

Evolving Dredging Practices to Engineer with Nature



Dr. Todd S. Bridges
Senior Research Scientist, Environmental Science
Engineer Research and Development Center (ERDC)

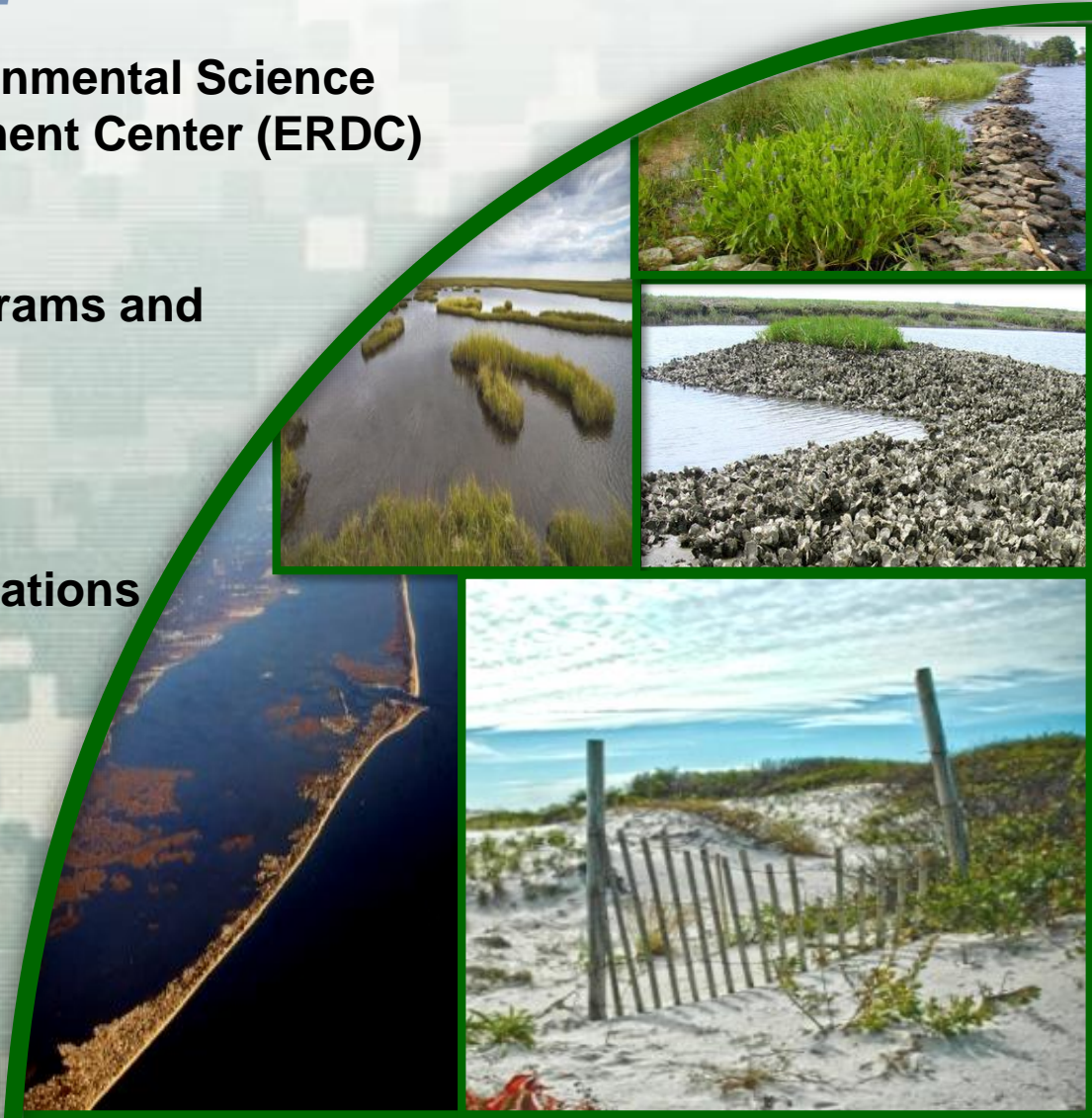
Dr. Edmond Russo
Deputy District Engineer for Programs and
Project Management
USACE Galveston District

Ms. Cynthia Banks
Program Manager, Dredging Operations
Technical Support Program
ERDC



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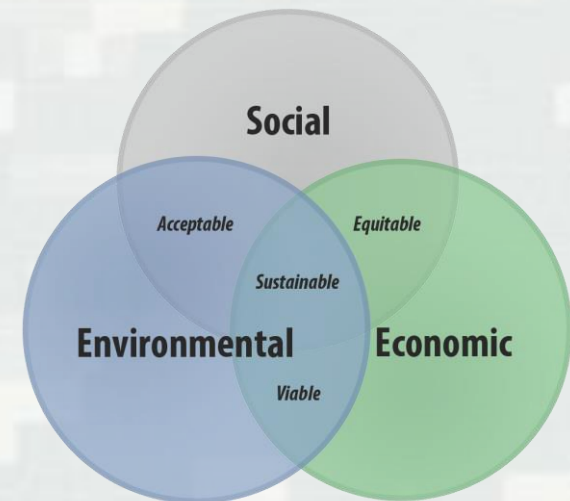


Engineering With Nature...

...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



www.engineeringwithnature.org



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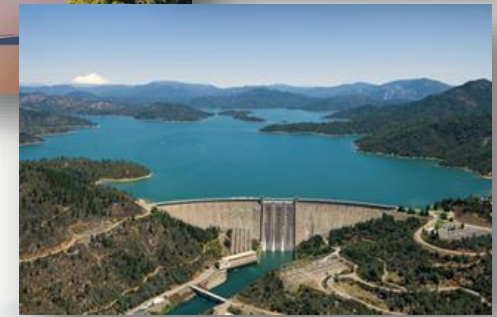
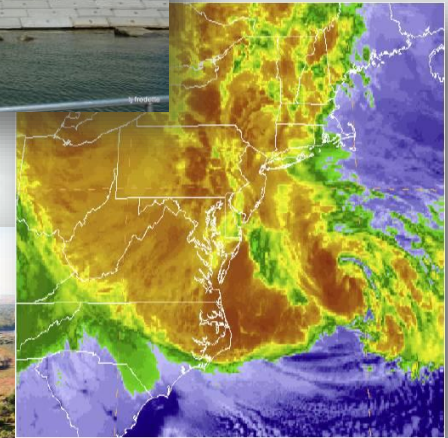


