Engineering With Nature: A Path to Sustainable Projects and Benefits

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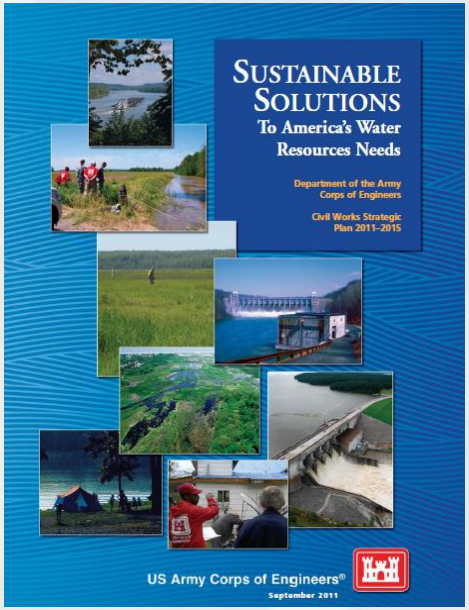
The Challenge

- 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.



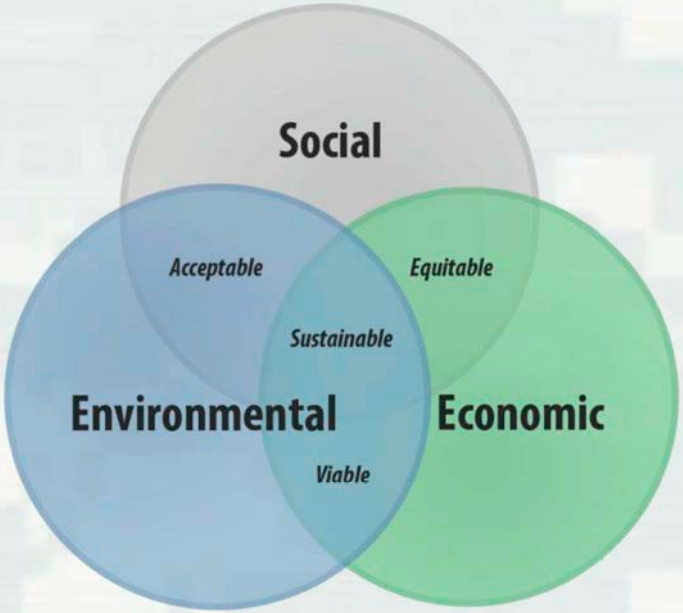
Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."

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

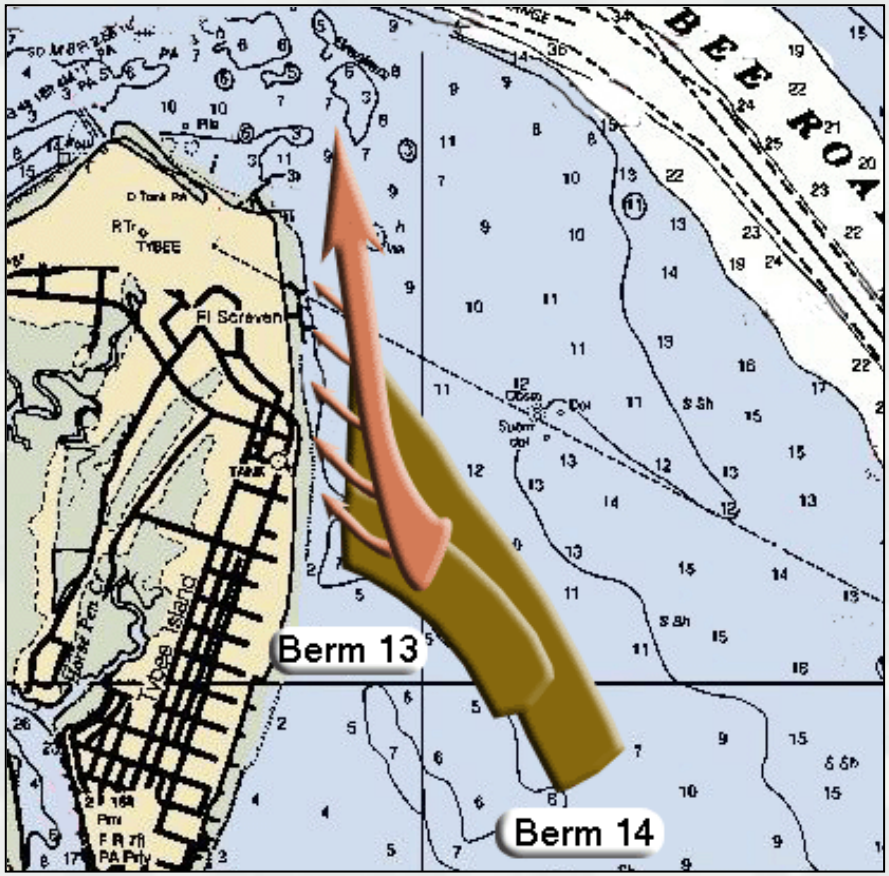


EWN Status

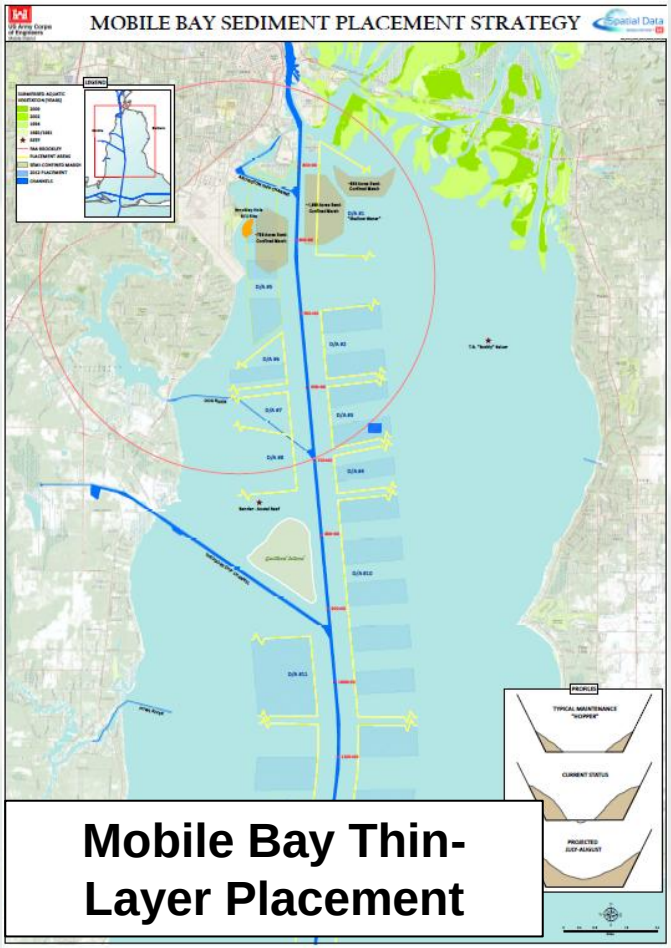
- *Engineering With Nature* initiative was started within the USACE Civil Works program in 2010. Over that period, we have:
  - Engaged > 200 ind. across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
    - Workshops (10), dialogue sessions, project development teams, etc.
  - Developed a strategic plan
  - Initiated field demonstration projects
  - Focused research projects on EWN
  - Begun implementing our communication plan

Example EWN Solutions

Strategic Sediment Placement

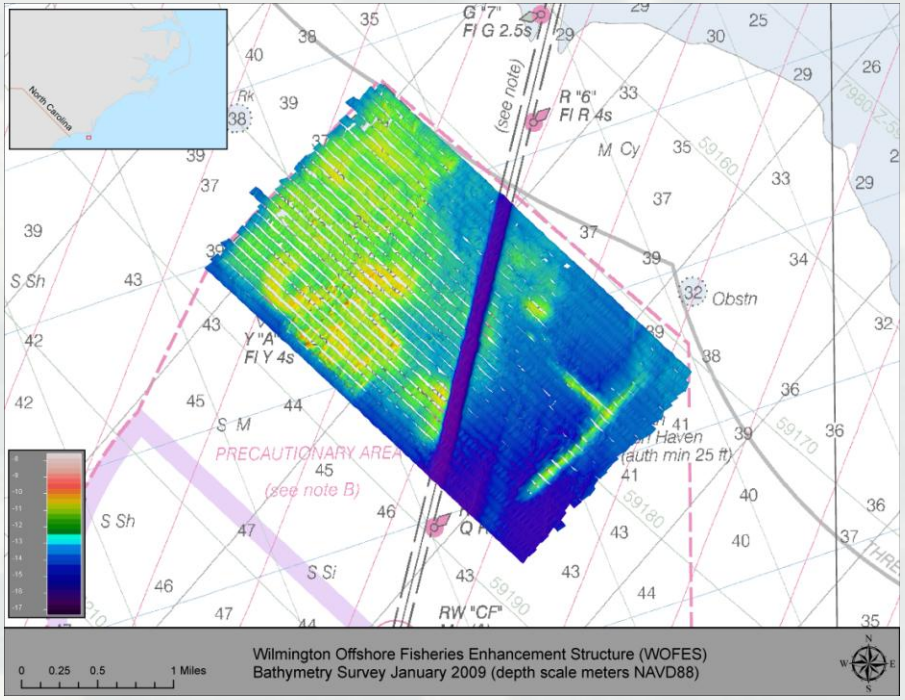


North Tybee Island
Savannah, Georgia



Mobile Bay Thin-Layer Placement

Example EWN Solutions

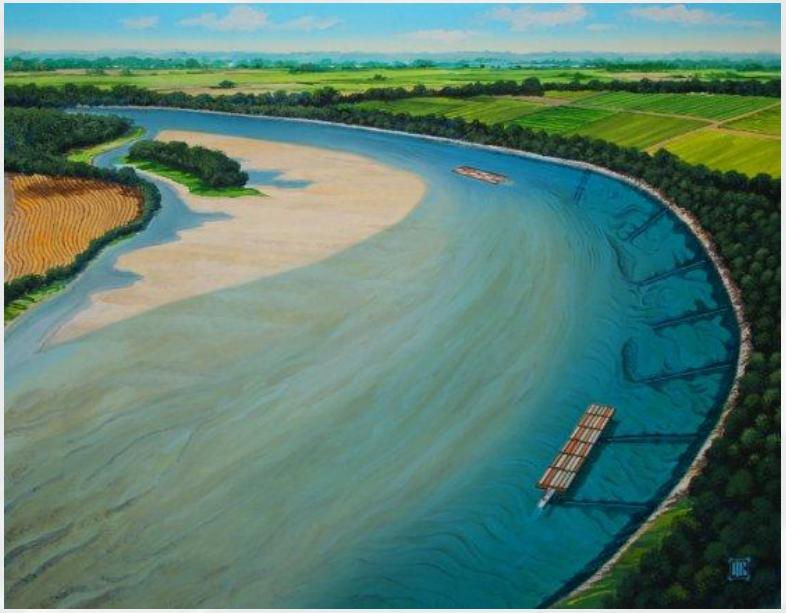


Wilmington Offshore Fisheries Enhancement Structure

Evia Island
Galveston Bay, Texas

Example EWN Solutions

Upper Mississippi River Training Structures: Chevrons



River Bendway Weirs

Environmentally Enhanced Breakwater Toe Blocks

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:

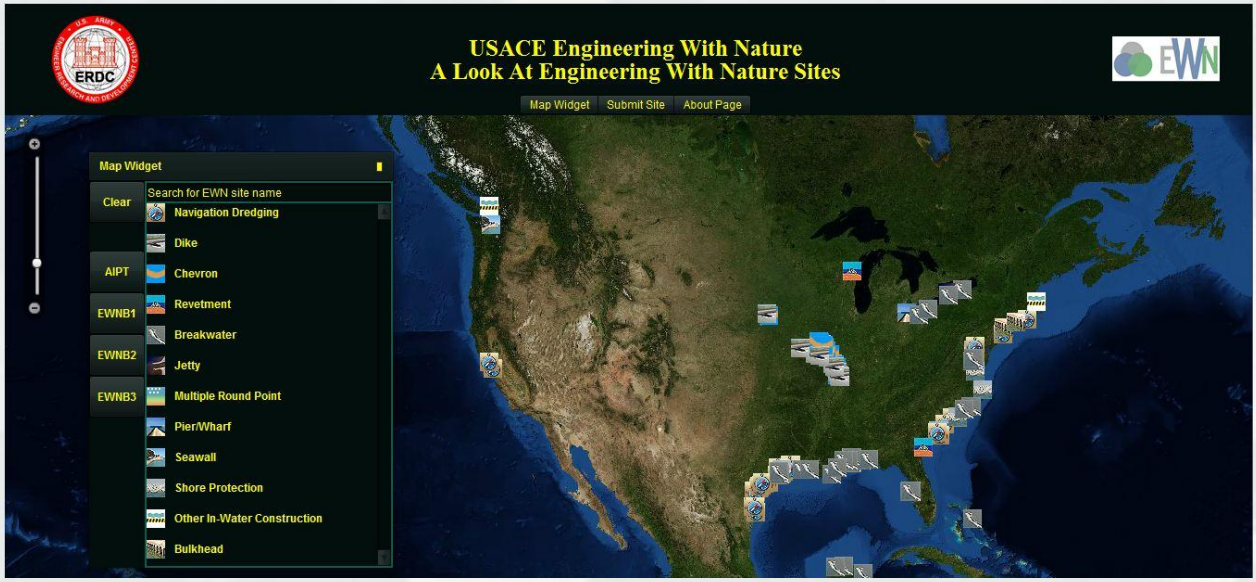
- Wetland primary productivity
- Sediment processes
  - Cohesive sediment settling
  - Sediment resuspension
  - Marsh platform erosion

Laboratory Analyses:

- Transport in vegetation
- Wave energy transformation

EWN ProMap

- Online GIS database of projects illustrating EWN principles and practices
  - Illustrating the four key attributes of EWN
- Currently contains 220 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



http://155.82.160.6/applications/opj/V013/public/viewer.swf

EWN
ENGINEERING WITH NATURE

HOME ABOUT RESOURCES R&D TOOLS ACTION PROJECTS CONTACT US

WHAT IS ENGINEERING WITH NATURE?

Engineering With Nature (EWN) is an initiative of the U.S. Army Corps of Engineers (USACE) to enable more sustainable delivery of economic, social, and environmental benefits associated with water resources infrastructure. EWN directly supports USACE's "Sustainable Solutions to America's Water Resources Needs: Civil Works Strategic Plan 2011 – 2015" and contributes to the achievement of its Civil Works Mission and Goals. EWN is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes.

UPCOMING EVENTS

21-23 MAY	USACE Coastal Resilience Conference: New Orleans, LA
1-5 JUNE	33rd PIANC World Congress: San Francisco, CA
15-18 JUNE	Western Dredging Assoc. and Texas A&M University Conference: Toronto, Canada

WHAT'S NEW

Dr. Todd Bridges, Senior Research Scientist, describes how Engineering With Nature fits within the USACE Navigation mission.

FEEDBACK FROM OTHERS

"In the old days, the Corps would identify a problem and come up with a solution and approach fish and wildlife and its partners very late in the process after resources had been pretty much committed, especially in the design phase. But because it was so late in the process, there was never any discussion about alternatives and it was pretty much take it or leave it. Engineering With Nature allows us to get involved early and have the dialogue that is needed to try some non-traditional approaches that work." -Partner Agency

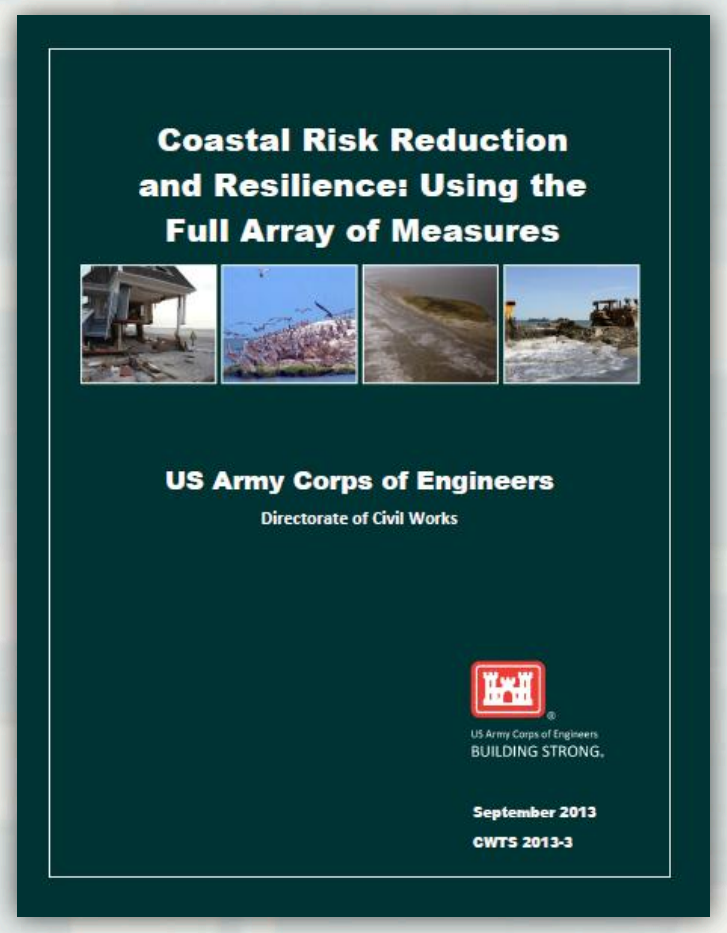
US Army Corps of Engineers

frontPORCHfodder DESIGN
www.frontporchfodder.com

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

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."*



NACCS Natural and Nature-Based Features: Multi-Disciplinary Team

Project Leaders:

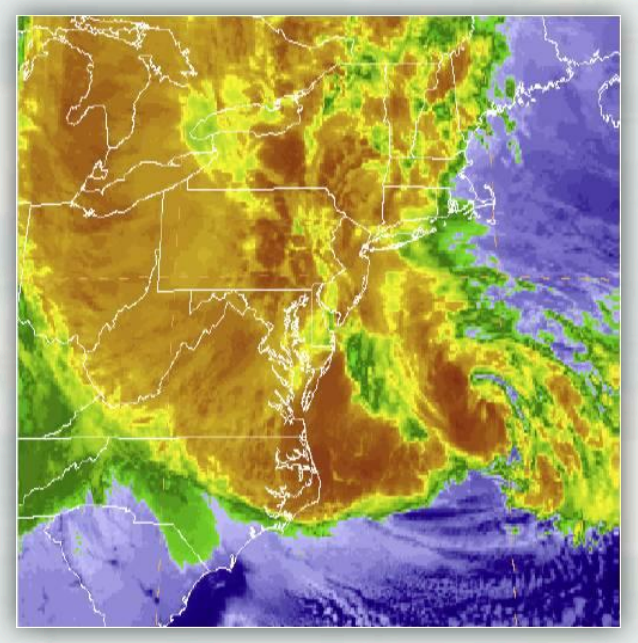
- **Paul Wagner (IWR)**
- **Todd Bridges (EL)**

Task Leaders:

- Kelly Burks-Copes (EL)
- Craig Fischenich (EL)
- Edmond Russo (EL)
- Deborah Shafer (EL)
- Ty Wamsley (CHL)

Study Team Members:

- Scott Bourne (EL)
- Pam Bailey (EL)
- Kate Brodie (EL)
- Zach Collier (EL)
- Sarah Miller (EL)
- Patrick O'Brien (EL)
- Candice Piercy (EL)
- Bruce Pruitt (EL)
- Burton Suedel (EL)
- Lauren Dunkin (CHL)
- Ashley Frey (CHL)
- Mark Gravens (CHL)
- Linda Lillycrop (CHL)
- Jeff Melby (CHL)
- Andy Morang (CHL)
- Cheryl Pollock (CHL)
- Jane Smith (CHL)
- Jennifer Wozencraft (CHL)



- Emily Vuxton (IWR)
- Jae Chung (IWR)
- Michael Deegan (IWR)
- Michelle Haynes (IWR)
- Lauren Leuck (IWR)
- David Raff (IWR)
- Lisa Wainger (U. Maryland)
- Sam Sifleet (U. Maryland)

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

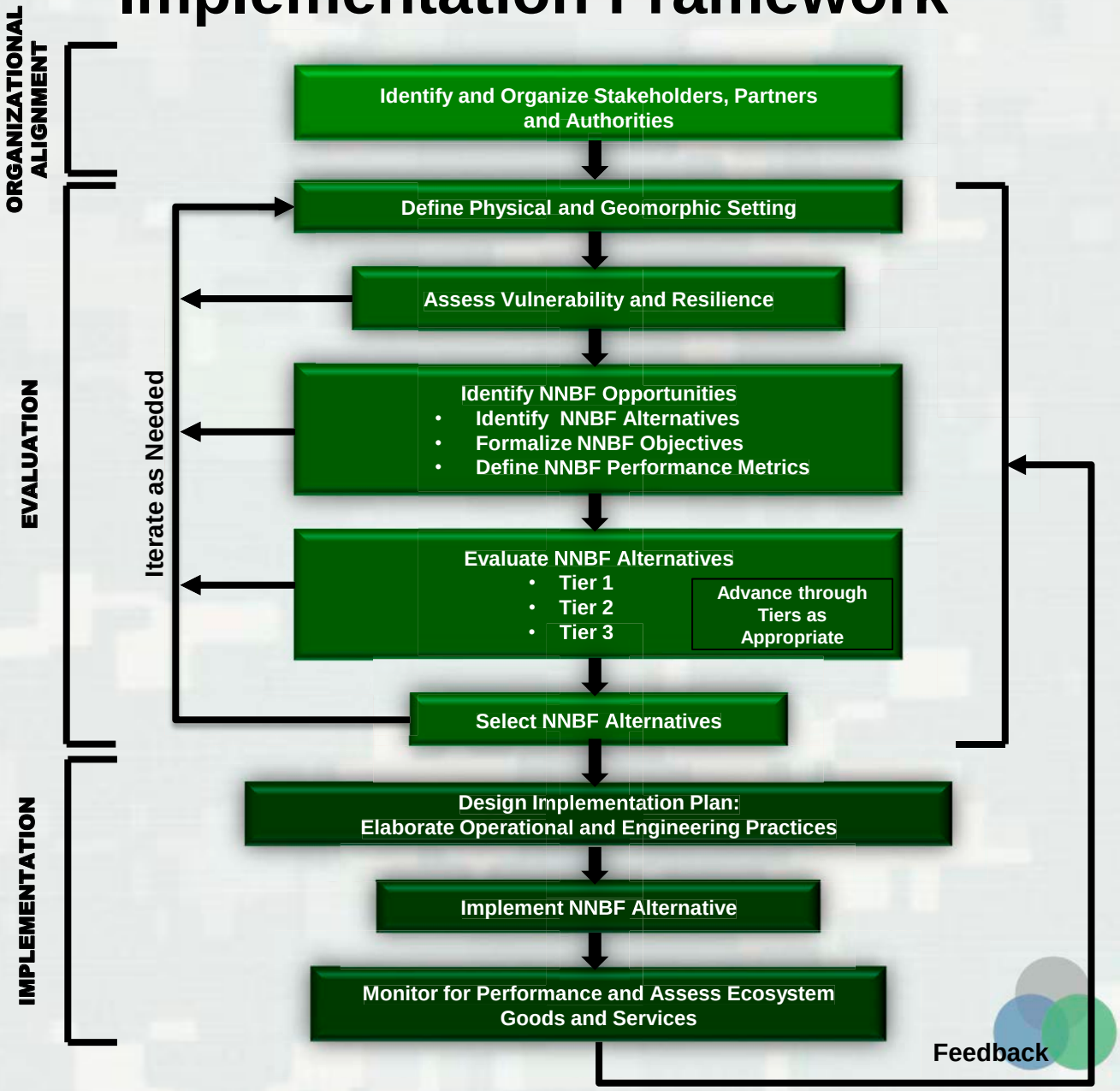
Vegetation height and density

Forest dimension

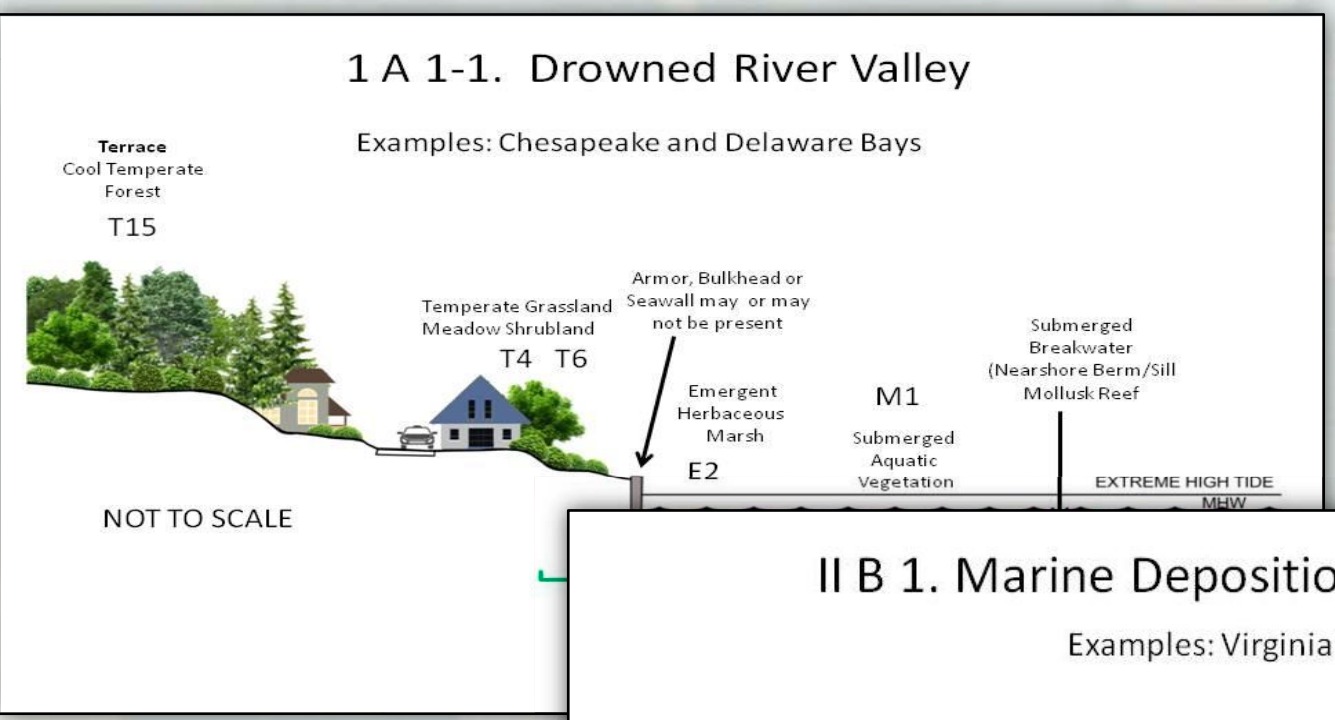
Sediment composition

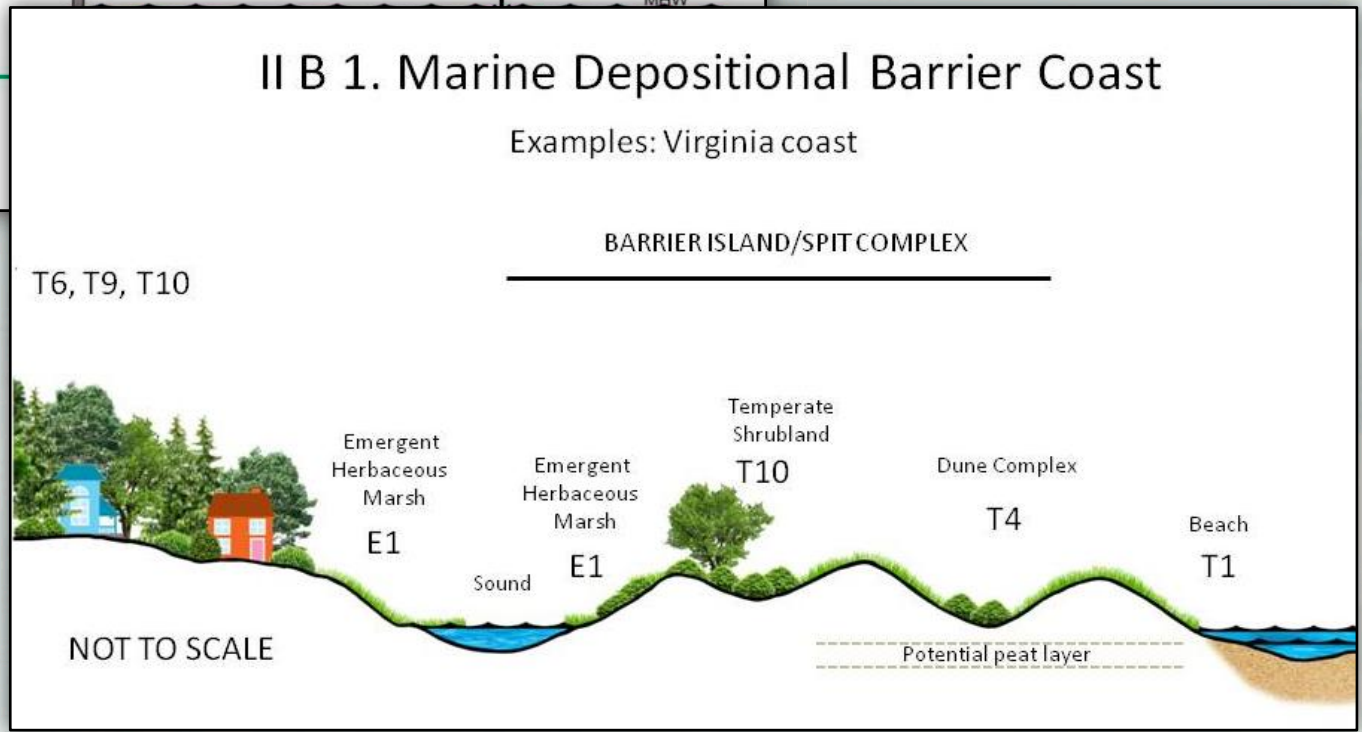
Platform elevation

Natural and Nature-Based Features Evaluation and Implementation Framework



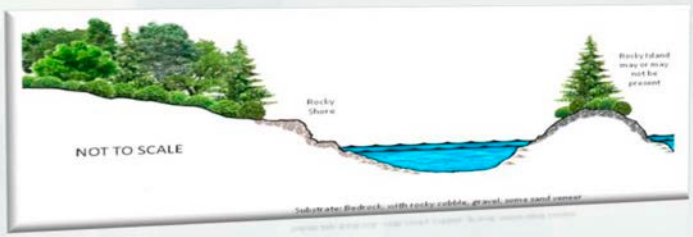
System Characterization



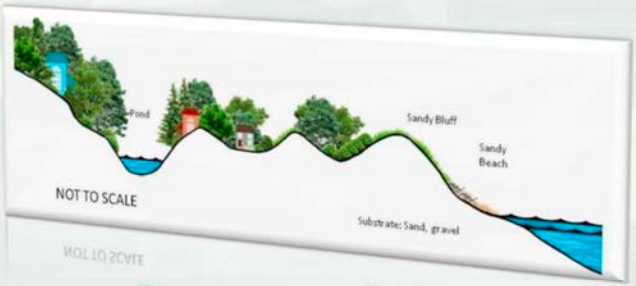


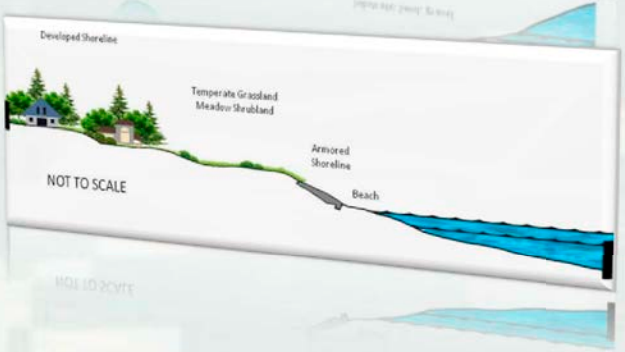
Vulnerability

Vulnerability wrt Nature-Based Features in the Coastal Zone



Relative vulnerability of coastal landscapes; how nature-based features affect vulnerability





<u>Vulnerability</u>: Degree to which a system is susceptible to, and unable to cope with, adverse effects from a hazard; vulnerability is a function of the character and magnitude of a hazard to which a system is exposed, its sensitivity, and its adaptive capacity.

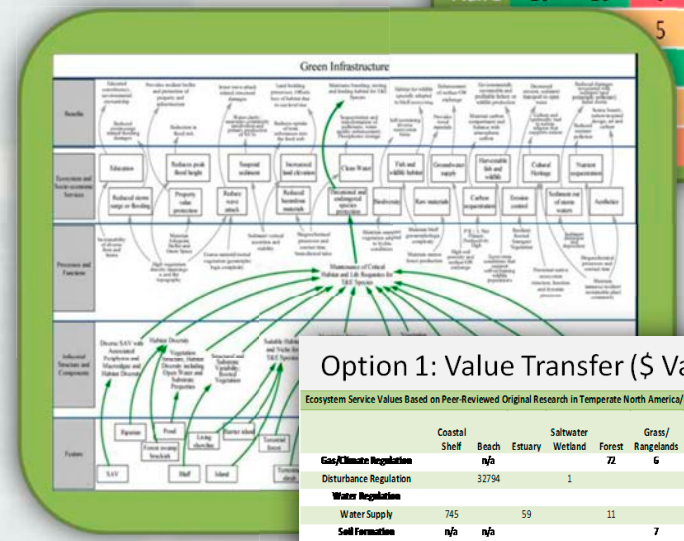
Wamsley et al. 2013 (in review)

System Performance Evaluation

- **Level 1** – Qualitative characterization of performance
- **Level 2** – Semi-quantitative characterization of performance
- **Level 3** – Quantitative characterization of performance

72 individual performance metrics identified for NNBF

Wt	1	2	4	3	5		
	B1	B2	B3	B4	B5	Mean	Wtd
Plan A	10	8	5	1	0	4.8	49
Plan B	10	10	0	0	0	4	30
			5	9	7	7.2	102
				8	5	7.8	115
				10	10	7	115
				4	7	5.6	80



Option 1: Value Transfer ($ Value per acre)

Ecosystem Service Values Based on Peer-Reviewed Original Research in Temperate North America/Europe (2012 $/(ac*yr))

	Coastal Shelf	Beach	Estuary	Saltwater Wetland	Forest	Grass/ Rangelands	Cropland	Freshwater Wetland	Open Fresh Water	Riparian Buffer	Urban Greenspace	Urban/ Barren
Gas/Climate Regulation		n/a			72	6					404	
Disturbance Regulation		32794		1						106		
Water Regulation								7162			7	
Water Supply	745		59		11			1396	492	2310		
Soil Formation	n/a	n/a				7			n/a			
Nutrient Cycling		n/a										
Waste Treatment		n/a		7322								
					195		10		n/a			
					277	1110			6			
					31	156	1	18	1889	428	1647	2562
					216						5	

Option 2: Ecosystem Production Functions

Moving Forward. . .

- Organize and expand science and engineering related to natural processes and features
  - Reduce uncertainties regarding design and performance of NNBF
  - Understand dynamic performance of NNBF
  - How to effectively integrate NNBF with other measures
- Integrating expertise across disciplines and organizations
  - Planning, designing, constructing, operating, monitoring, and maintaining integrated systems

Upcoming Event

Coastal Resilience Technical Conference:
The Environment, Infrastructure, and Human Systems

21-23 May 2014

New Orleans, Louisiana

US Army Corps of Engineers®

Points of Contact

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