Engineering With Nature

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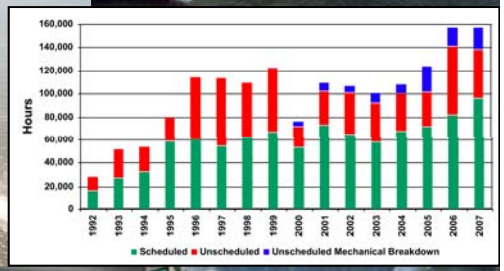
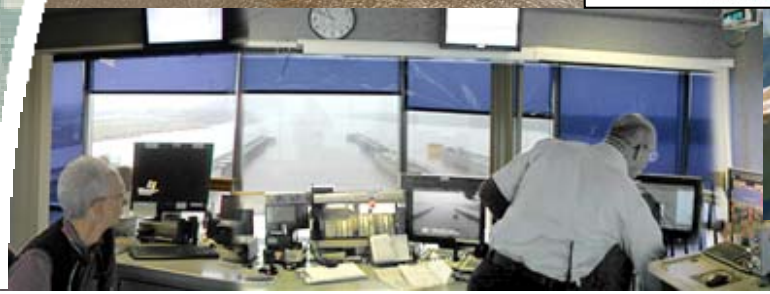
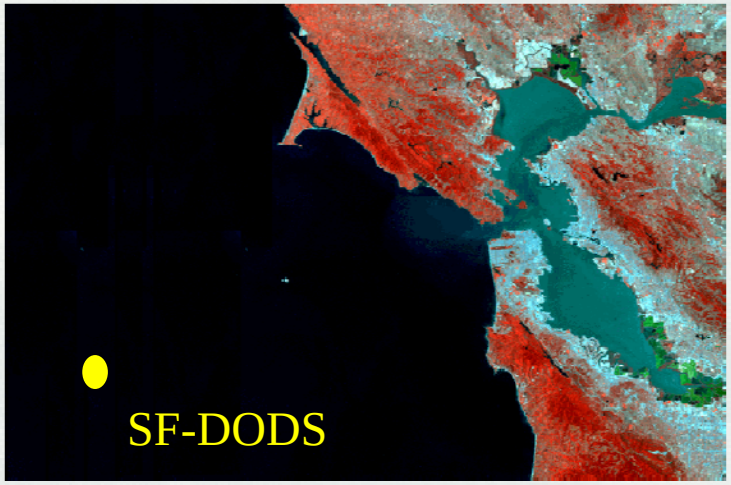
RSM Update
21 March 2013

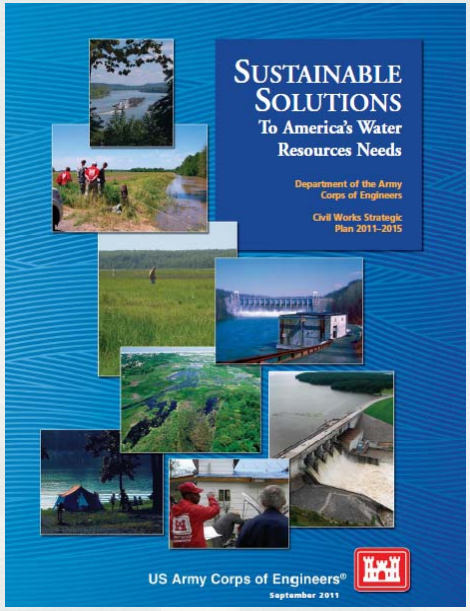




US Army Corps of Engineers
BUILDING STRONG®

The *Status Quo is Not An Option*





The need:

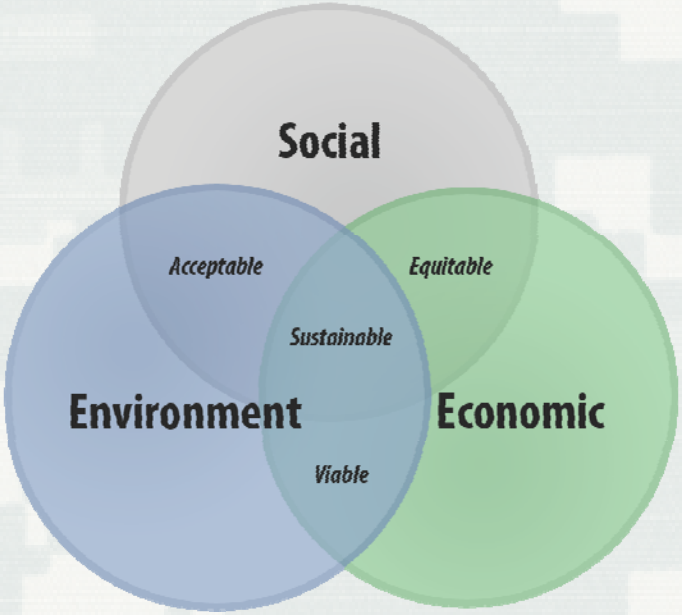
- Efficient, cost effective engineering and operational practices
- More collaboration and cooperation, less unproductive conflict.
  - Ports, commercial interests, regulators, NGOs, and others
- Sustainable projects. Triple-win outcomes integrating social, environmental and economic objectives.

