



# **St. Louis County, MN Coastal Hazard Analysis Flood Risk Review Meeting**

**May 2, 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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St. Louis County, MN

# **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:



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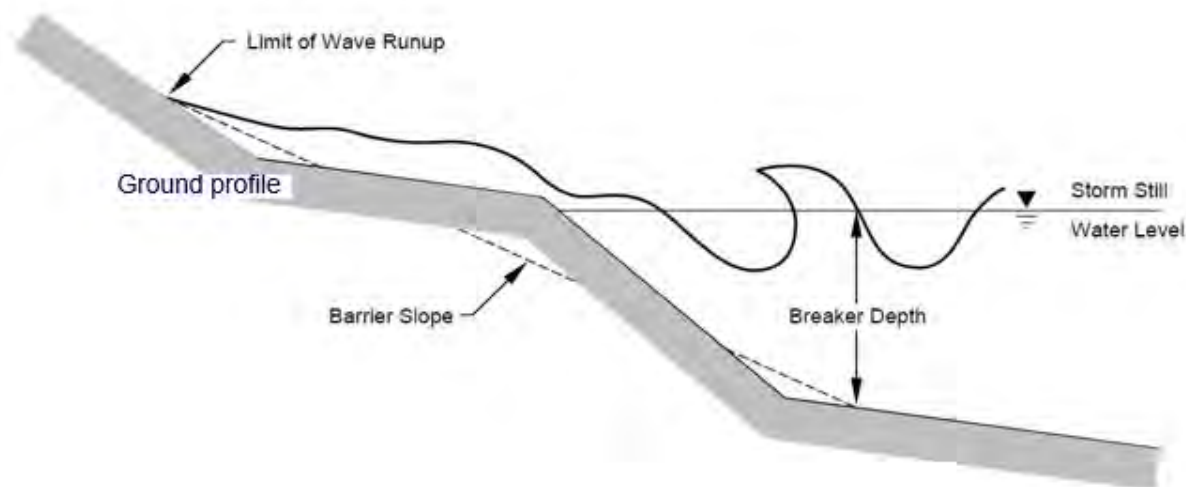
US Army Corps  
of Engineers®  
Detroit District



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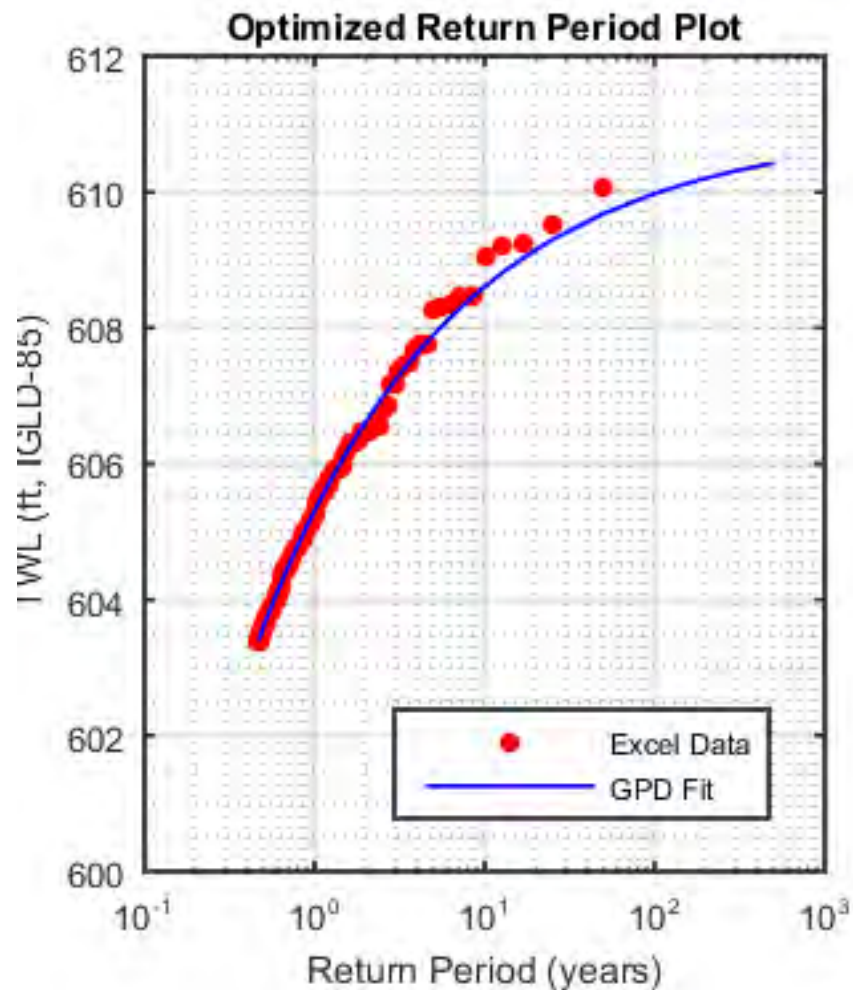
# Response-Based Wave Runup

- ▶ 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.



# Response-Based Wave Runup

St. Louis Transect 6



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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



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# 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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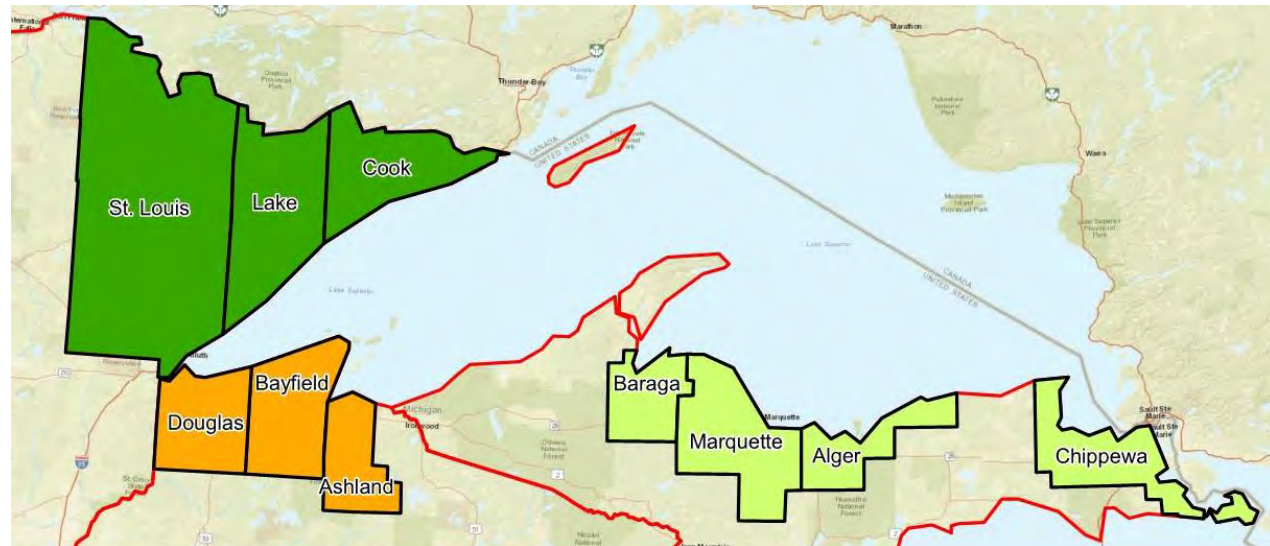
St. Louis County, MN

# **CURRENT STATUS REVIEW**

# Analyses/Mapping: Grouping

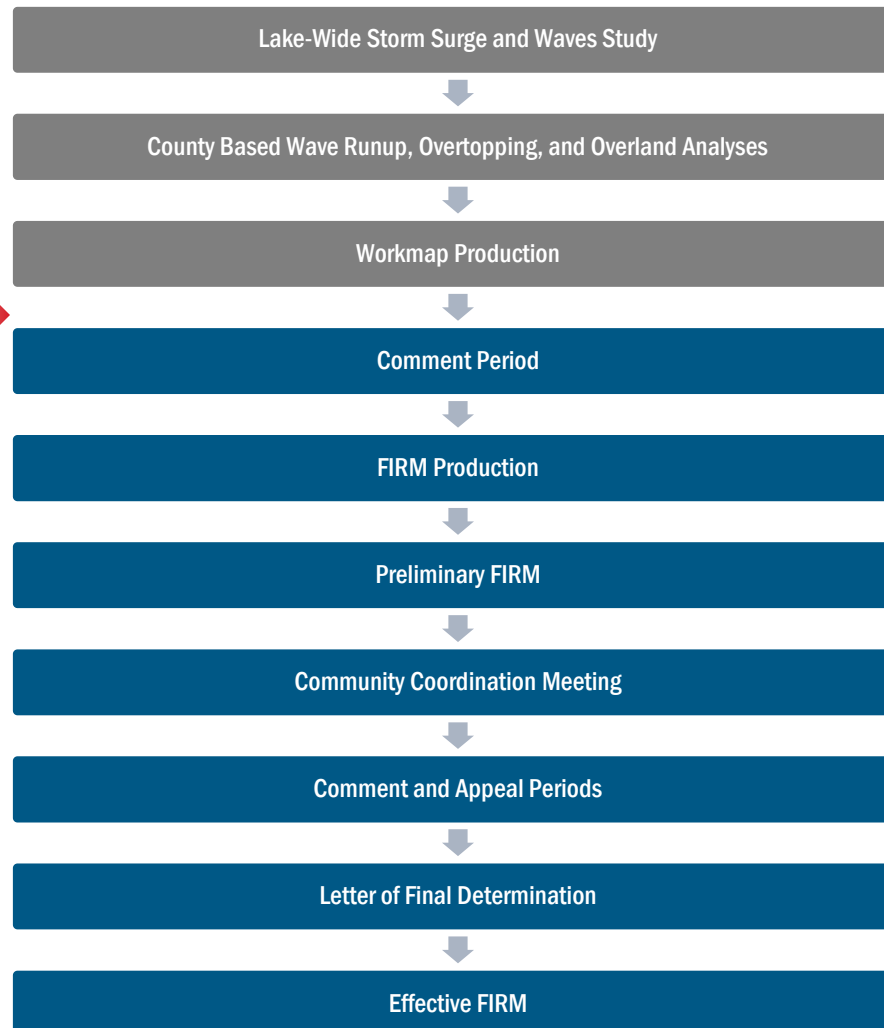
## Minnesota

- St. Louis
  - Cook
  - Lake
- ▶ FRR Meetings fall at the end of a multi-year study including sophisticated modeling
  - ▶ Next, coastal work maps and data would need to tie into riverine studies before proceeding to develop official regulatory Flood Insurance Rate Maps



