Evolving Dredging Practices to Engineer with Nature

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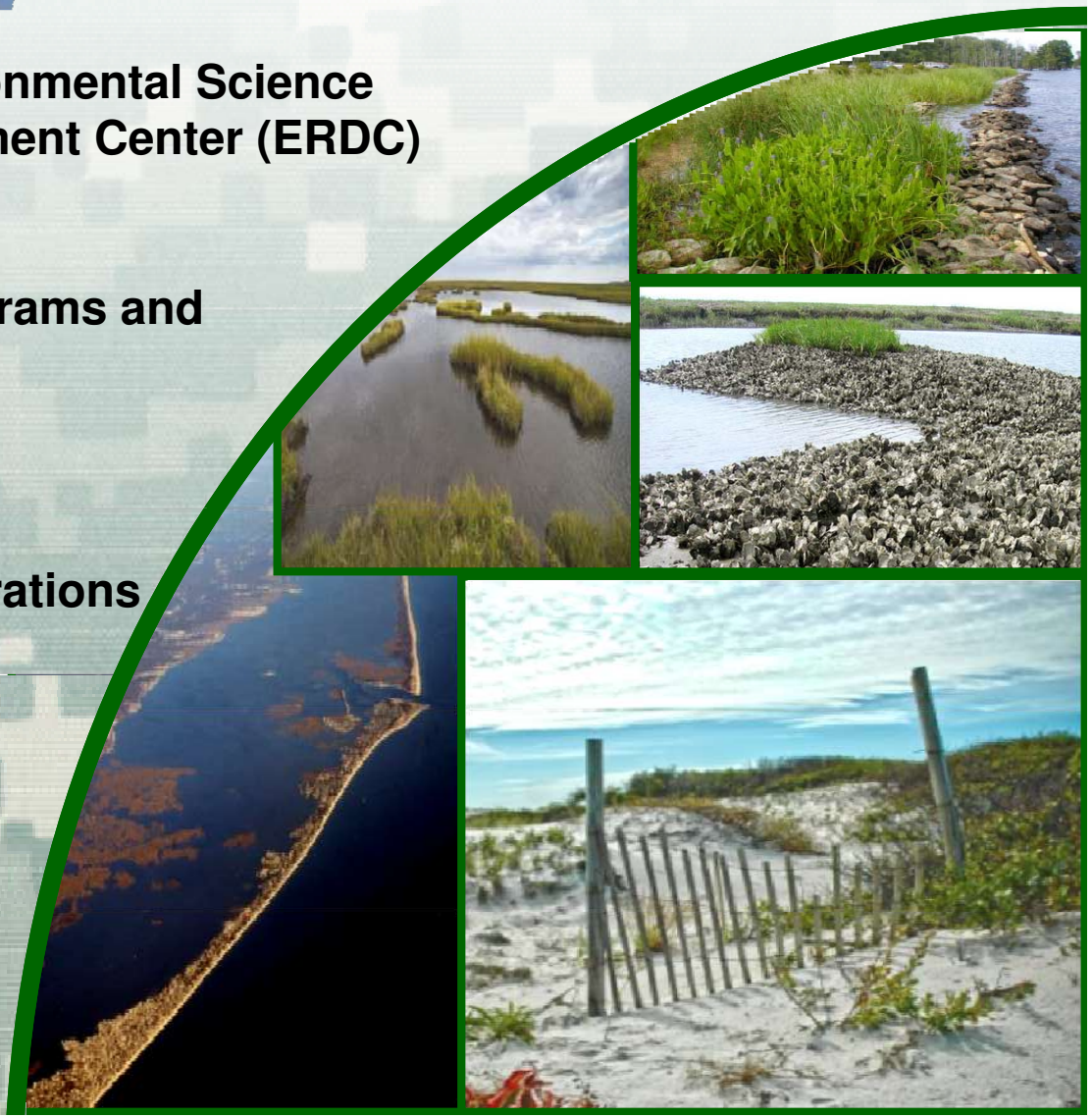


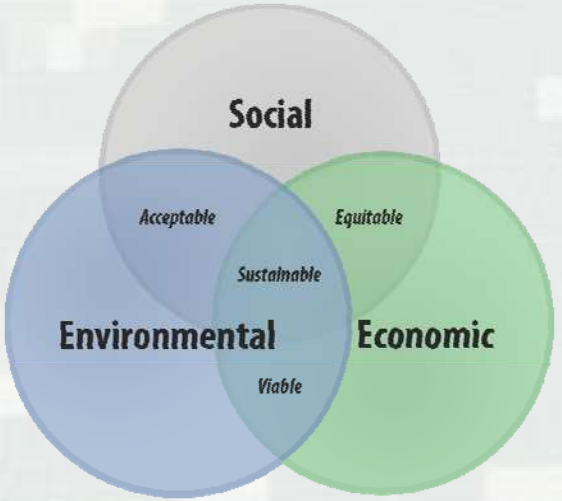
US Army Corps of Engineers
BUILDING STRONG®

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



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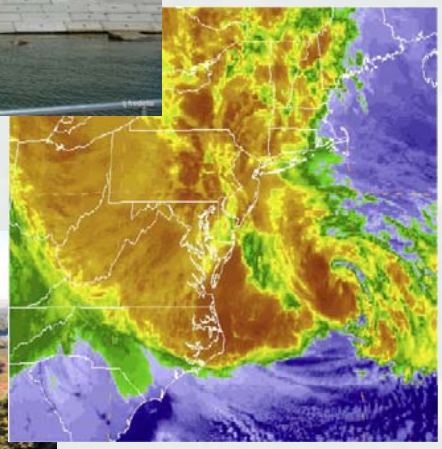
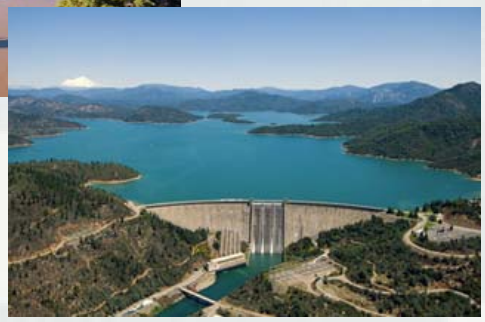
EWN Across USACE Mission Space

