ENGINEERING WITH NATURE: OPPORTUNITIES AND CHALLENGES

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U.S. Army Engineer Research and Development Center

USACE Dredging; Sausalito, CA

6 March 2019

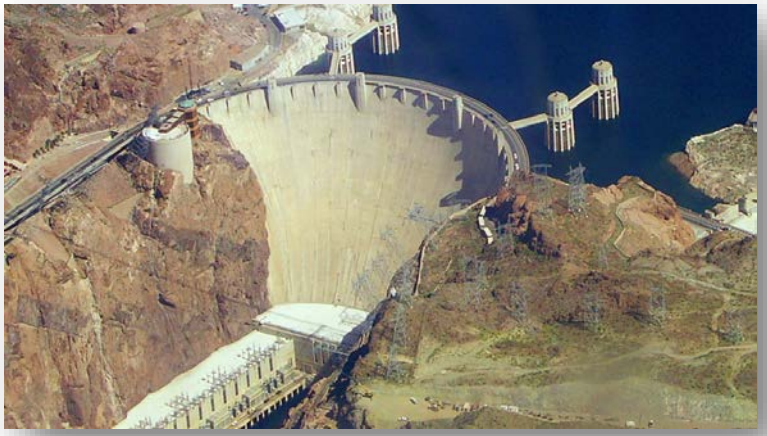



US Army Corps of Engineers

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

1900-2000: THE CENTURY OF INFRASTRUCTURE (US)

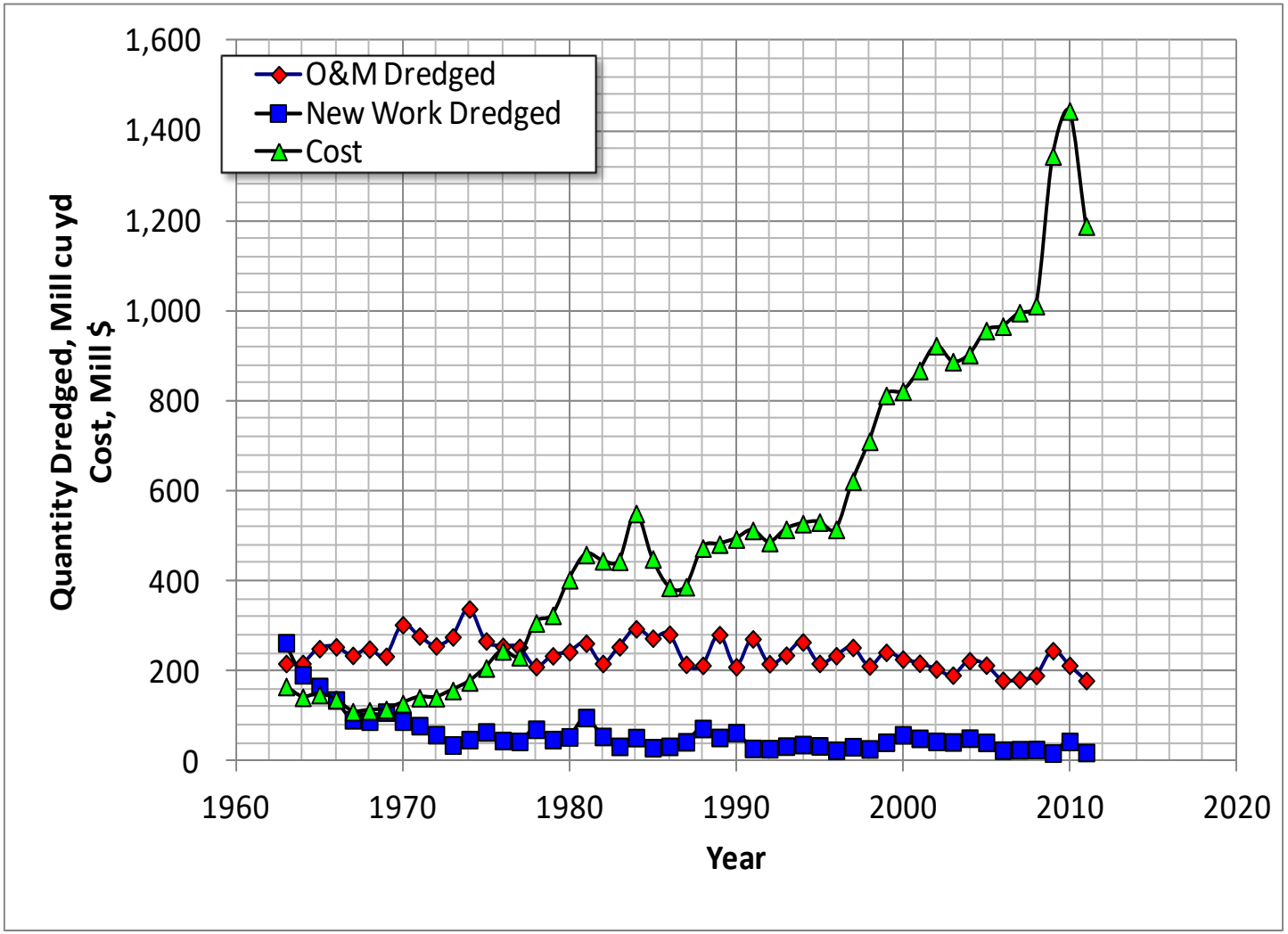
- 4,071,000 miles of roadway
  - 47,182 miles in the Interstate system
- 149,136 miles of mainline rail
- 640,000 miles of high-voltage transmission lines
- 614,387 bridges
- 90,580 dams
- 155,000 public drinking water systems
- 30,000 miles of levee
- 4,500 military installations
- 926 ports



