



# **Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems**

October 30, 2017

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US Army Corps of Engineers

# Creating Value through Alignment...

- What opportunities are there for achieving better alignment of natural and engineered systems?
  - Can improved alignment reduce risks to life, property and ecosystems?
  - What range of services can be produced through such alignment?
  - What are the science and engineering needs in order to achieve better alignment?



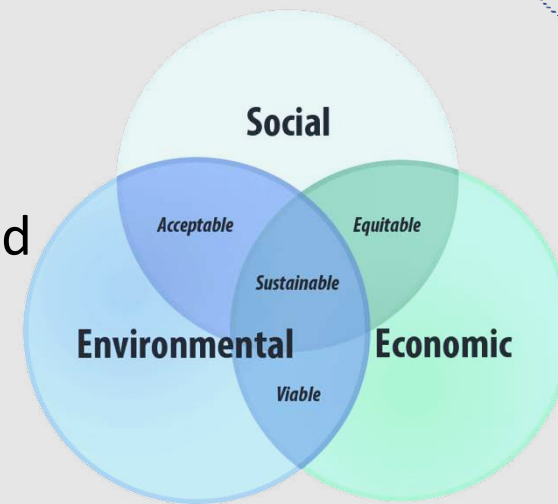
Sustainable Solutions Vision: “Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation’s water resources challenges.”

# 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:

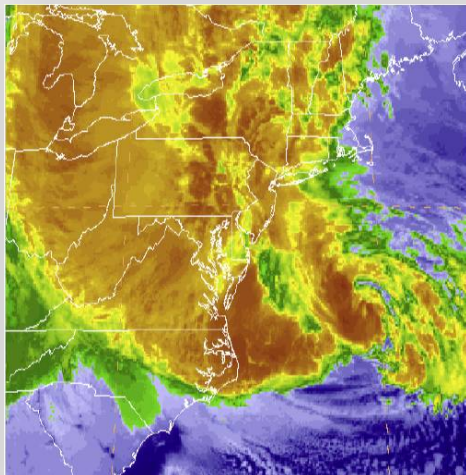
- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners



# 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





# The North Atlantic Coast Comprehensive Study

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

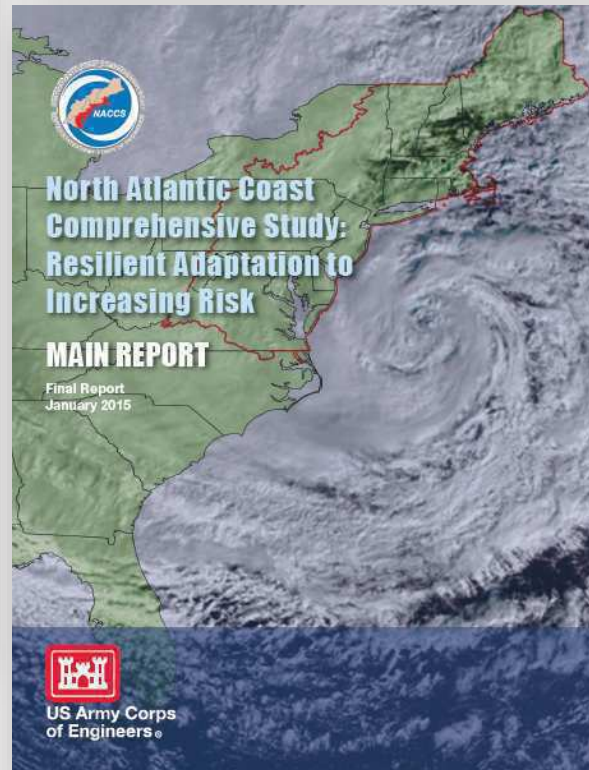


**US Army Corps of Engineers**  
Directorate of Civil Works



US Army Corps of Engineers  
BUILDING STRONG.

September 2013  
CWTS 2013-3



ERDC SR-15-1



US Army Corps  
of Engineers  
Engineer Research and  
Development Center

**ERDC**  
INNOVATIVE SOLUTIONS  
for a safer, better world

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

Final Report

Todd S. Bridges, Paul W. Wagner, Kelly A. Burks-Coppes,  
Matthew E. Baltes, Zachary A. Collier, Craig J. Fischelich,  
Joe Z. Galliani, Lauren D. Leuck, Candice D. Pierson,  
Julie D. Rosati, Edmond J. Russo, Deborah J. Shaffer,  
Burton C. Suedel, Emily A. Vuxton, and Ty V. Wamsley

January 2015



Approved for public release; distribution is unlimited.

