Mackinac County, MI
Lake Huron Coastal Hazard Analysis Flood Risk Review Meeting

July 11, 2018

FEMA

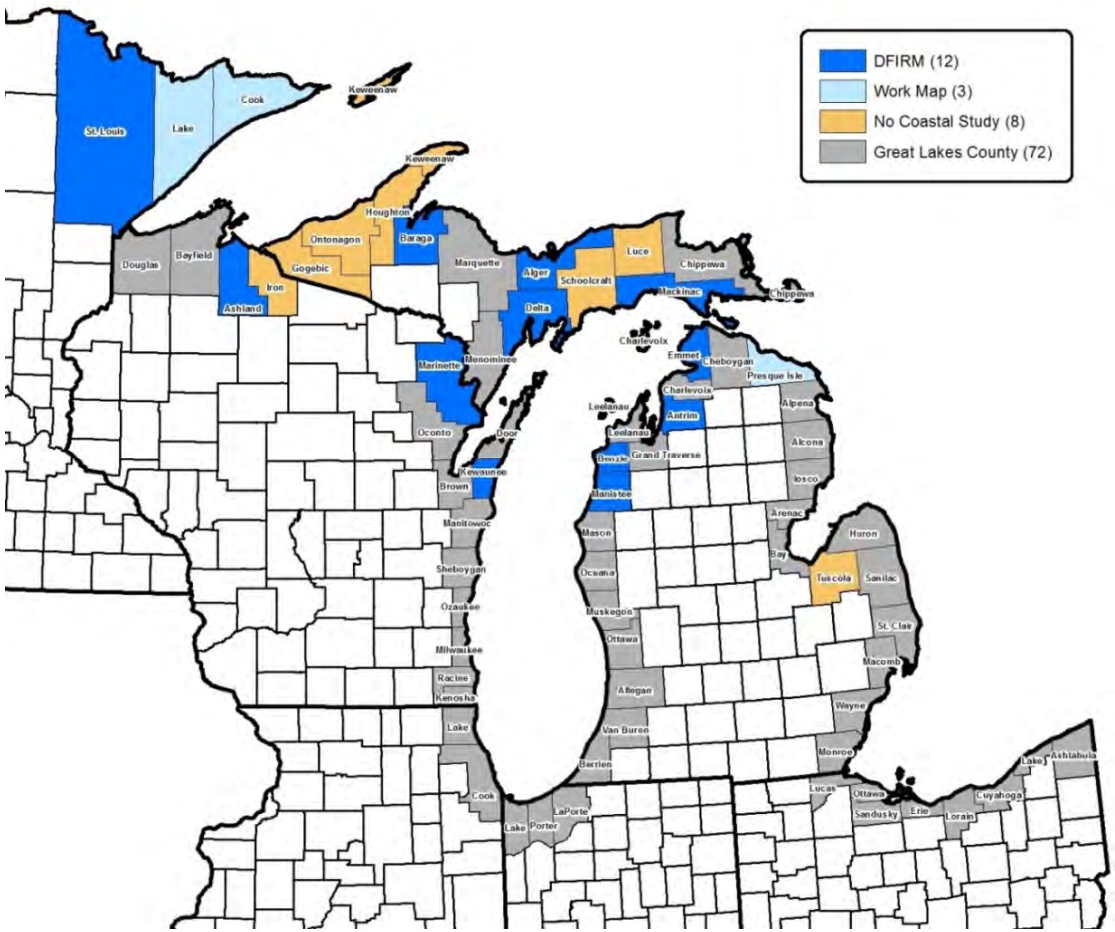
Agenda

- Introductions
- Coastal Flood Risk Study and Mapping Program
- Current Status
- Technical Overview of Study and Mapping
- Floodplain Management
- Next Steps
- Q&A
- Workmap Review

Mackinac County, MI

COASTAL FLOOD RISK STUDY AND MAPPING PROGRAM

Program Goals and Status



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Great Lakes Coastal Flood Study
greatlakescoast.org

Great Lakes Flood Study

- Comprehensive study of the Coastal Great Lakes flood hazards
- Latest technology, data, and models – including response based modelling concepts

Partners involved:

FEMA

US Army Corps of Engineers ®
Detroit District

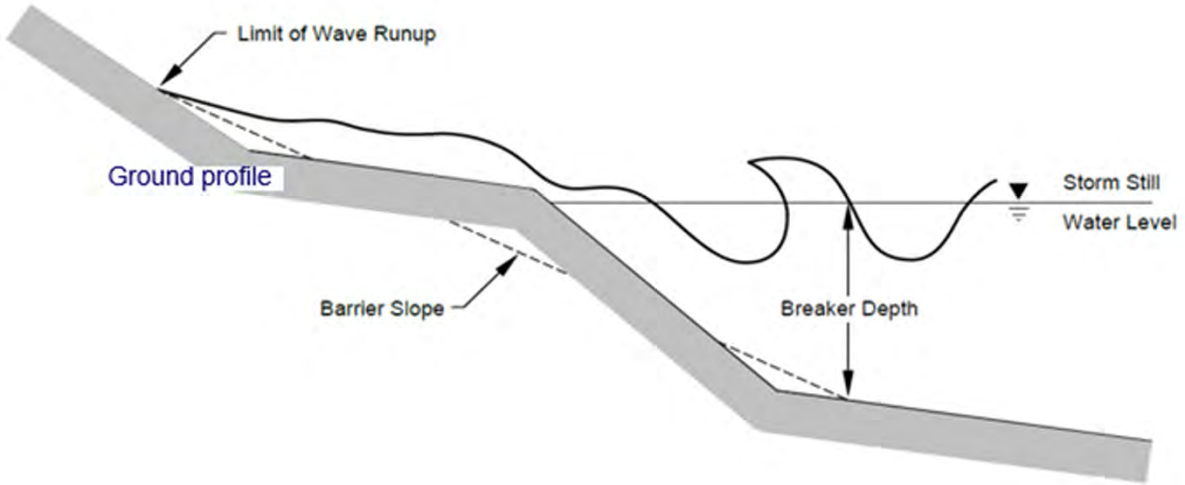
ERDC

RAMPP

STARR
Strategic Alliance for Risk Reduction

Response-Based Wave Runup

- Wave runup is the uprush of water from wave action on a beach, steep bluff or coastal structure.
- Calculated at each transect using appropriate hydrodynamic equations that simulate events for every time step captured for selected storms using lake-wide gridded record (ADCIRC-SWAN)
- Statistical analysis is performed on the maximum runup results at each transect to obtain the 1-percent-annual-chance runup elevation.



FEMA's Risk MAP Program

Risk Mapping, Assessment, and Planning …

- Will deliver quality data to increase public awareness and lead to action that reduces risk to life and property
- New non-regulatory products and datasets

