FLOOD INSURANCE STUDY

CHARLEVOIX COUNTY, MICHIGAN
(ALL JURISDICTIONS)

Community Name	Community Number
BAY, TOWNSHIP OF	260796
BOYNE CITY, CITY OF	260056
*BOYNE FALLS, VILLAGE OF	260371
BOYNE VALLEY, TOWNSHIP OF	261292
*CHANDLER, TOWNSHIP OF	261293
CHARLEVOIX, CITY OF	260057
CHARLEVOIX, TOWNSHIP OF	260790
*GRAND TRAVERSE BAND OF OTTAWA AND CHIPPEWA INDIANS	261803
EAST JORDAN, CITY OF	260372
EVANGELINE, TOWNSHIP OF	260800
EVELINE, TOWNSHIP OF	260773
HAYES, TOWNSHIP OF	260778
*HUDSON, TOWNSHIP OF	261294
LITTLE TRAVERSE BAY BAND OF ODAWA INDIANS	261525
MARION, TOWNSHIP OF	260808
MELROSE, TOWNSHIP OF	261295
NORWOOD, TOWNSHIP OF	260769
PEAINE, TOWNSHIP OF	261296
SOUTH ARM, TOWNSHIP OF	260761
ST. JAMES, TOWNSHIP OF	261297
*WILSON, TOWNSHIP OF	261298

*No Special Flood Hazard Areas Identified

Revised Preliminary: September 1, 2016
Effective: To Be Determined

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26029CV000A

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
CHARLEVOIX COUNTY, MICHIGAN (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This FIS revises and updates information on the existence and severity of flood hazards in the geographic area of Charlevoix County, including the Cities of Boyne City, Charlevoix and East Jordan; the Village of Boyne Falls; and the Townships of Bay, Boyne Valley, Chandler, Charlevoix, Evangeline, Eveline, Hayes, Hudson, Marion, Melrose, Norwood, Peaine, South Arm, St. James, and Wilson; the Grand Traverse Band of Ottawa and Chippewa Indians and the Little Traverse Bay Bands of Odawa Indians, (referred to collectively herein as Charlevoix 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 Boyne Falls, the Townships of Chandler, Hudson, and Wilson, and the Grand Traverse Band of Ottawa and Chippewa Indians have no mapped special flood hazard areas. This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e., annexation of new lands) or the availability of new scientific or technical data about flood hazards.

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:

Boyne City, City of:	The hydrologic and hydraulic analyses for Boyne River and Lake Charlevoix for the January 19, 1982, FIS report (FEMA, 1982a) were performed by US Army Corps of Engineers (USACE), Detroit District, for FEMA, under Interagency Agreement No. IAA-H-9-79, Project Order No. 21. The work was completed in January 1981.
East Jordan, City of:	The hydrologic and hydraulic analyses for Lake Charlevoix for the January 19, 1982, FIS report (FEMA, 1982b) were performed by USACE, Detroit District, for FEMA, under Interagency Agreement No. IAA-H-9-79, Project Order No. 21. The work was completed in January 1981.

The City of Charlevoix; Village of Boyne Falls; the Townships of Bay, Boyne Valley, Chandler, Charlevoix, Evangeline, Eveline, Hayes, Hudson, Marion, Melrose, Norwood, Peaine, South Arm, St. James, and Wilson; and the Grand Traverse Band of Ottawa and Chippewa Indians and Little Traverse Bay Bands of Odawa Indians have no previously printed FIS reports.

This Countywide FIS Report

For this countywide FIS, approximate analyses for flooding sources within Charlevoix County were developed by Atkins North America (referred herein as Atkins). Flooding effects from Lake Michigan were redelineated by Atkins, using elevation data from the "Revised Report on Great Lakes Open-Coast Flood Levels" and "Flood Levels Report on Grand Traverse Bay and Little Traverse Bay" prepared by the USACE, Detroit District (USACE, 1988 and USACE, 1990). Lake Charlevoix was updated to reflect updated flood information.