- 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

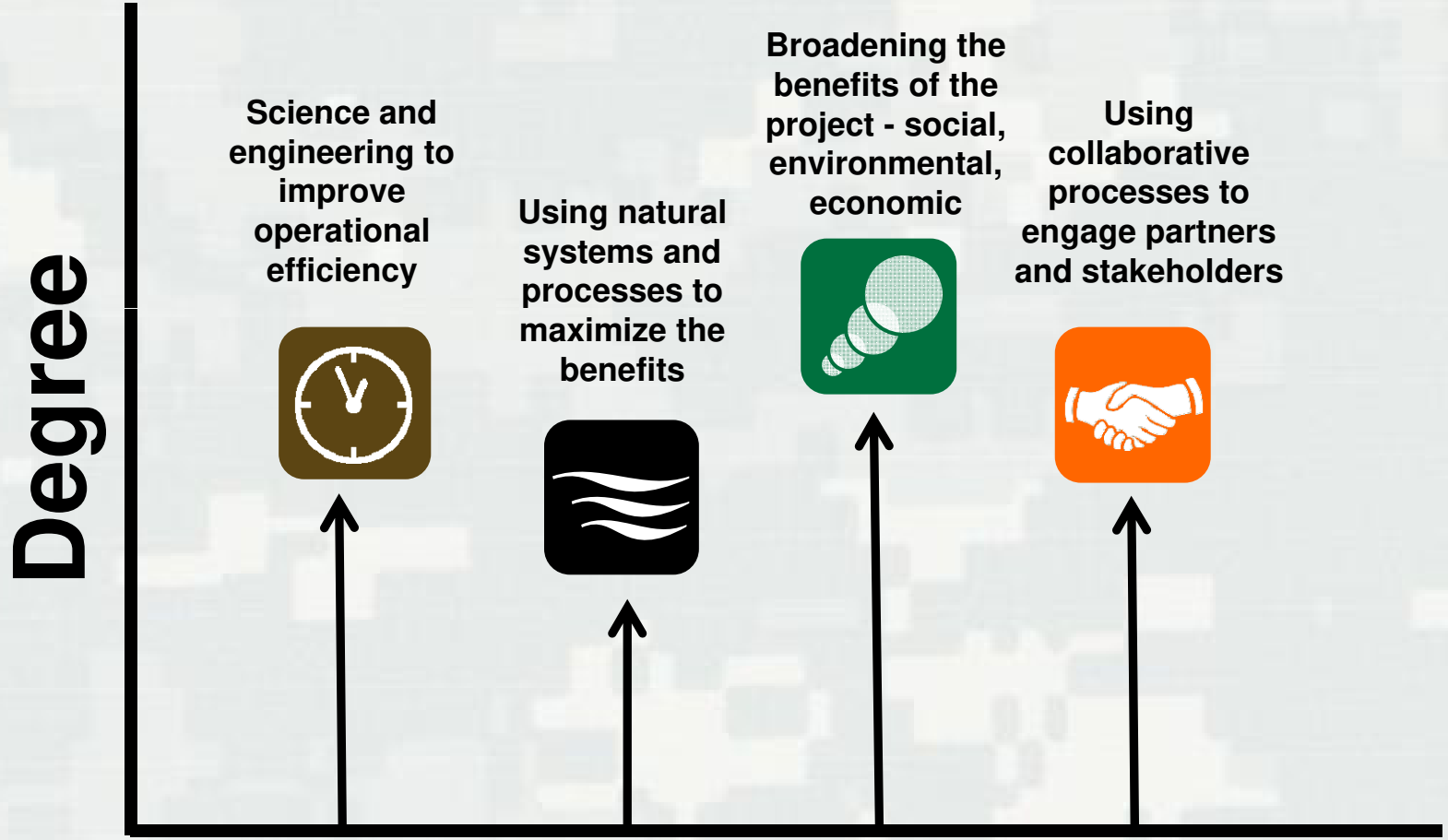




EWN Status

- *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



Science and Engineering to Improve Operational Efficiency

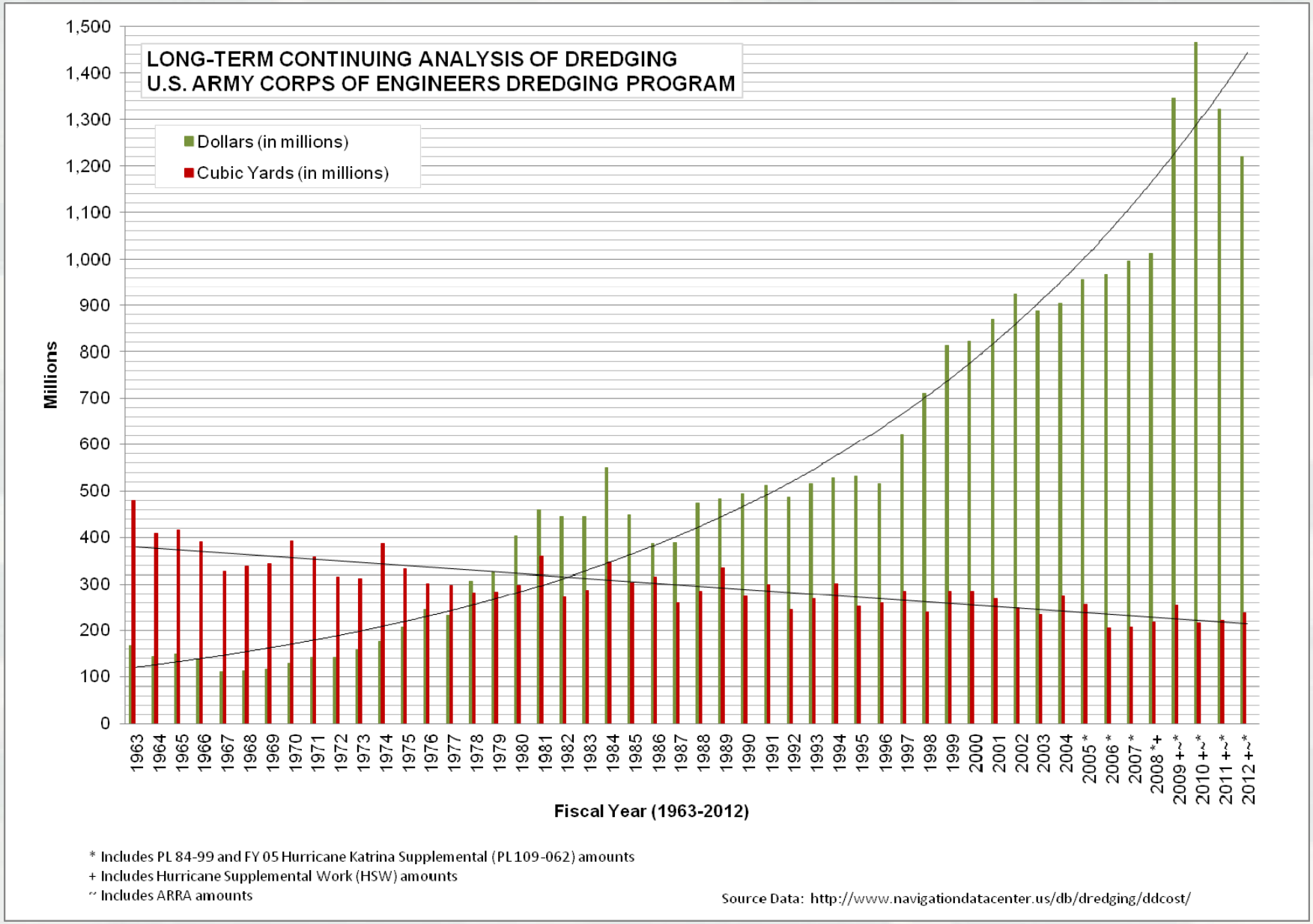
- USACE operates a lot of navigation projects
  - 1,067 coastal navigation projects
  - 13,000 miles of coastal navigation channels
  - 27 inland river systems with 12,000 miles of channels
  - 236 lock chambers at 192 lock sites