Mapping Assessment Planning

Mitigation Actions: A Shared Responsibility

STRUCTURE AND INFRASTRUCTURE PROJECTS

- Acquisition
- Elevation
- Revetments and Seawalls
- Breakwater

LOCAL PLAN AND REGULATIONS

- Zoning
- Building Codes
- Open Space Plan
- Lake Front Development Master Plan

CITIZEN AND BUSINESS ENGAGEMENT

- Firewise
- StormReady
- NFIP and CRS

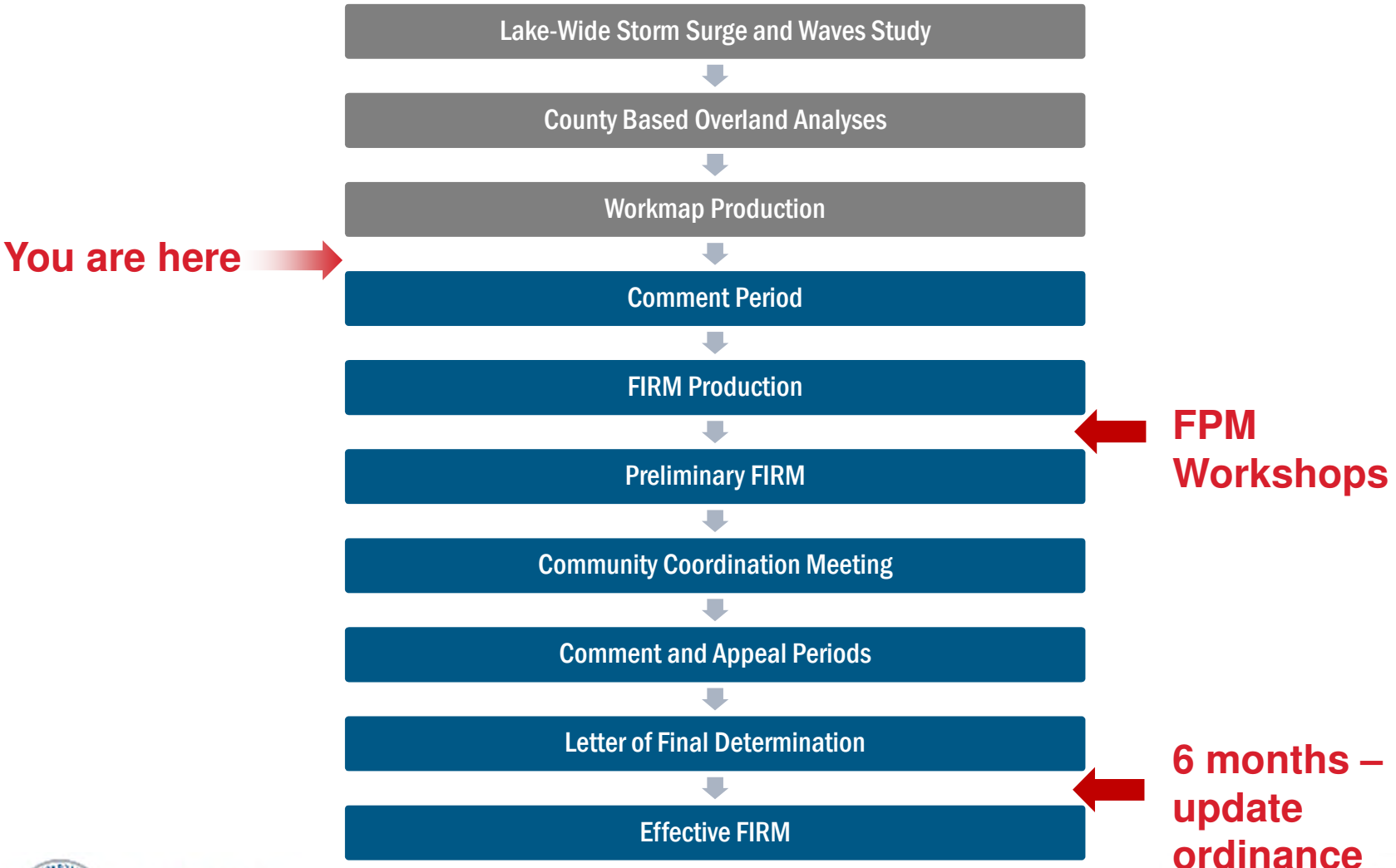
NATURAL SYSTEM PROTECTION

- Vegetation management
- Wetland restoration
- Erosion control

Mackinac County, MI

CURRENT STATUS REVIEW

Current Study Status



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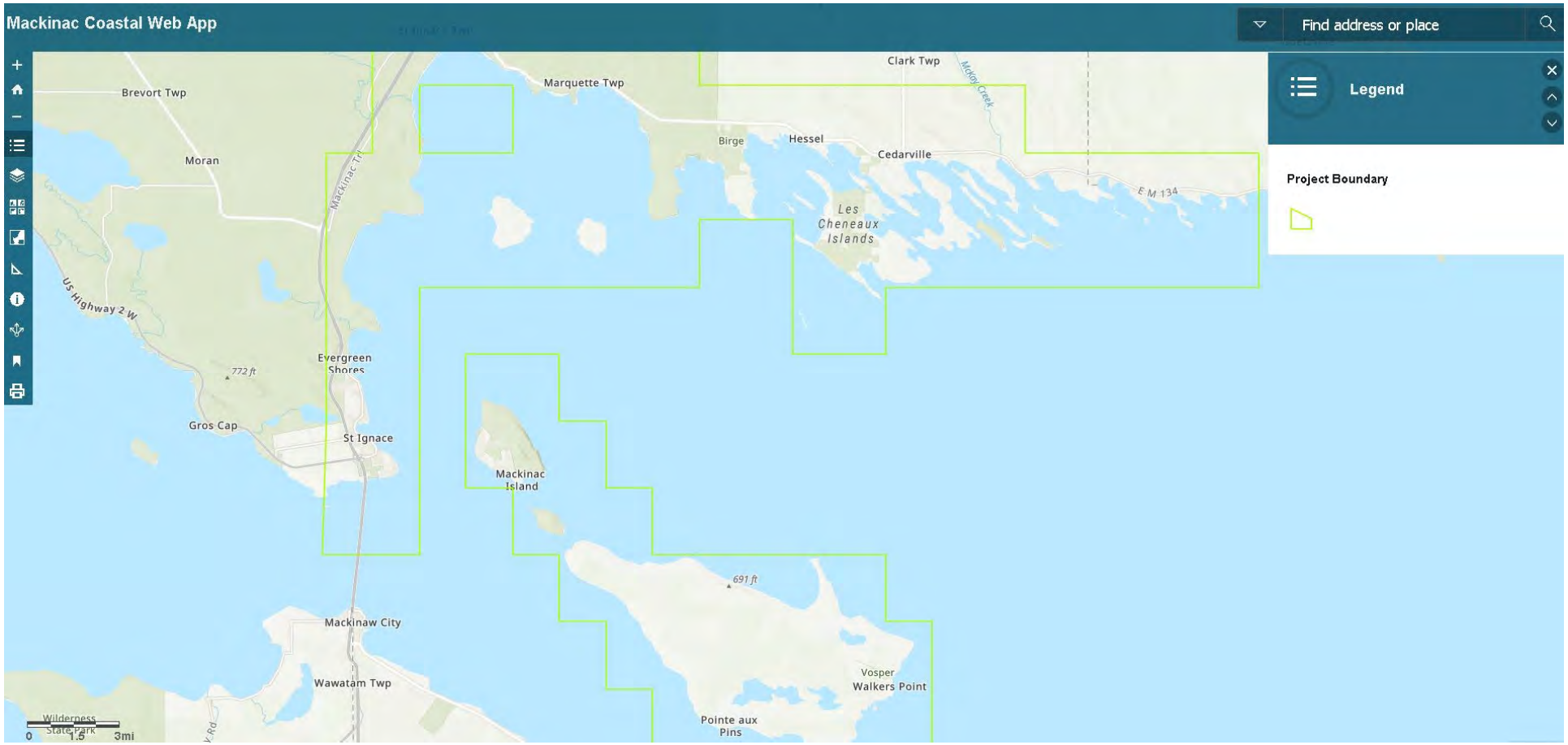
Floodplain Management Workshops

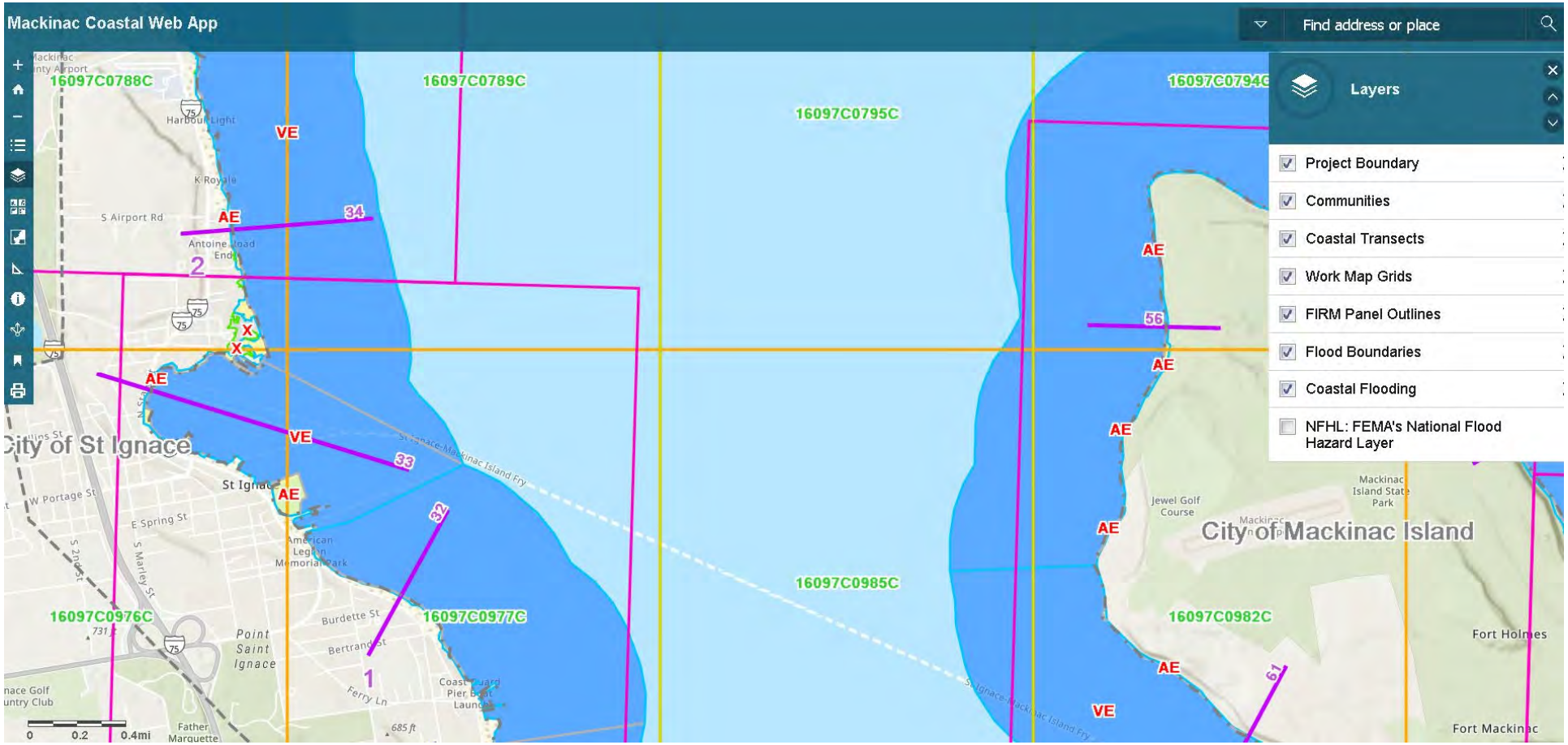
- Conducted by FEMA/DNR just before preliminary maps are released
- Workshop details:
  - Approximately 3 – 4 hours
  - Designed for floodplain administrator, zoning official, building inspectors, permit officials, etc.
  - Basics of Coastal Flooding
  - Using the Flood Insurance Study and FIRM for coastal studies
  - Floodplain Management Standards in Coastal High Hazard Areas (in depth)
  - NFIP Insurance in Coastal Zones

