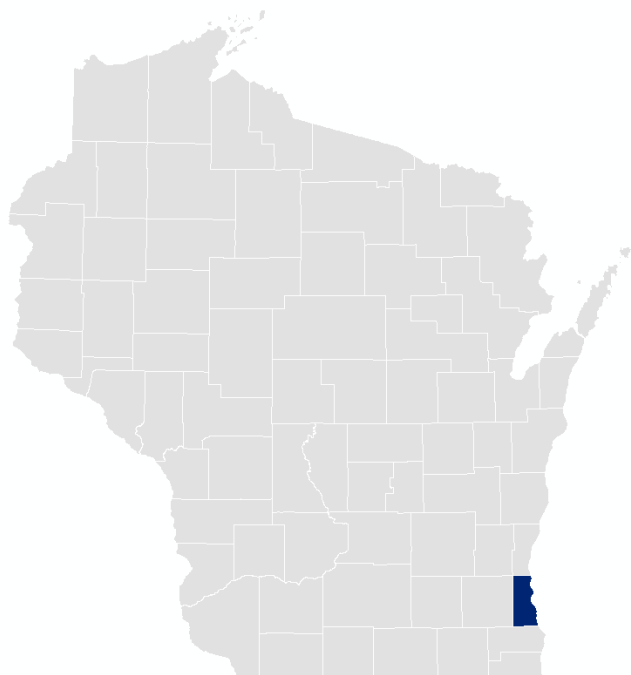


FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 6



MILWAUKEE COUNTY, WISCONSIN (ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
BAYSIDE, VILLAGE OF	550270	MILWAUKEE, CITY OF	550278
BROWN DEER, VILLAGE OF	550271	OAK CREEK, CITY OF	550279
CUDAHY, CITY OF	550272	RIVER HILLS, VILLAGE OF	550280
FOX POINT, VILLAGE OF	550274	SHOREWOOD, VILLAGE OF	550282
FRANKLIN, CITY OF	550273	SOUTH MILWAUKEE, CITY OF	550283
GLENDALE, CITY OF	550275	ST. FRANCIS, CITY OF	550281
GREENDALE, VILLAGE OF	550276	WAUWATOSA, CITY OF	550284
GREENFIELD, CITY OF	550277	WEST ALLIS, CITY OF	550285
HALES CORNERS, VILLAGE OF	550524	WEST MILWAUKEE, VILLAGE OF*	550561
		WHITEFISH BAY, VILLAGE OF	550286
TRIBAL NATION	NUMBER		
FOREST COUNTY POTAWATOMI COMMUNITY*	550661		

*No Special Flood Hazard Areas Identified

REVISED:

October 24, 2024

FLOOD INSURANCE STUDY NUMBER
55079CV001B
Version Number 2.8.3.3



FEMA

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Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT MILWAUKEE COUNTY, WISCONSIN

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary Federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60, *Criteria for Land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these floodprone buildings were built

by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as “Post-FIRM” buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) Report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum Federal requirements. Contact your State NFIP Coordinator to ensure that any higher State standards are included in the community’s regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of Milwaukee County, Wisconsin.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the United States Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC-8) sub-basins affecting each, are shown in Table 1. The FIRM panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community/Tribal Nation	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Bayside, Village of ³	550270	04040003, 04190000	55079C0033F, 55079C0034F, 55079C0041F, 55079C0042F	
Brown Deer, Village of	550271	04040003	55079C0028F ² , 55079C0029F, 55079C0036F, 55079C0037F, 55079C0038F, 55079C0039F ²	
Cudahy, City of	550272	04040002, 04040003, 04190000	55079C0159F, 55079C0167F, 55079C0178F, 55079C0179F, 55079C0186F	
Forest County Potawatomi Community ^{1,5}	550661	04040003	55079C0087F, 55079C0091F, 55079C0093F	
Fox Point, Village of	550274	04040003, 04190000	55079C0041F, 55079C0042F, 55079C0043F, 55079C00044F	
Franklin, City of	550273	04020002, 07120006	55079C0137F, 55079C0139F, 55079C0141F, 55079C0142F, 55079C0143F, 55079C0144F, 55079C0161F, 55079C0162F, 55079C0163F, 55079C0164F, 55079C0205F ² , 55079C0206F, 55079C0207F, 55079C0208F ² , 55079C0209F, 55079C0226F, 55079C0227F, 55079C0228F, 55079C0229F	
Glendale, City of	550275	04040003	55079C0037F, 55079C0039F ² , 55079C0041F, 55079C0043F, 55079C0077F, 55079C0081F, 55079C0100F ²	
Greendale, Village of	550276	04040002, 04040003	55079C0134F, 55079C0142F, 55079C0153F, 55079C0154F, 55079C0161F, 55079C0162F	
Greenfield, City of	550277	04040002, 04040003	55079C0127F, 55079C0129F, 55079C0131F, 55079C0132F, 55079C0133F, 55079C0134F, 55079C0151F, 55079C0152F, 55079C0153F, 55079C0154F, 55079C0161F, 55079C0162F	
Hales Corners, Village of	550524	04040002	55079C0129F, 55079C0133F, 55079C0134F, 55079C0137F, 55079C0141F, 55079C0142F	

¹ No Special Flood Hazard Areas Identified

² Panel Not Printed

³ Community is also mapped in Ozaukee County

⁵ Tribe is also mapped in Forest, Marinette, Oconto, and Fond du Lac Counties

Table 1: Listing of NFIP Jurisdictions (continued)

Community/Tribal Nation	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Milwaukee, City of ⁴	550278	04040002, 04040003, 04190000	55079C0004F ² , 55079C0008F, 55079C0009F ² , 55079C0012F, 55079C0014F, 55079C0016F, 55079C0017F, 55079C0018F, 55079C0019F, 55079C0028F ² , 55079C0036F, 55079C0037F, 55079C0038F, 55079C0039F ² , 55079C0052F, 55079C0056F, 55079C0057F ² , 55079C0058F, 55079C0059F ² , 55079C0066F, 55079C0067F, 55079C0068F, 55079C0069F, 55079C0076F, 55079C0077F, 55079C0081F, 55079C0082F, 55079C0084F, 55079C0086F, 55079C0087F, 55079C0088F ² , 55079C0089F, 55079C0091F, 55079C0092F, 55079C0093F, 55079C0094F, 55079C0100F ² , 55079C0103F, 55079C0111F, 55079C0131F, 55079C0132F, 55079C0151F, 55079C0152F, 55079C0153F, 55079C0154F, 55079C0156F, 55079C0157F, 55079C0158F, 55079C0159F, 55079C0162F, 55079C0166F, 55079C0167F, 55079C0176F	
Oak Creek, City of	550279	04020002, 04190000	55079C0162F, 55079C0164F, 55079C0166F, 55079C0167F, 55079C0168F, 55079C0169F, 55079C0188F, 55079C0189F, 55079C0227F, 55079C0229F, 55079C0231F, 55079C0232F, 55079C0233F, 55079C0234F, 55079C0251F, 55079C0252F, 55079C0253F, 55079C0254F	
River Hills, Village of	550280	04040003	55079C0029F, 55079C0033F, 55079C0037F, 55079C0041F, 55079C0043F	
Shorewood, Village of	550282	04040003, 04190000	55079C0081F, 55079C0082F, 55079C0084F, 55079C0101F, 55079C0103F	
South Milwaukee, City of	550283	04020002, 04190000	55079C0167F, 55079C0169F, 55079C0186F, 55079C0187F, 55079C0188F, 55079C0189F	
St. Francis, City of	550281	04040002, 04040003, 04190000	55079C0157F, 55079C0159F, 55079C0176F, 55079C0178F	

² Panel Not Printed

⁴ Community is also mapped in Washington and Waukesha Counties

Table 1: Listing of NFIP Jurisdictions (continued)

Community/Tribal Nation	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Wauwatosa, City of	550284	04040003	55079C0052F, 55079C0054F ² , 55079C0056F, 55079C0057F ² , 55079C0058F, 55079C0059F ² , 55079C0062F, 55079C0064F, 55079C0066F, 55079C0067F, 55079C0068F, 55079C0069F, 55079C0086F, 55079C0100F ²	
West Allis, City of	550285	04040002, 04040003	55079C0064F, 55079C0068F, 55079C0069F, 55079C0088F ² , 55079C0127F, 55079C0131F, 55079C0132F, 55079C0151F	
West Milwaukee, Village of ¹	550561	04040003	55079C0088F ² , 55079C0089F	
Whitefish Bay, Village of	550286	04040003, 04190000	55079C0043F, 55079C0044F, 55079C0081F, 55079C0082F	

¹ No Special Flood Hazard Areas Identified

² Panel Not Printed

³ Community is also mapped in Ozaukee County

⁴ Community is also mapped in Washington and Waukesha Counties

⁵ Tribe is also mapped in Forest, Marinette, Oconto, and Fond du Lac Counties

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages State and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1-percent-annual-chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 30, "Map Repositories," within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

The initial Countywide FIS Report for Milwaukee County became effective on September 26, 2008. Refer to Table 27 for information about subsequent revisions to the FIRMs.

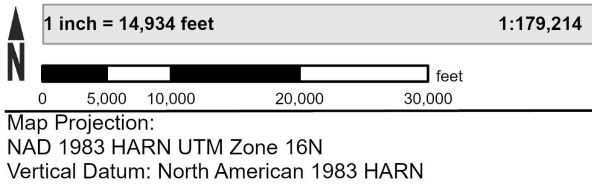
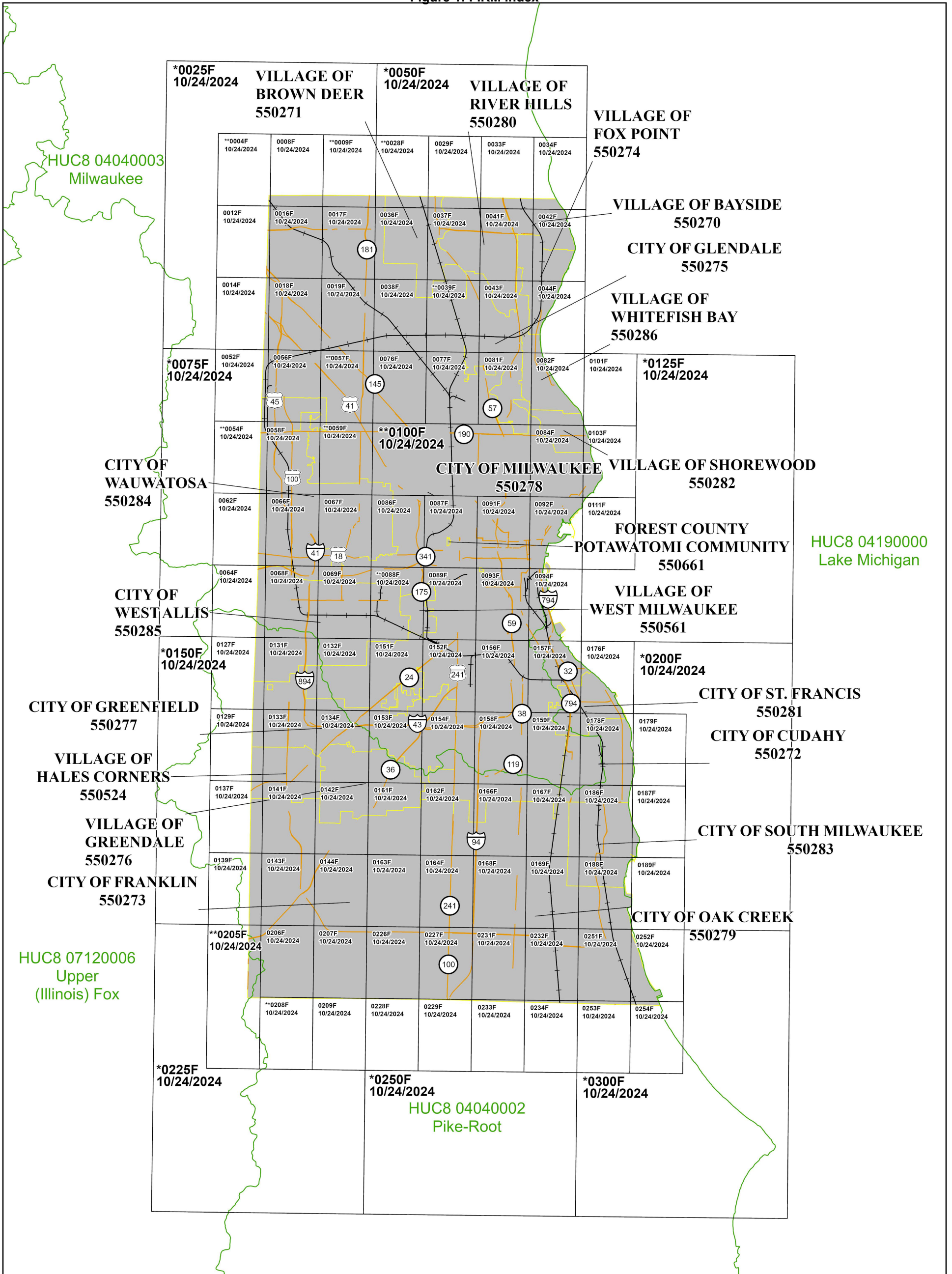
- The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at www.fema.gov/flood-insurance/rules-legislation/community-rating-system or contact your appropriate FEMA Regional Office for more information about this program.
- FEMA does not design, build, inspect, operate, maintain, or certify levees. FEMA is responsible for accurately identifying flood hazards and communicating those hazards and risks to affected stakeholders. FEMA has identified one or more levee systems in this jurisdiction summarized in Table 8 of this FIS Report. For FEMA to accredit the identified levee systems, the levee systems must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

Information on the levee systems in this jurisdiction can be obtained from the USACE National Levee Database (<https://levees.sec.usace.army.mil/>). For additional information, the user should contact the appropriate jurisdiction floodplain administrator and the levee owner or sponsor.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at www.fema.gov/flood-maps/tutorials.

The FIRM Index in Figure 1 shows the overall FIRM panel layout within Milwaukee County, and also displays the panel number and effective date for each FIRM panel in the county. Other information shown on the FIRM Index includes community boundaries, flooding sources, watershed boundaries, and USGS HUC-8 codes.

Figure 1: FIRM Index



THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT [HTTPS://MSC.FEMA.GOV](https://MSC.FEMA.GOV)

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - AREA OUTSIDE COUNTY BOUNDARY
**PANEL NOT PRINTED - NO SPECIAL FLOOD HAZARD AREAS

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP INDEX

MILWAUKEE COUNTY, WISCONSIN All Jurisdictions

PANELS PRINTED:

0008, 0012, 0014, 0016, 0017, 0018, 0019, 0029, 0033, 0034, 0036, 0037, 0038, 0041, 0042, 0043, 0044, 0052, 0056, 0058, 0062, 0064, 0066, 0067, 0068, 0069, 0076, 0077, 0081, 0082, 0084, 0086, 0087, 0089, 0091, 0092, 0093, 0094, 0101, 0103, 0111, 0127, 0129, 0131, 0132, 0133, 0134, 0137, 0139, 0141, 0142, 0143, 0144, 0151, 0152, 0153, 0154, 0156, 0157, 0158, 0159, 0161, 0162, 0163, 0164, 0166, 0167, 0168, 0169, 0176, 0178, 0179, 0186, 0187, 0188, 0189, 0206, 0207, 0209, 0226, 0227, 0228, 0229, 0231, 0232, 0233, 0234, 0251, 0252, 0253, 0254



FEMA

MAP NUMBER
55079CIND1B

EFFECTIVE DATE
October 24, 2024

Each FIRM panel may contain specific notes to the user that provide additional information regarding the flood hazard data shown on that map. However, the FIRM panel does not contain enough space to show all the notes that may be relevant in helping to better understand the information on the panel. Figure 2 contains the full list of these notes.

Figure 2: FIRM Notes to Users

<p style="text-align: center;">NOTES TO USERS</p> <p>For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Mapping and Insurance eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Flood Map Service Center website or by calling the FEMA Mapping and Insurance eXchange.</p> <p>Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.</p> <p>For community and countywide map dates, refer to Table 27 in this FIS Report.</p> <p>To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.</p>
<p>The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.</p> <p>BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Non-Coastal Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.</p> <p>Coastal Base Flood Elevations shown on the map apply only landward of the zero elevation referenced to Low Water Datum of Lake Michigan, administratively established by the National Oceanic and Atmospheric Administration at 176.0 meters (577.5 feet) above zero point International Great Lakes Datum of 1985. This lake-wide elevation is approximately equal to an elevation of 577.6 feet North American Vertical Datum of 1988 (NAVD88). Coastal flood elevations are also provided in the Coastal Transect Parameters table in the FIS Report for this jurisdiction. Elevations shown in the Coastal Transect Parameters table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.</p>

Figure 2. FIRM Notes to Users (continued)

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may have reduced flood hazards due to flood control structures. Refer to Section 4.3 "Dams and Other Flood Hazard Reduction Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was Universal Transverse Mercator (UTM) Zone 16N. The horizontal datum was the World Geodetic System (WGS) of 1984. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov.

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 30 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by the US Geological Survey. This information was last updated in the fall of 2020. For information about base maps, refer to Section 6.2 "Base Map" in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within Milwaukee County, Wisconsin, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 27 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

Figure 2. FIRM Notes to Users (continued)

SPECIAL NOTES FOR SPECIFIC FIRM PANELS

This Notes to Users section was created specifically for Milwaukee County, Wisconsin, effective October 24, 2024.

NON-ACCREDITED LEVEE SYSTEM: This panel contains a levee system that has not been accredited and is therefore not recognized as reducing the 1-percent-annual-chance flood hazard.

FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Each FIRM panel contains an abbreviated legend for the features shown on the maps. However, the FIRM panel does not contain enough space to show the legend for all map features. Figure 3 shows the full legend of all map features. Note that not all of these features may appear on the FIRM panels in Milwaukee County.

