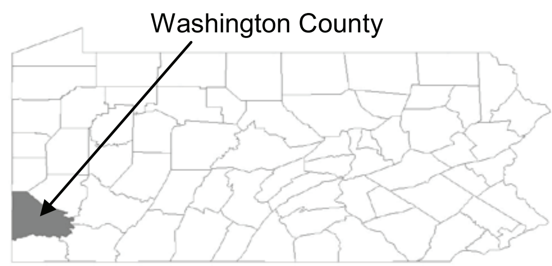
FLOOD INSURANCE STUDY

WASHINGTON COUNTY, PENNSYLVANIA

(ALL JURISDICTIONS)



COMMUNITY NAME	COMMUNITY NUMBER
ALLENPORT, BOROUGH OF	420845
AMWELL, TOWNSHIP OF	422615
BEALLSVILLE, BOROUGH OF	422129
BENTLEYVILLE, BOROUGH OF	420846
BLAINE, TOWNSHIP OF	422141
BUFFALO, TOWNSHIP OF	421200
BURGETTSTOWN, BOROUGH OF	420847
CALIFORNIA, BOROUGH OF	420848
CANONSBURG, BOROUGH OF	420849
CANTON, TOWNSHIP OF	421201
CARROLL, TOWNSHIP OF	422142
CECIL, TOWNSHIP OF	422143
CENTERVILLE, BOROUGH OF	422552
CHARLEROI, BOROUGH OF	420850
CHARTIERS, TOWNSHIP OF	422144
CLAYSVILLE, BOROUGH OF	422730
COAL CENTER, BOROUGH OF	422131
COKEBURG, BOROUGH OF	422731
CROSS CREEK, TOWNSHIP OF	422145
DEEMSTON, BOROUGH OF	422132
DONEGAL, TOWNSHIP OF	422146
DONORA, BOROUGH OF	420851
DUNLEVY, BOROUGH OF	422133
EAST BETHLEHEM, TOWNSHIP OF	422140
EAST FINLEY, TOWNSHIP OF	422147
EAST WASHINGTON, BOROUGH OF	422134
ELCO, BOROUGH OF	420852
ELLSWORTH, BOROUGH OF	422553
FALLOWFIELD, TOWNSHIP OF	422148
FINLEYVILLE, BOROUGH OF	422135
GREEN HILLS, BOROUGH OF	422732
HANOVER, TOWNSHIP OF	422555
HOPEWELL, TOWNSHIP OF	422556
HOUSTON, BOROUGH OF	422594
INDEPENDENCE, TOWNSHIP OF	421202
JEFFERSON, TOWNSHIP OF	422557
LONG BRANCH, BOROUGH OF	422136
MARIANNA, BOROUGH OF	420854
MCDONALD, BOROUGH OF	420855
MIDWAY, BOROUGH OF	422558
MONONGAHELA, CITY OF	420856
MORRIS, TOWNSHIP OF	422559
MOUNT PLEASANT, TOWNSHIP OF	422149
NEW EAGLE, BOROUGH OF	420857
NORTH BETHLEHEM, TOWNSHIP OF	422560
NORTH CHARLEROI, BOROUGH OF	422137
NORTH FRANKLIN, TOWNSHIP OF	422150
NORTH STRABANE, TOWNSHIP OF	422151
NOTTINGHAM, TOWNSHIP OF	422561
PETERS, TOWNSHIP OF	422152
ROBINSON, TOWNSHIP OF	422562
ROSCOE, BOROUGH OF	420858
SMITH, TOWNSHIP OF	422153
SOMERSET, TOWNSHIP OF	422154
SOUTH FRANKLIN, TOWNSHIP OF	422563
SOUTH STRABANE, TOWNSHIP OF	422155
SPEERS, BOROUGH OF	422138
STOCKDALE, BOROUGH OF	420859
TWILIGHT, BOROUGH OF	422564
UNION, TOWNSHIP OF	420860
WASHINGTON, CITY OF	420861
WEST BETHLEHEM, TOWNSHIP OF	422156
WEST BROWNSVILLE, BOROUGH OF	425391
WEST FINLEY, TOWNSHIP OF	422565
WEST MIDDLETOWN, BOROUGH OF	422139
WEST PIKE RUN, TOWNSHIP OF	422157

Please note this **Revised Preliminary** FIS report includes new updates that did not appear in the previously issued Nov. 19, 2009 Preliminary FIS report. Please refer to the Nov. 19, 2009 Preliminary FIS report for flooding source data that does not appear in or has been superseded by this **Revised Preliminary** FIS report.

Revised Preliminary
October 25, 2013

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
42051CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

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

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

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

Please note this **Revised Preliminary** FIS report includes new updates that did not appear in the previously issued Nov. 19, 2009 Preliminary FIS report. Please refer to the Nov. 19, 2009 Preliminary FIS report for flooding source data that does not appear in or has been superseded by this **Revised Preliminary** FIS report.

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FLOOD INSURANCE STUDY
WASHINGTON COUNTY, PENNSYLVANIA
(ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) report investigates the existence and severity of flood hazards in the geographic area of Washington County, Pennsylvania, including the Boroughs of Allenport, Beallsville, Bentleyville, Burgettstown, California, Canonsburg, Centerville, Charleroi, Claysville, Coal Center, Cokeburgh, Deemston, Donora, Dunlevy, East Washington, Elco, Ellsworth, Finleyville, Green Hills, Houston, Long Branch, Marianna, McDonald, Midway, New Eagle, North Charleroi, Roscoe, Speers, Stockdale, Twilight, West Brownsville, and West Middletown; the Townships of Amwell, Blaine, Buffalo, Canton, Carroll, Cecil, Chartiers, Cross Creek, Donegal, East Bethlehem, East Finley, Fallowfield, Hanover, Hopewell, Independence, Jefferson, Morris, Mount Pleasant, North Bethlehem, North Franklin, North Strabane, Nottingham, Peters, Robinson, Smith, Somerset, South Franklin, South Strabane, Union, West Bethlehem, West Finley, and West Pike Run; and the Cities of Monongahela, and Washington (referred to collectively herein as Washington County).

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the county that will establish actuarial flood insurance rates and to assist the county in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Boroughs of Claysville and East Washington do not contain special flood hazard areas. The Borough of West Alexander was dissolved into surrounding Donegal Township effective January 1, 2009. The Borough of McDonald is located in both Allegheny County and Washington County. It is included in its entirety in the Allegheny County FIS.

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

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

1.2 Authority and Acknowledgments

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

This FIS was prepared to include all jurisdictions within Washington County into a countywide format FIS. Information on the authority and acknowledgements for each of the previously printed FISs and Flood Insurance Rate Maps (FIRMs) for communities within Washington County was compiled, and is shown below:

Allenport, Borough of	In the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the U.S. Army Corps of Engineers (USACE), Pittsburgh District, for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 1). This work was completed in January 1980.
	For the November 16, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for the FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 1). This work was completed in October 1992.
Amwell, Township of	The hydrologic and hydraulic analyses for the September 15, 1989 FIS were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 2). This work was completed in November 1987.
Bentleyville, Borough of	The hydrologic and hydraulic analyses for the June 17, 1986 study were performed by the USACE, Pittsburgh District, for FEMA under Inter-Agency Agreement EMW-E-1153, Project Order No. 1, Amendment No. 28 (Reference 3). This study was completed in February 1985.
Burgettstown, Borough of	The hydrologic and hydraulic analyses for the February 17, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 4). This work was completed in November 1987.
California, Borough of	In the original December 15, 1980 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 5). This work was completed in January 1980.

California, Borough of (Continued)	In the September 6, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 5). This work was completed in October 1992.
Canonsburg, Borough of	The hydrologic and hydraulic analyses for the October 1979 study were prepared by Michael Baker Jr., Inc. for the FIA, under Contract No. H-4553. This work, which was completed in May 1968, covered all significant flooding sources in the Borough of Canonsburg (Reference 6). The hydrologic and hydraulic information for Chartiers Creek and Brush Run were obtained from the USACE, Pittsburgh District.
Canton, Township of	The hydrologic and hydraulic analyses for the November 5, 1986 study were performed by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement EMW-E-1153, Project Order No. 1, Amendment No. 28 (Reference 7). This work was completed in June 1985.
Carroll, Township of	In the original September 1979 FIS, the hydrologic and hydraulic analyses were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 8). This work was completed in October 1978. In the December 5, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 8). This work was completed in October 1992.
Cecil, Township of	The hydrologic and hydraulic analyses for March 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 9). This work, which was completed in April 1978, covered all significant flooding sources in the Township of Cecil.
Centerville, Borough of	For the original December 15, 1980 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-8-78, Project Order No. 29 (Reference 10). This work was completed in January 1980. For the December 15, 1995 revision, the hydrologic and hydraulic analyses were prepared by USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 10). This work was completed in October 1992.

Charleroi, Borough of	In the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 11). This work was completed in January 1980. In the January 19, 1996 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 11). This work was completed in October 1992.
Chartiers, Township of	The hydrologic and hydraulic analyses for the August 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 12). This work was completed in September 1978.
Coal Center, Borough of	For the original March 30, 1981 FIS, and September 30, 1981, FIRM, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 13). This work was completed in January 1980. For the September 6, 1995 revision, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 13). This work was completed in October 1992.
Donora, Borough of	The hydrologic and hydraulic analyses for the September 30, 1995 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 14). This work was completed in October 1992.
Dunlevy, Borough of	For the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 15). This work was completed in January 1980. For the October 18, 1995 revision, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 15). This work was completed in October 1992.

East Bethlehem, Township of	In the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by GAI Consultants, Inc., for the FIA, under Contract No. H-4762 (Reference 16). This work was completed in March 1980. In the October 18, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW 90-E-3263, Project Order No. 4 (Reference 16). This work was completed in October 1992.
Elco, Borough of	In the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 17). This work was completed in January 1980. In the October 18, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 17). This work was completed in October 1992.
Fallowfield, Township of	In the original February 17, 1989 study the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 18). This work was completed in December 1987. In the September 30, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 18). This work was completed in October 1992.
Houston, Borough of	The hydrologic and hydraulic analyses for June 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 19). This work was completed in July 1978.
Marianna, Borough of	The hydrologic and hydraulic analyses for the June 19, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-86-E-1822, Project Order No. 1, Amendment No. 25 (Reference 20). This work was completed in November 1987.

Midway, Borough of	The hydrologic and hydraulic analyses for the August 15, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 21). This work was completed in November 1987.
Monongahela, City of	In the original July 3, 1986 study, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-E-1153, Project Order No. 1, Amendment No. 28 (Reference 22). This work was completed in March 1985.
	In the September 20, 1995 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 22). This work was completed in October 1992.
New Eagle, Borough of	In the original September 1979 FIS, the hydrologic and hydraulic analyses were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 23). This work was completed in September 1978.
	In the February 2, 1996 revision, the hydrologic and hydraulic analyses for the Monongahela River were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 23). This work was completed in October 1992.
North Bethlehem, Township of	The hydrologic and hydraulic analyses for the October 15, 1985 study were performed by Michael Baker, Jr. Inc., during the preparation of the FIS for the Township of South Strabane (Reference 24). The South Strabane study was completed in June 1977.
North Charleroi, Borough of	For the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 25). This work was completed in January 1980.
	For the December 19, 1995 revision (Reference 25), the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4. This work was completed in September 1989.

North Franklin, Township of	The hydrologic and hydraulic analyses for the July 4, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 26). This work was completed in November 1987.
North Strabane, Township of	The hydrologic and hydraulic analyses for the August 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4533 (Reference 27). This work was completed in June 1977.
Peters, Township of	The hydrology and hydraulic analyses for the May 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 28). This work was completed in April 1978.
Roscoe, Borough of	For the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 29). This work was completed in January 1980. For the October 18, 1995 revision, the hydrologic and hydraulic analyses were prepared by USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E3263, Project Order No. 4 (Reference 29). This work was completed in October 1992.
South Franklin, Township of	The hydrologic and hydraulic analyses for the July 17, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-85-E-1822, Project Order No. 1, Amendment No. 25 (Reference 30). This work was completed in November 1987.
South Strabane, Township of	The hydrologic and hydraulic analyses for the October 1979 study were prepared by Michael Baker, Jr., Inc., for the FIA, under Contract No. H-4553 (Reference 31). This work was completed in June 1977.
Speers, Borough of	For the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 32). This work was completed in January 1980. For the December 19, 1995 revision, the hydrologic and hydraulic analyses were prepared by USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E3263, Project Order No. 4 (Reference 32). This work was completed in October 1992.

Stockdale, Borough of	For the original January 16, 1981 FIS, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for the FIA, under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 29 (Reference 33). This work was completed in January 1980. For the December 19, 1995 revision, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 33). This work was completed in October 1992.
Union, Township of	For the original June 15, 1984 study, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. IAA-H-15-72 (Reference 34). This work was completed in April 1983. For the December 19, 1995 revision, the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 34). This work was completed in September 1989.
Washington, City of	The hydrologic and hydraulic analyses for the November 5, 1986 study were performed by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement EMW-E-1153, Project Order No. 1, Amendment No. 28 (Reference 35). This work was completed in June 1985.
West Brownsville, Borough of	The hydrologic and hydraulic analyses for the September 6, 1995 study were prepared by USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-90-E-3263, Project Order No. 4 (Reference 36). This work was completed in October 1992.

There are no previous FIS reports or FIRMs published for the Boroughs of Claysville, Cokeburg, Green Hills, McDonald, and West Middletown. There are no previous FIS reports published for the Boroughs of Beallsville, Deemston, East Washington, Ellsworth, Finleyville, Long Branch, and Twilight; and the Townships of Blaine, Buffalo, Cross Creek, Donegal, East Finley, Hanover, Hopewell, Independence, Jefferson, Morris, Mount Pleasant, Nottingham, Robinson, Smith, Somerset, West Bethlehem, West Finley, and West Pike Run; therefore the previous authority and acknowledgment information for these communities are not included in this FIS. These communities may not appear in the Community Map History table (Section 6.0).

For this countywide study, new detailed hydrologic and hydraulic analyses were performed along Brush Run to Chartiers Creek, Maple Creek, Pigeon Creek and Wolfdale Run by GG3, a joint venture between Stantec and Gannet Fleming, Inc. All other streams studied by detailed methods have been redelineated using LIDAR data flown in 2006. For flooding sources studied with approximate methods, the 1-percent-annual-chance flood elevations were determined using updated hydrologic and hydraulic analyses. Because model cross section information was not supplemented with field survey data and the models did not include bridge and culvert information, the resulting floodplain boundaries are considered approximate.

The orthophotography base mapping was provided by the PAMAP Program, Bureau of Topographic and Geological Survey, PA Department of Conservation and Natural Resources, at a scale of 1:2,400 from photography dated 2006 or later. The digital countywide FIRM was produced in Pennsylvania State Plane South Zone (FIPS Zone 3702) coordinate system with a Lambert Conformal Conic projection, units in feet, and referenced to the North American Datum of 1983, GRS80 spheroid. Differences in datum and spheroid used in the production of the FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of the information shown on this FIRM.

1.3 Coordination

The initial and final Consultation Coordination Officer's (CCO) meeting dates for the previous FIS reports for Washington County and its communities are listed in Table 1, "Initial and Final CCO Meetings."

Table 1 – Initial and Final CCO Meetings

COMMUNITY NAME	FIS DATE	INITIAL MEETING	FINAL MEETING
Allenport, Borough of	January 16, 1981 November 16, 1995	December 20, 1977 September 1989	August 7, 1980 *
Amwell, Township of	September 15, 1989	May 23, 1985	July 22, 1988
Bentleyville, Borough of	June 17, 1986	August 9, 1983	August 6, 1985
Burgettstown, Borough of	February 17, 1989	May 23, 1985	March 29, 1988
California, Borough of	December 15, 1980 September 6, 1995	December 20, 1977 September 1989	July 15, 1980 May 11, 1994
Canonsburg, Borough of	October 1979	June 1977	December 6, 1978
Canton, Township of	November 5, 1986	August 9, 1983	December 10, 1985
Carroll, Township of	September 1979 December 5, 1995	June 1, 1977 September 1989	April 12, 1979 *
Cecil, Township of	March 1979	June 2, 1977	September 12, 1978
Centerville, Borough of	December 15, 1980 December 15, 1995	December 20, 1977 September 1989	July 15, 1980 *

* Data Not Available

<u>Table 1 – Initial and Final CCO Meetings</u> - Continued

COMMUNITY NAME	FIS DATE	INITIAL MEETING	FINAL MEETING
Charleroi, Borough of	January 16, 1981 January 19, 1996	December 19, 1977 September 1989	July 14, 1980 *
Chartiers, Township of	August 1979	June 1977	March 6, 1979
Coal Center, Borough of	March 30, 1981 September 6, 1995	December 20, 1977 September 1989	July 15, 1980 May 11, 1994
Donora, Borough of	September 30, 1995	September 1989	June 27, 1994
Dunlevy, Borough of	January 16, 1981 October 18, 1995	December 19, 1977 September 1989	July 14, 1980 *
East Bethlehem, Township of	January 16, 1981 October 18, 1995	April 4, 1978 September 1989	August 12, 1980 *
Elco, Borough of	January 16, 1981 October 18, 1995	December 20, 1977 September 1989	August 7, 1980 *
Fallowfield, Township of	February 17, 1989 September 30, 1995	May 23, 1985 September 1989	March 29, 1988 June 27, 1994
Houston, Borough of	June 1979	June 1977	December 4, 1978
Marianna, Borough of	June 19, 1989	May 23, 1985	July 5, 1988
McDonald, Borough of	May 15, 2003	January 17, 1979	*
Midway, Borough of	August 15, 1989	May 23, 1985	July 5, 1988
Monongahela, City of	July 3, 1986 September 20, 1995	August 9, 1983 September 1989	August 6, 1985 *
New Eagle, Borough of	September 1979 February 2, 1996	June 1, 1977 September 1989	March 7, 1979 *
North Bethlehem, Township of	October 15, 1985	*	October 11, 1984
North Charleroi, Borough of	January 16, 1981 December 19, 1995	December 19, 1977 September 1989	August 7, 1980 *
North Franklin, Township of	July 4, 1989	May 23, 1985	July 6, 1988
North Strabane, Township of	August 1979	June 1977	March 6, 1979
Peters, Township of	May 1979	June 1, 1977	October 16, 1978

* Data Not Available

<u>Table 1 – Initial and Final CCO Meetings</u> - Continued

COMMUNITY NAME	FIS DATE	INITIAL MEETING	FINAL MEETING
Roscoe, Borough of	January 16, 1981 October 18, 1995	December 20, 1977 September 1989	August 7, 1980 *
South Franklin, Township of	July 17, 1989	May 23, 1985	July 6, 1988
South Strabane, Township of	October 1979	June 1977	March 6, 1976
Speers, Borough of	January 16, 1981 December 19, 1995	December 19, 1977 September 1989	July 14, 1980 *
Stockdale, Borough of	January 16, 1981 December 19, 1995	December 20, 1977 September 1989	July 14, 1980 *
Union, Township of	June 15, 1984 December 19, 1995	* September 1989	* *
Washington, City of	November 5, 1986	August 9, 1983	December 11, 1985
West Brownsville, Borough of	September 6, 1995	September 1989	May 11, 1994

* Data Not Available

These meetings were attended by the study contractor, FEMA, and community officials. The initial meetings were held to discuss the nature and purpose of the proposed FIS. The final CCO meetings were held to review the results of the study.

For this countywide study, the CCO meeting was held on ___________, and attended by representatives of ______________. All problems raised at that meeting have been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Washington County, Pennsylvania, including incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction. Table 2, "Areas Studied by Detailed Methods" lists the streams that were studied by detailed methods.

Table 2 – Areas Studied by Detailed Methods

Stream	Limits of Detailed Study
Brush Run	From approximately 25 feet downstream of Valley Brook Road to just upstream of Bebout Road.
Brush Run to Chartiers Creek	From the confluence with Chartiers Creek to approximately 20 feet upstream of Valley View Road.
Brush Run to Little Tenmile Creek	From the confluence with Little Tenmile Creek to approximately 0.7 mile upstream of Dynamite Road.
Catfish Creek	From the confluence with Chartiers Creek to approximately 240 feet upstream of Shrontz Lane.
Chartiers Creek	From approximately 100 feet downstream of I-79 to just downstream of State Route 18.
Chartiers Run	From the confluence with Chartiers Creek to approximately 0.5 mile upstream of Farm Road.
Georges Run	From the confluence with Chartiers Creek to approximately 0.3 mile upstream of Farm Road.
Little Chartiers Creek	From approximately 50 feet downstream of U.S. Route 19 to approximately 50 feet upstream of U.S. Route 40.
Little Tenmile Creek	From approximately 0.2 mile downstream of Lone Pine Road to approximately 2.8 miles upstream of Lone Pine Road.
Log Pile Run	From the confluence with Chartiers Creek to approximately 0.6 mile upstream of Prigg Road.
Monongahela River	From the downstream county boundary to approximately 60 feet upstream of the confluence of Tenmile Creek.
Montgomery Run	From the confluence with Tenmile Creek to approximately 0.3 mile upstream of I-79.
Peters Creek	From approximately 525 feet downstream of Venetia Road to approximately 0.9 mile upstream of Lutes Road.
Pigeon Creek	From the confluence with the Monongahela River to approximately 0.3 mile upstream of Oliver Avenue.
Racoon Creek	From approximately 0.2 mile downstream of State Route 18 to approximately 0.2 mile upstream of West Pittsburgh Street.
Robinson Run	From approximately 0.4 mile downstream of St. John Street to just downstream of Dilly Street.
	From the downstream county boundary to approximately 0.3 mile upstream of McDonald Street.
Tenmile Creek	From the confluence with the Monongahela River to approximately 1.6 miles upstream of Cracraft Road.
Tributary 4	From the confluence with Little Chartiers Creek to approximately 1.5 miles upstream of Clokey Road.
Wolfdale Run	From the confluence with Chartiers Creek to approximately 0.3 mile upstream of Jefferson Avenue.

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

Table 3, “Stream Name Changes,” lists those streams whose names have changed, or differs from those published in the previous FIS for Washington County, or any of the communities within.

Table 3 – Stream Name Changes

Community	Old Name	New Name
Canonsburg, Borough of Chartiers, Township of	Brush Run	Brush Run to Chartiers Creek
Amwell, Township of	Brush Run	Brush Run to Little Tenmile Creek

No Letters of Map Revision (LOMRs) were incorporated as part of this study.

2.2 Community Description

Washington County is located in southwestern Pennsylvania, south of the City of Pittsburgh. The county is bordered on the north by the Counties of Beaver and Allegheny, Pennsylvania, by the east by the Counties of Westmoreland and Fayette, Pennsylvania; on the south by Greene County; and on the west by the State of West Virginia. Major transportation routes that serve Washington County include U.S. Interstates 70 and 79, State Routes 19, 22, and 40, and the Railroad. The 2010 population of Washington County was reported to be 207,820 (Reference 37).