THE 1970's: THE DECADE OF ENVIRONMENTAL LAW AND REGULATION

- National Environmental Policy Act of 1969
- Clean Water Act 1972
- Marine Protection, Research, and Sanctuaries Act of 1972
- Coastal Zone Management Act of 1972
- Endangered Species Act of 1973
- Resource Conservation and Recovery Act of 1976
- Comprehensive Environmental Response, Compensation and Liability Act of 1980

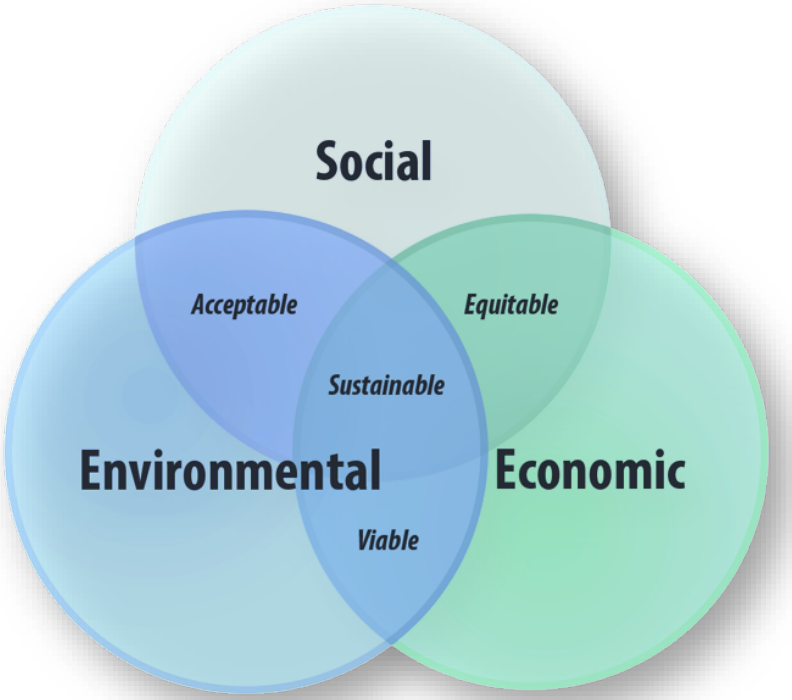
THE ESCALATING COSTS OF DREDGING




SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
SUSTAINABLE DEVELOPMENT GOALS

SUSTAINABILITY

Sustainability is achieved by efficiently investing resources to create present and future value



A "SUSTAINABILITY LEDGER" FOR SEDIMENT MANAGEMENT

Efficiency

- Reducing sedimentation in channels & reservoirs
- Reducing transport distances for dredged material
- Reducing dredging time
- Expanding operational flexibility
- Linking multiple projects

Value Creation

- Restoring natural sediment processes to sustain landscapes
- New nature-based features that reduce flood risks
- New habitat for fish and wildlife
- New features that provide recreational and other social value
- Budget space for additional infrastructure work