  - 929 navigation structures
  - 844 bridges
- Hundreds of projects in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

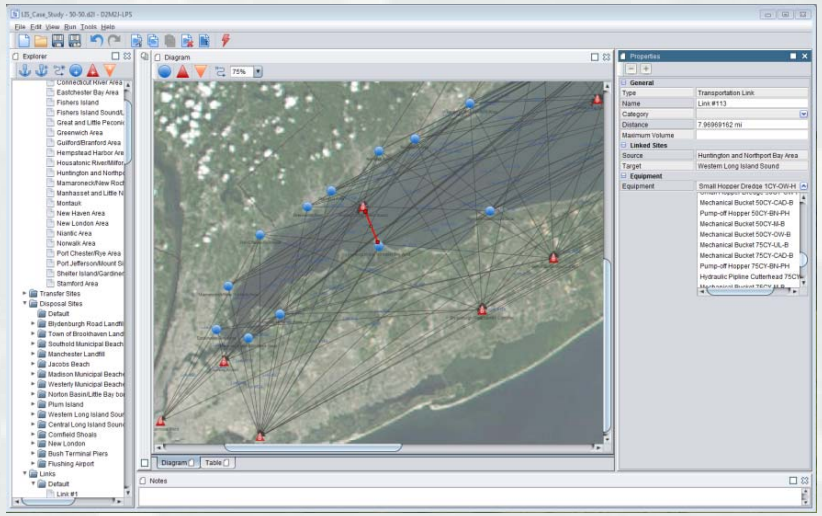
Environmental Restrictions

- 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
Dollars (in millions)
Cubic Yards (in millions)
Millions
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 * 2006 * 2007 * 2008 *+ 2009 +~* 2010 +~* 2011 +~* 2012 +~*
Fiscal Year (1963-2012)
* 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

