



# Discovery Report

**Great Lakes Coastal Flood Study**

**Lake Erie**

**Basin-wide Report**

*Report Number 01*

*Draft December 2012*



# FEMA

## **Preface**

The Department of Homeland Security (DHS), Federal Emergency Management Agency's (FEMA's) Risk Mapping, Assessment, and Planning (Risk MAP) program provides States, tribes, and local communities with flood risk information and tools that they can use to increase their resilience to flooding and better protect their citizens. By combining accurate floodplain maps with risk assessment tools and planning and outreach support, Risk MAP has transformed traditional flood mapping efforts into an integrated process of identifying, assessing, communicating, planning for, and mitigating flood-related risks.

This basin-wide Discovery Report provides users with a comprehensive and holistic understanding of historical flood risks, existing coastal data, and current flood mitigation activities in the Lake Erie area. The report includes a summary analysis of the data collected (including information that could influence flood risk decision-making), historical information, existing flood hazard data and information, and mitigation activities. Individual Discovery Reports for each meeting conducted in the project area, as well as data that will be used during the project, can be found in the appendices of this basin-wide report.

This Discovery Report summarizes FEMA's intent to proceed with a Risk MAP coastal flood study project based on available data, collected data, and pre-analysis performed to date.

*Cover photo: Road damage cause by coastal erosion along the Lake Erie shoreline in Ohio. Photo from Ohio Department of Natural Resources Office of Coastal Management.*

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**Project Area Community List for Lake Erie**

This list includes the communities in the Lake Erie Project Area covered by this report for the Great Lakes Coastal Study under consideration for new Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) products and datasets, which may include Flood Insurance Studies (FISs) and Flood Insurance Rate Maps (FIRMs). Not all communities will receive new or updated FEMA Risk MAP products and datasets or FISs and FIRMs.

<b>Monroe County, MI</b>	<b>Wayne County, MI</b>	<b>Ashtabula County, OH</b>
Berlin, Charter Township of	Brownstown, Charter Township of	Ashtabula County (Unincorporated Areas)
Erie, Township of	Dearborn, City of	Ashtabula, City of
Estral Beach, Village of	Detroit, City of	Conneaut, City of
Frenchtown, Charter Township of	Ecorse, City of	Geneva-on-the-Lake, Village of
La Salle, Township of	Flat Rock, City of	North Kingsville, Village of
Luna Pier, City of	Gibraltar, City of	
Monroe, City of	Grosse Ile, Township of	
Monroe, Charter Township of	Lincoln Park, City of	
South Rockwood, Village of	Melvindale, City of	
	Riverview, City of	
	River Rouge, City of	
	Rockwood, City of	
	Southgate, City of	
	Trenton, City of	
	Woodhaven, City of	
	Wyandotte, City of	



## Project Area Community List

<b>Cuyahoga County, OH</b>	<b>Erie County, OH</b>	<b>Lake County, OH</b>
Cuyahoga County (Unincorporated Areas)	Erie County (Unincorporated Areas)	Lake County (Unincorporated Areas)
Bay Village, City of	Bay View, Village of	Eastlake, City of
Bratenahl, Village of	Huron, City of	Fairport Harbor, Village of
Cleveland, City of	Kelleys Island, Village of	Grand River, Village of
Euclid, City of	Sandusky, City of	Lakeline, Village of
Lakewood, City of	Vermilion, City of	Mentor, City of
Rocky River, City of		Mentor-on-the-Lake, City of
		North Perry, Village of
		Timberlake, Village of
		Willoughby, City of
		Willowick, City of
<b>Lorain County, OH</b>	<b>Lucas County, OH</b>	<b>Ottawa County, OH</b>
Lorain County (Unincorporated Areas)	Lucas County (Unincorporated Areas)	Ottawa County (Unincorporated Areas)
Avon Lake, City of	Harbor View, Village of	Marblehead, Village of
Lorain, City of	Oregon, City of	Oak Harbor, Village of
Sheffield Lake, City of	Toledo, City of	Port Clinton, City of
Vermilion, City of		Put-In-Bay, Village of
<b>Sandusky County, OH</b>	<b>Erie County, PA</b>	
Sandusky County (Unincorporated Areas)	Erie, City of	
	Fairview, Township of	
	Girard, Township of	
	Harborcreek, Township of	
	Lake City, Borough of	
	Lawrence Park, Township of	
	Millcreek, Township of	
	North East, Township of	
	Springfield, Township of	

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AAL	Average Annualized Loss
AoMI	Areas of Mitigation Interest
ASFPM	Association of State Floodplain Managers
BFE	Base Flood Elevation
CAC	Community Assistance Contact
CAV	Community Assistance Visit
CBRS	Coastal Barrier Resources System
CEO	Community Elected Official
CIS	Community Information System
CNMS	Coordinated Needs Management Strategy
CO-OP	Center for Operational Oceanographic Products and Services
CRS	Community Rating System
CSLF	Changes Since Last FIRM
DAG	Flood-depth and analysis grid
ERDC	Engineering Research and Data Center
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GIS	Geographic Information System
GLCFS	Great Lakes Coastal Flood Study
Hazus-MH	Multi-Hazard Risk Assessment and Loss Estimation Software Program
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
LiDAR	Light Detection and Ranging
LiMWA	Limit of Moderate Wave Action
LOMC	Letter of Map Change
MDEQ	Michigan Department of Environmental Quality
MLI	Midterm Levee Inventory

MPTA	Mitigation Planning Technical Assistance
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
ODNR	Ohio Department of Natural Resources
PDM	Pre-Disaster Mitigation
RAMPP	Risk Assessment, Mapping, and Planning Partners
RFC	Repetitive Flood Claim
Risk MAP	Risk Mapping, Assessment, and Planning
RSC	Regional Support Center
SFHA	Special Flood Hazard Area
SHARPP	State Hazard Analysis Resource and Planning Portal
SHMO	State Hazard Mitigation Officer
SRL	Severe Repetitive Loss
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WHAFIS	Wave Height Analysis for Flood Insurance Studies



The Federal Emergency Management Agency's (FEMA's) Lake Erie Discovery Report provides users with a comprehensive understanding of historical flood risk, existing coastal data, and current flood mitigation activities within the Lake Erie basin. The report also summarizes FEMA's intent to proceed with a coastal flood hazard study under FEMA's Risk Mapping, Assessment, and Planning (Risk MAP) program and the Great Lakes Coastal Flood Study (GLCFS) project.

The GLCFS is a comprehensive study of coastal flood hazards for all United States shoreline along the Great Lakes Basin, including Lake Erie. The study is being performed by FEMA in cooperation with the U.S. Army Corps of Engineers (USACE), the Association of State Floodplain Managers (ASFPM), and other partners. The GLCFS project will put a wide range of data in the hands of communities along the Great Lakes, including Lake Erie, to promote long-term reduction in flood risk and enhance public safety.

Like all other Risk MAP projects, the GLCFS begins with a Discovery phase. The Discovery process for Lake Erie involved extensive basin-wide data collection and outreach efforts with Lake Erie stakeholders. The Lake Erie stakeholder group includes representatives from FEMA, other Federal agencies, State agencies, local government, and several other technical focus groups. Data collection efforts in the Discovery phase include base map data, coastal data, historic flood data, risk assessment, flood mitigation information, community plans and projects along the shoreline, and other comments based on local knowledge of flood risk. Additionally, certain useful datasets are being developed for use in this study. These datasets include oblique imagery, topography and bathymetry data, shoreline feature dataset to classify shoreline characteristics, a draft transect layout, and a storm surge and wave study, all of which will feed into the coastal flood hazard analysis for Lake Erie.

The GLCFS for Lake Erie will include coastal engineering and mapping for all communities located along the shoreline using the response-based computation approaches outlined in FEMA's draft Guidelines and Specifications for Coastal Studies along the Great Lakes, Appendix D.3 Update, dated May 2012. The coastal flood hazard results will be transferred to workmaps and released to communities for review prior to Flood Insurance Rate Map (FIRM) production. Coastal risk assessment products will be generated for identified Lake Erie coastal communities. These products may include Flood Risk Maps, Flood Risk Reports, Changes Since Last FIRM, Flood Depth and Analysis Grids, Hazus 2010 1-percent exposure, and some additional Great Lakes products that are under consideration.

The Lake Erie Coastal Flood Study may result in delineation of new Special Flood Hazard Areas (SFHAs), designation of Zone VE, and identification of Limits of Moderate Wave Action (LiMWAs) on the FIRM for the first time. Communities participating in the National Flood Insurance Program (NFIP) that will have Zone VE mapped as a result of this study, will be required to adopt floodplain management regulations that meet or exceed the minimum Zone VE NFIP requirements. FEMA does not impose any additional floodplain management requirements based on the LiMWA. The LiMWA is provided to help communicate the higher risk that exists in that area compared to the rest of the Zone AE areas.

In addition to identifying and assessing flood risk along the Great Lakes, the GLCFS project will provide communities with tools and information that encourage identification and implementation of mitigation actions to reduce risk. Mitigation is a critical foundation on which

to reduce loss of life and property by avoiding or reducing the impact of hazard events, and it is an essential part of this coastal flood study process.

As part of this Discovery process, local Hazard Mitigation Plans were reviewed to better understand existing flood risk within the Lake Erie communities, as well as the strategies and actions that have already been developed as part of the local planning processes to mitigate that risk. By first obtaining a better understanding of existing local risk and mitigation actions during this Discovery phase, FEMA intends to begin working with communities to identify new mitigation actions and strengthen existing actions throughout the coastal flood study. In addition, FEMA will seek to identify communities that could benefit from mitigation assistance through partnership with FEMA.

To support the identification and attainment of mitigation actions, as well as local mitigation planning efforts during this coastal flood study, FEMA introduced the Mitigation Action Form and Mitigation Action Tracker to Lake Erie stakeholders during Discovery. The form and tracker demonstrate FEMA's effort to help track and identify local potential Areas of Mitigation Interest (AoMI) and new or improved mitigation actions that could reduce risk.

Ongoing communication and coordination with stakeholders will be an essential part of this Lake Erie coastal flood study. The GLCFS Web site <http://www.greatlakescoast.org> is an excellent resource where stakeholders can obtain up-to-date information about the status of this study, data collection, upcoming meetings, new technical reports, the latest methodologies, fact sheets, and much more. FEMA encourages stakeholders to remain involved and will seek to identify partnership opportunities during the study.

## SECTION ONE INTRODUCTION

The intent of this report is to provide users with a comprehensive and holistic understanding of historical coastal flood risk, existing coastal data, and current activities underway to mitigate coastal flood risk within the Lake Erie basin. In other words, this report can help users discover the current and historic state of the Lake Erie basin as it relates to coastal flood risk and mitigation activities. This report includes a summary of data collected from Lake Erie stakeholders throughout the discovery process, as well as a compilation of Lake Erie long-term issues and trends related to coastal flooding. This document also provides users with information about the intent to move forward with a new coastal flood risk study along the Lake Erie shoreline as part of the Great Lakes Coastal Flood Study (GLCFS) initiative. An updated coastal flood study is needed to obtain a better estimate of coastal flood hazards on Lake Erie.

Lake Erie is the shallowest of the five Great Lakes and warms quickly in summer and freezes over more frequently in winter compared with the other lakes. With its relatively narrow width, Lake Erie is prone to larger surges and seiches at the eastern and western ends than is seen anywhere on the other Great Lakes. In the winter, Lake Erie develops more extensive ice cover than the other Great Lakes.

Historically, flooding along the Lake Erie shoreline is caused by a combination of abnormal stillwater levels and wind-generated waves. Major flooding occurred along Lake Erie in 1972 and 1973 due to record high water levels, resulting from consecutive years of above normal precipitation and accompanied by strong wind. There was extensive damage to residential and commercial structures as well damage many protective structures, such as seawalls, dikes, beaches and dunes, and roads.

Some of the worst recorded flooding damage occurred in Wayne County, Michigan in 1985 when water flowed through gaps in dikes that were built by the USACE under Operation Foresight in 1973 and 1974. In many locations, these dikes were lowered or removed by individual residents in the late 1970s to facilitate access to Lake Erie.

Flooding is more of a problem in the western part of Lake Erie where shoreline topography is flat and gently sloping. Shoreline erosion and bluff recession are the most significant Lake Erie coastal hazards in the eastern part of Lake Erie where the shoreline consists of high bluffs and steeper slopes.

### 1.1 RISK MAP INTRODUCTION

Risk Mapping, Assessment, and Planning (Risk MAP) is a Federal Emergency Management Agency (FEMA) program that provides communities with flood information and tools to use to enhance their mitigation plans and better protect their citizens against flood hazards. Through more accurate flood maps, risk assessment tools, and outreach support, Risk MAP strengthens local communities' ability to make informed decisions about reducing flood risk.

Through collaboration with State, local, and tribal entities, Risk MAP will deliver quality data that increases public awareness and leads to action that reduces risk to life and property. FEMA intends to collaborate with Federal, State, and local stakeholders to achieve the following goals:

- Address gaps in flood hazard data to form a solid foundation for risk assessment and floodplain management.
- Ensure that a measurable increase of the public's awareness and understanding of risk results in a measurable reduction of current and future vulnerability.
- Lead and support States and local and tribal communities to effectively engage in risk-based mitigation planning, resulting in sustainable actions that reduce or eliminate risks to life and property from natural hazards.
- Provide an enhanced digital platform that improves management of Risk MAP, stores information produced by Risk MAP, and improves communication and sharing of risk data and related products to all levels of government and the public.
- Align programs and develop synergies to enhance decision-making capabilities through effective risk communication and management.



## 1.2 GREAT LAKES COASTAL FLOOD STUDY

Through the Risk MAP program and in cooperation with the U.S. Army Corps of Engineers (USACE), the Association of State Floodplain Managers (ASFPM), and other partners, FEMA is conducting a comprehensive study of flood hazards for all United States shoreline along the Great Lakes Basin, including Lake Erie. Figure 1 provides an overview of the Great Lakes Basin. Throughout a Risk MAP project lifecycle, FEMA provides information to enhance local mitigation plans, improve community outreach, and increase local resilience to floods.

