



Bay County, MI Coastal Hazard Analysis Flood Risk Review Meeting

May 14, 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
- ▶ Work map Review



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Bay County, MI

COASTAL FLOOD RISK STUDY AND MAPPING PROGRAM

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



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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



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Bay County, MI

CURRENT STATUS REVIEW

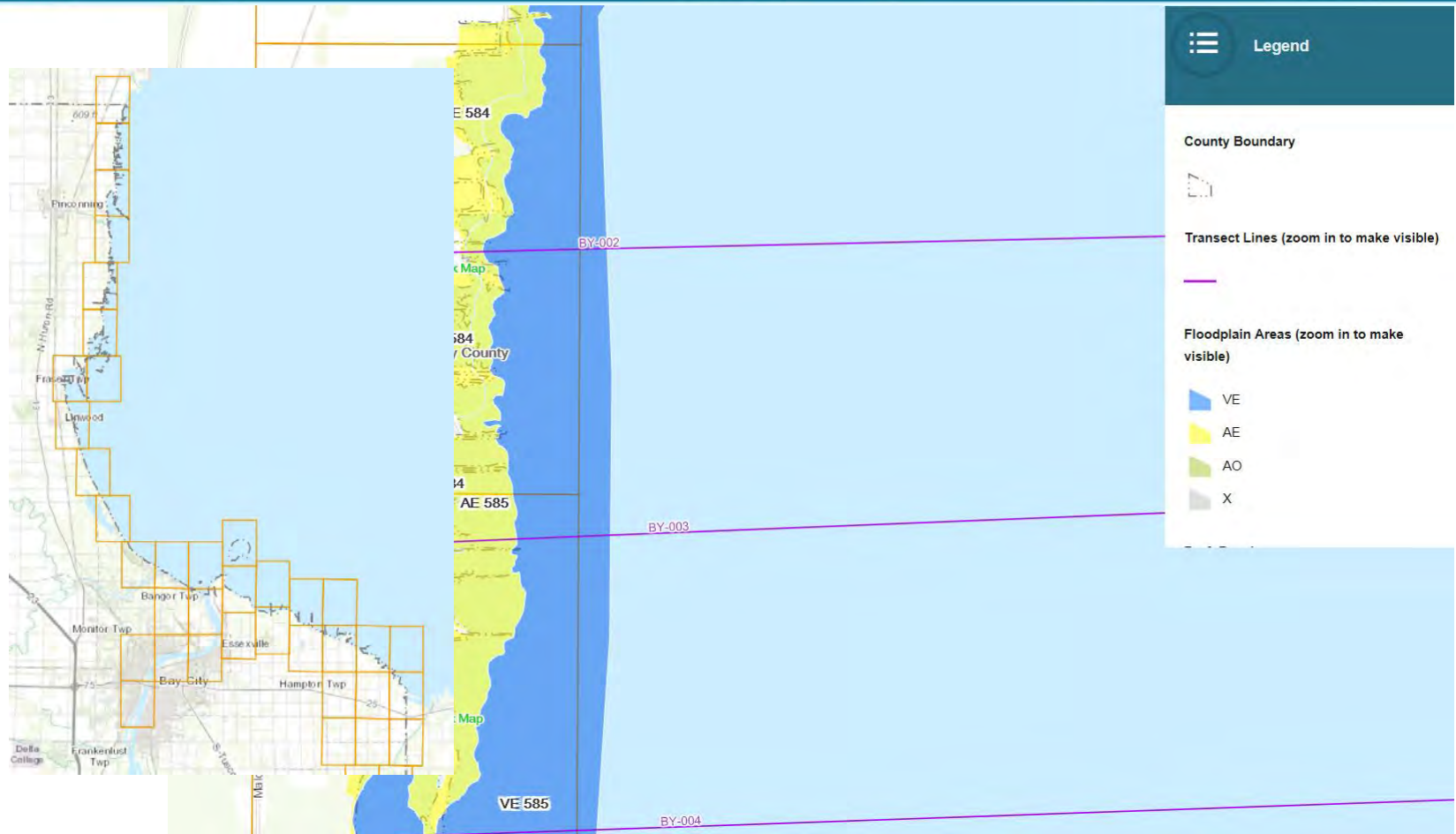
Current Study Status

You are here →



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Work Map Data Viewer: Online GIS Data

