



# Nature-Based Solutions Workshop for Hazard Mitigation

American Samoa  
August 25, 2021, via Zoom

- Sign-ins
- Fire Exits / Assembly Points
- Restrooms
- Wi-Fi Access
  - **Network:** ODAPM
  - **Password:** odapmhazmit

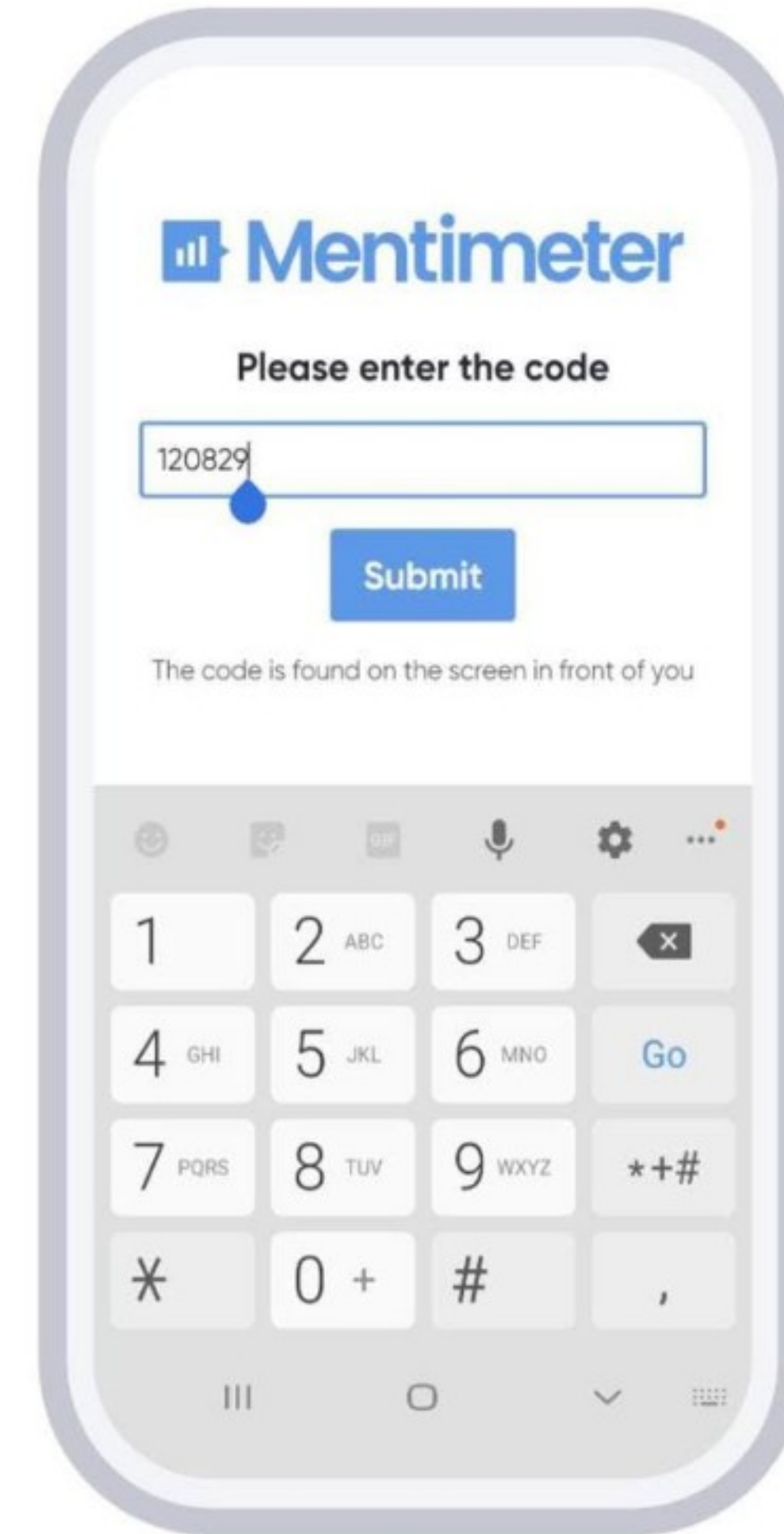
# Welcome Hazard Mitigation Council

- Talauega E. V. Ale, Governor's Authorized Representative, Office of the Governor
- Mauga Tasi Asuega, Secretary, Samoan Affairs
- Tuiagamoia Tavai, Senator, FONONO
- Ape Mike Asifoa, House Representative, FONONO
- Petti Matila, Director, Department of Commerce
- Chris King, Director, Department of Port Administration
- Faleosina Voigt, Director, Department of Public Works
- Fa'amao Asalele, Director, AS-Environmental Protection Agency
- Tuimalo Elvis Zodiacal, Officer, Historic Preservation Office
- Wallon Young, CEO, American Samoa Power Authority
- Chuck Leota, CEO, American Samoa Telecommunications Authority
- Lisa Tuato'o, Director, Office of Disaster Assistance & Petroleum Management
- Samana Ve'ave'a, Director, American Samoa Department of Homeland Security
- Ella Gurr, President, Chamber of Commerce

- Most guest speakers will be presenting via **Zoom**
  - Slides will be made available to all participants
  - Presentations will also be recorded
- We also want to hear from **YOU!**
- Your feedback will be captured via **Mentimeter**
  - Collective Q&A responses will be shared real-time
  - Your responses are kept anonymous and not recorded

# Mentimeter Instructions

- Get your cell phones ready!
- Got to [www.menti.com](http://www.menti.com)
- When prompted by questions, type in the number for your answer on the polling slide
- Your responses will be counted instantly!



# Instructions



# How was your breakfast today?



- Workshop Guide
  - Agenda
  - Speaker Bios
  - Speaker Contact Information
  - Resources



## Nature-Based Solutions Workshop for Hazard Mitigation

AUGUST 25, 2021





# Guest Speakers



**Todd S. Bridges**



**Jessica Podosky**



**Victoria Keener**



**Christopher Shuler**



**Kelley Anderson  
Tagarino**



**Michael W. Beck**



**Borja Reguero**



**Jocelyn  
Madison-Kelly**

# Workshop Objectives

Increase your understanding of how nature-based solutions may be used for risk reduction

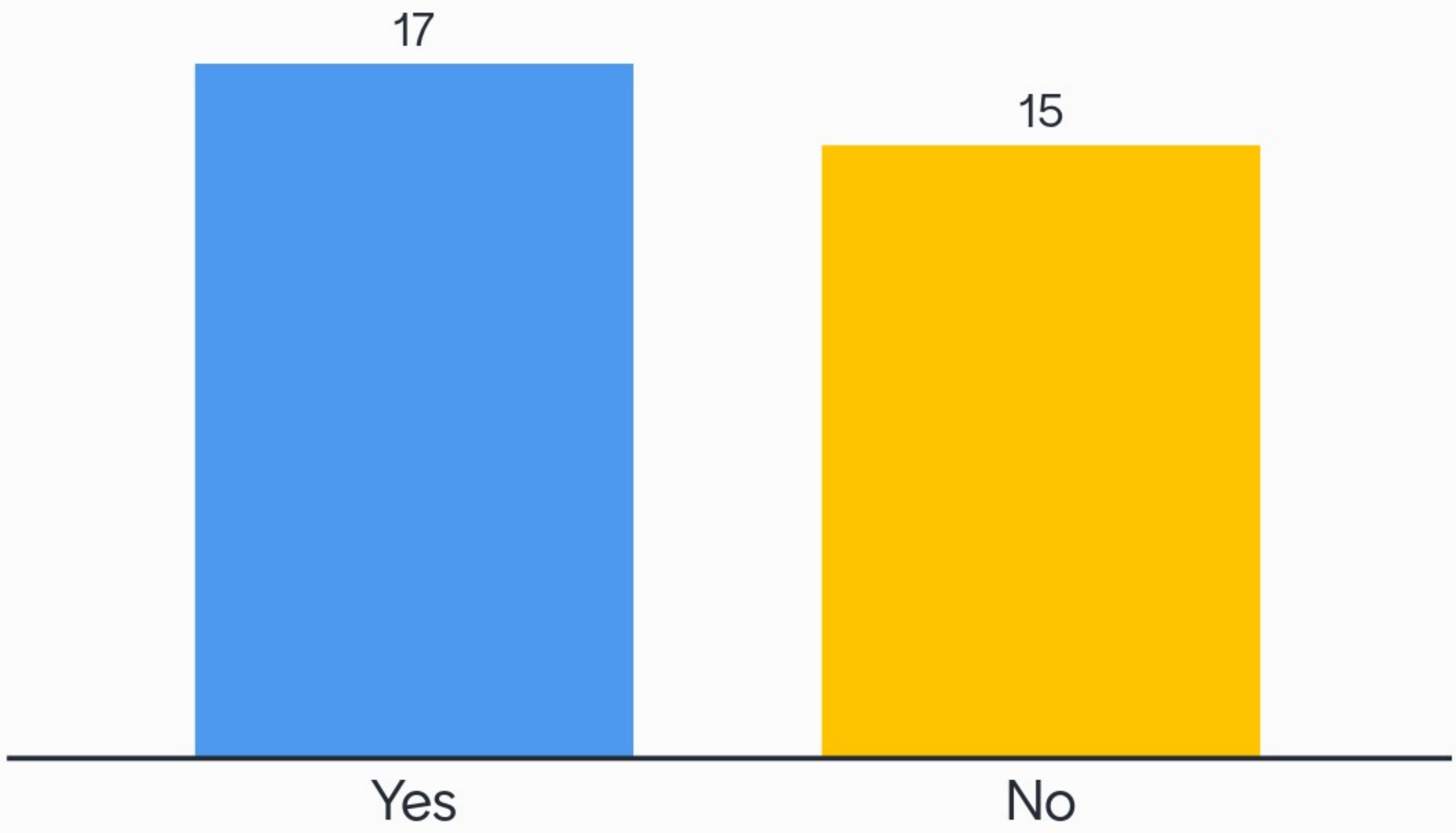
Help you to identify and capture opportunities to integrate nature-based solutions into hazard mitigation projects

