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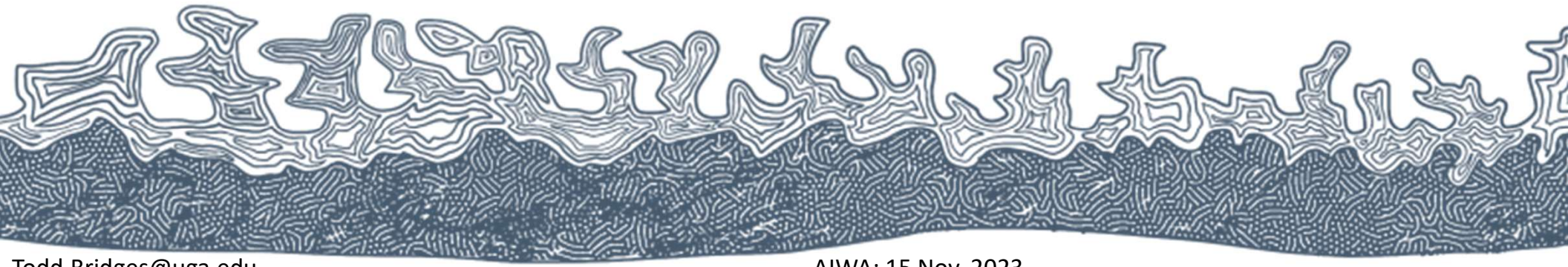
Nature-based Solutions and Future Waterway, Landscape, and Community Resilience

Dr. Todd S. Bridges
College of Engineering
University of Georgia



Todd.Bridges@uga.edu

USACE Infrastructure Portfolio

- 25,000 miles of navigation channel
  - Supporting 926 ports
- 707 dams
  - 75 hydroelectric power facilities
  - 55,390 miles of shoreline
- 14,500 miles of flood levee
- 236 lock chambers at 192 lock sites
- 929 navigation structures
- 844 bridges
- 12 million acres of public land and water

US Army Corps of Engineers

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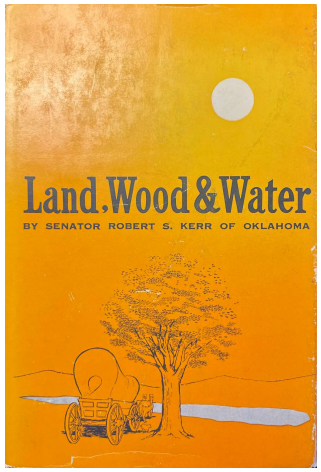
MKARNS

McClellan
Kerr
Arkansas River
Navigation System



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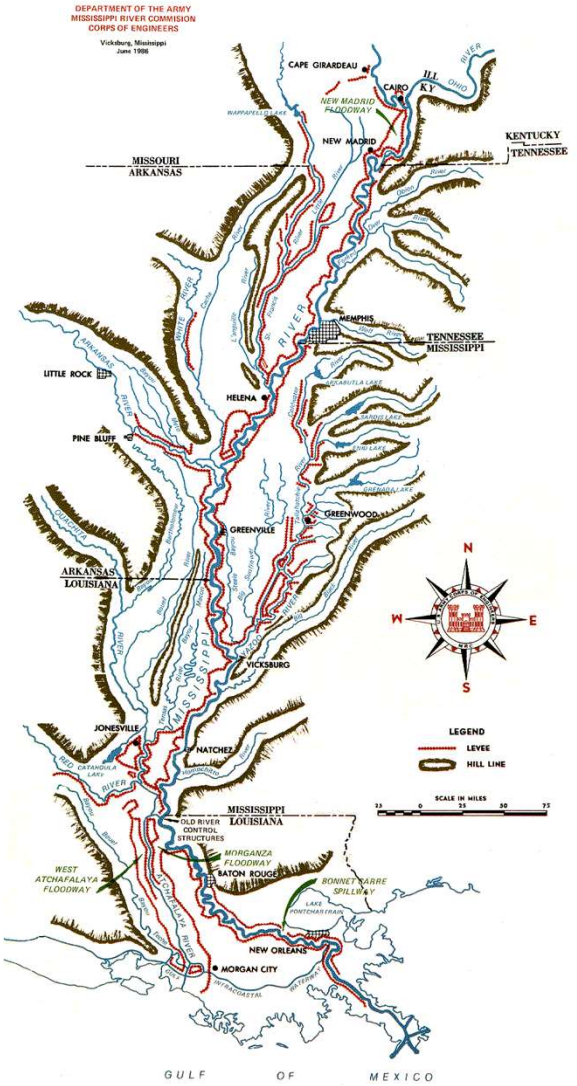
MISSISSIPPI RIVER &TRIBUTARIES PROJECT