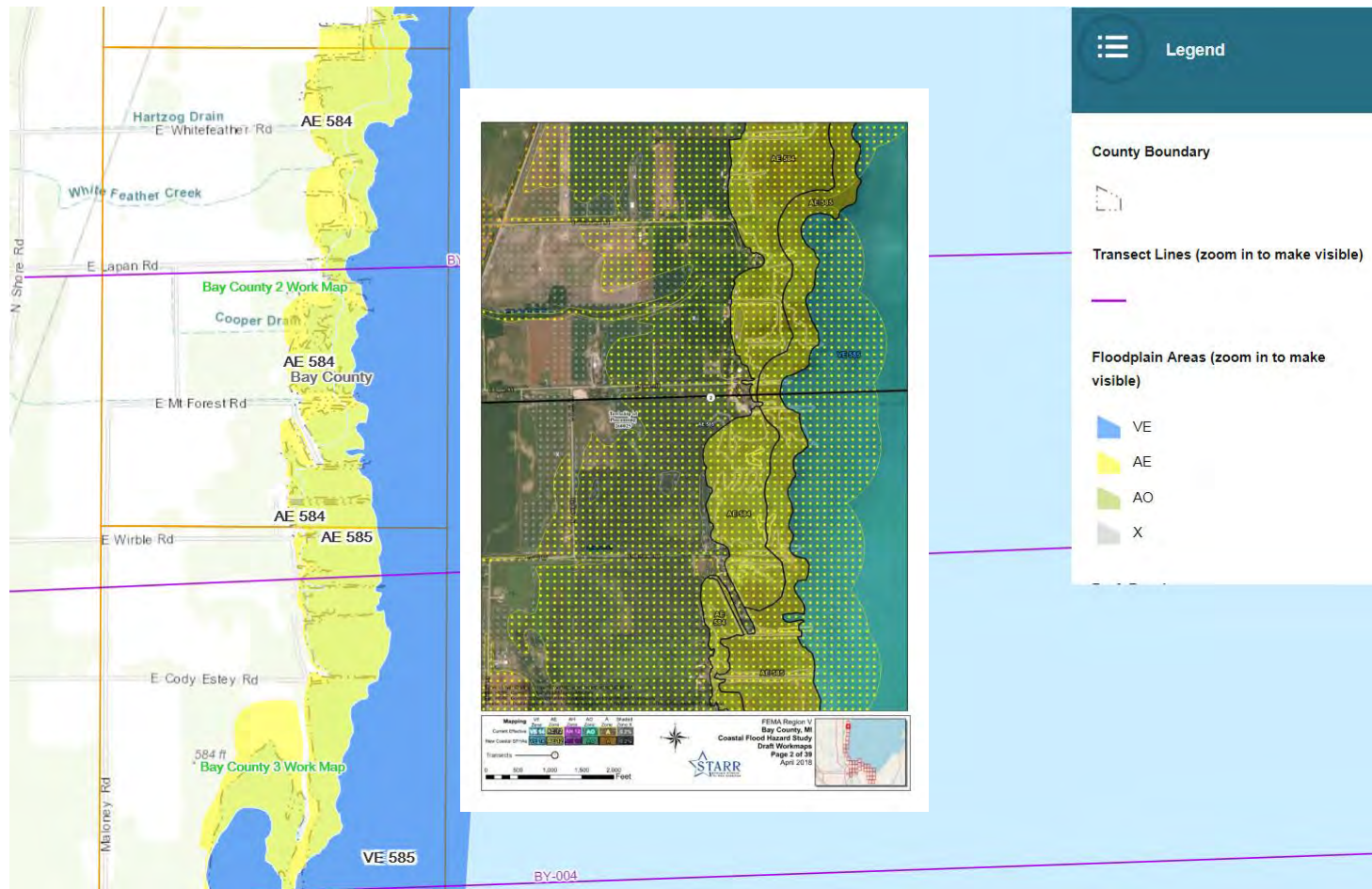


Link to the Bay County, MI Work Map Data Viewer: <http://arcg.is/49Ty5>



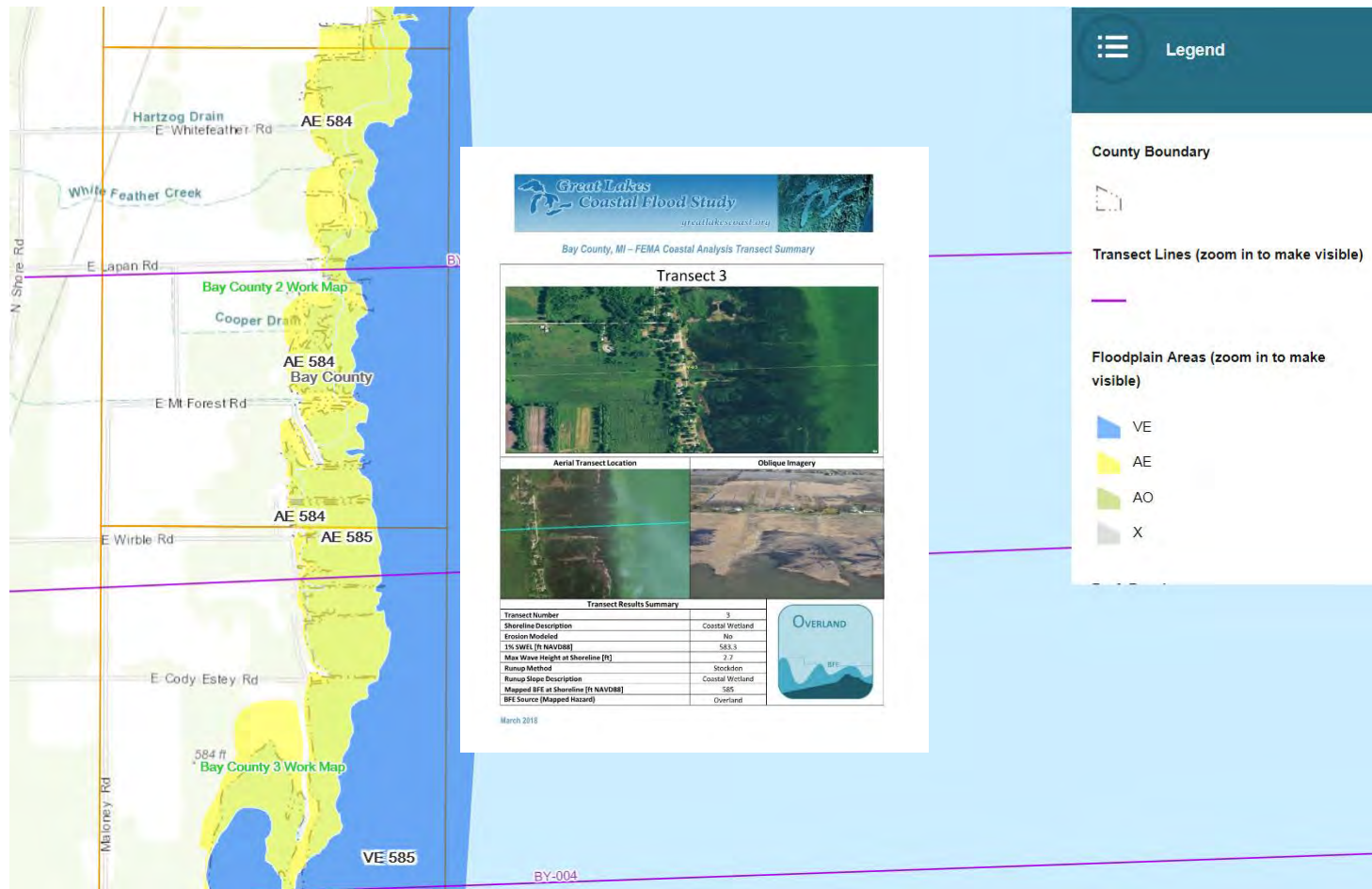
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Work Map Data Viewer: Maps



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Work Map Data Viewer: Transect Summary Sheets



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Bay County, MI

TECHNICAL OVERVIEW OF STUDY AND MAPPING

Coastal Flood Hazard Modeling Overview

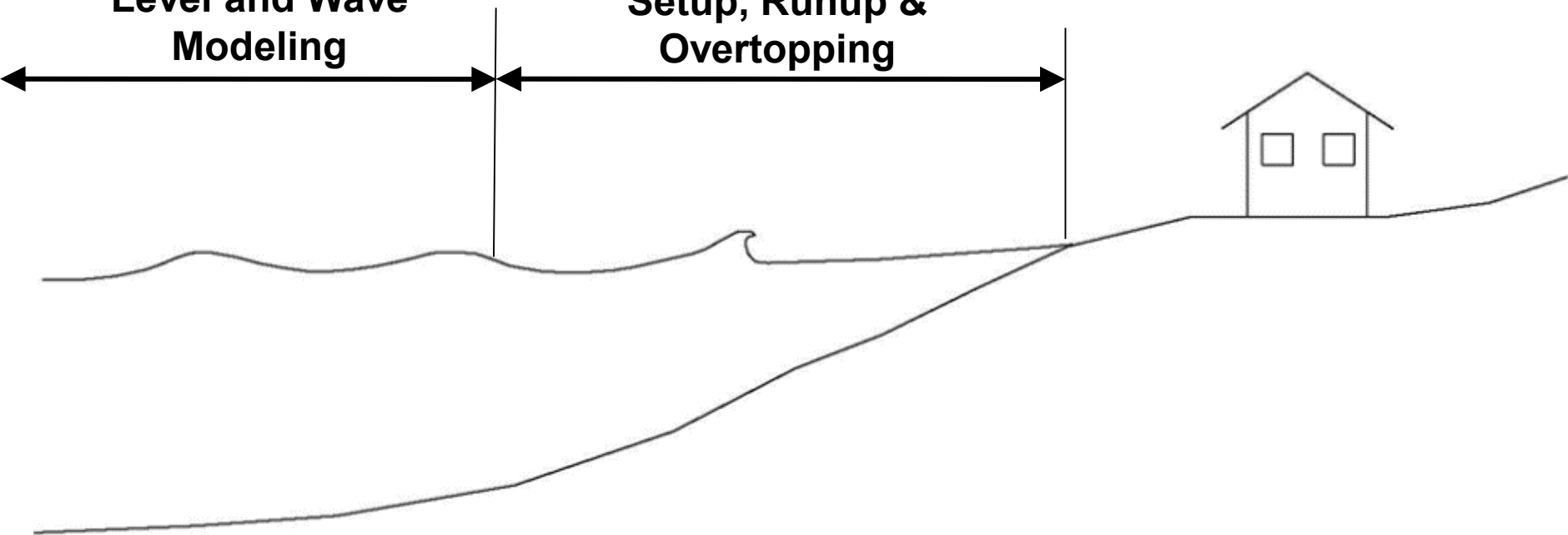
Lake-Wide Variation

Local Variation

Step 1: Offshore Water Level and Wave Modeling

Step 2: Nearshore Wave Setup, Runup & Overtopping

Step 3: Floodplain Mapping



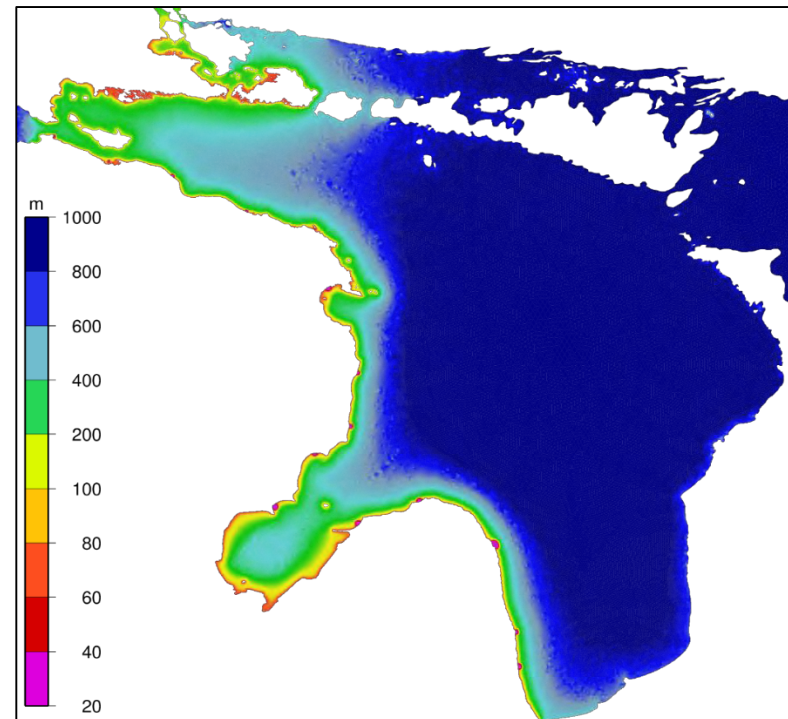
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Step 1: ADCIRC+SWAN Mesh



► Resolution as fine as 10 m along complex shoreline features including:

- Jetties
- Breakwaters
- Inlets
- Natural Shoals

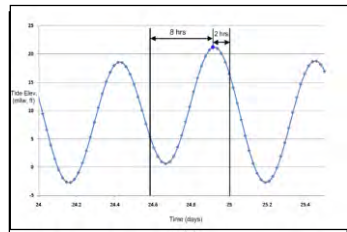


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Step 1: Run the Models

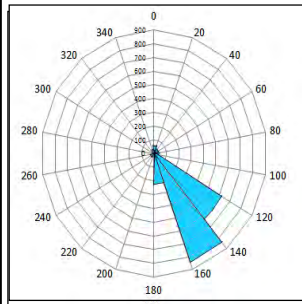
Baseline

Water Level

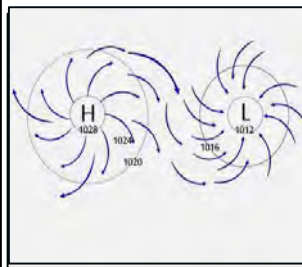


Meteorological Forcing

Wind



Pressure

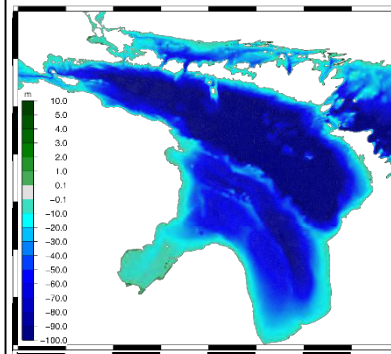


Ice



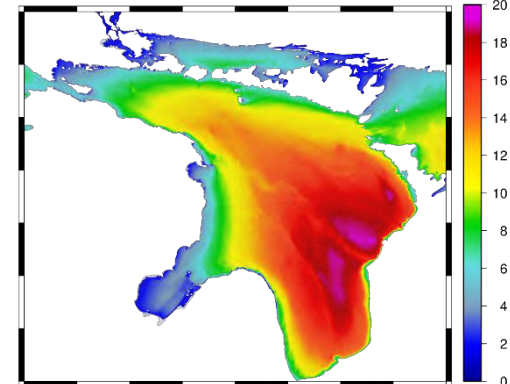
Physical Setting

Bathymetry



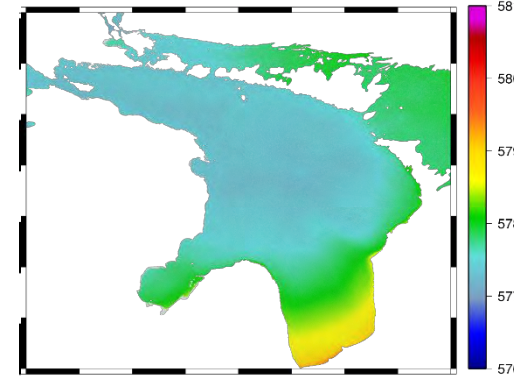
Waves

Storm #073, Lake Huron Sig. Wave Heights (ft)



