Engineering With Nature

Dr. Todd S. Bridges, ST

Senior Research Scientist, Environmental Science
Engineer Research and Development Center

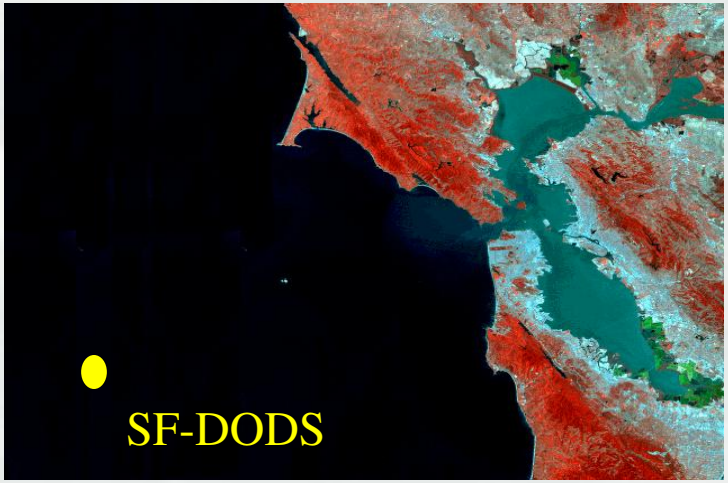
USACE Buffalo District Brief

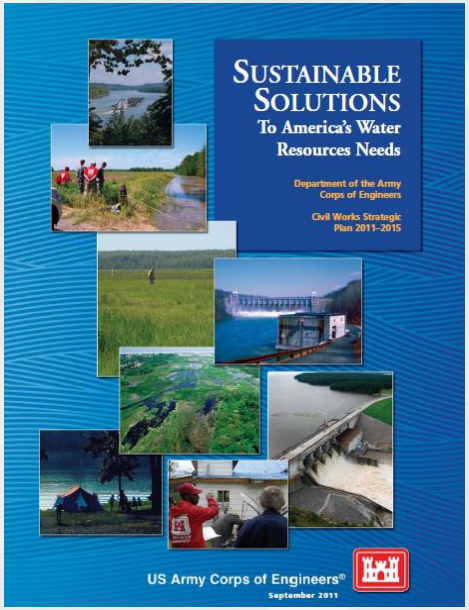
8 August 2014

todd.s.bridges@usace.army.mil

US Army Corps of Engineers
BUILDING STRONG®

Moving Beyond the *Status Quo*





Needs:

- Efficient, cost effective engineering and operational practices
- More collaboration and cooperation, less unproductive conflict.
  - Ports, commercial interests, regulators, NGOs, and others
- Sustainable projects. Triple-win outcomes integrating social, environmental and economic objectives.

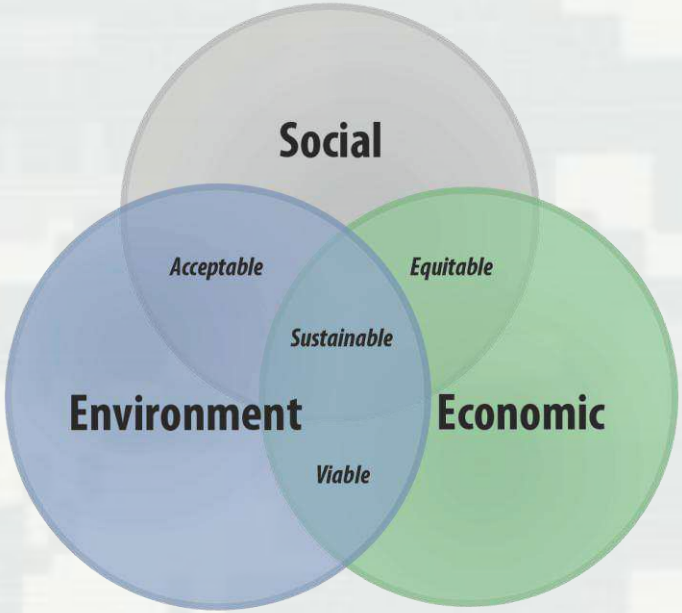
Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."

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 Ingredients

- 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



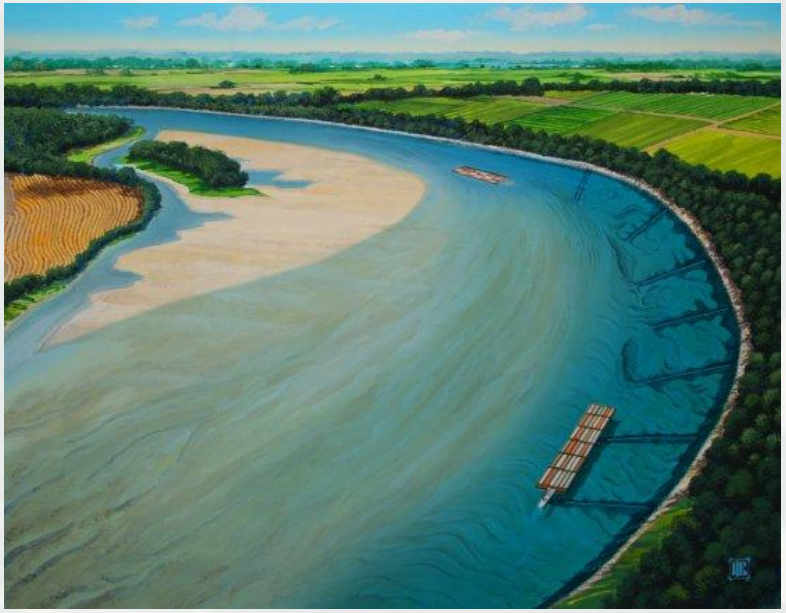
www.engineeringwithnature.org

EWN Status

- *Engineering With Nature* initiative started within USACE Civil Works program in 2010. Over that period we have:
  - Engaged > 300 ind. across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
    - Workshops (15), dialogue sessions, project development teams, etc.
  - Developed a strategic plan
  - Focused research projects on EWN
  - Initiated field demonstration projects
  - Begun implementing our communication plan
  - Awards
    - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
    - 2014 USACE Sustainability Award-Green Innovation