Engineering With Nature…

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

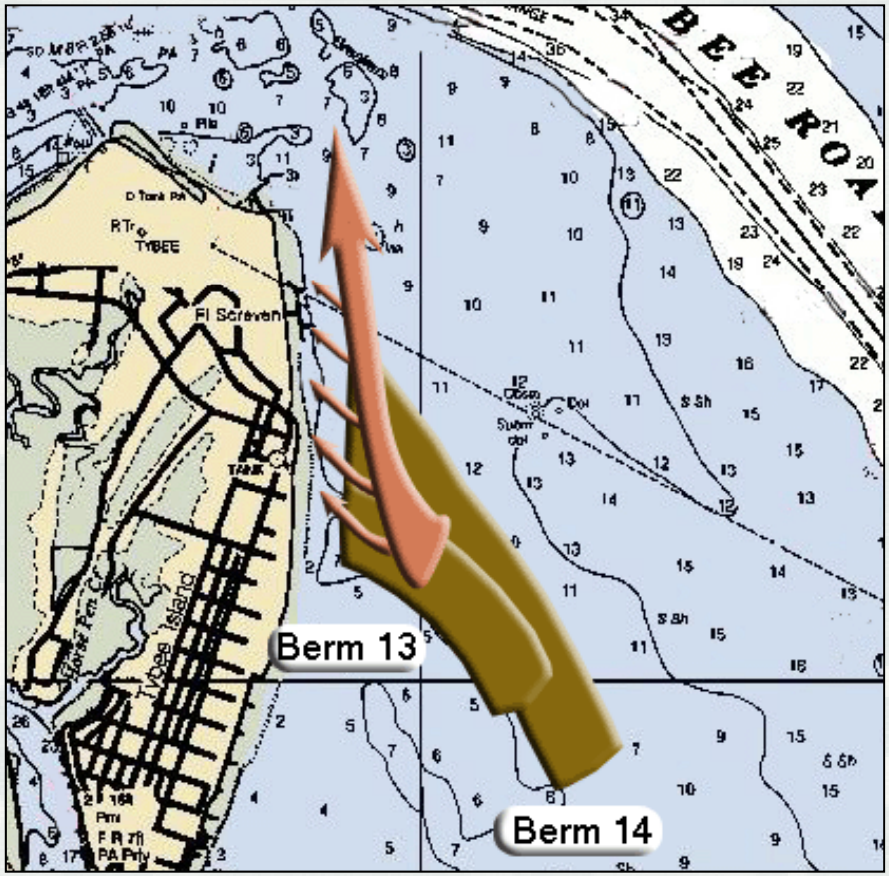
Key Ingredients

- 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

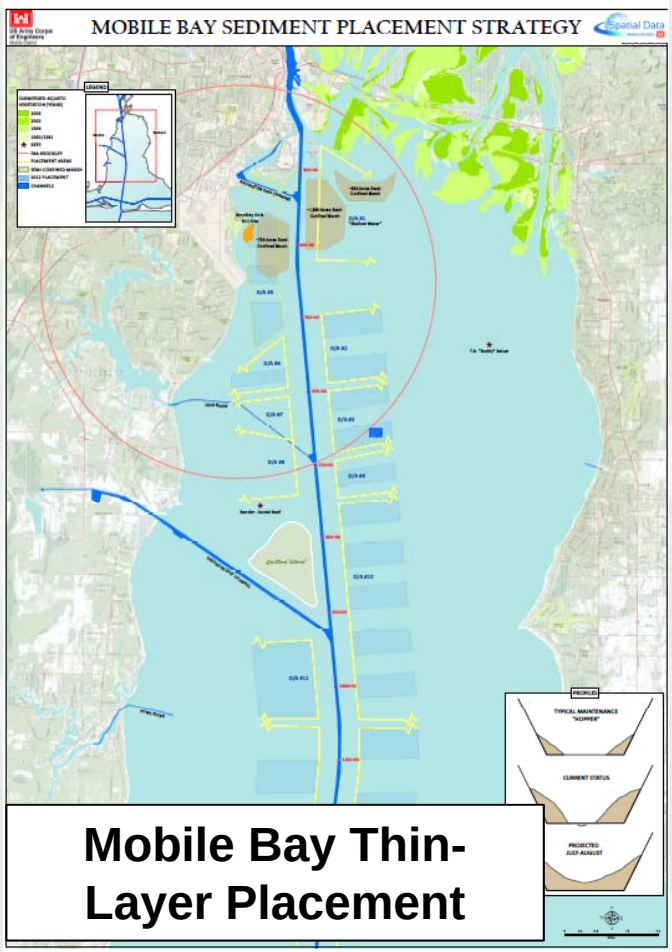


Example EWN Solutions

Strategic Sediment Placement



North Tybee Island
Savannah, Georgia



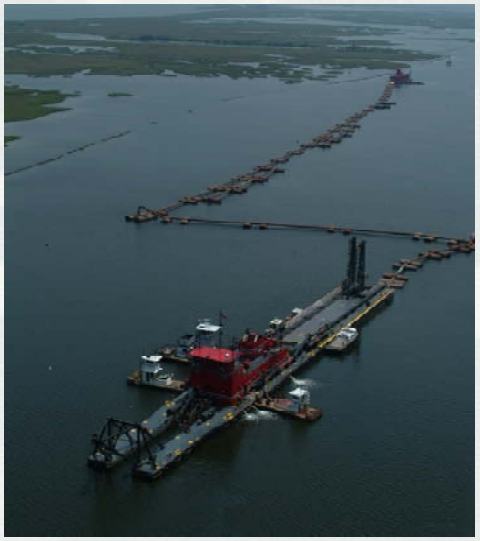
