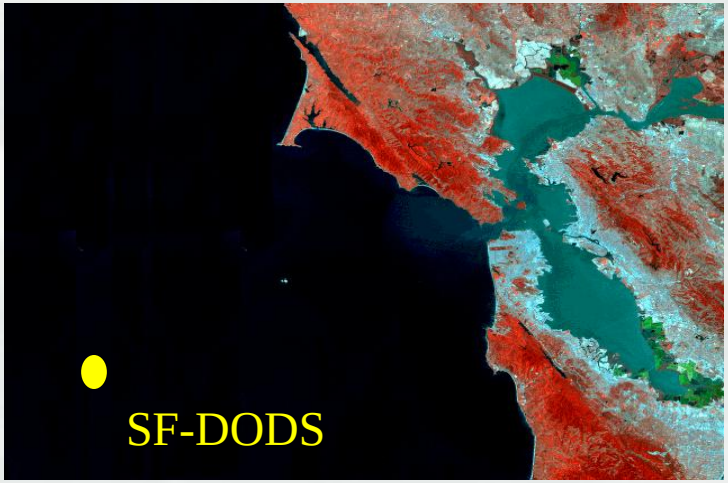
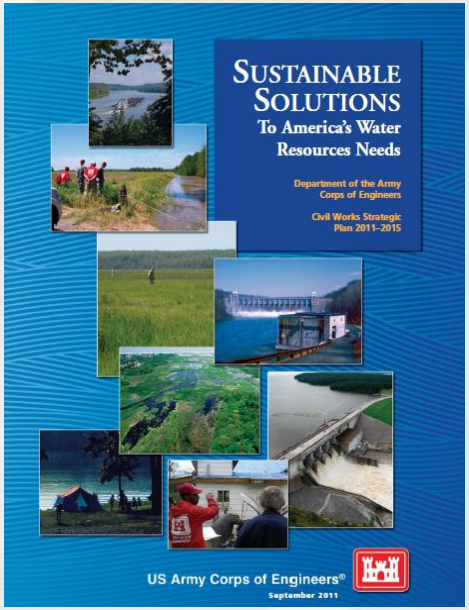
Engineering With Nature

Dr. Todd S. Bridges, ST
Senior Research Scientist, Environmental Science
Engineer Research and Development Center

todd.s.bridges@usace.army.mil

The *Status Quo is Not An Option*





The need:

- 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.

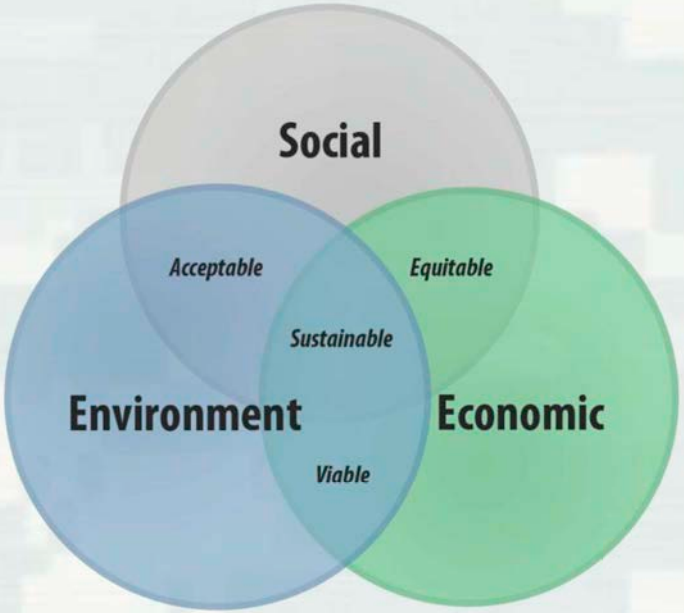
Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."

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



EWN Status

- *Engineering With Nature* initiative was started within the USACE Civil Works 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 (10), dialogue sessions, project development teams, etc.
  - Developed a strategic plan
  - Focused research projects on EWN
  - Initiated field demonstration projects
  - Begun implementing our communication plan

