia District. (August 1977). Special Flood Hazard Report, Maurice River, Cumberland County, New Jersey. Philadelphia, Pennsylvania.

U.S. Army Corps of Engineers, Philadelphia District. (1976). Flood Plain Information, Mantua Creek, Gloucester County, New Jersey. Philadelphia, Pennsylvania.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (January 1973). HEC-1 Flood Hydrograph Package, Users Manual. Davis, California.

U.S. Army Corps of Engineers, Hydrologic Engineering Center. (April 1976). Special Projects Memo No. 459, Hydrologic Study Associated with Maurice River Floodplain Information and Maurice River Township Flood Insurance Study, Salem and Cumberland Counties, New Jersey. Davis, California.

U.S. Army Corps of Engineers, Philadelphia District. (November 1972). Flood Plain Information, Mantua Creek, Gloucester County, New Jersey. Philadelphia, Pennsylvania.

U.S. Army Corps of Engineers. Hydrologic Modeling Software HEC-1.

U.S. Army Corps of Engineers. HECRAS version 3.1.3, hydraulic modeling software. (2005)

U.S. Census Bureau. Census Report of 2010.

U.S. Department of Agriculture, Natural Resources Conservation Service, July 2010, South Jersey Levee Inventory USDA Natural Resources Conservation Service Assisting New Jersey Department of Environmental Protection. Somerset, New Jersey. 176 pp.

U.S. Department of Commerce, Weather Bureau. (July 1958). Technical Paper No. 29, Rainfall Intensity-Frequency Regime. Washington, D.C. U.S. Government Printing Office.

U.S. Department of the Interior, Geological Survey. (Unpublished). Annual Peak Flow Frequency Analysis Following Water Resources Council Guidelines. Trenton, New Jersey.

U.S. Department of the Interior, Geological Survey. (October 5, 2007). Summary of April 15-18, 2007 Flooding in New Jersey.

U.S. Department of the Interior, Geological Survey. (1989). Water-Data Report NJ-88-1, Water Resources Data for New Jersey, Water Year 1988, Volume 2. W. R. Bauersfield, E. W. Moshinsky, E. A. Pustay, and W. D. Jones (authors). Trenton, New Jersey.

U.S. Department of the Interior, Geological Survey, Hydrology Subcommittee. (March 1982). Guidelines for Determining Flood Flow Frequency, Bulletin #17B.

U.S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data. (Revised September 1981). Guidelines for Determining Flood Flow Frequency, Bulletin 17B. Reston, Virginia.

U.S. Department of the Interior, Geological Survey. (August 1978). Log-Pearson Type III Flood Frequency Analysis. Washington, D.C.

U.S. Department of the Interior, Geological Survey, in cooperation with the State of New Jersey. (1974). Special Report No. 38, "Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization.

U.S. Department of the Interior, Geological Survey. (1971). Professional Paper 750-C, Prediction Error of Regression Estimates of Streamflow Characteristics at Ungauged Sites. C. H. Hardison (author).

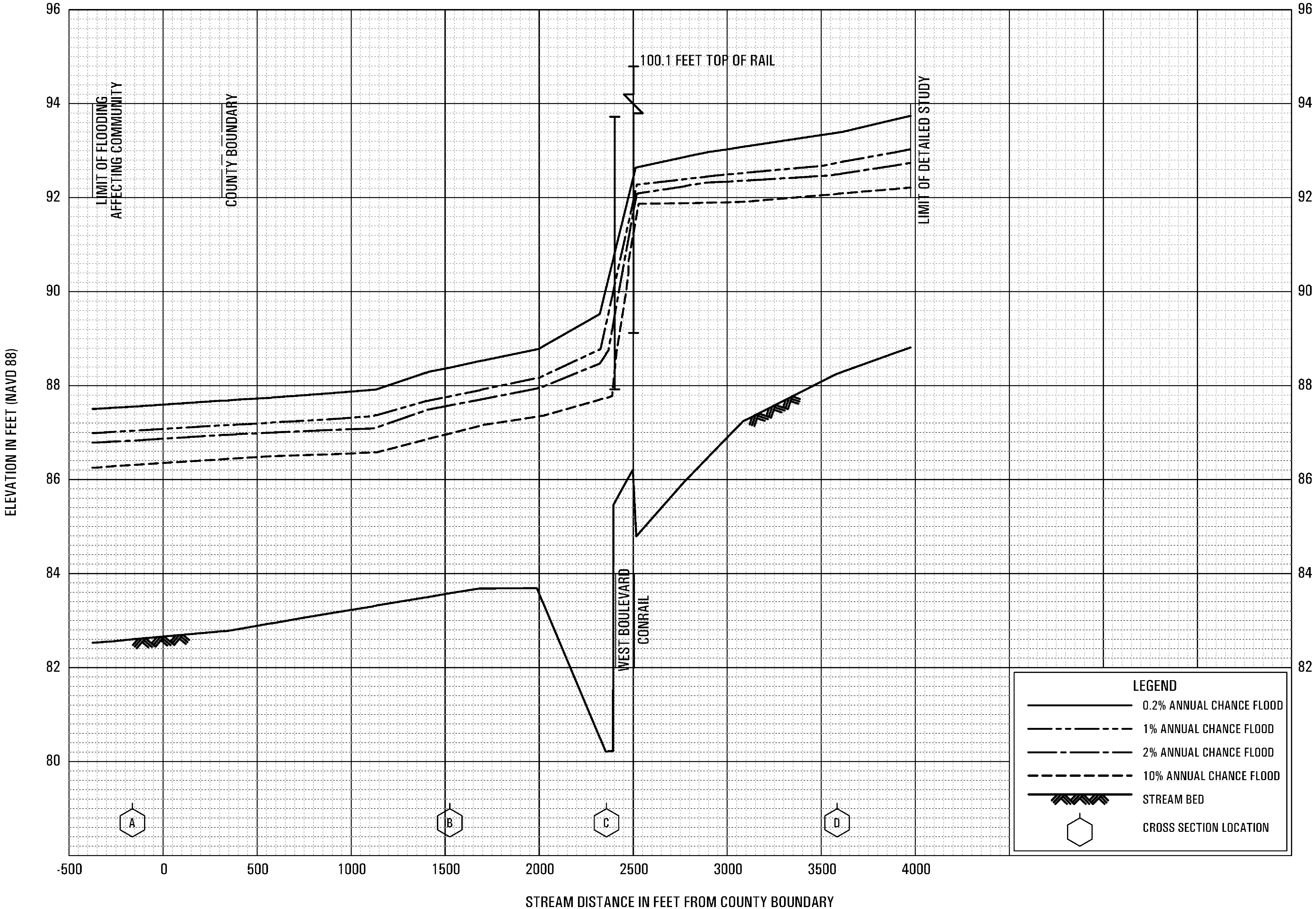
U.S. Department of the Interior, Geological Survey. (1967). Measurement of Peak Discharge at Dams by Indirect Methods, Techniques of Water Resources Investigations, Book 3, Chapter A5. Harry Hulsing (author).

U.S. Department of the Interior, Geological Survey. "Peak FQ," Annual Flood-Frequency Analysis Software Version 5.2.0.

U.S. House of Representatives, 88th Congress, 2nd Session. (1964). House Document 348, House Hurricane Study, Delaware River and Bay, Pennsylvania, New Jersey, and Delaware. Prepared by the U.S. Army Corps of Engineers. Washington, D.C.

Water Resources Council. (March 1976). Guidelines for Determining Flood Flow Frequency, Bulletin 17. Washington, D.C.

The Weather Channel. (Accessed September 2014) Monthly Averages for Woodbury, NJ. http://www.weather.com/weather/wxclimatology/monthly/graph/USNJ0572



FLOOD PROFILES

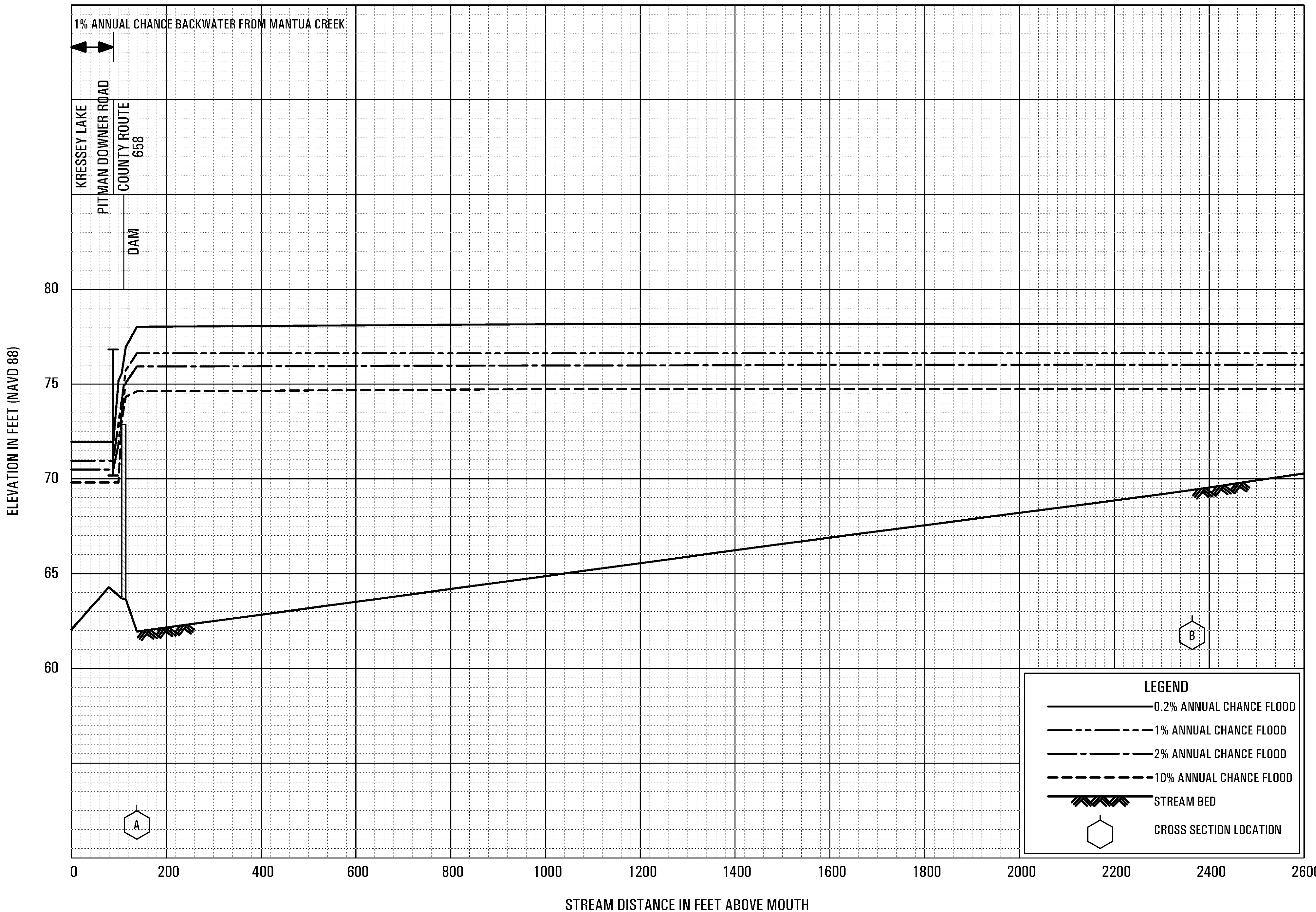
BURNT MILL BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

01P



FLOOD PROFILES

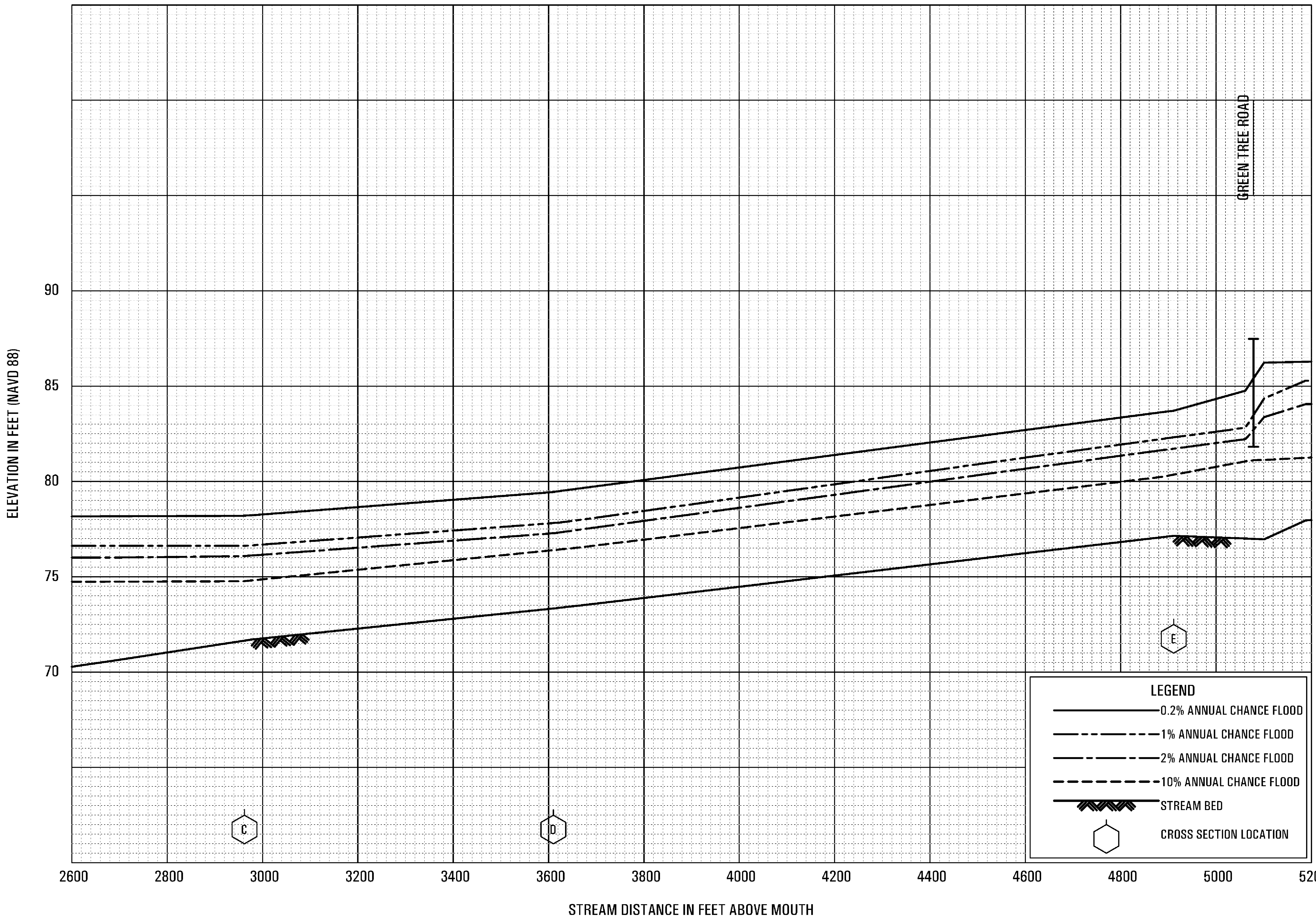
DUFFIELD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

02P



FLOOD PROFILES

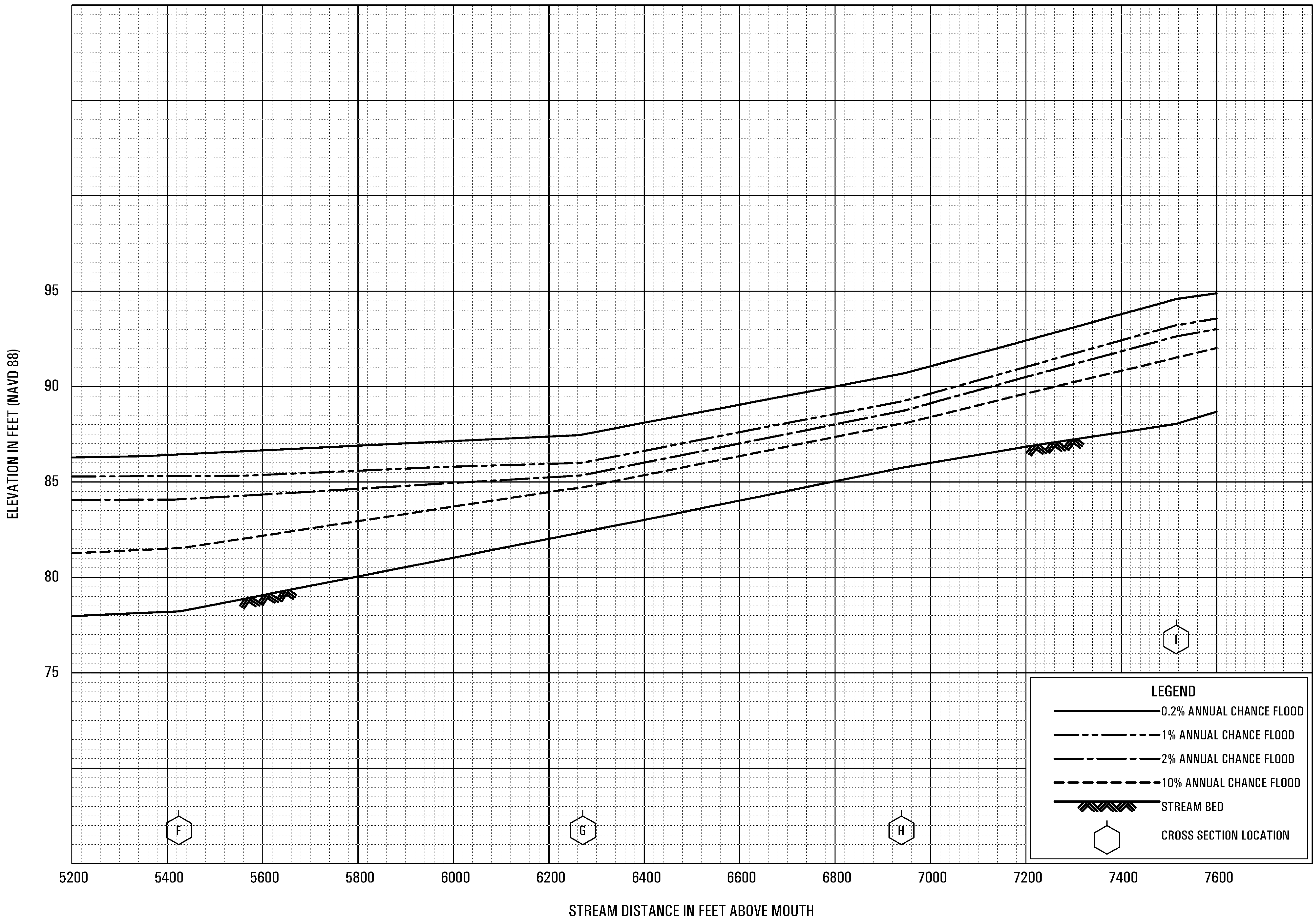
DUFFIELD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