The climate for this area is temperate with normal seasonal variation in temperature. Washington County is geographically located in a region of both polar and tropical air mass activity, subject to continental and maritime invasion. The weather is usually moderate, but may have occasional rapid changes resulting from frontal air mass movements. The average high temperature ranges from 82 degrees Fahrenheit (ºF) in July to 35ºF in January. The highest recorded temperature was 100ºF in July 1988. The lowest recorded temperature was -25ºF in January 1984. Yearly precipitation averages approximately 3.25 inches, with the maximum monthly average occurring in May, with 4.16 inches of rain and the minimum monthly average occurring in October, with 2.46 inches (Reference 38).

Vegetation in the residential areas of Brush Run watershed consists of lawns, trees, and shrubbery. In undeveloped areas, the vegetation consists of trees, brush, and weeds. Major drainage features in the community include Brush Run, flowing from southeast to northwest. Development along Brush Run consists of residences, small businesses and some industry.

Vegetation in the Brush Run to Chartiers Creek watershed consists of lawns, trees, and shrubbery in the residential areas and trees, brush, and weeds in the undeveloped areas. Brush Run to Chartiers Creek has a drainage area of 5.8 square miles at the downstream corporate limits of the Township of Chartiers. It is located along the northeast corporate limits of the Township of Chartiers and flows in a southeasterly direction, with an average channel slope of about 40 feet per mile.

Brush Run to Little Tenmile Creek, with a total drainage area of 3.2 square miles at its mouth, joins Little Tenmile Creek at Lone Pine, Pennsylvania, on the left bank at mile 6.1. It flows in a southwesterly direction. The average bedslope within the study limits is approximately 47 feet per mile. Local relief above the stream varies from a low of 950 feet to an average hilltop elevation of 1,400 feet. The valley floor varies from 100 to 800 feet in width.

Catfish Creek, with a total drainage area of 4.7 square miles, has its source in the southwestern portion of the Township of South Strabane. This stream flows in a northwestern direction through the City of Washington to its confluence with Chartiers Creek, a distance of 4 miles. The average gradient in the study reach is approximately 26 feet per mile. Only one major tributary enters Catfish Creek within the study reach. This unnamed tributary flows into Catfish Creek near the Washington and Jefferson College football stadium. Floodplain usage is primarily residential in the upper reach of the stream with scattered commercial and light industrial properties in the lower portion of the basin.

Chartiers Creek, with a total drainage area of 277 square miles at its mouth, has its source in the adjacent Township of South Franklin and flows approximately 2.5 miles downstream of the "Point" in Pittsburgh. The average stream gradient for Chartiers Creek is approximately 7 feet per mile. Above the stream valley, the local relief rises from approximately 1,020 feet to an average hilltop elevation of 1,200 feet.

Chartiers Run has a drainage area of 22.1 square miles at its mouth; and has an average channel slope of 10 feet per mile.

Georges Run, a tributary to Chartiers Creek, flows in a southeastern direction from its source in the southern portion of the Township of Mount Pleasant. It has a total drainage area of 7.57 square miles and an average channel slope of 25 feet per mile.

Little Chartiers Creek has a drainage area of 46.0 square miles at its mouth, at the downstream corporate limits of the Township of North Strabane. It flows in a northerly direction with an average channel slope of about 8.0 feet per mile.

Little Tenmile Creek, with a total drainage area of 27.2 square miles at its mouth, joins Tenmile Creek on the left bank at creek mile 14.7 at the West Bethlehem/Amwell Township line. It flows in a southeasterly direction from its source upstream of Harts Mills, Pennsylvania, for an approximate distance of 12 miles. The average stream gradient is 29 feet per mile. Elevations in the main valley vary from 900 feet at the mouth to 1,500 feet at the extreme headwaters at Harts Mill, located in Township of Amwell, Pennsylvania. The average channel slope within the study limits is approximately 15 feet per mile. Local relief above the stream varies from a low of 950 feet to an average hilltop elevation of 1,300 feet. The valley floor varies from 300 to 800 feet in width.

Log Pile Run flows in a northeastern direction near the southern corporate limits of the Township of Canton. This stream is approximately 2.6 miles long and has a total drainage area of 3.84 square miles at its confluence. The average channel slope of the stream is approximately 41 feet per mile.

Maple Creek, with a total drainage area of 10.2 square miles at its mouth, joins the Monongahela River on the left bank at mile 42.6 in the Locks and Dam No. 4 upper pool located in the Borough of Charleroi. Maple Creek flows in a southeastern direction from its source upstream of Warner, located in the Township of Fallowfield, for an approximate distance of 4 miles. The average stream gradient is 90 feet per mile. Elevations in the main valley vary from 740 feet at the mouth to 1,300 feet at the extreme headwaters. The average bed slope within the Township of Fallowfield is approximately 57 feet per mile. Local relief above the stream varies from a low of 780 feet to an average hilltop elevation of 1,300 feet. The valley floor varies from 50 to 300 feet in width.

The Monongahela River drains 7,348 square miles and joins the Allegheny River to form the Ohio River at Pittsburgh Pennsylvania. The Monongahela River is formed by the junction of the West Fork River and the Tygart River at Fairmont, West Virginia, 128.7 miles above its mouth. These rivers originate on the western slopes of the Appalachian Mountains in northwestern West Virginia. The Monongahela River flows north throughout its entire length. The general topography within the Monongahela River watershed consists of relatively narrow valleys and steep hillside slopes. The steep hills cause rapid initial runoff into the valley basins during storms. The river gradient on the Monongahela River is fairly flat, while those of the West Fork and Tygart Rivers are much steeper. The Monongahela River valley is narrow in the upper reaches and widens to approximately 0.5 mile at Greensboro and approximately 0.4 mile in the study area. The relief above the steam valleys varies from 300 to 400 feet, to an average hilltop elevation of approximately 1,200 feet.

The vegetation of the Monongahela River watershed generally consists of forested hills and floodplains. Clearings in the hills in the southern portion of the basin are used for agriculture. Most of the developed residential and industrial areas are located in the floodplains and valleys of the Monongahela River and 15 of its major tributaries.

Montgomery Run, with a total drainage area of 4.4 square miles at its mouth, joins Tenmile Creek on the left bank at creek mile 18.7 upstream of Tenmile, Pennsylvania. It flows in a southeasterly direction. The average bedslope within the study limits is approximately 31 feet per mile. Local relief above the stream varies from a low of 915 feet to an average hilltop elevation of 1,300 feet. The valley floor varies from 100 to 300 feet in width.

The Peters Creek watershed contains forest with brush and weeds surrounding the small farms in the area. Peters Creek flows from west to east. Along Peters Creek, development consists mostly of residences and farms with a few commercial interests. The Peters Creek watershed is rectangular, with a length of 6 miles. The drainage area above the mouth is 51.43 square miles, of which 55 percent is located upstream of the Washington-Allegheny County boundary. The watershed is characterized by a generally narrow valley with steep hills on both sides of the creek.

Pigeon Creek, with a total drainage area of 59.2 square miles at its mouth, joins the Monongahela River on the left bank approximately at mile 32.3 in the Locks and Dam No. 3 upper pool at Monongahela. Pigeon Creek flows in a northeastern direction from its source near Cokeburg located in the Borough of Bentleyville. The average stream gradient is approximately 26 feet per mile. Elevations in the main valley vary from the Monongahela River Locks and Dam No. 3 upper pool of 727 feet to 1,300 feet at the extreme headwaters.

Racoon Creek has a total drainage area of 18.3 square miles at its mouth. The average stream gradient is approximately 27 feet per mile. Elevations in the main valley vary from 960 feet at the mouth to 1,300 feet at the extreme headwaters. The average bedslope within the Borough of Burgettstown is 17.7 feet per mile. The valley floor varies from 100 to 800 feet in width.

Robinson Run, with a total drainage area of 41 square miles at its mouth, joins Chartiers Creek on the left bank at Glendale at Chartiers Creek mile 9.3. It flows from the Borough of Midway to its confluence with Chartiers Creek. The average stream gradient of Robinson Run is approximately 21 feet per mile.

Tenmile Creek, which forms the southern boundary of the Township of East Bethlehem, is approximately 29 miles long and drains 338 square miles at its confluence with the Monongahela River. At Clarksville, where Tenmile Creek and South Fork Tenmile Creek join, Tenmile Creek is 26 miles long and drains 140 square miles. Land use within the watershed of Tenmile Creek is 3 percent developed, 16 percent open space, 40 percent forest and woodland, and 41 percent crop and pasture land (Reference 39).

Tributary 4 has a drainage area of 12.1 square miles at its mouth. This stream is located in the eastern portion of the Township of South Strabane and flows in an easterly direction with an average channel slope of approximately 10 feet per mile.

Wolfdale Run, with a total drainage area of 4.33 square miles, generally flows in an easterly direction throughout its length for a distance of 3.8 miles. The average gradient of this stream is approximately 32 feet per mile.

2.3 Principal Flood Problems

Brush Run to Chartiers Creek flows in somewhat narrow valleys with steep-sided slopes, which during rainstorms are conducive to rapid runoff, causing streams to rise rapidly and reach high velocities. Flood damages and elevations can increase because of ice and floating debris, such as trees, logs and brush, which restrict the flow of water through the channel, culverts, and bridges. Although not a significant factor, snowmelt can cause flooding during sudden winter thaws, or in early spring. Tributary 4 flows through narrow valleys with steep side slopes which are conducive to rapid runoff during rainstorms. This causes streams to rise rapidly and to have high velocities. Flood damages and elevations can increase due to floating debris such as trees, logs, and brush which restrict the flow of water through the channel, culverts, and bridges.

Flooding on Brush Run to Little Tenmile Creek, Little Tenmile Creek, and Montgomery Run may occur at various times of the year as a result of high intensity, short duration thunderstorms.

Major floods may occur on Chartiers Creek at various times of the year. Flood records have been available since 1950 from the Jefferson Avenue and Wylie Avenue USACE recording gages located in the City of Washington, approximately 4 miles downstream of the Township of South Franklin. Prior to this, flood data were obtained from a series of non-recording gages, West Penn Power, and the City of Washington newspapers. The largest flood known to have occurred on Chartiers Creek was that of September 1912 with a discharge of approximately 2,790 cubic feet per second (cfs).

Chartiers Creek has a recorded history of flooding from the 1880s. The major flood of record occurred in September 1912, while other, more recent, floods occurred in August 1956, April 1961, March 1963, February 1966 (Reference 40), and September 2004 (Hurricane Ivan). The flood of September 1912 was the result of severe thunderstorms which dropped about 6 inches of rain. Swollen streams caused extensive damage to residences and businesses. Many bridges were either damaged or washed away.

The total cost of damages from the 1956 flood of Chartiers Creek within the Township of Canonsburg was $1,140,000. Damages for the 1961 flood are not available. Damages for the 1963 flood totaled $99,700. Total damages for the 1966 flood cost $82,400 (Reference 41). Total damages from the flood of August 1956, cost the Borough of Houston $127,000. Damage estimates for the 1961 flood are not available. Damages for the March 1963 flood totaled $50,400 (Reference 41). Damage estimates for the 1966 flood are not available.

Table 4, "Historical Floods on Chartiers Creek at the Main Street Bridge," shows elevations of five historical floods, measured at the Main Street Bridge in the Borough of Houston for Chartiers Creek.

Table 4 – Historical Floods on Chartiers Creek at the Main Street Bridge

Historical Flood	Elevation (ft)
September 1912	950.5
August 1956	948.9
April 1961	946.1
March 1963	948.0
February 1966	948.4

Table 5, "Historical Floods on Chartiers Creek at the Central Avenue Bridge," is a list of-past floods on Chartiers Creek, their return intervals, and elevations measured at the Central Avenue Bridge in Canonsburg (Reference 42).

Table 5 – Historical Floods on Chartiers Creek at the Central Avenue Bridge

Historical Flood	Elevation at Central Avenue Bridge, Canonsburg (ft)
September 1912	938.0
August 1956	936.3
April 1961	931.5
March 1963	934.0
February 1966	934.1

Table 6, "Historical Floods on Chartiers Creek at USACE Gage at Wylie Avenue," shows major floods of record as measured at the West Wylie Avenue recording gage located at mile 39.0 on Chartiers Creek.

Table 6 – Historical Floods on Chartiers Creek at USACE Gage at Wylie Avenue

Date of Crest	Stage (feet NAVD88)	Elevation (feet NAVD88)	Discharge (cfs)
September 2, 1912	17.53*	1,012.5*	2,790
August 5, 1956	16.33	1,011.3	2,050
July 27, 1956	16.03	1,011.0	1,890
January 15, 1951	15.33	1,010.3	1,580
December 4, 1950	14.53	1,009.5	1,220
February 4, 1955	14.53	1,009.5	1,220

Gage Zero = 994.98 feet North American Vertical Datum of 1988 (NAVD88)

*Based on high-water mark

Chartiers Run flows in a somewhat narrow valley with steep side slopes, which during rainstorms are conducive to rapid runoff, causing streams to rise rapidly with high velocities. Flood damage and elevations can increase because of ice and floating debris, such as trees, logs and brush, which restrict the flow of water through the channel, culverts, and bridges. Although not a significant factor, snowmelt can cause flooding during sudden winter thaws, or in early spring. No historical flood data are available for Catfish Creek, Georges Run, Log Pile Run, and Wolfdale Run. These streams are more susceptible to flash flooding from intense, short duration summer storms. The most recent flood to have occurred on Log Pile Run and Georges Run took place in July 1983. The highest reported flood on Catfish Creek occurred in August 1956.

Little Chartiers Creek flows in narrow valleys sided by steep slopes conducive to rapid runoff. During rainstorms, Little Chartiers Creek rises rapidly with high velocities. Flood elevations can be increased by ice jams and floating debris, such as trees, logs, and brush, all of which restrict the flow of water through the channels and culverts. The September 1912 flood was the result of severe thunderstorms which dropped approximately 6 inches of rain. Small streams became torrents, causing vast destruction to residences and businesses. Many bridges were either damaged or washed away. Although not as severe as the flood of 1912, the floods of 1956, 1961, 1963, 1966 and 2004 caused considerable damage.

Flooding may occur on Maple Creek at various times of the year. Most flooding is the result of heavy rain and snowmelt. However, due to the steep stream slope, rainfall would run off quickly and most flooding would be caused by bridge plugging from debris along Maple Creek.

The principal flood problem within the Borough of Charleroi is overbank flooding of the Monongahela River, which has a history of flooding dating from the 1800's. Floods on the Monongahela River usually occur between December and March. The floods of June 1941 and August 1956 resulted from widespread thunderstorms with high-intensity rainfall. The October 1954 flood was caused by intense rainfall of relatively short duration from Hurricane Hazel. The duration of flooding on the Monongahela River was several days. The stream gaging station was located at Locks and Dam No. 4 until 1976 when it was moved to Locks and Dam No. 3. Actual gage readings during flood events have been recorded at Locks and Dam No. 3 since 1937. During a major flood on the Ohio and/or Youghiogheny River, the upper gage readings may be affected by backwater from these rivers. The highest flood of record at Locks and Dam No. 3 (River Mile 23.8 to River Mile 28.0) along the Monongahela River occurred on March 18, 1936, and was the result of heavy rainfall and snowmelt from the 16th to the 18th of March.

The most significant floods of record experienced on the Monongahela River, as measured at Locks and Dam No. 3, are shown in Table 7, "Floods of Record on the Monongahela River Upper Gage at Locks and Dam No. 3."

Table 7 – Floods of Record on the Monongahela River Upper Gage at Locks and Dam No. 3

Date of Crest	Stage[1] (feet NAVD88)	Elevation (feet NAVD88)	Discharge (cfs)
March 18, 1936	35.0	749.9[1]	153,000
November 5, 1985	31.0	748.9[1]	184,900
June 24, 1972	28.4	746.3[1]	137,000
October 16, 1954	31.0	745.9[1]	141,000
March 7, 1967	32.8	745.7[1]	158,000
June 5, 1941	30.4	745.3[1]	143,000
March 5, 1963	29.0	743.9[1]	154,000
August 6, 1956	28.6	743.5[1]	133,000
October 29, 1937	28.4	743.3	130,500
May 25, 1968	25.1	743.0[1]	127,000

Note: Zero datum at the upper gage was 714.4 feet NAVD88 until November 1967

Zero datum at the upper gage was 717.4 feet NAVD88 from November 1967 feet to present

Upper gage heights are affected by backwater from the Ohio River at Pittsburgh and from the Youghiogheny River

[1]Elevation is modified by Tygart Dam and reservoir

The stages for floods prior to 1938 do not reflect the reductions that would have been provided had any of the USACE upstream dams and reservoirs been in operation. Since 1985, Stonewall Jackson Dam has been completed in the Monongahela River basin. This project, under construction during the November 1985 flood, would provide a negligible additional reduction at Locks and Dam No. 3. Flood stage on the Monongahela River at Locks and Dam No. 3, referenced to the upper gage, is 20 feet.

The gaging station at Locks and Dam No. 4, located in the Borough of Charleroi (4.4 miles downstream of Belle Vernon), was jointly operated by the U.S. Geological Survey (USGS) and the USACE between August 1932 and September 1976. The gage records are maintained by the Pittsburgh District of the USACE (Reference 43). Also, stage-discharge records have been maintained at Locks and Dam No. 4. The highest flood of record at this gaging station occurred on November 5, 1985, as a result of Hurricane Juan, and had a peak discharge of 191,300 cfs. The second highest flood of record occurred on March 7, 1967, and had a peak discharge of 158,000 cfs and a 3.23-percent-annual-chance flood recurrence interval (References 43 and 44). Although no exact stage is known, the flood of July 11, 1888, was estimated to have had a peak discharge of 214,000 cfs and a 0.21-percent-annual-chance flood recurrence interval. The most significant floods of record experienced on the Monongahela River, as measured at Locks and Dam No. 4, are shown in Table 8, "Floods of Record on the Monongahela River Lower Gage at Locks and Dam No. 4."

Table 8 – Floods of Record on the Monongahela River Lower Gage at Locks and Dam No. 4

Date of Crest	Stage[1] (feet NAVD88)	Elevation[1] (feet NAVD88)	Discharge (cfs)
November 5, 1985	41.8	759.7[1]	191,300
July 1888	*	759.5[2]	214,000
March 18, 1936	39.6	755.8[3]	153,000
March 7, 1967	39.5	755.7[1]	158,000
October 16, 1954	37.4	753.6[1]	141,000
March 5, 1963	37.4	753.6[1]	154,000
June 5, 1941	37.0	753.2[1]	143,000
June 24, 1972	34.9	752.8[1]	120,000
August 6, 1956	36.1	752.3[1]	133,000
March 25, 1936	35.5	751.7[3]	133,000
October 29, 1937	35.4	751.6[3]	130,500
May 25, 1968	33.4	751.3[1]	127,000

Note: Zero datum at the lower gage was 715.7 feet NAVD88 until November 1967

Zero datum at the lower gage was 717.4 feet NAVD88 from November 1967 to present

*Data not available

[1]Elevation is modified by Tygart Lake and Dam

[2]Historical flood

[3]Stages prior to any USACE flood control dam

The upper stages prior to 1967, when gates were added to the existing dam, were converted to the lower gage readings. The stages for floods prior to 1938 do not reflect the reductions that would have been provided had any of the USACE upstream dams and reservoirs been in operation. Since 1985, Stonewall Jackson Dam has been completed in the Monongahela River basin. This project, under construction during the November 1985 flood, would provide a negligible additional reduction at Locks and Dam No. 4. Flood stage on the Monongahela River at Locks and Dam No. 4, referenced to the lower gage, is 26 feet.

The highest flood of record from Maxwell Locks and Dam (River Mile 61.2) to Locks and Dam No. 7 (River Mile 85.0) occurred on November 5, 1985, also the remnants of Hurricane Juan. The most significant floods of record experienced on the Monongahela

River, as recorded at the Maxwell Locks and Dam, are shown in Table 9, “Floods of Record on the Monongahela River at Maxwell Locks and Dam”.

Table 9 – Floods of Record on the Monongahela River at Maxwell Locks and Dam

Date of Crest	Stage (feet NAVD88)	Elevation (feet NAVD88)	Discharge (cfs)
November 5, 1985	43.5[2]	778.0[2]	202,000
March 18, 1936	44.0	772.5[3,4]	152,000
March 7, 1967	43.7[1]	772.1[5]	158,000
October 29, 1937	43.6	772.1[3,4]	157,000
March 5, 1963	43.3	771.8[3,5]	154,200
October 16, 1954	42.7	771.2[5]	141,000
June 5, 1941	41.5	770.0[3,5]	142,200
August 6, 1956	40.5	769.0[3,5]	134,700
February 4, 1948	40.0	768.5[3,5]	131,400
February 4, 1939	38.7	767.2[3,5]	124,800
June 23, 1972	32.1[1]	766.6[5]	120,000

Note: Zero datum at the lower gage was 728.0 feet NAVD88 until November 1967

Zero datum at the lower gage was 734.0 feet NAVD88 from November 1967 to present

[1]Actual lower gage height

[2]Elevation is modified by present reservoir system

[3]Elevation determined from stage discharge relation

[4]Stages prior to any USACE flood control dam

[5]Elevation is modified by Tygart Lake and Dam

For both Pool 4 and the Maxwell Pool, the upper stages prior to 1967, when gates were added to the existing dam, were converted to the lower gage readings. The stages for floods prior to 1938 do not reflect the reductions that would have been provided had any of the USACE upstream dams and reservoirs been in operation. Since 1985, Stonewall Jackson Dam has been completed in the Monongahela River basin. Flood stage on the Monongahela River at Locks and Dam No. 4, referenced to the lower gage, is 26 feet. Flood stage on the Monongahela River at Maxwell Locks and Dam, referenced to the lower gage, is 32 feet.

Flooding on Pigeon Creek within the City of Monongahela is caused entirely by backwater from the Monongahela River. Major floods have occurred on Pigeon Creek in March 1936, August 1956, and March 1963. The flood of August 1956 is the maximum known flood of record and has an estimated 2-percent-annual-chance recurrence interval. This flood was the result of two distinct storm centers. Average rainfall over the Pigeon Creek basin was 4 to 5 inches. Flooding was extensive during the time of peak flow, but damage to structures was moderated by the quick recession of the stream.

Major floods may occur on Racoon Creek at various times of the year. Flooding in the Borough of Burgettstown is caused primarily by high intensity, short duration thunderstorms. The flood of July 1950, which was the highest since 1912, had an estimated peak flow of 2,000 cfs.

Major floods may occur on Robinson Run at various times of the year. Flooding in the Borough of Midway is caused primarily by high intensity, short duration thunderstorms. The most recent flood on Robinson Run occurred on August 18, 1980. Based on high-water mark data for the Borough of Oakdale, the highest flood probably occurred in June 1904. Other known floods occurred in June 1928, July 1943, July and September 1912, April 1922, July 1950, August 1965, and August 1975.

