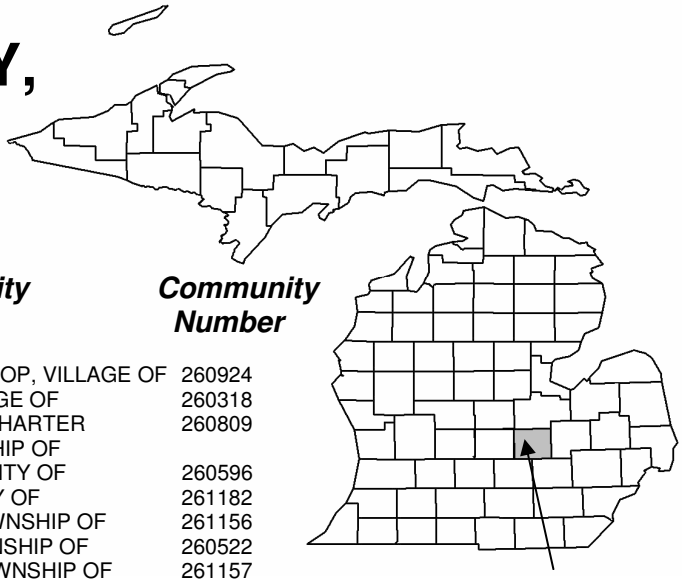
FLOOD INSURANCE STUDY

SHIAWASSEE COUNTY, MICHIGAN

(ALL JURISDICTIONS)



Shiawassee County

Community Name	*Community Number*
*ANTRIM, TOWNSHIP OF	261162
BANCROFT, VILLAGE OF	260520
BENNINGTON, TOWNSHIP OF	261163
BURNS, TOWNSHIP OF	260762
BYRON, VILLAGE OF	260601
CALEDONIA, CHARTER TOWNSHIP OF	260300
CORUNNA, CITY OF	260602
*DURAND, CITY OF	261181
*FAIRFIELD, TOWNSHIP OF	261164
HAZELTON, TOWNSHIP OF	260925
*LAINGSBURG, CITY OF	260950
*LENNON, VILLAGE OF	261183
MIDDLEBURY, TOWNSHIP OF	261155
*MORRICE, VILLAGE OF	261184
NEW HAVEN, TOWNSHIP OF	260521
NEW LOTHROP, VILLAGE OF	260924
*OVID, VILLAGE OF	260318
OWOSSO, CHARTER TOWNSHIP OF	260809
OWOSSO, CITY OF	260596
*PERRY, CITY OF	261182
*PERRY, TOWNSHIP OF	261156
RUSH TOWNSHIP OF	260522
*SCIOTA, TOWNSHIP OF	261157
SHIAWASSEE, TOWNSHIP OF	260523
VENICE, TOWNSHIP OF	261158
VERNON, TOWNSHIP OF	261159
VERNON, VILLAGE OF	260524
*WOODHULL, TOWNSHIP OF	261160

*No Special Flood Hazard Areas Identified

Preliminary:

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26155CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

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

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

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

Initial Countywide FIS Effective Date: To Be Determined

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FLOOD INSURANCE STUDY
SHIAWASSEE COUNTY, MICHIGAN (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Shiawassee County, including the Cities of Corunna, Durand, Laingsburg, Owosso, and Perry; the Charter Townships of Caledonia and Owosso; the Townships of Antrim, Bennington, Burns, Fairfield, Hazelton, Middlebury, New Haven, Perry, Rush, Sciota, Shiawassee, Venice, Vernon, and Woodhull; and the Villages of Bancroft, Byron, Lennon, Morrice, New Lothrop, Ovid, and Vernon (referred to collectively herein as Shiawassee County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Village of Lennon is geographically located in Genesee and Shiawassee Counties and the Village of Ovid is geographically located in Clinton and Shiawassee Counties. Only the portions of the Villages of Lennon and Ovid that are located in Shiawassee County are included in this countywide FIS. The FIS report and Flood Insurance Rate Map (FIRM) for areas outside of Shiawassee County are printed separately.

Please note that the Cities of Durand, Laingsburg, and Perry; the Villages of Lennon, Morrice, and Ovid; and Townships of Antrim, Fairfield, Perry, Sciota, and Woodhull have no mapped flood hazard areas.

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

The Digital Flood Insurance Rate Map (DFIRM) and FIS report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is

provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

1.2 Authority and Acknowledgments

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

Precountywide Analyses

Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below:

Caledonia, Charter Township of:	The hydrologic and hydraulic analyses for the Shiawassee River for the November 17, 1981, FIS report (FEMA, 1981) were performed by Commonwealth Associates, Inc., for FEMA, under Contract No. H-4729. The work was completed in August 1980.
Corunna, City of:	The hydrologic and hydraulic analyses for the Shiawassee River for the January 17, 1986, FIS report (FEMA, 1986) were performed by the U.S. Army Corps of Engineers (USACE), Detroit District, for FEMA, under Interagency Agreement No. EMW-E-0941, Project Order No. 11. The work was completed in February 1984.
Hazelton, Township of:	The hydrologic and hydraulic analyses for Misteguay Creek for the November 5, 1997, FIS report (FEMA, 1997a) were performed by the U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS), East Lansing, Michigan, for FEMA. The work was completed in October 1989.
New Lothrop, Village of:	The hydrologic and hydraulic analyses for Misteguay Creek for the November 5, 1997, FIS report (FEMA, 1997b) were performed by the USDA, SCS, East Lansing, Michigan, for FEMA. The work was completed in October 1989.

Owosso, Charter Township of:	The hydrologic and hydraulic analyses for Owosso Drain for the October 20, 1999, FIS report (FEMA, 1999) were taken from a study prepared by the USDA, SCS, East Lansing, Michigan, in cooperation with the City of Owosso, the Shiawassee County Drain Commissioner, the Charter Township of Owosso, the MDNR, and the Shiawassee Soil Conservation District (SCS, 1994). The work was completed in September 1994.
Owosso, City of:	The hydrologic and hydraulic analyses for the Shiawassee River for the initial September 1, 1981, FIS report (FIA, 1981) were performed by Gove Associates, Inc., for the Federal Insurance Administration (FIA), under Contract No. H-4728. The work was completed in April 1980. The January 16, 2003, FIS revision (FEMA, 2003) was performed to incorporate the Letter of Map Revision (LOMR) effective March 2, 2001, which reflected more up-to-date and detailed hydrologic and hydraulic analyses along Owosso Drain, and redelineations of the 1- and 2-percent-annual-chance floodplains along the Shiawassee River to match flood profiles previously revised by a LOMR effective March 18, 1985. The hydrologic and hydraulic analyses for Owosso Drain were performed by the USDA, SCS. The hydraulic analysis for the Shiawassee River was performed by the Michigan Department of Natural Resources (MDNR), now known as the Michigan Department of Environmental Quality (MDEQ).
Vernon, Village of:	The hydrologic and hydraulic analyses for Holly Drain and the Shiawassee River for the May 17, 1988, FIS report (FEMA, 1988) were performed by the U.S. Geological Survey (USGS), for FEMA, under Interagency Agreement No. EMW-85-E-1823, Project Order No. 18. The work was completed in August 1986.

The Cities of Durand, Laingsburg, and Perry; the Townships of Antrim, Bennington, Burns, Fairfield, Middlebury, New Haven, Perry, Rush, Sciota, Shiawassee, Venice, Vernon, and Woodhull; and the Villages of Bancroft, Byron, Lennon, Morrice and Ovid have no previously printed FIS reports for the areas within Shiawassee County.

This Countywide FIS Report

The hydrologic and hydraulic analyses for all streams studied by approximate methods in this countywide study were performed by PBS&J, for FEMA, under Contract No. HSFE05-05-D-0023. This work was completed in September 2008.

Base map information shown on the FIRM was derived from Michigan National Agriculture Imagery Program (NAIP) Digital Images produced by Remote Sensing and GIS Research and Outreach Services at the Michigan State University; Dated July 10, 2005 at a scale of 1:12,000. The projection used in the preparation of this map is Universal Transverse Mercator (UTM) zone 16, and the horizontal datum used is NAD 83, GRS80 spheroid.

1.3 Coordination

An initial meeting is held with representatives from FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied or restudied. A final meeting is held with representatives from FEMA, the community, and the study contractor to review the results of the study.

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

Community	FIS Date	Initial Meeting	Final Meeting
Caledonia, Charter Township of	November 17, 1981	April 2, 1978	June 17, 1981
Corunna, City of	January 17, 1986	August 1982	February 26, 1985
Hazelton, Township of	November 5, 1997	January 16, 1995*	October 29, 1996
New Lothrop, Village of	November 5, 1997	January 16, 1995*	October 29, 1996
Owosso, Charter Township of	October 20, 1999	February 29, 1996*	February 17, 1998
Owosso, City of	September 1, 1981 January 16, 2003	** March 2, 2001*	March 31, 1981 **

*Community notified by letter
**Data not available

Community	FIS Date	Initial Meeting	Final Meeting
Vernon, Village of	May 17, 1988	February 27, 1985	June 24, 1987

The initial meeting for this countywide FIS report was held on May 21, 2007, and attended by representatives of FEMA, PBS&J, and the communities.

The results of the study were reviewed at the final meeting 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 Shiawassee County, Michigan, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through the time of the study.

The streams studied by detailed methods are listed in Table 1.

Table 1 – Streams Studied by Detailed Methods

Holly Drain	Misteguay Creek
Owosso Drain	Shiawassee River

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

For this countywide study, all areas studied by approximate methods were either newly studied or revised based on updated hydrologic and hydraulic models.

Also for this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county, including both incorporated and unincorporated areas, is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD) to the North American Vertical Datum of 1988 (NAVD). In addition, the Universal Transverse Mercator coordinates, previously referenced to the North American Datum of 1927, are now referenced to the North American Datum of 1983.

