

# Engineering With Nature



**Dr. Todd S. Bridges**

**Senior Research Scientist, Environmental Science  
Engineer Research and Development Center**

**EWN & Water Operations**

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**[todd.s.bridges@usace.army.mil](mailto:todd.s.bridges@usace.army.mil)**

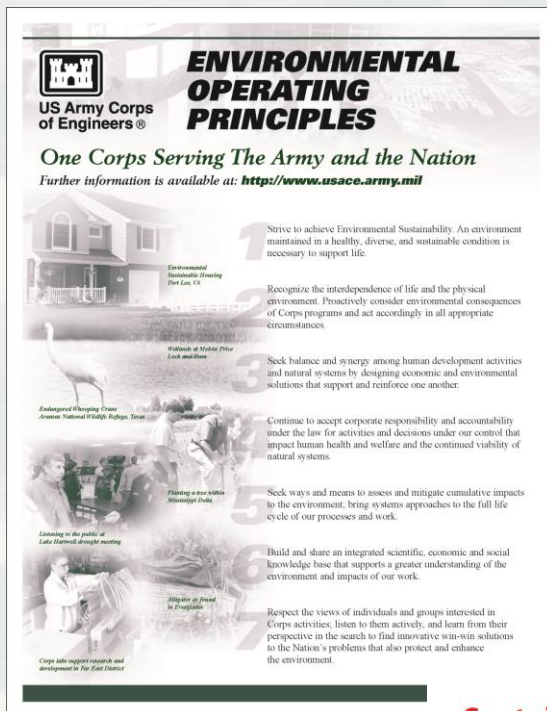


®

**US Army Corps of Engineers  
BUILDING STRONG®**



# Advancing USACE Practice



## Goals:

- More efficient, cost effective engineering and operational practices.
- More collaboration and cooperation, less unproductive conflict.
- Sustainable projects. Triple-win outcomes integrating social, environmental and economic objectives.

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



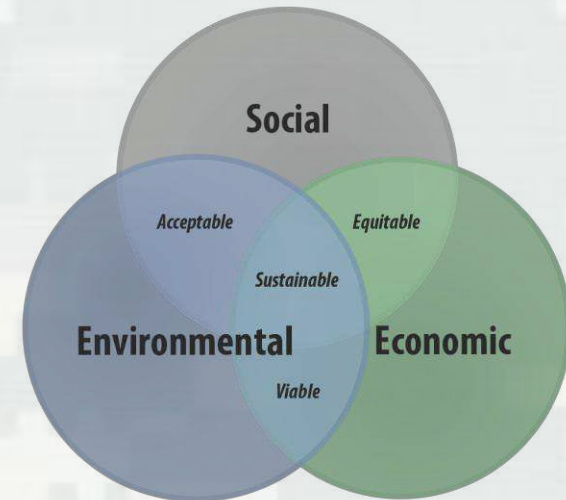
# Engineering With Nature...



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

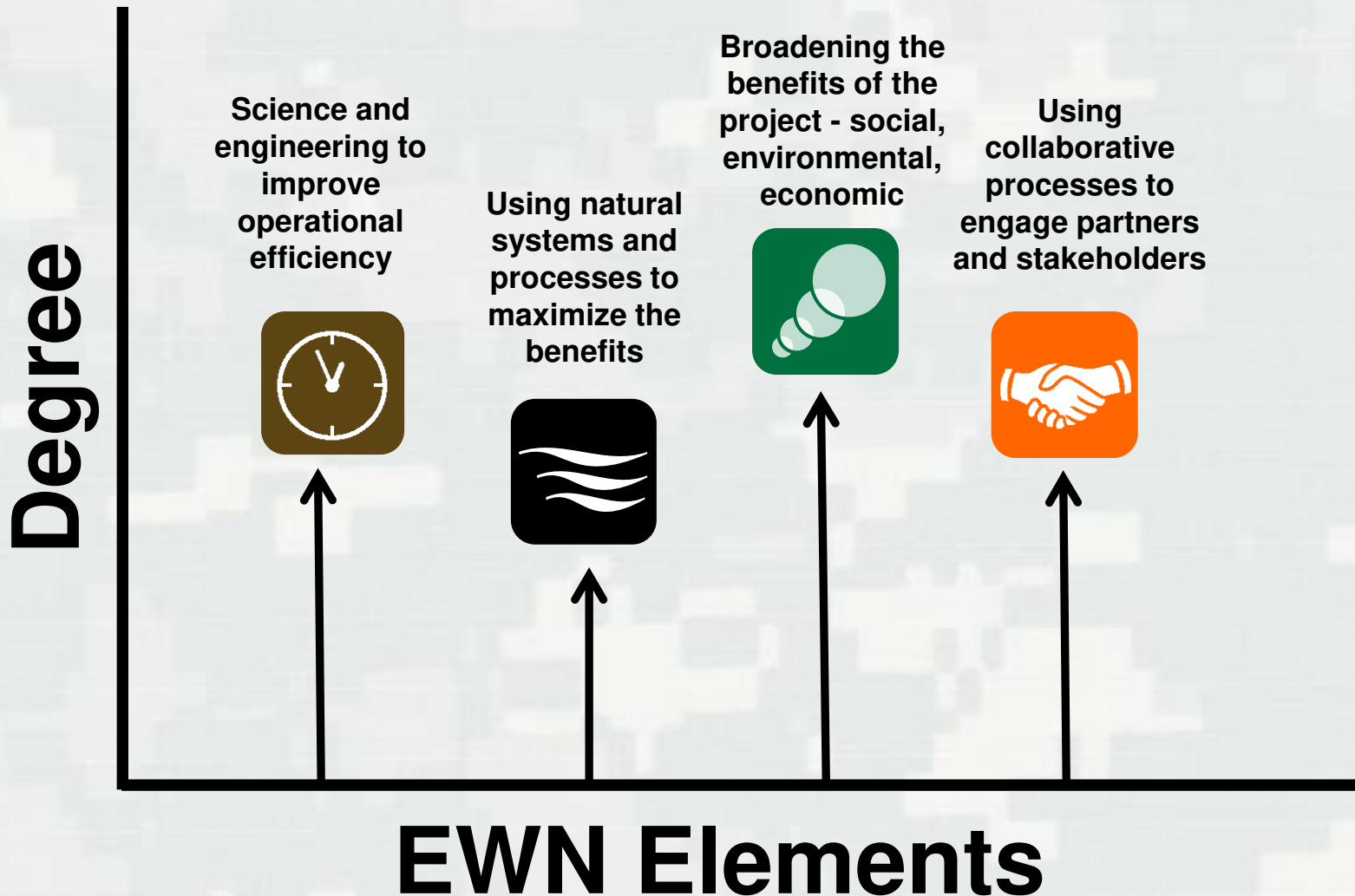
## Key Elements:

