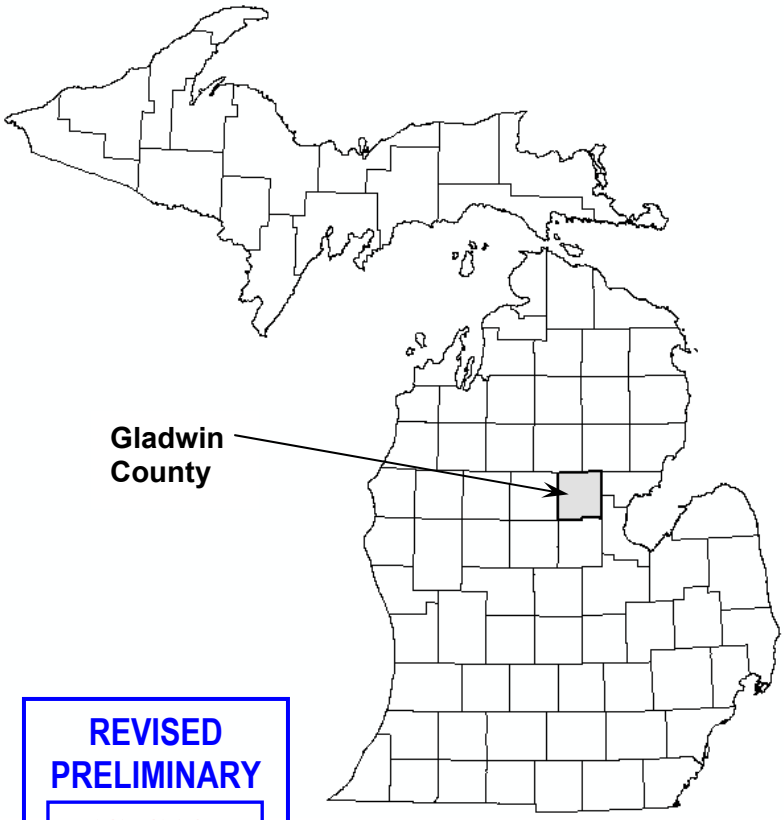
FLOOD INSURANCE STUDY

GLADWIN COUNTY, MICHIGAN

(ALL JURISDICTIONS)

Community Name	Community Number
Beaverton, City of	261339
Beaverton, Township of	261340
* Bentley, Township of	261341
Billings, Township of	261342
Bourret, Township of	261343
Buckeye, Township of	261344
Butman, Township of	261024
Clement, Township of	261346
Gladwin, City of	261347
Gladwin, Township of	261348
* Grim, Township of	361345
Grout, Township of	261349
Hay, Township of	260984
Sage, Township of	261350
Secord, Township of	260985
Sherman, Township of	261266
Tobacco, Township of	261060

* No Special Flood Hazard Areas identified



REVISED PRELIMINARY

3/27/2015

EFFECTIVE: TBD

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
26051CV000A

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.

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

Initial Countywide FIS Effective Date: To Be Determined

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PUBLISHED SEPARATELY
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Flood Insurance Rate Maps

FLOOD INSURANCE STUDY

GLADWIN COUNTY, MICHIGAN (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and supersedes the FIS reports, Flood Insurance Rate Maps (FIRMs), and/or Flood Boundary and Floodway Maps (FBFMs) in the geographic area of Gladwin County, Michigan, including the Cities of Beaverton and Gladwin and the Townships of Beaverton, Bentley, Billings, Bourret, Buckeye, Butman, Clement, Gladwin, Grim, Grout, Hay, Sage, Secord, Sherman, and Tobacco (hereinafter referred to collectively as Gladwin County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Please note that the Townships of Bentley and Grim 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. This information will also be used by Gladwin County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), 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 countywide FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

There are no previously printed FIS reports for the communities within Gladwin County.

