Engineering With Nature to Protect Shorelines and Create Habitat

February 25, 2021





Today's Speakers

Steve Thur - NOAA's National Centers for Coastal Ocean Science
 Todd Bridges - USACE's Engineer Research & Development Center
 Jenny Davis - NOAA's National Centers for Coastal Ocean Science
 Monica Chasten - USACE's Philadelphia District







Engineering With Nature_®

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USACE / NOAA-NCCOS EWN Congressional Brief February 25, 2021



Engineering With Nature





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9/11

1900-2000: The Century of Infrastructure

- •4,071,000 mi roads
- 149,136 mi rail
- 640,000 mi power lines
 155,000 drinking water systems
- 4,500 military installations

• 614,387 bridges • 90,580 dams •>30,000 mi flood levee •926 ports • 25,000 mi navigation channels

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1900-2000: The Century of Infrastructure (US)



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Leveraging Nature for Engineering Value: Mangroves

Florida Mangroves Study:

- Used an insurance industry catastrophe model to quantify the flood reduction benefits of mangroves across Florida
- During Hurricane Irma:
 - Mangroves averted \$1.5 billion dollars in flood damages to properties
 - 25% savings in counties with mangroves
 - >600,000 people living behind mangrove forests saw reduced flooding across Florida







Engineering With Nature_®

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

Key Elements:

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Increase and diversify infrastructure value
- Science-based collaboration to organize and focus interests, stakeholders, and partners

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Implementing Nature-Based Solutions: Conserving » Restoring » Projecting

- "Skate to where the puck is going to be..."
 - Where will landscape features create the most value *in the future*?
- Size it right
 - NBS are scalable and phaseable
 - Beware of over- engineering or constraining
 - Affordability is key!
- Everyone must commit to innovation!
 - Engineers, planners, economists, regulators, ecologists, conservationists, etc.



A Call to Action: Beneficial Use of Dredged Sediment

Beneficial use is using dredged sediment to achieve additional benefits beyond the purposes related to its removal, including other economic, environmental or social benefits.

An Imperative for the 21st Century: Getting to 100% Beneficial Use!

BU Status in the U.S.:

- >200 million cubic yards sediment dredged annually
- ${\sim}30\%$ of dredged sediment used beneficially
 - >1.5 billion cubic yards used in beach construction over last 100 years
 - 100s of millions cubic yards of BU since 1970
 - E.g., 25,000 acres of wetlands created in south Louisiana



The EWN_® Approach: "Revolutionizing" Practice Through

Nature-Based Solutions

- Policy development
 - Engagement with policymakers
 - Policy/procedure "modernization"
- Engagement, partnering, and teaming
 - Within USACE, e.g., EWN Proving Grounds
 - With other organizations inside and outside government
- Research
 - Innovations in practice
 - Taking the "long view"
 - Establishing future targets and conditions
 - Tools for delivery
- On-the-ground projects and demos
 - Across the spectrum of applications and project development (i.e., from planning to operations)
 - Scaling up nature-based solutions
- Strategic communications
 - Individual research papers
 - \circ $\:$ Visionary products, e.g., EWN Atlas $\:$
 - Education, e.g., academic curricula, training





International Guidelines on the Use of Natural and Nature-Based Features for Flood Risk Management

NNBF Guidelines Table of Contents

- Chapter 1. Introduction
- Chapter 2. Principles, Outcomes, and Frameworks
- Chapter 3. Engaging Communities and Stakeholders in Implementing Natural and Nature-Based Features
- Chapter 4. Planning and Implementing Natural and Nature-Based Feature
 Using a Systems Approach
- Chapter 5. NNBF Performance
- Chapter 6. Benefits and Costs of NNBF
- Chapter 7. Adaptive Management
- Chapter 8. Introduction to NNBF in Coastal Systems
- Chapter 9. Beaches and Dunes
- Chapter 10. Coastal Wetlands and Tidal Flats
- Chapter 11. Islands
- Chapter 12. Reefs
- Chapter 13. Plant Systems, Submerged Aquatic Vegetation, and Kelp
- Chapter 14. Enhancing Structural Measures for Environmental, Social, and Engineering Benefits
- Chapter 15. Introduction to Fluvial Section
- Chapter 16. Fluvial Systems and Their Influence on Flood Risk Management
- Chapter 17. Challenges and Benefits of Natural and Nature-Based Features in Fluvial Systems
- Chapter 18. Description of Fluvial Natural and Nature-Based Features
- Chapter 19. Fluvial Natural and Nature-Based Features Case Studies
- Chapter 20. The Future





