Engineering With Nature

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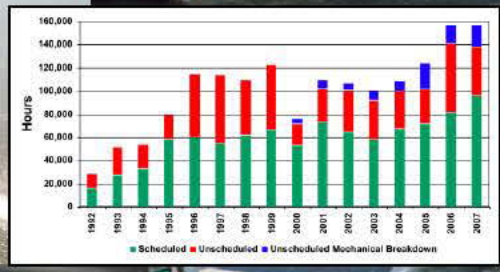


US Army Corps of Engineers
BUILDING STRONG®

The Challenge:
The *Status Quo is Not An Option*

The need:

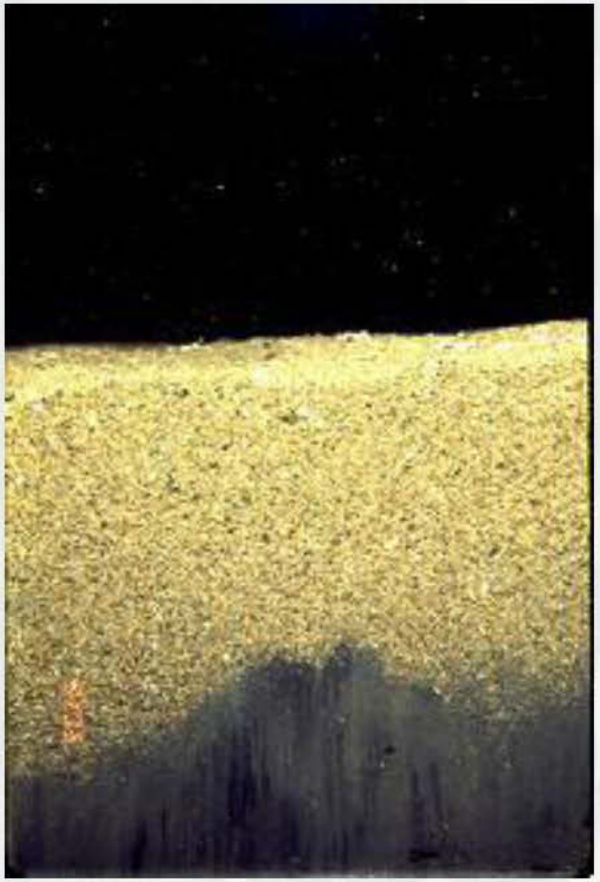
- Efficient, cost effective engineering and operational practices
- More collaboration and cooperation with our partners and stakeholders.
  - Ports, commercial interests, regulators, NGOs, and others
- Sustainable projects. Triple-win outcomes integrating social, environmental and economic objectives.

What is an empty aluminum can?

Resource

Waste

What is sediment?



What is sediment?

"Sediment is an essential component of freshwater, estuarine, and marine ecosystems. Sediment processes play important roles in determining the structures and functions of aquatic systems. Therefore, management processes applied to sediment, in relation to human activities, should recognize that sediment is an important natural resource."

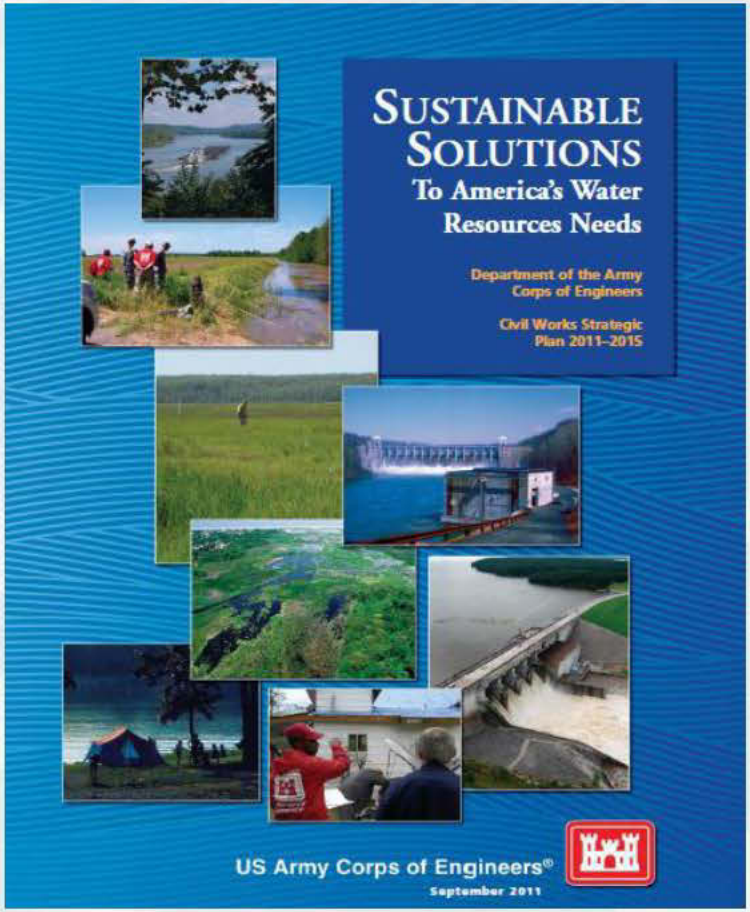
Paragraph 1, Updated "Specific Guidelines for the Assessment of Dredged Material" under the London Convention

The USACE Civil Works Strategic Plan

Sustainable Solutions to America's Water Resources Needs

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

- The goals established by this strategy are to:
  - Assist in providing for safe and resilient communities and infrastructure.
  - Help facilitate commercial navigation in an environmentally and economically sustainable fashion.
  - Restore degraded aquatic ecosystems and prevent future environmental losses.
  - Implement effective, reliable, and adaptive life-cycle performance management of infrastructure.
  - Build and sustain a high quality, highly dedicated workforce.

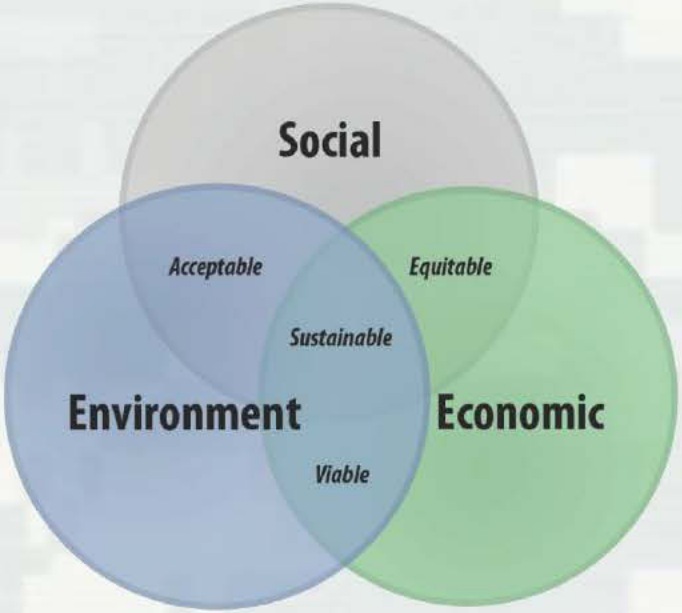


Engineering With Nature…

…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



EWN, A Systems View

- EWN- An *ecosystem approach* to infrastructure development and operations
  - A true integration of activities across the landscape
  - Applied across missions and business lines
  - Expanding environmental benefits and services provided by infrastructure