# Engineering Performance: NNBF

**International NNBF  
Guidelines Meeting  
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## 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



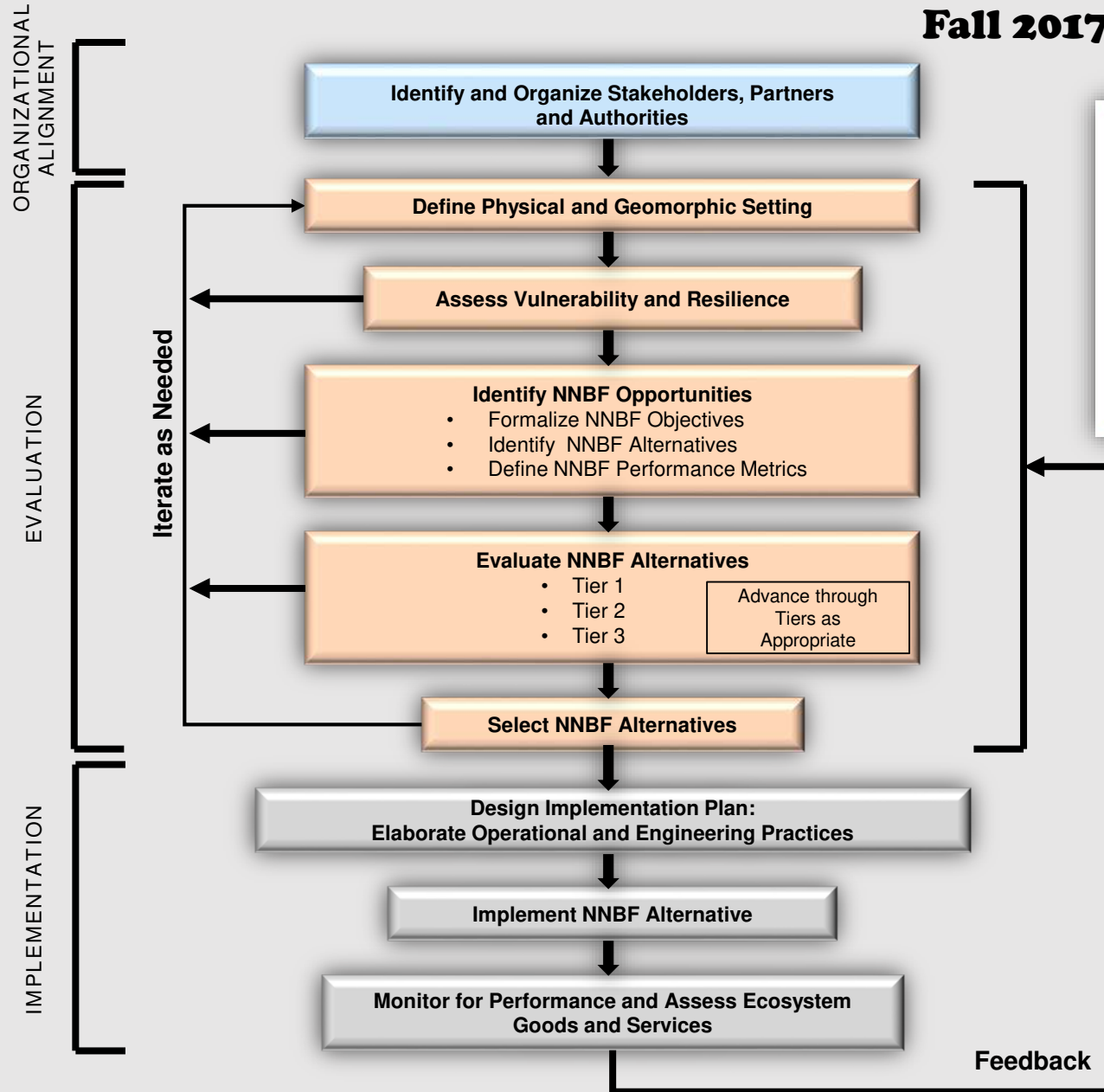
### Maritime Forests/Shrub Communities

**Benefits/Processes**  
Wave attenuation and/or dissipation  
Shoreline erosion stabilization  
Soil retention

**Performance Factors**  
Vegetation height and density  
Forest dimension  
Sediment composition  
Platform elevation

# NACCS NNBF Framework

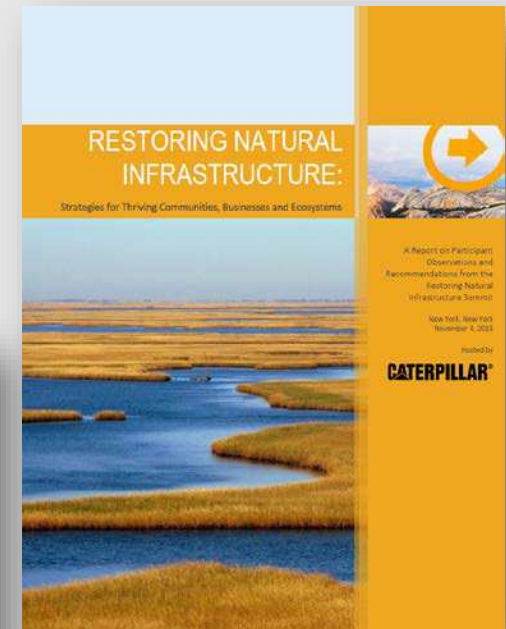
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# The Private Sector: Caterpillar Corporation's *Restoring Natural Infrastructure Summit* 4 November 2015, New York City

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



*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



# World Bank Principles and Implementation Guidance for Nature-Based Flood Protection



NBFP Workshop, 11-13 April 2017

# 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.

# Declaration on Nature-Based Solutions Being Considered during COP23 in Bonn, 6-17 Nov 2017

DRAFT V. 28 09 2017