Still Water Elevations

Storm #073, Lake Huron Max SWEL (ft, IGLD85)

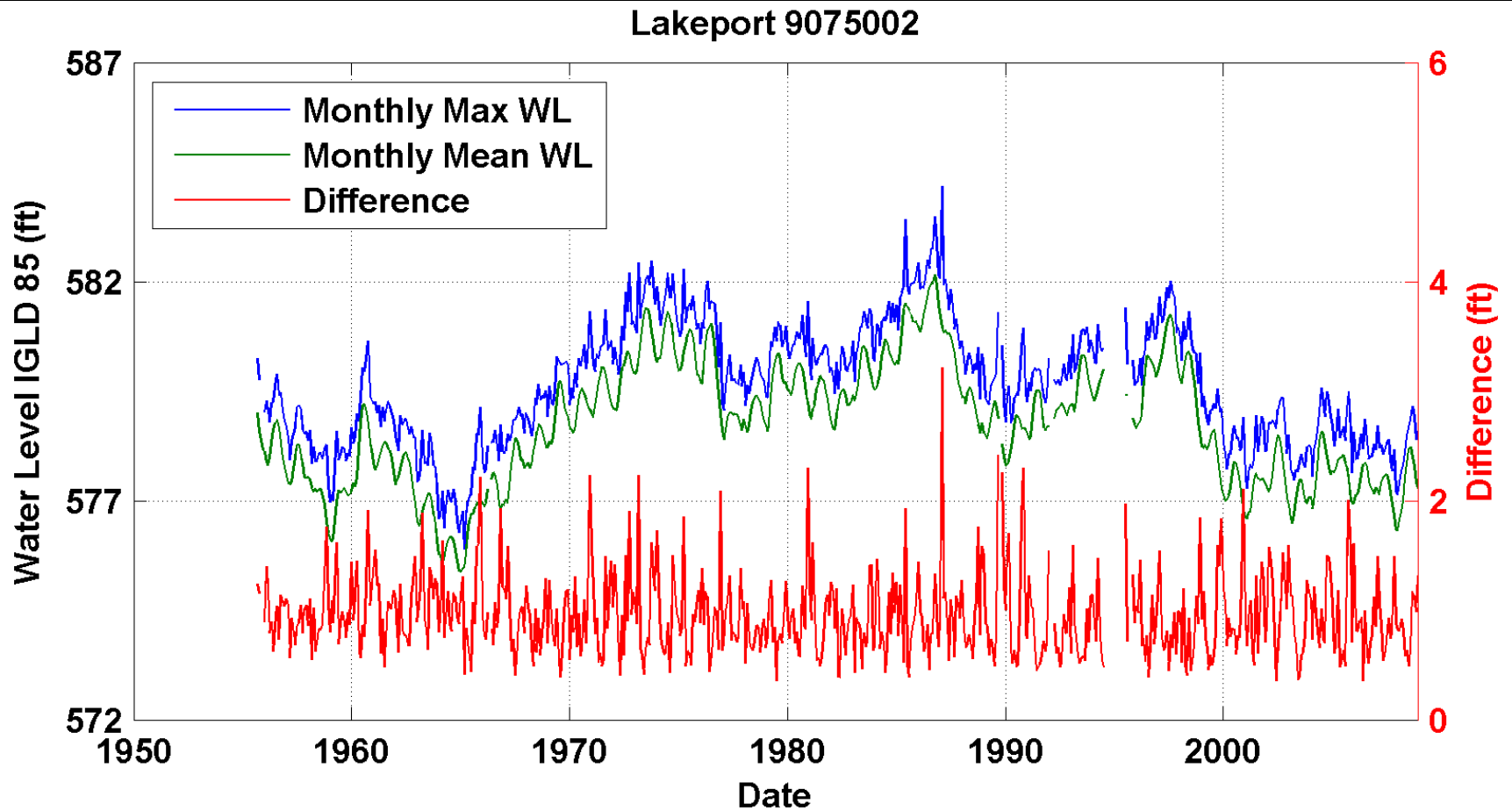


Total of 151 events between 1960-2009



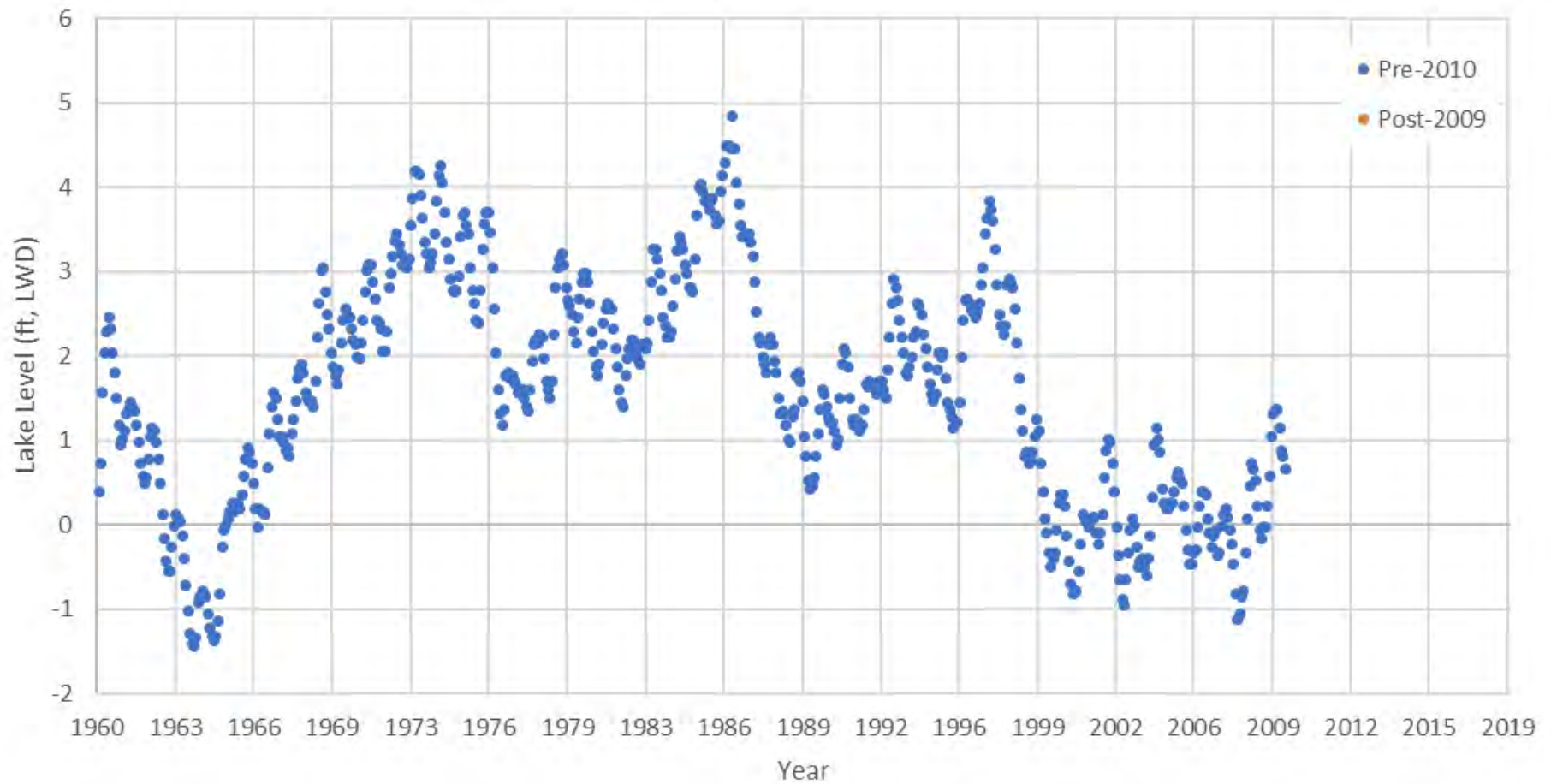
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Step 1: Lake Levels