The hydrologic and hydraulic riverine analyses for this countywide FIS were performed by Mill Road Engineering and were completed in December 2012. Boyce Hydro, LLC was contracted by Gladwin County to develop a scientific based flood study using unsteady flow methodology to determine the 1-percent-annual-chance flood elevations in Gladwin County for the Tobacco and Tittabawassee Rivers in 2011. Boyce Hydro, LLC

hired Mill Road Engineering to provide flood levels in Gladwin County upstream of the Edenville Dam. The purpose of engaging Mill Road Engineering was to create the hydraulic models that would determine the 1-percent-annual-chance flood elevations along the rivers.

The hydrologic analyses for two approximate zone lakes included in this countywide FIS were performed by the Michigan Department of Environmental Quality (DEQ).

These new studies were incorporated by the Strategic Alliance for Risk Reduction (STARR) for FEMA under Contract No. HSFEHQ-09-D-0370, Task Order HSFE05-11-J-0009. This countywide FIS includes new detailed and approximate studies 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 was merged into a single, updated Digital Flood Insurance Rate Map (DFIRM). The DFIRM includes 2005 digital orthophotography, mass points and breaklines capable of producing 2-foot contours, political boundaries, road centerlines with street names, railroads with names, airports, rivers, lakes, streams, bridges and other hydraulic structures, and elevation reference marks. This work, which was completed in December 2014, covered unprotected flooding sources affecting Gladwin County.

The digital base mapping information was provided by Boyce Hydro, Inc., and the Michigan Center for Geographic Information. These files were compiled by photogrammetric methods and meet or exceed National Map Accuracy Standards at the original compilation scale of 1:12,000. The coordinate system used for the production of this DFIRM is Michigan State Plane Zone 6376, North American Datum of 1983. Differences in the datum used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this FIRM.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO's) 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 concerning this countywide FIS was held on June 25, 2008, and attended by representatives of DEQ, FEMA, and Gladwin County, the study contractor, and other local participants. Another CCO meeting was held on May 25, 2011 and was attended by representatives of Gladwin County, DEQ, FEMA and STARR and other local participants.

The results of this study were reviewed at the final CCO meeting held on _____ __, 20__, and attended by representatives of _____, STARR, and other local participants. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This countywide FIS covers the geographic area of Gladwin County, Michigan.

No flooding sources in Gladwin County have been studied previously by detailed methods.

A new detailed study has been completed for Lake Lancer. This elevation was computed by Mill Road Engineering.

Approximate analyses are usually used to study areas having a low development potential or minimal flood hazards. For this countywide FIS, streams previously studied by approximate methods were restudied to update existing flood hazard areas and additional approximate analyses were performed to identify flood hazards not previously identified. The streams listed in Table 1 were studied by approximate methods as a part of this study.

TABLE 1 – Streams Studied by Approximate Methods

Cedar River	North Branch Tobacco River	Tittabawassee River
East Branch Tittabawassee River	Smallwood Lake	Tobacco River
Middle Branch Tittabawassee River	South Branch Tobacco River	West Branch Tittabawassee River
Middle Branch Tobacco River	Sugar River	

In addition to streams listed in TABLE 1, six lakes in Gladwin County were studied using approximate methods. These lakes are Lake Lancelot, Nineteen Lake, Ross Lake, Secord Lake, Wiggins Lake and Wixom Lake.

No Letters of Map Revision (LOMRs) were identified for this county.

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 SOMA may be obtained from the Community Map Repository. Copies of the TSDN may be obtained from FEMA.

2.2 Community Description

Gladwin County is located in the north-central portion of Michigan's Lower Peninsula and encompasses approximately 516 square miles, of which approximately 11 square miles is water. It is bordered on the north by Ogemaw and Roscommon Counties, on the east by Arenac and Bay Counties, on the south by Midland County, Ohio, and on the west by Clare County. According to U.S. Census Bureau figures, the April 1, 2010 population of Gladwin County was 25,692. The estimated July 1, 2013 population was

25,493. The county seat is the City of Gladwin, which is home to approximately 11 percent of the total population in Gladwin County (Reference 1).