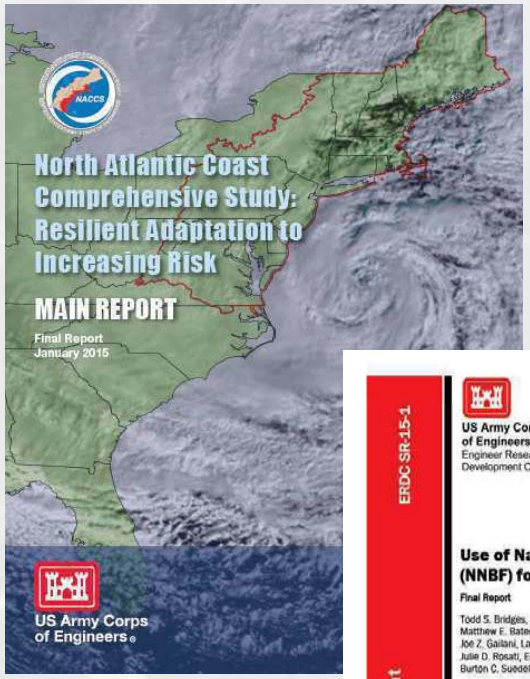


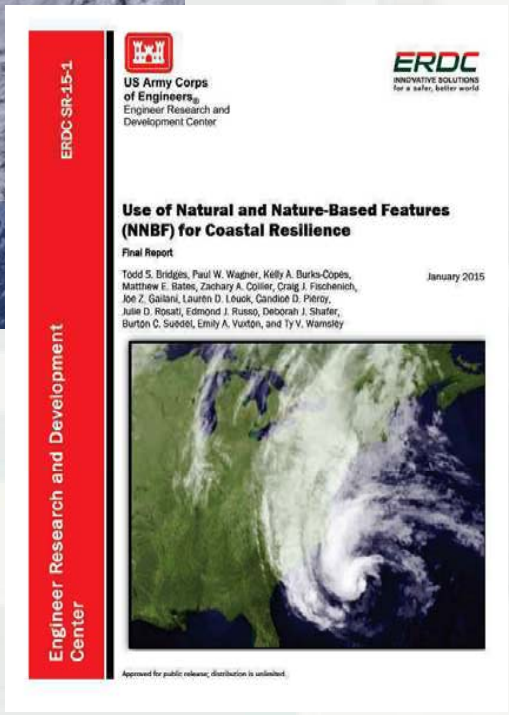
Using Natural Systems and Processes to Maximize Benefits

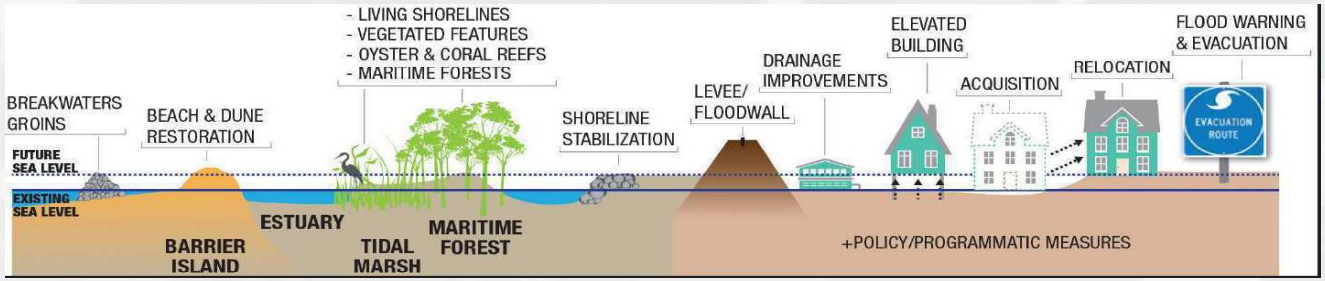
- A key element of sustainable projects
- Examples:
  - ► Strategic Sediment Placement
    - To support beaches, wetlands, mudflats etc.
  - ► Natural and Nature-Based Features
  - ► "Hydraulically Aided Dredging"
    - Water Injection Dredging
    - Agitation Dredging

North Atlantic Coast Comprehensive Study (NACCS)

- Explore opportunities to integrates 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.







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

ORGANIZATIONAL ALIGNMENT

EVALUATION

IMPLEMENTATION

Iterate as Needed

Identify and Organize Stakeholders, Partners and Authorities

Define Physical and Geomorphic Setting

Assess Vulnerability and Resilience

Identify NNBF Opportunities
- Formalize NNBF Objectives
- Identify NNBF Alternatives
- Define NNBF Performance Metrics