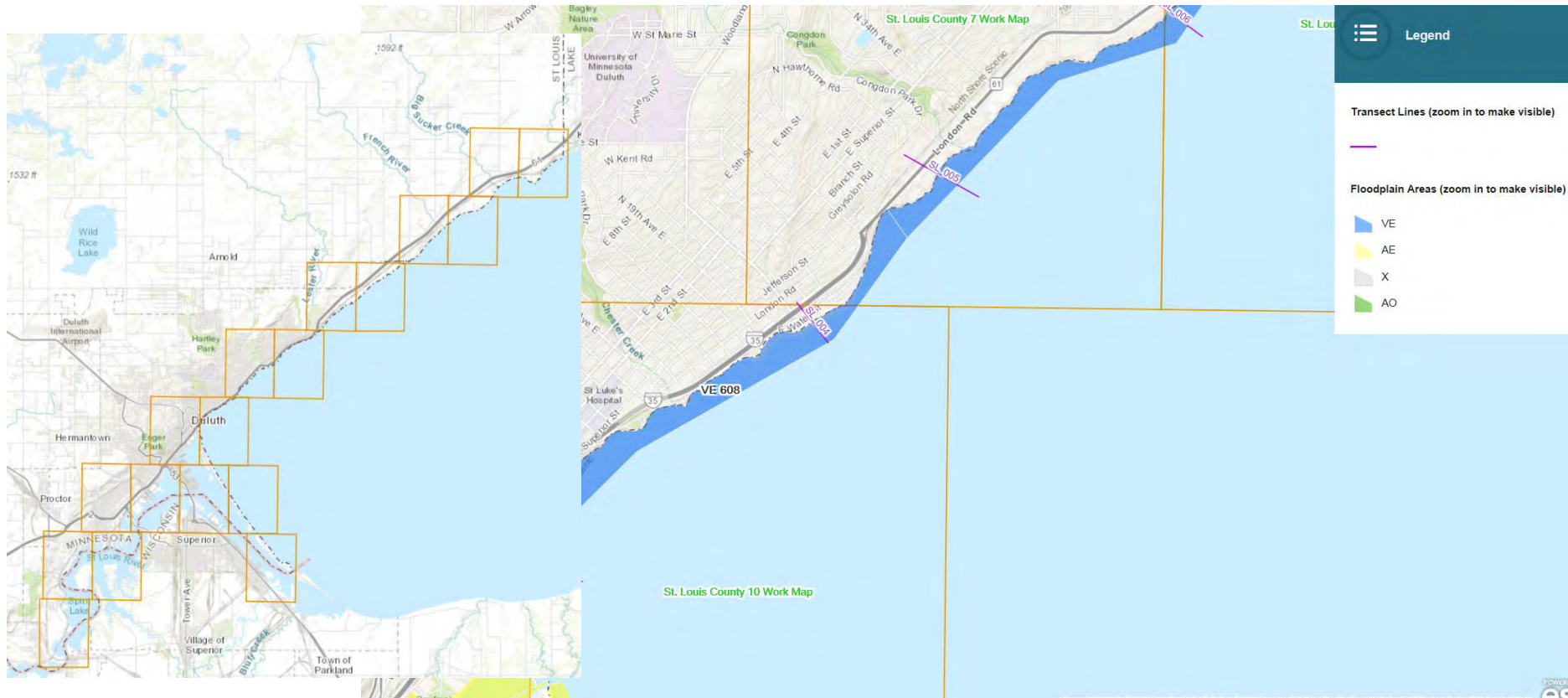
# Current Study Status

You are here →



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# Work Map Data Viewer: Online GIS Data