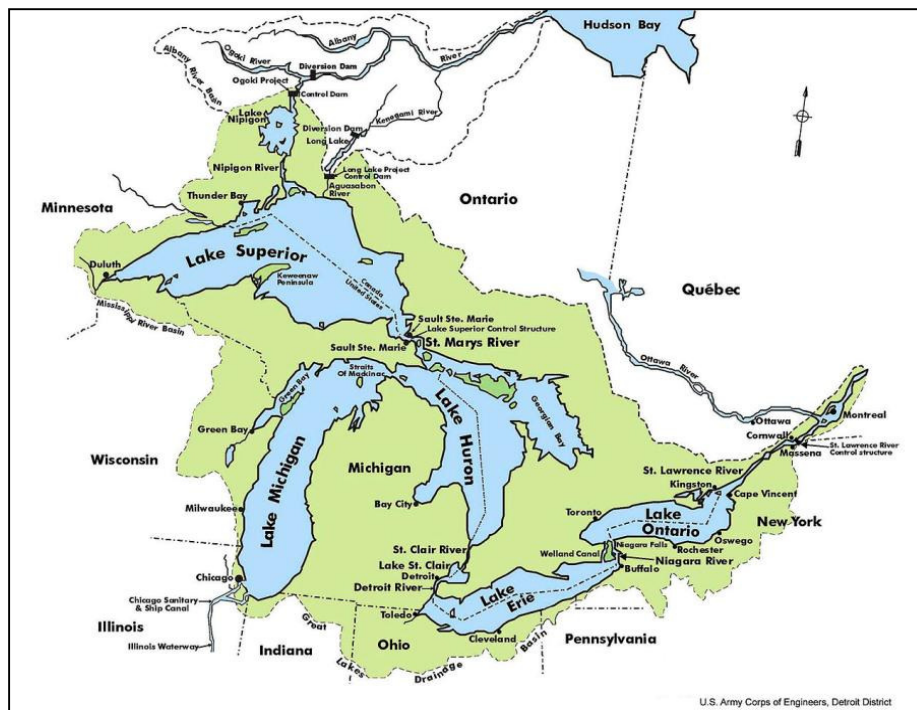


Figure 1: Great Lakes Basin overview

The updated coastal flood study is intended to obtain a better estimate of coastal flood hazards on the Great Lakes, including Lake Erie. Current, effective Flood Insurance Rate Maps (FIRMs) may be outdated due to the age of data and the coastal methodologies used to produce them. Major changes in National Flood Insurance Program (NFIP) policies and methodologies have been implemented since the effective date of many Flood Insurance Studies (FISs) in the area, creating the need for an update that will reflect a more detailed and complete hazard determination.

The GLCFS is a multi-year project that will accomplish the following:

- Provide storm-induced flood elevations based on surge and wave modeling and storm sampling from 50 years of recorded data for water level, meteorological, and ice field conditions
- Deliver updated flood maps and flood risk products in identified communities
- Provide oblique photos, high-resolution bathymetry, geospatial inventory of coastal land features and structures, and other coastal data to advance local, State, and Federal capabilities in public safety, hazard mitigation, and asset management initiatives
- Enhance local planning processes

FEMA manages the NFIP, which is the cornerstone of the national strategy for preparing communities for flood-related disasters. Emulating the NFIP and the Risk MAP program, the GLCFS includes a system-wide solution that provides a comprehensive analysis of storm and high-water events within the Great Lakes Basin. USACE, ASFFPM, State partners, and FEMA

contractors will collaborate to update the coastal methodology and flood maps and to create new flood risk products defined by FEMA's Risk MAP program.

The GLCFS incorporates modern analysis of historic storm and high-water events and provides for updated flood risk information serving United States communities having shoreline along the Great Lakes. The storm surge study is one of the most extensive coastal storm surge analyses to date, encompassing coastal floodplains in the eight States with coastlines on the Great Lakes. The new coastal flood hazard analyses will utilize updated 1-percent-annual-chance (i.e., 100-year) flood elevations obtained from the comprehensive storm surge study being developed by the USACE.

Each Risk MAP project, including the GLCFS, begins with a Discovery phase, which is the intent of this report. Section II of this report provides a Discovery overview.

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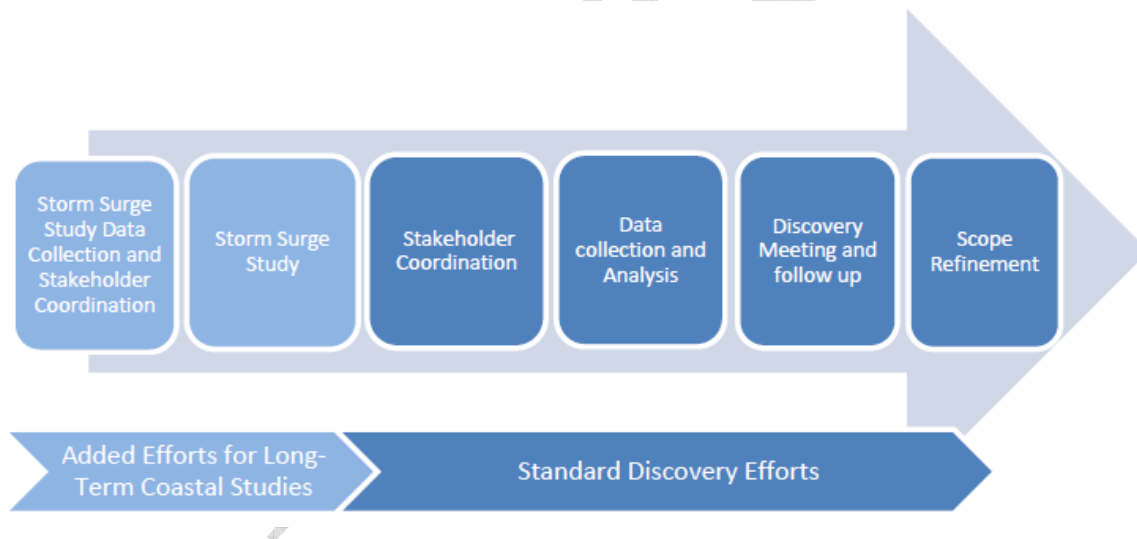


## SECTION TWO DISCOVERY OVERVIEW

Before moving forward with a Risk MAP project, FEMA conducts Discovery. During the Discovery phase, FEMA:

- Gathers information about local flood risks and flood hazards
- Reviews mitigation plans to understand local mitigation capabilities, hazard risk assessments, and current or future mitigation activities
- Supports communities within the project area to develop a vision for the future
- Collects information from communities about their flooding history, development plans, daily operations, and stormwater and floodplain management activities
- Uses information gathered to determine areas that require mapping, risk assessment, or mitigation planning assistance
- Develops a Discovery Map and Report that summarizes and displays the Discovery findings

The Discovery process involves coordinating with stakeholders at many levels, collecting and pre-analyzing data, conducting community interviews, holding a Discovery Meeting with stakeholders or those expected to benefit from the study, and developing potential recommendations that may modify the scope of the Risk MAP project based on an analysis of data and information gathered throughout the Discovery process. Figure 2 provides an overview of the Coastal Discovery Process.



**Figure 2: Coastal Discovery process overview**

### 2.1 PURPOSE OF LAKE ERIE DISCOVERY

The purpose of the Lake Erie Discovery process is to perform basin-wide data collection and outreach efforts that lead to an informed assessment of lake-wide issues and long-term trends, which in turn will contribute to the new coastal analysis, risk assessment, and mitigation strategy being developed for the current and potential future Lake Erie Risk MAP projects. This report

focuses on the Discovery efforts for Lake Erie coastal communities within Monroe and Wayne Counties in Michigan; Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, and Sandusky Counties in Ohio; and Erie County in Pennsylvania. Discovery for Lake Erie coastal communities within Chautauqua and Erie Counties in New York will be completed at a later date. Figure 3 shows the counties included in the Lake Erie basin-wide project area.



**Figure 3: Lake Erie basin-wide project area**

The Lake Erie Discovery process will also help FEMA to better identify the types of datasets and products that will be useful at the local level, especially as the data relates to identifying new mitigation strategies and actions, and for use in local planning efforts. Products that may be available to communities as a result of this Lake Erie flood study include updated FIRMs and FISs, coastal flood risk products, calibrated models for storm surge and wave analysis, and accurate depictions of water level and wave response of the lake occurring during hundreds of actual events. The type of product a community receives during a Risk MAP study depends not only on the coastal flood study analysis results, but also on the type of data (local or national) that is available.

The Lake Erie Discovery process included tabular and spatial data collection, information exchange between governmental levels of stakeholders, cooperative discussion with stakeholders to better understand the Lake Erie area, and a collaborative approach on the project planning. This process has allowed FEMA to continue to vet the Great Lakes coastal study methodologies with a large stakeholder group, to discuss local priorities and data, to discuss mitigation strategies and coastal issues, and to move toward potential projects that will successfully identify the risks associated with Lake Erie flooding.

The results of this Discovery process and next steps for the Lake Erie coastal flood study project are discussed in the remaining sections of this report.

### SECTION THREE STAKEHOLDER COMMUNICATION AND COORDINATION

Communication and coordination with Federal, State, and local stakeholders are key to the success of the GLCFS. Much emphasis has been placed on identifying stakeholders early and often and working with them continually throughout the study process, from Discovery through flood map and flood risk product development. The outreach goals are to increase understanding of the new coastal study methodologies and the tools and processes that will be available for risk-based community planning, and to increase flood hazard awareness within the Great Lakes Coastal Region.

Throughout this Great Lakes Flood Study process, FEMA identifies partnerships with stakeholders. By coordinating with stakeholders to identify local flood hazards, data, and mitigation needs, FEMA can better understand types of flood risk products that may be beneficial to communities as they seek to better protect and inform their citizens against flood hazards. Additional information about the coastal flood risk products that may be available to communities as a result of this study can be found in the individual reports under the “Coastal Flood Risk Products” section in Appendices D-1 (Monroe and Wayne Counties, MI), D-2 (Ashtabula and Lake Counties, OH), D-3 (Cuyahoga County, OH), D-4 (Erie and Lorain Counties, OH), D-5 (Lucas County, OH), D-6 (Ottawa and Sandusky Counties, OH), and D-7 (Erie County, PA) of this report.

#### 3.1 LAKE ERIE STAKEHOLDER COORDINATION FOR DISCOVERY

Meetings, Web meetings, emails, telephone calls, and letters are essential to communicate effectively throughout the life of this Lake Erie Coastal Flood Study project, beginning with Discovery. To kick-off the Discovery process, the Lake Erie Discovery Risk MAP Project Team [FEMA and Risk Assessment, Mapping, and Planning Partners (RAMPP)] identified a group of core stakeholders, including representatives from FEMA Regions II, III, and V as well as ASFPM, USACE, National Oceanic and Atmospheric Administration (NOAA) Sea Grant, FEMA Regional Support Centers (RSCs), U.S. Geological Survey, State NFIP Coordinators, State Hazard Mitigation Officers (SHMOs), State Coastal Managers, and State Engineers. A master list of core stakeholders within the Lake Erie project area is included in Appendix A.

A Pre-Discovery Kickoff Meeting conference call and Web meeting was held with the core stakeholders identified from each State. Core stakeholders were given an opportunity to review the Discovery plan, objectives, draft transect locations, and key outcomes for Lake Erie Discovery with FEMA, provide suggestions for outreach and communication, and raise any concerns related to Lake Erie and the coastal flood study process. The Pre-Discovery Kickoff Meeting presentations and meeting summaries are provided in Appendix B.

Following the kickoff process, outreach, communication, and coordination with local stakeholders were initiated. A list of local stakeholders was developed, including the community elected officials (CEOs), floodplain administrators, planners, engineers, emergency managers, community leaders, regional planning agencies, coastal organizations, and other key stakeholders. Representatives from the local governments—including cities, townships, villages and tribal communities—are considered fundamental stakeholders in this process because they have been elected or appointed to represent the interests of the residents of the project area. Core stakeholders were given an opportunity to review the list of local stakeholders and provide

additional local contacts before invitations were distributed for the Discovery Meeting. A list of all local stakeholders within the project area is included in the individual reports located in Attachment A of Appendix D. FEMA will continuously update this list throughout the life of this project.

Seven Discovery Meetings were held for the Lake Erie project area. Discovery Meeting invitations were sent to local stakeholders within the Lake Erie Coastal Flood Study project area in Monroe and Wayne Counties in Michigan; Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, and Sandusky Counties in Ohio; and Erie County in Pennsylvania. An email invitation was sent to the core stakeholders. An email reminder was also sent one day before the meeting.

The Discovery Meeting letter invitations included a Coastal Data Request Form and Risk MAP Flood Risk Products Fact Sheet, as shown in Appendix C. On the form, communities were asked to provide data that they had available at the local level that could be used during the flood study update and during development of the coastal flood risk products. The Coastal Data Request Form listed requests for information and data, including:

- Base map data
- Coastal data
- Historic flood data
- Risk assessment information
- Flood mitigation information
- Community plans and projects
- Other comments/concerns based on local knowledge

The individual Discovery Reports (one for each Discovery Meeting) are included in Appendix D of this basin-wide report. A summary of the data and information collected through the completed Coastal Data Request Forms can be found in Attachment B within the individual Discovery Reports found in Appendix D.

In addition to the hard-copy letter invitations, and in order to improve the communication and data sharing leading up to the Discovery Meeting, FEMA offered local communities an opportunity to attend pre-Discovery Meeting conference calls, also termed “Information Exchange Sessions.” The Information Exchange conference call information was included in the Discovery invitation letters mailed to local community officials, and an email reminder was sent out as well. The sessions were held to initiate the process of learning about local data availability and critical issues for the communities, and to review the Coastal Data Request Form. Copies of the presentations from the Information Exchange Session conference calls can be found in Attachment A within the individual Discovery Reports (Appendix D).

## SECTION FOUR LAKE ERIE DISCOVERY MEETINGS

The Discovery Meetings for Lake Erie coastal communities and stakeholders were held on the following dates:

- Monroe and Wayne Counties, MI: Thursday, August 9, 2:30–4:30 pm EDT in Woodhaven, MI
- Ashtabula and Lake Counties, OH: Thursday, July 19, 2012, 2:30–4:30 pm EDT in Mentor, OH
- Cuyahoga County, OH: Thursday, August 2, 2012, 9:30–11:30 am EDT in Bay Village, OH
- Erie and Lorain Counties, OH: Wednesday, August 1, 2012, 10:00 am–12:00 pm EDT in Vermilion, OH
- Lucas County, OH: Thursday, August 9, 2012, 9:30–11:30 am EDT in Toledo, OH
- Ottawa and Sandusky Counties, OH: Wednesday, August 1, 2012, 3:00–5:00 pm EDT in Oak Harbor, OH
- Erie County, PA: Wednesday, July 18, 2012, 4:00–6:00 pm EDT in Erie, PA

Communities and stakeholders affected by coastal flooding were invited to the Discovery Meetings. Figure 4 shows the meeting locations. The meetings were strategically divided into three groups so that multiple meetings could take place on consecutive days.