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

2.2 Community Description

Shiawassee County is surrounded by Saginaw County to the north; Genesee County to the east; Clinton County to the west; Livingston County to the southeast; Ingham County to the southwest; and Gratiot County to the northwest. The City of Corunna is the county seat.

According to the 2000 census, the total population for the county was 71,687. The total land area within Shiawassee County is approximately 541 square miles (U.S. Census Bureau, 2007).

The climate of Shiawassee County is characteristic of southern lower Michigan and varies from modified marine to continental. The mean annual temperature is 47 degrees Fahrenheit (°F), but extremes range from 14°F in the winter to 82°F in the summer. The average monthly rainfall for the county is 2.6 inches with the majority of the precipitation falling as rain during August and September (The Weather Channel, 2007).

Most soils in the area are loamy soils associated with till plains and moraines. The primary type of soil in the area consists of the Capac-Parkhill association. These are very deep, somewhat poorly drained soils on nearly level to gently sloping topography. They have high available water capacity and moderately slow permeability.

2.3 Principal Flood Problems

Annual flooding occurs in the early spring due to a combination of ice jams, snowmelt and rainfall, and occasionally in the fall due to heavy rains. Annual damages have been reduced significantly over time; however, large runoff events still inundate a considerable area.

Flooding occurs in the City of Owosso when high runoff causes the Shiawassee River to overflow it's banks. In 1947, ice jamming at the bridges, combined with high runoff, resulted in the record high flood in the City of Owosso. At the eastern city limits, the 1-percent-annual-chance floodplain is approximately 2,500 feet wide. Downstream of the South Washington Street Bridge, however, the 1-percent-annual-chance floodplain is in the range of 300 to 500 feet in width.

Flood damage along the Owosso Drain in the Charter Township of Owosso is severe. The 1-percent-annual-chance flood inundates approximately 458 aces. Three hundred seventeen residences would experience flooding and Dewey Street and South Street would be impassable during the 1-percent-annual-chance flood.

A USGS river flow gage is located on the Shiawassee River about one mile north of the City of Owosso. For comparison purposes, the recorded flows and gage heights of historic flows are listed in the following table:

Year	Flow at Owosso Gage Cubic feet per second (cfs)	Gage Height (feet)
1942	4,230	8.74
1947	6,240	10.35
1948	6,150	10.27
1975	4,840	9.25
1982	5,460	10.25

Low-lying farmland is inundated by a 1-percent-annual-chance flood west of Shiawassee River, while little flooding occurs along Holly Drain as shown on the flood profiles and the map.

Roads affected by flooding from Misteguay Creek, such as Allen, Easton Henderson, New Lothrop, Riley, and Juddville Roads, would have water depths ranging from approximately 0.2 to 12.7 feet in the event of a 1-percent-annual-chance flood.

2.4 Flood Protection Measures

A PL-566 Watershed Protection and Flood Prevention Work Plan was approved in 1960. This work plan proposed a 5-year project for the installation of land treatment and structural measures in the Misteguay Creek watershed. Installation was completed in the late 1960's. Land treatment measures consisted of cover cropping, diversion construction, waterway development, land smoothing, wildlife area improvement, hedgerow planting, minimum tillage, drainage (closed and open), erosion control structures, tree planting, hydrologic stand improvement, protection from overcutting and damaging logging, and protection from grazing. The structural measures included 3 floodwater retarding dams, 5.68 miles of dikes and 26.94 miles of channel improvement for agricultural management purposes.

Due to the density of development along the Shiawassee River, some individual residential and commercial property owners have constructed low seawalls along the river banks. These structures primarily protect against erosion, but also provide some flooding protection from annual spring high water levels.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled

or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance (100-year) flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

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

Precountywide Analyses

The 1-percent-annual-chance peak discharges for Holly Drain was estimated using regional regression equations (USGS, 1984) and basin characteristics determined from USGS topographic maps (USGS, 1972a) and quaternary geology maps (Farrand and Bell, 1984).

Drainage areas for Misteguay Creek were measured from USGS topographic maps. The SCS Technical Release No. 20 computer program (SCS, 1965) was calibrated to reproduce the September 5-6, 1985 flood event. Elevation-storage-discharge relationships for the dams were obtained from the Report on the Misteguay Watershed (Vieux, 1986).

The hydrologic analyses for Owosso Drain were obtained from a report, dated September 1994, titled "Flood Plain Management Study, Owosso Drain, Shiawassee County, Michigan" (SCS, 1994). In that study, the hydrologic analyses were determined using the SCS TR-20 computer program (SCS, 1965) to compute peak flow frequency. TR-20 was used to determine the impact of six natural storage areas or structures on peak flood discharges for Owosso Drain. Drainage areas for the 16 sub-watersheds were determined from USGS quadrangle maps (USGS, 1972b). Time of concentration for each of the 16 sub-watersheds was determined using the SCS TR-55 Computer Model (SCS, 1975) and Manning's Formula. TR-55 was also used to determine runoff curve numbers (SCS, 1994). These parameters were used with the TR-20 to produce runoff hydrographs for 5 hypothetical storms. The hypothetical storms were calculated using hourly rainfall data obtained from the Owosso, Michigan weather station. Flood elevations for Owosso Drain were determined using the TR-20 computer program. TR-20 was also used to replicate water-surface elevations (WSELs) from the October 1, 1981, flood along Owosso Drain. This historical flood is accepted basis of hydrology and flood routing for Owosso Drain.

Hydrologic analyses for the Shiawassee River were based on annual peak flows recorded during the period of 1931-1982 at the USGS gaging station (No. 04144500) at Owosso (USGS, 1971). The gage is situated 1.5 miles north of the City of Owosso. The log-Pearson Type III method (Water Resources Council, 1976) was employed to analyze the peak flows along the Shiawassee River. A generalized skew coefficient of -0.09 was used (Water Resources Council, 1981). Applying the log-Pearson method, the 10-, 2-, 1-, and 0.2-percent-annual-chance flows were determined. The peak flows required at the upstream and downstream limits of the study area were extrapolated from the gage using an exponent of 0.889 computed from data published in USGS Water Supply Paper 1677 (USGS, 1965).

This Countywide FIS Report

For all streams studied by approximate methods except North State Drain Tributary 1, Salesbury Drain, Shiawassee River, Shiawassee River Tributary 19.1, Shiawassee River Tributary 26, Shiawassee River Tributary 29, Shiawassee River Tributary 30, and Six Mile Creek Tributary 3, peak discharges were estimated by the published USGS regional regression equations (USGS, 1984).

For the Shiawassee River, peak flows were derived using USGS stream gage data at Byron, Michigan; Fergus, Michigan; and Owosso, Michigan gages (USGS, 2008a; USGS, 2008b; USGS, 2008c).

For North State Drain Tributary 1, Salesbury Drain, Shiawassee River Tributary 19.1, Shiawassee River Tributary 26, Shiawassee River Tributary 29, Shiawassee River Tributary 30, and Six Mile Creek Tributary 3, the drainage areas did not fall within the allowable range for use with the USGS regression equations. For these streams, the peak discharges were determined based on guidelines from the Michigan Department of Environmental Quality guidance document, *Computing Flood Discharges For Small Ungaged Watersheds* (Sorrell, 2008).

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 2.

Table 2 - Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
HOLLY DRAIN					
At the confluence with Shiawassee River	34.5	*	*	1,290	*

*Data not available

Table 2 – Summary of Discharges (*Continued*)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
MISTEGUAY CREEK					
At confluence of Porter Creek	64.10	2,520	5,480	6,220	8,260
At confluence of Onion Creek	54.96	2,230	5,020	5,670	7,500
At Dam	54.96	4,090	6,090	6,640	8,250
At Juddville Road	46.48	3,850	5,510	5,920	7,230
OWOSSO DRAIN					
At confluence with Shiawassee River	4.68	310	385	410	485
At Huron & Eastern Railway	4.40	205	230	250	290
At Freeman Street	4.40	195	320	375	520
Just upstream of Freeman Street	3.85	145	230	270	425
At West South Street	3.02	200	335	405	600
At Dirt Road	3.85	300	520	630	935
At Station 106+60	3.02	200	335	405	600
Out of natural detention area 2	1.41	150	305	375	570
Into natural detention area 2 south of West Dewey Road	1.41	270	460	550	790
At outlet to Hopkins Lake	0.44	10	15	20	25
At inlet to Hopkins Lake	0.44	115	160	195	305
Out of natural detention area 1	0.23	35	35	35	35
Into natural detention area 1 south of West Dewey Road and west of South Delaney Road	0.23	90	150	180	260
SHIAWASSEE RIVER					
Approximately 4,075 feet downstream of West Oliver Street	538.0	4,660	6,530	7,340	9,240
Approximately 825 feet upstream of South Gould Street	530.9	4,610	6,450	7,250	9,130
Approximately 6,485 feet upstream of North Shiawassee Street / State Highway 71	526.8	4,570	6,410	7,200	9,070
Approximately 7,030 feet upstream of North Shiawassee Street / State Highway 71	514.0	4,440	6,270	7,050	8,870
Just downstream of confluence of Holly Drain	451.0	*	*	5,450	*

*Data not available

3.2 Hydraulic Analyses

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

Precountywide Analyses

For Misteguay Creek, physical data were obtained from USGS topographic maps, soil survey maps, local topographic maps, aerial photos, as well as on-site field inspections.

Cross sections along the Owosso Drain and Shiawassee River outside of the Village of Vernon were obtained from field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

For the Shiawassee River in the Village of Vernon, a backwater analysis was conducted from State Highway 71 to the downstream side of the Huron & Eastern Railway bridge. This analysis was used to determine the effect of the Shiawassee River on WSELs on Holly Drain. Two channel cross sections were obtained from a field survey and four were synthesized for the analysis. The synthesized cross sections were estimated from adjacent surveyed sections and topographic maps (USGS, 1972a). Structural geometry and elevations for two bridges and road sections were obtained from a field survey. For the backwater analysis of Holly Drain, eight cross sections were surveyed and eleven were synthesized. Structural geometry and elevations were obtained for six bridges and road profiles.