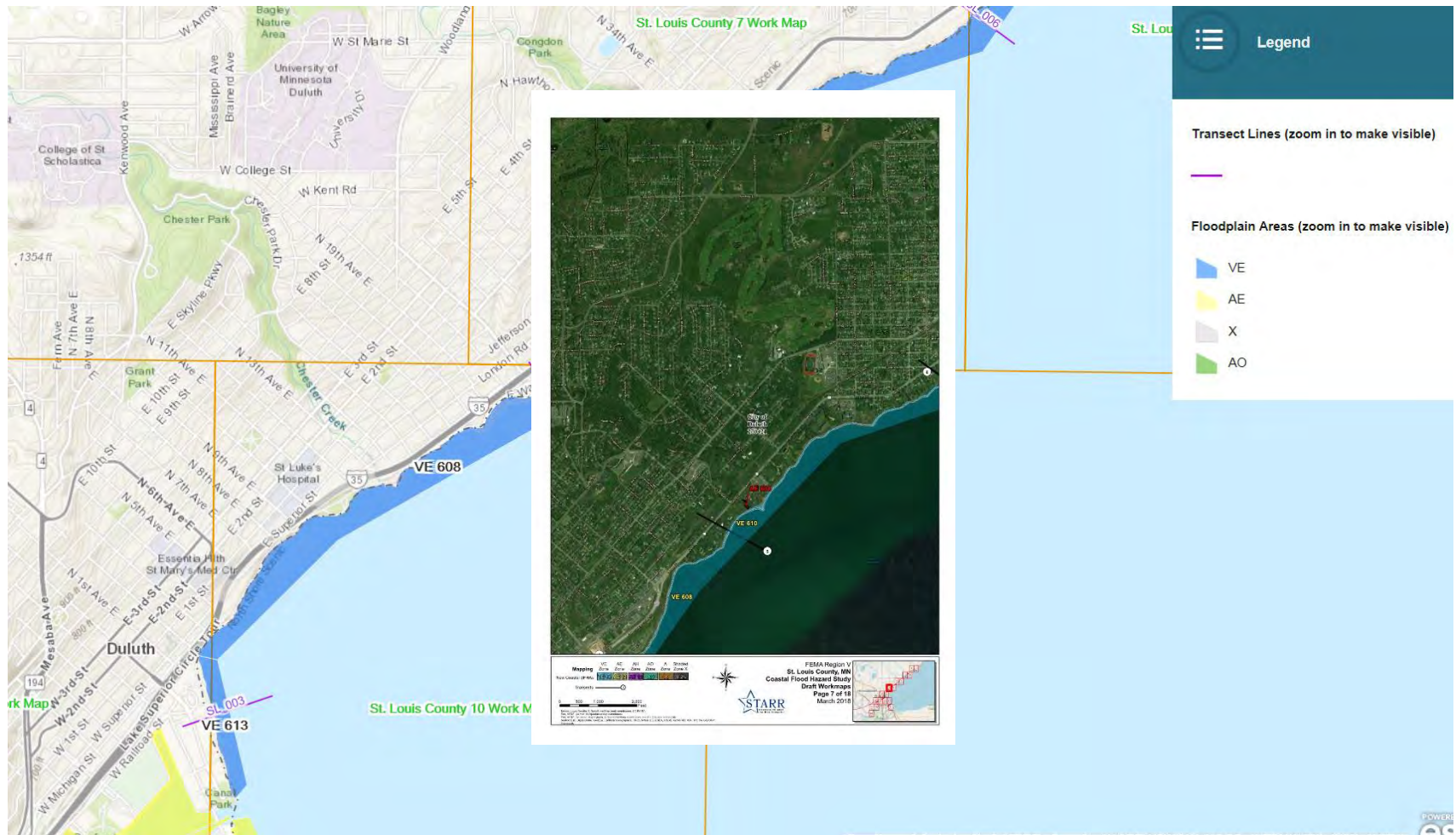


Link to the St. Louis County, MN Work Map Data Viewer: <http://arcg.is/0SKnie>



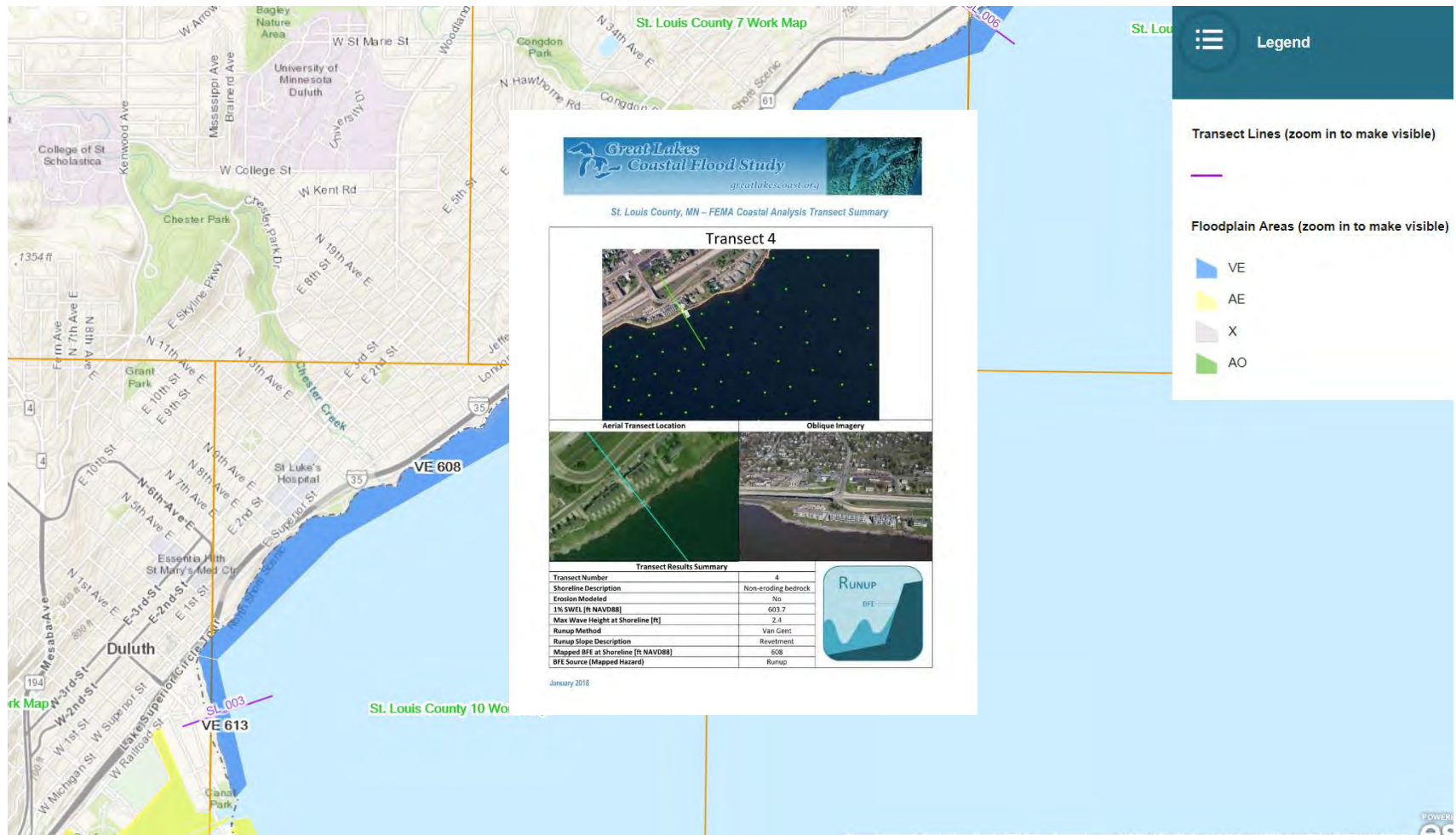
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# Work Map Data Viewer: Maps



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# Work Map Data Viewer: Transect Summary Sheets



