US Army Corps of Engineers®

Engineering With Nature

Natural and Nature-Based Feature (NNBF) Guidelines and Other EWN Strategic Communications

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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

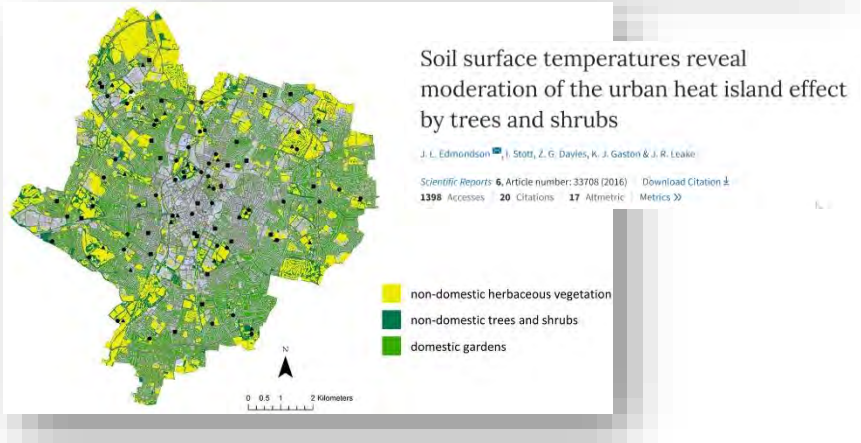
"We absolutely want to do more engineering with nature everywhere we work across the Corps, you have my commitment."
— LTG Scott A. Spellmon, 55th Chief of Engineers to the House Committee on Transportation & Infrastructure, Water Resources & Environment Subcommittee (24 June 2021)

Nature-Based Solutions:

Conserving, restoring, and engineering nature for the benefit of people and nature

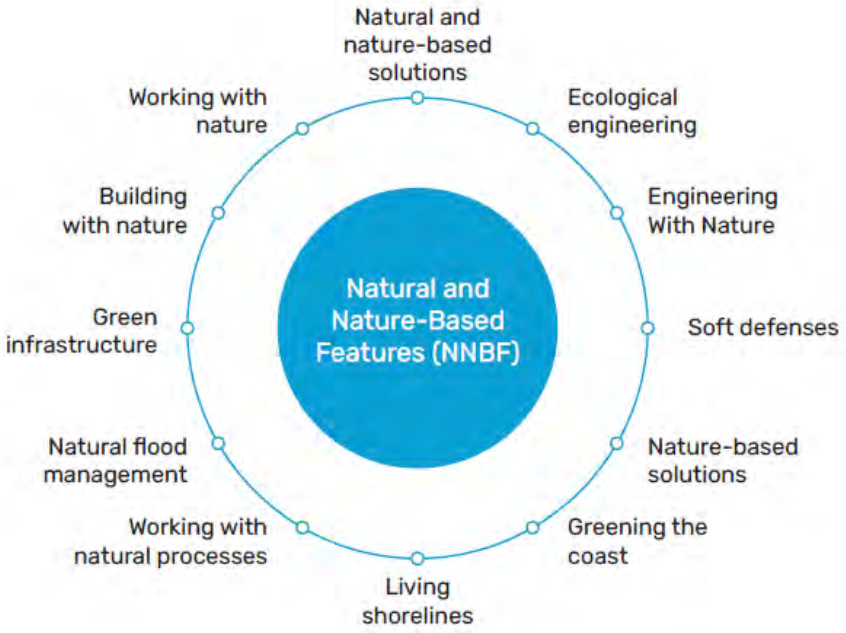
An Example: Trees as Infrastructure!

- Shaded surfaces can be 20-45°F cooler
- Evapotranspiration plus shading can reduce peak summer temperatures by 2-9°F
- Reducing wind speed and winter heat loss from buildings by 10-50%
- Improve local air quality
- Increase water infiltration, reducing surface water run-off



Natural and Nature-Based Features (NNBF)

- Flood Risk Management refers to actions taken to reduce future damage to people and property caused by flooding and erosion in coastal and fluvial systems.
- NNBF refers to the use of landscape features to produce flood risk management benefits and other economic, environmental, and social benefits (known as co-benefits).
  - E.g., beaches, dunes, wetlands, reefs, islands, others



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

NNBF Guidelines Table of Contents

www.engineeringwithnature.org

NNBF Guidelines

- >1,000 pages, 5-year effort
- >70 multi-sector organizations
- >170 authors and contributors

"The guidelines do not contain or represent the policy commitments or policy positions of the organizations that participated in their development. Policy development is the sole purview of each organization and the laws and procedures that govern their activities." Pages xi-xii.