Mobile Bay Thin-Layer Placement

A Progression: From Confinement/Disposal to In-Water Creation

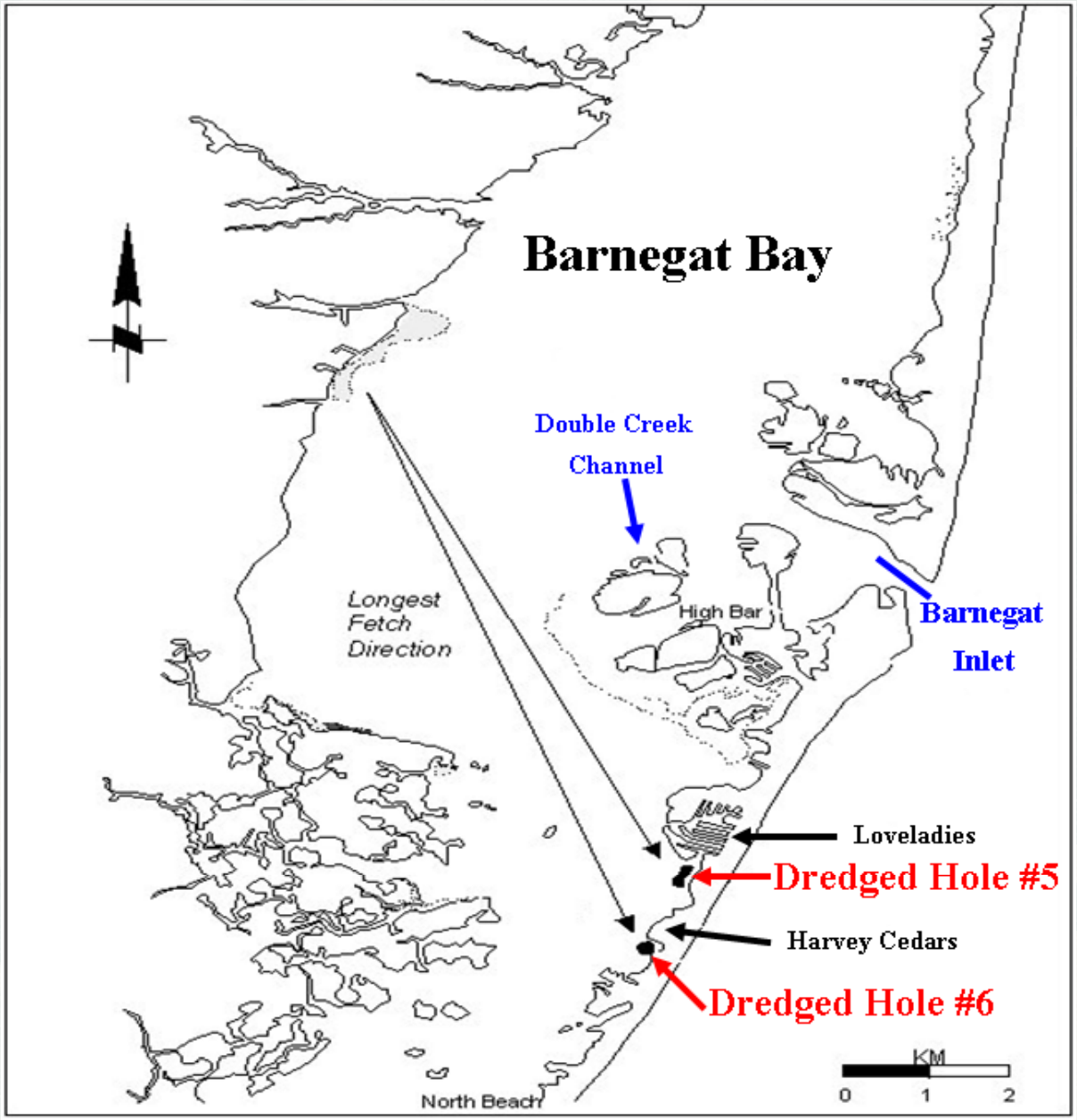
Craney Island, VA

Poplar Island, MD

Times Beach, NY



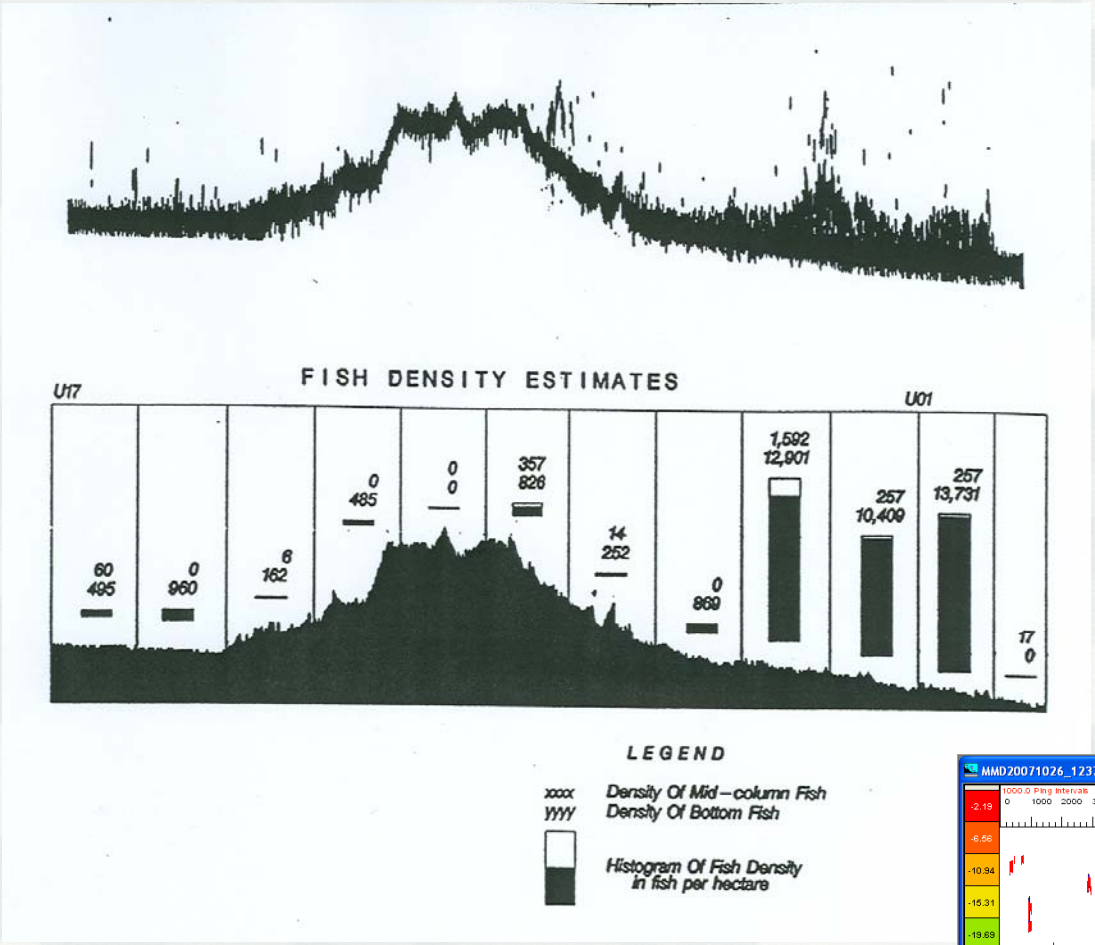
Wetland creation in LA



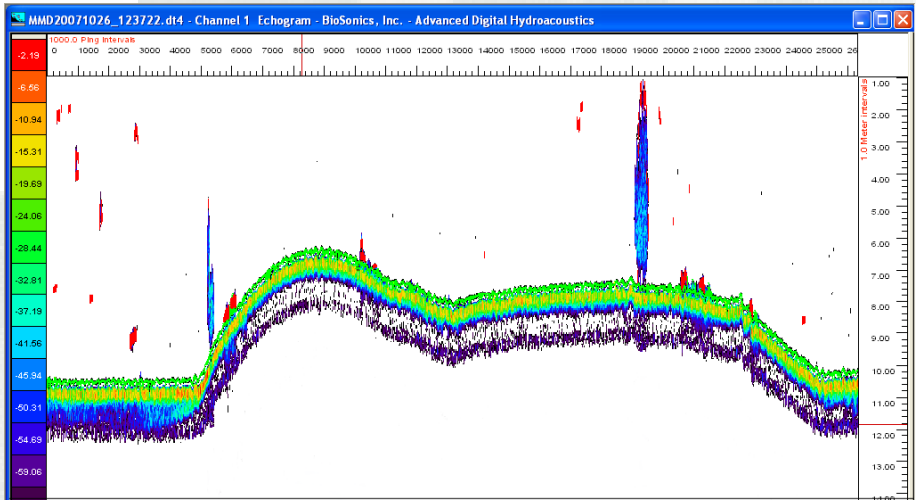
Partial fill of Dredged Hole #6 required 96K m^3 of hydraulically pumped dredged material

- **Constructed in 2006**
- **Monitoring showed presence of fish and improved water qual.**

Mobile Offshore Dredged Material Mound

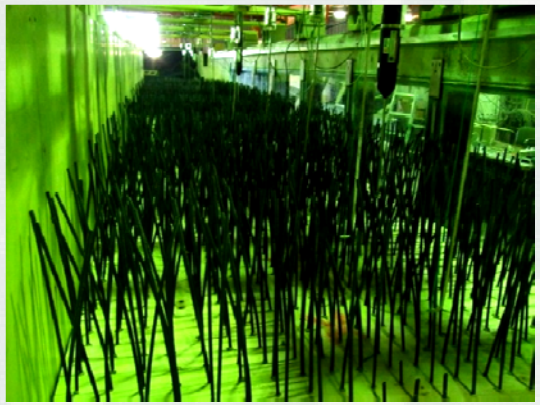


Hydroacoustics and trawling data used to document fisheries benefits provided by topographic relief created with dredged material



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.