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St. Louis County, MN

# **TECHNICAL OVERVIEW OF STUDY AND MAPPING**

# Coastal Flood Hazard Modeling Overview

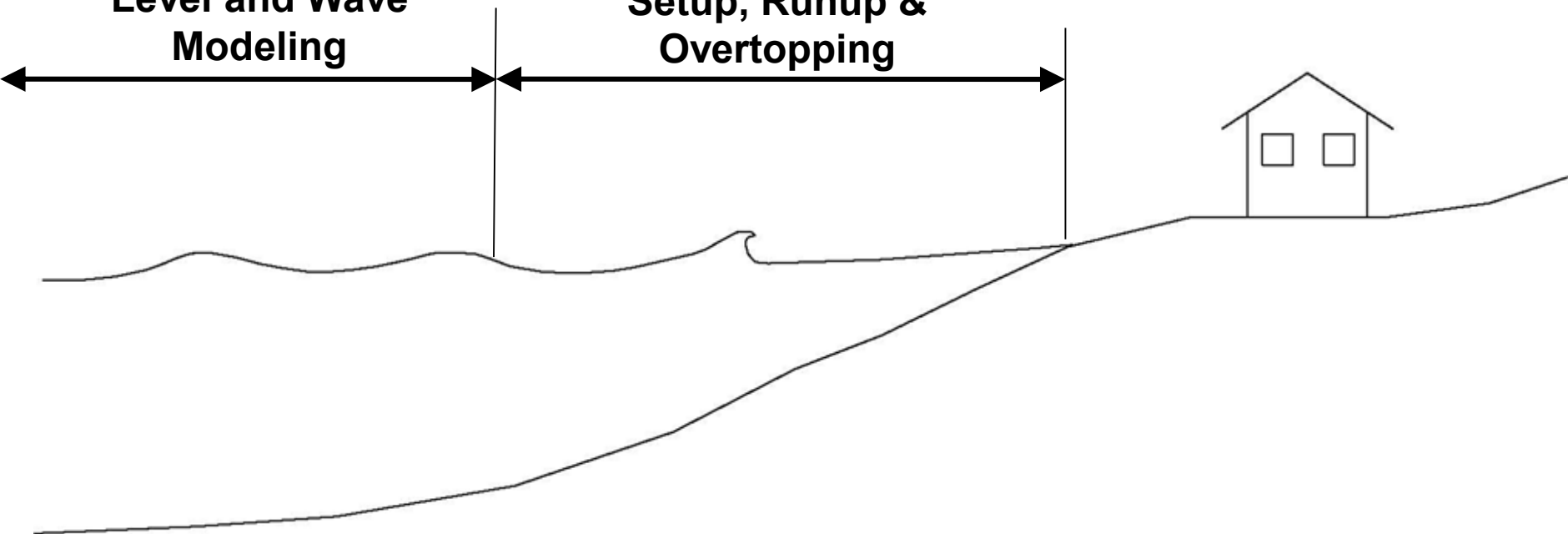
## *Lake-Wide Variation*

## *Local Variation*

**Step 1: Offshore Water Level and Wave Modeling**

**Step 2: Nearshore Wave Setup, Runup & Overtopping**

**Step 3: Floodplain Mapping**

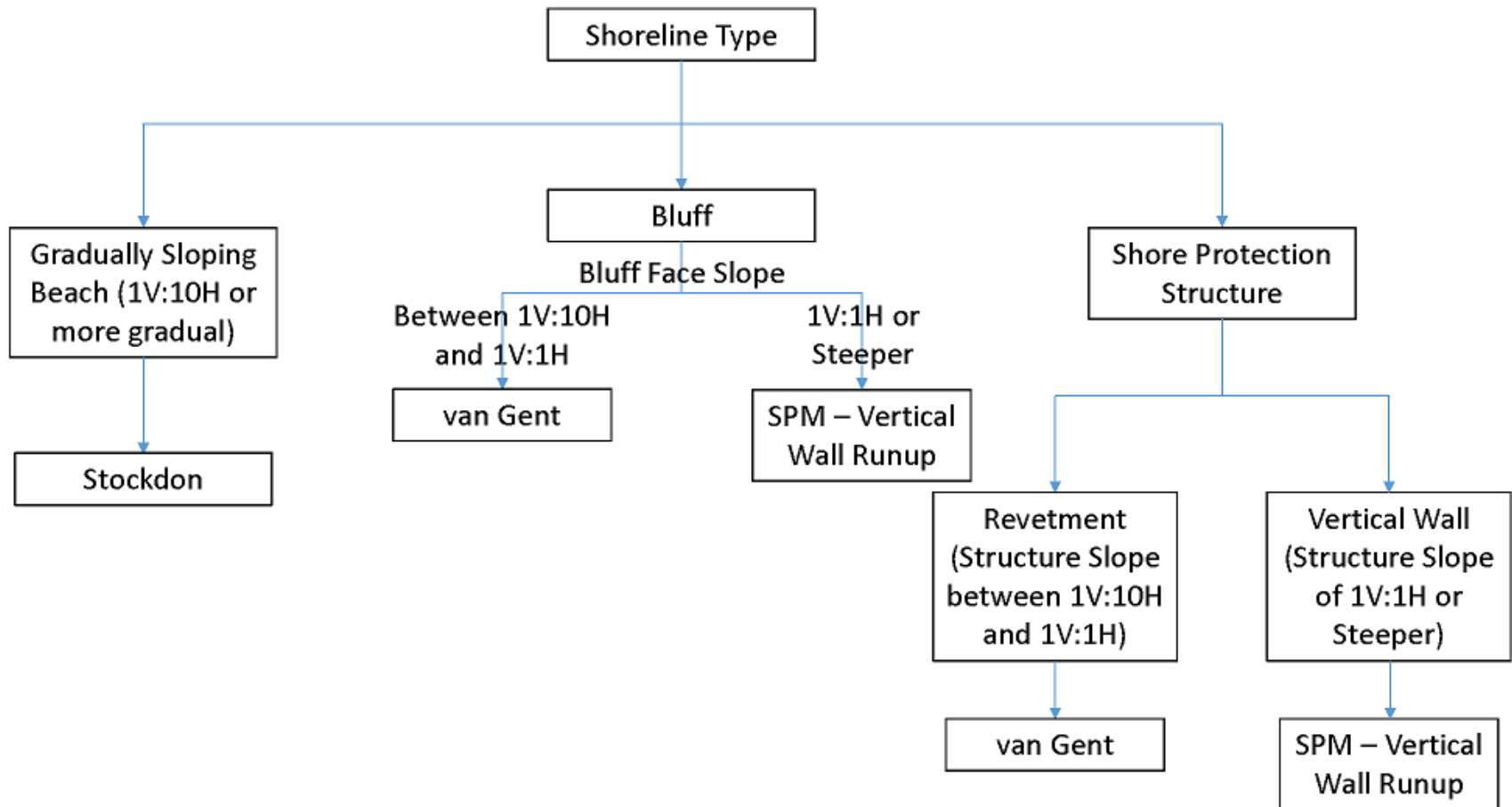


**FEMA**

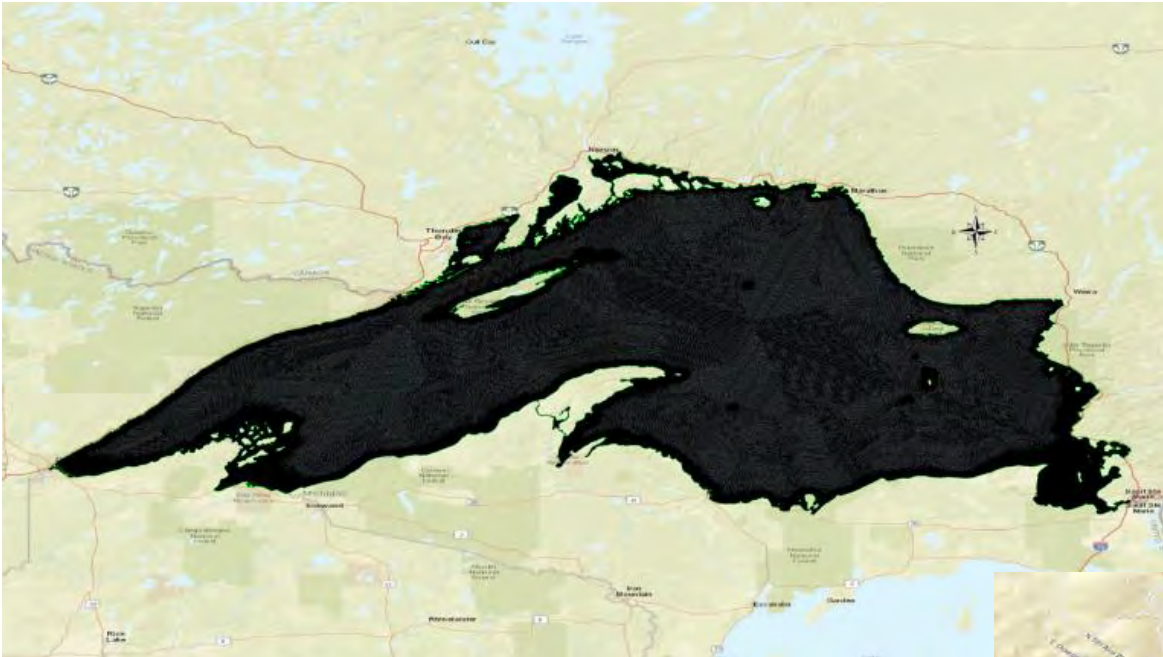
# Run-up Methods

## *Approach for Upper Lakes numerical modeling*

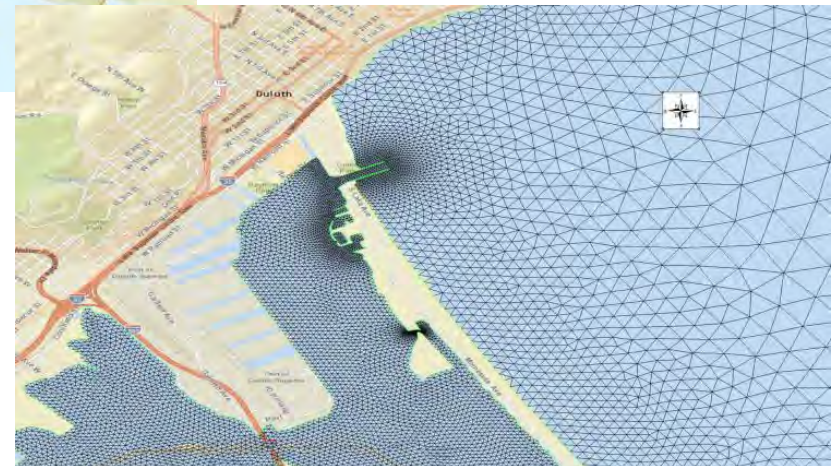
Runup Method Decision Flow Chart



## Step 1: ADCIRC+SWAN Mesh



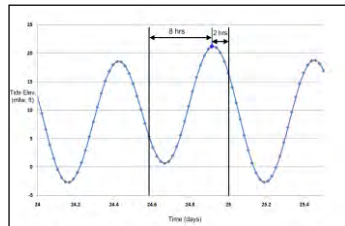
- ▶ Resolution as Fine as 10 m Along Complex Shoreline Features including Jetties, Breakwaters, Inlets, and Natural Shoals