- 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

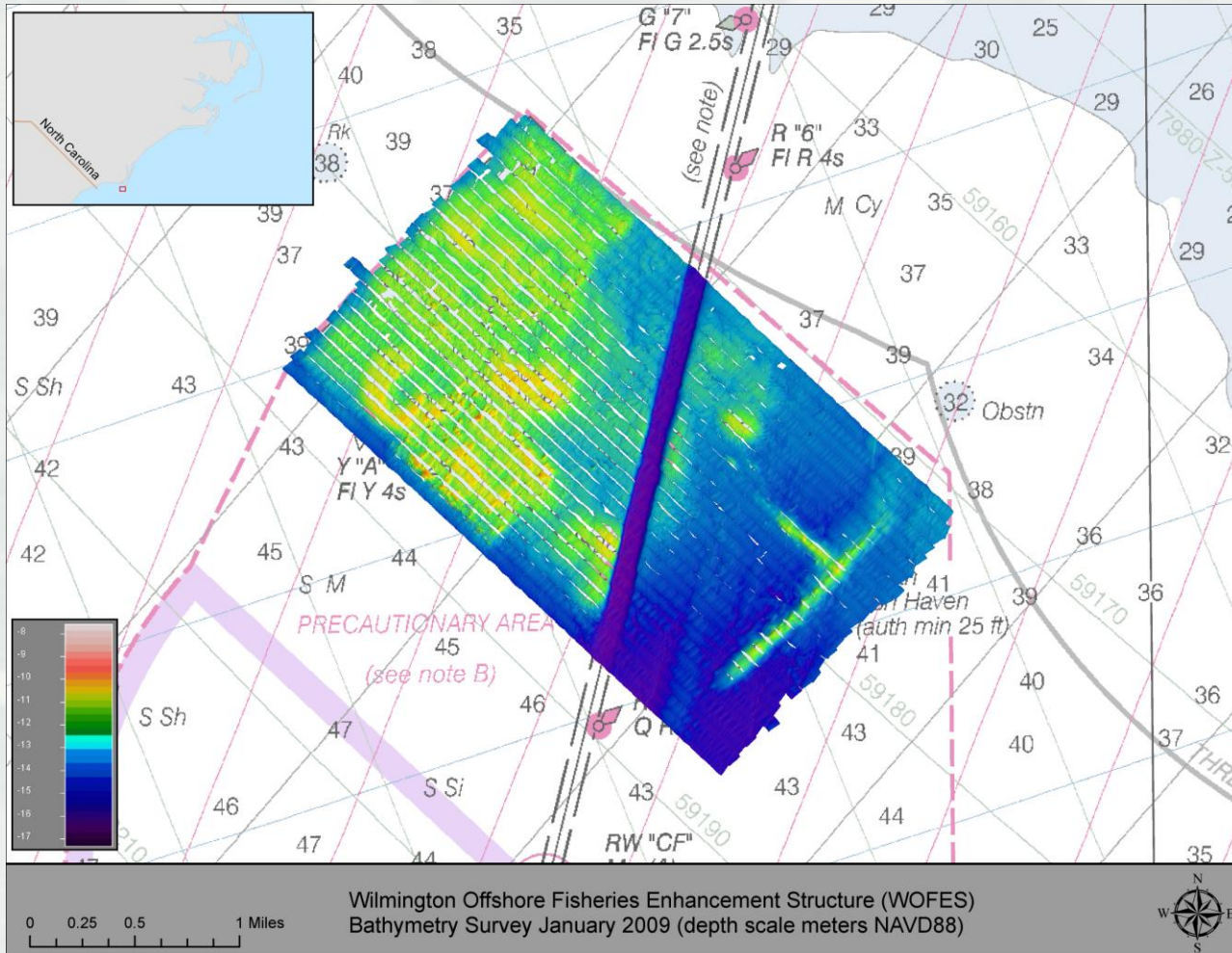




# *Engineering With Nature* Elements



# Example EWN Solutions



## Wilmington Offshore Fisheries Enhancement Structure