A Sediment Progression: From Confinement to In-Water Creation

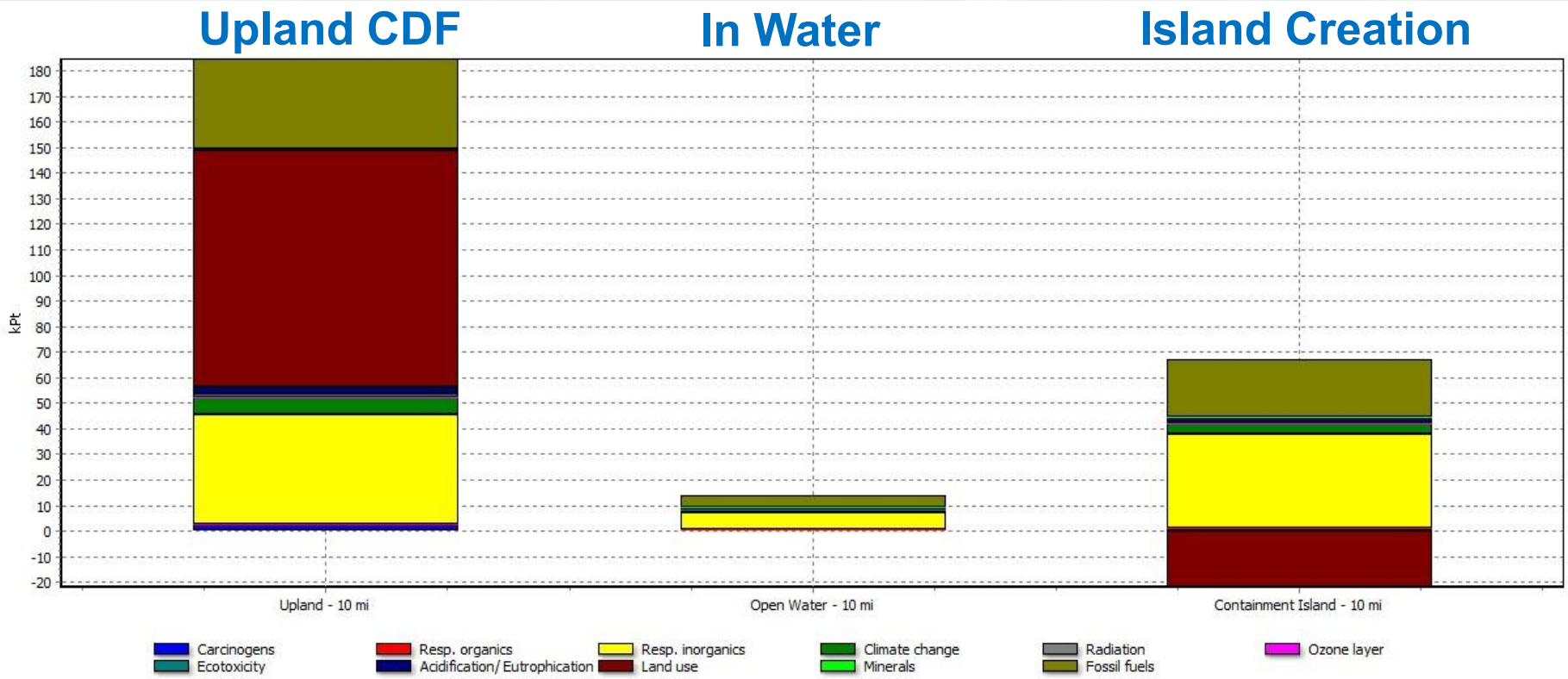
Craney Island, VA

Times Beach, NY

Poplar Island, MD

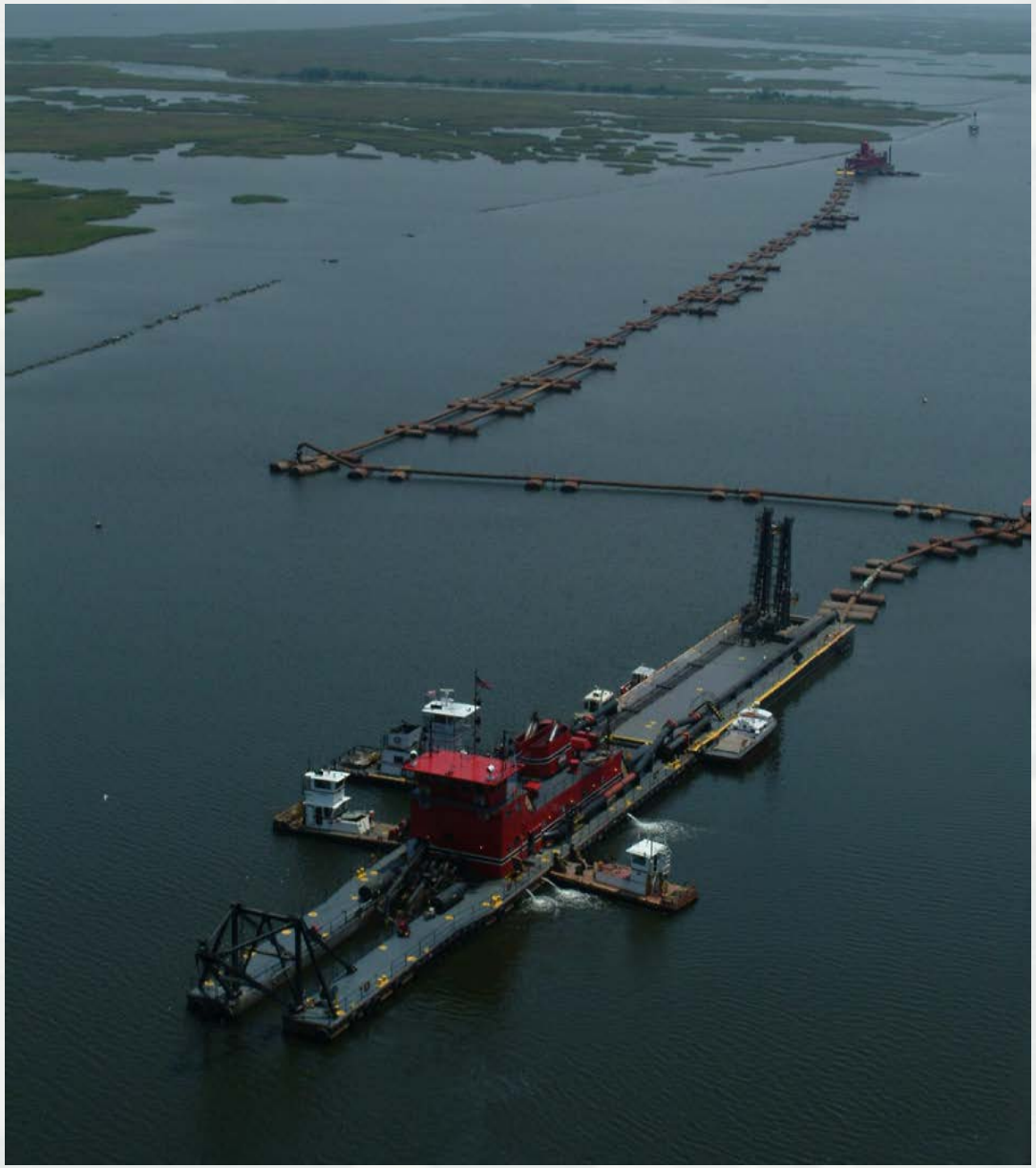
Wetland creation in LA

Life Cycle Assessment Applied to Sediment Management Options



Comparing 1 p 'Upland - 10 mi', 1 p 'Open Water - 10 mi' and 1 p 'Containment Island - 10 mi';
Method: Eco-indicator 99 (H) V2.08 / Europe EI 99 H/A / Single score