- >3,700 miles of levee system (embankments and floodwalls)
- 1,000 miles of articulated concrete mattress revetment
- Floodways:
  - Birds Point - New Madrid (Cairo, IL)
  - Morganza
  - West Atchafalaya
  - Atchafalaya Basin
  - Bonnet Carré
- 4 Back Water Areas (St Francis, White, Yazoo, Red Rivers)
- Old River Control Complex



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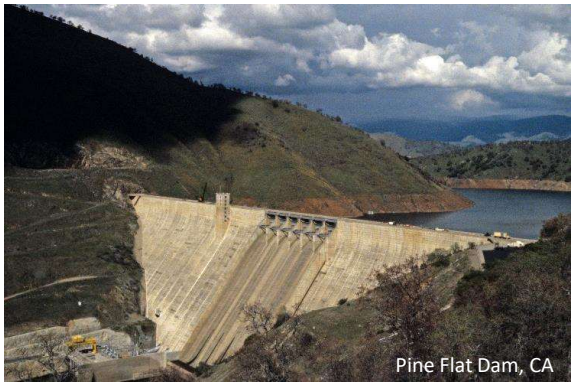
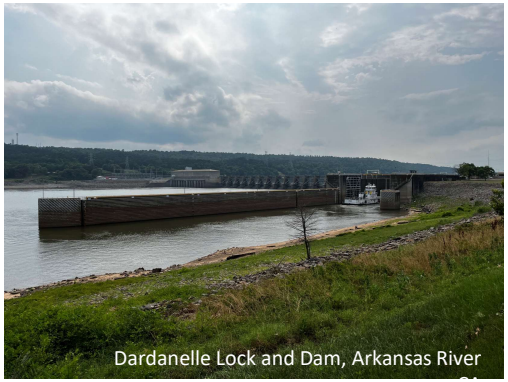
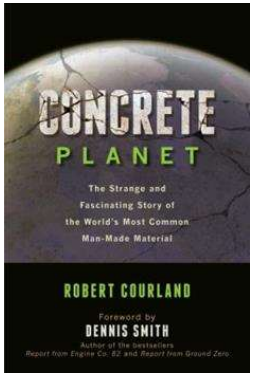
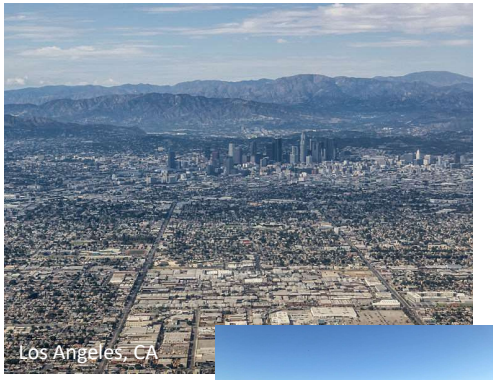
The 3 Parts of the Planetary Predicament:
Hazard + Climate Change + Landscape Transformation thru Engineering