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Innovative solutions for a safer, better world

EWN Across USACE Mission Space

- Navigation
 - ▶ Strategic placement of dredged material supporting habitat development
 - ▶ Habitat integrated into navigation structures
- Flood Risk Management
 - ▶ Natural and Nature-Based Features to support coastal resilience
 - ▶ Levee setbacks
- Ecosystem Restoration
 - ▶ Ecosystem services supporting engineering function
 - ▶ “Natural” development of designed features
- Water Operations
 - ▶ Shoreline stabilization using native plants
 - ▶ Environmental flows

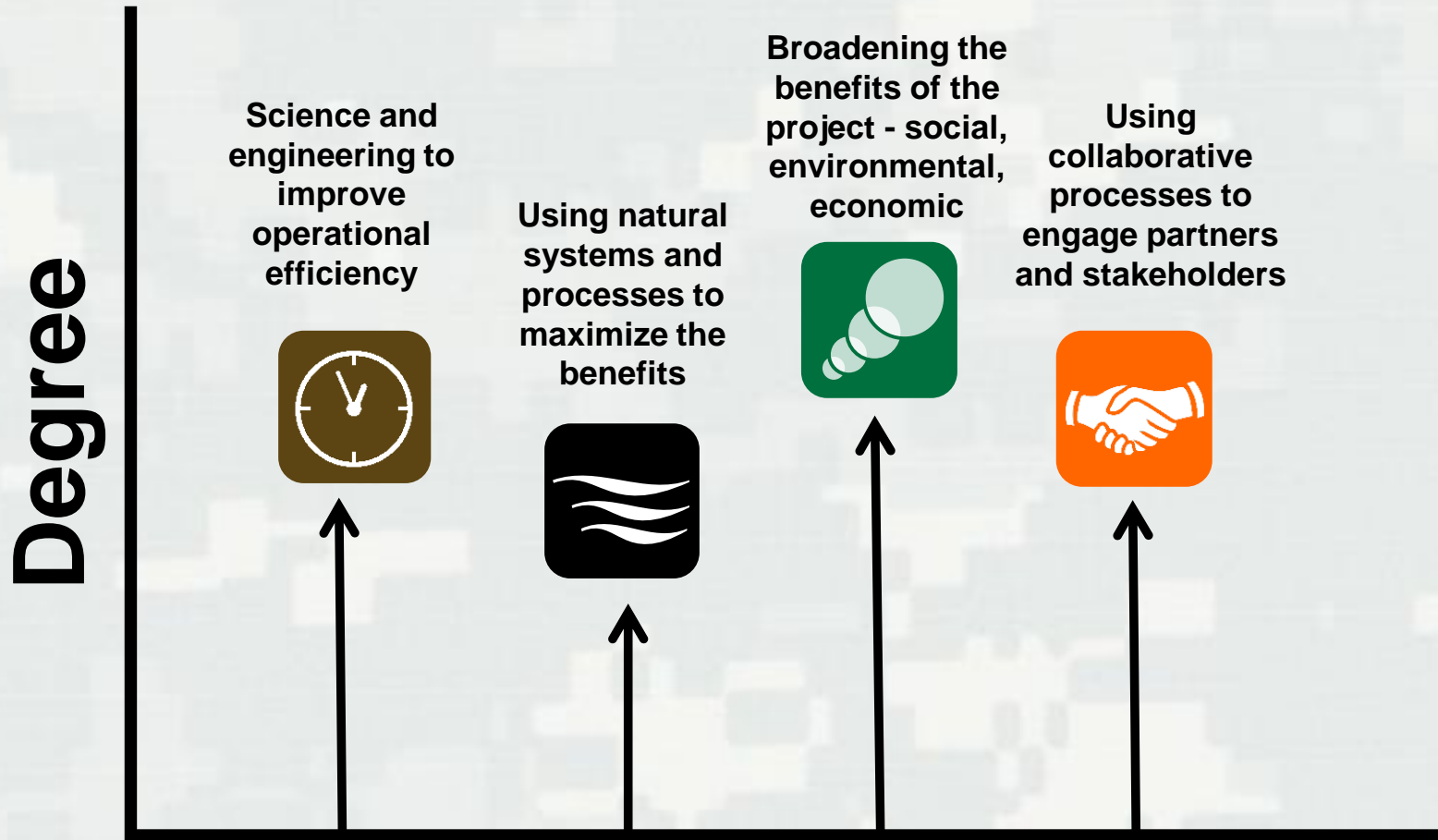


EWN Status

- *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
 - ▶ Awards
 - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
 - 2014 USACE National Award-Green Innovation



Engineering With Nature Elements



EWN Elements



Science and Engineering to Improve Operational Efficiency

- USACE operates a lot of navigation projects
 - ▶ 1,067 coastal navigation projects
 - ▶ 13,000 miles of coastal navigation channels
 - ▶ 27 inland river systems with 12,000 miles of channels
 - ▶ 236 lock chambers at 192 lock sites
 - ▶ 929 navigation structures
 - ▶ 844 bridges
- Hundreds of projects in maintenance backlog



Environmental Laws and Regulations Applicable to Dredging

- National Environmental Policy Act of **1969**
- Federal Water Pollution Control Act of **1972** (amended and renamed the Clean Water Act in **1977**)
- Marine Protection, Research, and Sanctuaries Act of **1972** (commonly called the Ocean Dumping Act)
- Coastal Zone Management Act of **1972**
- Marine Mammal Protection Act of **1972**, amended **1994**
- Endangered Species Act of **1973**
- Resource Conservation and Recovery Act of **1976**
- Magnuson-Stevens Act as reauthorized by the Sustainable Fisheries Act of **1996**