03P



FLOOD PROFILES

DUFFIELD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

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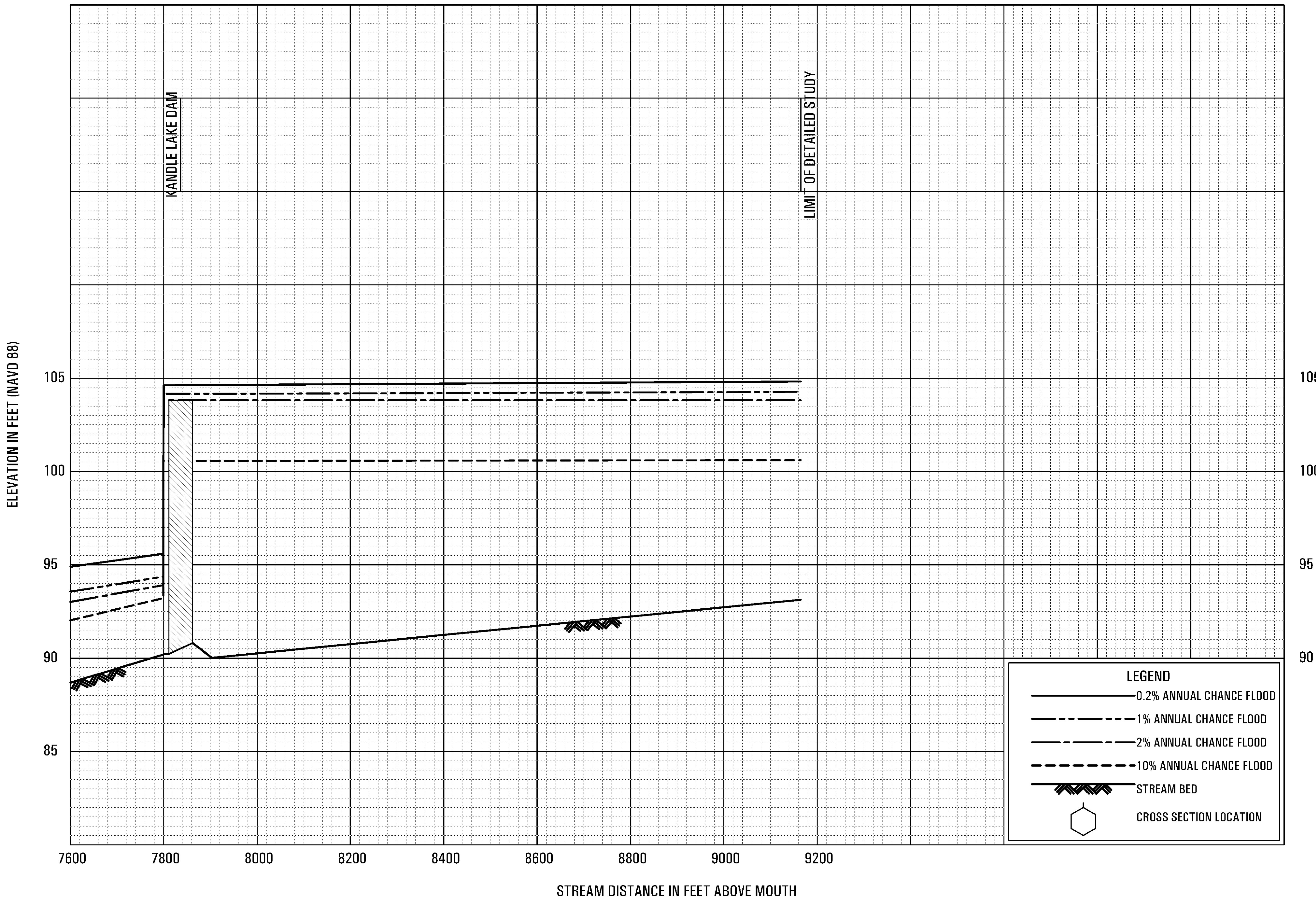


FLOOD PROFILES

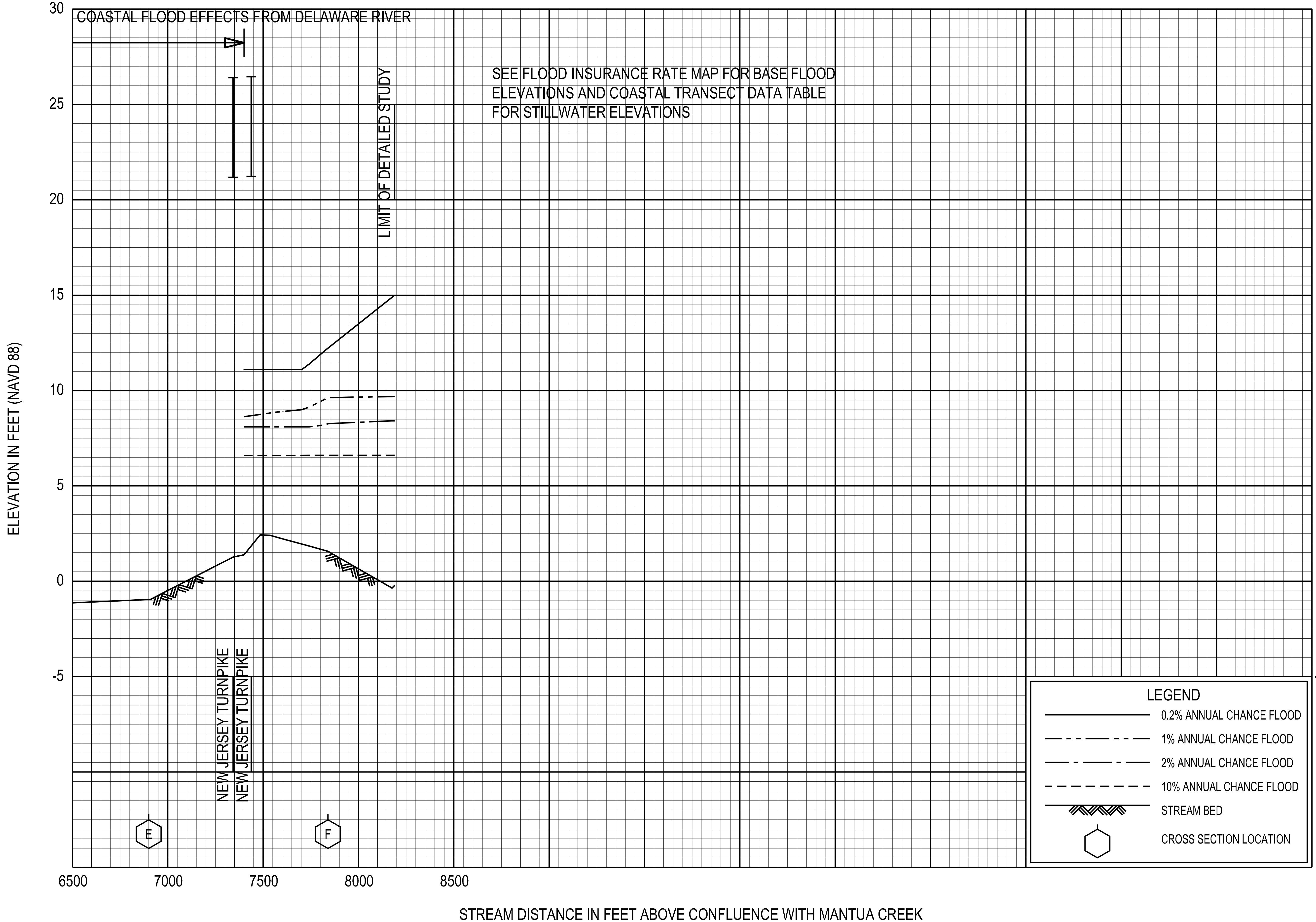
DUFFIELD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

05P



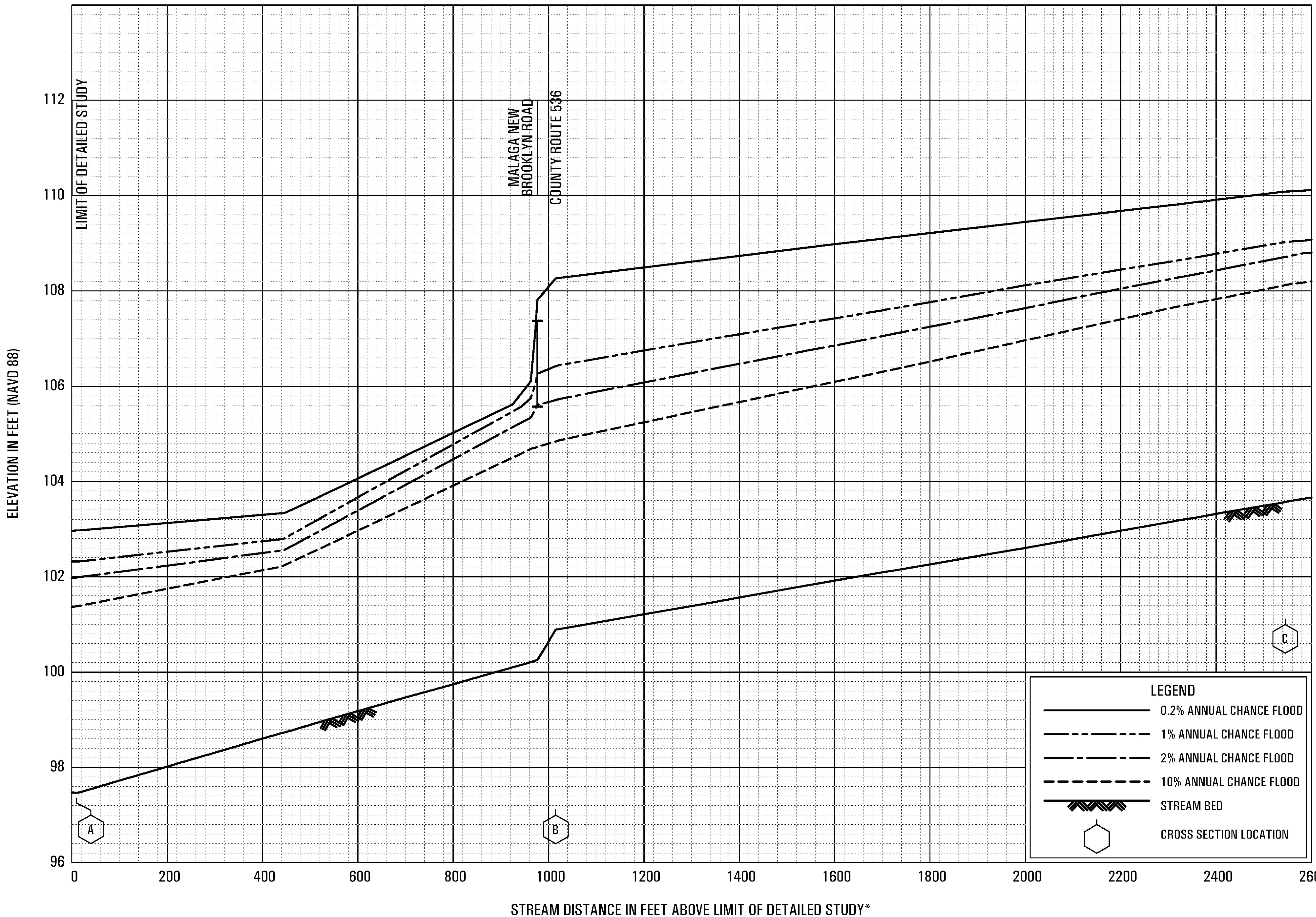
FLOOD PROFILES

EDWARDS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

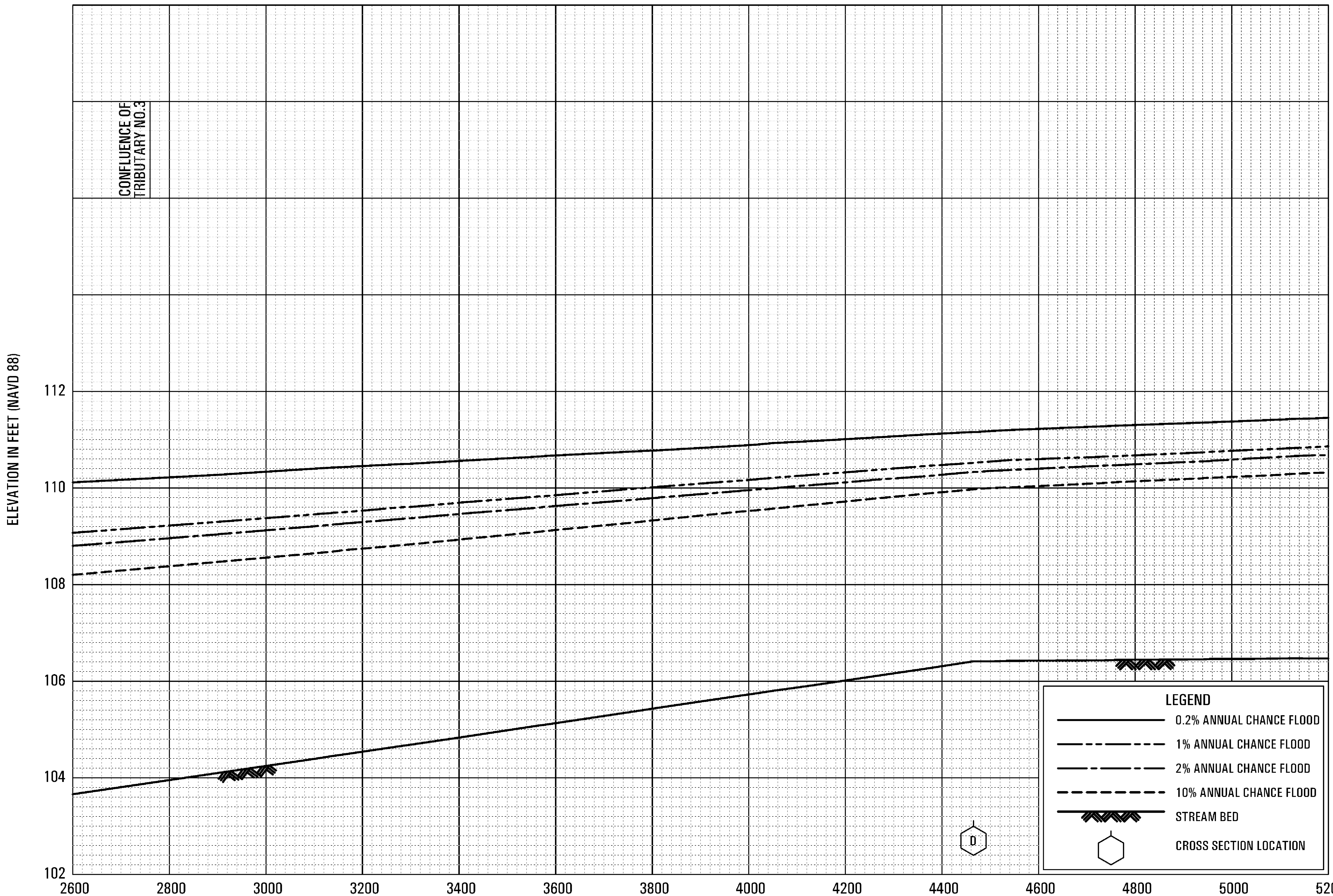
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