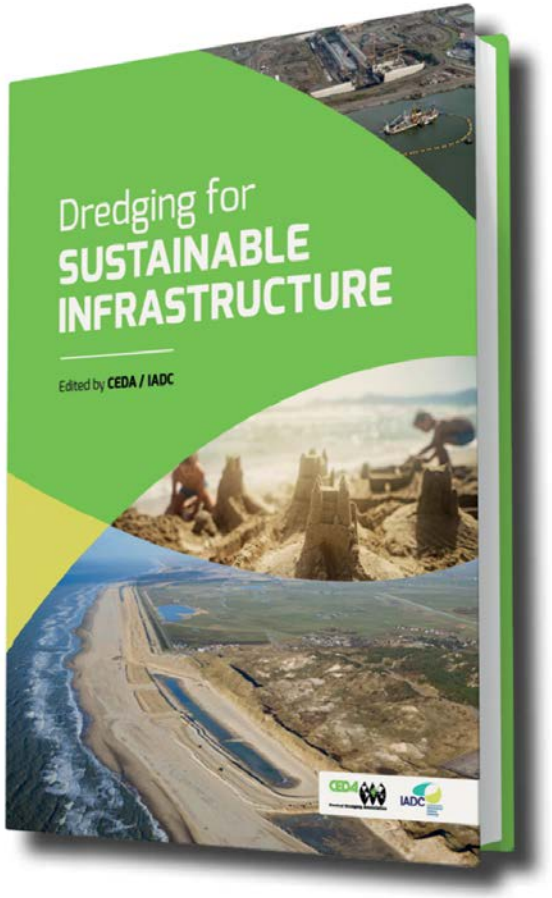
Dredging for Sustainable Infrastructure

Integrating Dredging with Sustainable Development

By Todd Bridges and Tiedo Velinga

Guiding Principles

1. *Comprehensive consideration and analysis of the social, environmental and economic costs and benefits of a project is used to guide the development of sustainable infrastructure.*
2. *Commitments to process improvement and innovation are used to conserve resources, maximize efficiency, increase productivity, and extend the useful lifespan of assets and infrastructure.*
3. *Comprehensive stakeholder engagement and partnering are used to enhance project value.*



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
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners

www.engineeringwithnature.org

EWN® OVERVIEW

Engineering With Nature® began in 2010

- Engaging across USACE, other agencies, NGOs, academia, private sector, international collaborators
- Guided by a strategic plan
- Established through Proving Grounds
  - Galveston, Buffalo, Philadelphia
- 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
  - 2015, 2017 WEDA Awards; 2017 DPC Award

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EWN® ACROSS USACE MISSION SPACE

Navigation
- Strategic placement of dredged material supporting habitat development
- Habitat integrated into structures
- Enhanced Natural Recovery

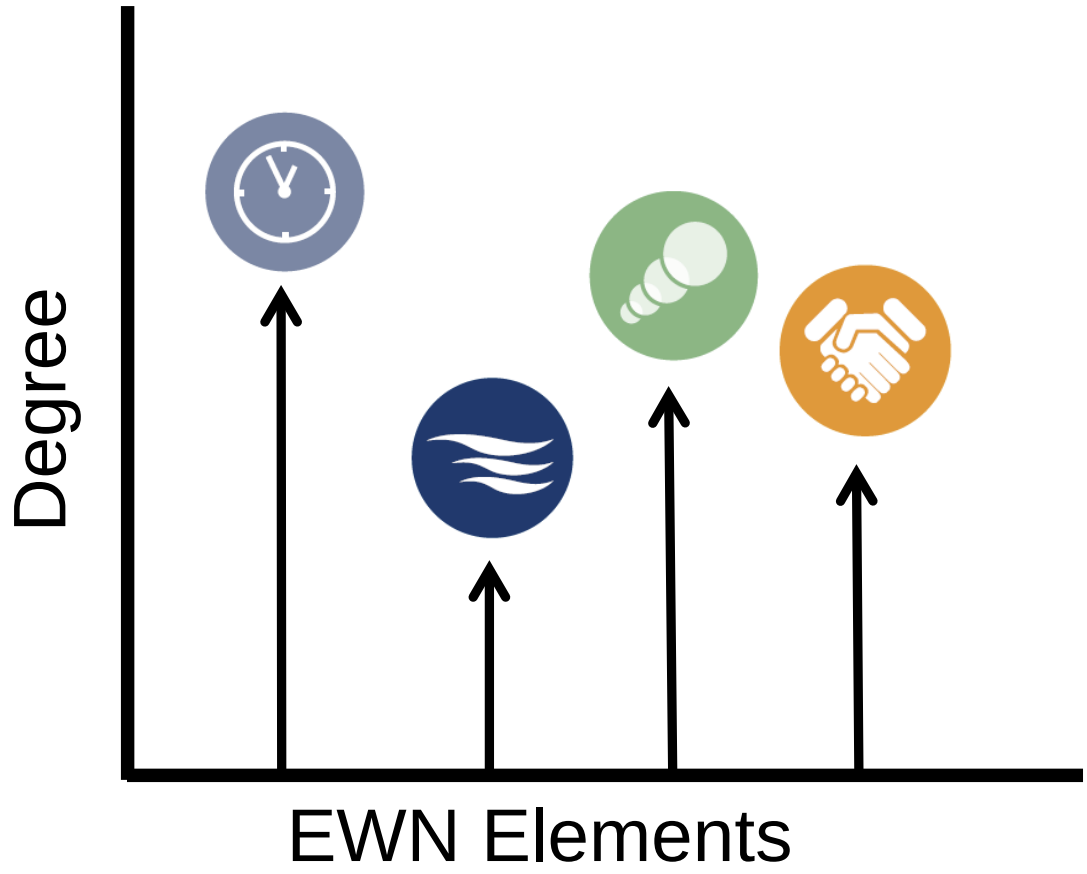
Flood Risk Management
- Natural and Nature-Based Features to support FRM
- Levee setbacks