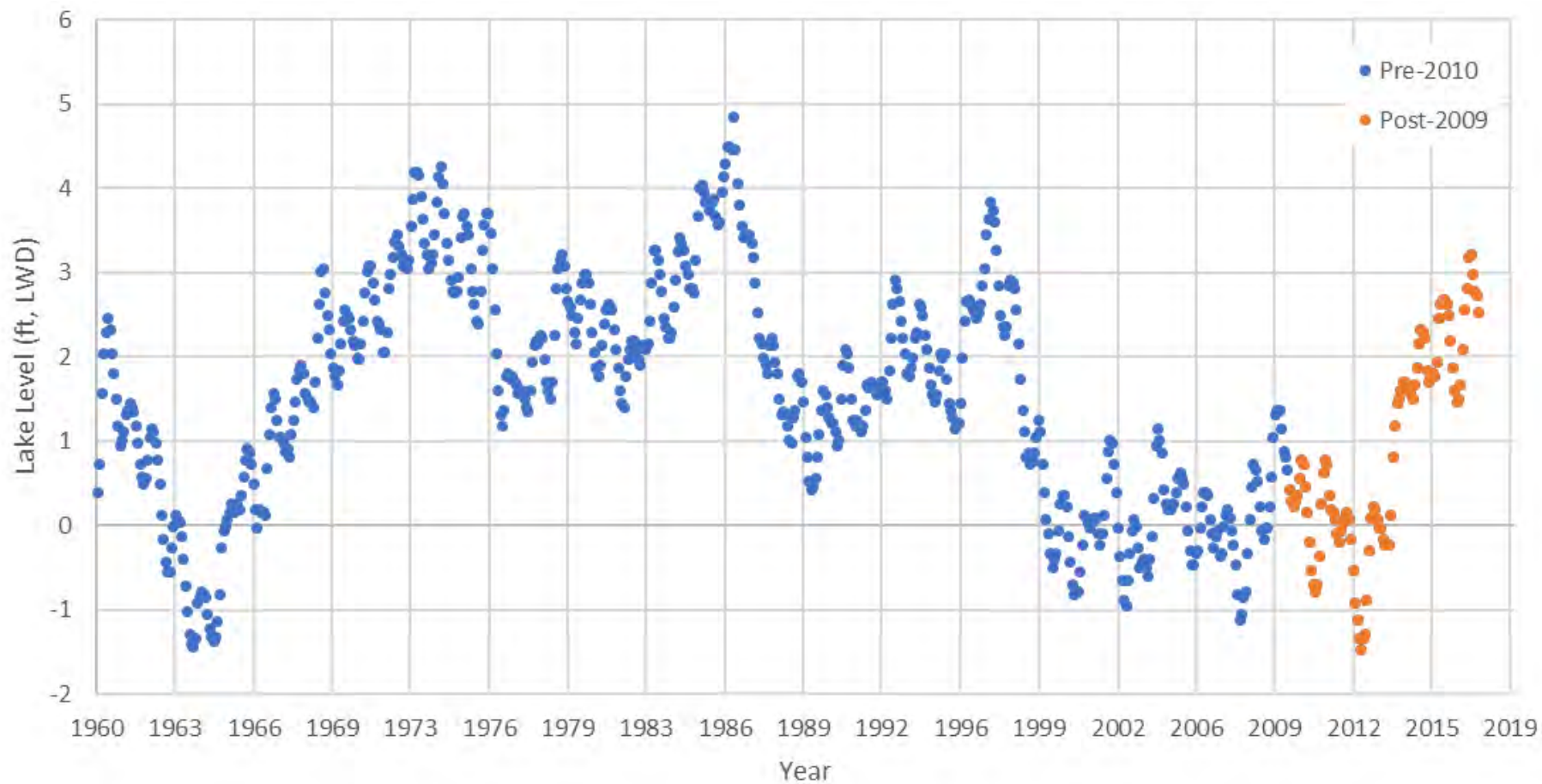
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Step 1: Lake Levels



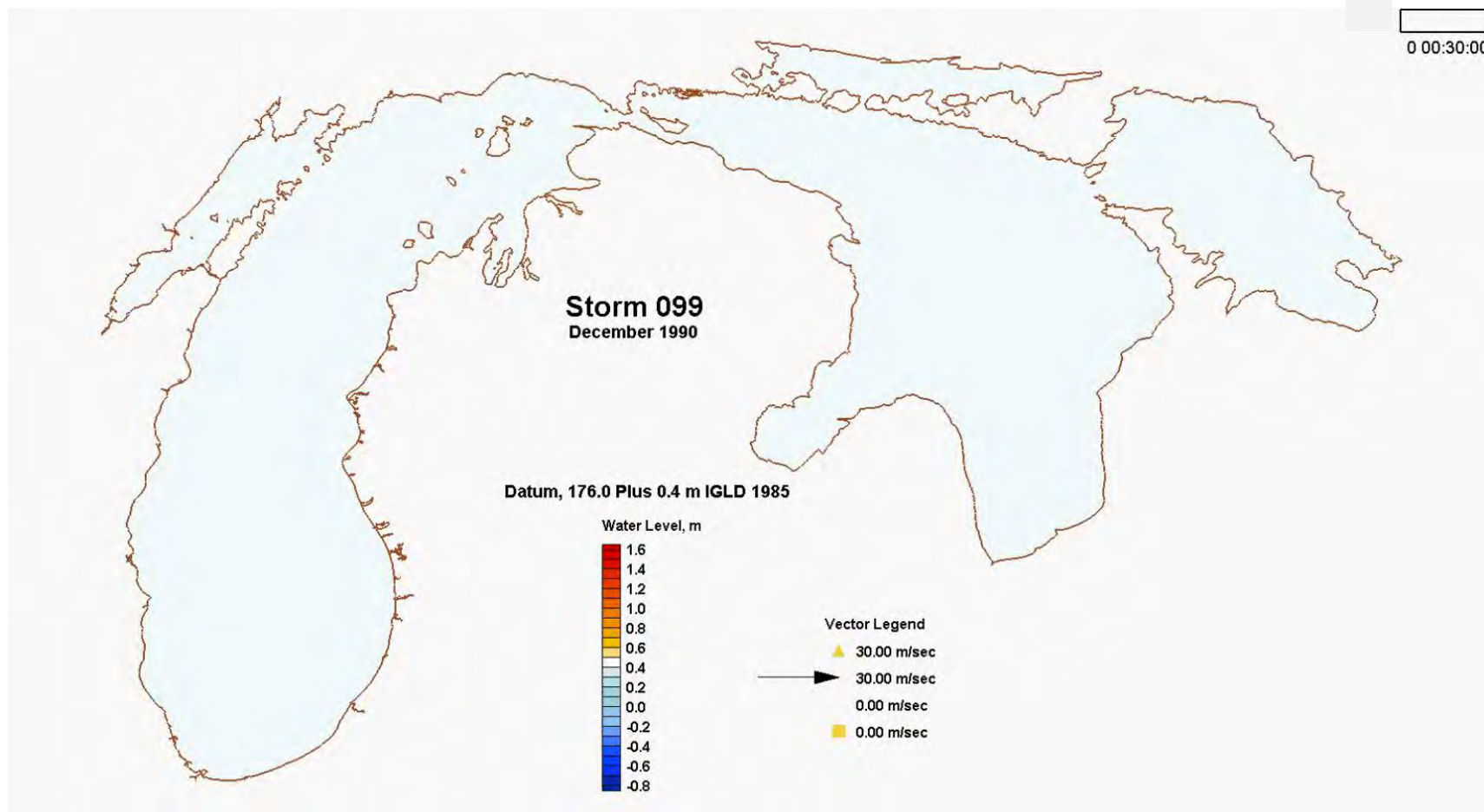
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Step 1: Lake Levels



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Step 1: Example Surge Behavior



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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



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Step 2: Nearshore Wave-Induced Flood Hazards

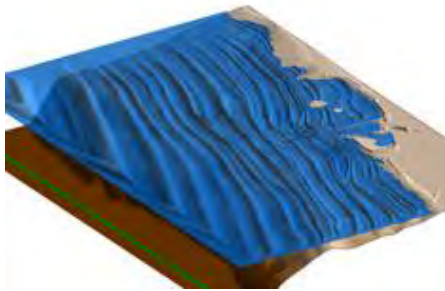
Nearshore Wave-Induced Flood Hazards Analysis includes:

- 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

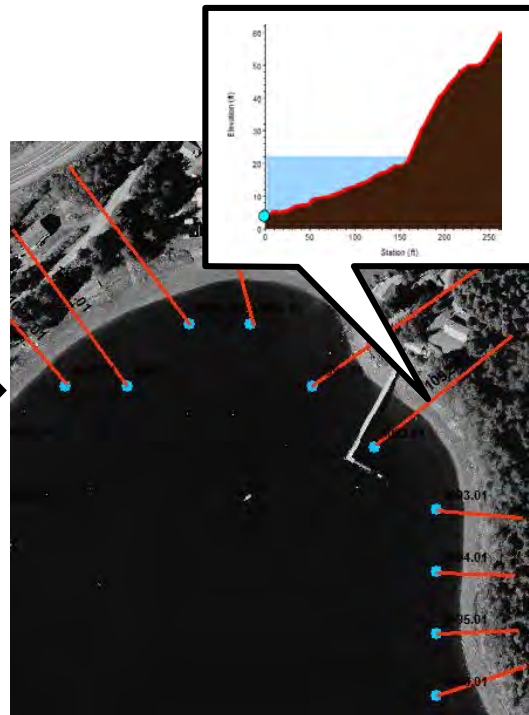
Along 1-D Transects

Step 2: Transect Analysis Overview

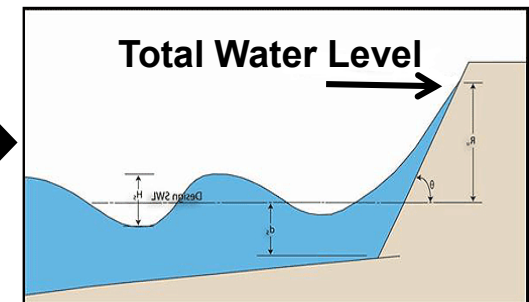
Water Level & Offshore Waves



Transect Analysis



Total Water Level

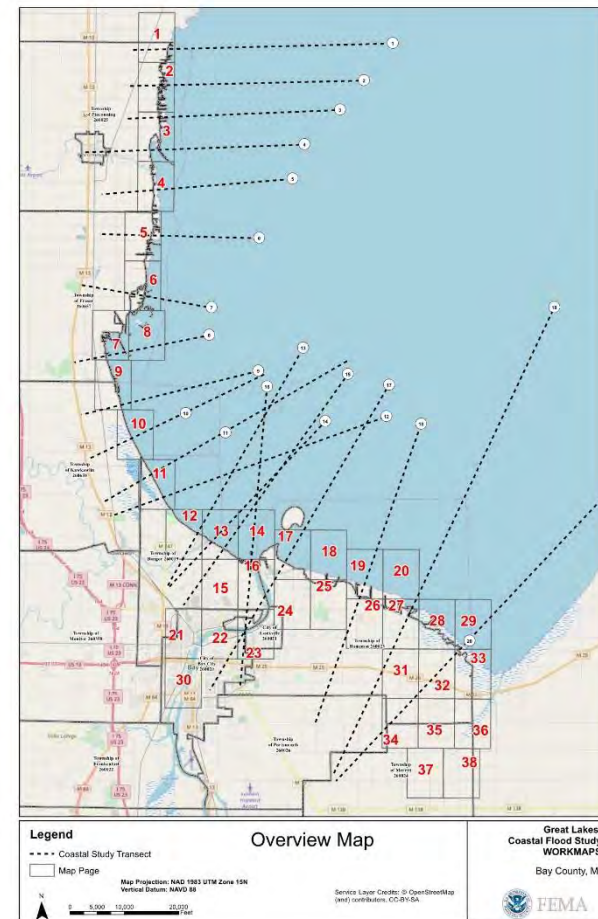


Total Water Level

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

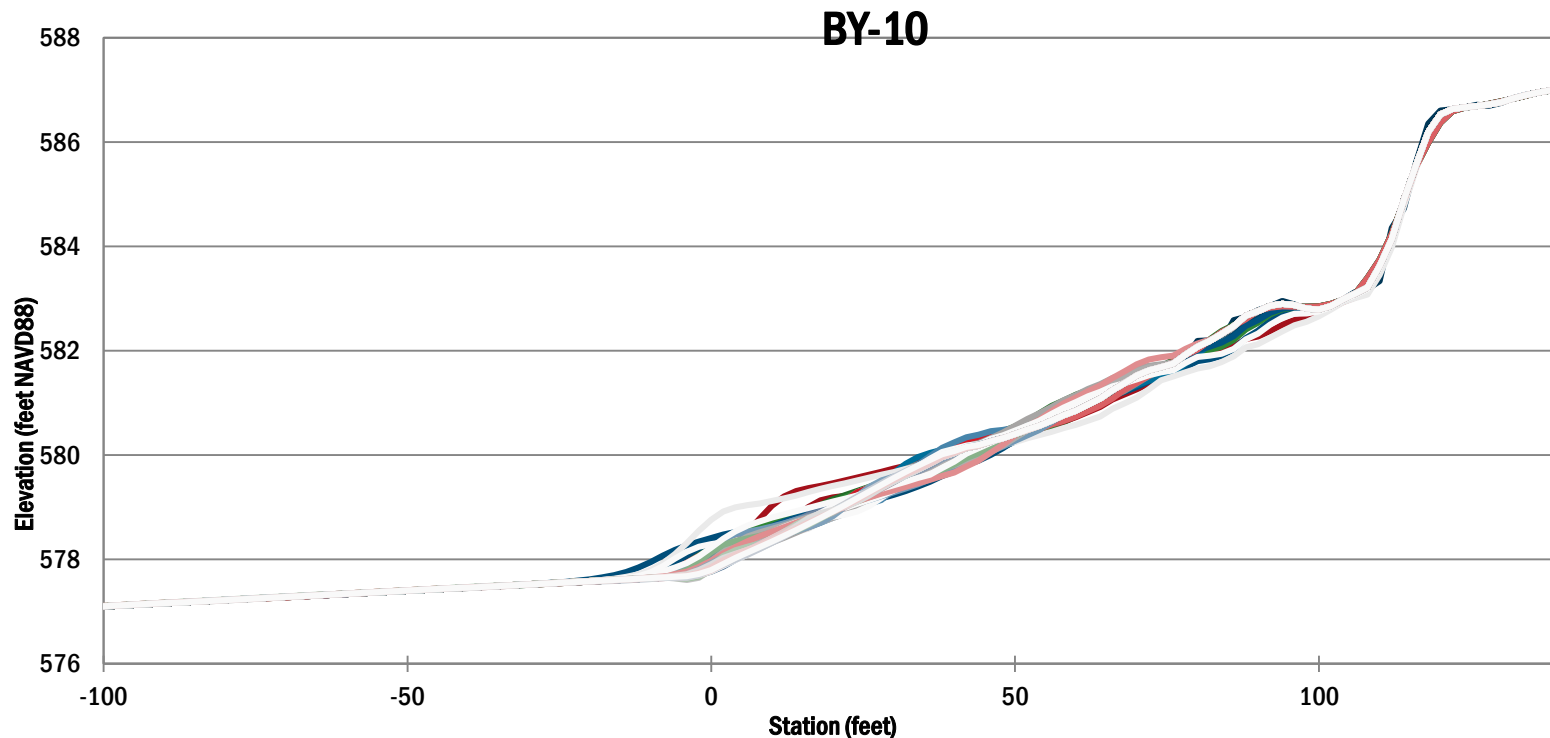
Step 2: Transect Layout

- Bay County:
 - 20 Transects
 - 38 Panels
- Transects placed at representative shoreline reaches based on:
 - Topography
 - Exposure
 - Shoreline Material
 - Upland Development



Step 2: Erode Transect Profiles

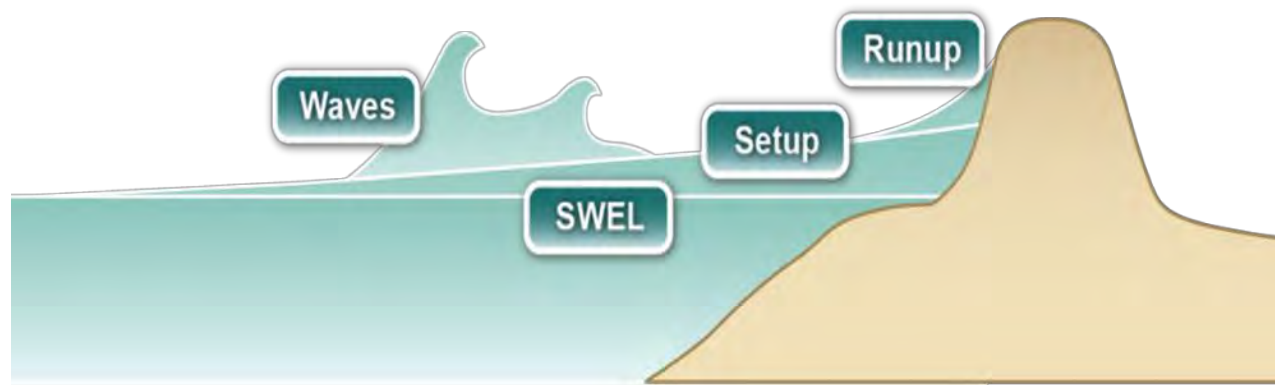
- Erosion analysis applied for sandy beach transects with gradual slopes.
- Eroded profiles are calculated using the USACE CSHORE model for each storm event.
- Influences wave setup, runup, and overtopping by affecting profile slope.



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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 150 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

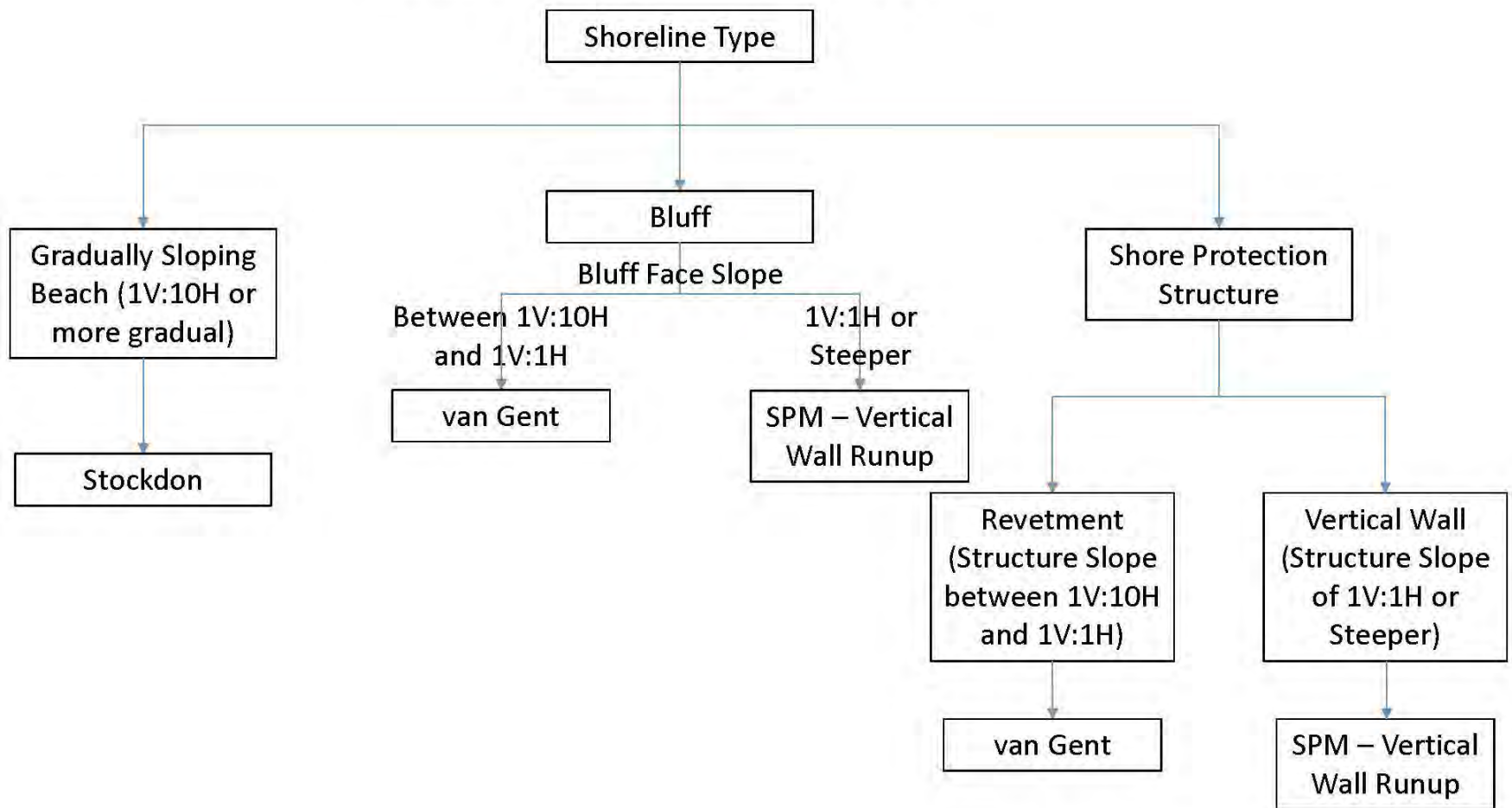
Wave Setup
Wave Runup



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Step 2: Response-Based Wave Runup

