RiskMAP
Increasing Resilience Together

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

ERDC
U.S. ARMY ENGINEER RESEARCH AND DEVELOPMENT CENTER

ASFPM
Association of State Floodplain Managers

RAMPP

STARR
Strategic Alliance for Risk Reduction

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

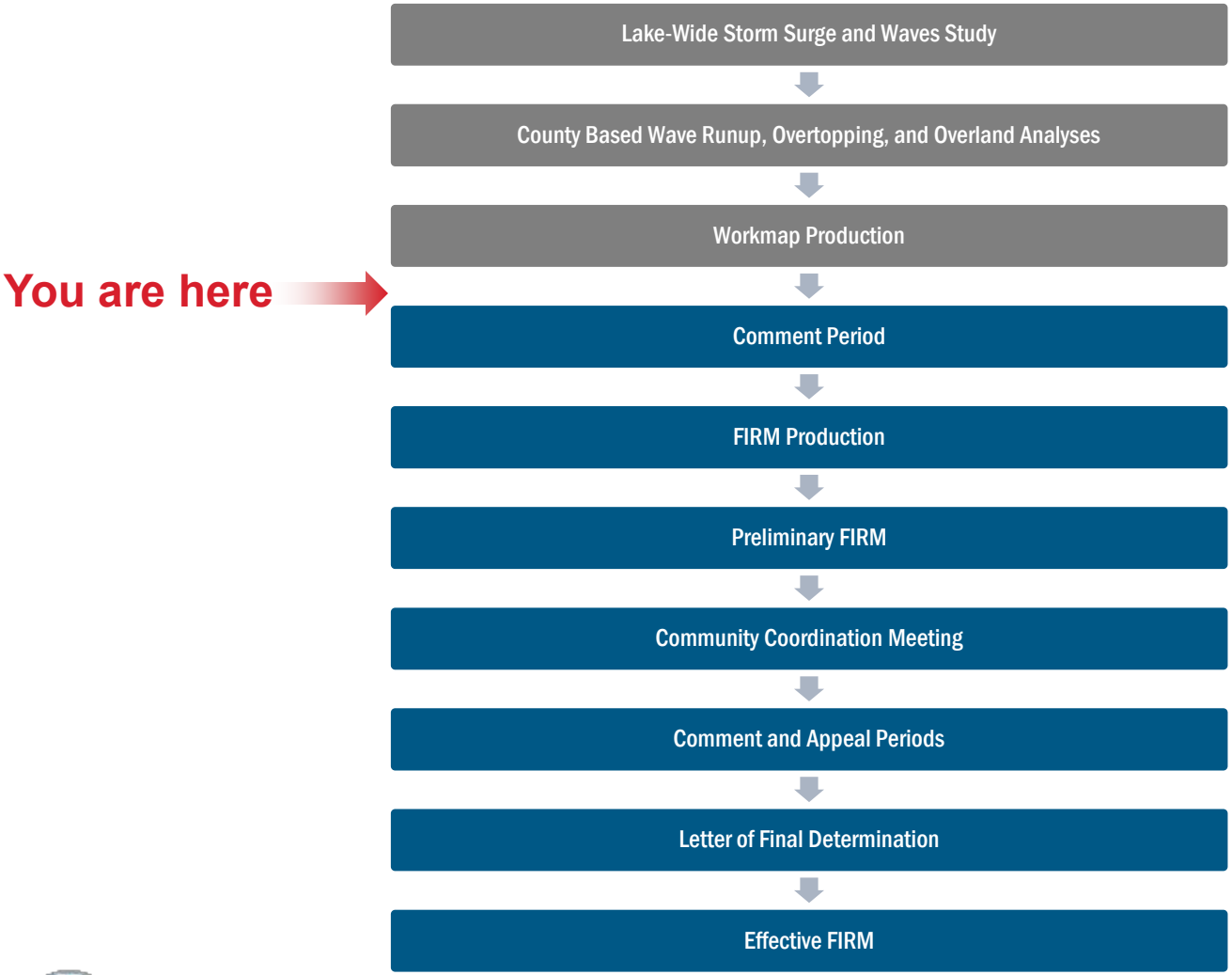
NATURAL SYSTEM PROTECTION

- Vegetation management
- Wetland restoration
- Erosion control

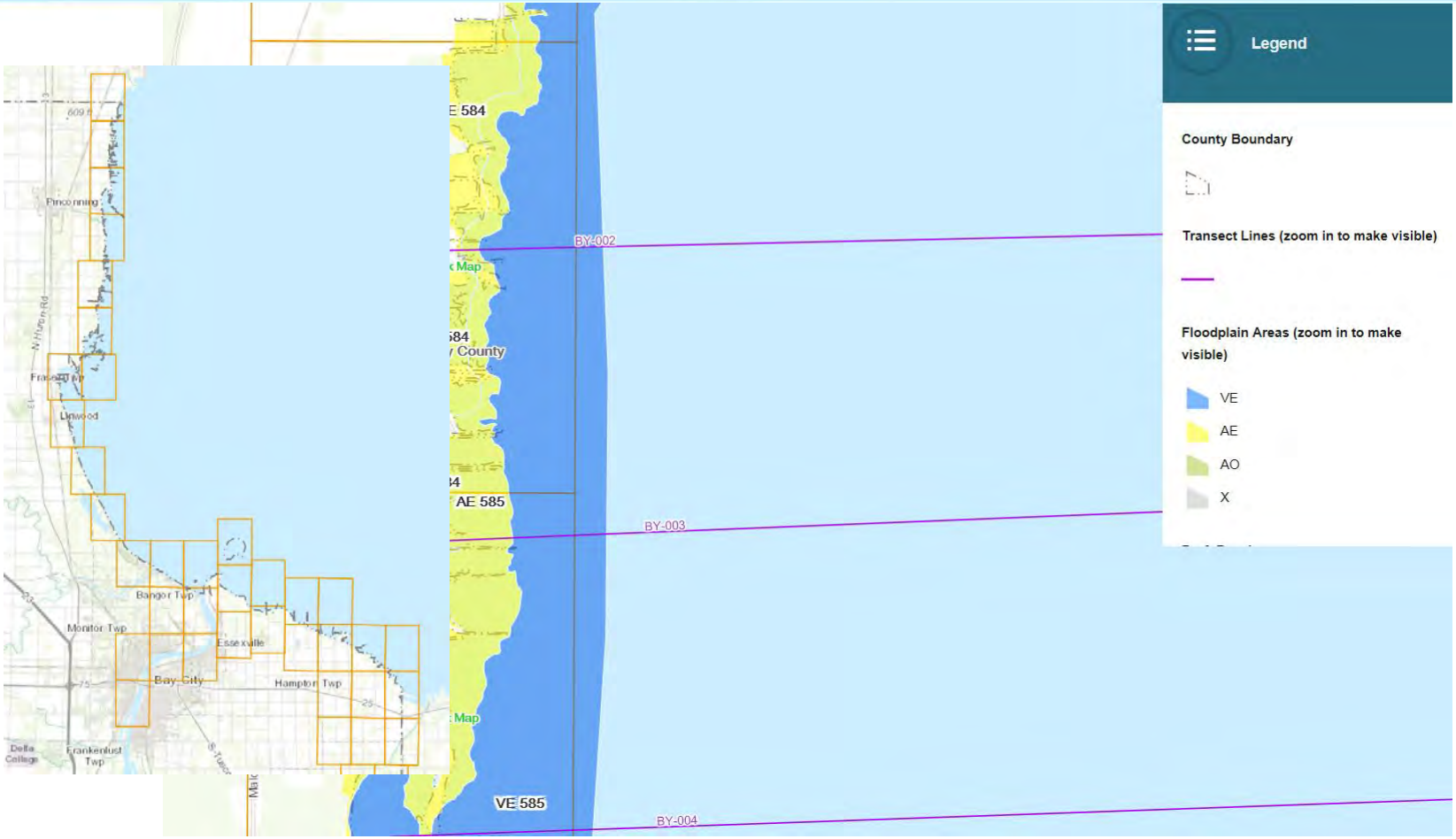
Bay County, MI

CURRENT STATUS REVIEW

Current Study Status

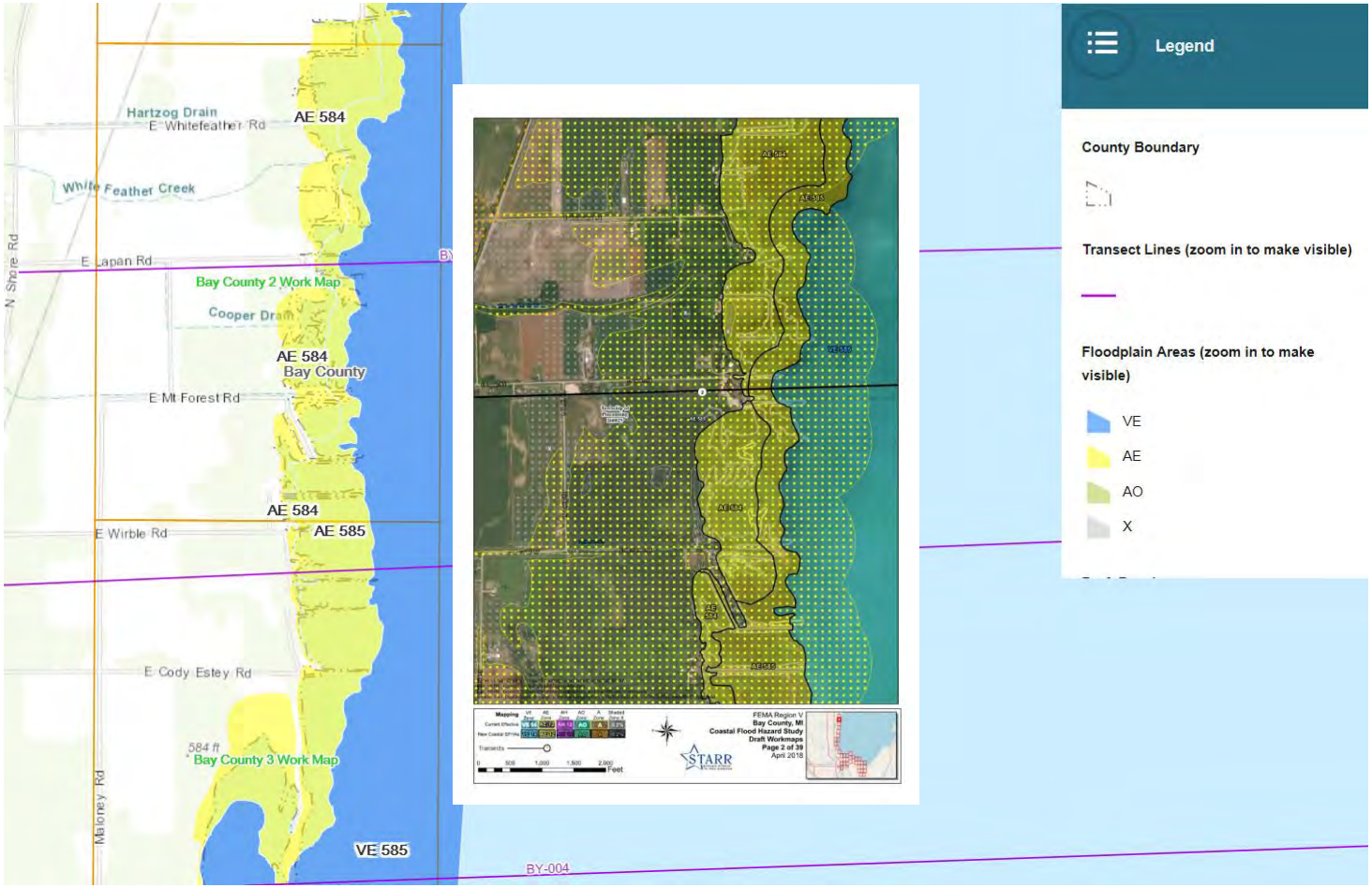


Work Map Data Viewer: Online GIS Data

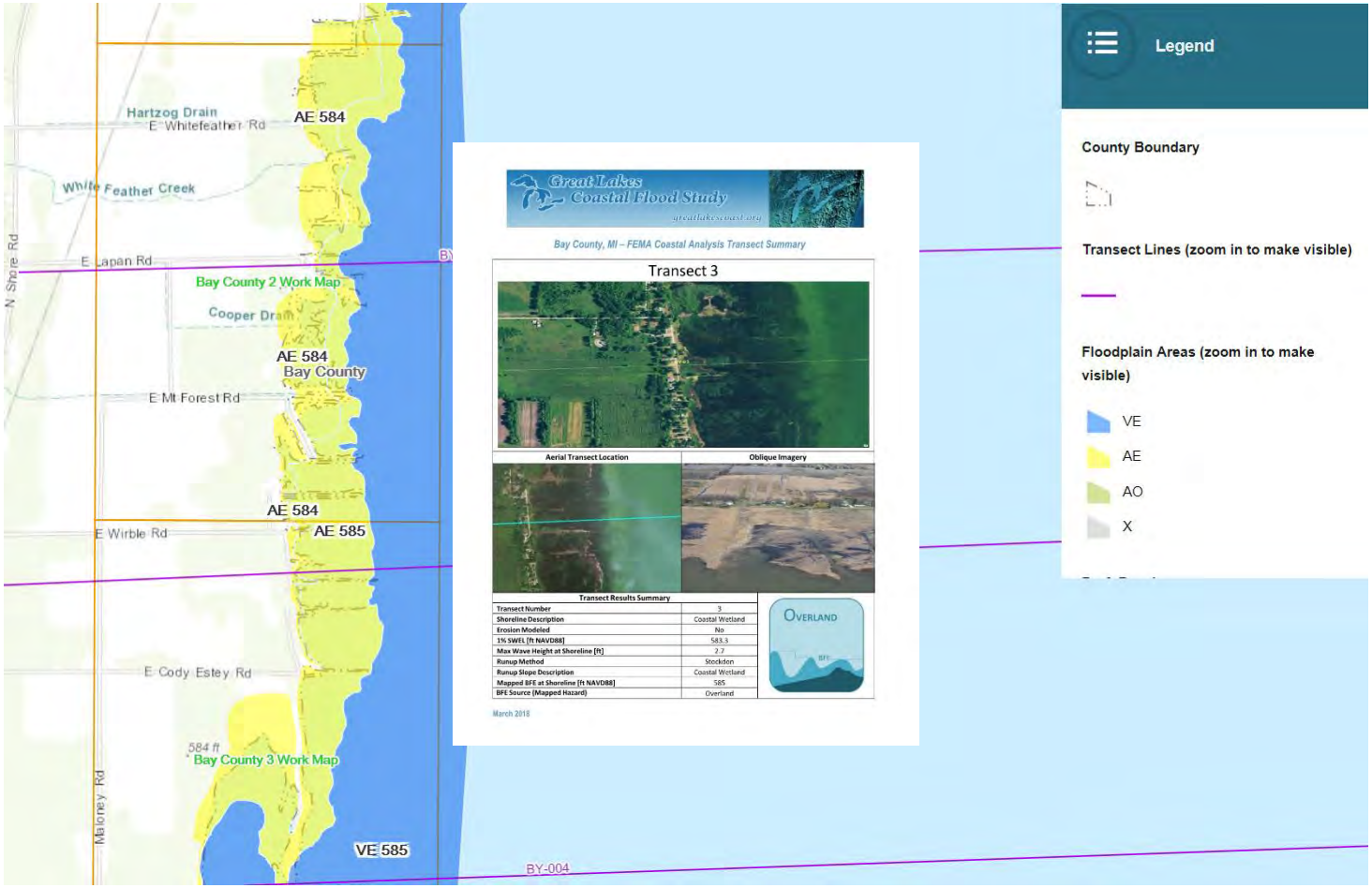