Example EWN Solutions

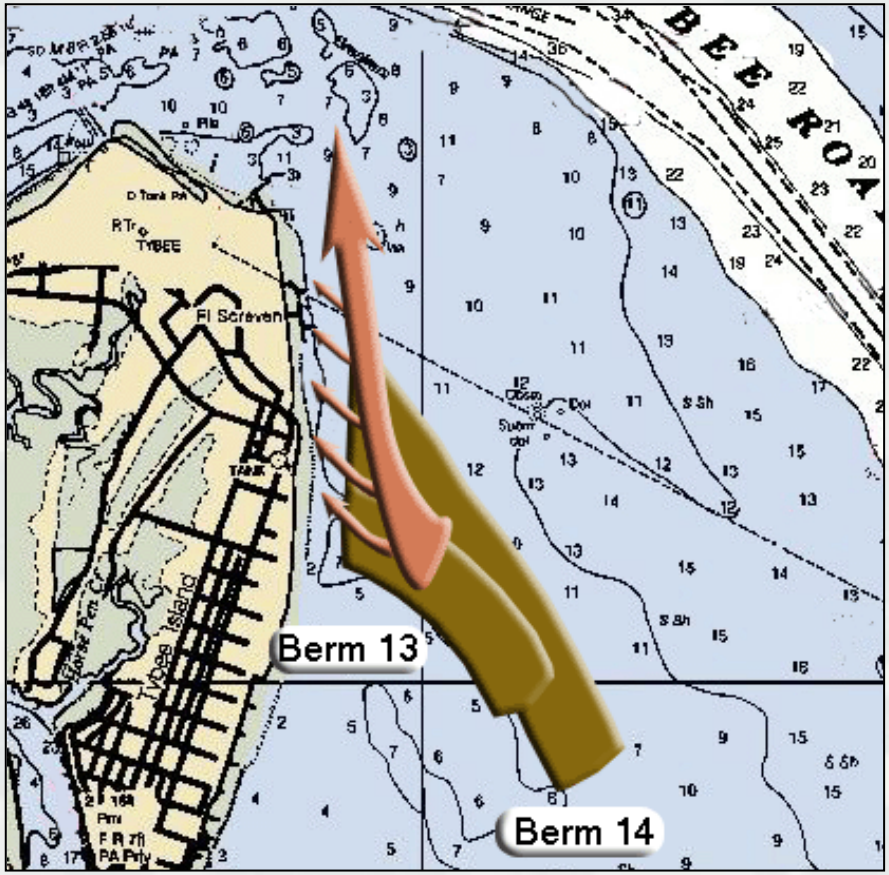


Long-distance pumping of dredged material for wetlands creation in coastal Louisiana, USA

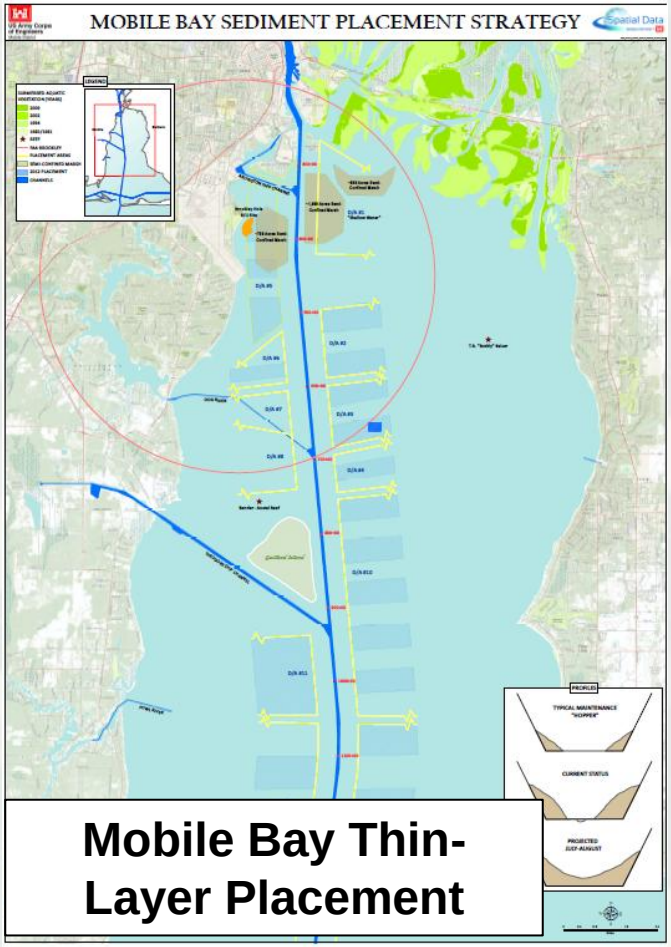
- ***How to marry LDC with natural transport processes to expand opportunities?***

Example EWN Solutions

Strategic Sediment Placement



North Tybee Island
Savannah, Georgia



Mobile Bay Thin-Layer Placement

Example EWN Solutions

Upper Missouri River Sandbar Habitat

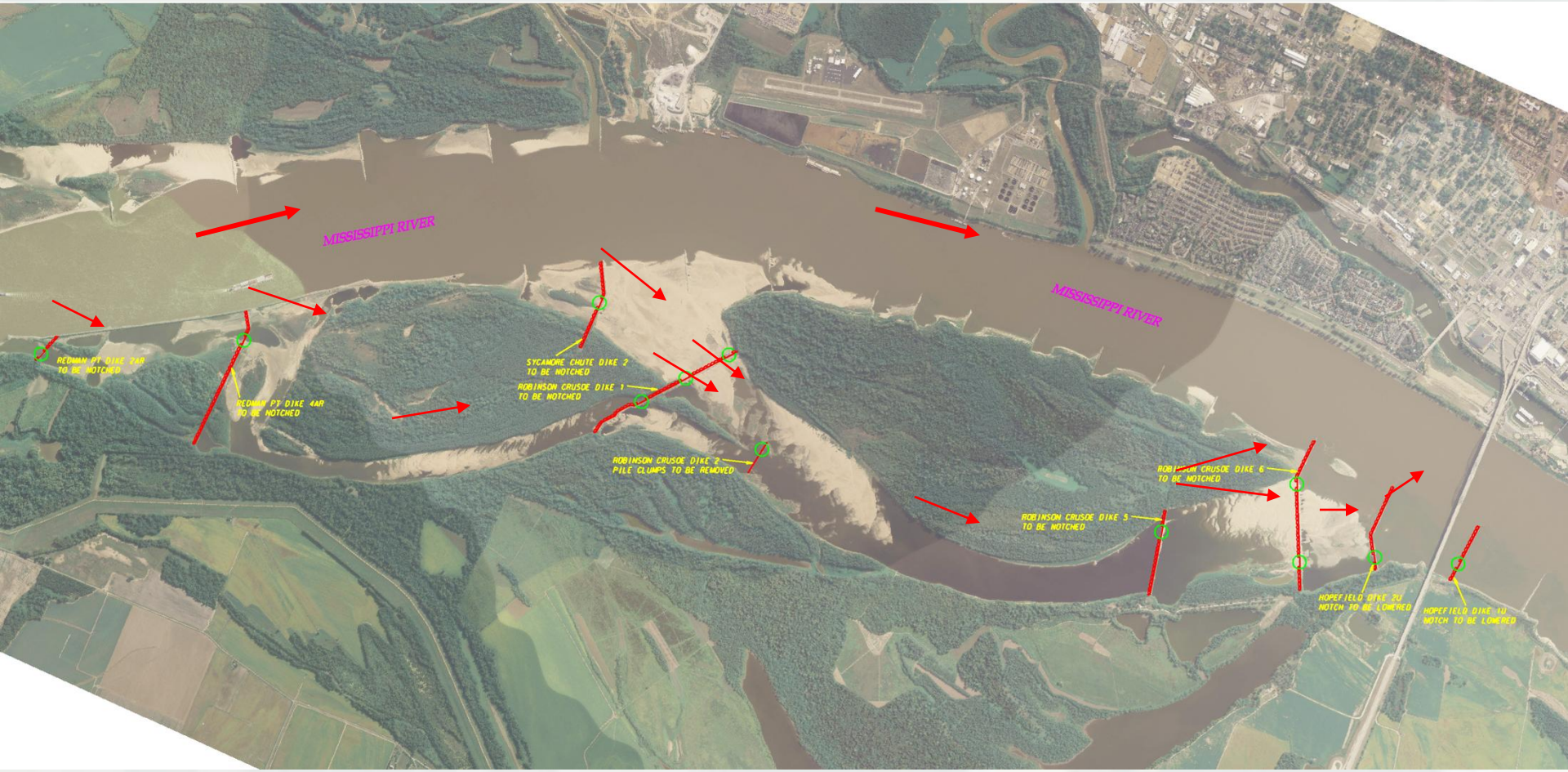
- $25 Million to construct 650 acres of sandbar
- 16,000 acres created by the flood of 2011