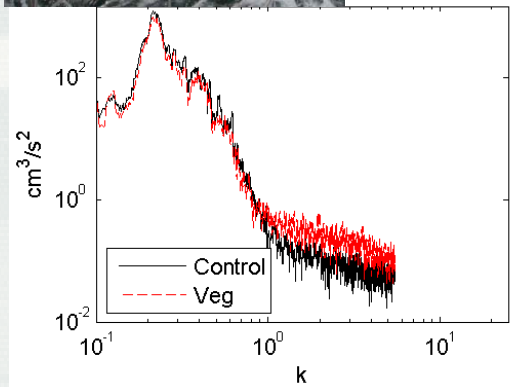


Field Research Activities:

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

Laboratory Analyses:

- Transport in vegetation
- Wave energy transformation



Three major types of resilience are described in the literature

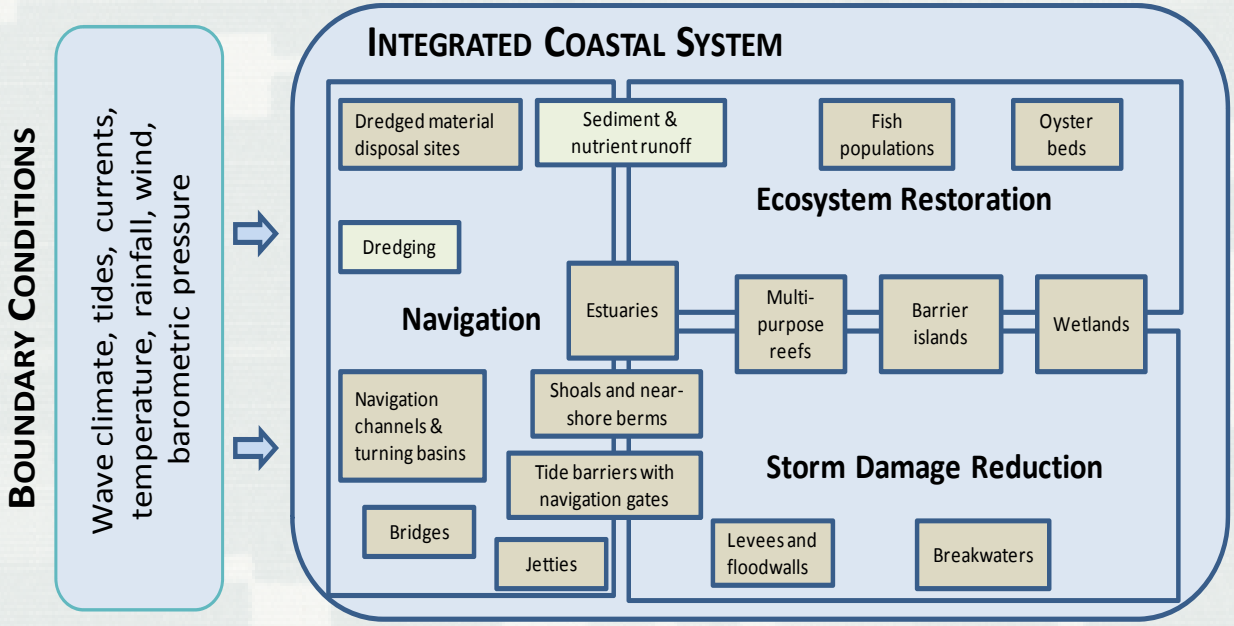
- Many alternate definitions have been proposed for each type
- Define resilience carefully!
- When quantifying resilience, clarify:
  - System of interest
  - Disturbance of interest
  - Motivation & objectives
  - Identify decisions to be informed
  - Identify the decision maker

TYPE	EXAMPLE DEFINITION
Ecological	The ability to resist being forced into an alternate state by a disturbance.
Engineering	The ability to resist loss of function during a disturbance and recover function following a disturbance.
Community	The ability to pre-empt losses by adapting new functions specifically conditioned on a disturbance.

The Quantification and Evolution of Resilience in Integrated Coastal Systems. Martin T. Schultz, S. Kyle McKay, and Lyndell Z. Hales. 2012. ERDC TR-12-7

Engineering resilience is a quantifiable property of infrastructure systems

- **System:** A network of components and processes engineered to perform one or more functions
  - Components: Physical features that support a function
  - Processes: Physical, chemical, and biological processes that support a function
- **Disturbance:** A transient excursion of forces (boundary conditions) that may interfere with functional performance of the system



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 (10), 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
    - Web page near deployment
    - GIS project viewer to go online in FY13

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.