Evaluate NNBF Alternatives
- Tier 1
- Tier 2
- Tier 3

Advance through Tiers as Appropriate

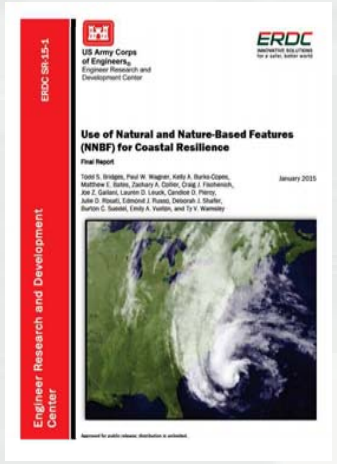
Select NNBF Alternatives

Design Implementation Plan: Elaborate Operational and Engineering Practices

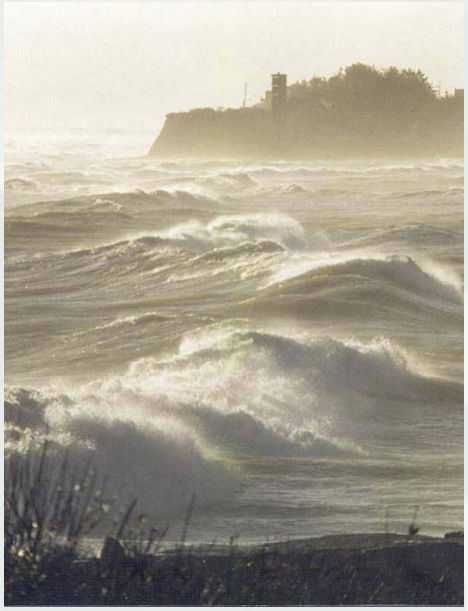
Implement NNBF Alternative

Monitor for Performance and Assess Ecosystem Goods and Services

Feedback



Advancing the Use of Natural Systems and Processes…

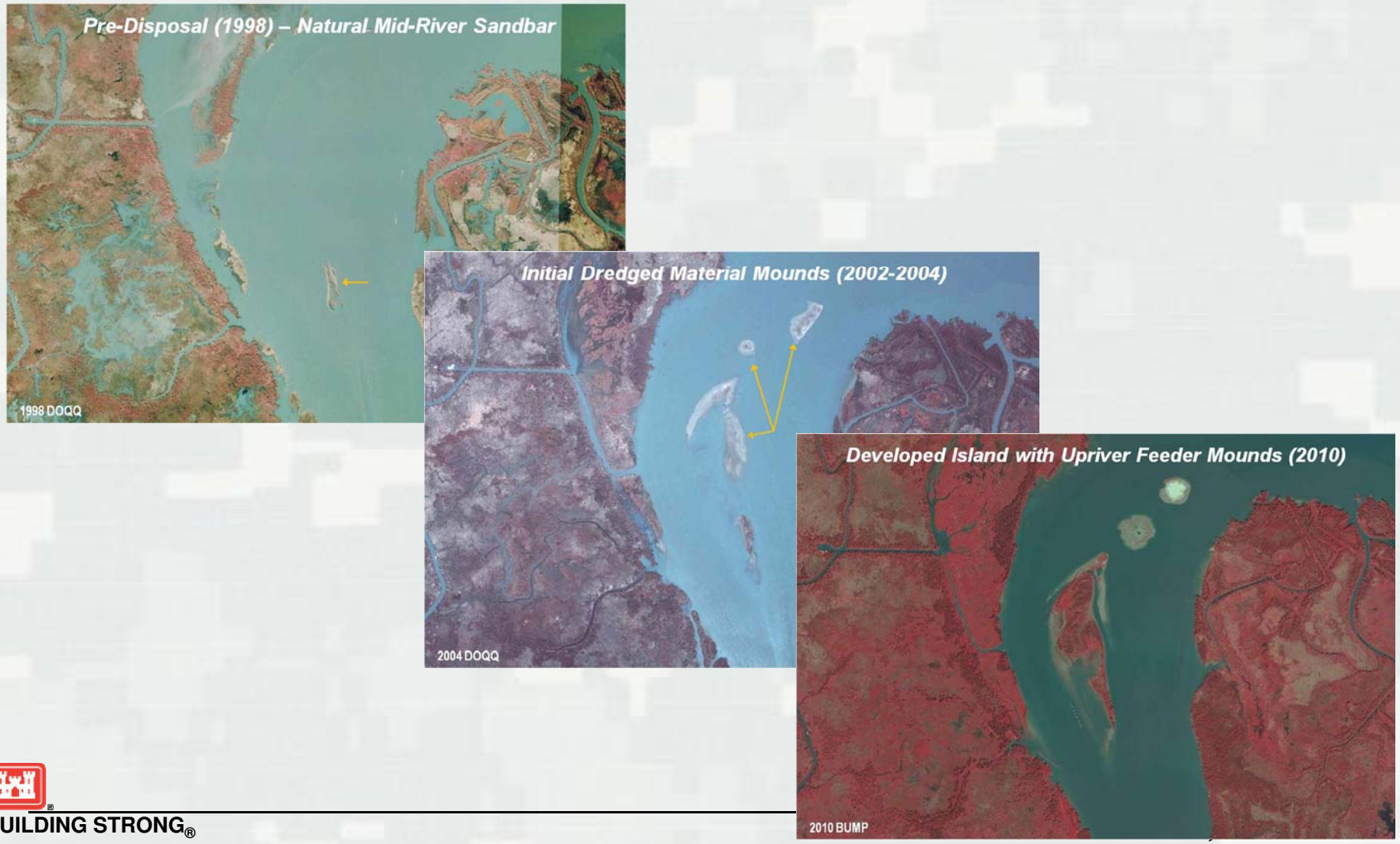


- More emphasis on innovation as a component of project development
- Address uncertainties
  - ► Expand communication about successes
    - "Yes, it can be done"
    - "Here's how we did it"
    - The power of the story to persuade
  - ► Operationalize adaptive management
- Overcome regulatory and procedural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