July 2009

November 2011

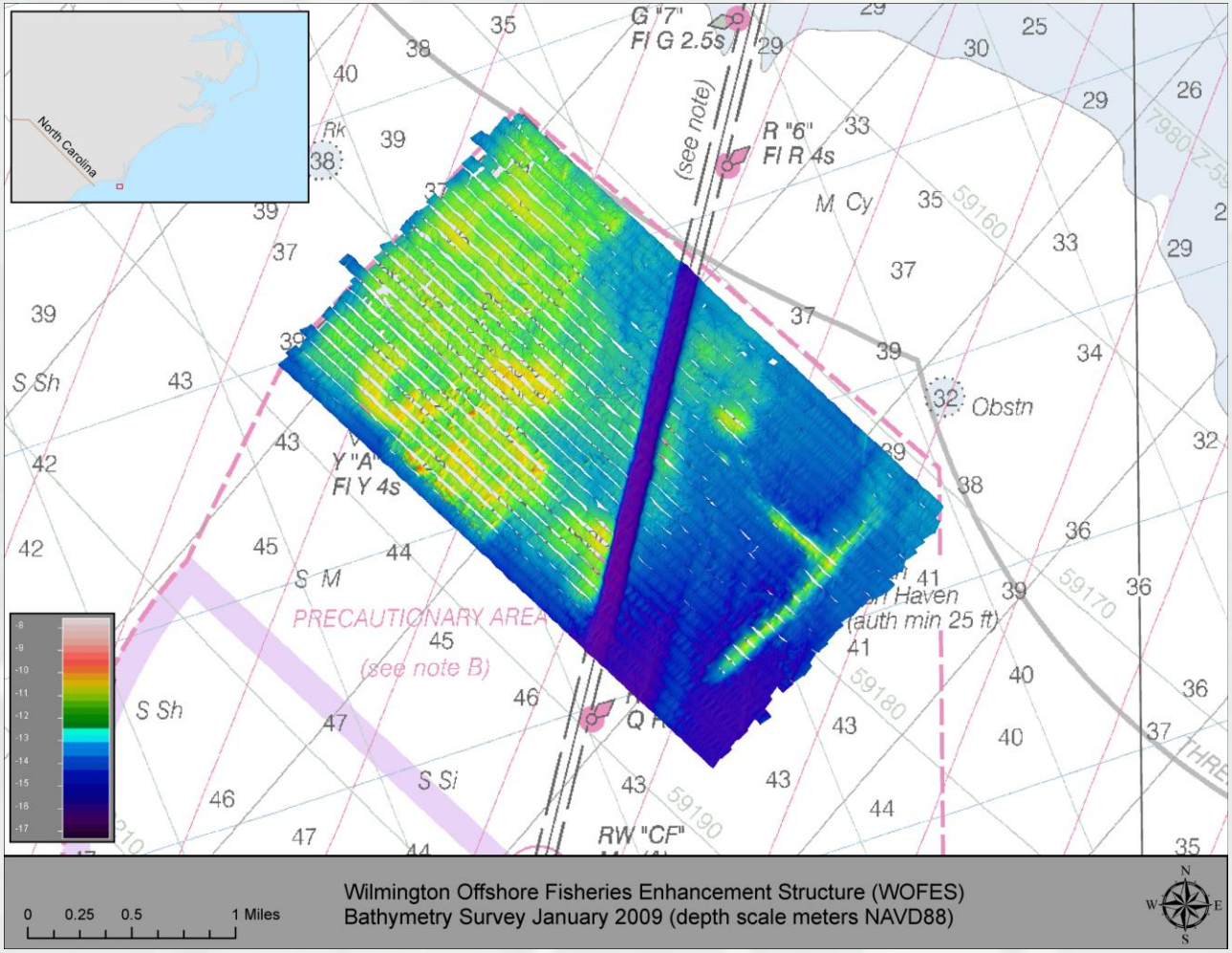
Courtesy: G. Pavelka
COE, 2012

Example EWN Solutions



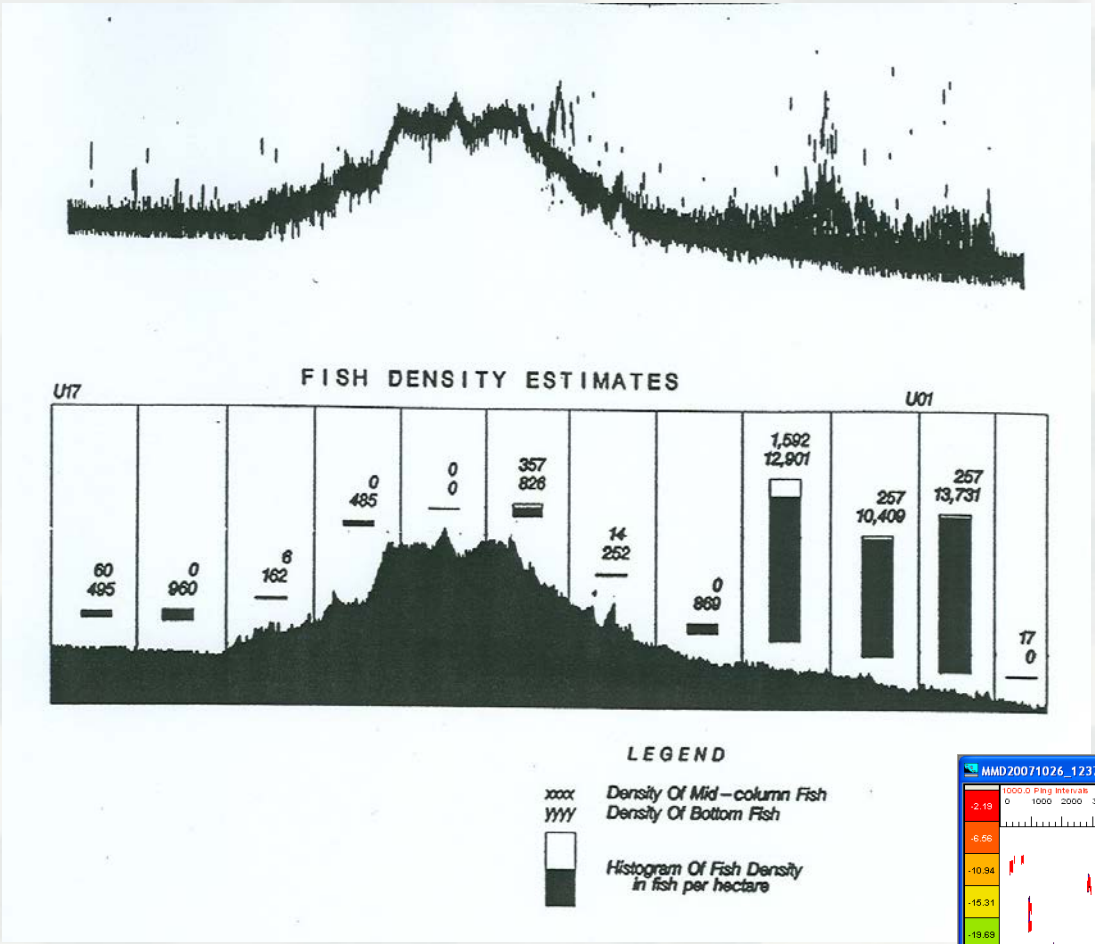
Loosahatchie Bar
Aquatic Habitat Rehabilitation

Example EWN Solutions

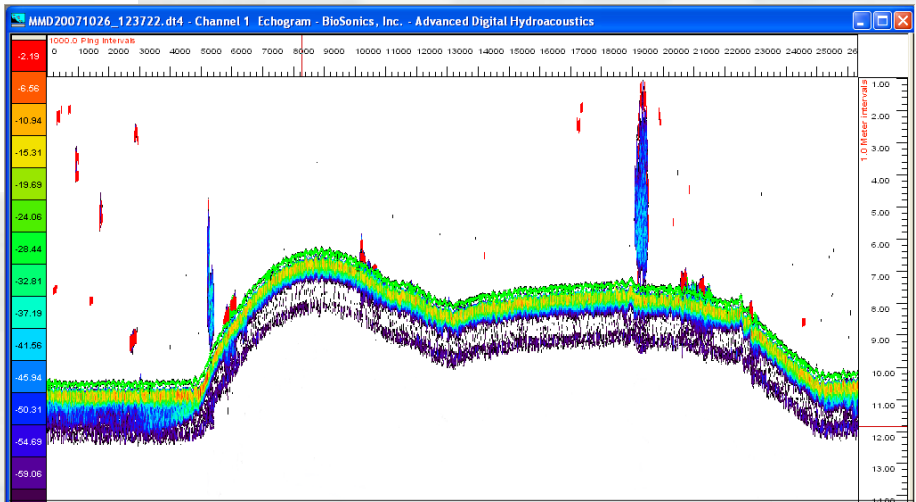


Wilmington Offshore Fisheries Enhancement Structure

Example EWN Solutions



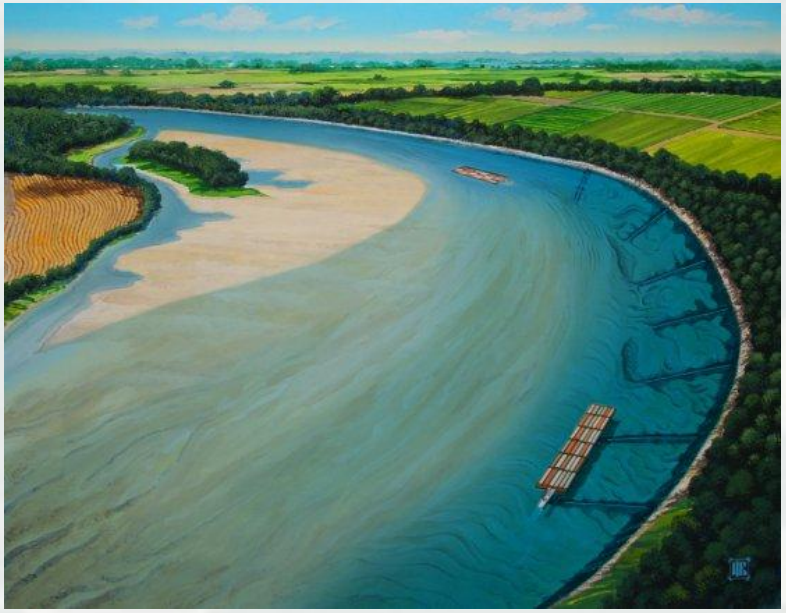
Hydroacoustics and trawling data used to document fisheries benefits provided by topographic relief created with dredged material



Mobile Offshore Dredged Material Mound