Link to the Bay County, MI Work Map Data Viewer: http://arcg.is/49Ty5

Work Map Data Viewer: Maps



Work Map Data Viewer: Transect Summary Sheets



Bay County, MI

TECHNICAL OVERVIEW OF STUDY AND MAPPING

Coastal Flood Hazard Modeling Overview

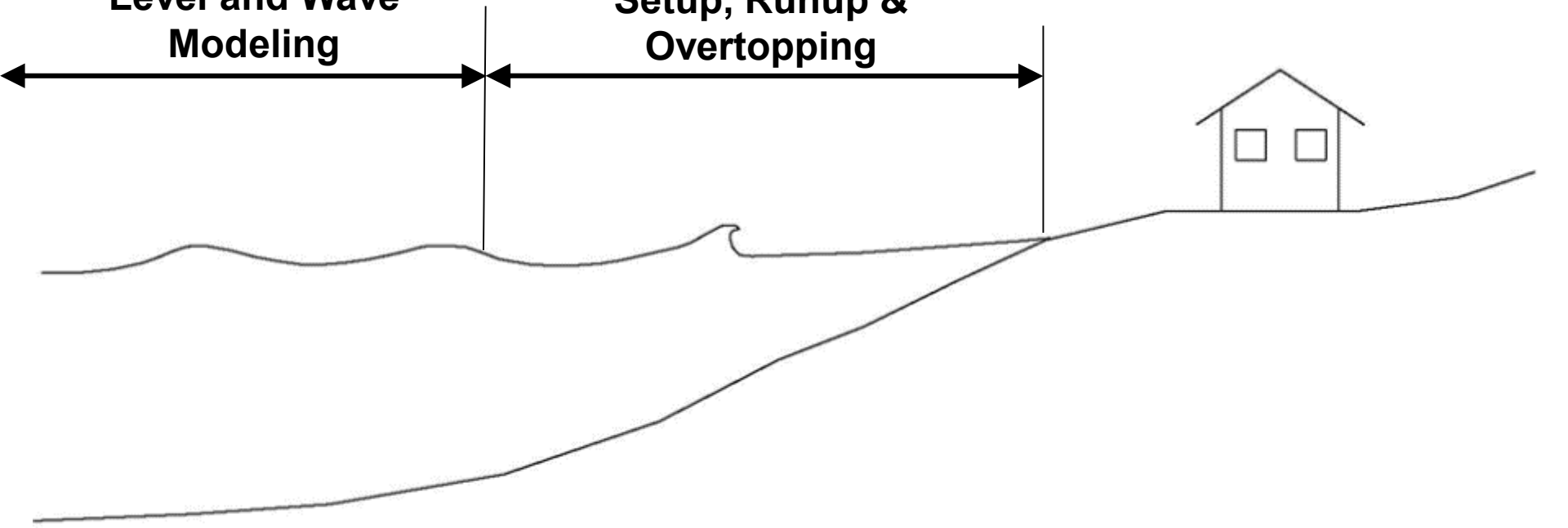
Lake-Wide Variation

Local Variation

Step 1: Offshore Water Level and Wave Modeling

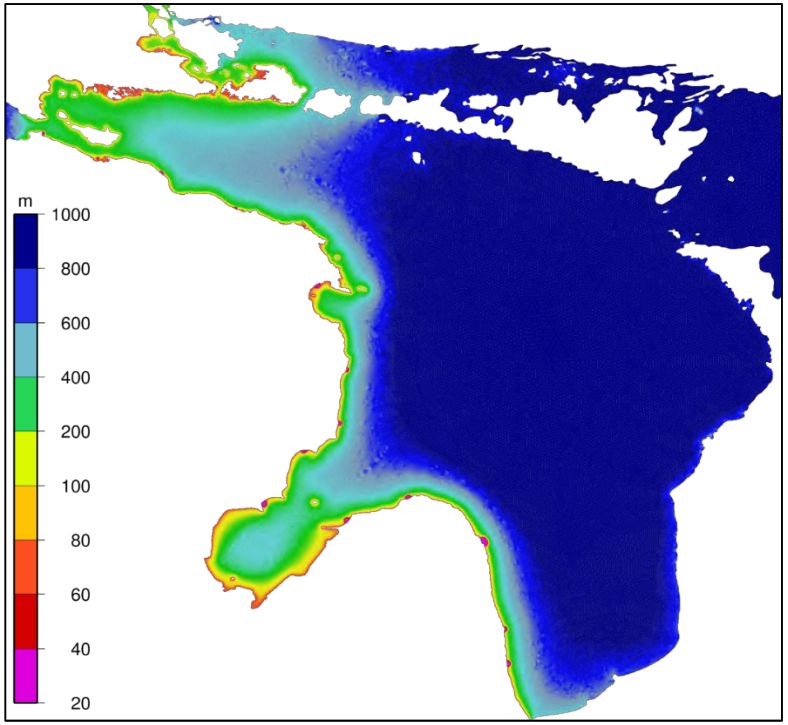
Step 2: Nearshore Wave Setup, Runup & Overtopping

Step 3: Floodplain Mapping



Step 1: ADCIRC+SWAN Mesh

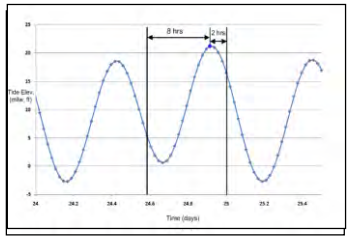
- Resolution as fine as 10 m along complex shoreline features including:
  - Jetties
  - Inlets
  - Breakwaters
  - Natural Shoals