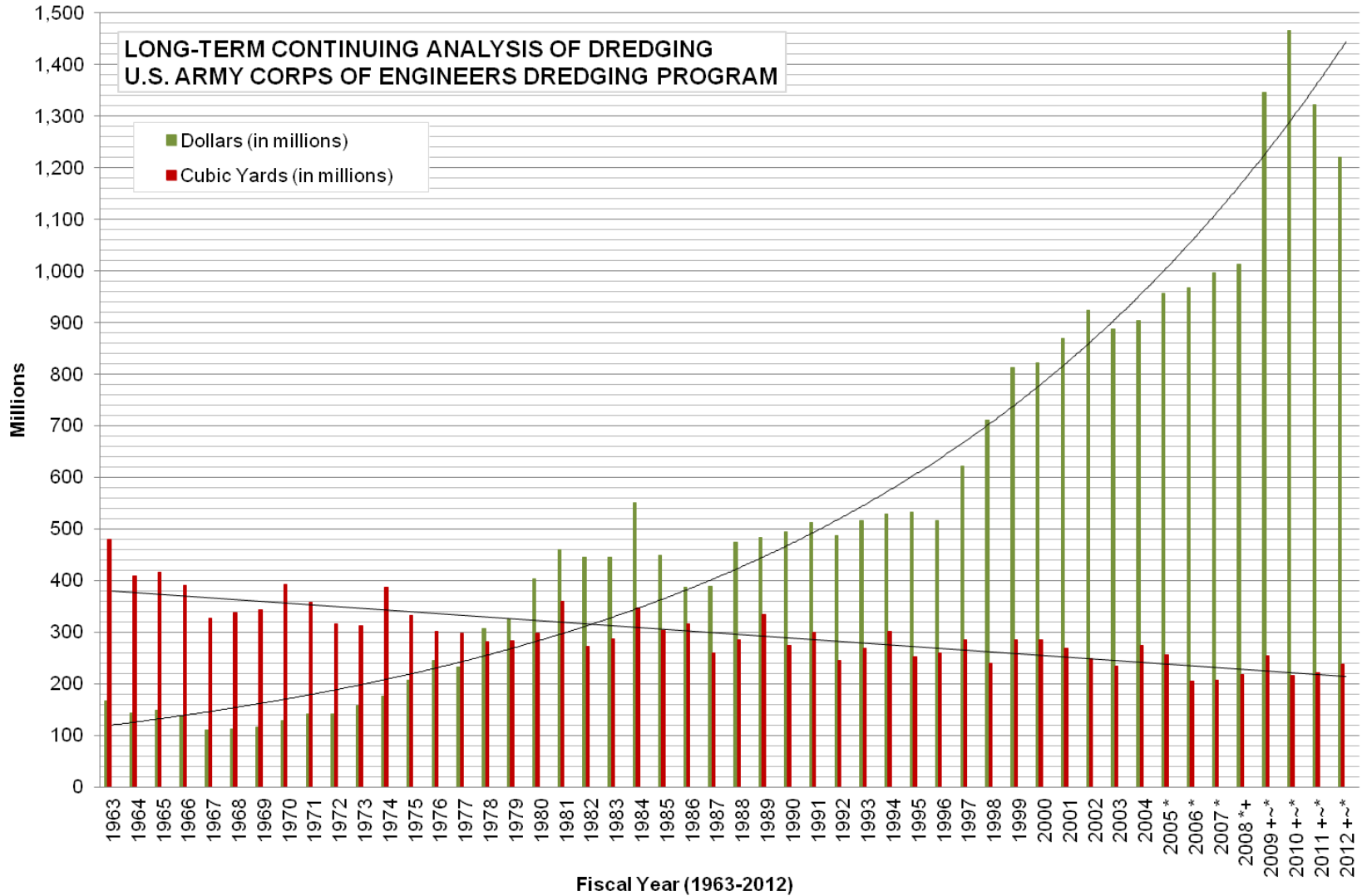


Environmental Restrictions

- The majority of our projects are restricted in terms of:
 - ▶ When we operate
 - i.e., dredging windows
 - ▶ The equipment we use
 - i.e., dredge type, barge size, etc.
 - ▶ How we operate the equipment
 - i.e., disposal site selection, overflow, decanting, discharge rates, etc.
- These restrictions increase operational costs and constrain execution



LONG-TERM CONTINUING ANALYSIS OF DREDGING U.S. ARMY CORPS OF ENGINEERS DREDGING PROGRAM



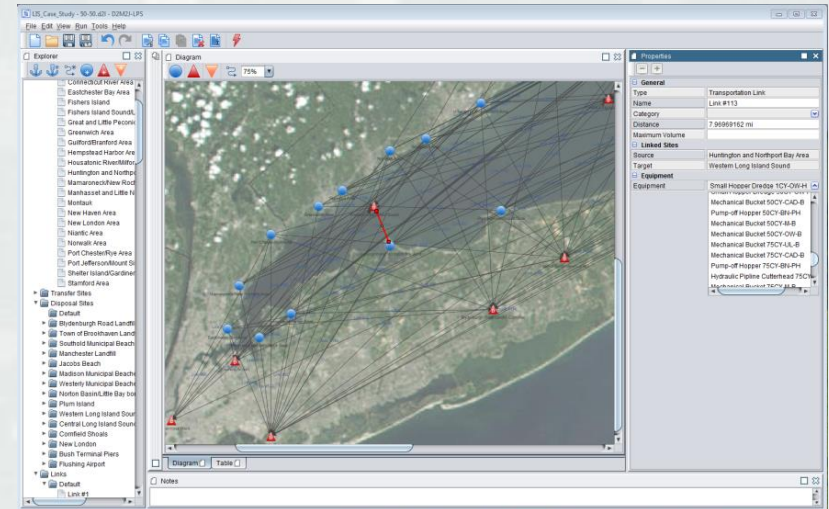
* Includes PL 84-99 and FY 05 Hurricane Katrina Supplemental (PL 109-062) amounts
 + Includes Hurricane Supplemental Work (HSW) amounts
 ~ Includes ARRA amounts

Source Data: <http://www.navigationdatacenter.us/db/dredging/ddcost/>



Advancing Operational Efficiency...