Ecosystem Restoration
- Ecosystem services supporting engineering function
- “Natural” development of designed features

Water Operations
- Shoreline stabilization using native plants
- Environmental flows and connectivity

Engineering With Nature®

Elements

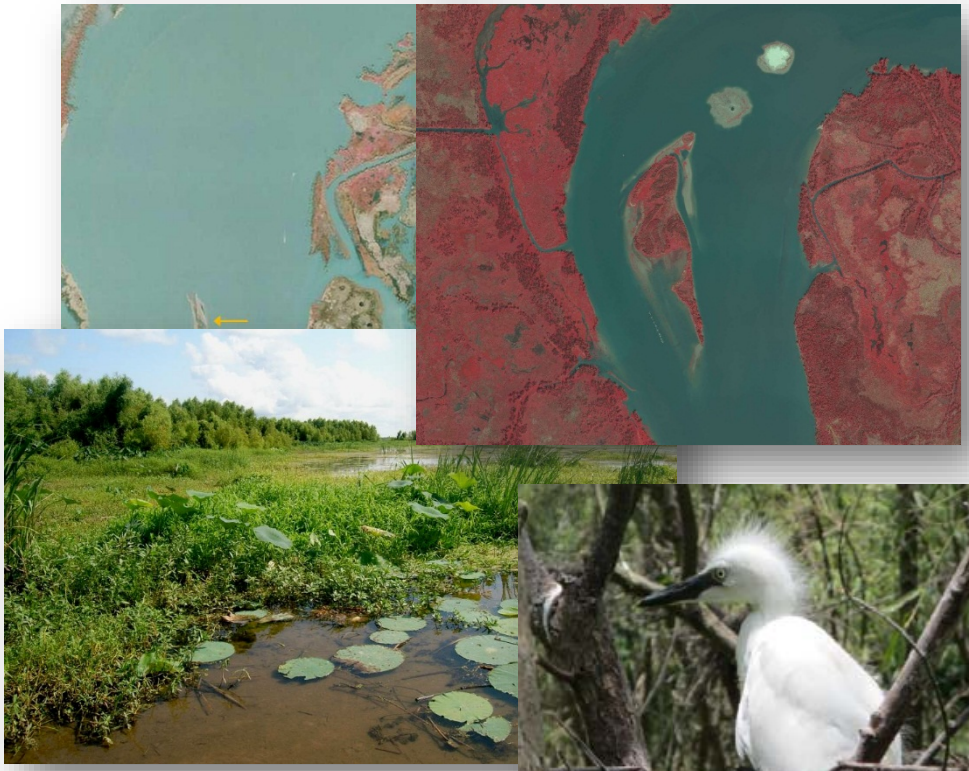


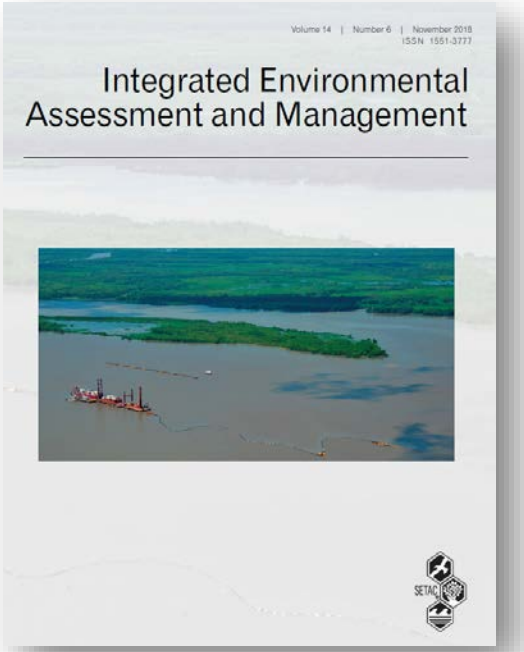
EWN Elements

Four major elements are involved in applying EWN to develop infrastructure projects:

- Using science and engineering to produce operational efficiencies
- Using natural processes to maximize benefit
- Increasing the value provided by projects to include social, environmental, and economic benefits
- Using collaborative processes to organize, engage, and focus interests, stakeholders, and partners

HORSESHOE BEND ISLAND, ATCHAFALAYA RIVER





Quantifying Wildlife and Navigation Benefits of a Dredging Beneficial-Use Project in the Lower Atchafalaya River: A Demonstration of Engineering with Nature®

Christy M Foran, ‡ Kelly A Burks-Copes, † Jacob Berkowitz, † Jeffrey Corbino, § and Burton C Suedel† †*

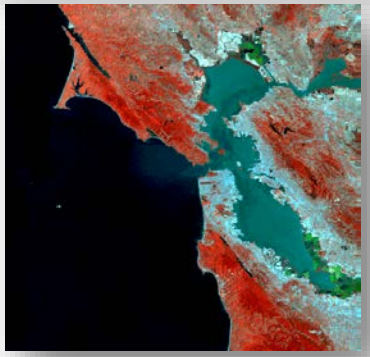
Project Awards:

- 2015 WEDA Award for Environmental Excellence
- 2017 WEDA Award for CC Adaption
- 2017 DPC Award for Working, Building, and Engineering with Nature

Middle Harbour Port of Oakland, USA

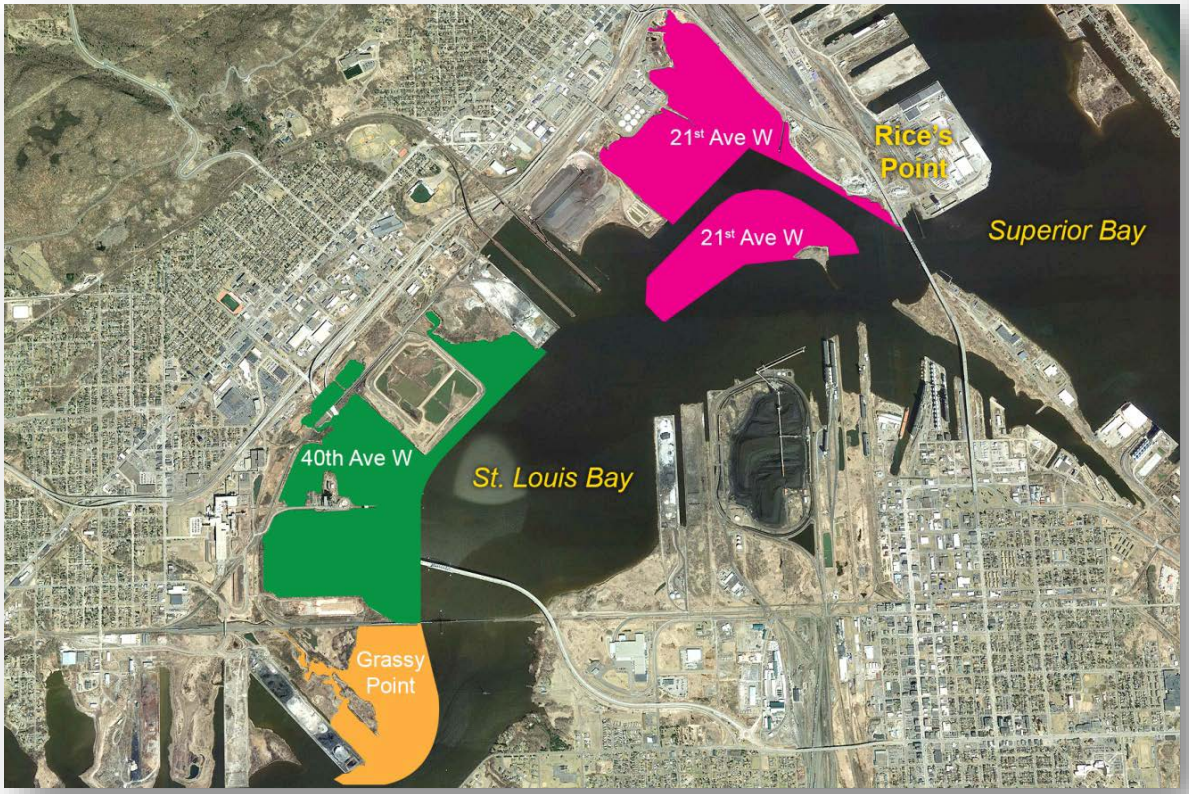
2018 PIANC *Working with Nature* Award Winner