STREAM DISTANCE IN FEET ABOVE LIMIT OF DETAILED STUDY*
*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

FLOOD PROFILES

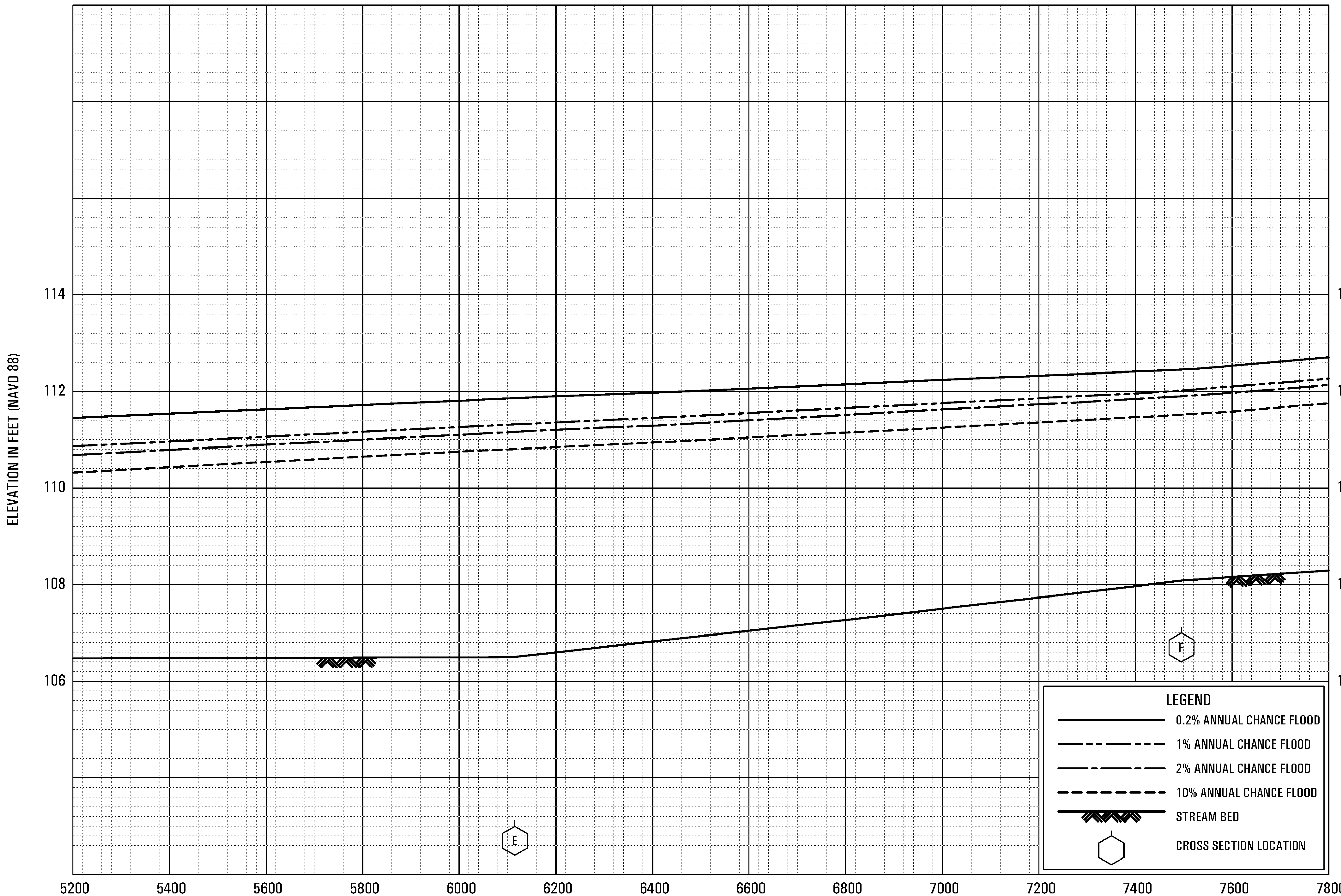
FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

08P



STREAM DISTANCE IN FEET ABOVE LIMIT OF DETAILED STUDY*

*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

FLOOD PROFILES

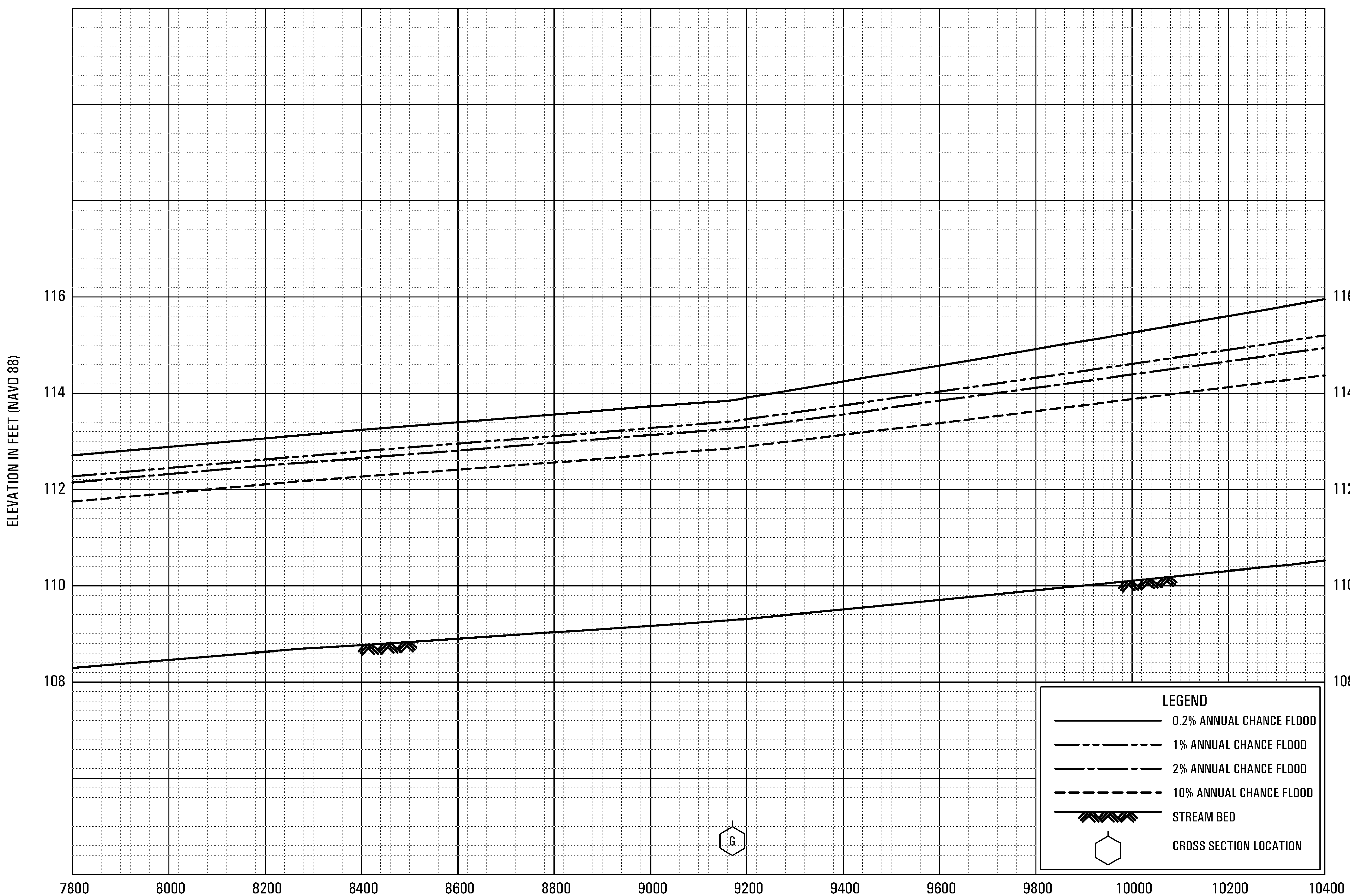
FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

09P



STREAM DISTANCE IN FEET ABOVE LIMIT OF DETAILED STUDY*

*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

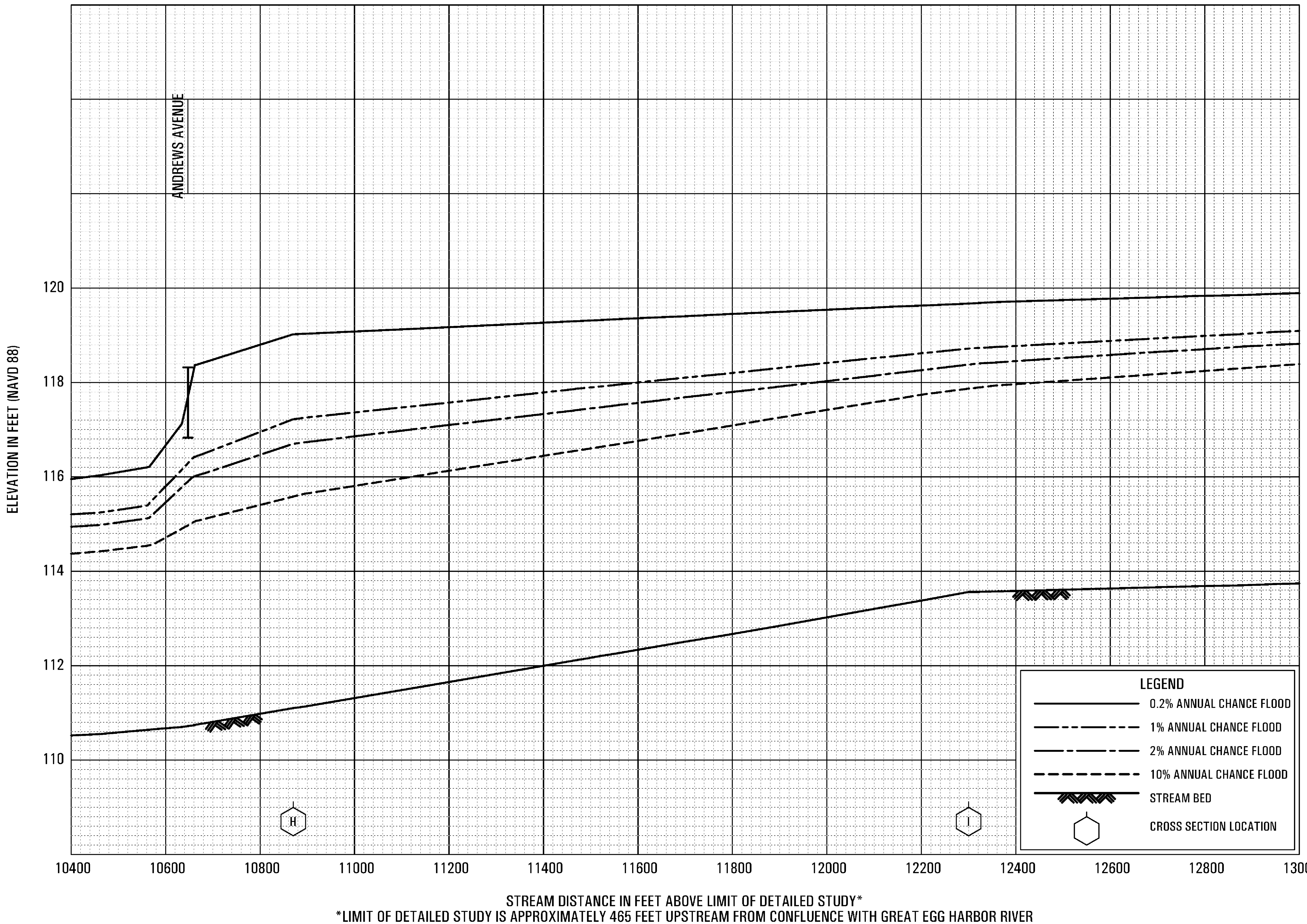
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



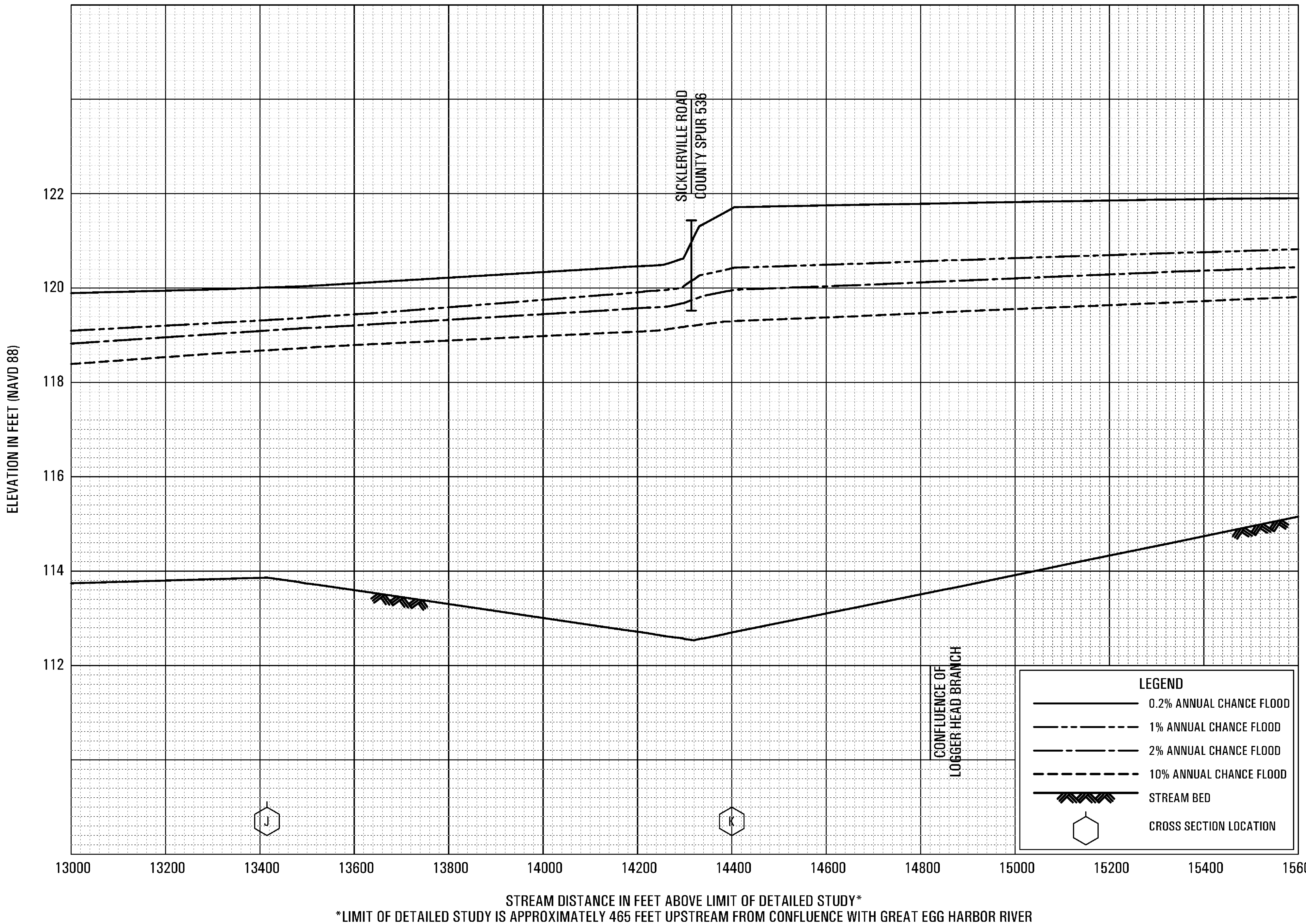
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



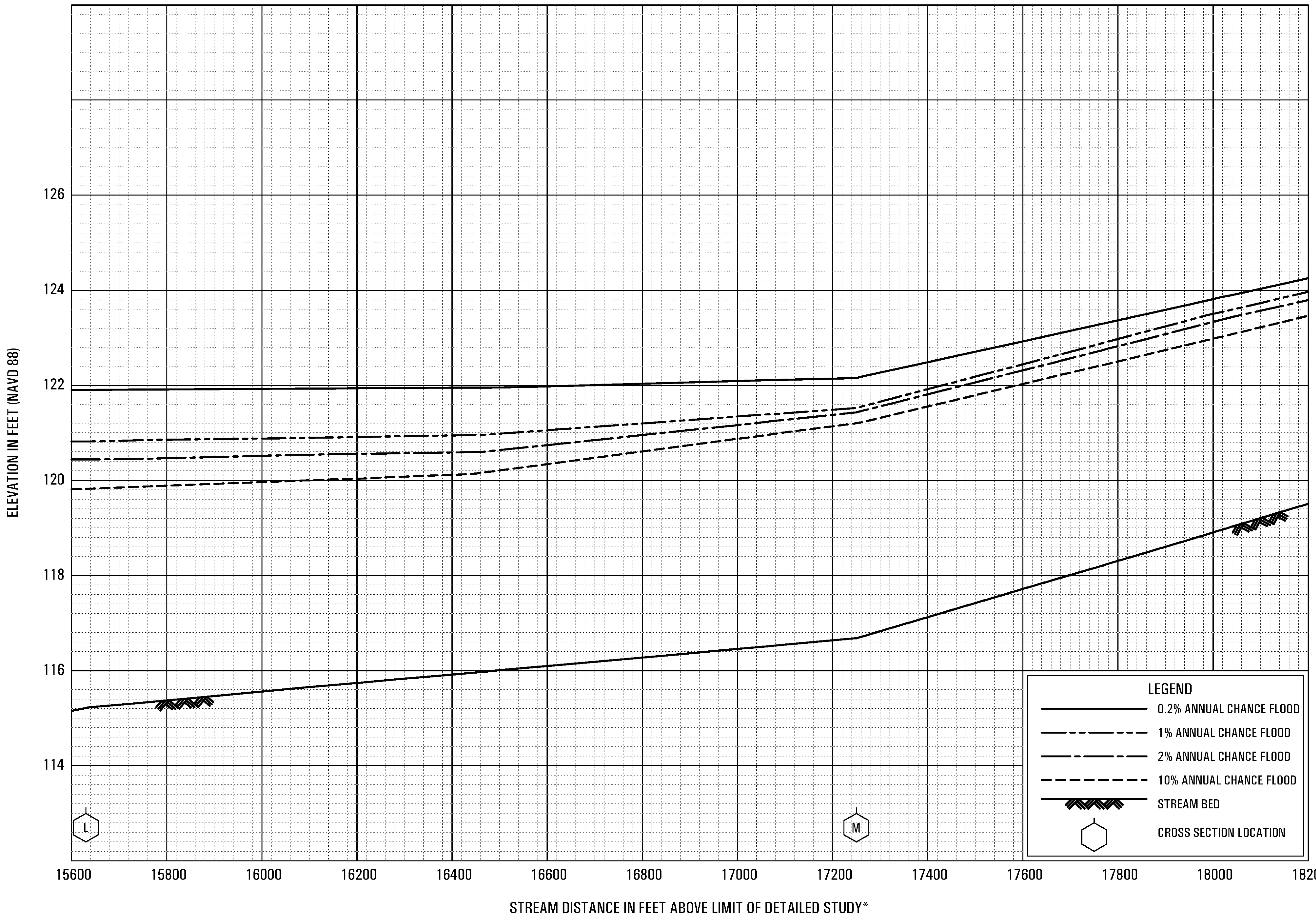
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