WSELs of floods of the selected recurrence intervals along Misteguay Creek were computed using the SCS WSP-2 computer program (SCS, 1976). The starting WSELs for Misteguay Creek at the Flint River were obtained from the Flood Hazard Maps for the Township of Spalding prepared by the USACE in 1978 (FIA, 1977).

Water surface profiles for Owosso Drain outside of the Charter Township of Owosso and the Shiawassee River outside of the Village of Vernon were developed using the USACE HEC-2 step-backwater program (HEC, 1968). The HEC-2 model was revised to incorporate new bridge data for the South Washington Street Bridge (HEC, 1976). For Owosso Drain within the Charter Township of Owosso, the SCS WSP2 Computer Model was used to develop

water surface profiles (SCS, 1976). The starting WSELs for the HEC-2 profiles for Owosso Drain and Shiawassee River were obtained from a discharge-elevation rating curve of the USGS gaging station at Owosso.

WSELs for the 1-percent-annual-chance floods were computed using WSPRO, a step-backwater computer program (Federal Highway Administration, 1986) for Holly Drain and Shiawassee River in the Village of Vernon. Starting WSELs were based on channel slope and conveyance characteristics.

Ice jamming in the 1947 flood contributed to water elevation levels along the Shiawassee River between the dam downstream of East Main Street and the South Washington Street bridge that approximately the same level as the 0.2-percent-annual-chance flood elevations developed by the study in the City of Owosso. It should also be noted that the hydraulic analysis indicates that significant flow may occur in streets parallel to the river such as Allendale, Jerome, and Grover Streets. During flood events, velocities greater than one foot per second may occur in these areas.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2).

Channel roughness factors (Mannings "n") used in the hydraulic computations for Holly Drain, Misteguay Creek, and the Shiawassee River in the City of Corunna, Charter Township of Caledonia, and the Village of Vernon, were estimated by field inspections.

Manning's "n" values for the Shiawassee River in the City of Owosso were estimated by field inspection at each cross section at the time of the field measurement. These estimates were then compared with the descriptions in Open-Channel Hydraulics (Chow, 1959) to obtain final values. The channel roughness values obtained by this process were further calibrated by matching high water elevations that were obtained from aerial photographs of the April 1975 flood. Expansion and contraction coefficients for the river were estimated from data obtained from the USACE (HEC, 1974).

The Manning's "n" values for all detailed studied streams are listed in the following table:

Manning's "n" Values

Stream	Channel "n"	Overbank "n"
Holly Drain	0.045	0.035-0.120
Misteguay Creek	*	*
Owosso Drain	*	*
Shiawassee River	0.030-0.045	0.050-0.146

*Data not available

This Countywide FIS Report

For the approximately studied streams, cross section data was obtained from the topography. Roads were modeled as weirs, using elevations from the topography. The studied streams were modeled using HEC-RAS version 3.1.3 (HEC, 2005).

The profile baselines depicted on the FIRM represent the hydraulic modeling baselines that match the flood profiles on this FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was NGVD. With the finalization of NAVD, many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base Flood Elevations (BFEs) across the corporate limits between the communities. Some of the data used in this study were taken from the prior effective FIS reports and adjusted to NAVD. The average conversion factor that was used to convert the data in this FIS report to NAVD was calculated using the National Geodetic Survey's (NGS) VERTCON online utility (NGS, 2007). The data points used to determine the conversion are listed in Table 3.

Table 3 – Vertical Datum Conversion

Quad Name	Corner	Latitude	Longitude	Conversion from NGVD to NAVD
Ashley	SE	43.125	-84.375	-0.522 feet
Chapin	SE	43.125	-84.250	-0.515 feet
Chesaning West	SE	43.125	-84.125	-0.522 feet
Chesaning East	SE	43.125	-84.000	-0.522 feet
Ovid West	SE	43.000	-84.375	-0.476 feet
Ovid East	SE	43.000	-84.250	-0.472 feet
Owosso North	SE	43.000	-84.125	-0.486 feet
Easton	SE	43.000	-84.000	-0.489 feet
Price	SE	42.875	-84.375	-0.446 feet
Laingsburg	SE	42.875	-84.250	-0.443 feet
Owosso South	SE	42.875	-84.125	-0.430 feet
Corunna	SE	42.875	-84.000	-0.433 feet
Bath	SE	42.750	-84.375	-0.433 feet
Shaftsburg	SE	42.750	-84.250	-0.430 feet
Perry	SE	42.750	-84.125	-0.427 feet
Corunna SE	SE	42.750	-84.000	-0.430 feet
			Average:	-0.467 feet

For additional information regarding conversion between NGVD and NAVD, visit the NGS website at www.ngs.noaa.gov, or contact the NGS at the following address:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

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

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

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance (100-

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

4.1 Floodplain Boundaries

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

For Misteguay Creek, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using aerial photography, USGS topographic maps, USACE topographic maps, and SCS topographic maps (Aerial Photographs, 1988; USGS, 1983; USACE, 1983; SCS, unknown date).

Between cross sections on the Owosso Drain and Shiawassee River in the City of Owosso, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 2 feet (Abrams Aerial Survey, 1974).

On the Owosso Drain, in the Charter Township of Owosso, the boundaries were interpolated between cross sections using topographic maps at an enlarged scale of 1:24,000 with a contour interval of 20 feet (USGS, 1972b; USGS 1974a; and USGS 1974b).

On Holly Drain and the Shiawassee River, in the Village of Vernon, between cross sections the boundaries were interpolated using topographic maps at an enlarged scale of 1:24,000 with a contour interval of ten feet (USGS, 1972a).

On the Shiawassee River, in the City of Corunna, between cross sections the boundaries were interpolated using topographic maps at an enlarged scale of 1:24,000 with a contour interval of ten feet (USGS, 1972a; USGS 1972b).

On the Shiawassee River, in the Charter Township of Caledonia, between cross sections the boundaries were interpolated using topographic maps at an enlarged scale of 1:12,000 and 1:62,500 with a contour interval of five or ten feet (USGS, 1941; USGS, 1972a; USGS, 1972b).

For all streams studied by approximate methods, between modeled cross sections the floodplain boundaries were delineated using topography derived from USDA topographic maps at a scale of 1:24,000, with a contour interval of 10 feet (USDA, 2002).

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

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

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies. The Michigan Floodplain Act (Act 167, P.A. 1968), however, limits floodplain encroachment to that which will cause only insignificant increases (0.1 foot or less) in flood heights (State of Michigan, 1968). Thus, at the recommendation of the Division of Water Management, a floodway having no more than a 0.1-foot surcharge has been delineated for this study.

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 4). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