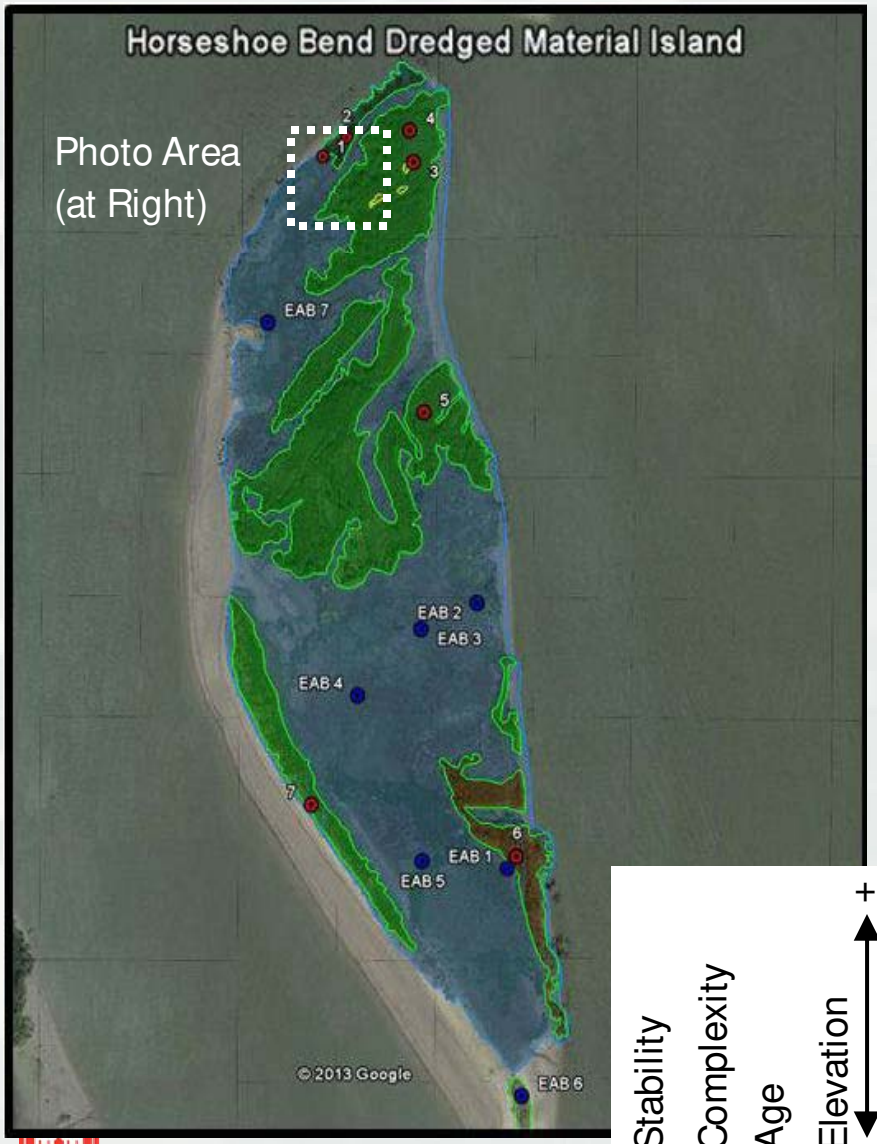
Expand the Benefits Provided by Projects