Pine Flat Dam, CA


Dardanelle Lock and Dam, Arkansas River



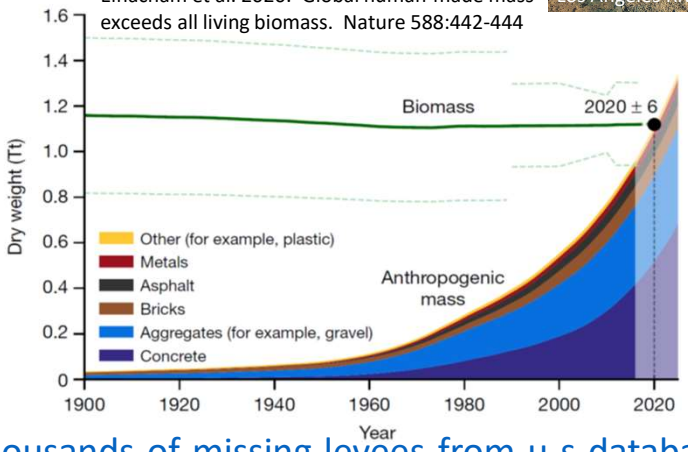

Los Angeles, CA

>90,000 dams in the US, impounding
>600,000 miles of river


Los Angeles River

250,000 sq. miles of paved surface on the planet

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




MS River levee near Cairo, IL


Levee at Dogtooth Bend


River Bank, St. Louis, MO

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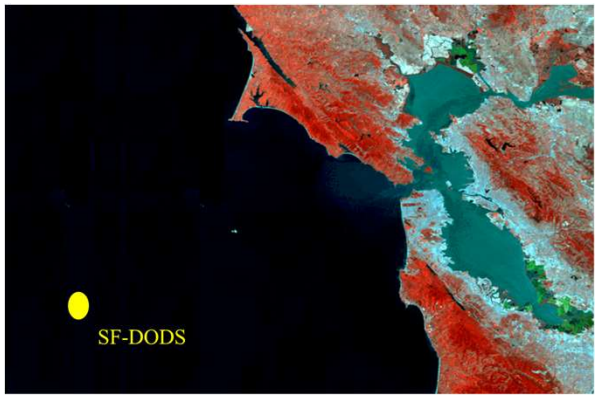
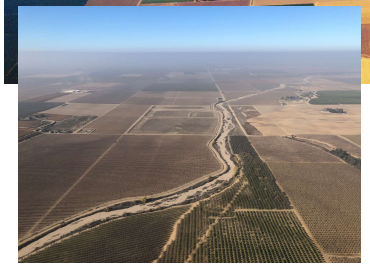
24,500 miles of levee in National Levee Database;
https://levees.sec.usace.army.mil/#/
>100,000 miles of levee total estimate for US;
https://eos.org/research-spotlights/algorithm-detects-thousands-of-missing-levees-from-u-s-database

The Story of US Wetlands





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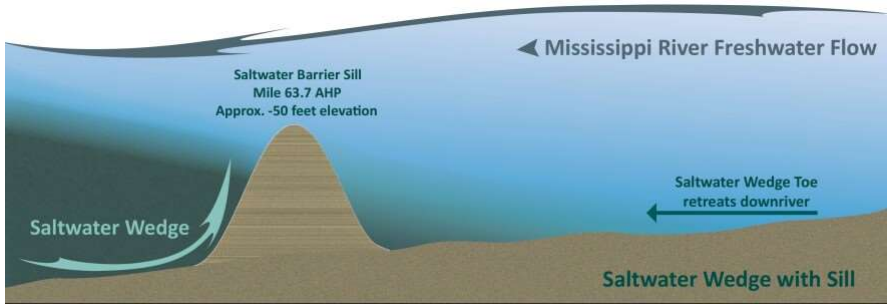
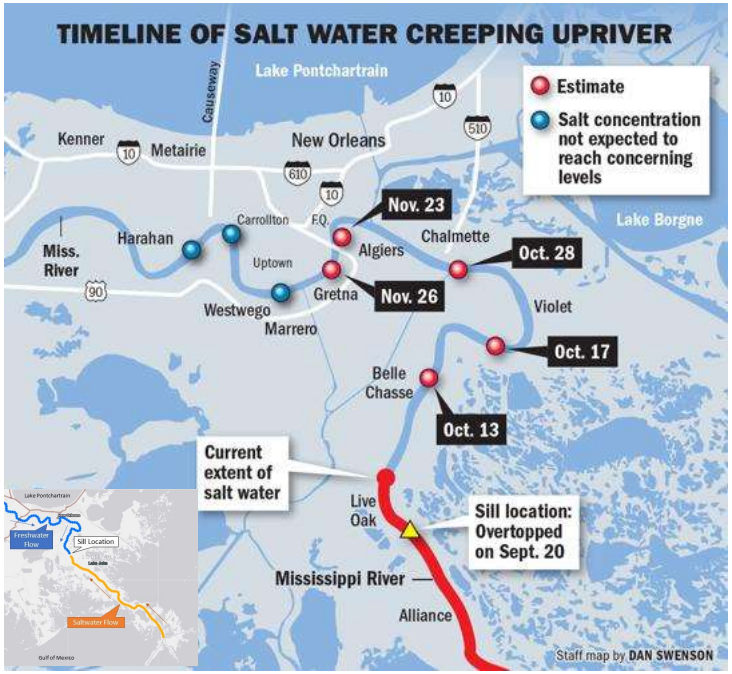
<u>Wetland Acreage in Conterminous US</u>
ca. 220,000,000 acres in 1700s
ca. 110,000,000 acres today

MS River Saltwater Intrusion:

Hazard x Climate Change x Engineering Legacy





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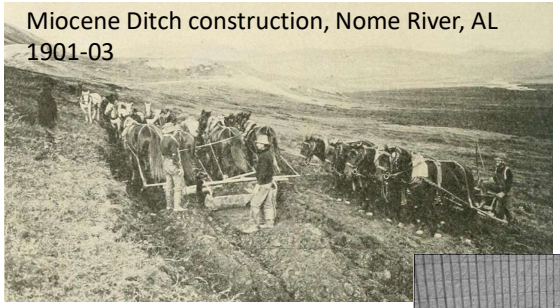
The Tools of Transformation