# Agenda

8:45 – 9:15	Introductions and Expected Outcomes
9:15 – 9:30	Engineering with Nature Introduction
9:30 – 9:50	Pacific Islands Regional Climate Assessment (PIRCA) Report
9:50 – 10:15	Engineering with Nature Opportunities and Challenges in American Samoa
10:15 – 10:35	American Samoa Living Shoreline Project
10:35 – 11:00	MBS Coral Reef Hazard Mitigation and the Value of Nature Based Solutions
11:00 – 11:15	FEMA's BRIC Program Overview and Notice of Funding Opportunities
11:15 – 11:30	Next Steps and Additional Resources



# Have you considered using a nature-based solution to mitigate risk?





# Nature-Based Solutions Workshop for Hazard Mitigation

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August 25, 2021, via Zoom



U.S. ARMY

# Engineering With Nature®

Dr. Todd S. Bridges  
Senior Research Scientist (ST), Environmental Science  
National Lead, USACE Engineering With Nature®  
US Army Corps of Engineers  
Todd.S.Bridges@usace.army.mil

Nature-Based Solutions Workshop- American Samoa  
25 August 2021



US Army Corps  
of Engineers



# The Multi-Hazard World



David Johnston, USGS



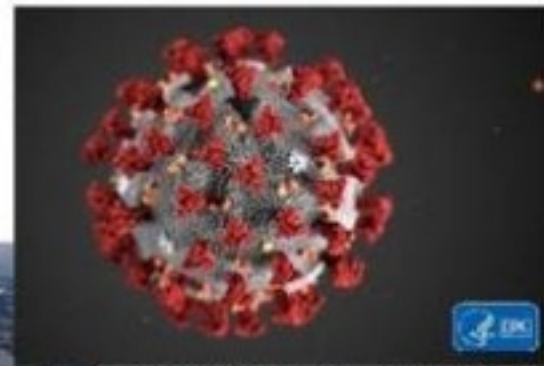
Mt. Saint Helens, 1980



New Madrid Seismic Zone



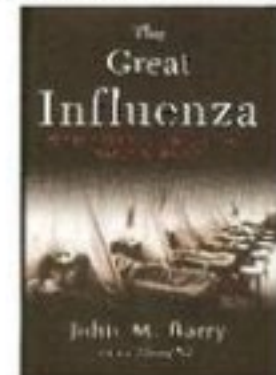
San Francisco, 1906



COVID-19, 2020-X



HABs, Lake Erie; 2008-2017



H1N1, 1918-1919



Beirut, Lebanon; 2020



Fukushima, 2011



Three Mile Island, 1979



Deepwater Horizon, 2010



9/11



Civil unrest, 2020  
Medfly "bio-attack"; CA, 1989



Camp Fire; CA 2018



Banqiao dam failure; China, 1975



Hurricane Katrina, 2005



Flood of 1927; Tallulah, LA



Dust Bowl, 1930s



Offutt AFB, 2019



2020 record-setting storm season

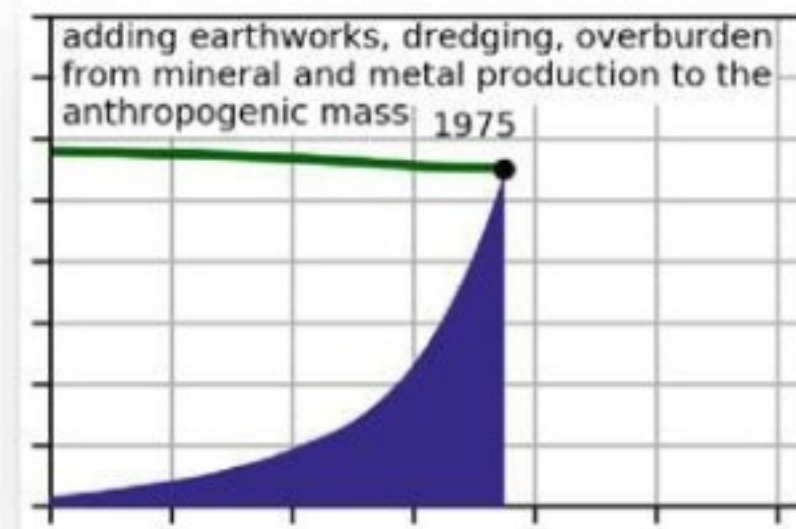


Hurricane Harvey; landfall and Houston, 2017

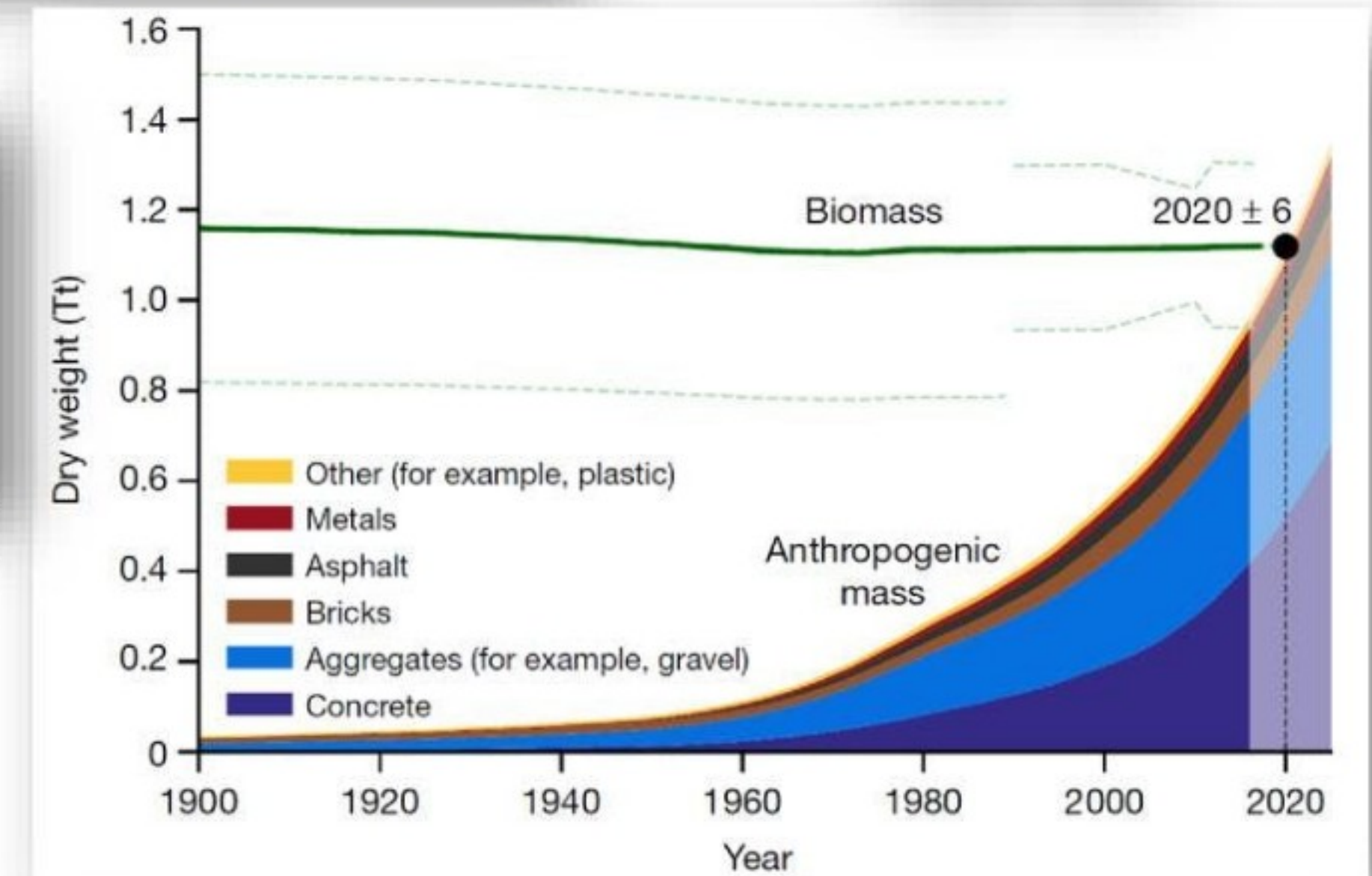


# 1900-2000: The Century of Infrastructure (US)

- 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
- >30,000 miles of flood levee
- 155,000 public drinking water systems
- 4,500 military installations
- 926 ports, 25,000 miles of navigation channel