# Example EWN Solutions

## Ashtabula Breakwater Tern Habitat

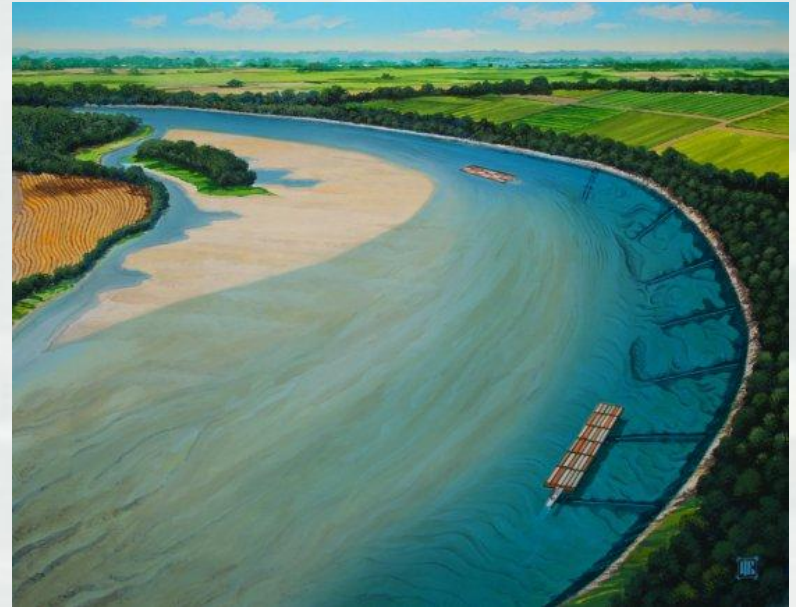




# Example EWN Solutions

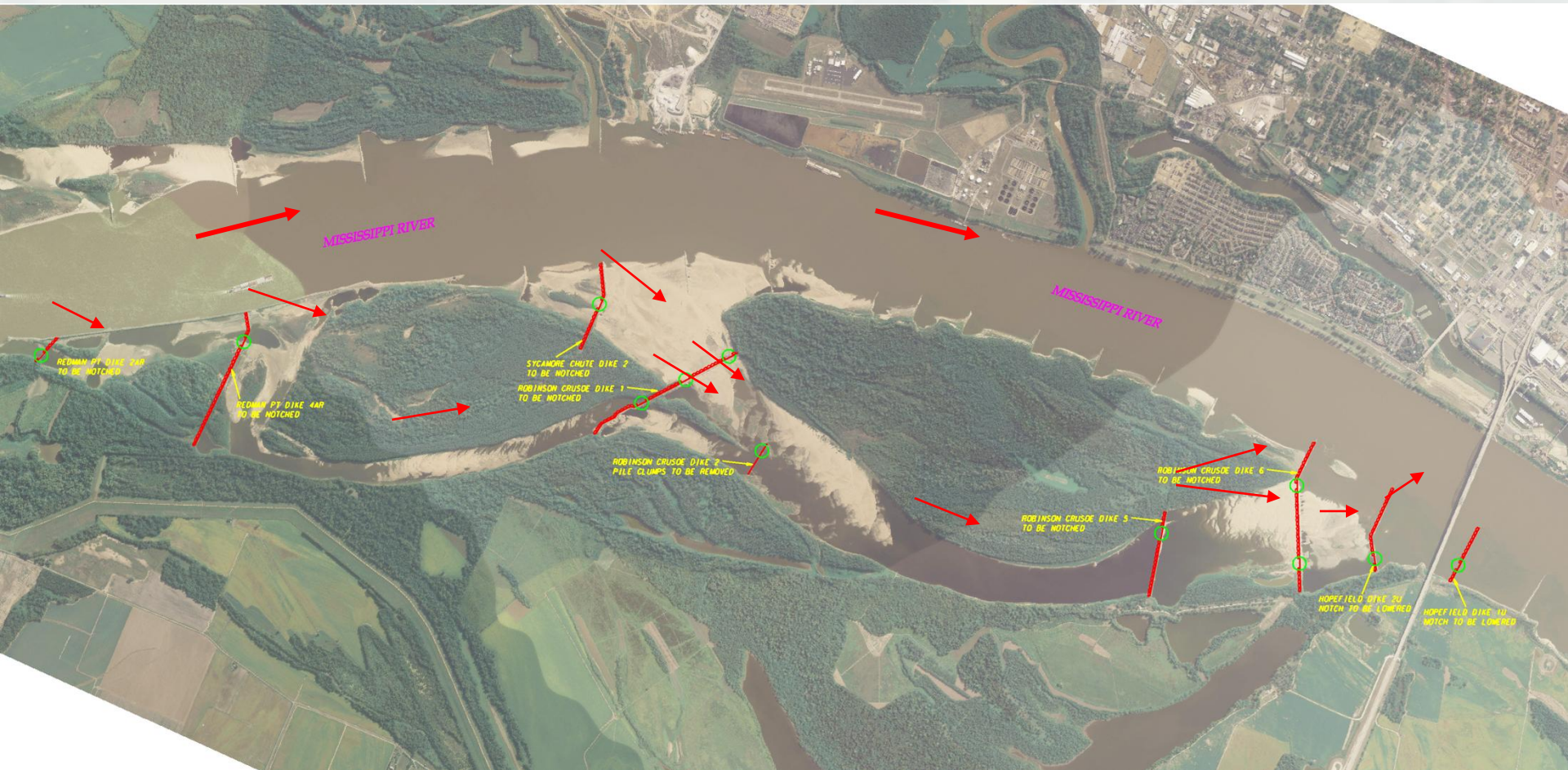


**Upper Mississippi River Training  
Structures: Chevrons**