Major floods have occurred along Tenmile Creek at various times of the year. However, the primary flood season on both rivers is usually December through March. Most of the floods that occur during this period are the result of heavy rain and snowmelt, although more recently, major floods have occurred during the summer or early fall months from the remnants of hurricanes.

Flood records have been available since 1969 from the Marianna USACE recording gage located at the Jefferson Avenue bridge, Marianna, Pennsylvania, approximately four miles downstream of the Township of Amwell corporate limit. The largest flood known to have occurred on Tenmile Creek was that of March 1963 with a discharge of approximately 8,000 cfs.

Table 10, "Historical Floods on Tenmile Creek at Marianna, Pennsylvania," shows major floods of record as measured at the Jefferson Avenue recording gage located at mile 11.2 on Tenmile Creek:

Table 10 – Historical Floods on Tenmile Creek at Marianna, Pennsylvania

Date of Crest	Actual Stage (feet NAVD88)	Elevation (feet NAVD88)	Discharge (cfs)
March 5, 1963	18.3	876.5	8,000
March 13, 1972	17.1	875.3	7,000
June 23, 1972	15.3	873.5	5,000
September 24, 1975	14.6	872.8	4,500

Gage Zero = 857.72 feet NAVD88

The gaging station on Tenmile Creek, operated by the USGS since 1967, is located approximately 2.2 miles upstream of Clarksville. The flood of record at this gage occurred on September 24, 1975. It had a discharge of 20,200 cfs and an estimated 0.19-percent-annual-chance recurrence interval (Reference 44).

2.4 Flood Protection Measures

For the Township of Canton and the City of Washington, the Washington Local Flood Protection Project was completed by the USACE in October 1962. This project consisted mainly of enlargement and realignment of the Chartiers Creek channel beginning approximately 1,200 feet upstream of the State Route 18 bridge and extending upstream to the Jessop Place bridge. The project also included the confluence of streams entering Chartiers Creek within the project reach and the construction of an 800 foot deflection dike at the upstream limit of the channel improvement. The project was designed to contain flood flows equal in magnitude to 60 percent greater than the flood of record of September 1912 of 4,500 cfs. The deflection dike prevents overland flow from such a flood. FEMA specifies that all levees must have a minimum of 3-foot freeboard against 1-percent-annual-chance flooding to be considered a safe flood protection structure. The deflection dike in the Township of Canton does not meet this freeboard requirement.

Within the Township of Cecil, after the flood of 1912 along Chartiers Creek, the railroad company built an earthen levee at Hills Station from just above the Main Street bridge upstream to the railroad bridge. After the flood of 1956 the levee was extended downstream to the Main Street bridge. The result is a levee from the Main Street bridge upstream to the railroad bridge high enough to contain a 2-percent-annual-chance flood but not high enough to contain a 1-percent-annual-chance flood.

A USACE flood protection project was constructed for a reach of Chartiers Creek in the Township of Chartiers and the adjoining Borough of Houston. The project, Unit 2B, consists of deepening, widening and re-aligning the channel of Chartiers Creek. The channelization of Chartiers Creek extends through the Boroughs of Canonsburg and Houston to a point 0.4 mile upstream of the Borough of Houston.

In 1970, the USACE channelized a section of Chartiers Creek from the Interstate 79 bridge upstream into the Borough of Canonsburg, a distance of about 1.6 miles (Reference 45). In 1971, the GSA constructed a channelization project from the USACE project upstream about 0.6 mile (Reference 46). In 1973, the USACE constructed another channelization project on Chartiers Creek about 0.8 mile from the GSA project upstream (References 47 and 40). The entire channelization work on Charters Creek, about 3.0 miles in length, contains a 2-percent-annual-chance flood but does not completely contain a 1-percent-annual-chance flood.

The Washington-East Washington Joint Authority completed a flood-protection dike on Chartiers Creek around the sewage treatment plant at Arden (Reference 48). This dike will contain a 1-percent-annual-chance flood, but will not contain a flood with a 0.2-percent-annual-chance.

No significant flood protection projects exist on the Monongahela River within Pool 3 located in the Boroughs of Donora, New Eagle, the City of Monongahela, and Townships of Carroll, and Union. However, flood control projects completed or authorized in the Monongahela River Basin include the following: Tygart Lake on the Tygart River, near Grafton, West Virginia; Stonewall Jackson Lake on the West Fork River near Weston, West Virginia; Rowlesburg Lake on the Cheat River near Rowlesburg, West Virginia; Deep Creek Reservoir on the Youghiogheny River near McHenry, Maryland; and the Youghiogheny River Lake on the Youghiogheny River near Confluence, Pennsylvania. Tygart Lake controls runoff from 1,184 square miles, while Stonewall Jackson Lake controls 102 square miles. Both of these reservoirs were constructed for flood control and reduce major flood crests at the Boroughs of East Bethlehem, North Charleroi. Flood impoundments in the Monongahela River Basin provide an average reduction of 3.5 feet in major flood peaks at the Boroughs of Allenport, California, Centerville, Charleroi, Coal Center, Dunlevy, Elco, Roscoe, Spears, Stockdale, and West Brownsville, and Locks and Dams No. 3 and 4. All of these reservoirs, with the exception of Deep Creek Reservoir, were constructed for flood control. All of the reservoirs have or will have secondary purposes that include flow augmentation for navigation, water supply, recreation, and power generation (References 49, 50, and 51). No significant flood protection is provided by the series of locks and dams on the Monongahela River (Reference 52).

The USACE has built a local flood protection project on Racoon Creek. The project starts at the upstream corporate limits of the Borough of Burgettstown and it extends downstream of the downstream corporate limits for approximately 3,100 feet through the Township of Smith. The project was designed to contain within the channel a flow of 2,000 cfs and reduce the stage of a flood equal to the flood of July 1950 by 3.5 feet at the Main Street bridge. The project was completed in November 1952 and it consisted mainly of widening, deepening, and straightening the channel.

The USACE has built a local flood protection project on Tenmile Creek. The project starts at the downstream corporate limits of the Borough of Marianna and extends downstream of the downstream corporate limits for approximately 5,400 feet through the Township of West Elizabeth, located in Allegheny County. The project was designed to contain a flood equal to that of March 1963 within the channel, with a reduction in stage of approximately 4.6 feet at the Jefferson Avenue bridge. The project was completed in August 1979, and it consisted mainly of widening, deepening, realigning, and stabilizing the channel.

At present, there are no flood protection projects on any other flooding source in the Boroughs of Bentleyville and Midway, the Townships of Amwell, Fallowfield, North Bethlehem, South Franklin, and no flood protection projects are proposed in Washington County.

A flood forecasting and warning system is provided by the National Oceanic and Atmospheric Administration's National Weather Service and the USACE to monitor weather conditions and flows in the Monongahela River basin.

The Township of Peters currently has a flood protection ordinance. Ordinance No. 92, amended by ordinance No. 132, prohibits construction in the flood plain area which is designated as alluvial soil on the Soil Conservation Service (SCS) map of the area (Reference 53). These areas are restricted to farming, recreation, wildlife preservation, or similar low-intensity use. The Township of South Strabane currently has a flood protection ordinance. Section 503 of this ordinance, Flood Plain Controls, protects areas of the floodplain subject to and necessary for floodwaters, and encourages the retention of open land for use in the floodplain areas. Floodplain areas are those areas subject to periodic flooding and delineated as alluvial soils on the SCS map of the area (Reference 53). The use of these areas is restricted to farming, recreation, wildlife preservation, or any similar use.

3.0 ENGINEERING METHODS

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

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied by detail methods affecting the communities within Washington County. Information on the methods used to determine the peak discharge-frequency relationships for each flooding source studied by detailed methods is shown below.

<u>Pre-countywide Analysis</u>

Flood flows for Brush Run were developed from information received by the USACE and correlated with similar watersheds to develop a natural flow drainage area versus discharge relationship. For the purposes of this study, the log-Pearson Type III method recommended by the Water Resources Council was used to determine discharge-frequency relationships (Reference 54).

Peak discharge-frequency relationships for Brush Run to Chartiers Creek were developed by correlating information on their watersheds from the USACE with information about similar watersheds, to come up with a drainage area versus discharge relationship. This was then analyzed by the log-Pearson Type III method (Reference 54).

There are no gage or flow records for Brush Run to Little Tenmile Creek, Catfish Creek, Georges Run, Log Pile Run or Montgomery Run. The 1-percent-annual-chance flood was developed using multiple regression formulae based on factors obtained from a USACE study of small streams in Pennsylvania (Reference 55). The factors used were drainage area, stream length, stream slope, and basin shape and were developed from an analysis of natural flow frequencies from gaged watersheds.

Natural discharge-frequency curves for Chartiers Creek were developed by correlating data from USACE gages located within the Chartiers Creek Basin. The relationships were analyzed following the log-Pearson Type III analysis as outlined in the Water Resources Council Bulletin 17B (Reference 56). A drainage area versus discharge relationship was then established for the basin. The 1-percent-annual-chance flood flow was determined from this relationship.

Peak discharge-frequency relationships for Chartiers Run were developed by correlating data from five gages in the Chartiers Creek watershed with those from similar watersheds. The relationships were then analyzed by the log-Pearson Type III method (Reference 54). Within the Township of Chartiers, peak discharge-frequency relationships for Georges Run were developed by correlating data from five gages in the Chartiers Creek watershed with those from similar watersheds. The relationships were then analyzed by the log-Pearson Type III method (Reference 54).

Flood flows for Little Chartiers Creek were developed by using information received from the USACE. This information was correlated with similar watersheds in order to develop a natural flow drainage area versus discharge relationship. The log-Pearson Type III method was used to determine discharge-frequency relationships (Reference 54).

There are no stream gages or flow records for Little Tenmile Creek, Maple Creek, Montgomery Run, Racoon Creek or Robinson Run. The 1-percent-annual-chance frequency flood was developed through: the use of multiple regression formula based on factors determined from a USACE study of small streams in Pennsylvania; the Federal Highway Administration Circular No. 17; Water Resources Council Bulletin No. 17; and the Penn State-IV Method for estimating design flood peaks for ungaged streams (References 55, 82, 54, and 58). The 1-percent-annual-chance frequency flood was determined by computing the average value of these methods.

The analyses of the natural peak discharge-frequency curves on the Monongahela River followed a standard log-Pearson Type III method as outlined by the Water Resources Council Bulletin 17B (Reference 56). The resulting flood flow frequencies developed on the Monongahela River at Locks and Dam No. 3, Locks and Dam No. 4, and Maxwell Locks and Dam were modified by means of an average reduction curve in order to reflect flow reduction by the present upstream flood control reservoirs. Frequency flood flows for Pools 3 and 4 of the Monongahela River were based on statistical analyses of stage-discharge records that have been maintained at Locks and Dam No.4, located at Charleroi, Pennsylvania, River Mile 41.5, over a 54-year period. A stream gaging station, jointly operated by the USGS and the USACE, was also located at this site until 1976, when it was moved to Locks and Dam No. 3. Actual gage readings during flood events have been recorded at Locks and Dam No. 3 since 1937. During a major flood on the Ohio and/or Youghiogheny River, the upper gage readings may be affected by backwater from these rivers. All stage-discharge records are maintained by the USACE, Pittsburgh District. The actual peak flows at Locks and Dam No. 4 were adjusted for the effects of the upstream flood control reservoirs that were constructed by the USACE between 1938 and 1990, to compute a natural peak flow for each flood event.

Frequency flood flows for the Maxwell Pool of the Monongahela River were based on a statistical analysis of stage-discharge records that have been maintained at Maxwell Locks and Dam located at Maxwell, Pennsylvania since 1967. Prior to the construction of Maxwell Locks and Dam, gage records were available at Locks and Dam No. 5 from 1921 to 1967. The total period used to compute the frequency flows was 66 years.

Flood flows for Peters Creek were developed from information received by the USACE and correlated with similar watersheds to develop a natural flow drainage area versus discharge relationship. For the purposes of this study, the log-Pearson Type III method recommended by the Water Resources Council was used to determine discharge-frequency relationships (Reference 54).

Within the Borough of Bentleyville, flows for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods on Pigeon Creek were taken from a discharge versus drainage area curve. This curve was based on a study of flood frequencies of streams within the Pigeon Creek watershed. Frequencies were computed from actual stream flow data or multiple regression formulae developed by the USACE (Reference 55).

Gage readings were also obtained at the railroad bridge upstream of Oliver Avenue within the Borough of Bentleyville from June 1965 to August 1966. Readings were also obtained at the Bentleyville-Monongahela Road Bridge in Van Voorhis, approximately 3 miles downstream of the study reach from June 1965 to November 1968. These gages were not included in the flood frequency analysis on Pigeon Creek because of the short period of records.

Within the City of Monongahela and the Township of Carroll, flows for Pigeon Creek were obtained from a regional analysis method developed for watersheds in Pennsylvania, known as PSU-III (Reference 57). The PSU-III analysis was judged to be more applicable for Pigeon Creek on the basis of the accuracy of predictions for watersheds of this size.

Peak flows for Tenmile Creek were estimated using the procedure outlined in the Water Resources Council Bulletin No. 13 (Reference 59). The method provides for estimates of flood flows at ungaged sites on unregulated gaged streams by weighting regression-derived estimates for the ungaged sites with station skew-derived log-Pearson Type III estimates for the gaged sites. The weighting is based on equivalent years of record for the respective estimates. The gaged sites would have drainage areas between one-third and three times that of the ungaged site for this method to yield reasonable estimates. Tenmile Creek, at the confluence with South Fork Tenmile Creek and the Monongahela River, falls within this range.

The estimates described above were determined from regression equations presented in the USGS publication. Equations were developed for the entire State of Pennsylvania that relate floods of several recurrence intervals to readily determined watershed characteristics. Individual equations include no more than two of the following watershed characteristics as independent variables: drainage area; channel slope; percent of area which serves for storage of surface water; and the index of average, annual excess precipitation. Drainage area and the index of average, annual excess precipitation are the independent variables applicable to southwestern Pennsylvania.

The log-Pearson Type III frequency analyses of data recorded on Tenmile Creek were obtained from the USGS Water Resources Department in Harrisburg, Pennsylvania (Reference 60). The analyses were performed in accordance with the latest recommendations of the Water Resources Council (Reference 61).

Flood flows on Tenmile Creek at the confluence with South Fork Tenmile Creek were based on the data recorded at the gage upstream from Clarksville. However, at its confluence with the Monongahela River, the peak flows were based on the data recorded at the gage on South Fork Tenmile Creek because of its longer period of record.

The peak flows determined using the method above for the reach of Tenmile Creek between the Monongahela River and Clarksville may be slightly underestimated. Examination of the USGS gaging records indicate that major floods on South Fork Tenmile Creek and Tenmile Creek peak at nearly the same time at their confluence. A much more detailed analysis would be required to establish the exact characteristics of flooding at the confluence of these streams.

Within the Borough of Marianna and the Township of Amwell, natural discharge-frequency curves for Tenmile Creek were developed by correlating data from recording gages located within the Tenmile Creek basin. The gages used in the analysis were the USACE gage at Marianna, Pennsylvania, and the USGS Gaging Station No. 03072840, located in Clarksville, Pennsylvania. The relationships were analyzed following the log-Pearson Type III analysis outlined by Bulletin 17B (Reference 56). A drainage area versus discharge relationship was then established for the basin using the Township of East Bethlehem FIS (Reference 16). The 1-percent-annual-chance frequency flood flow was determined from this relationship.

Within the Township of South Franklin, the 1-percent-annual-chance frequency flow on Tenmile Creek was developed using multiple regression formula based on parameters determined from a USACE study of small streams in Pennsylvania (Reference 55). These parameters include drainage area, stream length, stream slope, and basin shape. The 1-percent-annual-chance flow was then compared to the USACE recording gage at Marianna, Pennsylvania, and the discontinued USGS Clarkesville, Pennsylvania, gage by a discharge versus drainage area relationship.

The five gages used in developing the discharge-frequency relationships for Brush Run, Brush Run to Chartiers Creek, Chartiers Creek, Chartiers Run, Georges Run, Little Chartiers Run, Peters Creek, and Tributary 4 are listed below.

Stream and Location	Drainage Area (mi^2)	No. of Years of Record
Gage No. 855 Chartiers Creek Carnegie, PA	263	56
Gage No. 861 Big Sewickley Creek Ambridge, PA	15.6	14
Gage No. 11115 Brush Run Buffalo, PA	10.3	16
Gage No. 498 Little Pine Creek Etna, PA	5.78	14
Gage No. 830 Green Lick Run Green Lick Reservoir, PA	3.07	46

Several ungaged streams in the Chartiers Creek watershed, including Tributary 4, and Wolfdale Run were analyzed by a multiple regression method developed by the USACE (Reference 62). The USACE developed equations from this method by analyzing twelve different gage records for watersheds of less than 25 square miles. These gages have more than 25 years of records and are located in eastern Ohio, northern West Virginia, and western Pennsylvania (Reference 62). Flows for the streams in the Chartiers Creek watershed developed from the USACE multiple regression method were compared to the drainage area versus the discharge relationship and were found to agree.

Countywide Analyses

For this countywide FIS, new hydrologic analyses were performed by GG3, a joint venture between Stantec and Gannett Fleming, Inc., along Brush Run to Chartiers Creek in the Township of Peters; Maple Creek in the Township of Fallowfield and the Boroughs of Speers and Twilight; Pigeon Creek in the Townships of Monongahela, Carroll, Fallowfield, and the Boroughs of Bentleyville and Ellsworth; and Wolfdale Run in the Township of Canton. The methodology used to calculate peak discharges for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for these flooding sources is found in the 2008 USGS publication; *"Regression Equations for Estimating Flood Flows at Selected Recurrence Intervals for Ungaged Streams in Pennsylvania"* (Reference 63).

The arithmetic equation for discharge is:

$$\hat{Q}_T = 10^A (DA)^b (El)^c (1+0.01C)^d (1+0.01U)^e (1+0.1Sto)^f$$

Where $\hat{Q}_T$ is the T-year predicted flood flow, in cubic feet per second (cfs); A is the intercept (estimated by Generalized Least Squares (GLS)); DA is the drainage area, in square miles; El is mean elevation, in feet; C is basin underlain by carbonate bedrock, in percent; U is urban area in the basin, in percent; Sto is storage in the basin, in percent; and b, c, d, e, and f are basin characteristic coefficients of regression estimated by GLS.

The publication divides the state of Pennsylvania into four flood-flow regions and hydrologic unit code boundaries. Washington County is divided by Regions 3 and 4. The basin characteristic coefficients of regression for mean elevation, underlain by carbonate bedrock, and storage area only applicable for Region 3, which Brush Run East and Wolfdale Run falls within. Maple Creek and Pigeon Creek are within Region 4, only requiring drainage area as a variable.

Wolfdale Run's watershed was found to be urbanized beyond the acceptable limit of the state regression equations. Regression equations used to estimate urban peak discharges for ungaged sites were taken from the 1984 USGS publication; *"Flood Characteristic of Urban Watersheds in the United Stations"* (Reference 64). These equations were utilized in conjunction with the aforementioned rural equations to account for increased runoff due to urbanization.

The three-parameter estimating equations for urban discharge are:

$$UQ(10) = 9.51\ Area^{0.21}\ (13\text{-}BDF)^{-0.36}\ RQ(10)^{0.79}$$
$$UQ(50) = 8.04\ Area^{0.15}\ (13\text{-}BDF)^{-0.32}\ RQ(50)^{0.81}$$
$$UQ(100) = 7.70\ Area^{0.15}\ (13\text{-}BDF)^{-0.32}\ RQ(100)^{0.82}$$
$$UQ(500) = 7.47\ Area^{0.16}\ (13\text{-}BDF)^{-0.30}\ RQ(500)^{0.82}$$

Where *UQ(n)* is the discharge in cfs for the n-year recurrence interval; *Area*, contributing drainage area, in square miles; *BDF* is a basin development factor; and *RQ(n)* is the discharge in cfs for the n-year recurrence interval of the rural discharge calculated above.

BDF was computed by first dividing each basin into thirds. Then within each third, the drainage system is evaluated and each assigned a value according to four aspects:

- Channel Improvements
- Channel linings
- Storm drains, or storm sewers
- Curb-and-gutter streets

New hydrologic analyses were performed by GG3 for all flooding sources with base level analyses (Zone A). Peak flows were computed for the1-percent-annual-chance-flood events as required for Zone-A base study areas using USGS Scientific Investigations Report 2008-5102, *Regression Equations for Estimating Flood Flows at Selected Recurrence Intervals for Ungaged Streams in Pennsylvania*, by Mark A. Roland and Marla H. Stuckey, 2008 (Reference 63).

Peak discharge-drainage area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for each stream studied by detailed methods are presented in “Table 11 – Summary of Discharges.”