Example EWN Solutions

Upper Mississippi River Training Structures: Chevrons

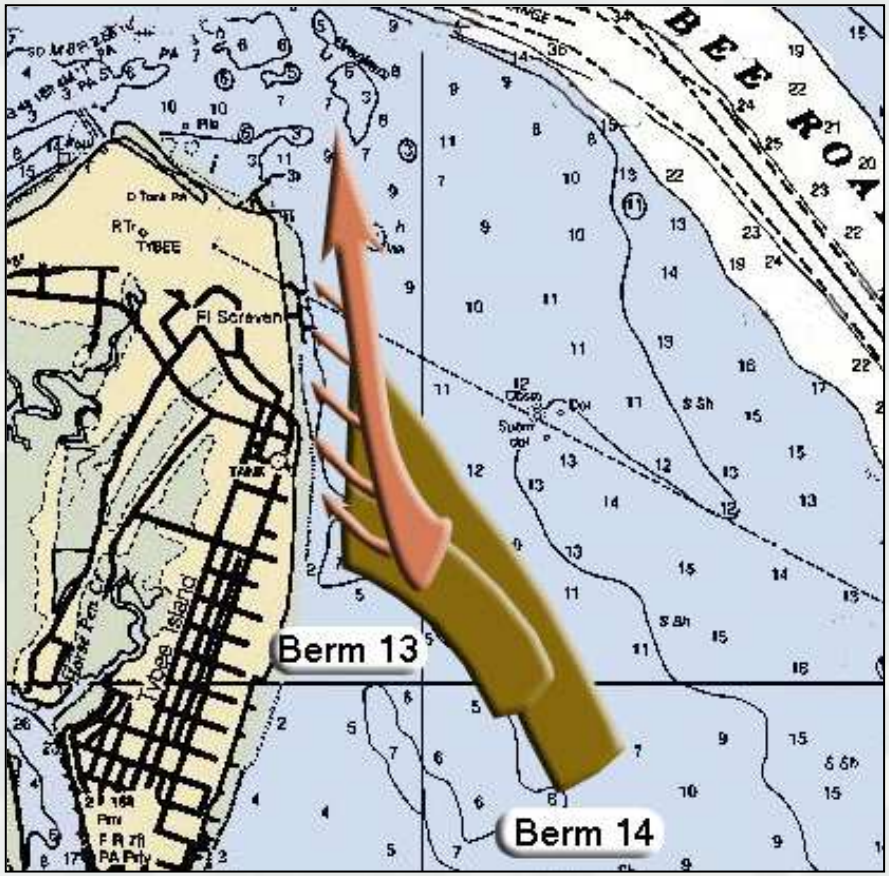


River Bendway Weirs

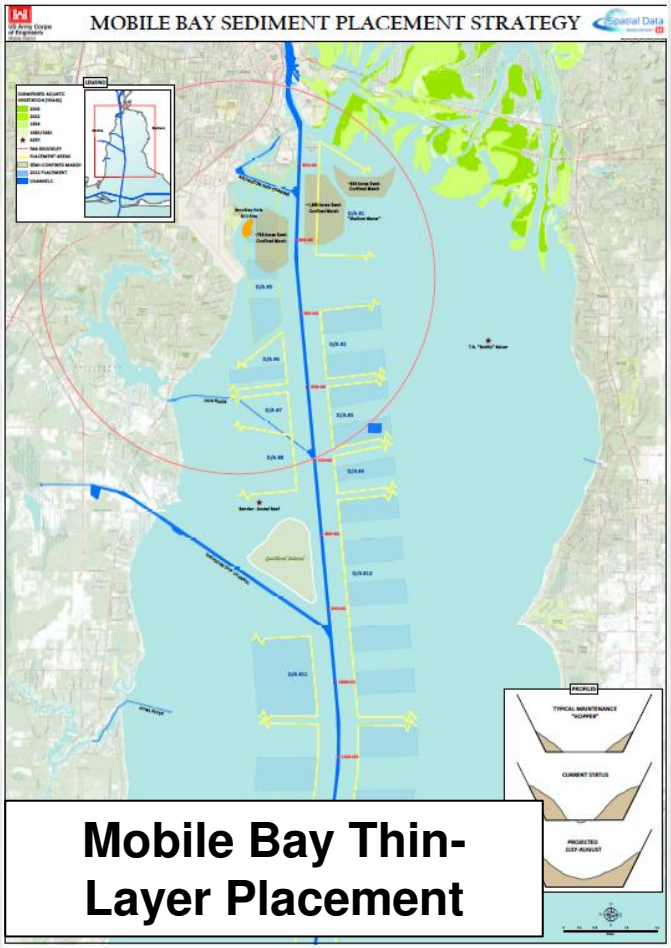
Environmentally Enhanced Breakwater Toe Blocks

