North Atlantic Coast Comprehensive Study
Draft Analyses Webinar: Coastal Flood Risk Management Strategies and Measures
U.S. Army Corps of Engineers
National Planning Center for Coastal Storm Risk Management
3 April 2014
Speakers

- Dave Robbins
  Project Manager, NACCS

- J.B. Smith
  Plan Formulation Lead, NACCS

- Matthew Schrader
  Engineering Team, NACCS

- Kelly Burks-Copes, Ph.D.
  Research Ecologist, U.S. Army Engineer Research & Development Center (ERDC)
  Natural and Nature-Based Features (NNBF) Team, NACCS
NACCS Background

- Hurricane/Post-Tropical Cyclone Sandy moved to the U.S. Atlantic Ocean coastline 22-29 October 2012
- Affected entire U.S. east coast: 24 States from Florida to Maine; New Jersey to Michigan and Wisconsin
- Areas of extensive damage from coastal flooding: New Jersey, New York, Connecticut
- Public Law 113-2 enacted 29 January 2013
NACCS Background

“That using up to $20,000,000* of the funds provided herein, the Secretary shall conduct a comprehensive study to address the flood risks of vulnerable coastal populations in areas that were affected by Hurricane Sandy within the boundaries of the North Atlantic Division of the Corps...” (*$19M after sequestration)

- Complete by January 2015

Goals

- Provide a Risk Reduction Framework, consistent with USACE-NOAA Rebuilding Principles

- Support Resilient Coastal Communities and robust, sustainable coastal landscape systems, considering future sea level rise and climate change scenarios, to reduce risk to vulnerable population, property, ecosystems, and infrastructure
Technical Teams

- USACE Enterprise
- Agency Subject Matter Experts
  - Engineering
  - Economics
  - Environmental, Cultural, and Social
  - Sea Level and Climate Change
  - Plan Formulation
  - Coastal GIS Analysis

Products

- Coastal Framework
  - Regional scale
  - Collaborative
  - Opportunities by region/state
  - Identify range of potential solutions and parametric costs by region/state
  - Identify activities warranting additional analysis and social/institutional barriers

- Not a Decision Document
  - No NEPA
  - No Recommendations
Coastal Flood Risk Management Strategies

- **Active Risk Management**
  - Structural, including Natural and Nature-Based Features (NNBF)

- **Acclimation**
  - NNBF and Non-structural
  - Policy/Programmatic

- **Retreat**
  - Buyout
  - Policy/Programmatic
**Flood Risk Management Measures**

- **Structural**
  - Storm surge barriers, levees/floodwall, breakwaters, beach fill/dunes
  - **NNBF**
    - (e.g., living shorelines, wetlands, oyster reefs, sub-aquatic vegetation restoration)

- **Non-Structural**
  - Floodproofing, elevation, acquisition
  - Evacuation, flood warning systems

- **Policy/Programmatic**
  - Floodplain management, land use planning
  - State/Local Coastal Zone Policies, Flood Insurance Programs
  - Natural resources/surface water management
# Structural Measures

**Table IV-4. Structural Measures Matrix**

<table>
<thead>
<tr>
<th>Aggregated Measure Category</th>
<th>Specific Measures</th>
<th>Typical Flood Risk Reduction Performance (Annual Probability of Design not Being Exceeded)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Storm Tide</td>
</tr>
<tr>
<td>Storm Surge Barriers</td>
<td></td>
<td>0.2%</td>
</tr>
<tr>
<td>Beach Restoration(^1)</td>
<td>Beach fill, dunes, barrier island restoration</td>
<td>1%</td>
</tr>
<tr>
<td>Breakwaters and Beach</td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td>Restoration(^1)</td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td>Groins and Beach Restoration</td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td>Shoreline Stabilization/Protection</td>
<td>Seawall, Revetment, Bulkhead</td>
<td>1%-10%</td>
</tr>
<tr>
<td>Deployable Floodwall</td>
<td></td>
<td>1%-10%</td>
</tr>
<tr>
<td>Floodwall/Levee</td>
<td>Levee, Dike, Floodwall</td>
<td>1%</td>
</tr>
<tr>
<td>Drainage Improvements</td>
<td>Pump station, culvert/drain/inlet, water storage/retention features</td>
<td>1%-20%</td>
</tr>
</tbody>
</table>