Work Map Data Viewer

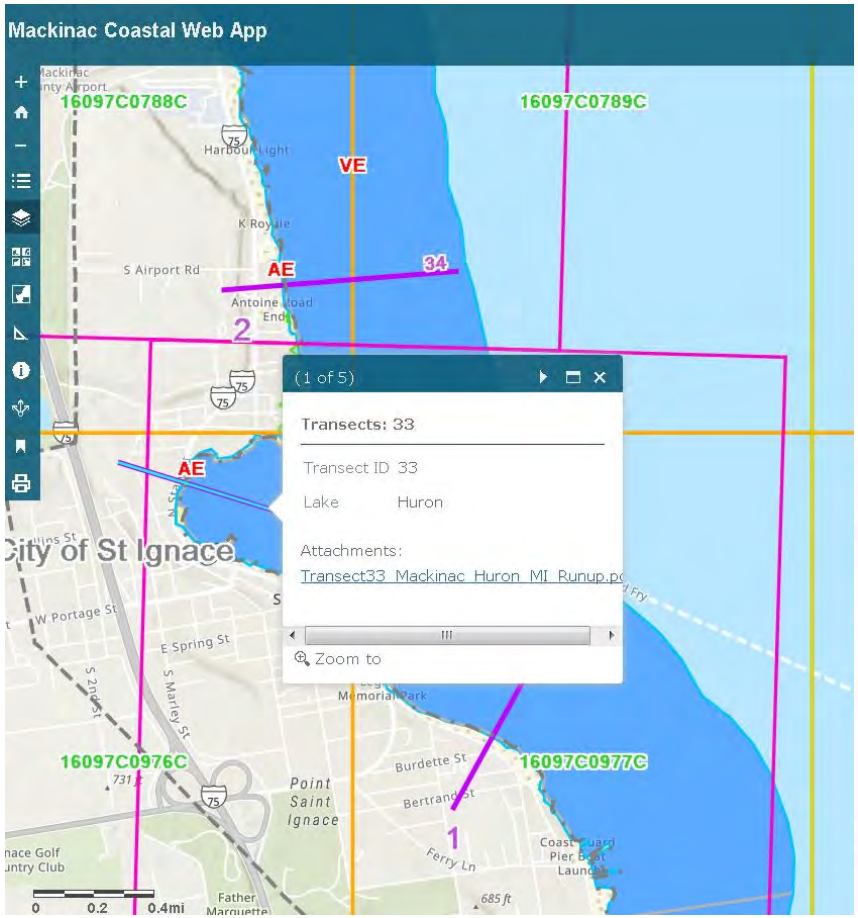


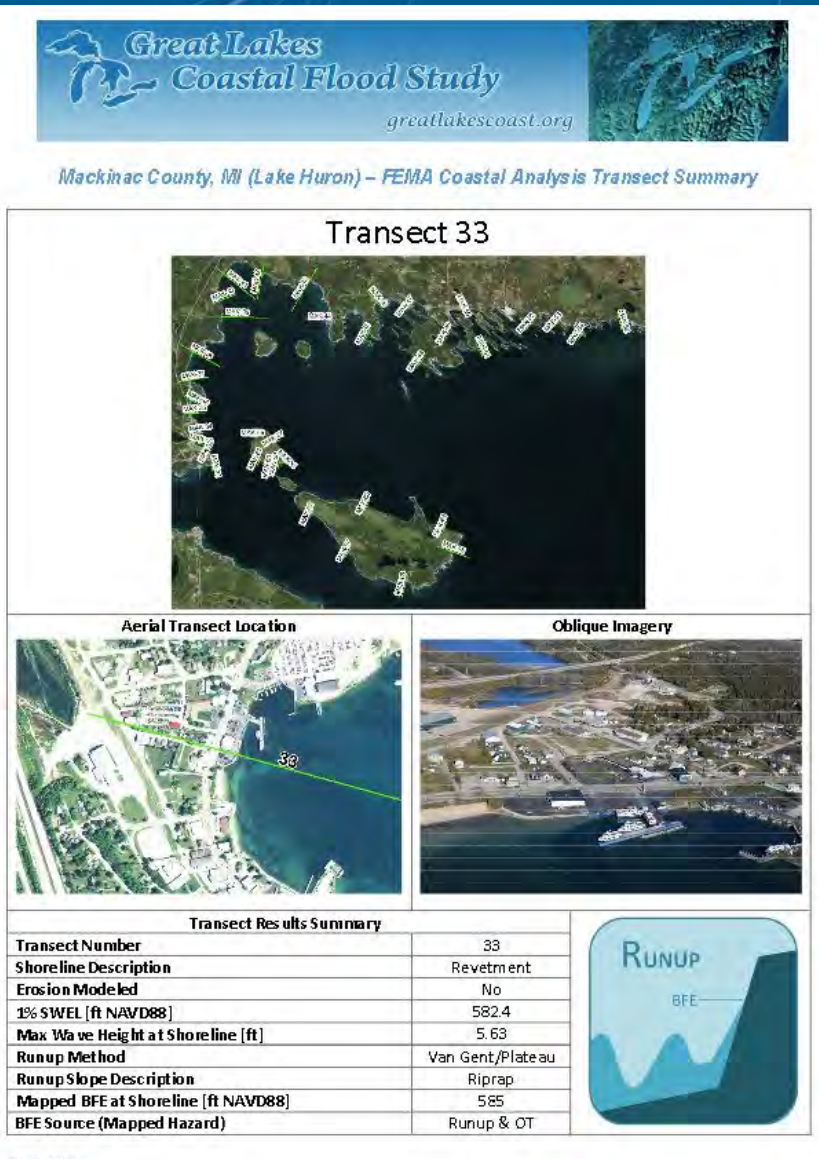
Link to the Mackinac County, MI Work Map Data Viewer: http://arcg.is/9K4yK

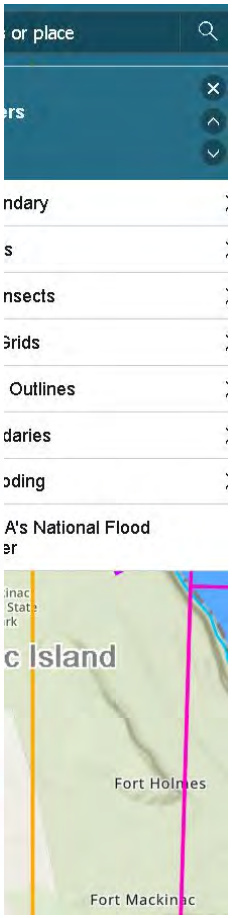
Work Map Data Viewer



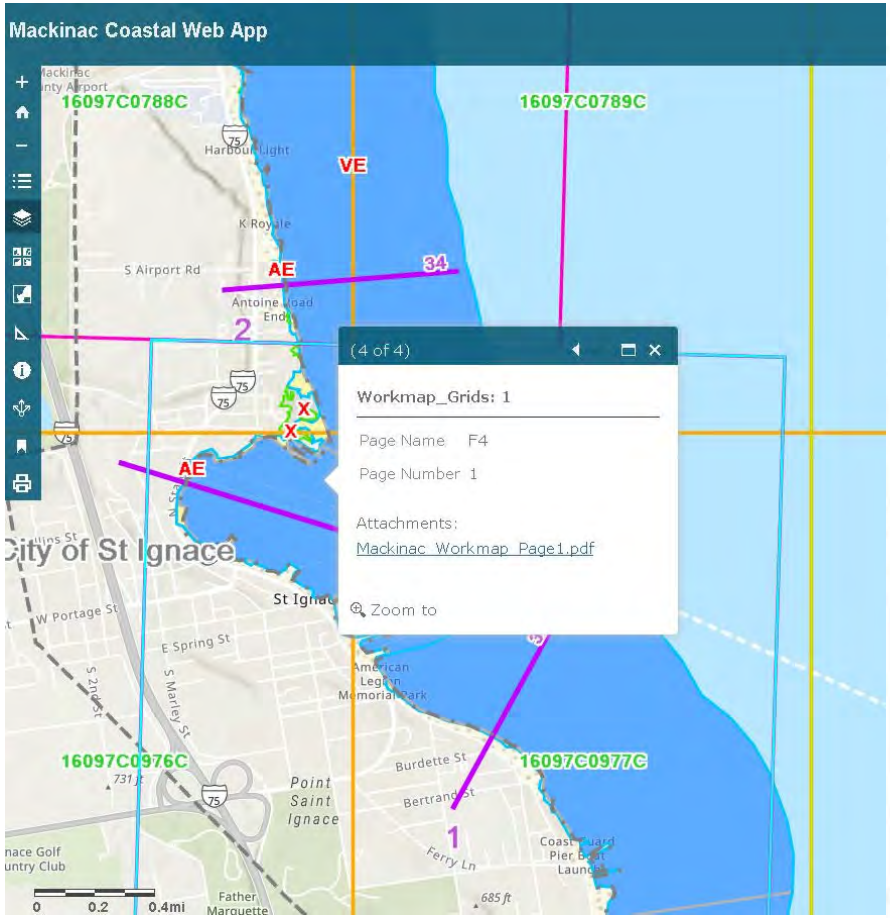
Work Map Data Viewer

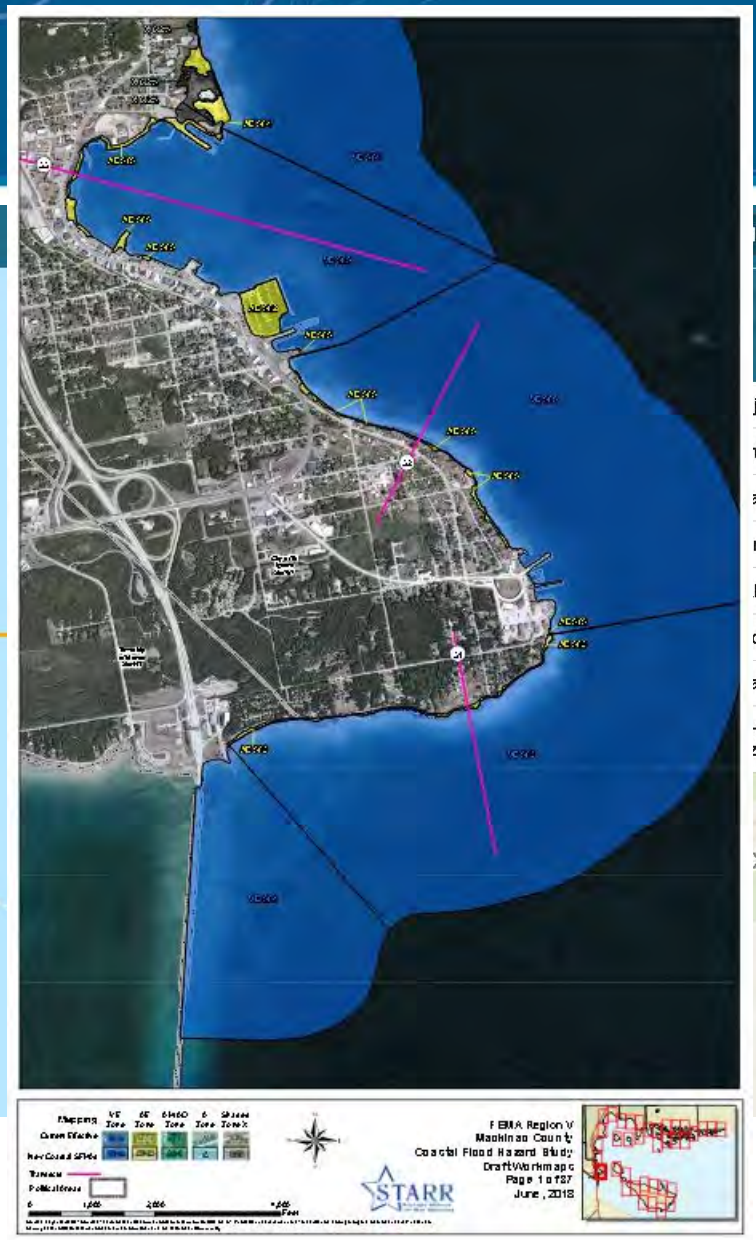


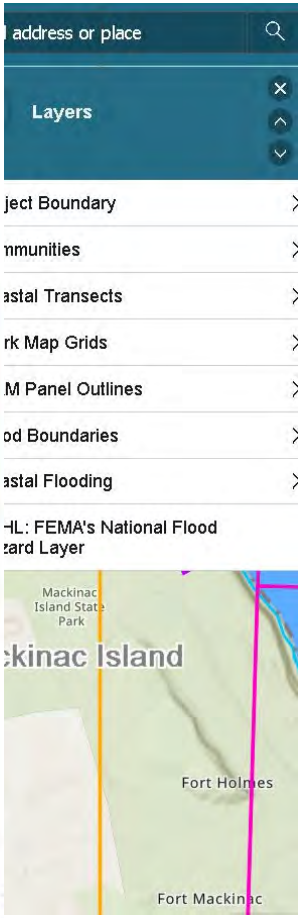




Work Map Data Viewer







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Work Map Data Viewer

FEMA Work Map Data Viewer User Guide

Project Background

The Federal Emergency Management Agency (FEMA) releases draft work maps for communities as engineering data is completed. These products display the results of FEMA's analysis. The intent of this release is to help community officials understand current flood risk and potential flood insurance requirements as well as provide them with an opportunity to review the findings prior to their inclusion within Preliminary Flood Insurance Rate Maps (FIRMs).

Leveraging FEMA's GeoPlatform, this information has been organized and shared with community partners through an interactive ArcGIS online web map viewer. This document provides an overview of how to navigate, visualize, and access the data and information within this tool.

Viewing work maps via FEMA GeoPlatform

When opening the FEMA Work Map Data Viewer for a county your screen should appear similar to Figure 1 below. If you want a general overview of the map click on the "Details" button (outlined below in Figure 1)