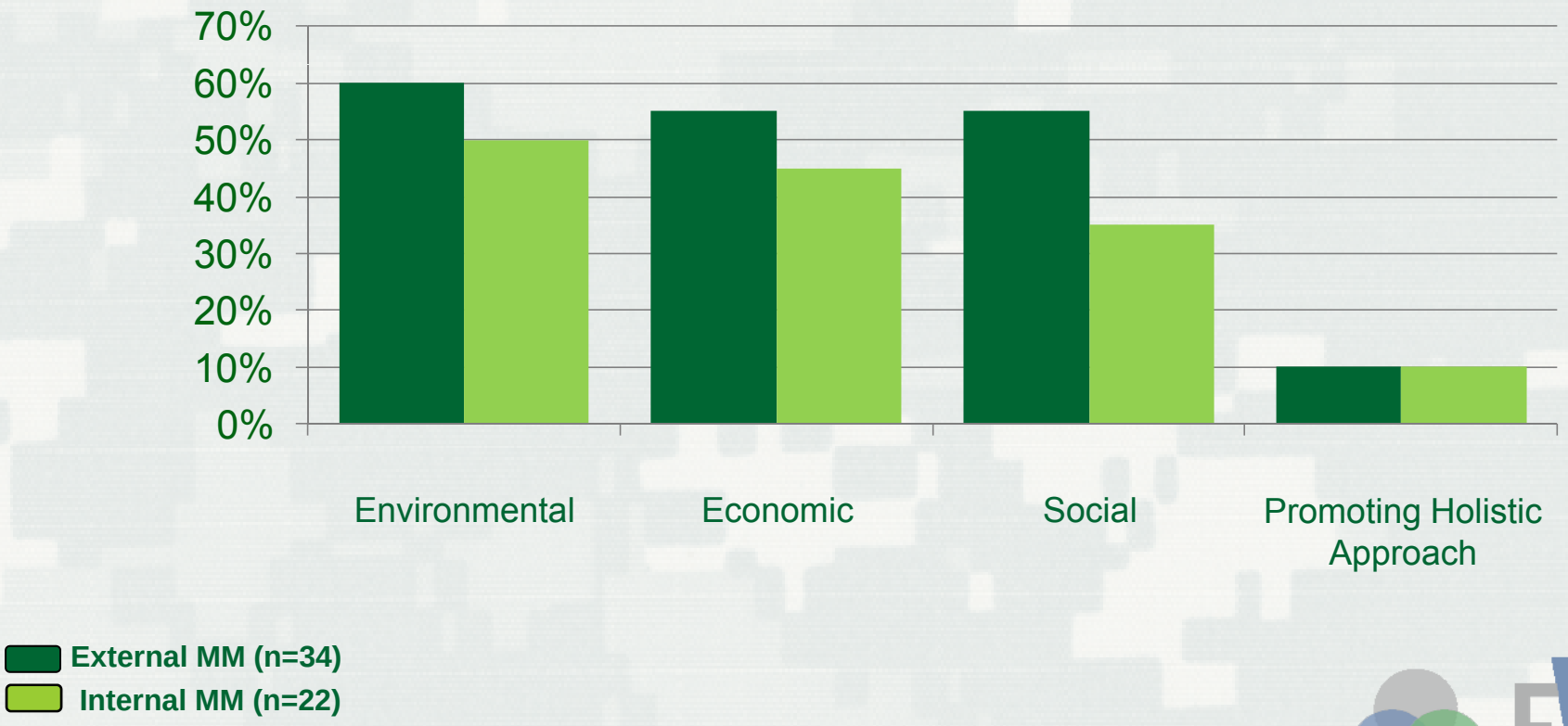
MM Research Summary

- 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.