HAMILTON AND SEARS POINT WETLANDS SAN PABLO BAY, CA



CAT ISLAND ON GREEN BAY, WISCONSIN

DULUTH HARBOR THIN-LAYER PLACEMENT



USACE PHILADELPHIA DISTRICT: EWN IN BACK BAY NEW JERSEY

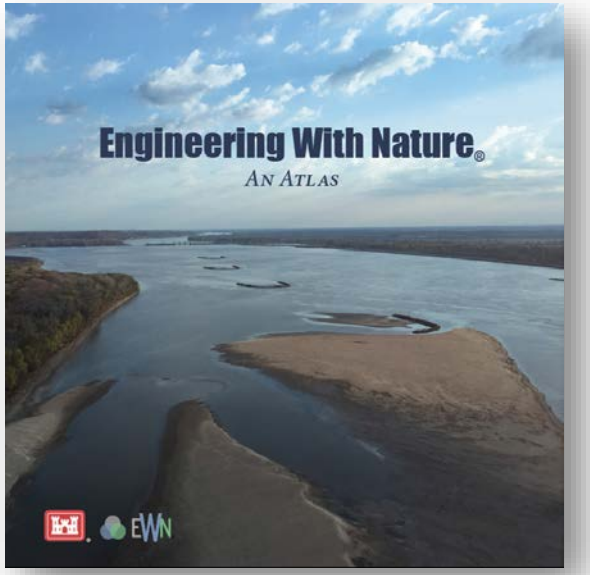
Dr. Candice Piercy

Mordecai Island

Avalon

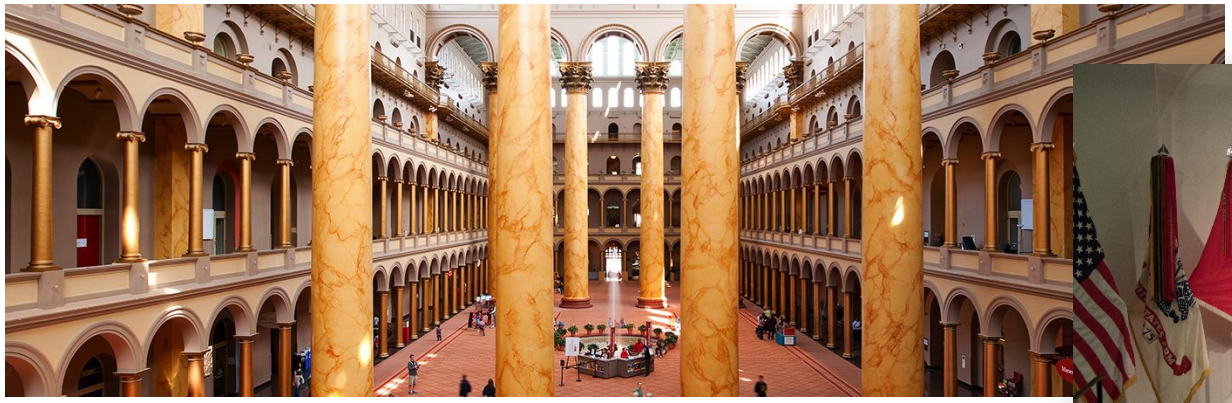
Stone Harbor

EWN ATLAS LAUNCH EVENT



10:30-12:00
January 16, 2019
National Building Museum
Washington, D.C.

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



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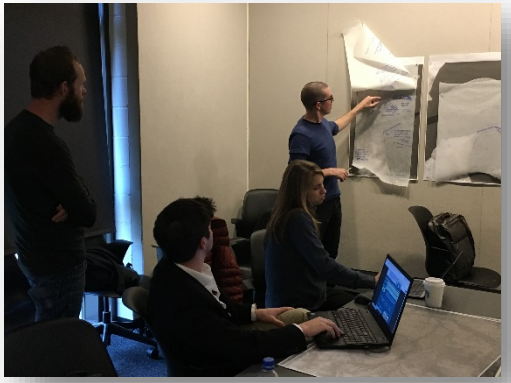
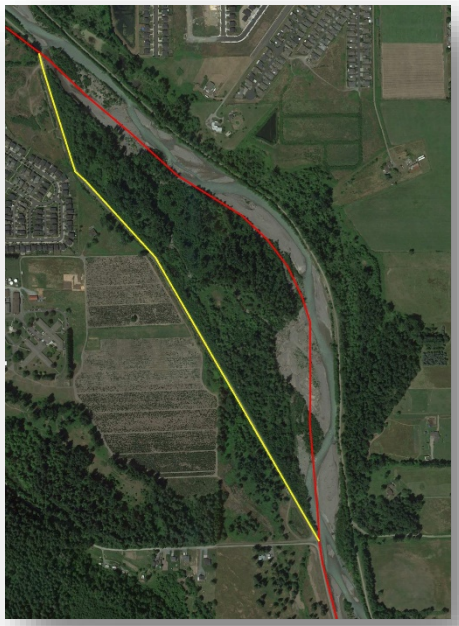
INCORPORATING EWN/LA TECHNIQUES AND PRACTICES INTO USACE INFRASTRUCTURE