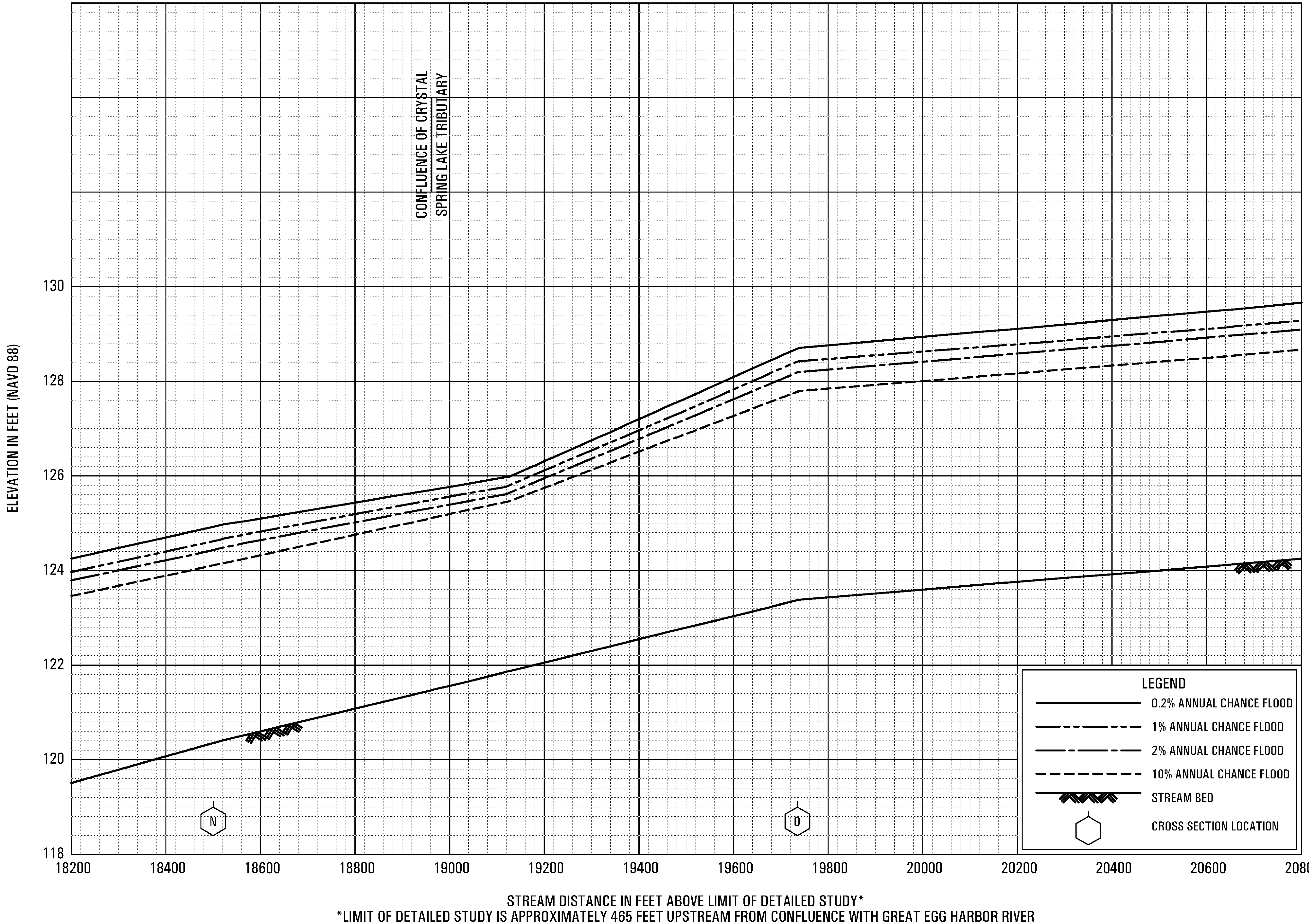
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



*LIMIT OF DETAILED STUDY IS APPROXIMATELY 465 FEET UPSTREAM FROM CONFLUENCE WITH GREAT EGG HARBOR RIVER

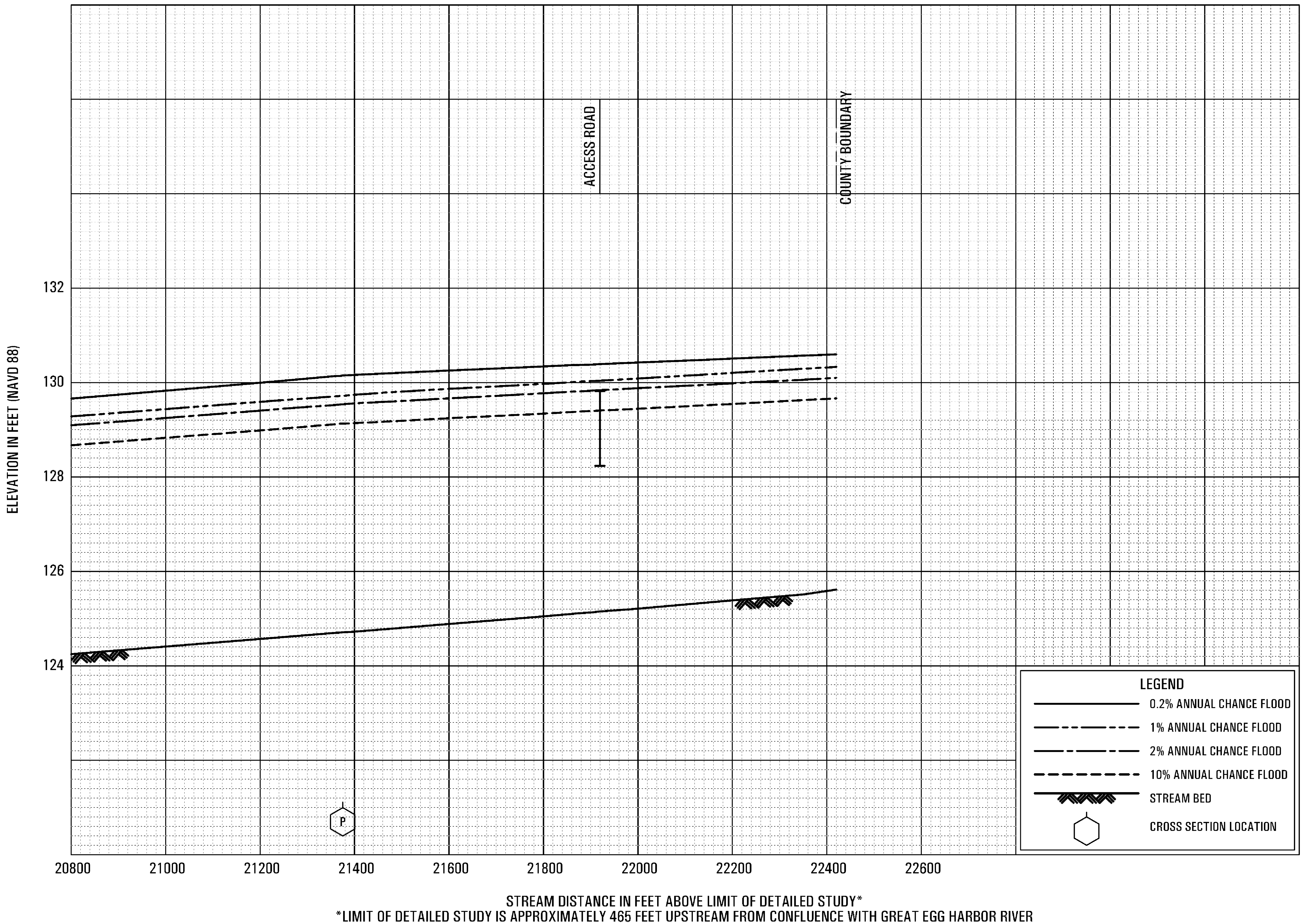
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



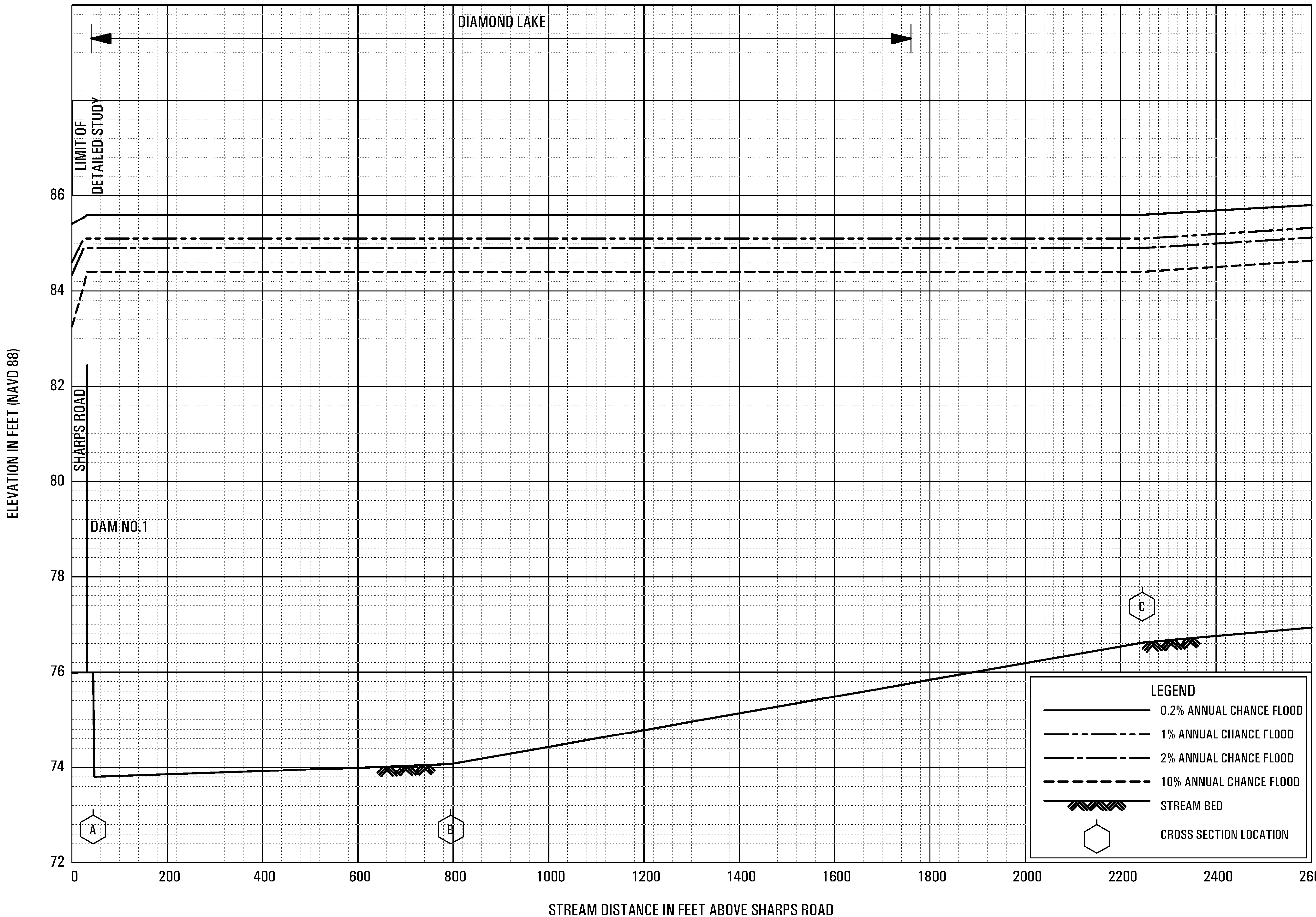
FLOOD PROFILES

FOURMILE BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

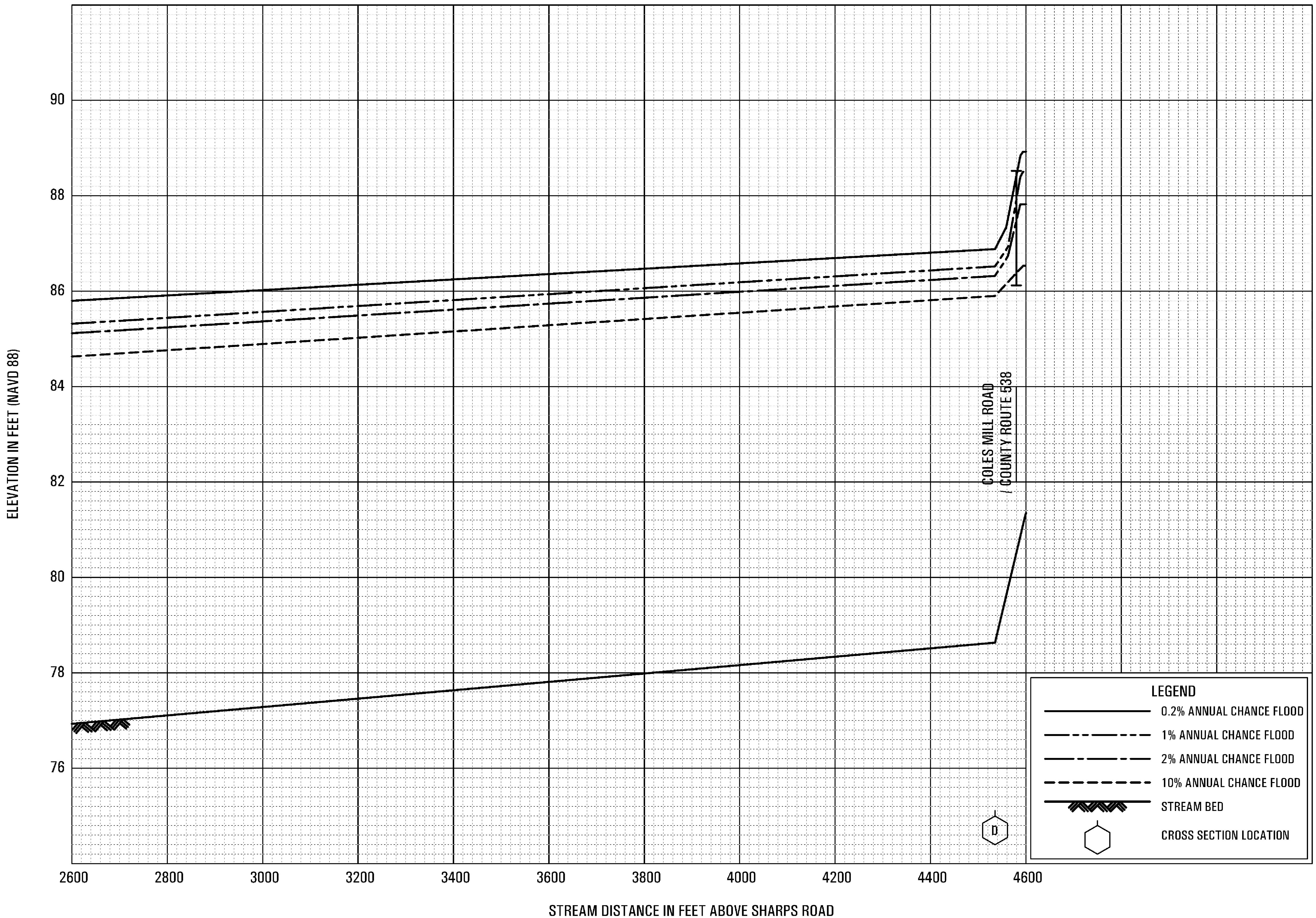
HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

