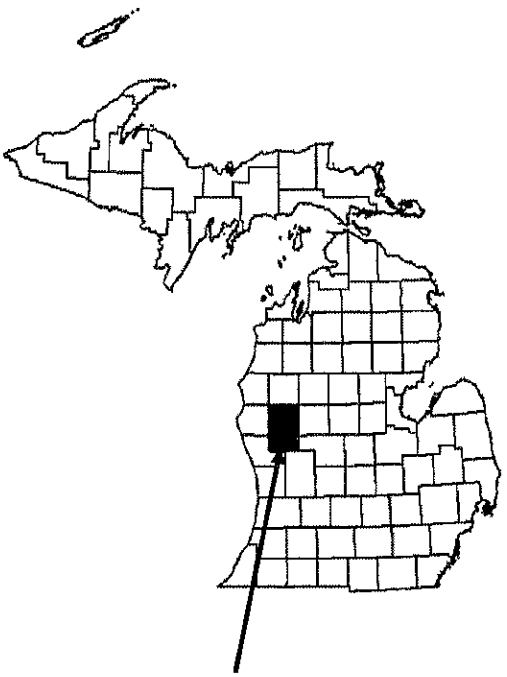
FLOOD INSURANCE STUDY

NEWAYGO COUNTY, MICHIGAN
(ALL JURISDICTIONS)

Community Name	Community Number
Ashland, Township of	260694
*Barton, Township of	261400
*Beaver, Township of	261401
*Big Prairie, Township of	260465
Bridgeton, Township of	260466
Brooks, Township of	260467
Croton, Township of	260468
Dayton, Township of	261402
*Denver, Township of	261403
*Ensley, Township of	261042
Everett, Township of	261404
Fremont, City of	260167
Garfield, Township of	260469
*Goodwell, Township of	261375
*Grant, City of	261376
*Grant, Township of	261405
*Home, Township of	261378
Lilley, Township of	261379
Lincoln, Township of	260828
Merrill, Township of	261380
*Monroe, Township of	261381
Newaygo, City of	260340
*Norwich, Township of	261382
Sheridan, Charter Township of	261899
Sherman, Township of	261384
*Troy, Township of	261406
White Cloud, City of	260470
Wilcox, Township of	261013



Newaygo County

*No Special Flood Hazard Areas Identified

February 18, 2015

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26123CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) 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. It is advisable to 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 at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult 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 Zones	New Zone
A1 through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date: February 18, 2015

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FLOOD INSURANCE STUDY

NEWAYGO COUNTY, MICHIGAN
(ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in Newaygo County, Michigan, including the Cities of Fremont, Grant, Newaygo, and White Cloud; the Charter Township of Sheridan; and the Townships of Ashland, Barton, Beaver, Big Prairie, Bridgeton, Brooks, Croton, Dayton, Denver, Ensley, Everett, Garfield, Goodwell, Grant, Home, Lilley, Lincoln, Merrill, Monroe, Norwich, Sherman, Troy, and Wilcox (hereinafter referred to collectively as Newaygo County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The City of Grant and the Townships of Barton, Beaver, Big Prairie, Denver, Ensley, Goodwell, Grant, Home, Monroe, Norwich, and Troy have no Special Flood Hazard Areas (SFHAs) identified. 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.

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 Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

Information on the authority and acknowledgments for each of the previously printed FISs and Flood Insurance Rate Maps (FIRMs) for communities within Newaygo County was compiled and is shown below.

City of Fremont: A Flood Hazard Boundary Map (FHBM) was prepared by the Federal Insurance Administration (FIA) and published on May 31, 1974. It was revised on September 26, 1975. A FIRM was prepared by FEMA and published on

August 10, 1979. It was revised on October 2, 1981. That FIRM is superseded by this countywide FIS.

City of White Cloud: A Flood Hazard Boundary Map (FHBM) was prepared by the Federal Insurance Administration (FIA) and published on April 11, 1975. The FHBM was converted by letter to a FIRM on September 1, 1988. That FIRM is superseded by this countywide FIS.

Township of Bridgeton: A FIRM was prepared by FEMA and published on September 4, 1986. It was revised March 5, 1990. The detailed study portions of that FIRM are incorporated into this countywide FIS; the approximate areas are superseded by this countywide FIS.

Township of Brooks: A FIRM was prepared by FEMA and published on July 3, 1986. The detailed study portions of that FIRM are incorporated into this countywide FIS; the approximate areas are superseded by this countywide FIS.

Township of Croton: A FIRM was prepared by FEMA and published on September 30, 1988. That FIRM is superseded by this countywide FIS.

Township of Garfield: A FIRM was prepared by FEMA and published on September 29, 1986. It was revised May 4, 1989. That FIRM is incorporated into this countywide FIS.

Township of Lincoln: A FIRM was prepared by FEMA and published on September 27, 1991. The detailed study portions of that FIRM are incorporated into this countywide FIS; the approximate areas are superseded by this countywide FIS.

New approximate study areas were incorporated in this FIS. The hydrologic and hydraulic analyses for these studies were prepared by the Michigan Department of Environmental Quality (DEQ) Water Resources Division for FEMA under Grant No. EMC-2008-CA-7012. This work was completed in July, 2013.

This countywide FIS includes new approximate studies, redelineation of effective profiles, and incorporation of approved Letters of Map Change (LOMCs). The vertical datum was shifted to North American Vertical Datum of 1988 (NAVD88). The digital floodplain data were merged into a single, updated DFIRM. The DFIRM includes 2009 digital orthophotography, political boundaries, road centerlines with street names, railroads with names, airports, rivers, lakes, streams, bridges and other hydraulic structures, and elevation reference marks.

The coordinate system used for the production of the DFIRMs is State Plane Michigan South, Zone 2113, referenced to the North American Datum of 1983 and the Geodetic Reference System 1980 ellipsoid.

1.3 Coordination

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

The initial CCO meeting was held on May 23, 2007, and was attended by representatives of the Townships of Bridgeton, Brooks, Denver, and Everett; FEMA; and the DEQ.

Coordination with these officials and agencies produced information pertaining to flood history and the location of historic flooded stream crossings.

The results of the study were reviewed at the final CCO meeting held on October 1, 2013, and attended by representatives of the Cities of Fremont, Newaygo, and White Cloud; the Townships of Big Prairie, Croton, Dayton, Denver, Lincoln, Monroe, Sheridan, and Sherman; and the DEQ. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Newaygo County, Michigan, including the communities listed in Section 1.1.

The flooding sources previously studied by detailed methods are listed in Table 1.

TABLE 1 – Limits of Previous Detailed Studies

Flooding Source	Limits of Detailed Study
Muskegon River	Muskegon County line to section 22, Township of Brooks
South Branch White River	Within the Township of Lincoln

Approximate analyses are used to study those areas having a low development potential or minimal flood hazard. Approximate analyses were performed to identify flood hazard areas on the flooding sources shown in Table 2.