Work on USACE Infrastructure Projects Continues with DRC Affiliates and UGA.

- Projects include:
  - Moses Lake Tide Gate Area (SWG);
  - Comite Canal Project (MVN);
  - Franklin Lock/Dam Recreation Area (SAJ);
  - Morehaven West Campground Site (SAJ);
  - Back Creek and Fishing Creek Jetties(NAB);
  - Proctor Creek (SAM); and
  - NEW: Sabine to Galveston (S2G) Project (SWG)
- Team has visited project sites and collected data
- Continue working with respective District POCs
- EWN/LA Team met JAN 19 at Auburn to work on initial renderings
- Meetings w/ USACE Districts to discuss rendering will begin in MAR 19
- Final report/renderings delivered to Districts JUL 19



DEVELOPING MULTI-PURPOSE BENEFITS



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

CECW-ZB

JUN 2 1 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.

6. **Incorporate Social and Environmental Benefits into Project Formulation, Design, and Implementation**. The nation and the communities we serve have a variety of objectives for USACE's Civil Works water resources development projects, such as public safety, economic vitality, recreation, and quality of life. Existing policies and practices in Civil Works are sometimes hampered by a single-objective look at water resource development, which constrains our ability to apply our full technical and problem-solving capability to water resources problems. Fully identifying, describing, and considering a broader array of potential project benefits is important to ensuring the solutions we develop, recommend, and implement are smart investments regardless of potential cost-share limitations. All Civil Works programs should consider how and under what conditions and circumstances expanded objectives and consideration of social and environmental considerations can be undertaken within existing legislated or policy-directed timelines. Also, all Civil Works programs will incorporate those broader objectives and considerations in our daily decision-making processes using qualitative and quantitative approaches where practical and appropriate. The following are some examples of ongoing efforts to achieve this goal:

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

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

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

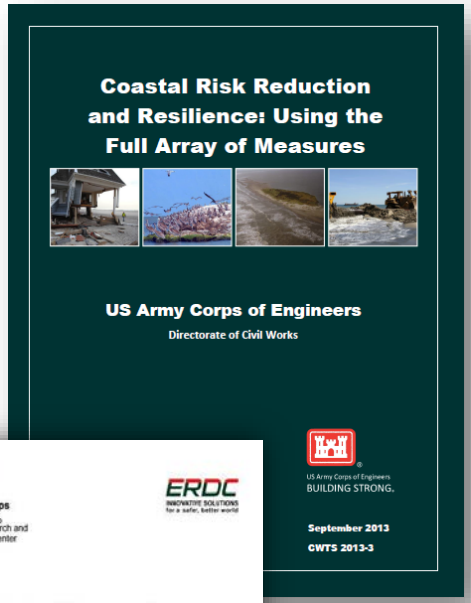
(4) structural measures.

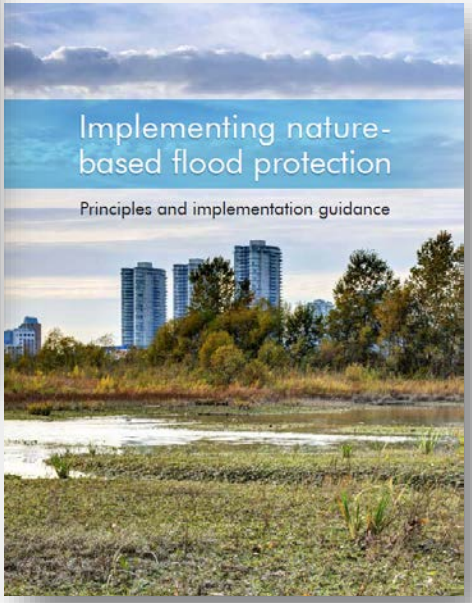
INTERNATIONAL GUIDELINES ON THE USE OF NATURAL AND NATURE-BASED FEATURES FOR SUSTAINABLE COASTAL AND FLUVIAL SYSTEMS