Base Map Information shown on this Flood Insurance Rate Map (FIRM) was provided in digital format by the Farm Services Administration, National Aerial Imagery Program. This information was photogrammetrically compiled at a scale of 1:40,000 from aerial photography dated 2005 or later. The projection used in the preparation of this map is Universal Transverse Mercator zone 16, and the horizontal datum used is the North American Datum of 1983 (NAD83), Geodetic Reference System of 1980 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 Charlevoix County and its communities are listed in Table 1:

Table 1 – Initial and Final Meeting Dates

Community	FIS Date	Initial Meeting	Final Meeting
Boyne City, City of	January 19, 1982	November 15, 1978	August 26, 1981
East Jordan, City of	January 19, 1982	November 15, 1978	August 21, 1981

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.

For this countywide FIS, the initial meeting was held in May 2008 and attended by representatives of FEMA, Michigan Department Environmental Quality (MDEQ), Atkins, and the communities.

The results of the study were reviewed at the final meeting held on July 12, 2011, and attended by representatives of FEMA, MDEQ, Atkins, and the communities. 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 Charlevoix 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 following streams and lakes are studied by detailed methods in this countywide FIS report are listed in Table 2:

Table 2 – Streams Studied by Detailed Methods

Boyne River	Lake Michigan
Lake Charlevoix	

Lake Charlevoix was redelineated outside of the Cities of Boyne City and East Jordan. Lake Michigan was newly studied by detailed methods.

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

For this countywide FIS, the FIS report and FIRM were converted to countywide format, and the flooding information for the entire county is shown. Also, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD29) to the North American Vertical Datum of 1988 (NAVD88). In addition, the Universal Transverse Mercator coordinates, previously referenced to the North American Datum of 1927 (NAD27), are now referenced to the NAD83.

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, MDEQ, and Atkins.

2.2 Community Description

Charlevoix County is located in the northwestern portion of Michigan's Lower Peninsula approximately 50 miles southwest of the Straits of Mackinac. It is bordered by Emmet County to the north, Cheboygan County to the east, Otsego County to the southeast, and Antrim County to the south. The county lies along the eastern shore of Lake Michigan and includes the Beaver Island archipelago, a group of islands located approximately midway between the Upper and Lower Peninsulas.

The estimated 2010 population of Charlevoix County is 25, 949 (U.S. Census Bureau, 2012). The county encompasses 416 square miles of land (Charlevoix County, 2010).

The average high temperature is 57 degrees Fahrenheit (°F), while the average low is 35°F. The prevailing winds are westerly in the winter months. The average annual precipitation is 31.5 inches and the average annual snowfall is 99 inches (The Weather Channel, 2012).

The topography of the county consists of low rolling hills with some areas in the eastern portion of the county rising to about 1500 feet. Most of the shoreline areas are flat, with some swampy areas occurring at the mouth of the Jordan River. The shoreline area in the vicinity of the mouth of the Boyne River is relatively flat, but the lake banks become more pronounced as they extend further west along Lake Charlevoix.

Lake Charlevoix, the third largest lake in Michigan, has a surface area of 17,200 acres and 56 miles of shoreline. The lake extends in a southeast-northwest direction for 13 miles and enters Lake Michigan at the City of Charlevoix (Charlevoix County, 2009).

The majority of soils found in Charlevoix County are well drained or moderately well drained, nearly level to gently sloping sandy soils on lake plains and valley trains (Soil Conservation Service, 1974). These sands characteristically have a low available water capacity and a rapid permeability. Water percolation through the soil substantially reduces the amount of surface runoff. Poorly drained, nearly level to gently sloping organic soils also exist in Charlevoix County in depressional areas on till plains, outwash plains and lake plains. These soils characteristically have a high available water capacity and a moderately rapid permeability. Surface runoff in these soils is very slow or is subject to ponding.

2.3 Principal Flood Problems

Shoreline erosion is due primarily to high water effects caused by winds along Lake Michigan and along Lake Charlevoix. Temporary seiche events, the sudden rise of water levels caused by weather disturbances, on Lake Michigan can also contribute to the erosion problems.

High water effects for Lake Charlevoix are caused by the seasonal and long term variations in lake levels. There is approximately a one-foot seasonal change in lake level from a low in winter to a high in early summer which is superimposed upon longer term variations. Precipitation in the Lake Michigan watershed, combined with evaporation, diversion, and the connecting navigational channel, is mainly responsible for the lake level. However, diversion has only a very minor effect on the level of Lake Michigan.