- 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

Tri-colored Heron

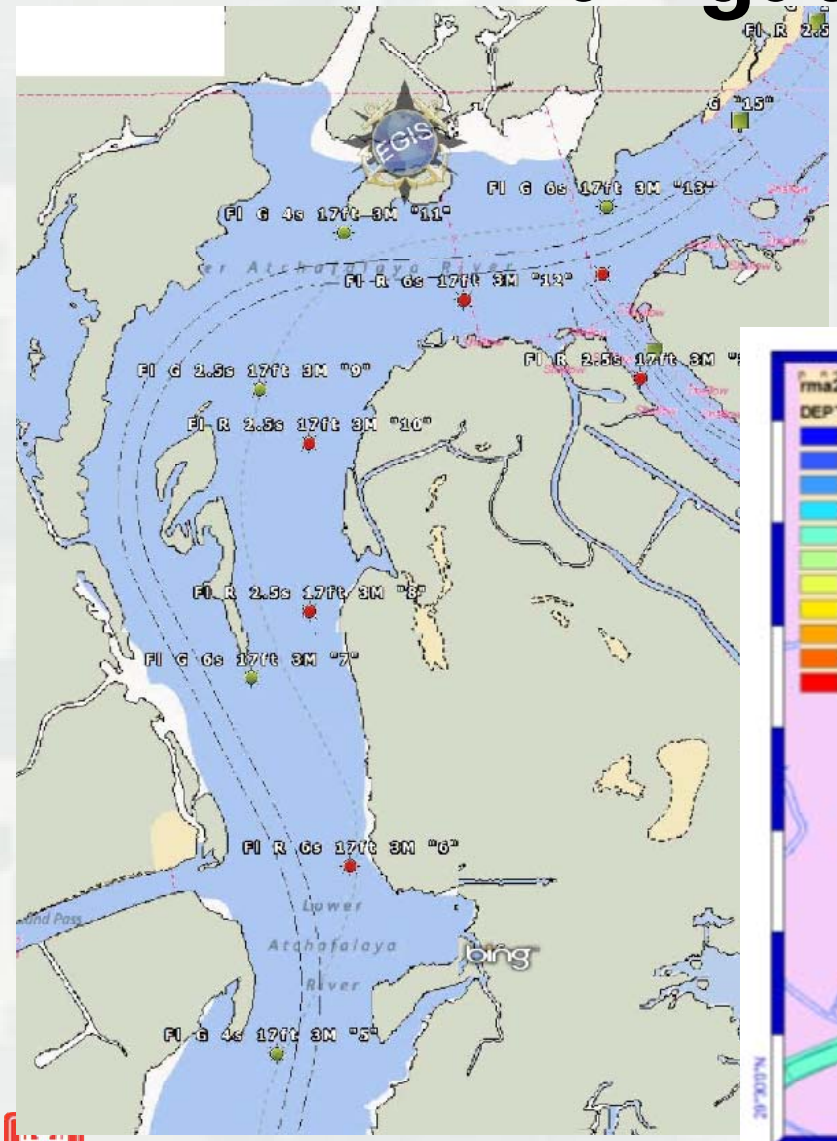
Snowy Egret

Glossy Ibis

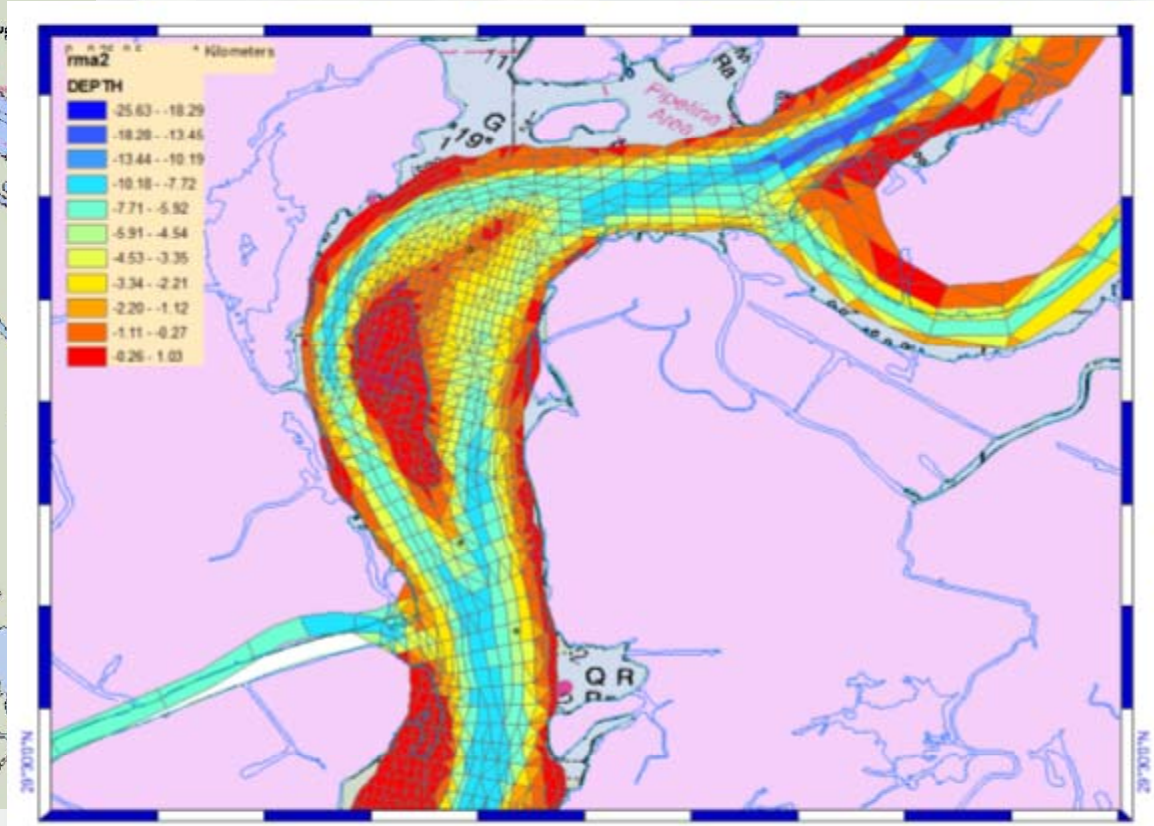
Avian community

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

Navigation Benefit

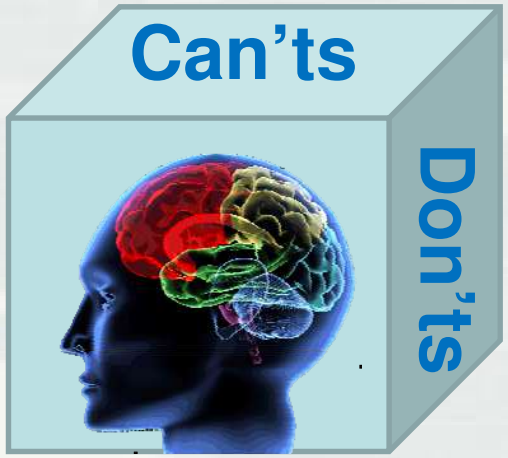


Modeling: Implement LTFATE to characterize study area hydrodynamics



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

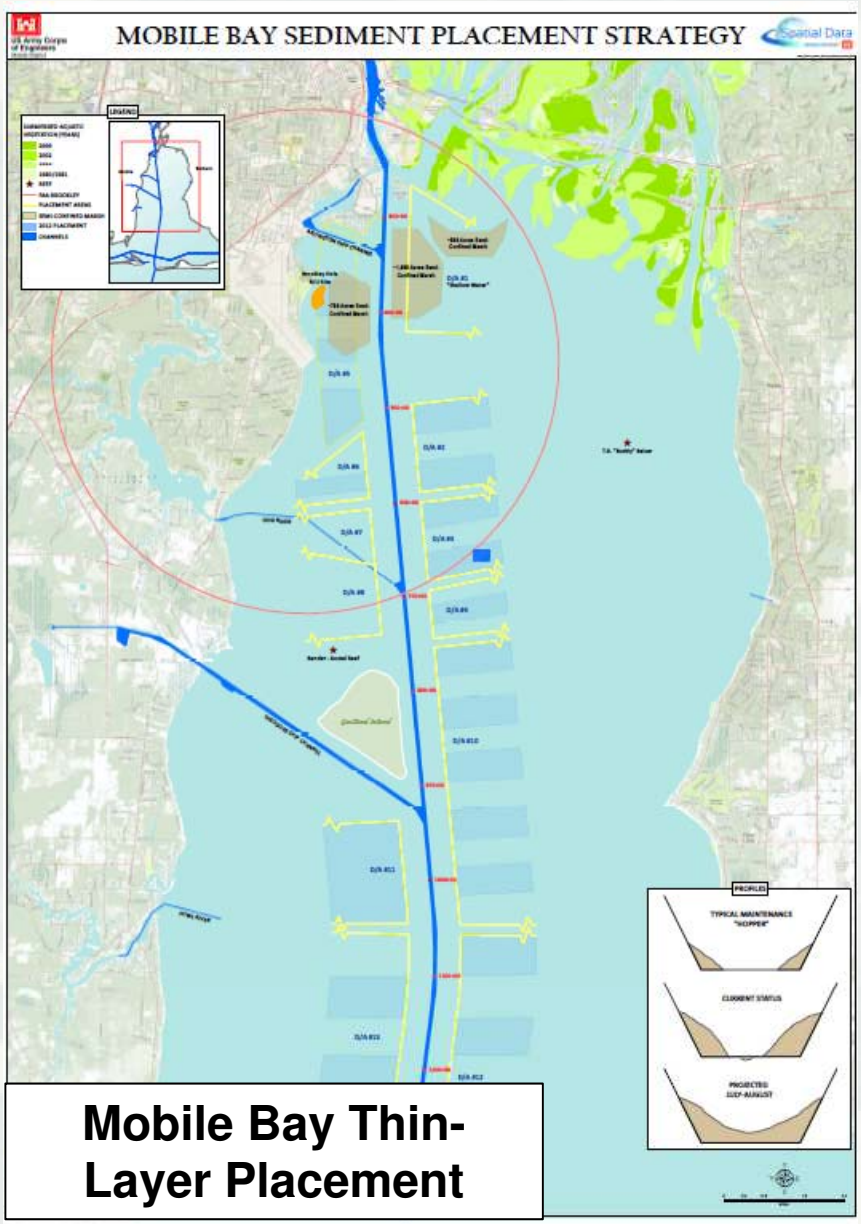