Example EWN Solutions

Strategic Sediment Placement

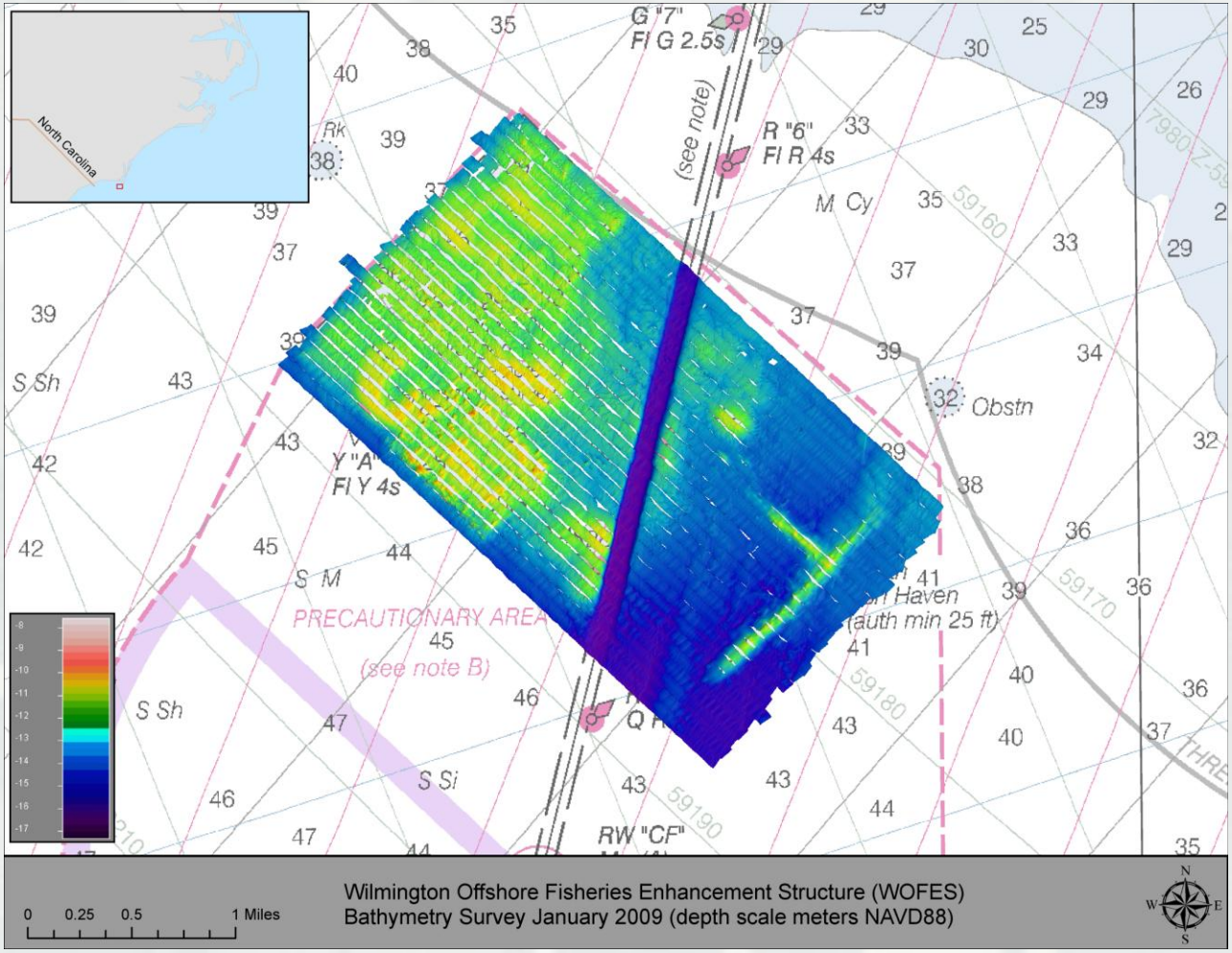


North Tybee Island
Savannah, Georgia



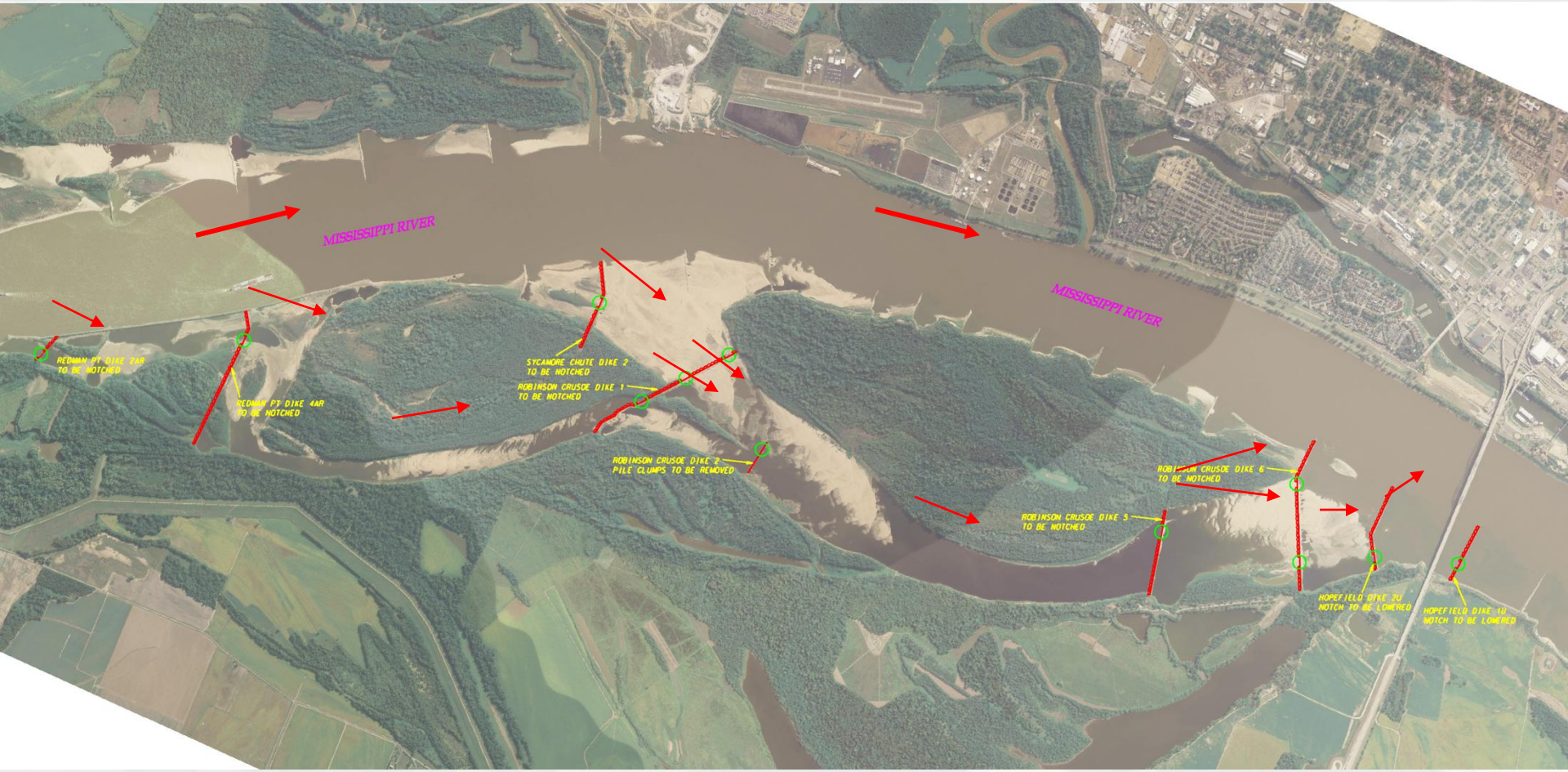
Mobile Bay Thin-Layer Placement

Example EWN Solutions



Wilmington Offshore Fisheries Enhancement Structure

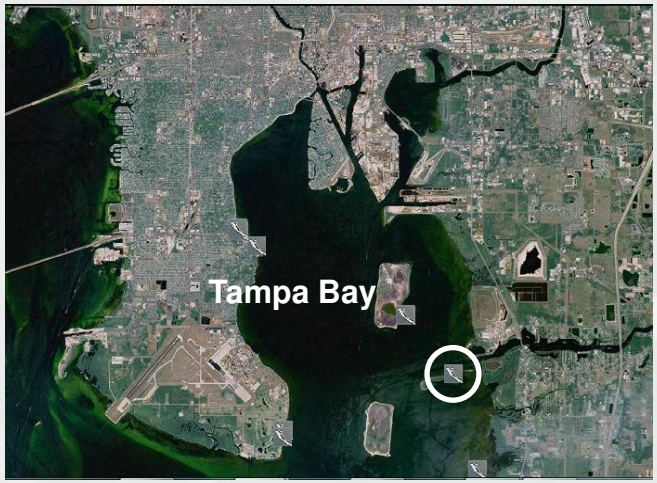
Example EWN Solutions



Loosahatchie Bar
Aquatic Habitat Rehabilitation

Alafia Banks Bird Sanctuary, FL

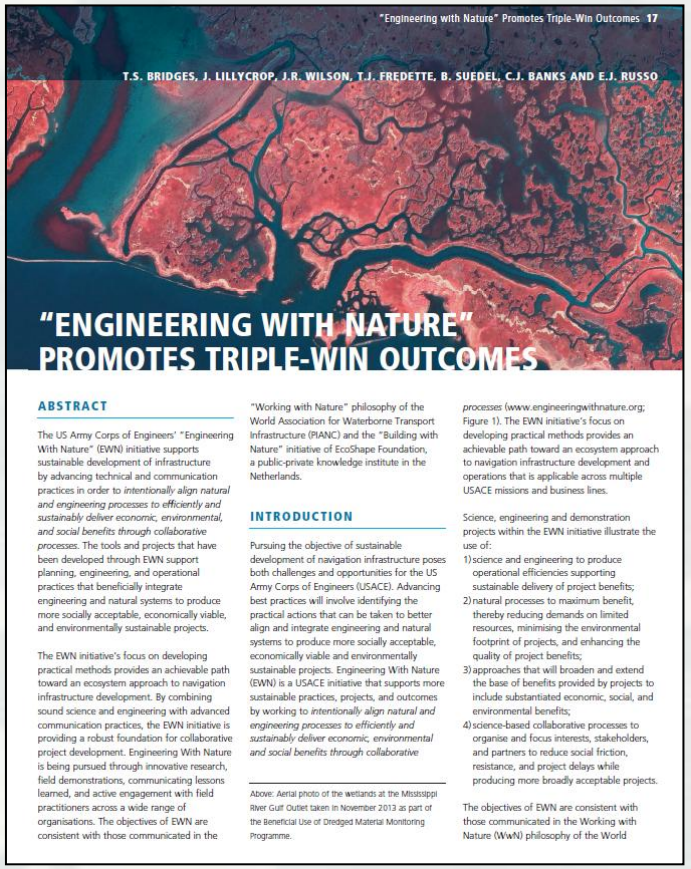
- 8000 lb reef module breakwaters (930 ft)
- Shore protection for Audubon bird sanctuary islands
- Help restore oyster populations
- Provide habitat



Example: www.reefball.org

Update

- EWN Demonstration Projects
- NACCS Natural and Nature-Based Features
- Workshops/Conferences
- Forsythe National Wildlife Refuge
- District Collaboration
  - Philadelphia Operations
  - Galveston EWN Proving Ground
- USFWS Collaboration on ESA and EWN
- Engagement
  - NWF, EDF, TNC, NFWF



"Engineering with Nature" Promotes Triple-Win Outcomes 17

T.S. BRIDGES, J. LILLYCROP, J.R. WILSON, T.J. FREDETTE, B. SUEDEL, C.J. BANKS AND E.J. RUSSO

"ENGINEERING WITH NATURE" PROMOTES TRIPLE-WIN OUTCOMES

ABSTRACT

The US Army Corps of Engineers' "Engineering With Nature" (EWN) initiative supports sustainable development of infrastructure by advancing technical and communication practices in order to *intentionally align natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes*. The tools and projects that have been developed through EWN support planning, engineering, and operational practices that beneficially integrate engineering and natural systems to produce more socially acceptable, economically viable, and environmentally sustainable projects.

