

# Engineering With Nature

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**EWN Workshop**

ERDC

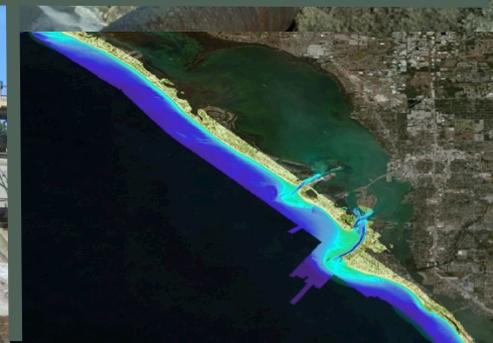
July 18-19, 2017



US Army Corps  
of Engineers.

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Engineer Research and  
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# Creating Value through Alignment...

- What opportunities are there for achieving better alignment of natural and engineered systems?
  - ▶ Can improved alignment produce engineering functions, services, benefits?
  - ▶ What range of services can be produced through such alignment?
  - ▶ What are the science and engineering needs in order to achieve better alignment?



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

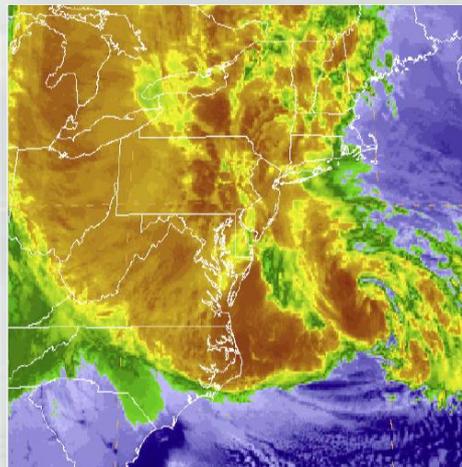


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# Value and Use of Natural Systems

## Following Hurricane Sandy:

- Risk industry-based tools used to quantify the economic benefits of coastal wetlands
  - ▶ Temperate coastal wetlands saved more than \$625 million in flood damages.
  - ▶ In Ocean County, New Jersey, salt marsh conservation can significantly reduce average annual flood losses by more than 20%.



### COASTAL WETLANDS AND FLOOD DAMAGE REDUCTION

Using Risk Industry-based Models  
to Assess Natural Defenses in the Northeastern USA

October 2016



# Engineering With Nature™...

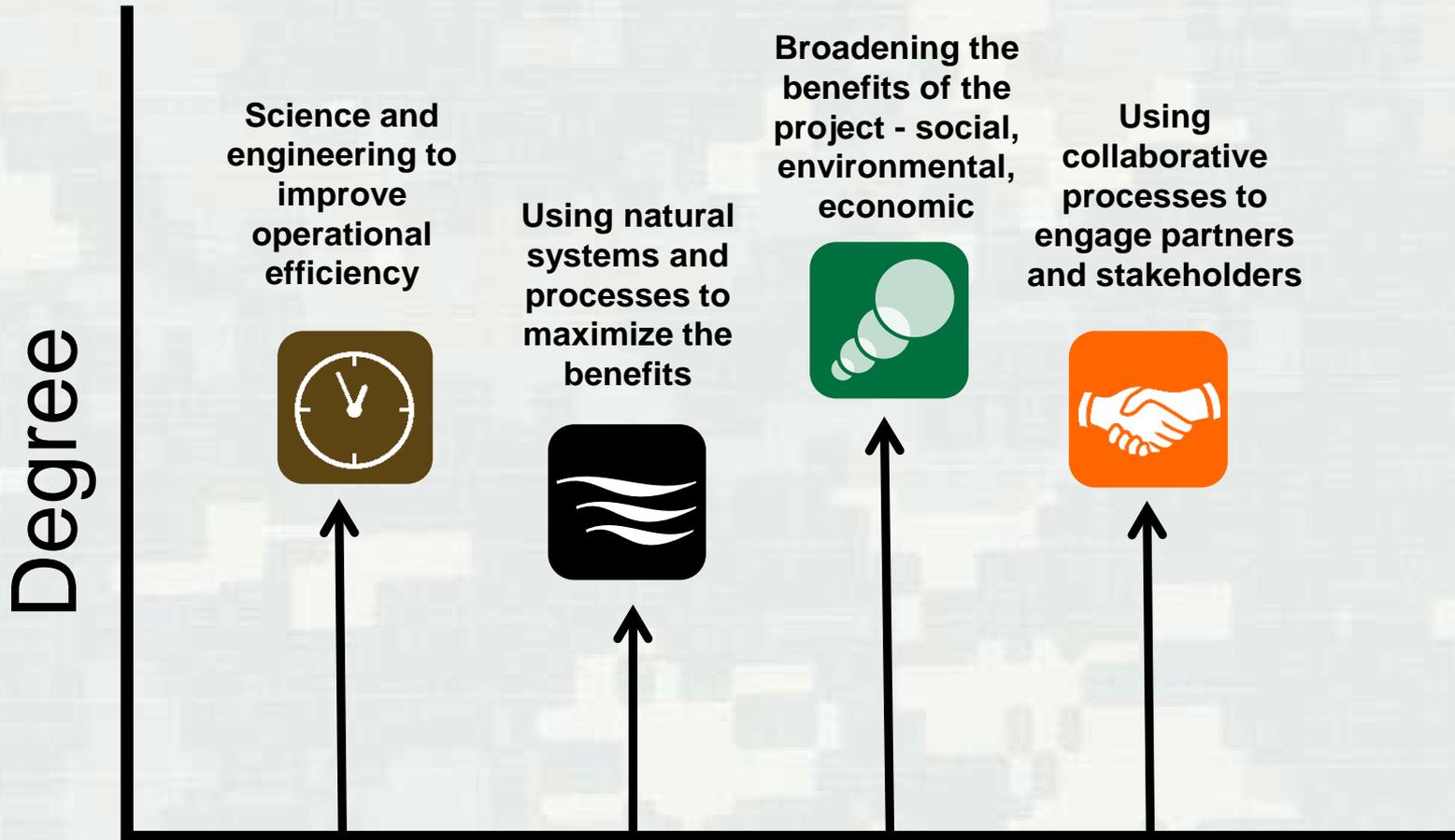
*...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.*