Murden


Bay State Dredging Company, 1884


Miocene Ditch construction, Nome River, AL
1901-03


Essayons


Goetz


Fresno Scrapper, invented by James Porteous, 1883

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Regenerative, Nature-Positive Outcomes, and the Circular Economy

Sustainability: "create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." NEPA (1969

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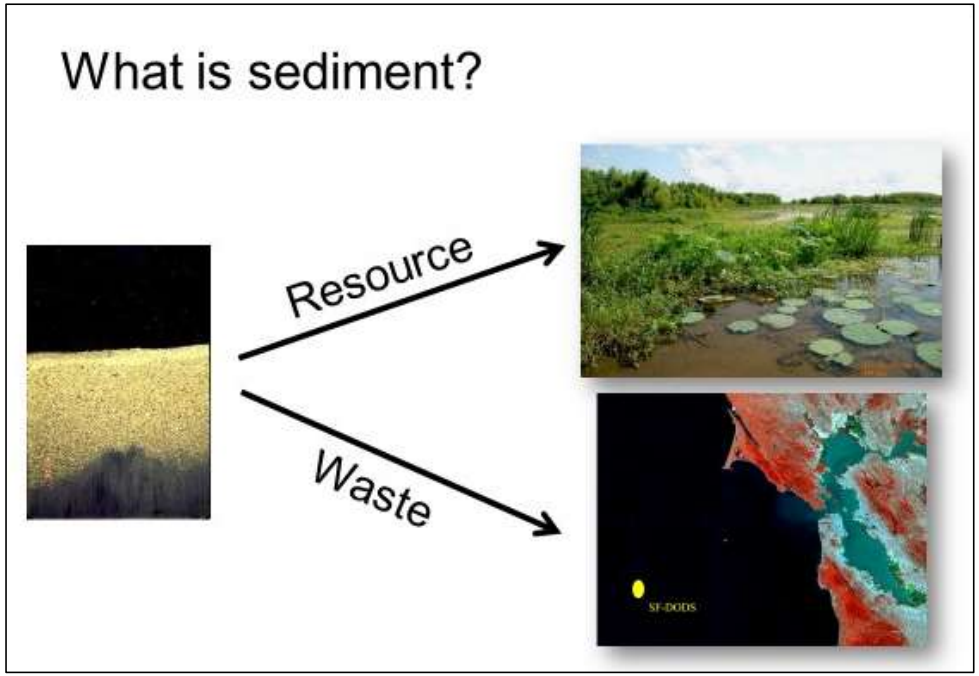
Application to Dredging



*From a presentation I gave at the National Dredging Meeting in May 2012

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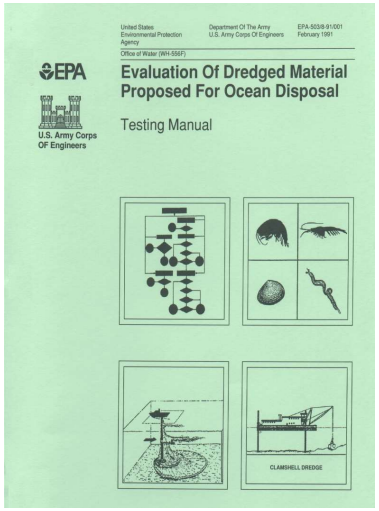
Bridges, T.S. and T. Velinga. 2018. Integrating Dredging in Sustainable Development. In *Dredging for Sustainable Infrastructure*, P. Lapoyrie, M. van Koningsveld, S. Aarninkof, M.Van Parys, M. Lee, A. Jensen, A. Csiti, and R. Kolman, eds. CEDA/IADC, The Hague, the Netherlands.