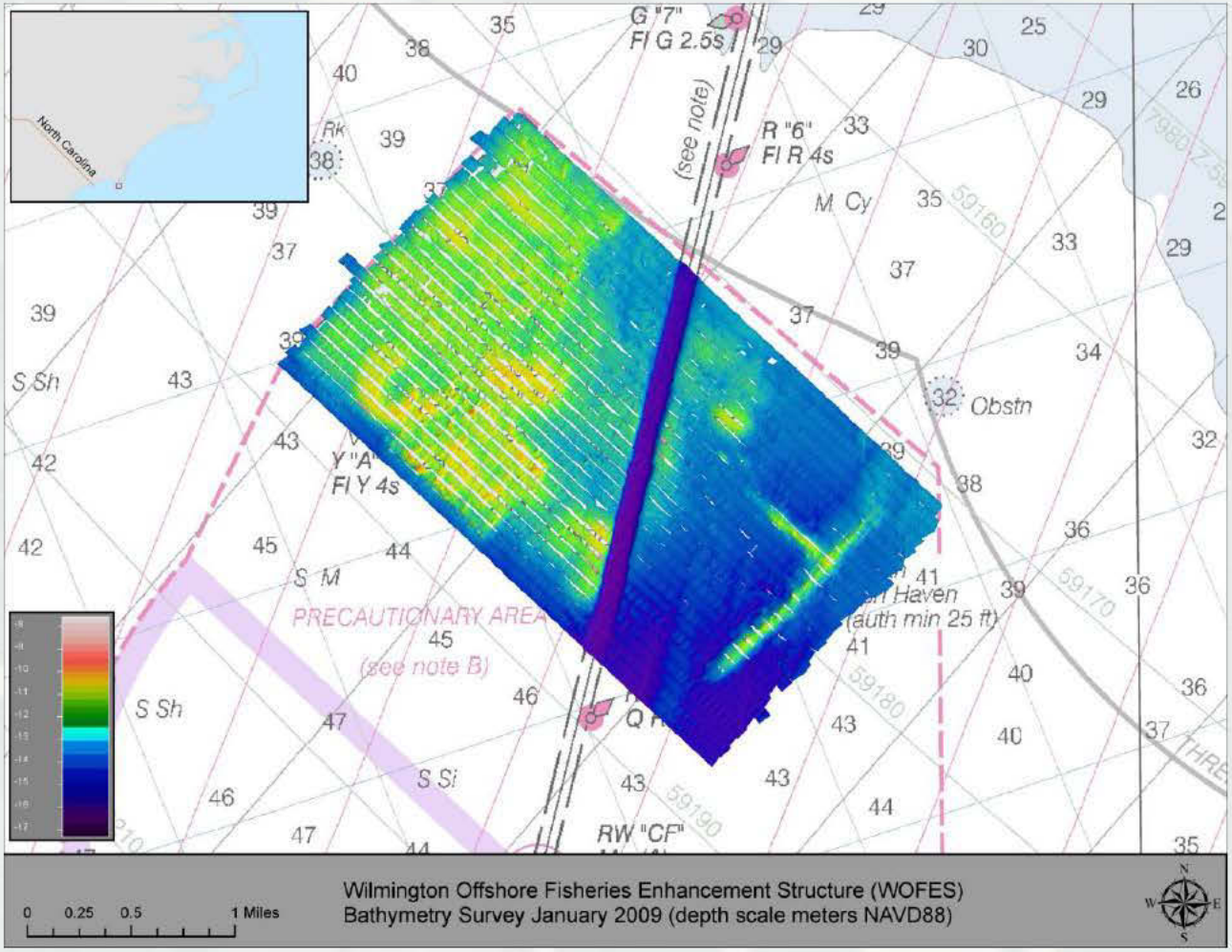
Example EWN Solutions

Upper Mississippi River Training Structures: Chevrons

River Bendway Weirs

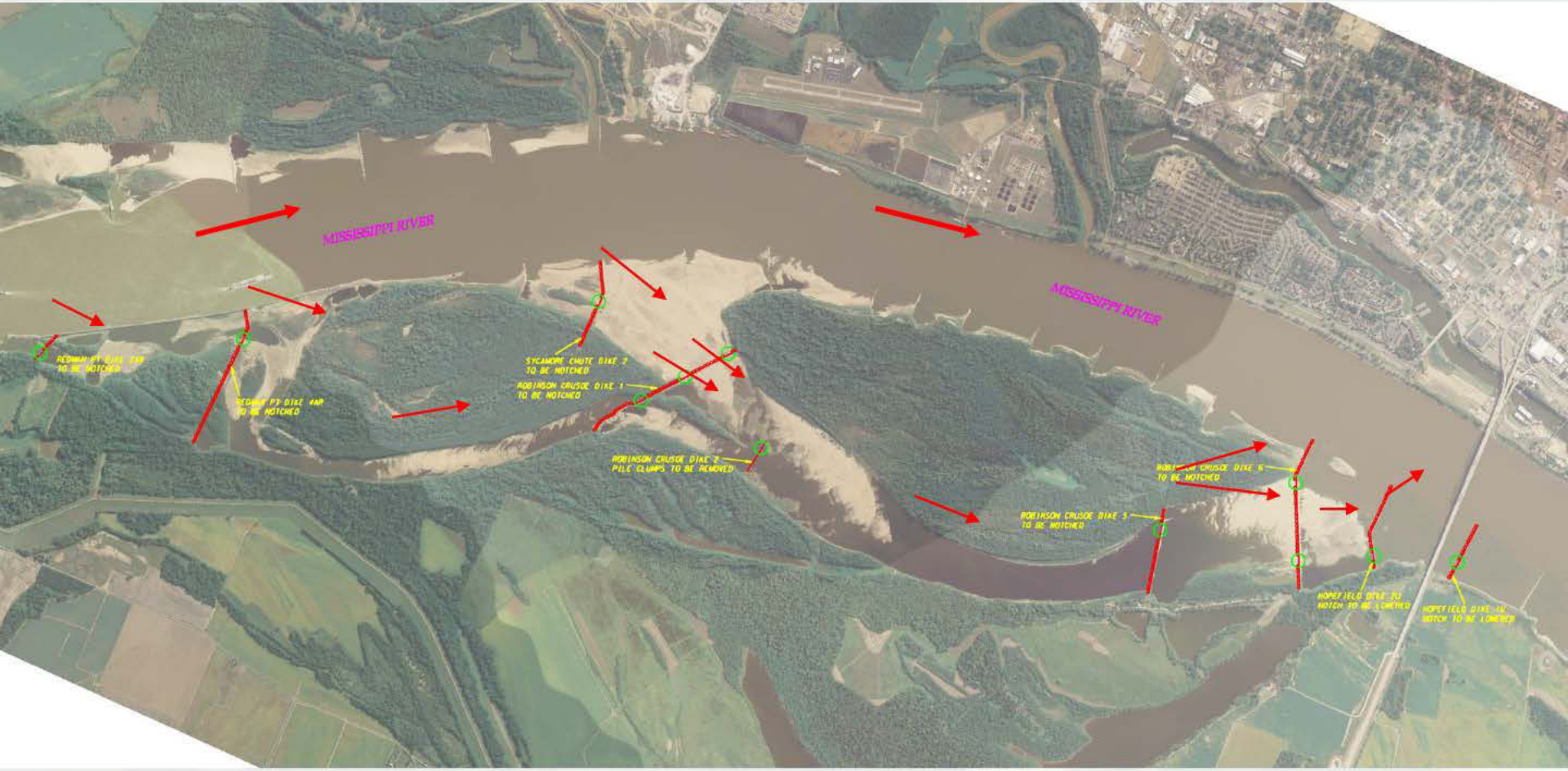
Environmentally Enhanced Breakwater Toe Blocks