Figure 3: Map Legend for FIRM

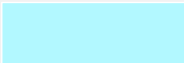

SPECIAL FLOOD HAZARD AREAS: The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.	
	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.
	Regulatory Floodway determined in Zone AE.

Figure 3: Map Legend for FIRM (continued)





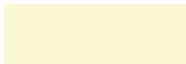








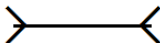
OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Area with Reduced Flood Hazard due to Accredited or Provisionally Accredited Levee System: Area is shown as reduced flood hazard from the 1-percent-annual-chance or greater flood by a levee system. Overtopping or failure of any levee system is possible. See Notes to Users for important information.
	Area with Undetermined Flood Hazard due to Non-Accredited Levee System: Analysis and mapping procedures for non-accredited levee systems were applied resulting in a flood insurance rate zone where flood hazards are undetermined, but possible.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.
	Unshaded Zone X: Areas of minimal flood hazard.
FLOOD HAZARD AND OTHER BOUNDARY LINES	
 (ortho) (vector)	Flood Zone Boundary (white line on ortho-photography-based mapping; gray line on vector-based mapping)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
 Aqueduct Channel Culvert Storm Sewer	Channel, Culvert, Aqueduct, or Storm Sewer
 Dam Jetty Weir	Dam, Jetty, Weir
	Levee, Dike, or Floodwall
 Bridge	Bridge

Figure 3: Map Legend for FIRM (continued)


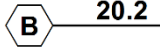
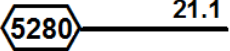
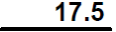



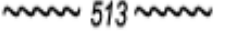






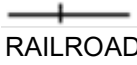



REFERENCE MARKERS	
	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
	Base Flood Elevation Line
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity

Figure 3: Map Legend for FIRM (continued)

BASE MAP FEATURES	
	River, Stream or Other Hydrographic Feature
	Interstate Highway
	U.S. Highway
	State Highway
	County Highway
	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
4276⁰⁰⁰mE	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16' 52.5"	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 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 hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and Milwaukee County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1-percent-annual-chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent annual chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 22), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1-percent and 0.2-percent-annual-chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1-percent-annual-chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1-percent and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM. Figure 3, “Map Legend for FIRM”, describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within Milwaukee County, respectively.

Table 2, “Flooding Sources Included in this FIS Report,” lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 12. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1-percent-annual-chance floodplain corresponds to the SFHAs. The 0.2-percent-annual-chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

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. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Beaver Creek	Brown Deer, Village of; Milwaukee, City of	Confluence with the Milwaukee River	Just upstream of North 70th Street	04040003	2.4	*	Y	AE	2017
C1 Tributary	Oak Creek, City of	Confluence with West Branch Crayfish River	Approximately 850 feet upstream of South Shepard Avenue	04040002	1.0	*	Y	AE	2005
C2 Tributary	Oak Creek, City of	Confluence with West Branch Crayfish River	Approximately 1,600 feet upstream of South Shepard Avenue	04040002	1.0	*	Y	AE	2005
C3 Tributary	Oak Creek, City of	Confluence with Crayfish River	11th Avenue	04040002	1.0	*	Y	AE	2005
C3A Tributary	Oak Creek, City of	Confluence with C3 Tributary	Approximately 2,500 feet upstream of C3 Tributary	04040002	0.5	*	Y	AE	2005
Caledonia Branch	Oak Creek, City of	Confluence with Crayfish River	East County Line Road	04040002	1.1	*	Y	AE	2005
CB1 Tributary	Oak Creek, City of	Confluence with Caledonia Branch	Approximately 600 feet upstream of Emerald Meadows Drive	04040002	1.3	*	Y	AE	2005
CB2 Tributary	Oak Creek, City of	Confluence with Caledonia Branch	Approximately 50 feet upstream of 10th Avenue	04040002	0.5	*	Y	AE	2005
CB3 Tributary	Oak Creek, City of	East County Line Road	Approximately 200 feet upstream of South Chicago Road	04040002	0.1	*	Y	AE	2005

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Crayfish Creek	Oak Creek, City of	East County Line Road	East Oakwood Road	04040002	1.1	*	Y	AE	1999
Dale Creek	Greendale, Village of	Confluence with Root River	Mansfield Drive	04040002	2.1	*	N	AE	1982
East Branch Root River	Franklin, City of	Mouth at Root River	West College Avenue	04040002	4.7	*	Y	AE	1981
Edgerton Channel	Cudahy, City of	Lake Parkway	South Whitnall Avenue	04040003	0.8	*	N	A	2008
Fish Creek	Bayside, Village of	Approximately 2,800 feet downstream of West Ravine Baye Road	County Line Road	04040003	1.1	*	Y	AE	1976
Hale Creek	West Allis, City of	Just upstream of West Cleveland Avenue	Approximately 3,500 feet upstream of West Cleveland Avenue	04040002	0.6	*	Y	AE	2008
Hale Creek	West Allis, City of	Mouth at Root River	Just upstream of West Cleveland Avenue	04040002	0.3	*	Y	AE	1980
Hale Creek	West Allis, City of	Approximately 3,500 feet upstream of West Cleveland Avenue	West Lincoln Avenue	04040002	0.1	*	N	A	2008
Honey Creek	Milwaukee, City of; Wauwatosa, City of	Mouth at Menomonee River	Interstate I-94	04040003	2.0	*	Y	AE	1987
Honey Creek	Milwaukee, City of	West Oklahoma Avenue	West Forest Home Avenue	04040003	1.3	*	Y	AE	1987

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Honey Creek	Greenfield, City of; Milwaukee, City of	Approximately 850 feet upstream of West Forest Home Avenue	Approximately 2,100 feet upstream of West Forest Home Avenue	04040003	0.3	*	N	A	2009
Honey Creek	Greenfield, City of; Milwaukee, City of	Approximately 2,100 feet upstream of West Forest Home Avenue	Just upstream of West Coldspring Road	04040003	0.1	*	Y	AE	1987
Honey Creek	Milwaukee, City of; Wauwatosa, City of	Just downstream of Interstate I-894	Approximately 800 feet upstream of West Layton Avenue	04040003	0.4	*	Y	AE	2015
Indian Creek	Bayside, Village of; Fox Point, Village of; River Hills, Village of	Confluence with Milwaukee River	Approximately 0.25 mile upstream of railroad	04040003	2.7	*	Y	AE	2018
Kinnickinnic River	Milwaukee, City of	Just downstream of railroad near mouth	Just upstream of West Lincoln Avenue	04040003	1.0	*	Y	AE	2019
Kinnickinnic River	Milwaukee, City of	Just upstream of West Lincoln Avenue	Approximately 190 feet downstream of S 16th Street	04040003	1.5	*	Y	AE	1987
Kinnickinnic River	Milwaukee, City of	Approximately 190 feet downstream of S 16th Street	Approximately 30 feet downstream of Railroad	04040003	0.5	*	Y	AE	2023
Kinnickinnic River	Milwaukee, City of	Approximately 30 feet downstream of Railroad	Approximately 130 feet upstream of Lyons Creek	04040003	5.0	*	Y	AE	1987
L1 Tributary	Oak Creek, City of	Approximately 500 feet upstream of Lake Michigan	Railroad	04040002	0.5	*	Y	AE	2005

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
L1 Tributary	Oak Creek, City of; South Milwaukee, City of	Lake Michigan	Approximately 500 feet upstream of Lake Michigan	04040002	0.1	*	N	A	2008
L5 Tributary	Oak Creek, City of	Approximately 500 feet upstream of Lake Michigan	Approximately 3,000 feet upstream of Lake Michigan	04040002	0.5	*	Y	AE	2005
L5 Tributary	Oak Creek, City of	Lake Michigan	Approximately 500 feet upstream of Lake Michigan	04040002	0.1	*	N	A	2008
Lake Michigan	Bayside, Village of; Cudahy, City of; Fox Point, Village of; Milwaukee, City of; Oak Creek, City of; Shorewood, South Milwaukee, City of; St. Francis, City of; Village of; Whitefish Bay, Village of	Entire Coastline	Entire Coastline	04190000	31.8	*	N	AE, AO, VE	2017
Legend Creek	Franklin, City of	Mouth at Root River	Just upstream of West Loomis Road	04040002	5.0	*	Y	AE	2005
Lincoln Creek	Milwaukee, City of	Mouth at Milwaukee River Right Split	Just downstream of North 60th Street	04040003	8.6	*	Y	AE	2005
Lincoln Creek Bypass	Milwaukee, City of	Convergence with Lincoln Creek	Divergence from Lincoln Creek	04040003	0.1	*	Y	AE	2005
Little Menomonee River	Milwaukee, City of	Mouth at Menomonee River	County Line Road	04040003	7.2	*	Y	AE	1987
Lyons Creek	Milwaukee, City of	Mouth at Kinnickinnic River	Just downstream of West Forest Home Avenue	04040003	1.3	*	Y	AE	1987

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
M1 Tributary	Oak Creek, City of	Mouth at Mitchell Field Drainage Ditch	South Howell Avenue	04040002	1.1	*	Y	AE	2005
M4 Tributary	Oak Creek, City of	Mouth at Mitchell Field Drainage Ditch	Approximately 2,400 feet upstream of mouth	04040002	0.5	*	Y	AE	2005
Menomonee River	Milwaukee, City of; Wauwatosa, City of;	Mouth at Milwaukee River	Confluence with Underwood Creek	04040003	8.5	*	Y	AE	2008
Menomonee River	Milwaukee, City of; Wauwatosa, City of;	Confluence with Underwood Creek	North 124th Street just upstream of confluence with Dretzka Park Tributary	04040003	7.3	*	Y	AE	1987
Milwaukee River	River Hills, Village of	Approximately 70 feet downstream of the Milwaukee / Ozaukee County Boundary	Approximately 330 feet upstream of the Milwaukee / Ozaukee County Boundary	04040003	0.1	*	Y	AE	2018
Milwaukee River	Brown Deer, Village of; Glendale, City of; Milwaukee, City of; River Hills, Village of; Shorewood, Village of	Mouth at Lake Michigan	Approximately 70 feet downstream of the Milwaukee / Ozaukee County Boundary	04040003	16.6	*	Y	AE	2005
Milwaukee River – Right Split	Glendale, City of; Milwaukee, City of	Convergence with Milwaukee River	Divergence from Milwaukee River	04040003	0.6	*	Y	AE	2005
Mitchell Field Drainage Ditch	Milwaukee, City of	Just upstream of South Howell Avenue	Just downstream of South 6th Street	04040002	0.5	*	Y	AE	2014
Mitchell Field Drainage Ditch	Milwaukee, City of; Oak Creek, City of	Mouth at Oak Creek	Just upstream of South Howell Avenue	04040002	3.3	*	Y	AE	2005

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
N4 Tributary	Oak Creek, City of	Mouth at N5 Tributary	Approximately 300 feet upstream of South 13th Street	04040002	0.7	*	Y	AE	2005
N5 Tributary	Oak Creek, City of	Mouth at North Branch Oak Creek	Just downstream of West Rawson Avenue	04040002	2.1	*	Y	AE	2005
N7 Tributary	Oak Creek, City of	Mouth at North Branch Oak Creek	Approximately 2,100 feet upstream of West Drexel Avenue	04040002	1.3	*	Y	AE	2005
N7A Tributary	Oak Creek, City of	Mouth at N7 Tributary	Approximately 900 feet upstream of South 20th Street	04040002	0.7	*	Y	AE	2005
North Branch Oak Creek	Milwaukee, City of; Oak Creek, City of	Mouth at Oak Creek	Approximately 1,300 feet upstream of I-94 Interstate Highway	04040002	5.9	*	Y	AE	2005
North Branch Oak Creek N2 Tributary	Milwaukee, City of; Oak Creek, City of	Confluence with North Branch Oak Creek	Approximately 4,000 feet upstream of its confluence with North Branch Oak Creek	04040002	0.7	*	Y	AE	2016
North Branch Whitnall Park Creek	Hales Corners, Village of	Confluence with Northwest Branch Whitnall Park Creek	Just downstream of West Edgerton Avenue	04040002	0.8	*	Y	AE	2009
Northwest Branch Whitnall Park Creek	Hales Corners, Village of	Mouth at Whitnall Park Creek	South 124th Street	04040002	1.5	*	Y	AE	1988
North Ridge Lake	Milwaukee, City of	Entire shoreline	Entire shoreline	04040003		0.1	N	AE	2017
O8 Tributary	Oak Creek, City of	Mouth at Oak Creek	Approximately 800 feet upstream of East Centennial Drive	04040002	0.5	*	Y	AE	2005

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
O16 Tributary	Oak Creek, City of	South Pennsylvania Avenue	Approximately 2,400 feet upstream of 15th Avenue	04040002	1.1	*	Y	AE	2005
O17 Tributary	Oak Creek, City of	South Pennsylvania Avenue	Approximately 1,250 feet upstream of East Woodview Avenue	04040002	0.9	*	Y	AE	2005
O17A Tributary	Oak Creek, City of	Approximately 750 feet East of South Pennsylvania Avenue	Approximately 2,600 feet East of South Pennsylvania Avenue	04040002	0.3	*	Y	AE	2005
O19 Tributary	Oak Creek, City of	Confluence with O19A Tributary	Approximately 80 feet upstream of Private Drive	04040002	0.2	*	Y	AE	2015
O19 Tributary	Oak Creek, City of	Approximately 80 feet upstream of Private Drive	Just upstream of Oak Leaf Trail	04040002	0.3	*	Y	AE	2005
O19-2 Tributary	Oak Creek, City of	Confluence with O19 Tributary	Just upstream of Oak Leaf Trail	04040002	0.1	*	Y	AE	2005
O19A Tributary	Oak Creek, City of	Confluence with Oak Creek	Approximately 132 feet downstream of South Shepard Avenue	04040002	1.2	*	Y	AE	2015
O19A Tributary Relief Swale	Oak Creek, City of	Confluence with O19A Tributary	Upstream face of Clemson Drive	04040002	0.3	*	Y	AE	2015
O20 Tributary	Oak Creek, City of	Confluence with Oak Creek	Just downstream of Oak Leaf Trail	04040002	0.5	*	Y	AE	2005
Oak Creek	Oak Creek, City of; South Milwaukee, City of	Mouth at Lake Michigan	Approximately 400 feet upstream of CP Railroad	04040002	10.4	*	Y	AE	2005

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Oak Creek	Oak Creek, City of	Approximately 400 feet upstream of CP Railroad	Approximately 400 feet upstream of 13th Street	04040002	0.4	*	Y	AE	2022
Oak Creek	Franklin, City of; Oak Creek, City of	Approximately 400 feet upstream of 13th Street	West Acre Avenue	04040002	3.3	*	Y	AE	2005
R2 Tributary	Oak Creek, City of	Racine/Milwaukee County Boundary	Approximately 2,400 feet upstream of West Oakwood Road	04040002	1.7	*	Y	AE	2005
R2A Tributary	Oak Creek, City of	Mouth at R2 Tributary	Just upstream of South 13th Street	04040002	0.3	*	Y	AE	2005
R5 Tributary	Oak Creek, City of	Mouth at Root River	East Elm Road	04040002	0.5	*	Y	AE	2005
Root River	Franklin, City of; Greendale, Village of; Greenfield, City of; West Allis, City of	Approximately 600 feet downstream of South Nicholson Road	Approximately 1,150 feet upstream of Forest Home Avenue	04040002	15.1	*	Y	AE	1981
Root River	Greenfield, City of	Approximately 1,150 feet upstream of Forest Home Avenue	Just downstream of West Cold Spring Road	04040002	1.2	*	Y	AE	2011
Root River	Greendale, Village of; West Allis, City of	Just downstream of West Cold Spring Road	West Lincoln Avenue	04040002	5.2	*	Y	AE	1982
Root River Zone A Tributaries	Franklin, City of	Various	Various	04040002	11.8	*	N	A	2008
Scout Lake Creek	Greendale, Village of	Mouth at Dale Creek	West Grange Avenue	04040002	1.0	*	N	AE	1982

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
South Branch to Wilson Park Creek	Cudahy, City of	At South Barland Avenue	Approximately 0.6 miles upstream of South Barland Avenue	04040003	0.6	*	N	A	2018
South Branch Underwood Creek	Wauwatosa, City of; West Allis, City of	Mouth at Underwood Creek	South 113th Street	04040003	1.6	*	Y	AE	2005
Southbranch Creek	Brown Deer, Village of; Milwaukee, City of	Mouth at Milwaukee River	West Bradley Road	04040003	1.6	*	Y	AE	2005
Southland Creek	Oak Creek, City of	Mouth at North Branch Oak Creek	South 27th Street	04040002	1.7	*	Y	AE	2005
Tess Corners Creek	Franklin, City of;	South Lovers Lane Road	Milwaukee/Waukesha County Boundary	04040002	1.7	*	Y	AE	1981
Tess Corners Creek	Franklin, City of; Hales Corners, Village of	South 92nd Street	South Lovers Lane Road	04040002	1.6	*	N	A	2008
Tess Corners Creek	Greendale, Village of	Mouth at Root River	South 92nd Street	04040002	0.4	*	N	AE	1982
TR-A	Greendale, Village of	Confluence with Unnamed Tributary No. 2 to the Root River	Split from Unnamed Tributary No. 2 to the Root River	04040002	0.2	*	Y	AE	2017
Tributary to Milwaukee River	River Hills, Village of	Confluence with Milwaukee River	Approximately 0.25 mile upstream of North Range Line Road	04040003	1.0	*	Y	AE	2018
Tributary to South Branch Underwood Creek	West Allis, City of	Approximately 1,000 feet downstream of Milwaukee / Waukesha County Boundary	Approximately 115 feet upstream of Milwaukee / Waukesha County Boundary	04040003	0.2	*	Y	AE	2019