Elhacham et al. 2020.  
**Global human-made mass exceeds all living biomass.**  
Nature 588:442-444



# 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

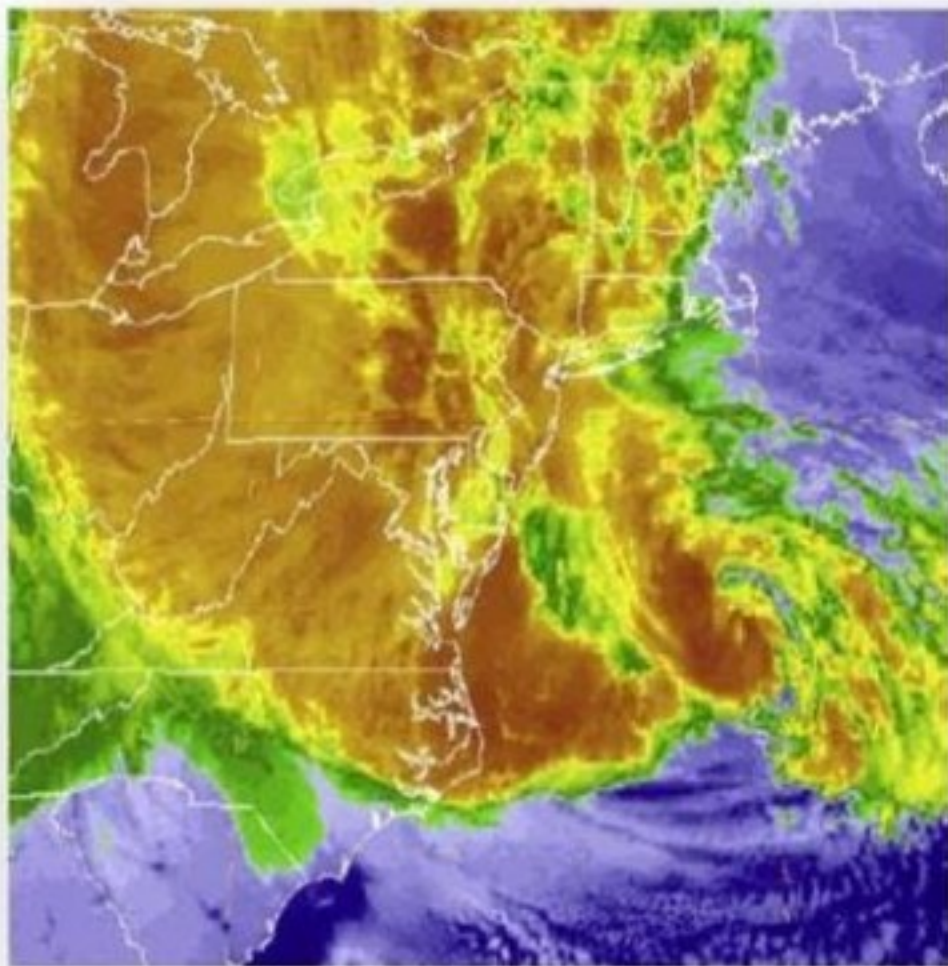


*"The mission of US Army Corps of Engineers is to deliver vital public and military engineering services; partnering in peace and war to strengthen our nation's security, energize the economy and reduce risks from disasters. [Engineering With Nature supports this mission which is why it will always be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

# 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



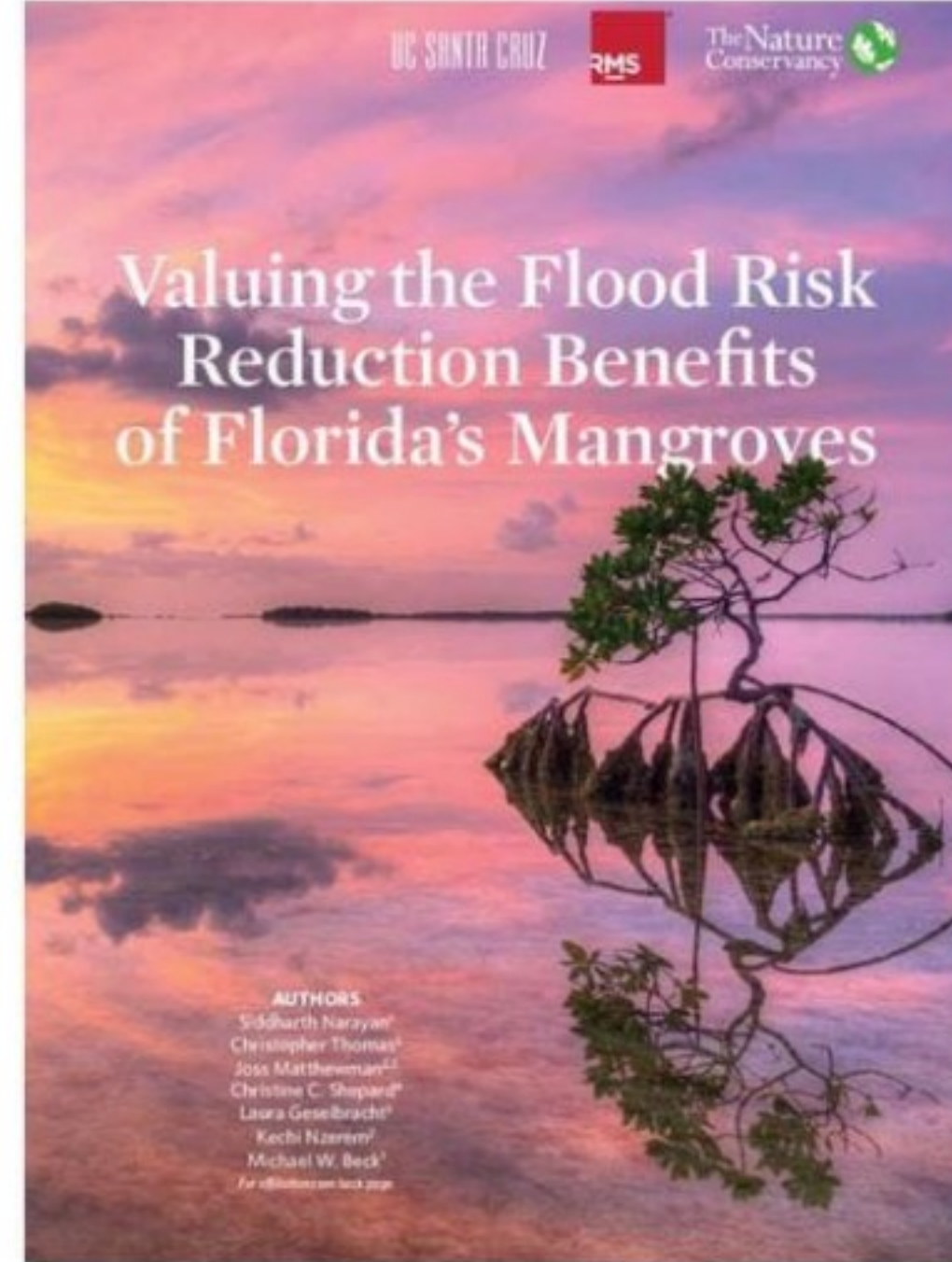
LLOYDS

TERCENTENARY  
RESEARCH  
FOUNDATION

# Leveraging Nature for Engineering Value: *Mangroves*

## Flood Risk Value of Florida Mangroves:

- 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



# 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

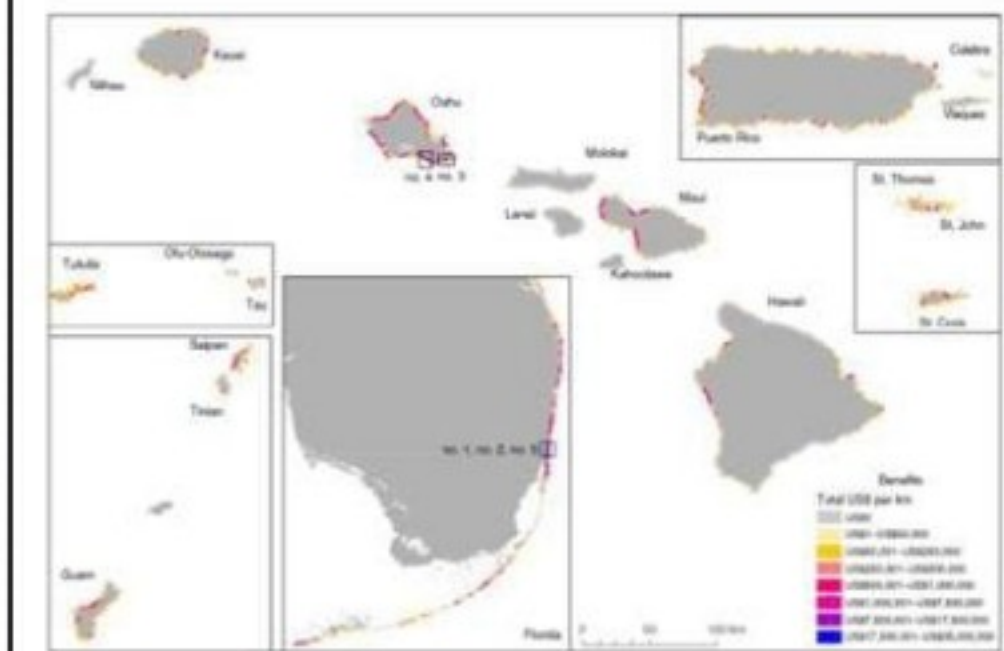


nature sustainability **ARTICLES**  
<https://doi.org/10.1038/s41893-021-00706-6>  
Check for updates