Specific information about each community in Gladwin County is listed below:

The City of Beaverton is located in the southwest portion of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,071. The size of the city is approximately 1.3 square miles.

The Township of Beaverton is located in the southwest corner of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,964. The size of the township is approximately 35.4 square miles.

The Township of Bentley is located in the southeast corner of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 844. The size of the township is approximately 35.7 square miles.

The Township of Billings is located in the southeast portion of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 2,416. The size of the township is approximately 23.2 square miles.

The Township of Bourret is located in the northeast corner of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 461. The size of the township is approximately 32.7 square miles.

The Township of Buckeye is located near the center of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,308. The size of the township is approximately 34.6 square miles.

The Township of Butman is located on the north side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,999. The size of the township is approximately 35.7 square miles.

The Township of Clement is located on the north side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 901. The size of the township is approximately 21.0 square miles.

The City of Gladwin is located on the west side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 2,933. The size of the city is approximately 2.9 square miles.

The Township of Gladwin is located in central Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,116. The size of the township is approximately 35.3 square miles.

The Township of Grim is located on the east side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 136. The size of the township is approximately 71.4 square miles.

The Township of Grout is located on the west side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,964. The size of the township is approximately 34.8 square miles.

The Township of Hay is located in central Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,362. The size of the township is approximately 22.7 square miles.

The Township of Sage is located in western Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 2,457. The size of the township is approximately 35.4 square miles.

The Township of Secord is located in central Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,151. The size of the township is approximately 23.4 square miles.

The Township of Sherman is located in northwest Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 1,043. The size of the township is approximately 35.3 square miles.

The Township of Tobacco is located on the south side of Gladwin County. According to 2010 U.S. Census Bureau figures, the population was 2,566. The size of the township is approximately 35.2 square miles.

Gladwin County is drained to Lake Huron by way of the Tittabawassee River watershed. A number of dams have been installed and have created sizeable lakes. Among the largest are Lake Lancer along the Sugar River, Secord Lake along the Tittabawassee River, and Wiggins Lake along the Cedar River.

The Tittabawassee River river is bifurcated at Edenville Dam, being comprised of the Tobacco River and the Tittabawassee River. These two branches peak at different times and the gates at Edenville Dam control the water elevation in the combined rivers at this point. Likewise river flows and elevations are controlled by two dams upstream of Edenville on the Tittabawassee River at the Smallwood and Secord Dams. The Tobacco River elevations are controlled by the dam and gates located at the Beaverton Dam, and the upper reach of the Cedar River is controlled by the gates and spillway at Chappel Dam. Water levels on the upper reach of the Sugar River are controlled by the Sugar River Dam. (Reference 5)

2.3 Principal Flood Problems

Runoff from heavy rainfall resulted in flooding along the Tittabawassee River on June 18, 1996. A small number of homes were inundated and between 12 and 15 people living along the river were evacuated by boat. The water level of Smallwood Lake was 1.8 feet above the average level of the lake. Operators of Smallwood Dam were concerned that floodwaters would breach the dam, and a crane was used to lift the dam's gates higher than they could be lifted by the dam hoist. Residents living downstream of the dam were asked to leave their homes as a precaution (References 2 and 3).

No additional flooding problems are known to exist within Gladwin County (Reference 4).

2.4 Flood Protection Measures

There 35 dams within the county. However these dams are not considered flood control structures (Reference 4). No other flood protection measures are known to exist.

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

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

The 1-percent-annual-chance flood elevation for Lake Lancer was provided to FEMA and STARR by Mill Road Engineering.

The stillwater elevation for the 1-percent-annual-chance flood event for the lake studied by detailed methods is shown in Table 2.

TABLE 2 – Summary of Stillwater Elevations

	Peak Elevation (feet NAVD88)			
Flooding Source and Location	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Lake Lancer				
Township of Butman	*	*	840.9	*

* Data not available

The 1-percent-annual-chance stillwater flood elevations for the approximate study lakes listed in Section 2.1 were obtained from Mill Road Engineering and DEQ.