Step 1: Run the Models

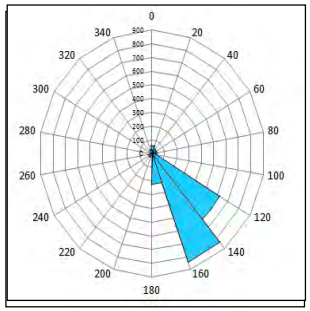
Baseline

Water Level

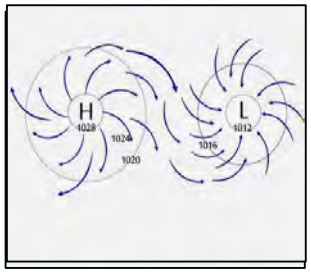


Meteorological Forcing

Wind



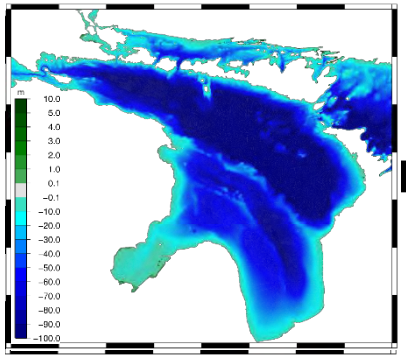
Pressure



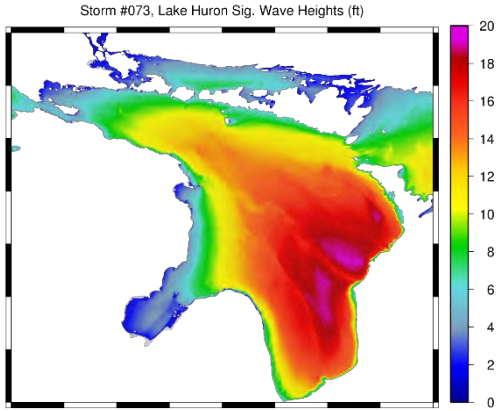
Ice

Physical Setting

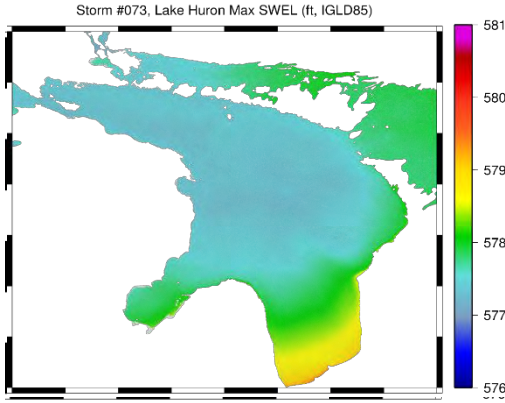
Bathymetry



Waves

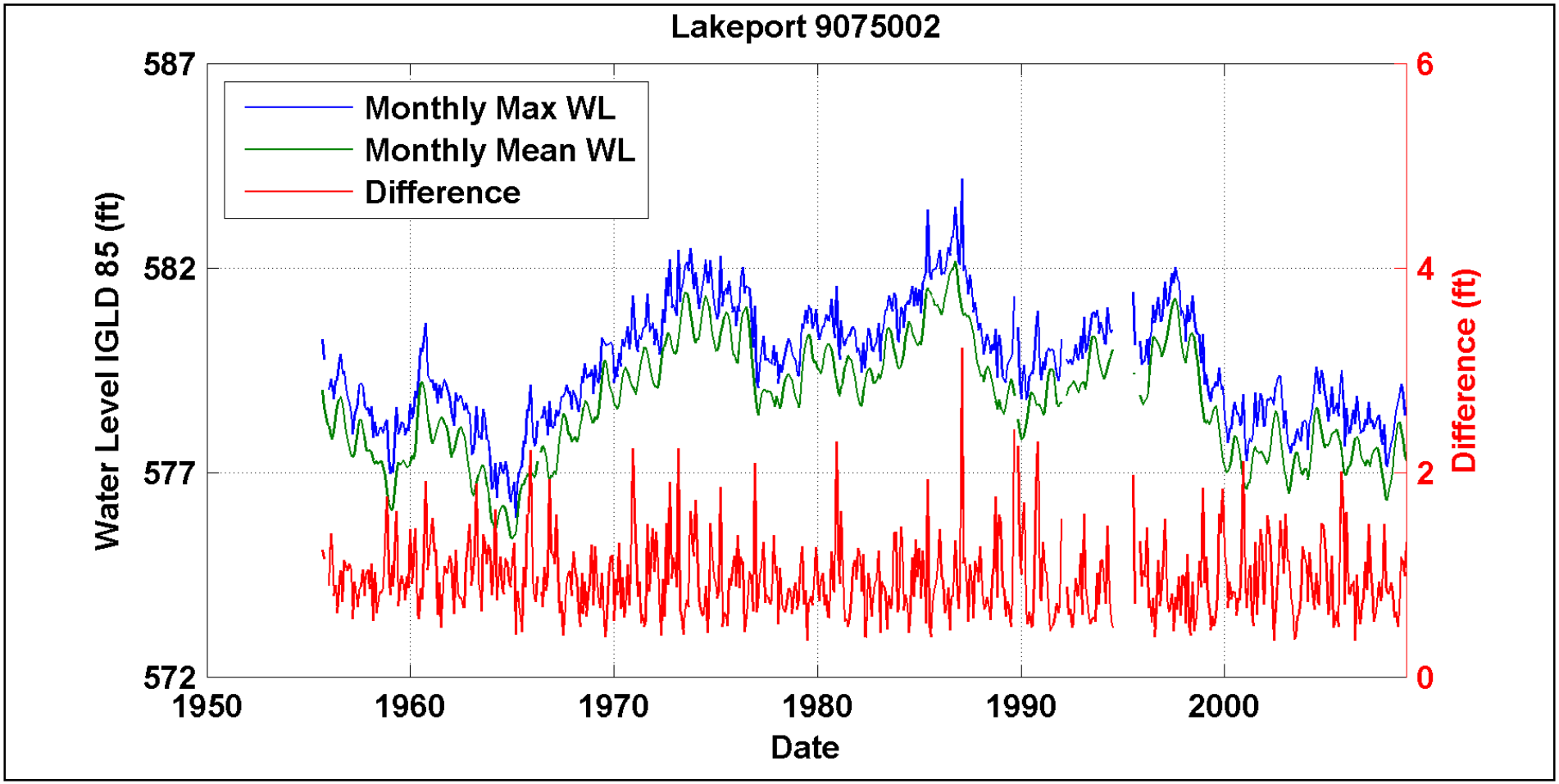