2.4 Flood Protection Measures

There are no known flood protection structures in Charlevoix County.

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

To determine the flood elevations on Lake Charlevoix, an analysis was performed to estimate the effects of local runoff on flood elevations. The analysis indicated flood elevations will rise significantly from the impact of local runoff and rainfall directly on the lake, but will be lower than the flood level associated with the same specific frequency levels on Lake Michigan at the inlet to Lake Charlevoix at the City of Charlevoix.

An analysis was then performed on the inlet navigation channel to determine its capability to transfer elevation variations of Lake Michigan to Lake Charlevoix. Due to the lack of recorded Lake Michigan elevations at the City of Charlevoix, historical data recorded on Lake Michigan at the City of Ludington were analyzed. Instantaneous peak rises, mean daily, and maximum monthly mean values from 1951 through 1980 were analyzed. From these data a stage hydrograph was developed for a significant event. Stage hydrographs for the various open coast frequency levels were also developed using the shape of the

historical event as a guide. These stage hydrographs were then routed through the navigation channel to determine if Lake Charlevoix could reach the same level as Lake Michigan. The analysis indicated that gradual variations will be transferred to Lake Charlevoix. However, the instantaneous peaks would be slightly reduced as they pass through the navigation channel. The resulting elevations would be higher than those caused by local runoff.

The flood elevations for Lake Michigan at Charlevoix were taken from "Report on Great Lake's Open-Coast Flood Levels", prepared by the USACE, Detroit District (USACE, 1977).

An analysis was also performed to determine the effect of additional wind set-up on peak lake elevations at the Cities of Boyne City and East Jordan. Since no gage records were available, wind set-up estimates were computed based on equations developed by the USACE (USACE, 1975). The analysis indicated that the increase in lake elevation would be negligible.

Within the city limits of East Jordan, there is a small portion of the lake which is located southeast of the Michigan State Highway 32 bridge (Bridge Street). In order to determine the backwater effects from this bridge, loss computations due to flow through the bridge were analyzed using equations recommended by the USACE Hydrologic Engineering Center (HEC) (HEC, 1979). The results indicate that only a negligible amount of losses will occur. Therefore, it was concluded that the peak flood elevations in this area will be equal to the elevations of Lake Charlevoix.

For the Boyne River, peak discharges are the same as those listed in the "National Dam Safety Program Inspection Report" for the Boyne River Dam (USACE, 1980a). The discharge values for the Dam Safety Report were developed by the MDEQ. MDEQ used a drainage area ratio based on a log-Pearson Type III analysis at U.S. Geological Survey (USGS) gage No. 041728 on the Jordan River (Bobee, 1975) and curves presented in the USGS Water Supply Paper 1677 (Wiitala, 1965) which involves computing the relationship between drainage basin size, near annual flood and recurrence interval.

This Countywide FIS Report

For streams studied by approximate analyses, 1-percent-annual-chance discharges were computed using published USGS regional regression equations (USGS, 1984) or gage analysis. Regression equations estimate peak discharges for ungaged streams based on characteristics of nearby gaged streams.

Peak discharge-drainage area relationships for each flooding source studied in detail are shown in Table 3.

Table 3 - Summary of Discharges

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
BOYNE RIVER					
At confluence with Charlevoix Lake	66.4	790	1,150	1,325	1,860

Stillwater elevations for lakes studied by detailed methods within Charlevoix County are shown in Table 4.

Table 4 - Summary of Stillwater Elevations

Flooding Source	Water Surface Elevations (Feet NAVD[1]) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
LAKE CHARLEVOIX	582.7	583.7	584.0	584.3
LAKE MICHIGAN (Township of Hayes)	583.4	584.4	584.8	585.5
LAKE MICHIGAN (Township of Hayes)	583.1	584.1	584.5	585.3
LAKE MICHIGAN (Township of Hayes)	582.9	583.9	584.3	585.2
LAKE MICHIGAN (City of Charlevoix, Township of Charlevoix, Township of Hayes, and Township of Norwood, Township of Peaine, Township of St. James)	582.7	583.8	584.2	585.1
LAKE MICHIGAN (Township of Norwood)	582.8	583.9	584.3	585.1