Runup Method Decision Flow Chart



Step 2: Runup



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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



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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

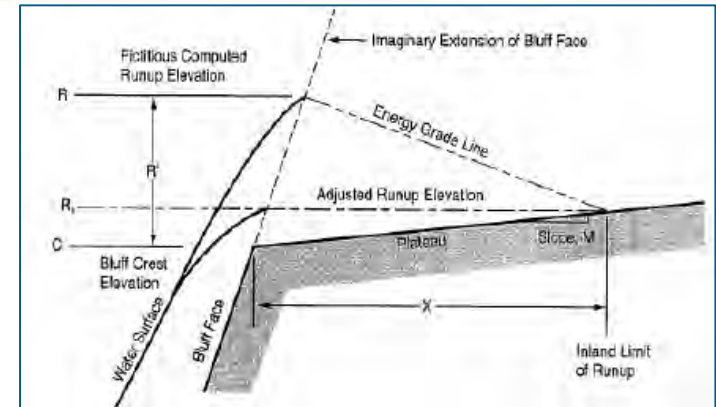


Figure D.3.5-3: Treatment of Runup onto Plateau above Low Bluff

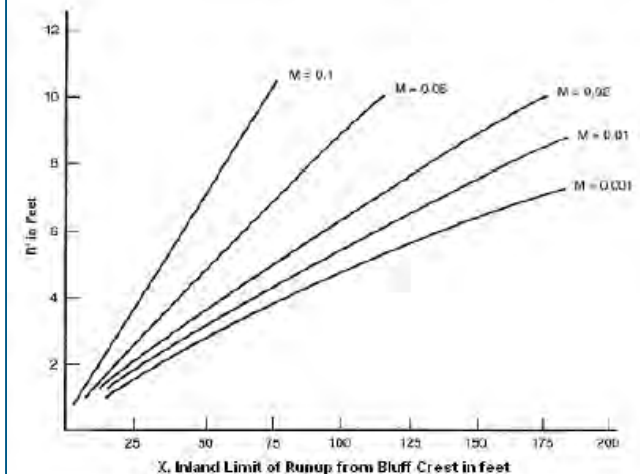


Figure D.3.5-4: Curves for Computation of Runup Inland of Low Bluffs

Step 2: Compute Setup, Runup, and Overtopping

- 150 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: Overland Wave Propagation

- ▶ Identify 5 pairs of water level and wave height that represent a 1% annual-chance occurrence (Joint Probability Method or JPM)
- ▶ Determine if transect is subject to erosion
 - Develop a theoretical storm event using the 5 pairs
- ▶ Determine wave setup elevations
 - Using the Direct Integration Method (DIM)
 - Wave setup + SWL = Total Stillwater Level (TSWL)
- ▶ Use Wave Height Analysis for Flood Insurance Studies (WHAFIS) to determine interaction of waves with the backshore

Step 2: Overland Wave Propagation

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Residents being evacuated out of Wenona Beach Estates after flooding

Posted: Apr 14, 2018 1:47 PM EDT
Updated: Apr 14, 2018 8:31 PM EDT
By Stephen Borowy [CONNECT](#)

Wenona Estates Flooding - 00:35

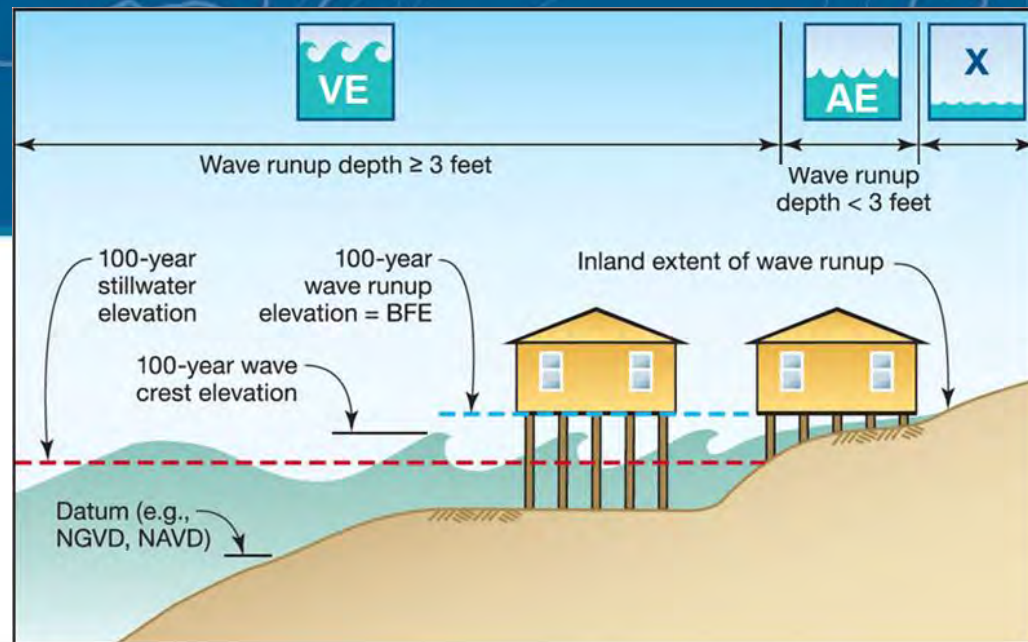


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Step 3: Mapping

Coastal Flood Hazard Zones

- **Zone VE:**
 - Represents coastal high hazard areas
 - Wave heights ≥ 3 ft
 - Wave runup ≥ 3 ft above ground elevation
 - Overtopping splash zones
 - BFEs are assigned
- **Zone AE:**
 - Inundation areas
 - Wave heights < 3 ft
 - Wave runup < 3 ft above ground elevation
 - BFEs are assigned



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Step 3: VE Zones

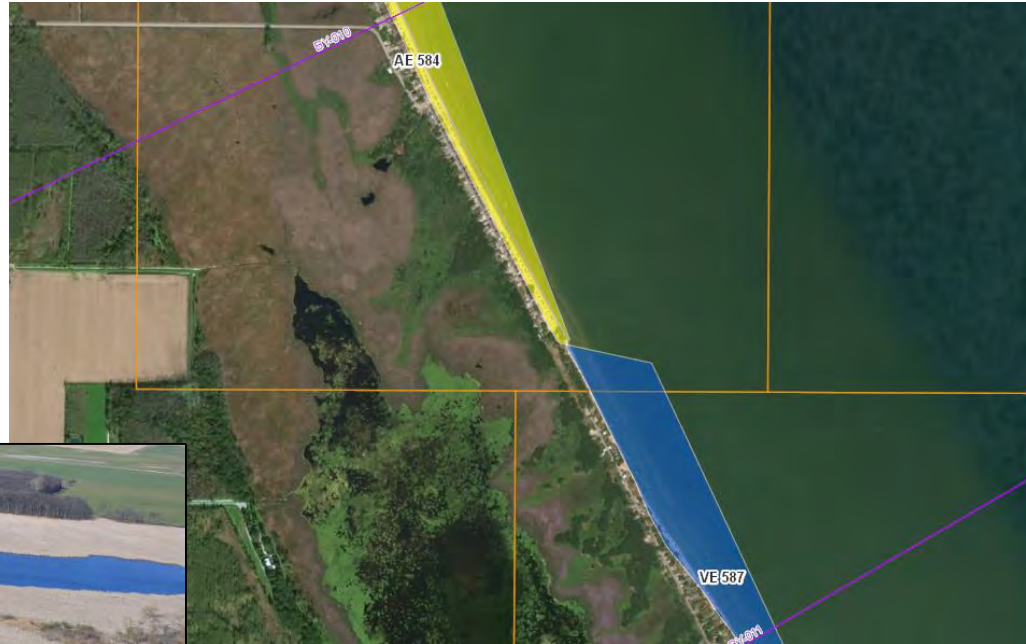
- ▶ **Intact transects**
 - VE zone mapped to elevation associated with TWL
- ▶ **Failed transects (coastal structures)**
 - VE zone mapped to station along the profile associated with TWL
 - Elevation will not match topography since failure include profile modification
- ▶ **Eroded profiles**
 - VE zone mapped to station along the profile associated with TWL
 - Elevation will not match topography since profile is eroded

Step 3: Overland Wave Propagation VE Zones

- ▶ VE zone associated with the location of the 3 foot breaking wave
- ▶ AE zones can exist with BFEs higher than TSWL as wave action is considered
- ▶ Most conservative of the 5 WHAFIS runs selected for mapping
- ▶ Most conservative is associated with largest extend of flooding and highest VE zone