# Step 1: Run the Models

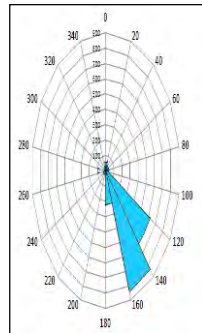
## Baseline

## Water Level

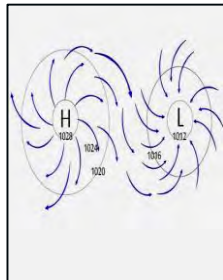


## Meteorological Forcing

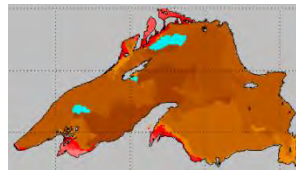
### Wind



### Pressure

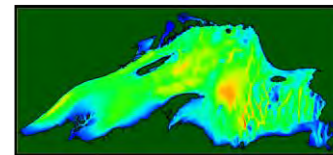


## Ice

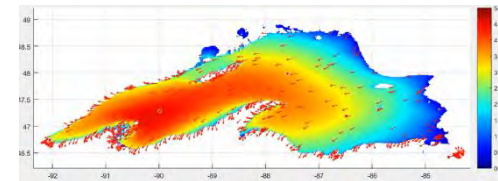


## Physical Setting

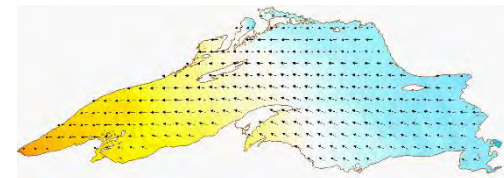
## Bathymetry



## Waves



## Still Water Elevations

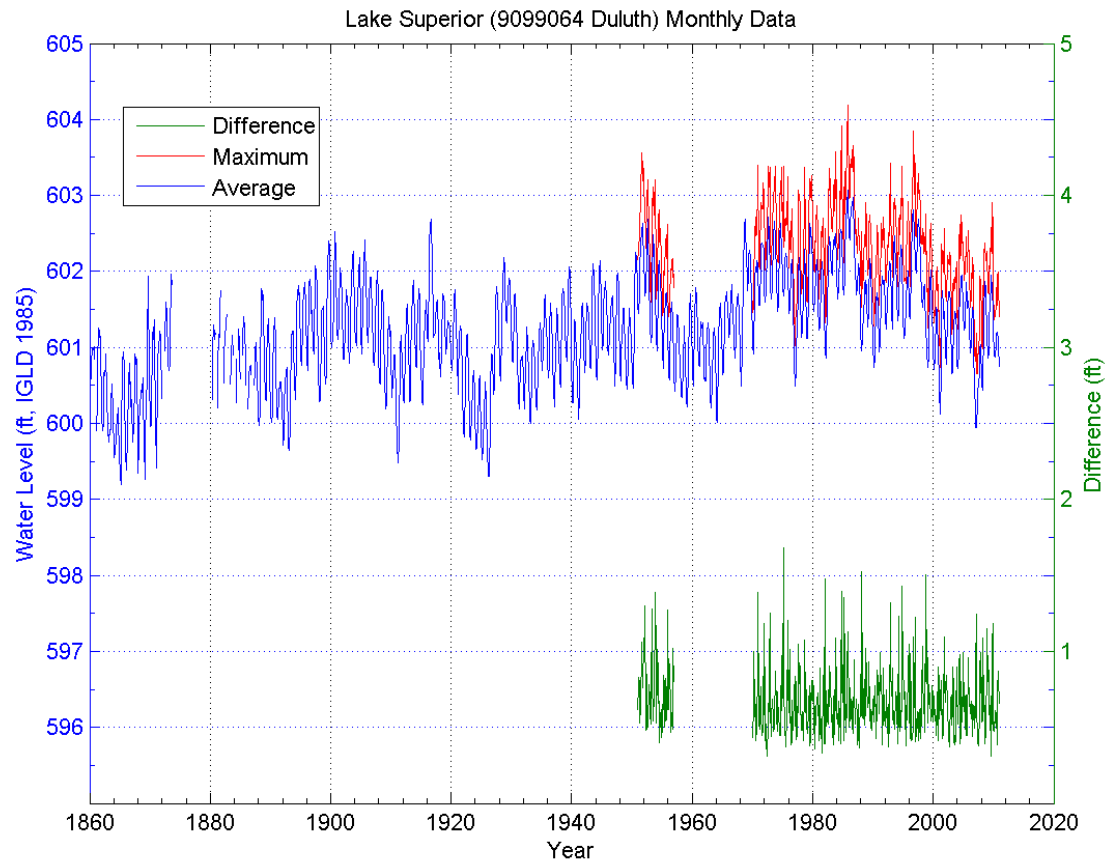


Total of 150 events between 1960-2009



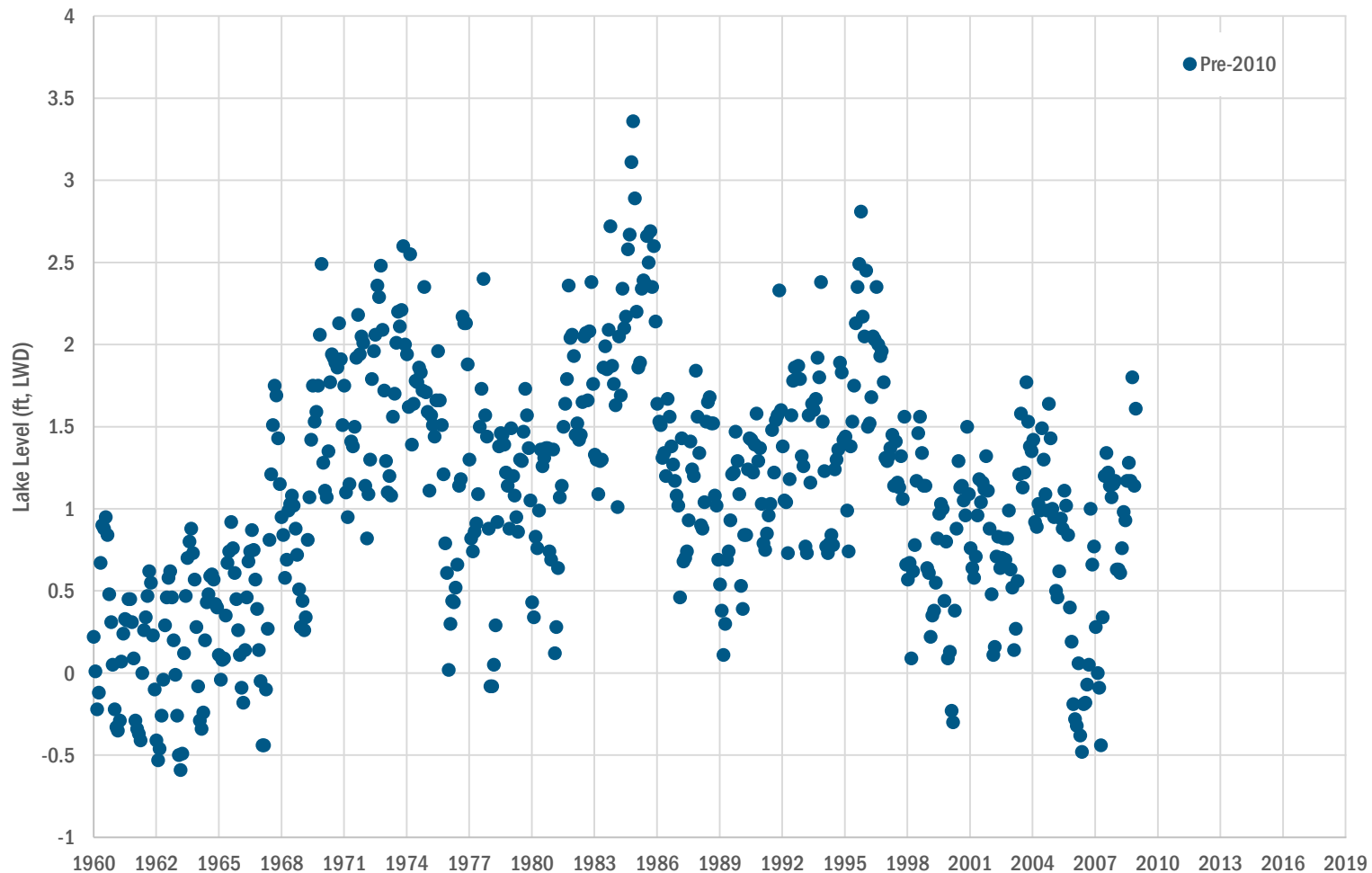
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# Step 1: Lake Levels



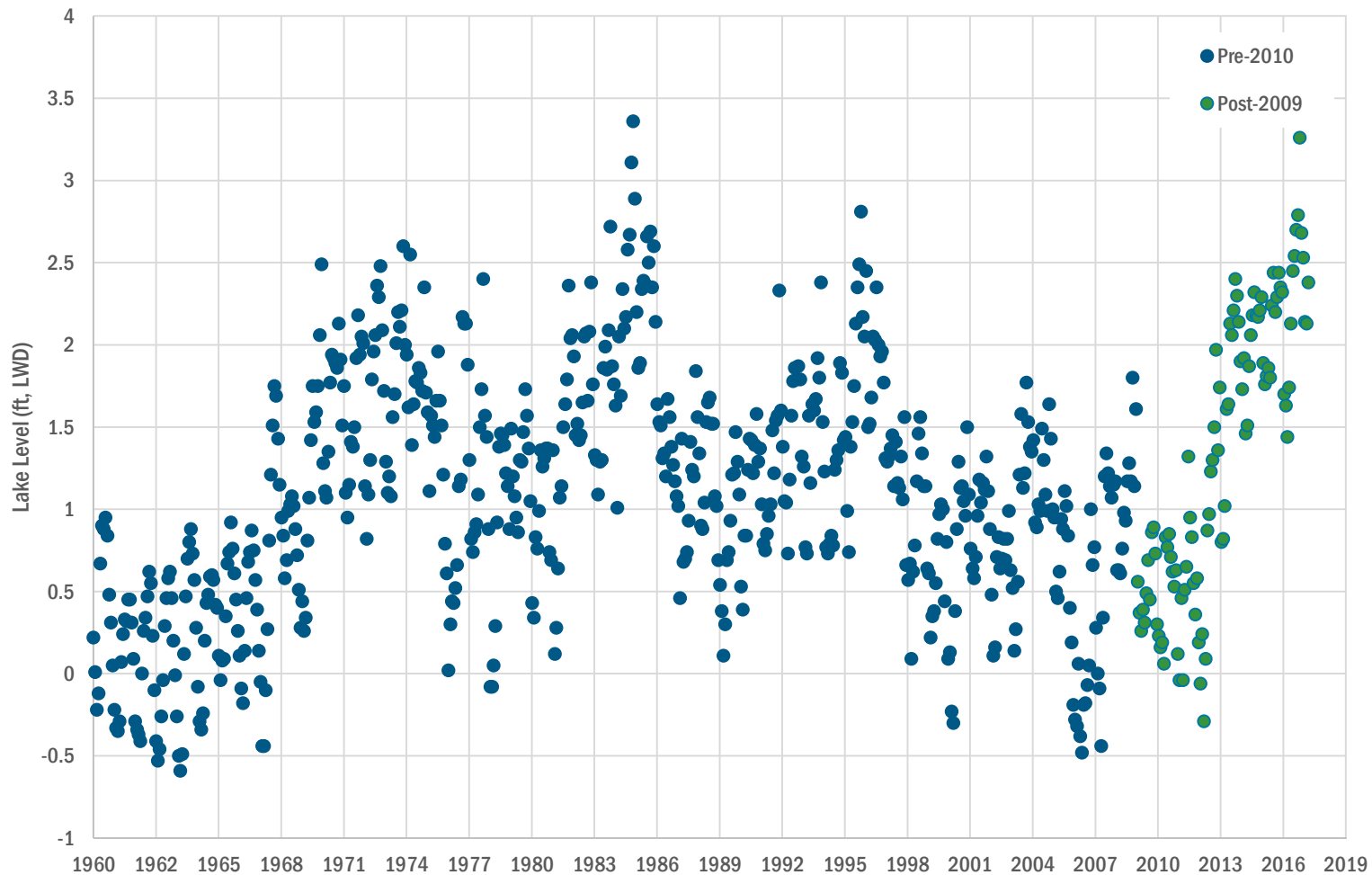
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# Step 1: Lake Levels



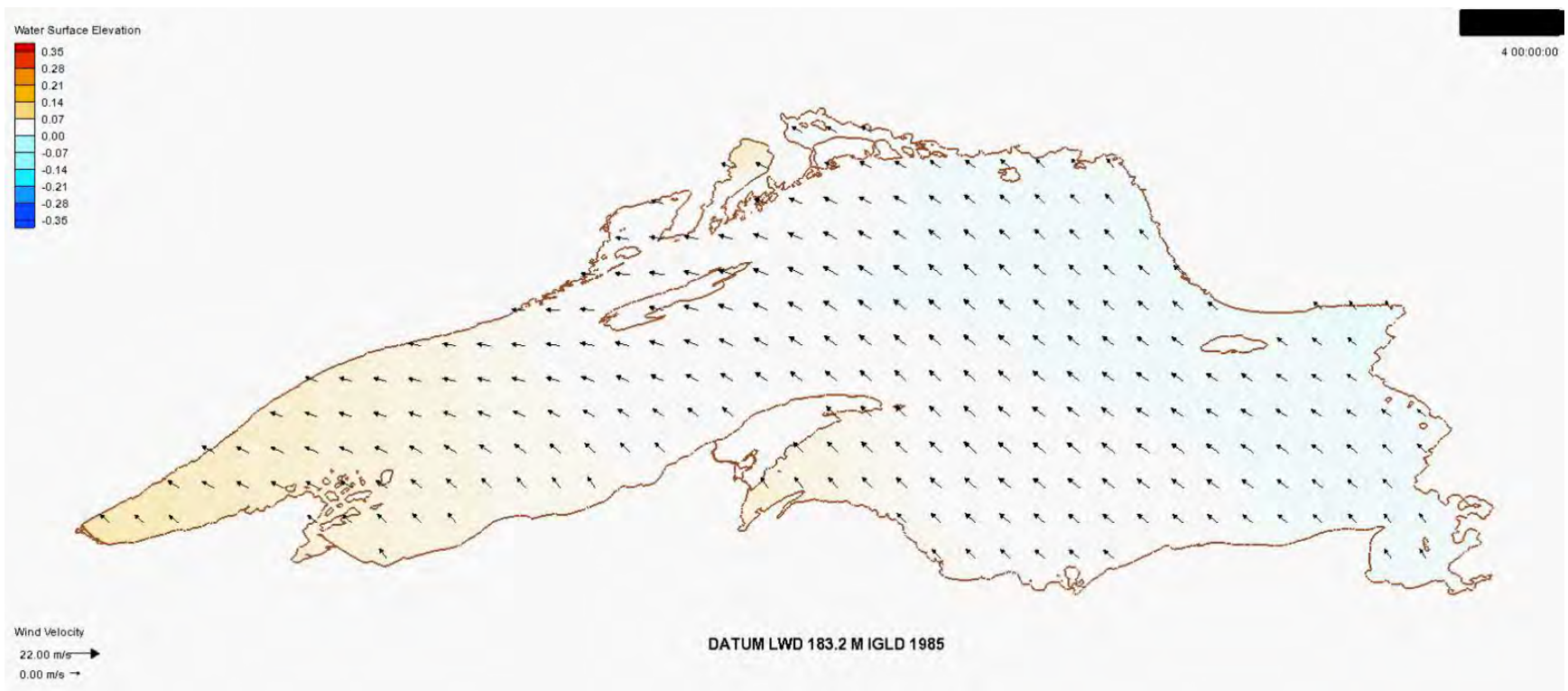
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# Step 1: Lake Levels



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# Step 1: Example Surge Behavior



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# Step 1: Water Level Accuracy Assessment

Location		1-percent-annual chance SWEL (m, IGLD85)	
		Modeled	Observed
9099004	Point Iroquois, MI	183.99	184.24
9099018	Marquette, MI	183.92	184.13
9099044	Ontonagon, MI	183.87	183.95
9099064	Duluth, MN	183.96	184.13
9099090	Grand Marais, MN	183.87	183.98



