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
COASTAL FLOOD RISK STUDY AND MAPPING PROGRAM

Alger and Marquette Counties, MI
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

RiskeyMAP
Increasing Resilience Together
Great Lakes Program Goals
Flood Study UpdatesScoped Reaches
Dead-Kelsey Watershed, MI

* Approximate number. Final miles could be different as stream centerlines will be digitized to follow LiDAR and aerial photography. Map Data - November 2017
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
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
Alger and Marquette Counties, MI

CURRENT STATUS REVIEW
Analyses/Mapping: Grouping

Michigan
• Baraga
• Marquette
• Alger
• Chippewa

▸ FRR Meetings fall at the end of a multi-year study including sophisticated modeling

▸ Next, FEMA Regional staff to determine status of developing official regulatory Flood Insurance Rate Maps
Current Study Status

- Lake-Wide Storm Surge and Waves Study
- County Based Wave Runup, Overtopping, and Overland Analyses
- Workmap Production
- Comment Period
- FIRM Production
- Preliminary FIRM
- Community Coordination Meeting
- Comment and Appeal Periods
- Letter of Final Determination
- Effective FIRM

You are here
Work Map Data Viewer: Online GIS Data

Link to the Alger County, MI Work Map Data Viewer: http://arcg.is/G4GqS
Link to the Marquette County, MI Work Map Data Viewer: http://arcg.is/0bP9zL
Work Map Data Viewer: Transect Summary Sheets
Alger and Marquette Counties, MI
TECHNICAL OVERVIEW OF STUDY AND MAPPING
Coastal Flood Hazard Modeling Overview

Lake-Wide Variation

Step 1: Offshore Water Level and Wave Modeling

Local Variation

Step 2: Nearshore Wave Setup, Runup & Overtopping

Step 3: Floodplain Mapping

RiskMAP
Increasing Resilience Together

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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

Meteorological Forcing

Physical Setting

Water Level

Wind

Ice

Bathymetry

Pressure

Waves

Still Water Elevations

Total of 150 events between 1960-2009
Step 1: Lake Levels

Lake Superior (9099018 Marquette) Monthly Data

- Water Level (ft IGLD 1985)
- Year
- Difference (ft)

Graph showing trends over time.
Step 1: Lake Levels
Step 1: Lake Levels

The graph shows the lake levels from 1980 to 2018, with a distinction made between Pre-2010 and Post-2009 data. The y-axis represents the Lake Level (ft, LWD) ranging from 600 to 604.5 feet, and the x-axis represents the years from 1980 to 2018.
Step 1: Example Surge Behavior

![Map showing water surface elevation and wind velocity with a legend indicating values from 0.35 to -0.35 and wind direction and speed information. The map includes a datum LWD 183.2 M IGLD 1985.]
## Step 1: Water Level Accuracy Assessment

<table>
<thead>
<tr>
<th>Location</th>
<th>1-percent-annual chance SWEL (ft, IGLD85)</th>
<th>Modeled</th>
<th>Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>9099004</td>
<td>Point Iroquois, MI</td>
<td>603.6</td>
<td>604.5</td>
</tr>
<tr>
<td>9099018</td>
<td>Marquette, MI</td>
<td>603.4</td>
<td>604.1</td>
</tr>
<tr>
<td>9099044</td>
<td>Ontonagon, MI</td>
<td>603.2</td>
<td>603.5</td>
</tr>
<tr>
<td>9099064</td>
<td>Duluth, MN</td>
<td>603.5</td>
<td>604.1</td>
</tr>
<tr>
<td>9099090</td>
<td>Grand Marais, MN</td>
<td>603.2</td>
<td>603.6</td>
</tr>
</tbody>
</table>
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

- Alger County
  - 31 transects
  - 42 panels

- Transects placed at representative shoreline reaches based on:
  - Topography
  - Exposure
  - Shoreline Material
  - Upland Development
Step 2: Transect Layout

- Marquette County
  - 38 transects
  - 49 panels

- Transects placed at representative shoreline reaches based on:
  - Topography
  - Exposure
  - Shoreline Material
  - Upland Development
Step 2: Transect Analysis Overview

Water Level & Offshore Waves

Transect Analysis

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
Step 2: Runup

Runup Method Decision Flow Chart

Shoreline Type

Gradually Sloping Beach (1V:10H or more gradual)

Stockdon

Bluff

Bluff Face Slope

Between 1V:10H and 1V:1H

van Gent

1V:1H or Steeper

SPM – Vertical Wall Runup

Shore Protection Structure

Revetment (Structure Slope between 1V:10H and 1V:1H)

van Gent

Vertical Wall (Structure Slope of 1V:1H or Steeper)

SPM – Vertical Wall Runup
Step 2: Overtopping

https://twitter.com/akpix/status/985285850245271552
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: Runup

Marquette Transect 32

Optimized Return Period Plot

- TWL (ft, IGLD-85)
- Excel Data
- GPD Fit

Return Period (years)
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 3: Mapping

- Identification of
  - VE
  - AE
  - AO
  - X
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

<table>
<thead>
<tr>
<th>$\bar{Q}$ Order of Magnitude</th>
<th>Flood insurance risk zone Behind Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.0001 cfs/ft</td>
<td>Zone X</td>
</tr>
<tr>
<td>0.0001-0.01 cfs/ft</td>
<td>Zone AO (1 foot depth) or Zone AE with BFE</td>
</tr>
<tr>
<td>0.01-0.1 cfs/ft</td>
<td>Zone AO (2 foot depth) or Zone AE with BFE</td>
</tr>
<tr>
<td>0.1-1.0 cfs/ft</td>
<td>Zone AO (3 foot depth) or Zone AE with BFE</td>
</tr>
<tr>
<td>&gt;1.0 cfs/ft*</td>
<td>30-foot width* of Zone VE (elevation 3 feet above barrier crest), landward Zone AO (3 foot depth) or Zone AE with BFE</td>
</tr>
</tbody>
</table>
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
Step 3: Zone Breaks

Zone Breaks Along the Coast

Represent the Extents of Each Unique Coastal Feature
Marquette County, MI Work Map

Marquette County, MI effective FIRM

Will not affect flood insurance requirements or costs
Current Study Status

- Lake-Wide Storm Surge and Waves Study
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You are here

FPM Workshops

6 months – update ordinance

RiskMAP
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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
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
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

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
312-408-5529
ken.hinterlong@fema.dhs.gov

Additional Information:
USACE High Resolution Oblique Aerial Images: https://greatlakes.ordc.dron.ai/

Wisconsin

Ozaukee and Sheboygan County
Tuesday, August 8, 9:30-11:30am
Racine Meeting Room

http://www.greatlakescoast.org/
Alger and Marquette Counties, 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 Marquette County – Last update July 2015

Multi-Hazard Mitigation Plan for Alger County – Last update July 2015

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

FEMA
Next Steps

Review and comment period ends 8/24/2018

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

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

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
555 17th Ave, Suite 500
Denver, CO 80202
Thank you for your participation!
Interactive session to review the coastal work maps

COASTAL WORK MAP DEMO