### The value of US coral reefs for flood risk reduction

Borja G. Reguero<sup>1</sup>, Curt D. Storlazzi<sup>2</sup>, Ann E. Gibbs<sup>2</sup>, James B. Shope<sup>1</sup>, Aaron D. Cole<sup>3</sup>, Kristen A. Cumming<sup>2</sup> and Michael W. Beck<sup>1</sup>

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 km<sup>2</sup>), 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<sup>-1</sup>, 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.nature.com/articles/s41893-021-00706-6.epdf?sharing\\_token=okXPN9-3ruX1jz\\_oEIQdrNRgN0jAjWef9jnR3ZoTv0P34Lz-UrjB\\_uD-zEphe5yVw5H6pLrLbdyEo9uxURsA1vaOBZYqEISikfmiDYbell1BcoZ0xZ9MDHv4a4G9NO31nT1-vVMdJuUiZvbQuw5XBaz\\_76ysNf6gB1qNwKbD-A%3D](https://www.nature.com/articles/s41893-021-00706-6.epdf?sharing_token=okXPN9-3ruX1jz_oEIQdrNRgN0jAjWef9jnR3ZoTv0P34Lz-UrjB_uD-zEphe5yVw5H6pLrLbdyEo9uxURsA1vaOBZYqEISikfmiDYbell1BcoZ0xZ9MDHv4a4G9NO31nT1-vVMdJuUiZvbQuw5XBaz_76ysNf6gB1qNwKbD-A%3D)

# Nature-Based Solutions

## Diversified Value

- **Engineering**
  - E.g., reduced flood risk, infrastructure maintenance
- **Economic**
  - E.g., increased property values, recreation
- **Environmental**
  - E.g., sustainable habitat, biodiversity
- **Social**
  - E.g., human health, community resilience



Federal Register / Vol. 84, No. 206 / Thursday, October 24, 2019 / Proposed Rules 54977

**PRESSURE CONTROL VALVE SETTING OR RELIEF VALVE SETTING**

Maximum start-to-discharge pressure (psig)	Maximum permitted filling density (percent by weight)				
	Ethylene	Ethylene	Ethylene	Hydrogen	Methane
17					6.60
45	52.6		51.1		20.5
75	10 psig	51.1	50 psig	50 psig	15 psig
Maximum pressure when offered for transportation					
Design service temperature Specification (see § 193.107(a)(3) of this subchapter)	Minus 200 °F 113K00W 113C00W	Minus 200 °F 113K120W 113C120W	Minus 150 °F 113K120W 113C120W	Minus 425 °F 113A170W 113A00W	Minus 200 °F 113K120W 113C120W

**DEPARTMENT OF THE INTERIOR**  
Fish and Wildlife Service  
50 CFR Part 17  
(Docket No. FWS-04-EIS-2018-0062; FWS-1113000000-178-FWS12000)

**Endangered and Threatened Wildlife and Plants, Removal of the Interior Least Tern From the Federal List of Endangered and Threatened Wildlife.**

**AGENCY:** Fish and Wildlife Service, Interior.  
**ACTION:** Proposed rule.

**SUMMARY:** We, the U.S. Fish and Wildlife Service (Service), propose to remove the inland population of the least tern (Interior least tern) (Sterna (now Stercoral) antillarum), from the Federal List of Endangered and Threatened Wildlife. The Interior least tern is a bird that nests adjacent to major rivers in the Great Plains and Lower Mississippi Valley. This proposed action is based on a thorough review of the best available scientific and commercial data, which indicate that the Interior least tern has recovered and no longer meets the definition of an endangered or a threatened species under the Endangered Species Act of 1973, as amended (ESA). Our review shows that threats identified for the species at the time of listing, i.e., habitat loss, curtailment of range, predation, and insularity of regulatory mechanisms, have been eliminated or

reduced, and the Interior least tern has increased in abundance and range. We also estimate the availability of a draft post-delisting monitoring (PDM) plan for the Interior least tern. We seek information, data, and comments from the public regarding this proposed rule and the associated draft PDM plan. **DATE:** We will accept comments received or postmarked on or before December 23, 2019. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES**, below) must be received by 11:59 p.m. Eastern Time on the closing date. We must receive requests for public hearings, in writing, at the address shown in **FOR FURTHER INFORMATION CONTACT** by December 9, 2019. **ADDRESSES:** Within comments, you may submit comments on this proposed rule and the associated draft PDM plan by one of the following methods: (1) **Electronically:** Go to the Federal eRulemaking Portal: <http://www.regulations.gov>. In the Search box, enter FWS-04-EIS-2018-0062, which is the docket number for this rulemaking. Then, click on the Search button. On the resulting page, in the Search panel on the left side of the screen, under the Document Type heading, click on the Proposed Rule box to locate this document. You may submit a comment by clicking on "Comment Now." (2) **By hard copy:** Submit by U.S. mail or hand-delivery to Public Comments Processing, Attn: FWS-04-EIS-2018-0062, U.S. Fish and Wildlife Service, MS: BPHC, 5275 Leesburg Pike, Falls Church, VA 22041-3803. We request that you send comments only by the methods described above. We will post all comments on <http://www.regulations.gov>. This generally means that we will post any personal information you provide as well as Public Comments, below, for more information. **Document availability:** The proposed rule, draft PDM plan, and supporting documents are available at <http://www.regulations.gov> under Docket No. FWS-04-EIS-2018-0062. **FOR FURTHER INFORMATION CONTACT:** Stephen Harka, Field Supervisor, U.S. Fish and Wildlife Service, Mississippi Ecological Services Field Office, 6075 Deepwood View Parkway, Jackson, MS 39233; telephone (601) 321-1122. Individuals who use a telecommunications device for the deaf (TDD), may call the Federal Relay Service at (800) 877-8339.