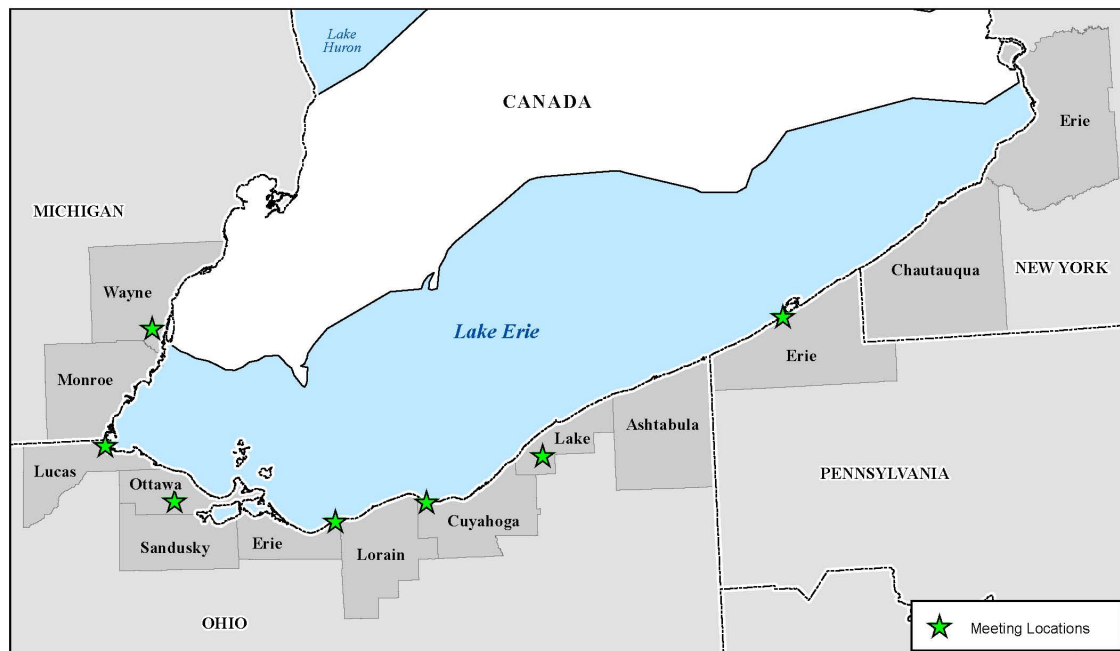


Figure 4: Lake Erie Discovery Meeting locations



Below is a summary of the stakeholders in attendance:

- Attendees included, but were not limited to, planners, engineers, Geographic Information System (GIS) specialists, natural hazard program specialists, educators, building inspectors, and conservation agents.
- Out of the 78 coastal communities included in this study area, 40 were represented at one of the seven Discovery Meetings. A total of 74 community officials attended, including multiple representatives from a single community in some cases. There were 161 total attendees at the seven Discovery Meetings.
- In total, 39 percent of the attendees were community officials, 21 percent were county officials, 11 percent were local engineering firms, 8 percent were State officials, 7 percent were from the academic community, 7 percent were community members and associations, and 7 percent were from the Air National Guard.

Sign-in sheets for each meeting can be found within the individual Discovery Reports in Appendix D.

The objectives of the Discovery Meetings included:

- Continuation and expansion of stakeholder engagement
- Discussion of data inputs from Federal, State, and local stakeholders
- Identification of local coastal flood hazard needs and areas of concern
- Identification of flood risk products and datasets that best advance coastal mitigation action
- NFIP regulatory updates
- Discovery schedule and deliverables

The Discovery Meeting presentations included the following information:

- An overview of the Great Lakes Coastal Flood Study and schedule
- Review of the Discovery process and outcomes
- Discussion of coastal mapping and flood risk topics
- Discussion of how the study may affect the communities, including compliance requirements
- Review of hazard mitigation opportunities and grant funding
- Encouragement and facilitation of discussion regarding coastal study needs, mitigation project needs, desired compliance support, and local flood risk awareness efforts



Attendees review draft Discovery Maps at the Ottawa and Sandusky County, OH Meeting



Draft Discovery Maps (found in Attachment C within the individual reports in Appendix D) were displayed and used during the meetings to encourage discussion regarding areas of coastal flood risk concern and Areas of Mitigation Interest (AoMI). The draft Discovery Maps shown at the meetings included geospatial and tabular data that had been collected before the meetings, such as:

### Geospatial Data:

- Average Annualized Loss (AAL) data
- Coastal Barrier Resources System (CBRS)<sup>1</sup>
- Coastal structures
- Coordinated Needs Management Strategy (CNMS) data<sup>2</sup>
- Dams
- Effective Special Flood Hazard Areas (SFHAs)
- Jurisdictional boundaries
- Letters of Map Change (LOMCs)
- Levees
- Ports
- Proposed transect locations
- Shoreline
- Streams
- U.S. Geological Survey (USGS) gages
- Watershed boundaries

### Tabular Data:

- Declared disasters
- Flood insurance data
- Potential mitigation actions (from local hazard mitigation plans)

Attendees were provided with markers, highlighters, and pens and were asked to cooperatively identify areas of concern and AoMIs within the Lake Erie study area by writing comments on the draft Discovery Maps (Attachment C within Appendix D) and through general discussion during the meeting. Copies of FEMA's Mitigation Action Form were provided to meeting participants to help facilitate discussion and identification of areas of concern and hazards.

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<sup>1</sup>The CBRS consists of the undeveloped coastal barriers and other areas located on the coasts of the United States that are identified and generally depicted on a series of maps. CBRS areas are ineligible for most new Federal expenditures and financial assistance.

<sup>2</sup>CNMS is FEMA's strategy for coordinating the management of mapping needs using modern geospatial technologies and current policies, requirements, and procedures. CNMS makes information related to mapping needs readily accessible and more usable. CNMS is only for riverine studies at this time.

Participants at the Discovery Meetings held in the State of Ohio were provided with an Ohio Department of Natural Resources (ODNR) Community Risk MAP Form as another tool to promote discussion on local hazards and needs. Ohio Discovery participants were also introduced to the State Hazard Analysis Resource and Planning Portal (SHARPP), which is sponsored by the Ohio Emergency Management Agency. SHARPP provides Ohio's communities with a means to communicate and map AoMIs and help identify potential mitigation projects.

In addition to the draft Discovery Maps, figures showing the location of initially proposed transects around Lake Erie were presented during the Discovery Meeting. Transects are profiles along which coastal flooding analysis is performed. They are used to transform offshore conditions to the shoreline and to define coastal flood risks inland of the shoreline. Transects are placed to define representative profiles for a shoreline reach. The transect GIS layer was available for viewing within a mapping software application immediately after the meeting. Stakeholders were encouraged to review the proposed transects and provide comments on their location. The proposed transect maps that were available at the Discovery Meeting can be found within meeting presentation slides found in Attachment D of the individual reports located in Appendix D. A sample map of proposed transect layout presented at the Discovery Meeting is shown in Figure 5.

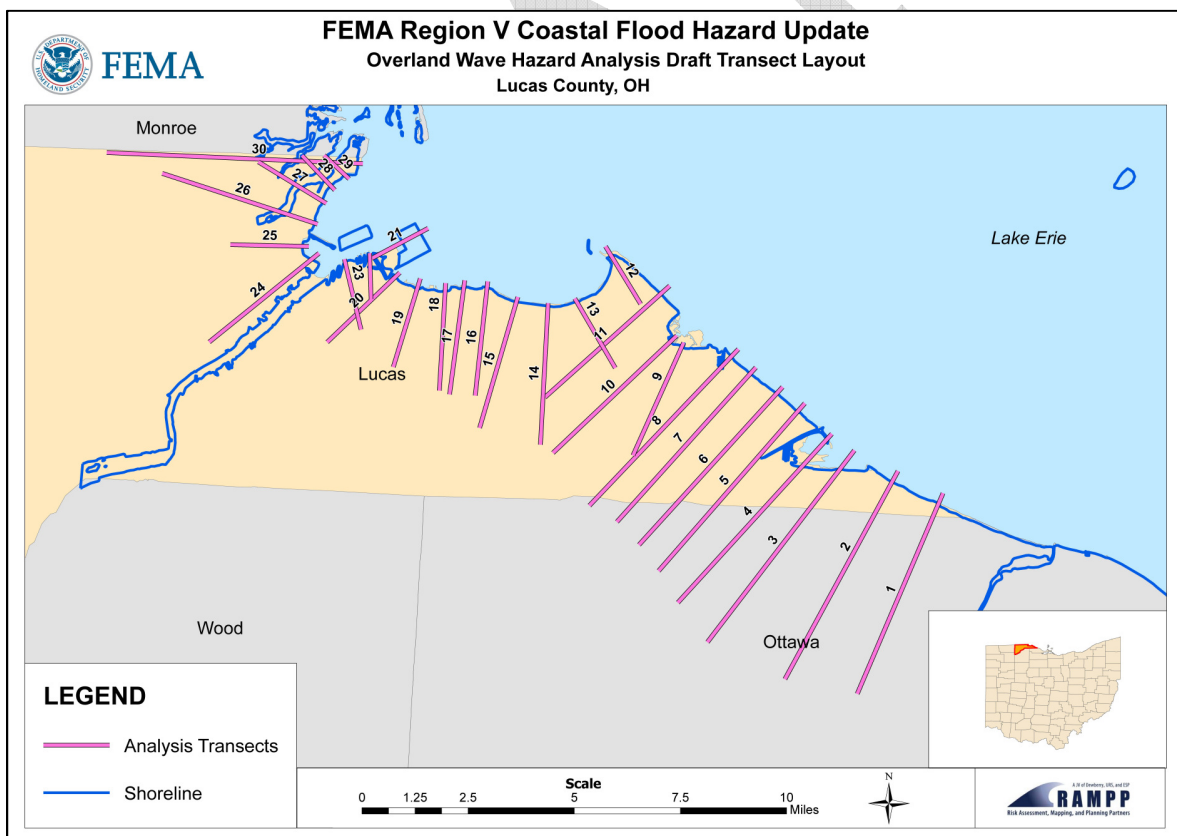


Figure 5: Sample proposed transect layout

The comments that were provided during the meetings on the draft Discovery Maps and transect figures have been compiled into geospatial layers and associated tables. A summary and analysis of the comments collected can be found in the individual Discovery Reports located in Appendix D.

Discovery Meeting documents – including meeting summaries, sign-in sheets, presentations, coastal data request forms, and meeting evaluation forms documentation – are included in the attachments for each individual Discovery Report in Appendix D.

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**SECTION FIVE SUMMARY OF DATA**

This section summarizes the data and information collected for Lake Erie during this Discovery process. A massive effort of collecting tabular and spatial data was conducted for all the coastal communities from Federal, State, and local sources. In addition, information was collected through Information Exchange Session conference calls, phone conversations, the Discovery Meetings, and the Discovery Coastal Data Request forms sent to each coastal community. Table 1 is a comprehensive list of the types of data collected for this study.

**Table 1: Data Collected for Lake Erie Discovery**

<b>Data Type</b>	<b>Deliverable/Product</b>	<b>Source</b>	<b>Date of Data Collection</b>	<b>Level</b>
Average Annualized Loss Data	Discovery Map	Federal Emergency Management Agency (FEMA)	April 2011	Nationwide
Census Blocks	Discovery Map	U.S. Census Bureau	December 2011	Countywide
Coastal Data Request Form	Discovery Report	Community and County Stakeholders	July/August 2012	Countywide
Contacts	Discovery Report	Local Community Web Sites, State/FEMA Updates	December 2011	Countywide
Community Assistance Visits	Discovery Report	FEMA Community Information System (CIS), Ohio Department of Natural Resources (ODNR)	December 2011	Countywide
Community Rating System	Discovery Report	FEMA's "Community Rating System Communities and Their Classes"	December 2011	Nationwide
Comprehensive Plans	Discovery Report	Local Community Web Sites	December 2011	Countywide
Coastal Barrier Resources System	Discovery Map	U.S. Fish and Wildlife Service	November 2011	Nationwide
Coastal Construction	Discovery Map	U.S. Army Corps of Engineers (USACE)	July 2012	Nationwide
Coastal Structures	Discovery Map	USACE	August 2012	Nationwide
Coordinated Needs Management Strategy	Discovery Map	FEMA	July 2012	Countywide
Critically Eroded Beach Areas	Discovery Report	ODNR, Michigan Department of Environmental Quality	December 2011, April 2012	Countywide
Critical Facilities	Discovery Report	Local Mitigation Plan, Discovery Meeting	April, July, and August 2012	Countywide
Dams	Discovery Map	USACE, National Inventory of Dams, Flood Insurance Rate Map (FIRM) Database	April 2012	Countywide

## Summary of Data

Data Type	Deliverable/Product	Source	Date of Data Collection	Level
Declared Disasters	Discovery Report	FEMA's "Disaster Declarations Summary"	April 2012	Nationwide
Demographics, Industry	Discovery Report	U.S. Census Bureau, Local Mitigation Plans	April 2012	Countywide
Effective Floodplains	Discovery Map	FEMA Map Service Center and Mapping Information Platform	April 2012	Countywide
Flood Insurance Policies	Discovery Report	FEMA CIS	April 2012	Nationwide
Hazard Mitigation Plans and Status	Discovery Report	Local Mitigation Plans	April 2012	Countywide
Hazard Mitigation Assistance Program Grants Received	Discovery Report	FEMA's "Hazard Mitigation Program Summary" Community Input	April 2012	Nationwide
Hazard Mitigation Projects	Discovery Report	Local Mitigation Plans, Ohio EMA, SHARPP	May 2012	Countywide
High Water Marks	Discovery Report	U.S. Geological Survey (USGS)	July 2012	Countywide
Historical Flooding & Storm Events	Discovery Report	Effective Flood Insurance Study (FIS), Local Mitigation Plans	April 2012	Countywide
Individual/Public Assistance	Discovery Report/ Tabular Data	FEMA's "Public Assistance Subgrantee Summary"	April 2012	Nationwide
Letters of Map Change	Discovery Report	FEMA's Mapping Information Platform	April 2012	Countywide
Meteorological Gages	Discovery Map	National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory	April 2012	Region-wide
Mid-term Levee Inventory (MLI)	Discovery Report	MLI Database	November 2011	Nationwide
Ordinances	Discovery Report	Local Community Web Sites, ODNr	April 2012	Countywide
Repetitive Loss	Discovery Report	FEMA CIS	April 2012	Countywide
Shoreline Classification	Discovery Map	USACE	July 2012	Region-wide
Stream Gages	Discovery Map	USGS	April 2012	Countywide
Water Level Gages	Discovery Map	NOAA, Canadian Department of Fisheries and Oceans	April 2012	Region-wide
Wave Gages	Discovery Map	NOAA	April 2012	Region-wide

Information collected for each county along Lake Erie was compiled into individual Discovery Reports, which can be found in Appendix D of this report. The data in the individual reports is divided into two sections: one section contains the data that can be used for Risk MAP products, and the other section contains the information that helped the study team to form a better understanding of the Lake Erie Project Area as they moved forward with the Great Lakes Coastal Flood Study.