Fax machine
Cell phone
Internet
www
Amazon.com

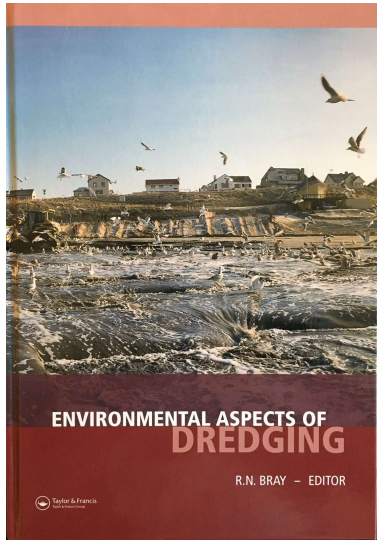
Progress

Dredging for Sustainable Infrastructure



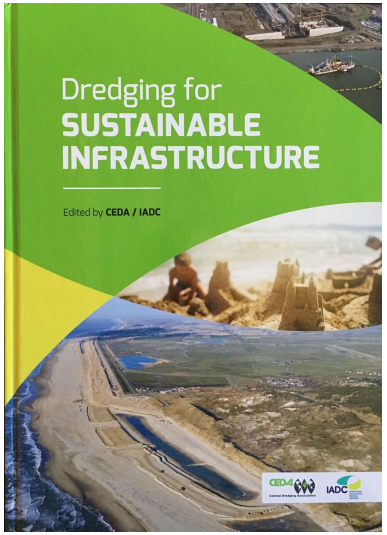
1977/1991

OTM 1977/1991: Will disposal of dredged material "unreasonably degrade or endanger: human health, welfare, or amenities, marine environment, ecological systems, or economic potentialities."



2008

CEDA 2008: "It is, therefore, of the utmost importance that we be able to determine whether any planned dredging will have a positive or negative impact on the environment."



2018

CEDA 2018: "This book …presents state-of-the-art guidance to achieve dredging projects that fulfill their primary functional requirement, while adding value to the (natural and socio-economic) system based on a thorough understanding of the natural system and proactive engagement of stakeholders throughout."

Chapter 2: *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.

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Beneficial Use Benefits: *The USACE '70 x 30' Goal*

"Beneficial use" is using dredged sediment to achieve additional benefits beyond its removal from a channel/waterway, including other economic, environmental or social benefits.

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY CORPS OF ENGINEERS
441 G STREET NORTHWEST
WASHINGTON DC 20314-1000

CECG 25 January 2023

Beneficial Use of Dredged Material Command Philosophy Notice

Teammates,

Today I am formally issuing a Beneficial Use of Dredged Material Command Philosophy Notice which outlines my vision for expanding the U.S. Army Corps of Engineers beneficial use of dredged material (BUDM) program. This philosophy notice aligns with two of my four key priorities for the organization, Partnerships and Innovate.

Dredged material is a valued resource that is not to be wasted, but instead used for benefits to the ecosystem, economy, and to deliver the USACE mission more effectively and efficiently across our portfolio of Navigation, Flood Risk Management and Aquatic Ecosystem Restoration projects.

Through a symbiotic relationship with navigation dredging, you are being called to generate productive and positive uses of dredged material. If there is a need for USACE to dredge an authorized channel, the operational strategy should inherently include beneficial use placement options. Equally, if there is a need for sediment, gravel, or rock material to implement a project, beneficial use from dredging operations within authorized channels should be considered as a source in the planning and execution strategy. We must do these things in compliance with applicable laws and regulations, including the Federal Standard for dredged material disposal or placement. A proper analysis of the total lifecycle cost of dredging and placement as well as the full benefits will result in an accurate determination of the Federal Standard.

USACE historically uses 30-40% of the sediments derived from the Navigation mission for beneficial purposes. I have established a goal for USACE to advance the practice of BUDM to 70% by the year 2030 ("70/30 Goal").

Achieving our vision will require purposeful documentation and an innovative pursuit both internally and externally with our partners and stakeholders. You will need to leverage available solutions, strategies, and tools to the maximum extent practicable while developing and applying new approaches and technologies to address the associated engineering challenges.

Districts and divisions are hereby called upon to participate in supporting this shared vision, provide input into the actions to be undertaken, and ensure ultimate success of the BUDM program.

Now is the time to get involved. For more information on how to get involved, contact Tiffany Burroughs, Chief Navigation, HQUSACE by phone at (202) 761-4474 or by email at tiffany.s.burroughs@usace.army.mil

BUILDING STRONG!

SCOTT A. SPELLMON
Lieutenant General, US Army
Commanding

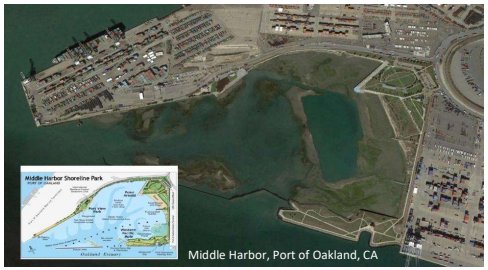
"Dredged material is a valued resource that is not to be wasted, but instead used for benefits to the ecosystem, economy, and to deliver the USACE mission more effectively and efficiently across our portfolio of Navigation, Flood Risk Management and Aquatic Ecosystem Restoration projects."

"I have established a goal for USACE to advance the practice of BUDM to 70% by the year 2030 ("70/30 Goal")."

BUILDING STRONG!

