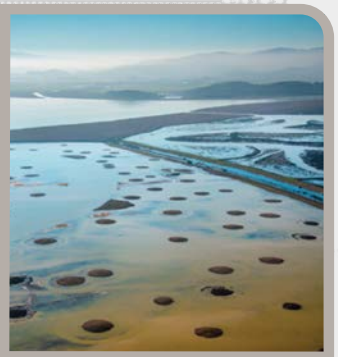
ENGINEERING WITH NATURE FOR SUSTAINABLE SYSTEMS

Todd S. Bridges, Ph.D.
Senior Research Scientist (ST), Environmental Science
National Lead, USACE EWN Initiative

U.S. Army Corps of Engineers
U.S. Army Engineer Research and Development Center

SAME; Seattle, WA

28 March 2019

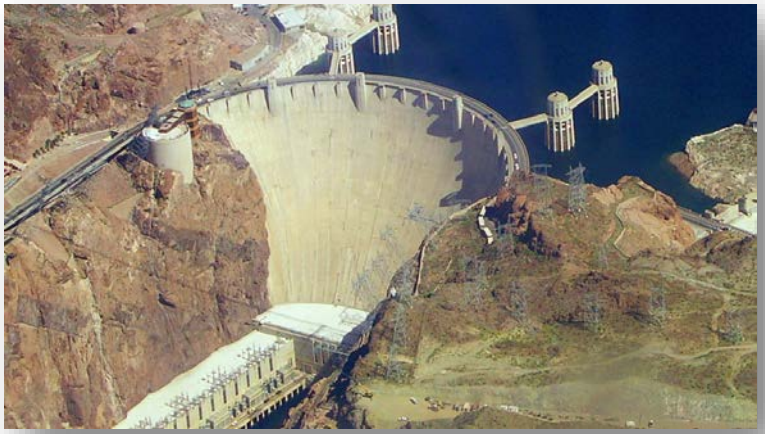


US Army Corps of Engineers

ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

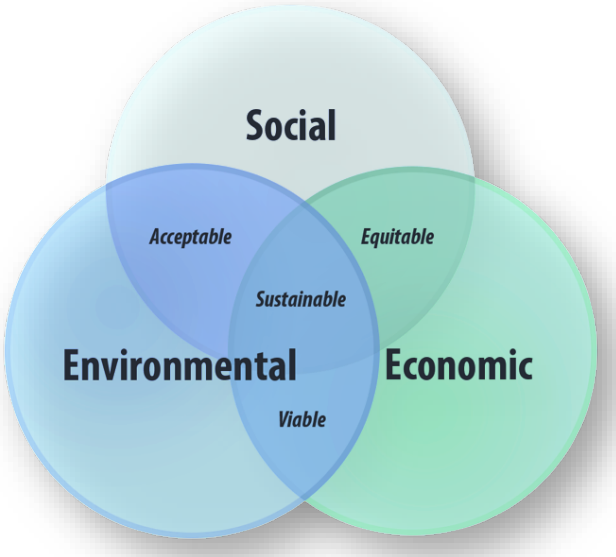
1900-2000: THE CENTURY OF INFRASTRUCTURE (US)

- 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
- 4,500 military installations
- 926 ports



SUSTAINABILITY

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



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

And Many More!

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

www.engineeringwithnature.org

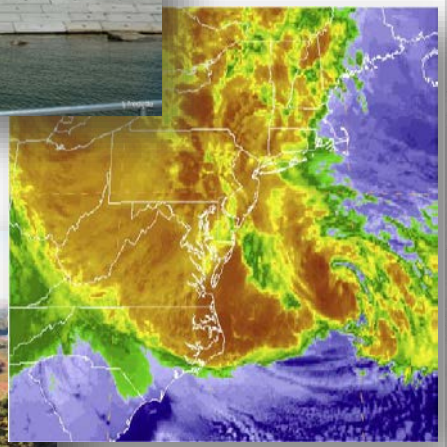
EWN® ACROSS USACE MISSION SPACE

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 FRM
- Levee setbacks

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

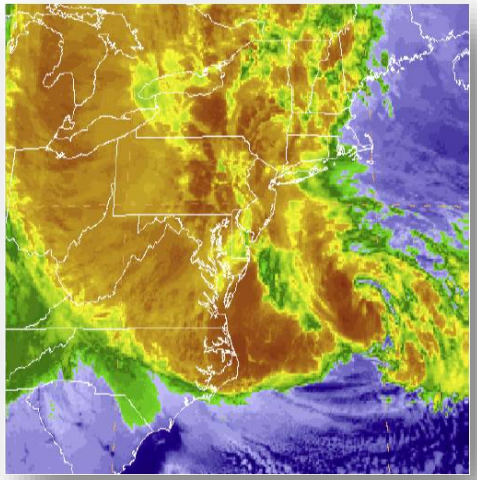
Water Operations
- Shoreline stabilization using native plants
- Environmental flows and connectivity