- More emphasis on the value produced by projects:
 - ▶ Economic
 - ▶ Social
 - ▶ Environmental
- More communication about cost implications associated with environmental restrictions
 - ▶ Unnecessary costs reduce project value



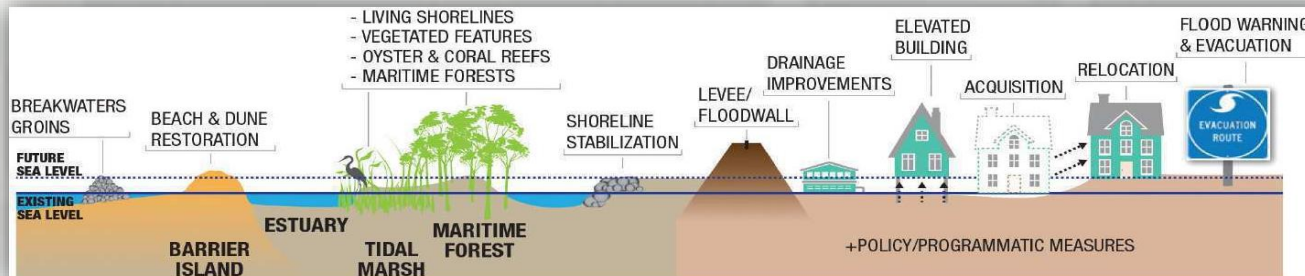
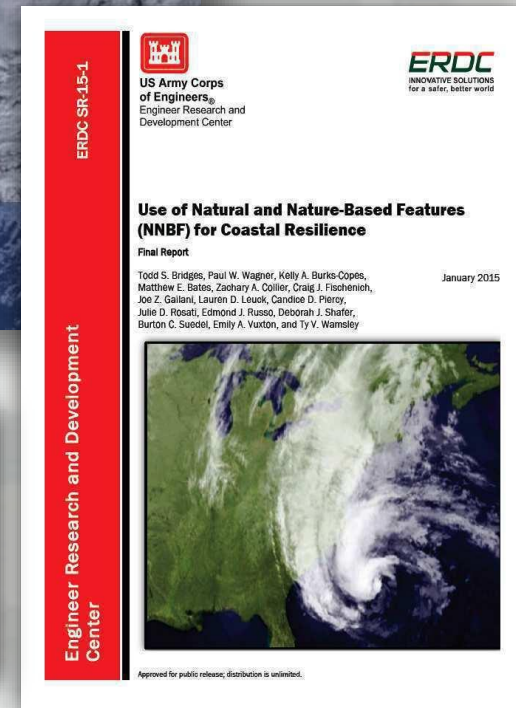
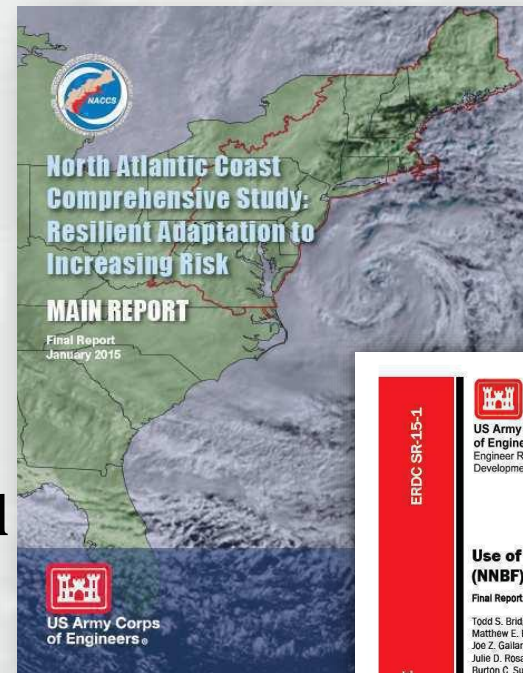
Using Natural Systems and Processes to Maximize Benefits

- A key element of sustainable projects
- Examples:
 - ▶ Strategic Sediment Placement
 - To support beaches, wetlands, mudflats etc.
 - ▶ Natural and Nature-Based Features
 - ▶ “Hydraulically Aided Dredging”
 - Water Injection Dredging
 - Agitation Dredging



North Atlantic Coast Comprehensive Study (NACCS)

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



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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

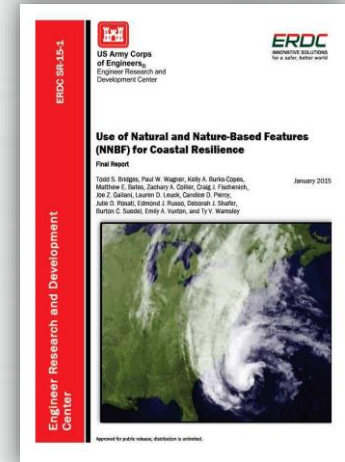
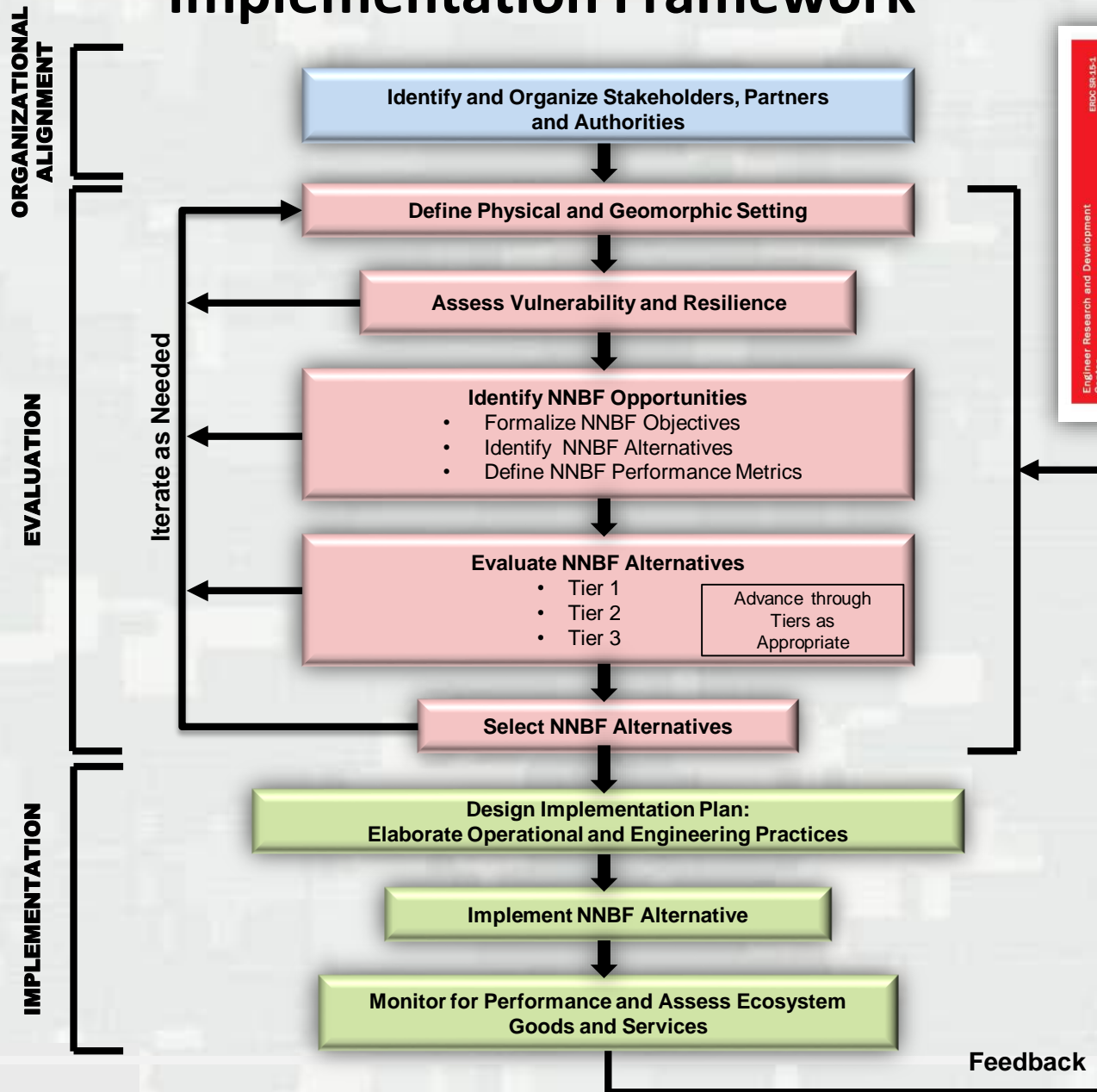
Benefits/Processes