SCOTT A. SPELLMON
Lieutenant General, US Army
Commanding

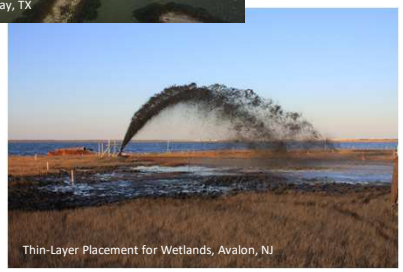

Horseshoe Bend, Atchafalaya, LA


Middle Harbor, Port of Oakland, CA


Hamilton Wetlands, San Francisco Bay, CA


Galveston Bay, TX


Cat Island, Green Bay, WI


Thin-Layer Placement for Wetlands, Avalon, NJ

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Beneficial Use and the "Federal Standard"

Federal standard means the dredged material disposal alternative or alternatives identified by the Corps which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the 404(b)(1) evaluation process or ocean dumping criteria. 33 CFR 335.7

WRDA 2020, SEC. 125: BENEFICIAL USE OF DREDGED MATERIAL

- **It is the policy of the United States for the Corps of Engineers to maximize the beneficial use, in an environmentally acceptable manner, of suitable dredged material…**
- **the Secretary shall consider—(i) the suitability of the dredged material for a full range of beneficial uses; and (ii) the economic and environmental benefits, efficiencies, and impacts...**
- **The economic benefits and efficiencies from the beneficial use of dredged material considered by the Secretary under subparagraph (A) shall be included in any determination relating to the "Federal standard"…**

"There are at least 3 categories of beneficial use: good, better, and best."
TSB

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)

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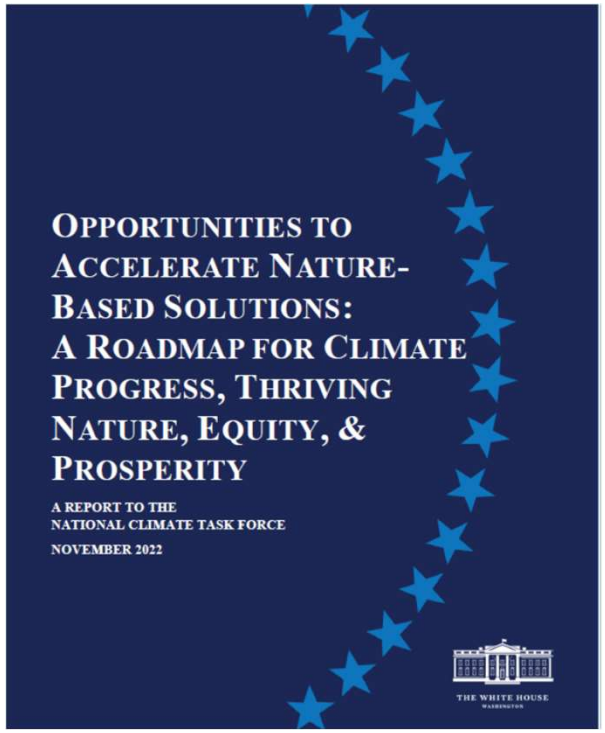
Nature-Based Solutions: A White House Priority

2022
Earth Day EO

BRIEFING ROOM

Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies

APRIL 22, 2022 • PRESIDENTIAL ACTIONS



EO 14072, Sec. 4. Deploying Nature-Based Solutions to Tackle Climate Change and Enhance Resilience: *"To further amplify the power of nature, including its ability to absorb climate pollution and increase resilience in all communities, today's Executive Order calls for the following:"*

1) ***Report on Nature-Based Solutions***
2) ***Guidance on Valuing Nature***
3) ***First U.S. National Nature Assessment***

Nature-based Solutions: "Actions to protect, sustainably manage, or restore natural or modified ecosystems to address societal challenges, simultaneously providing benefits for people and the environment."