**River Bendway Weirs**

# Example EWN Solutions

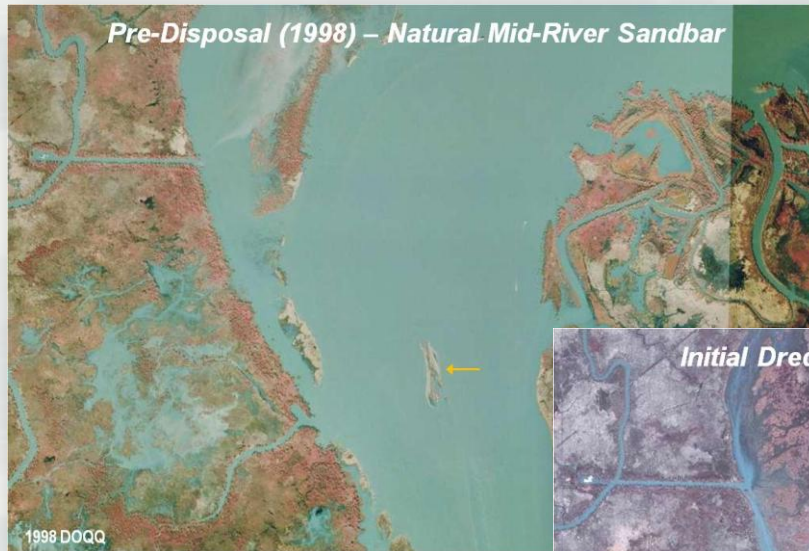


Loosahatchie Bar  
Aquatic Habitat Rehabilitation

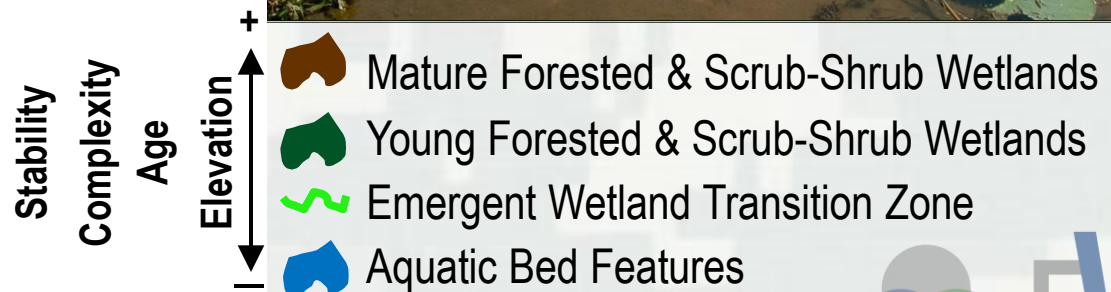
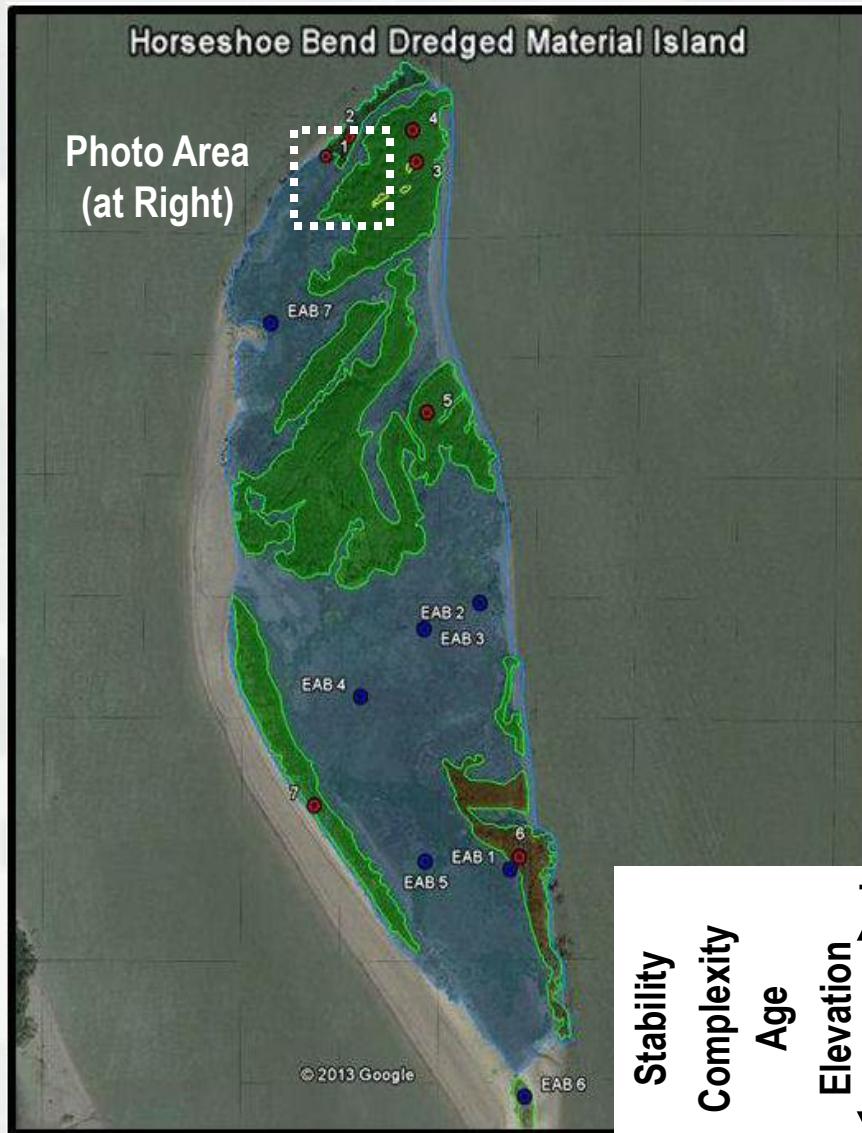