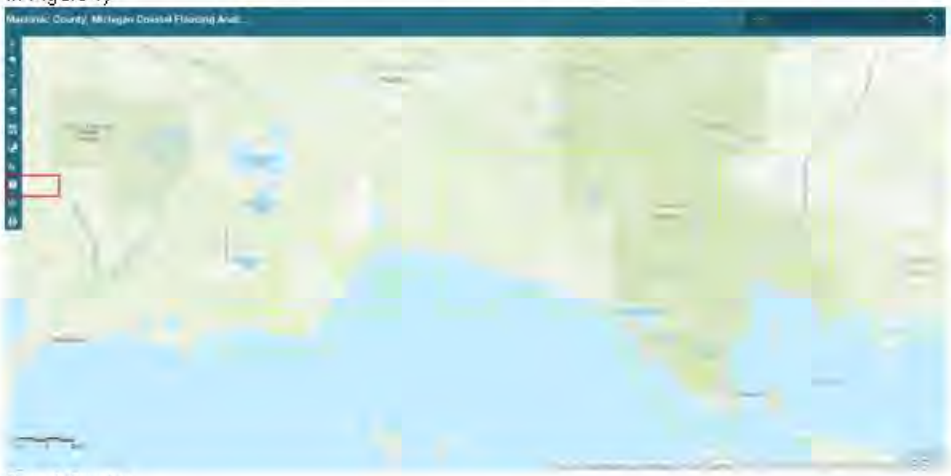


Figure 1: Overview

User guide location:

https://bit.ly/2M4K2BI

Mackinac County, MI

TECHNICAL OVERVIEW OF STUDY AND MAPPING

Coastal Flood Hazard Modeling Overview

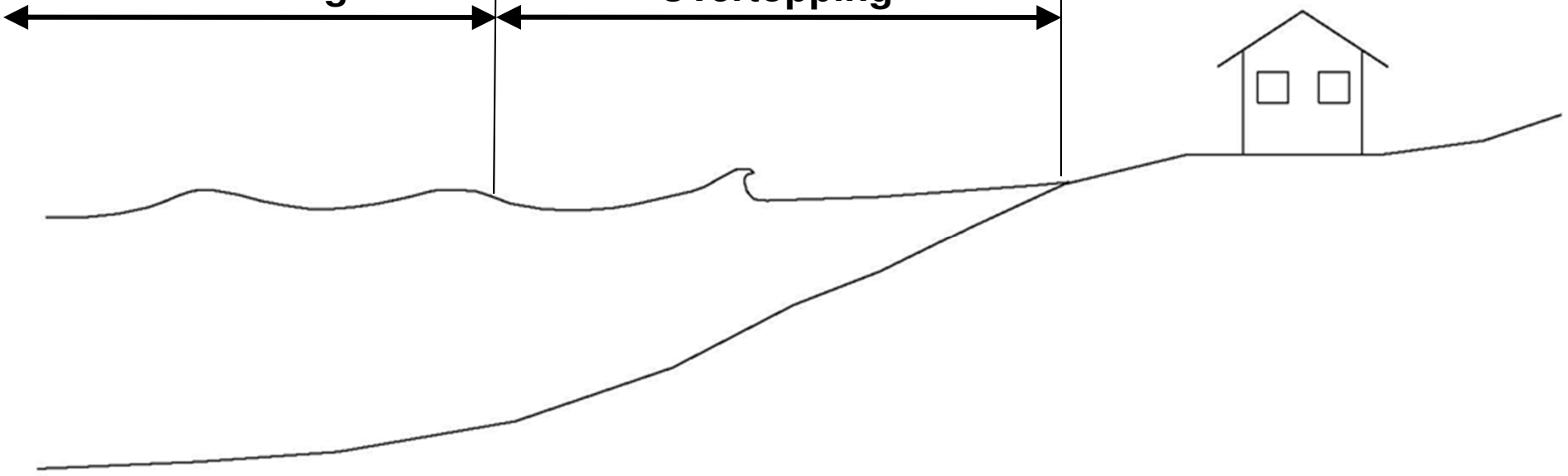
Lake-Wide Variation

Local Variation

Step 1: Offshore Water Level and Wave Modeling

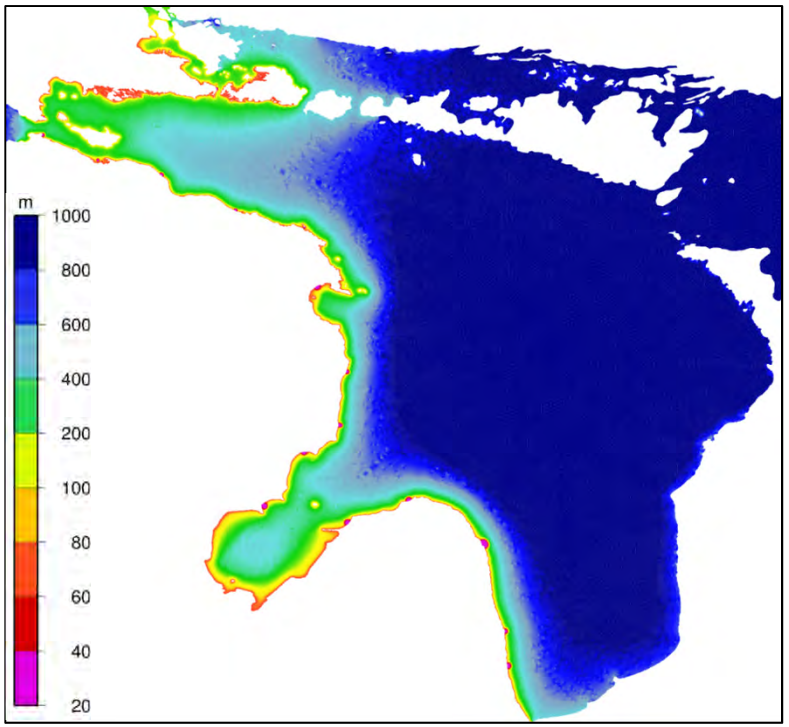
Step 2: Nearshore Wave Setup, Runup & Overtopping

Step 3: Floodplain Mapping



Step 1: ADCIRC+SWAN Mesh

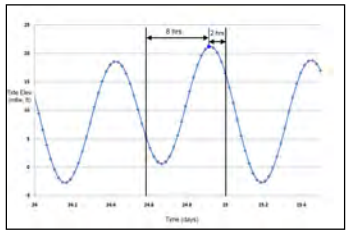
- Resolution as fine as 10 m along complex shoreline features including:
  - Jetties
  - Inlets
  - Breakwaters
  - Natural Shoals