TABLE 2 – Limits of Approximate Studies

Flooding Source	Limits of Approximate Study
Bigelow Creek	8th Street to south section line, section 21, Everett Township; Center of section 17, Brooks Township, to Mouth
Blood Drain	800 feet upstream of 128th Street to Mouth
Brooks Creek	Second and Third Lakes, Fremont Lake
Cedar Creek	Sisson Lake Outlet to Lake County Line
Little Muskegon River	Mecosta County Line to Mouth

TABLE 2 – Limits of Approximate Studies (continued)

Flooding Source	Limits of Approximate Study
Mena Creek	Minnie Lake Outlet to Luce Avenue
Minnie Creek	112th Street to Mouth
Muskegon River	Upstream corporate limit, Croton Township, to 600 feet upstream of north section line, section 22, Brooks Township
Ransom Creek	Bills Lake
Sand Creek	West section line, section 20, Ashland Township, to Mouth
Second Cole Creek	West section line, section 26, Lincoln Township, to Mouth
South Branch White River	City of White Cloud upstream corporate limit to Sherman Township downstream corporate limit
Tamarack Creek	Montcalm County Line to Mouth
Tributary to Centerline Drain	Pettit Lake
Tributary to Coonskin Creek	Crystal Lake
Tributary to Muskegon River	West section line, section 7, Ashland Township, to Mouth
Tributary to Sand Creek	116th Avenue to Mouth
Tributary to South Branch White River	Diamond Lake
Tributary to Tank Creek	Woodland Lake

This countywide FIS also incorporates the determination of letters issued by FEMA resulting in map revisions (Letters of Map Revision (LOMRs)) and map amendments (Letters of Map Amendment (LOMAs)).

Letters of Map Amendment (LOMAs) incorporated for this study are summarized in the Summary of Map Actions (SOMA) included in the Technical Support Data Notebook (TSDN) associated with this FIS update. Copies of the TSDN may be obtained from the Community Map Repository. No letter issued by FEMA resulted in map changes of sufficient scale to be incorporated in this FIS report.

2.2 Community Description

Newaygo County is in the west-central part of Michigan's Lower Peninsula. It is approximately 50 miles north of Grand Rapids. The area of the county is about 813 square miles. It is bordered on the east by Mecosta County and Montcalm County, on the south by Kent County and Muskegon County, on the west by Muskegon County and Oceana County, and on the north by Lake County. The major transportation arteries are M-20, M-37, and M-82.

Development within Newaygo County consists principally of single unit residential dwellings and some commercial development. The 2012 population of Newaygo County was estimated by the U.S. Census Bureau to be 47,959 (Reference 1).

Newaygo County's climate alternates between continental and semi-marine. Despite its inland location, Newaygo County's climate is influenced by Lake Michigan. The Lake's

influence is most evident during predominantly westerly winds, which cause increased cloudiness in fall and winter. The average annual daily temperature is 46 degrees Fahrenheit. The maximum average daily high temperature occurs in July at 83 degrees Fahrenheit. The minimum average daily low temperature occurs in February at 12 degrees Fahrenheit. The average annual precipitation is 32 inches, which includes 57 inches of snowfall, and is well distributed. The growing season averages 126 days annually (Reference 2).

2.3 Principal Flood Problems

In Newaygo County, floods generally occur as a result of heavy winter and spring rains coupled with snowmelt. The most notable floods experienced in Newaygo County occurred when frontal storms of great intensity, lengthy duration, and widespread areal extent moved over the county. Floods have also occurred as a result of the break-up of ice jams on the Muskegon River.

Newaygo County experienced a significant storm event that resulted in record flooding on many of its watercourses in September, 1986. The flood of record on the Muskegon River occurred at that time, with an estimated peak flow of 23,200 cubic feet per second at U.S. Geologic Survey (USGS) Gage No. 04122000 at Newaygo (Reference 3). The frequency of this flood was in excess of a 0.2-percent-annual-chance (500-year) flood. Other ungaged watercourses in Newaygo County also experienced record flooding as a result of this storm event.

2.4 Flood Protection Measures

No structural protection against floods exists in this county.

The Michigan Dam Safety Program lists 24 dams in Newaygo County. Eight are regulated under the state dam safety statute, seven have established legal lake levels, and two are regulated by the Federal Energy Regulatory Commission. These dams were constructed for recreational and power generation purposes and do not offer significant storage for flood protection.

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 one 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

The flood-flow frequencies for the Muskegon River were based on a statistical analysis of discharge records covering a 64-year period at the USGS gaging station on the Muskegon River at Newaygo, USGS gage no. 04122000 (Reference 3), including the flood of record that occurred in 1986. This analysis followed the standard log-Pearson Type III method as outlined by the U.S. Water Resources Council (Reference 4), using a regional skew coefficient determined specifically for Michigan (Reference 5).

The flood-flow frequencies for Bigelow Creek, Little Muskegon River, South Branch White River, and Tamarack Creek were developed using the regional regression method described in *Statistical Models for Estimating Flow Characteristics of Michigan Streams* (Reference 6).

The peak flows for Brooks Creek were developed using the U.S. Army Corps of Engineers (USACE) *Hydrologic Modeling System* (HEC-HMS) computer model (Reference 7). The HEC-HMS model generates runoff hydrographs for each drainage basin according to SCS methodology, and allows the user to combine and route these hydrographs to simulate the hydrologic interaction of multiple sub-basins in a watershed. The design precipitation for this method was obtained from the Midwest Climate Center Bulletin 71, *Rainfall Frequency Atlas of the Midwest* (Reference 8).

The peak flows for Bigelow Creek, Blood Drain, Cedar Creek, Mena Creek, Minnie Creek, Sand Creek, Second Cole Creek, Tributary to Muskegon River, and Tributary to Sand Creek, and were developed using the methodology described in the DEQ report entitled *Computing Flood Discharges for Small Ungaged Watersheds* (Reference 9). Flood volumes for Bills Lake, Crystal Lake, Diamond Lake, Pettit Lake, and Woodland Lake were also developed using this methodology. The method detailed in this report is similar to SCS methodology, but implements a state-specific dimensionless unit hydrograph and a relationship between the unit hydrograph peak and the time of concentration developed from an analysis of peak flows at gaged streams in Michigan. Bulletin 71 precipitation data were also used with this method. DEQ's Water Resources Division developed a spreadsheet that was used to calculate peak discharges using this method. The spreadsheet calculates the time of concentration based on the length, slope, and flow regime of the flow path to the most hydraulically distant point in the basin. The curve number is estimated by a procedure developed by the DEQ Hydrologic Studies Program that utilizes GIS shape files for soil type and land use and lookup tables to assign curve numbers to specific combinations of soil type and land use (Reference10). The ponded storage areas used in the calculations were also calculated using GIS.

The peak flows for at ungaged locations on gaged streams were estimated with the *Drainage Area Ratio Method* (Reference 8), where the point of "known" peak discharge and drainage area was one of the flood-flow frequency values estimated as described above.

Peak discharges calculated for detailed riverine studies are presented in Table 3.

TABLE 3 – Summary of Peak Discharges

Flooding Source and Location	Drainage Area (Sq. Miles)	Peak Discharge (cfs) 10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Muskegon River					
USGS Gage 04122000 at Newaygo	2,400	*	*	19,000	*
South Branch White River					
Upstream of Mena Creek	156	*	*	3,400	*
M-20	135	*	*	3,200	*
Baldwin Avenue	111	*	*	2,700	*

*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 for 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 report in conjunction with the data shown on the FIRM.

Water surface elevations for the Muskegon River from section 22 of Brooks Township to the Muskegon County line, and for the South Branch White River within the Township of Lincoln, were computed for floods of selected recurrence intervals using the USACE HEC-2 computer program (Reference 11). The HEC-2 program performs a backwater analysis of stream flows from one cross section to the next upstream section.

For all other studied reaches, water surface elevations for floods of the selected recurrence intervals were computed with the USACE *Hydrologic Engineering Center-River Analysis System* (HEC-RAS) computer model (Reference 12). The HEC-RAS computer model calculates water-surface profiles for steady, gradually-carried flow based on the solution of the one-dimensional energy equation.