Example EWN Solutions



Wilmington Offshore Fisheries Enhancement Structure

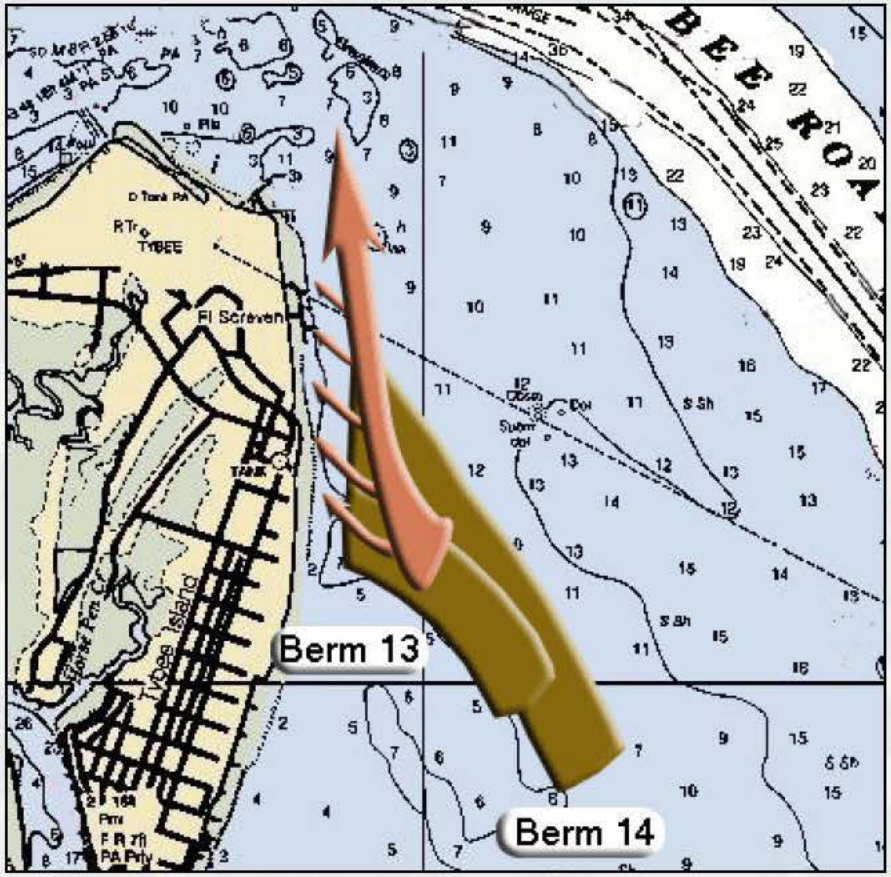
Example EWN Solutions



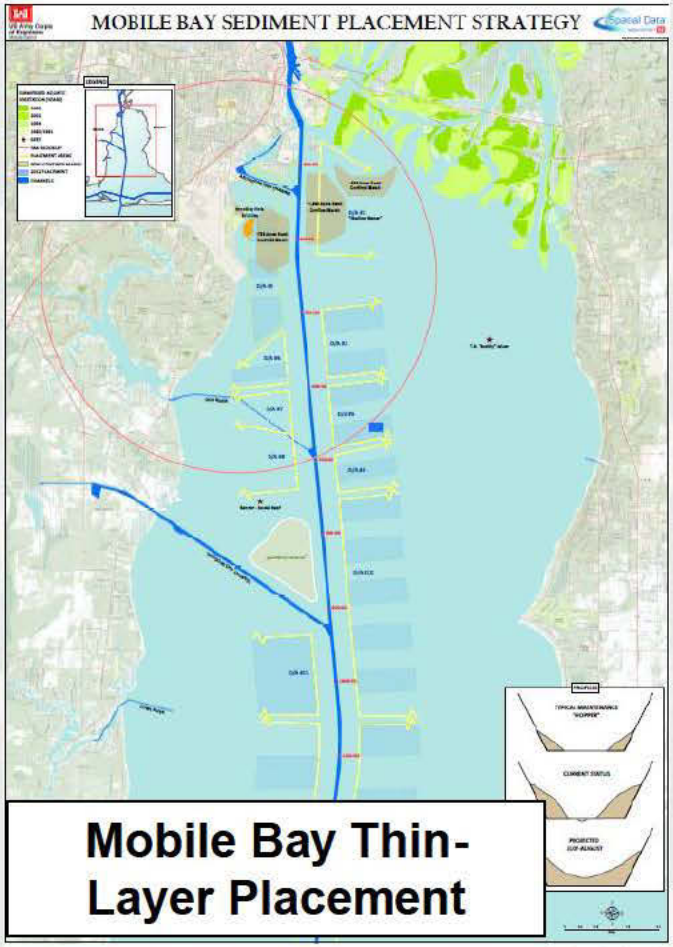
Loosahatchie Bar
Aquatic Habitat Rehabilitation