Exploring the Guidelines

The NNBF Guidelines include 20 chapters organized into three sections: overarching themes, coastal features, and fluvial features. Under each chapter icon, you can view an introductory presentation by a chapter author and explore individual chapters online.

01 The Need and Opportunity for NNBF – An Introduction to the Guidelines

02 Principles, Outcomes, and Framework

03 Engaging Communities and Stakeholders in Implementing NNBF

04 Planning and Implementing NNBF Using a Systems Approach

03 Engaging Communities and Stakeholders in Implementing NNBF

September 14, 2021

03 Engaging Communities and Stakeholders in Implementing NNBF

- Presentation (vimeo)
- Complete (ebook)

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Susan Durden, U.S. Army Corps of Engineers, United States

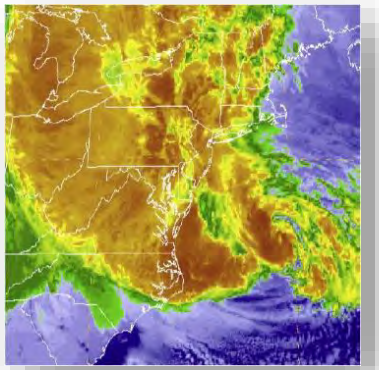
International Guidelines on NNBF for Flood Risk Management – Chapter 3

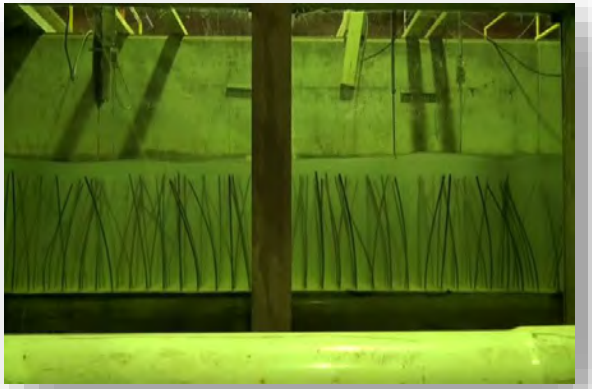
Learn more and download the International Guidelines on Natural and Nature-Based Features for Flood Risk Management at: https://ewn.erdc.dren.mil/?page_id=4351.

Leveraging Nature for Engineering Value: *Wetlands*

Wetland Value During Hurricane Sandy:

- Risk industry tools used to quantify the economic benefits of coastal wetlands
  - Temperate coastal wetlands averted 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

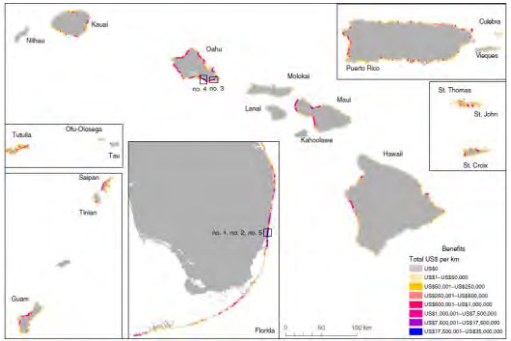
October 2016

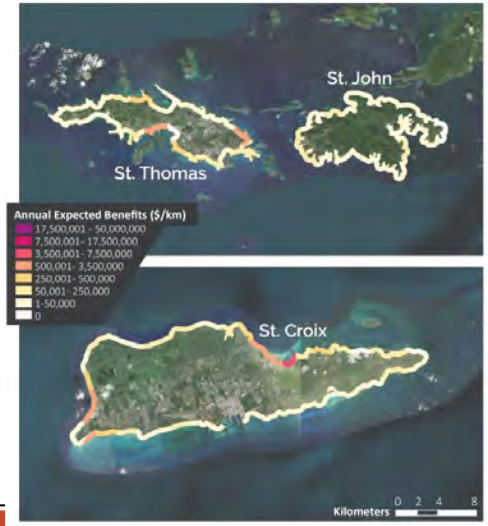
UNIVERSITY OF CALIFORNIA SANTA CRUZ · The Nature Conservancy · Wildlife Conservation Society · LLOYD'S TERCENTENARY RESEARCH FOUNDATION