Step 1: Run the Models

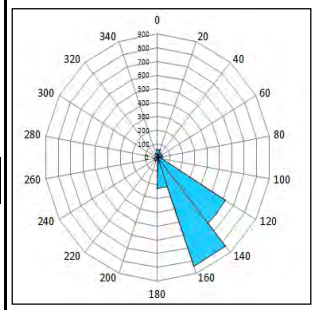
Baseline

Water Level

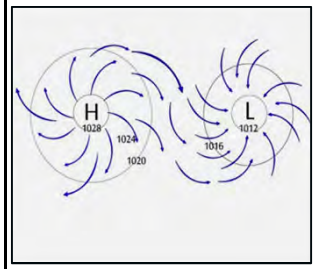


Meteorological Forcing

Wind



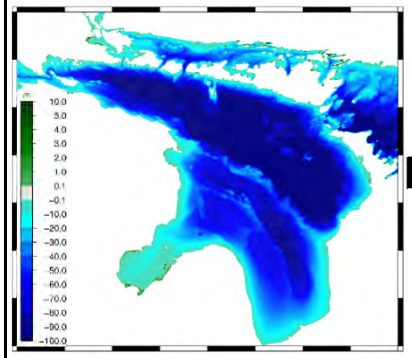
Pressure



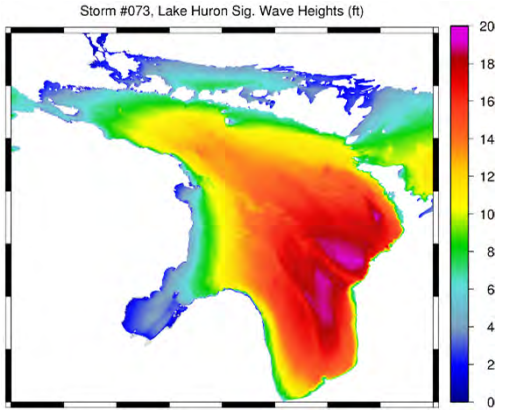
Ice

Physical Setting

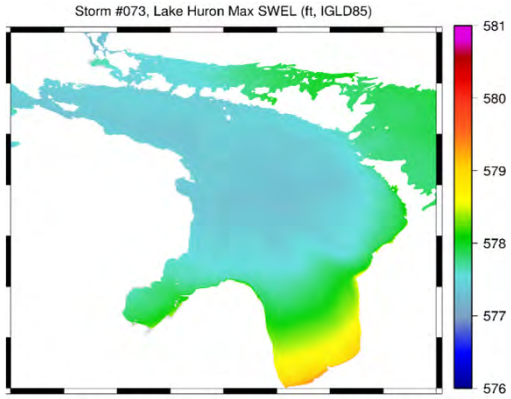
Bathymetry



Waves



Still Water Elevations



Total of 151 events between 1960-2009

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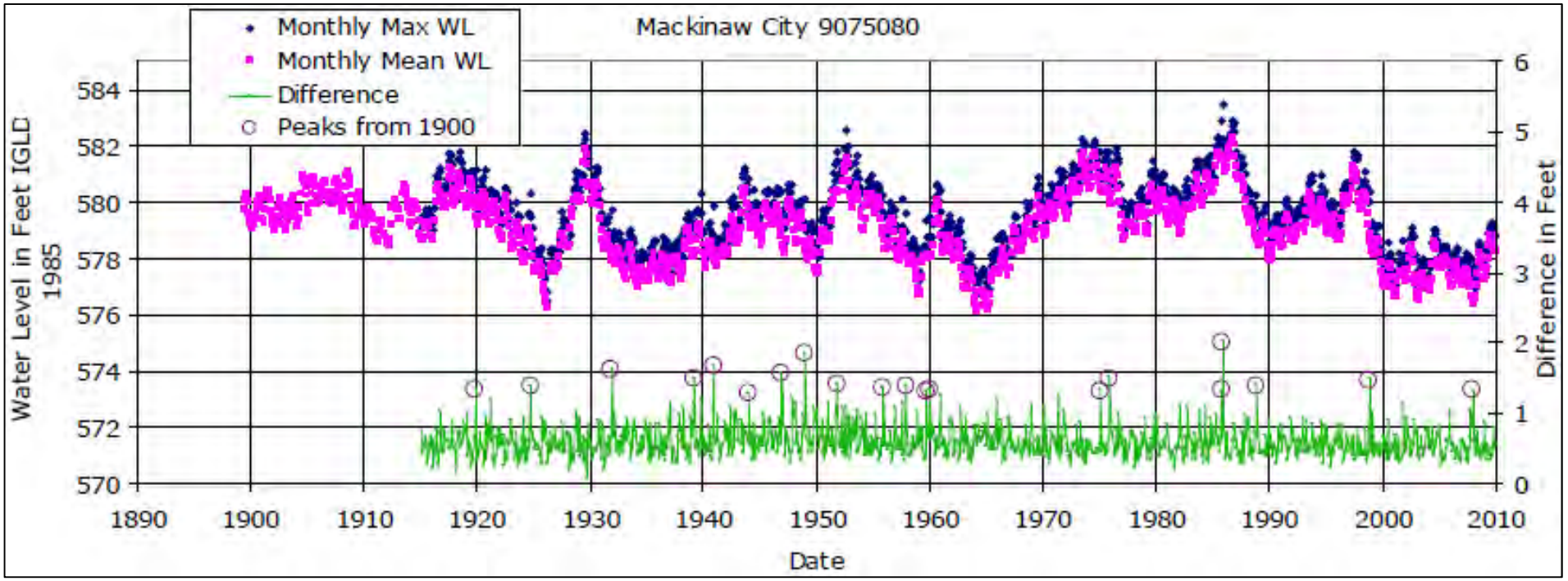
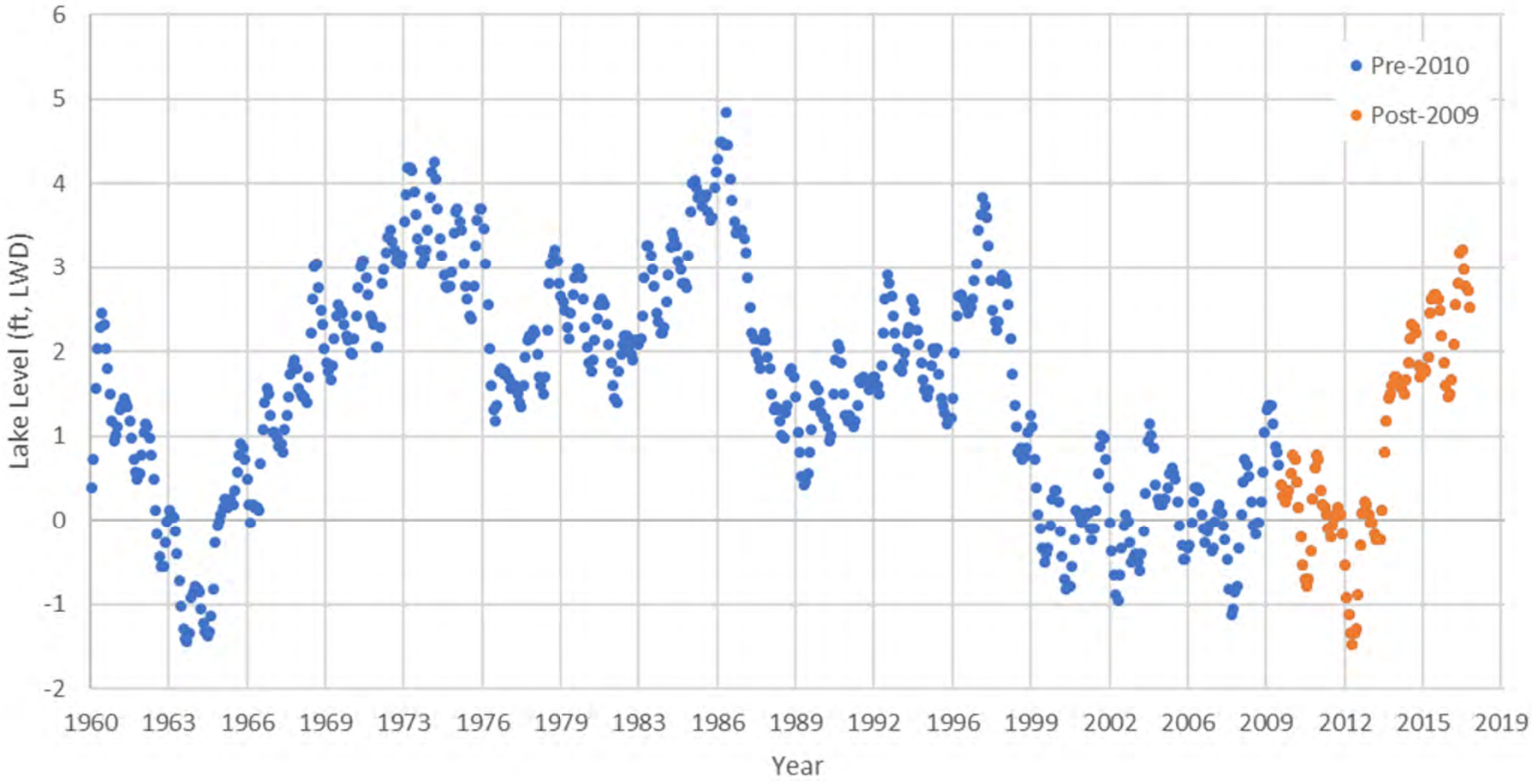
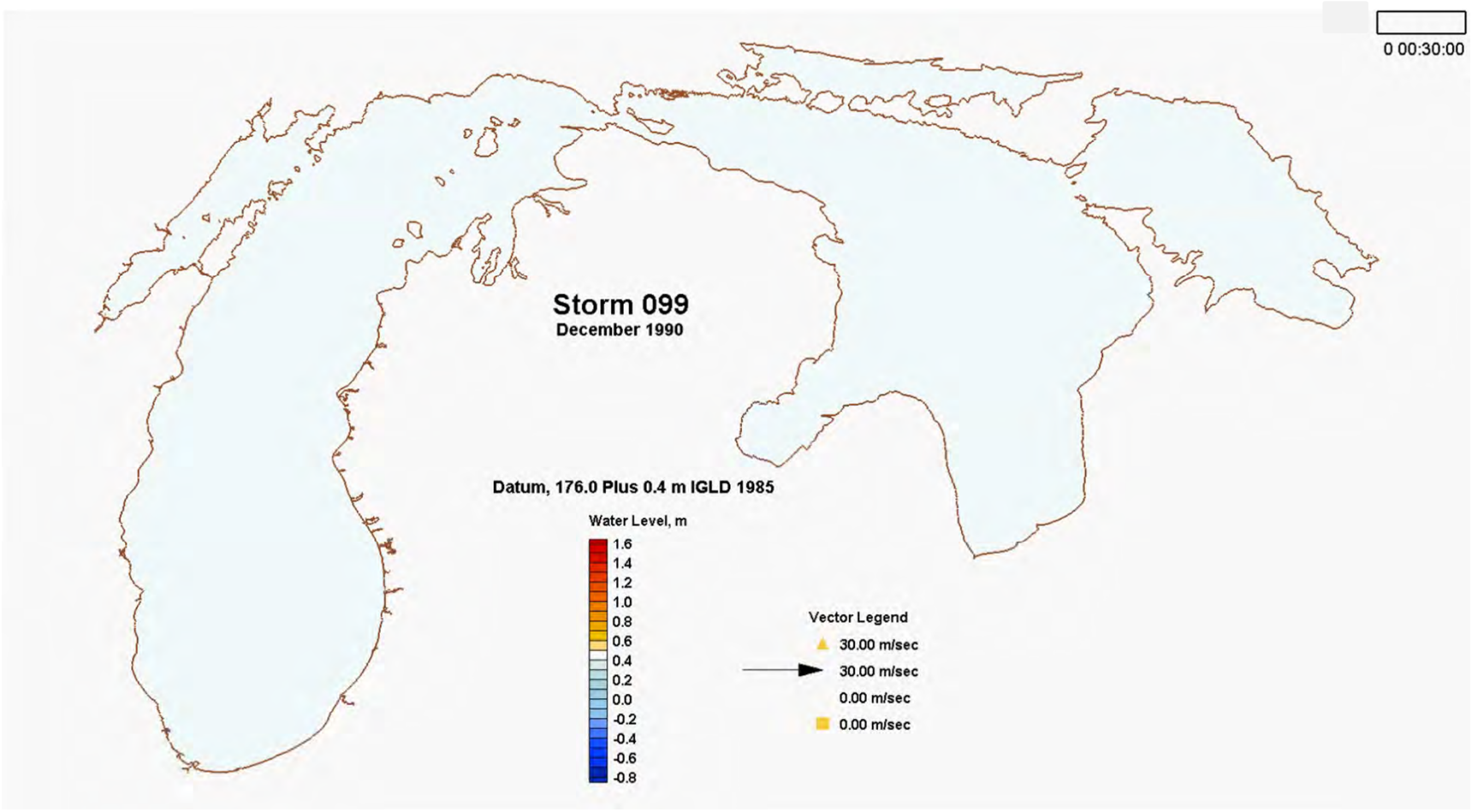
Step 1: Lake Levels



Step 1: Lake Levels



Step 1: Example Surge Behavior



Step 1: Model Accuracy Assessment

Water Level Gauge Station		RMS error (m)	Bias (m)
9075014	Harbor Beach	0.054	0.018
9075080	Mackinaw City	0.061	0.011
9075099	De Tour Village	0.051	0.026
9014098	Fort Gratiot	0.106	0.069
9075002	Lakeport	0.072	0.011
9075035	Essexville	0.103	-0.003
9075059	Harrisville	0.054	0.027
Average		0.071	0.023

Wave Buoy Station		RMS error (m)	Bias (m)
45003	North Lake Huron	0.317	-0.024
45008	South Lake Huron	0.310	0.051
Average		0.313	0.014

Step 2: Nearshore Wave-Induced Flood Hazards

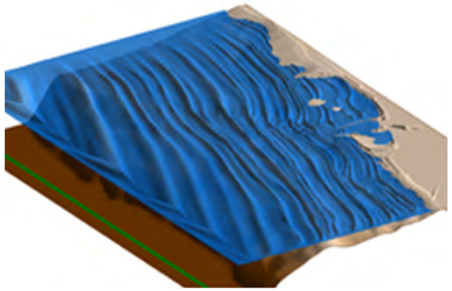
Nearshore Wave-Induced Flood Hazards Analysis includes:

- Shoreline classification
- 2-D Wave and Surge Model data extraction
- Wave setup
- Erosion
- Evaluation of coastal structures
- Wave runup
- Wave overtopping
- Overland wave propagation
- Statistical analysis

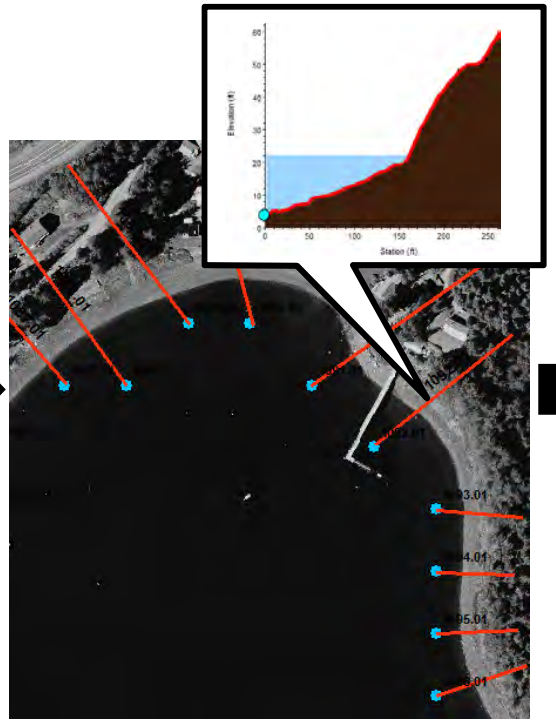
→ Along 1-D Transects

Step 2: Transect Analysis Overview

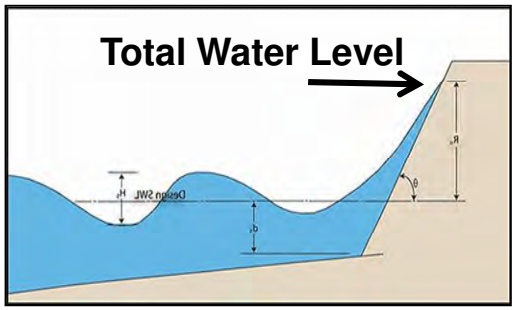
Water Level & Offshore Waves



Transect Analysis



Total Water Level



Total Water Level

- Water Level (Surge)
- Waves
- Setup, Runup and Overtopping

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Step 2: Transect Layout

- Mackinac County (Lake Huron):
  - 37 Analysis Transects
  - 260 Shoreline Miles
- Transects placed at representative shoreline reaches based on:
  - Topography
  - Exposure
  - Shoreline Material
  - Upland Development
- Mackinac County has 30 analysis transects on Lake Michigan