A list of local data and information collected from local stakeholders as part of this Discovery process using the Coastal Data Request Form (Appendix C) is summarized in Table 2 for Lake Erie.

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Table 2: Coastal Data Request Form Data Compilation

Community	County	State	Name	Base Map / Coastal Data	Other Data	Hazard Mitigation Plans	Coastal Mitigation Projects	Flooding Information (Historic and Current)	Grant History	Ability to implement mitigation actions and communicate to citizens	Community Plans and Projects	Comments / Concerns
Lakewood, City of	Cuyahoga	OH	Joe Beno, Public Works Director	none	none	none	Lakewood Park NW corner behind St. Augustine's	none	none	low	Planning Commission Sloane Condo Project- planned development	none
Rocky River, City of	Cuyahoga	OH	Ron Gottschalk, Inspector	none	none	none	none	none	Money given for debris clean up and police/fire (2007)	medium	FPA not available to participate in survey, so not sure.	none
Erie County	Erie	OH	Completed by various agencies	Digital topography and property information	Other digital relevant data	Yes, it is currently being updated. The plan states that FIRMs should be updated. Since that time, Erie County's FIRMs have been updated and became effective August 2008. Also, the plan notes that additional monitoring of water levels in streams and rivers should be provided with stream gauges and personnel. Since then, three gauges have been placed in Mills Creek, Pipe Creek, and Sawmill as well as a USGS gauge station on Old Woman Creek near Berlin Rd to develop flow rating curves for watersheds.	none	Post Disaster Recovery. Erie County's EMA assists residents during flooding events and coordinates with the County Sheriff's Office and local law enforcement agencies, County Engineers Office, Regional Planning, and Soil and Water Office. Planned developments in FP are required to meet FP regulations. Planned developments typically proceed through Regional Planning Commission's Committee process for review and approval.	none	medium	Comprehensive plan- not coordinated w/hazard mitigation plan, completed in 1995 and needs update. Plan refers to coastal barrier resource system (CBRA) and development proposals in the CBRA must be coordinated with the office of US Fish & Wildlife Service. Erie Regional Planning Commission is administered out of Erie Regional Planning and it serves as the umbrella agency for county planning. Floodplain- Flood damage regulations Resolution 2008-304. Existing zoning building codes. Watershed Action Plan calls for wetland and riparian setbacks to maintain ecosystem for hazard mitigation and review of zoning codes in phase 2 communities currently underway. County EMA working on flood mitigation plan for pipe Creek watershed.	Note 1: 2' Contour Maps forwarded via email with this form. Other Digital data indicated available on p.2 can be downloaded from the Erie County Auditors Website at <a href="http://downloads.ddti.net/ErieOH">http://downloads.ddti.net/ErieOH</a> . **Note 2: Southwest portion of County (Groton Township) has experienced karst flooding. ***Note 3: This questionnaire was completed by the following agencies and contact information for each agency provided as an attachment: -Erie County Emergency Management Agency -Erie County Soil & Water Conservation District -Erie County Engineers Office -Erie County Regional Planning Department.
Huron, City of	Erie	OH	Steve Osterlina, Fire Chief	none	none	none	none	none	none	n/a	none	none
Perkins, Township of	Erie	OH	Eric Dodrill, Highway Superintendent	Available on county level	none	Yes, currently being updated.	none	Erie County FP management coordinates floodplain management programs	none	medium	Comprehensive plan coordinated with the hazard mitigation plan. Zoning / Building FP Management through regional planning (Erie County) Development / Redevelopment of a small area outside coastal area	Perkins Township has very small area at northeast corner of township near Sandusky Bay. Protected area by metroparks & Ohio DNR - minimal exposure to coastal processes.
Vermilion, Township of	Erie	OH	Richard Simon, Zoning Inspector	none	none	none	none	none	none	n/a	Comprehensive plan	none

Community	County	State	Name	Base Map / Coastal Data	Other Data	Hazard Mitigation Plans	Coastal Mitigation Projects	Flooding Information (Historic and Current)	Grant History	Ability to implement mitigation actions and communicate to citizens	Community Plans and Projects	Comments / Concerns
Avon Lake, City of	Lorain	OH	Joseph Reitz, Engineering Manager	Hard Copy of: Coastal structures, Coastal features, Shoreline change, Location of beach restoration, Area of high erosion, Mean high water, Mean lake level	none	none	none	When planned unit developments are proposed, the FP are considered	none	medium	Planning Commission reviews plans and offers recommendations. New culvert- city applying for a map revision	How does the City become involved in the review of shoreline structures such as boat houses, patio's and rec rooms on submerged land lease areas that would be impacted by coastal flooding?
Lucas County	Lucas	OH	Robert A. Neubert, CET/CST, CFM, Drainage Technician	not provided	not provided	not provided	none	none	not provided	medium	Community has planning staff available in support of community floodplain management programs including TMACOG, stormwater management, and standards manual. No Comprehensive Plan or Coastal Zone Management Plan.	none
Erie Township	Monroe	MI	Michael Demski, Building Official	none	none	Adopted Hazard Mitigation Plan	none	none	Home elevation grants	medium	No Comprehensive Plan. Planning for open space and building/floodplain code enforcement.	none
Estral Beach, Village of	Monroe	MI	Danny Swindle, President & Ed Dyson, Dike Coordinator	Digital Coastal structures	Digital Hydraulic structures	Monroe County tasked with preparation - status unknown	none	Flood on 3/22/52 and 4/9/73 USACE installed "Operation Foresight" structures in 1973 USACE installed "Advanced Measures" structures in 1986	Had about 14 homes elevated from FEMA grant (2008-2010). Application pending approval to elevate 3 repetitive flood claim homes. Applied for Grant to elevate 3 repetitive flood claim homes- still awaiting as 7/27/12	low	Comprehensive plan. Use of ordinances contributing to effective administration of FP zoning.	none
Monroe County	Monroe	MI	Jeffery S. Boudrie, GIS Specialist	Digital topography and hard copy of property information (building footprints available after October 2012)	none	none	none	Experience with coastal flood disasters and flood disaster recovery	none	high	Comprehensive plan with special consideration for coastal areas and a coastal zone management plan. The Monroe County Planning Commission does not have direct oversight of FP, but acts as an advisory board for zoning/planning efforts by local communities.	none

Community	County	State	Name	Base Map / Coastal Data	Other Data	Hazard Mitigation Plans	Coastal Mitigation Projects	Flooding Information (Historic and Current)	Grant History	Ability to implement mitigation actions and communicate to citizens	Community Plans and Projects	Comments / Concerns
Sandusky County	Sandusky	OH	Chris Mock, Director & Lisa Heyman, Assistant Director	Digital topography available via Regional Planning	none	Yes, it is planned for updates in 2015.	Proactive mitigation-flood wall built in Fremont on the Sandusky River	none	Woodville Village repetitive flooding on residential homes. Mitigation Grant turned down, cost-benefit analysis did not meet guidelines Snow Declaration- public Flooding- public Tornado- public 2005 - Mitigation Grant for writing plan	medium	Comprehensive plan coordinated with the hazard mitigation plan. Regional Planning has coastal zone management plan and other planning/project information.	none
Huron-Clinton Metroparks	Wayne	MI	Michael Arens, Engineer	Hard Copy of : Property Information (after July 27, but did not specify when)	Hard Copy of: Hydraulic Structures (after July 27, but did not specify when)	none	none	none	none	N/A - not community	Comprehensive plan. Open space preservation and recreation plan also.	none
Rockwood, City of	Wayne	MI	Cindy Trombley, City Administrator	none	none	none	none	none	none	(blank)	none	none
Wyandotte, City of	Wayne	MI	Mark Kowalewski, City Engineer	none	none	(blank)	none	none	(blank)	high	Has planning staff, but did not specify what they do.	none
Trenton, City of	Wayne	MI	Paul L. Haley Emergency Management Coordinator Trenton, MI 48183 734.777.6670 phaley@trenton-mi.com	not provided	not provided	not provided	not provided	not provided	not provided	not provided	not provided	Provided copy of Wayne County Hazard Mitigation Plan
Erie County	Erie	PA	Dale Robinson, Emergency Management Coordinator	none	none	Adopted on June 11, 2012, however not every community has adopted the plan yet	none	June 30, 2009 - Experienced flash flooding to the north and south of I-90. Approximately four inches of rain fell in one hour	Presque Isle Mitigation Project	low	(blank)	(blank)
North Kingsville, Village of	Ashtabula	OH	Thomas Peters, Zoning	hard copies	hard copies	Yes	none	none	none	medium	none	(blank)
Mentor, City of	Ashtabula	OH	James Decker, FPA	Hard copy of coastal structures	(blank)	At County level	none	none	Applied for HMAG but did not receive grant (July 2006 Flood)	high	Yes Steep Slope Stream Valley Protection Balanced Growth Mentor Marsh Special Area Management Plan	(blank)

Community	County	State	Name	Base Map / Coastal Data	Other Data	Hazard Mitigation Plans	Coastal Mitigation Projects	Flooding Information (Historic and Current)	Grant History	Ability to implement mitigation actions and communicate to citizens	Community Plans and Projects	Comments / Concerns
ODNR	N/A	OH	Steve Lewis, GIS Database Administrator	Digital topo PDFs of permits jetties/levees Beach Nourishment permits	Digital hazards - Ohio Division of Soil and Water Resources	(blank)	(blank)	(blank)	(blank)	(blank)	(blank)	(blank)

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As the Risk MAP project for Lake Erie advances, FEMA will continue to work with local officials to determine partnerships that may be formed based on local community or county-based data that have been identified as already available through this Discovery process. Available datasets may be used to create certain flood risk products or to help initiate mitigation projects on a community-to-community basis.

### 5.1 NEW DATA FOR LAKE ERIE

In addition to data collected from local, State, and Federal sources, several new datasets were developed specifically as part of the overall GLCFS effort, and include the Lake Erie project area. These datasets are summarized in the sections below.

#### 5.1.1 Oblique Imagery

As part of the GLCFS, the USACE collected oblique imagery along Lake Erie in 2012. Oblique imagery is captured at an angle, as compared to an overhead view such as that provided by an orthophoto, and allows users a 3-dimensional view of landscape, buildings, and other features. This dataset may be useful to communities during emergency response; planning; identification of shoreline types and obstructions; and management of assets, critical facilities, and public properties along the Lake Erie shoreline. The oblique imagery is currently available via a Web-based browser at <http://greatlakes.usace.army.mil/>.

#### 5.1.2 Topography and Bathymetry

As part of the GLCFS, Light Detection and Ranging (LiDAR) was collected by the USACE to develop topographic and bathymetric data along the Lake Erie shoreline.

The topographic data is expected to become available during the spring of 2013 for this study area. There is a delay in the schedule to collect new bathymetric data; therefore, existing bathymetric data and new topographic data may be used for the transect-based coastal flood hazard analysis as well as the mapping of the coastal flood risks. Existing high-resolution bathymetric and topographic data is currently available at <http://csc.noaa.gov>.

#### 5.1.3 Shoreline Feature Dataset

The shoreline feature dataset was generated by the USACE Detroit District (U.S. Army Corps of Engineers, 2012) using 2012 oblique photographs. The dataset captures primary and secondary shoreline types, land uses, coverage, and vegetation types along the entire Great Lakes shoreline, including Lake Erie. The dataset includes identification of “artificial” shoreline, which may be indicative of local coastal flood protection structures. This dataset does not identify the level of protection of any coastal structures, and does not validate whether a coastal structure exists. The current dataset contains data at one-mile spacing. The dataset does not include field-based reconnaissance or sediment/subsurface soil collection.

The dataset (Great Lakes Shoreline Geodatabase) can be downloaded from <http://www.greatlakescoast.org/> under the “Technical Resources” section. Figure 6 and Figure 7 show the shoreline materials identified along Lake Erie.