Wave attenuation and/or dissipation
Shoreline erosion stabilization
Soil retention

Performance Factors

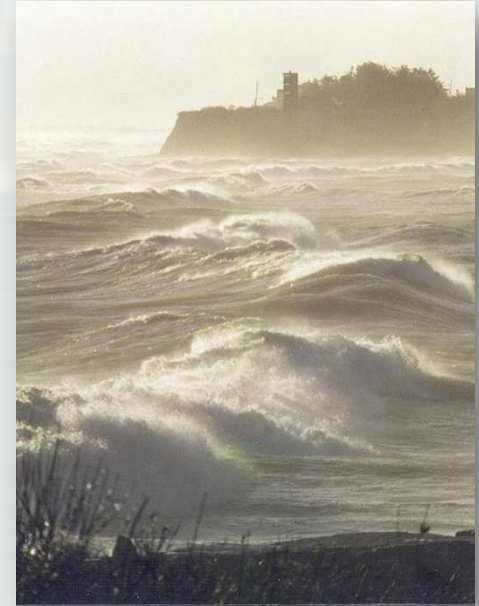
Vegetation height and density
Forest dimension
Sediment composition
Platform elevation

Natural and Nature-Based Features Evaluation and Implementation Framework



Advancing the Use of Natural Systems and Processes...

- More emphasis on innovation as a component of project development
- Address uncertainties
 - ▶ Expand communication about successes
 - “Yes, it can be done”
 - “Here’s how we did it”
 - The power of the story to persuade
 - ▶ Operationalize adaptive management
- Overcome regulatory and procedural inertia
 - ▶ Invest in effective coordination and collaboration
 - ▶ Identify existing flexibility and make use of it
 - ▶ Use demos and pilots to get moving

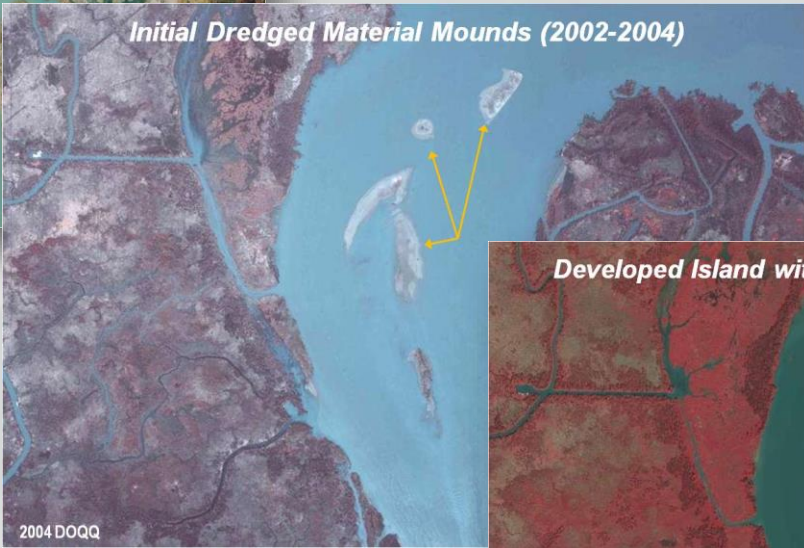
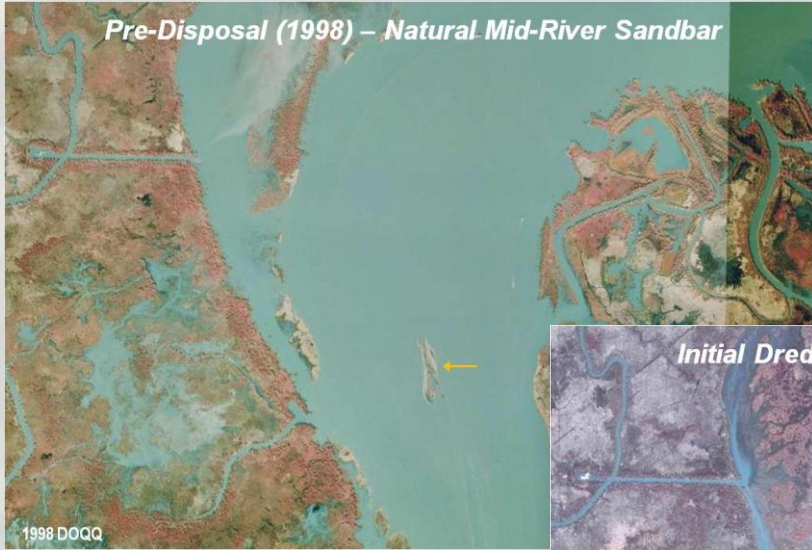