Explanations for the hydrologic analyses for this FIS were obtained from *FEMA Flood Study for Tittabawassee and Tobacco Rivers Upstream of the Edenville Dam to the Gladwin County Line, Gladwin County, Michigan*, *Rev 2* (Reference 5).

Inflow to the model was developed by ratio of the PMF (Probable Maximum Flood) model work created for the Edenville Dam storm hydrographs. Storm hydrographs were developed in the PMF model at the Beaverton Dam inflow along the river reach from Beaverton to the Edenville Dam. On the Tittabawassee River storm hydrographs were developed for the Sugar River, lateral inflow into the river at Molasses River, West and East Branch of the Tittabawassee River above Secord Dam. For this analysis, additional storm hydrographs were needed for each sub basin above these points and so the shape of the storm hydrograph was used to create storm hydrographs at location with the peak value developed using the State Hydrologists formula for peak sub-basin flow value [q=((DA/DA@Midland)^0.89)*Q100yr-Midland]. The discharge flows into each of the new extended reaches were created using the storm flow hydrographs for each new reach added to the river model. Storm hydrographs for the model work were created for a storm of 100 hour duration identical to the storm period used in the PMF study. No infiltration was considered, even though significant infiltration would occur during the 1-percent-annual-chance storm.

The discharge values at the various locations were sized using the local drainage area, storm hydrograph value and the output at Edenville Dam was reviewed to see that the outflow from the dam was as required to match the value for the 1-percent-annual-chance storm at Edenville as proscribed by the State Hydrologists. The flow value at the confluence of the Tobacco and Tittabawassee outlets of the Edenville Dam are to be at least the 1-percent-annual-chance storm flow of 19,159 cfs as required by the State Hydrologist.

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.

Hydraulic models for the streams listed in Table 1 were developed in order to compute the water surface elevations for the 1-percent-annual-chance flood.

Hydraulic computations were performed using the USACE HEC-RAS (3.1.3) computer program (Reference 6).

Explanations for the hydraulic analyses for this FIS were obtained from *FEMA Flood Study for Tittabawassee and Tobacco Rivers Upstream of the Edenville Dam to the Gladwin County Line, Gladwin County, Michigan*, *Rev 2* (Reference 5).

The HEC-RAS model was coded with the required information and run based on the 1-percent-annual chance (100 year) flow value at Edenville Dam, and additional river flow was created by modeling lateral inflows along some river reaches and in other cases by flows into upriver reaches as determined by storm hydrograph, and drainage area contribution upstream of the most upstream cross section modeled. During the course of the model work, it was determined that the entire river system was too complicated to

model as a single HEC RAS model. As a result the Tittabawassee River was modeled completely with the Tobacco River modeled up to cross section 15, located just downstream of the Beaverton Dam. The Tobacco River was modeled independently upstream of Tobacco River cross section 14. The model inputs and outputs at cross section 14 and 15 were conformed so the flow results in both models at these sections matched.

River cross sections were developed for use in providing input to the model. The cross sections were located on the topographic drawing supplied by Boyce Hydro, LLC as prepared by Williams Aerial & Mapping Service, Inc, and the horizontal versus vertical information was developed and tabularized. This information was then used to develop the model cross sections. Other features were incorporated into the model, including bridges along the river and dam gates at Edenville Dam and each dam upriver of the Edenville Dam.

Because the Wixom Lake is created by the Edenville Dam, operated by Boyce Hydro, LLC, the river performance is wholly controlled by the gate operations at the Dam. Six radial Tainter gates exist at Edenville Dam. Three such gates are located on the Edenville Spillway and three are located on the Tobacco River Spillway. The average gate plate dimensions are approximately 9.8 feet tall and 22.39 feet wide at Tobacco and 9.8 feet tall and 21.19 feet wide at Edenville. Gate information was obtained from the operators for Beaverton and Chappel Dams for use in the model.

Bridge information was obtained for the M-30 Bridge at Edenville causeway and other bridges by direct measurement or data obtained from the Michigan DOT. Details of the bridge decks were unnecessary since the flow water levels determined from model work did not approach the bridge decks.