# Atchafalaya River, Horseshoe Bend



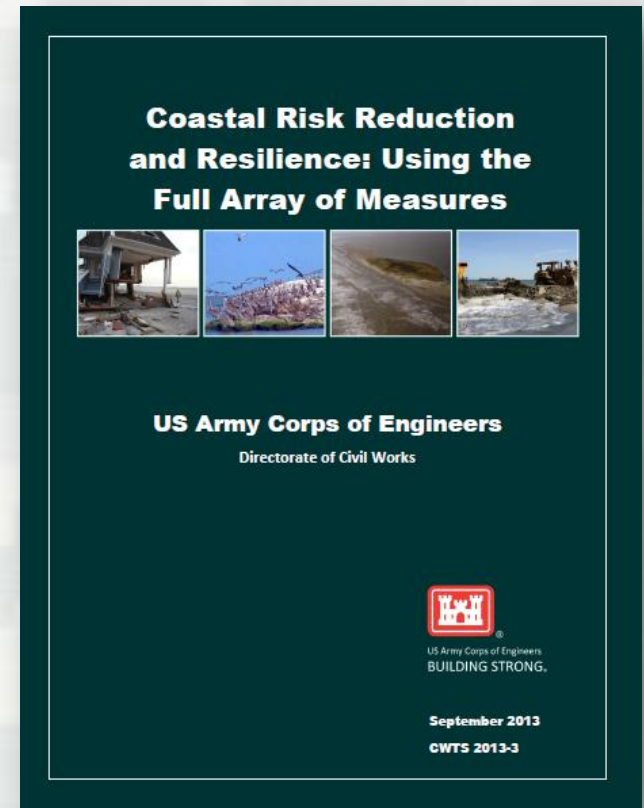
# Habitat Classification





# 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

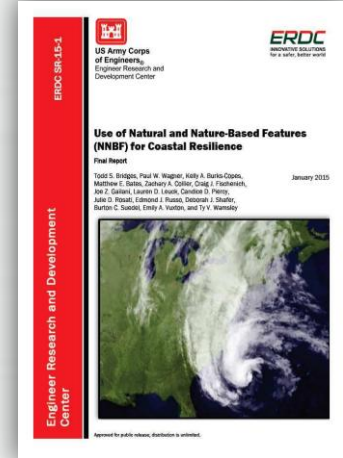
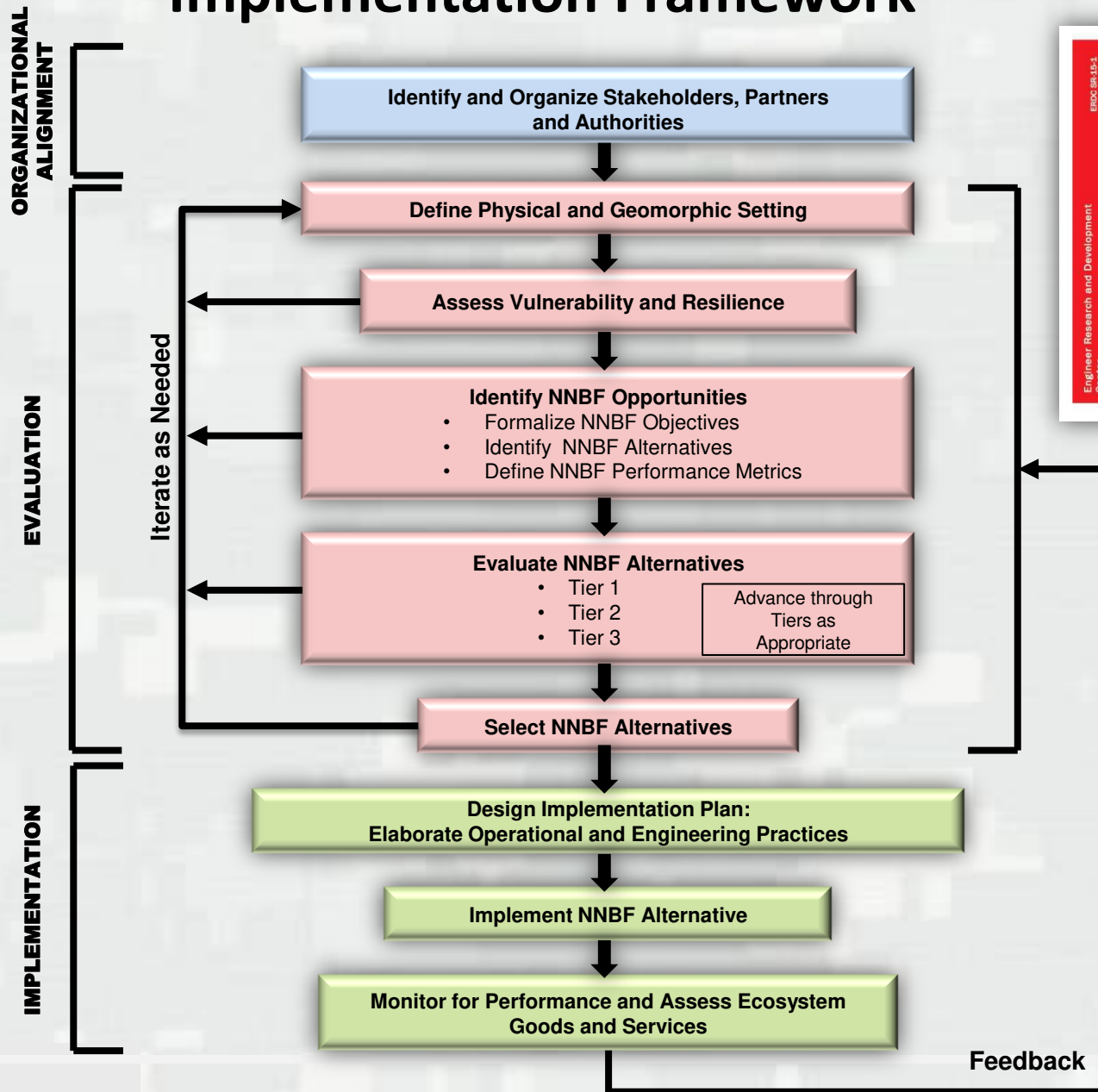
Wave attenuation and/or dissipation  
Shoreline erosion stabilization  
Soil retention

#### Performance Factors

Vegetation height and density  
Forest dimension  
Sediment composition  
Platform elevation

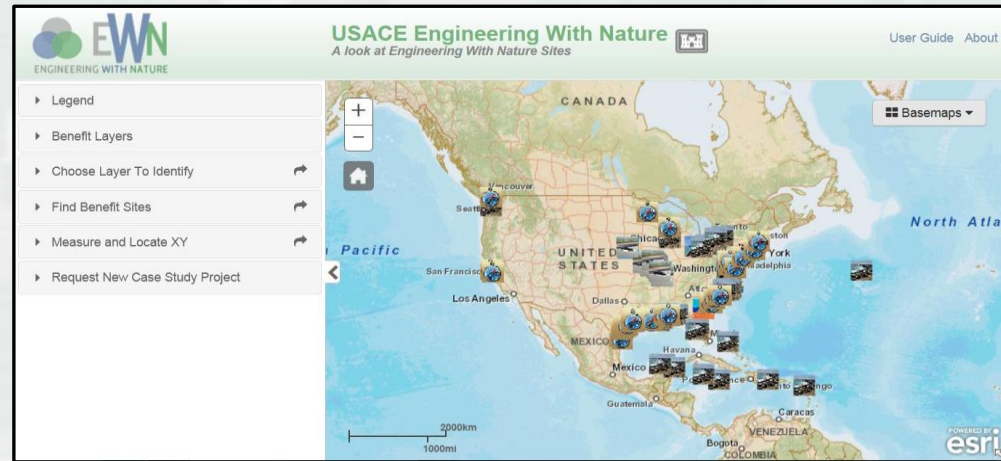


# Natural and Nature-Based Features Evaluation and Implementation Framework



# EWN Project Mapping Tool (EWN ProMap)

- Online GIS database of projects illustrating EWN principles and practices
  - ▶ Illustrating the key elements of EWN
- Currently contains ~175 projects
  - ▶ Name
  - ▶ Manager/Owner
  - ▶ Description
  - ▶ Infrastructure association e.g., jetty, breakwater, channel
  - ▶ Benefits e.g., fish habitat, bird habitat, recreation
  - ▶ Links, reports, photos
- Designed to facilitate communication about opportunities, lessons learned, and good practices
- Projects examples can be added through a process of self-nomination and independent evaluation