Still Water Elevations

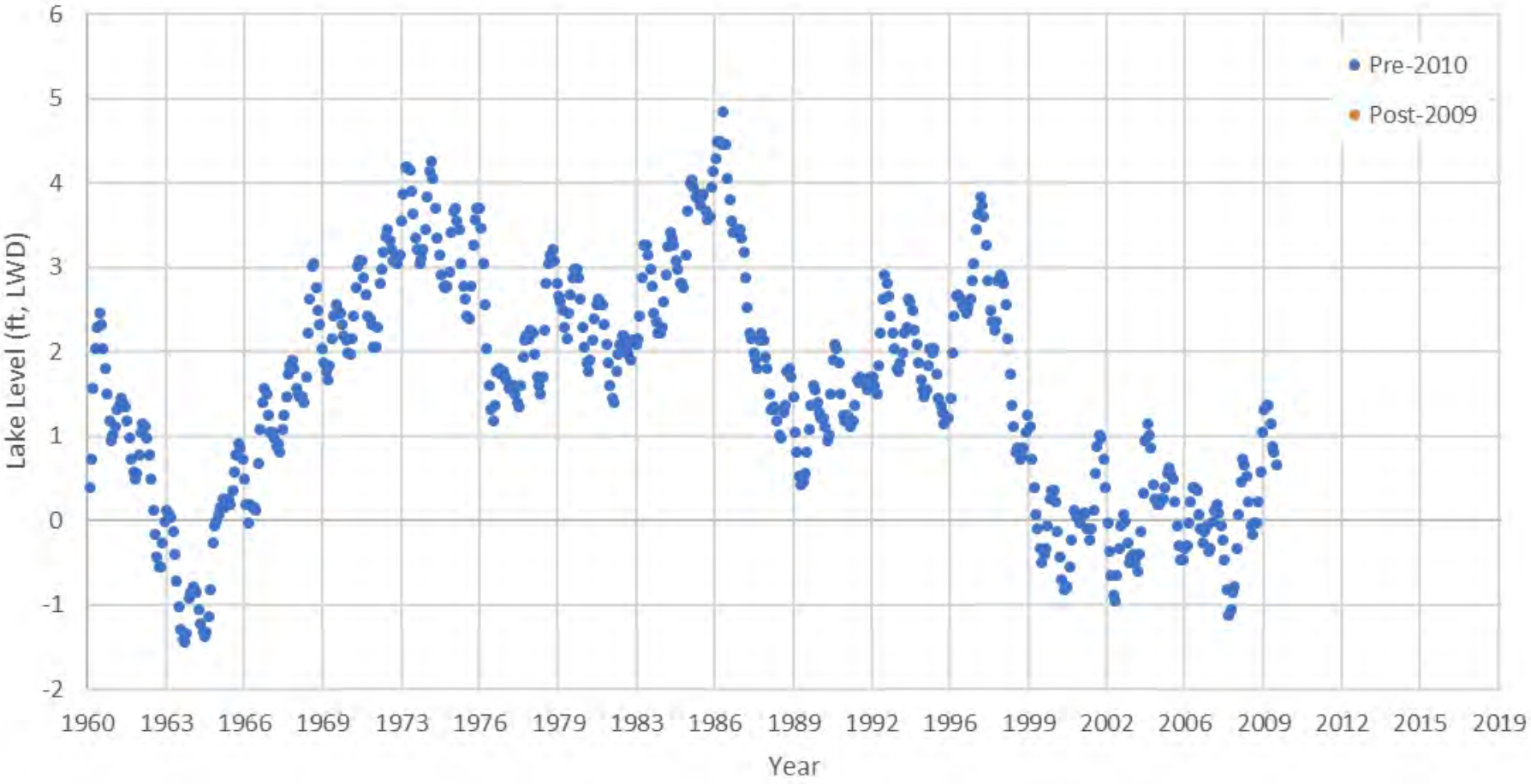


Total of 151 events between 1960-2009

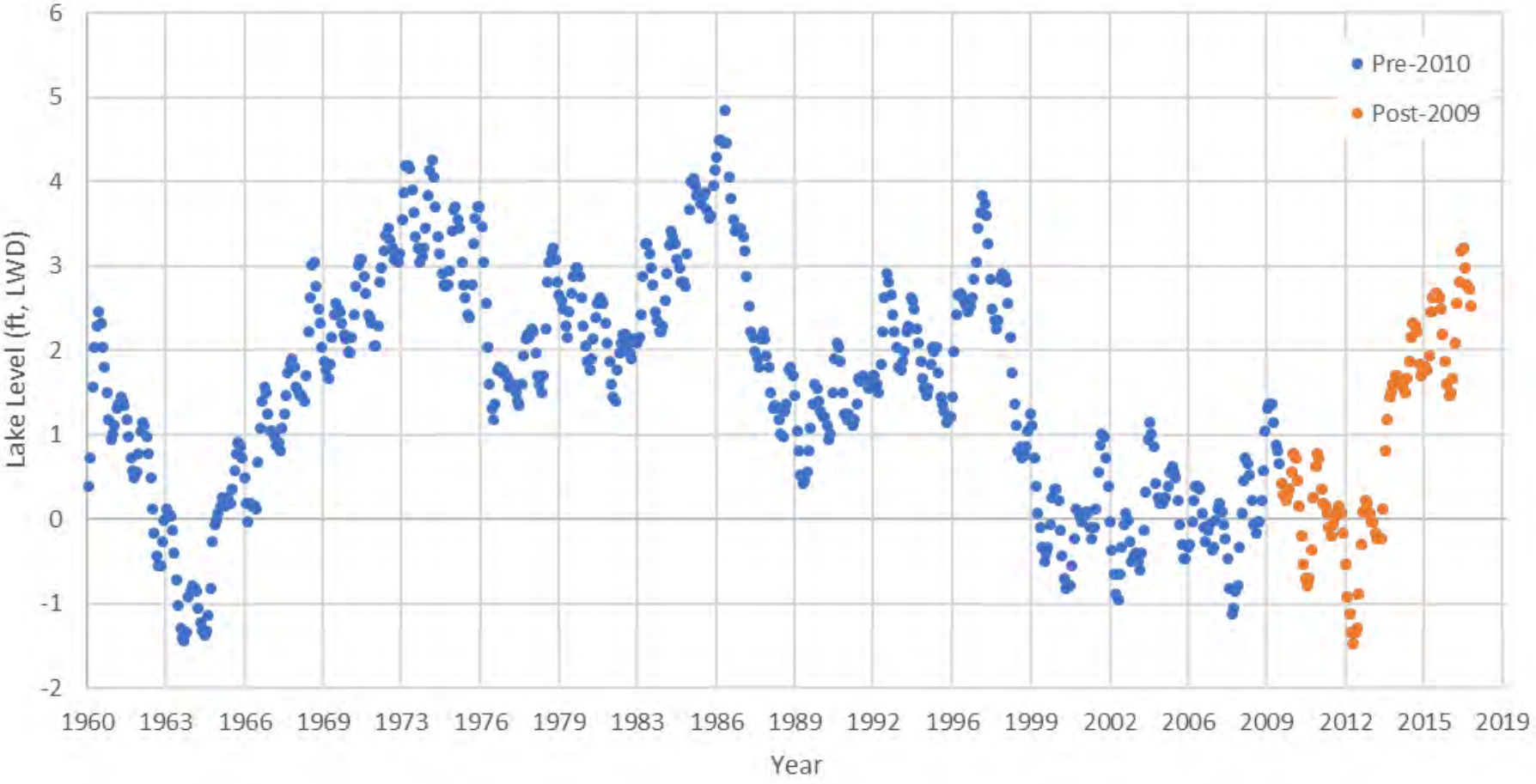
Step 1: Lake Levels



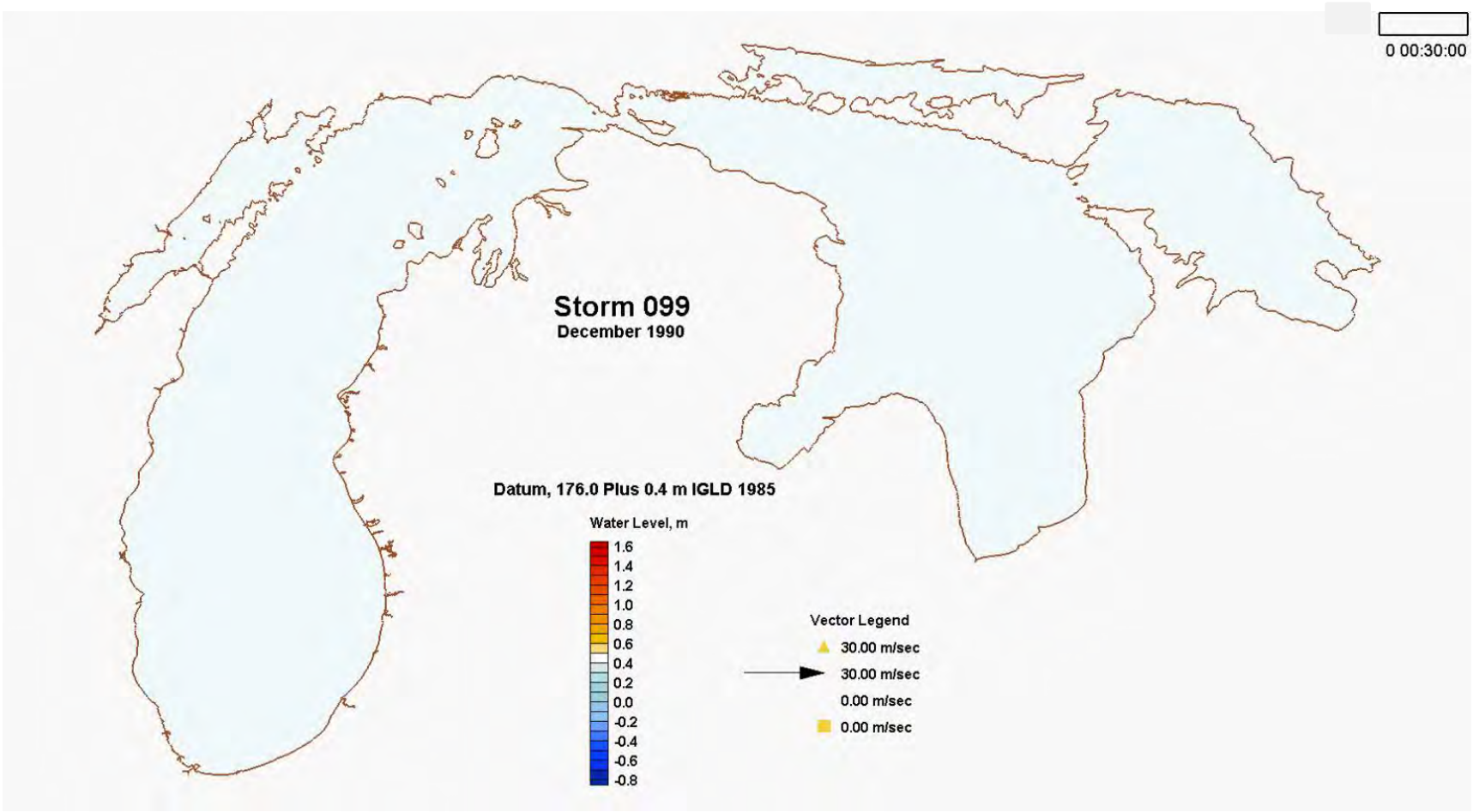
Step 1: Lake Levels



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

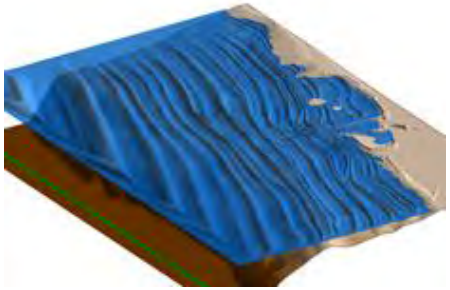
Nearshore Wave-Induced Flood Hazards Analysis includes:

- 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

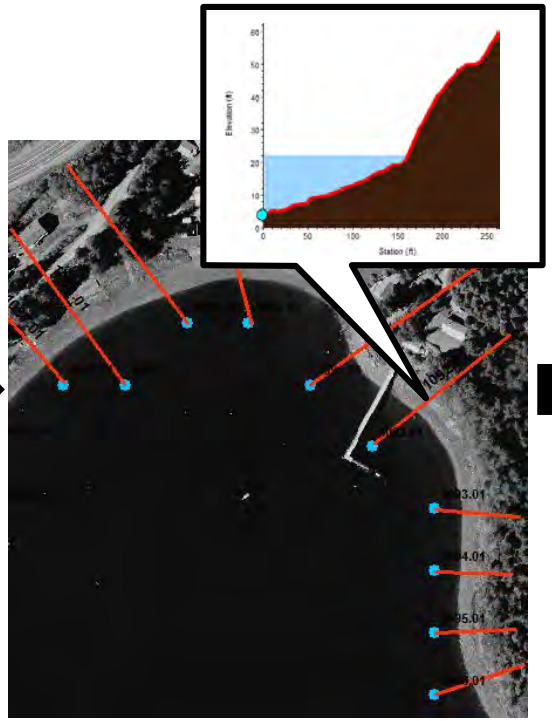
→ Along 1-D Transects

Step 2: Transect Analysis Overview

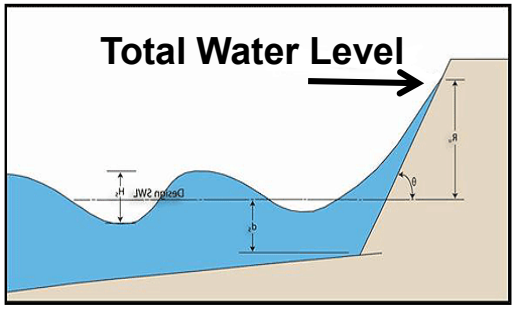
Water Level & Offshore Waves



Transect Analysis



Total Water Level

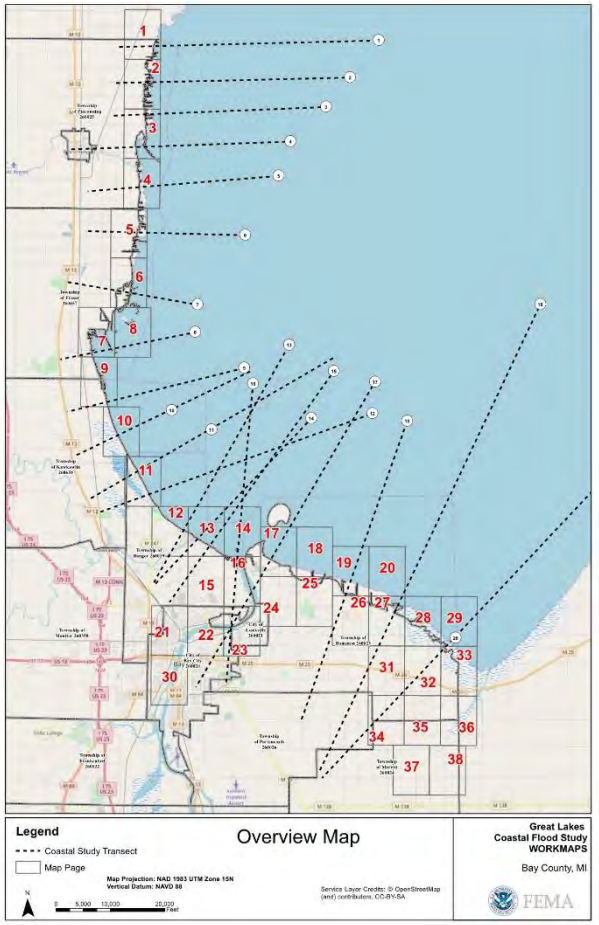


Total Water Level

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

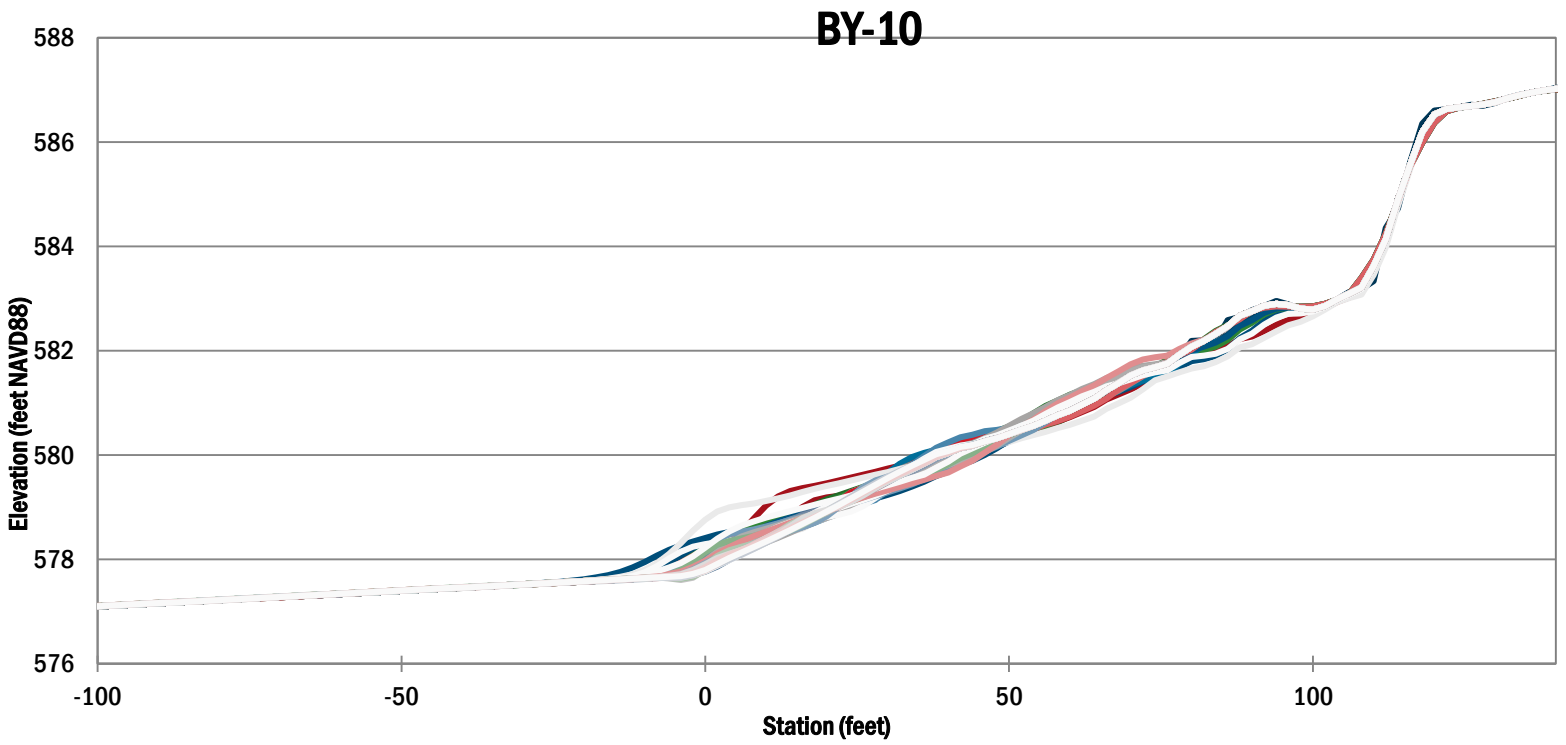
Step 2: Transect Layout

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



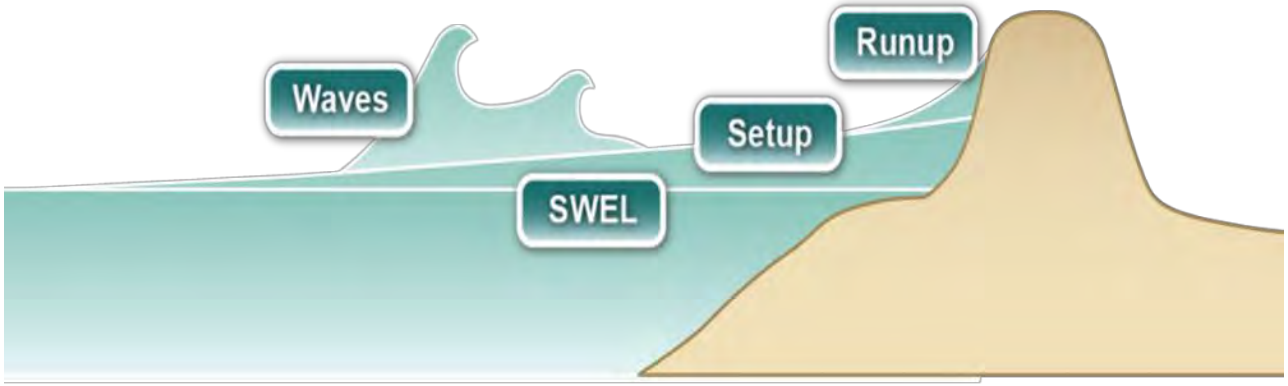
Step 2: Erode Transect Profiles

- 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.



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.

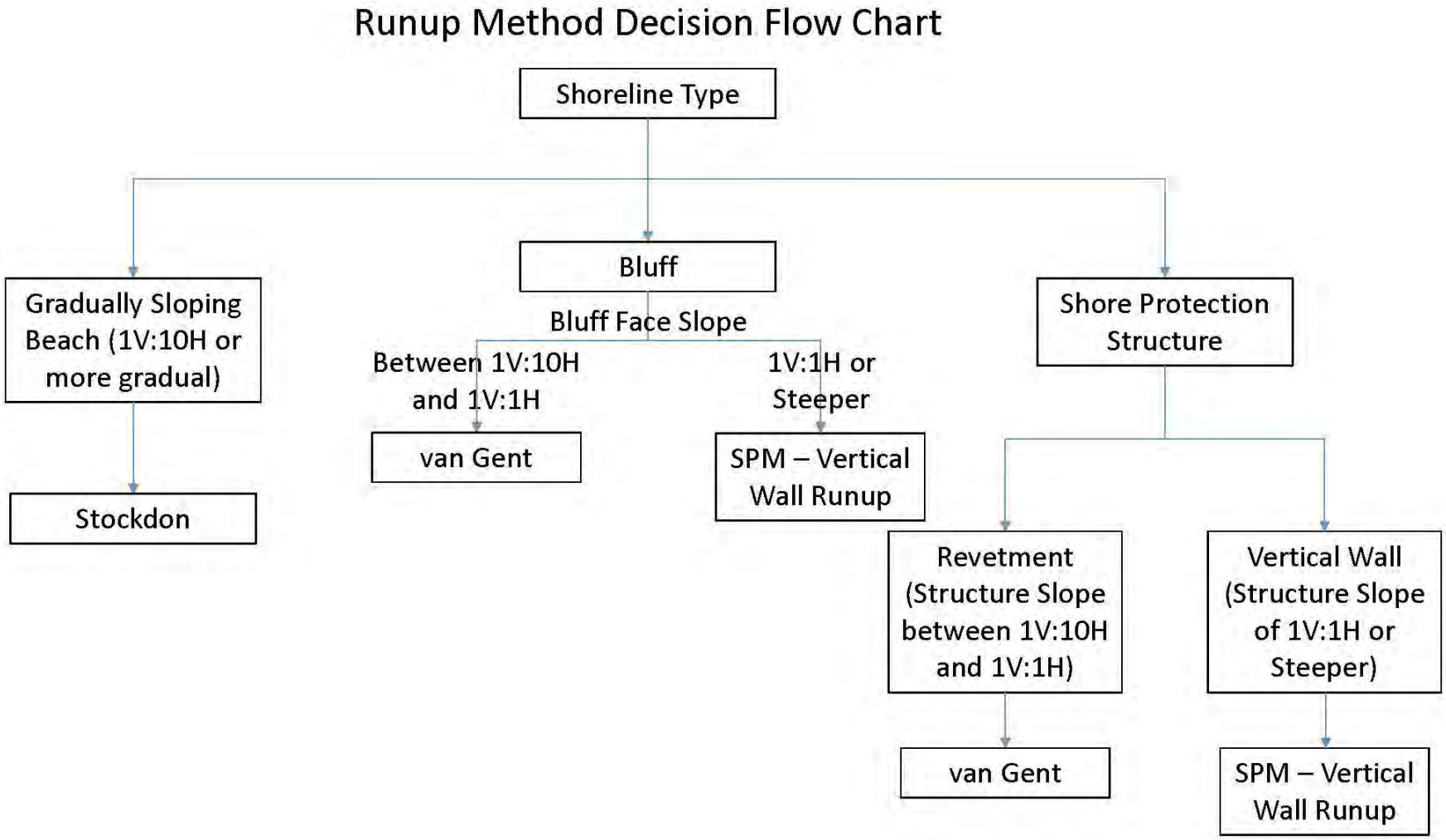


Wave Height
Wave Period
SWEL
Profile Slope

→

Wave Setup
Wave Runup

Step 2: 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

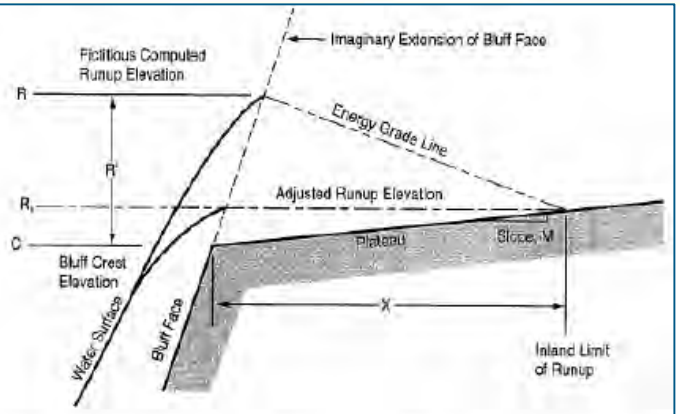


Figure D.3.5-3: Treatment of Runup onto Plateau above Low Bluff

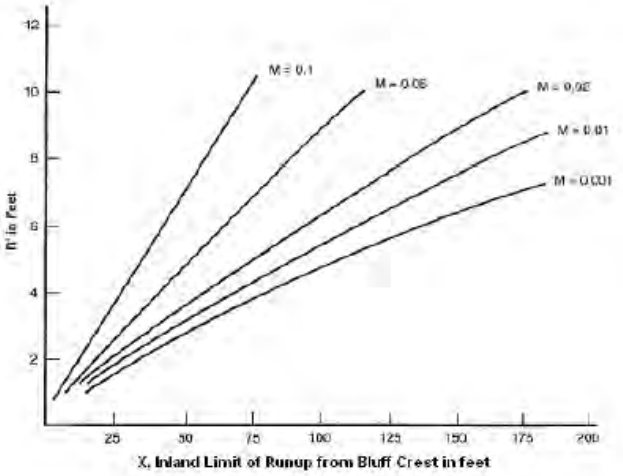


Figure D.3.5-4: Curves for Computation of Runup Inland of Low Bluffs

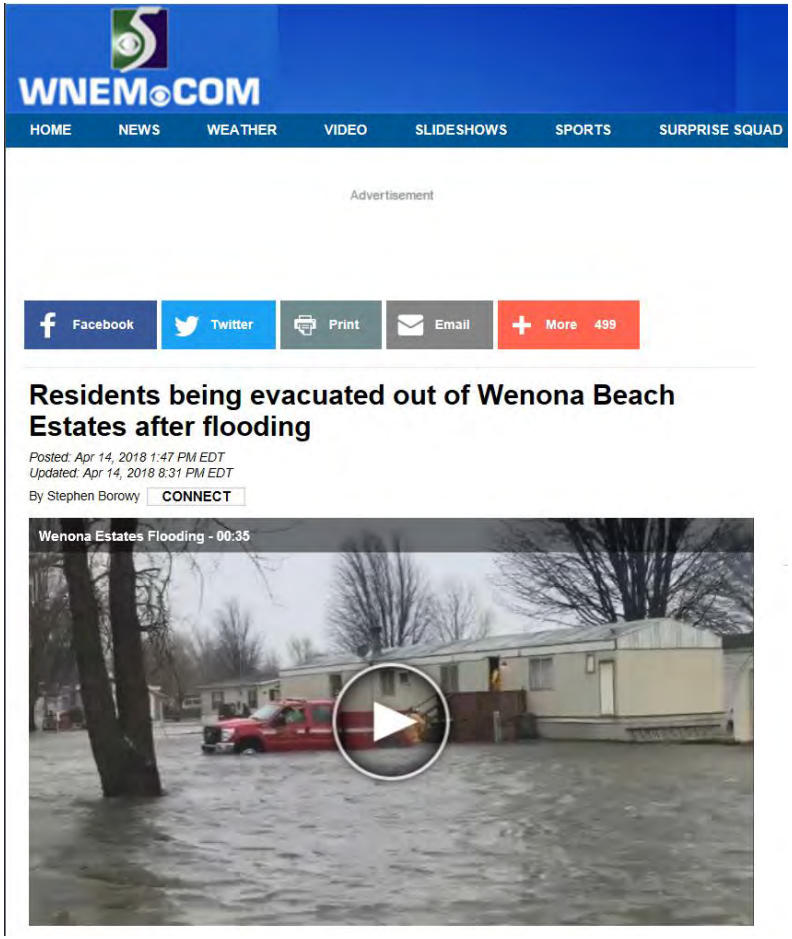
Step 2: Compute Setup, Runup, and Overtopping