16P



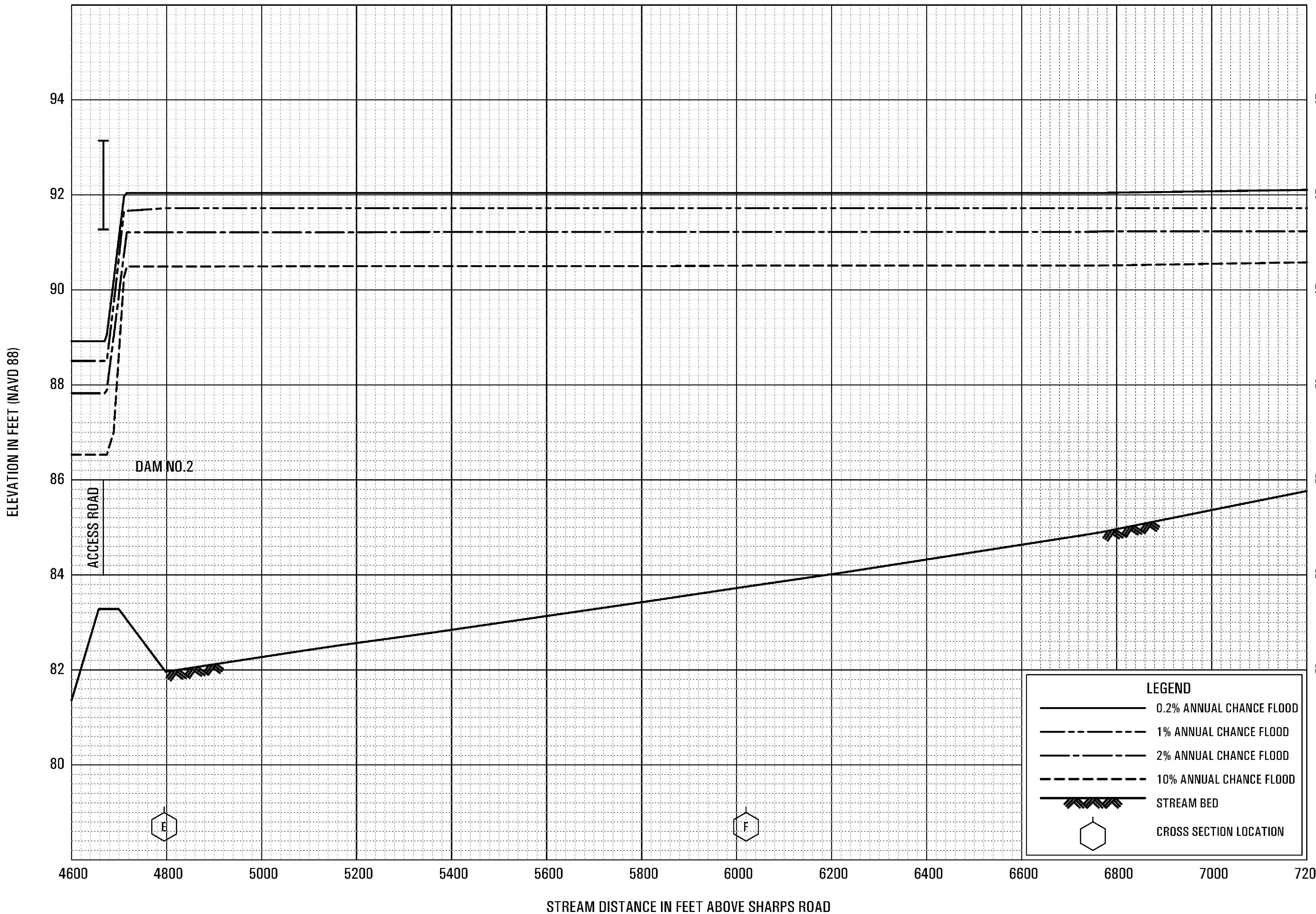
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



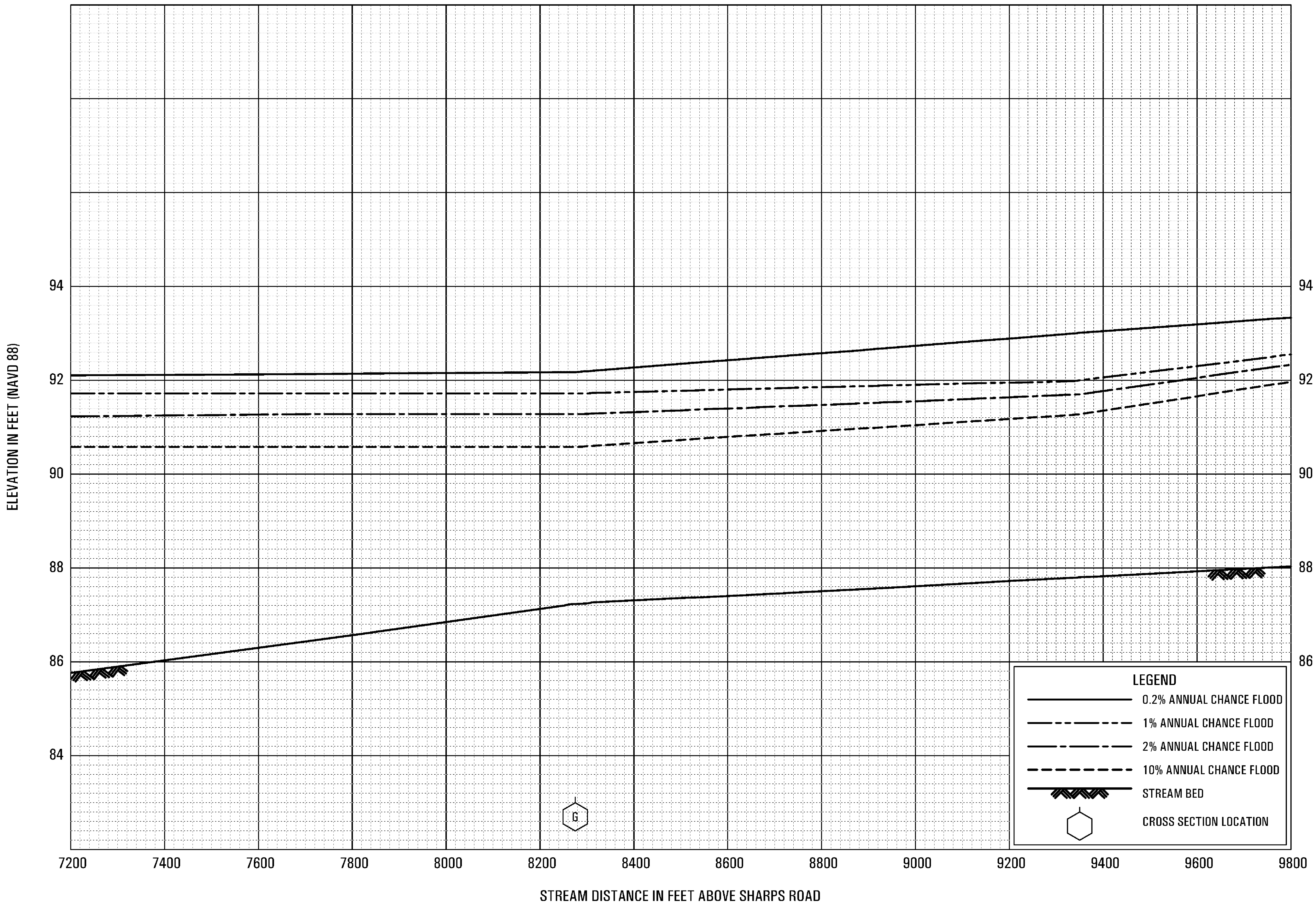
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



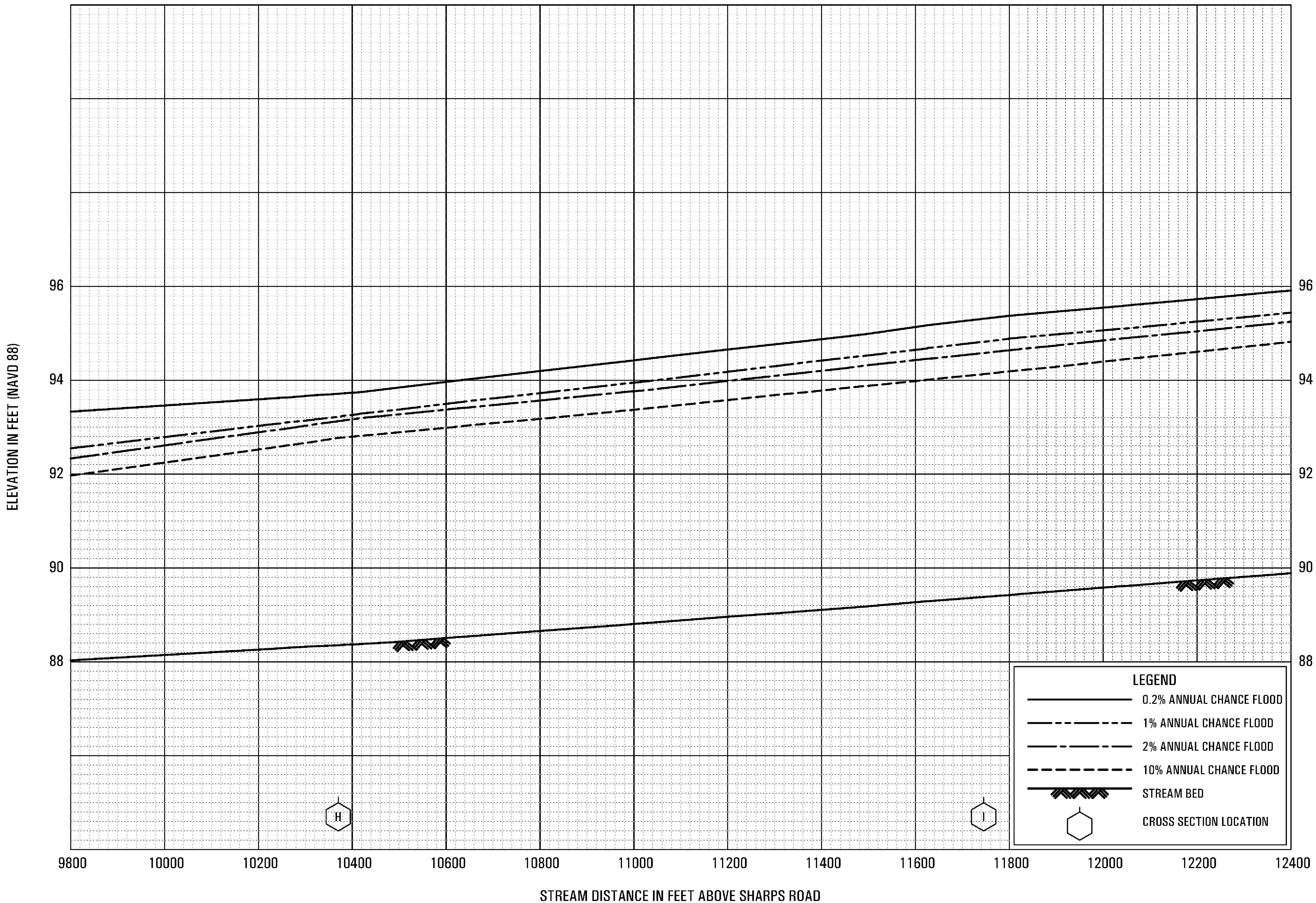
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



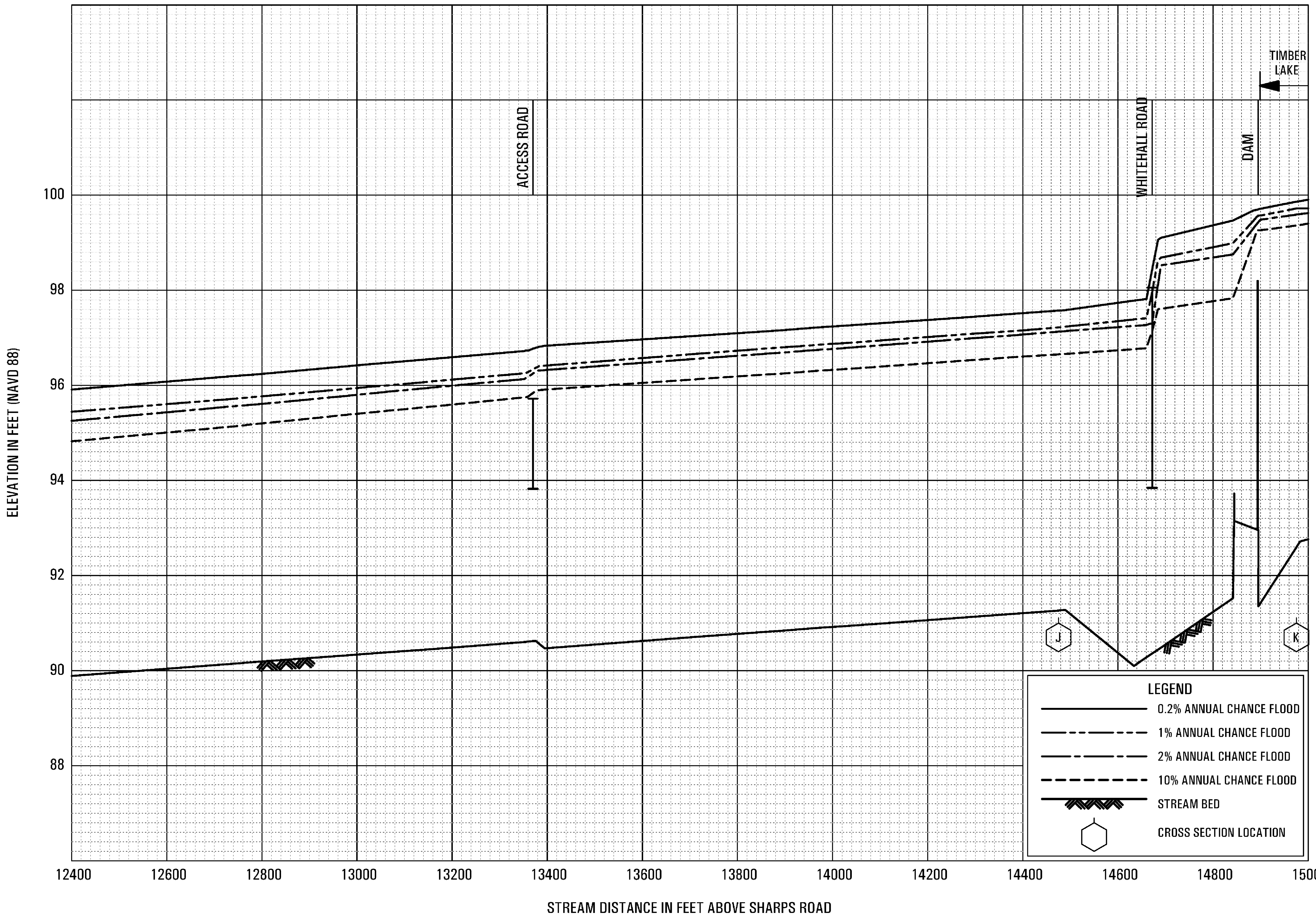
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



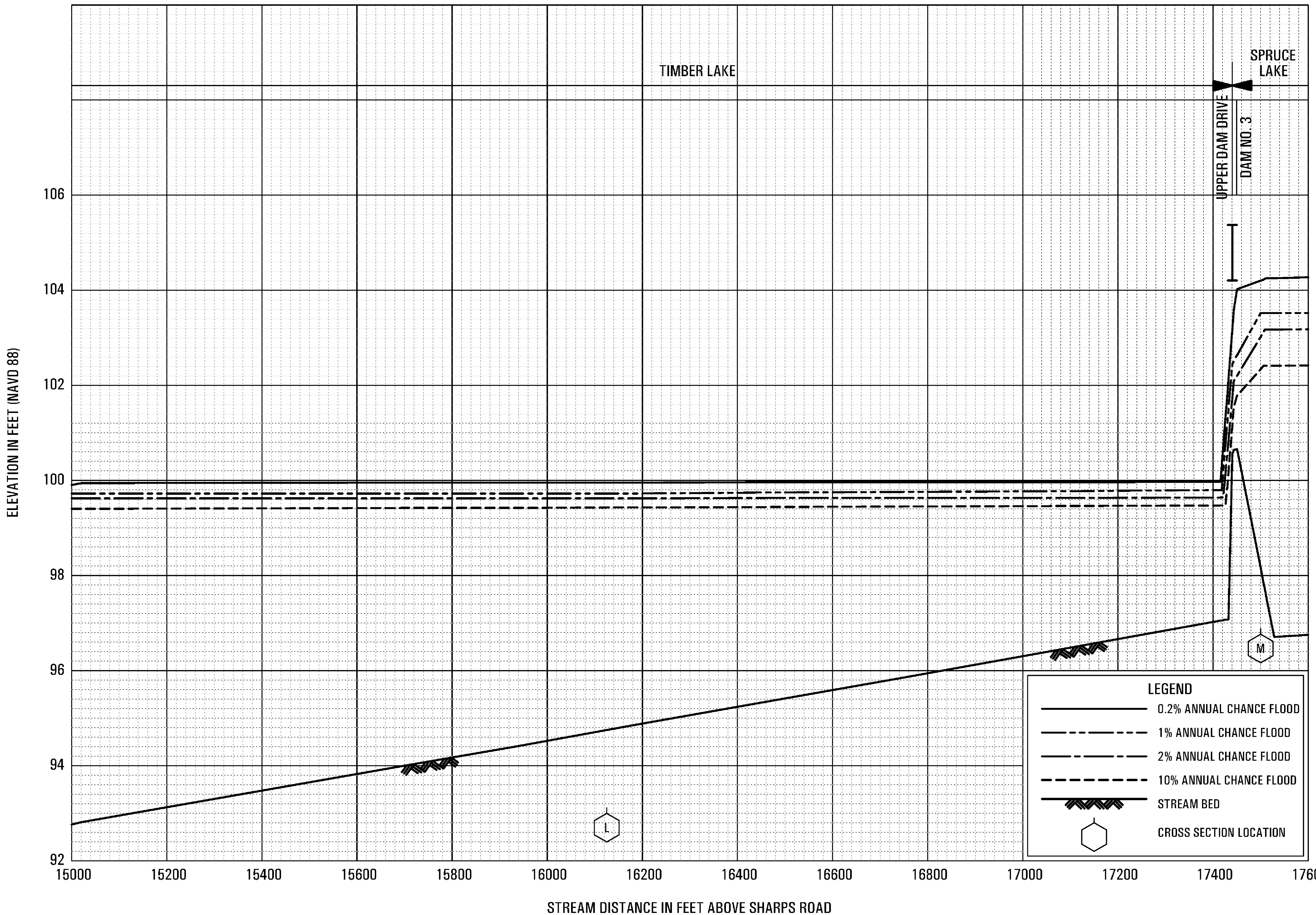
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