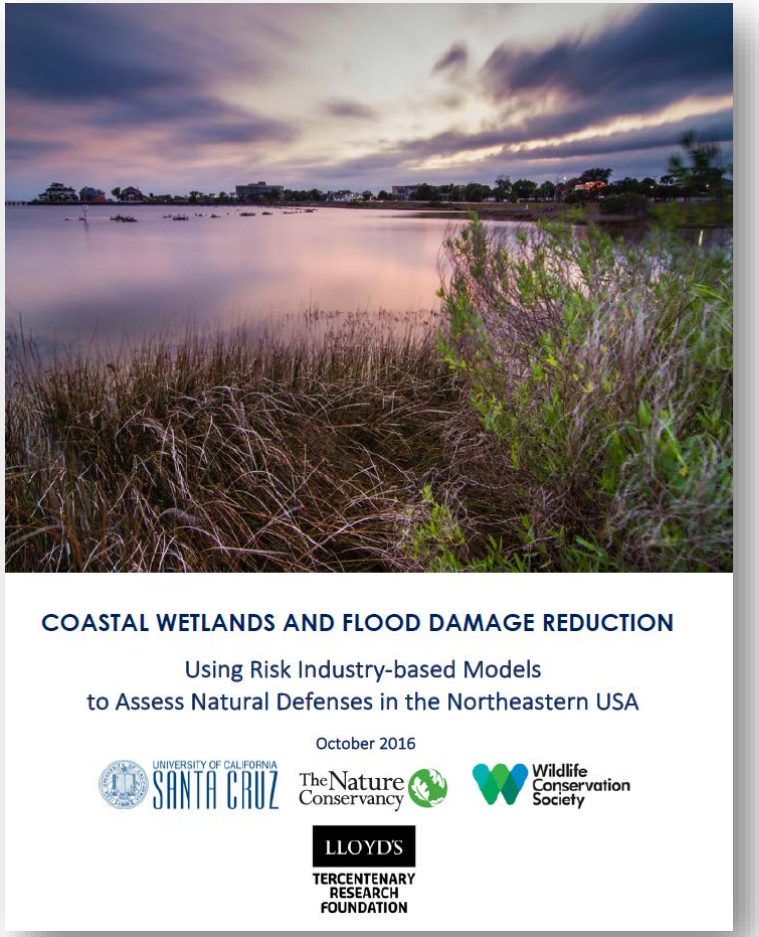


LEVERAGING NATURE FOR ENGINEERING VALUE

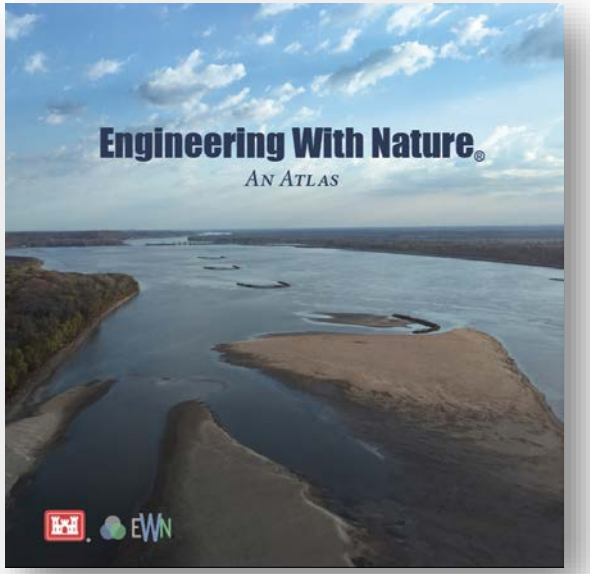
Following Hurricane Sandy:

- 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%.