Leveraging Nature for Engineering Value: *Coral Reefs*

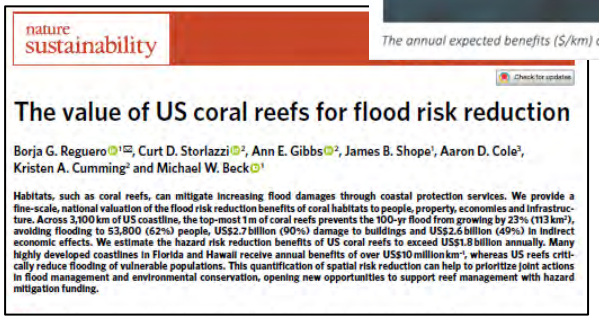
Coral Reefs and Flood Risk Reduction Value:

- Coral reefs line >3,100 km of US and US Trust Territory shorelines
  - –Provide >$1.8B in annual flood risk reduction benefits
  - –Highly developed coastlines in FL and HI receive annual benefits of $10M per km of coral reef
- Loss of the top-most meter of coral reefs:
  - An additional 50,000 people would experience flooding
  - $3B in additional damage to structures





The annual expected benefits ($/km) coral reefs provide in coastal flood reduction.



nature sustainability

Check for updates

The value of US coral reefs for flood risk reduction

Borja G. Reguero[1✉], Curt D. Storlazzi[2], Ann E. Gibbs[2], James B. Shope[1], Aaron D. Cole[3], Kristen A. Cumming[2] and Michael W. Beck[1]

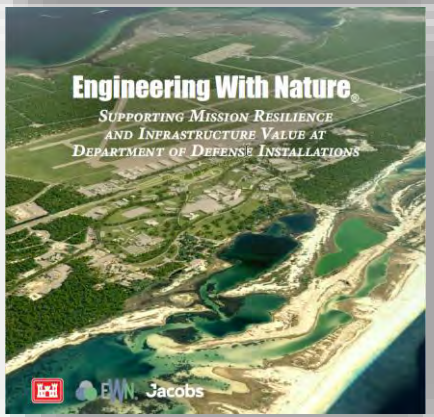
Habitats, such as coral reefs, can mitigate increasing flood damages through coastal protection services. We provide a fine-scale, national valuation of the flood risk reduction benefits of coral habitats to people, property, economies and infrastructure. Across 3,100 km of US coastline, the top-most 1 m of coral reefs prevents the 100-yr flood from growing by 23% (113 km²), avoiding flooding to 53,800 (62%) people, US$2.7 billion (90%) damage to buildings and US$2.6 billion (49%) in indirect economic effects. We estimate the hazard risk reduction benefits of US coral reefs to exceed US$1.8 billion annually. Many highly developed coastlines in Florida and Hawaii receive annual benefits of over US$10 million km⁻¹, whereas US reefs critically reduce flooding of vulnerable populations. This quantification of spatial risk reduction can help to prioritize joint actions in flood management and environmental conservation, opening new opportunities to support reef management with hazard mitigation funding.

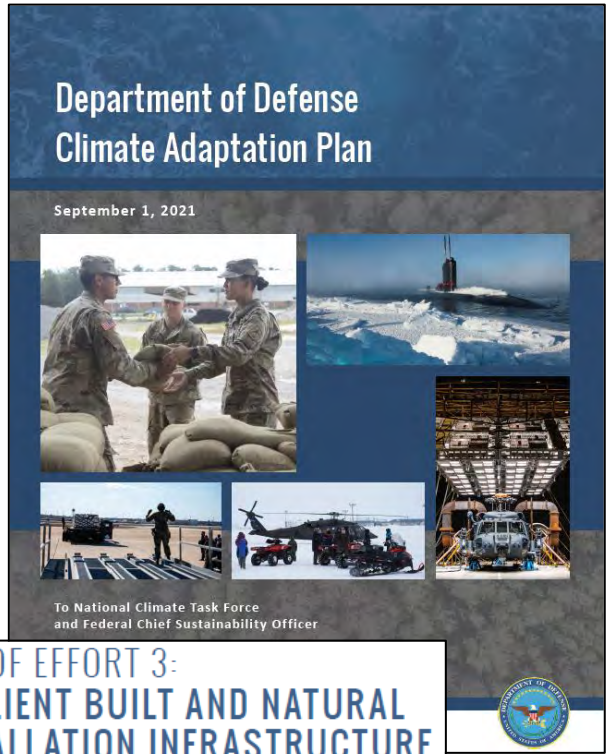
https://www.usgs.gov/centers/pcmsc/science/value-us-coral-reefs-risk-reduction?qt-science_center_objects=0#qt-science_center_objects