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

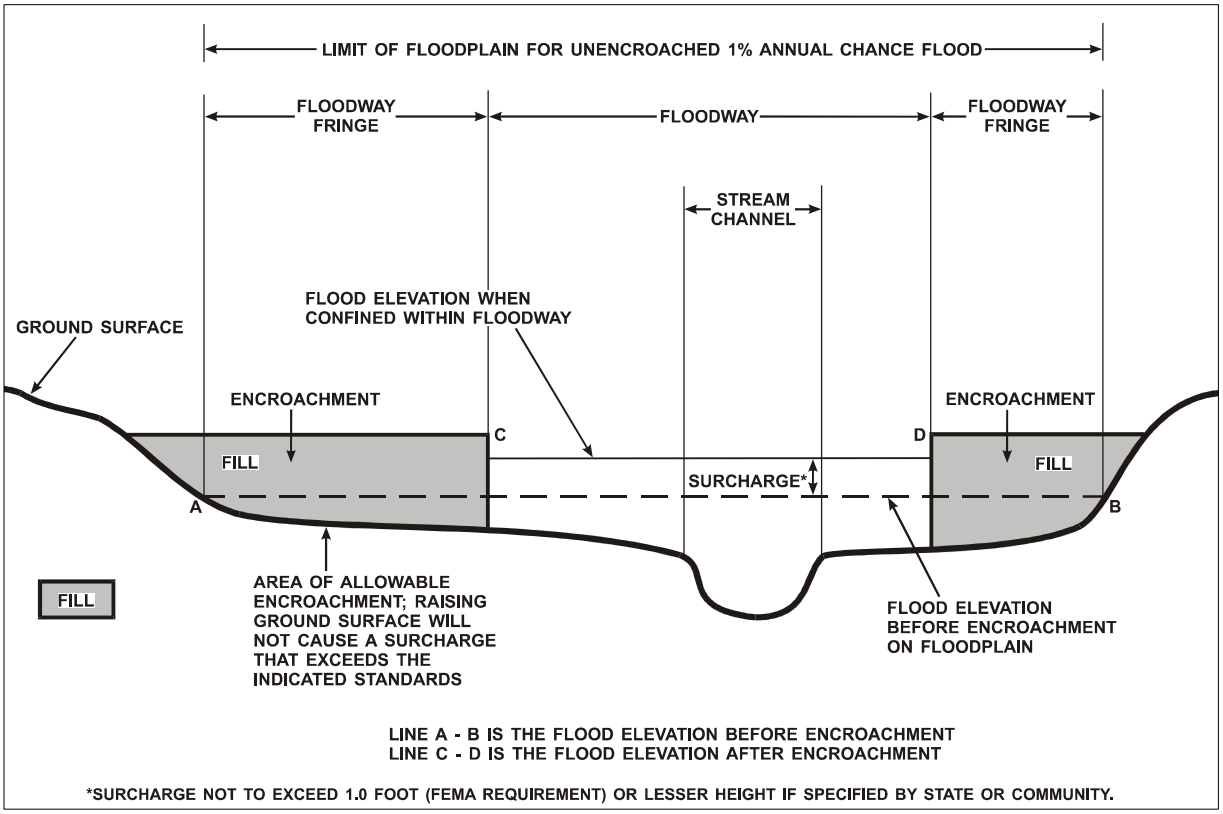

Figure 1 - Floodway Schematic

No floodways were computed for Holly Drain, Misteguay Creek, Owosso Drain, and the Shiawassee River in the Village of Vernon.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SHIAWASSEE RIVER								
A	235,120	333	2,109	3.5	719.0	719.0	719.0	0.0
B	235,920	181	1,555	4.7	719.7	719.7	719.7	0.0
C	236,500	290	2,089	3.5	720.1	720.1	720.1	0.0
D	236,930	234	1,530	4.8	720.4	720.4	720.4	0.0
E	237,320	258	1,774	4.1	720.9	720.9	720.9	0.0
F	238,020	209	1,551	4.7	721.4	721.4	721.4	0.0
G	238,580	301	2,210	3.3	721.9	721.9	721.9	0.0
H	238,929	144	1,601	4.6	722.0	722.0	722.0	0.0
I	239,079	230	1,679	4.4	722.0	722.0	722.0	0.0
J	239,499	252	1,460	5.0	722.5	722.5	722.5	0.0
K	240,184	210	1,946	3.8	723.8	723.8	723.8	0.0
L	241,224	297	2,222	3.3	724.3	724.3	724.3	0.0
M	241,574	346	2,569	2.9	724.6	724.6	724.6	0.0
N	241,844	302	2,456	3.0	724.8	724.8	724.8	0.0
O	242,314	336	2,128	3.4	725.0	725.0	725.1	0.1
P	242,690	182	1,839	4.0	726.0	726.0	726.1	0.1
Q	242,840	216	1,689	4.3	726.1	726.1	726.2	0.1
R	243,015	258	2,280	3.2	726.4	726.4	726.4	0.0
S	243,265	270	2,300	3.2	726.5	726.5	726.6	0.1
T	243,900	125	1,257	5.8	726.7	726.7	726.8	0.1
U	243,950	138	1,302	5.6	726.9	726.9	727.0	0.1
V	244,128	129	1,504	4.9	728.0	728.0	728.0	0.0

[1]Feet above confluence with Saginaw River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI (ALL JURISDICTIONS)

FLOODWAY DATA

SHIAWASSEE RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SHIAWASSEE RIVER (CONTINUED)								
W	244,248	127	1,281	5.7	728.0	728.0	728.1	0.1
X	244,828	210	1,320	5.6	728.5	728.5	728.6	0.1
Y	245,128	175	1,203	6.1	728.7	728.7	728.8	0.1
Z	245,516	114	1,555	4.7	729.7	729.7	729.8	0.1
AA	245,666	114	1,563	4.7	729.9	729.9	730.0	0.1
AB	245,946	190	2,255	3.3	730.0	730.0	730.1	0.1
AC	247,546	243	2,164	3.4	730.8	730.8	730.9	0.1
AD	247,996	400	2,714	2.7	731.0	731.0	731.1	0.1
AE	248,246	640	4,251	1.7	731.1	731.1	731.2	0.1
AF	248,861	895	4,054	1.8	731.3	731.3	731.4	0.1
AG	249,606	246	2,031	3.6	731.9	731.9	732.0	0.1
AH	249,821	284	2,835	2.6	732.1	732.1	732.2	0.1
AI	250,516	500	3,783	1.9	732.2	732.2	732.3	0.1
AJ	251,586	450	3,661	2.0	732.3	732.3	732.4	0.1
AK	254,591	780	3,852	1.9	733.3	733.3	733.3	0.0
AL	257,701	425	2,776	2.5	734.1	734.1	734.1	0.0
AM	260,501	545	2,819	2.5	734.8	734.8	734.8	0.0
AN	261,501	292	1,754	4.0	735.1	735.1	735.1	0.0
AO	262,401	574	3,455	2.0	735.8	735.8	735.8	0.0
AP	263,601	222	1,551	4.5	736.1	736.1	736.1	0.0
AQ	263,901	167	1,433	4.9	736.3	736.3	736.4	0.1

[1]Feet above confluence with Saginaw River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI (ALL JURISDICTIONS)

FLOODWAY DATA

SHIAWASSEE RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
SHIAWASSEE RIVER (CONTINUED)								
AR	265,501	370	2,718	2.6	739.9	739.9	739.9	0.0
AS	265,801	764	4,548	1.6	740.1	740.1	740.1	0.0
AT	266,601	1,301	5,424	1.3	740.2	740.2	740.2	0.0
AU	268,501	1,260	5,576	1.3	740.4	740.4	740.4	0.0
AV	271,101	565	4,064	1.7	740.8	740.8	740.8	0.0
AW	309,140	N/A	N/A	N/A	760.3	N/A	N/A	N/A
AX	309,390	N/A	N/A	N/A	760.6	N/A	N/A	N/A
AY	310,540	N/A	N/A	N/A	761.3	N/A	N/A	N/A
AZ	310,740	N/A	N/A	N/A	761.9	N/A	N/A	N/A
BA	311,140	N/A	N/A	N/A	762.1	N/A	N/A	N/A

[1]Feet above confluence with Saginaw River

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI (ALL JURISDICTIONS)

FLOODWAY DATA

SHIAWASSEE RIVER

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone X

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

6.0 FLOOD INSURANCE RATE MAP

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

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

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

The countywide FIRM presents flooding information for the entire geographic area of Shiawassee 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 5.

7.0 OTHER STUDIES

A countywide FIS report is in progress for Clinton, Gratiot, Ingham, Livingston, and Saginaw Counties, Michigan. FIS reports have been produced for the Township of Argentine (FIA, 1980b), Township of Clayton (FIA, 1980a), Township of Flushing (FIA, 1980c), and the Township of Gaines (FIA, 1979) in Genesee County.

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

8.0 LOCATION OF DATA

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

9.0 BIBLIOGRAPHY AND REFERENCES

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Federal Emergency Management Agency, Flood Insurance Study, Village of Vernon, Shiawassee County, Michigan, May 17, 1988.

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COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Antrim, Township of*	N/A	None	N/A	None
Bancroft, City of	To Be Determined	None	To Be Determined	None
Bennington, Township of	To Be Determined	None	To Be Determined	None
Burns, Township of	December 19, 1996	None	December 19, 1996	None
Byron, Township of	September 19, 1975	None	February 1, 1991	None
Caledonia, Charter Township of	January 3, 1975	None	May 17, 1982	None
Corunna, City of	September 19, 1975	None	January 17, 1986	None
Durand, City of*	N/A	None	N/A	None
Fairfield, Township of*	N/A	None	N/A	None
Hazelton, Township of	November 5, 1997	None	November 5, 1997	None
Laingsburg, City of*	N/A	None	N/A	None
Lennon, Village of*	N/A	None	N/A	None
Middlebury, Township of	To Be Determined	None	To Be Determined	None
Morrice, Village of*	N/A	None	N/A	None

*No special flood hazard areas identified

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
New Haven, Township of	July 25, 1975	None	April 1, 1988	None
New Lothrop, Village of	November 5, 1997	None	November 5, 1997	None
Ovid, Village of**	N/A	None	N/A	None
Owosso, Charter Township of	October 20, 1999	None	October 20, 1999	None
Owosso, City of	September 26, 1975	None	March 1, 1982	January 16, 2003
Perry, City of*	N/A	None	N/A	None
Perry, Township of*	N/A	None	N/A	None
Rush, Township of	August 8, 1975	None	February 1, 1986	None
Sciota, Township of*	N/A	None	N/A	None
Shiawassee, Township of	October 10, 1975	None	July 3, 1986	None
Venice, Township of	To Be Determined	None	To Be Determined	None
Vernon, Township of	To Be Determined	None	To Be Determined	None

*No special flood hazard areas identified
**No special flood hazard areas identified within Shiawassee County

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Vernon, Village of	July 11, 1975	None	May 17, 1988	None
Woodhull, Township of*	N/A	None	N/A	None

*No special flood hazard areas identified

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

Federal Emergency Management Agency, Flood Insurance Study, Village of New Lothrop, Shiawassee County, Michigan, November 5, 1997b.

Federal Emergency Management Agency, Flood Insurance Study, Township of Owosso, Shiawassee County, Michigan, October 20, 1999.