Step 2: Transect Analysis: Wave Setup and Runup

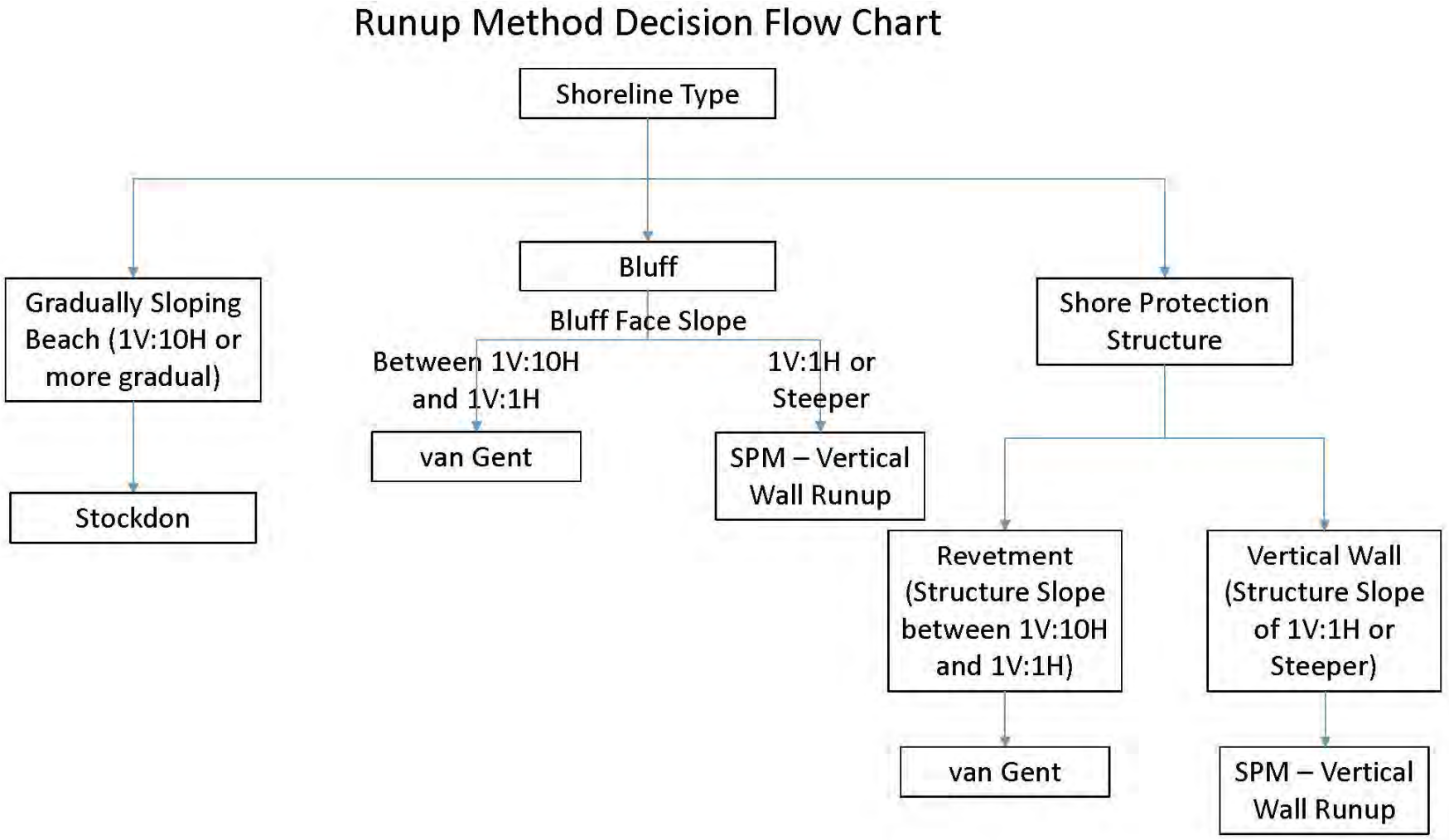
- Wave runup is the uprush of water from wave action on a beach or shore barrier such as a steep dune, bluff or coastal structure.
- Runup was calculated for every time step of each of the 151 storm events at each transect for the response-based approach.
- A statistical analysis was performed on the maximum runup results at each transect to obtain the 1-percent-annual-chance runup elevation.

Wave Height
Wave Period
SWEL
Profile Slope

→

Wave Setup
Wave Runup

Response-Based Wave Runup



Step 2: Runup

Step 2: Transect Analysis: Wave Overtopping

- If wave runup exceeds the barrier crest elevation, overtopping occurs.
- Overtopping rates are calculated using methods described in the EurOTop Manual
- Overtopping rates determine VE splash zones and AO Zone (sheet flow) depths

Step 2: Wave Overtopping

Step 2: Wave Overtopping – Plateau Method

- When overtopping occurs, the zone behind the barrier is designated as:
  - AE if landward slope is positive
  - AO if landward slope is negative
- Inland extent of overtopping mapping generally follows the 1-percent-annual-chance BFE contour
- Plateau method allows for an inland limit of runup to be calculated as the AE zone extent for gradually sloping upland areas behind a steep barrier
- Mapping extends to the seaward-most of the BFE contour or the inland extent of flooding

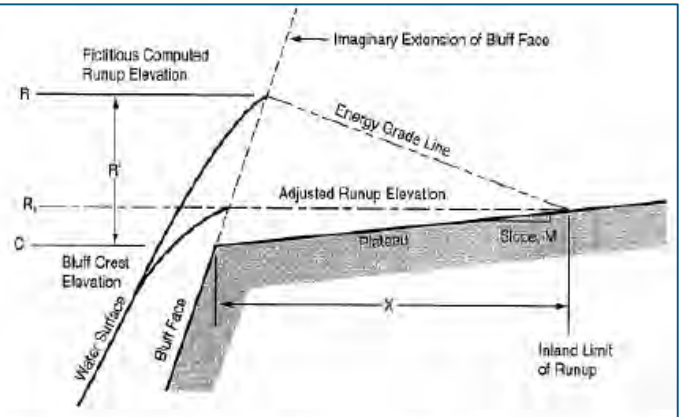


Figure D.3.5-3: Treatment of Runup onto Plateau above Low Bluff

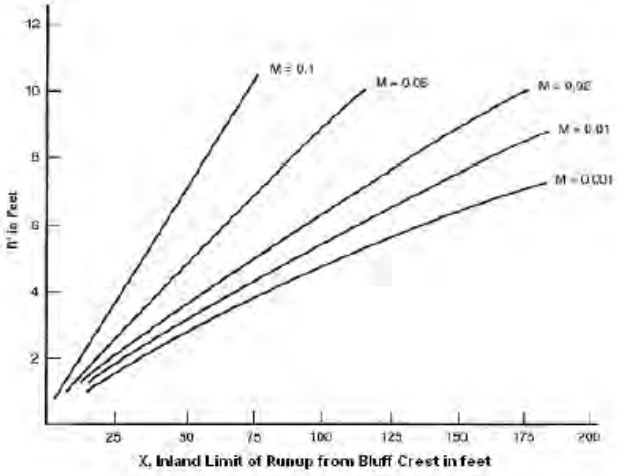
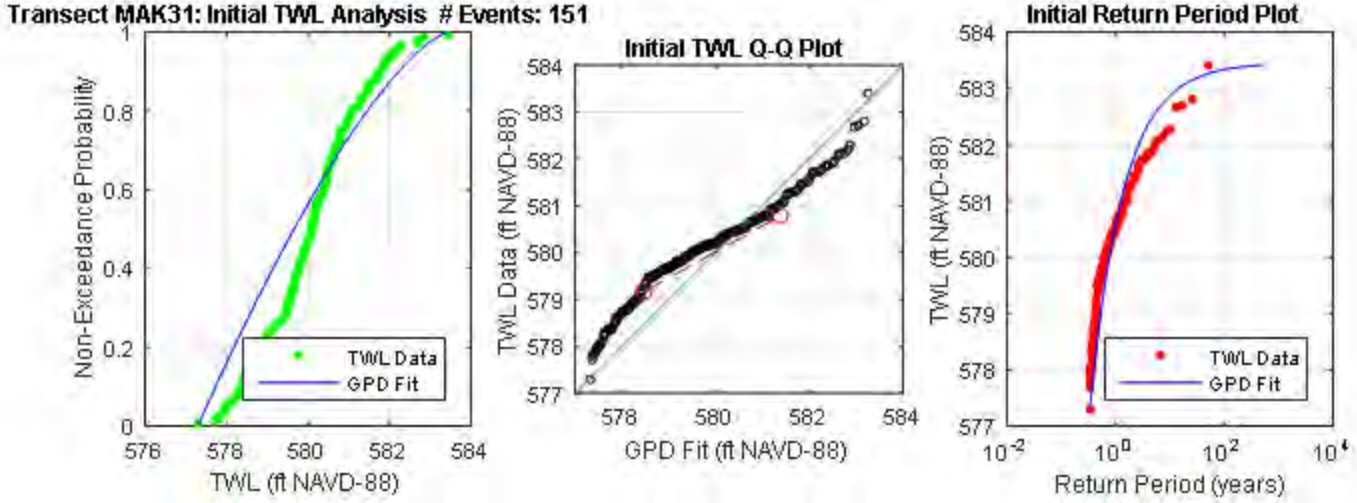


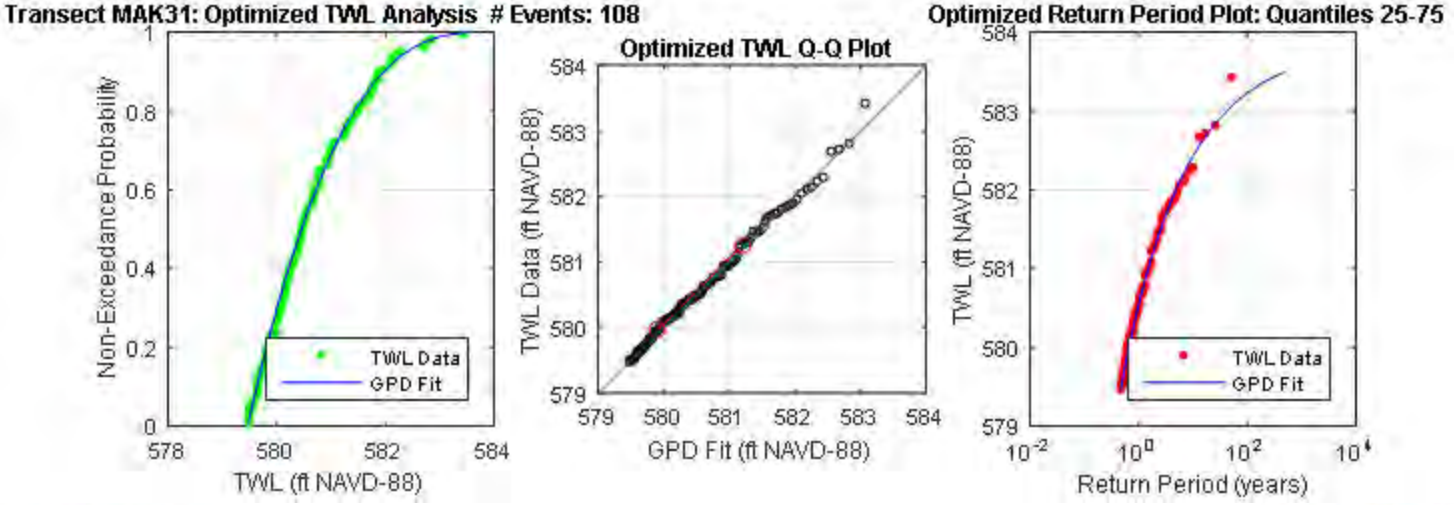
Figure D.3.5-4: Curves for Computation of Runup Inland of Low Bluffs

Step 2: Compute Setup, Runup, and Overtopping

- 151 storms with hourly waves and water levels yields hourly wave setup, runup and overtopping rates
- Hourly Still Water Levels (SWELs)
- Hourly Water Levels + Setup + Runup = Hourly Total Water Levels (TWLs)
- Extract the Peak SWEL and TWL from each storm
- Perform Return Period Analysis on SWEL and TWL
- 1-percent-annual-chance TWEL is used to define the Base Flood Elevation (BFE)