Example EWN Solutions

Strategic Sediment Placement



North Tybee Island
Savannah, Georgia



Mobile Bay Thin-Layer Placement

Example EWN Solutions

Upper Missouri River Sandbar Habitat

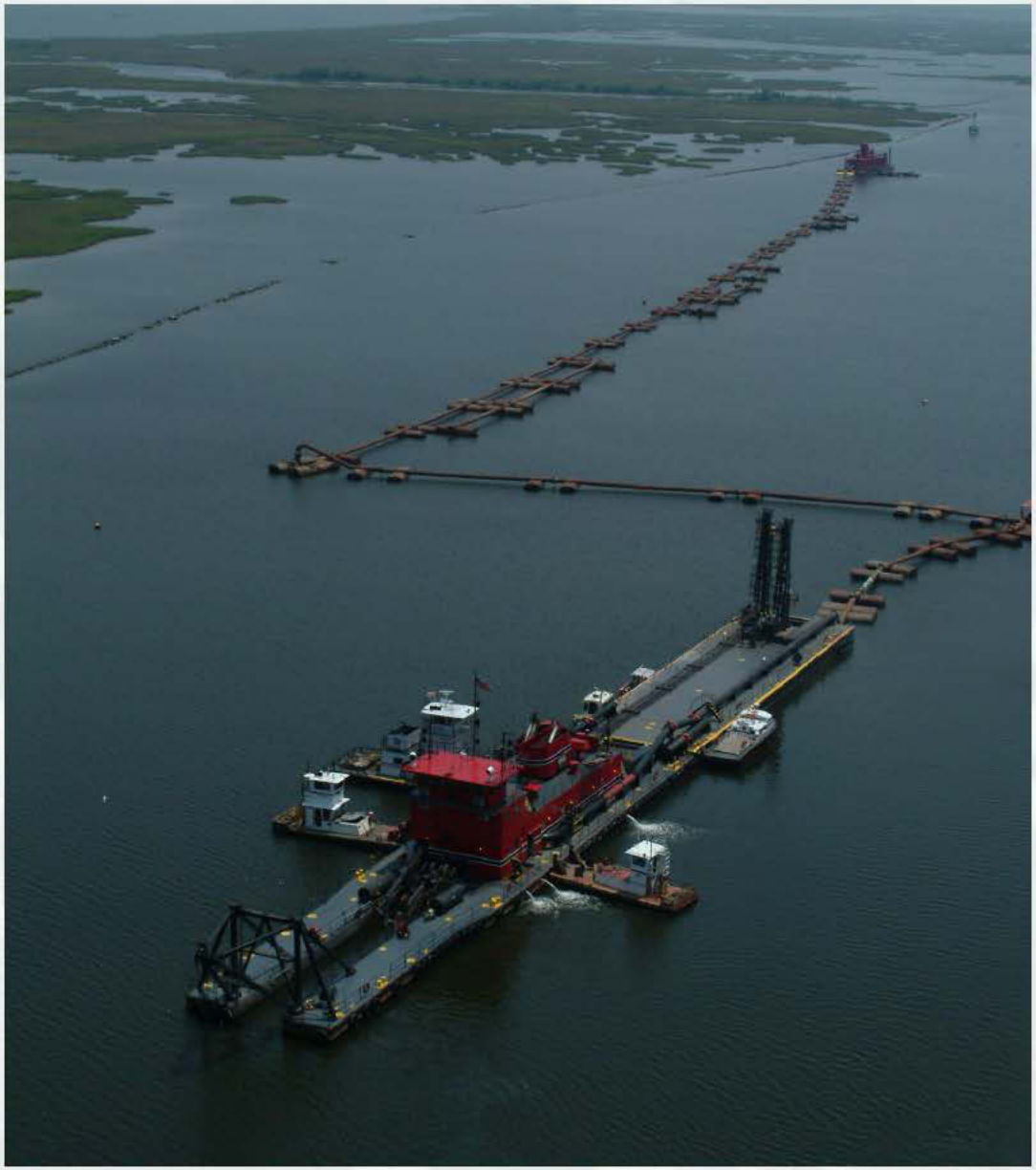
- $25 Million to construct 650 acres of sandbar
- Buried under 16,000 acres, 2011 flood

July 2009

November 2011

Courtesy: G. Pavelka
COE, 2012

Example EWN Solutions

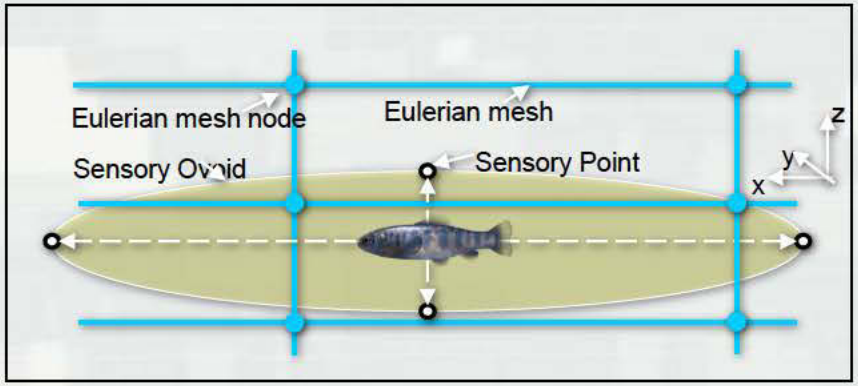


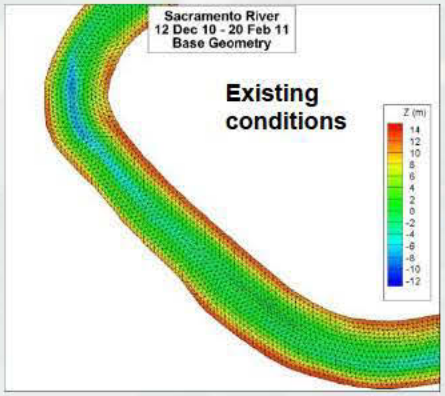
Long-distance pumping of dredged material for wetlands creation in coastal Louisiana, USA

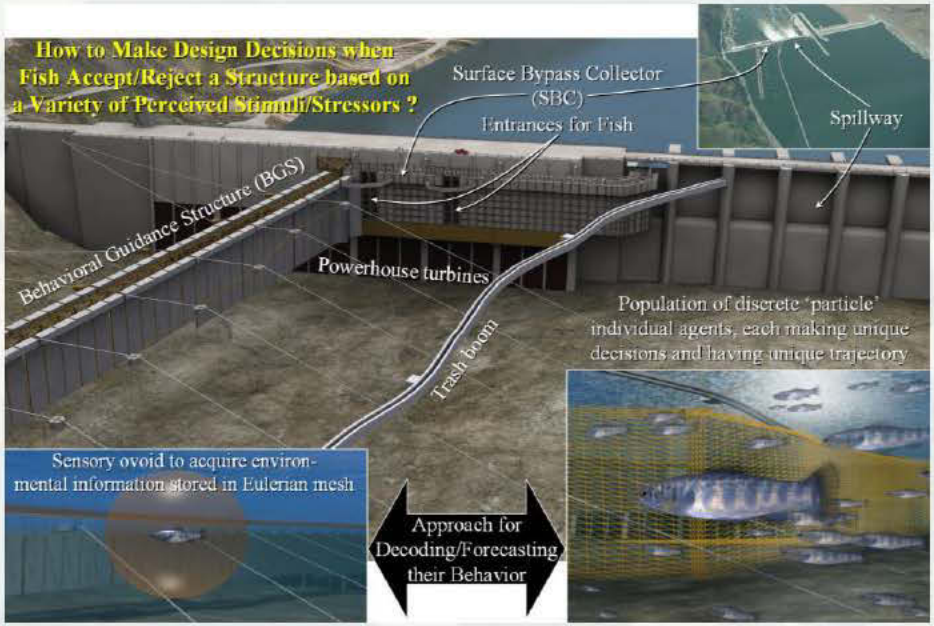
- ***How to marry LDC with natural transport processes to expand opportunities?***