[1] North American Vertical Datum of 1988

Flood elevations for Lake Michigan in portions of Charlevoix County were taken from the "Flood Levels Report on Grand Traverse Bay and Little Traverse Bay" prepared by the USACE, Detroit District (USACE, 1990). The report lists different water surface elevations (WSELs) for sections of Lake Michigan from

Emmet County to Leelanau County. The different water-surface elevations are a result of additional wave run-up analyses that were completed for the report. As a result, the Townships of Hayes and Norwood have multiple WSELs within their community boundaries. Additional information regarding the exact locations of these sections, and their corresponding WSELS, can be found in the original report (USACE, 1990). All other Lake Michigan flood levels were taken from the "Revised Report on Great Lake's Open-Coast Flood Levels" prepared by the USACE, Detroit District (USACE, 1988).

Still water elevations for Lake Charlevoix are heavily influenced by Lake Michigan and were calculated using the "Report on Great Lake's Open-Coast Flood Levels", "Revised Report on Great Lake's Open-Coast Flood Levels", and the Boyne City 1982 FIS (USACE, 1977; USACE 1988; FEMA 1982a). The still water elevations were calculated by using the previous established WSELs for Lake Charlevoix, from the Boyne City 1982 FIS, and adding an adjustment factor of 0.8 feet. The adjustment factor is equal to the increase of the 1-percent-annual-chance WSEL for Lake Michigan between the above-mentioned 1977 USACE report and the 1988 USACE report.

The Cities of Boyne City and East Jordan; the Village of Boyne Falls; the Townships of Bay, Boyne Valley, Chandler, Evangeline, Eveline, Hudson, Marion, Melrose, South Arm, and Wilson; and the Grand Traverse Band of Ottawa and Chippewa Indians are non-coastal communities and are not affected by these reports.

3.2 Hydraulic Analyses

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

Precountywide Analyses

Cross section data for the Boyne River was obtained by field survey with additional overbank points obtained from topographic maps prepared from aerial photography at a scale of 1:4,800 with a contour interval of two feet (USACE, 1980b). All bridges and culverts were field surveyed to obtain elevation data and structural geometry. Cross sections were located at close intervals upstream and downstream of bridges and culverts in order to compute significant backwater effects of these structures.

As recommended by the MDEQ, the mean lake levels on Lake Charlevoix were used as the starting WSELs for the Boyne River. WSELs of floods of the selected recurrence intervals were developed using the USACE HEC computer program, HEC-2 (HEC, 1984).

For the approximate reach of the Boyne River, WSELs were determined using the results of the detailed hydraulic analysis and normal depth calculations in the upper reaches.

The storm surge elevations for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods have been determined for Lake Charlevoix. The analyses reported herein reflect the still water elevations due to high lake levels and wind setup effects, but do not include the contributions from wave action effect such as the wave crest height and wave run-up. Nonetheless, this additional hazard due to wave action effect should be considered in planning of future development.

Flood profiles were drawn showing the computed WSELs for floods of the selected recurrence intervals.

Channel roughness factors (Mannings "n") used in the hydraulic computations were chosen by engineering judgment on the basis of field observations. The Manning's "n" values for all detailed studied streams are listed in Table 5:

Table 5 – Manning's "n" Values

	Manning's "n" Values	
Stream	Channel "n"	Overbank "n"
Boyne River	0.03-0.05	0.05-0.10

This Countywide FIS Report

Hydraulic analyses for the approximate study flooding sources were completed using the USACE, HEC computer program, HEC-RAS, version 3.1.3 (HEC, 2005). Structures were modeled as weirs, with the weir elevations approximated from the topographic data or bridge elevations from the USGS 7.5 minute quadrangle maps. Floodplain boundaries were delineated using the computed WSEL and GIS tool and scripts.

A composite Manning's "n" value of 0.05 was used for all approximately studied streams in the county.

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).

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 NGVD29. With the finalization of 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. Some of the data used in this study were taken from the prior effective FIS reports and adjusted to NAVD88. The average conversion factor that was used to convert the data in this FIS report to NAVD88 was calculated using the National Geodetic Survey's (NGS) VERTCON online utility (NGS, 2009). The data points used to determine the conversion are listed in Table 6.