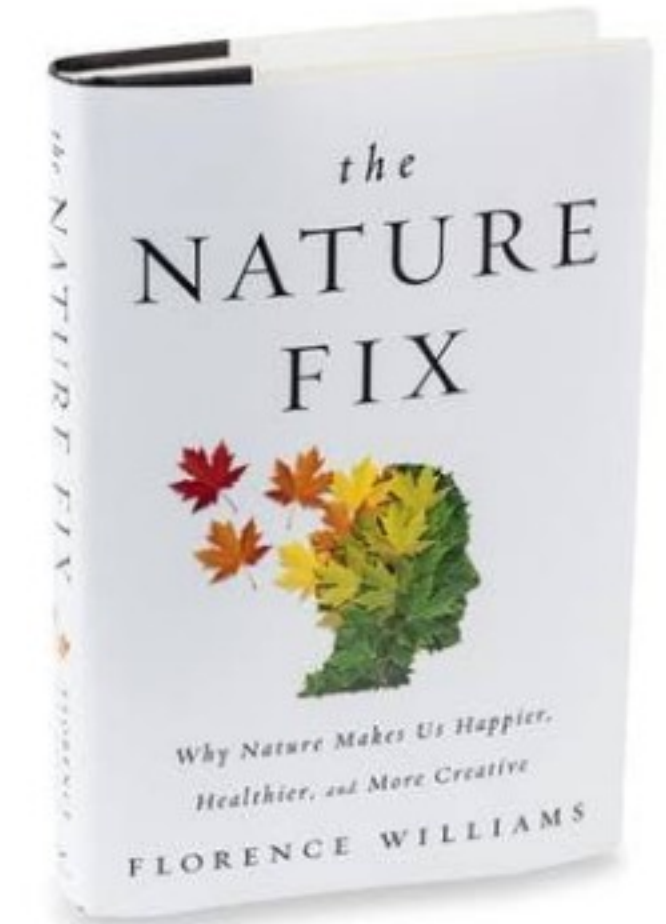
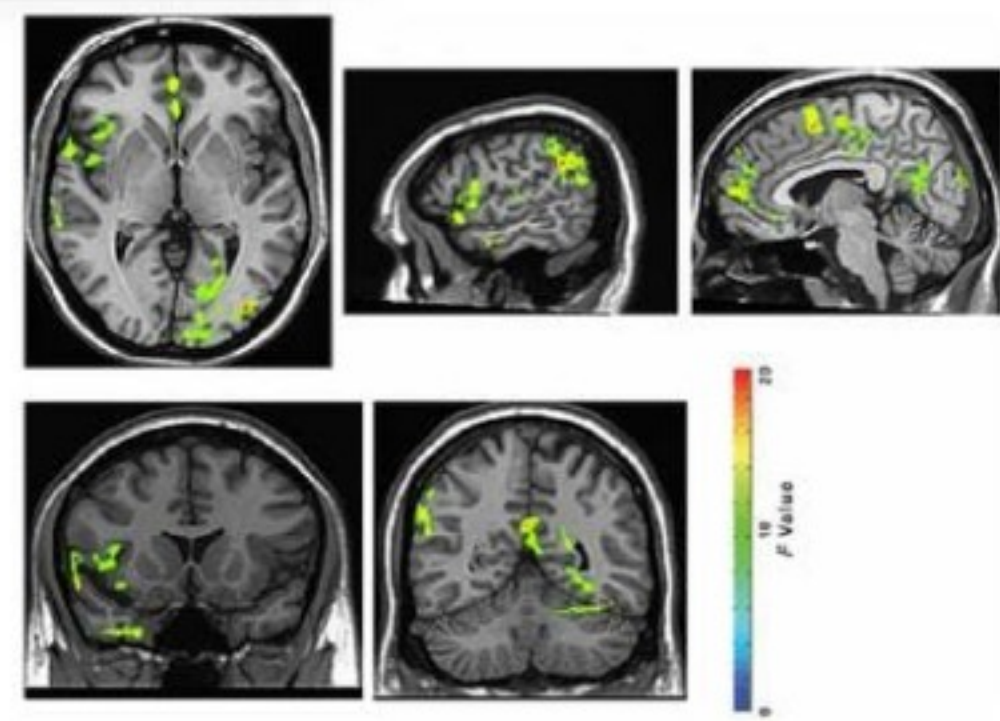
**SUPPLEMENTARY INFORMATION:**  
**Executive Summary**  
Why we need to publish a rule. Under the Act, we are required to conduct a review of all listed species at least once every 5 years (5-year review) to review their status and determine whether they should be classified differently or removed from listed status. In the Act, the term "species" includes "any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature." Therefore, we use the term "species" to refer to the Interior population of the least tern in this proposed rule. In our 2013 5-year review for the Interior least tern, we recommended removing the Interior least tern from the List of Endangered and Threatened Wildlife (i.e., "delisting" the species). However, to change the status of a listed species under the Act, we must complete the formal rulemaking process. Therefore, we are publishing this proposed rule in the Federal Register and seeking public comments on it. Within 1 year of the publication of this proposed rule, we will make a final determination on the proposed rule. **What this document does.** This document proposes to delist the Interior least tern (Sterna (now Stercoral) antillarum). **The basis for our action.** Under the Act, we may delist a species if the best scientific and commercial data indicate

Mississippi Valley Division Engineer Research and Development Center

US Army Corps of Engineers

**Conservation Plan for the Interior Least Tern, Pallid Sturgeon, and Fat Pocketbook Mussel in the Lower Mississippi River (Endangered Species Act, Section 7(a)(1))**  
MRG&P Report No. 4 • November 2014

MRG&P  
Mississippi River  
Geomorphology &  
Potamology Program

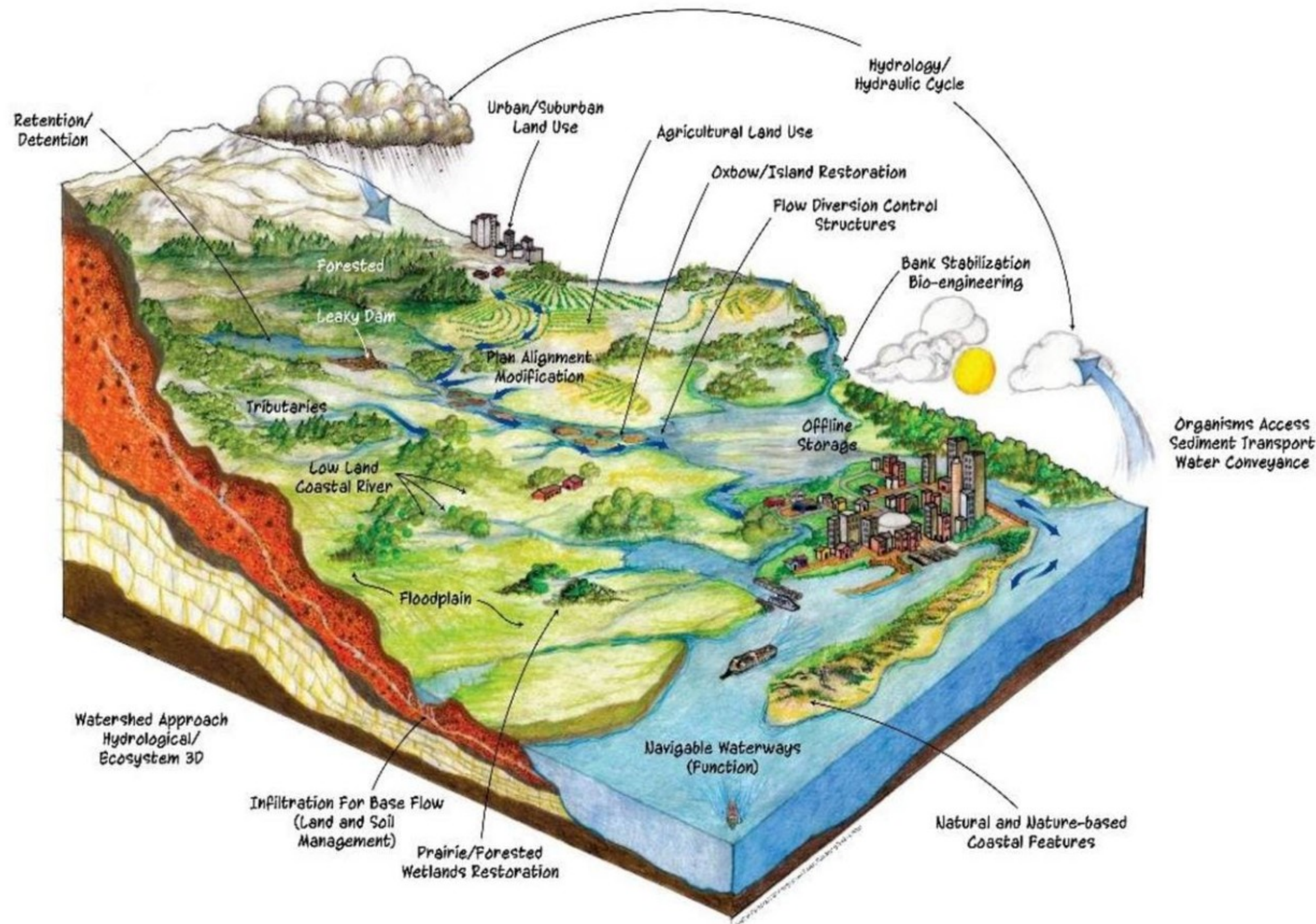


Nature experience reduces rumination and subgenual prefrontal cortex activation

Gregory N. Bratman, J. Paul Hamilton, Kevin S. Hahn, Gretchen C. Daily, and James J. Gross  
PNAS July 14, 2015 112 (28) 8567-8572; first published June 29, 2015 <https://doi.org/10.1073/pnas.1510459112>