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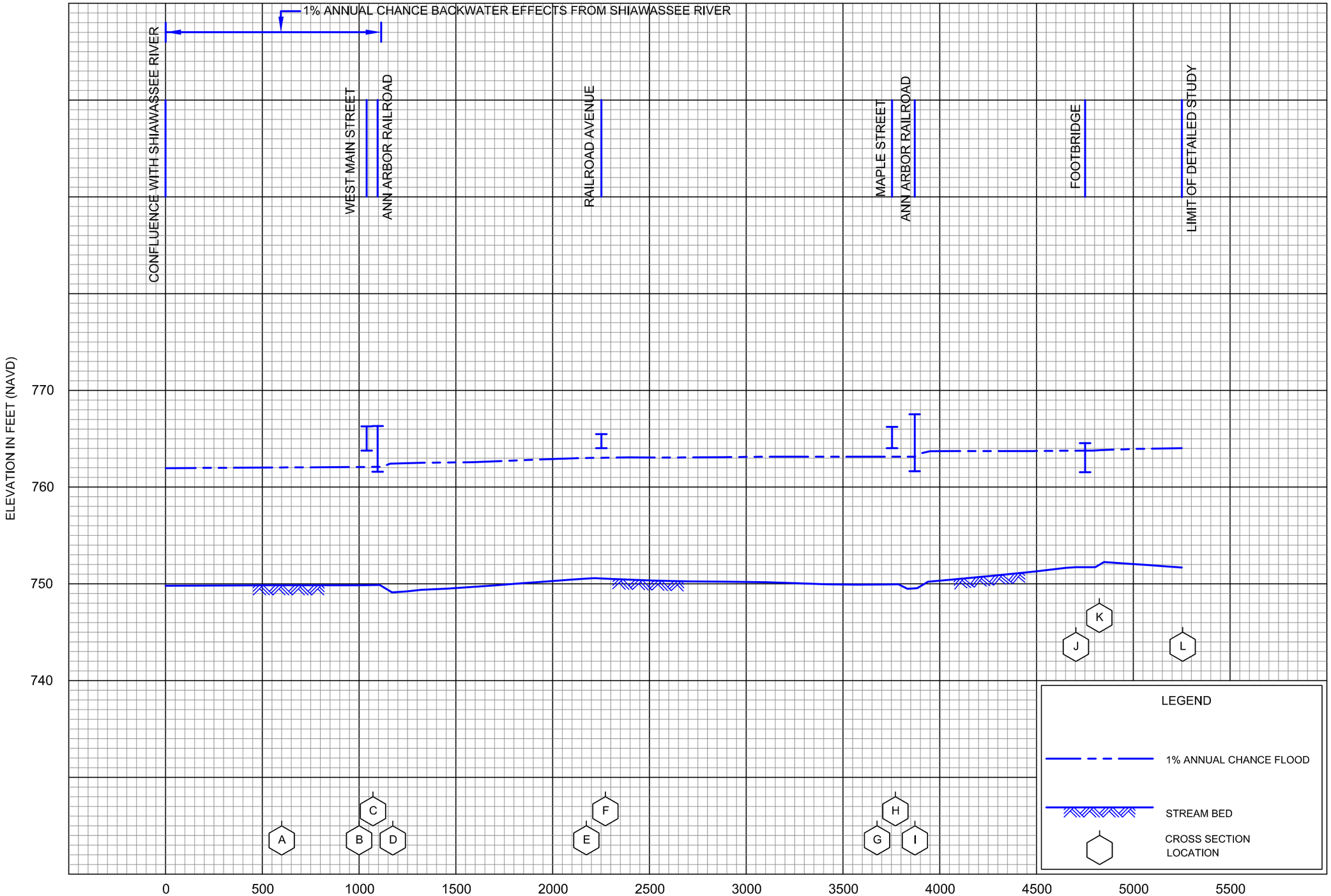


FLOOD PROFILES

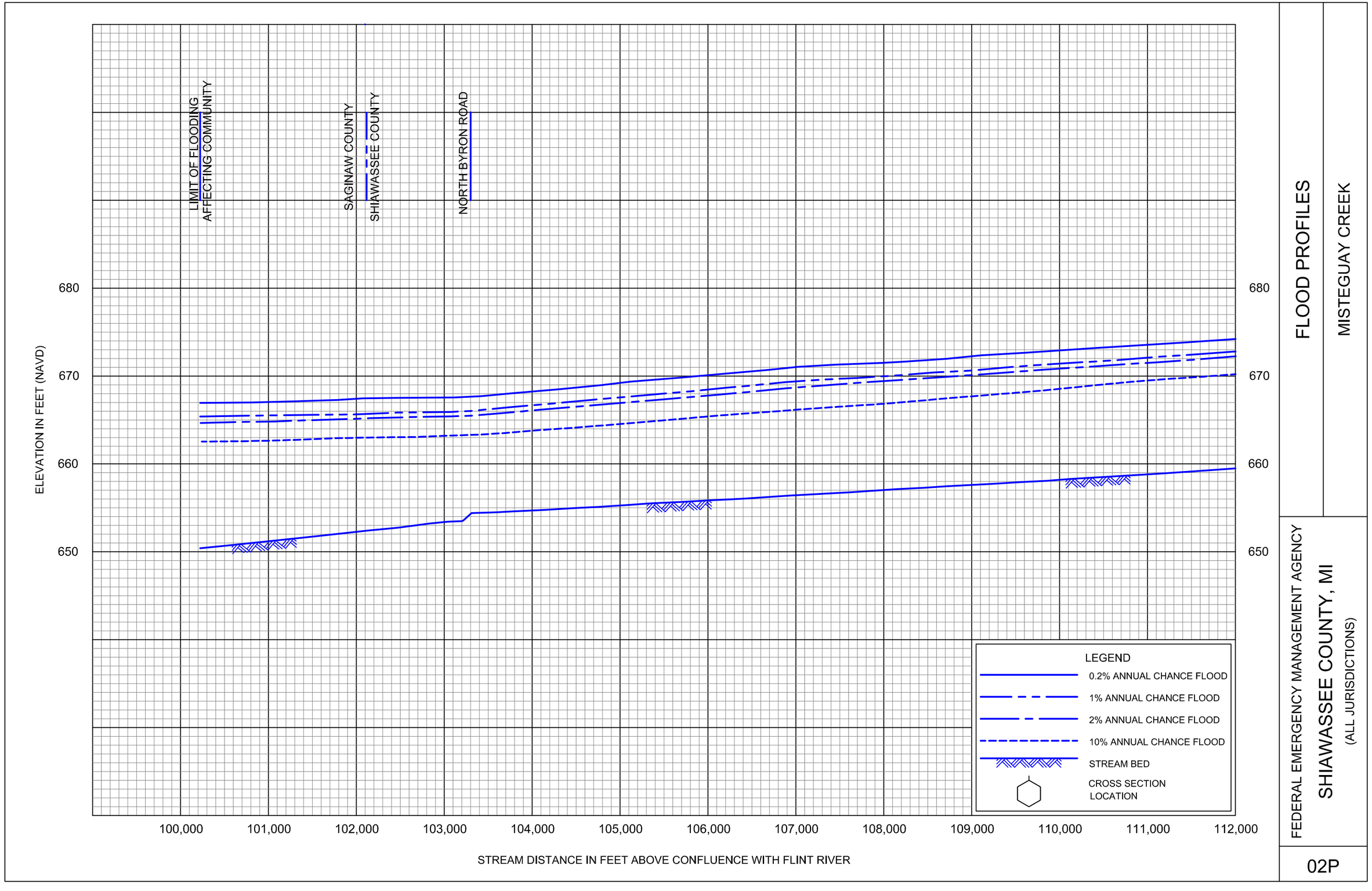
HOLLY DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

01P



FLOOD PROFILES

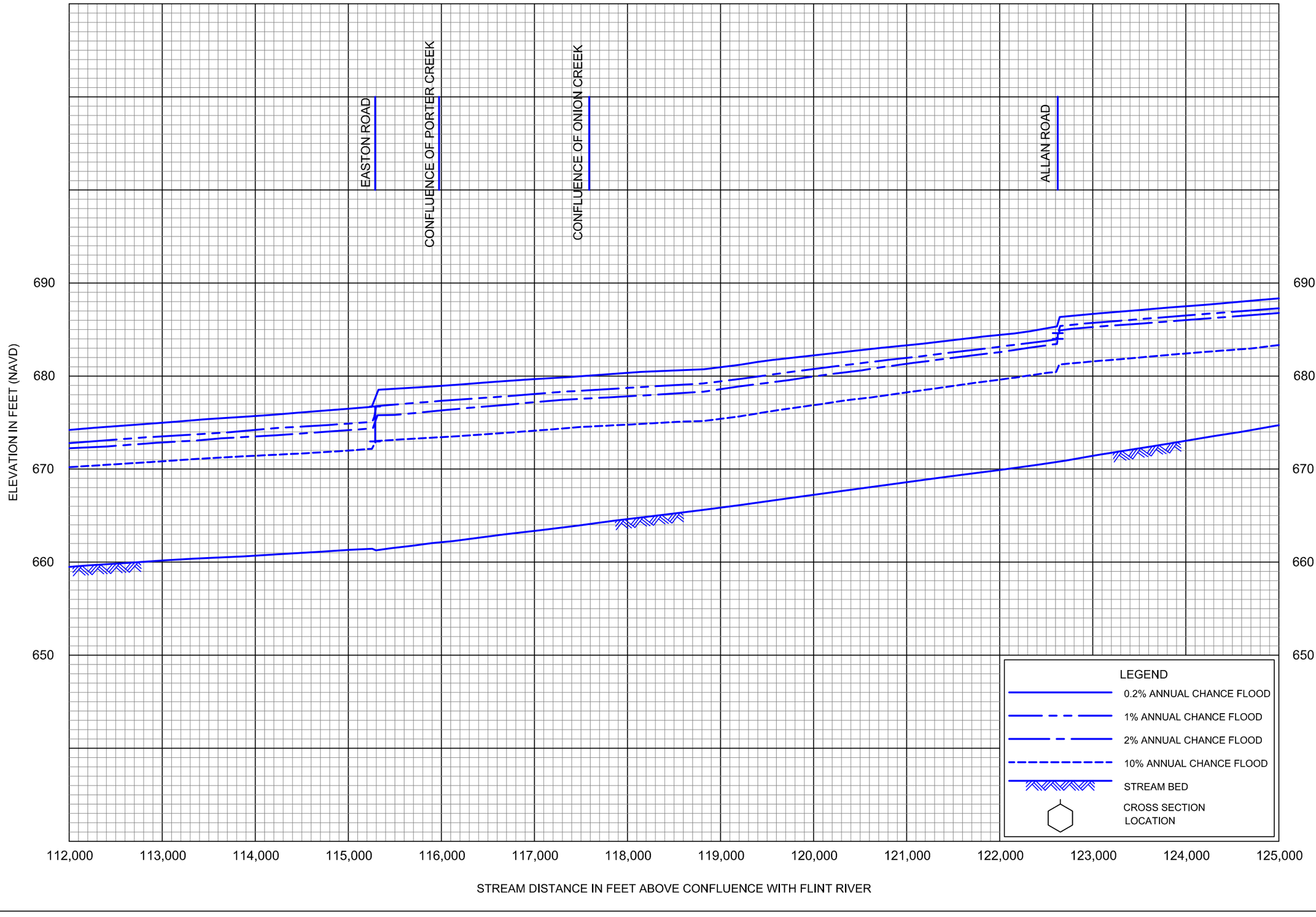
MISTEGUAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