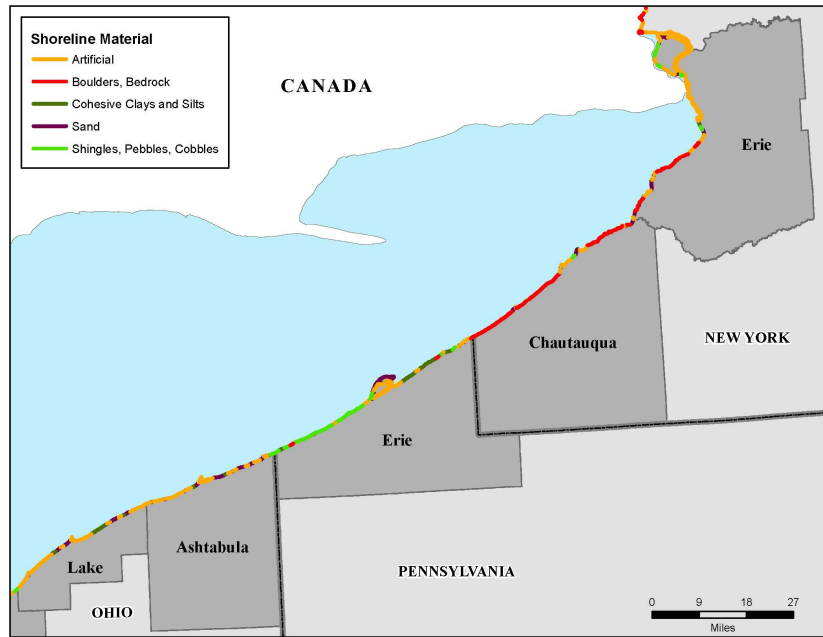


Figure 6: Shoreline materials for eastern part of Lake Erie

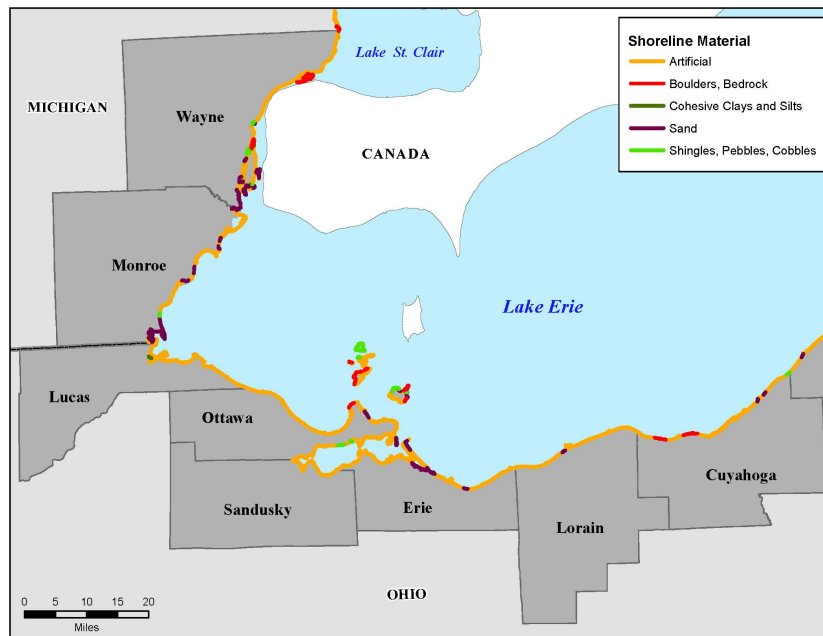


Figure 7: Shoreline materials for western part of Lake Erie



### 5.1.4 Proposed Transects

For Lake Erie, proposed transects were placed in advance of the Discovery Meetings and were provided to core and local stakeholders for review and comment. The proposed transects were revised to incorporate comments captured throughout the Discovery process. The revised proposed transects can be seen on the Final Discovery Maps, located in Attachment C of the individual Discovery Reports (Appendix D). These transects are subject to change based on the future coastal analysis and should not be considered final or be used for regulatory purposes at this time.

The final transect layout for a coastal hazards analysis and subsequent floodplain delineation is determined by physical factors such as changes in topography, bathymetry, shoreline orientation, and land cover data, in addition to societal factors such as variations in development and density. These physical factors will be re-examined after Discovery to assure final transect locations are appropriately placed.

### 5.1.5 Storm Surge and Wave Study

Lake level and wave climate data are necessary to identify the coastal flood risks. Since there are few observations of lake levels and waves within Lake Erie, the USACE modeled historical events (a process known as hindcasting). The hindcasted lake level and wave models are driven by wind and pressure fields on a grid defined by available bathymetric data. The resultant model outputs are available on a gridded basis within Lake Erie. Additional information can be found at <http://www.greatlakescoast.org/> under the “Technical Resources” section.

### SECTION SIX LAKE-WIDE ISSUES AND LONG-TERM TRENDS

Lake Erie is a freshwater lake that borders the States of Michigan, Ohio, Pennsylvania, and New York, as well as Canada to the north. Lake Erie is the eleventh largest lake in the world by surface area. Among the Great Lakes, it is the fourth largest in surface area, with the smallest volume. The lake is 241 miles long and 57 miles wide. The surface area is close to 10,000 square miles. As the shallowest of the five lakes, Lake Erie warms quickly in summer and freezes over more frequently in winter compared with the other lakes. With its relatively narrow width, the lake is prone to larger surges and seiches at the eastern and western ends than is seen anywhere on the other Great Lakes. Ninety-five percent of Lake Erie's total inflow is supplied through the Detroit River from the upper lakes. Lake Erie outflows into Lake Ontario through the Niagara River and the Welland Canal. In the winter, Lake Erie develops more extensive ice cover than the other Great Lakes.

#### 6.1 WATER LEVELS

The long-term water levels in Lake Erie vary on both annual and seasonal scales. Water levels in the Great Lakes are influenced by natural evaporation/precipitation cycles, which vary both seasonally and on longer inter-annual time scales. Longer water level cycles may include extended periods of drought or high precipitation and are affected by the El Niño and La Niña cycles. Seasonal variations are due to typical annual cycles such as light/heavy rainfall and snowmelt, and can be of similar magnitude as event-scale surges. Anthropogenic impacts, such as water usage, dredging, and flow modification, have increased over the last century.

Short-term lake level variation occurs due to surge induced by high winds and moving pressure systems over the lake during storms. The historical water level data shows that storm surge of 9 feet has occurred in some locations on the eastern end of the lake where the fetch is the longest.

The mean water level change in a single calendar year for Lake Erie could reach 3 feet in some instances, with a change of more than 2 feet within 3 months. At many gauge locations, monthly mean water levels can change more than 1.5 feet in a single month. Seasonal water level variations can be attributed to evaporation/precipitation cycles (FEMA, 2009). The highest mean water levels typically occur in June and July, and the lowest in December through February. The inter-annual variations are larger than the seasonal changes.

NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) maintains several water level stations along Lake Erie. CO-OPS' primary motivation is the collection and dissemination of high quality and accurate measurements of lake level for scientific studies. Table 3 lists the water level stations along Lake Erie.

**Table 3: Lake Erie Water Level Stations**

<b>Station Number</b>	<b>Station</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Hourly Records</b>	<b>6-minute Records</b>
9063012	Niagara Intake, NY	43.08 N	79.01 W	01/1970 - present	06/2002 - present
9063020	Buffalo, NY	42.88 N	78.89 W	01/1970 - present	01/1994 - present
9063028	Sturgeon Point, NY	42.69 N	79.05 W	01/1970 - present	02/1992 - present
9063038	Erie, PA	42.15 N	80.09 W	01/1970 - present	08/2000 - present
9063053	Fairport, OH	41.76 N	81.28 W	06/1975 - present	09/1996 - present
9063063	Cleveland, OH	41.54 N	81.64 W	01/1970 - present	08/1996 - present
9063079	Marblehead, OH	41.54 N	82.73 W	01/1970 - present	08/2000 - present
9063085	Toledo, OH	41.69 N	83.47 W	01/1970 - present	08/1996 - present
9063090	Fermi Power Plant, MI	41.96 N	83.26 W	01/1970 - present	08/1996 - present
9044020	Gibraltar, MI	42.09 N	83.19 W	01/1970 - present	01/1994 - present
9044030	Wyandotte, MI	42.20 N	83.15 W	01/1970 - present	09/1996 - present
9044036	Fort Wayne, MI	42.30 N	83.09 W	01/1970 - present	08/1996 - present
9044049	Windmill Point, MI	42.36 N	82.93 W	01/1970 - present	10/1999 - present

The station information and water level data are available at NOAA CO-OPS Website: [http://tidesandcurrents.noaa.gov/station\\_retrieve.shtml?type=Great Lakes Water Level Data&state=Lake+Erie&id1=841](http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Great Lakes Water Level Data&state=Lake+Erie&id1=841).

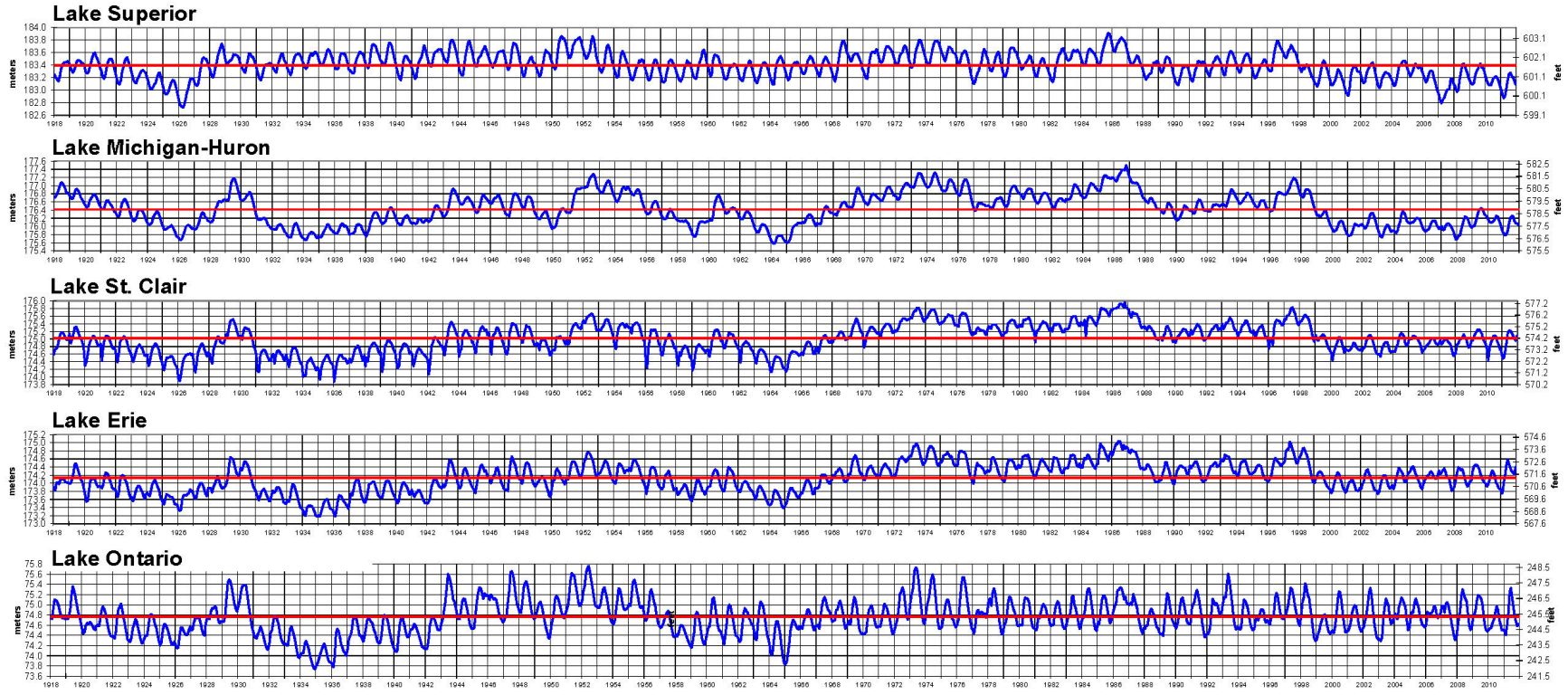
The monthly high and low water level data from the year 1918 to 2011 at Lake Erie are available at the USACE website: <http://www.lre.usace.army.mil/greatlakes/hh/greatlakeswaterlevels/>.

The USACE's graphic of Historic Great Lakes Water Levels from 1918 to 2011 (U.S. Army Corps of Engineers, 2012) is shown in Figure 8. Monthly mean level and long term annual water level elevations are shown in both feet and meters and are referenced to the International Great Lakes Datum (1985).



### Great Lakes Water Levels (1918-2011)

Monthly Mean Level  
Long Term Annual Average



The monthly average levels are based on a network of water level gages located around the lakes.  
Elevations are referenced to the International Great Lakes Datum (1985).

Figure 8: Great Lakes Water Levels from 1918 to 2011

## 6.2 SEICHES

Any basin, lake, or closed water body oscillates at its natural frequency if it is excited by an impulsive wind, earthquake, or other force. The Great Lakes are normally influenced by wind-driven seiches. Lake Erie is more prone to this phenomenon due to its shallow depth and small volume. During this phenomenon, the level may rise on the east side of the lake near Buffalo, NY, while the level falls on the western end of the lake near Toledo, OH. Seiches on Lake Erie can last several hours or days before dissipating. Most recently, a seiche occurred on May 27, 2012, in Lake County, OH. According to a news report from Channel 5 ABC News in Cleveland, OH, water levels fell and rose several feet within a matter of minutes. The rapid rise and fall of water levels is a public safety concern for the coastal communities as well as for boaters and others visiting the beaches and marinas.

## 6.3 HISTORICAL FLOODING AND HIGH WATER MARKS

Information on historical flooding and high water marks was collected during the Discovery data mining effort. Communities were asked to provide this data through the Coastal Data Request Form and at the Discovery Meetings. Sections 3.2.13 (High Water Marks) and 3.2.14 (Historical Flooding) from the individual reports in Appendix D contain more detailed information. High water mark data was available from the USGS only for the severe flooding event of June 22–24, 2006, along the Cuyahoga River near Independence and Valley View in Cuyahoga County, OH. High water marks were not available from the USGS or USACE for the other counties. No high water mark data has been provided by communities. Local stakeholders who may have historical flooding pictures and high water mark information are encouraged to submit them to the FEMA Region V Mitigation Division.

## 6.4 COASTAL FLOOD PROTECTION MEASURES

The USACE maintains over 900 coastal structures in the United States. These coastal structures protect harbors and shore-based infrastructures; provide beach and shoreline stability control; provide flood protection to varying degrees; and protect coastal communities, roadways and bridges, etc. These maintained coastal structures include seawalls, bulkheads, revetments, dikes and levees, breakwaters, groins, sills/perched beaches, jetties, and piers. The USACE coastal structure data for Lake Erie and the Detroit River was extracted from the Enterprise Coastal Inventory Database from the Engineer Research and Development Center (ERDC) and was provided through the USACE Buffalo District.

Table 4 lists the coastal structures found within the Lake Erie basin that are maintained by the USACE. There are no USACE-maintained coastal structures in Wayne County MI, Lucas County OH, or Sandusky County OH.