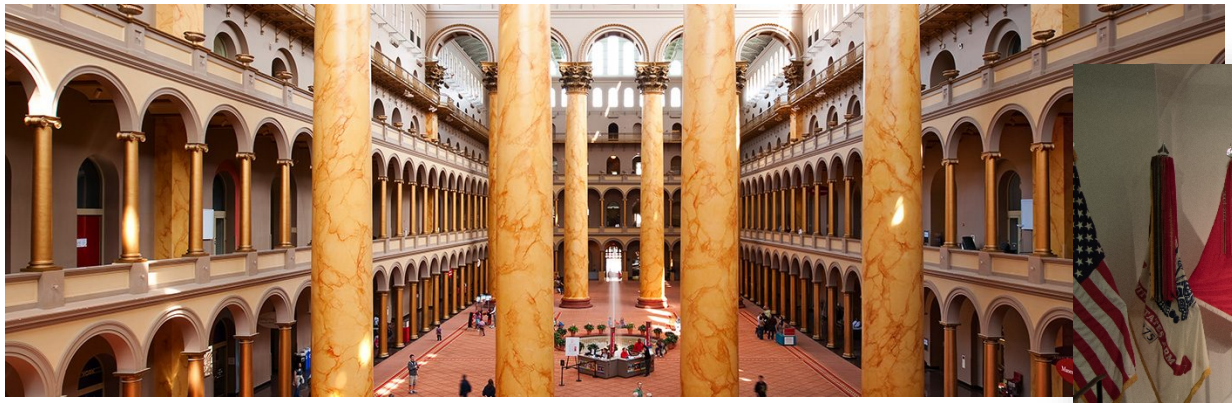


EWN ATLAS LAUNCH EVENT



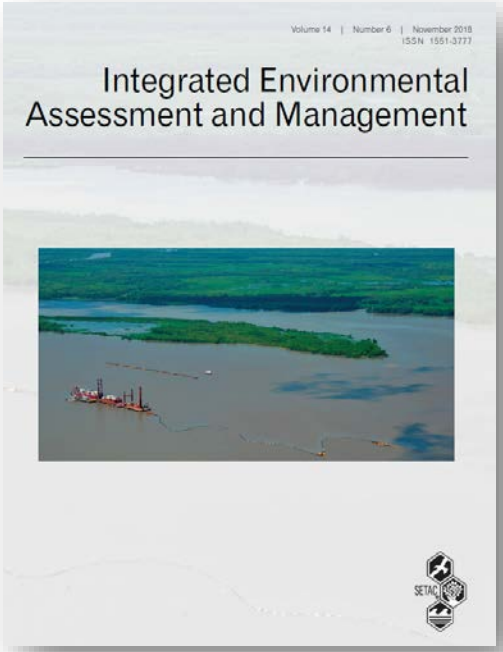
10:30-12:00
January 16, 2019
National Building Museum
Washington, D.C.

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



www.engineeringwithnature.org

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

DULUTH HARBOR THIN-LAYER PLACEMENT

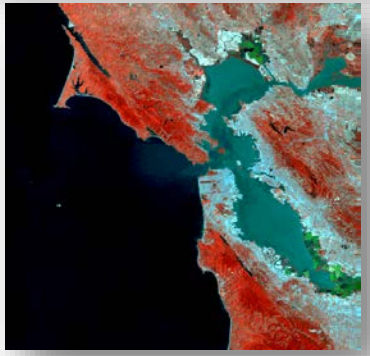
USACE PHILADELPHIA DISTRICT: EWN IN BACK BAY NEW JERSEY