https://www.nature.com/articles/s41893-021-00706-6.epdf?sharing_token=okXPN9-3ruX1jz_oEfQdrNRgN0jAjWel9jnR3ZoTv0P34Lz-UrljB_uD-zEphe5yVw5H6pLrLbdyEo9uxURsA1vaOBZYqElSlkfmfDYbeII1BcoZ0xZ9MDHv4a4G9NO31nT1-vVMdJuUiZvbQuw5XBAz_76ysNf6gB1qNwKbD-A%3D

Military Installation Resilience: Built + Natural Infrastructure

"Built and natural infrastructure are both necessary for successful mission preparedness and readiness."





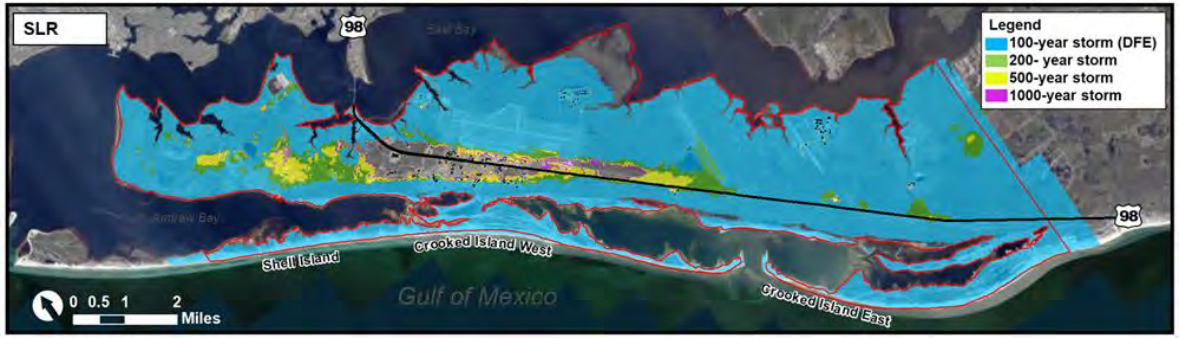
LINE OF EFFORT 3:
RESILIENT BUILT AND NATURAL INSTALLATION INFRASTRUCTURE

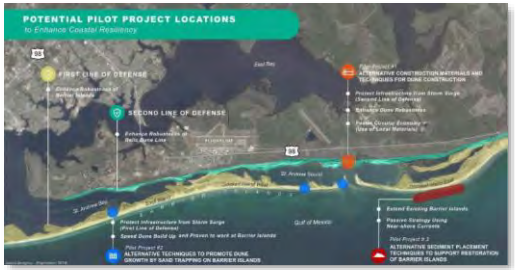
www.engineeringwithnature.org » About

EWN® Applied to Tyndall Air Force Base for Coastal Resilience

"By exploring a diverse menu of nature-based solutions we are in a better position to sustain, restore, and modernize natural infrastructure, ensuring the capability of Air Force lands to support the mission of the installation."