The methods used to obtain cross section data used in the Muskegon River and South Branch White River hydraulic models are described in Table 4.

TABLE 4 – Cross Section Data

Flooding Source	Year	Description
Muskegon River	1977, 1987	Land survey of channel and structures
South Branch White River	1989	Land survey of channel and structures

Locations of selected cross sections used in the hydraulic analyses for the Muskegon River and South Branch White River 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 shown on the FIRM.

Roughness factors were chosen by engineering judgment and based on field observations, photographs, aerial photographs (Reference 13), and methods used by Chow (Reference 14), the Soil Conservation Service (Reference 15), and USGS (Reference 16). Table 5 shows the channel and overbank "n" values typical for early summer conditions for the flooding sources.

TABLE 5 – Manning's "n" Values

	Mannings "n" Values	
Flooding Source	Channel	Overbank
Muskegon River	0.032 – 0.035	0.030 – 0.160
South Branch White River	0.020 – 0.045	0.030 – 0.120

The slope-area method used to determine the starting water surface elevations for both the Muskegon River and the South Branch White River.

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, and if channel and overbank conditions remain essentially the same as ascertained during this study.

Flood profiles were drawn showing the computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. In cases where two or more profiles are close together, due to limitation of the profile scale, only the higher profile has been shown.

All elevations are referenced from NAVD88; elevation reference marks used in the study are shown on the maps.

Streams studied by approximate methods are listed in Table 2. Elevation data for bridges and culverts for those streams studied by approximate methods were obtained by land survey or from construction drawings, if available. Manning's "n" values were based on field reconnaissance and aerial imagery.

The starting water surface elevation for the approximate model of the Muskegon River was the upstream water surface elevation from the Township of Brooks FIS (Reference 17). The starting water surface elevation for the approximate model of the South Branch White River was the upstream water surface elevation from the Township of Lincoln FIS (Reference 18). The starting water surface elevation for the Little Muskegon River model was the elevation of Croton Dam Pond. The models for Bigelow Creek, Blood Drain, Cedar Creek, Mena Creek, Minnie Creek, Sand Creek, Second Cole Creek, Tamarack Creek, Tributary to Muskegon River, and Tributary to Sand Creek used normal depth as the starting condition. The slope used for normal depth was determined from the USGS topographic maps.

3.3 Vertical Datum

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

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

The average conversion of -0.381 feet (see Table 6) was applied to convert all effective BFEs for Newaygo County.

TABLE 6 – Datum Conversion Calculation

USGS Quadrangle	Corner	Latitude	Longitude	Conversion (ft) from NGVD29 to NAVD88
Big Star Lake	SW	N 43.750	W 86.000	-0.312
Marlborough	SW	N 43.750	W 85.875	-0.338
Whipple Lake	SW	N 43.750	W 85.750	-0.341
Reed City South	SW	N 43.750	W 85.625	-0.325
Walkup Lake	SW	N 43.625	W 86.000	-0.325
Woodland Park	SW	N 43.625	W 85.875	-0.338
Woodville	SW	N 43.625	W 85.750	-0.354
Woodville NE	SW	N 43.625	W 85.625	-0.341
Dayton Center	SW	N 43.500	W 86.000	-0.351
White Cloud	SW	N 43.500	W 85.875	-0.358
Big Prairie	SW	N 43.500	W 85.750	-0.377
Big Bend	SW	N 43.500	W 85.625	-0.394
Fremont	SW	N 43.375	W 86.000	-0.410
Newaygo	SW	N 43.375	W 85.875	-0.413
Croton	SW	N 43.375	W 85.750	-0.417
Tift Corner	SW	N 43.375	W 85.625	-0.390
			Average Conversion:	-0.362
			Range:	-0.312 through -0.417
			Max offset:	0.105

For more information on NAVD88, see the FEMA publication entitled *Converting the National Flood Insurance Program to the North American Vertical Datum of 1988* (Reference 19), or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, 20910 (http://www.ngs.noaa.gov).

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the TSDN associated with

this FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

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 this FIS report, including Flood Profiles and Floodway Data Tables. Users should reference the data presented in this 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 (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each watercourse 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 floodplain boundaries between cross sections for detailed study areas were interpolated using topographic maps at a scale of 1:24,000, with a contour interval of either 5 meters or 10 feet (References 20 and 21).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM. 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 (Zone X). In cases where the 1- and 0.2-percent-annual-chace 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 watercourses studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. Approximate 1-percent-annual-chance floodplain boundaries were delineated using base map information described above.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of

encroachment so that the 1-percent-annual-chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The 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 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

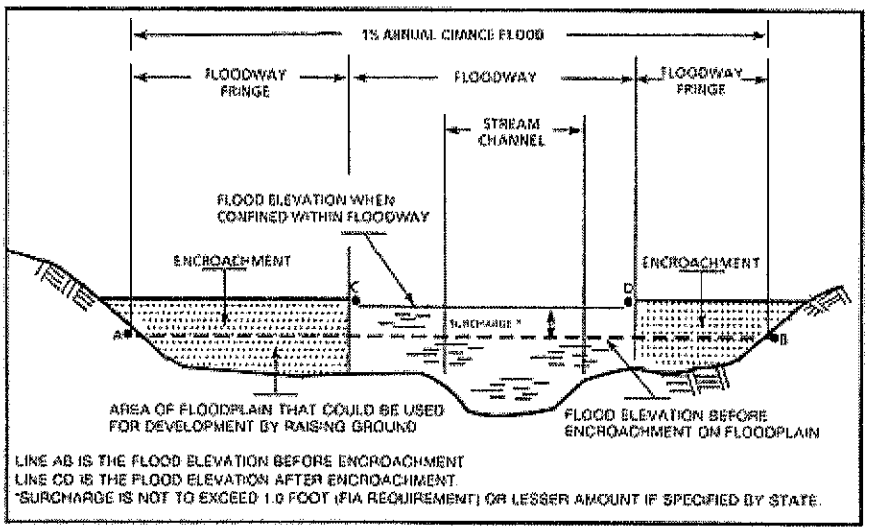

FIGURE 1 – Floodway Schematic

In Michigan, under the State's Floodplain Regulatory Authority, found in Part 31, Water Resources Protection, of the *Natural Resources and Environmental Protection Act*, 1994 PA 451 (Reference 22), encroachment in the floodplain is limited to that which will cause only insignificant increases in flood heights. At the recommendation of the Michigan Department of Environmental Quality, Water Resources Division, a floodway having no more than a 0.1-foot surcharge has been delineated for this FIS.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain.