Table 6 – Vertical Datum Conversion

Quad Name	Corner	Latitude	Longitude	Conversion from NGVD to NAVD
Charlevoix	SE	45.250	-85.250	-0.259
Charlevoix OE W	SW	45.250	-85.375	-0.292
Garden Island West	SE	45.750	-85.500	-0.131
Hog Island West	SE	45.750	-85.375	-0.151
Beaver Island North	SE	45.625	-85.500	-0.157
High Island	SE	45.625	-85.625	-0.138
Bay Shore	SE	45.250	-85.000	-0.256
Petrosky	SE	45.250	-84.875	-0.302
Atwood	SE	45.125	-85.250	-0.312

Table 6 – Vertical Datum Conversion *(continued)*

Quad Name	Corner	Latitude	Longitude	Conversion from NGVD to NAVD
Boyne City	SE	45.125	-85.000	-0.289
Boyne Falls	SE	45.125	-84.875	-0.285
Ironton	SE	45.250	-85.125	-0.276
Thumb Lake	SE	45.125	-84.750	-0.253
Trout Island	SE	45.750	-85.625	-0.108
BDY1330	SE	45.375	-85.125	-0.246
Ellsworth	SE	45.125	-85.125	-0.302
Epsilon	SE	45.250	-84.750	-0.187
			AVERAGE:	**-0.233**

For additional information regarding conversion between NGVD29 and NAVD88, 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. 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.

In order to provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for purposes of flood plain management measures. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 1- and 0.2-percent-annual-chance floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using topographic maps prepared from aerial photography at a scale of 1:4,800 with a contour interval of two feet (USACE, 1980b and 1980c). For lake shorelines other than Lake Michigan studied in detail, the boundaries have also been delineated using the topographic maps referenced above.

For the Lake Michigan coastline, the floodplain boundaries were delineated using a combination of USGS quad maps and coastal Light Detection and Ranging (LiDAR) data. The USGS quad maps for Charlevoix County are a scale of 1:24,000 and have a 5-meter contour interval. The coastal LiDAR was developed and managed by the Joint Airborne LiDAR Bathymetry Technical Center of Expertise, and the data has a horizontal accuracy of +/- 0.75 meters and a vertical accuracy of +/- 0.20 meters. The coastal LiDAR data was used, where available, to map the Lake Michigan floodplain boundaries, and in areas where the coastal LiDAR was not available, the USGS quad maps were used.

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. In the State of Michigan, though, under Michigan Act 245, Public Act of 1929, as amended by Act 167, Public Acts of 1968 (State of Michigan, 1968), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Water Management Division, a floodway having no more than 0.1-foot surcharge has been delineated for this study. 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 floodway presented in this FIS report and on the FIRM was computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 7). 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.