The EWN initiative's focus on developing practical methods provides an achievable path toward an ecosystem approach to navigation infrastructure development. By combining sound science and engineering with advanced communication practices, the EWN initiative is providing a robust foundation for collaborative project development. Engineering With Nature is being pursued through innovative research, field demonstrations, communicating lessons learned, and active engagement with field practitioners across a wide range of organisations. The objectives of EWN are consistent with those communicated in the "Working with Nature" philosophy of the World Association for Waterborne Transport Infrastructure (PIANC) and the "Building with Nature" initiative of EcoShape Foundation, a public-private knowledge institute in the Netherlands.

INTRODUCTION

Pursuing the objective of sustainable development of navigation infrastructure poses both challenges and opportunities for the US Army Corps of Engineers (USACE). Advancing best practices will involve identifying the practical actions that can be taken to better align and integrate engineering and natural systems to produce more socially acceptable, economically viable and environmentally sustainable projects. Engineering With Nature (EWN) is a USACE initiative that supports more sustainable practices, projects, and outcomes by working to *intentionally align natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes* (www.engineeringwithnature.org; Figure 1). The EWN initiative's focus on developing practical methods provides an achievable path toward an ecosystem approach to navigation infrastructure development and operations that is applicable across multiple USACE missions and business lines.

Above: Aerial photo of the wetlands at the Mississippi River Gulf Outlet taken in November 2013 as part of the Beneficial Use of Dredged Material Monitoring Programme.

Science, engineering and demonstration projects within the EWN initiative illustrate the use of:

1) science and engineering to produce operational efficiencies supporting sustainable delivery of project benefits;
2) natural processes to maximum benefit, thereby reducing demands on limited resources, minimising the environmental footprint of projects, and enhancing the quality of project benefits;
3) approaches that will broaden and extend the base of benefits provided by projects to include substantiated economic, social, and environmental benefits;
4) science-based collaborative processes to organise and focus interests, stakeholders, and partners to reduce social friction, resistance, and project delays while producing more broadly acceptable projects.

The objectives of EWN are consistent with those communicated in the Working with Nature (WwN) philosophy of the World

June 2014 issue of *Terra et Aqua*
Published by IADC

2013 EWN Action Demonstration Projects

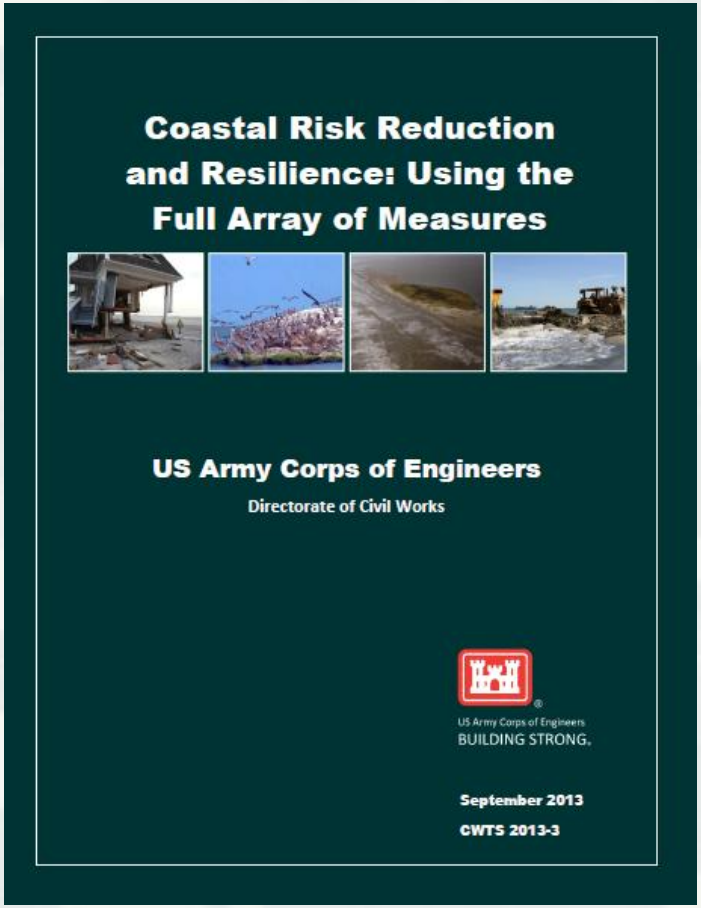
- Sediment Retention Engineering to Facilitate Wetland Development (San Francisco Bay, CA)
- Realizing a Triple Win in the Desert: Systems-level Engineering With Nature on the Rio Grande (Albuquerque, NM)
- Atchafalaya River Island and Wetlands Creation Through Strategic Sediment Placement (Morgan City, 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

2014 EWN Action Demonstration Projects

- 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)

Systems: Coastal Risk Reduction and Resilience

"The USACE planning approach supports an ***integrated approach*** *to reducing coastal risks and increasing human and ecosystem community resilience through a combination of* ***natural, nature-based, non-structural and structural measures****. This approach considers the engineering attributes of the component features and the dependencies and interactions among these features over both the short- and long-term. It also considers the* ***full range of environmental and social benefits*** *produced by the component 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