**Table 4: Coastal Structures Identified in USACE Coastal Inventory Database**

Coastal Structure Name	County	State
Bolles Harbor Disposal Site Dike, MI	Monroe	MI
Bolles Harbor Steel Sheetpile Wall, MI	Monroe	MI
Bolles Harbor West Jetty, MI	Monroe	MI



## Lake-Wide Issues and Long-Term Trends

Coastal Structure Name	County	State
Ashtabula Harbor Inner Breakwater, OH	Ashtabula	OH
Ashtabula Harbor East Breakwater, OH	Ashtabula	OH
Ashtabula Harbor West Breakwater, OH	Ashtabula	OH
Conneaut Harbor East Breakwater Extension, OH	Ashtabula	OH
Conneaut Harbor East Breakwater, OH	Ashtabula	OH
Conneaut Harbor East Pier, OH	Ashtabula	OH
Geneva-on-the-Lake Gabion Breakwater (Experimental), OH	Ashtabula	OH
Geneva-on-the-Lake Sta-Pod™ Breakwater (Experimental), OH	Ashtabula	OH
Geneva-on-the-Lake East Breakwater, OH	Ashtabula	OH
Geneva-on-the-Lake East Stone Revetment, OH	Ashtabula	OH
Geneva-on-the-Lake West Breakwater, OH	Ashtabula	OH
Geneva-on-the-Lake West Stone Revetment, OH	Ashtabula	OH
Lakeshore Park East Breakwater, OH	Ashtabula	OH
Lakeshore Park East Groin, OH	Ashtabula	OH
Lakeshore Park Middle Breakwater, OH	Ashtabula	OH
Lakeshore Park West Breakwater, OH	Ashtabula	OH
Lakeshore Park West Groin, OH	Ashtabula	OH
Cleveland Harbor East Arrowhead Breakwater, OH	Cuyahoga	OH
Cleveland Harbor East Breakwater, OH	Cuyahoga	OH
Cleveland Harbor East Pier, OH	Cuyahoga	OH
Cleveland Harbor West Arrowhead Breakwater, OH	Cuyahoga	OH
Cleveland Harbor West Breakwater, OH	Cuyahoga	OH
Cleveland Harbor West Pier, OH	Cuyahoga	OH
Euclid General Hospital Shore Protection, OH	Cuyahoga	OH
Rocky River Harbor East Pier, OH	Cuyahoga	OH
Huron Harbor Disposal Area Dike, OH	Erie	OH
Huron Harbor East Breakwater, OH	Erie	OH
Huron Harbor West Pier, OH	Erie	OH
Sandusky Harbor East Jetty, OH	Erie	OH
Sandusky Harbor Rock Dike, OH	Erie	OH
Sandusky Harbor Spur Dike, OH	Erie	OH
Vermilion Harbor Detached Breakwater, OH	Erie	OH
Vermilion Harbor East Pier, OH	Erie	OH
Vermilion Harbor West Pier, OH	Erie	OH
Whites Landing Levee, OH	Erie	OH



## Lake-Wide Issues and Long-Term Trends

Coastal Structure Name	County	State
Fairport Harbor East Pier, OH	Lake	OH
Fairport Harbor East Breakwater, OH	Lake	OH
Fairport Harbor West Breakwater, OH	Lake	OH
Fairport Harbor West Pier, OH	Lake	OH
Lakeview Park East Breakwater, OH	Lorain	OH
Lakeview Park East Groin, OH	Lorain	OH
Lakeview Park Middle Breakwater, OH	Lorain	OH
Lakeview Park West Breakwater, OH	Lorain	OH
Lakeview Park West Groin, OH	Lorain	OH
Lorain Harbor East Breakwater, OH	Lorain	OH
Lorain Harbor Disposal Area Dike, OH	Lorain	OH
Lorain Harbor East Breakwater Shore Arm, OH	Lorain	OH
Lorain Harbor East Pier, OH	Lorain	OH
Lorain Harbor Outer Breakwater, OH	Lorain	OH
Lorain Harbor West Breakwater, OH	Lorain	OH
Lorain Harbor West Pier, OH	Lorain	OH
Lorain Small Boat Harbor Main Breakwater, OH	Lorain	OH
Port Clinton Harbor East Jetty, OH	Ottawa	OH
Port Clinton Harbor West Jetty, OH	Ottawa	OH
Sandusky Harbor Jetty, OH	Ottawa	OH
West Harbor North Breakwater, OH	Ottawa	OH
West Harbor South Breakwater, OH	Ottawa	OH
Erie Harbor Disposal Facility, PA	Erie	PA
Erie Harbor North Pier, PA	Erie	PA
Erie Harbor South Pier, PA	Erie	PA
Presque Isle Peninsula East Breakwater, PA	Erie	PA
Presque Isle Peninsula Middle Breakwater, PA	Erie	PA
Presque Isle Peninsula West Breakwater, PA	Erie	PA

An additional 750 coastal structures were identified during a review of the USACE oblique imagery. Man-made coastal structures visible from a map scale of 1:1,500 to 1:3,000 were marked and inventoried. The USACE coastal structures and the additional structures identified by RAMPP are shown on the Discovery Maps provided in Appendix D.

### 6.5 COASTAL RECESSION

Coastal erosion is the recession of land and the removal of beach or dune sediments, and it affects all of the beaches and coasts in the world, including those of Lake Erie. Important factors in coastal erosion are the types of rock or soil being eroded, the presence or absence of beaches or human-made structures, and how the shore is oriented with respect to prevailing winds and waves, water levels, climatology, and groundwater and surface drainage.

#### **Michigan**

According to the Critical Dune Area Maps maintained by the Michigan Department of Environmental Quality (MDEQ) at [http://www.michigan.gov/deq/0,4561,7-135-3311\\_4114\\_4236-70207--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3311_4114_4236-70207--,00.html), there are no critical dune areas in Monroe and Wayne Counties.

Additional information can be found at the MDEQ's High Risk Erosion Areas Web site at [http://www.michigan.gov/deq/0,1607,7-135-3313\\_3677\\_3700-10860--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3677_3700-10860--,00.html).

#### **Ohio**

The Office of Coastal Management and the Division of Geological Survey of the ODNR has mapped the Lake Erie coast to identify coastal erosion areas since 1988. Eastern parts of Ohio along the Lake Erie shoreline within Cuyahoga, Ashtabula, and Lake Counties are more vulnerable to erosion than western parts of the State due to the steep bluffs in the eastern counties.

In 2010, ODNR released the latest Coastal Erosion Area Maps. The coastal recession between 1990 and 2004 was determined using mathematical calculations, aerial photographs, site visits, and extensive quality and consistency reviews. Coastal recession rates for the next 30 years were estimated based on the current recession rates, assuming no measures are taken to address the issues. Areas projected to erode beyond a certain threshold amount are designated as coastal erosion areas and are identified on coastal erosion maps. The coastal erosion maps can be found at the local ODNR offices or viewed online at <http://www.dnr.state.oh.us/tabid/22499/Default.aspx>.

#### **Pennsylvania**

Shoreline erosion and bluff recession are the most significant Lake Erie coastal hazards for Erie County, PA. The Pennsylvania Department of Environmental Protection Coastal Zone Management Program has defined Bluff Recession Hazard Areas as areas or zones "where the rate of progressive bluff recession creates a substantial threat to the safety or stability of nearby or future structures or utility facilities." These bluffs are present along the majority of Erie County's border with Lake Erie.

## SECTION SEVEN HAZARD MITIGATION RESOURCES, STRATEGIES, AND ACTIONS

Hazard mitigation resources, strategies, and actions were reviewed as part of this Discovery process and were discussed with Lake Erie stakeholders during the Information Exchange Sessions and Discovery Meetings. This section provides general information about hazard mitigation, as well as mitigation topics specific to Lake Erie.

### 7.1 HAZARD MITIGATION OVERVIEW

Hazard mitigation is any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards. Mitigation activities may be implemented before, during, or after an incident. However, it has been demonstrated that hazard mitigation is most effective when based on an inclusive, comprehensive, long-term plan that is developed before a disaster occurs. Hazard mitigation planning helps communities develop strategies to reduce their risk of harm or damage from natural hazard events.

Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters.

As part of this Discovery process, existing hazard mitigation plans were reviewed to provide a better understanding of flood risks within the Lake Erie communities, and the strategies and actions that have already been developed as part of their planning process. By obtaining a better understanding of efforts made at the local level to reduce risk, FEMA can identify areas of need or areas where partnerships may be formed throughout this Great Lakes Coastal Flood Study process.

Mitigation is a critical foundation on which to reduce loss of life and property by avoiding or reducing the impact of hazard events. This creates safer communities and facilitates resilience by enabling communities to return to normal function as quickly as possible after a hazard. Once local officials understand the risk posed by flooding and other hazards, the community is in a better position to identify potential mitigation actions that can reduce that risk to its people and property. FEMA mitigation plan requirements encourage communities to understand their vulnerability to hazards and take actions to minimize vulnerability and promote resilience.

The status of hazard mitigation plans for the Lake Erie coastal counties is listed in Table 5 below.

**Table 5: Hazard Mitigation Plan Status**

Jurisdiction	Approval Date	Expiration Date
Monroe County, MI	N/A	N/A
Wayne County, MI	04/27/2006	06/22/2012
Detroit, City of (Wayne County, MI)	01/24/2007	03/22/2012
Ashtabula County, OH	03/05/2007	07/03/2012
Cuyahoga County, OH	10/15/2012	12/22/2016
Erie County, OH	1/28/2008	1/28/2013
Lake County, OH	05/16/2011	12/23/2015

Jurisdiction	Approval Date	Expiration Date
Lucas County, OH	5/3/2005	5/3/2010
Lorain County, OH	1/29/2007	1/29/2012
Ottawa County, OH	02/13/2006	2/13/2011
Sandusky County, OH	2/18/2010	1/25/2015
Erie County, PA	06/11/2012	06/11/2017

### 7.2 THE MITIGATION ACTION FORM AND ACTION TRACKER

As part of this Discovery process, FEMA introduced the Mitigation Action Form and Mitigation Action Tracker to Lake Erie stakeholders. The Mitigation Action Form and Tracker are new Risk MAP tools designed to supplement existing mitigation planning processes. The Action Form, which aligns with questions on the Action Tracker Web site, can be completed by anyone who has identified a potential AoMI. Once in the Action Tracker, an AoMI can be tracked by a variety of entities – such as the community, the county, the State, and FEMA – for different uses, such as:

- To identify AoMIs in a community, State, or Region
- To document AoMIs between mitigation plan updates
- To track progress on mitigation activities
- To assess the Risk MAP program’s ability to encourage communities to take action to reduce risk

Ohio Discovery Meeting participants were also introduced to the Ohio Emergency Management Agency SHARPP tool as another means to identify, document, and track AoMIs within Ohio communities. SHARPP can be accessed at <http://ohiosharpp.ema.state.oh.us/ohiosharpp/>, and the AoMI entry tool for SHARPP can be found at <http://ohiosharpp.ema.state.oh.us/ohiosharpp/>. The Mitigation Action Tracker can be accessed at <http://fema.starr-team.com>. The Mitigation Action Form template can be downloaded and printed at <http://fema.starr-team.com/MAF-Form.pdf>.

Through collaboration among Risk MAP project teams and communities, new actions can be identified and existing actions may be improved upon. In addition, funding and collaboration opportunities to implement mitigation actions may be identified.

It is important to note that entering a potential mitigation action does not obligate a jurisdiction to fund or complete an identified action. When updating local hazard mitigation plans, local planning teams may find it useful to review the actions stored in the Mitigation Action Tracker, assess them, and consider adding them as new or modified actions during the planning process.

Stakeholders who attended the Discovery Meetings were provided with the Mitigation Action Form and were encouraged to complete and return the form to FEMA Region V or RAMPP. No forms for the Lake Erie project area have been returned to FEMA at the time this report was created.

FEMA began an effort in 2012, with support from State partners and a core stakeholder group, to identify a strategy that defines hazard mitigation actions to reduce loss of life and property and

build resilience throughout the coastal communities of the Great Lakes regions. FEMA's Mitigation Planning Technical Assistance (MPTA) may also be available to help communities plan for and reduce risks by providing communities with specialized assistance. MPTA is part of the Risk MAP program and includes risk assessment, mitigation planning, and traditional hazard identification (flood mapping) activities.

### 7.2.1 Types of Mitigation Actions

Hazard mitigation actions include adoption of local plans and regulations, creation of community-identified programs that may help to reduce flood risk or other risks within a community, and structure and infrastructure projects. The FEMA Mitigation Action Form requests the identification of potential mitigation actions in one of these three categories.

The outline presented below lists the types of actions within each category:

#### **Local Plans and Regulations:**

- *Building Codes* – The use and enforcement of building codes and development standards can ensure that structures are safe from flooding.
- *Planning and Land Use Regulations* – These regulations can mitigate flooding by influencing development. Communities can consider updating and aligning comprehensive and master plans, as well as other local plans, to ensure that risk is considered at all levels of community planning.
- *Stormwater Management* – Rainwater and snowmelt can cause flooding and erosion in developed areas.
- *Floodplain Management* – The NFIP enables property owners in participating communities to purchase insurance protection against flood losses.

#### **Community Identified Programs:**

- *Funding Mechanisms* – Mechanisms can be developed for local risk reduction.
- *Incentives for Local Risk Reduction* – Studies have shown that many people are willing to take actions to reduce their risk if they believe they are actually at risk.
- *Mitigation Program* – Regular maintenance will help drainage systems and flood control structures to continue functioning properly.

#### **Structure and Infrastructure Projects:**

- *Structure Protection* – There are many ways to protect residential and non-residential structures from flood damage, such as flood proofing and elevation.
- *Infrastructure and Critical Facility Protection* – Techniques can be used to protect infrastructure and critical facilities from flood events.
- *Flood Control Structures* – These structures can be built to prevent flood damage.

- *Natural Systems* – Natural systems can provide floodplain protection, riparian buffers, and other ecosystem services that mitigate flooding.
- *Soil Stabilization or Erosion Control* – These processes can stabilize slopes that may be susceptible to erosion.

To learn more about mitigation planning, actions, and best practices, visit <http://www.fema.gov/hazard-mitigation-planning-resources>.

### 7.3 HAZARD MITIGATION PROGRAMS AND ASSISTANCE

Hazard mitigation plans are required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93–288), as amended by the Disaster Mitigation Act of 2000 and the National Flood Insurance Act of 1968, as amended by the Flood Insurance Reform Act of 2004 (Public Law 108–264). Under the Disaster Mitigation Act of 2000, governments have certain responsibilities, including:

- Preparing and submitting a standard or enhanced mitigation plan (single or multi-jurisdictional)
- Reviewing and updating effective mitigation plans every five years
- Providing technical assistance and training to local governments to assist in hazard mitigation plan grant applications (as hazard mitigation plans are required for mitigation grant funding)

Hazard mitigation planning is important to help break the cycle of disaster damage, reconstruction, and repeated damage. Disasters cannot be avoided; but hazard mitigation planning can help lessen their effects.

Not all mitigation activities require funding, and those that do are not limited to outside funding sources. For those mitigation actions that require assistance through funding or technical expertise, several State and Federal agencies have flood hazard mitigation grant programs and offer technical assistance. These programs may be funded at different levels over time or may be activated under special circumstances, such as after a presidential disaster declaration.