Expand the Benefits Provided by Projects

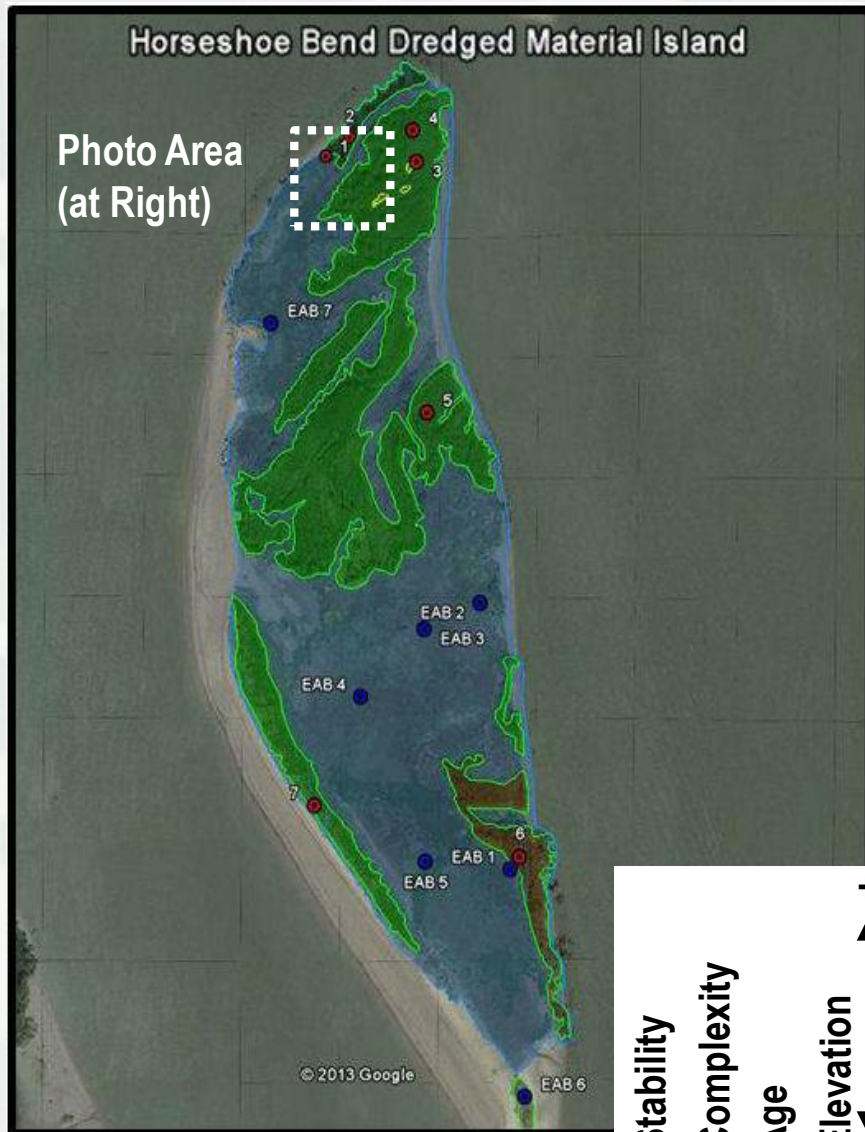
- Navigation dredging provides value to the Nation!
 - ▶ How?
- Value creation is a key concept in sustainability
 - ▶ Economic
 - ▶ Social
 - ▶ Environmental



Atchafalaya River, Horseshoe Bend



Habitat Development



Stability
Complexity
Age
Elevation

↑
↓

-  Mature Forested & Scrub-Shrub Wetlands
-  Young Forested & Scrub-Shrub Wetlands
-  Emergent Wetland Transition Zone
-  Aquatic Bed Features