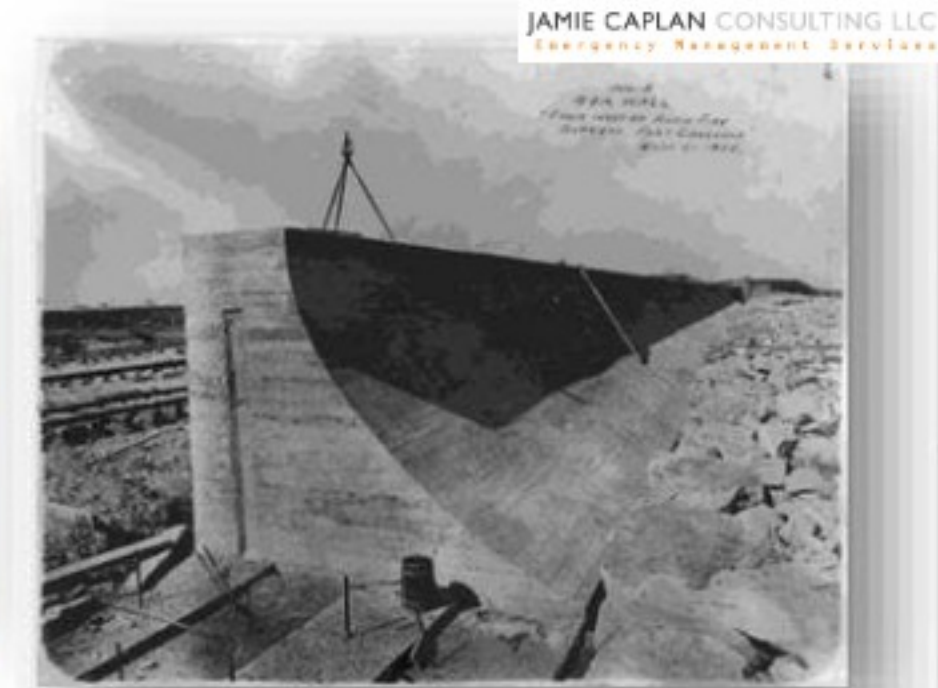
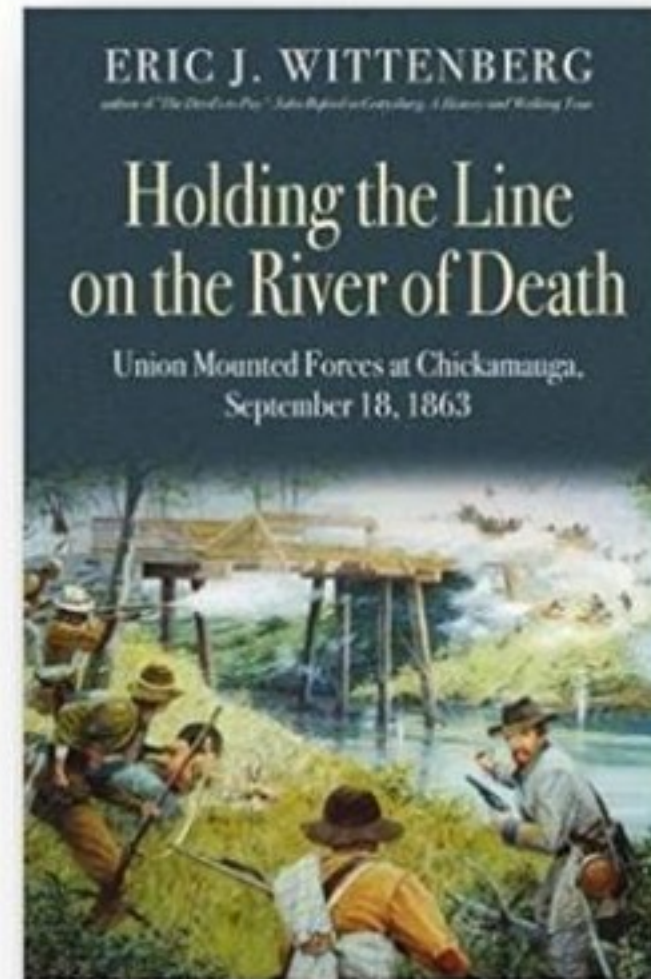


# A Systems View of Solutions



# Overarching Strategies

- **Hold the Line, “Hard”**
  - Galveston Seawall
  - Coast of Belgium
- **Retreat**
  - Savannah Lighthouse
  - Hamilton, Sears Point, CA
  - Belgium, Scheldt River Estuary
- **Advance**
  - New wetland, mangrove, island construction
  - New Jersey Bay Bays
  - Sabine to Galveston





# Upstream Intervention in the UK: *Spreading out the Flow*

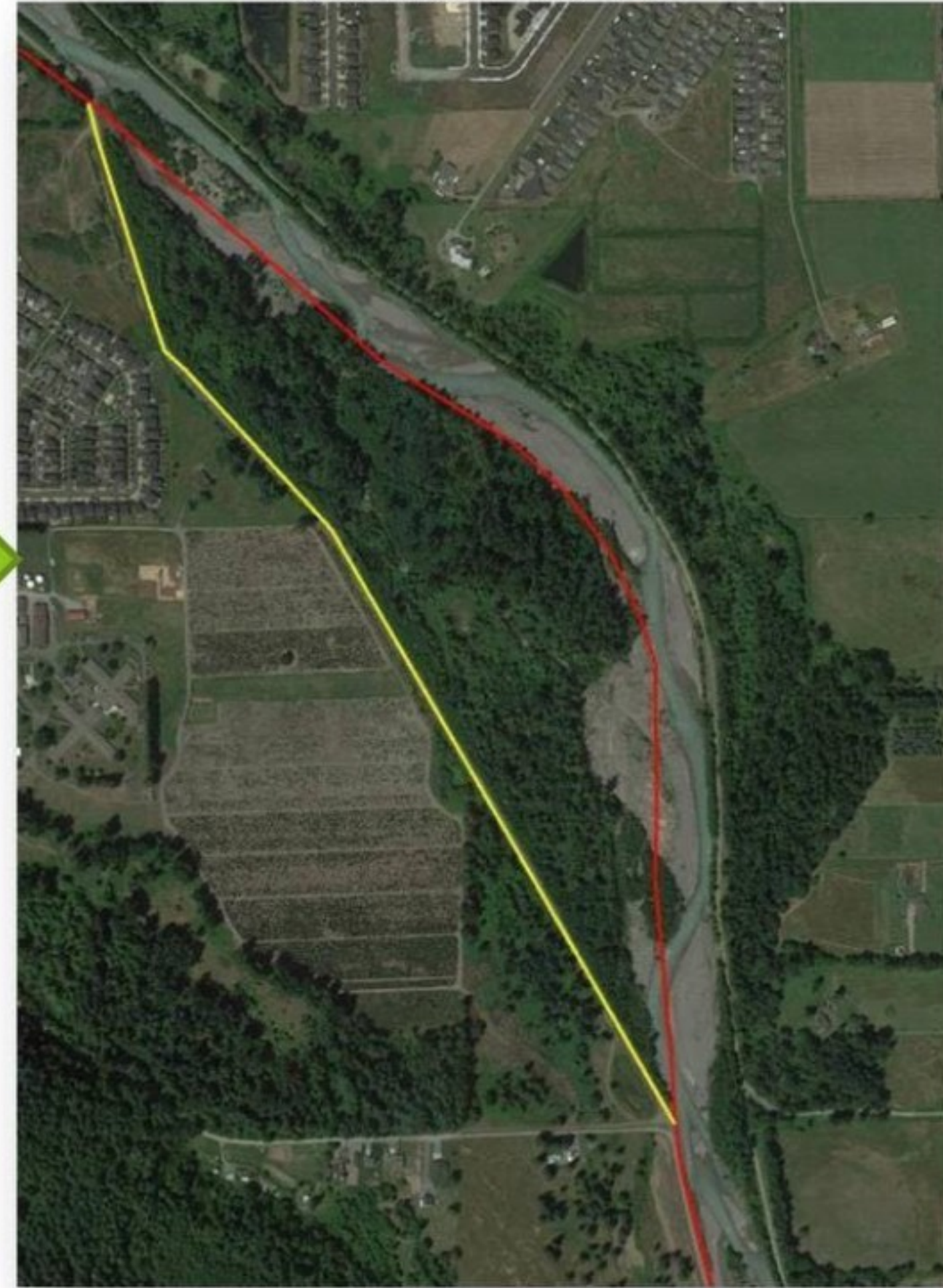


# Puyallup River, WA: Soldier's Home Levee and Floodplain

April 2006

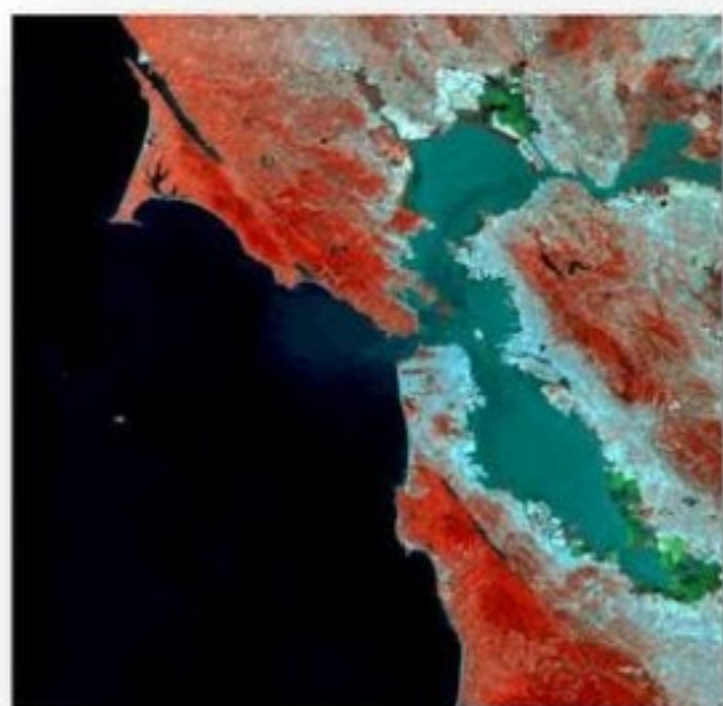


June 2016



US Army Corps of Engineers • Engineer Research and Development Center

# Hamilton and Sears Point Wetlands; San Pablo Bay, CA



Hamilton Army Airfield; 6 mcy BU, 500 acres  
Sonoma Land Trust; 1,000-acre tidal restoration