Table 11 – Summary of Discharges

		PEAK DISCHARGES (cfs)			
FLOODING SOURCE AND LOCATION	**DRAINAGE AREA (SQ. MILES)**	**10%-ANNUAL-CHANCE**	**2%-ANNUAL-CHANCE**	**1%-ANNUAL-CHANCE**	**0.2%-ANNUAL-CHANCE**
BRUSH RUN					
0.9 mile above mouth	10.6	1,150	1,990	2,410	3,590
1.2 miles above mouth	7.0	900	1,550	1,890	2,800
2.6 miles above mouth	3.9	640	1,110	1,350	2,000
BRUSH RUN TO CHARTIERS CREEK					
At Valley Brook Road	9.95	1,260	2,000	2,400	3,430
Upstream of Camp Lane	9.67	1,230	1,950	2,340	3,340
850 ft. Upstream of State Route 19	6.88	850	1,360	1,630	2,350
Downstream of Maplewood Drive	6.27	790	1,270	1,530	2,200
2,420 ft. Upstream of Maplewood Drive	4.97	670	1,080	1,300	1,860
900 ft. Downstream of McMurray Road	4.63	640	1,030	1,230	1,770
At McMurray Road	3.53	570	900	1,080	1,550

*Data not available

Table 11 – Summary of Discharges - Continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
LITTLE CHARTIERS CREEK (Continued)					
Above confluence with tributary along Christy Road	23.9	2,075	3,700	4,550	6,900
At the downstream corporate limits of South Strabane	21.2	2,075	3,700	4,550	6,900
Upstream of confluence of Tributary 4	9.6	1,075	1,850	2,290	3,375
Upstream of the confluence of the unnamed tributary at the downstream end of the Interstate 70 culvert	6.0	825	1,425	1,725	2,550
Upstream of confluence of Tributary 9, 0.9 mile above Interstate 70	3.1	585	990	1,200	1,750
At the downstream end of the U.S. Route 40 culvert	2.1	470	800	960	1,410
LITTLE TENMILE CREEK					
Downstream of Brush Run	17.9	*	*	2,900	*
Upstream of Brush Run	14.8	*	*	2,570	*
Upstream of Potato Run	12.2	*	*	2,290	*
Upstream of Shipe Run	10.6	*	*	2,080	*
Upstream of Redd Run	6.3	*	*	1,500	*
at Harts Mill	3.4	*	*	1,050	*
LOG PILE RUN					
At the confluence with Chartiers Creek	3.8	650	1,130	1,420	2,070
MAPLE CREEK					
Downstream of Twilight Hollow Road	4.75	1,070	1,700	2,060	2,970
800 ft. Upstream of Calvary Road	4.26	980	1,560	1,900	2,730

*Data not available

<u>Table 11 – Summary of Discharges</u> - Continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
MAPLE CREEK (Continued)					
At Fox Stop Road	3.61	860	1,380	1,670	2,410
At Rogers Lane	2.96	740	1,180	1,430	2,060
Upstream of Pennsylvania Expressway	2.11	500	820	990	1,430
At Zippay Rd.	1.47	370	620	750	1,080
MONONGAHELA RIVER					
From Locks and Dam No. 3 to Locks and Dam No. 4	5,332/ 4,046[1]	140,000	180,000	198,000	240,000
From Locks and Dam No. 4 to River Mile 55.1	5,205/ 3,919[1]	168,500	212,000	231,000	275,000
River Mile 55.1 to Maxwell Locks and Dam	4,961/3,879[1]	140,000	180,000	198,000	240,000
MONTGOMERY RUN					
At mouth	4.4	*	*	1,280	*
PETERS CREEK					
At downstream corporate limits of the Township of Peters	8.0	980	1,680	2,050	3,000
1.6 miles above corporate limits of the Township of Peters	3.9	640	1,110	1,350	2,000
At upstream corporate limits of the Township of Peters	2.4	510	865	1,040	1,530
PIGEON CREEK					
At the confluence with Monongahela River	59.4	4,495	7,380	8,860	13,045
Above the confluence of Taylors Run	54.0	4,160	6,850	8,230	12,140

[1]Reduced by Tygart Dam and Stonewall Jackson Dam

*Data not available

<u>Table 11 – Summary of Discharges</u> - Continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
PIGEON CREEK (Continued)					
Upstream of confluence of Sawmill Creek	45.0	3,600	5,950	7,160	10,585
Upstream of confluence of unnamed tributary near Redds Mill	42.3	3,430	5,680	6,835	10,115
Upstream of confluence of unnamed tributary near Gibson to upstream corporate limits of Fallowfield Township	37.2	3,090	5,140	6,195	9,185
Above confluence with North Branch Pigeon Creek	23.8	2,165	3,640	4,405	6,575
Above confluence with two unnamed tributaries in the Borough of Bentleyville	22.0	2,035	3,430	4,150	6,200
RACOON CREEK					
At downstream corporate limits of the Borough of Burgettstown	15.0	*	*	2,800	*
ROBINSON RUN					
At downstream corporate limits of the Borough of Midway	1.6	*	*	620	*
ROBINSON RUN					
At downstream Borough of McDonald corporate limits	10.40	1,170	2,050	2,500	3,750
At Township of North Fayette downstream Corporate limits	12.90	1,170	2,200	2,700	4,200

[1]Reduced by Tygart Dam and Stonewall Jackson Dam

*Data not available

<u>Table 11 – Summary of Discharges</u> - Continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ. MILES)	PEAK DISCHARGES (cfs) 10%-ANNUAL-CHANCE	2%-ANNUAL-CHANCE	1%-ANNUAL-CHANCE	0.2%-ANNUAL-CHANCE
TENMILE CREEK					
At confluence with Monongahela River	338	15,300	20,200	22,300	27,500
At confluence with South Fork Tenmile Creek	140	7,900	12,300	14,400	20,000
At downstream corporate limits of the Borough of Marianna	116.7	*	*	12,000	*
At the downstream corporate limits of the Township of Amwell	66.5	*	*	10,100	*
At the Township of South Franklin downstream corporate limits	5.9	*	*	1,400	*
TRIBUTARY 4					
At mouth on Little Chartiers Creek	12.1	1,250	2,160	2,640	3,900
Upstream of confluence with Tributary 5	8.1	990	1,690	2,050	3,010
WOLFDALE RUN					
At confluence with Chartiers Creek	4.2	765	1,190	1,415	1,970
Approximately 170 feet downstream of South Hewitt Road	3.6	650	1,025	1,215	1,695
Approximately 1080 feet upstream of South Hewitt Road	3.1	585	920	1,085	1,515
Downstream of confluence of two unnamed tributaries near McClay Road Bridge	2.4	470	740	875	1,220
Approximately 1100 feet downstream of Old Johnson Lane	2.0	385	610	720	1,010
Approximately 300 feet downstream of Jefferson Avenue	1.6	330	520	615	860

*Data not available

3.2 Hydraulic Analyses

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

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5-foot for floods of the selected recurrence intervals. 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 is computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2). Unless specified otherwise, the hydraulic analyses for these studies 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.

All elevations shown on the Flood Profiles and FIRM (Exhibits 1 and 2) are referenced to the NAVD88.

<u>Pre-countywide Analyses</u>

For Brush Run, all cross-section data were obtained by field measurement and all bridges were surveyed to obtain structural geometry and elevation data. Water surface profiles of floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 65). The starting water-surface elevations for Brush Run were estimated by slope-area method (Reference 66).

Cross-sectional data for Brush Run to Little Tenmile Creek were obtained by field measurement. All bridges, dams, and culverts were field-surveyed to obtain elevation data and structural geometry. Cross-sections were surveyed to compute the significant backwater effects of these structures. Water-surface elevations of floods of the selected recurrence intervals for Brush Run Little Tenmile Creek, studied by the limited detailed methods, were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for Brush Run to Little Tenmile Creek were obtained by the slope/area method.

Within the Township of Canton, cross-section data for Catfish Creek were obtained from USACE topographic maps (Reference 67). Within the City of Washington, cross-section data for the portion of Catfish Creek from the South Wade Avenue bridge to the upstream corporate limits were obtained from topographic maps compiled from aerial photographs flown in November 1983 at a scale of 1:4,800 with a contour interval of 4 feet (Reference 68). Cross-section data for Catfish Creek from the downstream corporate limits to the South Wade Avenue Bridge were obtained from USACE topographic maps at a scale of 1”=6000’ with a contour interval of 2 feet (Reference 67). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Starting water-surface elevations for Catfish Creek were obtained from a rating curve at the confluence with Chartiers Creek; final frequency profiles were determined by combining the effects of both sources of flooding, which were assumed to be independent. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

For Chartiers Creek, water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). The starting water-surface elevations for Chartiers Creek were estimated by the slope/area method as outlined in the USACE HEC-2 users manual (Reference 66).

Within the Borough of Houston and the Townships of Chartiers, North Strabane, and Peters, cross-sections for Chartiers Creek were obtained by field measurement. All bridges were field surveyed to obtain elevation data and structural geometry.

Within the City of Washington and the Township of Canton, cross-section data for Chartiers Creek were obtained from topographic maps compiled from aerial photographs flown in November 1983 at a scale of 1:4,800 with a contour interval of 4 feet (Reference 68). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Within the Borough of Canonsburg and the Townships of Cecil and North Strabane, cross-section data for Chartiers Creek (excluding the channelized area) were obtained by conventional field surveys. For the channelized portion of Chartiers Creek, cross-sections and bridge information were obtained from USACE and U.S. Department of the Interior, Geological Survey Chartiers Creek Channelization Plans. All other bridges were surveyed to obtain structural geometry and elevation data.

Within the Township of South Strabane, cross-section data for Chartiers Creek were obtained by conventional field surveys. Cross-section data for the flood protection dike were obtained from plans for the Washington-East Washington Joint Authority wastewater treatment plant additions (Reference 48). All bridges were surveyed to obtain structural geometry and elevation data.

Cross-section data for Chartiers Run were obtained by conventional field surveys. All bridges were surveyed to obtain structural geometry and elevation data. Cross-sections were located at close intervals above and below bridges, culverts and other hydraulic structures in order to compute the significant backwater effects from these structures. Water-surface elevations for Chartiers Creek for floods of the selected recurrence intervals were computed through the use of the USACE's HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for all streams studied in detail were computed by the slope/area method.

Cross-section data for Georges Run were obtained by conventional field surveys. All bridges were surveyed to obtain structural geometry and elevation data. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for Georges Run were started at critical depth. The area near the confluence of Georges Run is subject to flooding from the stream itself and by backwater from Chartiers Creek. For the entire length of Georges Run, the final frequency profiles were determined by combining the effects of both sources of flooding, which were assumed to be independent. At selected sections within this reach, the probability of flooding at any elevation was obtained by summing the expected number of occurrences from each source; however, from its confluence with Chartiers Creek to approximately 1,930 feet upstream, the final frequency profiles delineated are based on backwater from Chartiers Creek.

Cross-section data for Little Chartiers Creek were obtained by conventional field surveys. Cross-section data for the flood protection dike were obtained from plans for the Washington-East Washington Joint Authority wastewater treatment plant additions (Reference 48). All bridges were surveyed to obtain structural geometry and elevation data. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for Little Chartiers Creek were estimated from a discharge versus elevation curve developed from the Canonsburg Lake spillway and dam (Reference 69).

Cross-sectional data for Little Tenmile Creek were obtained by field measurement. All bridges, dams, and culverts were field-surveyed to obtain elevation data and structural geometry. Cross-sections were surveyed to compute the significant backwater effects of these structures. Water-surface elevations of floods of the selected recurrence intervals for the above streams studied by the limited detailed methods were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for Little Tenmile Creek were obtained by the slope/area method.

Cross-section data for Log Pile Run were obtained from topographic maps compiled from aerial photographs flown in November 1983 (Reference 68). All bridges and culverts were surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting elevations for Log Pile Run were started at critical depth. The area near the confluence of these streams is subject to flooding from the stream itself and by backwater from Chartiers Creek.

For the Monongahela River, cross-sections were obtained from a digital 3-dimensional terrain model created by utilizing an Intergraph/Inroads software design package with the digital design map files and hydrographic data developed in 1990 (Reference 70). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65).

Starting water-surface elevations for Pool 3 of the Monongahela River were obtained from the continuation of profiles from the upper end of Pool 2 and transferred to the upper pool at Locks and Dam No. 3 by weir computations.

Starting water-surface elevations for Pool 4 of the Monongahela River were obtained from the continuation of profiles from the upper end of Pool 3 and transferred to the upper pool at Locks and Dam No. 4 by weir computations.

Starting-water surface elevations for the Maxwell Pool of the Monongahela River were obtained from the continuation of profiles from the upper end of Pool 4 and were transferred to the upper pool at Maxwell Locks and Dam by weir computations.

Cross-sectional data for Montgomery Run were obtained by field measurement. All bridges, dams, and culverts were field-surveyed to obtain elevation data and structural geometry. Cross-sections were surveyed to compute the significant backwater effects of these structures. Water-surface elevations of floods of the selected recurrence intervals for the above streams studied by the limited detailed methods were computed using the USACE HEC-2 step-backwater computer program (Reference 65). Starting water-surface elevations for Montgomery Run were obtained by the slope/area method.

For Peters Creek, water surface profiles of floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 65). The starting water-surface elevations for the streams studied by detailed method were estimated by slope-area method (Reference 66). All cross-section data were obtained by field measurement and all bridges were surveyed to obtain structural geometry and elevation data.

Cross-sectional data for Racoon Creek were obtained by field measurement. All bridges were field surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). The starting water-surface elevation for Racoon Creek was based on the slope/area method.

Cross-sectional data for Robinson Run were obtained by field measurement. All bridges were field surveyed to obtain elevation data and structural geometry. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). In the Borough of McDonald, cross-section data were taken from surroundings and aerial photographs (Reference 71) The starting water-surface elevation for Robinson Run was based at critical depth at the mouth.

Water-surface elevations of floods of the selected recurrence intervals for all streams studied by the limited detailed methods were computed using the USACE HEC-2 step-backwater computer program (Reference 65).

Within the Borough of Marianna and the Township of Amwell, estimates of the 1-percent-annual-chance flood elevations on Tenmile Creek within the study reach were developed through the use of past floods for which high-water marks, gaging station data, and discharge values are available and applicable to the present stream conditions. The well-defined floods of May 6, 1971 and March 13, 1972 and the moderate flow of March 14, 1972 were selected. The water-surface elevations versus corresponding discharge for each of the historical flood events were plotted on logarithmic paper at key rating locations along the stream. Rating locations were chosen at points where the channel gradient changed significantly. Flood profiles were drawn using the extrapolated 1-percent-annual-chance water surface elevation at each of the selected rating locations.

Within the Township of East Bethlehem, cross-sections and bridge data for Tenmile Creek were determined by field measurement and aerial photogrammetry (Reference 72). Starting water-surface elevations for Tenmile Creek were estimated using the slope/area method of predicting an initial water-surface elevation outlined in the HEC-2 Users Manual (Reference 66).

Cross-section data for Tributary 4 were obtained by conventional field surveys. Cross-section data for the flood protection dike were obtained from plans for the Washington-East Washington Joint Authority wastewater treatment plant additions (Reference 48). All bridges were surveyed to obtain structural geometry and elevation data. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 65). The starting water-surface elevations for Tributary 4 were estimated by the slope/ area method as outlined in the USACE HEC-2 user's manual (Reference 66).

Channel and overbank roughness factors (Manning's "n") used in the hydraulic computations were estimated by engineering judgment and based on field observation at each cross-section and adjusted with known high-water marks and stream gage rating curves where possible (References 73 and 74). Table 12, "Manning's "n" Values", shows the channel and overbank "n" values for the streams studied by detailed methods.

Countywide Analyses

As part of this countywide FIS, new detailed hydraulic analyses were performed along reaches on Brush Run to Chartiers Creek, Maple Creek, Pigeon Creek and Wolfdale Run by GG3, a Joint Venture between Stantec and Gannet Fleming, Inc.

The new detailed analysis along Brush Run to Chartiers Creek extended from approximately 30 feet downstream of West Valley Brook Road in the Township of Peters to approximately 235 feet upstream of Bebout Road. The detailed analysis along Maple Creek extended from its confluence with Monogahela River to a point approximately 170 feet downstream of the railroad in The Township of Fallowfield. The new detailed analysis along Pigeon Creek extended from its confluence with the Monongahela River in the Township of Monongahela up to a point approximately 1,175 feet upstream of the Railroad in the Boroughs of Bentlyville and Ellsworth. The analysis along Wolfdale Run extended from its confluence with Chartiers Creek to a point approximately 1,675 feet upstream of Jefferson Avenue in Canton Township.

The hydraulic analyses for these studies were steady flow models based on unobstructed flow. Flood elevations and floodway determination was calculated using the USACE HEC-RAS computer program (Reference 75). Hydraulic structures are assumed to remain unobstructed, operating properly, and do not fail. The starting water surface elevations (WSEL) for were calculated using the normal depth method.

The HEC-RAS model developed by GG3 included cross section geometry generated using manual and semi-automated methods derived from Geographic Information Systems (GIS) techniques and data. Cross section elevations for all streams were extracted from a Digital Terrain Model (DTM) developed from 2006 PAMAP LiDAR (Reference 76) data and field surveyed channel geometry. The DTM was generated by combining overbank elevation data from LiDAR with data from traditional field survey of the stream channel and its immediate overbank areas. All bridges, culverts, dams, and other hydraulic obstructions were field surveyed to provide data on elevation, orientation, and structural geometry. All field survey data for structures and stream channels was provided by GG3 partner, Gannett Fleming, Inc.

The HEC-RAS models for both streams were not calibrated to historic events because high-water elevation information was not available.

A streamline was derived using PAMAP orthoimagery. This serves as a base line to define distances along the stream channel as indicated on the Flood Profile and the Floodway Data Tables. Selected cross sections used in the hydraulic analysis are located on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2) relative to distances along this base line.

Manning's values used for the analysis were estimated based on a field reconnaissance conducted by GG3 and supplemented by aerial photography and 2006 National Land Use Dataset (Reference 76) in extended overbank areas of cross sections. Overbank manning's "n" values range from paved area with "n" equaling 0.013 to dense brush and forested areas with "n" equaling 0.12. Typical channel manning's "n" values range from 0.045 to 0.065, with some exceptions.

For flooding sources studied with approximate methods, the 1-percent-annual-chance flood elevations were determined using USGS Regression Equations (Reference 63) and the USACE HEC-RAS computer program (Reference 75). The peak flood discharges from the regression equations were input into a HEC-RAS model that included cross sections extracted from PAMAP LiDAR data collected in 2006 (Reference 76). Because this cross section information was not supplemented with field survey data and the models did not include bridge and culvert information, the resulting floodplain boundaries are considered approximate. Approximately 570 stream miles in Washington County were analyzed using this approach.

Table 12, "Manning's "n" Values", shows the channel and overbank "n" values for the streams studied by detailed methods.

Table 12 - Manning's "n" Values

Stream	Channel	Overbank
Brush Run	0.020 – 0.050	0.040 – 0.100
Brush Run to Chartiers Creek	0.013 – 0.045	0.012 - 0.100
Brush Run to Little Tenmile Creek	0.020 – 0.045	0.040 – 0.050
Catfish Creek	0.025 – 0.040	0.025 – 0.080
Chartiers Creek	0.0265 – 0.040	0.030 – 0.100
Chartiers Run	0.040 – 0.055	0.060 – 0.150
Georges Run	0.035 – 0.050	0.035 – 0.100
Little Chartiers Creek	0.015 – 0.055	0.100 – 0.120
Little Tenmile Creek	0.035	0.040
Log Pile Run	0.040	0.080
Maple Creek	0.030 – 0.048	0.010 – 0.150
Monongahela River	0.025 – 0.030	0.060
Pool 3	0.025 – 0.030	0.060
Pool 4	0.025 – 0.030	0.060
Maxwell Pool	0.023 – 0.032	0.060
Montgomery Run	0.020 – 0.040	0.050

<u>Table 12 - Manning's "n" Values</u> - Continued

Stream	Channel	Overbank
Peters Creek	0.045 – 0.050	0.070 – 0.100
Pigeon Creek	0.055 – 0.065	0.060 – 0.120
Racoon Creek	0.020 – 0.040	0.050
Robinson Run	0.011 – 0.045	0.035
Tenmile Creek	0.032 – 0.040	0.045 – 0.080
Tributary 4	0.035 – 0.045	0.080 – 0.100
Wolfdale Run	0.050 – 0.065	0.060 – 0.120

All qualifying bench marks 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 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.

Bench marks 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 bench marks, 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 bench marks 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. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988, 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. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Washington County is -0.49 feet. The data points used to determine the conversion are listed in Table 13, "Vertical Datum Conversion."

Table 13 – Vertical Datum Conversion

Quad Name	Corner	Longitude	Latitude	Conversion from NGVD29 to NAVD88
Amity	SE	80.125	40.000	-0.476 feet
Avella	SE	80.375	40.250	-0.463 feet
Bethany	SE	80.500	40.125	-0.486 feet
Bridgeville	SE	80.000	40.250	-0.528 feet
Burgettstown	SE	80.375	40.375	-0.472 feet
California	SE	79.875	40.000	-0.538 feet
Canonsburg	SE	80.125	40.250	-0.472 feet
Claysville	SE	80.375	40.000	-0.453 feet
Clinton	SE	80.250	40.375	-0.453 feet
East Liverpool South	SE	80.500	40.500	-0.495 feet
Ellsworth	SE	80.000	40.000	-0.505 feet
Glassport	SE	79.875	40.250	-0.554 feet
Hackett	SE	80.000	40.125	-0.558 feet
Hookstown	SE	80.375	40.500	-0.466 feet
Midway	SE	80.250	40.250	-0.456 feet
Monongahela	SE	79.875	40.125	-0.630 feet
Prosperity	SE	80.250	40.000	-0.440 feet
Steubenville East	SE	80.500	40.250	-0.522 feet
Valley Grove	SE	80.500	40.000	-0.463 feet
Washington East	SE	80.125	40.125	-0.489 feet
Washington West	SE	80.250	40.125	-0.436 feet
Weirton	SE	80.500	40.375	-0.535 feet
West Middletown	SE	80.375	40.125	-0.459 feet
			AVERAGE	**-0.493 feet**

NAVD88 = NGVD29 + conversion factor

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

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

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

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

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

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. The boundaries were interpolated between cross sections using digital terrain models developed from PAMAP LiDAR data collected in 2006 (Reference 76).

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). The boundary of the 1-percent-annual-chance floodplain was delineated using digital terrain models developed from PAMAP LiDAR data collected in 2006 (Reference 76).