Example EWN Solutions

Upper Mississippi River Training Structures: Chevrons

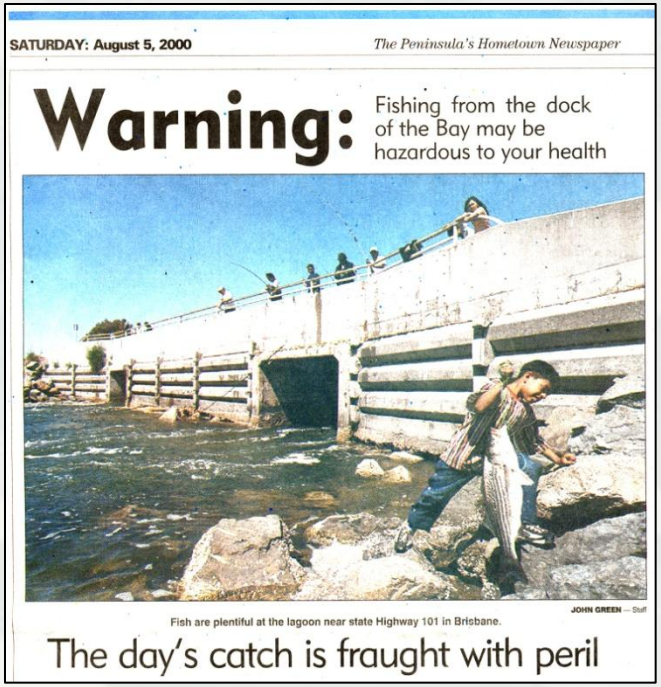


River Bendway Weirs

Environmentally Enhanced Breakwater Toe Blocks

Scope of Contaminated Sediment Problem in US

- EPA 1997 sediment survey report concludes 1.2 billion yd^3 surficial sediment "pose potential risks"
- Cleanup programs
  - ~350 sediment sites in Superfund
    - ~ 30 megasites (> $50M)
- Navigation dredging
  - 250 M m^3 of sediment dredged annually in the US
  - Management costs for sediment range over 3 orders of magnitude