## Step 2: Nearshore Wave-Induced Flood Hazards

- **Nearshore Wave-Induced Flood Hazards Analysis includes:**

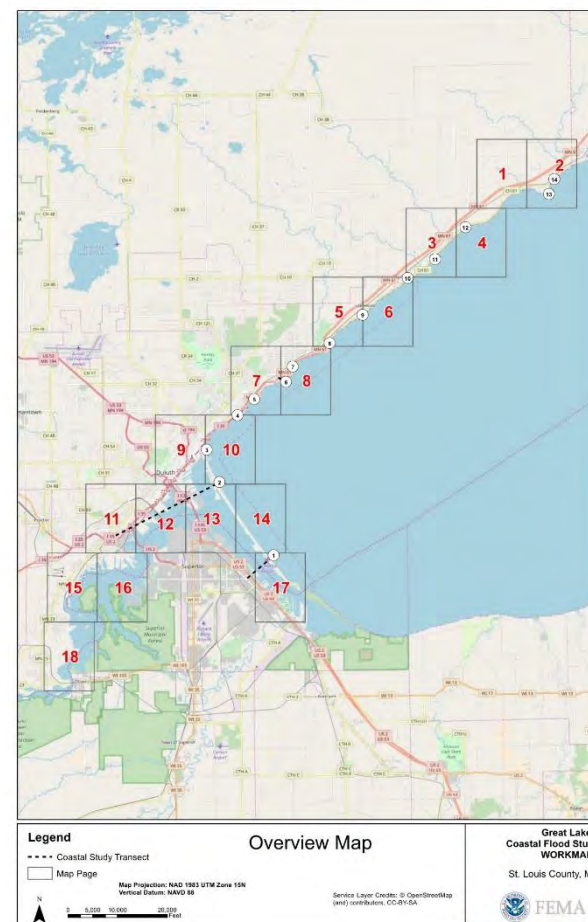
- Shoreline classification
- 2-D Wave and Surge Model data extraction
- Wave setup
- Erosion
- Evaluation of coastal structures
- Wave runup
- Wave overtopping
- Overland wave propagation
- Statistical analysis



Along 1-D Transects

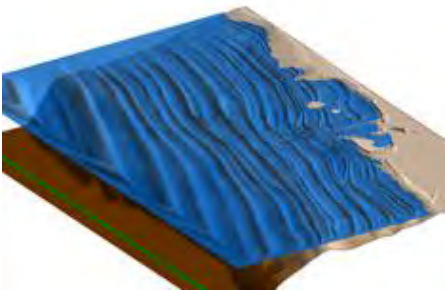
# Step 2: Transect Layout

- ▶ St. Louis County
- ▶ 14 transects
- ▶ 18 panels

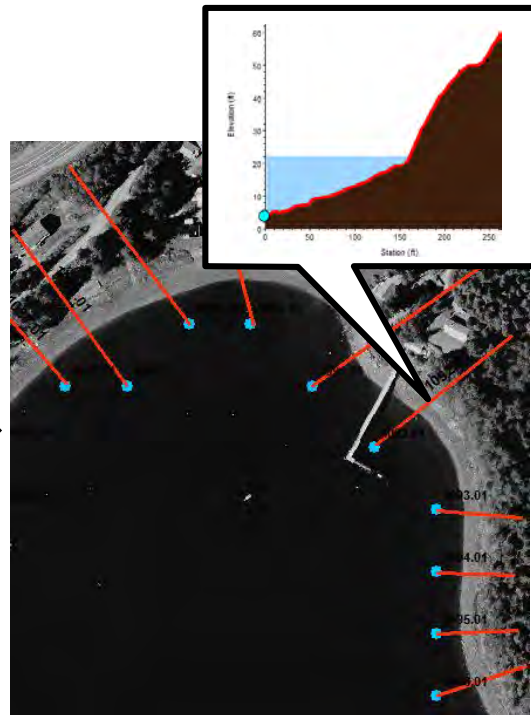


## Step 2: Transect Analysis Overview

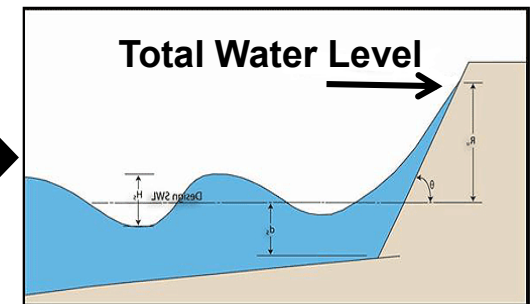
### Water Level & Offshore Waves



### Transect Analysis



### Total Water Level

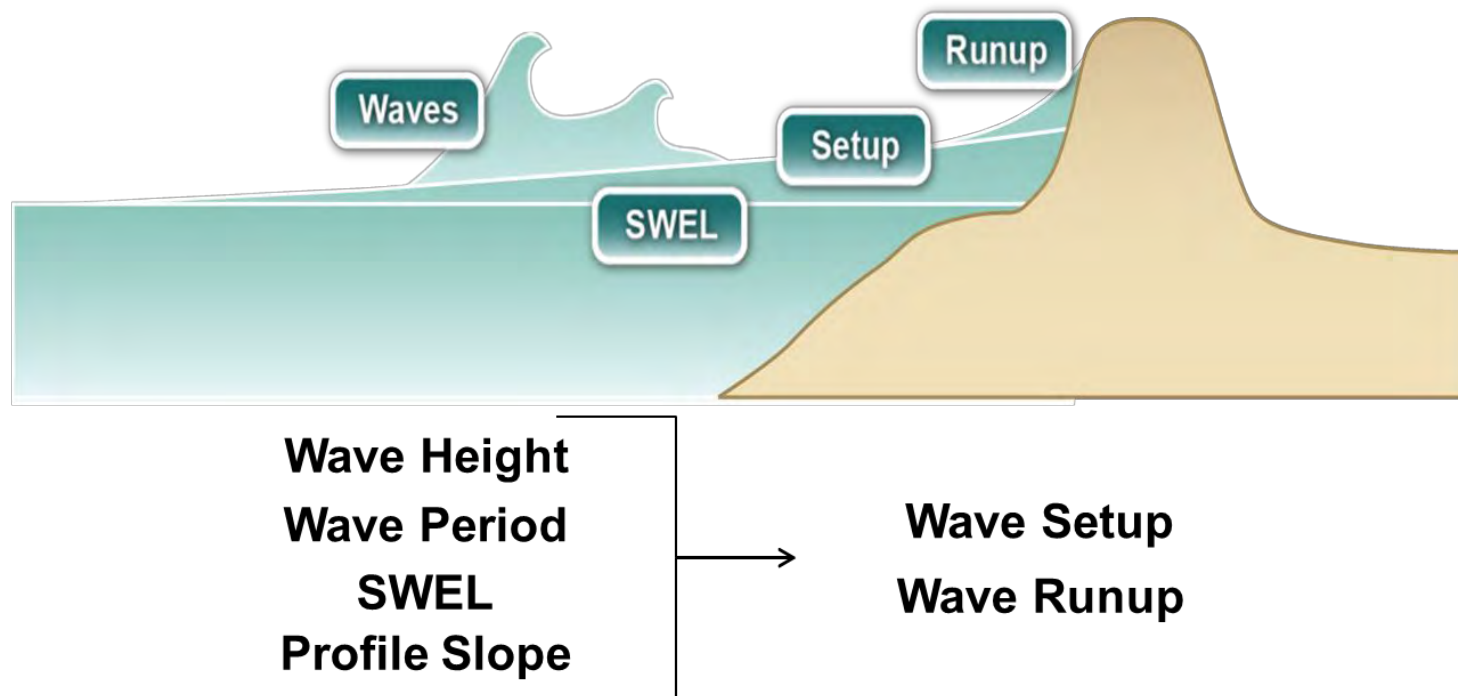


### Total Water Level

1. Water Level (Surge)
2. Waves
3. Setup, Runup and/or Overtopping

## Step 2: Transect Analysis: Wave Setup and Runup

- Wave Runup is the uprush of water on a barrier
  - Barriers include dune, seawall, revetment, bluff, or other steep shoreline feature



## Step 2: Transect Analysis: Wave Overtopping

- If the wave runup exceeds the elevation of the barrier, overtopping will occur



## Step 2: Runup



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## Step 2: Overtopping



<https://twitter.com/akpix/status/985285850245271552>



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## Step 2: Compute Setup, Runup, and Overtopping