# Fort Pierce City Marina, Florida

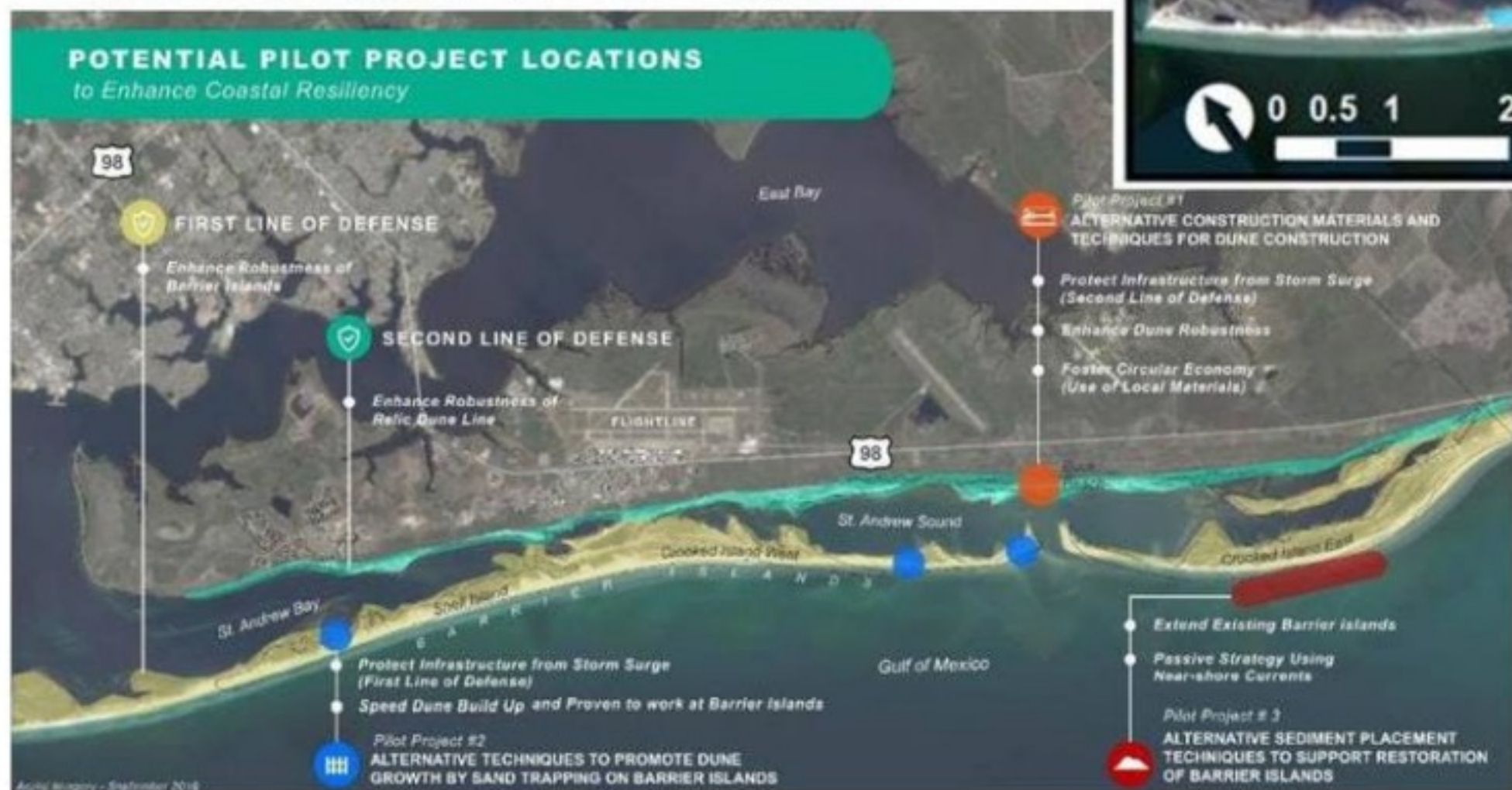
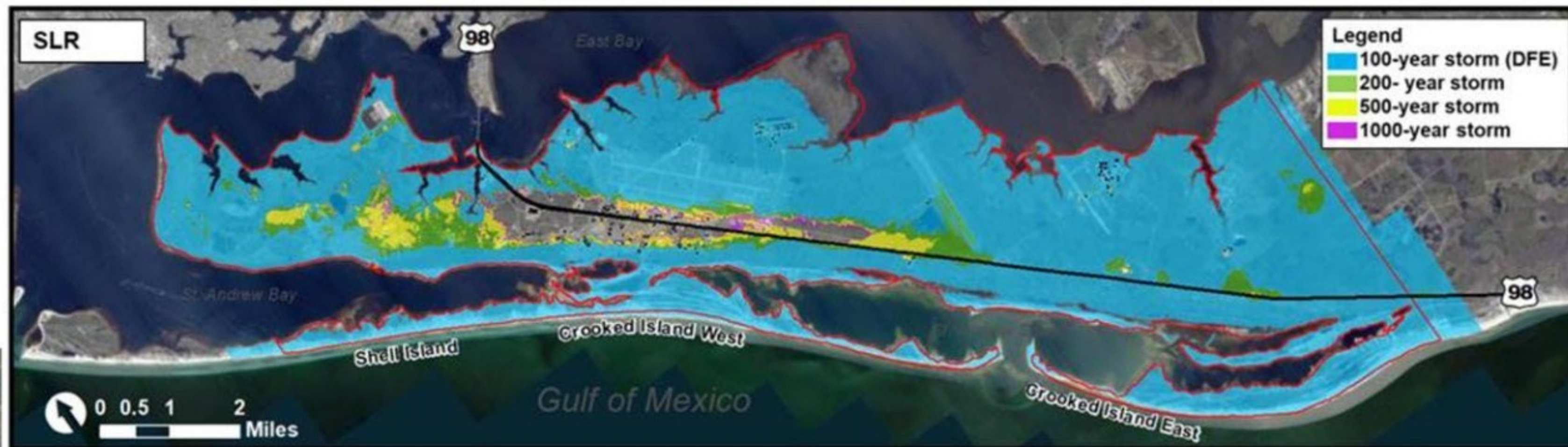


US Army Corps of Engineers • Engineer Research and Development Center

# EWN<sup>®</sup> Applied to Tyndall Air Force Base Rebuild



Hurricane Michael, 10-11 OCT, 2018



Tyndallcoastalresilience.com

EngineeringWithNature.org,  
EWN Podcast Episode 3, BG Melancon



US Army Corps of Engineers • Engineer Research and Development Center



# Defense Advanced Research Projects Agency (DARPA): REEFENSE

- **Program Vision:** Develop hybrid biological and engineered reef-mimicking structures to mitigate wave and storm damage that increasingly threaten DoD personnel and infrastructure
- **Program Funding:** \$50M over 5 years
- **ERDC Role:** Leading Independent Verification & Validation Team
- 3 Technical Areas
  - Structure Design and Structure
  - Adaptive Biology
  - Ecosystem Engineering
- 5 Year Program
  - Pre-design and Deployment (18 months)
  - Ecosystem Optimization (18 months)
  - Environmental Resilience (24 months)
- 2 Reef Habitats
  - Oyster
  - Coral