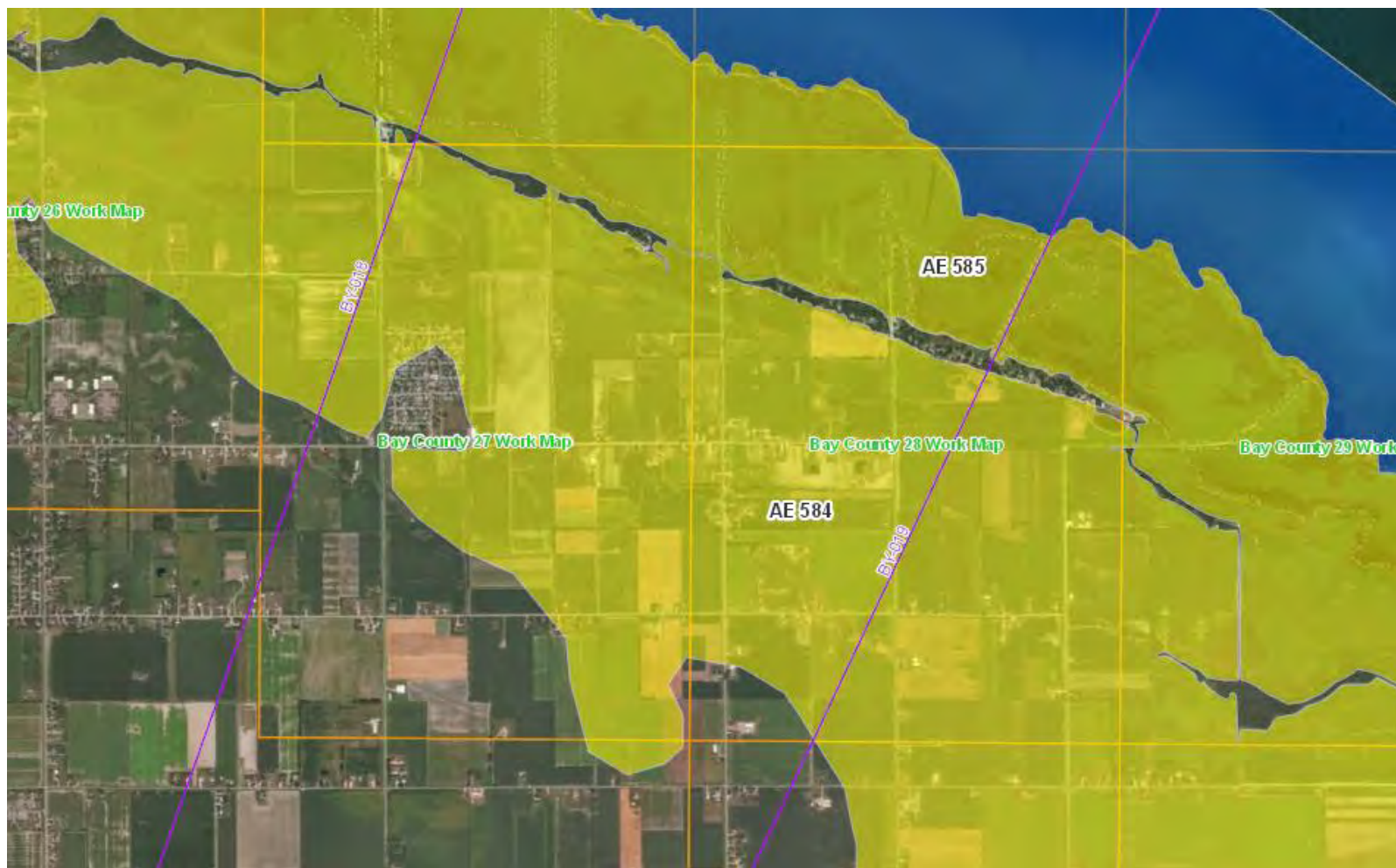
Step 3: Zone Breaks

- 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



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Step 3: SWEL Inundation



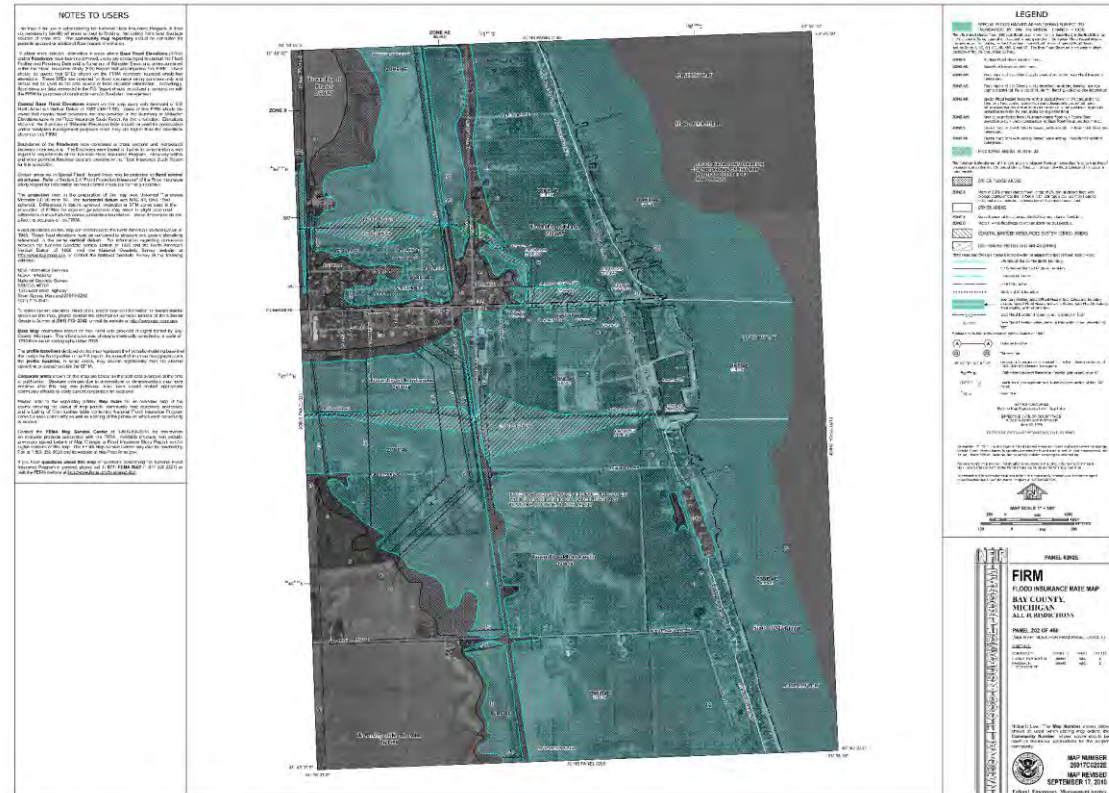
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Draft Work Map vs FIS/FIRM

Bay County, MI Work Map



Bay County, MI effective FIRM

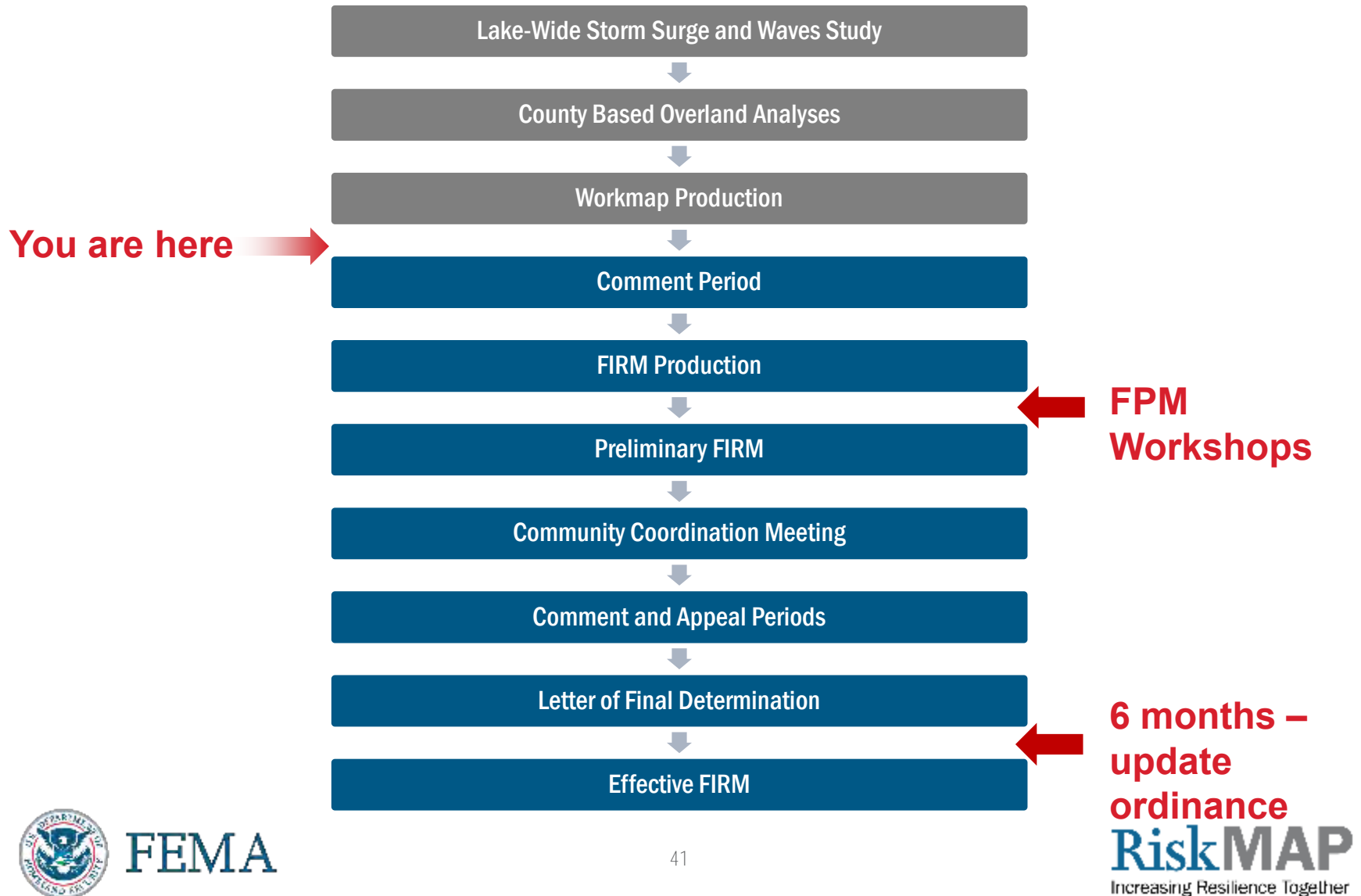




Bay County, MI

FEMA FLOODPLAIN MANAGEMENT

Current Study Status



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Floodplain Management Workshops