Mordecai Island

Stone Harbor

Avalon

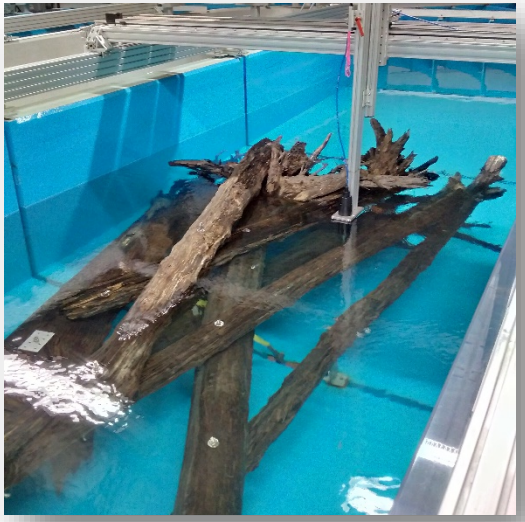
HAMILTON AND SEARS POINT WETLANDS SAN PABLO BAY, CA

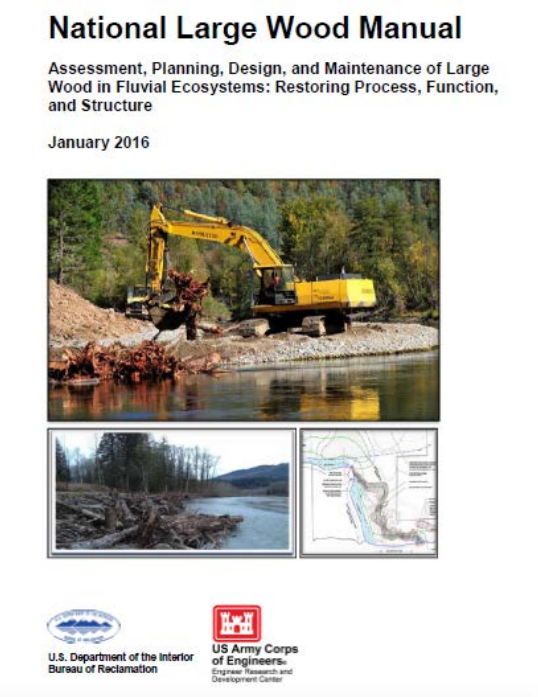


HUMBER ESTUARY; ALKBOROUGH, UK (INCREASED FLOOD STORAGE CAPACITY)

KRUIBEKE, SCHELDT RIVER BELGIUM

ENGINEERING WITH NATURE: MATERIALS





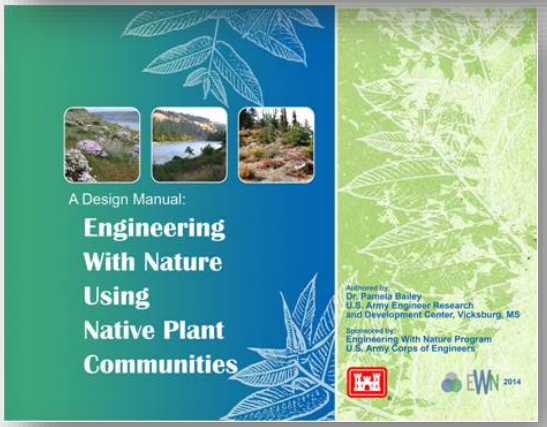
National Large Wood Manual

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

January 2016

U.S. Department of the Interior Bureau of Reclamation

US Army Corps of Engineers. Engineer Research and Development Center



A Design Manual:

Engineering With Nature Using Native Plant Communities

Authored by: Dr. Pamela Bailey, U.S. Army Engineer Research and Development Center, Vicksburg, MS

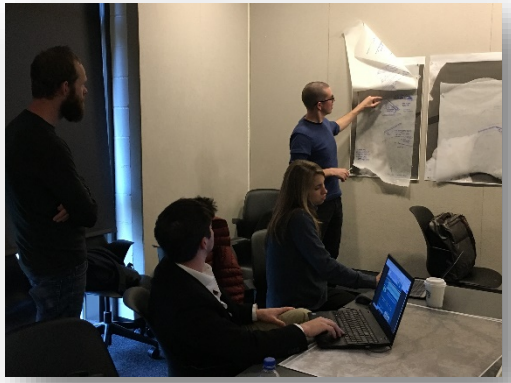
Sponsored by: Engineering With Nature Program, U.S. Army Corps of Engineers

EWN 2014

www.engineeringwithnature.org

INCORPORATING EWN INTO INFRASTRUCTURE THROUGH LANDSCAPE ARCHITECTURE

- Team of EWN and academic and private LAs
- USACE 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
  - 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



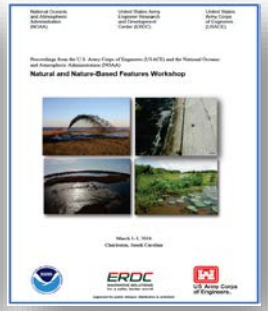
INTERNATIONAL GUIDELINES ON THE USE OF NATURAL AND NATURE-BASED FEATURES FOR SUSTAINABLE COASTAL AND FLUVIAL SYSTEMS

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

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 "Construction Methods Supporting Engineering With Nature"