SATURDAY: August 5, 2000 — The Peninsula's Hometown Newspaper

Warning: Fishing from the dock of the Bay may be hazardous to your health

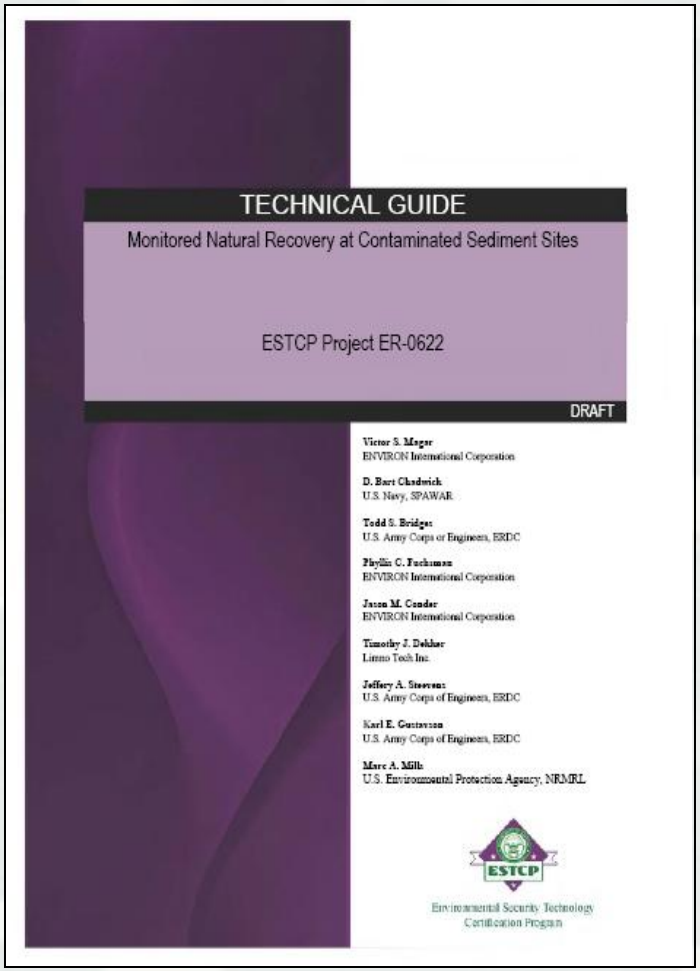
JOHN GREEN — Staff

Fish are plentiful at the lagoon near state Highway 101 in Brisbane.

The day's catch is fraught with peril

Advancing Monitored Natural Recovery Through EWN

- Opportunities for “light touch” engineering for Enhanced MNR
- MNR and E-MNR as a part of sustainable practice
- Value creation through innovative remedies
- Resilient remedies– adaptable remedies that last


TECHNICAL GUIDE

Monitored Natural Recovery at Contaminated Sediment Sites

ESTCP Project ER-0622

DRAFT

Victor S. Magar
ENVIRON International Corporation

D. Bart Chadwick
U.S. Navy, SPAWAR

Todd S. Bridges
U.S. Army Corps of Engineers, ERDC

Phyllis C. Fuchsman
ENVIRON International Corporation

Jason M. Conder
ENVIRON International Corporation

Timothy J. Dekker
Limno Tech Inc.

Jeffery A. Steevens
U.S. Army Corps of Engineers, ERDC

Karl E. Gustavson
U.S. Army Corps of Engineers, ERDC

Marc A. Mills
U.S. Environmental Protection Agency, NRMRL

ESTCP

Environmental Security Technology Certification Program

DoD 2009 *Technical guide: Monitored natural recovery at contaminated sediment sites.* ESTCP-ER-0622.
http://www.epa.gov/superfund/health/conmedia/sediment/documents.htm

EWN Action 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

Research: EWN for Coastal Resilience

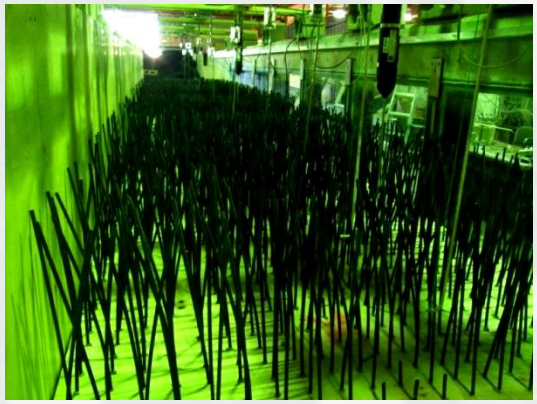
Research collaboration to improve the efficiency of engineering and operational practices, expand and extend project benefits, and improve the resilience and sustainability of coastal systems under climate change.

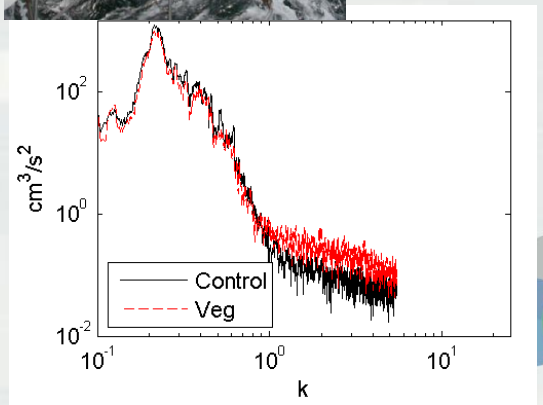
Field Research Activities:

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

Laboratory Analyses:

- Transport in vegetation
- Wave energy transformation

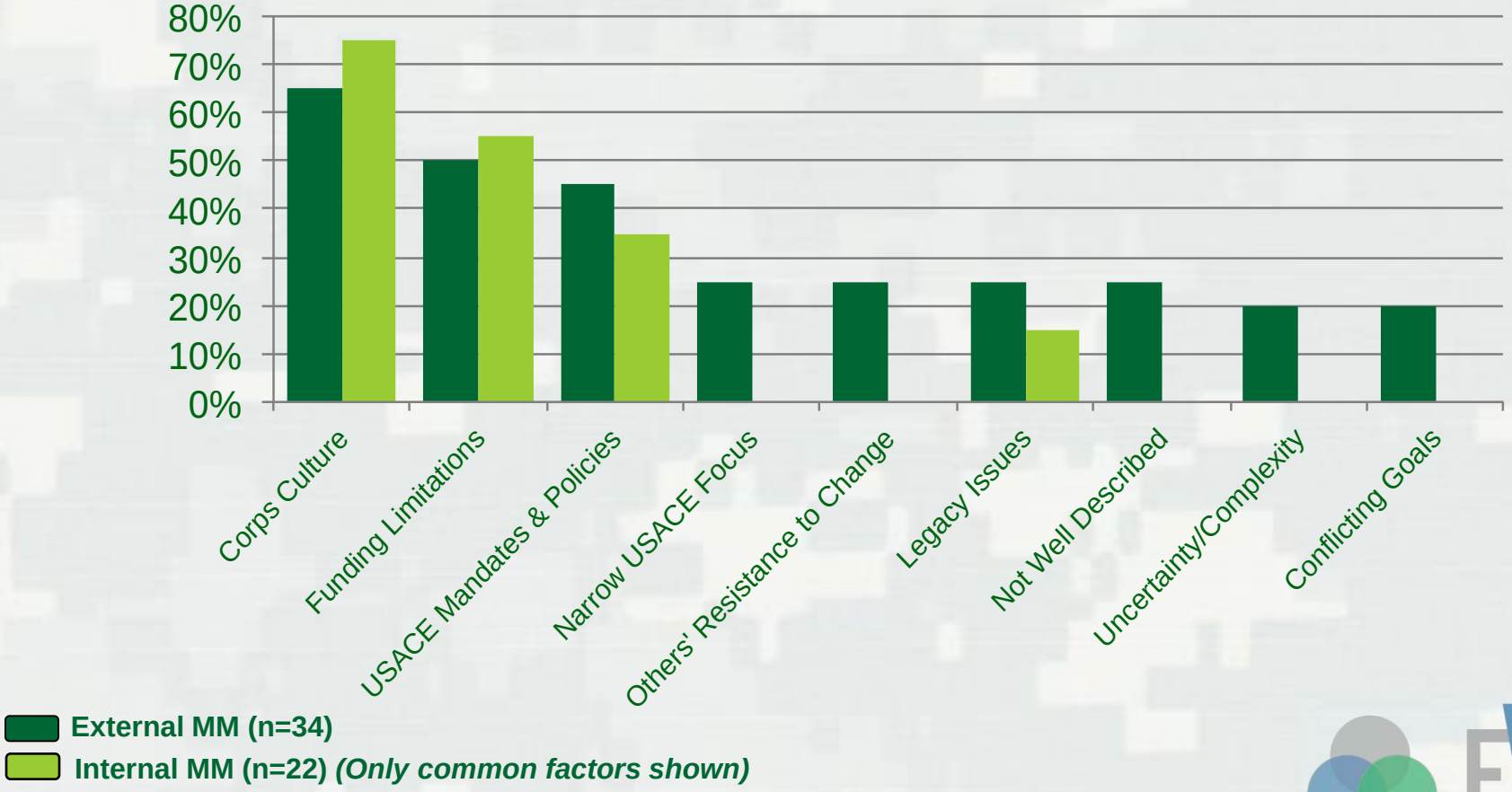




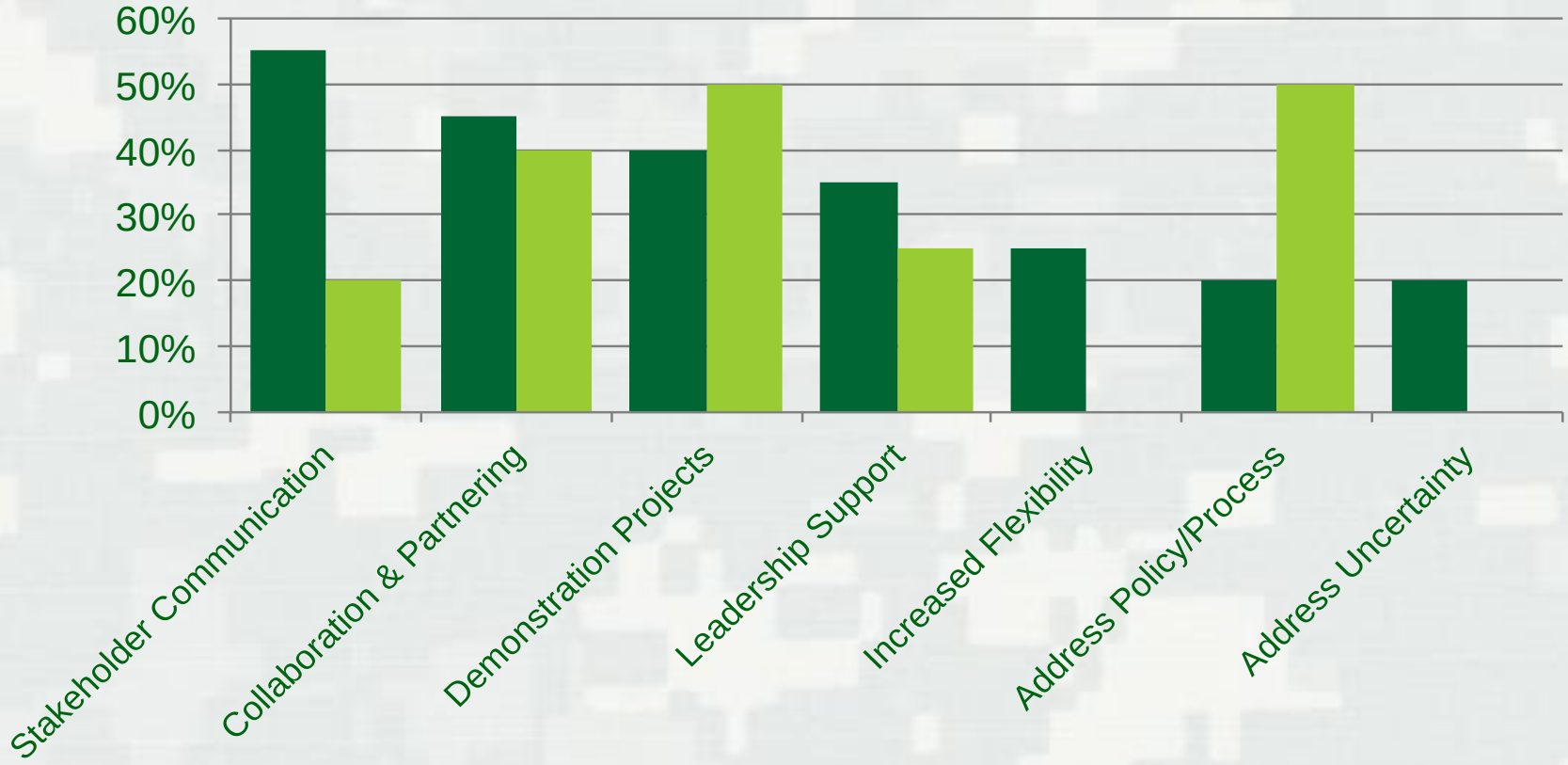
Dialogue Sessions on EWN

- 22 internal USACE stakeholders representing a diverse population across specialty areas and geography (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
- 34 external stakeholders representing a diverse population of stakeholder types and geographical areas (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.

Barriers to EWN Adoption



Overcoming Barriers to EWN

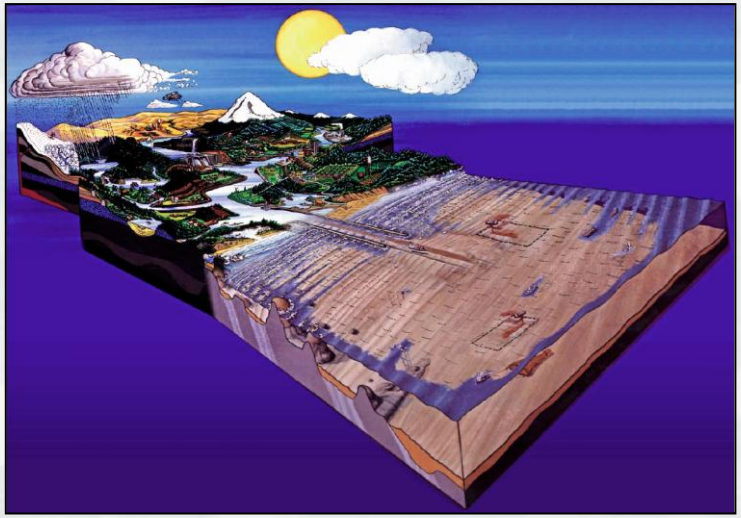


External MM (n=34)

Internal MM (n=22) ***(Only common factors shown)***

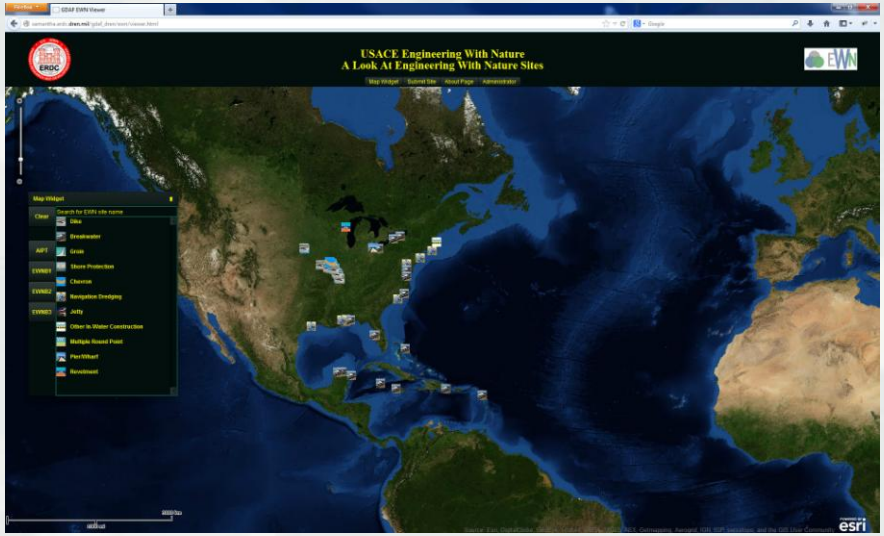
A Systems Approach to Project Implementation

- EWN- An *ecosystem approach* to project development and operations