- Lieutenant Colonel Brandy Smart, Commander of the 325th Civil Engineer Squadron



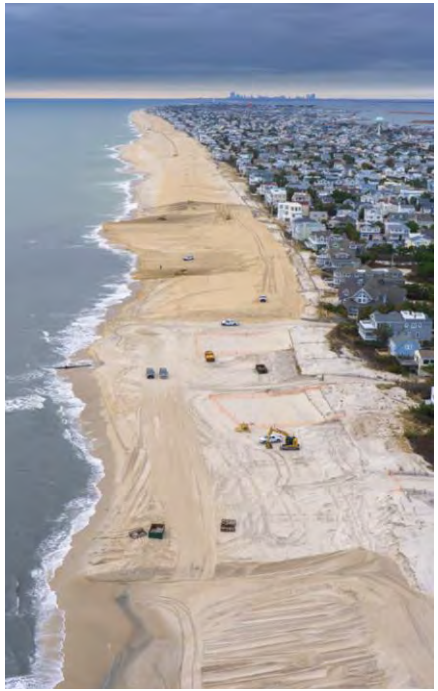


Tyndallcoastalresilience.com

Winner of 2021
UK Environment Agency Flood & Coast International Excellence Award

NNBF: Overarching Observations

- Natural features and landscapes have always contributed to flood resilience.
- The function and success of FRM measures and systems are related to scale.
- Sustainable FRM systems will include combinations of conventional, natural, and nature-based elements.
- The flexibility and adaptability of NNBF are useful for achieving flood resilience.
- NNBF can increase and diversify the value provided by infrastructure.
- Innovation in practice will be key to addressing future problems and opportunities.
- Policies need to be developed to guide and expand the use of NNBF.
- Coordination, collaboration, and partnership will fuel successful implementation of NNBF.



The Power of Partnership: *SMIIL*

Seven Mile Island Innovation Laboratory

Engineering With Nature

- Collaboration and partnership that is building first-of-their-kind NBS projects in coastal New Jersey
  - Began in conversation
  - Accelerated by a storm (Sandy)
  - Progressed through piloting
  - Now in full-scale implementation

US Army Corps of Engineers

The Nature Conservancy
Protecting nature. Preserving life.

NEW JERSEY DIVISION OF Fish and Wildlife

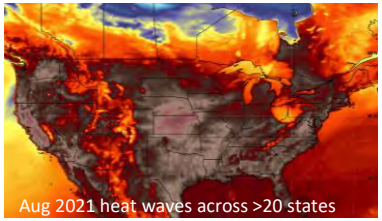
Wetlands INSTITUTE

Nature-Based Solutions

Conserving, restoring, and engineering nature for the benefit of people and nature

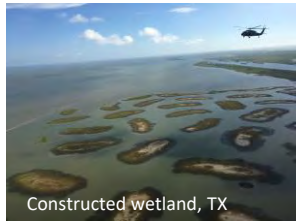
Engineering With Nature®

- **Project delivery**—"faster, cheaper"
- **Project performance**—complete solutions
- **Adaptability**—scalable, phase-able, flexible
- **Sustainability**—self-repair
- **Value to the Nation**—multi-functional benefits
- **Diversified investment**—diversified value→ diversified partnerships
- **Social license**—community and stakeholder support and participation
- **Regulatory efficiency**—resolving conflict through win-win solutions