Collaborative Processes to Engage Stakeholders and Partners

- 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



Mobile Bay Thin-Layer Placement

Philadelphia District: Coastal NJ

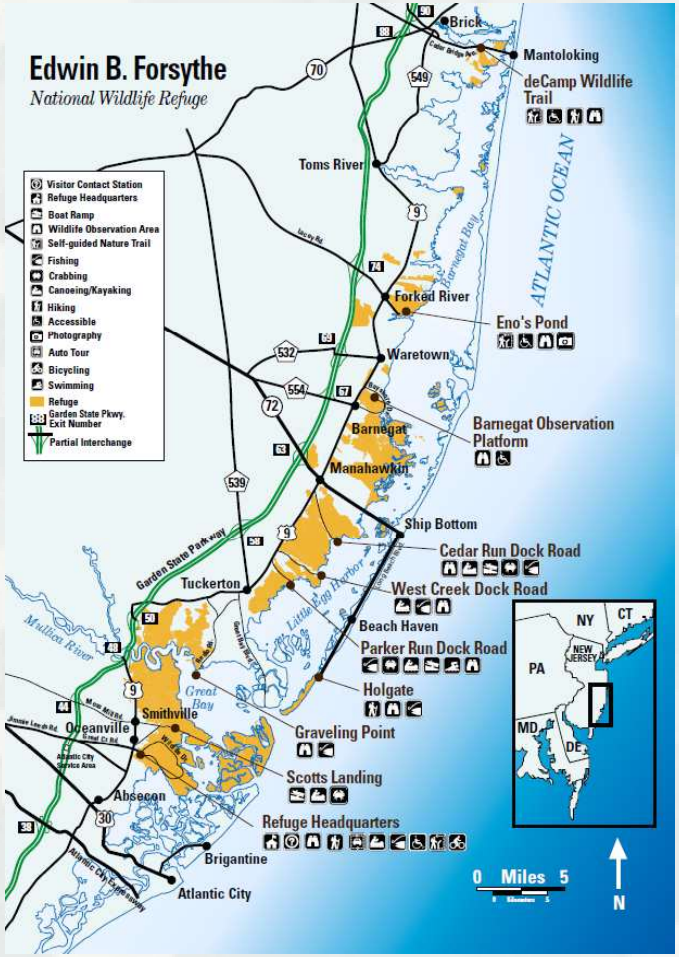
December 2014

Stone Harbor

Avalon

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



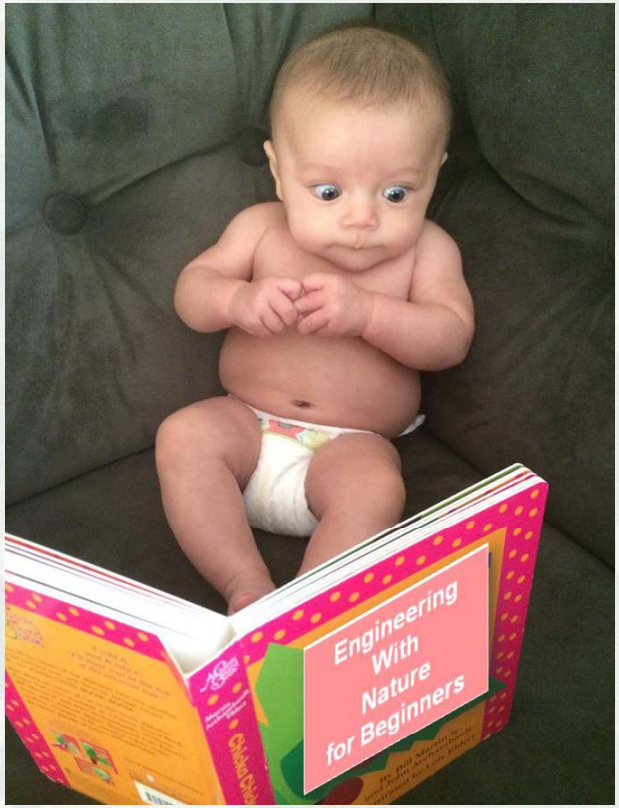
Advancing Collaborative Processes…

- 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



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