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Underwood Creek	Wauwatosa, City of	Mouth at Menomonee River	Waukesha/Milwaukee County Boundary	04040003	2.6	*	Y	AE	2005
Underwood Creek Old Channel	Wauwatosa, City of	Convergence with Underwood Creek	Divergence from Underwood Creek	04040003	0.7	*	Y	AE	2005
Unnamed Tributary No. 1 to Fish Creek	Bayside, Village of	Mouth at Fish Creek	North Port Washington Road	04040003	0.4	*	Y	AE	1976
Unnamed Tributary No. 1 to Oak Creek	Franklin, City of	Mouth at Oak Creek	West Puetz Road	04040002	0.5	*	Y	AE	2005
Unnamed Tributary No. 1 to Southbranch Creek	Brown Deer, Village of	Mouth at Southbranch Creek	Approximately 1,350 feet upstream of North 55th Street	04040003	0.4	*	Y	AE	2005
Unnamed Tributary No. 1 to Southland Creek	Oak Creek, City of	Mouth at Southland Creek	West Puetz Road	04040002	0.7	*	Y	AE	2005
Unnamed Tributary No. 1 to the East Branch Root River	Franklin, City of	Mouth at East Branch Root River	West College Avenue	04040002	0.3	*	Y	AE	1981
Unnamed Tributary No. 1 to the East Branch Root River	Greendale, Village of	Approximately 450 feet downstream of Teakwood Drive	Just southeast of Squire Drive	04040002	0.5	*	N	AE	1982
Unnamed Tributary No. 2 to the Root River	Greendale, Village of	Approximately 2,000 feet downstream of Root River Drive	Approximately 1,900 feet upstream of Eastway	04040002	1.3	*	Y	AE	2017
Unnamed Tributary No. 3 to the Root River	Greendale, Village of	Mouth at Root River	Just downstream of South 76th Street	04040002	0.4	*	N	AE	1982
Unnamed Tributary No. 4 to the Root River	Greendale, Village of	Mouth at Root River	Approximately 250 feet downstream of South 76th Street	04040002	0.5	*	N	AE	1982

* Not applicable to this Flood Risk Project

Table 2: Flooding Sources Included in this FIS Report (continued)

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi ²) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Unnamed Tributary No. 5 to the Root River	Greendale, Village of	Mouth at Root River	Approximately 400 feet west of South 84th Street	04040002	0.5	*	Y	AE	1982
Upper Kelly Lake	Hales Corners, Village of	Entire shoreline	Entire shoreline	04040002	*	0.1	N	AE	1988
UT1 Little Menomonee River	Milwaukee, City of	Confluence with Little Menomonee River	At West Mill Road	04040003	2.3	*	N	A	2018
UT1.1 Little Menomonee River	Milwaukee, City of	Confluence with UT1 Little Menomonee River	At West Mill Road	04040003	0.4	*	N	A	2018
West Branch Crayfish Creek	Oak Creek, City of	Mouth at Crayfish Creek	Confluence with C1 and C2 Tributaries	04040002	0.4	*	N	AE	2008
West Branch Root River	West Allis, City of	Mouth at Root River	South 124th Street	04040002	0.8	*	Y	AE	1980
Whitnall Park Creek	Greendale, Village of	Mouth at Tess Corners Creek	South 92nd Street	04040002	0.2	*	N	AE	1988
Whitnall Park Creek	Hales Corners, Village of	Just upstream of Whitnall Park Drive	Upper Kelly Lake	04040002	2.2	*	Y	AE	1982
Wilson Park Creek	Milwaukee, City of	Mouth at Kinnickinnic River	West Layton Avenue	04040003	3.5	*	Y	AE	1987

* Not applicable to this Flood Risk Project

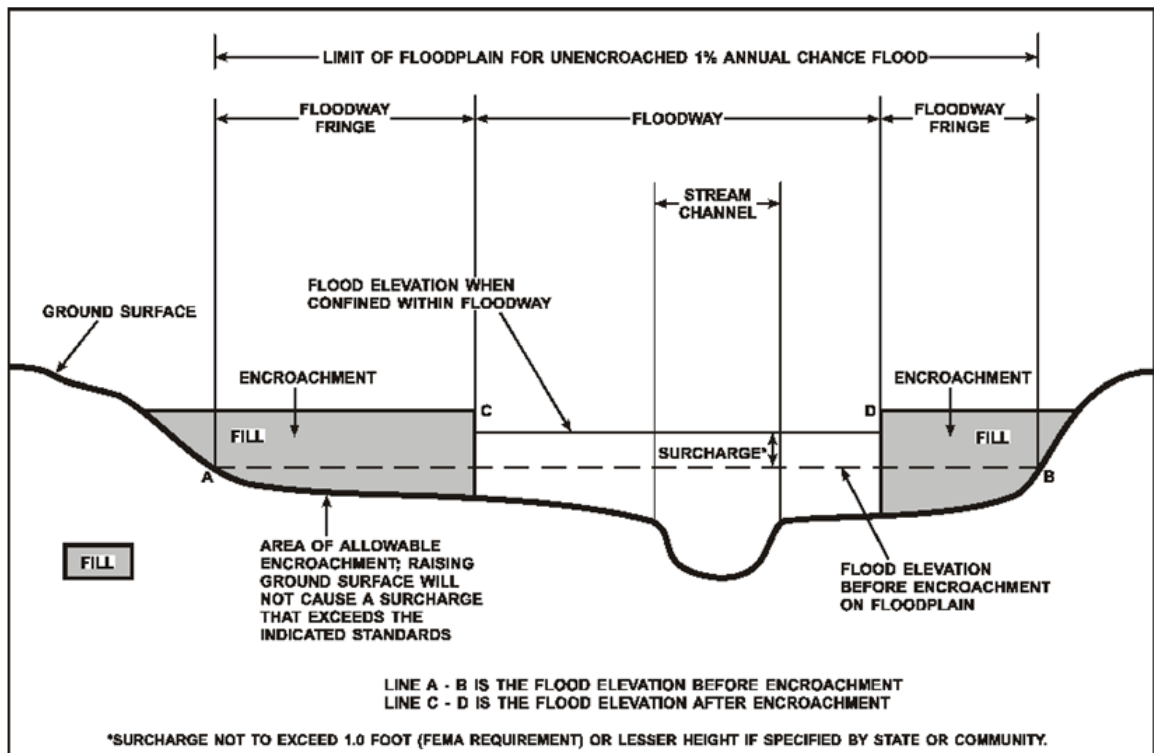
2.2 Floodways

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 balancing floodplain development against increasing flood hazard. With this approach, the area of the 1-percent-annual-chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1-percent-annual-chance flood. The floodway fringe is the area between the floodway and the 1-percent-annual-chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water surface elevation of the 1-percent-annual-chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. Regulations for Wisconsin require communities in Milwaukee County to limit increases caused by encroachment to 0.00 feet and several communities have adopted additional restrictions. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic



Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 23, "Floodway Data."

All floodways that were developed for this Flood Risk Project are shown on the FIRM using the symbology described in Figure 3. 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 on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The BFE is the elevation of the 1-percent-annual-chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

BFEs are primarily intended for flood insurance rating purposes. Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. 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. For example, the user may use the FIRM to determine the stream station of a location of interest and then use the profile to determine the 1-percent annual chance elevation at that location. Because only selected cross sections may be shown on the FIRM for riverine areas, the profile should be used to obtain the flood elevation between mapped cross sections. Additionally, for riverine areas, whole-foot elevations shown on the FIRM may not exactly reflect the elevations derived from the hydraulic analyses; therefore, elevations obtained from the profile may more accurately reflect the results of the hydraulic analysis.

2.4 Non-Encroachment Zones

This section is not applicable to this Flood Risk Project.

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1-percent-annual-chance flood and the geometry of the floodplain. Floods in these areas are typically caused by runoff from storm events. However, for areas on, or near, the Great Lakes, ocean coasts, large rivers, or other large bodies of water, the BFE and floodplain boundaries may be based on additional components that include storm surge and wave dynamics.

Coastal flooding sources that are included in this Flood Risk Project are shown in Table 2.

2.5.1 Water Elevations and the Effects of Waves

Specific terminology is used in coastal analyses to indicate which components have been included in evaluating flood hazards.

The stillwater elevation (SWEL or still water level) is the surface of the water resulting from astronomical tides, storm surge, and freshwater inputs, but excluding wave setup contribution or the effects of waves.

- *Astronomical tides* are periodic rises and falls in large bodies of water caused by the rotation of the earth and by the gravitational forces exerted by the earth, moon and sun. Tidal-induced fluctuations in the Great Lakes are small and their presence is masked by the normal fluctuations due to atmospheric forcing. The Great Lakes can be treated as if no tidal signal exists, and this contribution to water levels is neglected.
- *Storm surge, inclusive of wind setup and seiche-induced fluctuation*, is the additional water depth that occurs during large storm events. These events can bring air pressure changes and strong winds that force water up against the shore. The most common cause of a large seiche in the Great Lakes is the oscillating water level after a storm that moves over the lake, with the downwind portion of the lake subject to wind setup as water piles up against the coast and the upwind portion subject to a decrease in water levels.
- *Freshwater inputs* include rainfall that falls directly on the body of water, runoff from surfaces and overland flow, and inputs from rivers.

The 1-percent-annual-chance stillwater elevation is the stillwater elevation that has been calculated for a storm surge from a 1-percent-annual-chance storm. The 1-percent-annual-chance storm surge can be determined from analyses of water level station records, statistical study of regional historical storms, or other modeling approaches. Stillwater elevations for storms of other frequencies can be developed using similar approaches.

The total stillwater elevation (also referred to as the mean water level) is the stillwater elevation plus wave setup contribution but excluding the effects of waves, such as wave runup or overland wave propagation.

- *Wave setup* is the increase in stillwater elevation at the shoreline caused by the breaking of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.

Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1-percent-annual-chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since water level stations are often located in areas sheltered from wave action and do not capture wave height or wave setup information.

Coastal analyses may examine the effects of overland waves by analyzing storm-induced erosion, overland wave propagation, wave runup, and/or wave overtopping.

- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to general erosion that occurs over time.
- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move

onshore.

- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the stillwater elevation intersects the land, as shown in Figure 5a.
- *Wave overtopping* refers to wave runup that occurs when waves pass over the crest of a barrier, as shown in Figure 5b.

Figure 5a: Wave Runup Transect Schematic

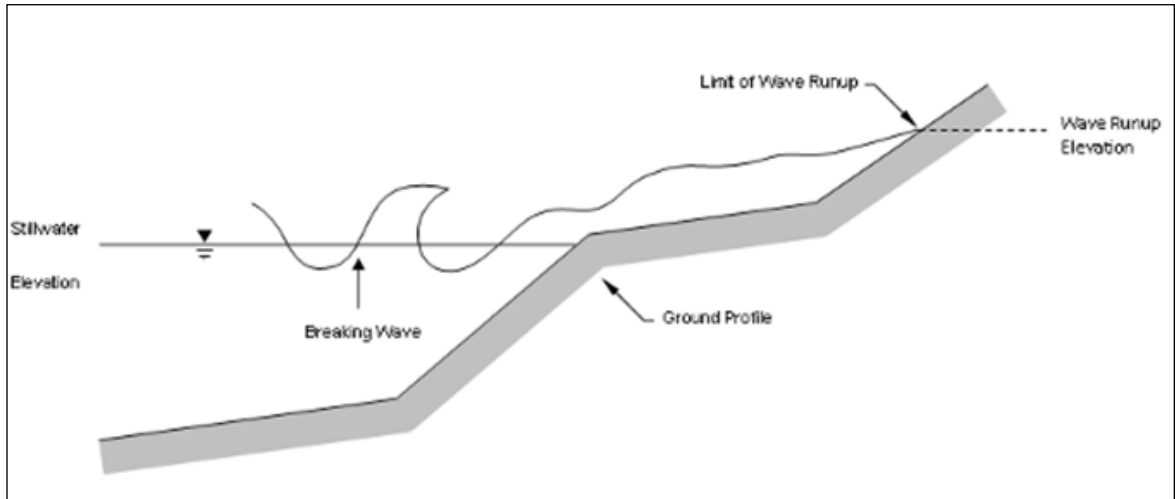


Figure 5b: Wave Overtopping Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

For coastal communities along the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and the Caribbean Sea, flood hazards must take into account how storm surges, waves, and in some cases extreme tides or lake level variations interact with factors such as topography, structures, and vegetation. Storm surge and waves must also be considered in assessing flood risk for certain communities on rivers or large inland bodies of water.

Beyond areas that are affected by storm surges and waves, coastal communities can also have riverine floodplains with designated floodways, as described in previous sections.

Floodplain Boundaries

In many coastal areas, storm surge is the principle component of flooding. The extent of the 1-percent-annual-chance floodplain in these areas is derived from the stillwater elevation for the 1-percent-annual-chance storm. The methods used for calculation of total stillwater elevations for coastal areas are described in Section 5.3 of this FIS Report.

In areas dominated by overland wave propagation, the coastal BFEs represent the wave dissipation and generation as the wave propagates landward from the shoreline. The landward extent of the 1-percent-annual-chance floodplain is determined by the stillwater elevation with the addition of wave setup, where applicable. The methods used for calculation of wave setup and overland wave propagation are described in Section 5.3 of this FIS Report.

In some areas, the 1-percent-annual-chance floodplain is determined based on the limit of wave runup or wave overtopping for the 1-percent-annual-chance storm surge. The Special Flood Hazard Area (SFHA) extent is determined based on the elevation of the land in relation to the wave runup elevation or the amount of wave overtopping. For areas dominated by wave runup, the coastal BFE can vary from reach to reach. Where wave runup exceeds the crest of a coastal feature, the SFHA extent is determined by the limit of the overtopping zone. The methods that were used for calculation of wave hazards are described in Section 5.3 of this FIS Report.

Table 25 presents the types of coastal analyses that were used in mapping the 1-percent-annual-chance floodplain in coastal areas.

Coastal BFEs

Coastal BFEs are calculated as the stillwater elevation for the 1-percent-annual-chance storm plus the additional flood hazard from wave effects (storm-induced erosion, wave setup, overland wave propagation, wave runup and wave overtopping).

Where they apply, coastal BFEs are calculated along transects extending from offshore to the limit of coastal flooding onshore. Results of these analyses are accurate until local topography, vegetation, or development type and density within the community undergoes major changes.

Parameters that were included in calculating coastal BFEs for each transect included in this FIS Report are presented in Table 16, "Coastal Transect Parameters." The locations of transects are shown in Figure 11, "Transect Location Map." More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.

2.5.3 Coastal High Hazard Areas

Certain areas along the open coast and other areas may have higher risk of experiencing structural damage caused by wave action and/or high-velocity water during the 1-percent-annual-chance flood. These areas will be identified on the FIRM as Coastal High Hazard Areas.

- *Coastal High Hazard Area (CHHA)* is a SFHA extending from offshore to the inland limit of the primary frontal dune (PFD) or any other area subject to damages caused by wave action and/or high-velocity water during the 1-percent-annual-chance flood.
- *Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

The landward limit of the PFD occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope; this point represents the landward extension of Zone VE.

No PFDs were identified in this county.

CHHAs are designated as “VE” zones (for “velocity wave zones”) and are subject to more stringent regulatory requirements and a different flood insurance rate structure. BFEs are assigned to Zones VE on the FIRM. More detailed information about the identification and designation of Zone VE is presented in Section 6.4 of this FIS Report.

Areas that are not within the CHHA but are SFHAs may still be impacted by coastal flooding and damaging waves; these areas are shown as “AE” zones on the FIRM.

Figure 6a, “Coastal Transect Schematic (Wave Runup and Overtopping),” illustrates the relationship between the base flood elevation, the 1-percent-annual-chance stillwater elevation, and the ground profile as well as the location of the Zone VE and Zone AE/AO in areas subject to wave runup and overtopping.