\(^1\) Beaches and dunes are also considered Natural and Nature-Based Features.
Structural Design Criteria

Table I-7. Criteria for Conceptual Design of NACCS Risk Reduction Measures

<table>
<thead>
<tr>
<th>Measure Type</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural (not barriers)¹</td>
<td>1 percent flood elevation + 3-foot sea level rise allowance</td>
</tr>
<tr>
<td>Storm Surge Barriers</td>
<td>0.2 percent flood elevation + 3-foot sea level rise allowance</td>
</tr>
</tbody>
</table>

¹ Beaches and dunes are also considered Natural and Nature-Based Features.
Structural Measure Examples

Storm Surge Barriers

Beach Restoration with Breakwaters

Figure II-1. Fox Point Storm Surge Barrier, Providence RI (Source: Providence Journal)

Figure II-8. Breakwater Field at Ocean View
Structural Measure Examples

Deployable Floodwalls

Floodwalls

Figure II-13. Rapid Deployment Floodwall
(Courtesy: Plainschase.com)

Figure II-14. Typical Floodwall Construction
# Non-Structural and Policy/Programmatic Options

## Table IV-6. Nonstructural Measures Matrix

<table>
<thead>
<tr>
<th>Aggregated Measure Category</th>
<th>Specific Measures</th>
<th>Typical Flood Risk Reduction Performance (Annual Probability of Design not Being Exceeded)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Storm Tide</td>
</tr>
<tr>
<td>Building Retrofit</td>
<td>Floodproofing¹, elevating structures, relocating structures, ringwalls</td>
<td>1%-20%</td>
</tr>
<tr>
<td>Acquisition and Evacuation</td>
<td>Acquisition, evacuation</td>
<td>1%-20%</td>
</tr>
<tr>
<td>Enhanced Flood Warning &amp;</td>
<td>Early warning systems, emergency response systems, elevating roads, modify/remove</td>
<td>NA</td>
</tr>
<tr>
<td>Evacuation Planning</td>
<td>structures for better channel function (ex. bridges), floodable development</td>
<td></td>
</tr>
</tbody>
</table>

For the purposes of this report, all floodproofing measures are considered nonstructural.

## Table IV-7. Policy/Programmatic Measures Matrix

<table>
<thead>
<tr>
<th>Aggregated Measure Category</th>
<th>Specific Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floodplain Management</td>
<td>Strategic acquisition, rolling easements, relocation/managed retreat</td>
</tr>
<tr>
<td>Land Use Planning</td>
<td>Land use zoning, subdivision regulations, design and location of services and utilities</td>
</tr>
<tr>
<td>State/Municipal Policy</td>
<td>Building codes, housing codes, tax adjustments</td>
</tr>
<tr>
<td>Natural Resources</td>
<td>Wetland migration, coastal zone management, beneficial use of dredged material, regional sediment management, ecosystem protection</td>
</tr>
<tr>
<td>Surface Water Management</td>
<td>Low impact development, stormwater best management practices</td>
</tr>
<tr>
<td>Increase Awareness in Vulnerable Coastal Populations</td>
<td>Education, special assistance programs</td>
</tr>
</tbody>
</table>
Natural and Nature-Based Features

Natural and Nature-Based Infrastructure at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
STORM INTENSITY, TRACK, AND FORWARD SPEED, AND SURROUNDING LOCAL BATHYMETRY AND TOPOGRAPHY

- **Dunes and Beaches**
  - Benefits/Processes:
    - Break offshore waves
    - Attenuate wave energy
    - Slow inland water transfer
  - Performance Factors:
    - Berm height and width
    - Beach Slope
    - Sediment grain size and supply
    - Dune height, crest, width
    - Presence of vegetation

- **Vegetated Features:**
  - **Salt Marshes, Wetlands, Submerged Aquatic Vegetation (SAV)**
    - Benefits/Processes:
      - Break offshore waves
      - Attenuate wave energy
      - Slow inland water transfer
      - Increase infiltration
    - Performance Factors:
      - Marsh, wetland, or SAV elevation and continuity
      - Vegetation type and density