02P



FLOOD PROFILES

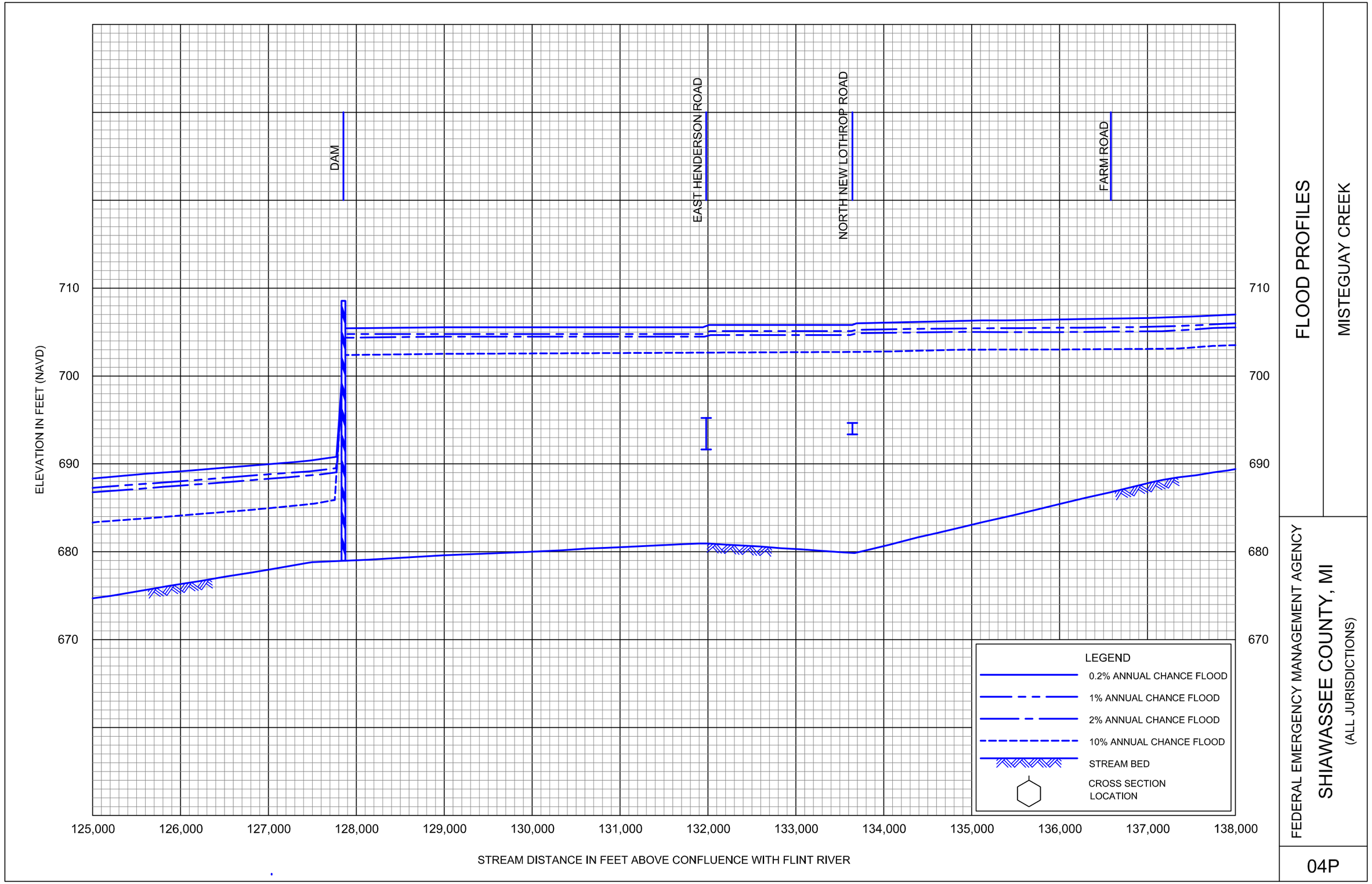
MISTEGUAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

03P



FLOOD PROFILES

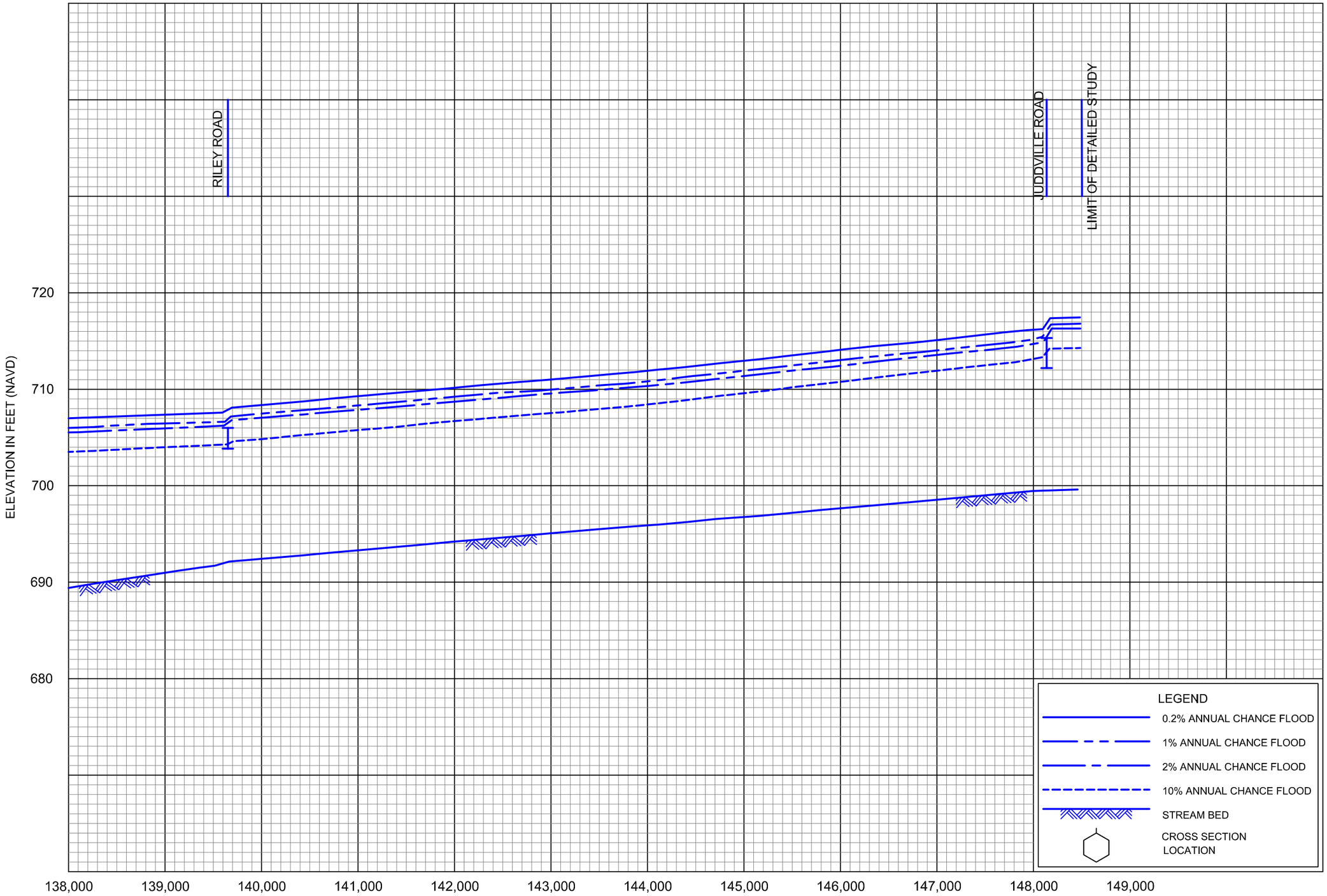
MISTEGUAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

04P



FLOOD PROFILES

MISTEGUAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

NOTE: THE 2% AND 10% ANNUAL CHANCE FLOOD PROFILE IS TOO CLOSE TO THE 1% ANNUAL CHANCE FLOOD ELEVATION TO BE SHOWN SEPARATELY

ELEVATION IN FEET (NAVD)

740
738
736
734
732
730
728
726
724

HURON & EASTERN RAILWAY
MILWAUKEE STREET
FLETCHER STREET
RYAN STREET
WEST STEWART STREET
AMENT STREET
SOUTH LYON STREET
STATE STREET