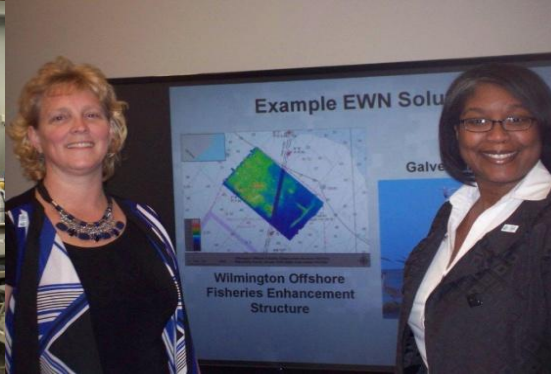
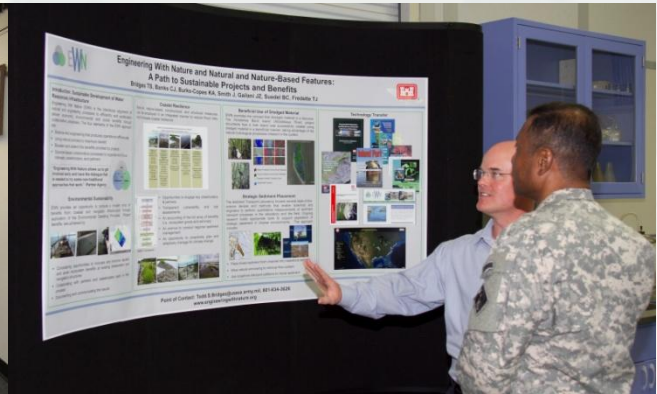


# EWN Status

- *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

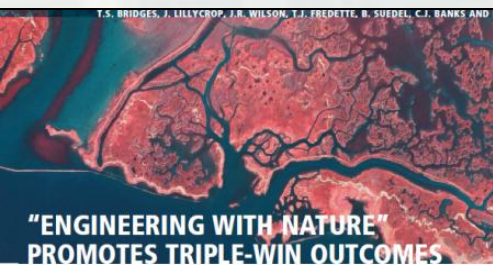
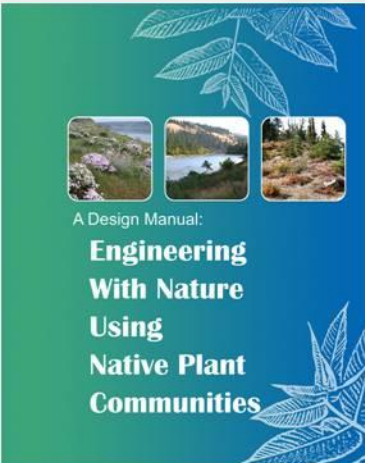


# Engagement





# Publications and Recognition



## ABSTRACT

The U.S. 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 benefitably integrate engineering and natural systems to produce more socially acceptable, economically viable, and environmentally sustainable projects.

## INTRODUCTION

Pursuing the objective of sustainable development of navigation infrastructure poses both challenges and opportunities for the U.S. 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 processes 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 (see engineeringwithnature.org). The objectives of EWN are consistent with those communicated in the World Nature (WN) philosophy of the

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## Technical Articles

Dedicated to the USA, Host Country of PIANC's AGA 2014 and the 33<sup>rd</sup> PIANC World Congress

## ERDC environmental research supports USACE

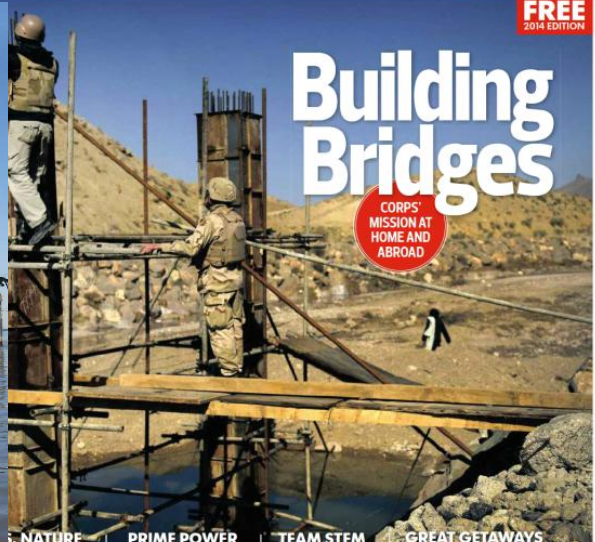
By Dr. Beth Fleming, Director, Environmental Laboratory, U.S. Army Engineer Research and Development Center (ERDC). The U.S. Army Engineer Research and Development Center (ERDC) Environmental Laboratory (EL) scientists and engineers work to develop sustainable solutions to the nation's old and military environmental challenges. Researchers understand that solutions developed for old world challenges can be leveraged to solve military challenges and vice versa. This interdisciplinary approach allows EL to focus on durable results for customers that balance social, economic and environmental factors as part of a sustainable solution.