The Tittabawassee River model covers the northern limits of the Sugar River, West, Middle and Eastern Branch of the Tittabawassee River and many short tributaries along the route. Dams at Smallwood, Secord, Edenville and Sugar River are modeled. Gates in the dams with gates are also modeled. Cross sections below Edenville Dam are included in order to properly model the gate functions at the Edenville and Tobacco Spillways. The river flow at the confluence of the Tobacco and Tittabawassee Rivers below Edenville is modeled using the flow hydrograph created for this location based on the prior PMF model work completed for the river reach between Sanford and Edenville Dams.

Two models were created, one for the Tobacco River below the Beaverton Dam including all the Tittabawassee, and one with cross sections below the Beaverton dam but developed to generate flood levels for the Tobacco River above the Beaverton Dam. Output from the Beaverton Dam model were used as input to the Tittabawassee model at the proper cross section to produce the Tittabawassee River results and the proper inflows over time to the Wixom Lake allowing the model to properly account for gate operations at the Edenville Dam spillways and gates.

A storm of 100 hours duration was modeled with the 1-percent-annual-chance storm flow values as provided by the Michigan State Hydrologists for the upper reaches of the Tobacco and Tittabawassee Rivers and at the Edenville Dam. The model assumes a starting time of hour zero on August 1, 1994 and ending time of August 4, 1994 at hour 15. The date and times are arbitrary and have no meaning except to create a storm of 100

hours duration which has the peak flow values as provided by the State hydrologist. The discharge values over this time period are created by scaling the discharge of the PMF flow values as noted above for the local drainage basins in the method as described above. The original PMF flows were created by development and use of storm hydrographs for each of the Tobacco and Tittabawassee River sub-basins located above the Edenville and Tobacco River Dam.

The model runs made using the HEC-RAS model provided with the input and flows as described in the section above, result in water levels initially controlled by the gate structure located at Sanford Dam. One might think that the narrows at the Route 10 bridge would be a river water level control, but of greater interest is the natural river control found between river cross section 14.5 and 18.5. Water levels on Sanford Pond begin to increase substantially once the river narrows occur between these cross sections. Normal operating water level at the Dam is elevation 675.3' NAVD88 and the gates at the dam control the water level by opening and closing as required maintaining this normal elevation.

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.

Effective information for this countywide FIS report was converted from NGVD29 to NAVD88 based on data presented in Table 3. The average conversion of NGVD29-0.510=NAVD88 was applied to convert all effective Base Flood Elevations (BFEs). Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities in other counties not presented in this countywide FIS may be referenced to NGVD29. This may result in differences in BFEs across the corporate limits between communities.

Elevations in the Mill Road Engineering report (Reference 5) were in MSL. For this FIS, elevations in MSL were understood as being the same as NGVD29. Therefore, the same datum shift listed above was used to convert elevations from MSL to NAVD88.