## Key Elements:

- 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



# Engineering With Nature Elements

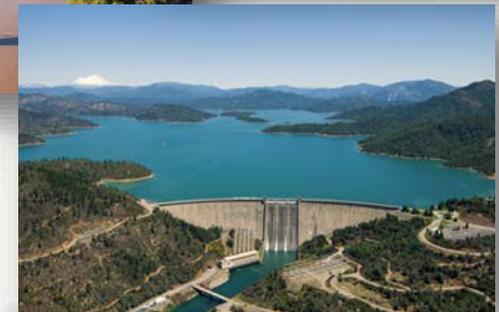
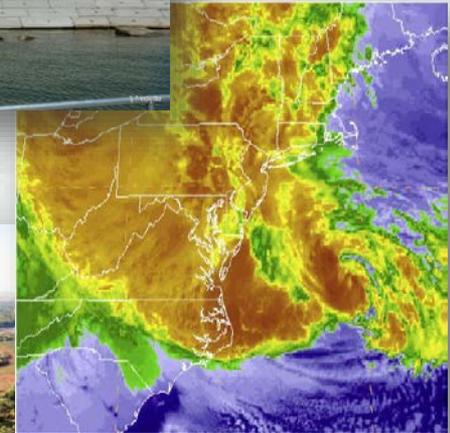


EWN Elements



# EWN Across USACE Mission Space

- Navigation
  - ▶ Strategic placement of dredged material supporting habitat development
  - ▶ Habitat integrated into structures
  - ▶ Enhanced Natural Recovery
- Flood Risk Management
  - ▶ Natural and Nature-Based Features to support coastal resilience
  - ▶ Levee setbacks
- Ecosystem Restoration
  - ▶ Ecosystem services supporting engineering function
  - ▶ “Natural” development of designed features
- Water Operations
  - ▶ Shoreline stabilization using native plants
  - ▶ Environmental flows and connectivity



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# EWN Status

- *Engineering With Nature* initiative started within USACE Civil Works program in 2010.
  - ▶ Engaging across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
    - Workshops (>20), dialogue sessions, project development teams, etc.
  - ▶ Guided by a strategic plan
  - ▶ Informed by focused R&D
  - ▶ Demonstrated with field projects
  - ▶ Advanced through partnering
  - ▶ Shared by strategic communications
  - ▶ Marking progress
    - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
    - 2014 USACE National Award-Green Innovation



[www.engineeringwithnature.org](http://www.engineeringwithnature.org)

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# EWN Assistant Leads



Mary Bryant



Jeff King



# USACE Galveston, Buffalo, Philadelphia Districts: EWN “Proving Grounds”

- EWN Proving Ground Kick-Off Workshops
  - ▶ October (SWG) and December (LRB) 2014; June 2016 (NAP)
  - ▶ District, Division, EWN Leadership Team
- Identify opportunities to implement EWN across current and future programs and projects
- Emphasis on solution co-development



# Chehalis Basin Floodplain Restoration



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# Noordwaard



# Onehunga Bay Foreshore Restoration Auckland, New Zealand



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# Dutch Sand Motor



- 2011 construction
- 21.5 mcm of sand



# Fort Pierce City Marina, Florida



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# Enhancing Ecosystem Value



Upper Mississippi River Training Structures: Chevrons



Loosahatchie Bar, Memphis

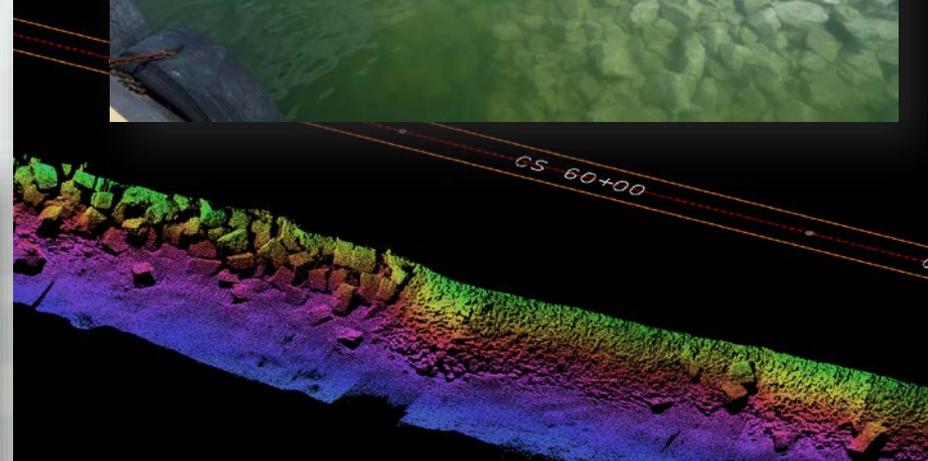


# EWN for Breakwaters

## Ashtabula Harbor



## Milwaukee Harbor



# Horseshoe Island EWN Project Atchafalaya River

- Options for managing DM via shore-based wetland creation were exhausted
- Strategic placement of sediment (0.5-1.8 mcy/1-3 yrs) was used to create a ~35 ha island
- Producing significant environmental and engineering benefits
- Project won WEDA's 2015 Environmental Excellence and 2017 Climate Change Adaptation awards



# Engineering with Natural Materials



## National Large Wood Manual

Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure

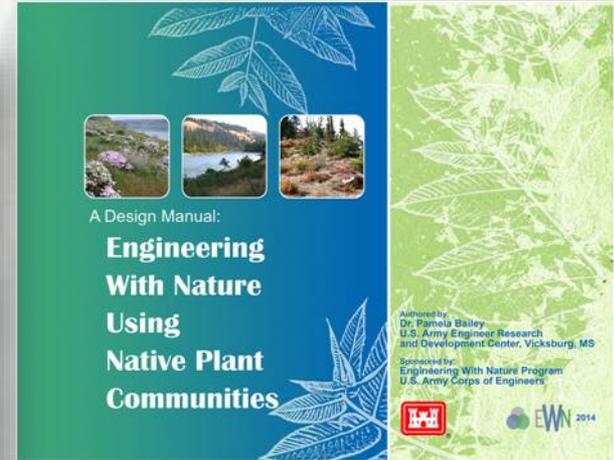
January 2016



U.S. Department of the Interior  
Bureau of Reclamation



US Army Corps  
of Engineers  
Engineer Research and  
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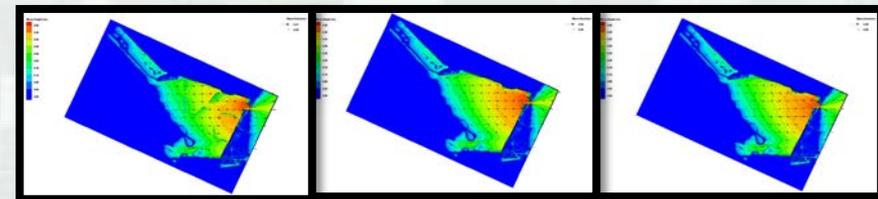
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# EWN Research at Hamilton and Sears Point Wetland Development, San Pablo Bay

- Accelerate wetland development using berms to support sedimentation during tidal inundation
- Remotely monitoring physical processes: wind, waves, currents suspended sediments, settling velocities, etc.
- Modeling wave generation and dissipation, testing different shapes/configurations of berms



Linear Berms (As-Built)

No Berms (Control)

Mounds (ala Sears Pt.)



# Duluth Harbor Thin-Layer Placement



# USACE Philadelphia District: Back Bay EWN



Mordecai Island



Stone Harbor

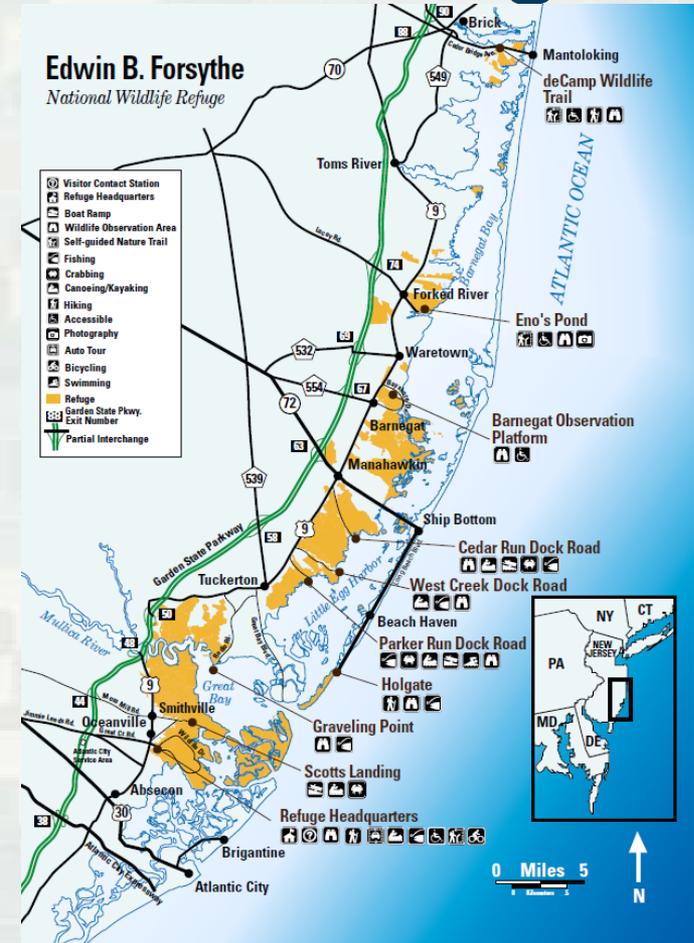


Avalon

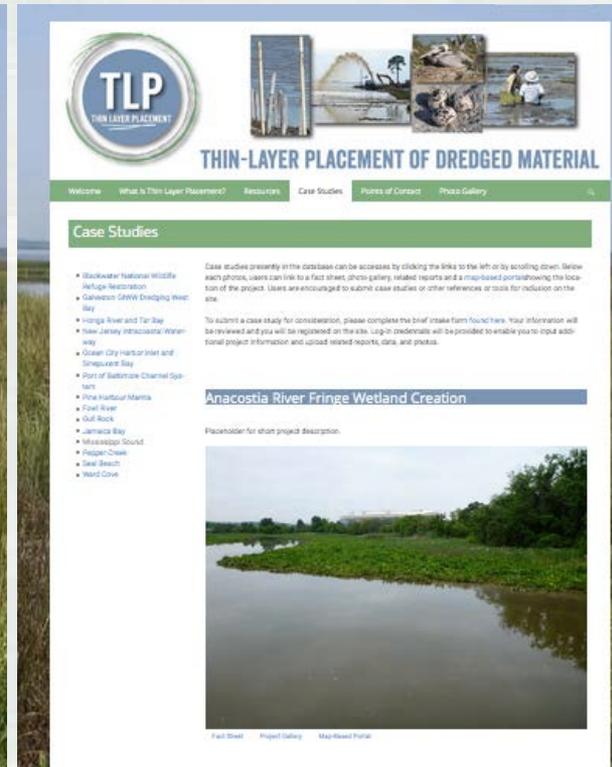
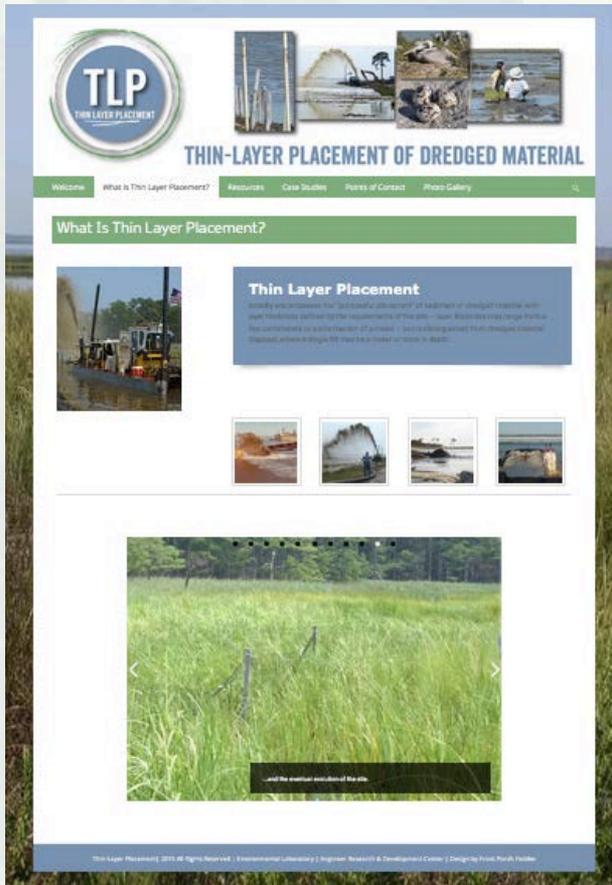


# US Fish and Wildlife Service Forsythe National Wildlife Refuge

- Forsythe NWR: >40,000 acres of wetlands and other habitat in coastal NJ
- Collaboration objective: Enhance ecosystem resilience through engineering and restoration
- Means: Smart use of sediment resources and EWN principles and practices



# Thin-Layer Placement Website



[www.engineeringwithnature.org](http://www.engineeringwithnature.org) (under Tools)



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# Vegetation on Levees



DEPARTMENT OF THE ARMY  
U.S. ARMY CORPS OF ENGINEERS  
441 G STREET, NW  
WASHINGTON, D.C. 20314-1000

CECW-ZB

JUN 21 2017

MEMORANDUM FOR MAJOR SUBORDINATE COMMANDS, AND DISTRICTS

SUBJECT: Further Advancing Project Delivery Efficiency and Effectiveness of USACE Civil Works

1. Beginning 1 July 2017, this office will embark on a comprehensive organizational review of current authorities, policies, regulations, and procedures. The desired outcome is to identify opportunities for enhanced project delivery and increased organizational efficiency and effectiveness by reducing redundancies and delegating authority for decision making to the most practical and appropriate level. As a world class organization, we are committed to reliably delivering the best quality projects and services on time, and within budget. To do so, we must fully implement our Project Management doctrine, recognize risk and uncertainties, and develop mitigation strategies that allow us to accept appropriate levels of risk to improve project delivery. As part of the Civil Works strategy, I intend to operationalize risk-informed decision making at all levels in the organization, and then I expect discipline in documenting these decisions at the appropriate level. The following five paragraphs capture the key lines of effort that I expect us all to advance.

2. **Embrace and Operationalize Risk-Informed Decision Making.** We must change our behavior regarding risk management across Civil Works and in our policies, analytical approaches and models, priorities, and dialogue with sponsors and communities. Civil Works will undertake the following steps to develop a more comprehensive understanding and application of risk-informed decision making and project delivery across the agency:

a. Publish an Engineer Circular entitled *USACE Risk Framework*. This document will establish common principles for assessing, managing, and communicating risk. It

c. Levee Safety is working with the Engineer Research and Development Center Engineering with Nature effort and natural resources interests to design a risk-informed decision-making process for consideration of endangered species habitat needs as they relate to vegetation on levees.

7. I look forward to getting your feedback on these ideas and actions and advancing Civil Works policies, procedures, and operations.

Handwritten signature of James C. Dalton.

JAMES C. DALTON, P.E.  
Director of Civil Works

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# The North Atlantic Coast Comprehensive Study

## Coastal Risk Reduction and Resilience: Using the Full Array of Measures

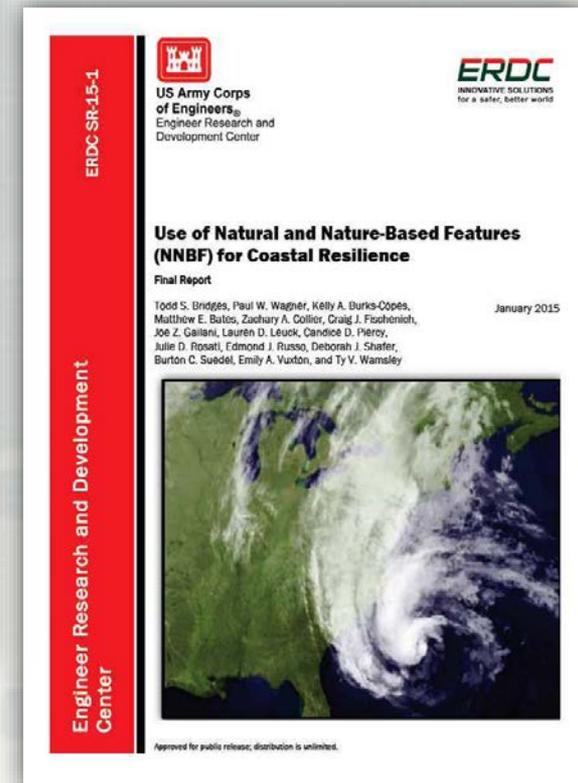
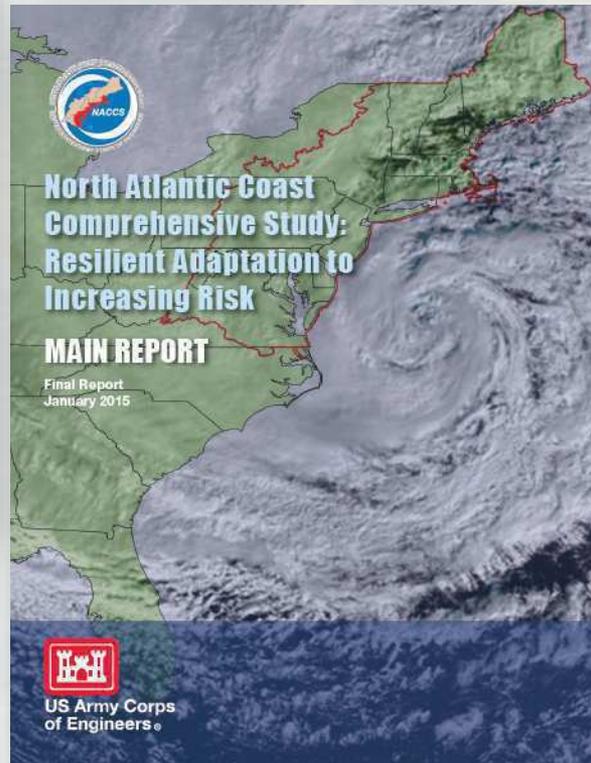


**US Army Corps of Engineers**  
Directorate of Civil Works



US Army Corps of Engineers  
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September 2013  
CWTS 2013-3

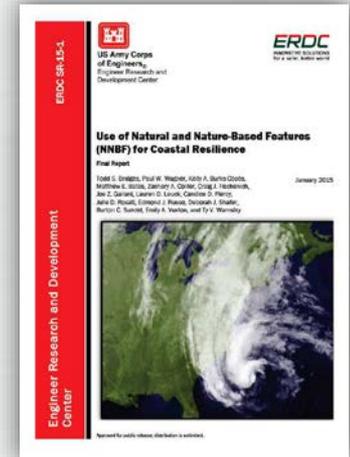
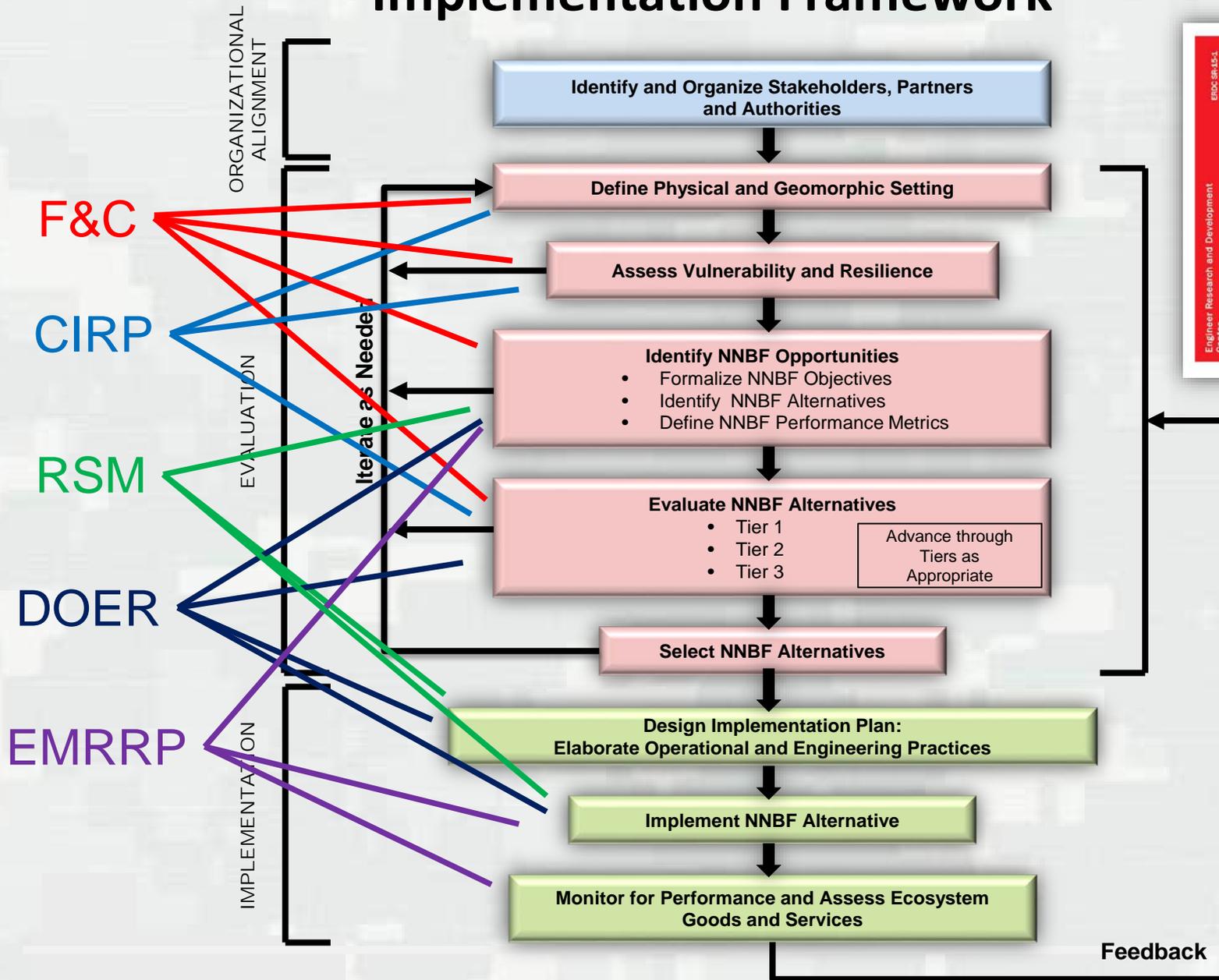


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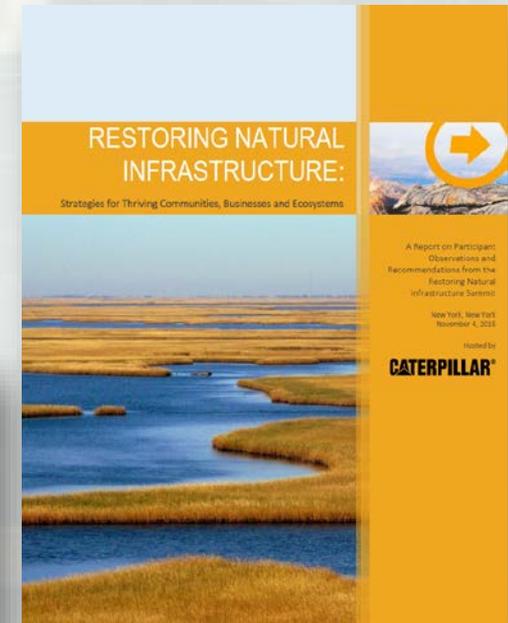
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<http://www.nad.usace.army.mil/CompStudy>

# Natural and Nature-Based Features Evaluation and Implementation Framework



# Caterpillar Corporation's *Restoring Natural Infrastructure Summit* 4 November 2015, New York City

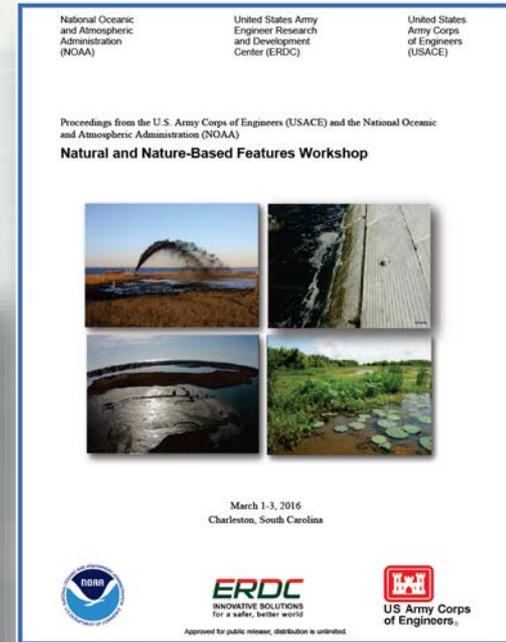


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<http://www.caterpillar.com/en/company/sustainability/natural-infrastructure.html>

# USACE – NOAA Collaboration Workshop on Natural and Nature-Based Features Charleston, SC; 1-3 March 2016



[www.engineeringwithnature.org](http://www.engineeringwithnature.org) (NNBF)



# USACE/NOAA-NMFS Collaboration Workshop on Engineering with Nature Gloucester, MA; October 5-6, 2016



[www.engineeringwithnature.org](http://www.engineeringwithnature.org)

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# Laws and Mandates: Water Infrastructure Improvements for the Nation Act (WIIN Act) 2016

SEC. 1184. Consideration of measures.

(a) Definitions.—In this section, the following definitions apply:

(1) NATURAL FEATURE.—The term “natural feature” means a feature that is created through the action of physical, geological, biological, and chemical processes over time.

(2) NATURE-BASED FEATURE.—The term “nature-based feature” means a feature that is created by human design, engineering, and construction to provide risk reduction in coastal areas by acting in concert with natural processes.

(b) Requirement.—In studying the feasibility of projects for flood risk management, hurricane and storm damage reduction, and ecosystem restoration the Secretary shall, with the consent of the non-Federal sponsor of the feasibility study, consider, as appropriate—

- (1) natural features;
- (2) nature-based features;
- (3) nonstructural measures; and
- (4) structural measures.



# International Guidelines for Use of Natural and Nature-Based Features for Sustainable Systems

- Publish coastal NNBF technical guidelines by 2020:
  - ▶ Multi-author: government, academia, NGOs, engineering firms, construction companies, etc.
  - ▶ Addressing the full project life cycle: planning, design, engineering, construction, and maintenance



# International NNBF Guidelines: Team Meeting #2

## United Kingdom, 10-13 July, 2017



# Other EWN Collaborations

- The Nature Conservancy
  - ▶ Several topics involving both coastal, estuarine, and inland EWN
- World Bank and UN Development Program
  - ▶ Guidelines for international investment in NNBF in the developing world
- Texas A&M EWN Curriculum



# Other EWN Collaborations (International)

- Rijkswaterstaat
  - ▶ Case studies report and project twinning
- Deltares
  - ▶ Collaboration on performance processes
- EcoShape's Building with Nature program
  - ▶ Multiple levels
- German Federal Institute of Hydrology
- Korea Institute of Ocean Science and Technology
- Academia
  - ▶ TU Delft
  - ▶ University of Applied Science/HZ



# Next Steps for Science and Engineering...

- What processes and engineering requirements are critical to engineering performance and resilience?
- How will integrated solutions and systems evolve over time in dynamic environments?
- How can integrated systems be assembled to reduce long-term O&M costs in order to sustainably deliver resilience?
- How can field-scale demonstration projects be used to accelerate progress?

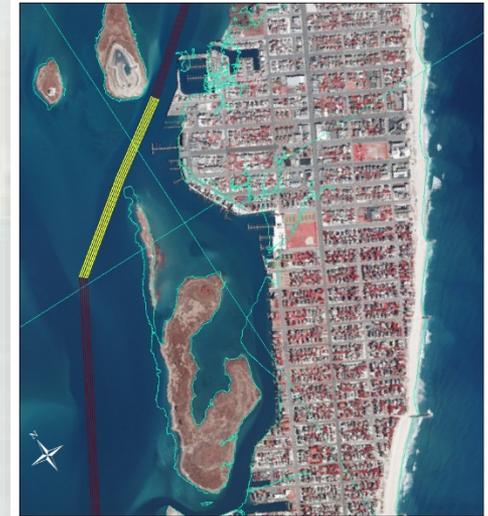


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# Science, Engineering, Technology Research Targets for EWN

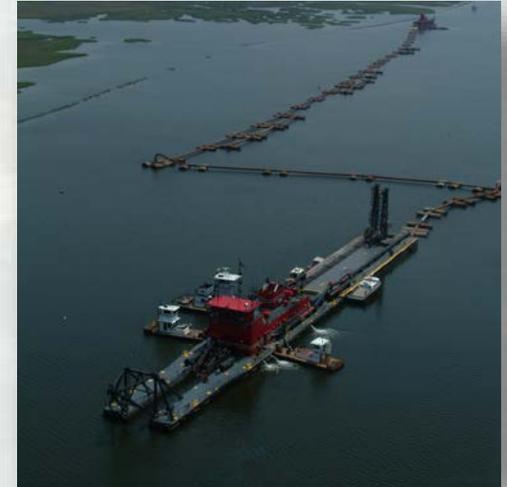
- Fundamental processes, e.g.,
  - ▶ Sediment transport through and around integrated systems
  - ▶ Long-term engineering and environmental performance of EWN measures
  - ▶ Ecosystem Services provided by EWN measures
  - ▶ Processes contributing to system-scale resilience
- Modeling systems that support broad-scale application, e.g.,
  - ▶ Planners, stakeholders and decision-makers
  - ▶ Engineering design for EWN measures
  - ▶ Operations and maintenance
- Reliable, cost-efficient monitoring technologies, e.g.,
  - ▶ Measuring system evolution
  - ▶ Infrastructure/EWN measure performance
- Demonstration/pilot projects to innovate, evaluate, and learn at relevant field scales, e.g.,
  - ▶ Facilitate necessary collaboration
  - ▶ Evolve organizational culture and practice
  - ▶ Produce credible evidence of success
  - ▶ Fuel the “power of the story”



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# EWN Points of Discussion: Big View

- What are the priority opportunities/needs within USACE?
- How can/should we capture the diverse benefits produced by USACE projects?
- What opportunities are there to scale-up progress?
- How can/should we “institutionalize” EWN progress/approaches?
- Other strategic partnerships to target?



# EWN Points of Discussion: LA

- How can LA approaches be used to integrate EWN principles and practices within water infrastructure projects?
- How do we use LA to visualize and communicate project/EWN functions and values?
- How do we use LA to communicate the progressive development of a project's vision?



# 1906 San Francisco Earthquake



# Agnews State Hospital, 1906



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# Let the Fun Begin!



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