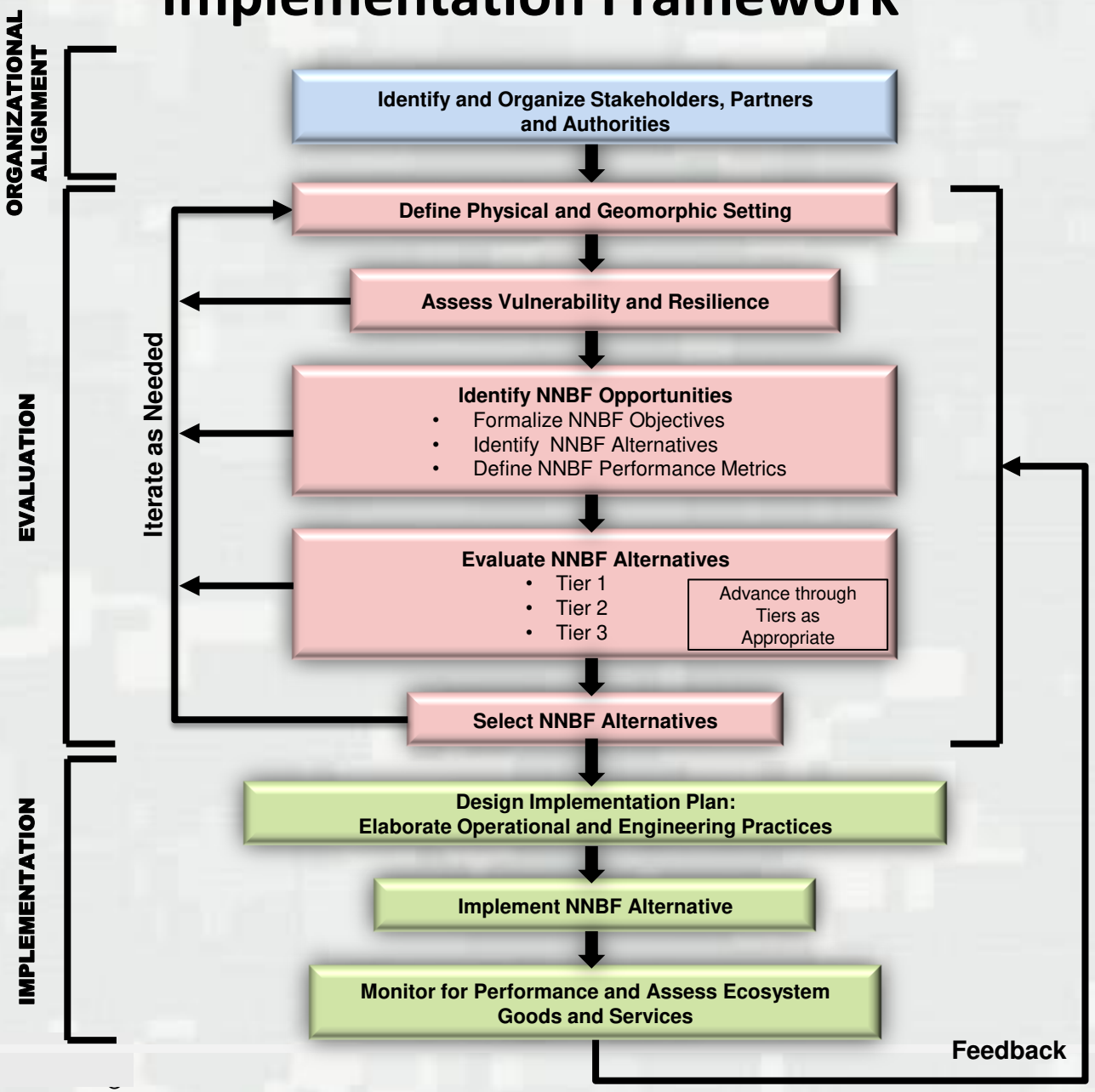
Vegetation height and density

Forest dimension

Sediment composition

Platform elevation

Natural and Nature-Based Features Evaluation and Implementation Framework

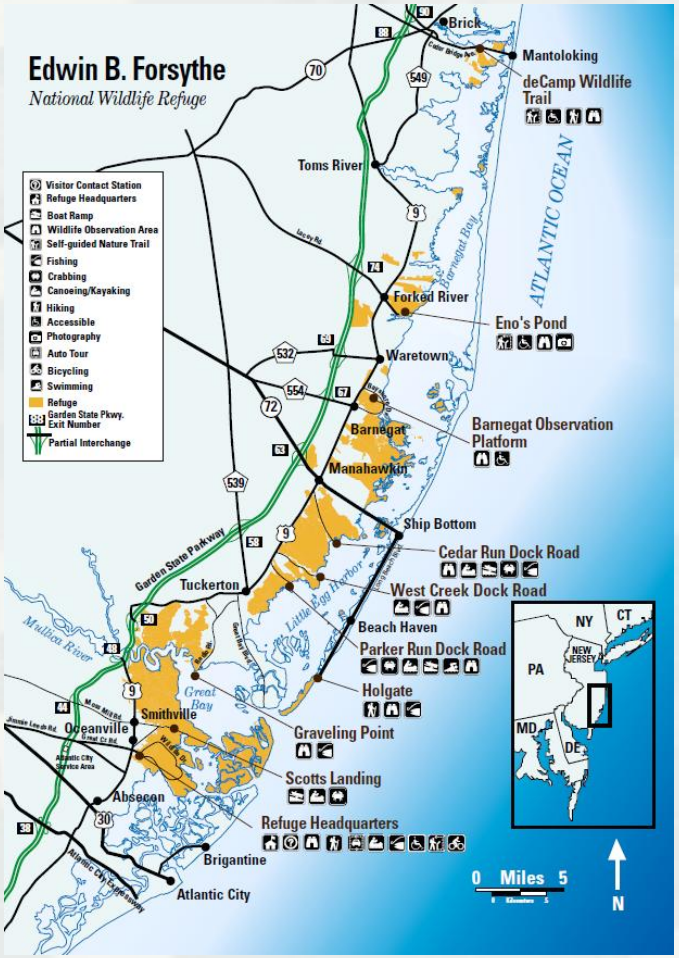


2013/2014 EWN-Sponsored Workshops

- Regional Sediment Management and Engineering With Nature Inland Working Meeting; 29 April – 1 May 2014; Omaha, NE
- Coastal Resilience: The Environment, Infrastructure and Human Systems; 21-23 May 2014; New Orleans, LA (partnered with USEPA and USDOE)
- Working with Nature in Navigating the New Millennium; 1 June 2014, San Francisco, CA (in association with the 33rd PIANC World Congress
- Flood Risk Management and Engineering With Nature Collaborative Meeting; 10-11 June 2014; Vicksburg, MS