FEMA awards many mitigation grants each year to States and communities so they can undertake mitigation projects to prevent future loss of life and property resulting from hazard impacts, including flooding. The FEMA Hazard Mitigation Assistance (HMA) programs provide grants for mitigation through the programs listed in Table 6. Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction projects. More information about FEMA HMA programs can be found at <http://www.fema.gov/government/grant/hma/index.shtm>.



Communities can link hazard mitigation plans and actions to the right FEMA grant programs to fund flood risk reduction. More information about FEMA HMA programs can be found at <http://www.fema.gov/hazard-mitigation-assistance>.



**Table 6: FEMA Hazard Mitigation Assistance Programs**

Mitigation Grant Program	Authorization	Purpose
Hazard Mitigation Grant Program (HMGP)	Robert T. Stafford Disaster Relief and Emergency Assistance Act	Activated after a presidential disaster declaration; provides funds on a sliding scale formula based on a percentage of the total Federal assistance for a disaster for long-term mitigation measures to reduce vulnerability to natural hazards
Flood Mitigation Assistance (FMA)	National Flood Insurance Reform Act	Reduces or eliminates claims against the NFIP
Pre-Disaster Mitigation (PDM)	Disaster Mitigation Act	National competitive program focused on mitigation project and planning activities that address multiple natural hazards (program under review)
Repetitive Flood Claims (RFC)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduces flood claims against the NFIP through flood mitigation; properties must be currently NFIP insured and must have had at least one NFIP claim
Severe Repetitive Loss (SRL)	Bunning-Bereuter-Blumenauer Flood Insurance Reform Act	Reduces or eliminates the long-term risk of flood damage to SRL residential structures currently insured under the NFIP

The HMGP and PDM programs offer funding for mitigation planning and project activities that address multiple natural hazard events. The FMA, RFC, and SRL programs focus funding efforts on reducing claims against the NFIP. Funding under the HMA programs is subject to availability of annual appropriations, and HMGP funding is also subject to the amount of FEMA disaster recovery assistance provided under a presidential major disaster declaration.

FEMA's HMA grants are awarded to eligible States, tribes, and territories (applicant) that, in turn, provide sub-grants to local governments and communities (sub-applicant). The applicant selects and prioritizes sub-applications developed and submitted to them by sub-applicants and submits them to FEMA for funding consideration. Prospective sub-applicants should consult the office designated as their applicant for further information regarding specific program and application requirements. Contact information for the FEMA Regional Offices and the State Hazard Mitigation Officers (SHMOs) is available on the FEMA Web site ([www.fema.gov](http://www.fema.gov)).

Some examples of other Federal programs that include funding available for hazard mitigation are displayed in Table 7. Several of these agencies, including the USACE, Natural Resource Conservation Service, and USGS have specialists on staff and can offer further information on flood hazard mitigation. The State NFIP Coordinator and SHMO are State-level sources of information and assistance.

## Hazard Mitigation Resources, Strategies, and Actions

**Table 7: Other Agency Mitigation Programs and Assistance**

Mitigation Program or Assistance	Agency	Purpose
Coastal Services Center Cooperative Agreements	National Oceanic & Atmospheric Administration (NOAA)	Funds for coastal wetlands management and protection, natural hazards management, public access improvement, reduction of marine debris, special area management planning, and ocean resource planning. <a href="http://www.csc.noaa.gov/funding/">http://www.csc.noaa.gov/funding/</a>
Coastal Services Center Grant Opportunities	NOAA	Formula and program enhancement grants for implementing and enhancing Coastal Zone Management programs that have been approved by the Secretary of Commerce. <a href="http://www.csc.noaa.gov/funding/">http://www.csc.noaa.gov/funding/</a>
Coastal Zone Management Program	NOAA	The Office of Ocean and Coastal Resource Management (OCRM) provides federal funding and technical assistance to better manage our coastal resources. <a href="http://coastalmanagement.noaa.gov/funding/welcome.html">http://coastalmanagement.noaa.gov/funding/welcome.html</a>
Marine and Coastal Habitat Restoration	NOAA	Funding for habitat restoration, including wetland restoration and dam removal. <a href="http://www.nmfs.noaa.gov/habitat/recovery/">http://www.nmfs.noaa.gov/habitat/recovery/</a>
Planning Assistance to States (PAS)	U.S. Army Corps of Engineers (USACE)	Fund plans for the development and conservation of water resources, dam safety, flood damage reduction and floodplain management. <a href="http://www.lre.usace.army.mil/planning/assist.html">http://www.lre.usace.army.mil/planning/assist.html</a>
Emergency Streambank and Shoreline Protection	USACE	To prevent erosion damages to public facilities by the emergency construction or repair of streambank and shoreline protection works. <a href="http://www.usace.army.mil">www.usace.army.mil</a>
Environmental Laboratory	USACE	Guidance for implementing environmental programs such as ecosystem restoration and reuse of dredged materials. <a href="http://el.erdc.usace.army.mil/index.cfm">http://el.erdc.usace.army.mil/index.cfm</a>
Small Flood Control Projects	USACE	To reduce flood damages through small flood control projects not specifically authorized by congress. <a href="http://www.usace.army.mil">www.usace.army.mil</a>
Coastal Wetlands Conservation Grant Program	U.S. Fish & Wildlife Service	Matching grants to states for acquisition, restoration, management or enhancement of coastal wetlands. <a href="http://ecos.fws.gov/coastal_grants/viewContent.do?viewPage=home">http://ecos.fws.gov/coastal_grants/viewContent.do?viewPage=home</a>

## Hazard Mitigation Resources, Strategies, and Actions

Mitigation Program or Assistance	Agency	Purpose
Disaster Recovery Assistance	U.S. Department of Housing and Urban Development (HUD)	Disaster relief and recovery assistance in the form of special mortgage financing for rehabilitation of impacted homes. <a href="http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri">http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri</a>
Neighborhood Stabilization Program	HUD	Funding for the purchase and rehabilitation of foreclosed and vacant property in order to renew neighborhoods devastated by the economic crisis. <a href="http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/neighborhoodspg">http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/neighborhoodspg</a>
USDA Smith-Lever Special Needs Funding	U.S. Department of Agriculture (USDA)	Grants to State Extension Services at 1862 Land-Grant Institutions to support education-based approaches to addressing emergency preparedness and disasters. <a href="http://www.csrees.usda.gov/funding/rfas/smith_lever.html">http://www.csrees.usda.gov/funding/rfas/smith_lever.html</a>
Community Facilities Direct Loans	USDA	Loans for essential community facilities. <a href="http://www.rurdev.usda.gov/HCF_CF.html">http://www.rurdev.usda.gov/HCF_CF.html</a>
Community Facilities Direct Grants	USDA	Grants to develop essential community facilities. <a href="http://www.rurdev.usda.gov/HCF_CF.html">http://www.rurdev.usda.gov/HCF_CF.html</a>
Farm Service Agency Disaster Assistance Programs	USDA	Emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland and livestock damaged by natural disasters. <a href="http://www.fsa.usda.gov/">http://www.fsa.usda.gov/</a>
Small Business Administration Loan Program	U.S. Small Business Administration (SBA)	Low-interest, fixed rate loans to small businesses for the purpose of implementing mitigation measures to protect business property from damage that may be caused by future disasters. Also available for disaster damaged property. <a href="http://www.sba.gov/about-sba-services/208">http://www.sba.gov/about-sba-services/208</a>

The programs described above may require a local match or have requirements that must be met in order for one to be eligible. To learn more about these programs and assistance, contact the SHMO as they are the state-level source of information and assistance. A listing of SHMOs can be found by visiting <http://www.fema.gov/state-hazard-mitigation-officers>.

### SECTION EIGHT RISK MAP PROJECTS AND NEEDS

This section provides information about the planned next steps for the Great Lakes Coastal Flood Study along Lake Erie, including information about the upcoming coastal flood study, potential for mitigation technical assistance within the project area, changes in compliance as a result of the coastal flood study, future communications, and how unmet needs will be addressed.

#### 8.1 FUTURE COASTAL STUDY

Information and data collected as part of the Lake Erie Discovery effort and provided in this report will be used in the upcoming GLCFS for Lake Erie.

A summary of the GLCFS project can be found at <http://www.greatlakescoast.org/> under the “Great Lakes Coastal Analysis & Mapping” section.

Engineering and mapping analysis performed as part of this study will follow guidance provided within FEMA’s Draft Guidelines and Standards (G&S) for Coastal Studies Along the Great Lakes, issued on May 8, 2012 (FEMA, 2012). The upcoming study is expected to include the following tasks: creation of bathymetric and topographic data, base map acquisition, coastal flood hazard analysis, and Risk MAP product development.

##### 8.1.1 Engineering and Mapping

Coastal flood hazard analyses and mapping will be performed for all communities of the United States located along the Lake Erie shoreline. Below is a summary of data that will be collected and analysis that will be performed:

- 1) Creation of Bathymetric and Topographic Map Data Inventory:

Topographic data for the coastal areas to be studied will be used for coastal analysis, floodplain boundary delineation, and/or testing of floodplain boundary standard compliance. The topographic data used will be based on the data collected as part of this Discovery process, and will depend on the date and accuracy of existing topographic data. Only topographic data that is of better quality than that of the original study or effective studies will be used. New topographic and bathymetric LiDAR, RGB imagery, and hyperspectral imagery will be used for the coastal study areas and will replace the existing datasets. The bathymetric LiDAR is discussed in more detail in Section 5.1.2.

- 2) Base Map Acquisition

Base map data for all counties, including data collected during this Discovery process as an initial inventory, will be collected and organized. The necessary permissions from the map sources will be obtained to allow FEMA to use and distribute hard-copy and digital map products using the digital base map. Base map data must comply with FEMA G&S (FEMA, 2003).

- 3) Coastal Flood Hazard Analysis

Response-based computational approaches outlined in FEMA G&S Appendix D.3 (dated May 2012) will be used to perform coastal flood hazard analysis for the

Lake Erie shoreline and areas subject to coastal flooding. The coastal flood hazard analyses include the following components:

- Wave setup
- Erosion
- Wave runup
- Wave overtopping
- Overland wave propagation
- Primary frontal dune identification (where applicable)

A transect-based approach for assessing coastal flood risks along Lake Erie will be used. The Lake Erie coastal flood study will include Sandusky Bay and areas of the Detroit River included within the model domain defined by U.S. Army Corps of Engineers ERDC for Lake Erie.

The 1.5-foot breaking wave height will be selected from the Wave Height Analysis for Flood Insurance Studies (WHAFIS) results and used to define the Limit of Moderate Wave Action (LiMWA) as described in FEMA Procedural Memorandum No. 50 updated in 2012.

The coastal flood hazard results will be transferred to topographic work maps. Topographic data provided by the USACE in 2012 will be used. Coastal flood hazards will be mapped as outlined in FEMA's G&S Appendix D.3 dated May 2012 (FEMA, 2012). Flood hazard mapping will extend to the landward limit of coastal flooding as a result of waves and storm surge.

Coastal flood maps (or workmaps) will be produced for the study area. The workmap will include the 1-percent- and 0.2-percent-annual-chance SFHA, Coastal High Hazard (VE Zone) and Coastal A Zone (AE Zone), Base Flood Elevations (BFEs), and LiMWA. Communities will be provided with an opportunity to review the workmaps after the coastal modeling is complete and before FEMA approves of and adopts the updated coastal flood maps.

### **8.1.1.1 National Flood Insurance Program Data Integration**

Regulatory FIRM files will be updated through FEMA's Physical Map Revision process, using the floodplain delineations created from the work performed in the Engineering and Mapping tasks. For areas adjacent to updated coastal analysis, tie-ins will be resolved between coastal and riverine floodplains using the topographic data acquired.

Data collected as part of the coastal analysis will be put into FIRM database format and reviewed per FEMA's G&S Procedural Memorandum No. 42 for Quality Control Requirements in the FIRM Production Process.

The final production and distribution of updated FIRMs will depend on the results of the coastal analysis. Therefore, the exact communities that will receive updated FIRMs for adoption cannot be identified at this time. The risk assessment products and their distribution, discussed below, also depend on the results of the coastal analysis and are subject to change.

### 8.1.1.2 Risk Assessment Product Development

Depending on the data available, results of coastal analysis, and fiscal year funding, coastal flood risk products, such as Flood Risk Map, Flood Risk Report, Changes Since Last FIRM (CSLF), Flood Depth and Analysis Grids, and Hazus-MH analyses, may be generated for identified coastal communities in Lake Erie coastal counties. Optional Flood Risk Assessment products such as coastal wave height grids, erosion risk determination, and wave hazard severity area datasets have not yet been funded. Below is a brief description of each flood risk product and its uses:

#### **Changes Since Last FIRM**

- Identifies areas and types of flood zone change:
  - Compares current effective (previous) with proposed (new) flood hazard mapping
  - Categorizes and quantifies flood zone changes
- Provides study/reaches level rationale for changes, including:
  - Methodology and assumptions
  - Changes of model inputs or parameters (also known as Contributing Engineering Factors)

#### **Flood Depth and Analysis Grids**

- Flood Depth and Analysis Grids (DAGs) will be created for the 1-percent-annual-chance event of the coastal engineering studies performed and as appropriate for the data. Wave runup areas may not apply.

#### **HAZUS 2010 1 Percent Exposure**

- The 2010 HAZUS national dataset for 1 percent exposure data will be used to tabulate the results by identified communities.

A Flood Risk Map, Flood Risk Report, and Flood Risk Database may also be developed as part of this process, in conjunction with the products described above, and depending on results of the coastal analysis, data availability, and fiscal year funding.

## 8.2 POTENTIAL FOR MITIGATION PROJECTS

During the Discovery process, FEMA (and RAMPP) met with the communities and discussed their recent and current mitigation projects. At the Discovery Meetings, communities did not provide additional or future mitigation projects they are planning. Based on the results of the Lake Erie coastal study, the communities can determine if their existing projects and programs are adequate or if they would benefit from additional mitigation measures.

MPTA will offer specialized assistance to help communities plan for and reduce risks. MPTA can help communities increase awareness and take action to reduce risk. Determining which communities receive MPTA depends on identification of a need, the willingness of a community to partner with FEMA, availability of local resources and data, and availability of Federal



funding. Unfortunately, not every community will be able to receive MPTA as part of a Risk MAP project.

Forming a partnership between FEMA and a local community is an essential part of initiating an MPTA project. Assistance will be prioritized after all data and information are collected and assessed by FEMA in coordination with the local communities to determine where MPTA resources would be beneficial. Communities should alert FEMA of any resources that are available at the local level, and of actions they are interested in implementing in partnership with FEMA. Technical assistance activities should be based on the needs of the community and should address already established capabilities.