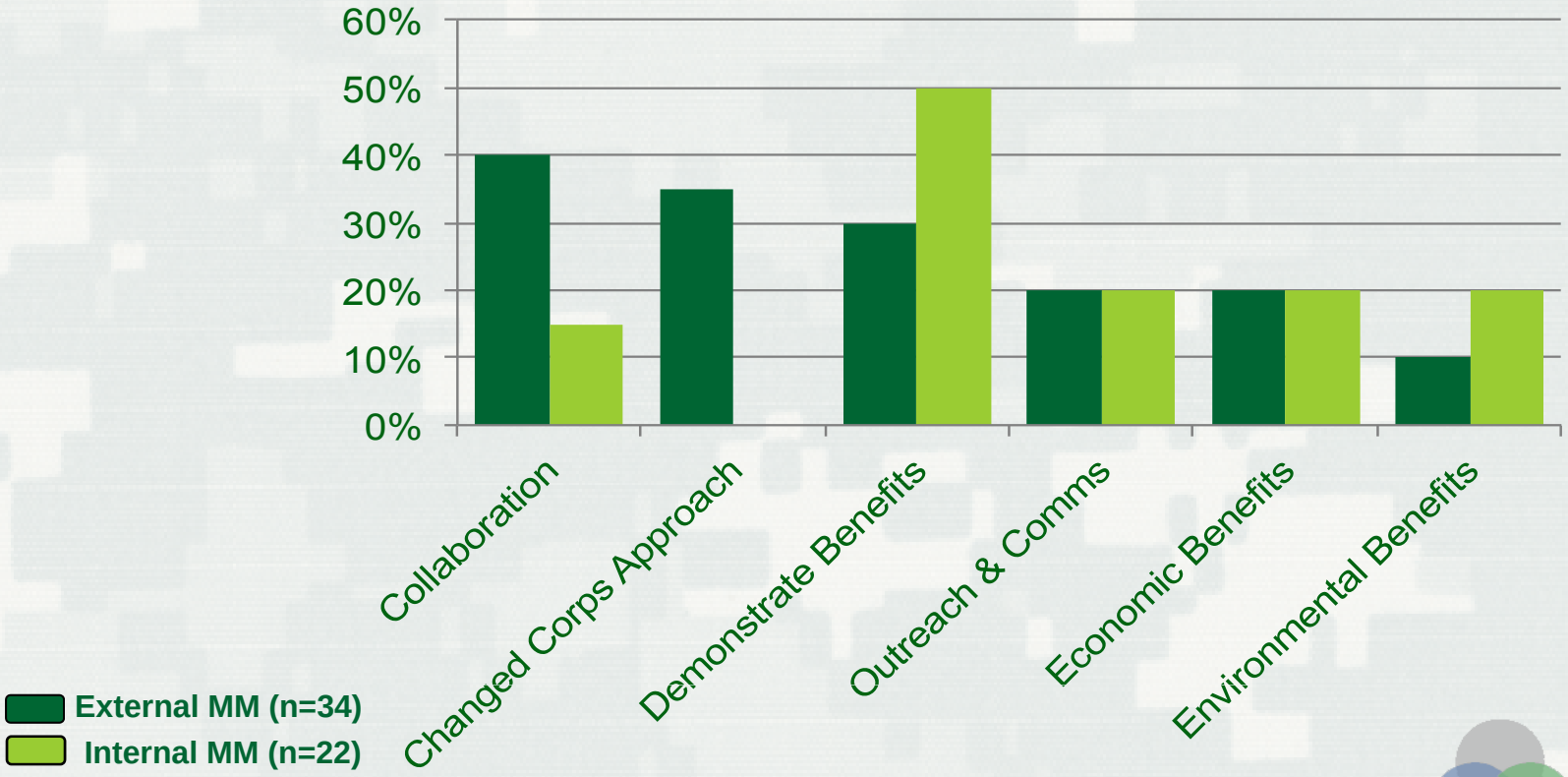
External MM Research Participants

- 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

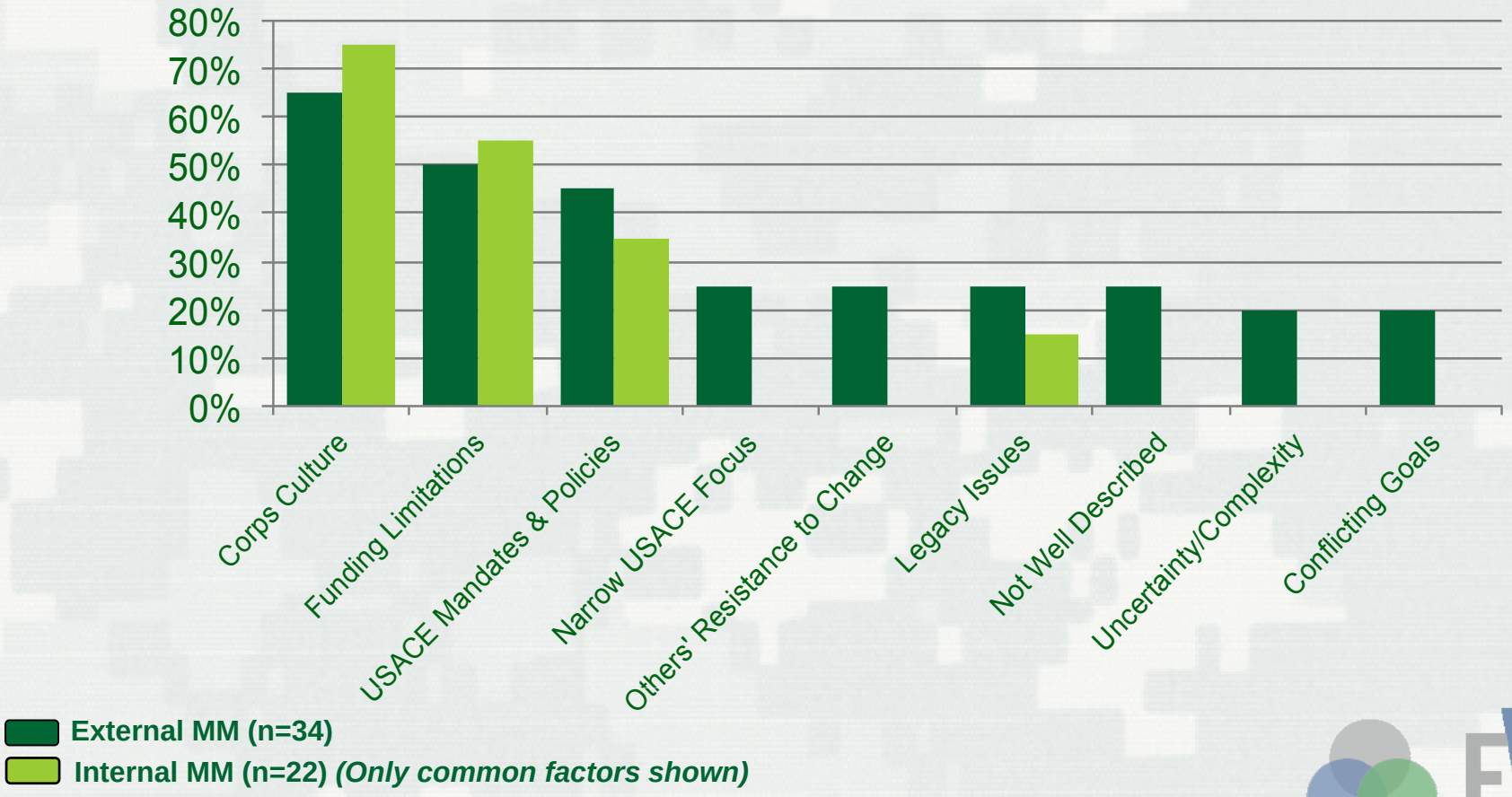
Benefits of EWN



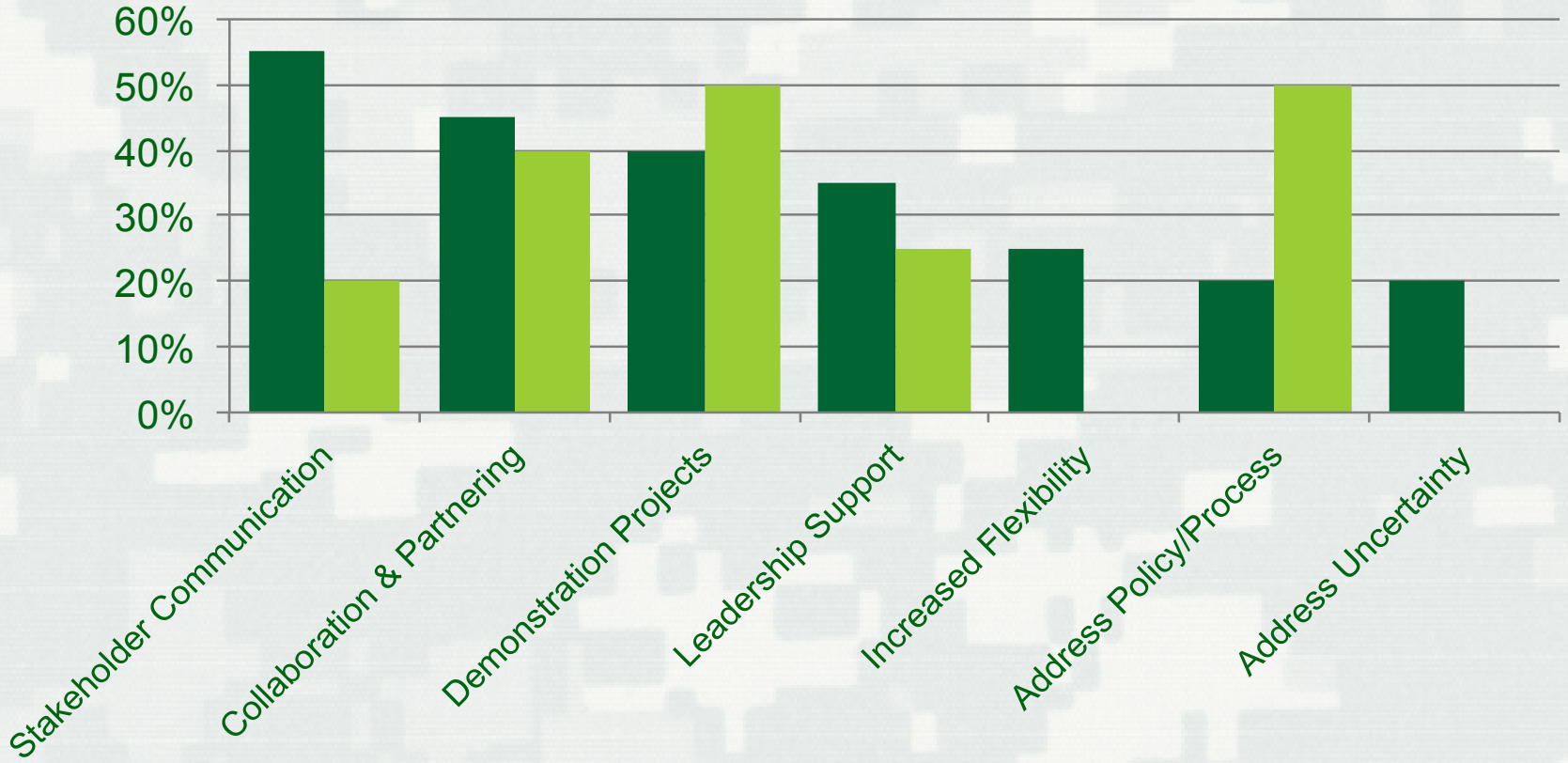
Influences on Stakeholder Interest in EWN



Barriers to EWN Adoption



Overcoming Barriers to EWN



External MM (n=34)