Snowy Egret



**Tri-colored
Heron**



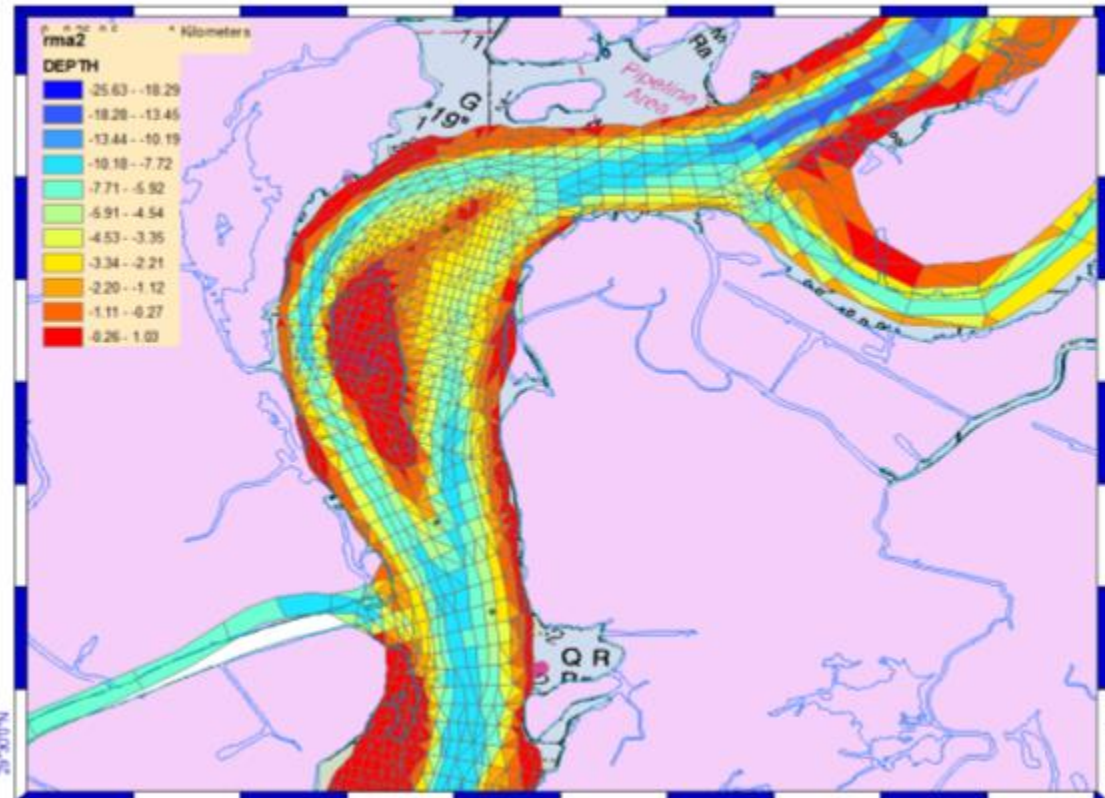
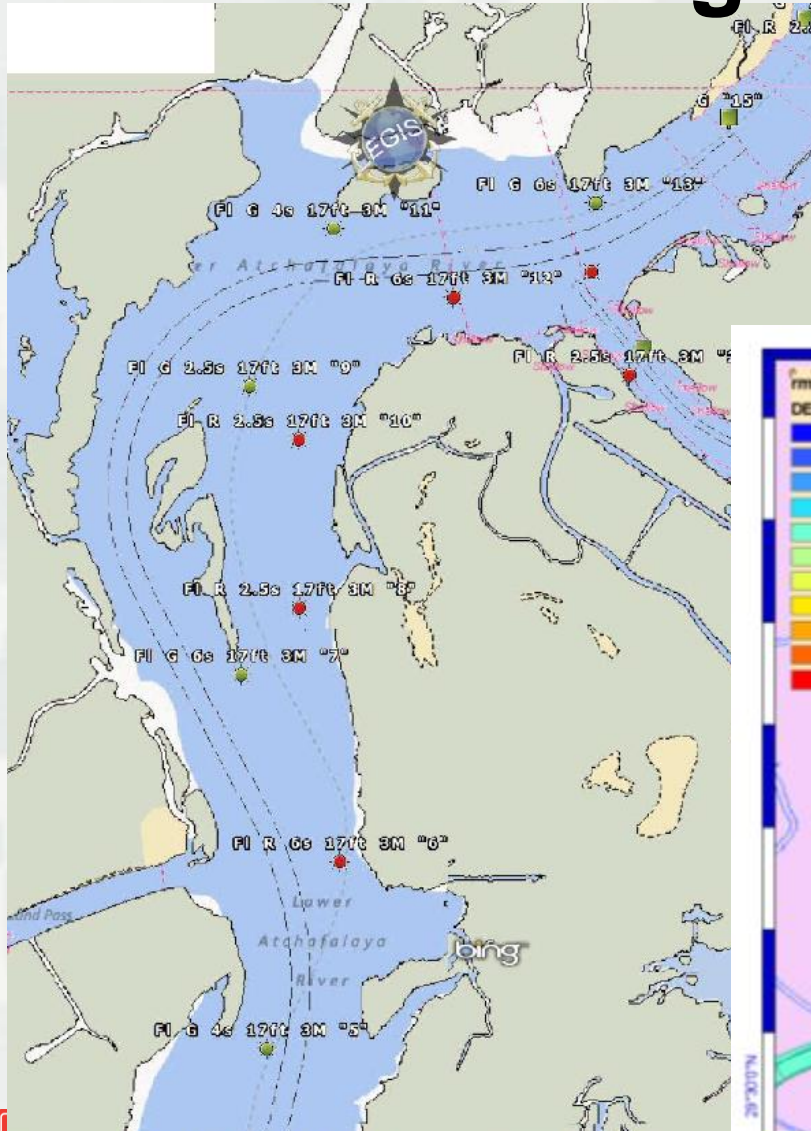
Glossy Ibis

Avian community

- 9 species of wading birds
- >78% juveniles
- 0.27 birds/ transect m in rookery
- Island design favorable to rookery establishment

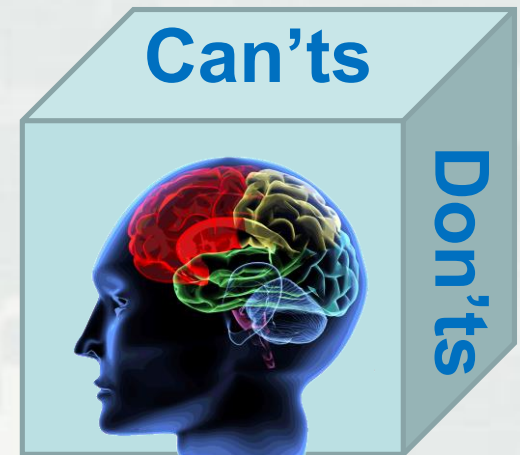
Navigation Benefit

Modeling: Implement LTFATE to characterize study area hydrodynamics



Advancing Expanded Benefits...

- More visioning about what benefits the project could produce
 - ▶ Developing a robust value proposition
- More partnering with others
- Less focus on historical constraints
- Document the benefits that are produced