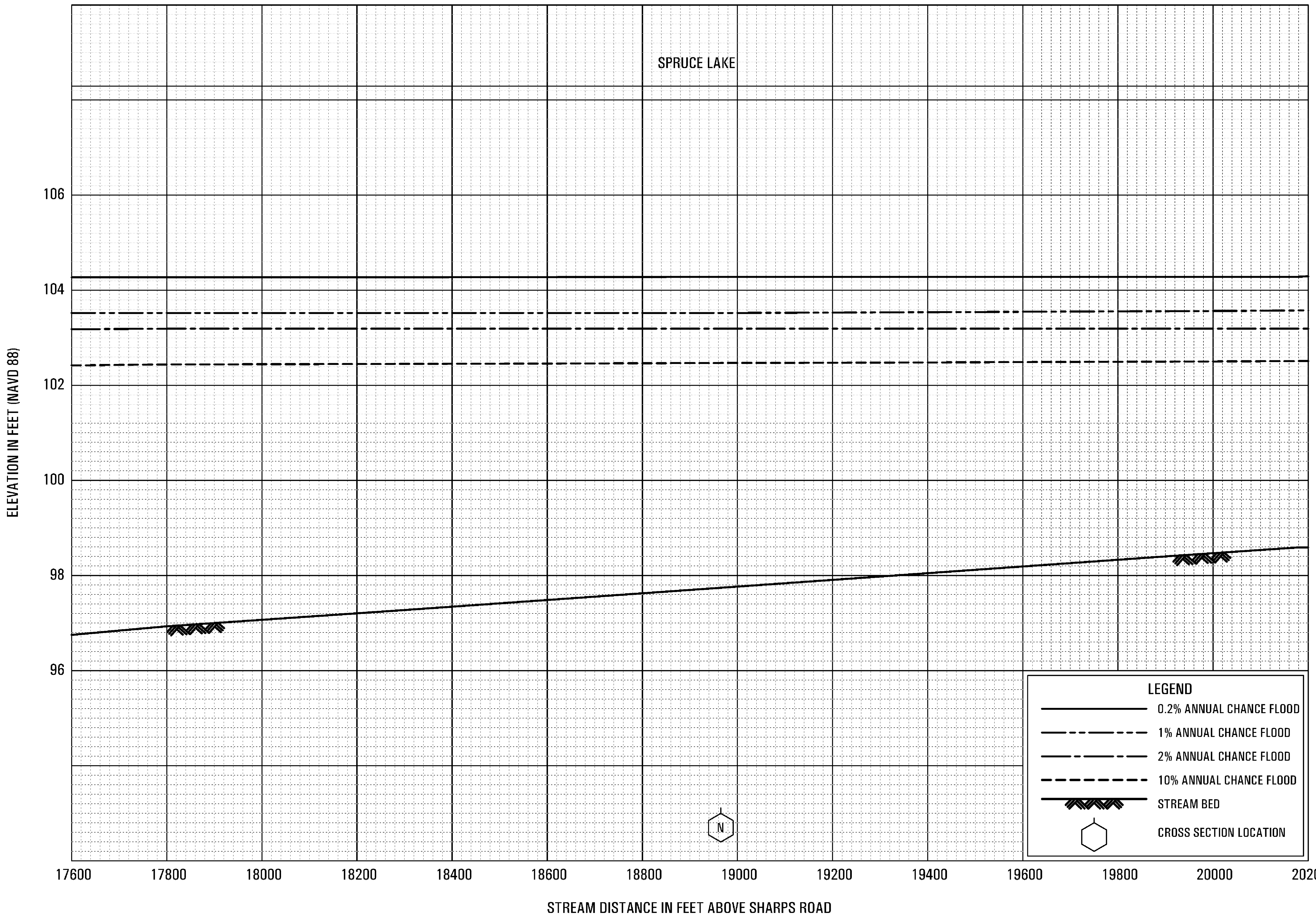
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



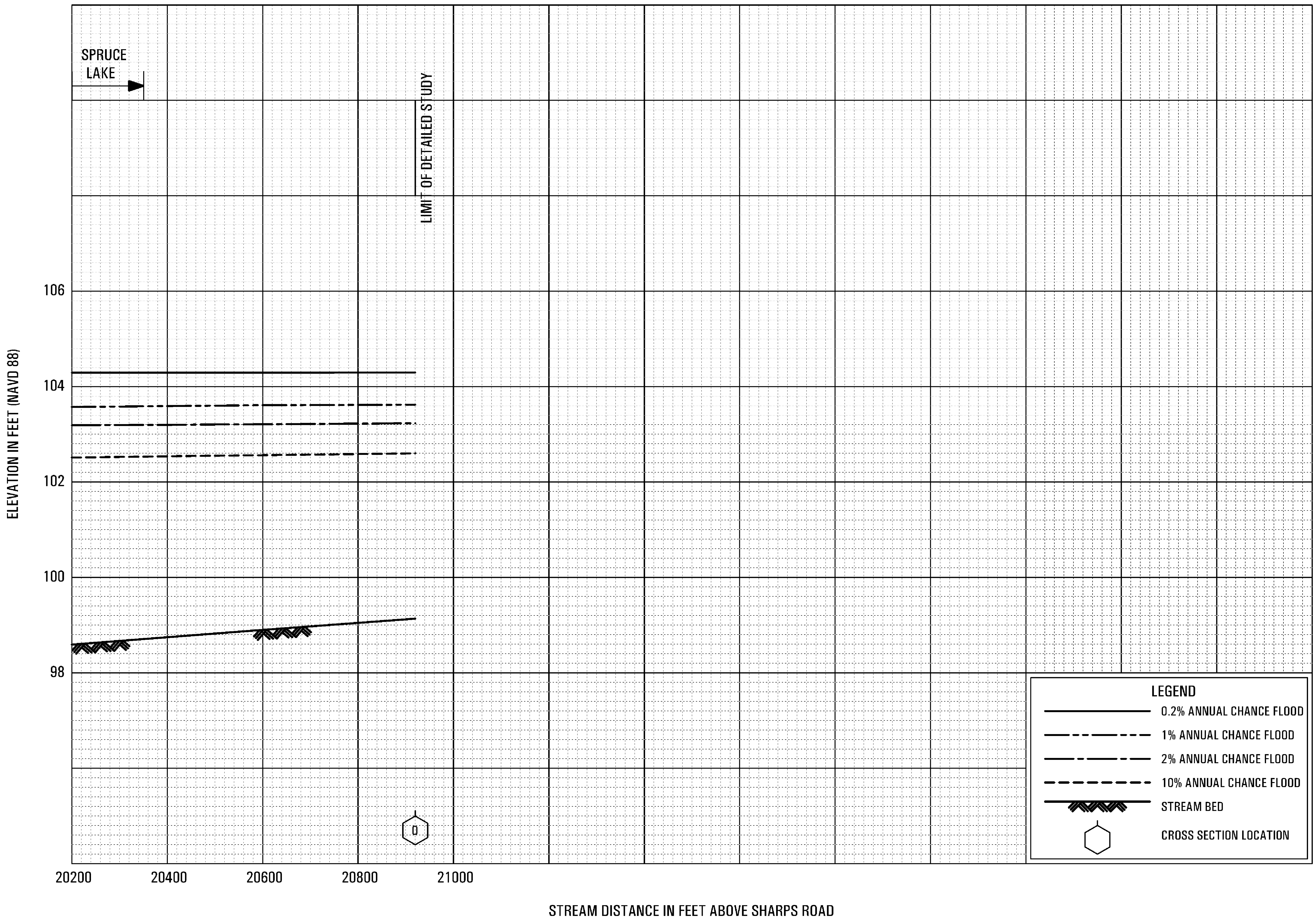
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