- 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

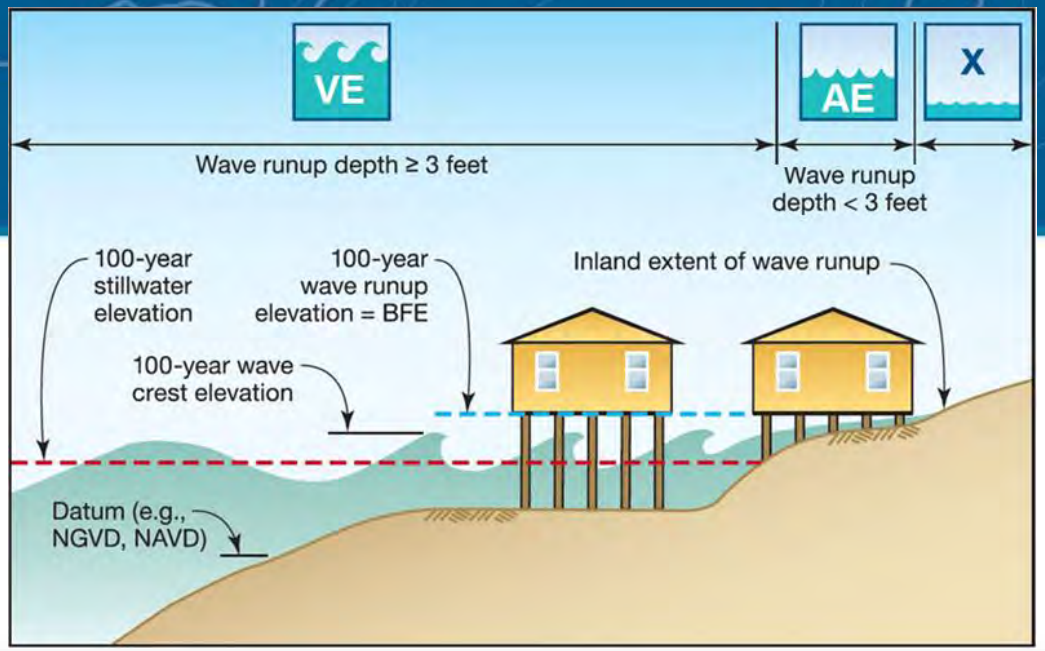
Step 2: Overland Wave Propagation

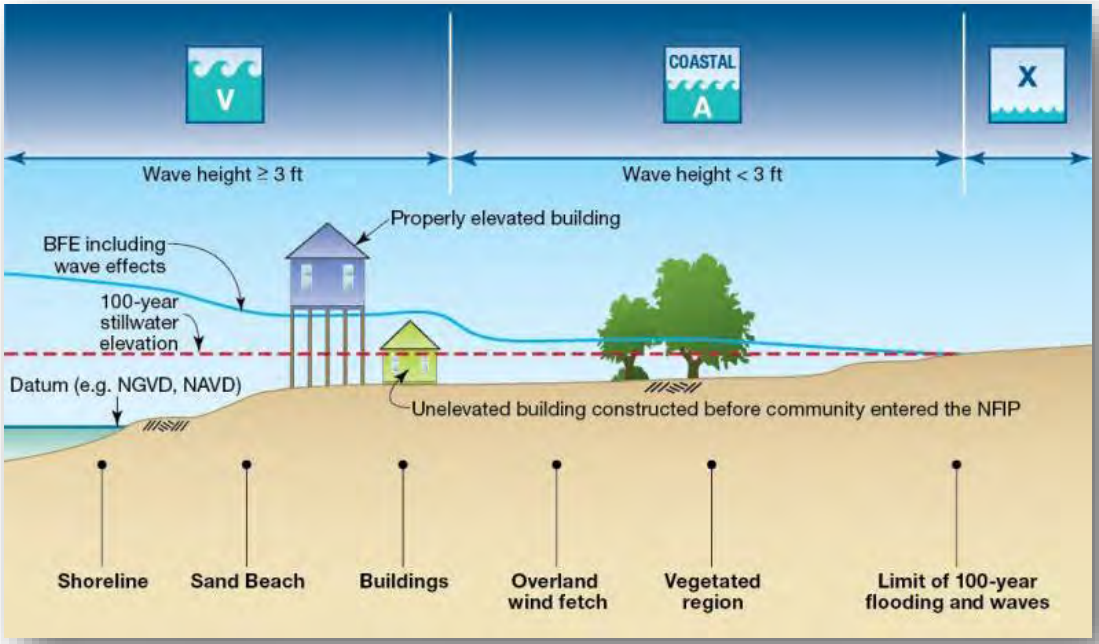


Step 3: Mapping

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





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Step 3: VE Zones

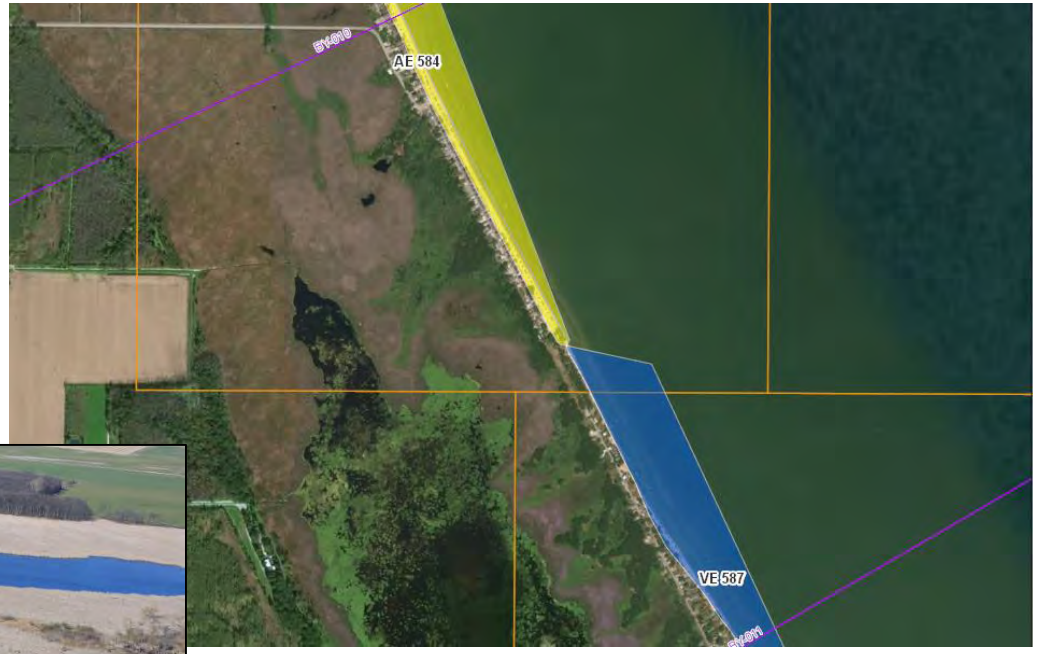
- Intact transects
  - VE zone mapped to elevation associated with TWL
- Failed transects (coastal structures)
  - VE zone mapped to station along the profile associated with TWL
  - Elevation will not match topography since failure include profile modification
- Eroded profiles
  - VE zone mapped to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

Step 3: Overland Wave Propagation VE Zones

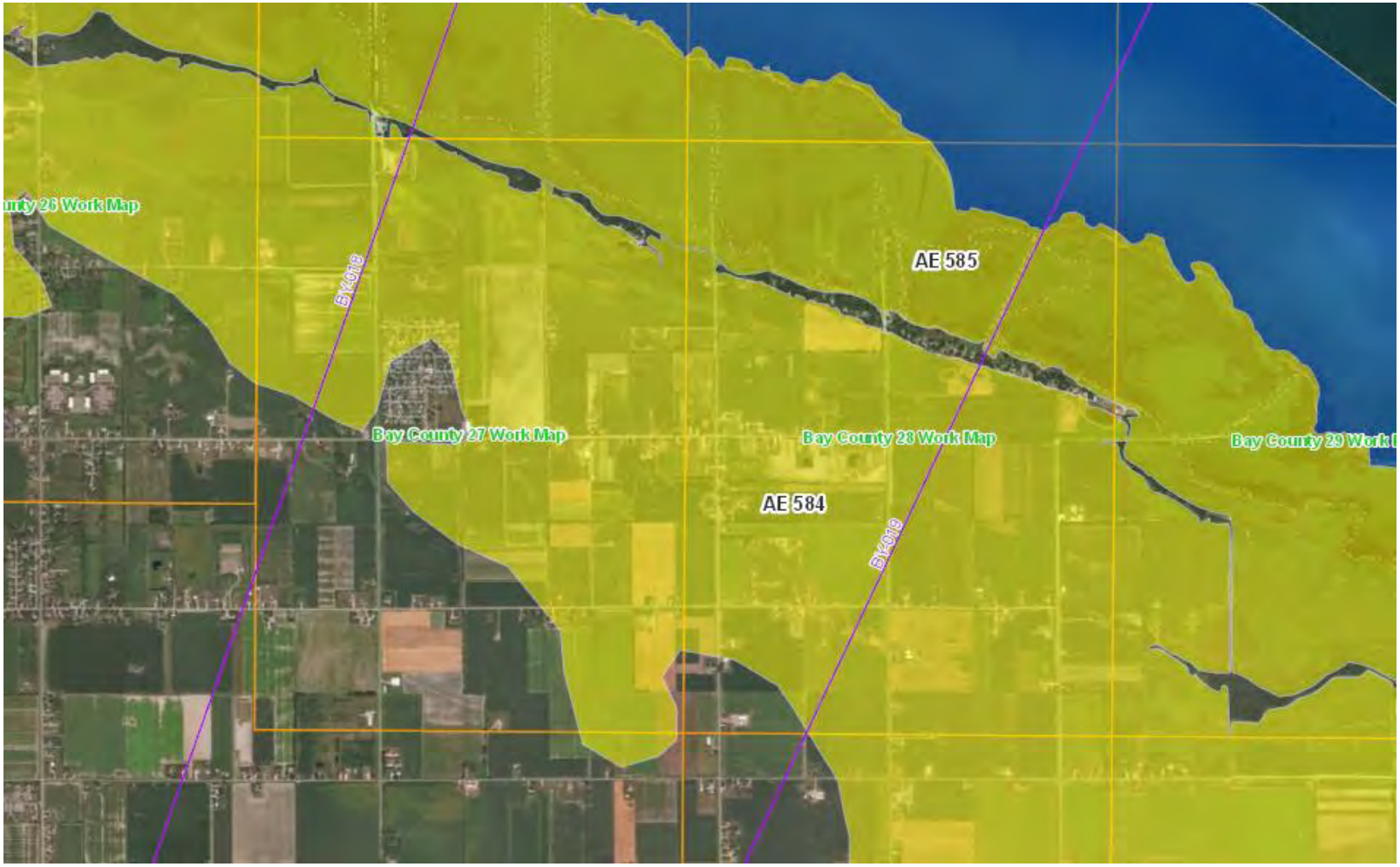
- VE zone associated with the location of the 3 foot breaking wave
- AE zones can exist with BFEs higher than TSWL as wave action is considered
- Most conservative of the 5 WHAFIS runs selected for mapping
- Most conservative is associated with largest extend of flooding and highest VE zone