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

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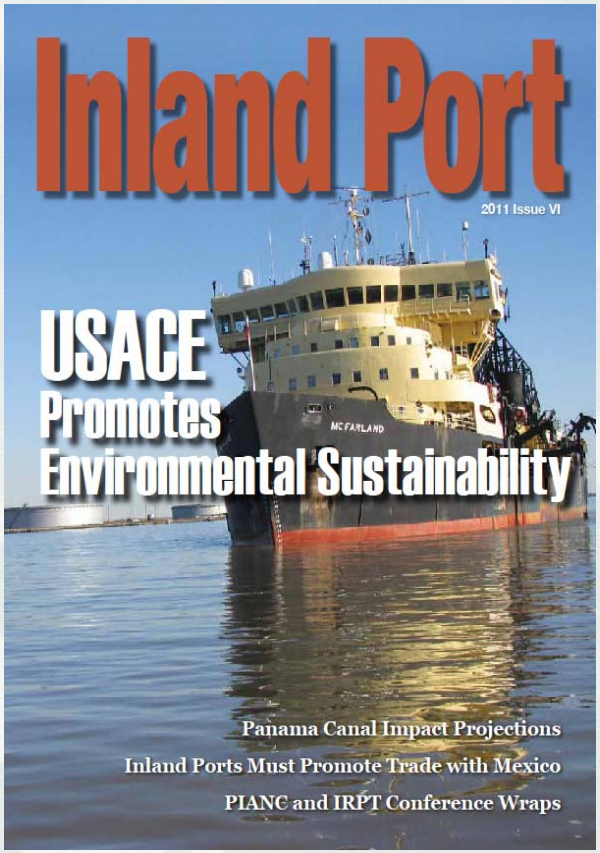
- Expand the range of benefits provided through water-based infrastructure
  - "Doing more with less"
- Balancing consideration of environmental risks with **benefits**
- A path to more sustainable projects