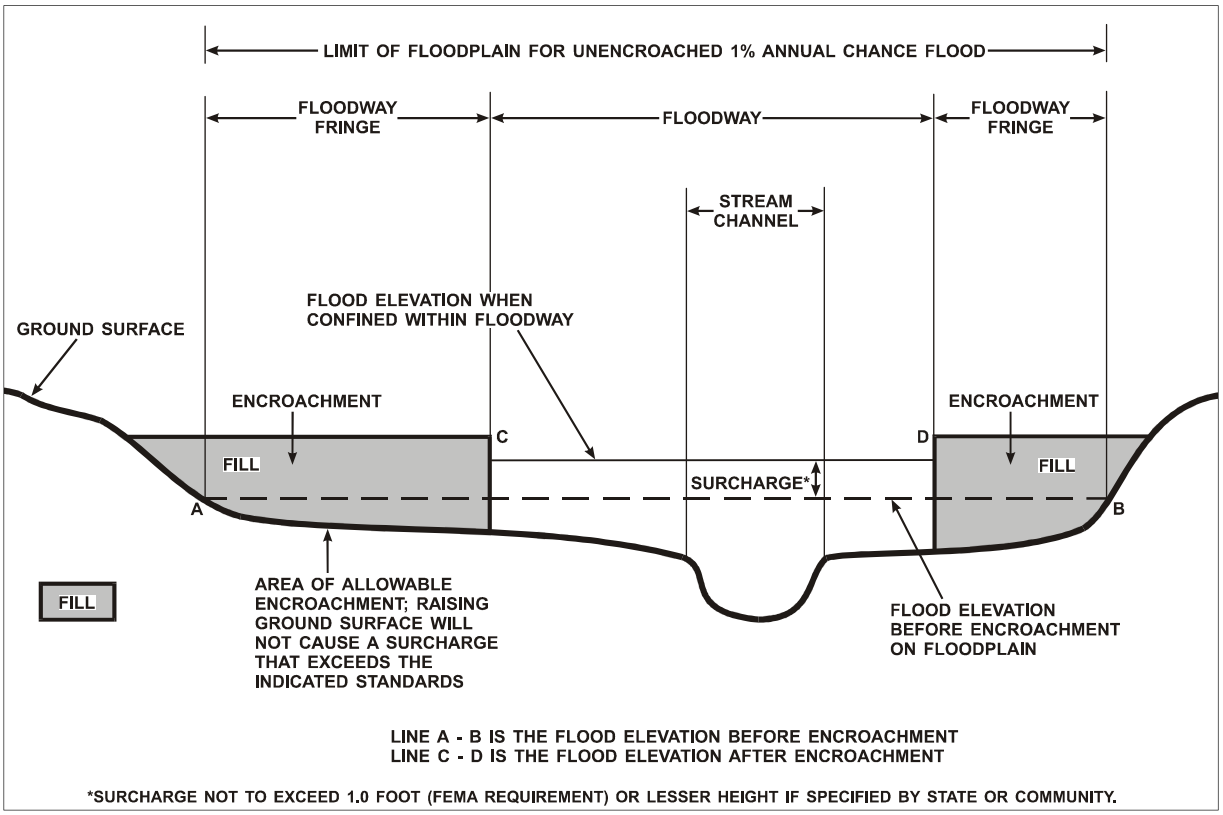

Figure 1 - Floodway Schematic

No floodways are shown for Lake Charlevoix and Lake Michigan because the concept of the floodway does not apply to lacustrine flooding.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
BOYNE RIVER								
A	120	35	132	10.0	584.0	579.9[2]	580.0[2]	0.1
B	497	55	427	3.1	584.0	583.2[2]	583.2[2]	0.0
C	629	53	328	4.0	584.0	583.4[2]	583.4[2]	0.0
D	909	71	384	3.5	584.0	583.8[2]	583.8[2]	0.0
E	1,165	58	370	3.6	584.1	584.1	584.1	0.0
F	1,945	136	944	1.4	584.6	584.6	584.7	0.1
G	2,875	180	811	1.6	584.8	584.8	584.9	0.1
H	3,715	136	698	1.9	585.3	585.2	585.3	0.1

[1]Feet above confluence with Lake Charlevoix

[2]Elevation computed without consideration of backwater effects from Lake Charlevoix

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

CHARLEVOIX COUNTY, MI (ALL JURISDICTIONS)

FLOODWAY DATA

BOYNE 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.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Bay, Township of[1]	None	None	None	
Boyne City, City of	March 29, 1974	June 11, 1976	July 19, 1982	
Boyne Falls, Village of[1,2]	October 22, 1976	None	N/A	None
Boyne Valley, Township of[1]	None	None	None	
Chandler, Township of[1,2]	N/A	N/A	N/A	N/A
Charlevoix, City of	June 7, 1974	October 10, 1975	February 11, 1983	
Charlevoix, Township of[1]	None	None	None	
East Jordan, City of	July 11, 1975	Jul 11, 1975	July 19,1982	
Evangeline, Township of[1]	None	None	None	
Eveline, Township of[1]	None	None	None	
Grand Traverse Band of Ottawa and Chippewa Indians[1,2]	N/A	N/A	N/A	N/A
Hayes, Township of[1]	None	None	None	
Hudson, Township of[1,2]	N/A	N/A	N/A	N/A

[1]This community does not have map history prior to the first countywide mapping
[2]No special flood hazard areas identified

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

CHARLEVOIX COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE	FIRM EFFECTIVE DATE	FIRM REVISION DATE
Little Traverse Bay Bands of Odawa Indians[1]	N/A	N/A	N/A	N/A
Marion, Township of[1]	None	None	None	
Melrose, Township of[1]	None	None	None	
Norwood, Township of[1]	None	None	None	
Peaine, Township of[1]	None	None	None	
Saint James, Township of[1]	None	None	None	
South Arm, Township of[1]	None	None	None	
Wilson, Township of[1,2]	N/A	None	N/A	None

[1]This community does not have map history prior to the first countywide mapping
[2]No special flood hazard areas identified

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

CHARLEVOIX COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

The countywide FIRM presents flooding information for the entire geographic area of Charlevoix 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 8.