Figure 6a: Coastal Transect Schematic (Wave Runup and Overtopping)

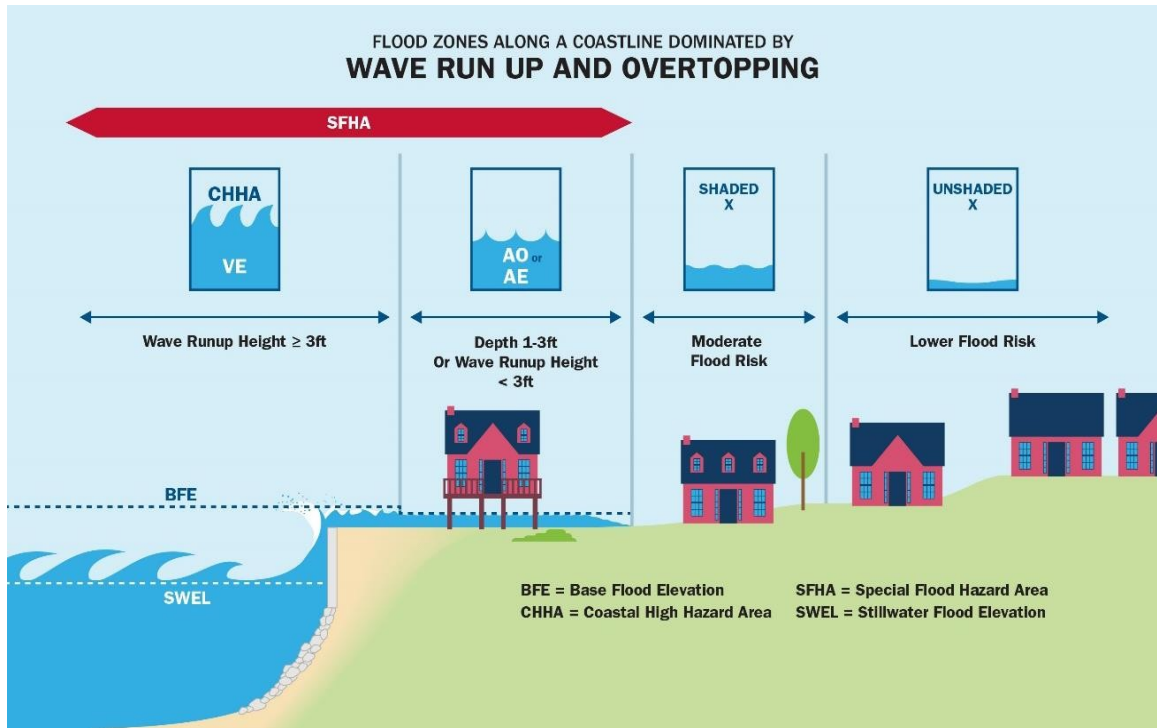
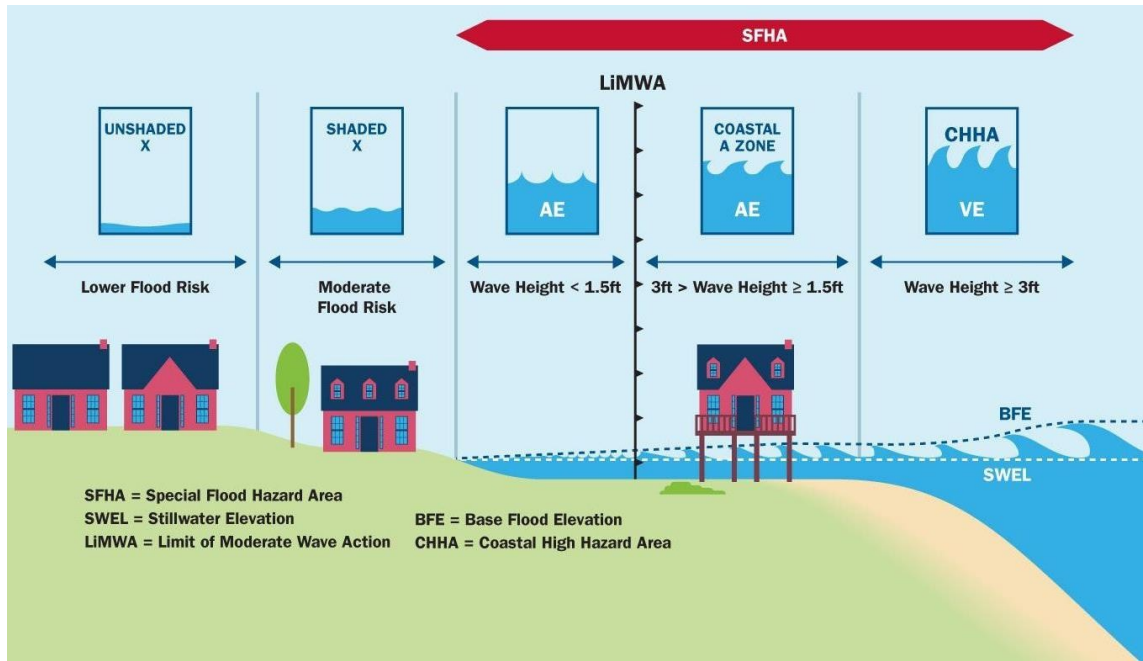


Figure 6b, “Coastal Transect Schematic (Overland Wave Propagation),” illustrates the relationship between the base flood elevation, the 1-percent-annual-chance stillwater elevation, and the ground profile as well as the location of the Zone VE and Zone AE in areas subject to overland wave propagation. This figure also illustrates energy dissipation and regeneration of a wave as it moves inland.

Figure 6b: Coastal Transect Schematic (Overland Wave Propagation)



Methods used in coastal analyses in this Flood Risk Project are presented in Section 5.3 and mapping methods are provided in Section 6.4 of this FIS Report.

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3, “Map Legend for FIRM.” The BFE mapped on the FIRM at the shoreline is determined by the 1-percent-annual-chance total water elevation, which includes the stillwater elevation plus wave effects. The 1-percent-annual-chance total water elevations are included in Table 16, along with the statistical stillwater elevations. If the BFE on the FIRM is higher than the stillwater elevations shown in Table 16 due to the presence of wave effects, the higher elevation should be used for construction and/or floodplain management purposes.

2.5.4 Limit of Moderate Wave Action

Laboratory tests and field investigations have shown that wave heights as little as 1.5 feet can cause damage to and failure of typical Zone AE building construction. Wood-frame, light gage steel, and masonry walls on shallow footings or slabs are subject to damage when exposed to waves less than 3 feet in height. Other flood hazards associated with coastal waves (floating debris, high velocity flow, erosion, and scour) can also damage Zone AE construction.

Therefore, a LiMWA boundary may be shown on the FIRM as an informational layer to assist coastal communities in safe rebuilding practices. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The location of the LiMWA relative to Zone VE and Zone AE is shown in Figure 6b.

The effects of wave hazards in Zone AE between Zone VE (or the shoreline where Zone VE is not identified) and the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot or greater breaking waves are projected to occur during the 1-

percent-annual-chance flooding event. Communities are therefore encouraged to adopt and enforce more stringent floodplain management requirements than the minimum NFIP requirements in areas lakeward of the LiMWA. The NFIP Community Rating System provides credits for these actions.

In areas where wave runup elevations dominate over wave crest elevations (Figure 6a), the LiMWA should not be shown on the FIRM. Examples of runup dominated areas include shorelines with steeply sloped beaches, bluffs, or flood protection structures that lie parallel to the shore. Similarly, in areas where the Zone VE designation is based on the presence of a PFD or wave overtopping, the LiMWA is not shown on the FIRM.

The LiMWA was not applicable for any transects within this county.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, “Map Legend for FIRM.” Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in Milwaukee County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Bayside, Village of	AE, VE, X
Brown Deer, Village of	AE, X
Cudahy, City of	A, VE, X
Forest County Potawatomi Community	X
Fox Point, Village of	AE, VE, X
Franklin, City of	A, AE, X
Glendale, City of	AE, X
Greendale, Village of	A, AE, X
Greenfield, City of	A, AE, X
Hales Corners, Village of	A, AE, X
Milwaukee, City of	A, AE, AO, VE, X
Oak Creek, City of	A, AE, AH, VE, X
River Hills, Village of	AE, X
Shorewood, Village of	AE, VE, X

Table 3: Flood Zone Designations by Community (continued)

Community	Flood Zone(s)
South Milwaukee, City of	A, AE, VE, X
St. Francis, City of	AE, VE, X
Wauwatosa, City of	AE, X
West Allis, City of	A, AE, X
West Milwaukee, Village of	X
Whitefish Bay, Village of	VE, X

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 4 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 4: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Pike-Root	04040002	Root River	Encompasses approximately the southern 1/3 of Milwaukee County	418
Milwaukee	04040003	Milwaukee River	Encompasses approximately the northern 2/3 of Milwaukee County	879
Lake Michigan	04190000	Lake Michigan	Entire surface water area of Lake Michigan	22,457
Upper Fox	07120006	Fox River	Encompasses a very small southwest corner of Milwaukee County	1,544

4.2 Principal Flood Problems

Table 5 contains a description of the principal flood problems that have been noted for Milwaukee County by flooding source.

Table 5: Principal Flood Problems

Flooding Source	Description of Flood Problems
Beaver Creek	On 6/17/1996-6/18/1996 a three-day rainfall totaling over 7 inches of rain fell in the northern part of the county on top of already saturated ground. This resulted in widespread flooding of mainstream rivers, streams, and creeks. Many roads, basements, businesses, and golf courses were flooded, especially in low lands near waterways. Concrete headwall washouts were noted in the City of Brown Deer.

Table 5: Principal Flood Problems (continued)

Flooding Source	Description of Flood Problems
Honey Creek	Recorded floods occurred along Honey Creek in 1959, 1972, and 1973. 9/18/1972 was the largest of these three floods. On 6/21/1997, severe flash flooding occurred as a result of heavy rainfall amounts of up to nearly 10 inches over a 30-hour period ending about noon. This flash flooding was greater than a 100-year rainfall based on rainfall frequency maps. Honey Creek in Wauwatosa reached the highest levels that local residents could ever remember. Water depths at nearby roads and Honey Creek Parkway reached at least 5 feet. One hundred nearby homes were evacuated.
Kinnickinnic River	Historical flooding is affected significantly by various manmade changes, including channel straightening, diking, bridges, and floodplain occupancy in the industrial valley. For equivalent flood discharges, stages may be higher or lower than normal, depending on the location and type of modification. Numerous channel modifications were made between the 1960 and 1973 floods. The residential and light commercial area between South 6 th Street and South 16 th Street has undergone flood damage during every significant flood. Causative factors include inadequate channel capacity and constrictive hydraulic structures. An estimated 20 to 40 structures along this reach within two blocks of the channel suffered damages to basement or first floor levels in 1973. In June 1997, fast flowing, high waters on the river in the southern parts of the City of Milwaukee resulted in four 500 ton barges breaking loose. These barges then drifted down river and collided with 21 pleasure crafts just west of South 1 st Street.

Table 6 contains information about historic flood elevations in the communities within Milwaukee County.

Table 6: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Honey Creek	South 72 nd Street	731.3	09/18/1972	N/A	2008 FIS Report
Honey Creek	South 72 nd Street	730.8	04/21/1973	N/A	2008 FIS Report
Indian Creek	Northwest side of Bradley Road at Indian Creek	647.68	06/21/1997	25	Surveyed mud line by WDNR on 6/24/1997
Lincoln Creek	Sherman Boulevard Bridge	648.6	04/21/1973	N/A	Milwaukee Metropolitan Sewerage District
Lincoln Creek	Sherman Boulevard Bridge	654.8	06/21/1997	N/A	Milwaukee Metropolitan Sewerage District
Little Menomonee River	Railroad Bridge just upstream of West Bradley Road	716.3	04/21/1973	N/A	2008 FIS Report

Table 6: Historic Flooding Elevations (continued)

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Kinnickinnic River	South 35 th Street	642.3	08/03/1960	N/A	2008 FIS Report
Kinnickinnic River	South 7 th Street	599.9	04/21/1973	N/A	2008 FIS Report
Menomonee River	Railroad bridge just upstream of I-94	602.7	04/21/1973	N/A	2008 FIS Report
Menomonee River	West Hampton Avenue	702.2	04/21/1973	N/A	2008 FIS Report
Menomonee River	USGS gage 04087120	647.21	06/21/1997	N/A	USGS
Menomonee River	USGS gage 04087120	648.88	08/06/1998	N/A	USGS
Milwaukee River	Gage at Estabrook Park	616.91	06/21/1997	N/A	National Weather Service
Milwaukee River	Gage at Estabrook Park	617.39	07/22/2010	N/A	National Weather Service
Oak Creek	Gage at South Milwaukee	642.69	06/08/2008	N/A	National Weather Service
Oak Creek	Gage at South Milwaukee	642.38	07/23/2010	N/A	National Weather Service
Root River	Gage at Franklin	685.2	06/08/2008	N/A	National Weather Service
Root River	Gage at Franklin	684.71	07/23/2010	N/A	National Weather Service
Underwood Creek	USGS gage 04087088	696.6	08/06/1997	N/A	2008 FIS Report
Wilson Park Creek	West Howard Avenue	651.3	04/21/1973	N/A	2008 FIS Report

4.3 Dams and Other Flood Hazard Reduction Measures

Table 7 contains information about non-levee flood hazard reduction measures within Milwaukee County such as dams or jetties. Levee systems are addressed in Section 4.4 of this FIS Report.

Table 7: Dams and Other Flood Hazard Reduction Measures

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Lake Michigan	3712-3840 S Lake Dr., St. Francis	Other / Misc Structure	3712-3840 S Lake Dr., St. Francis	Other / Misc Structure
Lake Michigan	Amphitheater and Pavilion	Seawall	Amphitheater and Pavilion	Seawall
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Bender Park revetment	Revetment	Bender Park revetment	Revetment
Lake Michigan	Cupertino Park quay	Seawall	Cupertino Park quay	Seawall
Lake Michigan	Cupertino Park revetment	Revetment	Cupertino Park revetment	Revetment
Lake Michigan	Donges Bay shoreline stabilization/protection	Revetment	Donges Bay shoreline stabilization/protection	Revetment
Lake Michigan	East Michigan Street, Milwaukee, WI	Revetment	East Michigan Street, Milwaukee, WI	Revetment
Lake Michigan	East Michigan Street, Milwaukee, WI	Revetment	East Michigan Street, Milwaukee, WI	Revetment
Lake Michigan	East Michigan Street, Milwaukee, WI	Seawall	East Michigan Street, Milwaukee, WI	Seawall
Lake Michigan	Jet Ski Marina breakwater	Other / Misc Structure	Jet Ski Marina breakwater	Other / Misc Structure
Lake Michigan	Jet Ski Marina revetment	Revetment	Jet Ski Marina revetment	Revetment
Lake Michigan	Jones Island Water Reclamation Facility	Seawall	Jones Island Water Reclamation Facility	Seawall
Lake Michigan	Just north of Lake Vista Park, Oak Creek, WI	Revetment	Just north of Lake Vista Park, Oak Creek, WI	Revetment
Lake Michigan	Lake Park	Revetment	Lake Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment

Table 7: Dams and Other Flood Hazard Reduction Measures (continued)

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Revetment	Lakeshore State Park	Revetment
Lake Michigan	Lakeshore State Park	Seawall	Lakeshore State Park	Seawall
Lake Michigan	Lakeshore State Park	Seawall	Lakeshore State Park	Seawall
Lake Michigan	Lakeshore State Park	Seawall	Lakeshore State Park	Seawall
Lake Michigan	Lakeshore State Park	Seawall	Lakeshore State Park	Seawall
Lake Michigan	Linwood Water Treatment Plant	Seawall	Linwood Water Treatment Plant	Seawall
Lake Michigan	McKinley Beach breakwater/beach stabilization	Other / Misc Structure	McKinley Beach breakwater/beach stabilization	Other / Misc Structure
Lake Michigan	McKinley Beach breakwater/McKinley Marina seawall with revetment	Revetment	McKinley Beach breakwater/McKinley Marina seawall with revetment	Revetment
Lake Michigan	McKinley Marina inner breakwater	Other / Misc Structure	McKinley Marina inner breakwater	Other / Misc Structure
Lake Michigan	Milwaukee Bulk Terminals Jones Island pier	Pier	Milwaukee Bulk Terminals Jones Island pier	Pier
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure

Table 7: Dams and Other Flood Hazard Reduction Measures (continued)

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Lake Michigan	Milwaukee offshore breakwaters	Other / Misc Structure	Milwaukee offshore breakwaters	Other / Misc Structure
Lake Michigan	North Point	Revetment	North Point	Revetment
Lake Michigan	Oak Creek Power Plant	Revetment	Oak Creek Power Plant	Revetment
Lake Michigan	Oak Creek Power Plant intake breakwater	Other / Misc Structure	Oak Creek Power Plant intake breakwater	Other / Misc Structure
Lake Michigan	Oak Creek Power Plant intake seawall	Seawall	Oak Creek Power Plant intake seawall	Seawall
Lake Michigan	Oak Creek Power Plant outflow	Other / Misc Structure	Oak Creek Power Plant outflow	Other / Misc Structure
Lake Michigan	Oak Creek Power Plant seawall	Seawall	Oak Creek Power Plant seawall	Seawall
Lake Michigan	Oak Creek Power Plant southern intake jetty	Other / Misc Structure	Oak Creek Power Plant southern intake jetty	Other / Misc Structure
Lake Michigan	Oak Creek shoreline stabilization	Revetment	Oak Creek shoreline stabilization	Revetment
Lake Michigan	Oakwood Cliff and Trails revetment	Revetment	Oakwood Cliff and Trails revetment	Revetment
Lake Michigan	Port of Milwaukee General Cargo Terminal	Revetment	Port of Milwaukee General Cargo Terminal	Revetment
Lake Michigan	Sea Dog Sailing seawall	Seawall	Sea Dog Sailing seawall	Seawall
Lake Michigan	Sheridan Park	Revetment	Sheridan Park	Revetment
Lake Michigan	Sheridan Park impoundment	Seawall	Sheridan Park impoundment	Seawall
Lake Michigan	South Milwaukee Yacht Club	Seawall	South Milwaukee Yacht Club	Seawall
Lake Michigan	South Milwaukee Yacht Club detached breakwater	Other / Misc Structure	South Milwaukee Yacht Club detached breakwater	Other / Misc Structure
Lake Michigan	South Milwaukee Yacht Club harbor	Seawall	South Milwaukee Yacht Club harbor	Seawall
Lake Michigan	South Milwaukee Yacht Club harbor breakwater	Seawall	South Milwaukee Yacht Club harbor breakwater	Seawall
Lake Michigan	South Shore Water Reclamation Facility	Seawall	South Shore Water Reclamation Facility	Seawall
Lake Michigan	South Shore Yacht Club seawall	Seawall	South Shore Yacht Club seawall	Seawall

Table 7: Dams and Other Flood Hazard Reduction Measures (continued)

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Lake Michigan	Texas Rock revetment	Revetment	Texas Rock revetment	Revetment
Lake Michigan	U.S. Coast Guard harbor jetty	Other / Misc Structure	U.S. Coast Guard harbor jetty	Other / Misc Structure
Lake Michigan	Veterans Park Harbor seawall	Seawall	Veterans Park Harbor seawall	Seawall
Oak Creek and Lake Michigan	Grant Park shoreline stabilization and groin	Other / Misc Structure	Grant Park shoreline stabilization and groin	Other / Misc Structure
Oak Creek and Lake Michigan	Oak Creek near Grant Park	Other / Misc Structure	Oak Creek near Grant Park	Other / Misc Structure

4.4 Levee Systems

For purposes of the NFIP, FEMA only recognizes levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with comprehensive floodplain management criteria. The Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10) describes the information needed for FEMA to determine if a levee system reduces the flood hazard from the 1-percent-annual-chance flood. This information must be supplied to FEMA by the community or other party when a flood risk study or restudy is conducted, when FIRMs are revised, or upon FEMA request. FEMA reviews the information for the purpose of establishing the appropriate flood hazard zone.

Levee systems that are determined to reduce the hazard from the 1-percent-annual-chance flood are accredited by FEMA. FEMA can also grant provisional accreditation to a levee system that was previously accredited on an effective FIRM and for which FEMA is awaiting data and/or documentation to demonstrate compliance with 44 CFR 65.10. These levee systems are referred to as Provisionally Accredited Levees, or PALs. Provisional accreditation provides communities and levee owners with a specified timeframe to obtain the necessary data to confirm the levee system's accreditation status. Accredited levee systems and PALs are shown on the FIRM using the symbology shown in Figure 3. If the required information for a PAL is not submitted within the required timeframe, or if information indicates that a levee system no longer meets 44 CFR 65.10, FEMA will consider the levee system as non-accredited and issue an effective FIRM showing the levee-impacted area as a SFHA or Zone D.