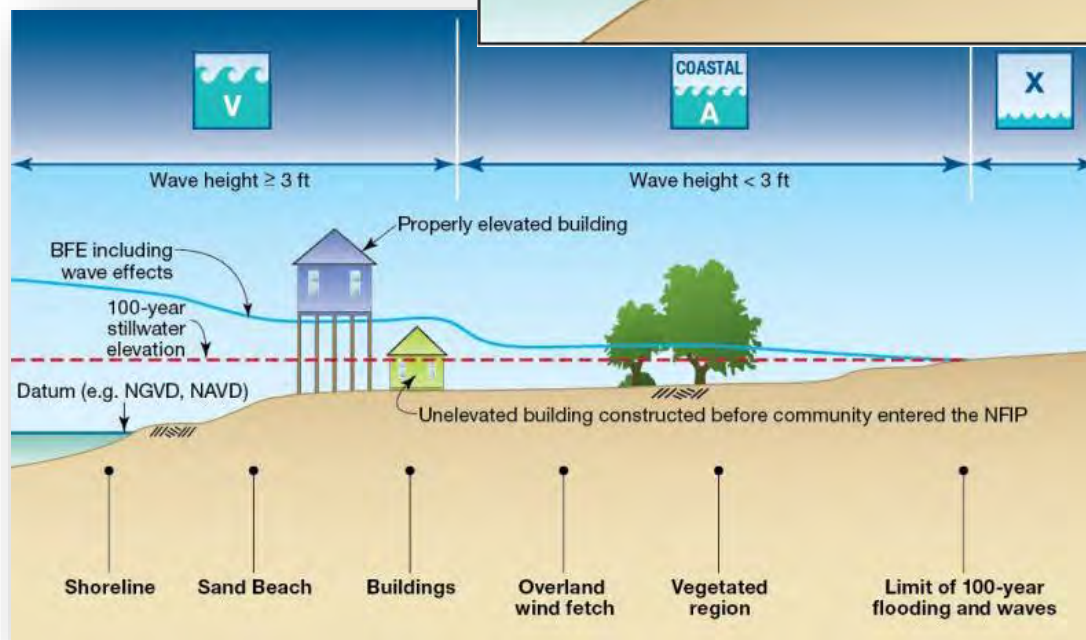
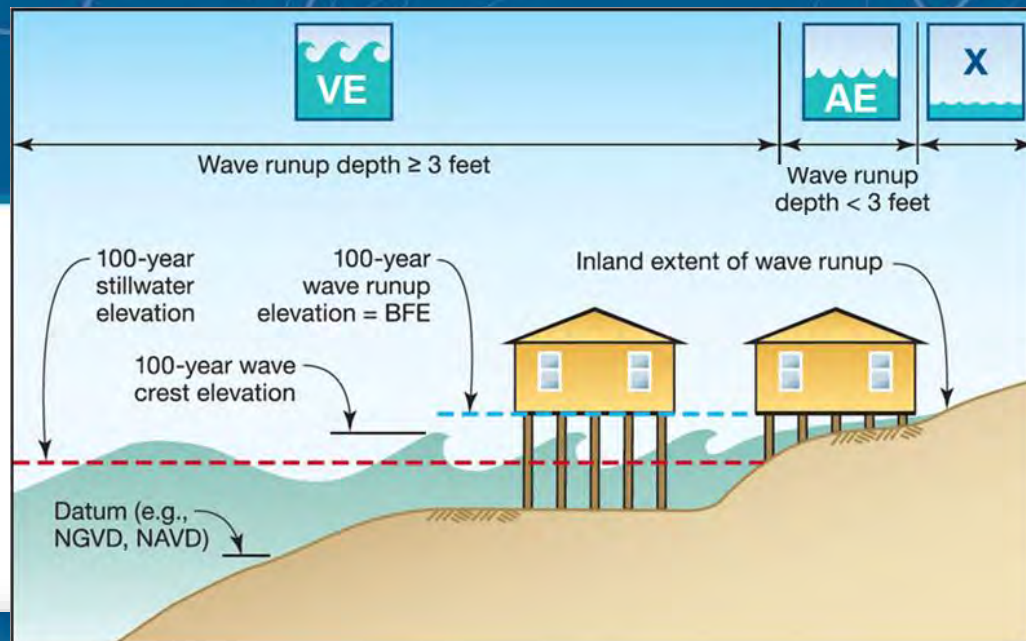
- ▶ 150 storms with hourly waves and water levels yields hourly wave setup, runup and overtopping rates
- ▶ Hourly Stillwater Levels (SWELs)
- ▶ Hourly Setup + Runup = Hourly Total Water Levels (TWLs)
- ▶ Extract the peak SWEL and TWL from each storm
- ▶ Return period analysis performed on TWL and SWEL

# 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)
  - $\text{Wave setup} + \text{SWL} = \text{Total Stillwater Level (TSWL)}$
- ▶ Use Wave Height Analysis for Flood Insurance Studies (WHAFIS) to determine interaction of waves with the backshore

# Step 3: Mapping

- Identification of
- VE
- AE
- AO
- X



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# Step 3: Runup 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: Other Overtopping Zones

## ► AO Zones

- Applied in areas of shallow flooding, usually sheet flow on sloping terrain
- BFEs not provided, instead average flood depths of between one and three feet is specified
- Flooding depth associated with overtopping rate

$\bar{Q}$ 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 <sup>+</sup> of Zone VE (elevation 3 feet above barrier crest), landward Zone AO (3 foot depth) or Zone AE with BFE

