

Engineering With Nature



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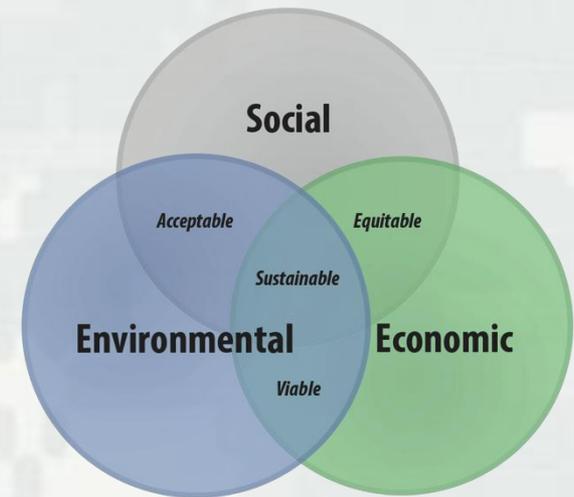


Engineering With Nature...

...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

Key Elements:

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners



EWN Status

- *Engineering With Nature* initiative started within USACE Civil Works program in 2010. Over that period we have:
 - ▶ Engaged across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
 - Workshops (>20), dialogue sessions, project development teams, etc.
 - ▶ Implementing strategic plan
 - ▶ Focused research projects on EWN
 - ▶ Field demonstration projects
 - ▶ Communication plan
 - ▶ District EWN Proving Grounds established
 - ▶ Awards
 - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
 - 2014 USACE National Award-Green Innovation



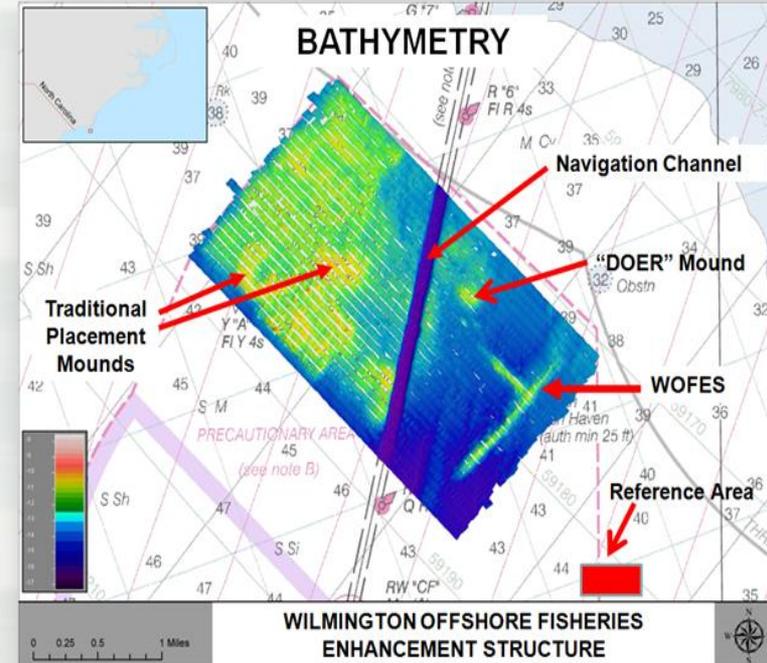
Evia Island, Galveston Bay, TX

- 6-acre island was constructed using sediment dredged during the deepening of the Houston Ship Channel in 1998
- Island provides substantial bird and other habitat
- Producing significant environmental benefits