- **Oyster and Coral Reefs**
  - Benefits/Processes:
    - Break offshore waves
    - Attenuate wave energy
    - Slow inland water transfer
  - Performance Factors:
    - Reef width, elevation and roughness

- **Barrier Islands**
  - Benefits/Processes:
    - Wave attenuation and/or dissipation
    - Sediment stabilization
  - Performance Factors:
    - Island elevation, length, and width
    - Land cover
    - Breach susceptibility
    - Proximity to mainland shore

- **Maritime Forests/Shrub Communities**
  - Benefits/Processes:
    - Wave attenuation and/or dissipation
    - Shoreline erosion stabilization
    - Soil retention
  - Performance Factors:
    - Vegetation height and density
    - Forest dimension
    - Sediment composition
    - Platform elevation
Blended Solutions

<table>
<thead>
<tr>
<th></th>
<th>SB1</th>
<th>NBI 1</th>
<th>NBI 2</th>
<th>NBI 3</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>✔️</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bulkhead (B1)
Blended Solutions

<table>
<thead>
<tr>
<th></th>
<th>SB1</th>
<th>NBI 1</th>
<th>NBI 2</th>
<th>NBI 3</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S5</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Bulkhead (B1)
- Emergent Herbaceous Marsh (GI 1)
Blended Solutions

<table>
<thead>
<tr>
<th>SB1</th>
<th>NBI 1</th>
<th>NBI 2</th>
<th>NBI 3</th>
<th>ALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>S2</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>S3</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>S4</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>S5</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>S6</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

Submerged Breakwater (Nearshore Berm/Oyster Reef/Sill) (GI 2)

Submerged Aquatic Vegetation (GI 3)
Blended Solutions

 Bulkhead (B1)

 Emergent Herbaceous Marsh (GI 1)

 Submerged Aquatic Vegetation (GI 3)

 Submerged Breakwater (Nearshore Berm/Oyster Reef/Sill) (GI 2)
# Shoreline Applicability

<table>
<thead>
<tr>
<th>Measures</th>
<th>Rocky shores (Exposed)</th>
<th>Rocky shores (Sheltered)</th>
<th>Beaches (Exposed)</th>
<th>Man-made structures (Exposed)</th>
<th>Man-made structures (Sheltered)</th>
<th>Scarpas (Exposed)</th>
<th>Scarpas (Sheltered)</th>
<th>Vegetated Low banks (Sheltered)</th>
<th>Wetlands/Marshes/ Swamps (Sheltered)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storm Surge Barrier¹</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beach Restoration²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakwaters and Beach Restoration³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groins and Beach Restoration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoreline Stabilization/Protection</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deployable Floodwall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floodwall/Levee</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage Improvements</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Natural and Nature-Based Features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Living Shoreline</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reefs</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAV Restoration⁴</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overwash Fan⁴</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Drainage Improvements</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

¹ Barriers are applicable to all types of shorelines.
² Beaches and dunes are also considered Natural and Nature-Based Features.
³ SAV restoration is not associated with any particular shoreline type. Initially assumed to apply to wetland shorelines.
⁴ Overwash fans may apply to the back side of barrier islands, which are not explicitly identified in the NOAA Environmental Sensitivity index Shoreline Classification dataset.
What Happens Next?

- The NACCS team will receive comments for integration into the NACCS report
  - Mid-April 2014
- Integration
  - Mid-April/May 2014
- Draft Final Report production
  - June 2014
- Final USACE vertical team review
  - July – December 2014
- Submit to Congress
  - January 2015
Review Information

- Review documents are DRAFT and NOT FOR DISTRIBUTION
- Download the documents via AMRDEC
  - See email from No-Reply@amrdec.army.mil
- Review the draft analyses documentation
- Follow the link to the feedback form
  - Keep the feedback questions in mind during your review
  - Complete the online feedback form
- Tune into subject-specific webinars
- All feedback forms due by April 14, 2014
What Happens Next?

► Technical Challenges with accessing document and comment forms?
► General issues or for further coordination?
► Contact via email:
  Dave Robbins
  Baltimore District, USACE
  Email: David.W.Robbins@usace.army.mil
Questions