4.2 Floodways

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

The floodways presented in this FIS report and on the FIRM were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross-sections. Between cross-sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross-sections (Table 14, Floodway Data). The computed floodways are shown on the FIRM. In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

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

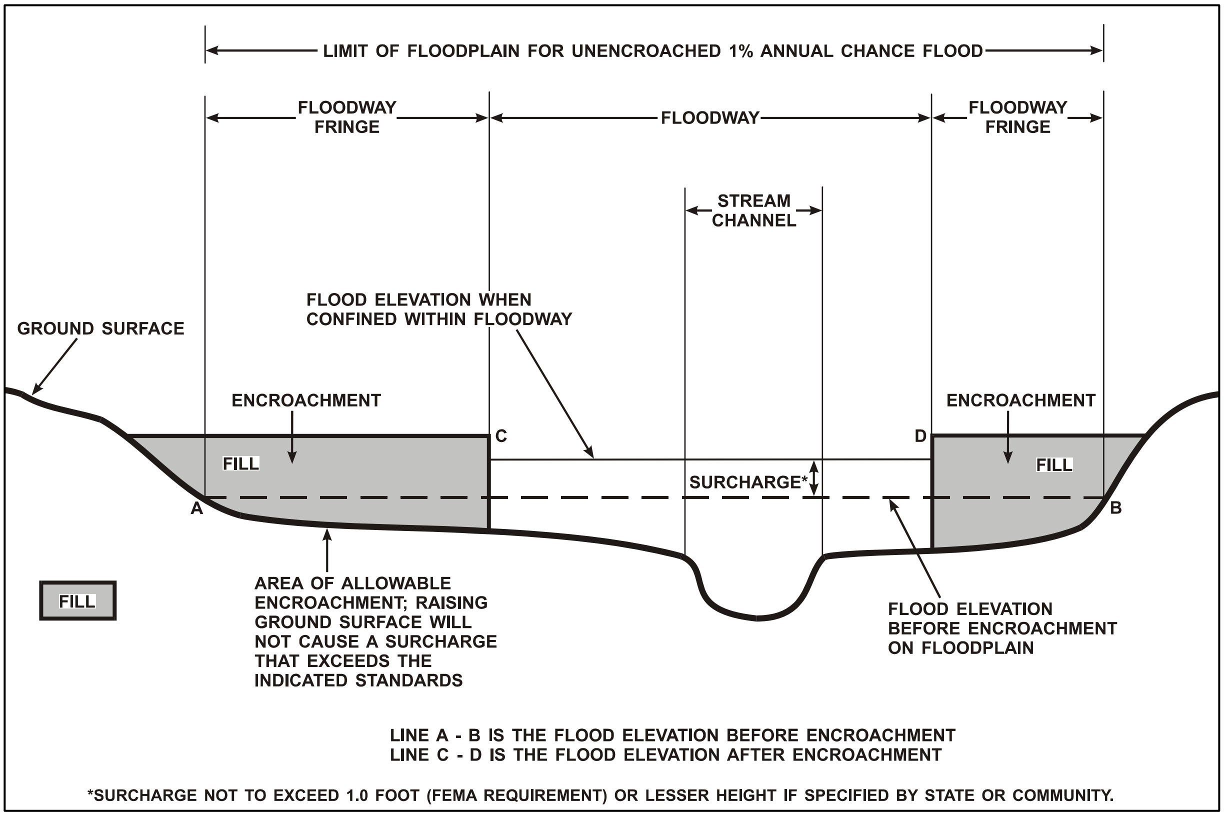

Figure 1 – Floodway Schematic

No floodways were computed for Brush Run to Little Tenmile Creek, Little Tenmile Creek, Maple Creek, Montgomery Run and Racoon Creek; and portions of Chartiers Creek, Tenmile Creek and Robinson Run.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
BRUSH RUN TO CHARTIERS CREEK								
A	-30	58	342	7.0	897.7	897.7	897.7	0.0
B	303	39	235	10.2	900.1	900.1	900.3	0.2
C	715	48	318	7.6	905.2	905.2	905.7	0.5
D	1,064	43	326	7.4	908.1	908.1	908.5	0.4
E	1,808	33	231	10.4	911.6	911.6	912.3	0.7
F	2,456	27	177	9.2	920.0	920.0	920.0	0.0
G	2,978	61	307	5.3	925.1	925.1	925.1	0.0
H	3,716	55	181	9.0	929.3	929.3	929.6	0.3
I	4,915	44	192	8.5	938.7	938.7	939.4	0.7
J	6,608	40	225	7.3	954.1	954.1	954.7	0.6
K	8,227	47	248	5.2	964.5	964.5	965.0	0.5
L	9,440	37	121	9.0	972.4	972.4	972.7	0.3
M	10,016	38	231	4.7	978.7	978.7	978.8	0.1
N	10,973	34	184	5.9	983.6	983.6	984.1	0.5
O	12,510	53	261	4.1	993.6	993.6	994.2	0.6
P	14,076	39	79	7.8	1,004.6	1,004.6	1,004.9	0.3
Q	14,738	58	123	5.1	1,012.2	1,012.2	1,012.2	0.0

[1] Feet above West Valley Brook Road

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

FLOODWAY DATA

BRUSH RUN TO CHARTIERS CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
MAPLE CREEK								
A	531	108	344	6.0	763.3	760.4[2]	761.1[2]	0.7
B	1,018	95	473	4.4	766.1	766.1	766.5	0.4
C	1,623	36	190	10.8	769.2	769.2	769.7	0.5
D	2,029	48	228	9.1	775.5	775.5	776.0	0.5
E	3,241	82	301	6.3	791.2	791.2	791.5	0.3
F	3,746	36	161	11.8	798.2	798.2	798.3	0.1
G	4,566	83	251	7.6	810.9	810.9	811.0	0.1
H	6,143	26	147	11.4	831.2	831.2	831.9	0.7
I	6,909	35	194	8.6	842.7	842.7	843.5	0.8
J	7,598	54	204	8.2	854.2	854.2	854.2	0.0
K	8,501	19	120	12.0	868.4	868.4	868.9	0.5
L	9,240	27	122	11.7	886.2	886.2	886.2	0.0
M	9,775	45	365	2.7	898.8	898.8	899.6	0.8
N	10,264	52	237	4.2	899.7	899.7	900.3	0.6
O	10,828	55	316	3.1	920.1	920.1	921.0	0.9
P	11,154	74	284	3.5	924.7	924.7	925.6	0.9
Q	11,900	25	91	10.8	935.2	935.2	935.2	0.0
R	12,462	33	214	3.5	943.7	943.7	943.8	0.1
S	12,867	29	125	6.0	945.6	945.6	946.2	0.6
T	13,576	39	162	4.6	953.4	953.4	954.4	0.9
U	14,467	17	80	9.4	964.6	964.6	965.5	0.9

[1] Feet above confluence with South Fork Maple Creek

[2] Elevation computed without consideration of backwater from Monongahela River

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

AND INCORPORATED AREAS

FLOODWAY DATA

MAPLE CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
PIGEON CREEK								
A	180	158	2,145	4.1	755.4	744.4[2]	744.9	0.5
B	601	118	1,642	5.4	755.4	744.9[2]	745.4	0.5
C	1,507	264	3,858	2.3	755.4	746.7[2]	747.1	0.4
D	2,511	477	5,826	1.5	755.4	747.1[2]	747.6	0.5
E	3,528	260	3,110	2.9	755.4	747.5[2]	748.0	0.5
F	4,788	563	5,986	1.5	755.4	749.5[2]	750.5	1.0
G	5,369	616	6,138	1.4	755.4	749.7[2]	750.6	1.0
H	6,552	175	1,485	6.0	755.4	751.0[2]	751.7	0.7
I	7,365	370	3,592	2.5	755.4	752.7[2]	753.5	0.7
J	8,742	311	2,898	3.1	755.7	755.7	756.5	0.8
K	10,541	247	1,885	4.4	759.8	759.8	760.6	0.9
L	11,712	143	1,376	6.0	763.5	763.5	763.8	0.3
M	12,755	244	2,013	4.1	766.9	766.9	767.3	0.4
N	14,049	291	1,777	4.6	770.8	770.8	771.4	0.6
O	16,008	337	2,104	3.9	778.7	778.7	779.3	0.6
P	18,644	230	1,543	5.3	789.7	789.7	790.2	0.6
Q	22,332	144	1,334	6.2	803.2	803.2	803.7	0.5
R	25,801	249	2,624	3.1	817.2	817.2	818.0	0.8
S	27,711	230	2,332	3.5	822.6	822.6	823.5	0.9
T	28,802	237	2,558	3.2	827.0	827.0	827.7	0.7

[1] Feet above confluence with Monongahela River

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

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

FLOODWAY DATA

PIGEON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
PIGEON CREEK (CONTINUED)								
U	31,885	230	2,480	2.9	836.4	836.4	837.0	0.6
V	34,449	110	1,144	6.3	844.0	844.0	844.7	0.7
W	37,093	173	1,572	4.6	852.6	852.6	852.9	0.3
X	39,916	162	1,527	4.7	863.7	863.7	864.1	0.4
Y	44,590	151	1,447	4.7	885.4	885.4	886.1	0.7
Z	46,485	197	1,411	4.8	892.9	892.9	893.4	0.5
AA	48,886	142	1,148	6.0	904.1	904.1	904.3	0.2
AB	50,612	128	1,116	5.6	910.1	910.1	910.9	0.8
AC	53,724	293	2,672	2.3	924.4	924.4	924.5	0.1
AD	54,968	190	1,461	3.0	925.6	925.6	926.0	0.5
AE	55,338	143	1,126	3.9	926.4	926.4	926.8	0.4
AF	56,146	162	1,187	3.7	928.9	928.9	929.8	0.8
AG	57,480	152	1,526	2.9	934.7	934.7	935.3	0.6
AH	58,510	333	2,768	1.6	935.4	935.4	936.2	0.8
AI	59,457	233	1,125	3.9	936.3	936.3	937.1	0.8
AJ	60,141	175	1,131	3.9	939.5	939.5	940.2	0.7
AK	61,556	167	1,081	4.1	945.0	945.0	945.4	0.3
AL	62,418	211	1,844	2.4	948.4	948.4	949.0	0.6
AM	63,361	233	1,859	2.4	948.8	948.8	949.4	0.6

[1] Feet above confluence with Monongahela River

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

FLOODWAY DATA

PIGEON CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
PIGEON CREEK (CONTINUED)								
AN	64,301[1]	153	1,245	3.3	949.4	949.4	950.1	0.7
AO	64,842[1]	153	844	4.9	950.3	950.3	950.9	0.6
AP	65,290[1]	189	1,441	2.9	952.0	952.0	952.9	0.9
AQ	65,582[1]	182	1,414	2.9	952.4	952.4	953.2	0.8
AR	66,601[1]	151	1,333	3.1	955.7	955.7	956.6	0.9
ROBINSON RUN								
A	153[2]	38	195	12.8	968.9	968.9	925.9	0.6
B	1,767[2]	168	338	7.4	976.5	976.5	976.7	0.2
C	3,280[2]	274	1,515	1.7	982.0	982.0	983.0	1.0
D-H*								

[1] Feet above confluence with Monongahela River

[2] Feet above confluence with Chartiers Creek

* No floodway data computed

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

FLOODWAY DATA

PIGEON CREEK AND ROBINSON RUN

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
WOLFDALE RUN								
A	947	47	316	4.5	1,013.0	1,013.0	1,013.3	0.3
B	2,456	105	535	2.7	1,015.0	1,015.0	1,015.9	0.9
C	4,254	80	553	2.6	1,023.7	1,023.7	1,024.1	0.3
D	7,042	77	397	2.7	1,034.8	1,034.8	1,035.0	0.2
E	8,523	66	252	4.3	1,043.3	1,043.3	1,044.1	0.8
F	9,640	79	265	4.1	1,050.8	1,050.8	1,050.9	0.1
G	10,305	64	219	4.0	1,054.6	1,054.6	1,055.2	0.7
H	11,937	55	283	2.5	1,067.7	1,067.7	1,068.2	0.5
I	13,705	63	288	2.1	1,078.4	1,078.4	1,079.2	0.7
J	15,150	68	203	3.0	1,085.4	1,085.4	1,085.9	0.5

[1] Feet above confluence with Chartiers Creek

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

FLOODWAY DATA

WOLFDALE RUN

5.0 INSURANCE APPLICATIONS

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

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) 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 report by detailed methods. Whole-foot BFEs 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 areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs 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 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

Zone AR is the flood insurance risk zone that corresponds to an area of special flood hazard formerly protected from the base 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 BFEs 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 BFEs 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 BFEs 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, 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 (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Zone X (Future Base Flood)

Zone X (Future Base Flood) is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined based on future-conditions hydrology. No BFEs or base flood 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 risk zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

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

The countywide FIRM presents flooding information for the geographic area of Washington County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps, where applicable. Historical data relating to the maps prepared for each community are presented in Table 15, “Community Map History.”

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Allenport, Borough of	June 21, 1974	May 28, 1976	July 16, 1981	November 16, 1995
Amwell, Township of	March 4, 1977	None	September 15, 1989	
Beallsville, Borough of	December 13, 1974	July 16, 1976	September 24, 1984	
Bentleyville, Borough of	February 1, 1974	June 4, 1976	June 17, 1986	
Blaine, Township of	October 18, 1974	August 6, 1976	July 2, 1982	
Buffalo, Township of	November 1, 1974	July 9, 1976	June 11, 1982	
Burgettstown, Borough of	January 23, 1974	June 18, 1976	February 17, 1989	
California, Borough of	October 8, 1976	None	June 15, 1981	September 6, 1995
Canonsburg, Borough of	February 1, 1974	May 7, 1976	April 1, 1980	
Canton, Township of	September 20, 1974	May 21, 1976	November 5, 1986	
Carroll, Township of	November 15, 1974	None	March 18, 1980	December 5, 1995
Cecil, Township of	January 17, 1975	None	September 5, 1979	
Centerville, Borough of	February 28, 1975	None	June 15, 1981	December 5, 1995
Charleroi, Borough of	January 23, 1974	May 7, 1976	June 16, 1981	January 19, 1996
Chartiers, Township of	November 1, 1974	July 2, 1976	February 1, 1980	

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Coal Center, Borough of	November 8, 1974	July 1, 1977	September 30, 1981	September 6, 1995
Cross Creek, Township of	September 13, 1974	November 12, 1976	February 1, 1987	
Deemston, Borough of	November 1, 1974	October 24, 1975	May 1, 1985	
Donegal, Township of	December 6, 1974	February 6, 1981	October 15, 1982	
Donora, Borough of	January 18, 1974	None	September 30, 1995	
Dunlevy, Borough of	January 3, 1975	None	July 16, 1981	October 18, 1995
East Bethlehem, Township of	August 12, 1977	None	July 16, 1981	October 18, 1995
East Finley, Township of	November 29, 1974	January 30, 1981	May 1, 1985	
East Washington, Borough of	October 30, 1978	None	TBD	None
Elco, Borough of	November 22, 1974	None	July 16, 1981	October 18, 1995
Ellsworth, Borough of	January 3, 1975	None	September 10, 1984	
Fallowfield, Township of	November 8, 1974	None	February 17, 1989	September 30, 1995
Finleyville, Borough of	November 15, 1974	None	September 1, 1986	
Hanover, Township of	January 10, 1975	None	September 24, 1984	
Hopewell, Township of	January 3, 1975	None	August 6, 1982	

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Houston, Borough of	April 12, 1974	June 11, 1976	December 18, 1979	
Independence, Township of	September 6, 1974	July 23, 1976	February 1, 1987	
Jefferson, Township of	January 10, 1975	None	June 30, 1976	
Long Branch, Borough of	November 8, 1974	None	September 1, 1986	
Marianna, Borough of	February 8, 1974	June 18, 1978	June 19, 1989	
Midway, Borough of	January 24, 1975	None	August 15, 1989	
Monongahela, City of	February 7, 1975	None	July 3, 1986	September 20, 1995
Morris, Township of	March 21, 1975	None	August 5, 1986	
Mount Pleasant, Township of	December 6, 1974	None	October 8, 1982	
New Eagle, Borough of	January 23, 1974	June 4, 1976	March 18, 1980	February 2, 1996
North Bethlehem, Township of	January 10, 1975	None	October 15, 1985	
North Charleroi, Borough of	November 1, 1974	None	July 16, 1981	December 19, 1995
North Franklin, Township of	February 7, 1975	None	July 4, 1989	
North Strabane, Township of	December 13, 1975	September 24, 1976	February 15, 1980	
Nottingham, Township of	January 17, 1975	None	September 10, 1984	
Peters, Township of	January 10, 1975	None	November 1, 1979	

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Robinson, Township of	January 17, 1975	None	February 25, 1983	
Roscoe, Borough of	June 7, 1974	May 28, 1976	July 16, 1981	October 18, 1995
Smith, Township of	December 13, 1974	January 23, 1981	July 1, 1986	
Somerset, Township of	January 3, 1975	None	July 1, 1986	
South Franklin, Township of	January 3, 1975	None	July 17, 1989	
South Strabane, Township of	December 20, 1974	None	April 15, 1980	
Speers, Borough of	November 1, 1974	None	July 16, 1981	December 19, 1995
Stockdale, Borough of	June 14, 1974	May 7, 1976	July 16, 1981	December 19, 1995
Twilight, Borough of	January 31, 1975	None	September 28, 1979	
Union, Township of	June 28, 1974 June 18, 1976	None	February 2, 1977	June 15, 1984 December 19, 1995
Washington, City of	November 12, 1976	None	November 5, 1986	
West Bethlehem, Township of	November 29, 1974	None	September 1, 1986	
West Brownsville, Borough of	April 27, 1973	None	April 27, 1973	July 1, 1974 August 22, 1975 September 6, 1995
West Finley, Township of	December 27, 1974	None	September 24, 1984	
West Pike Run, Township of	December 6, 1974	None	September 1, 1986	

TABLE 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

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

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, PA 19106.

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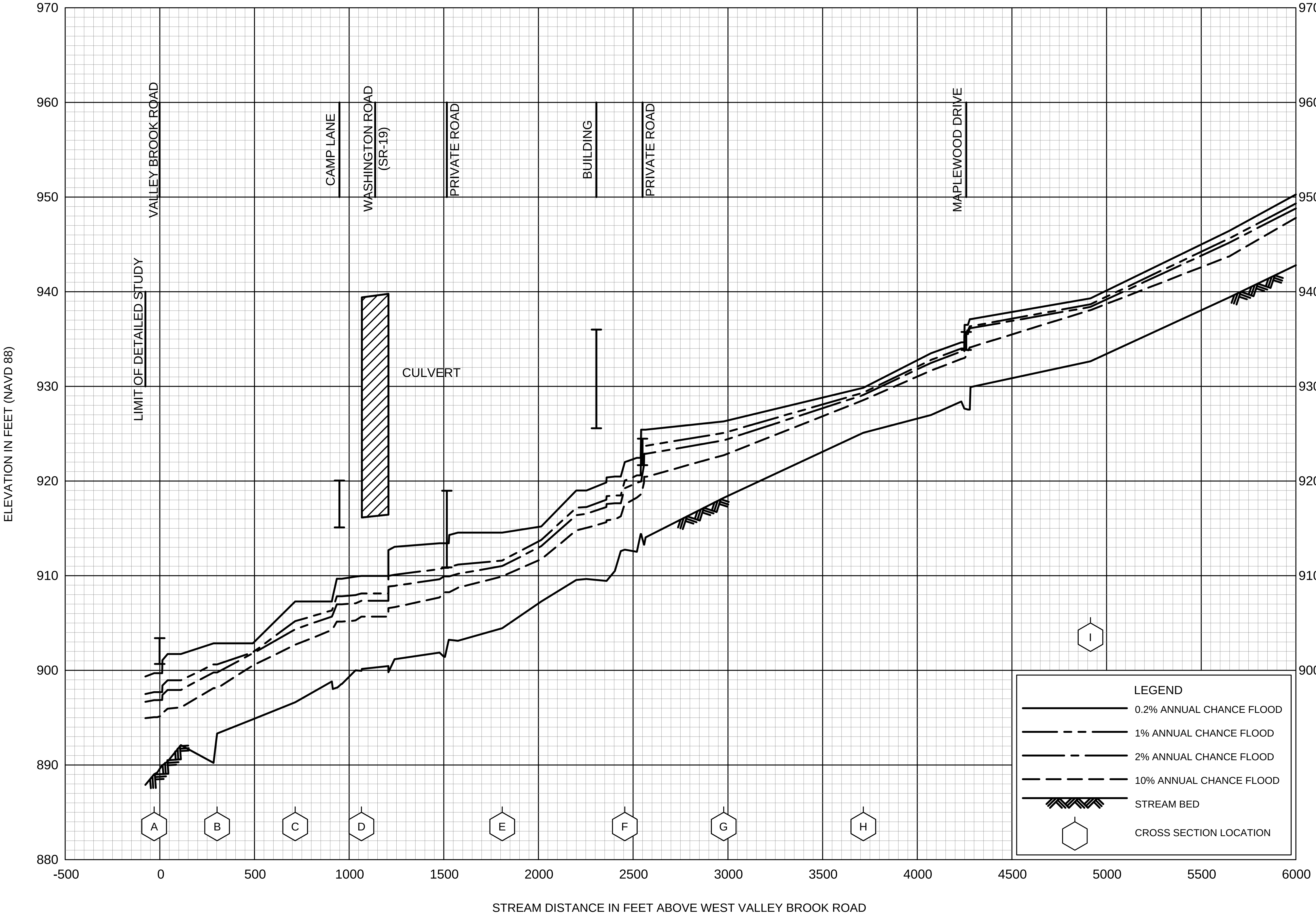


FLOOD PROFILES

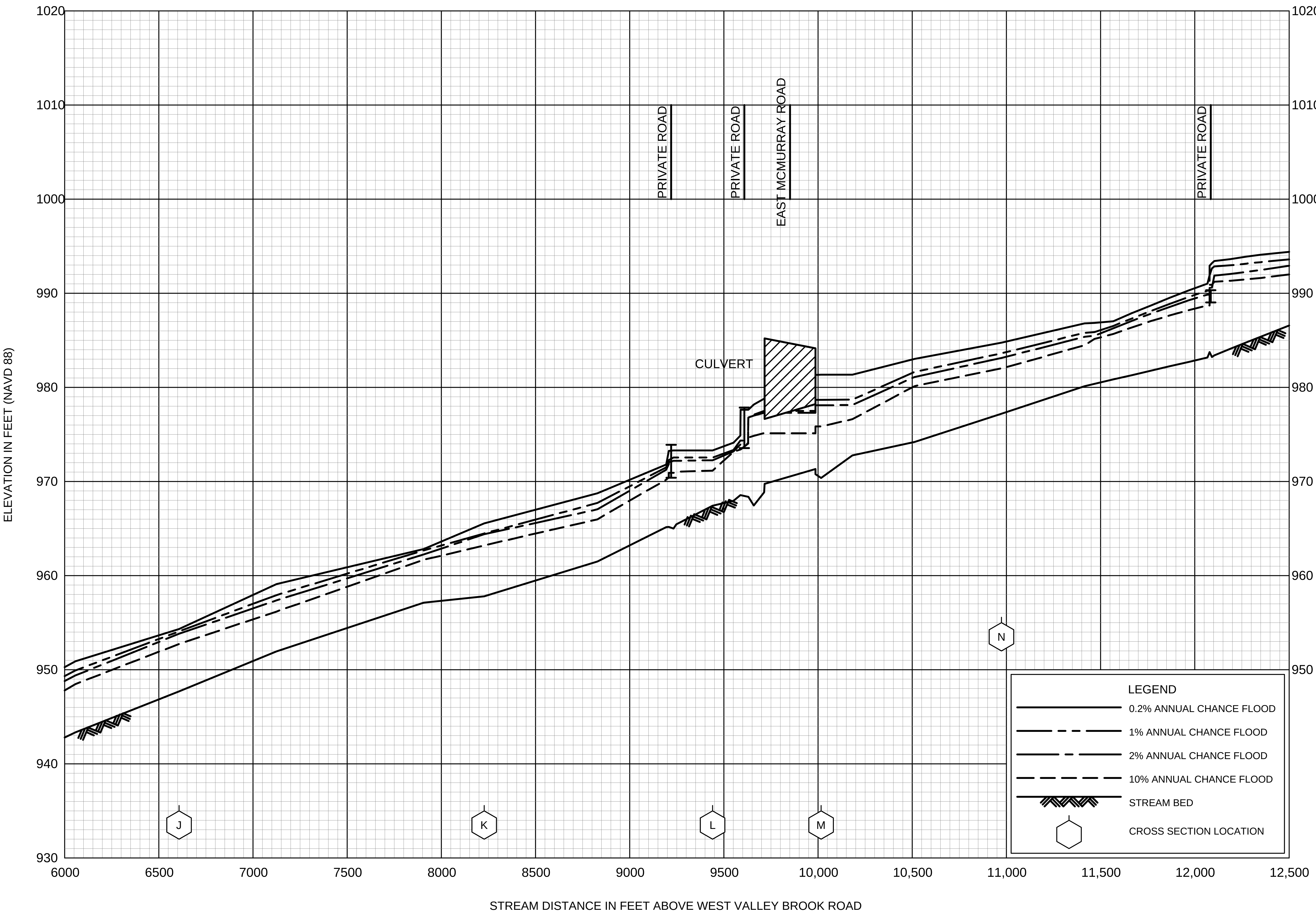
BRUSH RUN TO CHARTIERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