Forsythe National Wildlife Refuge

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



District Collaboration

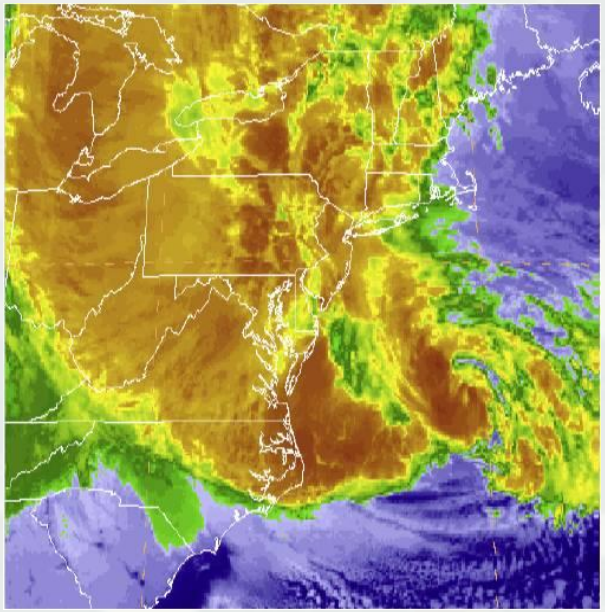
- Collaborating with NAP-Operations on using dredged material to increase the resilience of coastal NJ
- SWG to serve as a “proving ground” for district-wide integration of EWN principles and practices

Collaboration with USFWS on EWN and Endangered Species Act

- USACE spends $300M per year on ESA compliance
- Combining ESA 7(a)(1) authority with EWN presents opportunity to reduce time and cost, while increasing benefits for species conservation

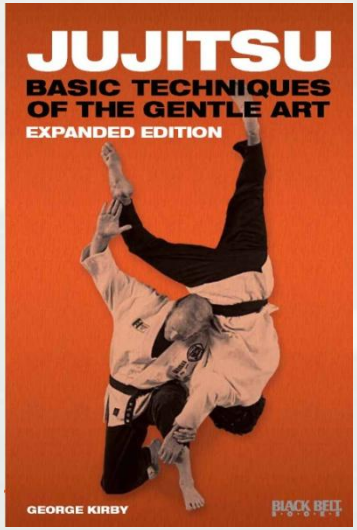
Engagement with NGOs

- National Wildlife Federation
  - Use of EWN for conservation and NNBF
- Environmental Defense Fund
  - Coastal resilience investment
- The Nature Conservancy
  - Science for Nature and People (SNAP)- Integrating Natural Defenses into Coastal Disaster Risk Reduction
- National Fish and Wildlife Foundation
  - "Building Ecological Solutions to Coastal Community Hazards"
    - Collaboration with NJDEP, NWF, USACE, Sustainable Jersey, NJ Sea Grant Consortium