Island With

Wetland Fringe

Construct New Wetland

Managed

Realignment Site

(Levee Breach)

Natural and Nature-Based Infrastructure at a Glance

SENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS

US Army Corps of Engineers • Engineer Research and Development Center

- NNBF Guidelines
- Publication summer 2021
- >800 pages
- >150 authors and contributors from >70 organizations and 10 countries

Engineering With Nature_® Atlases



<u>Volume 1</u> 56 Projects, 27 USACE

Volume 2 62 Projects 23 USACE



"Engineering With Nature is an important initiative for the U.S. Army Corps of Engineers." James Dalton, USACE Director Civil Works

www.engineeringwithnature.org

"The mission of US Army Corps of Engineers is to deliver vital public and military engineering services; partnering in peace and war to strengthen our nation's security, energize the economy and reduce risks from disasters. Engineering With Nature supports this mission which is why it will always be an important initiative for the Corps." LTG Scott A. Spellman, 55th Chief of Engineers, Commanding General, USACE

EWN_® Podcast: Season 1

www.engineeringwithnature.org

https://podcasts.apple.com/ca/podcast/ewn-engineering-with-nature/id1528233207

Guest: **Todd S. Bridge**s, Ph.D., Senior Research Scientist (ST), Environmental Science, and National Lead, Engineering With Nature Initiative, US Army Corps of Engineers

2. Using Natural Forces and Sediment to Restore Coastal Marsh Habitat

Guest: **Jeff Corbino**, Chief, Environmental Function, Operations Division -Technical Support Branch, New Orleans District, US Army Corps of Engineers

3. Using Natural Infrastructure to Increase Resilience for Military Installations Guest: Brigadier General Patrice Melancon, Executive Director of the Program Management Office, Tyndall Air Force Base, US Air Force

4. Characterizing Storm and Flood Risk Reduction Benefits Derived from Mangroves During Extreme Weather Events Guest: Tori Tomiczek, Ph.D., Assistant Professor, School of Naval Architecture and Ocean Engineering, United States Naval Academy

5. Collaborating to Create Wildlife Habitat While Restoring Islands and Improving Community Resilience Guest: Paula Whitfield, Research Ecologist, National Centers for Coastal Ocean Science, National Oceanic and Atmospheric Administration



6. Assessing the Value of Natural and Nature-Based Features in Coastal Storm and Flood Risk Reduction Guest: Mike Beck, Ph.D., Research Professor and Head of the Coastal Resilience Lab, University of California at Santa Cruz

7. Incorporating EWN into Coastal Texas Resilience and Restoration

Guest: **Edmond Russo**, Ph.D., P.E., Deputy District Engineer for Planning, Programs and Project Management, Galveston District, US Army Corps of Engineers

8. Protecting Fragile Coasts and Improving Community Resilience

Guest: **Monica Chasten**, Project Manager, Operations Division, Philadelphia District, US Army Corps of Engineers

9. Collaborating with Industry to Promote Natural Infrastructure

Guests: **Don McNeill**, Director of Natural Infrastructure Initiative, Caterpillar, Inc. and **Mike Donahue**, Ph.D., Vice-President of Water Resources and Environmental Services, AECOM

10. Collaborating with Academia to Develop Future Practice and Practitioners Guests: Brian Bledsoe, Ph.D., Director of University of Georgia's Institute for Resilient Infrastructure Systems and Todd S. Bridges, Ph.D., Senior Research Scientist (ST), Environmental Science, and National Lead, Engineering With Nature Initiative, US Army Corps of Engineers

The Spectrum

"Wild and Free-Flowing Nature"

"Tamed and Constrained Nature"



Duwamish River, WA 1800s



San Joaquin Valley, CA 1800s

Achieving Nature-Engineering Balance

- Community Needs and Values
- Innovation in Science & Technology
- Enabling Policy
- Collaboration Across Boundaries