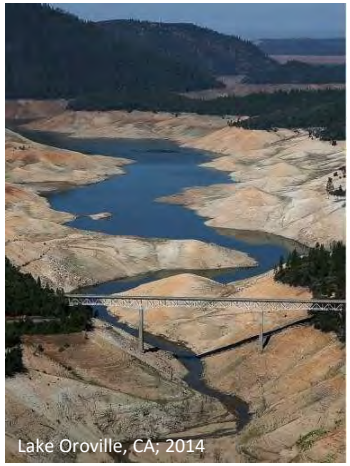

Aug 2021 heat waves across >20 states


Camp Fire, CA; 2018


Forest recovery; MT


Constructed wetland, TX


San Joaquin River National Wildlife Refuge, CA

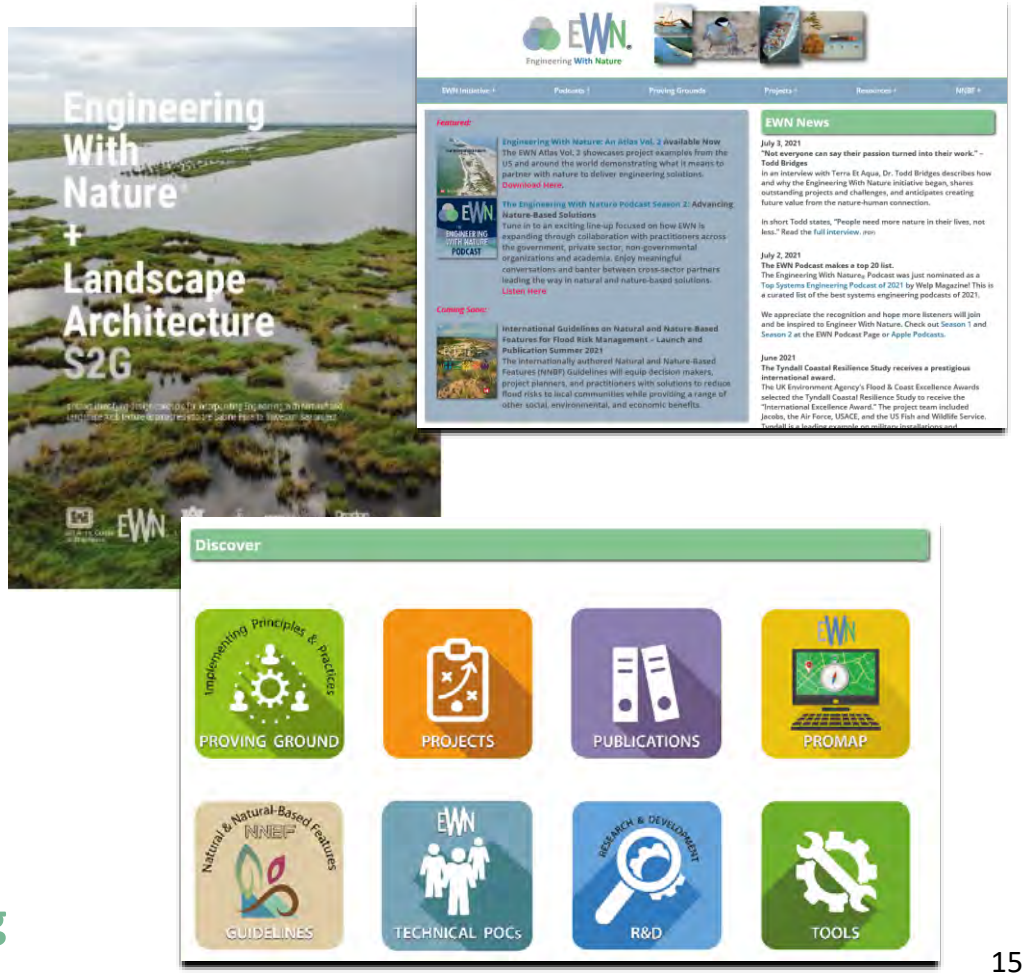

Lake Oroville, CA; 2014

EWN Website

One-stop shop for accessing all things related to EWN

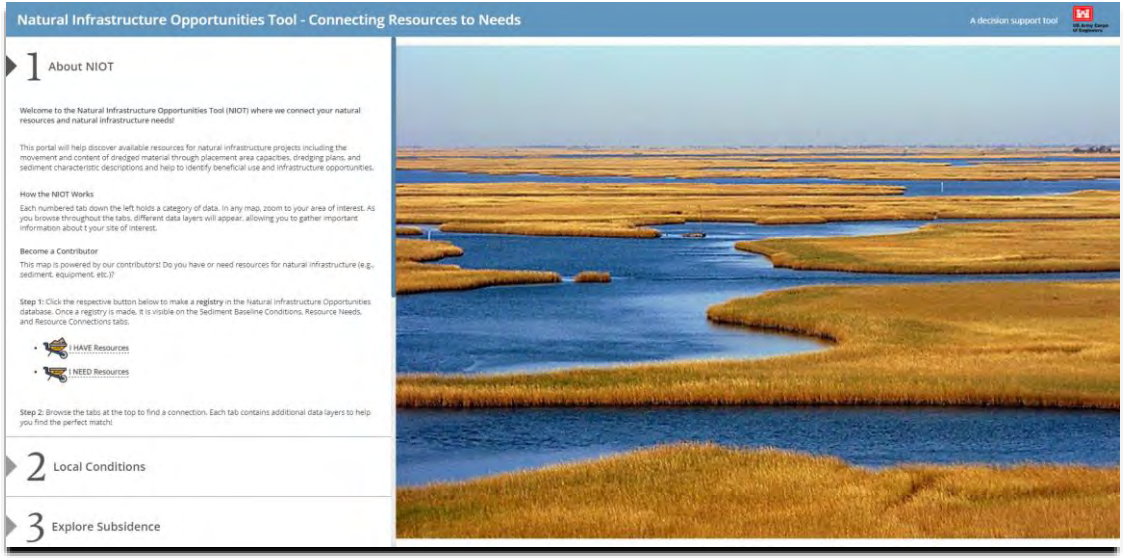
- What's new
- Tools
- Podcasts
- Proving grounds
- Current and past projects
- Publications
- Technical points of contact
- Links to related websites

www.engineeringwithnature.org



Natural Infrastructure Opportunities Tool (NIOT)