FEMA coordinated with the USACE, the local communities, and other organizations to compile a list of levee systems that exist within Milwaukee County. Table 8, "Levee Systems," lists all accredited levee systems, PALs, and non-accredited levee systems shown on the FIRM for this FIS Report. Other categories of levees may also be included in the table. The Levee ID shown in this table may not match numbers based on other identification systems that were listed in previous FIS Reports. Levee systems identified in the table are displayed on the FIRM with notes to users to indicate their flood hazard

mapping status.

Please note that the information presented in Table 8 is subject to change at any time. For that reason, the latest information regarding the levee systems presented in the table may be obtained by accessing the National Levee Database. For additional information, contact the levee owner/sponsor or the local community shown in Table 30.

Table 8: Levee Systems

Community	Flooding Source(s)	NLD Levee System ID	NLD Levee System Name	Levee System Status on Effective FIRM	FIRM Panel(s)	Levee Owner(s) / Sponsor(s)
Milwaukee, City of	Menomonee River	1505001128	Falk Levee	Non-Accredited	55079C0089F	*
Milwaukee, City of	Menomonee River	1505001129	Valley Park Levee	Non-Accredited	55079C0087F	*

* Data not available

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources 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 at least once on the average during any 10-, 25-, 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-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2-percent-annual-chance, respectively, of being equaled or exceeded during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 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.

In addition to these flood events, the “1-percent-plus”, or “1%+”, annual chance flood elevation has been modeled and included on the flood profile for certain flooding sources in this FIS Report. While not used for regulatory or insurance purposes, this flood event has been calculated to help illustrate the variability range that exists between the regulatory 1-percent-annual-chance flood elevation and a 1-percent-annual-chance elevation that has taken into account an additional amount of uncertainty in the flood discharges (thus, the 1% “plus”). For flooding sources whose discharges were estimated using regression equations, the 1%+ flood elevations are derived by taking the 1-percent-annual-chance flood discharges and increasing the modeled discharges by a percentage equal to the average predictive error for the regression equation. For flooding sources with gage- or rainfall-runoff-based discharge estimates, the upper 84-percent confidence limit of the discharges is used to compute the 1%+ flood elevations.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 26, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 12. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

A summary of the discharges is provided in Table 9. Frequency Discharge-Drainage Area Curves used to develop the hydrologic models may also be shown in Figure 7 for selected flooding sources. A summary of stillwater elevations developed for non-coastal flooding sources is provided in Table 10. (Coastal stillwater elevations are discussed in Section 5.3 and shown in Table 16.) Stream gage information is provided in Table 11.

Table 9: Summary of Discharges

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Beaver Creek	At confluence with Milwaukee River	3.49	712	*	929	1,006	*	1,194
Beaver Creek	Approximately 800 feet downstream of Brown Deer Trail Bridge	3.37	766	*	1,077	1,218	*	1,870
Beaver Creek	Approximately 280 feet downstream of North 51st Street	3.17	1,069	*	1,704	2,102	*	3,097
Beaver Creek	Just upstream of North 51st Street	2.72	780	*	1,219	1,459	*	2,366
Beaver Creek	Approximately 730 feet upstream of North 60th Street	2.16	686	*	1,086	1,380	*	2,423
Beaver Creek	Just upstream of North 64th Street	1.72	446	*	758	973	*	1,567
Beaver Creek	Just downstream of North 70th Street	0.80	150	*	280	361	*	571
C1 Tributary	At confluence with West Branch Crayfish Creek	0.44	60	*	*	160	*	*
C2 Tributary	At confluence with West Branch Crayfish Creek	0.49	145	*	*	355	*	*
C3 Tributary	1,800 feet upstream of Oakwood Road	0.46	105	*	*	265	*	*
C3A Tributary	At confluence with C3 Tributary	*	35	*	*	110	*	*
Caledonia Branch	At confluence with Crayfish Creek	2.3	*	*	*	230	*	*
CB1 Tributary	At outlet	0.34	100	*	*	240	*	*
CB2 Tributary	At outlet	0.17	55	*	*	140	*	*

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
CB3 Tributary	190 feet downstream of State Highway 32	0.40	85	*	*	205	*	*
Crayfish Creek	At Milwaukee-Racine County Line	5.72	309	*	672	777	*	*
Crayfish Creek	At Elm Road	2.80	217	*	270	295	*	*
Dale Creek	At confluence with the Root River	1.3	700	*	780	810	*	875
Dale Creek	At Clover Lane	1.0	555	*	620	640	*	695
Dale Creek	Above confluence with Scout Lake Creek	0.6	430	*	490	515	*	560
Dale Creek	At Schoolway	0.4	305	*	350	365	*	400
Dale Creek	At West Grange Avenue	0.2	160	*	185	195	*	210
East Branch Root River	About 630 feet upstream of the Root River	4.9	490	*	800	940	*	1,350
East Branch Root River	About 300 feet upstream of West Rawson Avenue	2.4	440	*	720	850	*	1,200
Fish Creek	At downstream crossing of Ozaukee-Milwaukee County Line	5.1	500	*	620	705	*	860
Hale Creek	Upstream of its confluence with the Root River	1.86	1,112	*	1,589	1,759	*	2,200
Honey Creek	At confluence with the Menomonee River	10.3	2,100	*	3,000	3,500	*	4,500
Honey Creek	At 68th Street Bridge (USGS Gage 04087100)	3.3	1,500	*	2,200	2,500	*	3,300
Honey Creek	Upstream of I-894	2.1	495	*	821	988	*	1,460

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Indian Creek	250 ft downstream of River Road	3.4	1,344	1,912	2,424	3,032	3,997	4,635
Indian Creek	125 ft upstream of River Road	2.4	876	1,250	1,582	1,988	2,623	3,049
Indian Creek	Just downstream of I-43	2.0	851	1,199	1,513	1,881	2,472	2,863
Indian Creek	Just downstream of N Indian Parkway	1.6	694	966	1,203	1,490	1,932	2,251
Indian Creek	Just downstream of N Manor Lane	1.1	425	589	737	910	1,182	1,396
Indian Creek	330 ft upstream of Union Pacific railroad	0.5	81	113	141	181	235	296
Indian Creek	1,200 ft upstream of Union Pacific railroad	0.4	47	54	57	60	180	224
Kinnickinnic River	At Kinnickinnic Avenue Bridge	24.0	4,550	*	6,500	7,400	*	9,800
Kinnickinnic River	Upstream from Wilson Park Creek	5.6	1,600	*	2,300	2,600	*	3,300
L1 Tributary	380 feet above Lake Michigan	0.41	95	*	*	210	*	*
L5 Tributary	At outlet to Lake Michigan	0.36	99	*	*	263	*	*
L5 Tributary	508 feet above Lake Michigan	0.19	60	*	*	155	*	*
Legend Creek	Just upstream of confluence with the Root River	4.05	585	*	960	1,150	*	1,690
Legend Creek	0.1 miles upstream of South 68th Street	3.59	545	*	895	1,070	*	1,575
Legend Creek	Just downstream of West Drexel Avenue	3.19	540	*	815	945	*	1,290

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Legend Creek	0.3 miles upstream of South 76th Street	2.38	285	*	425	490	*	655
Legend Creek	0.3 miles downstream of West Forest Hill Avenue	1.29	105	*	140	155	*	185
Legend Creek	At State Highway 100	0.62	95	*	135	155	*	200
Legend Creek	0.3 miles upstream of State Highway 100	0.28	65	*	105	125	*	185
Lincoln Creek	Approximately 950 feet upstream of North Green Bay Avenue	*	4,820	*	6,530	7,300	*	9,900
Lincoln Creek	Approximately 450 feet downstream of West Villard Avenue	*	4,020	*	5,470	6,350	*	9,900
Lincoln Creek	Just downstream of North 35th Street	*	4,280	*	5,540	6,060	*	7,820
Lincoln Creek	Approximately 50 feet downstream of North Sherman Boulevard	*	4,840	*	6,310	6,880	*	8,680
Lincoln Creek	Approximately 1,400 feet upstream of North Sherman Boulevard	*	4,640	*	6,040	6,570	*	8,070
Lincoln Creek	Approximately 1,100 feet downstream of North 60th Street	*	4,120	*	5,220	5,660	*	6,730
Lincoln Creek	Just downstream of West Hampton Avenue	*	3,030	*	4,050	4,310	*	5,360
Lincoln Creek	Approximately 1,000 feet downstream of West Villard Avenue	*	2,200	*	3,190	3,500	*	4,370

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Lincoln Creek	Approximately 100 feet downstream of North 60th Street	*	1,300	*	1,800	2,030	*	2,630
Lincoln Creek	Approximately 415 feet upstream of North 60th Street	*	1,110	*	1,610	1,850	*	2,350
Lincoln Creek	Just downstream of West Silver Spring Drive	*	1,140	*	1,520	1,700	*	2,160
Lincoln Creek	Just upstream of West Silver Spring Drive	*	620	*	840	1,000	*	1,240
Lincoln Creek	Approximately 200 feet upstream of trail upstream of railroad	*	580	*	780	890	*	1,120
Lincoln Creek	Approximately 80 feet downstream of West Woolworth Avenue	*	1,080	*	1,450	1,620	*	1,790
Lincoln Creek	Just upstream of West Woolworth Avenue	*	830	*	1,080	1,200	*	1,790
Lincoln Creek	Approximately 1,250 feet downstream of West Green Tree Road	*	740	*	920	1,020	*	1,400
Lincoln Creek	Approximately 925 feet downstream of West Green Tree Road	*	690	*	860	940	*	1,350
Lincoln Creek	Just upstream of West Green Tree Road	*	610	*	760	840	*	1,250
Lincoln Creek	Approximately 1,600 feet downstream of West Good Hope Road	*	410	*	590	680	*	900

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Lincoln Creek	Approximately 1,330 feet downstream of West Good Hope Road	*	1,300	*	1,310	1,550	*	2,360
Lincoln Creek	Approximately 115 feet downstream of West Good Hope Road	*	660	*	950	1,100	*	1,610
Lincoln Creek	Just upstream of railroad upstream of West Good Hope Road	*	520	*	740	830	*	1,170
Lincoln Creek	Approximately 300 feet downstream of North 60th Street	*	310	*	370	400	*	440
Lincoln Creek Bypass	At confluence with Lincoln Creek	*	832	*	2080	2916	*	4684
Little Menomonee River	At confluence with the Menomonee River	21.0	800	*	1,200	1,500	*	2,100
Little Menomonee River	At Brown Deer Road	12.1	330	*	500	580	*	770
Lyons Creek	At confluence with the Kinnickinnic River	1.0	670	*	980	1,100	*	1,500
M1 Tributary	At confluence with Mitchell Field Drainage Ditch	0.37	110	*	*	135	*	*
M4 Tributary	At confluence with Mitchell Field Drainage Ditch	0.25	150	*	*	335	*	*
Menomonee River	At confluence with the Milwaukee River	136.0	14,700	*	19,900	22,000	*	*
Menomonee River	At 70th Street Bridge (USGS Gage 04087120)	123.0	9,640	*	13,100	14,500	*	*

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Menomonee River	At Hampton Avenue Bridge	82.0	2,718	*	3,186	3,687	*	5,000
Menomonee River	At 124th Street near Fond du Lac Avenue	49.0	1,300	*	1,900	2,200	*	2,900
Milwaukee River	Just upstream of confluence with the Kinnickinnic River (RM 0.19)	*	13,100	*	19,400	26,700	*	34,220
Milwaukee River	Just downstream of the Water Street Bridge (RM 0.79)	*	13,100	*	19,400	26,700	*	34,220
Milwaukee River	At Buffalo Street (RM 0.99)	*	8,790	*	12,900	14,800	*	18,810
Milwaukee River	Location of former North Avenue Dam (RM 3.12)	702.0	8,790	*	12,900	14,800	*	18,810
Milwaukee River	At USGS Gaging Station No. 04087000 (RM 6.5)	*	8,790	*	12,900	14,800	*	18,810
Milwaukee River	Just downstream of the Estabrook Park Dam (RM 6.67)	*	8,790	*	12,900	14,800	*	18,810
Milwaukee River	Near the Port Washington Road Bridge (RM 6.87)	*	8,790	*	12,900	14,800	*	18,810
Milwaukee River	At the north end of Lincoln Park (RM 7.98)	*	8,790	*	12,550	14,380	*	18,245
Milwaukee River	At the Wisconsin & Southern Railroad Bridge (RM 8.09)	*	8,790	*	12,550	14,380	*	18,245

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Milwaukee River	At Silver Spring Drive (RM 8.5)	*	8,790	*	12,550	14,340	*	18,240
Milwaukee River	At Green Tree Road (RM 11.29)	*	8,790	*	12,550	14,340	*	18,240
Milwaukee River	At the Ozaukee-Milwaukee County Line (RM 16.34)	646.0	8,790	10,960	12,550	14,340	*	18,240
Milwaukee River Right Split	At confluence with Milwaukee River	*	1,149	*	1,780	1,847	*	2,236
Mitchell Field Drainage Ditch	At confluence with Oak Creek	3.80	535	*	720	800	*	1,000
Mitchell Field Drainage Ditch	Just upstream of Rawson Avenue	3.18	535	*	710	790	*	975
Mitchell Field Drainage Ditch	Just upstream of College Avenue	1.75	385	*	510	565	*	700
Mitchell Field Drainage Ditch	About 1,000 feet downstream of Howell Avenue	0.88	340	*	605	755	*	1,200
Mitchell Field Drainage Ditch	Just upstream of Howell Avenue	0.55	225	*	315	355	*	450
N4 Tributary	At confluence with N5 Tributary	0.68	275	*	*	610	*	*
N5 Tributary	At confluence with North Branch Oak Creek	1.52	420	*	*	900	*	*
N7 Tributary	At confluence with North Branch Oak Creek	1.27	210	*	*	510	*	*
N7A Tributary	At confluence with Milwaukee River	*	150	*	*	280	*	*

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
N7A Tributary	Approximately 3,150 feet upstream of mouth	*	110	*	*	260	*	*
N7A Tributary	Just upstream of Interstate 94	*	40	*	*	95	*	*
North Branch Oak Creek	At confluence with Oak Creek	8.10	905	*	1,230	1,380	*	1,740
North Branch Oak Creek	Just upstream of confluence with Southland Creek	6.50	935	*	1,320	1,490	*	1,930
North Branch Oak Creek	Just upstream of confluence with N7 Tributary	4.70	755	*	1,050	1,190	*	1,540
North Branch Oak Creek	Just upstream of confluence with N5 Tributary	2.70	590	*	815	915	*	1,170
North Branch Oak Creek	Just upstream of Rawson Avenue	2.30	510	*	705	795	*	1,020
North Branch Oak Creek	Just upstream of confluence with North Branch Oak Creek N2 Tributary	1.28	150	*	200	225	*	280
North Branch Oak Creek N2 Tributary	At confluence with North Branch Oak Creek	0.71	185	*	*	385	*	*
North Branch Whitnall Park Creek	At mouth	0.32	130	*	190	220	*	280
Northwest Branch Whitnall Park Creek	Just upstream from confluence with Whitnall Park Creek	1.25	320	*	470	540	*	710

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Northwest Branch Whitnall Park Creek	Just upstream from confluence with North Branch Whitnall Park Creek	0.83	210	*	310	360	*	470
O8 Tributary	At confluence with Oak Creek	0.50	305	*	*	620	*	*
O16 Tributary	At South 15th Avenue	0.29	95	*	*	235	*	*
O17 Tributary	At Woodview Avenue	*	48	*	*	121	*	*
O17A Tributary	At outlet to unnamed lake	*	26	*	*	57	*	*
O19 Tributary	At confluence with O19A Tributary	0.15	60	*	*	150	*	*
O19-2 Tributary	At confluence with O19 Tributary	*	15	*	*	35	*	*
O19A Tributary	At confluence with Oak Creek	0.69	190	*	*	460	*	*
O19A Tributary Relief Swale	At confluence with O19A Tributary	*	8	*	*	70	*	*
O20 Tributary	At confluence with Oak Creek	0.75	295	*	*	610	*	*
Oak Creek	At mouth	28.20	1,430	*	1,940	2,160	*	2,670
Oak Creek	At USGS Gage No. 04087204 (at 15th Avenue in the City of South Milwaukee)	25.72	1,360	*	1,850	2,070	*	2,610
Oak Creek	At USGS Gage No. 04087200 (at Nicholson Road in the City of Oak Creek)	14.46	1,090	*	1,380	1,500	*	1,780
Oak Creek	Just upstream of South 27th Street	1.97	435	*	570	625	*	755

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
R2 Tributary	1 mile upstream of its confluence with the Root River	0.94	245	*	*	560	*	*
R2A Tributary	Just upstream of South 13th Street	*	75	*	*	185	*	*
R2A Tributary	Approximately 130 feet downstream of South 13th Street	*	55	*	*	130	*	*
R5 Tributary	At confluence with the Root River	0.29	115	*	*	270	*	*
Root River	Just upstream of South 27th Street	136.30	3,210	*	5,450	6,700	*	10,500
Root River	Just upstream of West South County Line Road	131.40	3,260	*	5,500	6,700	*	10,400
Root River	Just upstream of West Oakwood Road	56.50	2,050	*	3,850	4,900	*	8,600
Root River	900 feet upstream of West Oakwood Road	50.40	1,900	*	3,600	4,500	*	8,200
Root River	Just upstream of the confluence of East Branch Root River	41.40	2,000	*	4,050	5,400	*	11,400
Root River	About 1,000 feet upstream West Rawson Avenue	36.30	2,250	*	4,600	6,100	*	11,800
Root River	At City of Franklin/Village of Greendale Corporate Limits	34.70	2,950	*	5,100	6,400	*	11,800
Root River	At College Avenue	16.10	2,250	*	3,650	4,400	*	7,500
Root River	At Forest Home Avenue	13.70	2,750	*	4,700	5,800	*	10,200