## **HIGH-LEVEL DECLARATION** **Nature-based solutions for water under climate change**

*We, representatives of governments, international and national organizations, donors, national and transboundary basin organizations, local authorities, civil society and companies, research organizations, support the integration of nature-based solutions into the Marrakech Partnership for Global Climate Action.*

...

### *We commit to:*

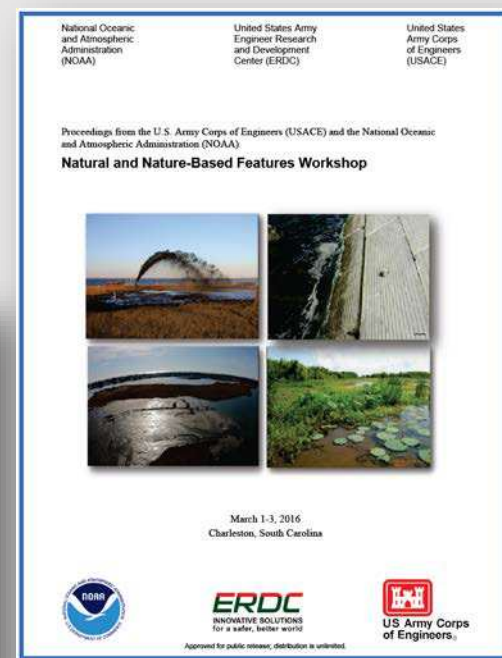
- Include nature-based solutions in our international, regional, national, basin and local long-term strategies and policies on climate change and resources management.
- Raise awareness on the necessity to operationalize research works on nature-based approaches by promoting nature-based solutions and this declaration towards our peers.
- Make sure that nature-based solutions are providing co-benefits for human well-being and development as well as biodiversity.

...



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

## International NNBF Guidelines Meeting Fall 2017



# Fort Pierce City Marina, Florida





# USACE Philadelphia District: Back Bay NJ



Mordecai Island



Stone Harbor



Avalon

# Onehunga Bay Foreshore Restoration Auckland, New Zealand





# Humber Estuary; Alkborough, UK

(Increased Flood Storage Capacity)