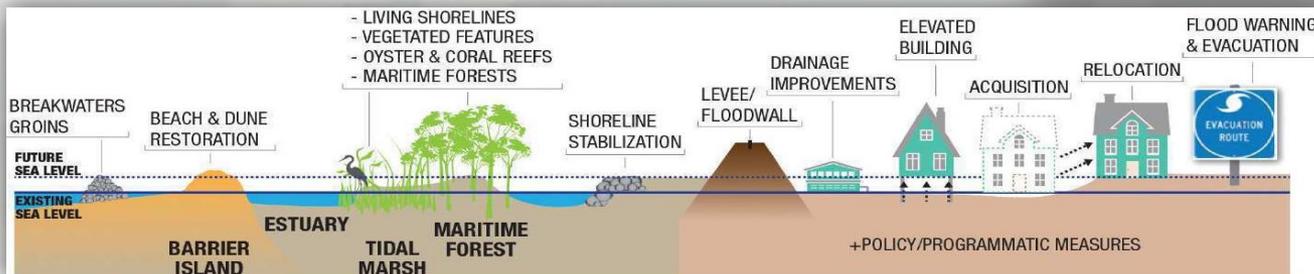
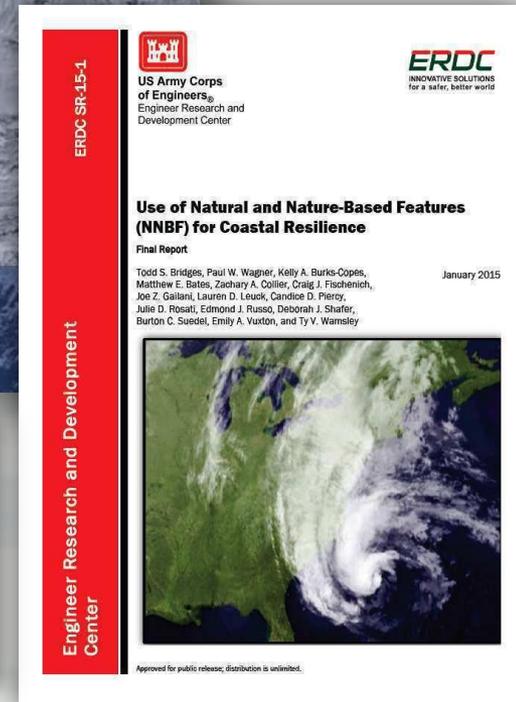
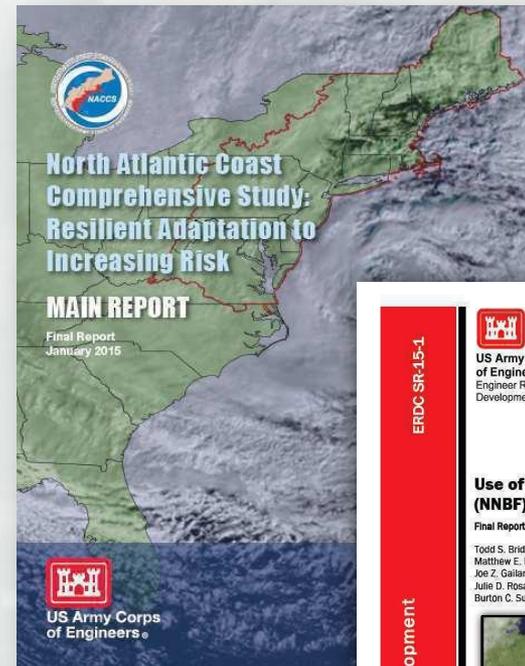
WOFES, Wilmington, NC

- Created in 1994-1997 from 764,600 cubic meters of limestone dredged as part of the Wilmington channel deepening
- Located three nautical miles off of the mouth of the Cape Fear River in North Carolina
- The location and design of the reef involved extensive participation by stakeholders, and the North Carolina Department of Environment and Natural Resources supported the project as a local sponsor.
- Produced significant social benefits as a popular destination for fishing



Natural and Nature-Based Features: North Atlantic Coast Comprehensive Study

- Opportunities to integrate Natural and Nature-Based Features (NNBF) with structural and non-structural measures to provide multiple lines of defense against storms and sea level rise, generating a full array of relevant economic, environmental and social ecosystem goods and services.