# 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: SWL or TSWL Inundation



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## Step 3: Zone Breaks

### Zone Breaks Along the Coast

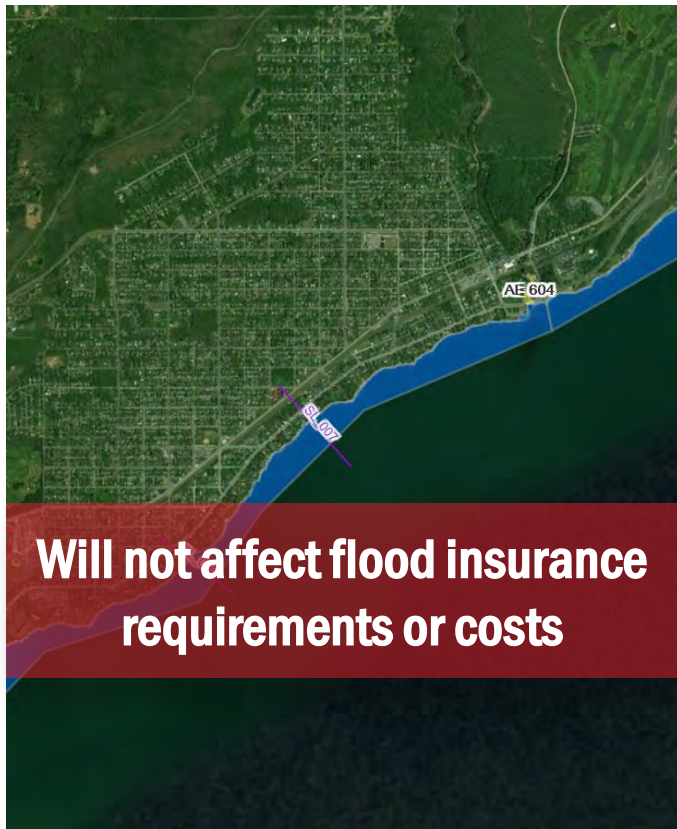


### Represent the Extents of Each Unique Coastal Feature

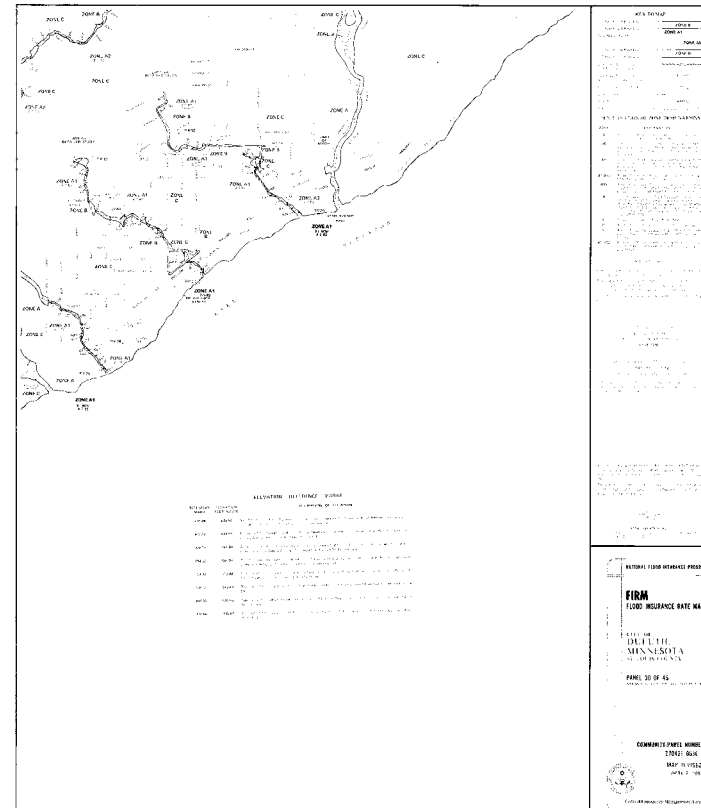


# Draft Work Map vs FIS/FIRM

St. Louis County, MN Work Map



St. Louis County, MN effective FIRM





Interactive session to review the coastal work maps

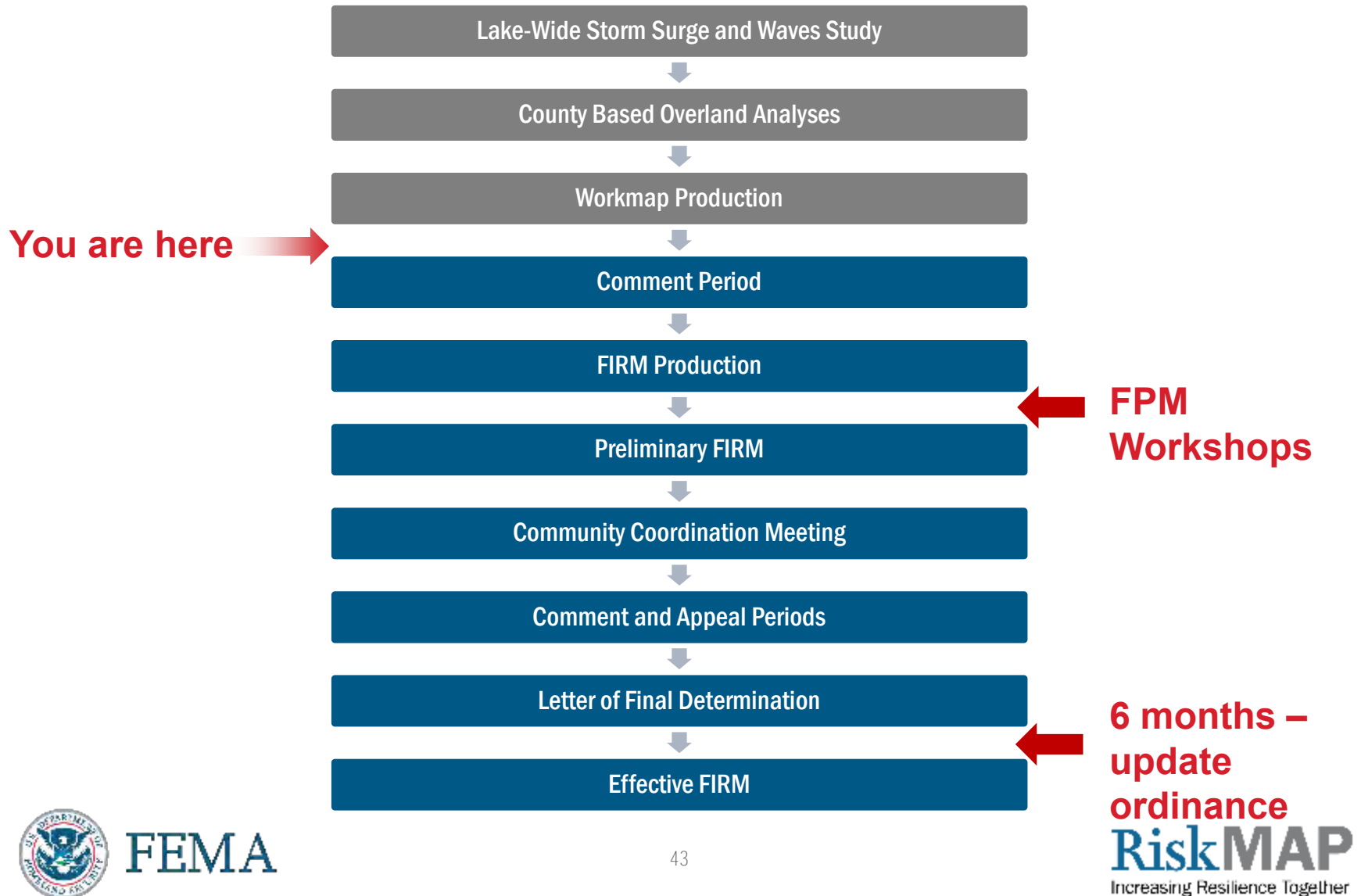
# **COASTAL WORK MAP DEMO**



St. Louis County, MN

# **FEMA FLOODPLAIN MANAGEMENT**

# Current Study Status



FEMA

# Floodplain Management Workshops

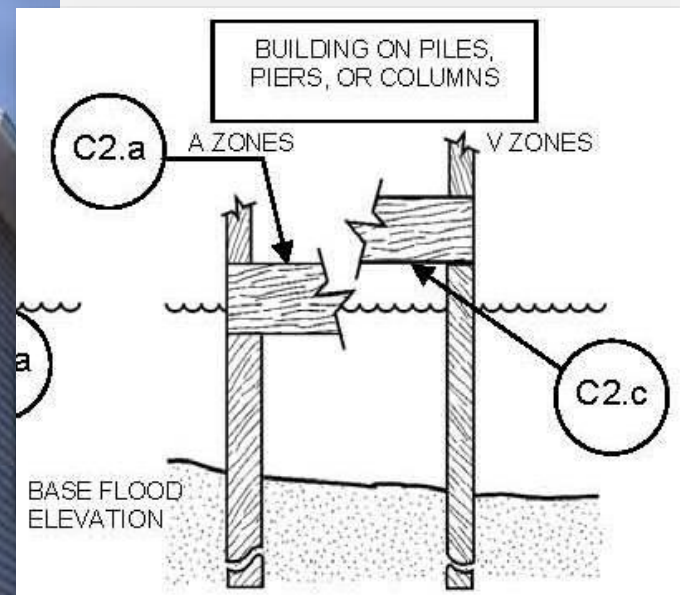
- ▶ Conducted by FEMA/DNR just before preliminary maps are released
- ▶ Workshop details:
  - Approximately 3 – 4 hours
  - Designed for floodplain administrator, zoning official, building inspectors, permit officials, etc.
  - Basics of Coastal Flooding
  - Using the Flood Insurance Study and FIRM for 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/m<sup>2</sup>) 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

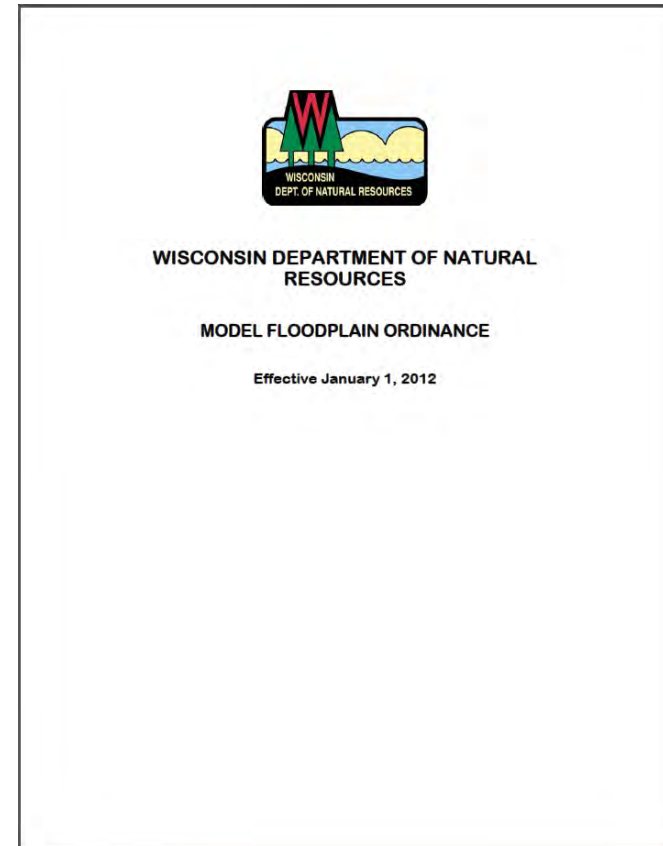
This certification is to be signed and sealed by a registered professional engineer or architect authorized by law to certify structural designs. I certify the V Zone Design Certification Statement (Section II) and \_\_\_\_\_ the Breakaway Wall Design Certification Statement (Section IV, check if applicable).

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

Place Seal Here: \_\_\_\_\_

# Model Ordinance Development

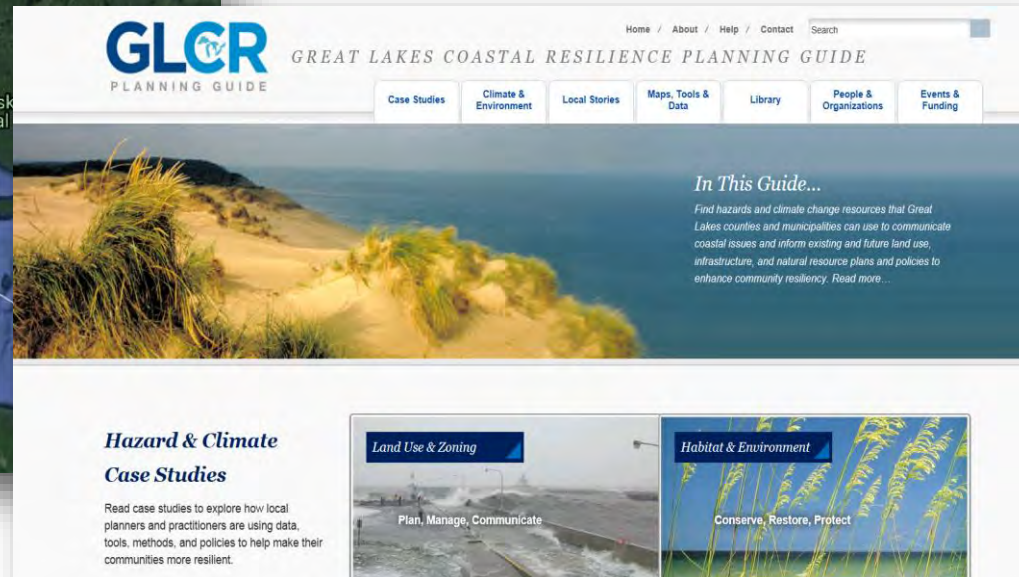
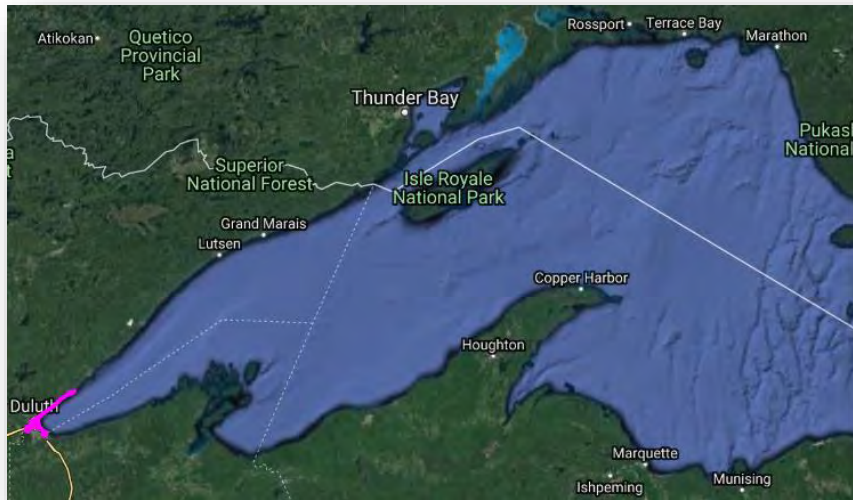
- ▶ FEMA Region V and Wisconsin DNR are working together to prepare a model ordinance to incorporate V zone standards
- ▶ Wisconsin DNR is working through their legal chains to determine the requirements per NR 116
- ▶ Ordinances must be updated/adopted by effective date of maps



# Online Resources

High resolution oblique aerial images


<https://greatlakes.erd.dren.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](http://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](http://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:  
KEN HINTERLONG  
Senior Engineer, Risk Analysis  
FEMA Region 5  
312-408-5529  
[ken.hinterlong@fema.dhs.gov](mailto: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.ercd.dren.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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St. Louis County, MN

## **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 St. Louis County**  
**– Last update March 2013**

## 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 6/18/2018

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)



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# Comments

Send comments via email to [williamsjo@cdmsmith.com](mailto: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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*FEMA Region 5*

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## COMMENT REPOSITORY:

Send comments via email to

[williamsjo@cdmsmith.com](mailto: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**

Questions?



# FEMA

**Thank you for your participation!**



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