# Chehalis Basin Floodplain Restoration

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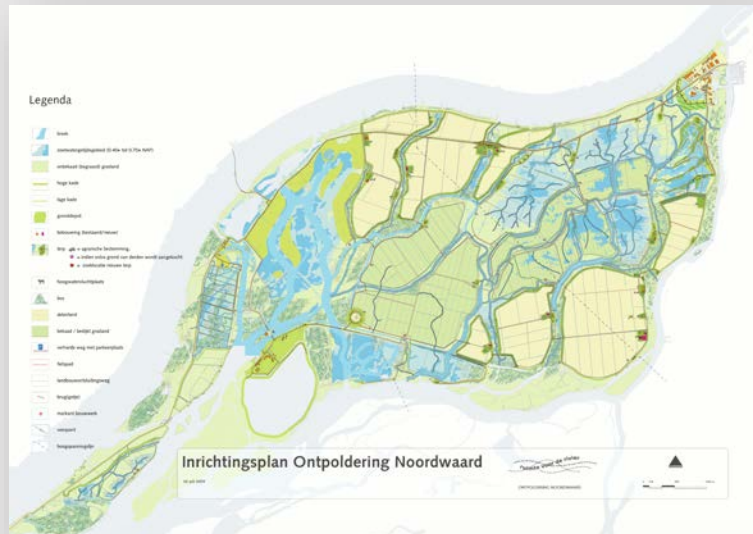
**RAMBOLL**

**ENVIRON**



# Noordwaard, The Netherlands

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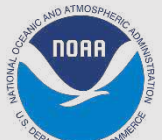
# International Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

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**Purpose: Develop guidelines for using NNBF to provide engineering functions relevant to flood risk management while producing additional economic, environmental and social benefits.**

- Publish 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
  - ▶ Guidelines in 4 Parts
    - Overarching
    - Coastal Applications
    - Fluvial Applications
    - Conclusions



Rijkswaterstaat  
Ministry of Infrastructure and the Environment





# Guidelines Table of Contents

## International NNBF Guidelines Meeting Fall 2017



### Part 1: Informing the Use of NNBF

- Preface/Definitions
- Introduction
- Principles for Use of NNBF in Coastal and Fluvial Systems
- Community Engagement
- General NNBF Framework
- System Considerations and Combining Elements
- Analysis of NNBF Benefits
- Monitoring, Maintenance, and Adaptive Management

### Part 2: Coastal Systems

- Introduction
- Beaches and Dunes
- Wetlands and Intertidal Areas
- Islands
- Reefs
- Sub-Aquatic Vegetation
- Upland Plant Communities
- Enhancing Environmental Value of Conventional Infrastructure

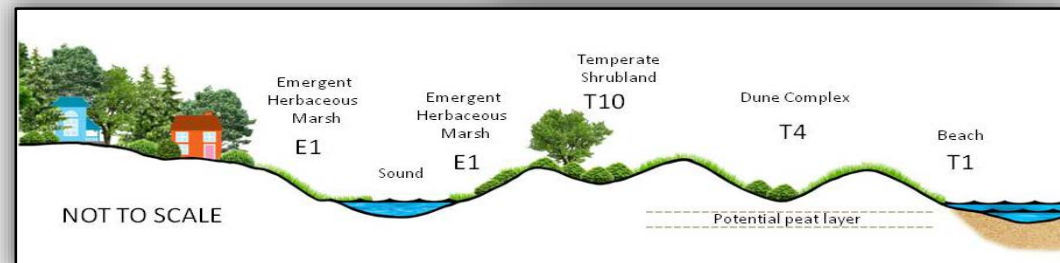


### Part 3: Fluvial Systems

- Introduction
- Applying NNBF at Watershed Scale
- Applying NNBF at Sub-Watershed Scale
- Naturalizing Techniques

### Part 4: Conclusion

- Summation and Future Directions



# Development Approach

- Voluntary project team
- Editorial Board
- Individual Chapter Teams, with Co-Leads
- Peer review of final product
- Periodic, in-person working meetings combined with virtual engagement and drafting



# International NNBF Guidelines: Team Meeting #1; United States; Vicksburg, MS; 25-26 October, 2016

**International NNBF  
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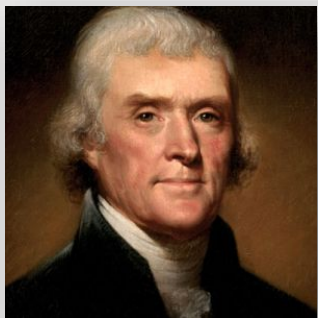
# International NNBF Guidelines: Team Meeting #2; United Kingdom; 10-13 July, 2017



## International NNBF Guidelines Meeting Fall 2017







# The Pursuit of Resilience...

"I endeavor to keep their attention fixed on the main objects of all science, the freedom & happiness of man."



**Thomas Jefferson to Tadeusz Kosciuszko, 1810**

## *The Battlefield at Saratoga*

"The great tacticians of the campaign were hills and forests, which a young Polish engineer was skillful enough to select for my encampment." Major General Horatio Gates