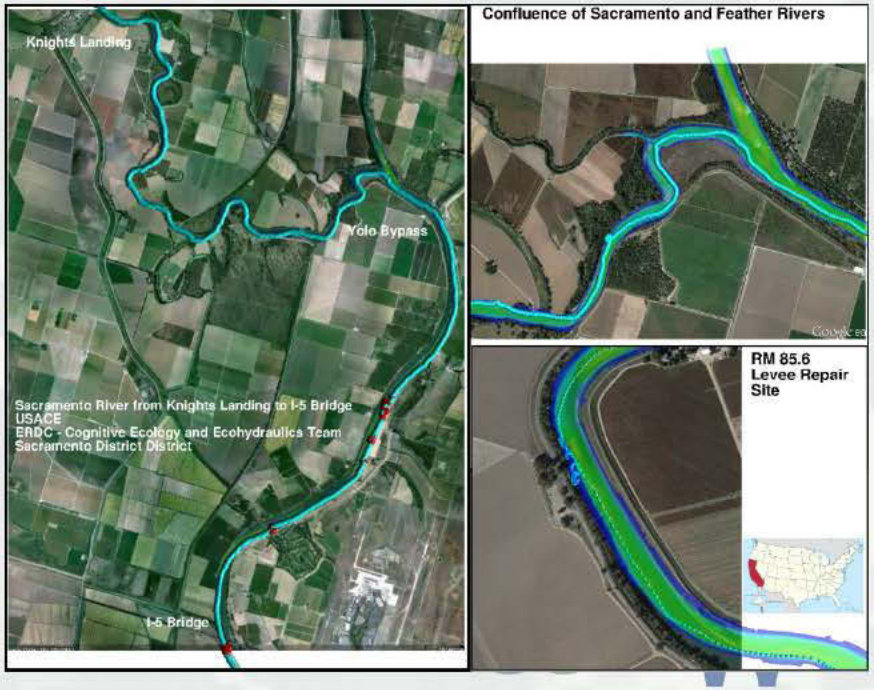
Example EWN Solutions

Fish Modeling in the Columbia and Sacramento Rivers









EWN for Coastal Resilience

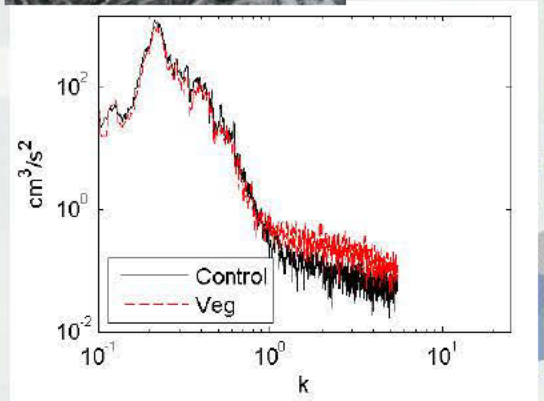
DOER-EMRRP research collaboration to improve the efficiency of engineering and operational practices, expand and extend project benefits, and improve the resilience and sustainability of coastal systems under climate change.

Field Research Activities:

- Wetland primary productivity
- Sediment processes
  - Cohesive sediment settling
  - Sediment resuspension
  - Marsh platform erosion

Laboratory Analyses:

- Transport in vegetation
- Wave energy transformation



Integrated Climate Change and Threatened Bird Population Modeling to Mitigate Operations Risks on Florida Military Installations

Sponsor: SERDP **PDT: EL, UF, Stony Brook Univ., Eglin AFB**

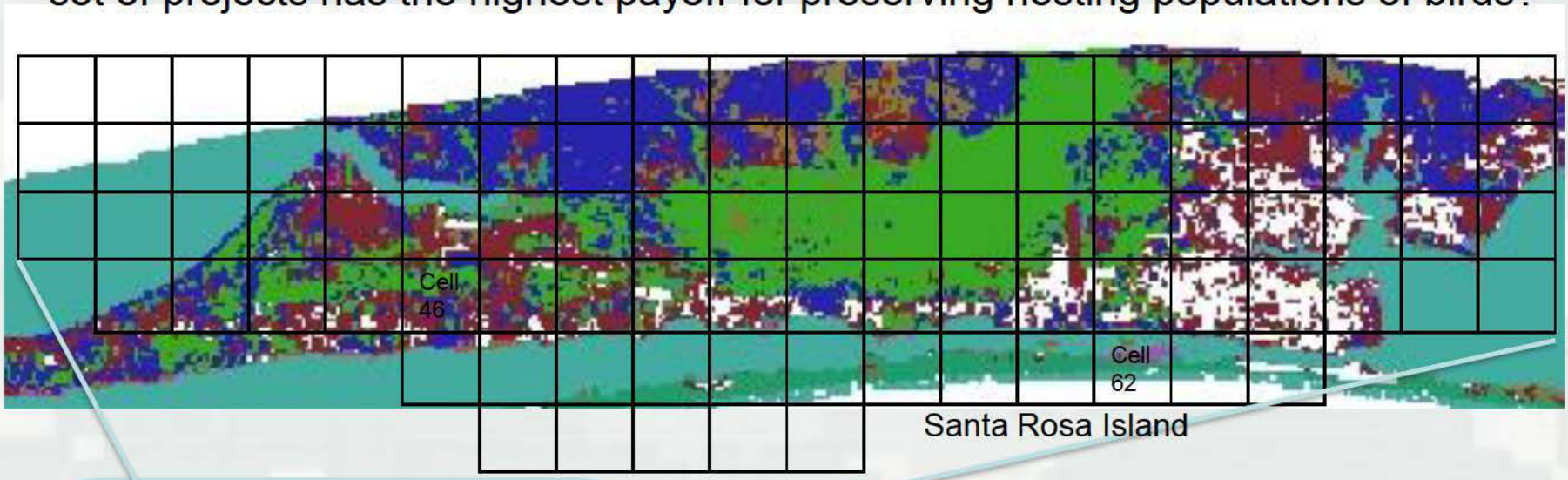
- Purpose/Objective
  - Integrate climate, land use and ecosystem information into a systematic tool set to:
    - Assess vulnerability for Eglin AFB
    - Develop habitat models for coastal TES birds
    - Create risk-informed, decision model for management options

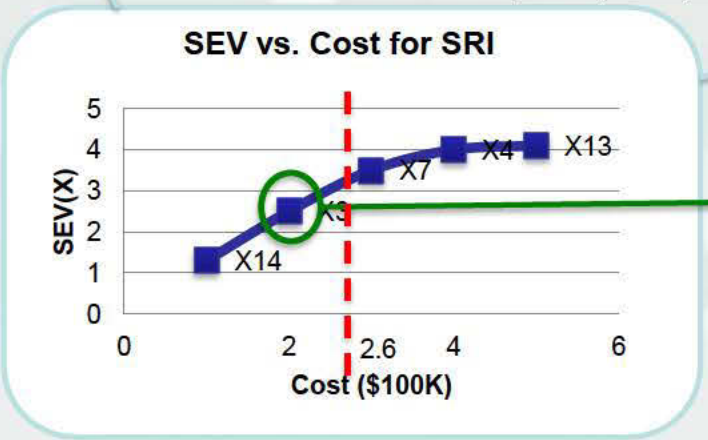
- Solution/Approach/Tools
  - Ecological, Physical and Climate Database Development
  - Habitat Suitability Modeling / Species Distribution Modeling
  - Habitat Model with SLAMM
  - Multi Criteria Decision Analysis for Management Alternatives

- Outcomes/Results/Products
  - Decision analysis framework for evaluating environmental management options at military installation (Eglin AFB)
  - Integrated modeling framework (CC> hydrologic>ecological>management)
  - Published papers and presentations

Best Alternative Set for Given Resources

Example: Given military training needs and a fixed budget for conservation, what set of projects has the highest payoff for preserving nesting populations of birds?