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



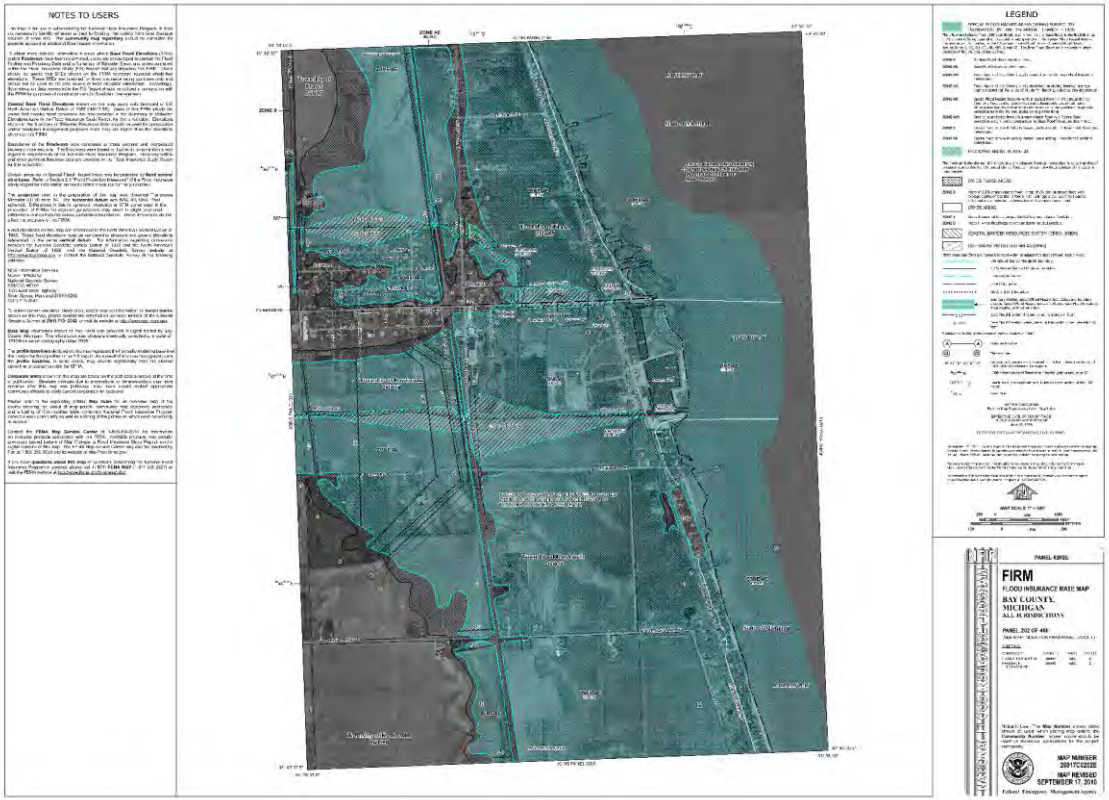
Step 3: SWEL Inundation



Draft Work Map vs FIS/FIRM

Bay County, MI Work Map

Bay County, MI effective FIRM



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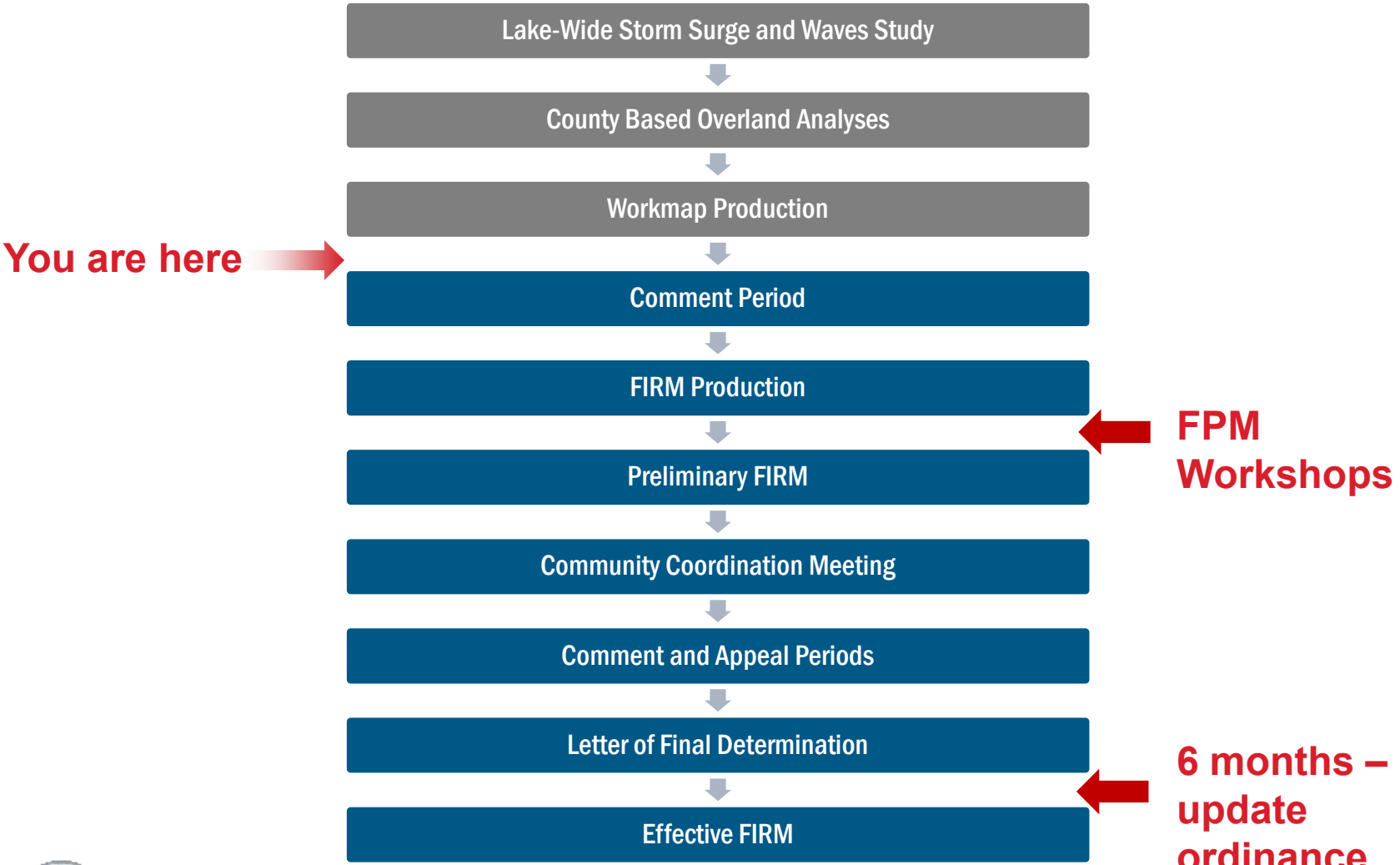
FEMA FLOODPLAIN MANAGEMENT

Current Study Status



Floodplain Management Workshops

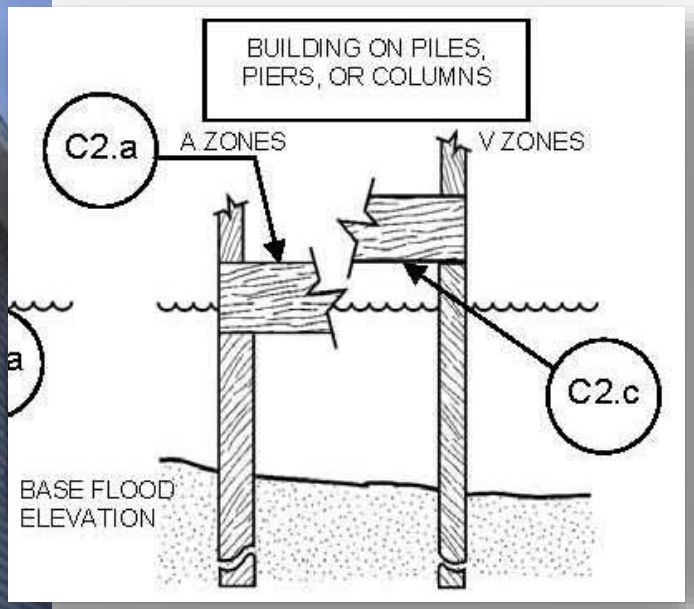
- Conducted by FEMA/DNR just before preliminary maps are released
- Workshop details:
  - Approximately 3 – 4 hours
  - Designed for floodplain administrator, zoning official, building inspectors, permit officials, etc.
  - Basics of Coastal Flooding
  - Using the Flood Insurance Study and FIRM for coastal 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,

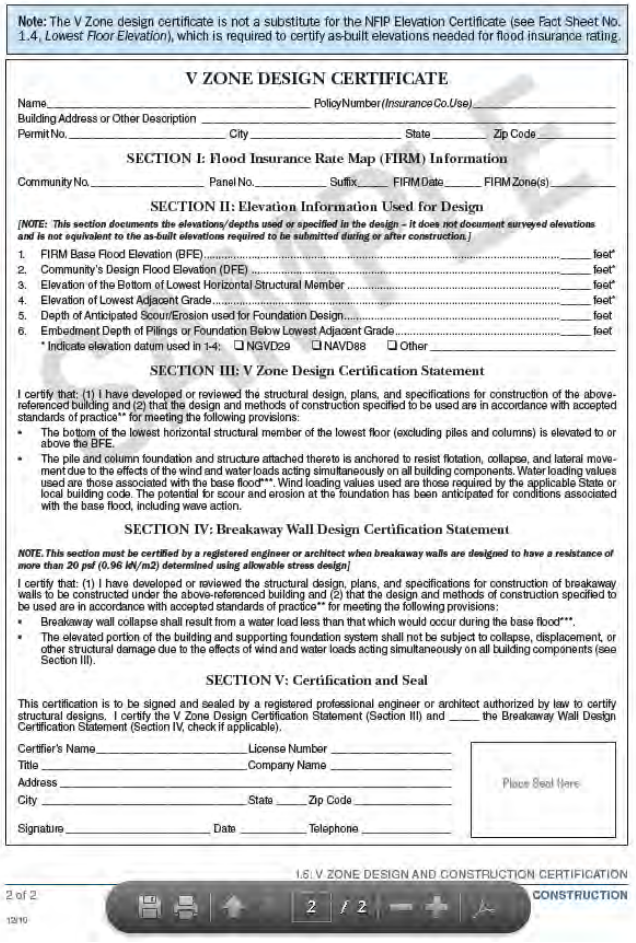
> ... with the space below the lowest floor either free of obstruction or constructed with non-supporting breakaway walls ...