Technical assistance is available through Risk MAP to help communities identify, select, and implement activities to support mitigation planning and risk reduction. Activities could include (but are not limited to):

- Advising in the creation of initial hazard mitigation plans
- Advising in the update of existing hazard mitigation plans
- Training to improve a community's capabilities for reducing risk
- Assisting in incorporating flood risk datasets and products into potential and effective community legislation, guidance, regulations, procedures, etc.
- Assisting with creating, acquiring, and incorporating GIS data into potential and effective maps, planning mechanisms, emergency management procedures, etc.
- Facilitating the identification of data gaps and interpreting technical data to identify risk reduction deficiencies that should be corrected

At the time this report was completed, potential future mitigation projects and mitigation technical assistance had not yet been identified for Lake Erie communities. As this coastal project moves forward, continued discussion will be essential regarding FEMA's partnership with local communities to help develop new mitigation actions and move those actions forward.

### **8.3 COMPLIANCE STATUS**

FEMA uses a number of tools to determine a community's compliance with the minimum regulations of the NFIP. Among them are Community Assistance Contacts (CACs) and Community Assistance Visits (CAVs). These tools help assess a community's implementation of its floodplain management regulations and identify any deficiencies and/or violations.

The CAC is a telephone call or brief visit by a FEMA staff member (or staff of a State agency on behalf of FEMA) verifying the community's floodplain management contact. The CAC can be used as a way to screen for potential floodplain management issues in communities that would require a CAV.

The CAV is a visit to a community that serves the dual purpose of providing technical assistance to the community and ensuring that the community is adequately enforcing its floodplain management regulations. Potential violations may be identified during the CAV as a result of touring the floodplain, inspecting community permit files, and meeting with local appointed and elected officials. "Open" CAVs can be indicative of unresolved violations. Fifteen open CAVs

were found for the Michigan coastal communities for Lake Erie, and six were found in the Ohio coastal communities.

If administrative problems or potential violations are identified, the community will be notified and given the opportunity to correct those administrative procedures and remedy the violations to the maximum extent possible within established deadlines. FEMA or the State will work with the community to help bring the program into compliance with NFIP requirements. In extreme cases where the community does not take action to bring itself into compliance, FEMA may initiate an enforcement action against the community.

During the Discovery process of this study, stakeholders were provided with information regarding NFIP requirements that are associated with coastal hazard zones, as well as information about new FEMA guidance related to moderate wave action. These topics, including coastal SFHAs, building requirements in VE Zones, and LiMWA, are compiled below and discussed in greater detail.

### 8.3.1 Coastal Special Flood Hazard Areas

The Lake Erie Coastal Flood Hazard study analysis may result in new SFHAs, which are defined as areas that will be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent-annual-chance flood is also referred to as the base flood or 100-year flood. SFHAs labeled as Zone AE have been studied by detailed methods and show BFEs. SFHAs labeled as Zone VE are along coasts and are subject to additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic analyses are shown within these zones.

The NFIP shows coastal flood hazards in two different zones on its FIRMs:

- Zone VE, where the delineated flood hazard includes wave heights equal to or greater than 3 feet; and
- Zone AE, where the delineated flood hazard includes wave heights less than 3 feet.

These zones were discussed in greater detail during the Discovery Meetings, as the updated coastal analysis results may show that these flood risks exist along the Great Lakes shorelines.

Additional information on coastal SFHAs can be found at <http://www.greatlakescoast.org> under the “Great Lakes Flood Zones Overview” section.

### 8.3.2 Building Requirements in VE Zones

The zone designation and the BFE are critical factors in determining which requirements apply to a building and, as a result, how the structure must be built. The NFIP minimum requirements for buildings constructed in Zone VE (Coastal High Hazard Areas) are as follows:

1. The building must be elevated on pile, post, pier, or column foundations.
2. The building must be adequately anchored to the foundation.
3. The building must have the bottom of the lowest horizontal structural member at or above the BFE.

4. The building design and method of construction must be certified by a design professional.
5. The area below the BFE must be free of obstructions.
6. Enclosures must be made of lightweight wood lattice, insect screening, or breakaway walls.

Communities participating in the NFIP that have mapped VE Zones must adopt floodplain management regulations that meet or exceed the minimum NFIP requirements described above.

### 8.3.3 Limit of Moderate Wave Action

Post-storm field investigations and laboratory tests have confirmed that waves as small as 1.5 feet can cause significant damage to structures that are constructed without consideration of coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour, which can cause damage to Zone AE-type construction in these coastal areas.

To help community officials and property owners recognize this increased potential for damage due to wave action in the AE Zone, FEMA issued Procedure Memorandum 50 in December 2008, which provides guidance on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action, or LiMWA. The LiMWA alerts property owners on the inland side of this line that although their property is in a Zone AE area, it may also be affected by waves 1.5 feet or higher. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary, as the area may face a high risk—though not as high as Zone VE. Figure 9 helps to explain the LiMWA zone location.

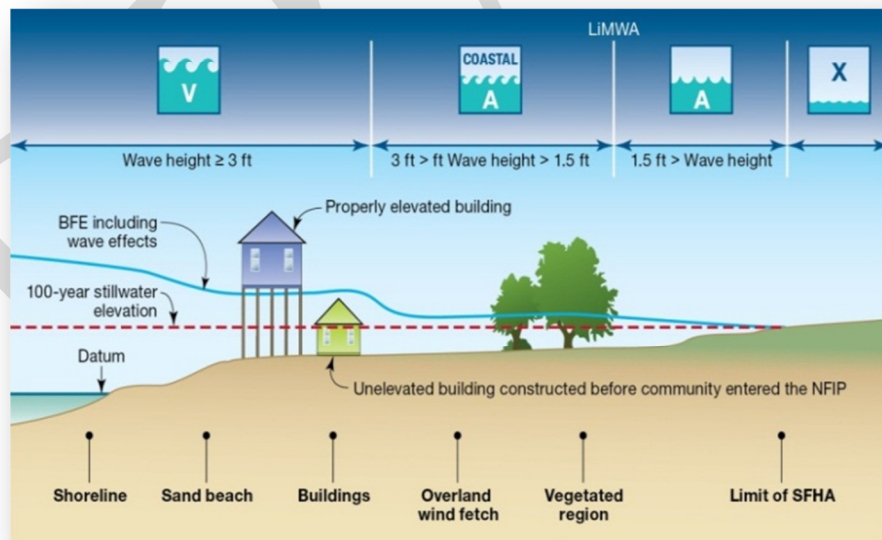
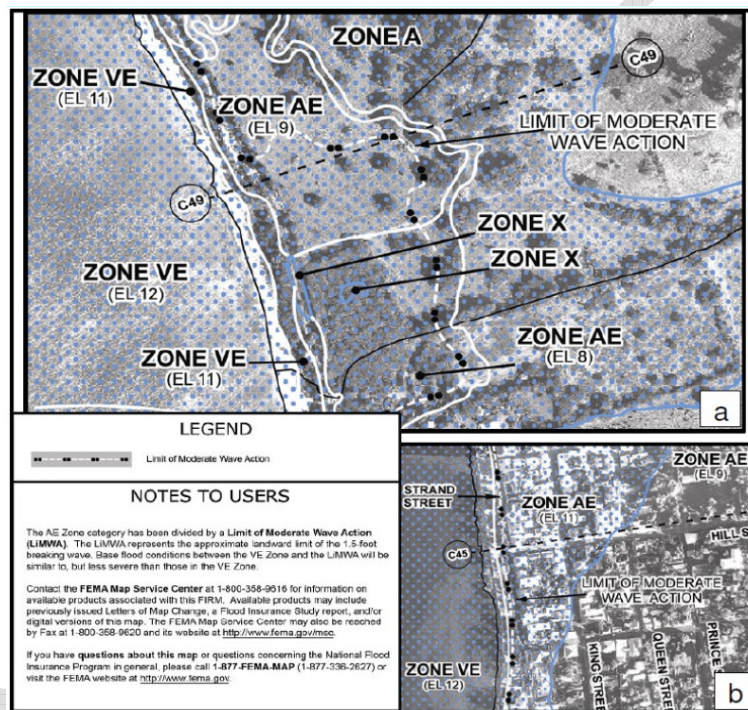


Figure 9: Limit of Moderate Wave Action

A new line layer will be added to the FIRM Database to accommodate the LiMWA features. The new layer will be depicted on updated FIRMs as two black dots and three white dashed lines in a sequential pattern. The LiMWA will be identified in the FIRM legend as “Limit of Moderate Wave Action,” and a note will be included in the “Notes to Users” section on the map panel to explain the LiMWA boundary.

Figure 10 is an example FIRM showing the delineated LiMWA. The area in Map A shows the delineation of the LiMWA in an area where the predominant coastal flood hazard is overland wave propagation. Map B shows delineation of the LiMWA in a region where the major coastal flood hazard is wave breaking and runup.



**Figure 10: Example FIRM showing LiMWA**

While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Because the 1.5-foot breaking wave in the LiMWA zone can potentially cause foundation failure, communities are encouraged to adopt building construction standards similar to those in Zone VE in those areas. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. CRS credits can lower insurance premiums for residents and business owners. Additional information on CRS can be found online at <http://www.fema.gov/national-flood-insurance-program/community-rating-system>.

Mapping the LiMWA will provide community officials and other stakeholders with additional important flood risk details to consider when buying/ developing, mitigating, or enforcing floodplain management regulations in coastal flood hazard areas.



Residents and business owners living or working in the LiMWA zone should be aware of the potential wave action along with floating debris, erosion, and scour that could cause significant damage to their property. They are encouraged to build safer and higher than the minimum local requirements in order to reduce the risk to life and property.

While the risk of damage is higher between the LiMWA line and the Zone VE line than it is in other parts of the coastal AE Zone, the NFIP flood insurance rates currently do not differ from other AE Zone rates.

The Federal mandatory purchase requirement does apply in these zones, and property owners are encouraged to carry coverage equivalent to the replacement cost of their building and to include contents coverage.

For additional background information on the LiMWA, please refer to FEMA Procedure Memorandum No. 50 at [www.fema.gov/library/viewRecord.do?id=3481](http://www.fema.gov/library/viewRecord.do?id=3481).

### 8.4 COMMUNICATION

Throughout this Discovery process, community representatives and local stakeholders indicated the need to be kept informed about the results of Discovery, the upcoming coastal flood study, and opportunities for public input throughout the study process. As a result of communication to date, several new stakeholders have been identified and added to the master contact database for this study.

Ongoing communication and coordination will be an essential part of this Lake Erie Coastal Flood Study. Throughout this Discovery process, Federal, State, and local stakeholders were kept informed via email, letters, newsletters, and meetings. A dedicated email account was created ([LakeErieCoastalFloodStudy@RAMPP-Team.com](mailto:LakeErieCoastalFloodStudy@RAMPP-Team.com)) to distribute project information, meeting reminders, and summaries.

Stakeholder involvement will continue to be important through the remainder of the project. The Great Lakes Coastal Flood Study Web site <http://www.greatlakescoast.org> is an excellent resource where stakeholders can obtain the most up-to-date information about the status of the Great Lakes Coastal Flood Study, data collection, upcoming meetings, new technical reports, the latest methodologies, factsheets, and additional information.

FEMA encourages stakeholders to remain involved and will seek to identify partnership opportunities during the study process.

Social media sites such as Twitter (<http://www.twitter.com/GreatLakesCoast>) and Facebook (<http://www.facebook.com/pages/Great-Lakes-Coastal-Flood-Mapping-Program/225293657496579>) will also be important communication tools to keep stakeholders informed and engaged throughout this process.

State agencies in Michigan and Ohio provided data storage and public access of draft deliverables on their Web sites. The Michigan Department of Environmental Quality is hosting data on Ohio and Michigan Web sites and the RAMPP team Web site.

- Ohio Department of Natural Resources:  
<http://www.dnr.state.oh.us/water/tabid/3524/Default.aspx>

- Michigan Department of Environmental Quality: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3684\\_3725-285488--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3684_3725-285488--,00.html)
- Pennsylvania: Information for Erie County available on the RAMPP Team Web site at <https://www.rampp-team.com/pa.htm> under the “Risk MAP Watershed Projects” section

### 8.5 UNMET NEEDS

The Lake Erie Discovery process did not identify unmet needs during this study. At the conclusion of the Lake Erie Coastal Flood Study, communities can examine the results and determine if their existing mitigation projects and floodplain management programs are adequate or if they have needs that have not been met by the new study.

During the Discovery Meetings, Lake Erie stakeholders had questions about the process of proceeding with a new coastal flood risk study. There are currently no V-zones mapped along the Lake Erie shoreline, and there were some concerns over the adoption of new coastal flood maps and having to update zoning ordinances. The stakeholders’ questions were addressed – and will continue to be addressed throughout the study.



## SECTION NINE      CLOSE

Federal, State, and local stakeholders were interested in the Discovery process and in providing local data that may assist in the upcoming Lake Erie Coastal Flood Study. Many stakeholders are interested in learning more about the new methodologies being used as part of the Great Lakes Coastal Flood Studies, and how their community would be specifically affected by the Lake Erie Coastal Flood Study. The information gathered in this Discovery process will provide invaluable information as the Lake Erie Coastal Flood Study proceeds.

DRAFT

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**SECTION TEN      REFERENCES**

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## SECTION ELEVEN APPENDICES

The Discovery Report and appendices are stored digitally under their respective folders on the FEMA Mapping Information Platform (MIP) at:

\\Discovery\Project\_Discovery\_Initiation\Discovery\_Report\

The Discovery Report and appendices are also available for download from the following Web site: <http://www.greatlakescoast.org/>

Expiration Date: TBD

Appendix A: Lake Erie Core Stakeholder List

Appendix B: Pre-Discovery Kickoff Meeting

Appendix B-1: Presentation and Meeting Summary for Michigan

Appendix B-2: Presentation and Meeting Summary for Ohio

Appendix B-3: Presentation and Meeting Summary for Pennsylvania

Appendix C: Community Discovery Coastal Data Request Form

Appendix D: Discovery Reports

Appendix D-1: Monroe and Wayne Counties, MI

Appendix D-2: Ashtabula and Lake Counties, OH

Appendix D-3: Cuyahoga County, OH

Appendix D-4: Erie and Lorain Counties, OH

Appendix D-5: Lucas County, OH

Appendix D-6: Ottawa and Sandusky Counties, OH

Appendix D-7: Erie County, PA