See Bridges et. al., 2015
<http://www.nad.usace.army.mil/CompStudy>



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



ERDC

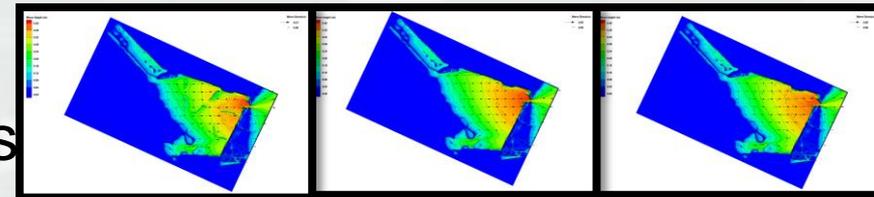
Horseshoe Bend, Atchafalaya River

- Options for managing dredged material via shore-based wetland creation were exhausted
- Strategic placement of sediment (0.5-1.8 mcy/1-3 yrs) was used to create a ~35 ha island
- Producing significant environmental and engineering benefits
- Project won WEDA's 2015 Award for Environmental Excellence



Hamilton Wetland, San Pablo Bay

- Beneficial use of dredged material to restore army air field to wetlands
- Dredged material was placed directly to contour wetland
- ERDC monitoring of new wetland to quantify waves, other physical processes and accretion
- ERDC modeling wave generation and dissipation, testing different shapes for barriers to fetch
- Plants will volunteer in tidal areas as sufficient accretion occurs



Linear Berms (As-Built)

No Berms (Control)

Mounds (ala Sears Pt.)



Coastal NJ, Philadelphia District



December 2014



Stone Harbor



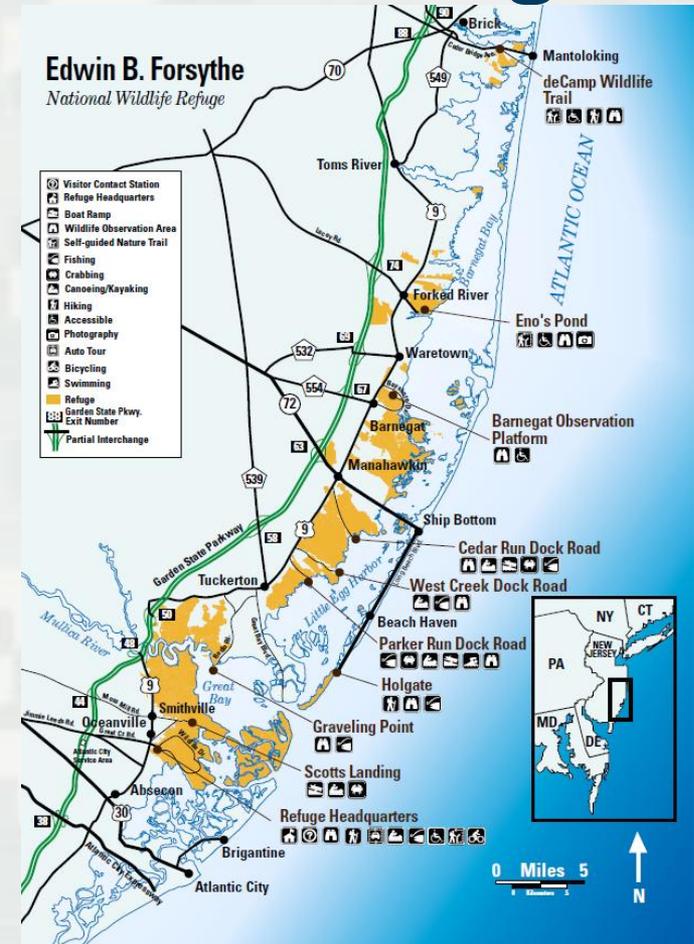
Avalon

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US Fish and Wildlife Service Forsythe National Wildlife Refuge

- Forsythe NWR: >40,000 acres of wetlands and other habitat in coastal NJ
- Collaboration objective: Enhance ecosystem resilience through engineering and restoration
- Means: Smart use of sediment resources and EWN principles and practices



USACE Galveston and Buffalo Districts: EWN “Proving Grounds”



EWN Proving Ground Kick-Off Workshops

- ▶ October (SWG) and December (LRB) 2014
- ▶ ~70 participants
- ▶ SWG, SWD, LRB, ERDC, IWR and HQ