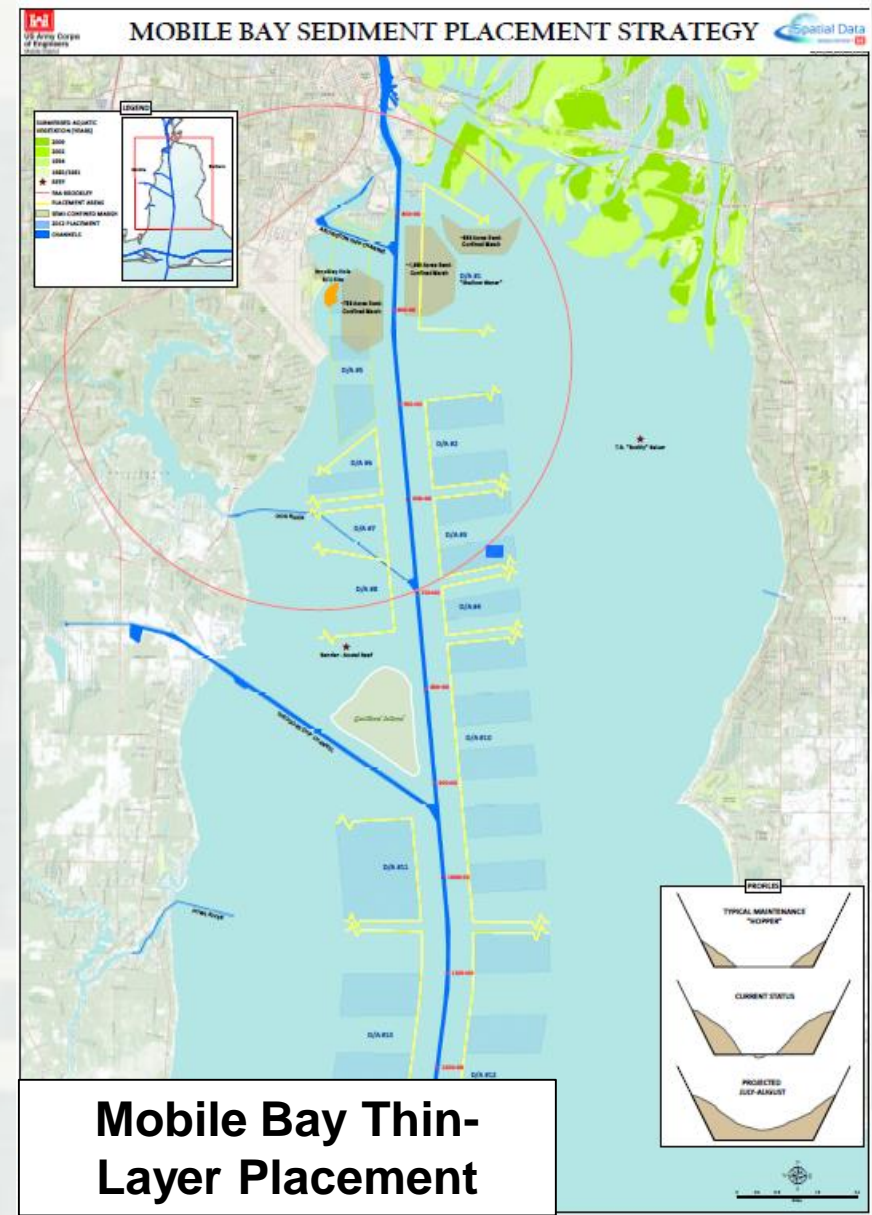
Collaborative Processes to Engage Stakeholders and Partners

- There are a lot of stakeholders!
 - ▶ News Flash: They don't all care about the same things
- By investing more in stakeholder engagement we can:
 - ▶ Accelerate schedules
 - ▶ Reduce costs
 - ▶ Identify new opportunities to create value



Strategic Sediment Placement in Mobile Bay

- 25 years ago, in-bay disposal of dredged material was banned
 - Shoreline erosion and loss of habitat followed
- Thin-layer placement was demonstrated on full-scale to restore sediment processes
- Many opportunities for in-water beneficial use
- Ecosystem benefits being documented



Philadelphia District: Coastal NJ



December 2014



Stone Harbor



Avalon



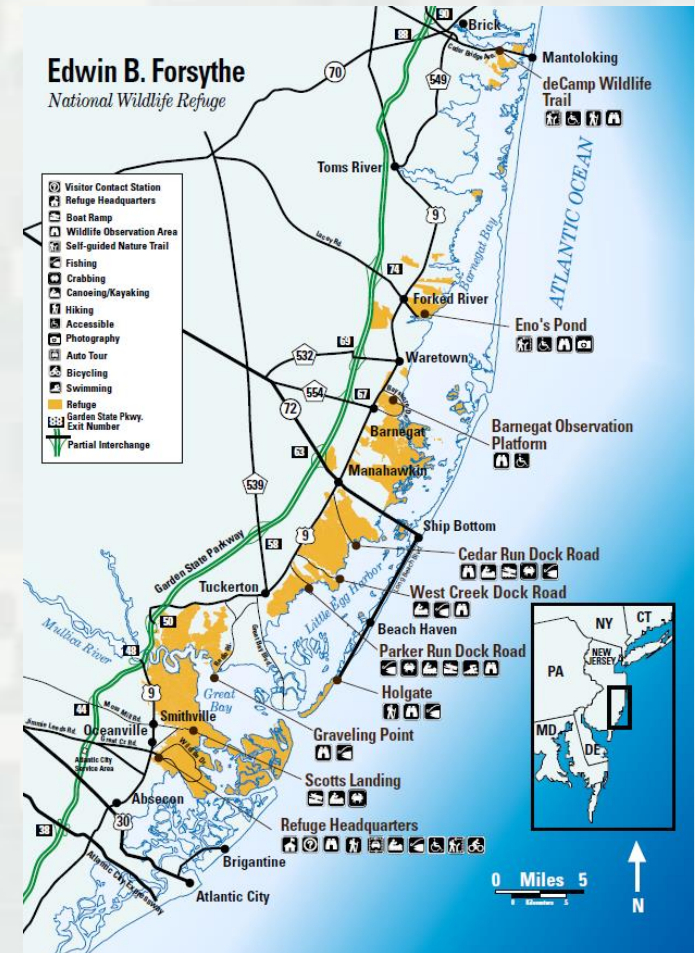
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Forsythe National Wildlife Refuge

- Forsythe NWR: >40,000 acres of wetlands and other habitat in coastal NJ
- Objective: Enhance ecosystem resilience through engineering and restoration
- Means: Apply EWN principles and practices



Advancing Collaborative Processes...

- Requires positive leadership within the project team
 - ▶ Vision, patience, persistence, commitment, transparency, trust-building...
- Professional help
 - ▶ This is more than public relations or meeting facilitation
 - ▶ Serious application of social science
- Biggest challenge: overcoming the attitude that dismisses stakeholder collaboration as hogwash



Evolving Practice by *Engineering With Nature*

- Value arguments resonate
- Diversifying project benefits (economic, social, environmental) provides more opportunities for identifying agreeable trade-offs
 - ▶ Basis for partnerships
 - ▶ Alternative financing
 - ▶ Productive negotiation
- Complementing sustainability policies with sound operational practice