Best Alternative Set for SRI = Set X_3

X_3
- Cell 46: Monitor PP, Create EP for SP, etc…
- Cell 62: Do nothing RK, Do nothing SP, etc …
- Cell XYZ: Create EP for SP and PP, etc…

EWN Status

- *Engineering With Nature* initiative was started by USACE Navigation program in 2010. Over that period we have:
  - Engaged > 200 ind. across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
    - Workshops (9), dialogue sessions, project development teams, etc.
  - Developed a strategic plan for the initiative
  - Initiated research to support the intent of EWN
  - Implementing our communication plan

Implementation Strategy
Engineering With Nature

- Over the next 5-7 years, we will implement Engineering With Nature across USACE through a strategy comprising four interrelated waves of activity:
  - **Wave I:** Build a Base of Support 2011 – 2013
  - **Wave II:** Focus R&D Investments 2011 – 2018
  - **Wave III:** Demonstrate EWN 2013 – 2018
  - **Wave IV:** Establish USACE Leadership 2015 – 2018

Wave 1

Build a Base of Support

- Concentrate efforts on building a base of support within USACE, while beginning to engage key external stakeholders.
  - Steering team established to guide the EWN initiative. Twice annual workshops; ongoing collaboration.
  - Identification of and outreach to early adopters – internal and external.
  - Presentations, engagement, outreach to gain support for EWN within the water infrastructure community.
  - Mental models research with key internal and external stakeholders to further refine and develop plans, including the Collaborative Framework.
  - Next: Development of a Collaborative Framework for EWN integrating behavioral and communications sciences with engineering and natural sciences. Purpose: to gain insight from and build support and commitment of early adopters in key partner agencies and key stakeholder organizations.

Mental Modeling Approach

- The Mental Modeling Approach has been used effectively in many applications, including organizational transformation, to develop robust solutions that incorporate the values, beliefs and priorities of stakeholders. It is ideally suited to opportunities where:
  - Multiple stakeholders are or should be involved;
  - Disparate viewpoints must be elicited and synthesized;
  - Decisions are required among multiple potential options with a significant degree of consequence; and
  - Transparency is required when characterizing the opportunity, incorporating stakeholder input, and designing appropriate solutions;
  - The results must be sustainable.

EWN Internal and External Research

MM Research Summary

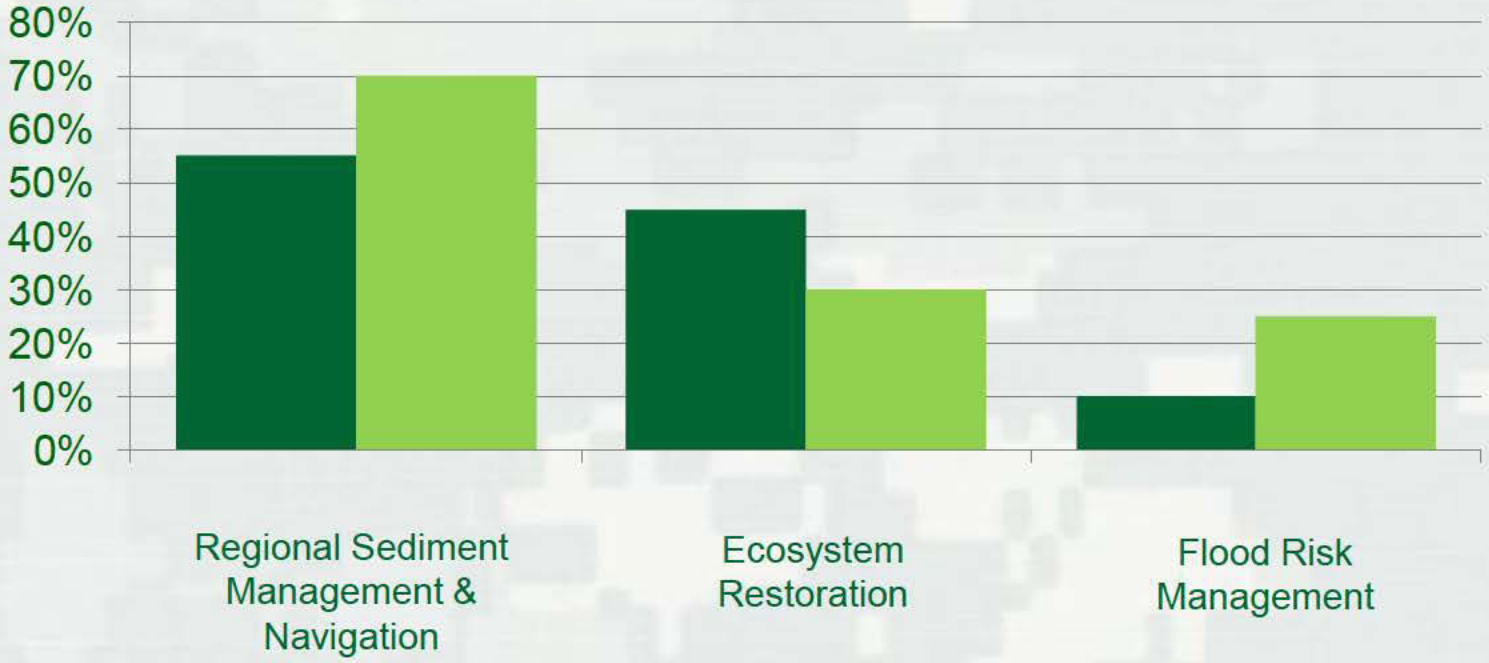
- Interviews with 22 internal USACE stakeholders represented a diverse population across specialty areas and geography were conducted in July and August of 2012, averaging 56 minutes:
  - Specialty Areas: Senior Leadership, Research, Navigation, Flood Risk Management, Operations and Regulatory, Coastal, Planning, Environment, Water Resources
  - Geographical Areas: Washington DC, Mississippi, Florida, New York, Massachusetts, Texas, Oregon, Alabama, New Jersey, South Carolina, Nebraska
- Interviews with 34 external stakeholders again represented a diverse population of stakeholder types and geographical areas were conducted in October and November 2012, averaging 37 minutes:
  - Stakeholder Types: Academia, Federal Government Agencies, State Government Agencies, Non-Governmental Organizations, Private Industry and European Experts with Related Expertise.
  - Geographical Areas: Those with responsibilities and expertise in coastal areas, rivers and lakes.