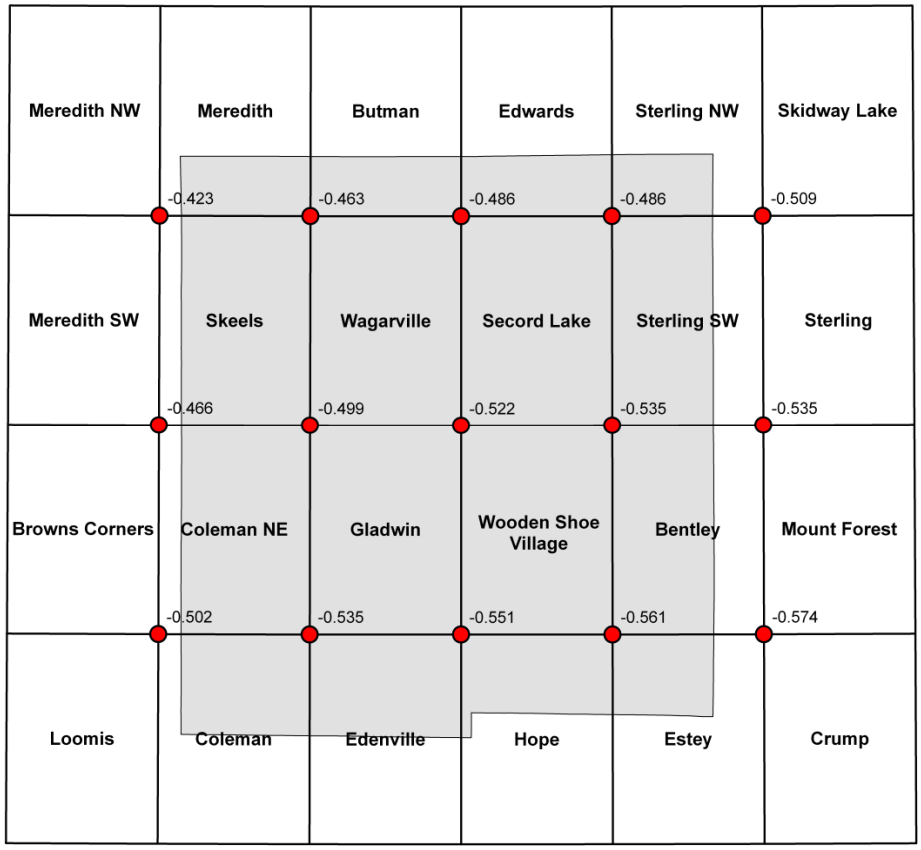

FIGURE 1 – Quadrangle Corner Intersections

TABLE 3 – Vertical Datum Conversion Calculations

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Difference
Bentley	SE	43.875	-84.125	-0.574 ft
Browns Corners	SE	43.875	-84.625	-0.502 ft
Butman	SE	44.125	-84.375	-0.486 ft
Edwards	SE	44.125	-84.250	-0.486 ft
Gladwin	SE	43.875	-84.375	-0.551 ft
Gladwin	SW	43.875	-84.500	-0.535 ft
Meredith	SE	44.125	-84.500	-0.463 ft
Meredith NW	SE	44.125	-84.625	-0.423 ft
Meredith SW	SE	44.000	-84.625	-0.466 ft
Skeels	SE	44.000	-84.500	-0.499 ft
Skidway Lake	SW	44.125	-84.125	-0.509 ft
Sterling SW	SW	44.000	-84.250	-0.535 ft
Sterling SW	SE	44.000	-84.125	-0.535 ft
Wagarville	SE	44.000	-84.375	-0.522 ft
Wooden Shoe Village	SE	43.875	-84.250	-0.561 ft

Average Conversion	-0.510
Range	-0.574 to -0.423
Max Offset	0.087

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 7), 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 countywide 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 l-percent-annual-chance (100-year) flood elevations and delineations of the 1- and 0.2-percent-annual-chance (500-year) floodplain boundaries and l-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 countywide FIS report, including Flood Profiles, Floodway Data table, and Summary of Stillwater Elevations table. Users should reference the data presented in this countywide 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 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. Between cross sections, the boundaries were interpolated using topographic maps with a contour interval of 2 feet. Please note that no cross sections are shown on the FIRM prepared for this countywide study.

The 1-percent-annual-chance floodplain boundaries are shown on the FIRM. On this map, the l-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). 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 l-percent-annual-chance floodplain boundary is shown on the FIRM.

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 l-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 l-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 floodway presented in this countywide 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. In cases where the floodway and l-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and l-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 l-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 2.