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Root River	At Forest Home Avenue	13.40	1,230	*	1,850	2,160	*	2,890
Root River	At West Layton Avenue	*	1,050	*	1,600	1,840	*	2,470
Root River	At West Cold Springs Road	*	745	*	1,120	1,300	*	1,750
Root River	At State Highway 100	8.10	710	*	1,080	1,260	*	1,680
Root River	Upstream of West Morgan Avenue	5.52	1,932	*	2,507	2,763	*	3,400
Root River	Upstream of the mouth of Hale Creek	1.86	1,112	*	1,589	1,759	*	2,200
Scout Lake Creek	At Loomis Road	0.4	305	*	350	365	*	400
Scout Lake Creek	At Scout Lake Outlet	0.2	145	*	170	180	*	200
Scout Lake Creek	At River Mile 0.77	0.1	40	*	45	50	*	55
South Branch Underwood Creek	At confluence with Underwood Creek	5.4	1,700	*	2,340	2,630	*	3,340
Southbranch Creek	At confluence with the Milwaukee River	2.9	652	*	1,044	1,275	*	1,960
Southland Creek	At confluence with North Branch Oak Creek	1.10	60	*	95	110	*	150
Southland Creek	Just upstream of confluence with Unnamed Tributary No. 1 to Southland Creek	0.57	25	*	35	40	*	55
Southland Creek	Just downstream of South 20th Street	0.44	165	*	235	270	*	350
Southland Creek	Just upstream of Grays Lane	0.31	125	*	175	195	*	245
Tess Corners Creek	At confluence with the Root River	14.9	2,000	*	3,800	5,000	*	8,700

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Tess Corners Creek	At 92nd Street	9.6	1,200	*	2,280	3,000	*	5,220
Tess Corners Creek	Just upstream of U.S. Highway 45	8.4	350	*	710	910	*	1,610
Tess Corners Creek	About 2,000 feet upstream of U.S. Highway 45	6.8	290	*	600	780	*	1,410
TR-A	Confluence with Unnamed Tributary No. 2 to the Root River	*	63	*	241	356	*	685
TR-A	673 feet upstream of confluence with Unnamed Tributary No. 2 to the Root River	*	63	*	178	240	*	415
TR-A	Split from Unnamed Tributary No. 2 to the Root River	*	20	*	35	45	*	75
Tributary to Milwaukee River	At Brown Deer Road	0.2	100	135	173	217	269	337
Tributary to Milwaukee River	At Range Line Road	0.2	74	105	134	167	207	257
Tributary to Milwaukee River	Approximately 1,200 feet upstream of Range Line Road	0.1	30	43	55	68	85	104
Tributary to South Branch Underwood Creek	At South Elm Grove Road	0.8	517	747	952	1,190	1,659	1,880
Underwood Creek	At confluence with the Menomonee River	19.8	3,700	*	5,590	6,480	*	8,790

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Underwood Creek	Just upstream of South Branch Underwood Creek	14.4	928	*	1,480	1,750	*	2,470
Underwood Creek Old Channel	At confluence with Underwood Creek	*	*	*	116	150	*	*
Unnamed Tributary No. 1 to Fish Creek	At confluence with Fish Creek	1.4	240	*	510	675	*	1,200
Unnamed Tributary No. 1 to Oak Creek	At confluence with Oak Creek	0.25	50	*	85	100	*	155
Unnamed Tributary No. 1 to Southbranch Creek	At mouth	*	*	*	*	*	*	*
Unnamed Tributary No. 1 to Southland Creek	At mouth	0.41	45	*	70	80	*	110
Unnamed Tributary No. 1 to the East Branch Root River	About 160 feet upstream of the mouth at East Branch Root River	*	180	*	240	270	*	340
Unnamed Tributary No. 1 to the East Branch Root River	At the City of Franklin/Village of Greendale Corporate Limits	0.3	135	*	180	200	*	250
Unnamed Tributary No. 1 to the East Branch Root River	At West Ramsey Road	0.2	100	*	135	150	*	185
Unnamed Tributary No. 2 to the Root River	Root River Drive	0.53	210	*	395	500	*	795

*Data not available

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)					
			10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	1%+ Annual Chance	0.2% Annual Chance
Unnamed Tributary No. 2 to the Root River	At Eastway	0.31	150	*	290	370	*	595
Unnamed Tributary No. 3 to the Root River	At Parkway Drive	0.2	260	*	350	390	*	490
Unnamed Tributary No. 4 to the Root River	At Parkway Drive	0.8	725	*	870	925	*	1,050
Unnamed Tributary No. 5 to the Root River	At Parkway Drive	0.4	195	*	255	280	*	340
West Branch Crayfish Creek	At mouth			*		299	*	
West Branch Root River	Upstream of Oklahoma Avenue	1.79	580	*	840	960	*	1,200
Whitnall Park Creek	At College Avenue	5.30	800	*	1,520	2,000	*	3,480
Whitnall Park Creek	At road crossing in Whitnall Park	4.74	1,000	*	1,500	1,800	*	2,300
Whitnall Park Creek	Just upstream from the confluence with Northwest Branch Whitnall Park Creek	2.25	370	*	580	670	*	970
Wilson Park Creek	At confluence with the Kinnickinnic River	11.3	1,400	*	2,000	2,300	*	2,900
Wilson Park Creek	At the 6th Street Bridge	6.1	970	*	1,300	1,500	*	1,800

*Data not available

**Figure 7: Frequency Discharge-Drainage Area Curves
[Not Applicable to this Flood Risk Project]**

Table 10: Summary of Non-Coastal Stillwater Elevations

Flooding Source	Location	Elevations (feet NAVD88)				
		10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
North Ridge Lake	Entire shoreline within the county	678.5	*	679.2	679.6	680.4
Scout Lake	Entire shoreline within the county	733.0	*	733.2	733.2	733.4
Upper Kelly Lake	Entire shoreline within the county	808.7	*	809.9	810.7	811.6

* Data not available

Table 11: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Milwaukee River	0487000	USGS	Milwaukee River at Milwaukee, WI	696	04/01/1914	01/01/2008

5.2 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. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. 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. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed in Table 23, "Floodway Data."

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 12. Roughness coefficients are provided in Table 13. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Beaver Creek	Confluence with the Milwaukee River	Just upstream of North 70 th Street	EPA-SWMM (EPA, 2005)	HEC-RAS 4.1.0 (USACE, 2010)	2017	AE w/ Floodway	LOMR # 16-05-7247P
C1 Tributary	Confluence with West Branch Crayfish River	Approximately 850 feet upstream of South Shepard Avenue	HEC-1 (USACE, 1988)	HEC-RAS 3.1.1 (USACE, 2003)	2005	AE w/ Floodway	
C2 Tributary	Confluence with West Branch Crayfish River	Approximately 1,600 feet upstream of South Shepard Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
C3 Tributary	Confluence with Crayfish River	11th Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
C3A Tributary	Confluence with C3 Tributary	Approximately 2,500 feet upstream of C3 Tributary	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Caledonia Branch	Confluence with Crayfish River	East County Line Road	HSPF (USGS, 1993)	HEC-RAS 3.1.1	2005	AE w/ Floodway	
CB1 Tributary	Confluence with Caledonia Branch	Approximately 600 feet upstream of Emerald Meadows Drive	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
CB2 Tributary	Confluence with Caledonia Branch	Approximately 50 feet upstream of 10th Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
CB3 Tributary	East County Line Road	Approximately 200 feet upstream of South Chicago Road	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Crayfish Creek	East County Line Road	East Oakwood Road	HEC-1	HEC-2 (USACE, 1991)	1999	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Dale Creek	Confluence with Root River	Mansfield Drive	ILLUDAS (ISWS, 1974)	HEC-2	1982	AE	
East Branch Root River	Mouth at Root River	West College Avenue	Hydrocomp (Hydrocomp, 1976)	HEC-2	1981	AE w/ Floodway	
Edgerton Channel	Lake Parkway	South Whitnall Avenue	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	
Fish Creek	Approximately 2,800 feet downstream of West Ravine Baye Road	County Line Road	1971 Regression Equations (USGS, 1971)	E-431 (USGS, 1975)	1976	AE w/ Floodway	
Hale Creek	Just upstream of West Cleveland Avenue	Approximately 3,500 feet upstream of West Cleveland Avenue	Rational Method	HEC-RAS 3.1.1	2008	AE w/ Floodway	LOMR # 20-05-2969X
Hale Creek	Mouth at Root River	Just upstream of West Cleveland Avenue	Rational Method	HEC-2	1980	AE w/ Floodway	
Hale Creek	Approximately 3,500 feet upstream of West Cleveland Avenue	West Lincoln Avenue	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	
Honey Creek	Mouth at Menomonee River	Interstate I-94	Hydrocomp	HEC-2	1987	AE w/ Floodway	
Honey Creek	West Oklahoma Avenue	West Forest Home Avenue	Hydrocomp	HEC-2	1987	AE w/ Floodway	
Honey Creek	Approximately 850 feet upstream of West Forest Home Avenue	Approximately 2,100 feet upstream of West Forest Home Avenue	HSPF	HEC-RAS	2009	A	LOMR # 09-05-4073P
Honey Creek	Approximately 2,100 feet upstream of West Forest Home Avenue	Just upstream of West Coldspring Road	Hydrocomp	HEC-2	1987	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Honey Creek	Just downstream of Interstate I-894	Approximately 800 feet upstream of West Layton Avenue	HSPF	HEC-RAS	2015	AE w/ Floodway	LOMR # 15-05-0082P
Indian Creek	Confluence with Milwaukee River	Approximately 0.25 mile upstream of railroad	HEC-HMS 3.5	HEC-RAS 4.1.0	2018	AE w/ Floodway	
Kinnickinnic River	Just downstream of railroad near mouth	Just upstream of West Lincoln Avenue	Hydrocomp	HEC-RAS	2019	AE w/ Floodway	LOMR # 18-05-6243P
Kinnickinnic River	Just upstream of West Lincoln Avenue	Approximately 190 feet downstream of S 16 th Street	Hydrocomp	HEC-2	1987	AE w/ Floodway	
Kinnickinnic River	Approximately 190 feet downstream of S 16 th Street	Approximately 30 feet downstream of Railroad	Hydrocomp	HEC-RAS	2023	AE w/ Floodway	LOMR # 21-05-3522P
Kinnickinnic River	Approximately 30 feet downstream of Railroad	Approximately 130 feet upstream of Lyons Creek	Hydrocomp	HEC-2	1987	AE w/ Floodway	
L1 Tributary	Approximately 500 feet upstream of Lake Michigan	Railroad	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
L1 Tributary	Lake Michigan	Approximately 500 feet upstream of Lake Michigan	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	
L5 Tributary	Approximately 500 feet upstream of Lake Michigan	Approximately 3,000 feet upstream of Lake Michigan	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
L5 Tributary	Lake Michigan	Approximately 500 feet upstream of Lake Michigan	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Legend Creek	Mouth at Root River	Just upstream of West Loomis Road	HSPF	HEC-RAS 2.2.1	2005	AE w/ Floodway	
Lincoln Creek	Mouth at Milwaukee River Right Split	Just downstream of North 60th Street	EPA-SWMM	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Lincoln Creek By-pass	Convergence with Lincoln Creek	Divergence from Lincoln Creek	EPA-SWMM	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Little Menomonee River	Mouth at Menomonee River	County Line Road	Hydrocomp	HEC-2	1987	AE w/ Floodway	
Lyons Creek	Mouth at Kinnickinnic River	Just downstream of West Forest Home Avenue	Hydrocomp	HEC-2	1987	AE w/ Floodway	
M1 Tributary	Mouth at Mitchell Field Drainage Ditch	South Howell Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
M4 Tributary	Mouth at Mitchell Field Drainage Ditch	Approximately 2,400 feet upstream of mouth	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Menomonee River	Mouth at Milwaukee River	Confluence with Underwood Creek	HSPF	HEC-RAS 3.1.1	2008	AE w/ Floodway	
Menomonee River	Confluence with Underwood Creek	North 124th Street just upstream of confluence with Dretzka Park Tributary	Hydrocomp	HEC-2	1987	AE w/ Floodway	
Milwaukee River	Approximately 70 feet downstream of the Milwaukee / Ozaukee County Boundary	Approximately 330 feet upstream of the Milwaukee / Ozaukee County Boundary	Gage Analysis (USGS, 1987)	HEC-RAS 4.1.0	2018	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Milwaukee River	Mouth at Lake Michigan	Approximately 70 feet downstream of the Milwaukee / Ozaukee County Boundary	Gage Analysis	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Milwaukee River – Right Split	Convergence with Milwaukee River	Divergence from Milwaukee River	Gage Analysis	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Mitchell Field Drainage Ditch	Just upstream of South Howell Avenue	Just downstream of South 6 th Street	HSPF	HEC-RAS	2014	AE w/ Floodway	LOMR # 14-05-0354P
Mitchell Field Drainage Ditch	Mouth at Oak Creek	Just upstream of South Howell Avenue	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
N4 Tributary	Mouth at N5 Tributary	Approximately 300 feet upstream of South 13th Street	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
N5 Tributary	Mouth at North Branch Oak Creek	Just downstream of West Rawson Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
N7 Tributary	Mouth at North Branch Oak Creek	Approximately 2,100 feet upstream of West Drexel Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
N7A Tributary	Mouth at N7 Tributary	Approximately 900 feet upstream of South 20th Street	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
North Branch Oak Creek	Mouth at Oak Creek	Approximately 1,300 feet upstream of I-94 Interstate Highway	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
North Branch Oak Creek N2 Tributary	Confluence with North Branch Oak Creek	Approximately 4,000 feet upstream of its confluence with North Branch Oak Creek	HEC-1 / PondPack	HEC-RAS 4.1.0	2016	AE w/ Floodway	LOMR # 16-05-0269P
North Branch Whitnall Park Creek	Confluence with Northwest Branch Whitnall Park Creek	Just downstream of West Edgerton Avenue	HSPF	HEC-RAS 3.1.1	2009	AE w/ Floodway	LOMR # 10-05-1009X
Northwest Branch Whitnall Park Creek	Mouth at Whitnall Park Creek	South 124th Street	TR-55 (SCS, 1975)	HEC-2	1988	AE w/ Floodway	
North Ridge Lake	Entire shoreline	Entire shoreline	EPA-SWMM	HEC-RAS 4.1.0	2017	AE	LOMR # 16-05-7247P
O8 Tributary	Mouth at Oak Creek	Approximately 800 feet upstream of East Centennial Drive	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O16 Tributary	South Pennsylvania Avenue	Approximately 2,400 feet upstream of 15th Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O17 Tributary	South Pennsylvania Avenue	Approximately 1,250 feet upstream of East Woodview Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O17A Tributary	Approximately 750 feet East of South Pennsylvania Avenue	Approximately 2,600 feet East of South Pennsylvania Avenue	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O19 Tributary	Confluence with O19A Tributary	Approximately 80 feet upstream of Private Drive	HEC-1	HEC-RAS 4.1.0	2015	AE w/ Floodway	LOMR # 15-05-2729P