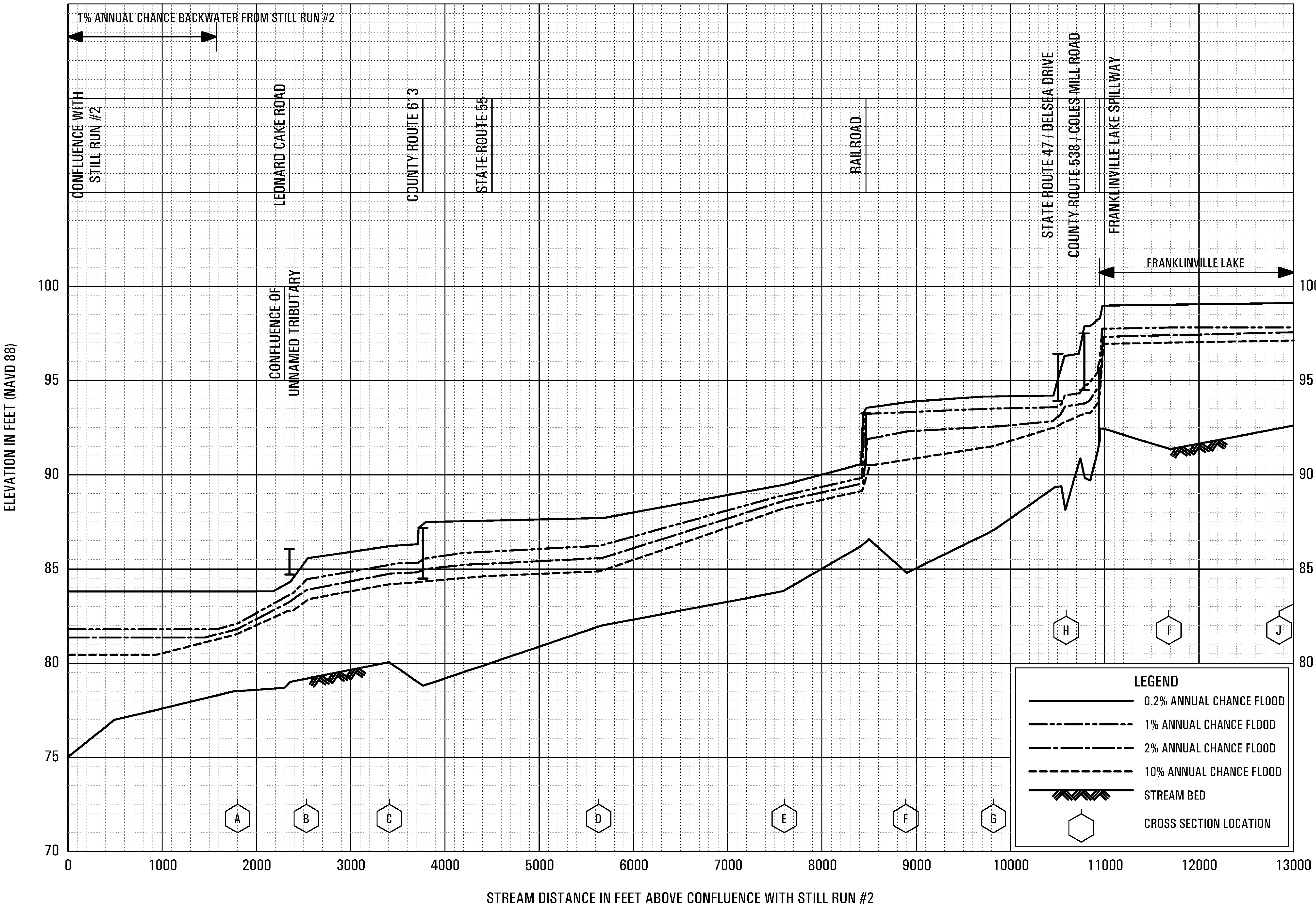
FLOOD PROFILES

HOSPITALITY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



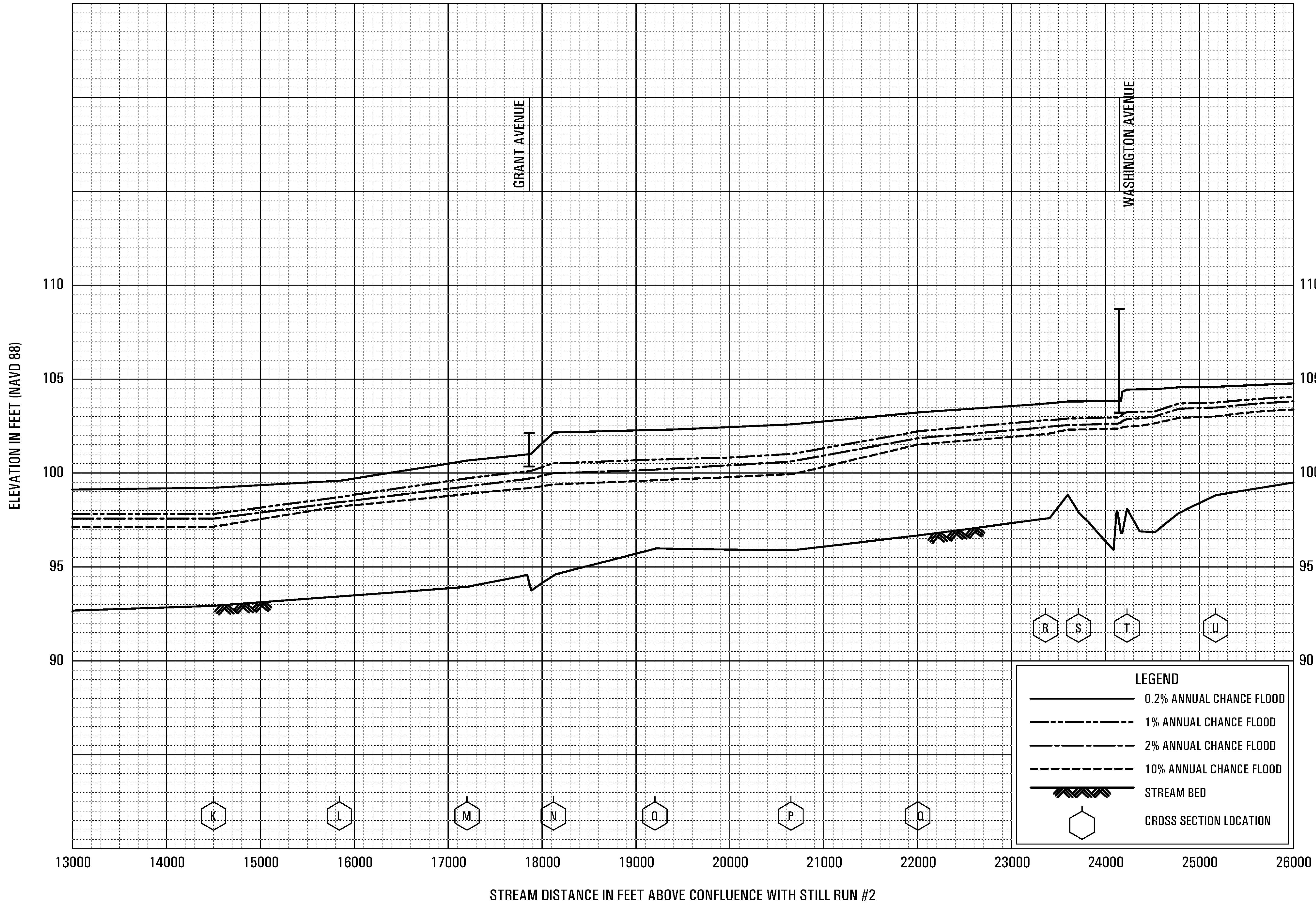
FLOOD PROFILES

LITTLE EASE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



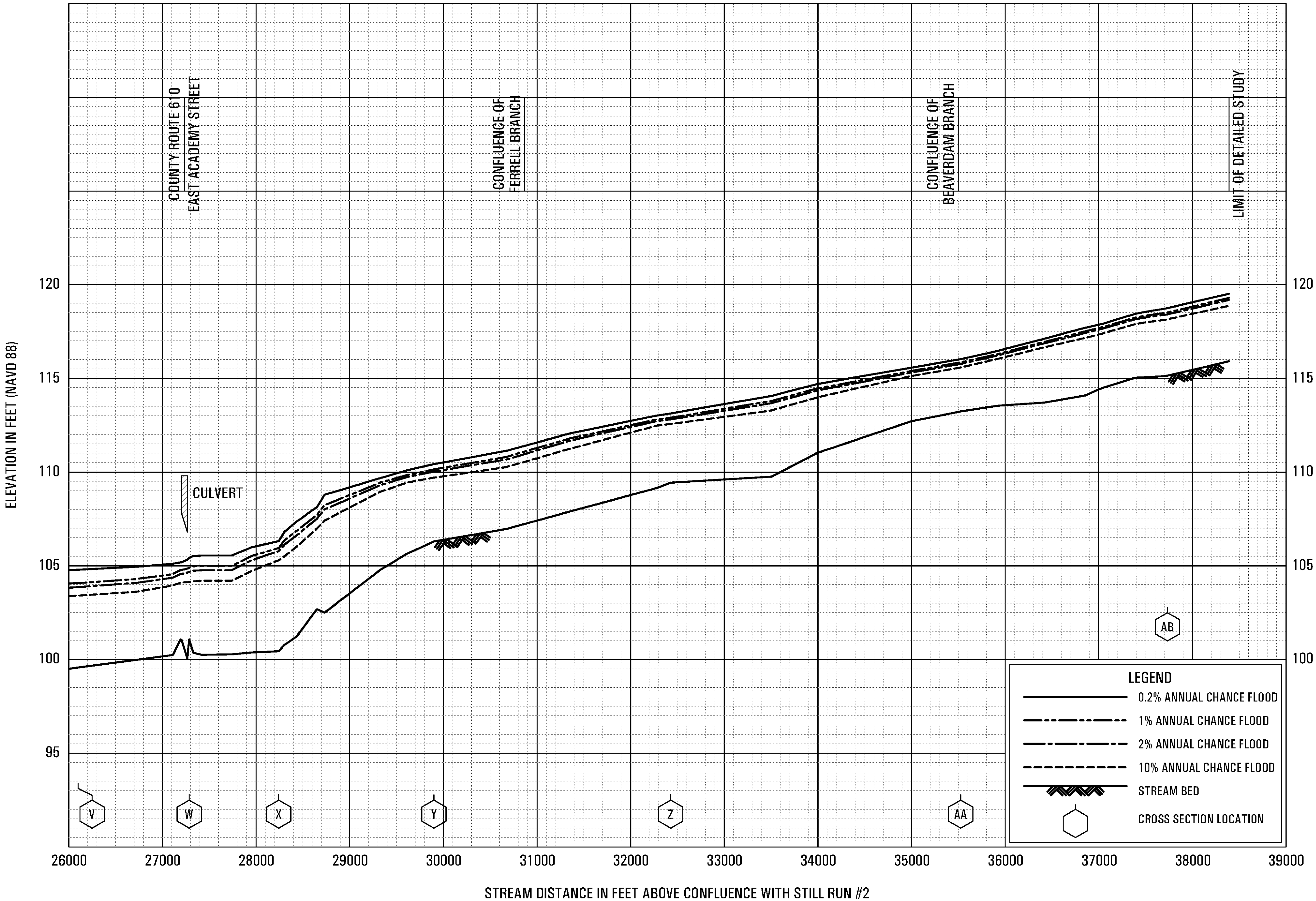
FLOOD PROFILES

LITTLE EASE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



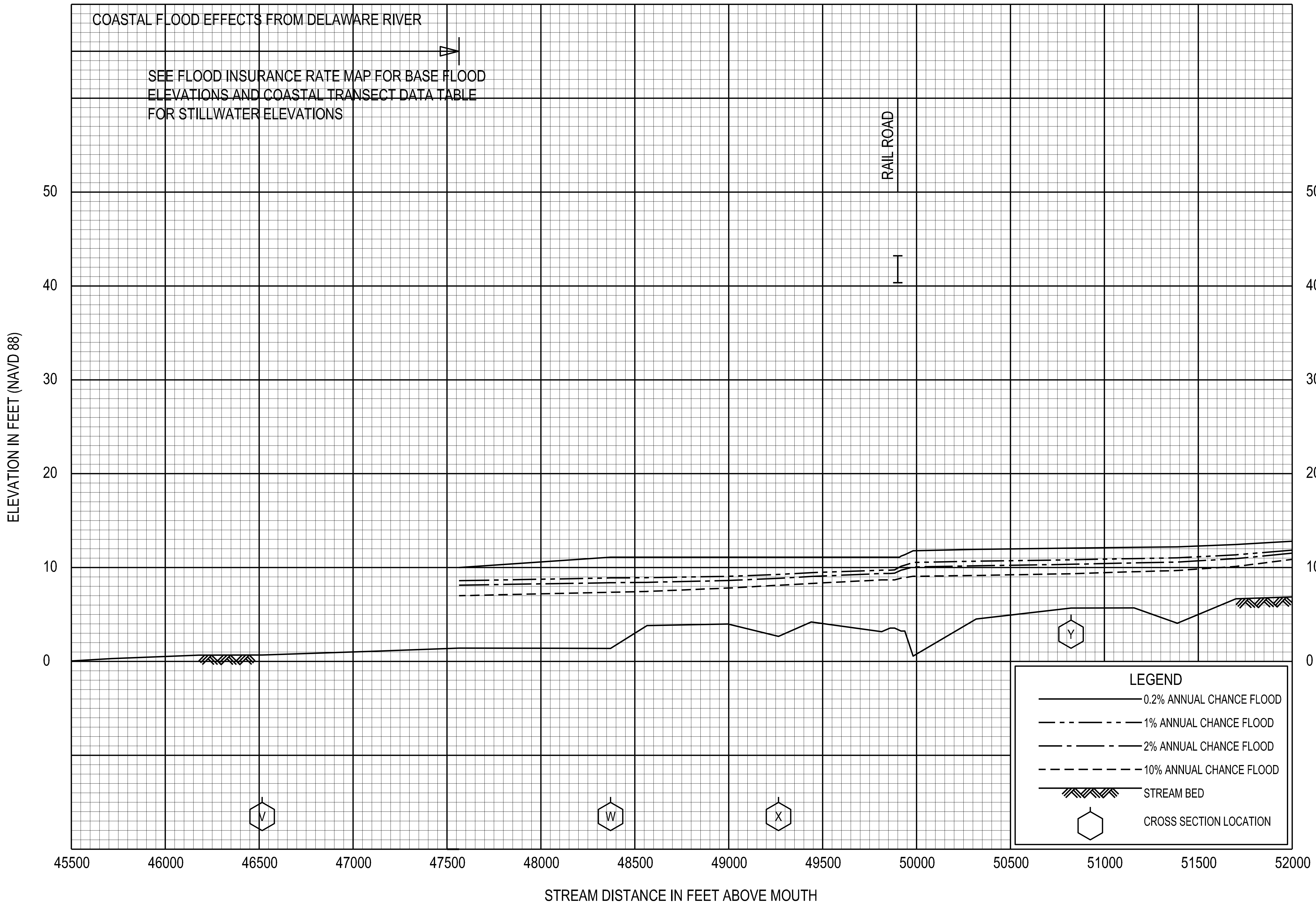
FLOOD PROFILES

LITTLE EASE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



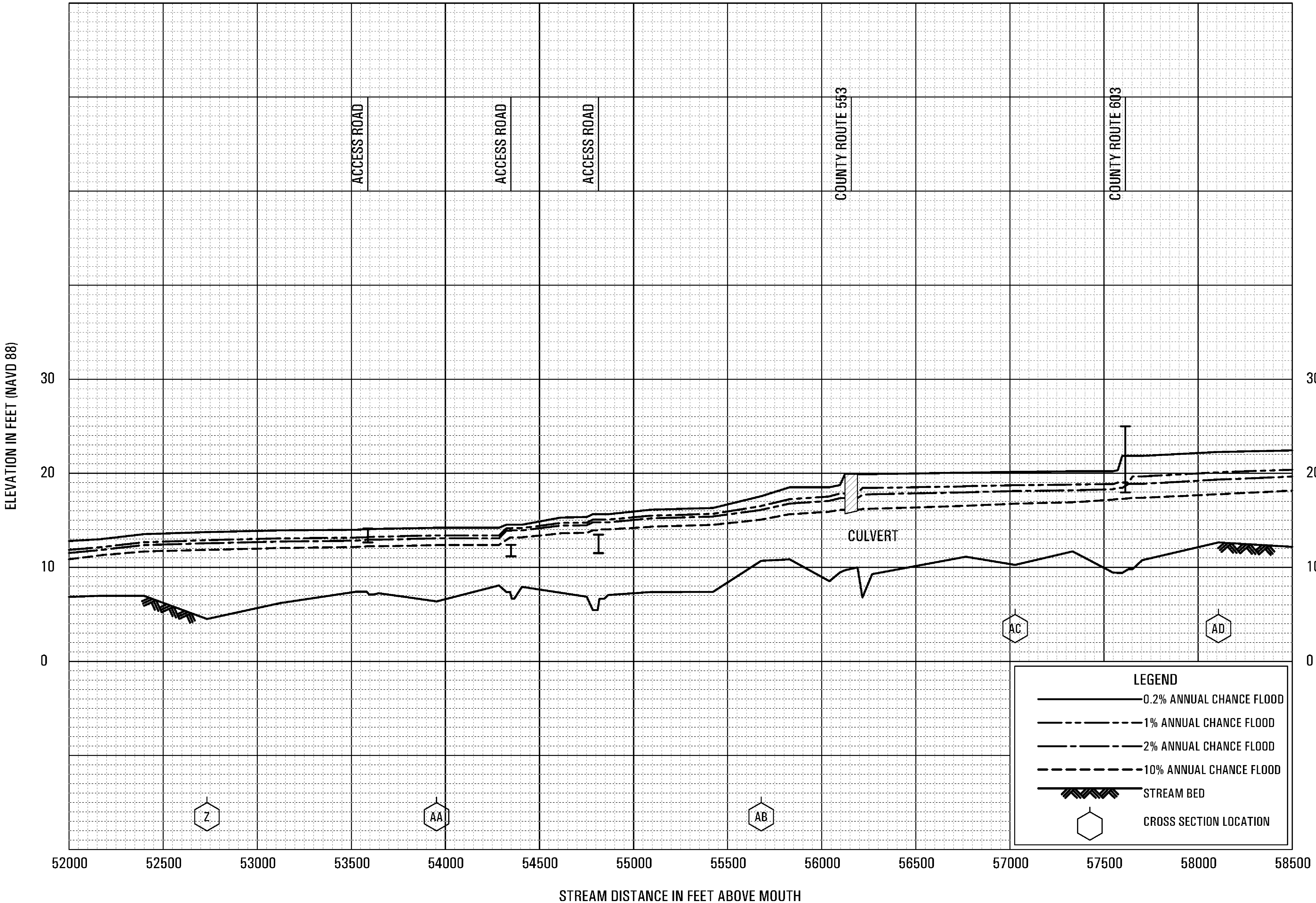
FLOOD PROFILES

MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

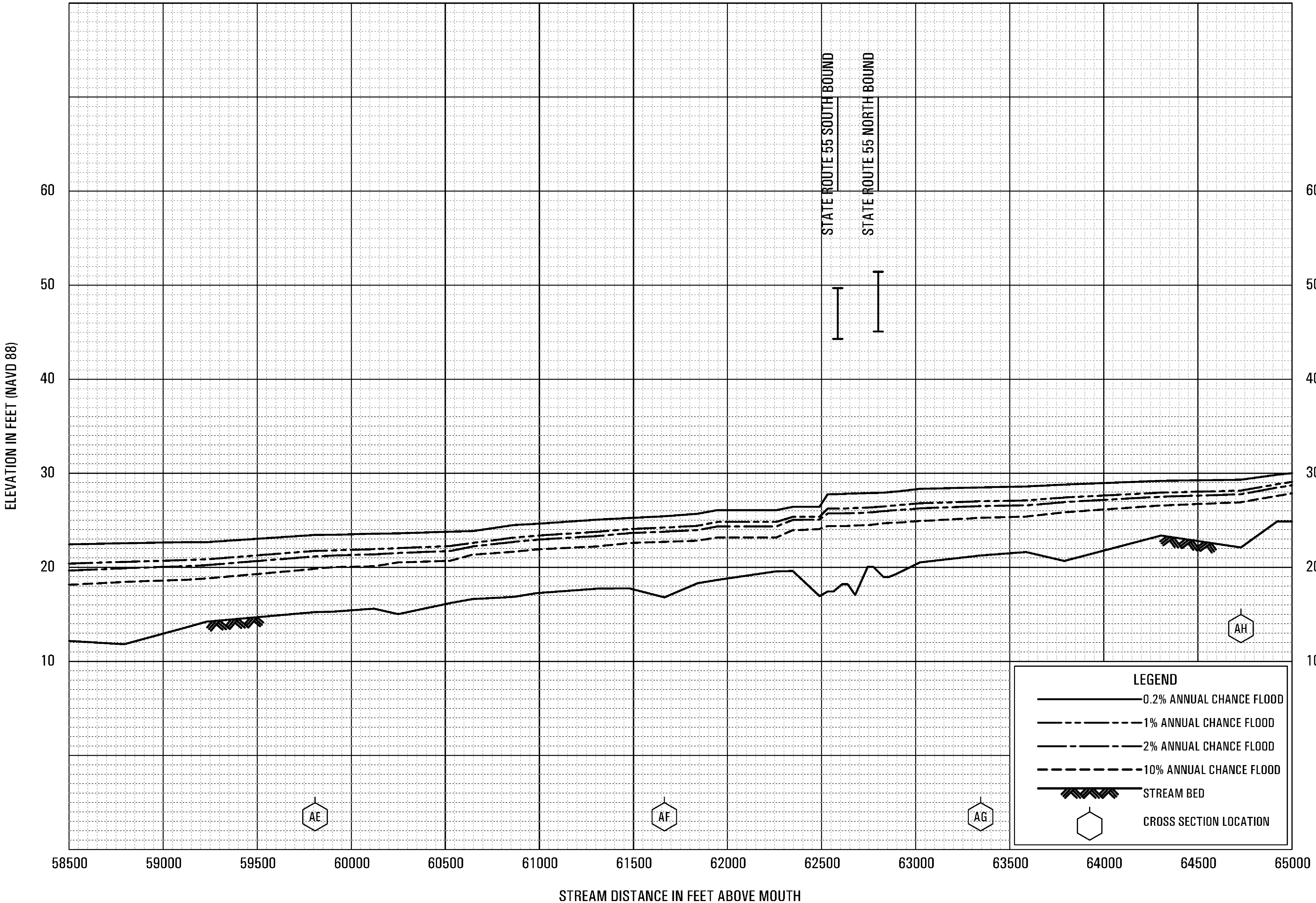
MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

29P



FLOOD PROFILES

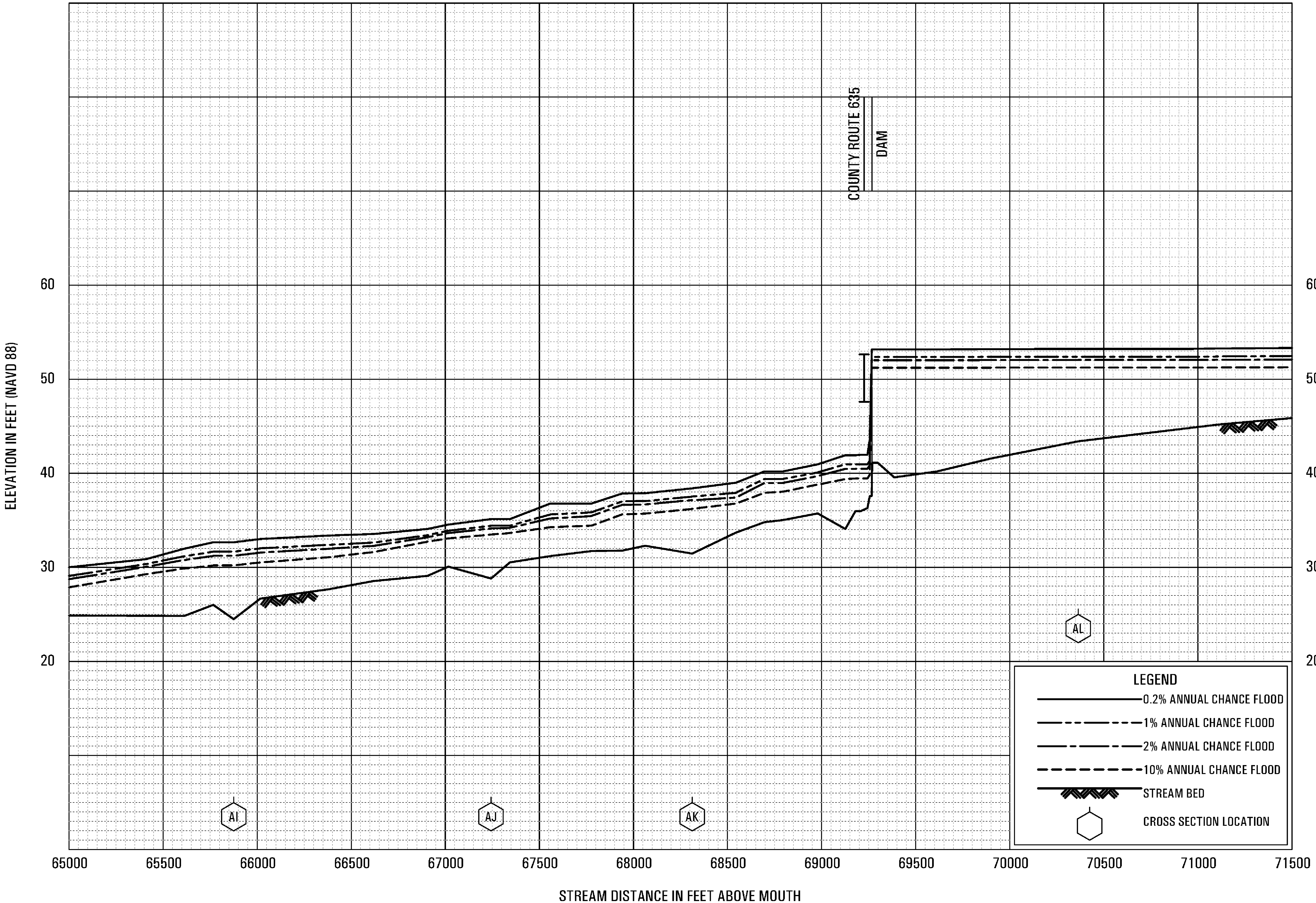
MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