EWN Internal and External Research

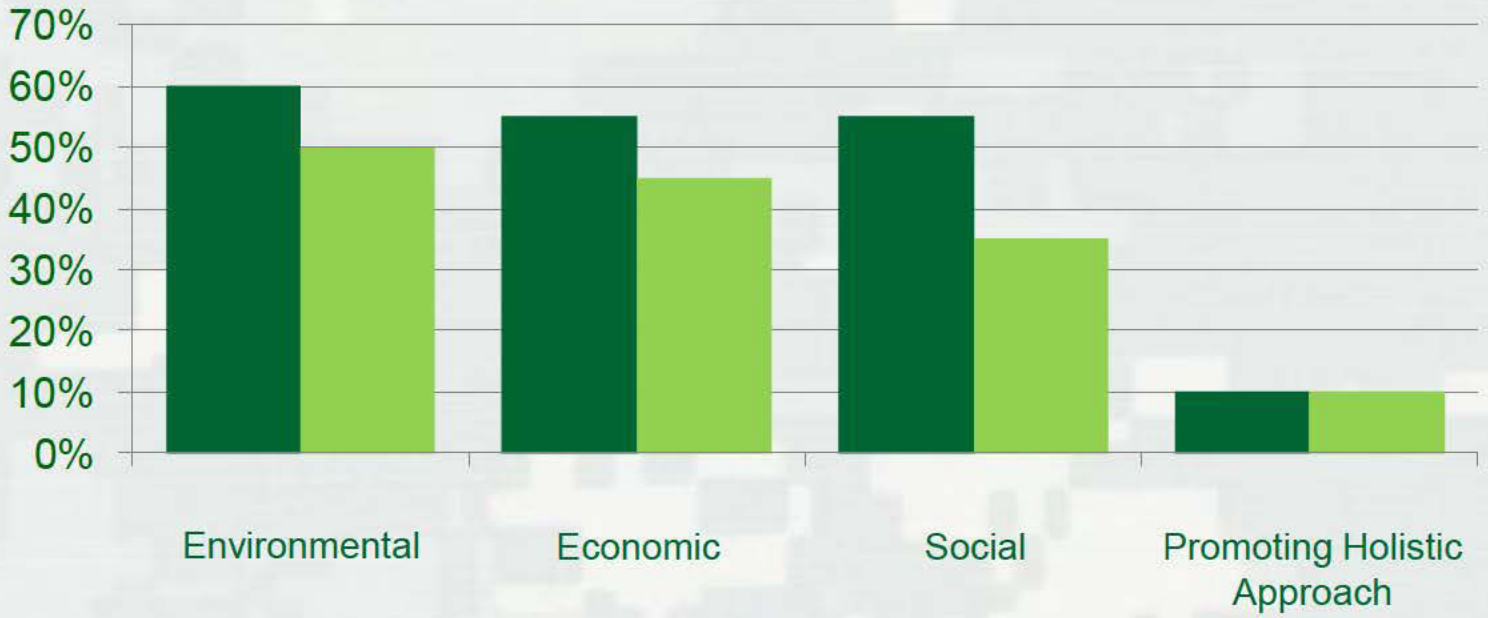
External MM Research Participants

- Organizations included in external research includes:
  - Academia: University of Maryland, University of New Orleans, Colorado State University, Virginia Institute of Marine Science.
  - Federal Government Agencies: USFWS, USEPA, USGS, NOAA, USBR, CMTS
  - State Government Agencies: Delaware, Louisiana, New Jersey, Florida, Wisconsin, Indiana
  - Non-Governmental Organizations: Restore America's Estuaries, Ducks Unlimited, National Wildlife Federation, Lake Ponchatraine Bay Foundation, Surfrider
  - Private Industry: Great Lakes Dredge and Dock, Weeks Marine
  - European Experts with Related Expertise: Federal Hydraulic Institute, Germany; University of Nottingham, UK; Ecoshape, Royal Boskalis, The Netherlands