7.0 OTHER STUDIES

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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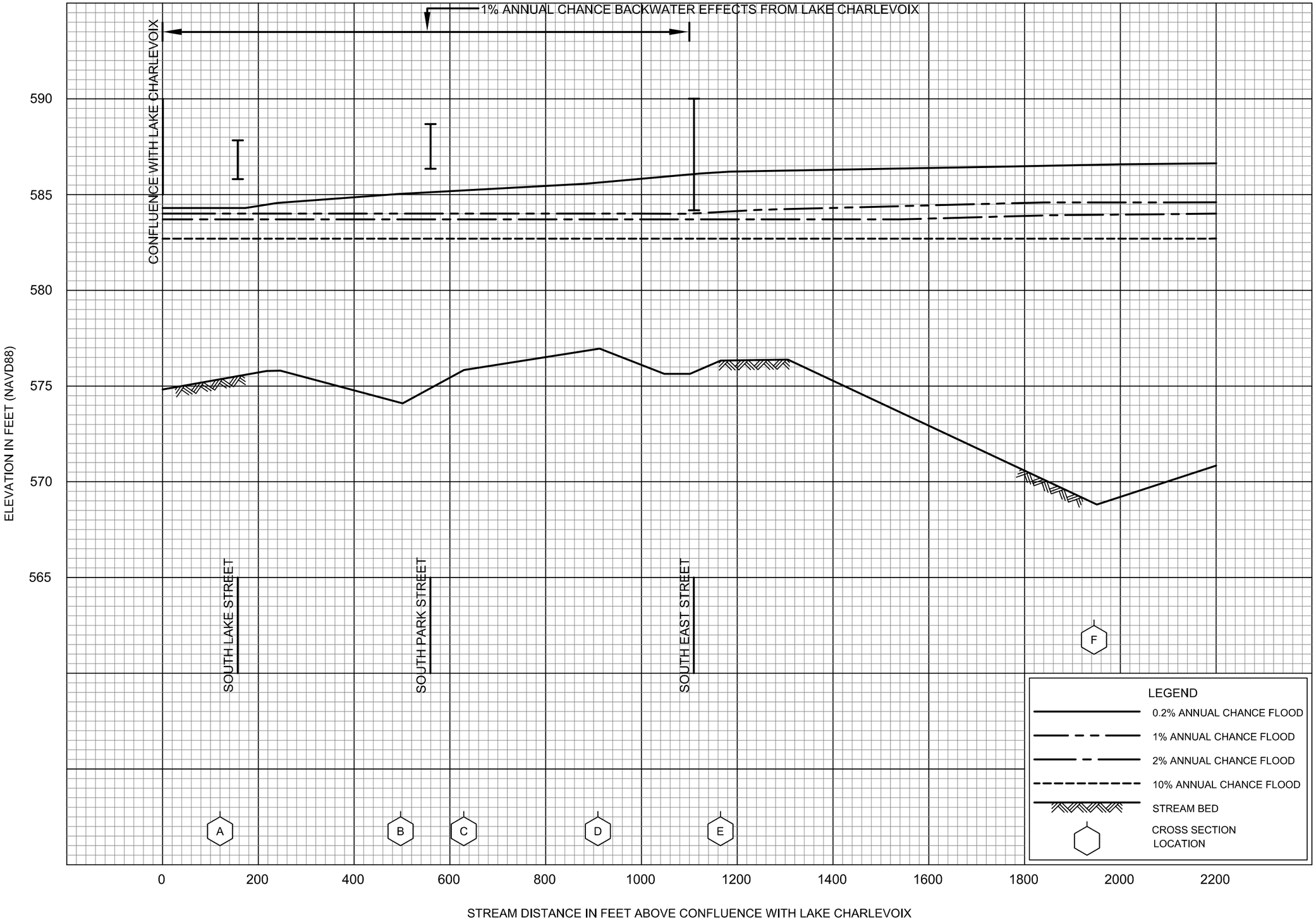