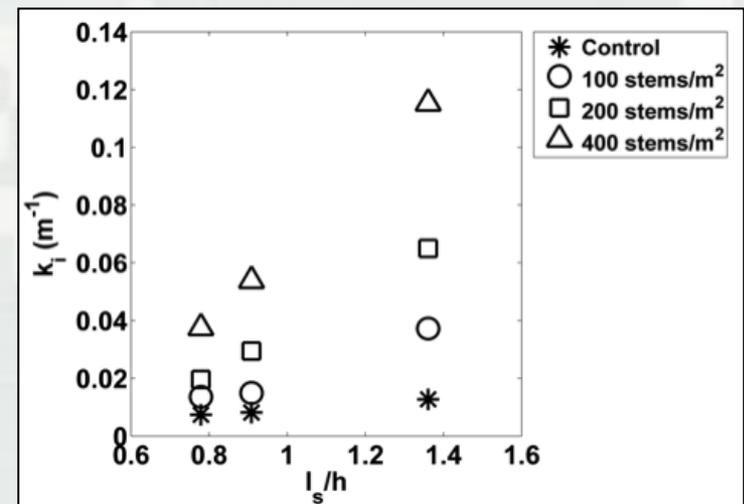
Identified opportunities to implement EWN within current and future programs and projects

Emphasis on solution co-development



R&D Example: Engineering Performance of NNBF

- What are the engineering benefits of wetlands with respect to waves?
- Flume studies being performed in the 10 ft flume
 - Complemented by examination of sediment processes and field studies
- Wave attenuation was found to:
 - increase with stem density
 - increase with submergence ratio
 - slight increase with incident wave height
- Results used to update STWAVE



EWN Action Demonstration Projects, 1

- Sediment Retention Engineering to Facilitate Wetland Development (San Francisco Bay, CA)
- Realizing a Triple Win in the Desert: Systems-level Engineering With Nature on the Rio Grande (Albuquerque, NM)
- Atchafalaya River Island and Wetlands Creation Through Strategic Sediment Placement (Morgan City, LA)
- Portfolio Framework to Quantify Beneficial Use of Dredged Material (New Orleans and New England)
- Engineering Tern Habitat into the Ashtabula Breakwater (Ashtabula, OH)
- Living Shoreline Creation Through Beneficial Use of Dredged Material (Duluth, MN)
- A Sustainable Design Manual for Engineering With Nature Using Native Plant Communities



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EWN Action Demonstration Projects, 2

- Landscape Evolution of the Oil Spill Mitigation Sand Berm in the Chandeleur Islands, Louisiana
- Guidelines for Planning, Design, Placement and Maintenance of Large Wood in Rivers: Restoring Process and Function (Collaboration with BoR)
- The Use and Value of Levee Setbacks in Support of Flood Risk Management, Navigation and Environmental Services (a strategy document)
- Strategic Placement of Sediment for Engineering and Environmental Benefit (an initial guide to opportunities and practices)



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Coastal Resilience: The Environment, Infrastructure, and Human Systems

- USACE was the primary sponsor and host (USEPA and USDOE were co-sponsors)
 - ▶ Dr. Todd Bridges, Conference Chair
 - ▶ Ms. Cynthia Banks, Conference Organizer
- 85 participants from 8 countries (Barbados, Fiji, Mexico, The Netherlands, South Africa, South Korea, United Kingdom, and United States)
 - ▶ Diversity of organizational perspectives:
 - USACE, NOAA, USEPA, USFWS, OMB, CEQ, DOE, US Navy, Treasury Department, State Department, TNC, AAPA, Water Institute of the Gulf, National Wildlife Federation, Great Lakes Dredge & Dock Company, Environ Corp., Dewberry, several universities, and many other organizations
- Conference consisted of a series of plenary presentations and panel discussions
 - ▶ Share information about science and engineering relevant to coastal resilience



The audio and visuals for each presentation are at:
<http://el.erd.c.usace.army.mil/ewn/workshop.cfm?List=14MayCR>

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High Points

- Focus energy to motivate and facilitate innovation in both technical and business processes
- Important to elevate communication about advancing practice within and external to USACE
 - ▶ Creating project value
- Accelerate progress through co-development of solutions!
 - ▶ Districts with ERDC
 - ▶ USACE with others