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

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
MUSKEGON RIVER								
A	30,423	801	6776	2.8	619.0	619.0	619.0	0.0
B	32,343	741	6135	3.1	619.5	619.5	619.5	0.0
C	33,523	308	4348	4.3	619.9	619.9	619.9	0.0
D	35,103	543	5891	3.2	620.3	620.3	620.3	0.0
E	40,723	1092	10808	1.7	621.7	621.7	621.7	0.0
F	44,523	587	6122	3.1	622.8	622.8	622.8	0.0
G	49,313	474	6013	3.1	624.0	624.0	624.0	0.0
H	51,813	704	7636	2.5	624.8	624.8	624.9	0.1
I	55,428	823	8708	2.2	625.6	625.6	625.7	0.1
J	58,628	610	6217	3.0	626.7	626.7	626.8	0.1
K	62,053	550	6073	3.1	628.1	628.1	628.2	0.1
L	65,813	770	8272	2.3	629.5	629.5	629.6	0.1
M	67,963	955	10298	1.8	630.4	630.4	630.5	0.1
N	72,463	495	5311	3.5	631.4	631.4	631.4	0.0
O	75,113	594	7155	2.6	632.6	632.6	632.6	0.0
P	77,063	425	5050	3.7	633.4	633.4	633.5	0.1
Q	78,913	897	6140	3.1	634.4	634.4	634.5	0.1
R	82,138	1076	8825	2.1	635.3	635.3	635.4	0.1
S	83,893	1430	16093	1.2	635.8	635.8	635.9	0.1
T	85,993	900	7279	2.6	636.0	636.0	636.1	0.1
U	86,993	1588	12303	1.5	636.6	636.6	636.6	0.0
V	90,193	687	4844	3.9	637.1	637.1	637.2	0.1
W	92,418	427	5683	3.3	638.6	638.6	638.7	0.1
X	95,288	450	5080	3.7	639.6	639.6	639.7	0.1
Y	97,788	410	5163	3.6	640.6	640.6	640.7	0.1

[1]Distance in feet above county line

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

MUSKEGON RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
MUSKEGON RIVER								
Z	100,668	393	5344	3.5	641.5	641.5	641.5	0.0
AA	101,668	303	4412	4.3	641.7	641.7	641.7	0.0
AB	102,268	319	4532	4.1	641.9	641.9	642.0	0.1
AC	103,408	460	4862	3.9	642.4	642.4	642.5	0.1
AD	103,958	293	4206	4.5	642.6	642.6	642.7	0.1
AE	104,088	296	4096	4.6	642.5	642.5	642.6	0.1
AF	106,168	259	3493	5.4	643.4	643.4	643.5	0.1
AG	106,718	325	4102	4.6	643.8	643.8	643.9	0.1
AH	107,178	323	3715	5.1	643.9	643.9	644.0	0.1
AI	107,543	233	3036	6.2	644.0	644.0	644.1	0.1
AJ	107,743	314	3892	4.8	644.4	644.4	644.5	0.1
AK	109,263	260	3048	6.2	645.1	645.1	645.2	0.1
AL	110,573	238	2377	7.9	645.8	645.8	645.9	0.1
AM	111,473	373	3910	4.8	647.1	647.1	647.2	0.1
AN	113,653	240	2696	7.0	648.3	648.3	648.4	0.1
AO	115,143	237	2844	6.6	649.6	649.6	649.7	0.1
AP	117,253	230	2934	6.4	651.1	651.1	651.1	0.0
AQ	119,813	225	2868	6.6	652.5	652.5	652.6	0.1
AR	121,013	264	2867	6.6	653.4	653.4	653.4	0.0
AS	121,753	183	2353	8.0	653.7	653.7	653.7	0.0
AT	124,203	411	4045	4.6	656.2	656.2	656.3	0.1
AU	126,713	822	3839	4.9	657.8	657.8	657.9	0.1
AV	128,273	686	5289	3.6	659.1	659.1	659.2	0.1
AW	128,993	189	2904	6.5	659.3	659.3	659.3	0.0
AX	130,663	932	7306	2.6	660.6	660.6	660.7	0.1

[1]Distance in feet above county line

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

MUSKEGON RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
MUSKEGON RIVER								
AY	131,423	890	5842	3.2	660.8	660.8	660.9	0.1
AZ	132,163	845	4982	3.8	661.1	661.1	661.2	0.1
BA	133,943	1410	7491	2.5	662.7	662.7	662.8	0.1
BB	135,863	859	5013	3.7	663.7	663.7	663.8	0.1

[1]Distance in feet above county line

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

MUSKEGON RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION, FEET			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (NAVD)	WITHOUT FLOODWAY (NAVD)	WITH FLOODWAY (NAVD)	INCREASE
SOUTH BRANCH WHITE RIVER								
A	56,395	310	2049	1.6	762.1	762.1	762.2	0.1
B	59,940	582	2011	1.7	764.0	764.0	764.1	0.1
C	66,370	214	887	3.8	776.1	776.1	776.2	0.1
D	66,640	128	669	4.8	776.6	776.6	776.7	0.1
E	73,588	497	2420	1.3	783.0	783.0	783.1	0.1
F	78,218	340	1554	2.1	786.3	786.3	786.4	0.1
G	78,808	104	746	3.6	787.1	787.1	787.2	0.1
H	84,375	706	3525	0.8	790.1	790.1	790.2	0.1
I	90,920	526	2107	1.3	792.5	792.5	792.6	0.1

[1]Distance in feet above county line

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOODWAY DATA

SOUTH BRANCH WHITE RIVER

5.0 INSURANCE APPLICATION

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

This FIRM presents flooding information for the entire geographic area of Newaygo County. Previously, separate FIRMs were prepared for each community with special flood hazard areas.

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 purposes of the National Flood Insurance Program.

FEMA has previously published an FIS report and FIRMs for the Townships of Ashland (References 23 and 24), Bridgeton (References 25 and 26), Brooks (References 17 and 27), Garfield (References 28 and 29), and Lincoln (References 18 and 30). The results presented in this FIS report and on the FIRM for Newaygo County are in exact agreement with the results for the detailed study portion of the Chippewa River in the Township of Fork, and supersede all other previous studies. A list of Newaygo County communities and their flood insurance map history is presented on Table 8.

8.0 LOCATION OF DATA

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

9.0 BIBLIOGRAPHY AND REFERENCES

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4. U.S. Department of the Interior, Geological Survey, Interagency Advisory Committee on Water Data, Office of Water Data Coordination, Hydrology Subcommittee, Bulletin No. 17B, Guidelines for Determining Flood Flow Frequency, September 1981, revised 1982.

5. Croskey, Hope M., and Holtschlag, D. J., Estimating Generalized Flood Skew Coefficients for Michigan, U.S. Geological Survey, prepared jointly with Michigan Department of Natural Resources, Water Management Division, Water Resources Investigation Report 83-4194, Lansing, Michigan, 1983.

6. Holtschlag, D.J. and H.M. Croskey, U.S. Geological Survey, Michigan Department of Natural Resources, Water Resources Investigation Report 84-4207, Statistical Models for Estimating Flow Characteristics of Michigan Streams, Lansing, Michigan, 1984.

7. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-HMS, Hydrologic Modeling System, v. 3.1.0, Davis, California, April 2006.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Ashland, Township of	May 19, 1978	N/A	September 1, 1986	May 4, 1989
[1,2] Barton, Township of	N/A	N/A	N/A	
[1,2] Beaver, Township of	N/A	N/A	N/A	
[1,2] Big Prairie, Township of	N/A	N/A	N/A	
Bridgeton, Township of	October 22, 1976	N/A	September 4, 1986	March 5, 1990
Brooks, Township of	July 18, 1975	N/A	July 3, 1986	November 3, 1989
Croton, Township of	March 10, 1978	N/A	September 30, 1988	
[2] Dayton, Township of	N/A	N/A	N/A	
[1,2] Denver, Township of	N/A	N/A	N/A	
[1,2] Ensley, Township of	N/A	N/A	N/A	
[2] Everett, Township of	N/A	N/A	N/A	
Fremont, City of	May 31, 1974	September 26, 1975	August 10, 1979	October 2, 1981
Garfield, Township of	August 8, 1975	N/A	September 29, 1986	May 4, 1989
[1,2] Goodwell, Township of	N/A	N/A	N/A	
[1,2] Grant, City of	N/A	N/A	N/A	
[1,2] Grant, Township of	N/A	N/A	N/A	
[1,2] Home, Township of	N/A	N/A	N/A	
[2] Lilley, Township of	N/A	N/A	N/A	
Lincoln, Township of	September 27, 1991	N/A	September 27, 1991	
[2] Merrill, Township of	N/A	N/A	N/A	
[1,2] Monroe, Township of	N/A	N/A	N/A	
[2] Newaygo, City of	N/A	N/A	N/A	
[1,2] Norwich, Township of	N/A	N/A	N/A	
[2] Sheridan, Charter Township of	N/A	N/A	N/A	
[2] Sherman, Township of	N/A	N/A	N/A	
[1,2] Troy, Township of	N/A	N/A	N/A	
White Cloud, City of	April 11, 1975	N/A	September 1, 1986	
[2] Wilcox, Township of	N/A	N/A	N/A	

N/A – Not Applicable
[1]No Special Flood Hazard Areas Identified
[2]This community does not have map history prior to the first countywide mapping

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

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24. Federal Emergency Management Agency, Flood Insurance Study, Township of Ashland, Newaygo County, Michigan, May 4, 1989.

25. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Bridgeton, Newaygo County, Michigan, March 5, 1990.

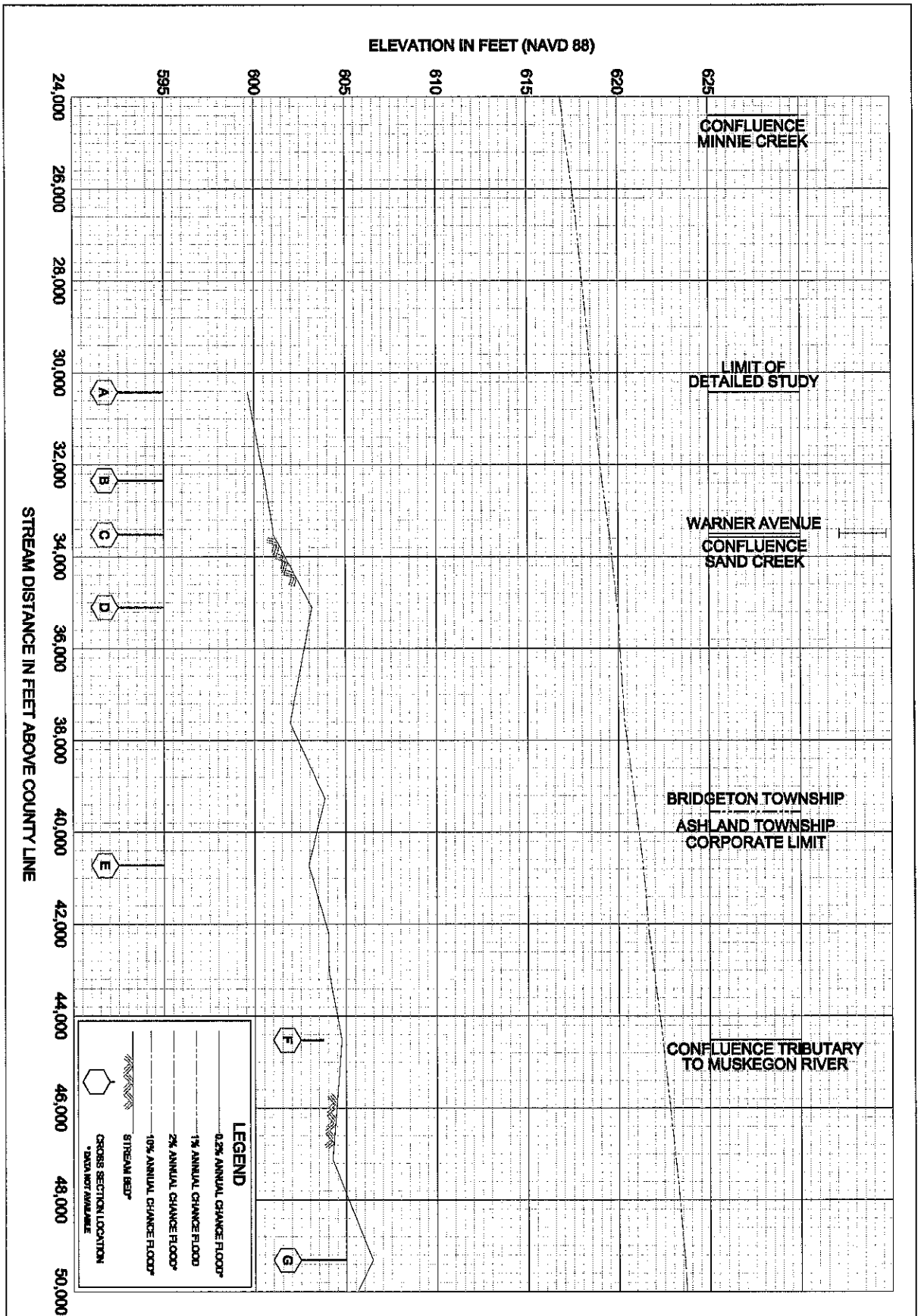
26. Federal Emergency Management Agency, Flood Insurance Study, Township of Bridgeton, Newaygo County, Michigan, March 5, 1990.

27. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Brooks, Newaygo County, Michigan, November 3, 1989.

28. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Garfield, Newaygo County, Michigan, May 4, 1989.

29. Federal Emergency Management Agency, Flood Insurance Study, Township of Garfield, Newaygo County, Michigan, May 4, 1989.

30. Federal Emergency Management Agency, Flood Insurance Rate Map, Township of Lincoln, Newaygo County, Michigan, September 27, 1991.