FLOOD PROFILES

BOYNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CHARLEVOIX COUNTY, MI

(ALL JURISDICTIONS)

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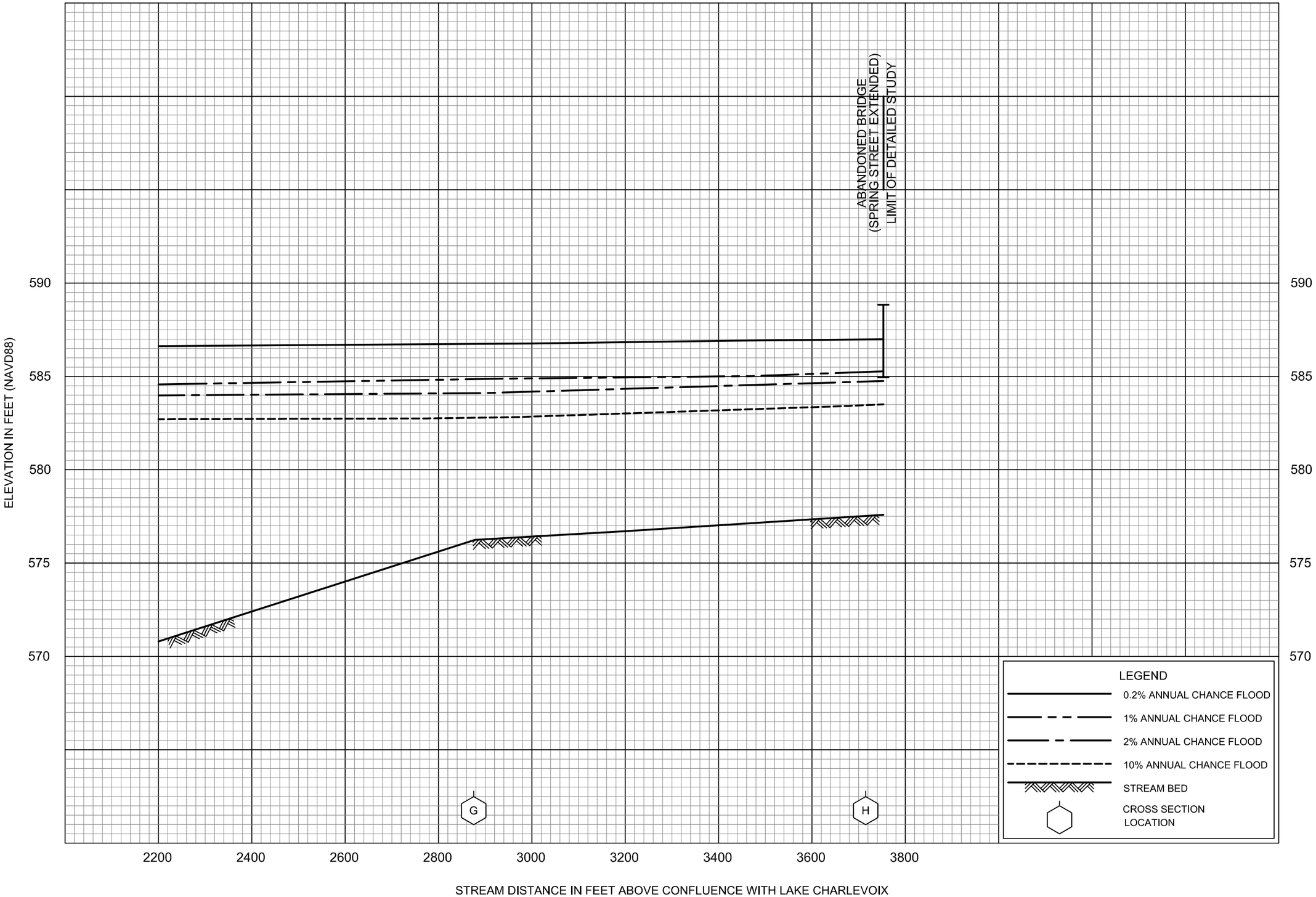

FLOOD PROFILES

BOYNE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CHARLEVOIX COUNTY, MI

(ALL JURISDICTIONS)

02P