



Engineer Research and  
Development Center

# R&D Supporting Sustainable Solutions

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E&C-R&D Webinar Discussion  
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US Army Corps  
of Engineers®



# R&D Relevant to Sustainability Outline

- Energy conservation, alternative fuels
- Sustainability through *Engineering With Nature*
  - Tools: Efficiency, “Footprint”
  - Getting the most from natural processes
  - Getting the most from natural systems
  - EWN Action Projects
- Sustainability opportunities



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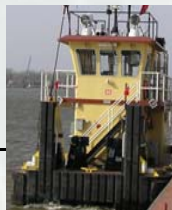
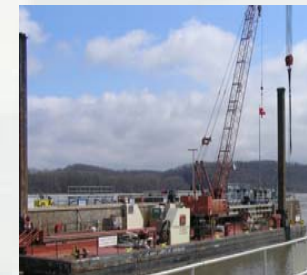
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# Evaluation of the Viability of Using Alternative Fuels in USACE Floating Plant



## • Process

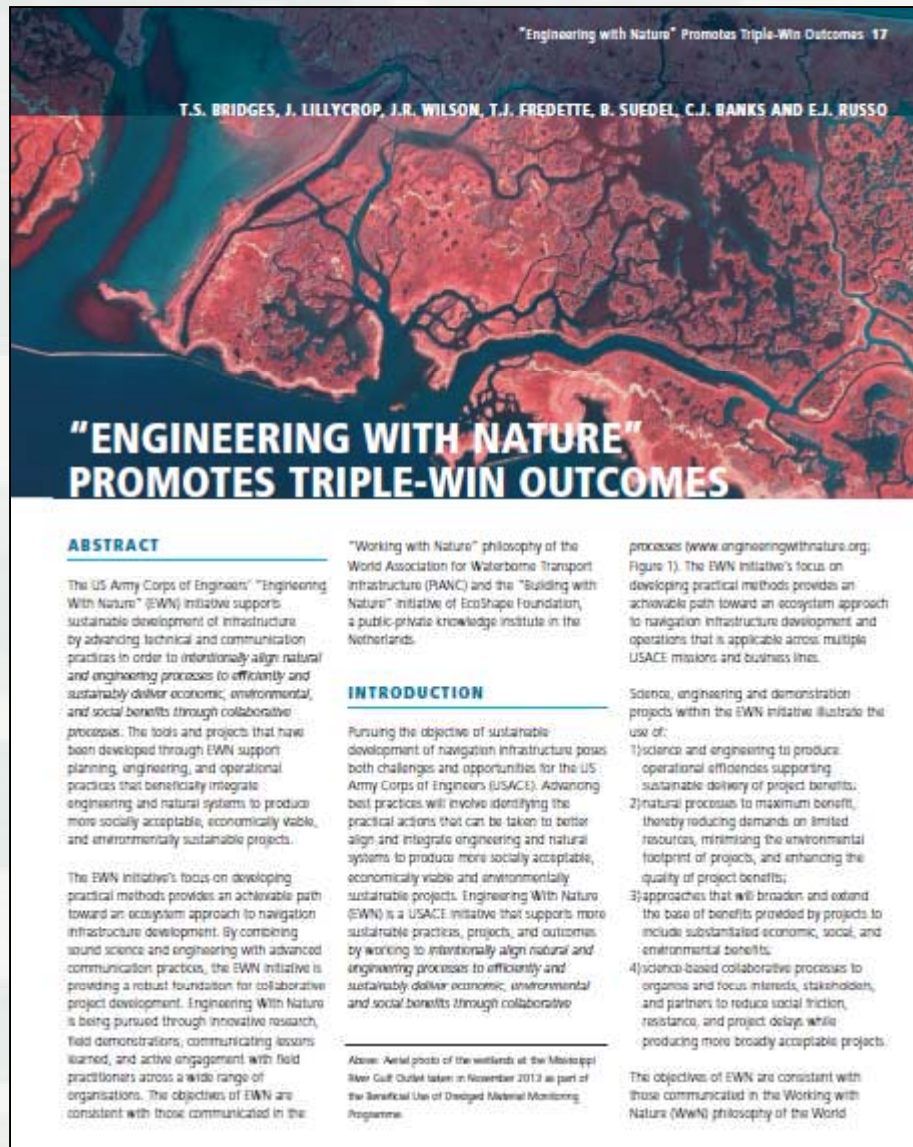
- Preparatory Steps: Educate crew, conduct pretrial engine assessments, and develop vessel-specific action plans.
- Initially tested 4 vessels with (soybean-based) B100. for engine performance/maintenance and basic emissions.
- Based on successful results, expanded biodiesel testing (ranging from B5 to B100 and included a 2<sup>nd</sup> generation algae-based biodiesel provided by Navy on 10 additional floating plant and did detailed emissions testing on two of these).



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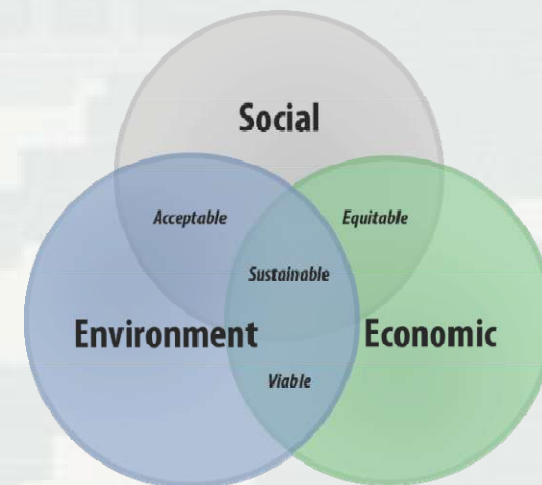
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# Triple-Win Solutions: From "s" to "S" Sustainability

- Current focus is on energy conservation
- The concept of Sustainability addresses the full distribution of benefits and costs

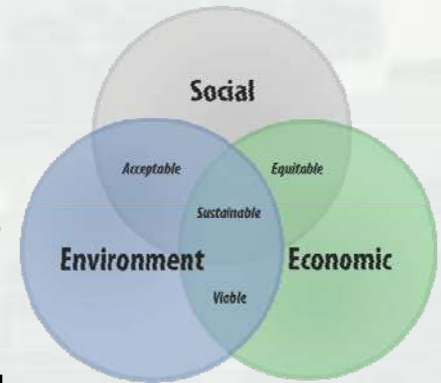


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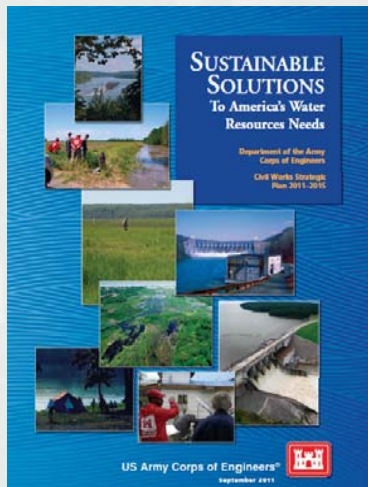
# *Engineering with Nature for Sustainable, Resilient Systems*



## **Engineering With Nature**

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

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Expanding the benefits provided by projects
- Science-based collaboration

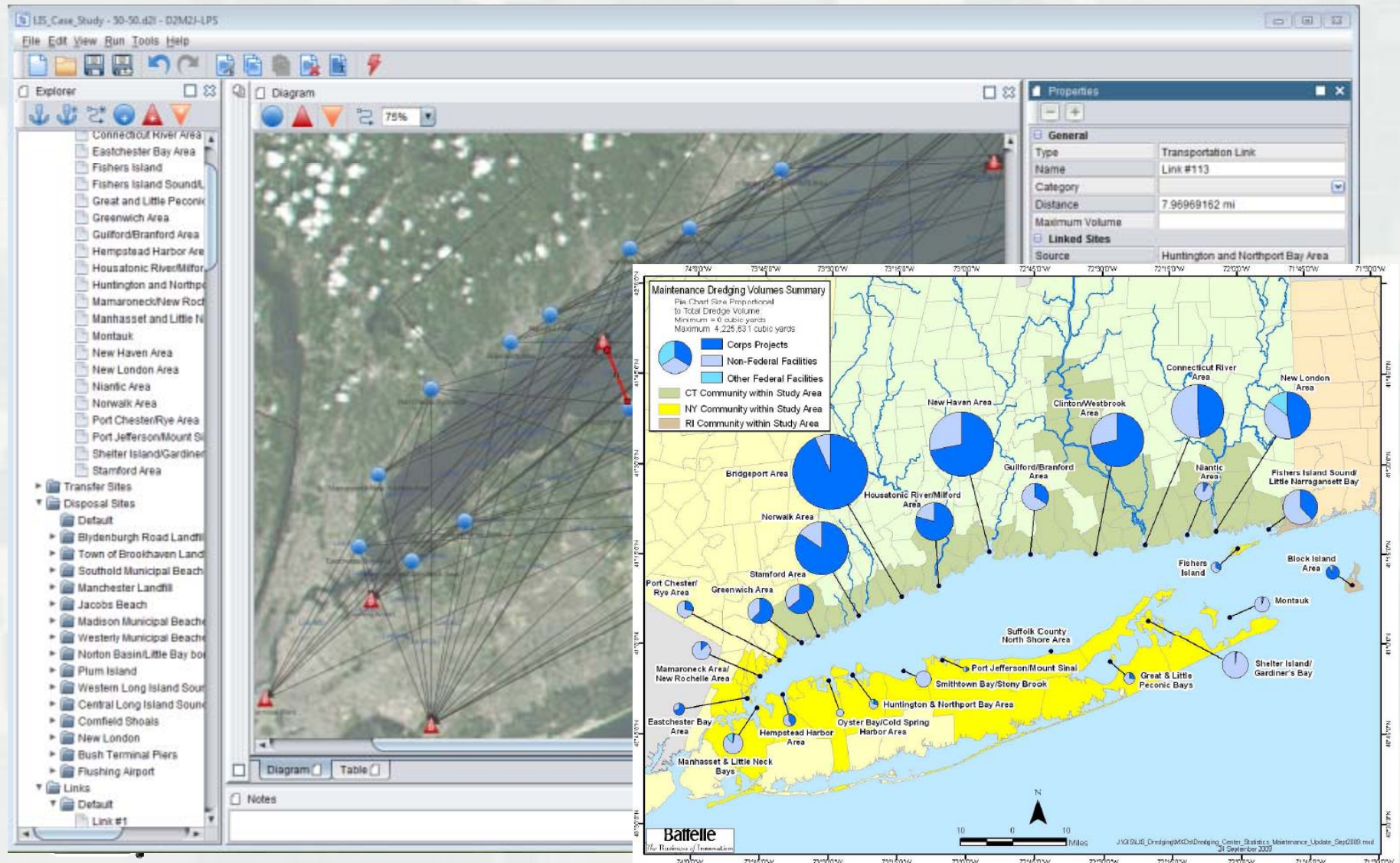


Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."





# Optimizing Operations: Dredged Material Management Decisions (D2M2)



# Understanding “Footprint”: Life Cycle Assessment

1. Goal and Scope Definition
2. Inventory Analysis
3. Impact Assessment
4. Results and Interpretation

Definition

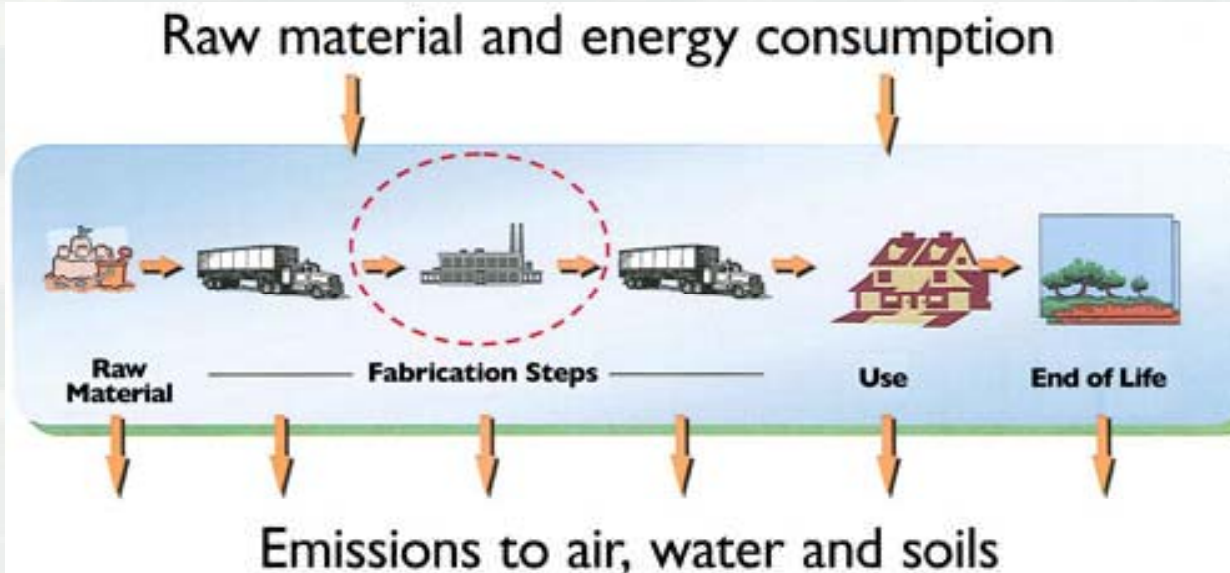
- Define goal and scope
- Collect data

Inventory

- Create/import flows
- Process inventory
- Implement characterisation factors

Results

- Choose LCIA method
- Compare alternatives
- Sensitivity analysis



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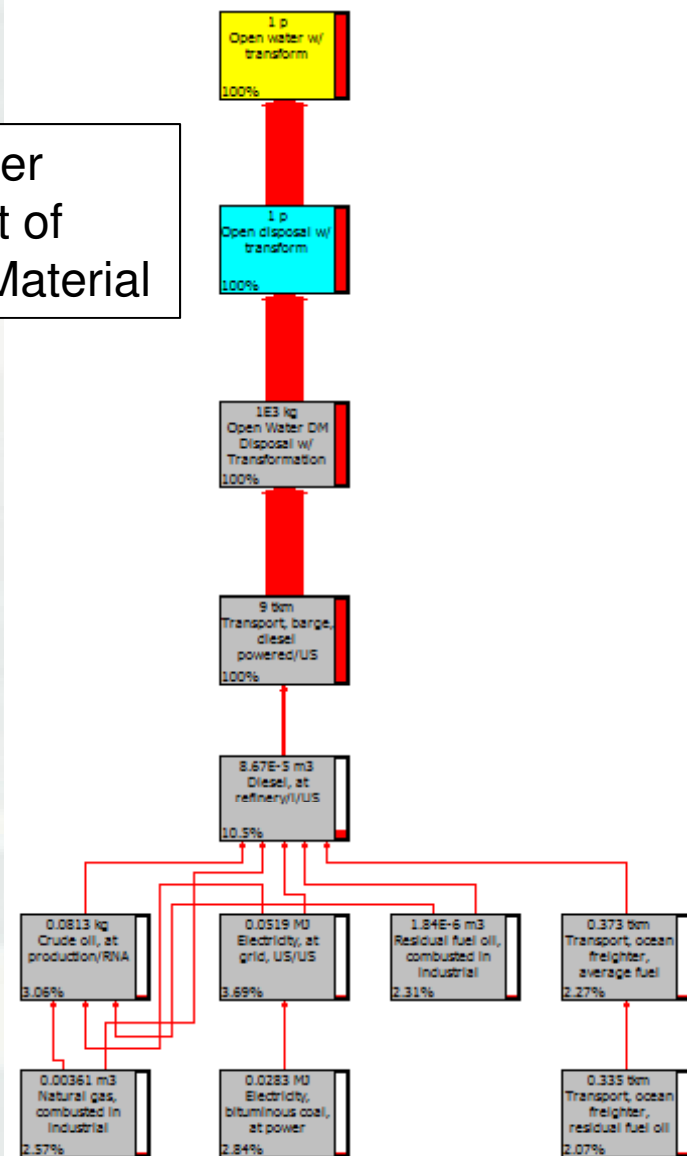


## Open-Water Placement of Dredged Material

## Databases of Inputs and Outputs

### Inputs

Flow	Category	Flow property	Amount	Unit	Star
F Aluminium, 24% in b...	Elemen...	Fr Mass	5.24E-8	kg	
F Anhydrite, in ground	Elemen...	Fr Mass	3.26E-12	kg	
F Barite, 15% in crude o...	Elemen...	Fr Mass	2.85E-6	kg	
F Basalt, in ground	Elemen...	Fr Mass	9.17E-8	kg	
F Borax, in ground	Elemen...	Fr Mass	2.22E-10	kg	
F Bromine, 0.0023% in ...	Elemen...	Fr Mass	3.65E-13	kg	
F Cadmium, 0.30% in s...	Elemen...	Fr Mass	5.89E-11	kg	
F Calcite, in ground	Elemen...	Fr Mass	8.93E-6	kg	
F Carbon dioxide, in air	Elemen...	Fr Mass	2.15E-6	kg	
F Carbon, in organic m...	Elemen...	Fr Mass	5.8E-10	kg	
F Chromium, 25.5% in ...	Elemen...	Fr Mass	4.75E-8	kg	
F Chrysotile, in ground	Elemen...	Fr Mass	6.96E-12	kg	
F Cinnabar, in ground	Elemen...	Fr Mass	6.24E-13	kg	
F clay occupation	Ztest	Fr Volume	6.26E-4	m3	
F Clay, bentonite, in gr...	Elemen...	Fr Mass	3.19E-7	kg	
F Clay, unspecified, in ...	Elemen...	Fr Mass	2.08E-6	kg	



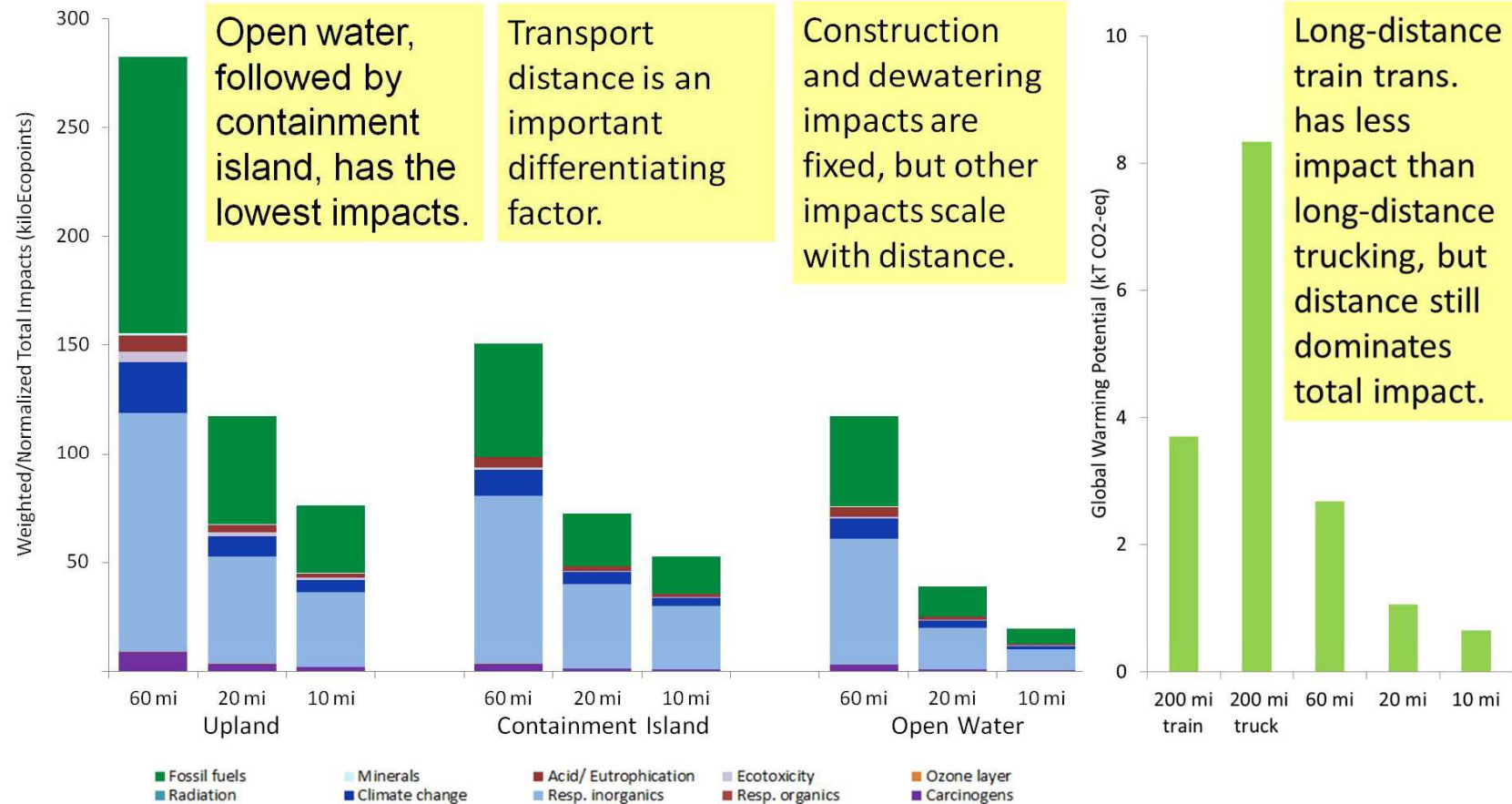
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# LCA Results Applied to DM Management

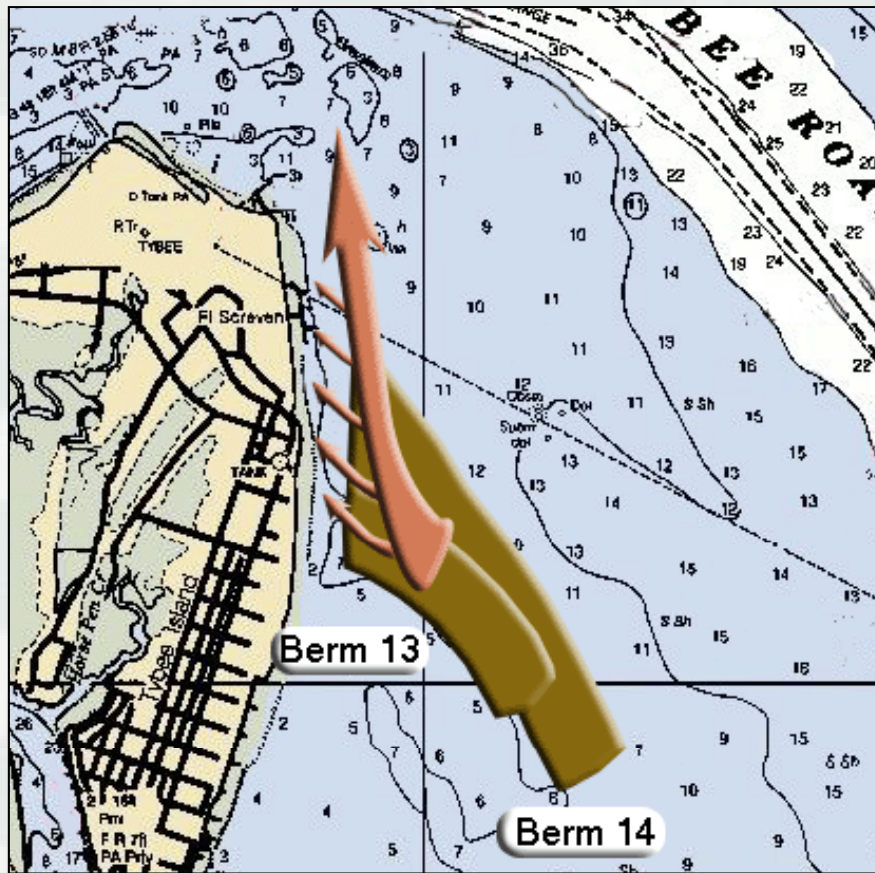


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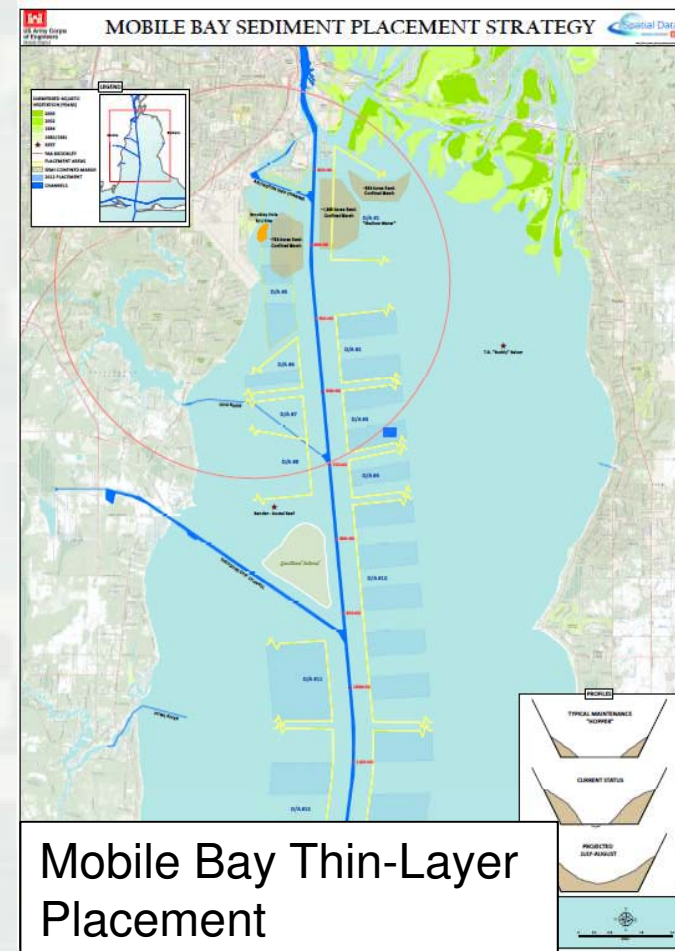
# Sustainable Solutions: *Strategic Sediment Placement*



North Tybee Island  
Savannah, Georgia



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Mobile Bay Thin-Layer  
Placement



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# Sustainable Solutions: *Using Large-Scale, Natural Forces*

## Missouri River:

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

July 2009



November 2011



Courtesy: G. Pavelka  
USACE, 2012



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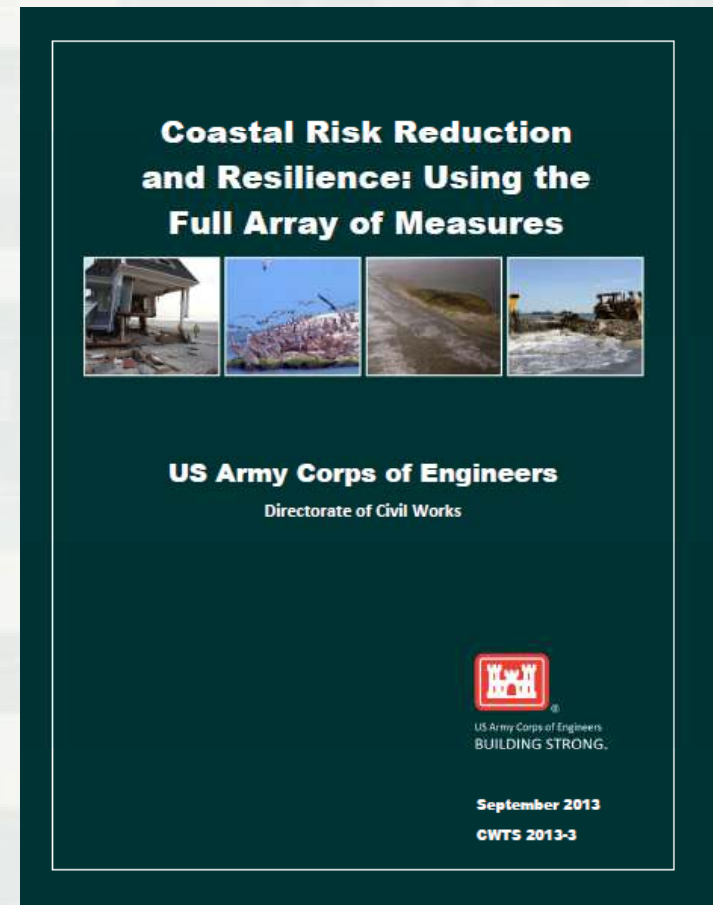
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# Systems: Coastal Risk Reduction and Resilience

*“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.”*



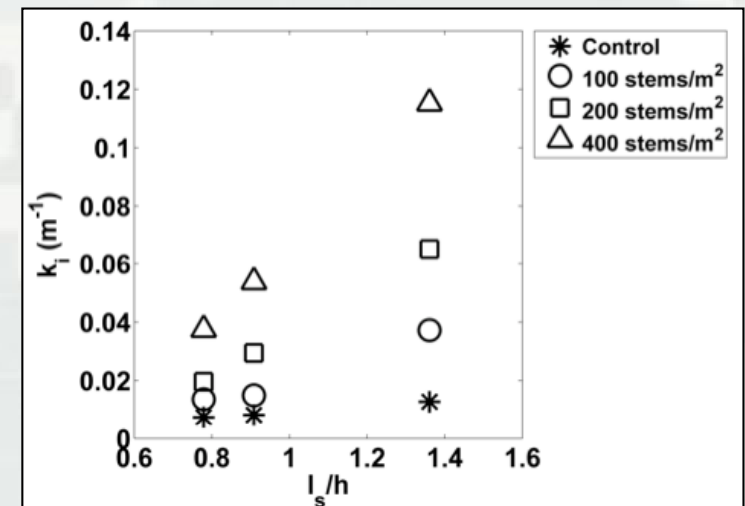
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# Wave Attenuation by Wetlands

- What are the engineering benefits of wetlands of waves?
- Flume studies being performed in the 10 ft flume
  - Complemented by examination of sediment processes and field studies
- Wave attenuation was found to:
  - increase with stem density
  - increase with submergence ratio
  - slight increase with incident wave height
- Results used to update STWAVE



# 82<sup>nd</sup> Annual Conference of Mayors

June 20-23, 2014; Dallas, TX

## Conference Resolution on Natural Infrastructure

**BE IT RESOLVED**, that The United States Conference of Mayors encourages its members to prioritize **natural infrastructure** and supports the funding and implementation of **natural solutions** to protect freshwater supplies, **defend the nation's coastlines**, maintain a healthy tree and greenspace cover and protect air quality, and create a new generation of environmental leaders, which ensures cities can support a growing population and prepare for the future; and

**BE IT FURTHER RESOLVED**, that The U.S. Conference of Mayors believes partnerships developed between local governments and non-profit organizations are an effective way to identify and implement opportunities for **green infrastructure**.



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# 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



# Sustainability Opportunities

- “Sustainability” provides an opportunity for USACE to remold regulatory paradigms and constraints
  - Balancing consideration of environmental risks with project **benefits**
- Combining the goals of engineering / operational efficiency with production of broader range of benefits is a stronger argument for infrastructure



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