ERDC's scientific expertise in environmental research and risk and decision processes is unique within the Army and Department of Defense. We are committed to sharing the application of these capabilities in a relevant way and demonstrating the environmental impact, risk, benefits and sustainability of new technologies and materials in all of our work initiatives. These work initiatives are the focus of this column. Environmental Life Cycle Assessment (ELCA) is an early initiative that will provide a comprehensive view of the environmental impacts from the development, production, use and disposal of Army materials and products. Green Remediation Technologies (GRT) is an initiative in the prototype phase that focuses on reducing the migration of hazardous materials, and provides a new way

of looking at existing activities such as dredging. This initiative, while in its introductory stages, is already proving valuable to both the old world and military missions communities. The U.S. Army Corps of Engineers, through its design-related activities, is responsible for the placement of approximately 200 million cubic yards of dredged material at an annual cost of more than \$1.2 billion. EL is introducing an ELCA approach into the dredged material management plan process as a way to understand and consistently compare alternatives by quantifying associated environmental impacts, benefits, human health and resource consumption. In the placement of dredged material, the cycle assessment includes the environmental impacts of extracting raw materials from the earth, the production of equipment and materials needed to handle and transport dredged material and associated placement sites, and the ongoing process to produce the final needed and the subsequent final construction. Life cycle assessment can also quantify the ecosystem benefits associated with creating new habitat through dredged material placement, allowing more consistent inclusion in the decision process. The payoffs of this important effort, the Army Environmental Life Cycle Material for Acquisition and Costing, or ALCMA, include a scientifically defensible approach for determining the environmental risk increased confidence in anticipating product and technology impact with respect to environmental regulatory requirements when testing, introducing Army facility and improved soldier safety, and enhanced sustainability of current and future military technologies.



Beth Fleming



# USACE *Engineering With Nature* Across USACE

- Collaborating with NAP, LRE, SPN, MVN, on using sediment to enhance coastal resilience
- SWG and LRB serving as “proving grounds” for district-wide integration of EWN principles and practices





# 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

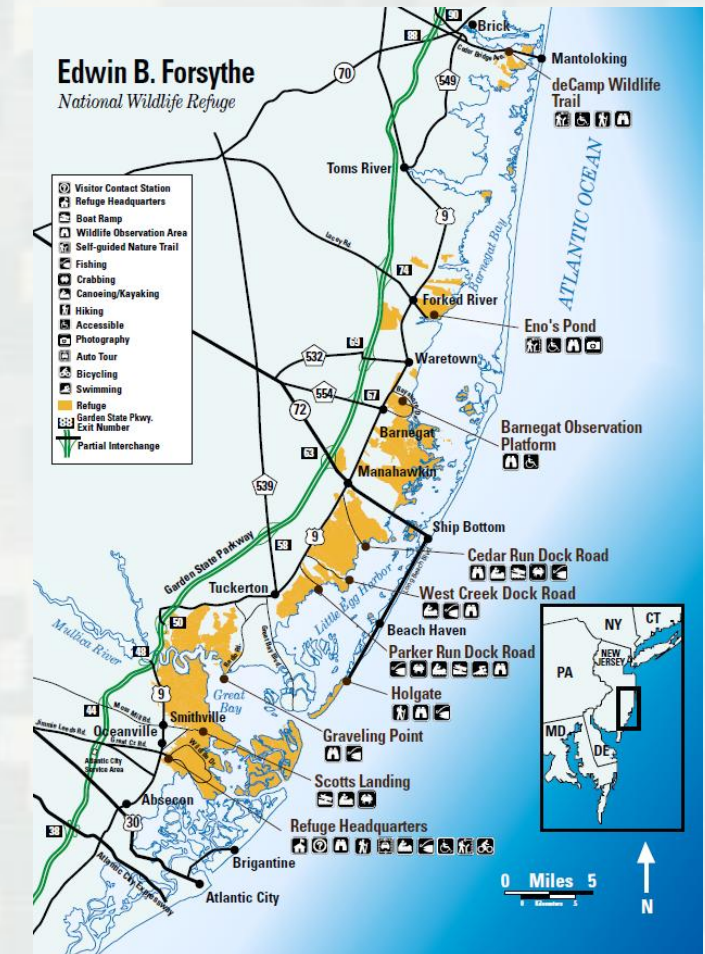
- Landscape Evolution of the Oil Spill Mitigation Sand Berm in the Chandeleur Islands, Louisiana
- Guidelines for Planning, Design, Placement and Maintenance of Large Wood in Rivers: Restoring Process and Function (Collaboration with BoR)
- The Use and Value of Levee Setbacks in Support of Flood Risk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





# 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



# 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



[www.engineeringwithnature.org](http://www.engineeringwithnature.org)



# 2014/2015 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 33<sup>rd</sup> PIANC World Congress)
- Flood Risk Management and Engineering With Nature Collaborative Meeting; 10-11 June 2014; Vicksburg, MS
- EWN in Water Operations; 31 March – 1 April 2015; Vicksburg, MS





# Creating Value by Engineering With Nature

- Value arguments resonate
  - ▶ Must take assertive control of the dialogue
- Correcting the hyper-focus on risk is achieved by giving more attention to compensating benefits
  - ▶ ...Not by giving more attention to risk
- There are potentially valuable allies in “unlikely” places
- Our projects have the potential to produce multiple benefit streams, but you have to claim them!