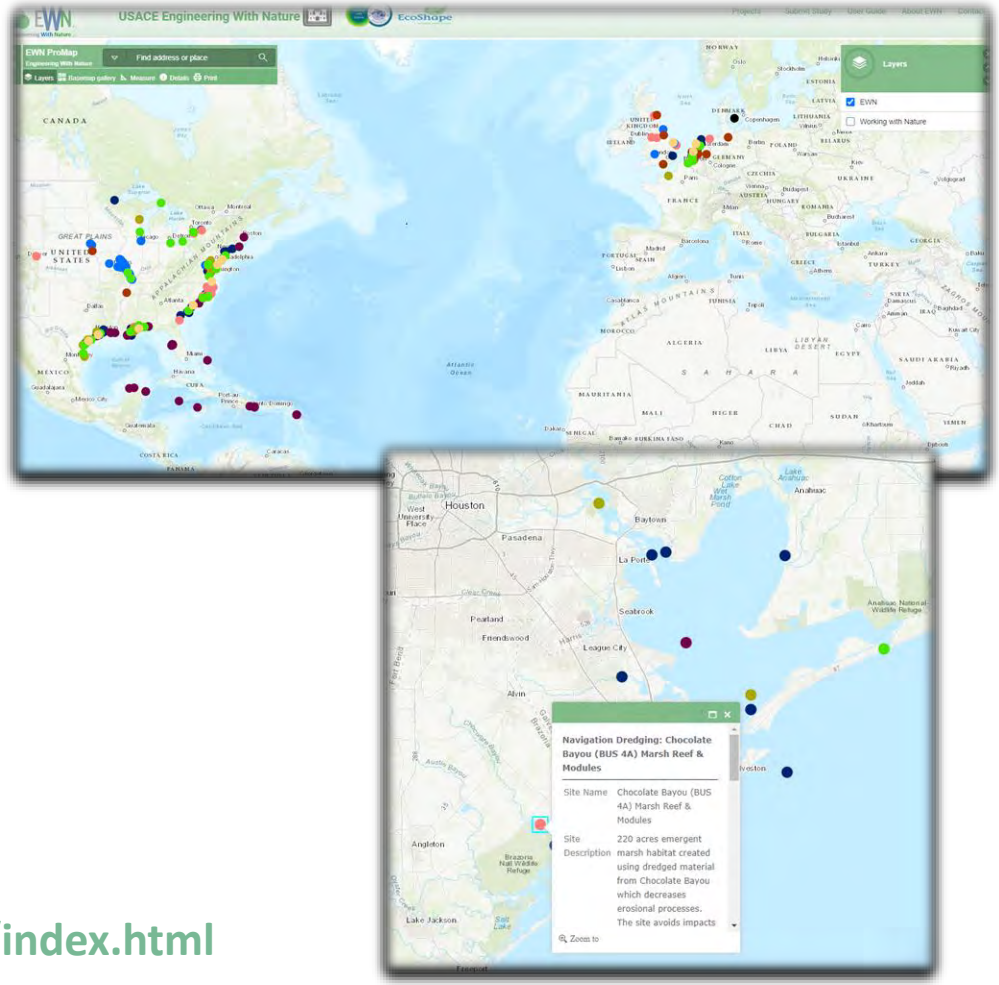
- EWN partnered with the Natural Infrastructure Initiative, a private-sector consortium of organizations led by Caterpillar, to develop the NIOT
- Supports partnership development for projects, including BU projects



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

EWN Project Mapper (ProMap)