Step 2: Return Period Analysis

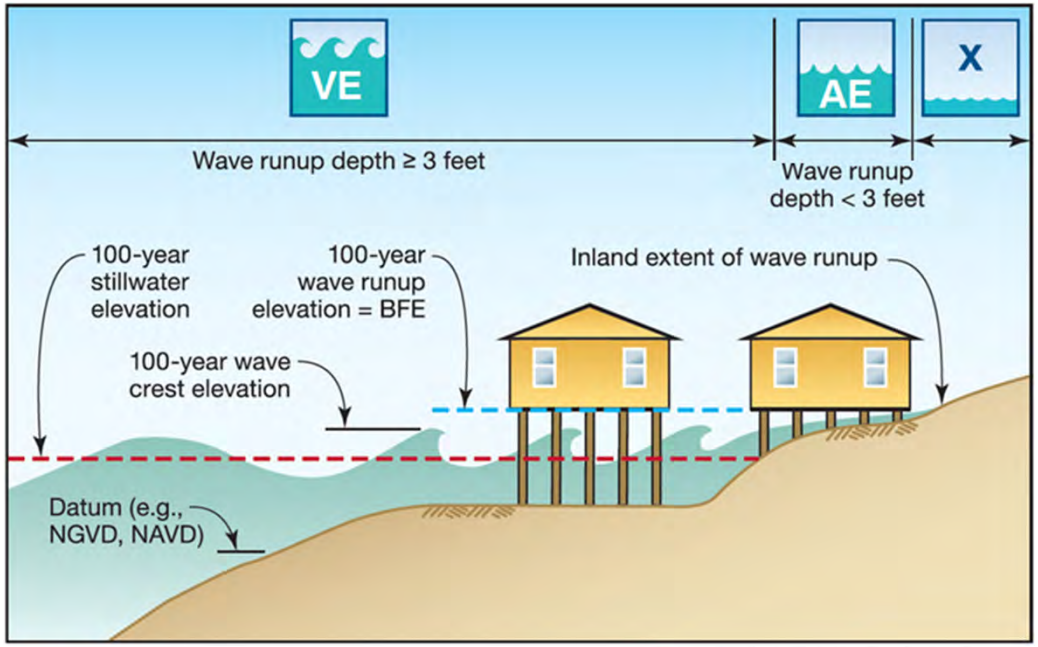




Step 3: Mapping

Coastal Flood Hazard Zones

- Zone VE:
  - Represents coastal high hazard areas
  - Wave heights ≥ 3ft
  - Wave runup ≥ 3ft above ground elevation
  - Overtopping splash zones
  - BFEs are assigned
- Zone AE:
  - Inundation areas
  - Wave heights < 3ft
  - Wave runup < 3ft above ground elevation
  - BFEs are assigned
- Zone AO:
  - Applied in areas of sheet-flow shallow flooding
  - Designated with depths of 1-, 2-, or 3-ft
- Zone Shaded-X:
  - Areas impacted by the 0.2-percent-annual-chance event



Step 3: Zone Breaks

- Zone breaks are placed along the coast where the characteristics of the shoreline transition from one shore type to another
- Define the extents of each representative shoreline reach

Step 3: Runup VE Zones

- Runup VE zones are limited to steep face of beaches, bluffs, revetments, and other similar coastal barriers.
- Runup mapped to elevation associated with BFE or structure crest elevation.
- VE/AE transition occurs where runup is less than 3 feet above ground elevation.
- Where Plateau Method is applied, mapping extends to the seaward-most of the BFE contour or the inland extent of flooding.

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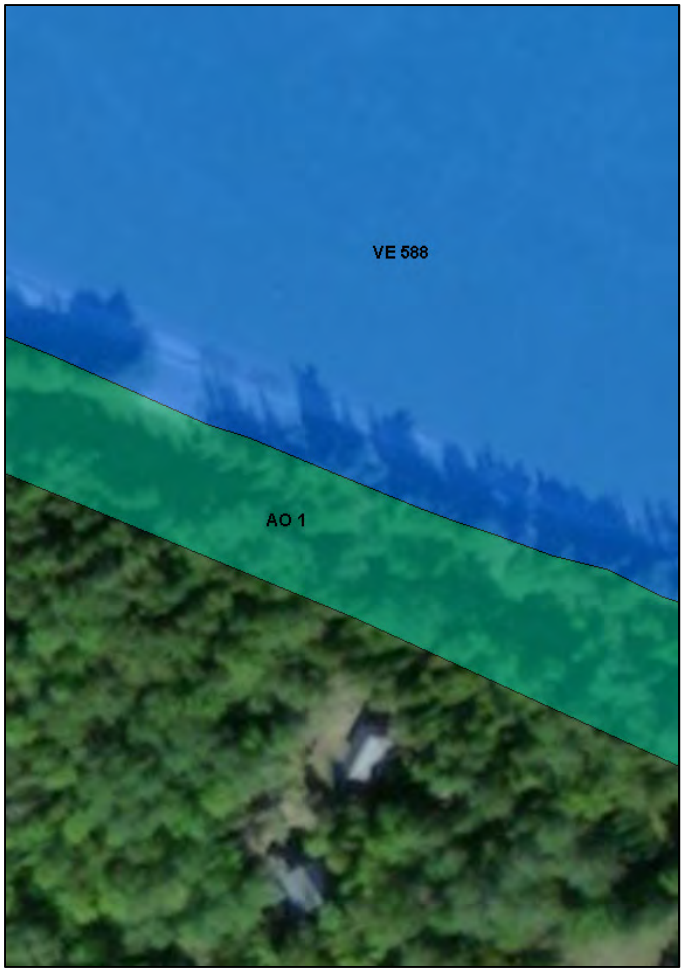
Step 3: Overtopping Zones

AO Zones

- Applied in areas of shallow flooding, usually sheet flow on sloping terrain
- BFE not provided, instead average flood depth between one and three feet is specified
- Flood depth determined based on overtopping rate

$\overline{Q}$ Order of Magnitude	Flood insurance risk zone Behind Barrier
<0.0001 cfs/ft	Zone X
0.0001-0.01 cfs/ft	Zone AO (1 foot depth) or Zone AE with BFE
0.01-0.1 cfs/ft	Zone AO (2 foot depth) or Zone AE with BFE
0.1-1.0 cfs/ft	Zone AO (3 foot depth) or Zone AE with BFE
>1.0 cfs/ft*	30-foot width^{+} of Zone VE (elevation 3 feet above barrier crest), landward Zone AO (3 foot depth) or Zone AE with BFE

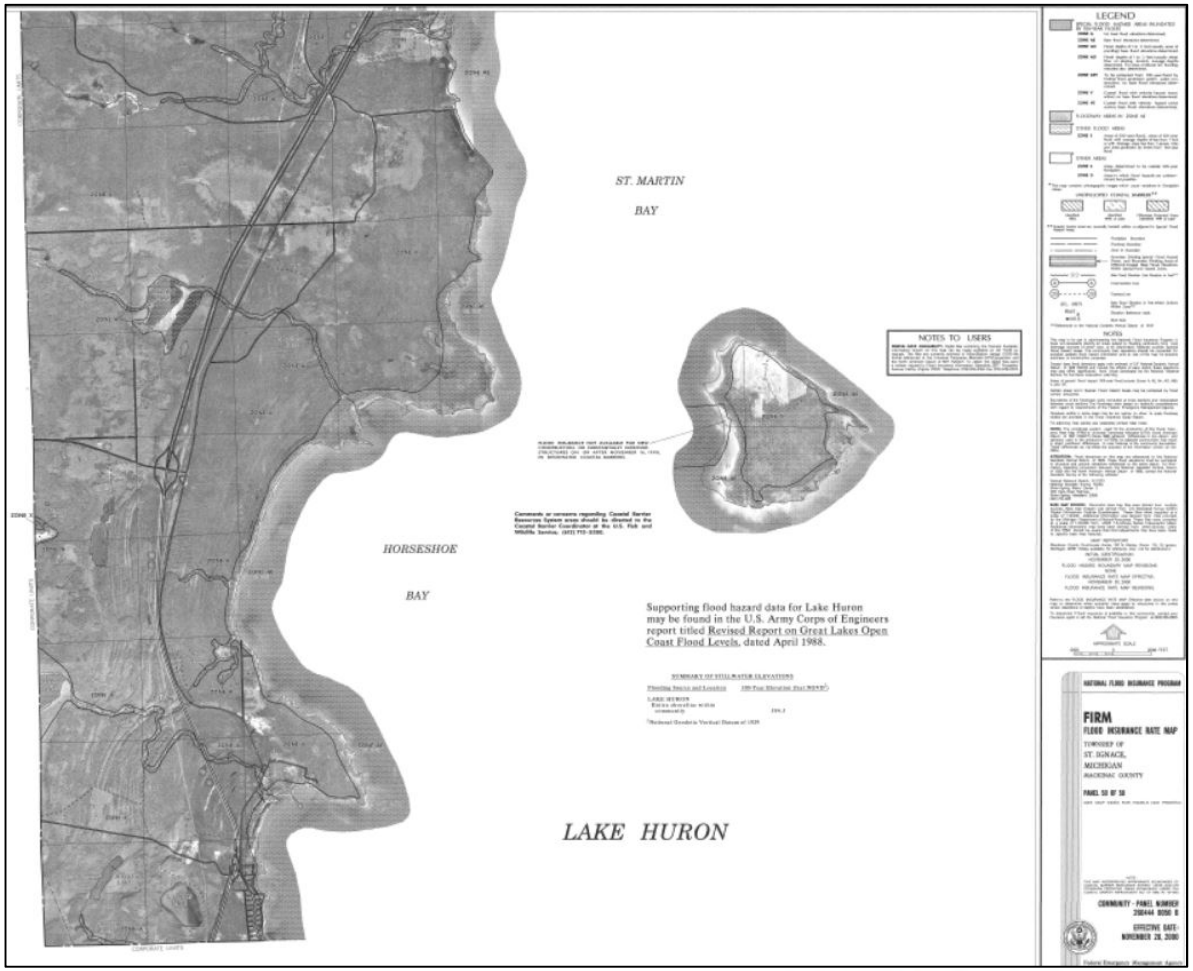


Step 3: SWEL Inundation

Draft Work Map vs FIS/FIRM

Mackinac County, MI Workmap

Mackinac County, MI Effective FIRM



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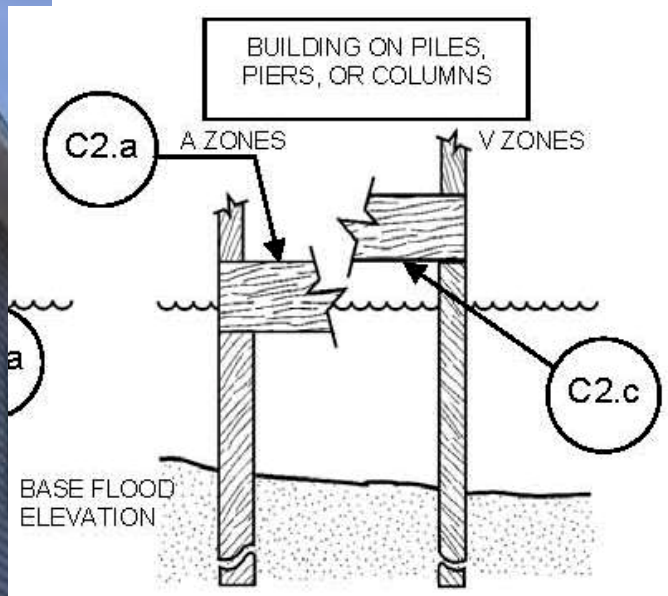
FEMA FLOODPLAIN MANAGEMENT