02P

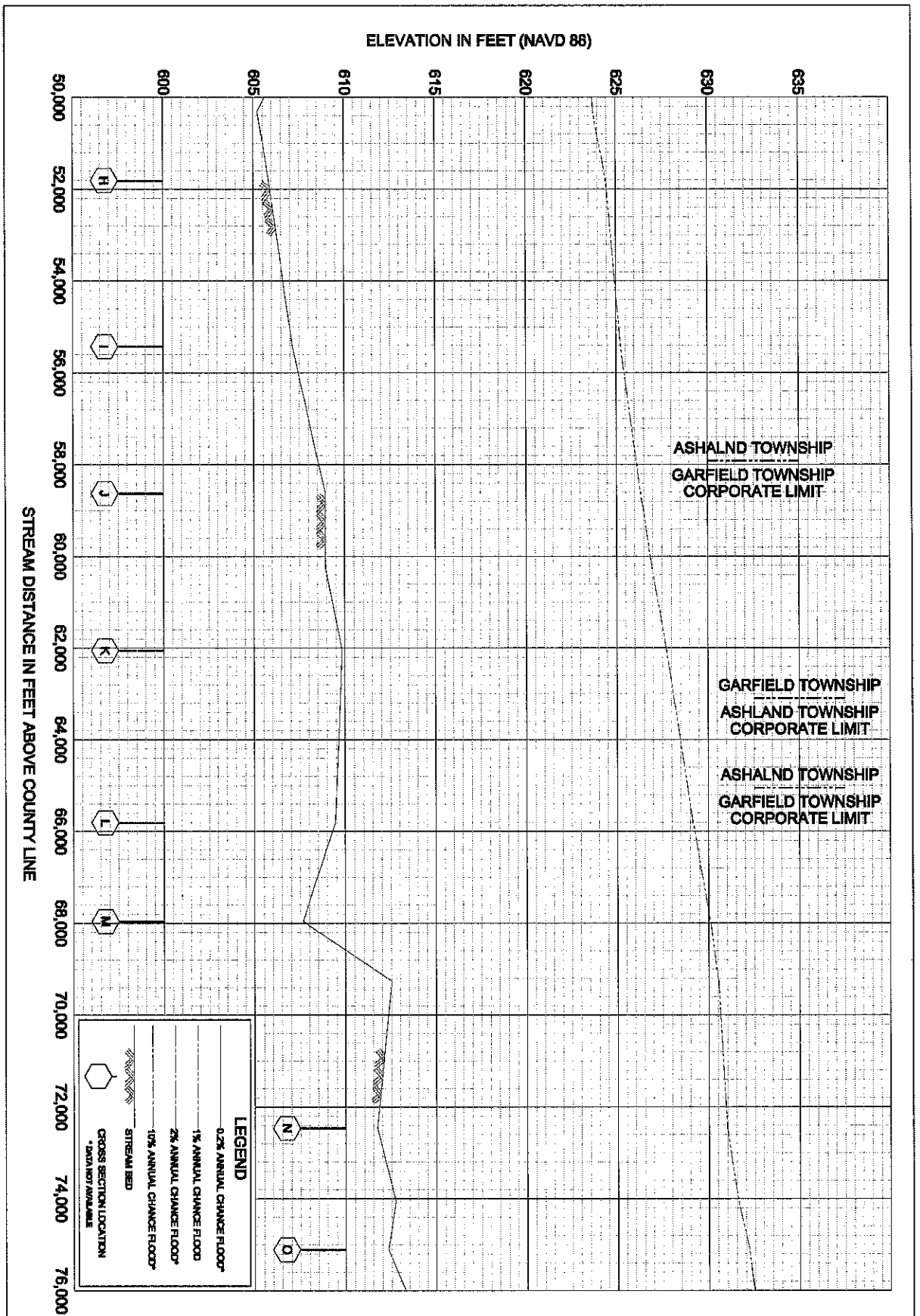
FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI

(ALL JURISDICTIONS)

FLOOD PROFILES

MUSKEGON RIVER



03P

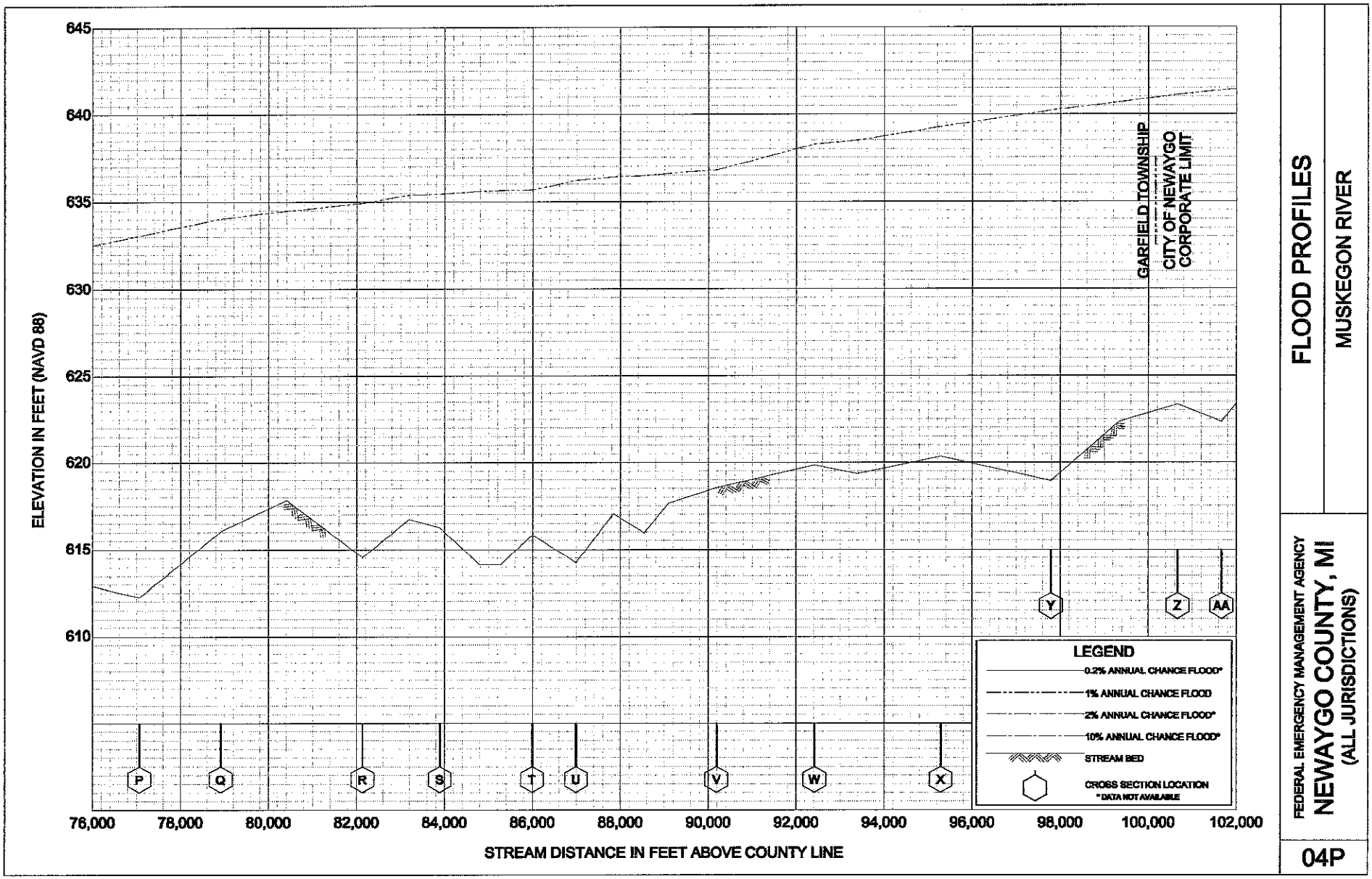
FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI

(ALL JURISDICTIONS)