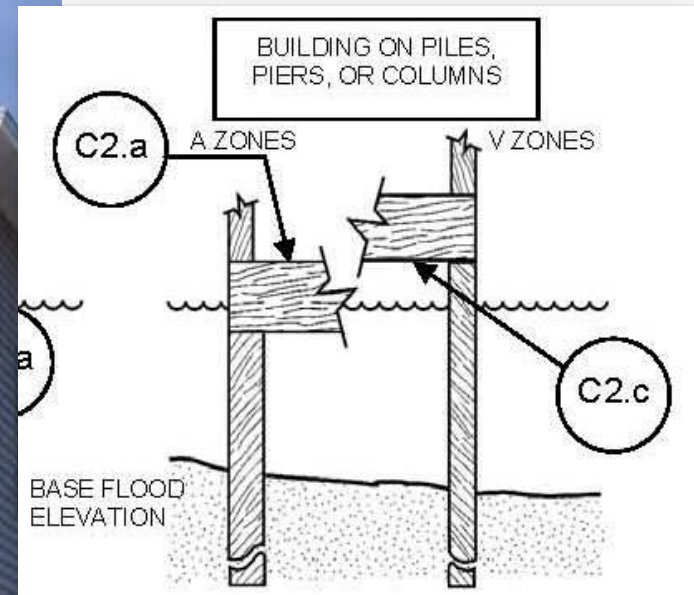
- ▶ Conducted by FEMA/DNR just before preliminary maps are released
- ▶ Workshop details:
 - Approximately 3 – 4 hours
 - Designed for floodplain administrator, zoning official, building inspectors, permit officials, etc.
 - Basics of Coastal Flooding
 - Using the Flood Insurance Study and FIRM for coastal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

Key V Zone minimum standard: 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



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

* 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 II) 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: _____

Model Ordinance Development

- ▶ FEMA Region V and Michigan DEQ are working together to prepare a model ordinance to incorporate V zone standards
- ▶ Ordinances must be updated/adopted by effective date of maps

Floodplain Engineering Staff

www.mi.gov/floodplainmanagement

Cadillac District Office: 120 W. Chapin St, Cadillac 49601

Gaylord Field Office: 2100 West M-32, Gaylord 49735

Grand Rapids District Office: 5th Fl, 350 Ottawa Ave NW, Grand Rapids 49503

Jackson District Office: 301 E. Louis Glick Hwy, Jackson 49201

Kalamazoo District Office: 7953 Adobe Road, Kalamazoo 49009

Lansing District Office: PO Box 30242, 525 W. Allegan, Lansing 48909

Saginaw Bay District Office: 401 Ketchum Street, Suite B, Bay City 48708

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Houghton Field Office: 47420 State Highway M26, Suite 62, Houghton 49931

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[Jacob Patin](mailto:Jacob.Patin@mi.gov) 616-204-7176, Grand Rapids

Water Resources Division 517-284-5567

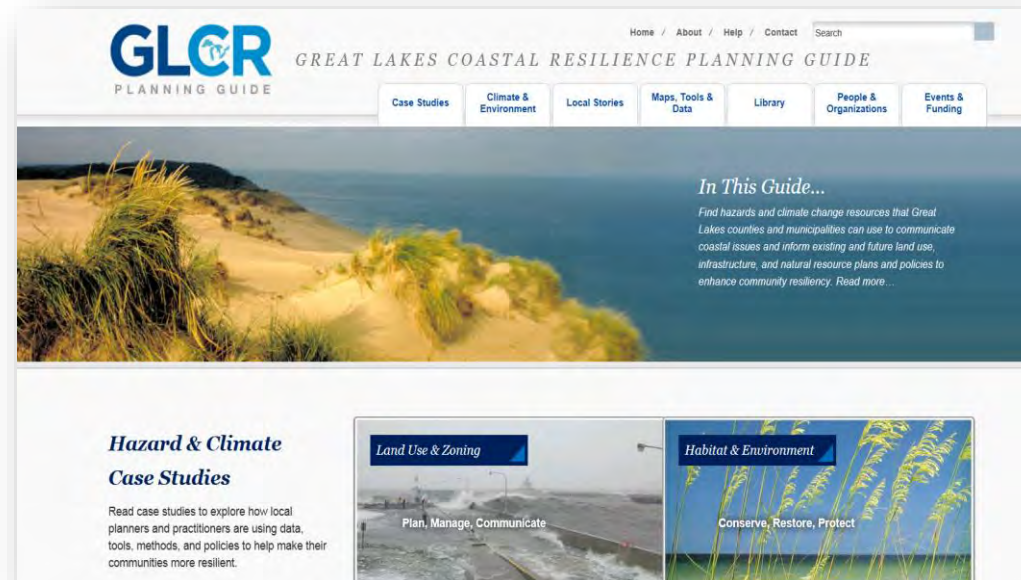
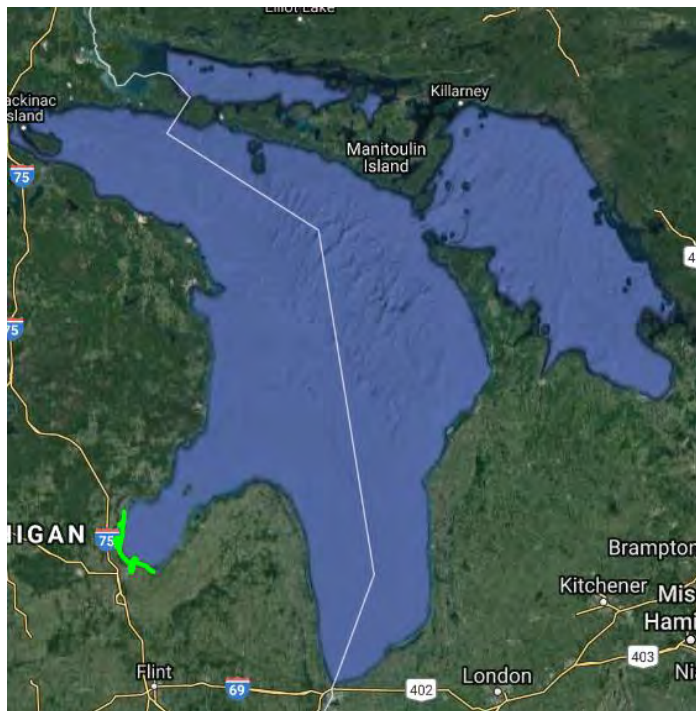
www.michigan.gov/wrd

3/15/2018

Online Resources

High resolution oblique aerial images


<https://greatlakes.erdcdren.mil/>



Great Lakes Coastal Resilience Planning:

<https://coast.noaa.gov/digitalcoast/tools/gl-resilience.html>

Great Lakes Coastal Flood Study



Great Lakes Coastal Flood Study

Great Lakes Coastal Analysis & Mapping Additional Resources

Welcome to
GreatLakesCoast.org

- Great Lakes Coastal Analysis & Mapping
- Wind Surge Study
- Coastal Hazard Analysis & Mapping
- Great Lakes Flood Zones Overview
- Technical Resources
- Outreach
- Fact Sheets
- Newsletters
- Presentations
- Events
- Coastal Scoping & Discovery Reports
- Additional Resources
- Contact Information
- Site Map

Search for:

Welcome to the **Great Lakes Coastal Flood Study** website at greatlakescoast.org. This is the official public website for FEMA's comprehensive storm and wind study of the Great Lakes basin for the purpose of updating the coastal flood hazard information and Flood Insurance Rate Maps (FIRM) for Great Lakes coastal communities. This is the main page of the website and contains the most recent content posted to the site. Use the menu at the left to visit pages with additional content pertaining to the **Great Lakes Coastal Flood Study**.

Home

FEMA Announces Additional Lake Michigan WorkMap Meetings

July 27, 2017 — Great Lakes Coast

Local officials and technical stakeholders are being invited to community meetings to review and comment on FEMA's draft coastal flood hazard workmaps for the Lake Michigan Shoreline. FEMA's outreach for the 2017 workmaps started in early July. Meetings have already occurred for Illinois, Indiana and Wisconsin communities. The meeting schedule for Michigan and the remaining Wisconsin counties is below.

Each meeting will include a summary of the draft work maps, Q&A, and a breakout for review of community-specific data via printed and online maps. Staff members and officials representing villages, cities, and county government, regional organizations, non-governmental bodies, neighborhood associations, and harbor and shoreline protection engineers are encouraged to attend and to provide feedback within the 60-day comment period.


[Link to Map Viewer User Guide](#) to learn more about the Draft Work Maps.

For more information:
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FEMA Region 5
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ken.hinterlong@fema.dhs.gov

Additional Information:
Great Lakes Coastal Resilience Planning Guide: <http://www.greatlakesresilience.org/>
USACE High Resolution Oblique Aerial Images: <https://greatlakes.erdcdren.mil/>

Wisconsin

Ozaukee and Sheboygan County
Tuesday, August 8, 9:30-11:30am
Rocca Meeting Room
Menominee Public Library



RSS Feed

[Great Lakes Coast RSS](#)

Archives

- July 2017 (2)
- July 2016 (1)
- September 2014 (1)
- July 2014 (1)
- June 2014 (1)
- April 2014 (1)
- February 2014 (1)
- December 2013 (1)
- July 2013 (2)
- October 2012 (1)
- August 2012 (1)

<http://www.greatlakescoast.org/>



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Bay County, MI

NEXT STEPS

Coastal Risk Awareness

KNOW YOUR RISK

Do your residents know about their flood risk?

KNOW YOUR ROLE

Do your residents know what mitigation actions they should/can take?

Multi-Hazard Mitigation Plan for Bay County – Last update June 2010

TAKE ACTION

Encourage your residents to take the actions that can build their resiliency to flooding.



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Next Steps

Review and comment period ends 6/26/2018

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

Comments

Send comments via email to williamsjo@cdmsmith.com or mail to:

Great Lakes Coastal Flood Study
Comment Repository
c/o CDM Smith
Attn: Jordan Williams
555 17th Ave, Suite 500
Denver, CO 80202

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

FEMA Contacts

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COMMENT REPOSITORY:

Send comments via email to

williamsjo@cdmsmith.com

or mail to:

Great Lakes Coastal Flood Study

Comment Repository

c/o CDM Smith

Attn: Jordan Williams

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Questions?



FEMA

Thank you for your participation!



FEMA



Interactive session to review the coastal work maps

COASTAL WORK MAP DEMO