04P



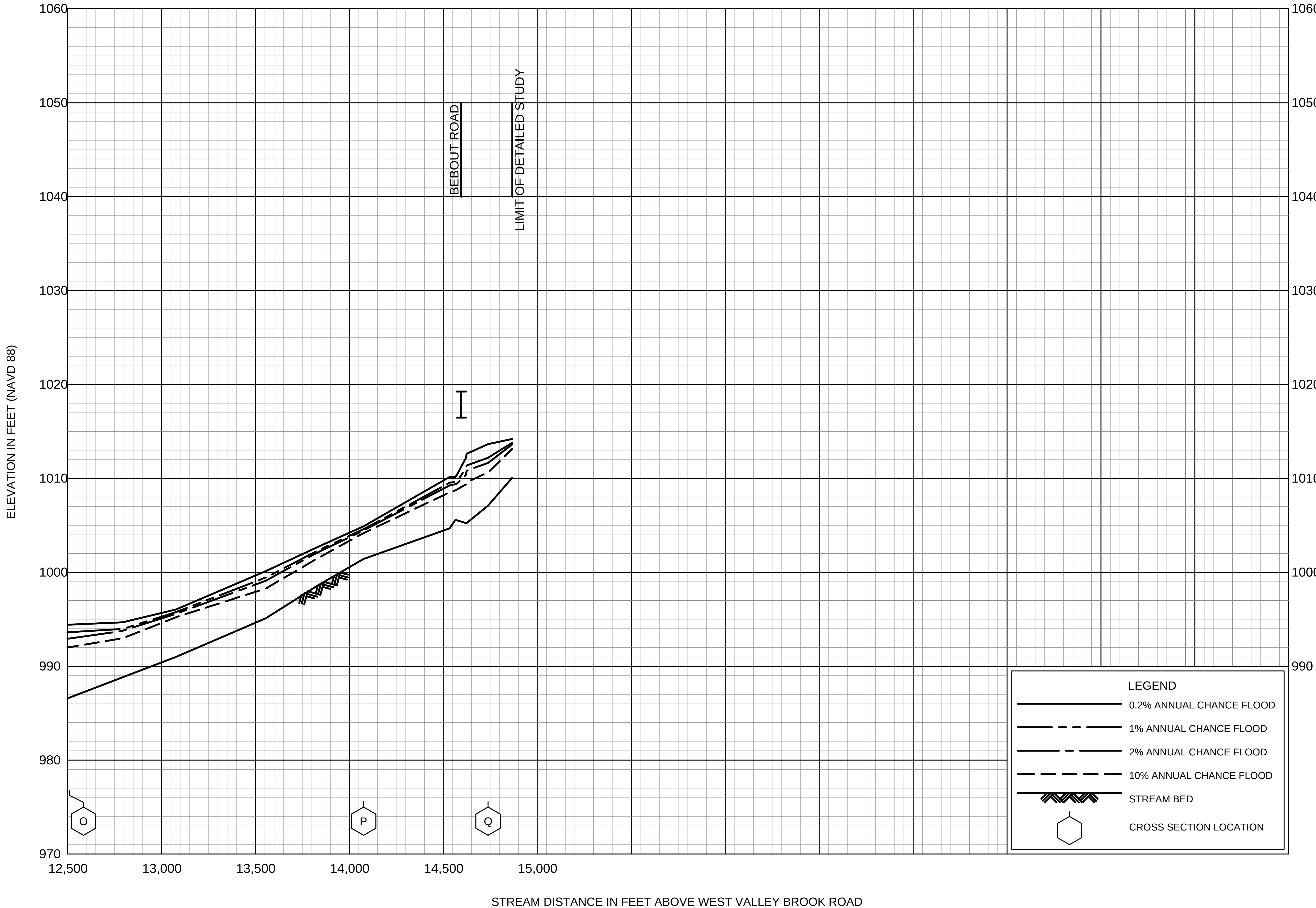
FLOOD PROFILES

BRUSH RUN TO CHARTIERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

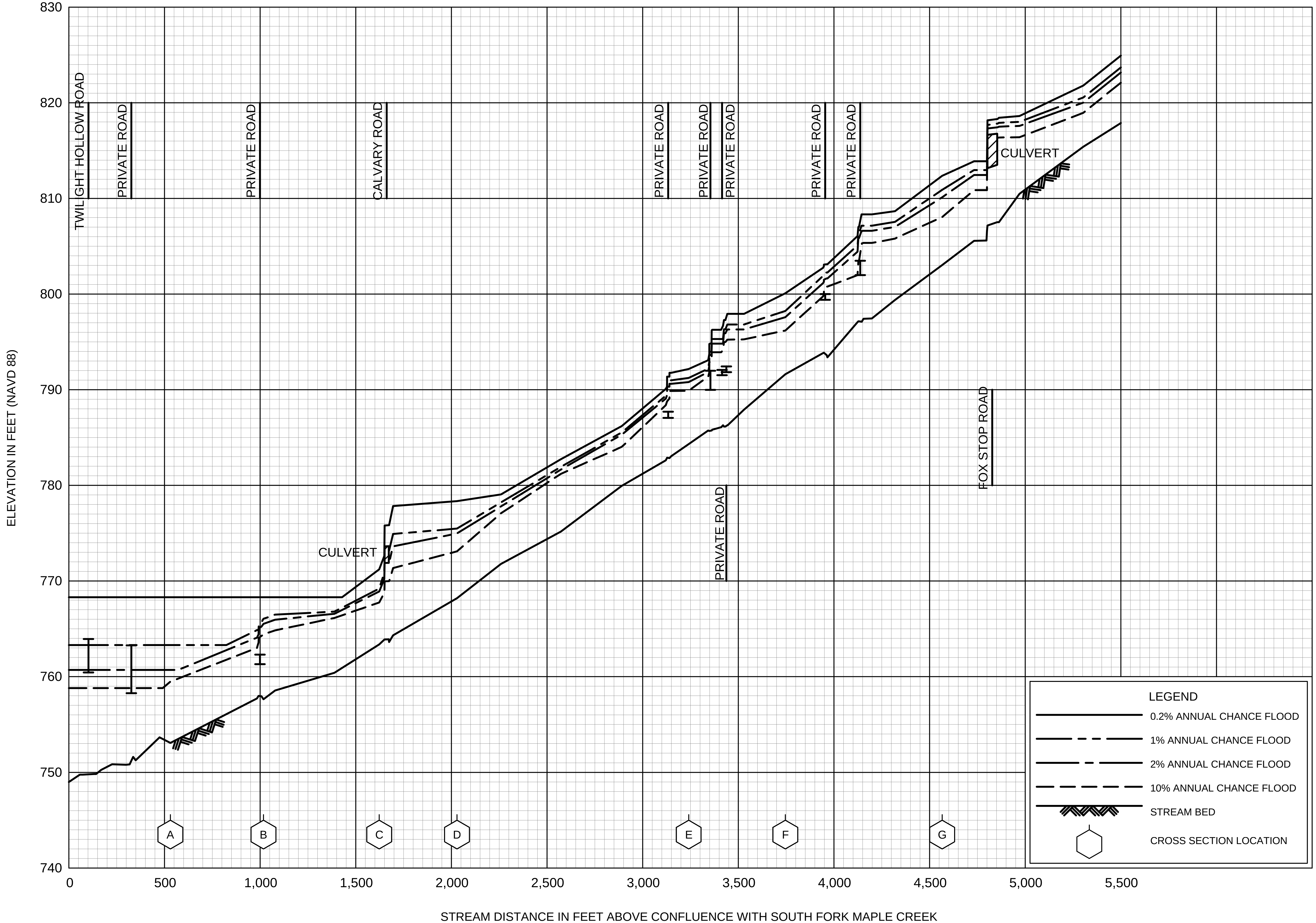
BRUSH RUN TO CHARTIERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