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

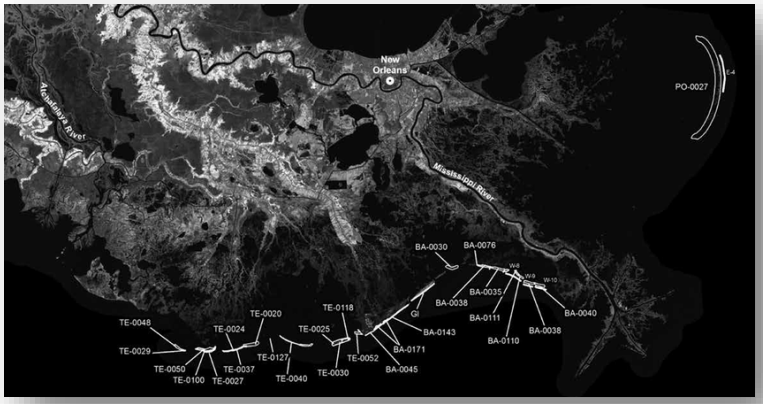
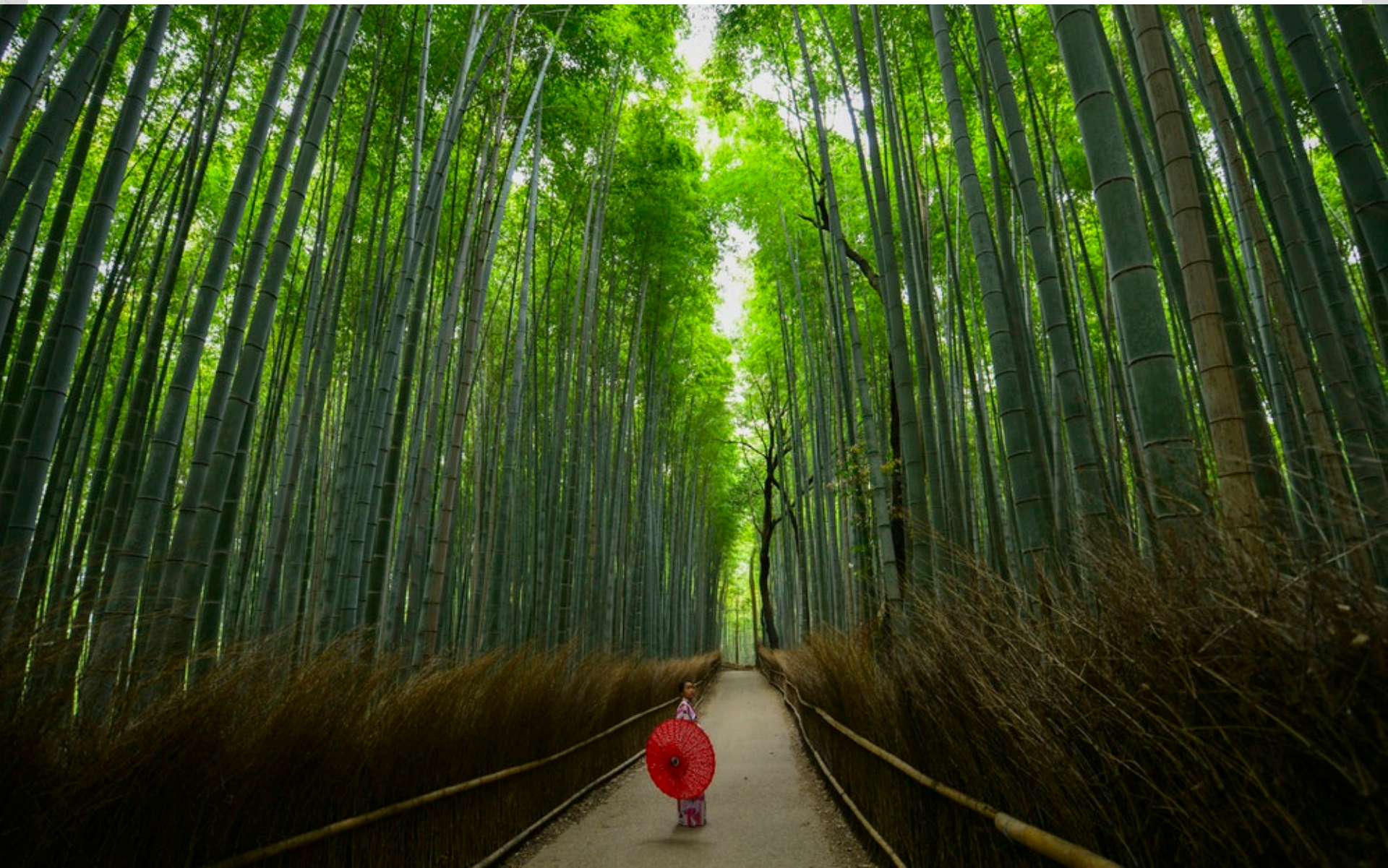
COLLABORATION WITH ACADEMIA

- 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

TOWARD SUSTAINABILITY

- Look forward, not back, to identify need and opportunity
- Expand project “vision” to diversify project benefits
- Collaborate and partner to build the business case
- Commit to experimentation and innovation
- Document and communicate the value created



森林浴 *Shinrin-yoku*: “Forest Bathing”