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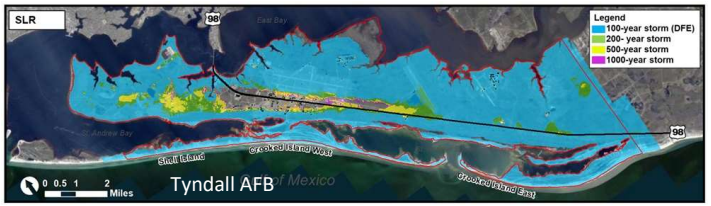
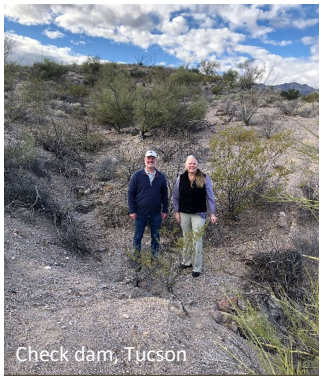
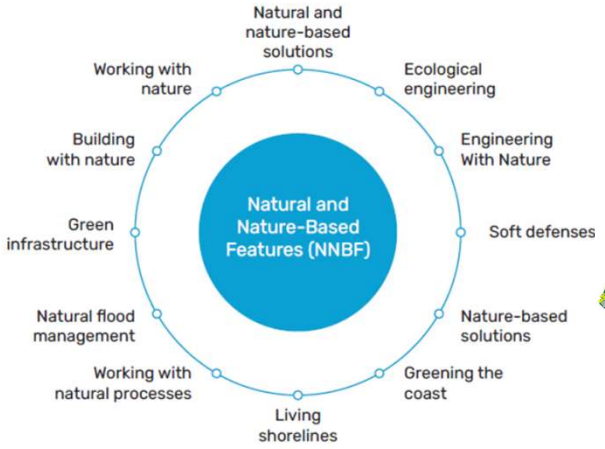
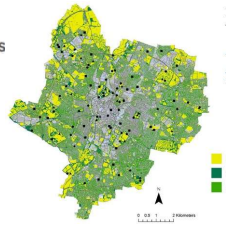
Nature-Based Solutions: *Conserving, restoring, and engineering nature for the benefit of people and nature*

- **Coastal Storm Risk Management**; e.g., an island-wetland complex that attenuates storm surge and waves.
- **Inland Flood Risk Management**; e.g., a restored inland floodplain that provides space for high flows.
- **Surface Heat Reduction**; e.g., creation of green space, forest restoration.
- **Drought and Wildfire Resilience**; e.g., restored native vegetation + grazing + 'slow-water' interventions + ecological forest management.
- **Water Resilience**; a constructed freshwater wetland that absorbs excess nutrients and recharges depleted groundwater aquifers.
- **Climate Change Mitigation**; e.g., restored native grasslands / plant communities that sequester carbon in soils.









Soil surface temperatures reveal moderation of the urban heat island effect by trees and shrubs

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The Importance of Leadership Intent on Nature-Based Solutions…

"My vision for the future is driven by a sense of urgency. I'd like the Army Corps, a capable and talented organization, to be innovative in developing new strategies and to build climate resilience to better protect and prepare communities for some of the challenges they're facing. We need to take advantage of nature-based infrastructure and figure out how we can bring multiple benefits to our projects so that we're not just doing flood risk and coastal storm management but are also helping to further environmental restoration and even augment water supply where we can."

Michael Connor, ASA(CW)
***Municipal Water Leader,* May 2022**

"Serious consideration of NNBFs is non-negotiable."

Eric L. Bush, SES
Chief, Planning and Policy (HQUSACE)
July, 2022

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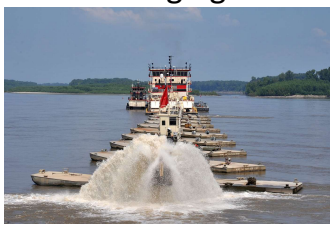
Applying the Full Range Practices for *Sustainable Sediment Management*

Sediment “Recharge” via Dredging

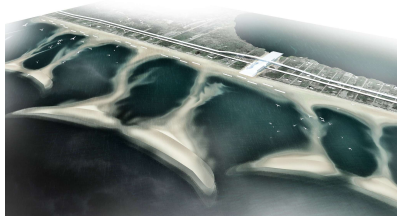


Direct Wetland “Nourishment”

Wetland Creation

Island Enhancement or Restoration

Engineering / Operational Effort



Strategic Placement

Thin-Layer Placement for Bottom Contouring

Beach and Dune Construction

New Island Construction

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Middle Harbour Port of Oakland, USA

2018 PIANC *Working with Nature* Award Winner

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Seattle's New Seawall

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Fort Pierce City Marina, Florida

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Documenting NBS Benefits: Horseshoe Bend Island, Atchafalaya River, Louisiana, USA

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 Western Dredging Association Award for Environmental Excellence
- 2017 Western Dredging Association Award for Climate Change Adaption
- 2017 Dredging and Port Construction Award for Engineering with Nature
- 2020 USACE Green Innovation Award