Duwamish River, WA today



San Joaquin Valley, CA today



Island Restoration at Swan Island, MD





SCIENCE SERVING COASTAL COMMUNITIES

Nature Based Solutions for Coastal Protection

Swan island, protects the town of Ewell, MD from the full force of wave energy in Chesapeake Bay

wind Intensity(m/s) by cardinal direction





SINCCOS NATIONAL CENTERS FOR COASTAL OCEAN SCIENCE



Wave energy combined with high local rates of relative sea level rise have taken a toll



ISLAND RESTORATION PROTECTS COASTAL COMMUNITIES

Islands are natural features that shield nearby shorelines from wave energy and as a result, many islands become degraded over time due to erosion. Restoration of degraded islands enhances their protective function and habitat value.



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Restoration + Navigation Dredging:

- Increases Habitat Diversity
- Builds Resilience
- Protects Developed Shorelines
- Keeps Sediment in the System



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Quantifying relationships among physical and ecological components is key to optimization of EWN approaches





In Situ Measurements





Modeling to Quantify Performance

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- Swan Island provides a demonstration of EWN principles in action

- On a national scale, there are innumerable opportunities to pair dredging with habitat restoration for risk reduction
- Research efforts at Swan Island will inform the use of Islands as EWN solutions nationwide



Swan Island, September 2020

ADVANCING DREDGING AND BENEFICIAL USE PRACTICES IN COASTAL NEW JERSEY TO SUPPORT RESILIENCE: MORDECAI ISLAND

Monica Chasten Project Manager U.S. Army Corps of Engineers Philadelphia District, Operations Division







Organizational Perspective U.S. Army Corps Of Engineers Philadelphia District



- Navigation Mission: USACE Philadelphia District maintains federal channels, including the Delaware River & Bay, coastal inlets, and the 117-mile New Jersey Intracoastal Waterway
- When dredged sediment is CLEAN, District strives to find opportunities to use 100% of it beneficially.
- Moving toward this goal has been an evolution over many years
- **Partnership & Collaboration:** District became Engineering with Nature Proving Ground in 2016.















Mordecai Island Restoration Location & Initial Placement



- 45-acre uninhabited coastal salt marsh island
- 28,000 cubic yards of sediment dredged from a critical shoal in the federal channel
- Placement in eroded section of island
- Island provides important habitat and provides buffer for Beach Haven, NJ (Long Beach Island)







Mordecai Island Restoration: Planting & Adaptive Management



- Planted different varieties of marsh grass based on site topography
- Adaptive management: placed additional sediment on site in 2017 to elevate habitat
- Monitoring and R&D collaboration to inform past and future strategies for resilience







Mordecai Island: Partnership and Stewardship

















Mordecai Island: Partners and Sharing the Message















Taking it to next level: Seven Mile Island Innovation Laboratory







Taking it to the next level: Seven Mile Island Innovation Laboratory









Taking it to next level: Seven Mile Island Innovation Laboratory







Dredging & marsh restoration at Great Flats near Stone Harbor, NJ in 2018



BARNEGAT INLET AND BAY, NJ WRDA 2016 SECTION 1122 PILOT: BUILDING ISLANDS, RESTORING MARSH AND INNOVATIVE NEARSHORE PLACEMENT







Philosophical Approach



- "Sediment is the currency of marsh ecosystems" ~ Dr. Lenore Tedesco, Exec. Director of The Wetlands Institute
- USACE is perhaps the largest national "sediment broker" due to navigation mission and dredging
- Question how can we improve our stewardship of that sediment "currency"?



State endangered Black Skimmer at newly created habitat from dredged sediment, Ring Island, NJ



Opportunities & Challenges For Advancing Practice



Rapid Progress

- Next level is to continue to develop systems approach and scale up
- Progression from 25% (pre-Hurricane Sandy) to 60% (post- Hurricane Sandy) to a goal of 100% beneficial use of clean channel sediments in coastal New Jersey

Key Partnerships and Long-term Sustainability

- Maintain strong leadership & engage to overcome remaining obstacles
- Agreements with resource agencies, collaboration at national, regional levels
- Need for continued R&D and engaging dredging industry
- Continued policy changes remain critical

Questions

X

Answers

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