FLOOD PROFILES

MUSKEGON RIVER



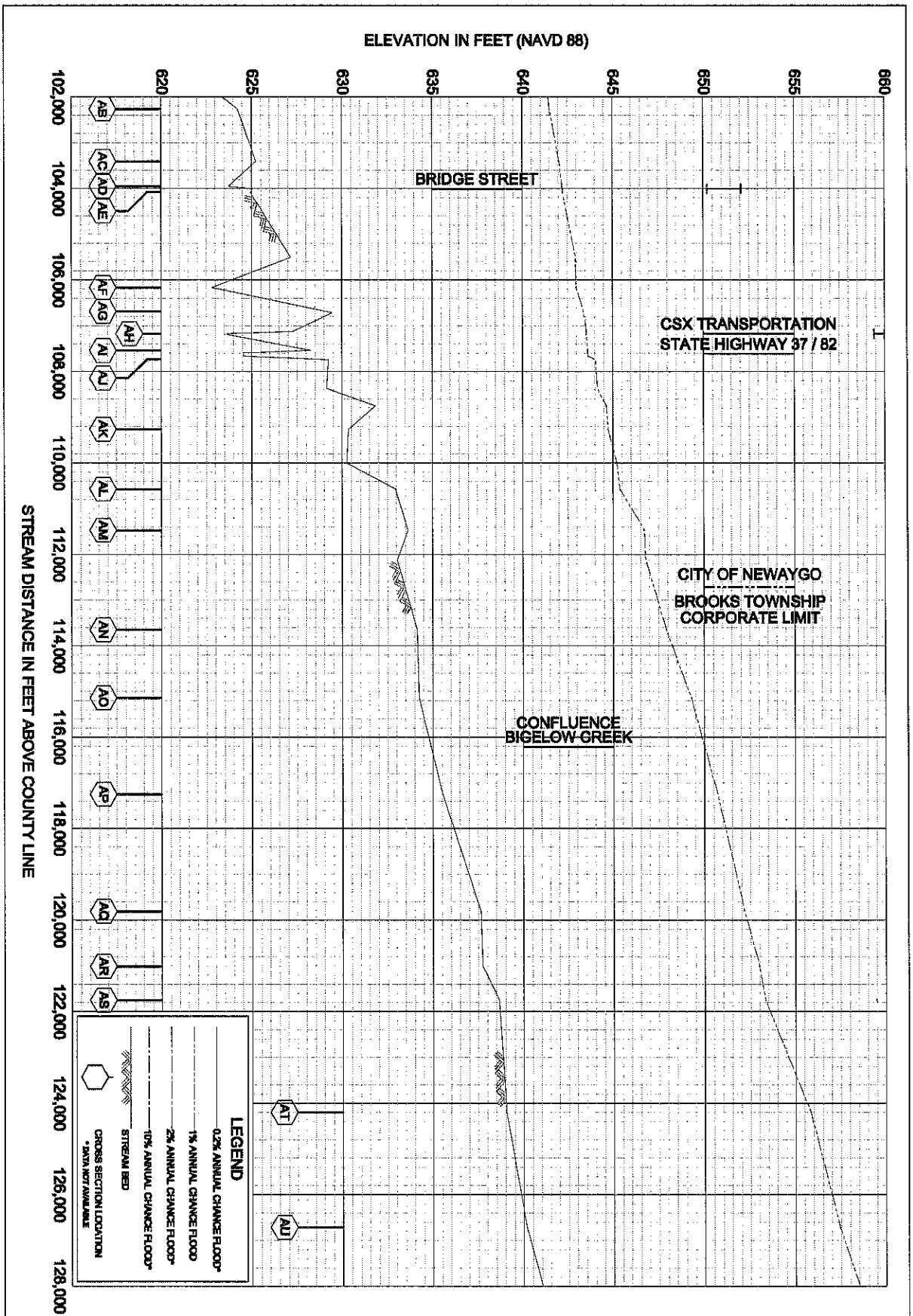
FLOOD PROFILES

MUSKEGON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

04P



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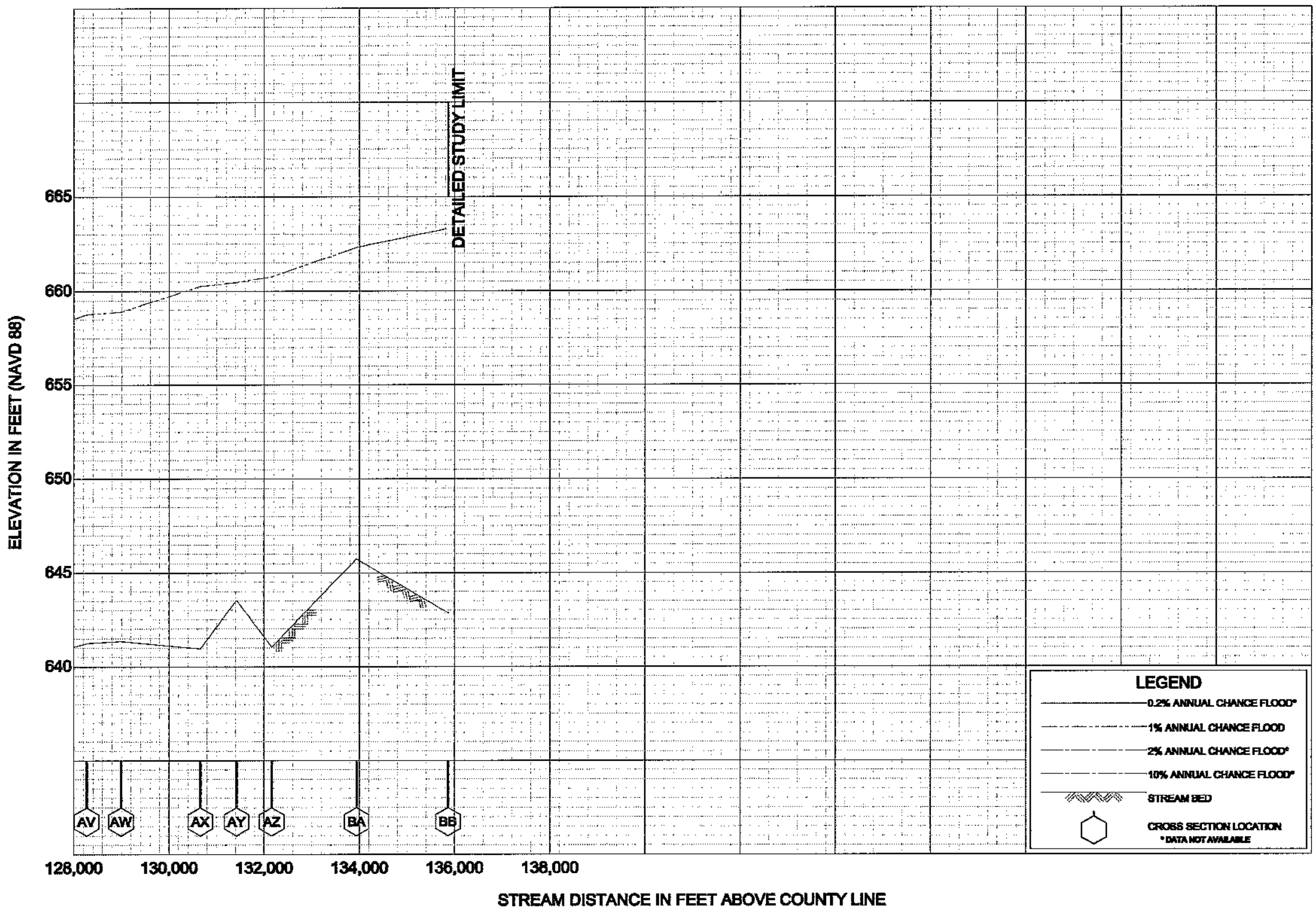
FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOOD PROFILES