  - An integration of activities across the landscape
  - Applied across programs and missions (within and across agencies)
  - Expanding environmental benefits and services provided by infrastructure

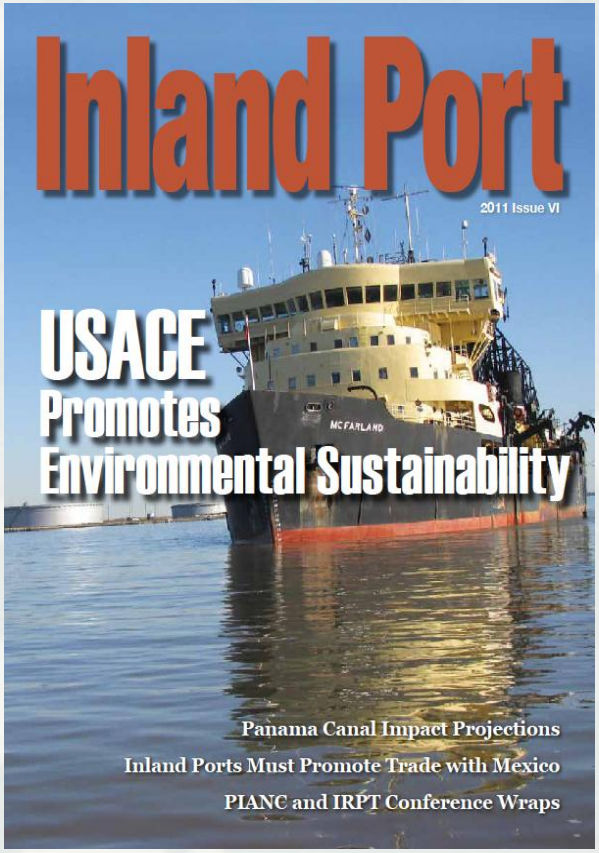


EWN ProMap

- Online GIS database of projects illustrating EWN principles and practices
  - Illustrating the four key attributes of EWN
- Currently contains 120 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 will be added through a process of self-nomination and independent evaluation



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

Engineering With Nature

- Expand the range of benefits provided through water-based infrastructure
  - Create value!
- Balancing consideration of environmental risks with project **benefits**
- A path to more sustainable projects