V-zone Floodplain Management : 44 CFR 60.3(e)

The community must require that all new construction and substantial improvements have the lowest horizontal structural member of the lowest floor elevated to or above the base flood level,

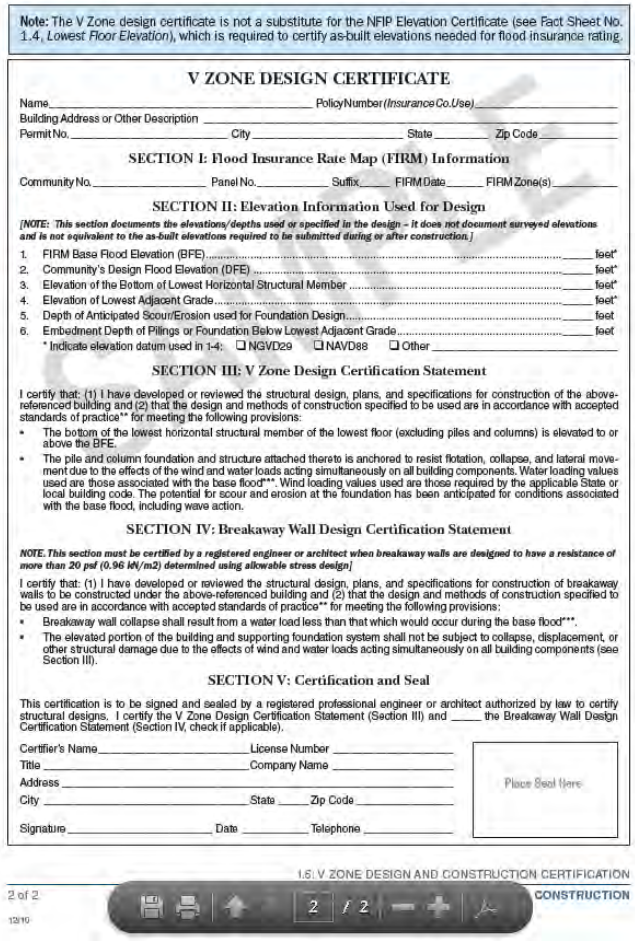
> … with the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls …

Lowest Horizontal Structural Member



Other key standards in Zone VE:

- Fill for structural support is prohibited
- Elevated portion of the building and piling/column foundation must be designed to withstand water and wind loads acting simultaneously under base flood conditions
- Structural design, specifications and plans for construction must be developed or reviewed and certified by a registered professional engineer or architect



Note: The V Zone design certificate is not a substitute for the NFIP Elevation Certificate (see Fact Sheet No. 1.4, *Lowest Floor Elevation*), which is required to certify as-built elevations needed for flood insurance rating.

V ZONE DESIGN CERTIFICATE

Name _____ Policy Number *(Insurance Co. Use)* _____
Building Address or Other Description _____
Permit No. _____ City _____ State _____ Zip Code _____

SECTION I: Flood Insurance Rate Map (FIRM) Information

Community No. _____ Panel No. _____ Suffix _____ FIRM Date _____ FIRM Zone(s) _____

SECTION II: Elevation Information Used for Design

[NOTE: This section documents the elevations/depths used or specified in the design – it does not document surveyed elevations and is not equivalent to the as-built elevations required to be submitted during or after construction.]

1. FIRM Base Flood Elevation (BFE) _____ feet*
2. Community's Design Flood Elevation (DFE) _____ feet*
3. Elevation of the Bottom of Lowest Horizontal Structural Member _____ feet*
4. Elevation of Lowest Adjacent Grade _____ feet*
5. Depth of Anticipated Scour/Erosion used for Foundation Design _____ feet
6. Embedment Depth of Pilings or Foundation Below Lowest Adjacent Grade _____ feet

* Indicate elevation datum used in 1-4: ❑ NGVD29 ❑ NAVD88 ❑ Other _____

SECTION III: V Zone Design Certification Statement

I certify that: (1) I have developed or reviewed the structural design, plans, and specifications for construction of the above-referenced building and (2) that the design and methods of construction specified to be used are in accordance with accepted standards of practice** for meeting the following provisions:

- The bottom of the lowest horizontal structural member of the lowest floor (excluding piles and columns) is elevated to or above the BFE.
- The pile and column foundation and structure attached thereto is anchored to resist flotation, collapse, and lateral movement due to the effects of the wind and water loads acting simultaneously on all building components. Water loading values used are those associated with the base flood***. Wind loading values used are those required by the applicable State or local building code. The potential for scour and erosion at the foundation has been anticipated for conditions associated with the base flood, including wave action.

SECTION IV: Breakaway Wall Design Certification Statement

NOTE: This section must be certified by a registered engineer or architect when breakaway walls are designed to have a resistance of more than 20 psf (0.96 kN/m2) determined using allowable stress design.

I certify that: (1) I have developed or reviewed the structural design, plans, and specifications for construction of breakaway walls to be constructed under the above-referenced building and (2) that the design and methods of construction specified to be used are in accordance with accepted standards of practice** for meeting the following provisions:

- Breakaway wall collapse shall result from a water load less than that which would occur during the base flood***.
- The elevated portion of the building and supporting foundation system shall not be subject to collapse, displacement, or other structural damage due to the effects of wind and water loads acting simultaneously on all building components (see Section III).

SECTION V: Certification and Seal

This certification is to be signed and sealed by a registered professional engineer or architect authorized by law to certify structural designs. I certify the V Zone Design Certification Statement (Section III) and _____ the Breakaway Wall Design Certification Statement (Section IV, check if applicable).

Certifier's Name _____ License Number _____
Title _____ Company Name _____
Address _____
City _____ State _____ Zip Code _____
Signature _____ Date _____ Telephone _____

Place Seal Here

1.6 V ZONE DESIGN AND CONSTRUCTION CERTIFICATION
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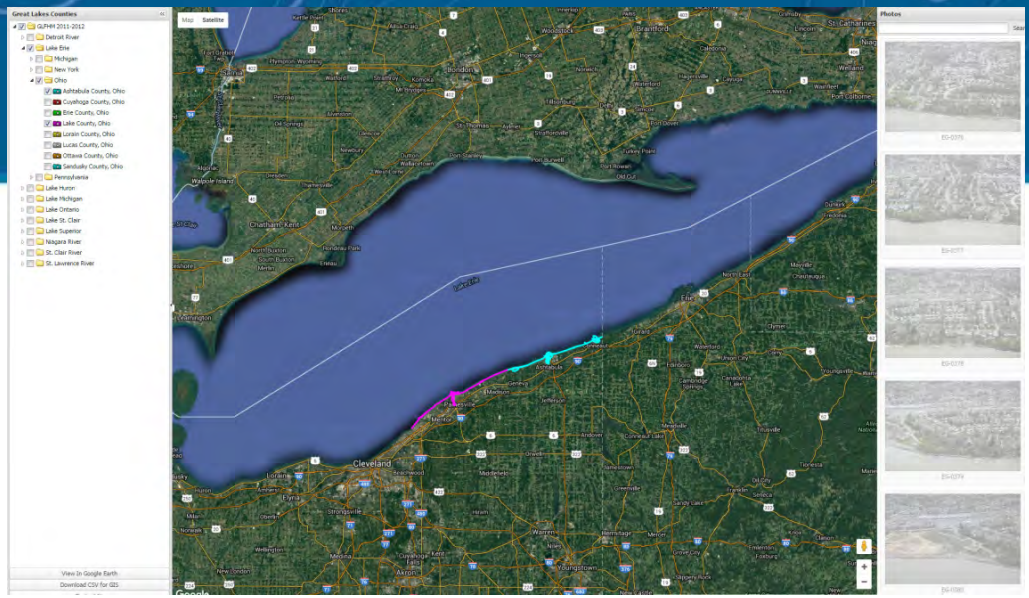
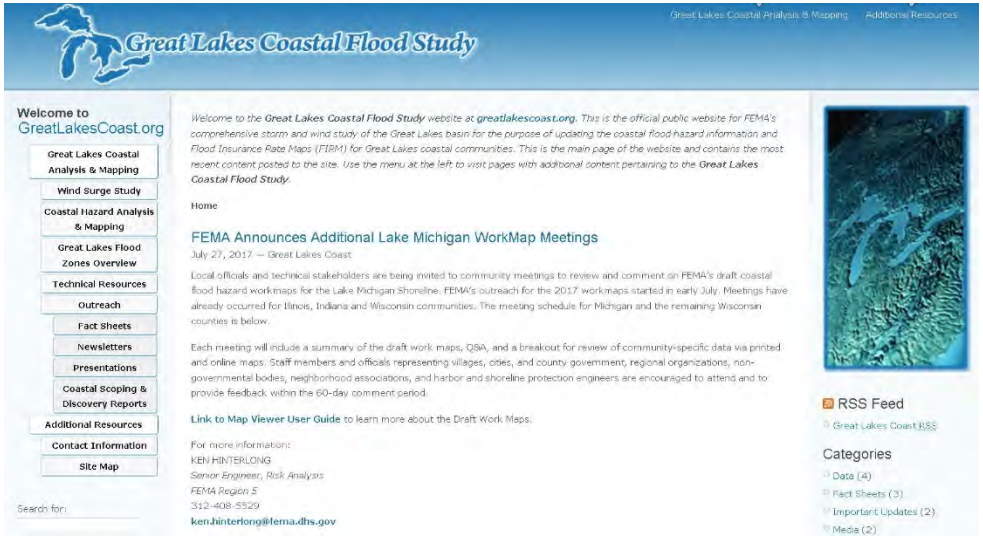
CONSTRUCTION

Online Resources

High resolution oblique aerial images
https://greatlakes.erdc.dren.mil/



Great Lakes Coastal Flood Study
http://www.greatlakescoast.org



Great Lakes Coastal Resilience Planning:
http://www.greatlakesresilience.org/

FEMA

RiskMAP
Increasing Resilience Together

Mackinac County, MI

NEXT STEPS

Comments

Send comments via email to brett.holthaus@atkinsglobal.com or mail to:

Great Lakes Coastal Flood Study
Comment Repository
c/o Atkins
Attn: Brett Holthaus
3901 Calverton Boulevard, Suite 400
Calverton, MD 20705

Include county, community, map panel number, description of area (screenshots or drawings are very helpful), detailed comment, and contact information

- You will receive acknowledgement of receipt of your comment within 3 business days
- Within 3 weeks, FEMA's response will indicate if enough technical justification was provided to necessitate a map change
- If you are not satisfied with a comment response on technical grounds, consider using the appeal process during Preliminary FIRM rollout

Next Steps

60 day review and comment period ends August 19, 2018.

FEMA's next steps:

1. Inventory all comments received
2. Evaluate and incorporate comments and data as appropriate
3. Move studies into the NFIP regulatory process (developing FIRMs)

FEMA Contacts

KEN HINTERLONG
Senior Engineer, Risk Analysis
FEMA Region 5
312-408-5529
ken.hinterlong@fema.dhs.gov

COMMENT REPOSITORY:

Send comments via email to
brett.holthaus@atkinsglobal.com
or mail to:

Great Lakes Coastal Flood Study
Comment Repository
c/o Atkins
Attn: Brett Holthaus
3901 Calverton Boulevard, Suite 400
Calverton, MD 20705

Questions?

FEMA

Thank you for your participation!