06P



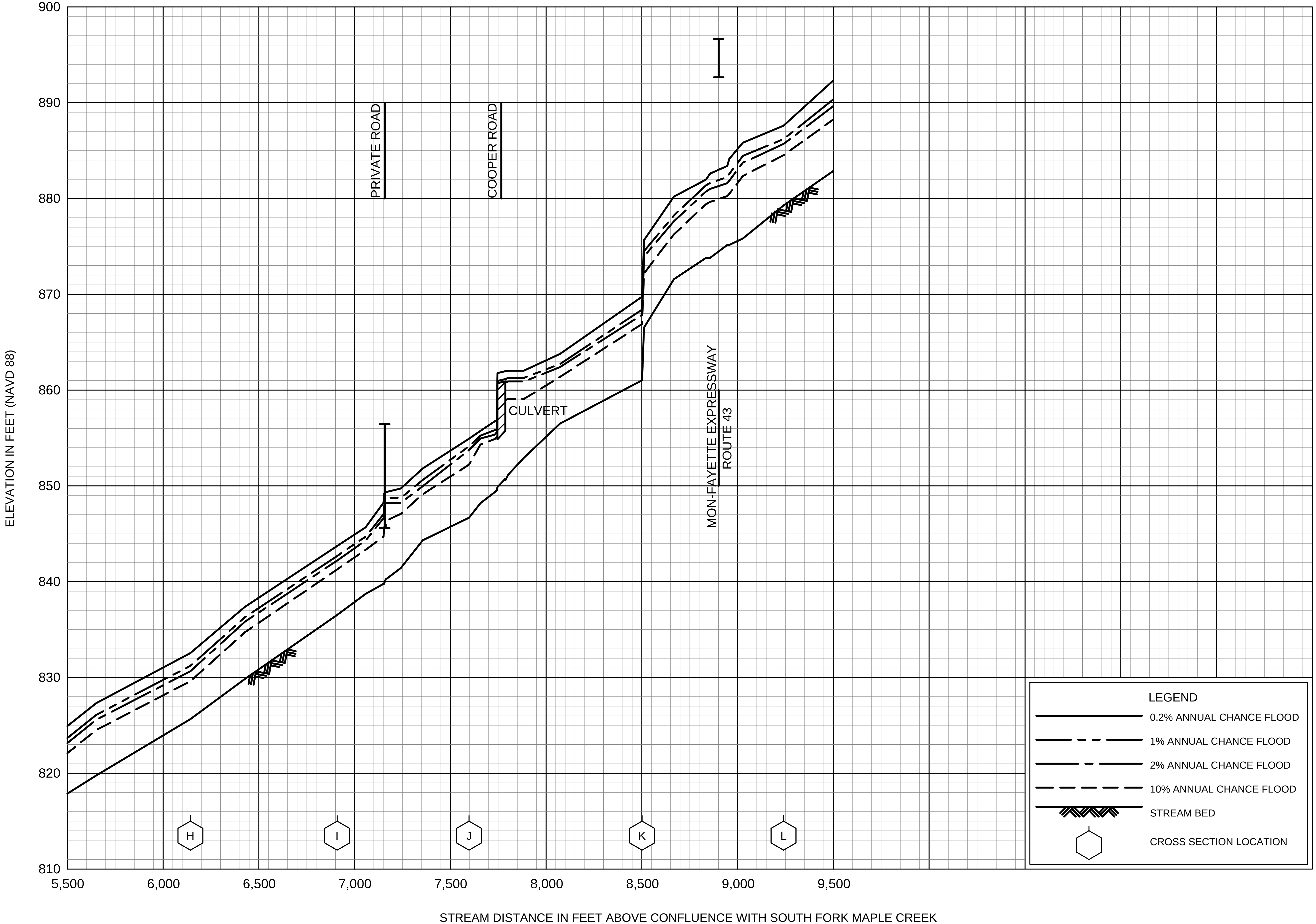
FLOOD PROFILES

MAPLE CREEK

FEDERAL EMERGENCEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



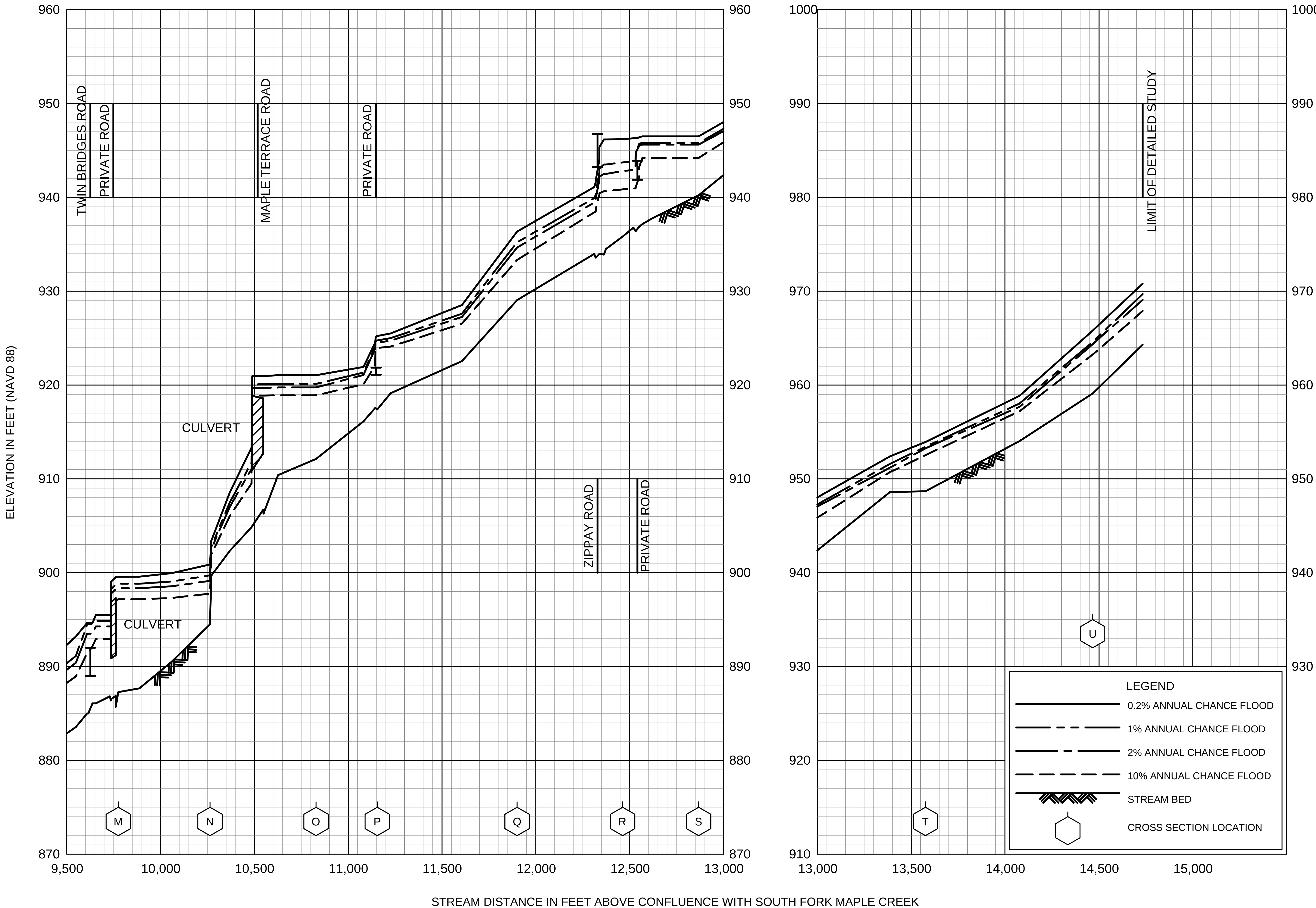
FLOOD PROFILES

MAPLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



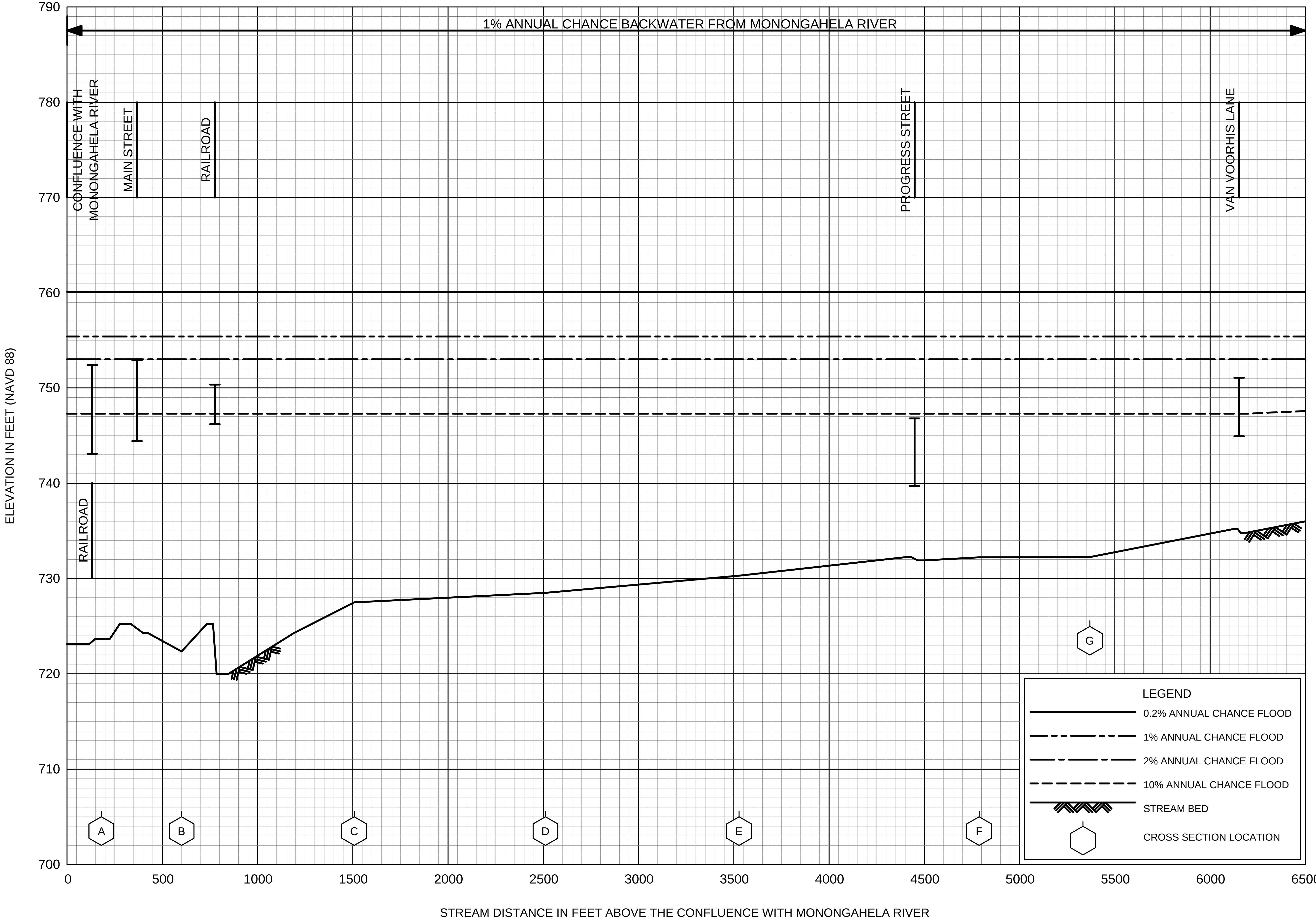
FLOOD PROFILES

MAPLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



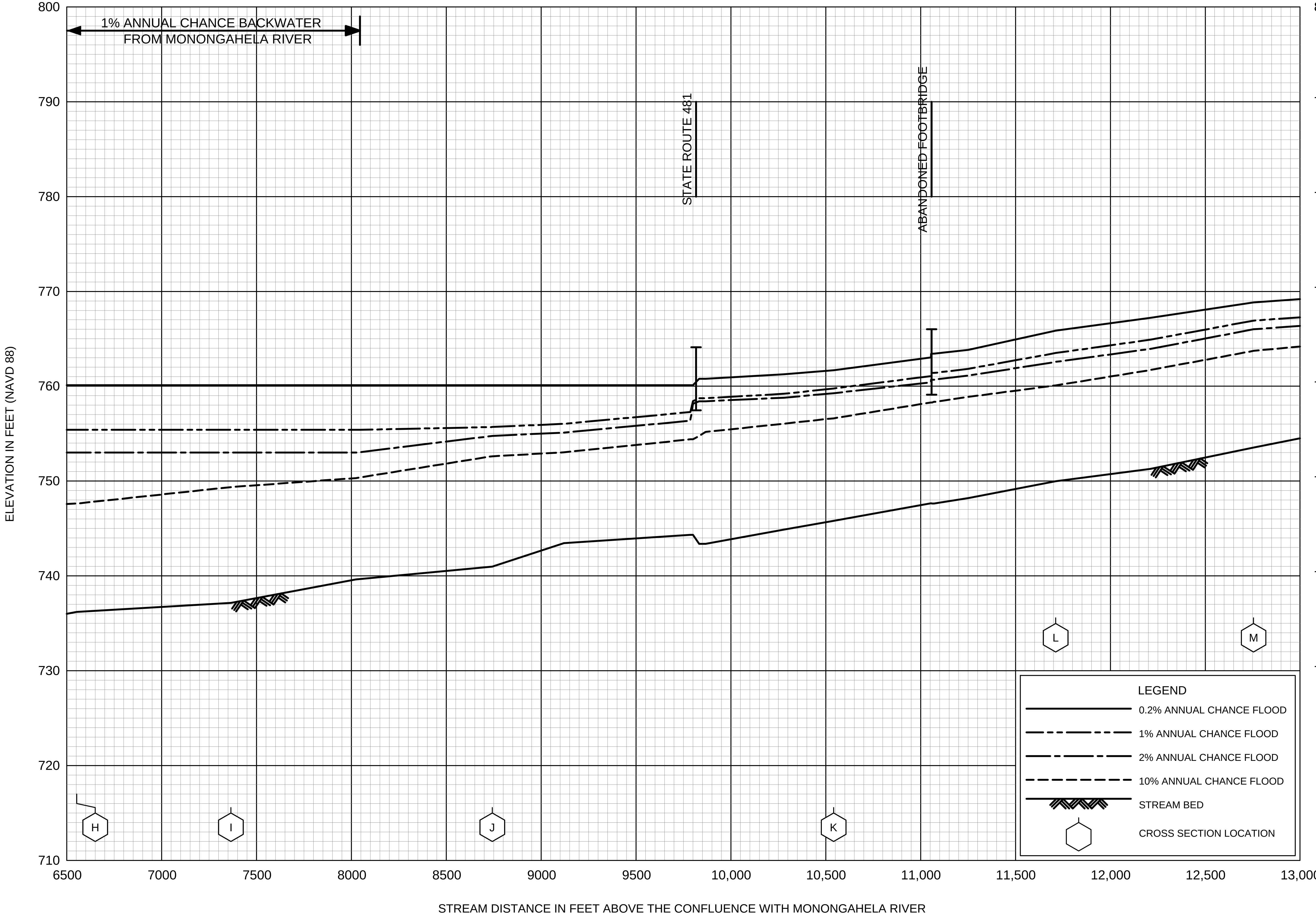
FLOOD PROFILES

PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



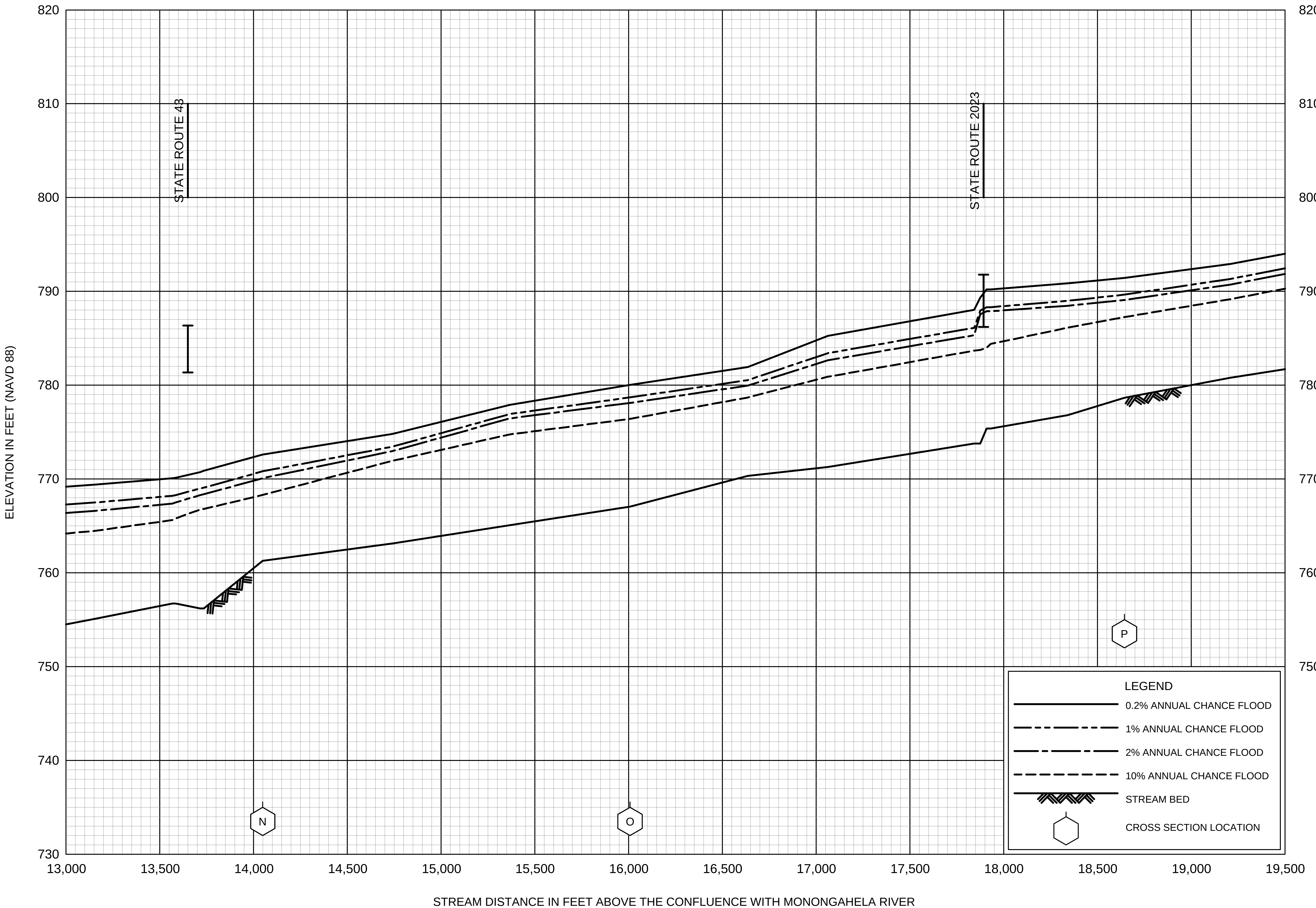
FLOOD PROFILES

PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



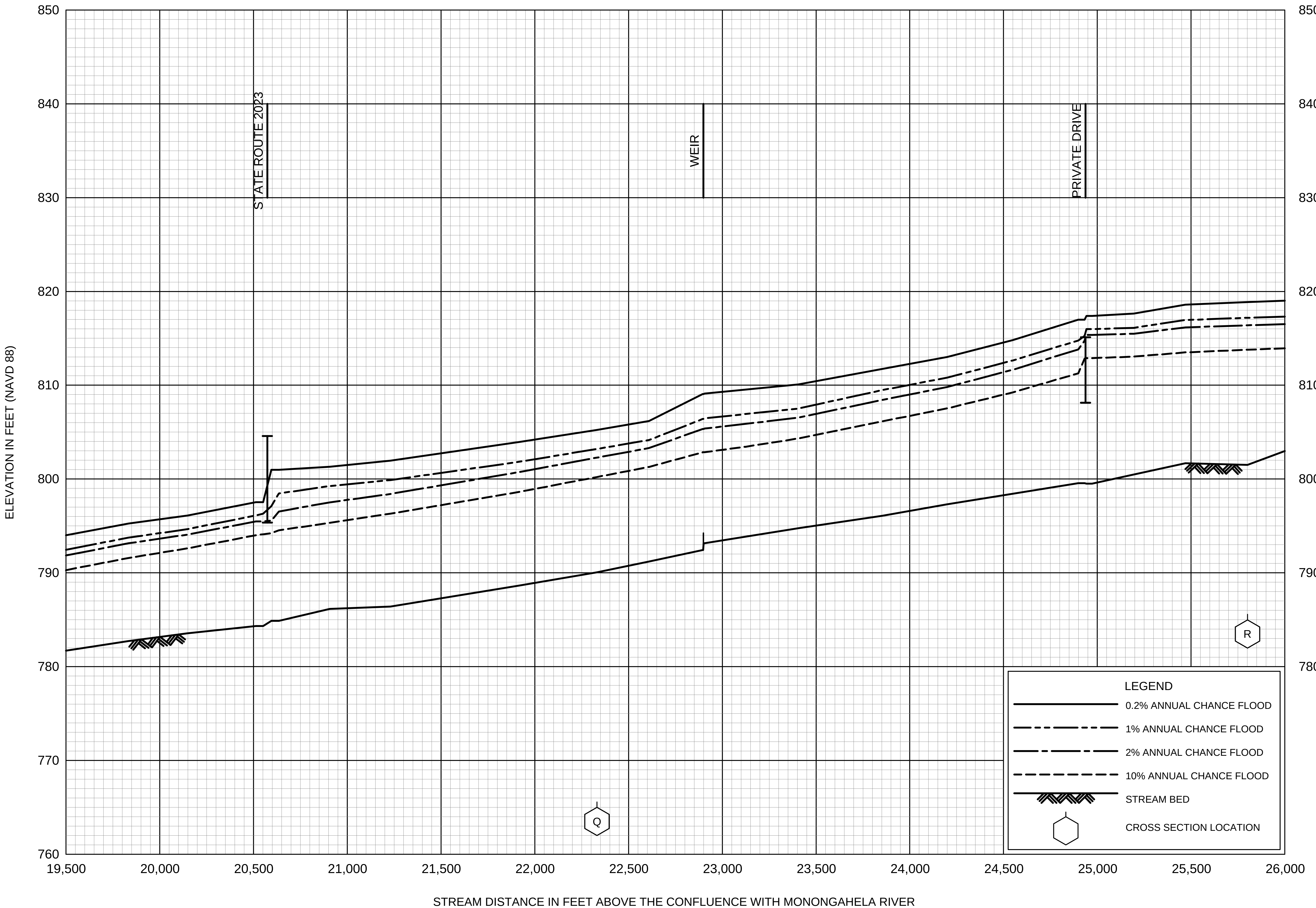
FLOOD PROFILES

PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

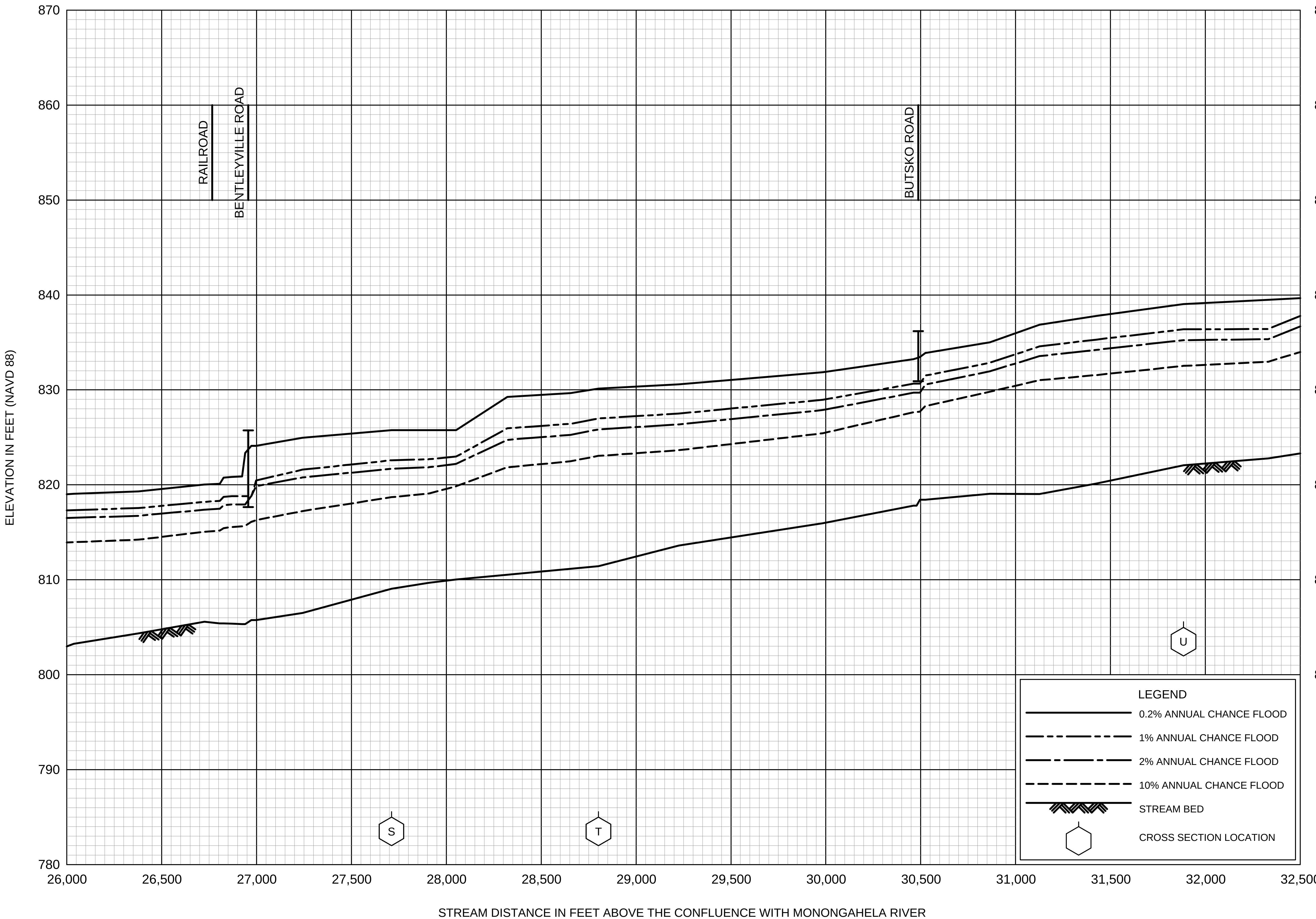
PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)

102P



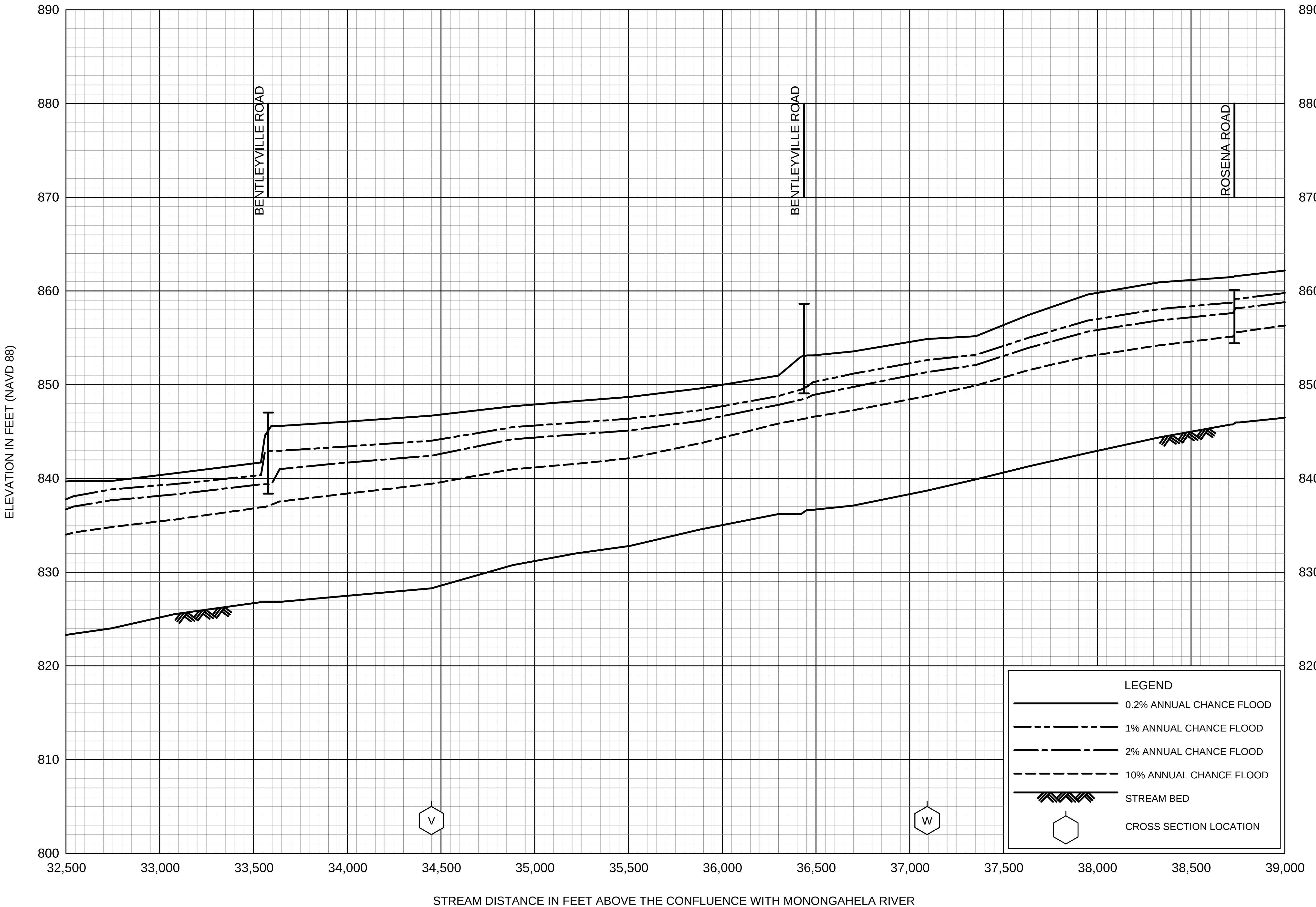
FLOOD PROFILES

PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



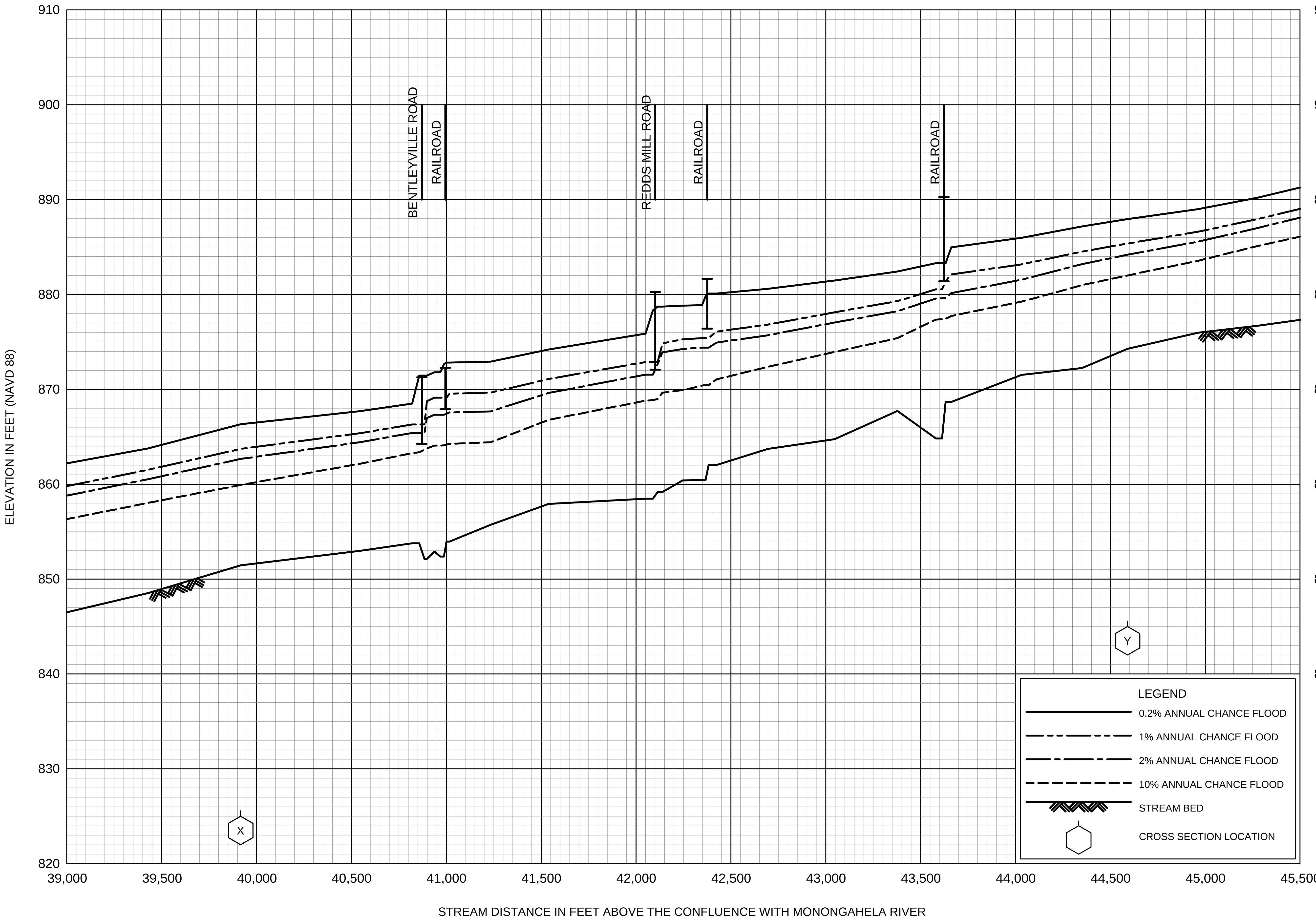
FLOOD PROFILES

PIGEON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

PIGEON CREEK

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WASHINGTON COUNTY, PA

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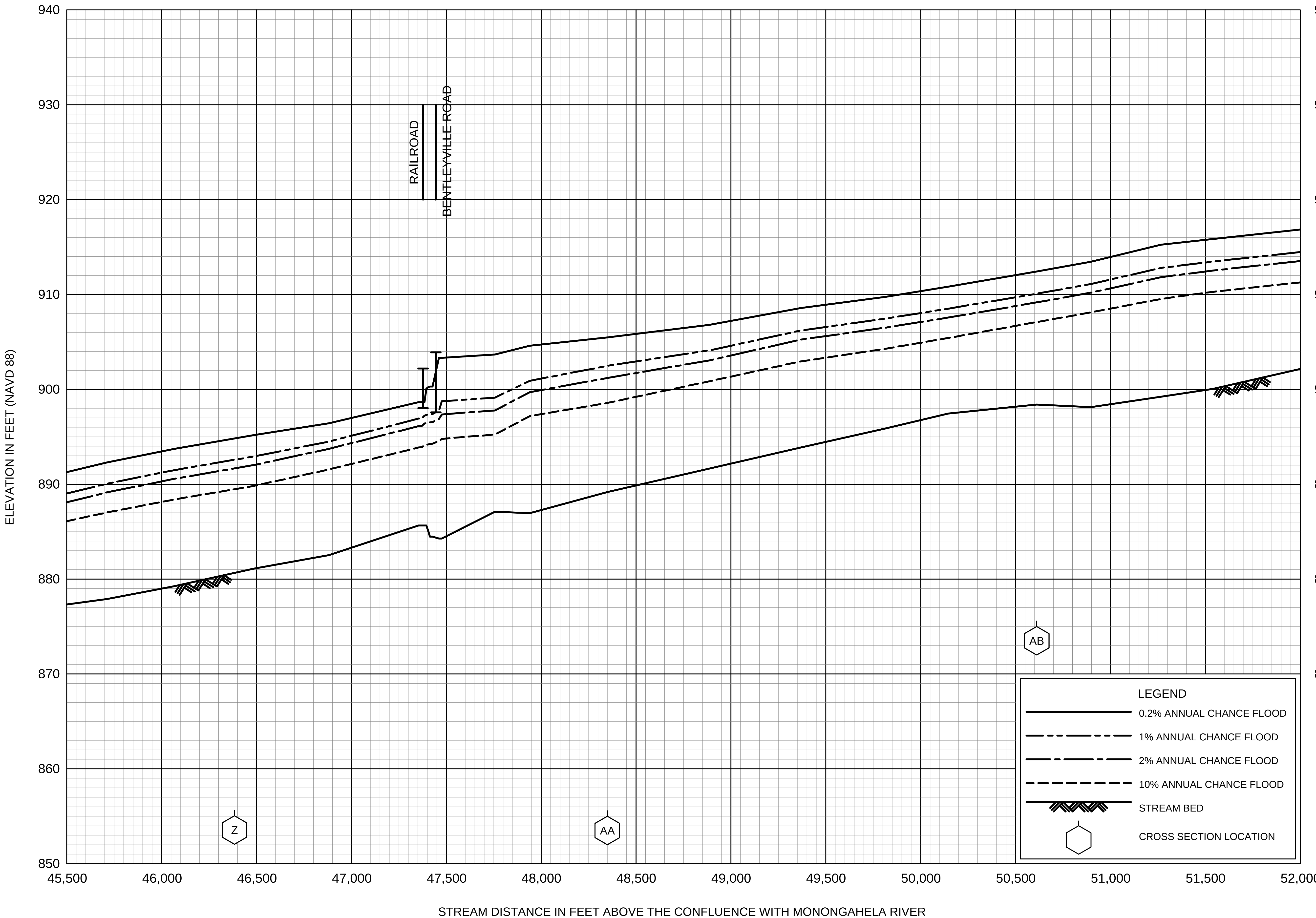