MUSKEGON RIVER



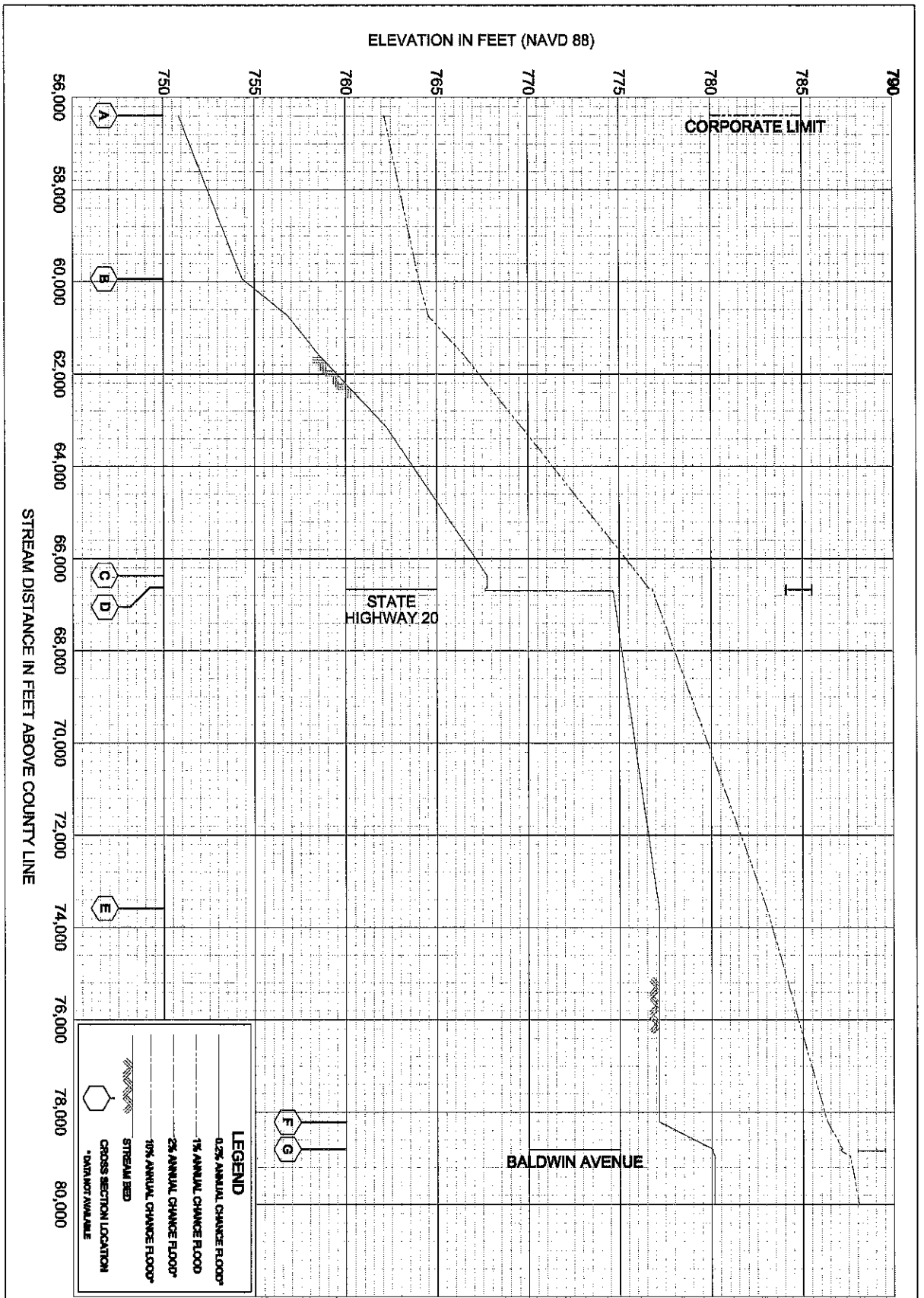
FLOOD PROFILES

MUSKEGON RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI

(ALL JURISDICTIONS)



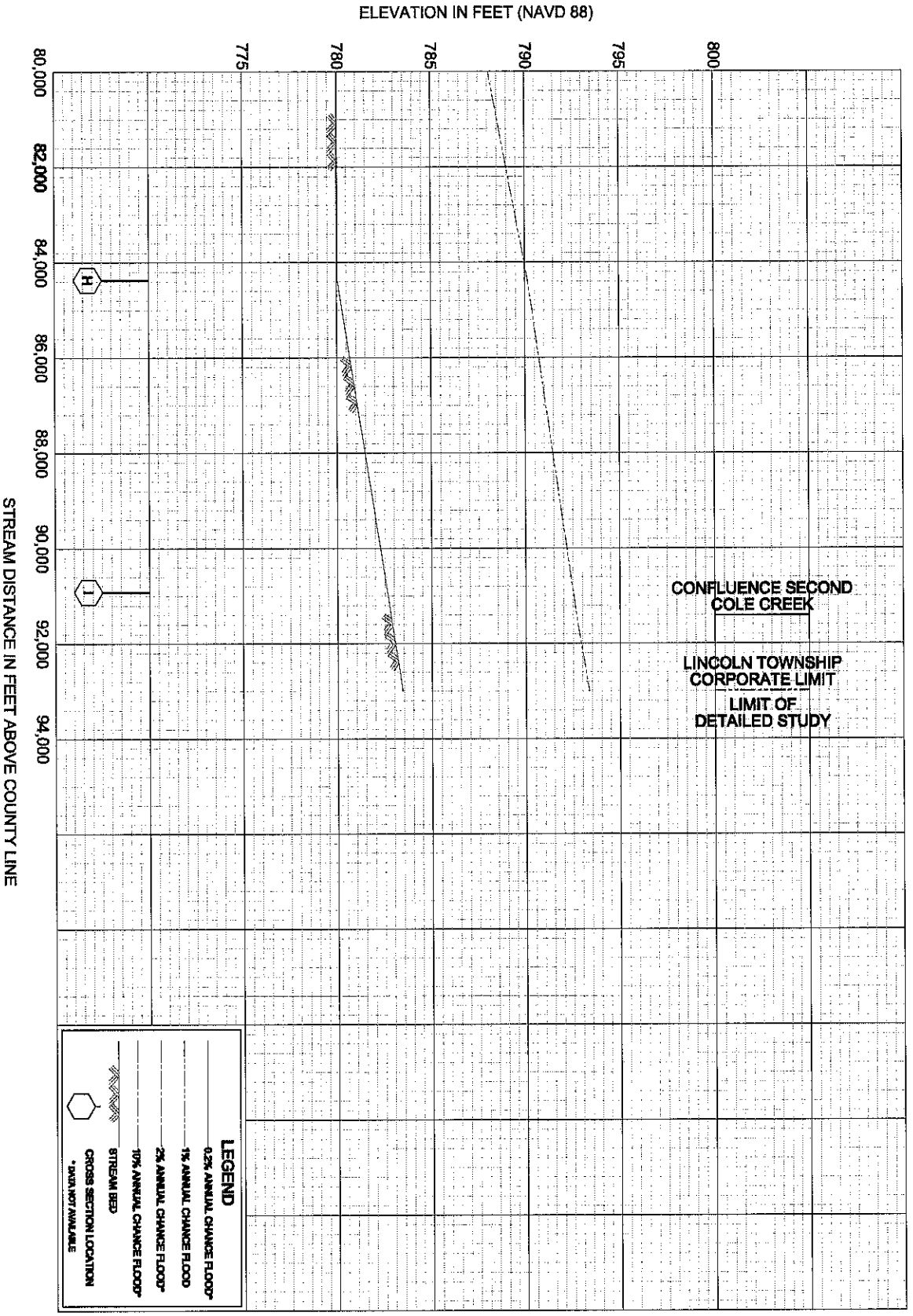
07P

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI
(ALL JURISDICTIONS)

FLOOD PROFILES

SOUTH BRANCH WHITE RIVER



08P

FEDERAL EMERGENCY MANAGEMENT AGENCY

NEWAYGO COUNTY, MI

(ALL JURISDICTIONS)

FLOOD PROFILES

SOUTH BRANCH WHITE RIVER