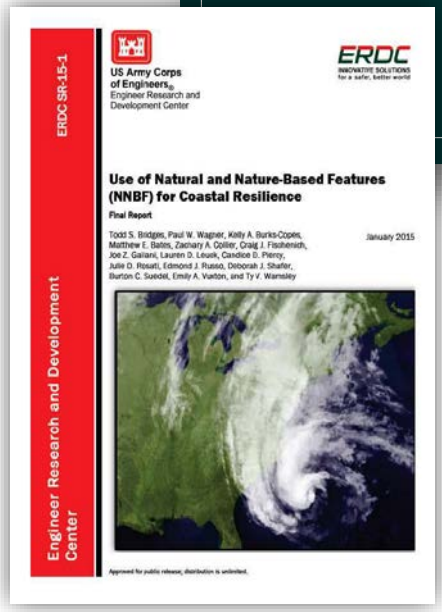
Purpose: Develop guidelines for using NNBF to provide engineering functions relevant to flood risk management while producing additional economic, environmental and social benefits.

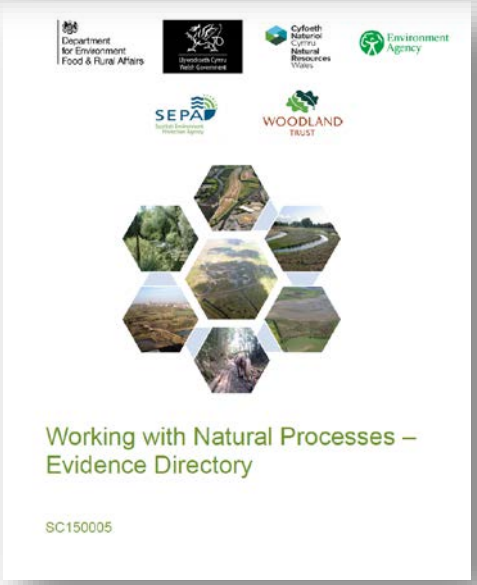
- Publish NNBF technical guidelines by 2020:
  - Multi-author: government, academia, NGOs, engineering firms, construction companies, etc.
  - Addressing the full project life cycle
  - Guidelines in 4 Parts
    - Overarching
    - Coastal Applications
    - Fluvial Applications
    - Conclusions

NATURE-BASED GUIDANCE, STANDARDS, EVIDENCE









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How innovation happens: humans working with other humans, across organizational boundaries, to co-develop solutions

COLLABORATION ACROSS GOVERNMENT

USACE/NOAA Collaboration Workshop: Natural and Nature-based Features, Charleston, SC; 1-3 March 2016

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

www.engineeringwithnature.org (NNBF)

COLLABORATION WITH THE PRIVATE SECTOR

- Caterpillar Inc.
  - Restoring Natural Infrastructure Summit; November 4th, 2015; New York City
  - Natural Infrastructure Initiative – USACE Collaboration Work Streams
    1. NI Opportunity Evaluation Tool. Capitalizing on enterprise-level capability: CE Dredge DST
    2. Evaluation and Decision Making
    3. Field Application and Demonstration
- Western Dredging Association (WEDA)
  - Collaborative technical workshop on engineering and construction techniques for Engineering With Nature

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

COLLABORATION WITH ACADEMIA

- Texas A&M University
  - Partnering through the Coastal Science and Engineering Collaborative (CSEC)
  - Joint research on NNBF
  - EWN Seminar spring 2018
  - Developing graduate curriculum to support EWN

- University of Georgia
  - Institute for Resilient Infrastructure Systems (IRIS)
  - CRADA and Educational Partnering Agreement
  - Multiple levels of collaboration on EWN and NNBF
  - EWN curriculum development

Institute for Resilient Infrastructure Systems
UNIVERSITY OF GEORGIA

BUILDING PROGRESS

Engineering With Nature

- Commit to innovation
  - **What would it take to get to 100% beneficial use?**
- Expand the “vision” to diversify project benefits
  - **Where will landscape features create the most value *in the future*?**
- Increase collaboration and cross-sector partnerships
  - **How can EWN approaches be used to incentivize progress with regulatory and resource agencies?**
- Pursue realistic and affordable projects
  - **How can demonstration projects be used to promote innovation in engineering and design AND reduce BU project costs?**
- Document and communicate the value created
  - **How can developing a library of published regional EWN case studies be used to build momentum?**