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PIGEON CREEK

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WASHINGTON COUNTY, PA

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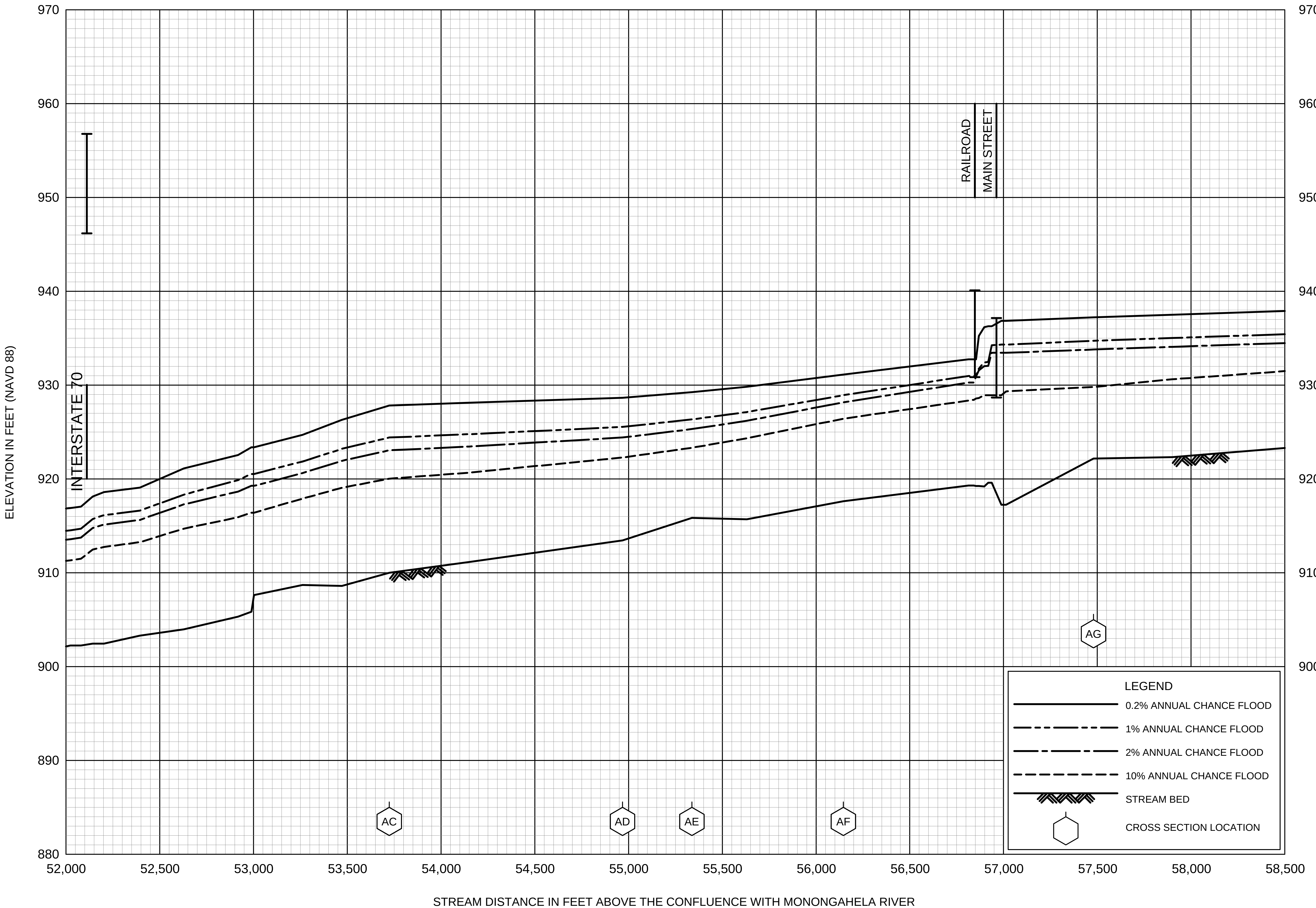

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WASHINGTON COUNTY, PA

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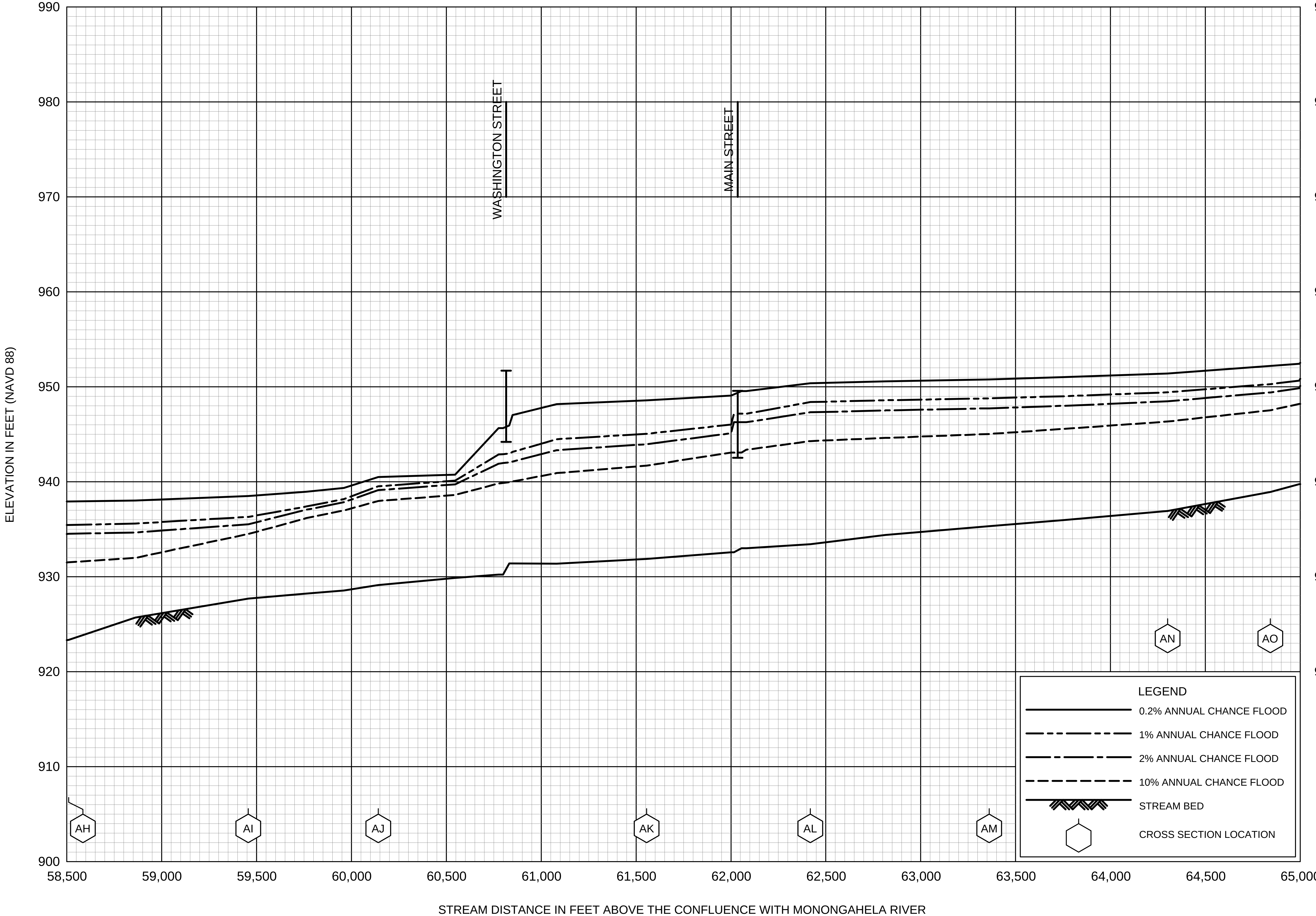

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WASHINGTON COUNTY, PA

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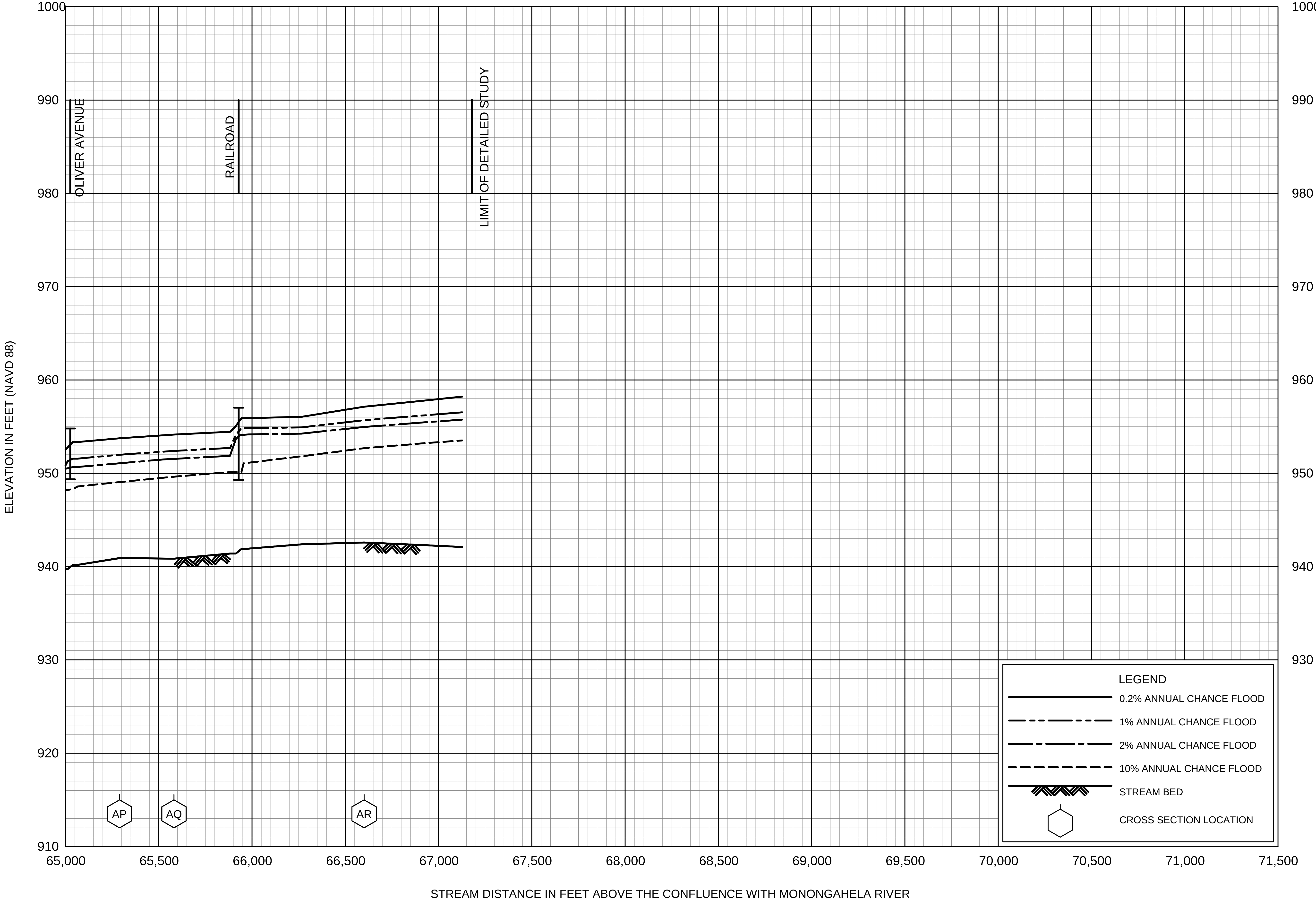

FLOOD PROFILES

PIGEON CREEK

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WASHINGTON COUNTY, PA

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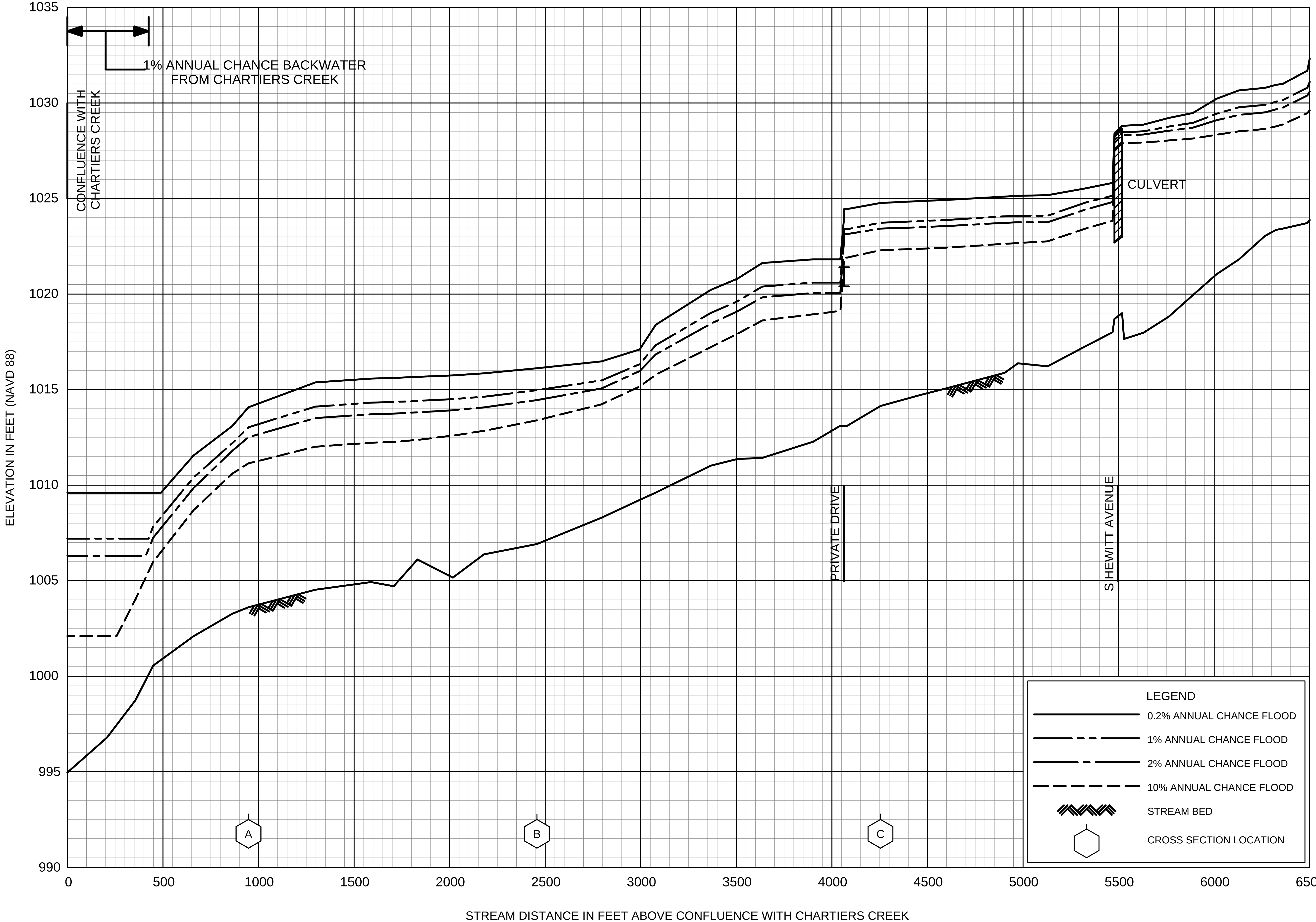


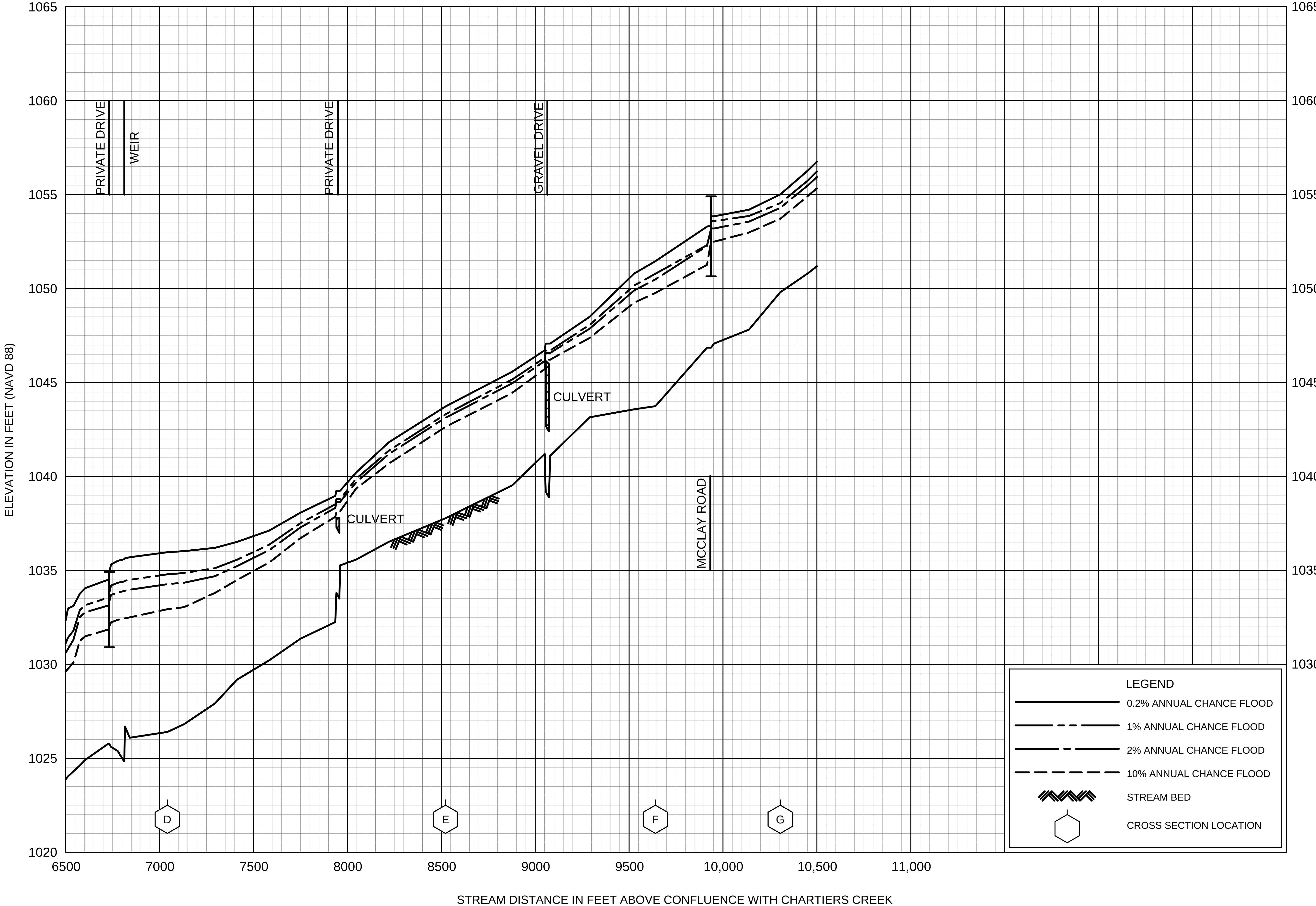
FLOOD PROFILES

WOLFDALE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

WOLFDALE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

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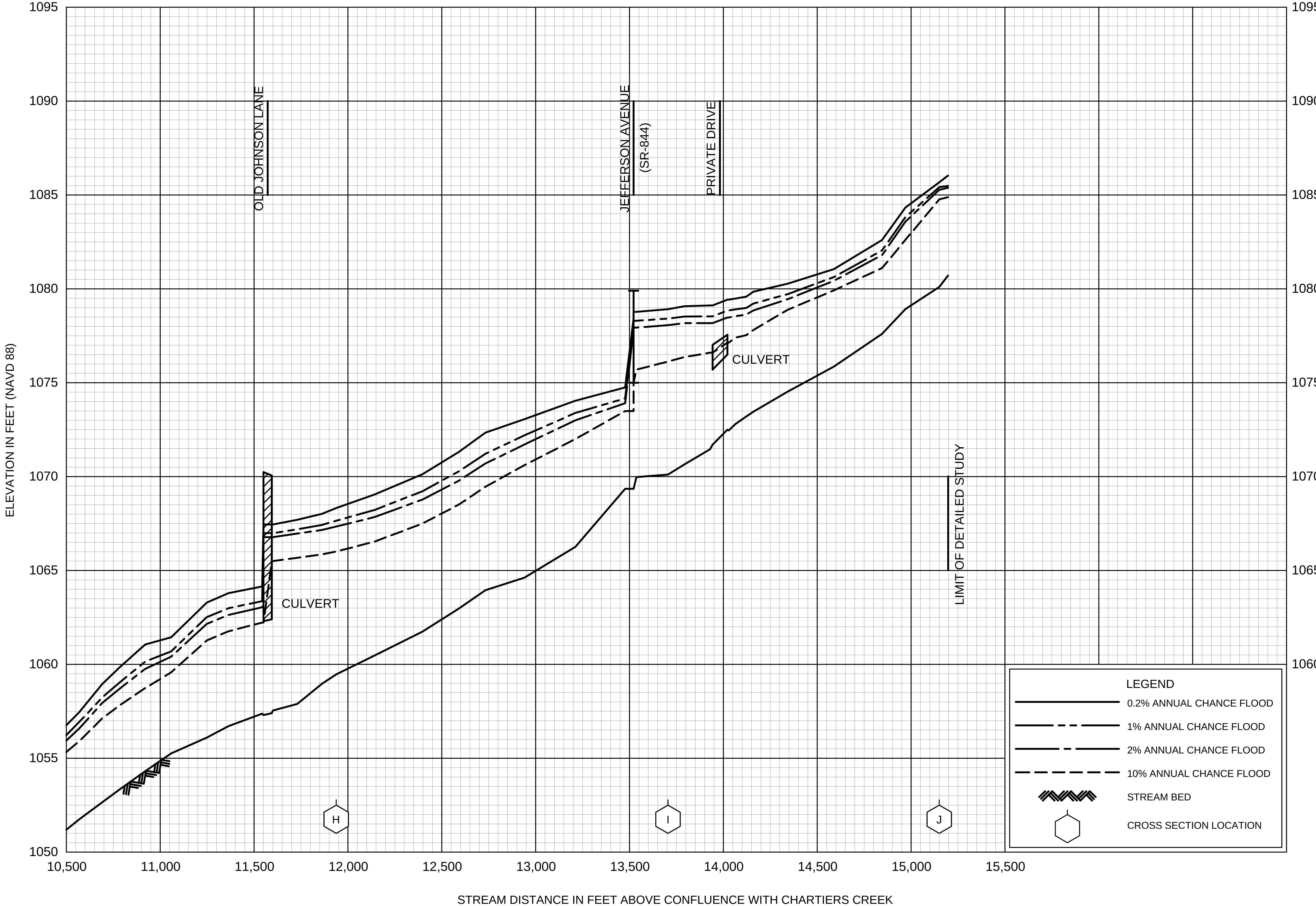

FLOOD PROFILES

WOLFDALE RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, PA

(ALL JURISDICTIONS)