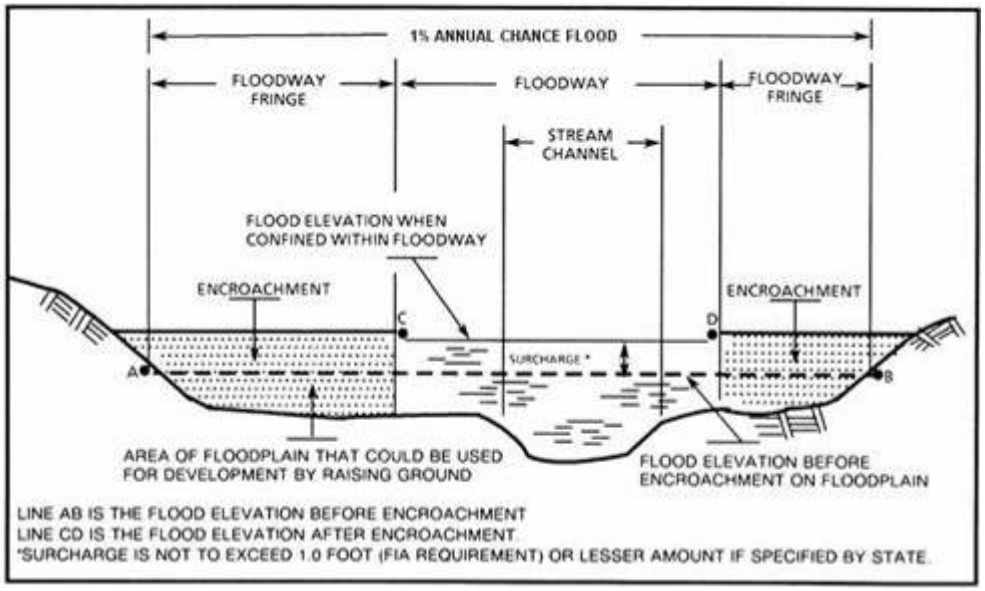

FIGURE 2 – Floodway Schematic

In Michigan, under the state's Floodplain Regulatory Authority, found in Part 31 of the Natural Resources and Environmental Protection Act, 1994 PA 451, (Reference 42), encroachment in the floodplain is limited to that which will cause only insignificant increases in flood heights. At the recommendation of MDEQ, Land and Water

Management Division, a floodway having no more than a 0.1-foot surcharge has been delineated for this countywide FIS.

Please note that no floodways were computed for this FIS.

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 lessthan 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-percent-annual-chance floodplain.

The current FIRM presents flooding information for the entire geographic area of Gladwin County. Previously, separate FIRMs were prepared for each incorporated community with special flood hazard areas identified and for the unincorporated areas of the county

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FIRM EFFECTIVE DATE	FIRM REVISION DATE(S)
[2] Beaverton, City of	N/A	N/A	N/A	
[2] Beaverton, Township of	N/A	N/A	N/A	
[1, 2] Bentley, Township of	N/A	N/A	N/A	
[2] Billings, Township of	N/A	N/A	N/A	
[2] Bourret, Township of	N/A	N/A	N/A	
[2] Buckeye, Township of	N/A	N/A	N/A	
[2] Butman, Township of	N/A	N/A	N/A	
[2] Clement, Township of	N/A	N/A	N/A	
[2] Gladwin, City of	N/A	N/A	N/A	
[2] Gladwin, Township of	N/A	N/A	N/A	
[1, 2] Grim, Township of	N/A	N/A	N/A	
[2] Grout, Township of	N/A	N/A	N/A	
Hay, Township of	September 22, 1999	None	September 22, 1999	None

[1] No Special Flood Hazard Areas identified
[2] This community does not have map history prior to the first countywide mapping.

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLADWIN COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FIRM EFFECTIVE DATE	FIRM REVISION DATE(S)
[2] Sage, Township of	N/A	N/A	N/A	
[2] Secord, Township of	N/A	N/A	N/A	
[2] Sherman, Township of	N/A	N/A	N/A	
[2] Tobacco, Township of	N/A	N/A	N/A	

[1] No Special Flood Hazard Areas identified

[2] This community does not have map history prior to the first countywide mapping.

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

GLADWIN COUNTY, MI
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for 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 the Flood Insurance and Mitigation Division, Federal Emergency Management Agency, 536 South Clark Street, Sixth Floor, Chicago, Illinois 60605-1509.

9.0 BIBLIOGRAPHY AND REFERENCES

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