- Geography-based data viewer presenting projects that exemplify EWN principles
- Presents information helpful in applying EWN elsewhere
- Projects can be viewed by infrastructure type (e.g., dredging project, breakwater) or by intended environmental or social benefits
- Incorporates Working with Nature (WwN) and EcoShape projects



https://ewn.el.erdc.dren.mil/ProMap/index.html

Other EWN Web-based Resource Tools

- Dredging Operations Technical Support program and website

https://dots.el.erdc.dren.mil/

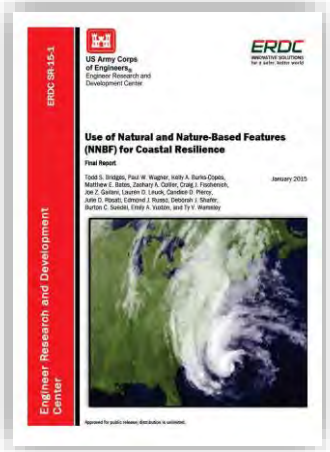
- USACE Thin-Layer Placement website

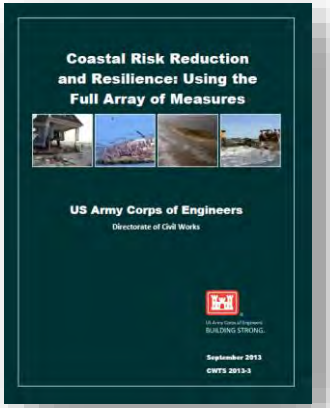
https://tlp.el.erdc.dren.mil/

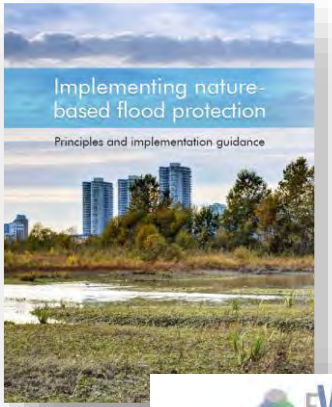
- USACE Beneficial Use website

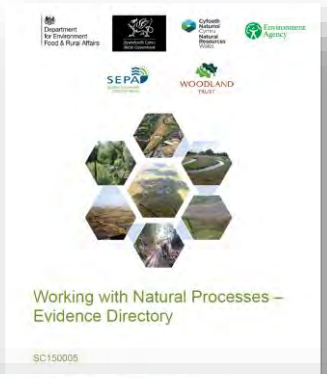
https://budm.el.erdc.dren.mil/

Nature-Based Guidance, Standards, Evidence to Foster Innovation









Engineering With Nature® Atlases

Volume 1
56 Projects
27 USACE

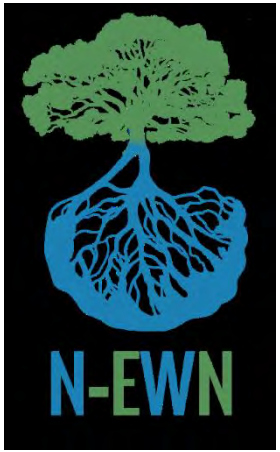
Volume 2
62 Projects
23 USACE

"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

www.engineeringwithnature.org

Network for Engineering With Nature (N-EWN)

- Large scale network is needed for innovation / knowledge acceleration
- Driven primarily by research community
- Aligning research with the needs of practice
- Grounding research in real projects
- EWN education: curricula and training
- Experiential learning for students – systems thinking, cross-disciplinary training
- Types of partners
  - Research – academic, private
  - Industry practitioners
  - Users and project owners
- Freely flowing communication & knowledge sharing
- Shorten road to implementation



Institute for Resilient Infrastructure Systems
UNIVERSITY OF GEORGIA

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

https://n-ewn.org/

The Spectrum

"Wild and Free-Flowing Nature"

"Tamed and Conquered Nature"

Duwamish River, WA 1800s

Duwamish River, WA today

"Not either / or, but and"

(Structural vs. Natural)

San Joaquin Valley, CA 1800s

Conserved Nature

Engineered Nature-Based Solutions

+ Engineered Structures

Lasting, Sustainable, Resilient Systems

San Joaquin Valley, CA today

Questions?

EngineeringWithNature.org

Download

- Executive Summary (70 pages)
- International Guidelines on NNBF for Flood Risk Management (1,000 pages)
- https://ewn.erdc.dren.mil/?page_id=4351