LIMIT OF DETAILED STUDY

MANHOLE
MANHOLE
MANHOLE
MANHOLE

CLOSED PIPE

SOUTH CHIPMAN STREET
FREDERICK STREET
FREEMAN STREET
KENWOOD DRIVE
HERMAN STREET
GEORGE STREET
WEST SOUTH STREET

LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000 6500

STREAM DISTANCE IN FEET ABOVE HURON & EASTERN RAILWAY

FLOOD PROFILES

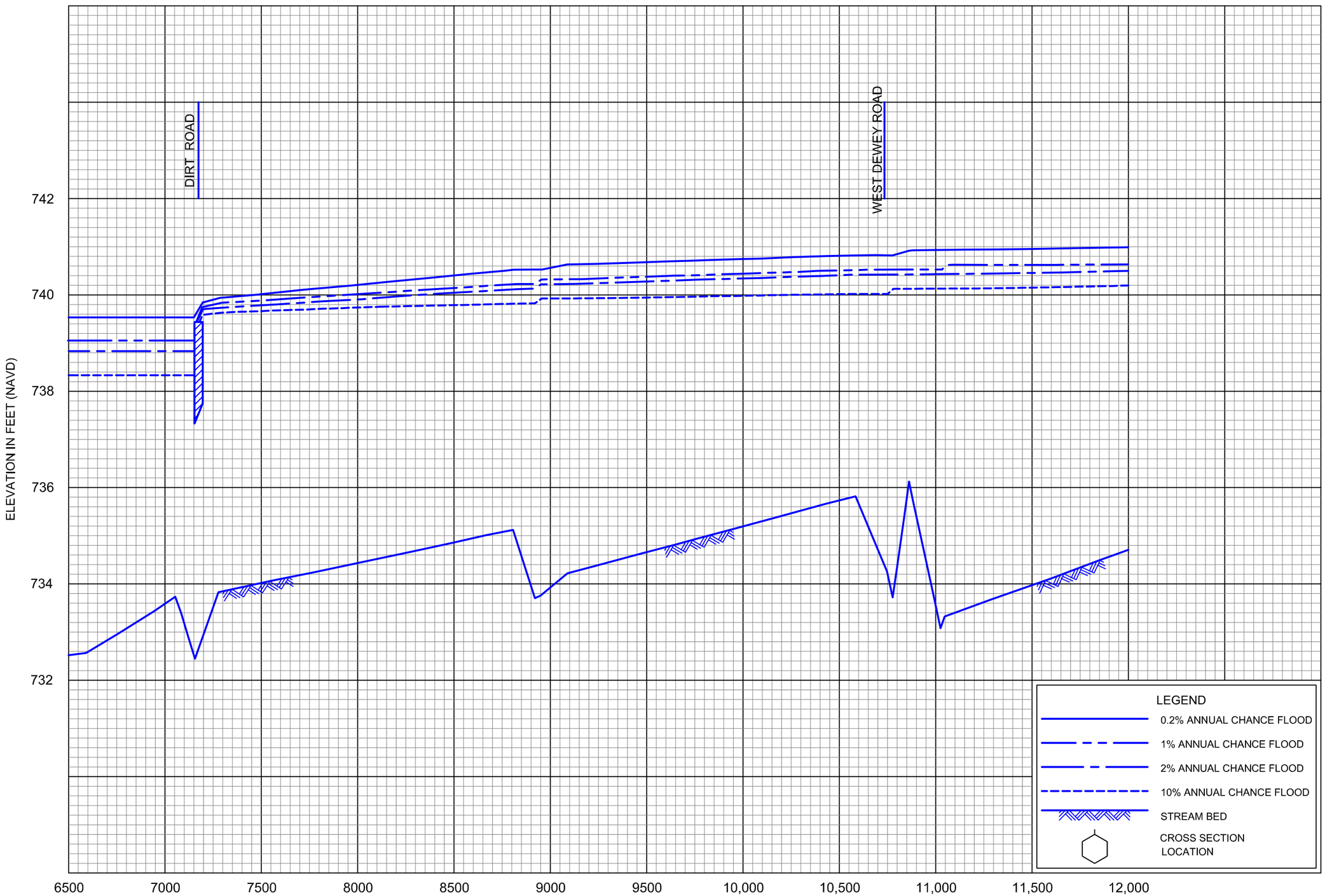
OWOSSO DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

06P



FLOOD PROFILES

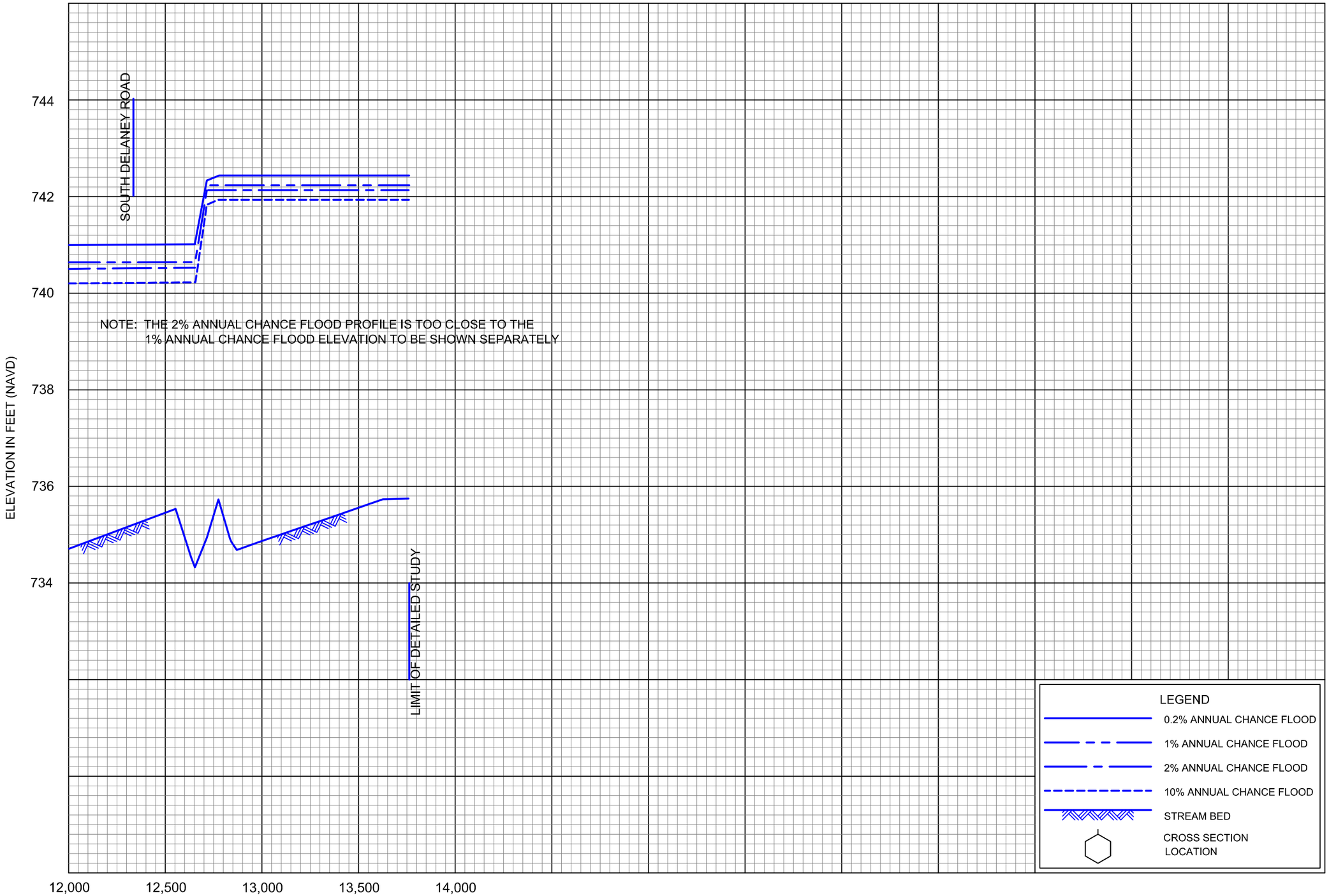
OWOSSO DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

07P



FLOOD PROFILES

OWOSSO DRAIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

08P

FLOOD PROFILES

SHIAWASSEE RIVER

LIMIT OF DETAILED STUDY

DAM

WEST OLIVER STREET

DAM

STATE HIGHWAY 52/
NORTH SHIAWASSEE STREET

UNNAMED ROAD

DAM

EAST MAIN STREET /
STATE HIGHWAY 21

SOUTH WASHINGTON STREET

ELEVATION IN FEET (NAVD)

735
730
725
720
715
710
705

234,000 235,000 236,000 237,000 238,000 239,000 240,000 241,000 242,000 243,000 244,000 245,000 246,000 247,000

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH SAGINAW RIVER

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z AA AB

LEGEND

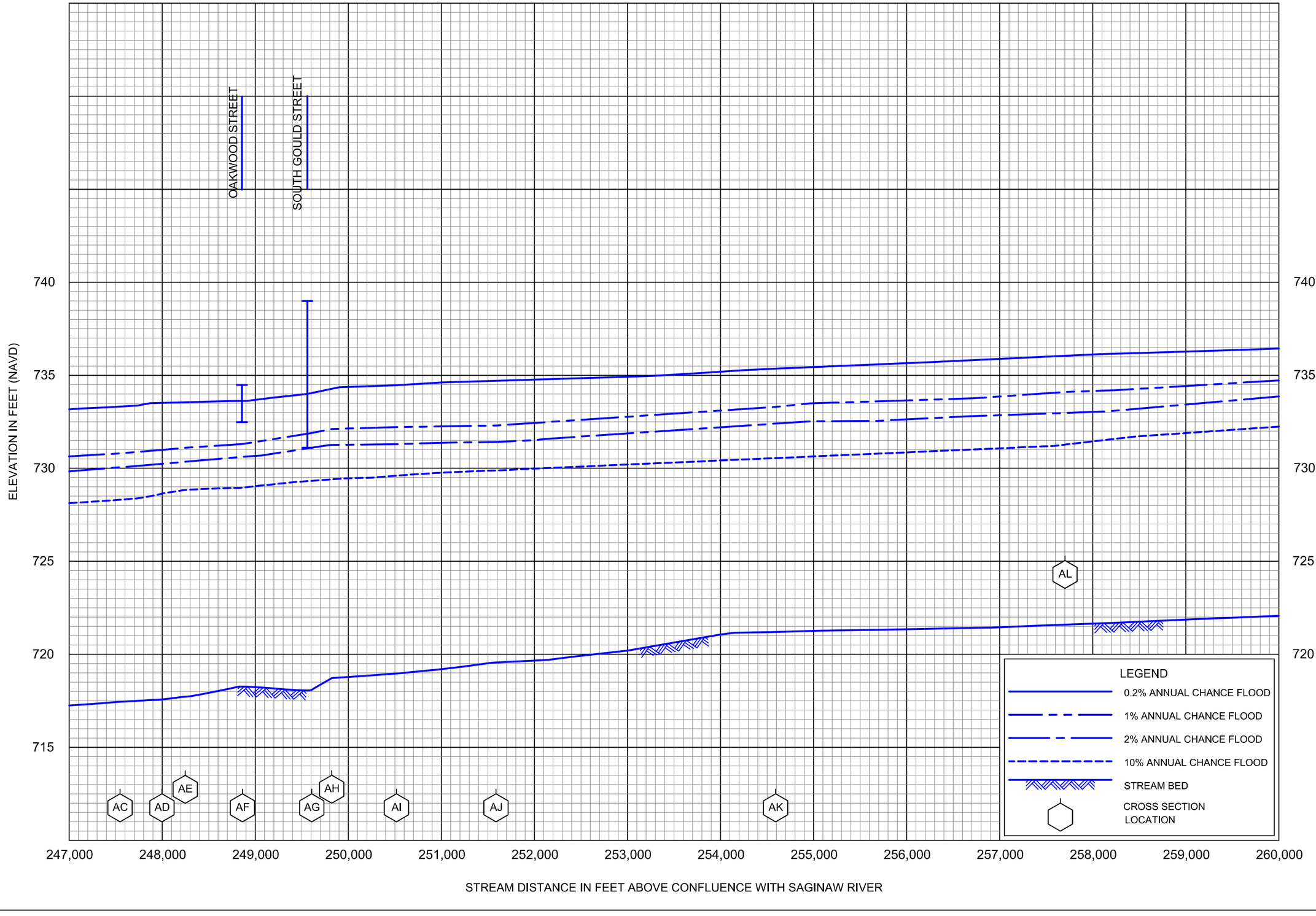
- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