30P



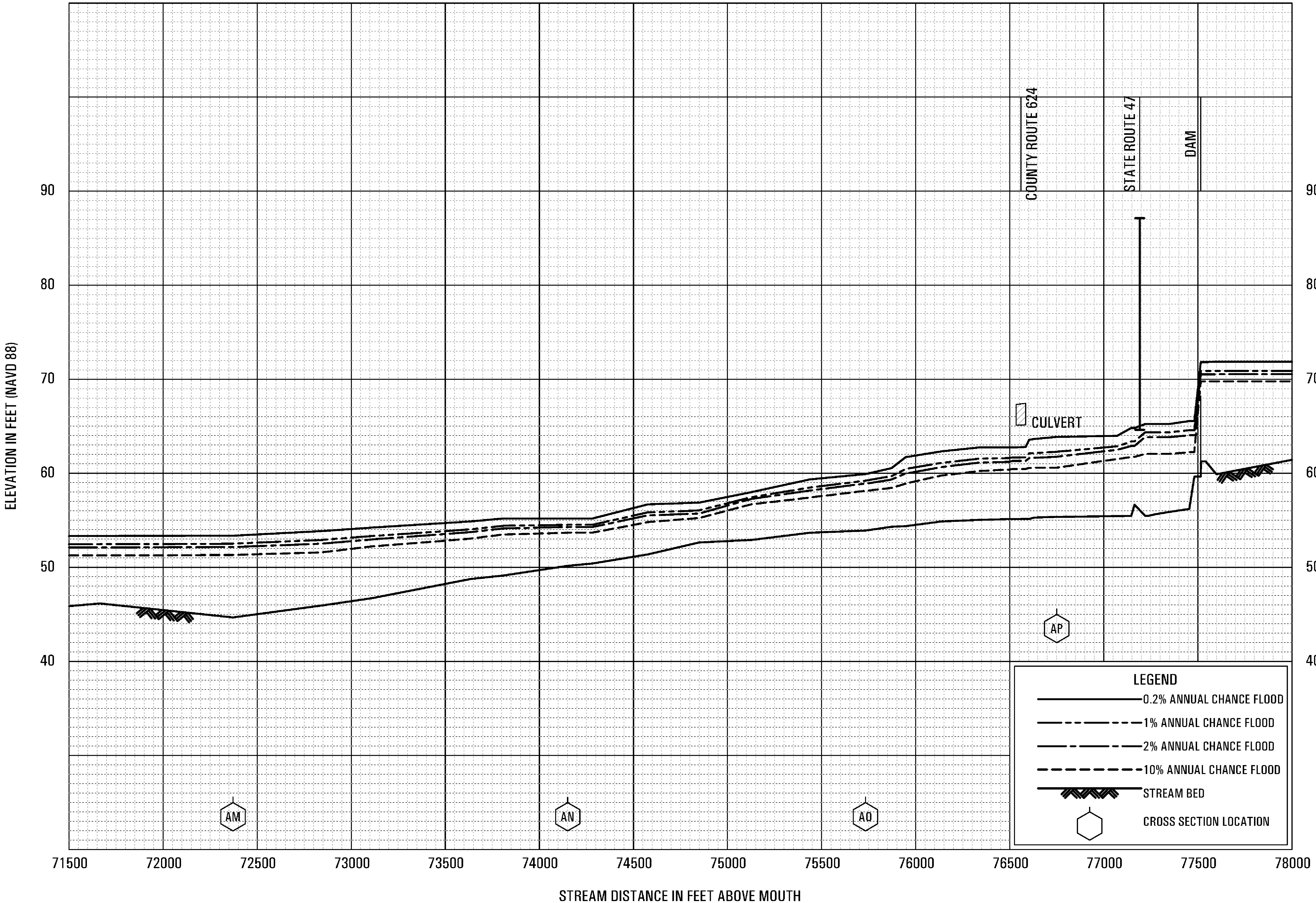
FLOOD PROFILES

MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

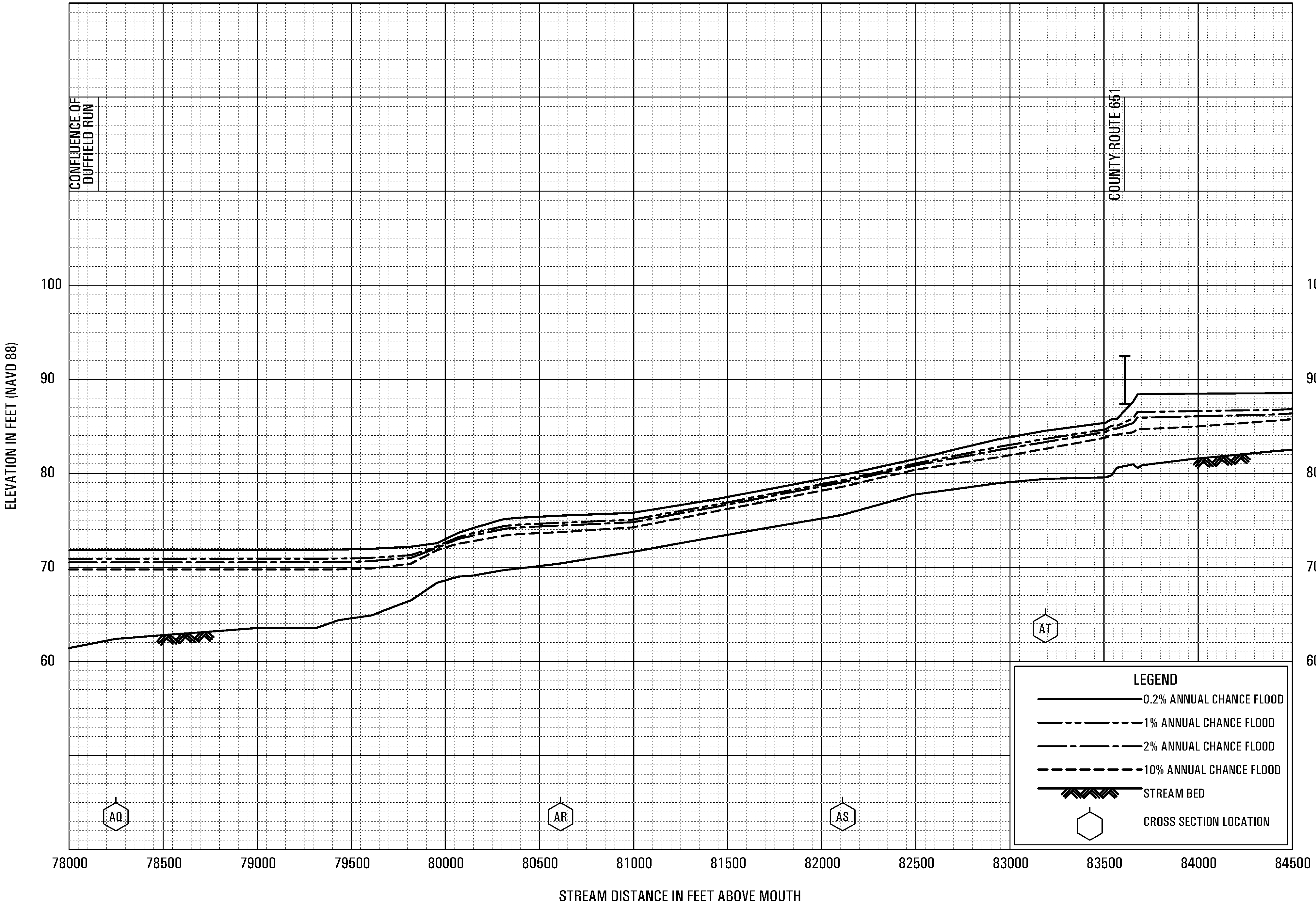
MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)

32P



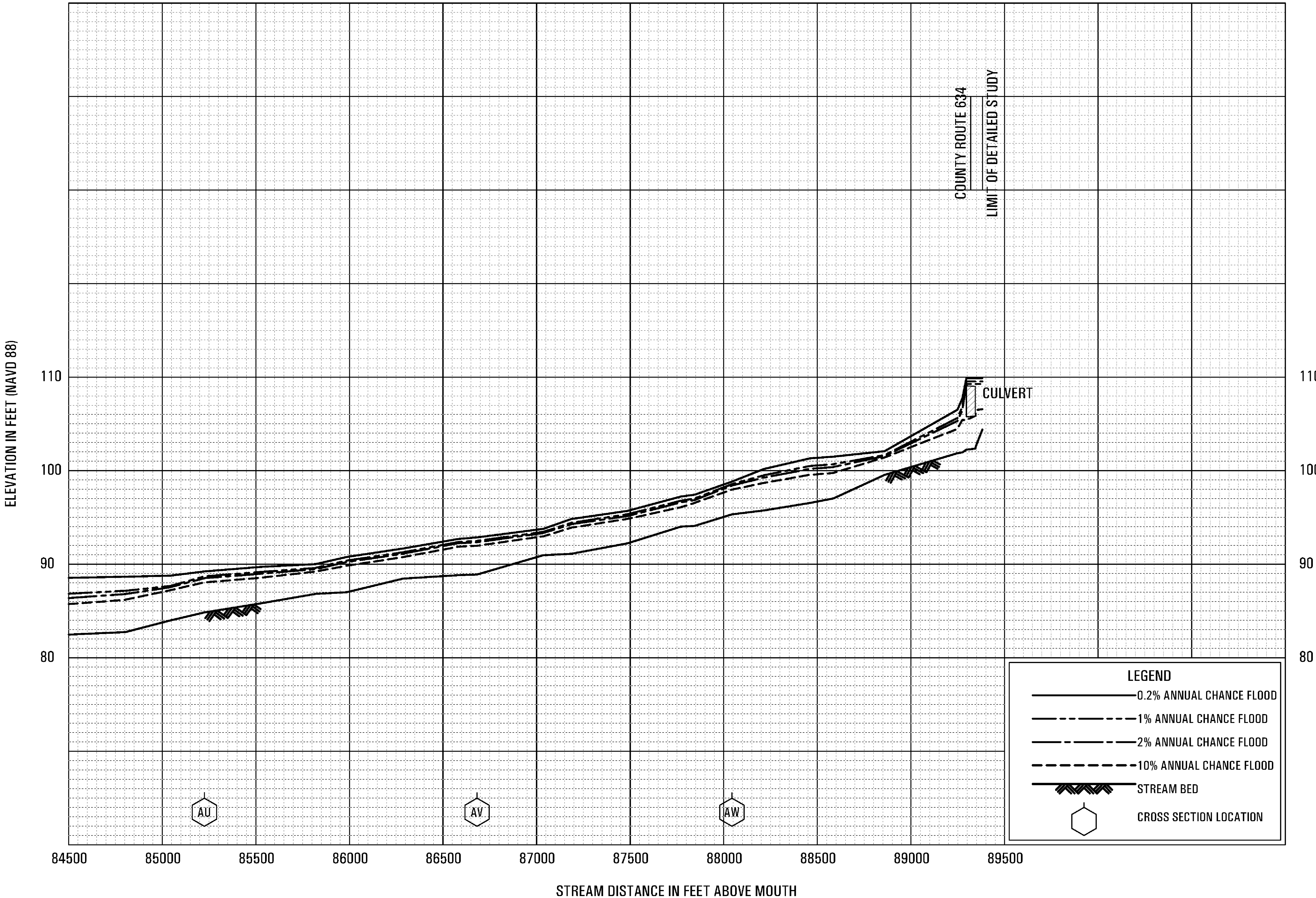
FLOOD PROFILES

MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



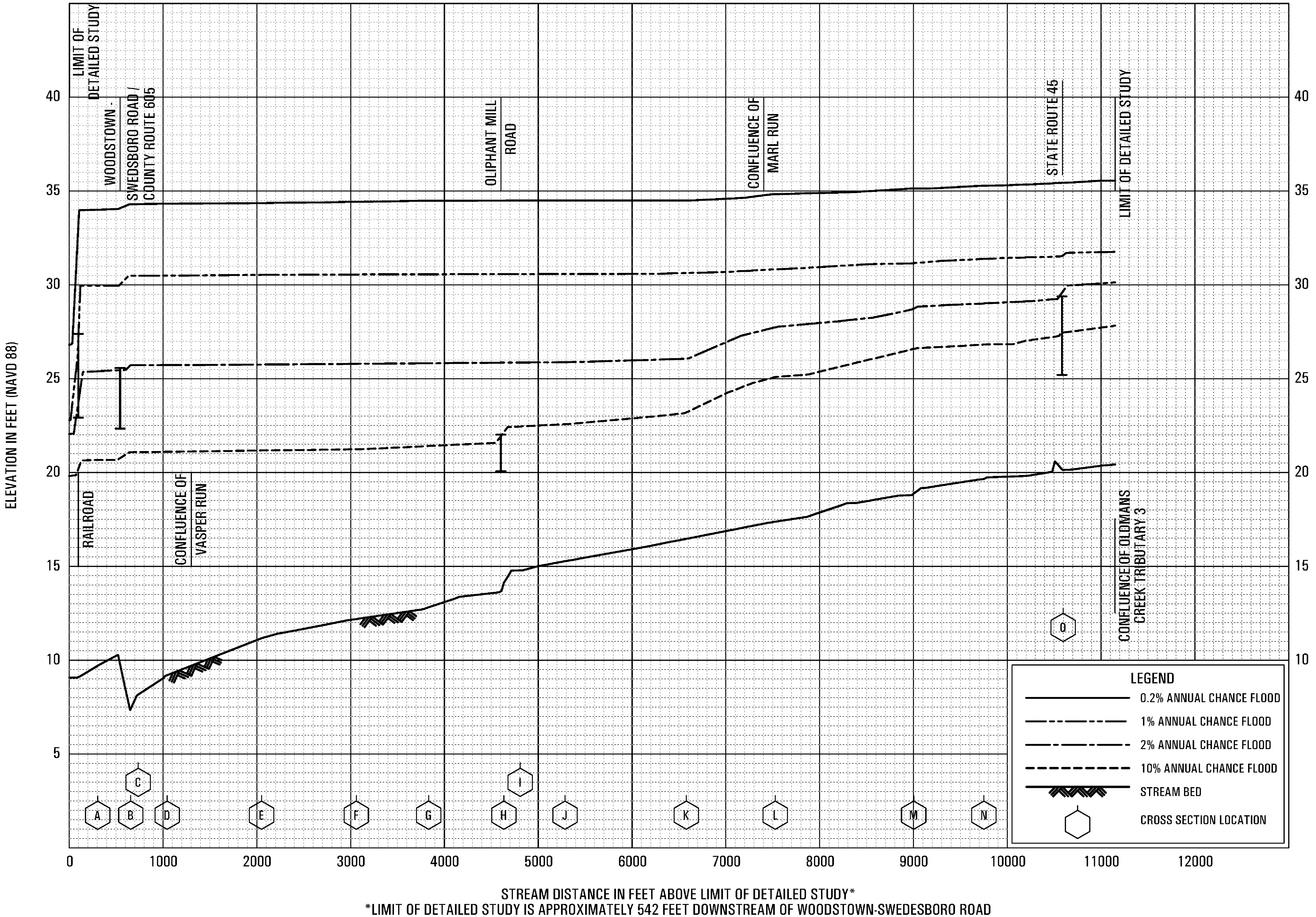
FLOOD PROFILES

MANTUA CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



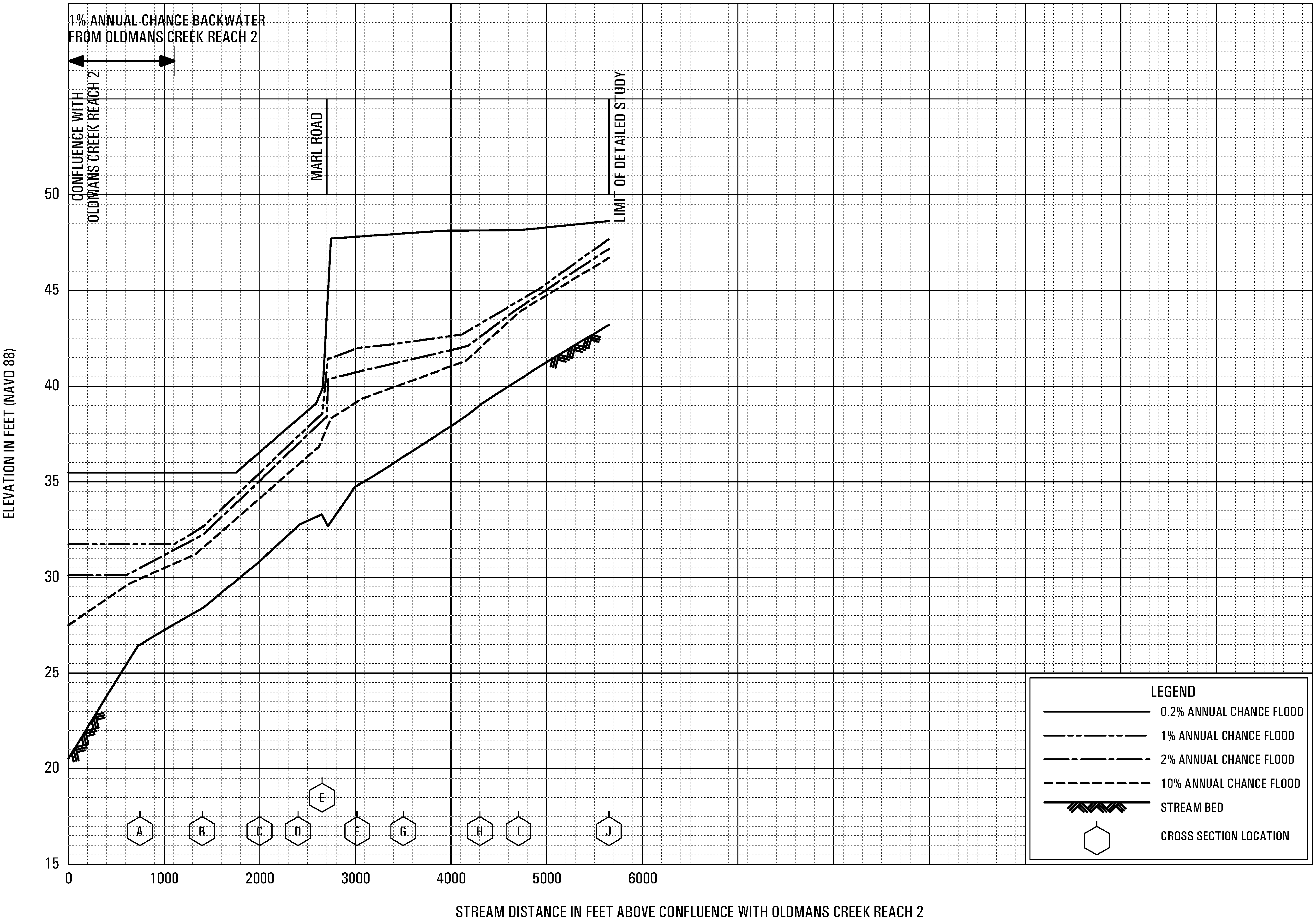
FLOOD PROFILES

OLDMANS CREEK REACH 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

OLDMANS CREEK REACH 2 TRIBUTARY 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLOUCESTER COUNTY, NJ

(ALL JURISDICTIONS)