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
O19 Tributary	Approximately 80 feet upstream of Private Drive	Just upstream of Oak Leaf Trail	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O19-2 Tributary	Confluence with O19 Tributary	Just upstream of Oak Leaf Trail	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
O19A Tributary	Confluence with Oak Creek	Approximately 132 feet downstream of South Shepard Avenue	HEC-1	HEC-RAS 4.1.0	2015	AE w/ Floodway	LOMR # 15-05-2729P
O19A Tributary Relief Swale	Confluence with O19A Tributary	Upstream face of Clemson Drive	HEC-1	HEC-RAS 4.1.0	2015	AE w/ Floodway	LOMR # 15-05-2729P
O20 Tributary	Confluence with Oak Creek	Just downstream of Oak Leaf Trail	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	The FIS profile published 09/26/2008 did not show the correct BFE for the area affected by backwater from Oak Creek. The profile has been corrected in the subsequent FIS.
Oak Creek	Mouth at Lake Michigan	Approximately 400 feet upstream of CP Railroad	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Oak Creek	Approximately 400 feet upstream of CP Railroad	Approximately 400 feet upstream of 13 th Street	HSPF	HEC-RAS	2022	AE w/ Floodway	LOMR # 21-05-0691P
Oak Creek	Approximately 400 feet upstream of 13 th Street	West Acre Avenue	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
R2 Tributary	Racine/Milwaukee County Boundary	Approximately 2,400 feet upstream of West Oakwood Road	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
R2A Tributary	Mouth at R2 Tributary	Just upstream of South 13th Street	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	
R5 Tributary	Mouth at Root River	East Elm Road	HEC-1	HEC-RAS 3.1.1	2005	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Root River	Approximately 600 feet downstream of South Nicholson Road	Approximately 1,150 feet upstream of Forest Home Avenue	HSPF	E-431	1981	AE w/ Floodway	Downstream reach
Root River	Approximately 1,150 feet upstream of Forest Home Avenue	Just downstream of West Cold Spring Road	HSPF	HEC-RAS 4.0.1 (USACE, 2008)	2011	AE w/ Floodway	LOMR # 11-05-1089P
Root River	Just downstream of West Cold Spring Road	West Lincoln Avenue	HSPF	HEC-2	1982	AE w/ Floodway	Upstream reach
Root River Zone A Tributaries	Various	Various	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	
Scout Lake Creek	Mouth at Dale Creek	West Grange Avenue	ILLUDAS	HEC-2	1982	AE	
South Branch to Wilson Park Creek	At South Barland Avenue	Approximately 0.6 miles upstream of South Barland Avenue	HEC-HMS 4.2.1 (USACE, 2017)	HEC-RAS 4.1.0	2018	A	When available, structure geometry from DOT bridge plans was utilized in modeling. If not available, the road grade was entered with a notch representing the opening.
South Branch Underwood Creek	Mouth at Underwood Creek	South 113th Street	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Southbranch Creek	Mouth at Milwaukee River	West Bradley Road	EPA-SWMM	EPA-SWMM	2005	AE w/ Floodway	
Southland Creek	Mouth at North Branch Oak Creek	South 27th Street	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Tess Corners Creek	South Lovers Lane Road	Milwaukee/Waukesha County Boundary	1971 Regression Equations / ILLUDAS	E-431	1981	AE w/ Floodway	
Tess Corners Creek	South 92nd Street	South Lovers Lane Road	2003 Regression Equations	HEC-RAS 3.1.1	2008	A	
Tess Corners Creek	Mouth at Root River	South 92nd Street	1971 Regression Equations / ILLUDAS	E-431	1982	AE	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
TR-A	Confluence with Unnamed Tributary No. 2 to the Root River	Split from Unnamed Tributary No. 2 to the Root River	HEC-HMS	HEC-RAS 4.0.1	2017	AE w/ Floodway	LOMR # 17-05-5076P
Tributary to Milwaukee River	Confluence with Milwaukee River	Approximately 0.25 mile upstream of North Range Line Road	HEC-HMS 4.0 (USACE, 2013)	HEC-RAS 4.1.0	2018	AE w/ Floodway	
Tributary to South Branch Underwood Creek	Approximately 1,000 feet downstream of Milwaukee / Waukesha County Boundary	Approximately 115 feet upstream of Milwaukee / Waukesha County Boundary	HSPF	HEC-RAS 4.1.0	2019	AE w/ Floodway	
Underwood Creek	Mouth at Menomonee River	Waukesha/Milwaukee County Boundary	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Underwood Creek Old Channel	Convergence with Underwood Creek	Divergence from Underwood Creek	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Unnamed Tributary No. 1 to Fish Creek	Mouth at Fish Creek	North Port Washington Road	1971 Regression Equations	E-431	1976	AE w/ Floodway	
Unnamed Tributary No. 1 to Oak Creek	Mouth at Oak Creek	West Puetz Road	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Unnamed Tributary No. 1 to Southbranch Creek	Mouth at Southbranch Creek	Approximately 1,350 feet upstream of North 55th Street	EPA-SWMM	HEC-RAS 3.1.1	2005	AE w/ Floodway	
Unnamed Tributary No. 1 to Southland Creek	Mouth at Southland Creek	West Puetz Road	HSPF	HEC-RAS 3.1.1	2005	AE w/ Floodway	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Unnamed Tributary No. 1 to the East Branch Root River	Mouth at East Branch Root River	West College Avenue	1971 Regression Equations	HEC-2	1981	AE w/ Floodway	
Unnamed Tributary No. 1 to the East Branch Root River	Approximately 450 feet downstream of Teakwood Drive	Just southeast of Squire Drive	ILLUDAS / Rational Method	HEC-2	1982	AE	
Unnamed Tributary No. 2 to the Root River	Approximately 2,000 feet downstream of Root River Drive	Approximately 1,900 feet upstream of Eastway	HEC-HMS	HEC-RAS 4.0.1	2017	AE w/ Floodway	LOMR # 17-05-5076P
Unnamed Tributary No. 3 to the Root River	Mouth at Root River	Just downstream of South 76th Street	ILLUDAS	HEC-2	1982	AE	
Unnamed Tributary No. 4 to the Root River	Mouth at Root River	Approximately 250 feet downstream of South 76th Street	ILLUDAS	HEC-2	1982	AE	
Unnamed Tributary No. 5 to the Root River	Mouth at Root River	Approximately 400 feet west of South 84th Street	ILLUDAS	HEC-2	1982	AE w/ Floodway	
Upper Kelly Lake	Entire shoreline	Entire shoreline	HEC-1	Hand calculations	1988	AE	
UT1 Little Menomonee River	Confluence with Little Menomonee River	At West Mill Road	HEC-HMS 4.2.1	HEC-RAS 4.1.0	2018	A	When available, structure geometry from DOT bridge plans was utilized in modeling. If not available, the road grade was entered with a notch representing the opening.
UT1.1 Little Menomonee River	Confluence with UT1 Little Menomonee River	At West Mill Road	HEC-HMS 4.2.1	HEC-RAS 4.1.0	2018	A	When available, structure geometry from DOT bridge plans was utilized in modeling. If not available, the road grade was entered with a notch representing the opening.
West Branch Crayfish Creek	Mouth at Crayfish Creek	Confluence with C1 and C2 Tributaries	HSPF	HEC-RAS 3.1.1	2008	AE	

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
West Branch Root River	Mouth at Root River	South 124th Street	1971 Regression Equations	HEC-2	1980	AE w/ Floodway	
Whitnall Park Creek	Mouth at Tess Corners Creek	South 92nd Street	ILLUDAS / Rational Method	HEC-2	1988	AE	
Whitnall Park Creek	Just upstream of Whitnall Park Drive	Upper Kelly Lake	TR-55	HEC-2	1982	AE w/ Floodway	
Wilson Park Creek	Mouth at Kinnickinnic River	West Layton Avenue	Hydrocomp	HEC-2	1987	AE w/ Floodway	

Table 13: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Beaver Creek	0.016-0.060	0.020-0.120
C1 Tributary	0.030-0.045	0.018-0.045
C2 Tributary	0.020-0.050	0.025-0.090
C3 Tributary	0.030-0.050	0.035-0.090
C3A Tributary	0.050	0.060-0.090
Caledonia Branch	0.045	0.055
CB1 Tributary	0.030-0.055	0.035-0.100
CB2 Tributary	0.035-0.040	0.040-0.080
CB3 Tributary	0.050-0.100	0.060-0.100
Crayfish Creek	0.040-0.070	0.045-0.100
Dale Creek	*	*
Dretzka Park Tributary	*	*
East Branch Root River	0.040-0.045	0.040-0.100
Edgerton Channel	*	*
Fish Creek	0.035-0.110	0.035-0.110
Hale Creek	0.035	0.060-0.090
Honey Creek	0.017-0.100	0.017-0.100
Indian Creek	0.035-0.050	0.050-0.100
Kinnickinnic River	0.015-0.068	0.015-0.160
L1 Tributary	0.035-0.060	0.030-0.100
L5 Tributary	0.005-0.065	0.055-0.100
Legend Creek	0.024-0.150	0.024-0.350
Lincoln Creek	0.018-0.040	0.020-0.100
Lincoln Creek By-pass	0.030	0.030-0.080
Little Menomonee River	0.035-0.055	0.035-0.160
Lyons Creek	0.017-0.045	0.030-0.120
M1 Tributary	0.035-0.055	0.030-0.100
M4 Tributary	0.045-0.050	0.050-0.090
Menomonee River	0.015-0.068	0.015-0.160
Milwaukee River	0.013-0.048	0.025-0.155
Milwaukee River – Right Split	0.035-0.040	0.035-0.050
Mitchell Field Drainage Ditch	0.025-0.055	0.035-0.070
N4 Tributary	0.016-0.055	0.018-0.100
N5 Tributary	0.013-0.085	0.035-0.100
N7 Tributary	0.024-0.100	0.035-0.100
N7A Tributary	0.035-0.075	0.035-0.100
North Branch Oak Creek	0.015-0.060	0.035-0.120
North Branch Oak Creek N2 Tributary	0.035-0.080	0.018-0.110
North Branch Whitnall Park Creek	0.020-0.040	0.013-0.060

*Data not available

Table 13: Roughness Coefficients (continued)

Flooding Source	Channel "n"	Overbank "n"
Northwest Branch Whitnall Park Creek	0.017-0.045	0.020-0.120
O8 Tributary	0.035-0.065	0.020-0.100
O16 Tributary	0.030-0.045	0.018-0.090
O17 Tributary	0.045	0.018-0.090
O17A Tributary	0.045-0.080	0.080
O19 Tributary	0.050-0.055	0.030-0.100
O19-2 Tributary	0.055	0.075-0.100
O19A Tributary	0.030-0.070	0.030-0.100
O19A Tributary Relief Swale	0.030	0.030-0.045
O20 Tributary	0.045-0.050	0.035-0.100
Oak Creek	0.015-0.045	0.032-0.110
R2 Tributary	0.045-0.060	0.035-0.100
R2A Tributary	0.035-0.050	0.030-0.080
R5 Tributary	0.014-0.055	0.035-0.100
Root River	0.040-0.100	0.030-0.120
Root River Zone A Tributaries	*	*
Scout Lake Creek	0.035-0.050	0.050-0.060
South Branch to Wilson Park Creek	0.035	0.070
South Branch Underwood Creek	0.013-0.050	0.017-0.150
Southbranch Creek	0.020-0.200	0.050-0.200
Southland Creek	0.015-0.055	0.015-0.070
Tess Corners Creek	0.028-0.065	0.045-0.110
TR-A	0.035	0.045
Tributary to Milwaukee River	0.035-0.045	0.050-0.100
Tributary to South Branch Underwood Creek	0.020-0.045	0.050-0.120
Underwood Creek	0.017	0.035-0.085
Underwood Creek Old Channel	0.017-0.120	0.017-0.120
Unnamed Tributary No. 1 to Fish Creek	*	*
Unnamed Tributary No. 1 to Oak Creek	0.030-0.050	0.030-0.070
Unnamed Tributary No. 1 to Southbranch Creek	*	*
Unnamed Tributary No. 1 to Southland Creek	0.045-0.055	0.050-0.065
Unnamed Tributary No. 1 to the East Branch Root River	0.035-0.045	0.045-0.110
Unnamed Tributary No. 2 to the Root River	0.035-0.045	0.045-0.070
Unnamed Tributary No. 3 to the Root River	0.045	0.060-0.075

*Data not available

Table 13: Roughness Coefficients (continued)

Flooding Source	Channel "n"	Overbank "n"
Unnamed Tributary No. 4 to the Root River	0.020-0.035	0.035-0.060
Unnamed Tributary No. 5 to the Root River	0.040	0.060
UT1 Little Menomonee River	0.030	0.050
UT1.1 Little Menomonee River	0.030	0.050
West Branch Crayfish Creek	0.030-0.150	0.030-0.150
West Branch Root River	0.045	0.055-0.100
Whitnall Park Creek	0.017-0.045	0.020-0.120
Wilson Park Creek	0.017-0.035	0.017-0.040

*Data not available

5.3 Coastal Analyses

For the areas of Milwaukee County that are impacted by coastal flooding processes, coastal flood hazard analyses were performed to provide estimates of coastal BFEs. Coastal BFEs reflect the increase in water levels during a flood event due to storm surge as well as overland wave effects.

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation (STARR 2017). Table 14 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

Table 14: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Erosion	CSHORE	06/01/2017
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Statistical Analyses	Q-Q Optimization nGPD	06/01/2017
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Storm Surge	ADCIRC	10/30/2016
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Wave Generation	SWAN	10/30/2016
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Wave Overtopping	EurOtop Manual; Plateau Method	10/01/2017

Table 14: Summary of Coastal Analyses (continued)

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Wave Runup	Stockton, VanGent and SPM	06/01/2017
Lake Michigan	Entire coastline of Milwaukee County	Entire coastline of Milwaukee County	Wave Setup	Direct Integration Method (DIM) ¹	06/01/2017

¹ U.S. Army Corps of Engineers (USACE) Shore Protection Manual (SPM), 1984

5.3.1 Stillwater Elevations

The stillwater elevations for the 1-percent-annual-chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 14. The stillwater elevation that was used for each transect in the coastal analyses is shown in Table 16, “Coastal Transect Parameters.” Figure 10 shows an example of the stillwater elevations for the 1-percent-annual-chance flood that was determined for this coastal analysis; wave setup is computed at each transect location and added to the stillwater elevation to determine a total stillwater elevation.

Stillwater elevations and starting wave conditions for Milwaukee County were determined from the lake-wide wave and storm surge study conducted for Lake Michigan by FEMA and Strategic Alliance for Risk Reduction (STARR, 2016). The study was performed using the coupled SWAN + ADCIRC hydrodynamic and wave model on a mesh of 1,045,141 nodes and validated using water levels and waves for six historical storms. The model was then used to simulate 150 selected historic storms based on historic peak water levels and peak wave heights. When available, ice coverage was accounted for in validation and production events. The modeled data were used to create a history of water elevation and wave height records from which the 10-, 2-, 1-, and 0.2-percent-annual-chance of exceedance elevations were calculated.

Figure 8: 1-Percent-Annual-Chance Stillwater Elevations for Coastal Areas



Storm Surge Statistics

Storm surge is modeled based on characteristics of actual storms responsible for significant coastal flooding. The characteristics of these storms are typically determined by statistical study of the regional historical record of storms or by statistical study of water level stations.

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels. An extreme value analysis was performed on the storm surge modeling results to determine a stillwater elevation for the 1-percent-annual-chance event.

In an oceanic environment, water level stations can be used instead of historic records of storms when the available station record for the area represents both the astronomical tide component and the storm surge component. Great Lakes studies rely on water level stations to identify the highest water level storm events from the historic record. The selected storms are then used to simulate storm surge and wave heights across the study area. Table 15 provides the water level station name, managing agency, station type, station identifier, start date, end date, and statistical methodology applied to each station to determine the stillwater elevations.

Table 15: Water Level Station Analysis Specifics

Station Name	Managing Agency of Station	Station Type	Start Date	End Date ¹	Statistical Methodology
Calumet Harbor, IL (9087044)	National Oceanic and Atmospheric Administration (NOAA)	Water Level	1960	2009	N/A
Green Bay, WI (9087079)	NOAA	Water Level	1960	2009	N/A
Holland, MI (9087031)	NOAA	Water Level	1960	2009	N/A
Kewaunee, WI (9087068)	NOAA	Water Level	1973	2009	N/A
Ludington, MI (9087023)	NOAA	Water Level	1960	2009	N/A
Mackinaw City, MI (9075080)	NOAA	Water Level	1960	2009	N/A
Milwaukee, WI (9087057)	NOAA	Water Level	1960	2009	N/A
Port Inland, MI (9087096)	NOAA	Water Level	1964	2009	N/A
Sturgeon Bay, WI (9087072)	NOAA	Water Level	1960	2009	N/A

¹Available data within study period of record (1960-2009).

5.3.2 Waves

Starting wave heights and wave periods for Milwaukee County were determined from the lake-wide wave and storm surge study conducted for Lake Michigan by FEMA and STARR as described in Section 5.3.1. The modeled data were used to create a history of wave height and wave period records which was used to determine starting wave conditions for the transect analysis.

Wave Setup Analysis

Wave setup was computed based on the wave and water level modeling results through the methods and models listed in Table 14. To adequately capture the complex hydrodynamics of wave-breaking across the surf zone, wave setup was calculated at each transect using the Direct Integration Method (DIM).

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated using the methods listed in Table 14 to determine the modification to existing topography that is expected to be associated with coastal flooding events. The post-event eroded profile was used for the subsequent transect-based onshore wave hazard analyses.

5.3.4 Wave Hazard Analyses

Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects where waves are expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1-percent-annual-chance flood. The transect analysis was performed with elevations in the vertical datum of IGLD85 and ultimately converted to NAVD88 for mapping.

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 11, "Transect Location Map," are also depicted on the FIRM. Table 16 provides the location, stillwater elevations, and total water elevations for all coastal analysis transects. Starting wave conditions are also provided for each transect evaluated for overland wave hazards. In this table, "starting" indicates the parameter value at the beginning of the transect.

Wave Height Analysis

Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by coastal flooding and subject to overland wave propagation hazards. Refer to Figure 6b for a schematic of a coastal transect evaluated for overland wave propagation hazards.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS). This method is based on three major concepts. First, depth-limited waves in shallow water reach maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in the NAS Report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. The joint probability method (JPM) is used to compute five theoretical combinations of wave and water level conditions that have a joint 1-percent-annual-chance probability of occurrence. These theoretical combinations were simulated to determine the water levels, which include wave setup, and wave conditions at the shoreline. Wave heights and wave crest elevations were modeled using the methods and models listed in Table 14.

There were no overland wave propagation transects within this county.

Wave Runup and Overtopping Analysis

Wave runup is the uprush of water caused by wave action on a shore barrier exceeding the total stillwater level. As part of the coastal study, an evaluation of wave runup is conducted to determine the total water elevation due to storm surge, wave setup, and wave runup, and whether that total water elevation is the dominant coastal flood hazard for an area. Wave runup is evaluated for areas having dune barrier systems, coastal bluffs, as well as sloped and vertical structures. Structures that are not certified to withstand the 1-percent-annual-chance coastal flood event were analyzed in both the intact and failed conditions. Failed structure geometries were calculated using the methods and models listed in Table 14.

Wave runup elevations were calculated for each coastal transect using the methods and models listed in Table 14, which follow the FEMA Guidelines and Specifications. For gently sloping shorelines (slopes less than 1:10), the Stockdon equations were applied (Stockdon et al., 2006). For steeper (but non-vertical) sloping shorelines, the van Gent method was performed (van Gent, 2001). For vertical structures, runup elevations were determined using the guidance in Figure D-14 of the FEMA Guidelines and Specifications obtained from the SPM (USACE, 1984). The SPM results in a mean wave runup value, which was multiplied by 2.2 to obtain the 2-percent runup height.

Wave overtopping occurs when the potential wave runup elevation is greater than the topographic feature crest elevation. The overtopping rate will depend on the incident water level and wave conditions, the barrier geometry and roughness characteristics, and the upland slope. Overtopping rates were calculated using the methods and models listed in Table 14, which follow the FEMA Guidelines and Specifications.

Wave overtopping behavior is determined based on the slope landward of the barrier crest. Where the shoreline geometry is characterized by a low-crested bluff or structure backed by a positively-sloping, nearly level upland, the Plateau Method was applied to calculate an adjusted runup elevation and the inland extent of runup. Where the shoreline geometry is characterized by a negative slope landward of the barrier crest, the overtopping water will result in sheet flow on the negative slope and may propagate until it reaches another flooding source or ponding area.