09P



FLOOD PROFILES

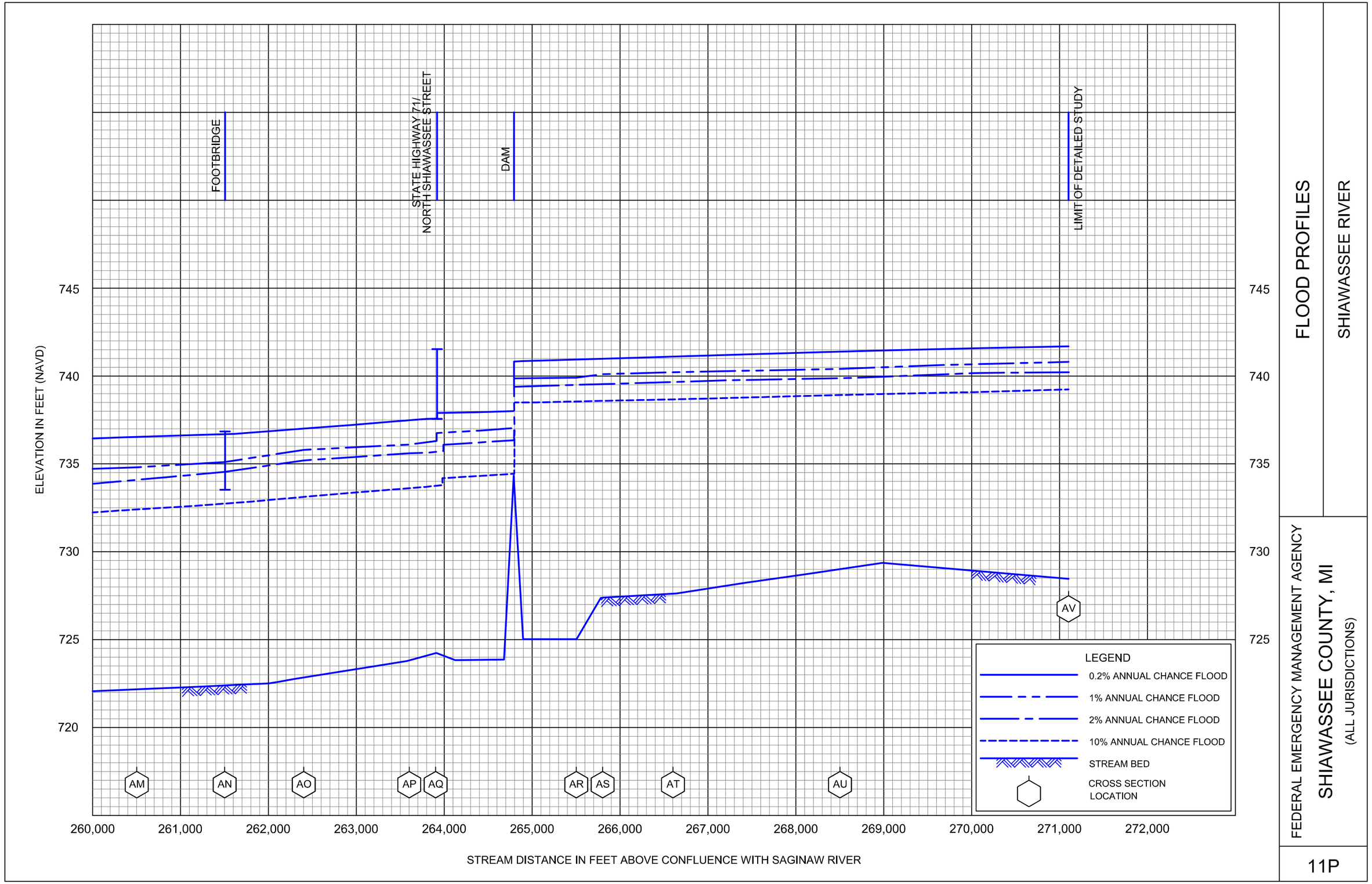
SHIAWASSEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

10P



FLOOD PROFILES

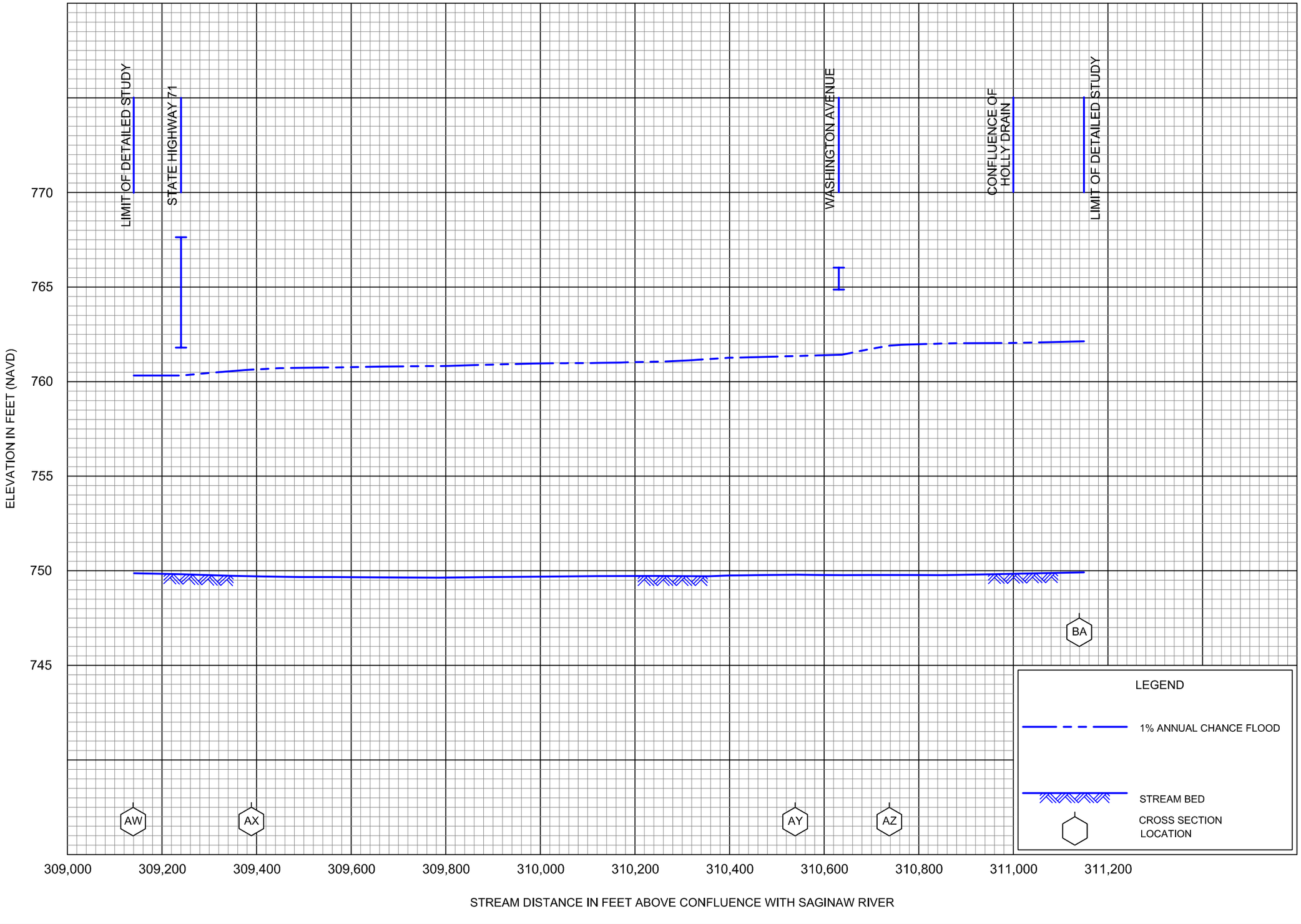
SHIAWASSEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)

11P



FLOOD PROFILES

SHIAWASSEE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

SHIAWASSEE COUNTY, MI

(ALL JURISDICTIONS)