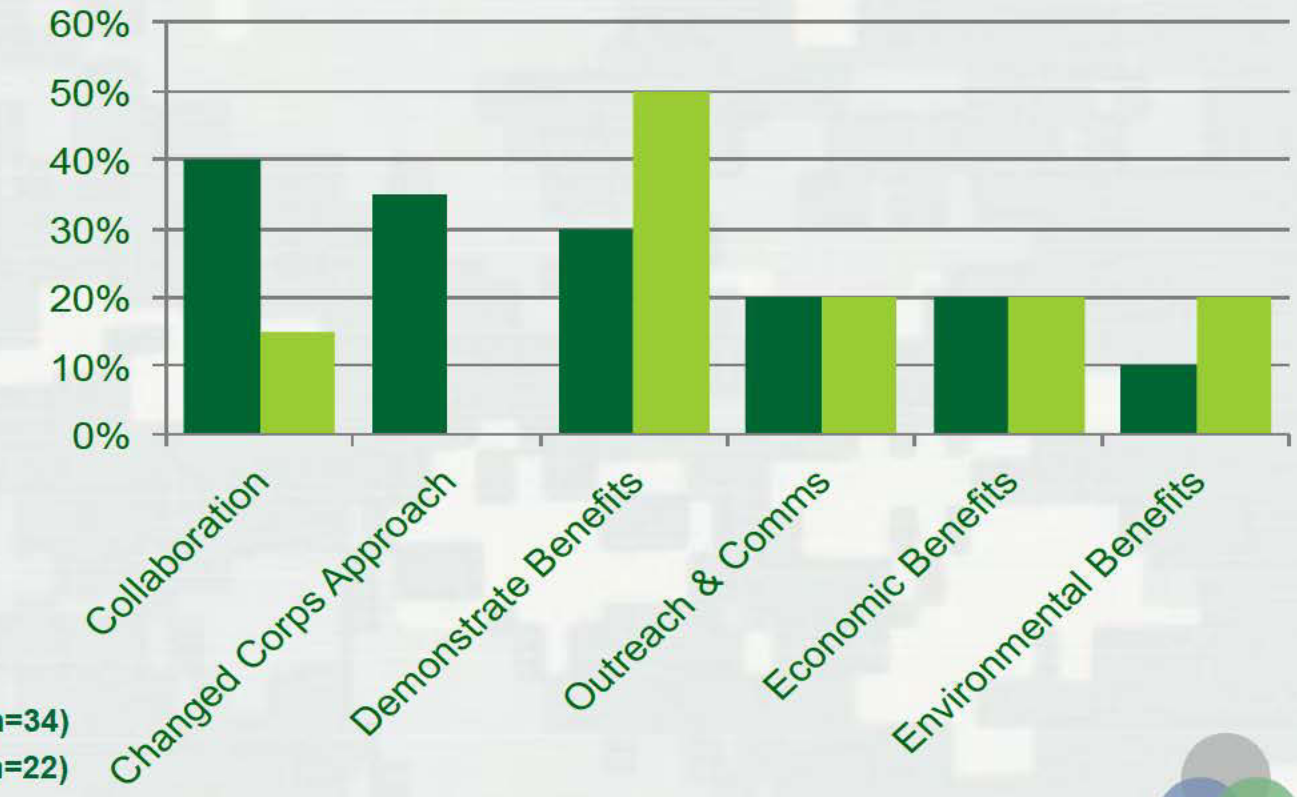
Best Projects for EWN



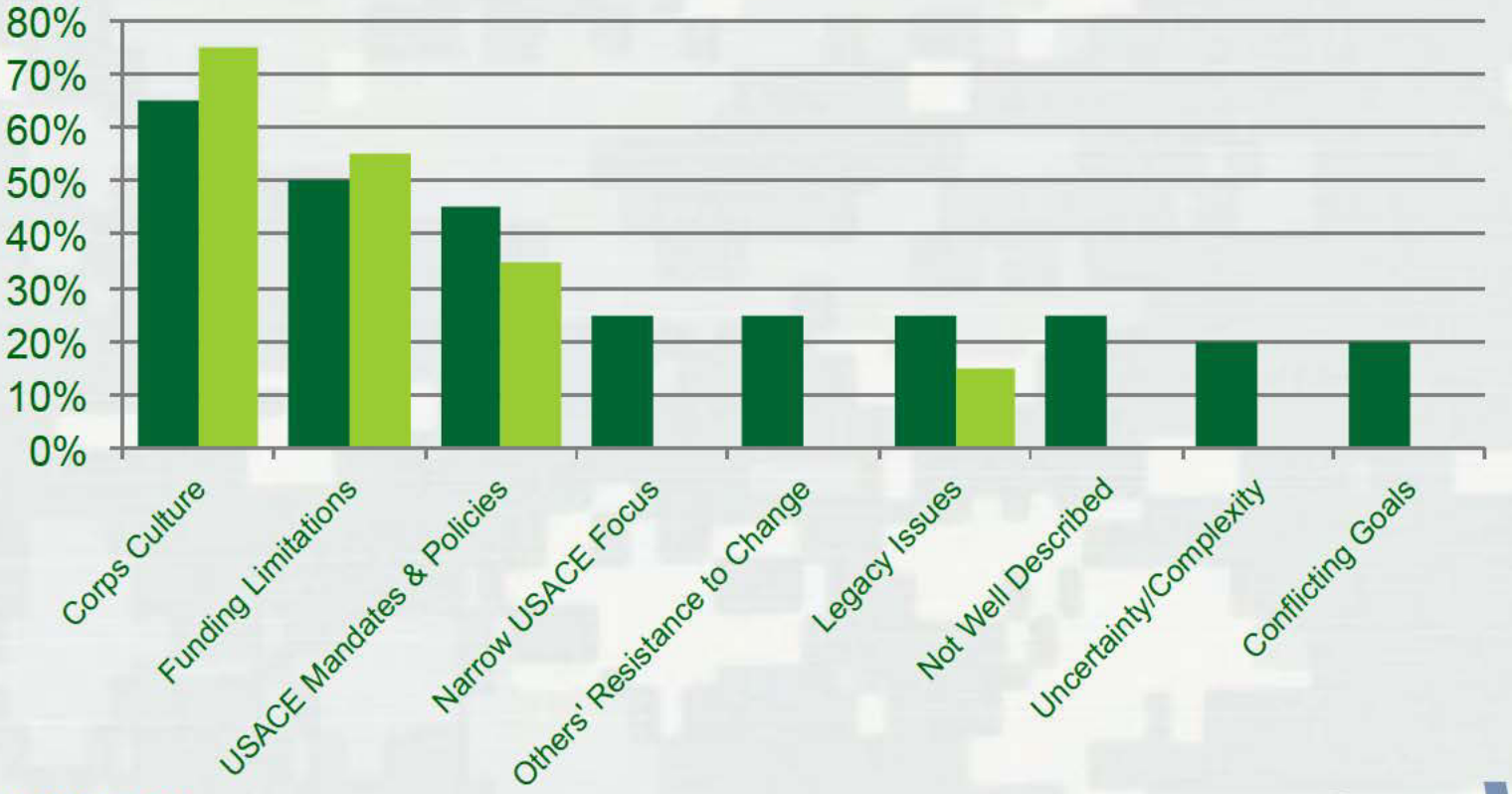
Benefits of EWN



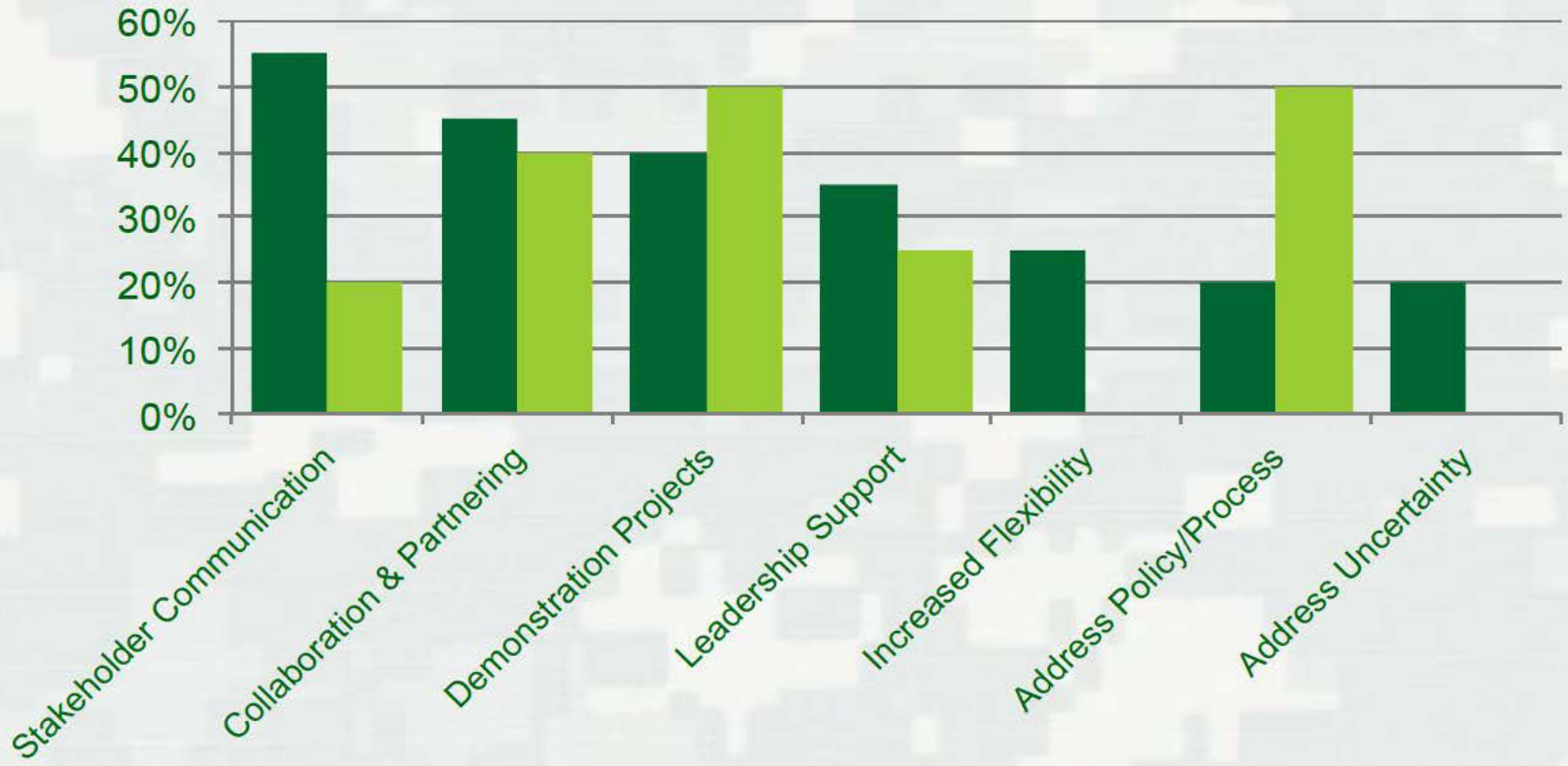
Influences on Stakeholder Interest in EWN



Barriers to EWN Adoption



Overcoming Barriers to EWN



EWN Internal and External Research

Key Findings

- Overall, interviewees were positive and supportive of the EWN approach.
- Many emphasized a demonstration project highlighting a successful, effective application of EWN would be the most important influence on engaging and encouraging adoption of EWN.
- Internal interviewees suggested that all internal USACE stakeholders need to be engaged to ensure successful adoption of EWN.
- External stakeholders encouraged USACE to engage in early and ongoing dialogue and collaboration with all key project stakeholders.
- Many underscored the importance of USACE leadership in supporting and promoting EWN, as key to encouraging adoption.

Engineering With Nature

- Expand the range of benefits provided through water-based infrastructure
  - "Doing more with less"
- Balancing consideration of environmental risks with **benefits**
- A path to more sustainable projects

Issues and Opportunities Discussion

- What challenges or issues are negatively affecting navigation dredging projects?
- What opportunities exist for improving dredging projects?
- What are the keys to increasing BU for dredged material?
- What are the regional opportunities for incorporating EWN principles and practices?