Table 16: Coastal Transect Parameters

Flooding Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance ^{1,2}		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)					1% Annual Chance Total Water Elevation ³ (ft NAVD88)
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance ³	0.2% Annual Chance	
Lake Michigan	01	N/A	N/A	581.9	582.1	582.3	582.4	582.5	587.7
Lake Michigan	02	N/A	N/A	581.9	582.2	582.4	582.5	582.6	586.8
Lake Michigan	03	N/A	N/A	582.0	582.2	582.4	582.5	582.6	588.8
Lake Michigan	04	N/A	N/A	582.1	582.3	582.4	582.5	582.6	589.4
Lake Michigan	05	N/A	N/A	582.0	582.2	582.4	582.4	582.5	590.7
Lake Michigan	06	N/A	N/A	582.0	582.2	582.3	582.4	582.5	591.2
Lake Michigan	07	N/A	N/A	582.0	582.3	582.4	582.5	582.6	586.4
Lake Michigan	08	N/A	N/A	582.1	582.3	582.4	582.5	582.6	590.5
Lake Michigan	09	N/A	N/A	581.9	582.2	582.3	582.4	582.6	614.8†

¹Wave data provided for WHAFIS-dominant transects only. The 1-percent starting wave parameters are not applicable for runup transects since a response-based approach is utilized.

²Wave data correspond to the 1-percent-annual-chance floodplain but may not be directly associated with the 1-percent-annual-chance SWEL.

³Includes wave action representative of 1% Total Water Level (for wave runup and overtopping) or 1% Wave Crest Elevation (for overland wave propagation).

†Reported 1% Total Water Elevation corresponds to the raw potential runup and not the capped runup or adjusted plateau runup value.

*Not calculated for this Flood Risk Project

Table 16: Coastal Transect Parameters (continued)

Flooding Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance ^{1,2}		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)					1% Annual Chance Total Water Elevation ³ (ft NAVD88)
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance ³	0.2% Annual Chance	
Lake Michigan	10	N/A	N/A	582.0	582.2	582.4	582.4	582.5	589.8
Lake Michigan	11	N/A	N/A	582.1	582.3	582.5	582.6	582.7	585.6
Lake Michigan	12	N/A	N/A	581.9	582.2	582.4	582.5	582.6	605.4 [†]
Lake Michigan	13	N/A	N/A	582.0	582.3	582.4	582.5	582.6	609.1 [†]
Lake Michigan	14	N/A	N/A	582.0	582.3	582.4	582.5	583.0	601.7 [†]
Lake Michigan	15	N/A	N/A	582.0	582.2	582.4	582.4	582.6	610.4 [†]
Lake Michigan	16	N/A	N/A	582.1	582.3	582.4	582.5	582.6	599.0 [†]
Lake Michigan	17	N/A	N/A	582.0	582.3	582.4	582.5	582.6	605.6 [†]
Lake Michigan	18	N/A	N/A	582.1	582.4	582.5	582.6	582.7	594.2
Lake Michigan	19	N/A	N/A	582.1	582.3	582.4	582.5	582.6	591.3

¹Wave data provided for WHAFIS-dominant transects only. The 1-percent starting wave parameters are not applicable for runup transects since a response-based approach is utilized.

²Wave data correspond to the 1-percent-annual-chance floodplain but may not be directly associated with the 1-percent-annual-chance SWEL.

³Includes wave action representative of 1% Total Water Level (for wave runup and overtopping) or 1% Wave Crest Elevation (for overland wave propagation).

[†]Reported 1% Total Water Elevation corresponds to the raw potential runup and not the capped runup or adjusted plateau runup value.

*Not calculated for this Flood Risk Project

Table 16: Coastal Transect Parameters (continued)

Flooding Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance ^{1,2}		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)					1% Annual Chance Total Water Elevation ³ (ft NAVD88)
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance ³	0.2% Annual Chance	
Lake Michigan	20	N/A	N/A	582.1	582.3	582.5	582.5	582.7	590.6
Lake Michigan	21	N/A	N/A	582.1	582.3	582.5	582.5	582.6	590.5
Lake Michigan	22	N/A	N/A	582.1	582.4	582.5	582.6	582.7	590.9
Lake Michigan	23	N/A	N/A	582.2	582.4	582.5	582.5	582.6	590.1
Lake Michigan	24	N/A	N/A	582.1	582.3	582.5	582.5	582.6	586.9
Lake Michigan	25	N/A	N/A	582.2	582.4	582.5	582.6	582.7	587.6
Lake Michigan	26	N/A	N/A	582.1	582.3	582.5	582.5	582.7	610.1†
Lake Michigan	27	N/A	N/A	582.2	582.4	582.5	582.6	582.7	591.5
Lake Michigan	28	N/A	N/A	582.2	582.4	582.6	582.6	582.7	589.7

¹Wave data provided for WHAFIS-dominant transects only. The 1-percent starting wave parameters are not applicable for runup transects since a response-based approach is utilized.

²Wave data correspond to the 1-percent-annual-chance floodplain but may not be directly associated with the 1-percent-annual-chance SWEL.

³Includes wave action representative of 1% Total Water Level (for wave runup and overtopping) or 1% Wave Crest Elevation (for overland wave propagation).

†Reported 1% Total Water Elevation corresponds to the raw potential runup and not the capped runup or adjusted plateau runup value.

*Not calculated for this Flood Risk Project

Table 16: Coastal Transect Parameters (continued)

Flooding Source	Coastal Transect	Starting Wave Conditions for the 1% Annual Chance ^{1,2}		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations (ft NAVD88)					1% Annual Chance Total Water Elevation ³ (ft NAVD88)
		Significant Wave Height H _s (ft)	Peak Wave Period T _p (sec)	10% Annual Chance	4% Annual Chance	2% Annual Chance	1% Annual Chance ³	0.2% Annual Chance	
Lake Michigan	29	N/A	N/A	582.2	582.4	582.5	582.6	582.7	593.7
Lake Michigan	30	N/A	N/A	582.1	582.4	582.5	582.5	582.6	599.2 [†]

¹Wave data provided for WHAFIS-dominant transects only. The 1-percent starting wave parameters are not applicable for runup transects since a response-based approach is utilized.

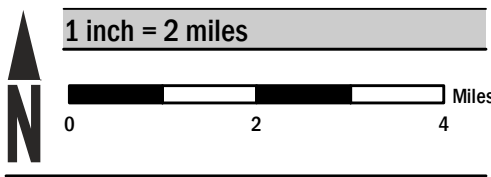
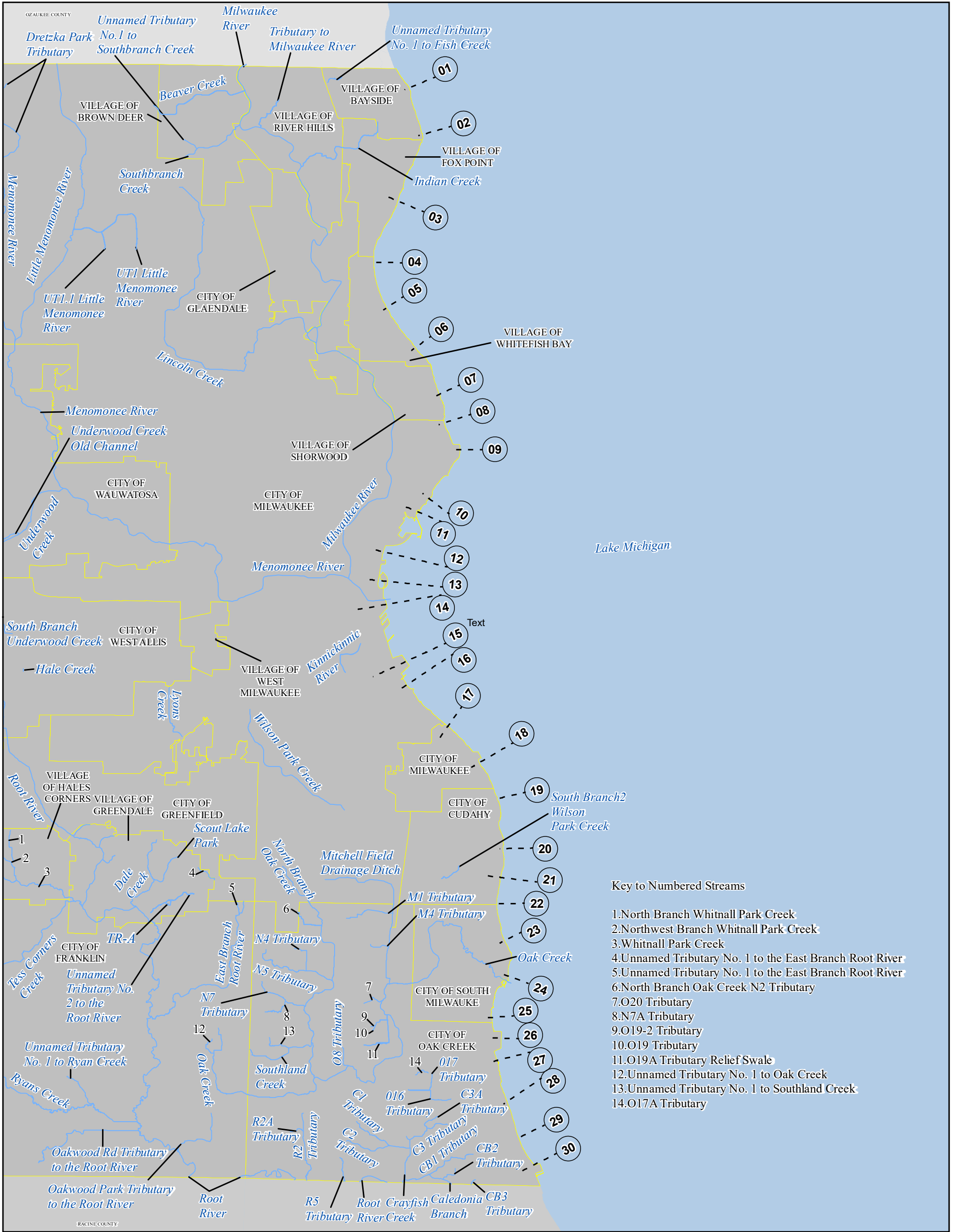
²Wave data correspond to the 1-percent-annual-chance floodplain but may not be directly associated with the 1-percent-annual-chance SWEL.

³Includes wave action representative of 1% Total Water Level (for wave runup and overtopping) or 1% Wave Crest Elevation (for overland wave propagation).

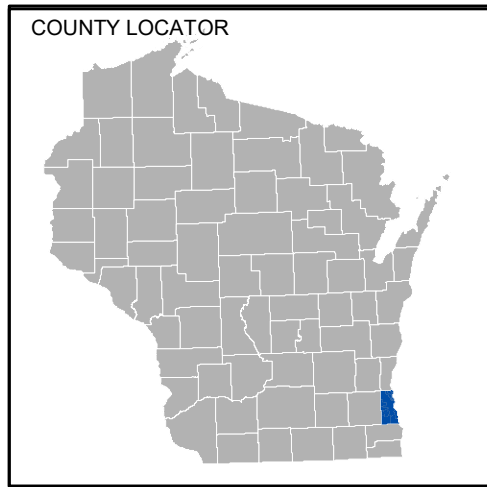
[†]Reported 1% Total Water Elevation corresponds to the raw potential runup and not the capped runup or adjusted plateau runup value.

*Not calculated for this Flood Risk Project

Figure 9: Transect Location Map



Map Projection:
 Universal Transverse Mercator Zone 16N;
 North American Datum 1983



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Transect Locator Map

PANELS WITH TRANSECTS:
 0034, 0042, 0044, 0082, 0092, 0093, 0094, 0103, 0111, 0157,
 0176, 0178, 0179, 0186, 0187, 0188, 0189, 0252



FEMA

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project.

**Table 17: Summary of Alluvial Fan Analyses
[Not Applicable to this Flood Risk Project]**

**Table 18: Results of Alluvial Fan Analyses
[Not Applicable to this Flood Risk Project]**

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

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

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at 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 archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please visit the NGS website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for Milwaukee County are provided in Table 19.

Table 19: Countywide Vertical Datum Conversion

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
Greendale	SE	42.875	87.875	-0.250
Greendale	SW	42.875	88.000	-0.280
Milwaukee	NE	43.125	87.875	-0.280
Milwaukee	NW	43.125	88.000	-0.290
Milwaukee	SE	43.000	87.875	-0.330
Milwaukee	SW	43.000	88.000	-0.290
Average Conversion from NGVD29 to NAVD88 = -0.287 feet				

**Table 20: Stream-Based Vertical Datum Conversion
[Not Applicable to this Flood Risk Project]**

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA’s FIRM Database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA’s *Guidelines and Standards for Flood Risk Analysis and Mapping*, www.fema.gov/flood-maps/guidance-partners/guidelines-standards.

Base map information shown on the FIRM was derived from the sources described in Table 21.

Table 21: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Datum Conversion Points for Milwaukee County, WI	Wisconsin Department of Natural Resources	2019	1:6,000	Spatial and attribute information for vertical datum conversion from NGVD29 to NAVD88 in Milwaukee County, WI (WDNR, 2019c)
Political Boundaries for Milwaukee County, WI	Wisconsin Department of Natural Resources	2019	1:100,000	Spatial and attribute information for political boundaries in Milwaukee County, WI (WDNR, 2019b)

Table 21: Base Map Sources (continued)

Data Type	Data Provider	Data Date	Data Scale	Data Description
Transportation data for Milwaukee County, WI	Wisconsin Department of Natural Resources	2019	1:100,000	Spatial and attribute information for transportation areas in Milwaukee County, downloaded from OpenStreetMap (OSM) Roads. (WDNR, 2019a)
USGS National Map: Orthoimagery for Milwaukee County	US Geological Survey	2020*		Orthorectified digital aerial photographs and satellite images of 1-meter (m) pixel resolution or finer. (USGS, 2020)
Watershed Boundary Dataset (WBD), HUC8 Boundaries	US Geological Survey	2017	1:24,000	Spatial and attribute information for HUC-8 subbasins (NHD, 2017)
Wisconsin County Boundaries	Wisconsin Department of Natural Resources	2020	1:24,000	Spatial and attribute information for Wisconsin county boundaries (WDNR, 2020)
Wisconsin Hydrological Features	Wisconsin Department of Natural Resources	2004	1:24,000	Spatial and attribute information for hydrologic network in Milwaukee County, WI (WDNR, 2004)
Wisconsin PLSS sections from 1:24K Landnet	Wisconsin Department of Natural Resources	1996	1:24,000	Spatial and attribute information for PLSS areas and boundaries (WDNR, 1996)

*Most recently refreshed data

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 22. For each coastal flooding source studied as part of this FIS Report, the mapped floodplain boundaries on the FIRM have been delineated using the flood and wave elevations determined at each transect; between transects, boundaries were delineated using land use and land cover data, the topographic elevation data described in Table 22, and knowledge of coastal flood processes. In ponding areas, flood elevations were determined at each junction of the model; between junctions, boundaries were interpolated using the topographic elevation data described in Table 22.

In cases where the 1-percent 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.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 23, "Floodway Data."

Table 22: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Vertical Accuracy	Horizontal Accuracy	Citation
Bayside, Village of; Brown Deer, Village of; Cudahy, City of; Fox Point, Milwaukee, City of; Village of; River Hills, Village of; West Allis, City of	Indian Creek, Milwaukee River at Milwaukee/Ozaukee County Boundary, South Branch to Wilson Park Creek, Tributary to Milwaukee River, Tributary to South Branch Underwood Creek, UT1 Little Menomonee River, UT1.1 Little Menomonee River	2015 LiDAR Derived Digital Elevation Model for Milwaukee County, Wisconsin.	4.1 cm RMSEz	*	WDNR, 2017
Entire Coastline of Milwaukee County, WI	Lake Michigan	2013 Milwaukee County, WI 5-foot Digital Elevation Model (DEM)	15.0 cm RMSEz	0.5 m RMSE	JALBTCX, 2013
Brown Deer, Village of; Cudahy, City of; Franklin, City of; Glendale, City of; Greenfield, City of; Milwaukee, City of; Oak Creek, City of; River Hills, Village of; Shorewood, Village of; South Milwaukee, City of; Wauwatosa, City of; West Allis, City of	All streams not listed elsewhere in this table	2003 topography with a contour interval of 2 feet	15.0 cm RMSEz	+/- 3 ft at 90% confidence	SEWRPC, 2003

*Data not available

Table 22: Summary of Topographic Elevation Data used in Mapping (continued)

Community	Flooding Source	Source for Topographic Elevation Data			
		Description	Vertical Accuracy	Horizontal Accuracy	Citation
Greendale, Village of	Dale Creek, Root River, Scout Lake Creek, Unnamed Tributary No. 1 to the East Branch Root River, Unnamed Tributaries 2-5 to the Root River	1979 topographic map for the Village of Greendale with a contour interval of 5 feet	46.3 cm RMSEz	+/- 7 ft at 90% confidence	Aerometric, 1979
Milwaukee, City of	Honey Creek, Kinnickinnic River, Little Menomonee River, Lyons Creek, Menomonee River, Wilson Park Creek	1976 topographic maps for the City of Milwaukee with a contour interval of 2 feet	18.5 cm RMSEz	+/- 3 ft at 90% confidence	Abrams, 1976
Hales Corners, Village of	Northwest Branch Whitnall Park Creek, Upper Kelly Lake, Whitnall Park Creek	1976 topographic maps for the Village of Hales Corners with a contour interval of 2 feet	18.5 cm RMSEz	+/- 3 ft at 90% confidence	Aerometric, 1976
Wauwatosa, City of	Honey Creek, Menomonee River	1975 topographic maps for the City of Wauwatosa with scale of 1:4800	*	*	SEWRPC, 1975
West Allis, City of	Hale Creek, Root River, West Branch Root River	1973 topographic map for the City of West Allis with a contour interval of 2 feet	18.5 cm RMSEz	+/- 3 ft at 90% confidence	Alster, 1973

*Data not available

BFEs shown at cross sections on the FIRM represent the 1-percent-annual-chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations.