# **Engineering With Nature**

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Engineer Research and **Development Center** 





EWN

# **Advancing Technical Practice**

#### USACE

#### **Environmental Operating Principles**

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all Corps activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

# **Outcomes:**

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of Engineers

Cost-effective engineering and operational practices
Efficient resolution of environmental conflicts

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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Sustainable Solutions To America's Water Resource Needs Crell Works Strategic Plan 2014-2018

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 Sustainable delivery of project benefits. 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 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





# **EWN Status**

- *Engineering With Nature* initiative started within USACE Civil Works program in 2010. Over that period, we have:
  - Engaged across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
    - Workshops (>20), dialogue sessions, project development teams, etc.
  - Implementing strategic plan
  - Focused research projects on EWN
  - Field demonstration projects
  - Communication plan
  - District EWN Proving Grounds established



- Awards
  - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
  - 2014 USACE National Award-Green Innovation



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www.engineeringwithnature.org



# **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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## 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
  - Emphasis on solution co-development





## **The North Atlantic Coast Comprehensive Study: Natural and Nature-Based Features**

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



US Army Corps of Engineers Directorate of Civil Works



September 2013 CWTS 2013-3





#### **Use of Natural and Nature-Based Features** (NNBF) for Coastal Resilience

Todd S. Briddes, Paul W. Wagher, Kelly A. Burks-Copes Jóe Z. Gailani, Lauren D. Leuck, Candice D. Piercy, Julie D. Rosati, Edmond J. Russo, Deborah J. Shafer

Matthew E. Bates, Zachary A. Collier, Craid J. Fischenich urton C. Suedel, Emily A. Vuxton, and Ty V. Wamsle

January 2015







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

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### Engineering Performance: Nature-Based Features Work in Different Ways

#### 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

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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



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

### CATERPILLAR

#### **Restoring Natural Infrastructure Summit**

November 4, 2015 New York City





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### NY DEC and Sea Grant Exploring Nature-Based Shoreline Erosion Management Practices Along NY's Great Lakes and Connecting Channels 5 November 2015, Rochester, NY











A Workshop for Practitioners: Exploring Nature-Based Shoreline Erosion Management Practices Along NY's Great Lakes and Connecting Channels

> November 5, 2015 -- 8:30am to 5:00pm International Arrivals Hall Rochester International Airport 1200 Brooks Ave, Rochester, NY 14624

#### Goal

To gain an understanding of the various types of nature-based shoreline (NBS)\* protection techniques and approaches that may be applicable to NY's Great Lakes shorelines, to manage erosion and stabilize shorelines while maintaining coastal processes and preserving or enhancing nearshore habitat. A secondary goal is to establish a dialogue and coordinated strategy among regional experts and practitioners to promote the implementation of nature-based shoreline management practices for erosion management along NY's Great Lakes shorelines.

#### Workshop Objectives

- Learn how nature-based shoreline methods are being used and how they may apply to NY's Great Lakes shorelines;
- Assess opportunities and constraints for implementing nature-based shoreline projects;
- Identify data, research, outreach, and resource needs to advance nature-based shorelines in NYS's Great Lakes;
- Identify demonstration project opportunities by region/reach;
- Identify next steps to work towards a coordinated management approach.







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### Exploring nature-based solutions: the role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards

"...instead of automatically defaulting to grey solutions like dikes and pipes for flooding, we first should look at restoring floodplains or wetlands. Rather than building sea walls, we need to think about conserving sand banks...Planners should compare green to grey and identify new opportunities for investing in nature, including a combination of green and grey approaches when nature-based solutions alone are insufficient. As planners explore how to accommodate infrastructure demands in the future, the lesson is clear: think about green before investing in grey."



EEA Technical Report No 12/2015

EEA Technical report No 12/2015

#### Exploring nature-based solutions

The role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards

ISSN 1725-3237







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



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## **Fort Pierce City Marina**

Dock Reconfiguration, Dredging, and Storm Protection Habitat Islands

Veterans Park
Community Center
Amphitheater
Art Gallery
Boat Ramp Area
Tourist Information Center

Tiki Bar
Marina Square
New Public Library

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Dity of Fort Pierce Waterfront Protection Project

# **Alafia Banks Bird Sanctuary, FL**

- 8000 lb reef module breakwaters (930 ft)
- Shore protection for Audubon bird sanctuary islands
- Help restore oyster populations
- Provide habitat





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## 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 Award for Environmental Excellence







## **Natural Materials**

https://ewn.el.erdc.dren.mil/Tools.html



#### National Large Wood Manual

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

January 2016











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## **Example EWN Solutions: Green Breakwaters**

### **Ashtabula Harbor**

### **Milwaukee Harbor**



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# **Coastal NJ, Philadelphia District**



December 2014



**Stone Harbor** 







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**Duluth Harbor TLP** 





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## Thin-Layer Placement Website www.engineeringwithnature.org (under tools) https://tlp.el.erdc.dren.mil/



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# **EWN High Points**

- Conservation / development of natural systems support future sustainability and resilience
  - Incentivizing and financing
- Focus energy to facilitate innovation in both technical and business processes
- Elevate communication about advancing practice
- Accelerate progress through co-development of solutions
  - Across government
  - Between government and industry
  - Among government, industry, academia, and NGOs





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