Agenda

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

COASTAL FLOOD RISK STUDY AND MAPPING PROGRAM
Program Goals and Status

Map of Michigan with coastal counties labeled:
- DFIRM (12)
- Work Map (3)
- No Coastal Study (8)
- Great Lakes County (72)
Program Goals and Status

Counties for Inland Rivers * and Lakes

Michigan U.P.
1. Alger (79 /0) **
2. Baraga (23 /4.5) **
3. Delta (162 /12.5) **
4. Mackinac (260 /0) **

Michigan L.P. Counties
5. Manistee (46 /8.3) **
6. Benzie (32 /0) **
7. Antrim (16 /34) **
8. Emmet (6 /0) **

Minnesota
9. St. Louis (1,905 /59)

Wisconsin
10. Ashland (119 /40.5) **
11. Kewaunee (53 /47)
12. Marinette (783 /101) **

* (Approx miles / AE miles) per CNMS stream threads on existing FIRMs
** fy14 LiDAR counties
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
- ERDC
- RAMPP
- STARR
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

Lorain Transect 19

FEMA

RiskMAP
Increasing Resilience Together
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
Manistee and Benzie Counties, MI

CURRENT STATUS REVIEW
Analyses/Mapping: Grouping

Orange and Blue: Phase 1
- Cook, IL
- Lake, IL
- Lake, IN
- Porter, IN
- La Porte, IN

- Remaining Counties on this map are being finalized and FRR meetings will be in August
- FRR Meetings fall at the end of a multi-year study including sophisticated modeling
- Next, the maps and data will be put into the official regulatory format
Current Study Status

Lake-Wide Storm Surge and Waves Study

County Based 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

FPM Workshops

6 months – update ordinance

Risk MAP

Increasing Resilience Together
Floodplain Management Workshops

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

FEMA Coastal Work Map Data Viewer User Guide:
Lake Michigan shoreline at Michigan

Project Background

The Federal Emergency Management Agency (FEMA) is releasing draft work maps for communities along Lake Michigan within coastal communities in the state of Michigan. These products display the results of FEMA’s comprehensive storm and wind study of the Great Lakes basin. The intent of this release is to help community officials understand current flood risk and potential flood insurance requirements as well as provide them with an opportunity to review the findings prior to their inclusion within Preliminary Flood Insurance Rate Maps (FIRMs).

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

Web links to Lake Michigan Great Lakes Coastal Flood Study Update – Michigan

The following table lists web location of the Lake Michigan coastal updates for the state of Michigan. The GeoPlatform link will take you to the ArcGIS web application. Please use this document to help assist you while navigating through the web application (See Table 1).

<table>
<thead>
<tr>
<th>County</th>
<th>GeoPlatform link</th>
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<tr>
<td>Allegan</td>
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Table 1 - Coastal Workmap GeoPlatform entry points for Michigan

Viewing the Lake Michigan Coastal Workmap via FEMA GeoPlatform

To open the FEMA Work Map Data Viewer for a county referenced in the table above follow the GeoPlatform link in the adjacent column for that county and your screen should appear similar to Figure 1 below. If you want a general overview of the map click on the "Details" button (outlined below in Figure 1)
Manistee and Benzie 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
Step 1: ADCIRC+SWAN Mesh

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

- Jetties
- Breakwaters
- Inlets
- Natural Shoals
Step 1: Run the Models

Baseline Meteorological Forcing

Wind

Water Level

Pressure

Physical Setting

Bathymetry

Waves

Ice

Still Water Elevations

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

![Graph showing Lake Levels from 1960 to 2017.](image)

- Y-axis: Lake Level (ft, LWD)
- X-axis: Year

The graph illustrates the fluctuation in lake levels over the years, with a notable increase around 1985 and a decrease post-2010.
Step 1: Lake Levels
Step 1: Example Surge Behavior
## Step 1: Water Level Accuracy Assessment

<table>
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<th>Station</th>
<th>1 percent annual chance still water level (m)</th>
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<tr>
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</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 Analysis Overview

Water Level & Offshore Waves

Transect Analysis

Total Water Level

- Water Level (Surge)
- Waves
- Setup, Runup and Overtopping
Step 2: Transect Layout

- Manistee County:
  - 5 Analysis Transects
  - 29 Shoreline Miles

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

- Benzie County
  - 4 Analysis Transects
  - 26 Shoreline Miles

- 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.
Response-Based Wave 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
          - 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: 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: Overtopping

http://journalstar.com/ap/business/two-story-waves-on-great-lakes-halt-shipping/article_bcf2bb34-b528-52f5-8cd4-0c57e7ea8922.html
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: Return Period Analysis

Transect EMM08: Initial TWL Analysis # Events: 148

Initial TWL Q-Q Plot

Transect EMM08: Optimized TWL Analysis # Events: 111

Optimized TWL Q-Q Plot

Optimized Return Period Plot: Quantiles 25-75

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Step 3: Mapping

Coastal Flood Hazard Zones

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

- Zone breaks are placed along the coast where the characteristics of the shoreline transition from one shore type to another.
- Define the extents of each representative shoreline reach.
Step 3: Runup VE Zones

• Intact transects
  • VE zone mapped to elevation associated with TWL or structure crest elevation

• Failed transects (coastal structures)
  • VE zone mapped to station along the profile associated with TWL
  • Elevation may not match topography since mapping extent is associated with failed structure elevation

• Eroded profiles
  • VE zone mapped to station along the profile associated with TWL
  • Elevation may not match topography since mapping extent is associated with the eroded profile elevation
Step 3: SWEL Inundation
Draft Work Map vs FIS/FIRM

Benzie County, MI Workmap

Not a Regulatory Product

Benzie County, MI Effective FIRM
Manistee and Benzie Counties, MI

FEMA FLOODPLAIN MANAGEMENT
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
Online Resources

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

High resolution oblique aerial images https://greatlakes.erdc.dren.mil/
Manistee and Benzie Counties, MI

NEXT STEPS
Comments

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

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

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

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

60 day review and comment period ends October 28, 2017.

FEMA’s next steps:

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

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FEMA Region 5
312-408-5529
ken.hinterlong@fema.dhs.gov

COMMENT REPOSITORY:
Send comments via email to brett.holthaus@atkinsglobal.com or mail to:
Great Lakes Coastal Flood Study Comment Repository
c/o Atkins
Attn: Brett Holthaus
3901 Calverton Boulevard, Suite 400
Calverton, MD 20705
Thank you for your participation!