Lowest horizontal structural member



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

2 of 2

12/10

CONSTRUCTION

FEMA

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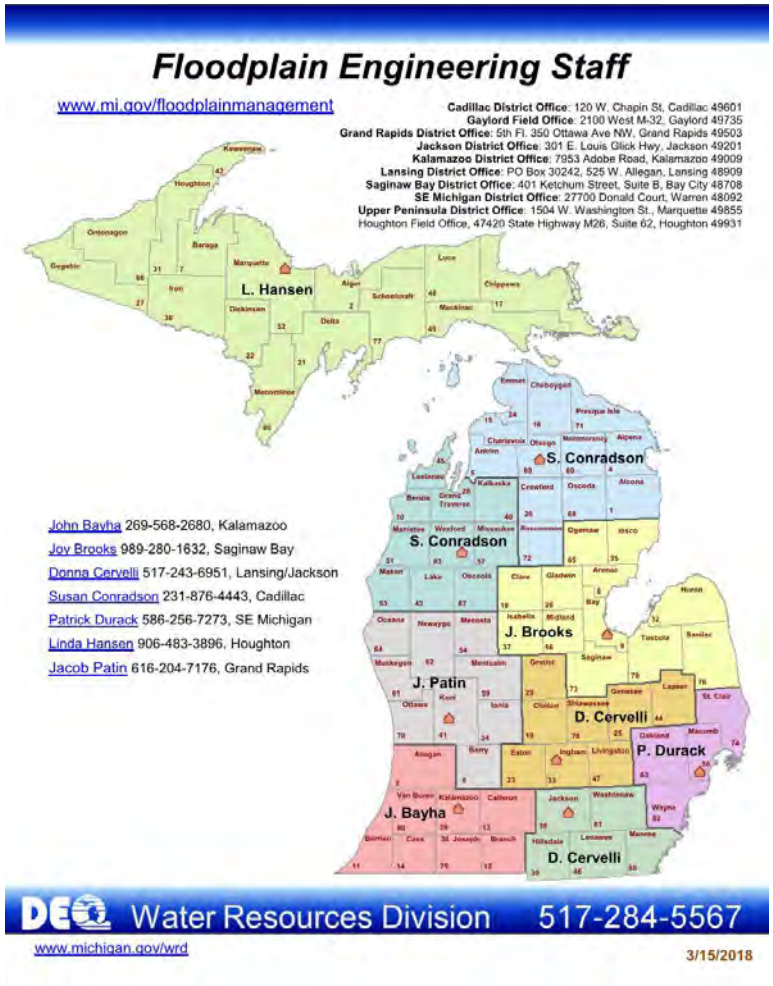
Model Ordinance Development

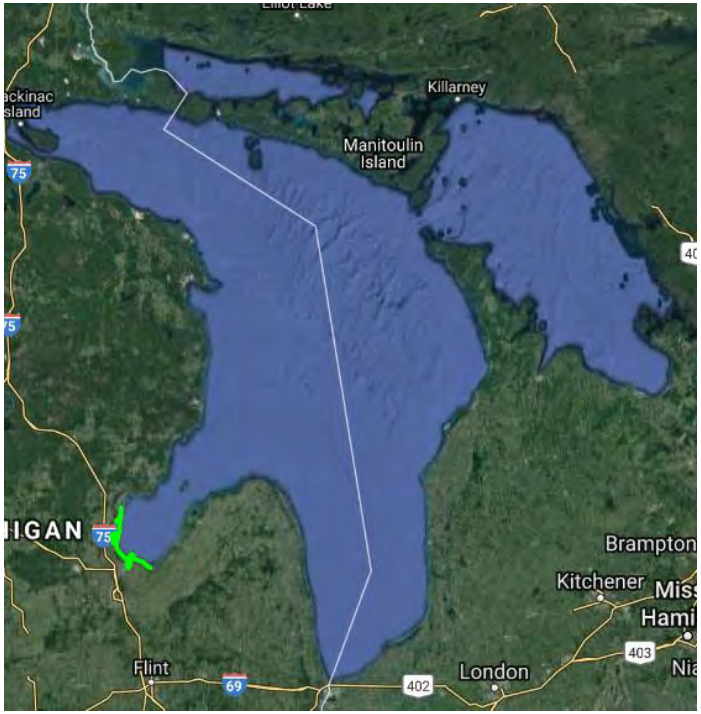
- FEMA Region V and Michigan DEQ are working together to prepare a model ordinance to incorporate V zone standards
- Ordinances must be updated/adopted by effective date of maps

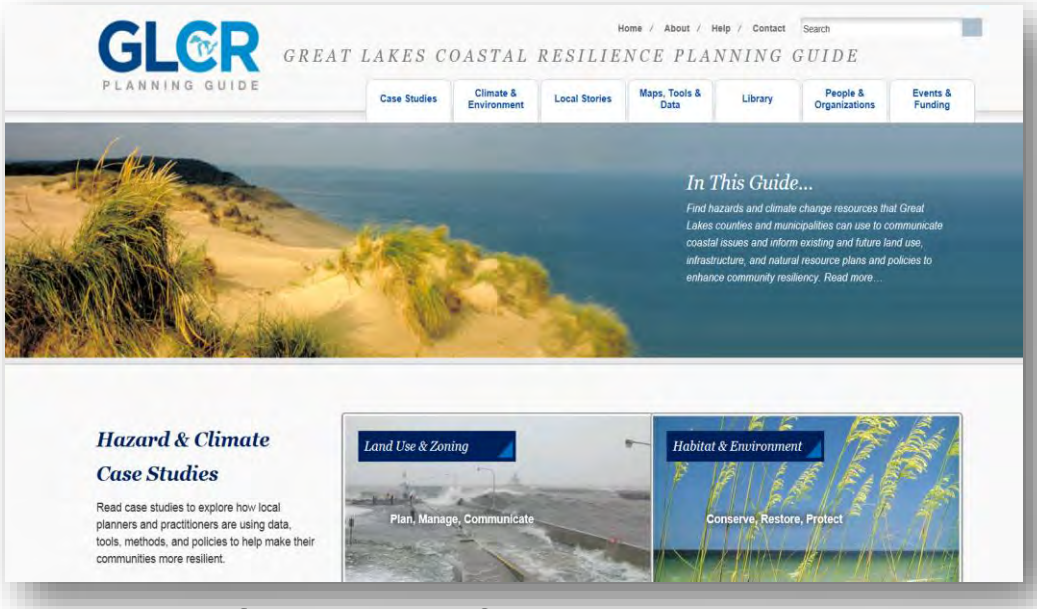


Online Resources

High resolution oblique aerial images

https://greatlakes.erdc.dren.mil/

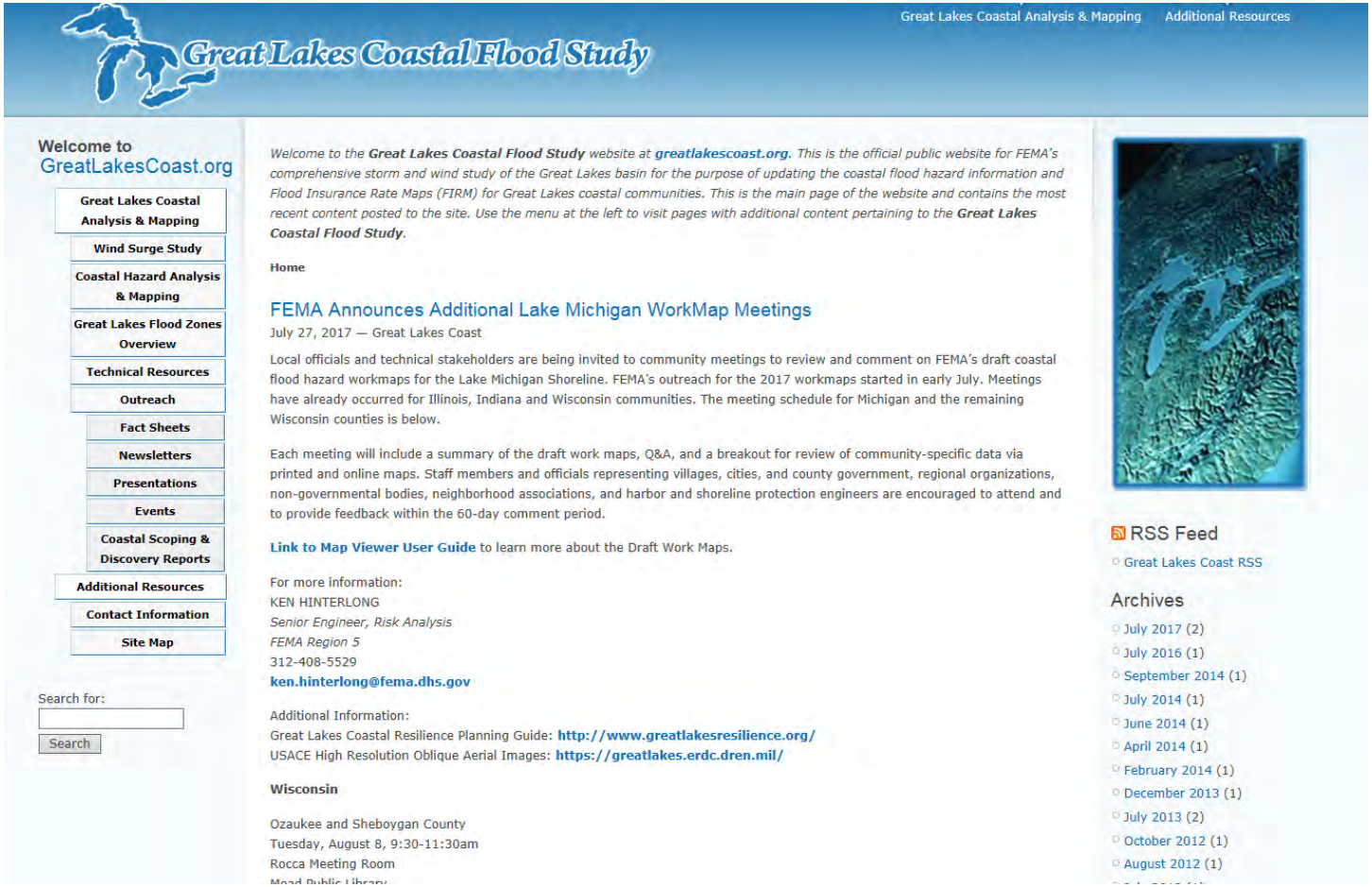




Great Lakes Coastal Resilience Planning:

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

Great Lakes Coastal Flood Study



http://www.greatlakescoast.org/

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.

FEMA

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)

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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Questions?

FEMA

Thank you for your participation!

Interactive session to review the coastal work maps

COASTAL WORK MAP DEMO