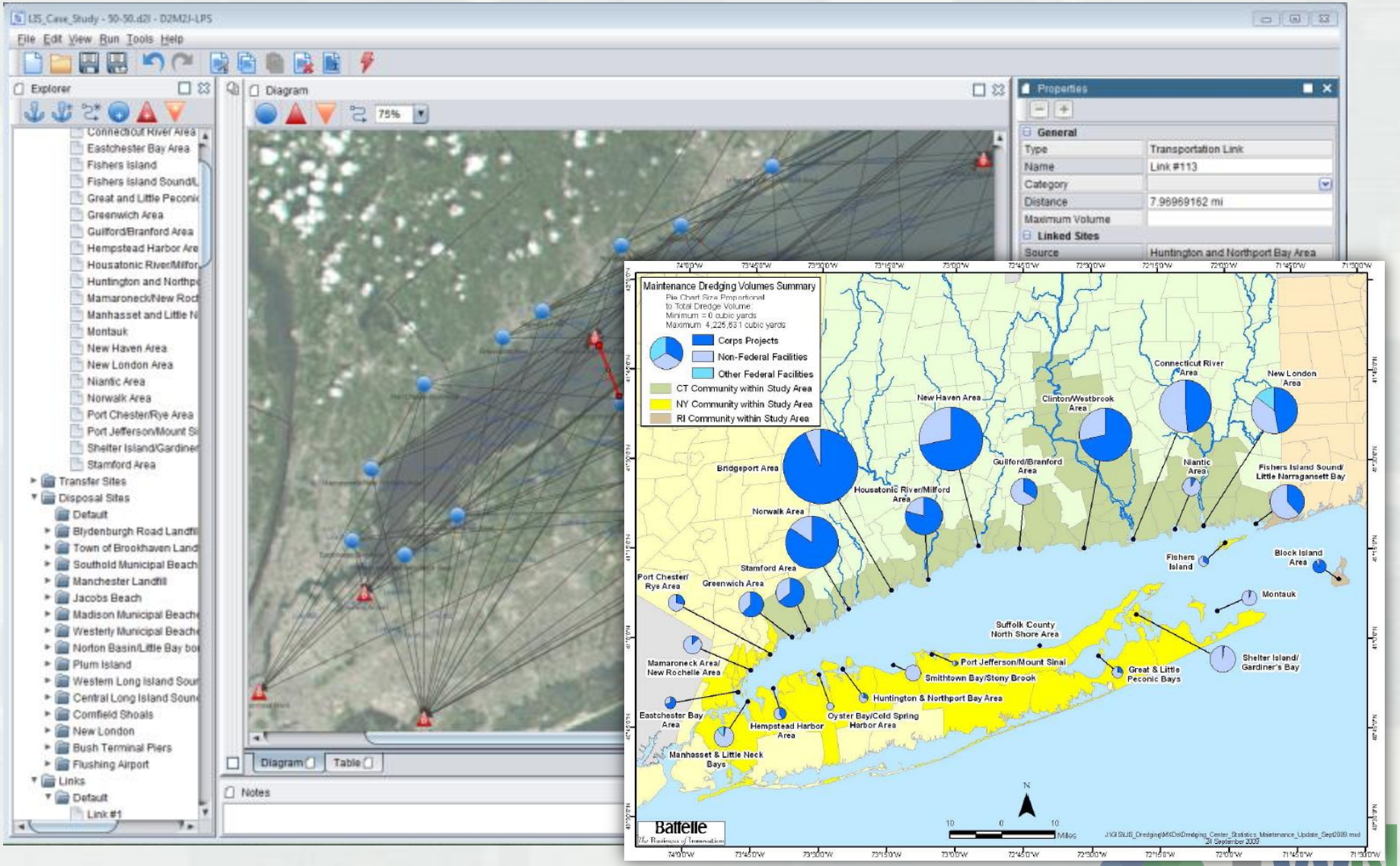


Considering EWN Opportunities

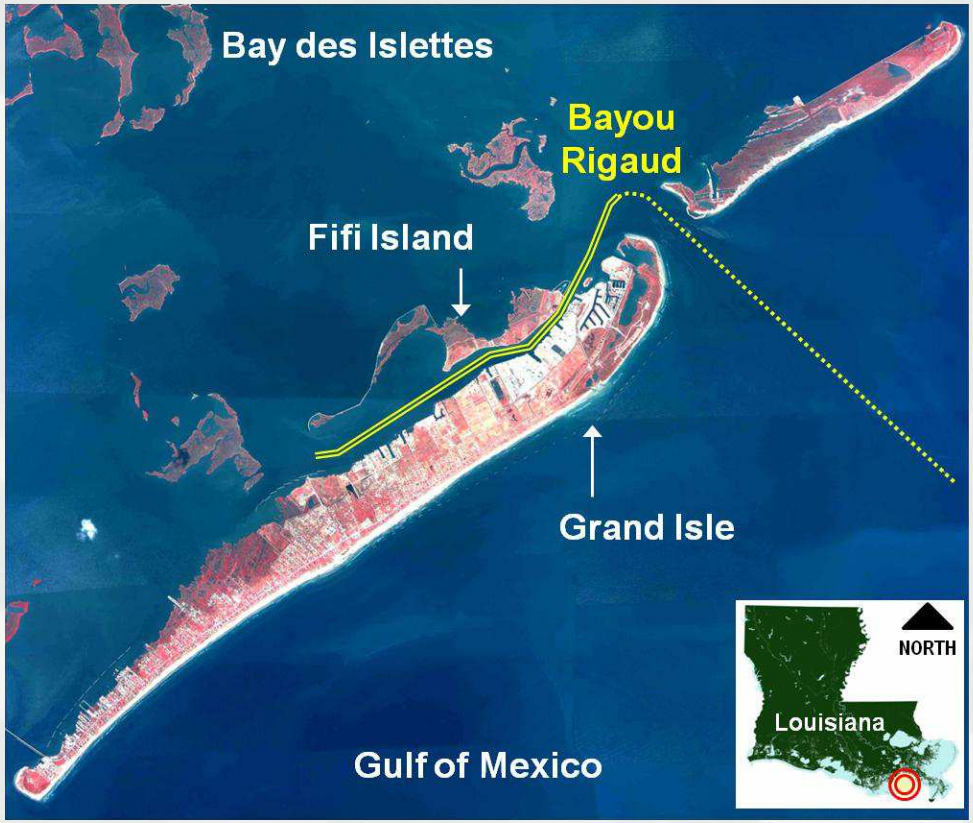
- **Key Factors, the 4 Ps**
  - Processes
    - Physics, geology, biology…
    - Foundation of “coastal engineering Jujitsu”
  - Programmatic context
    - Planning, engineering, constructing, operating, or regulating
  - Project scale
    - Individual property owner to an entire coastal system
  - Performance
    - Configuring the system
    - Quantifying the benefits



D2M2: Dredged Material Management Decisions



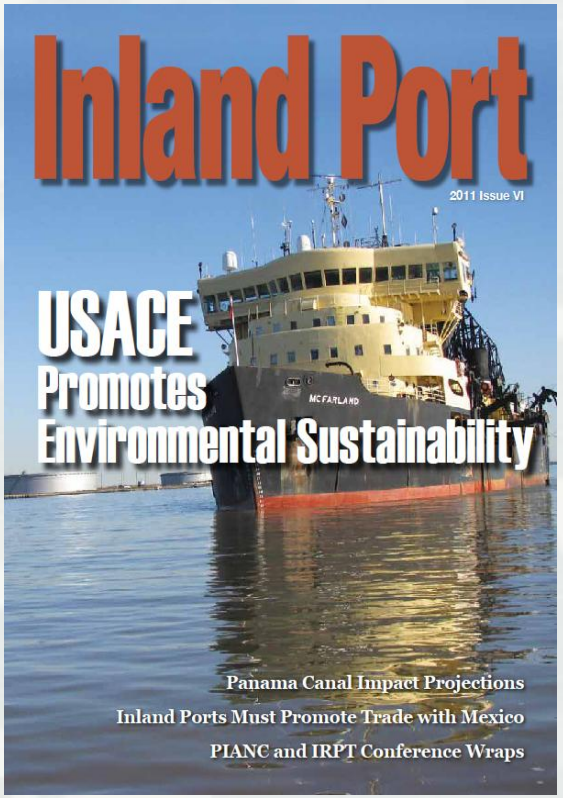
Example EWN Solutions



Bayou Rigaud, Louisiana

Expanding Opportunities

- Increasing communication about opportunities and successes
  - Across business lines within the Corps
  - Among partners and stakeholders
- Establishing basis for more fully sustainable practice



- Strategic communication about successes and lessons learned is key to reshaping culture

www.EngineeringWithNature.org
http://el.erdc.usace.army.mil/ewn

EWN