Lum, 2014



MDGovPics, 2013



# REEFENSE

# US Coral Reef Task Force

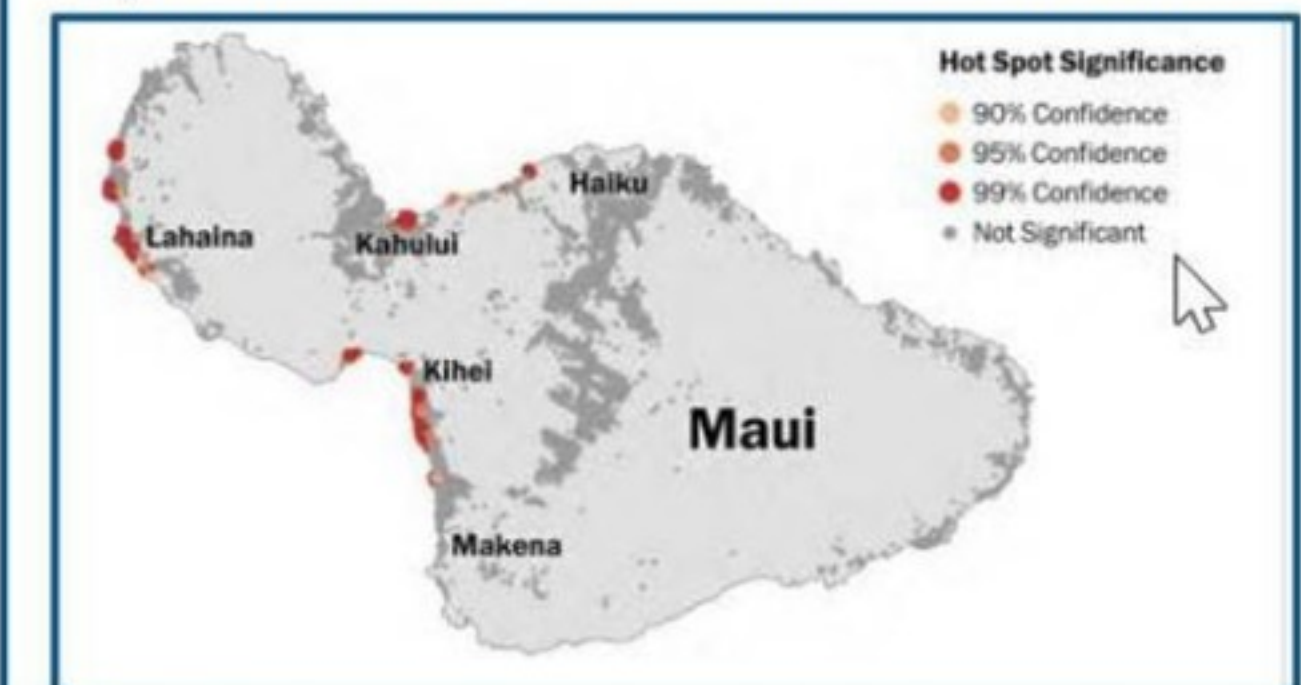
- **Mission:** USCRTF was established in 1998 to preserve and protect coral reef ecosystems.
- **USACE Role:** USACE is a Task Force member & supporting the “restoration and intervention” working group (RIWG).
- **RIWG Initiative:** Team is creating a handbook for community-based coral reef restoration projects that reduce flood risk, including:
  - Site Selection  
*(risk – exposure – opportunities - impact)*
  - Project Scoping  
*(cost benefit analysis – alternatives analysis - maintenance)*
  - Application Development  
*(scope – budget – schedule - data documentation – match – administration)*
- **Stakeholder Engagement:** Testing the handbook with State and local partners for effectiveness and usability.
- **Project Partners:** FEMA, NOAA, USACE, USGS, UC Santa Cruz.



Annual hazard risk reduction value of theoretical restoration along Florida's reef tract.

Source: <https://doi.org/10.3133/ofr20211054>

Optimal locations for restoration on Maui.



Source: <https://www.fema.gov/case-study/mapping-risk-reduction-benefits-coral-reef-conservation>

# International Guidelines on 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 Features 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



- ### NNBF Guidelines
- Publish September 2021
  - 1,000 pages
  - >170 authors and contributors from >70 organizations and 10 countries



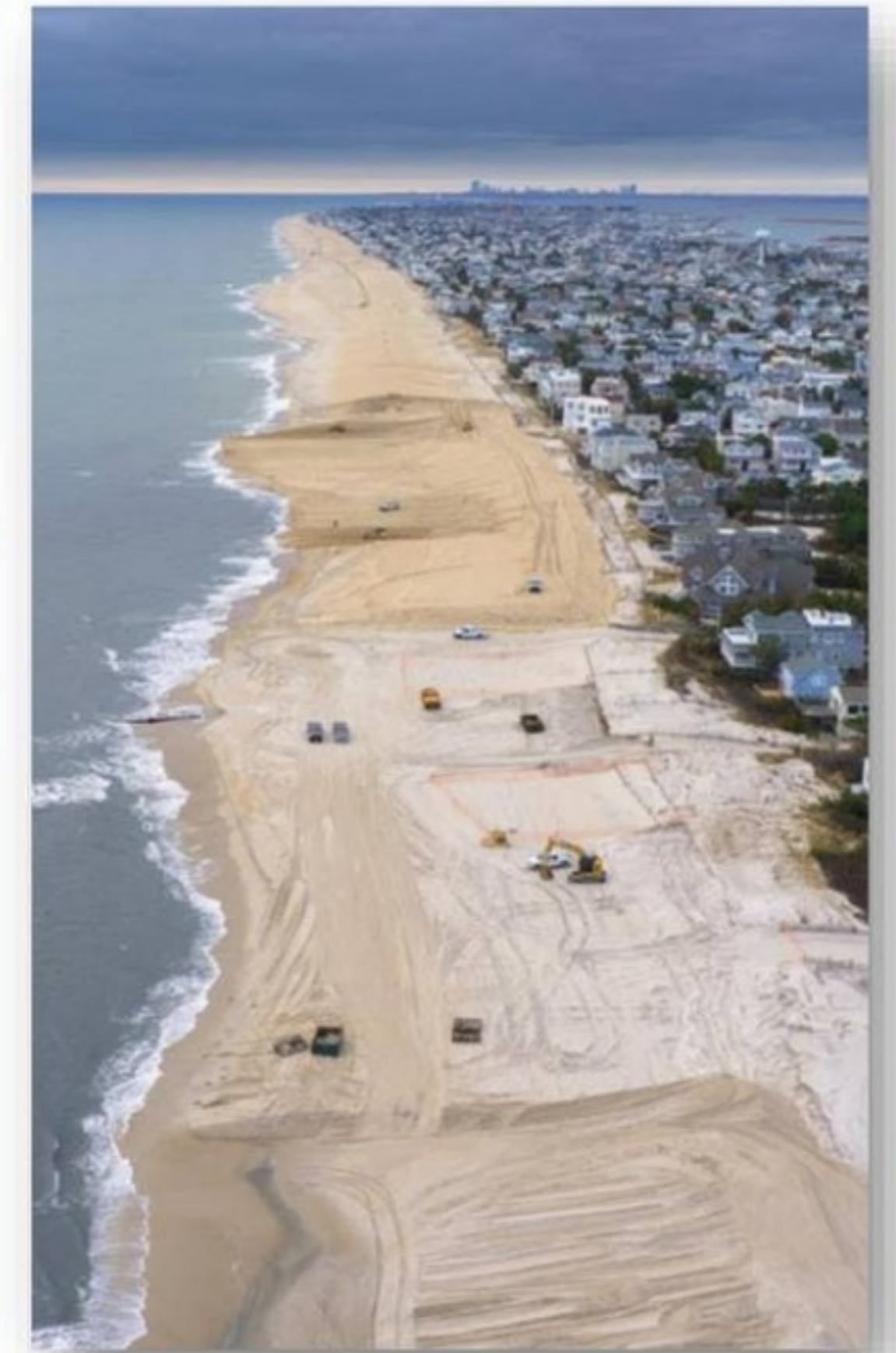
[www.engineeringwithnature.org](http://www.engineeringwithnature.org)



# Nature-Based Solutions

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

- **Project delivery**—“faster, cheaper”
- **Project performance**—complete solutions
- **Adaptability**—scalable, phaseable, 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



# The Spectrum

*“Wild and Free-Flowing Nature”*

*“Tamed and Conquered Nature”*



Duwamish River, WA 1800s



San Joaquin Valley, CA 1800s

## Achieving Nature-Engineering Balance

### Priorities for Advancing EWN

- 21<sup>st</sup> century vision for water infrastructure
- Policy and its implementation supporting the vision
- Modernized approach to community and stakeholder engagement
- Comprehensive approach to benefits evaluation
- Incremental development of engineering guidance



Duwamish River, WA today



San Joaquin Valley, CA today

# What prevents your agency/department from building with nature?

Experience

Funding

funding and expertise

Right of Way

right of way

Expertise

Knowledge and resource

Nothing Lack of ingenuity

No knowledge in engineering of nature based solutions

# What prevents your agency/department from building with nature?

Not enough land

Often costs more

Experience

Trust in the Solution

BCR/BCA/Engineers not believing in NNBF

Us - for not addressing it at all, but this information has been very helpful and has opened our minds to possibilities...

knowledge

Department leadership

lack of knowledge

# What prevents your agency/department from building with nature?

Maintenance

Unclear benefits according to policy to justify

Red tape

Having the support of the government and community, at the planning stages

knowledge in resource

Lack of creativity

Not funded in the past. Now funded, but access to funding is very limited - huge barriers to BRIC funding, etc

too many red tape from other agencies

right of way, expertise, funding

# What prevents your agency/department from building with nature?

Funding

Funding, and lack of knowledge and experience

Funds

limited knowledge and resourcesfunding

More creative staff

funding

Support from other departments.

Federal Recognition

funding

# What prevents your agency/department from building with nature?

More time and resources to consider American Samoa-specific alternatives

funding

funding

lack of funding...knowledge

More creative staff

funding and resources

funding, policies, knowledge

Enough land, engineering designs that are place based and sufficient funding to explore and implement it.

Funding

# What prevents your agency/department from building with nature?

Fundings, resources, expertise, equipment

58755293



# What would enable your agency/department to build with nature?

Education

Funding

Funding

Funding

support and knowledge

Policy

resources

More guidance

Funding

# What would enable your agency/department to build with nature?

Funding

Experience showing it can be done!

knowledge and understanding of the benefits

Proper training and resource

Education and funding

Reduced barriers to funding sources like BRIC

funding

An updated policy guidance to establish benefits

Money and knowledge

# What would enable your agency/department to build with nature?

Good and supportive leadership

The presentation that just ended blew me away...we will definitely look into it.



# Nature-Based Solutions Workshop for Hazard Mitigation

American Samoa  
August 25, 2021, via Zoom