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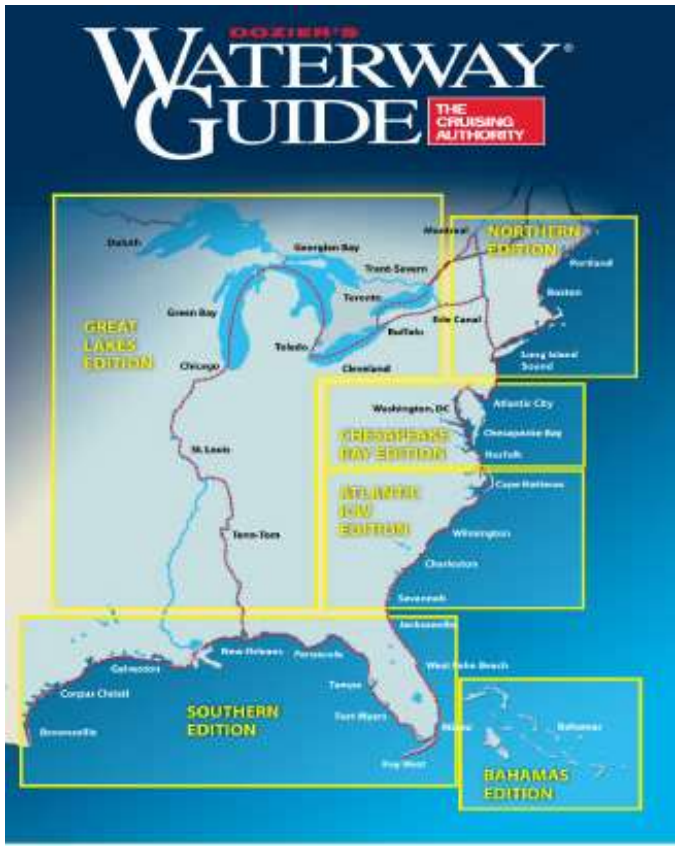
Island Creation, Enhancement, Repurposing



US Intracoastal Waterway: Massachusetts to Brownsville, TX: 3,000 miles

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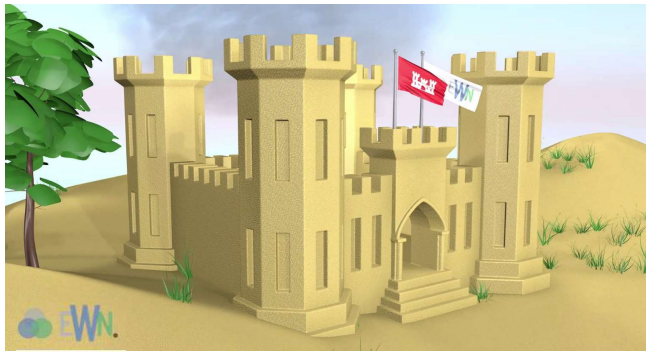
A Call to Action: A Regenerative, Nature-Positive Navigation System

***An Imperative for the 21st Century:* 100% Beneficial Use of Dredged Sediment**

~~"Spoil"~~ ~~"Disposal"~~

Beneficial Use Innovation: *There's something for everyone to do!*

- Government Agencies: Innovate policy, procedure, and business practices
- Ports / Navigation Sector: Pursue multi-purpose projects
- Regulatory Agencies: Efficiently pursue win-wins
- Dredging / Engineering Companies: Innovate engineering and operational practices
- Environmental NGOs: Facilitate P3s



Think of dredged material volumes in terms of "wetland units"

How many acres of wetland could 250 mcy of sediment create?

50,000-100,000 acres!

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Mission, Responsibility, and Codes: ASCE

- ASCE Code of Ethics, Fundamental Cannons
  - "Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties."
- ASCE Policy Statement (418) on "the role of the civil engineer in sustainable development"
  - ASCE "defines sustainability as a set of economic, environmental, and social conditions (aka "The Triple Bottom Line") in which all of society has the capacity and opportunity to maintain and improve its quality of life indefinitely without degrading the quantity, quality, or the availability of economic, environmental, and social resources. Sustainable development is the application of these resources to enhance the safety, welfare, and quality of life for all of society."
- ASCE supports the following steps to achieve a sustainable project:
  - Perform Life Cycle Assessment from Planning to Reuse.
  - Use Resources Wisely.
  - Plan for Resiliency. Sustainability requires planning for the impact natural and man-made disasters and changing conditions can have on economic, environmental, and social resources.
  - Validate Application of Principles.

The Institute for Resilient Infrastructure Systems

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Institute for Resilient Infrastructure Systems

Vision: *Natural and conventional infrastructure working together for thriving communities, businesses and natural systems.*

- >50 faculty, researchers, staff spanning 15 colleges, public service organizations, and extension programs at UGA.
- >60 graduate students focused on resilient infrastructure.
- >12 collaborative research and implementation projects with communities and military installations.
- Partnering across sectors.
- Producing high-impact products, education, and training for a new wave of 21st century professionals.
- The Network for Engineering With Nature (N-EWN), https://n-ewn.org/ .

https://iris.uga.edu/

Industry Summit on Nature-based Solutions

- 100 participants from 50 for-profit and non-profit organizations across private sector
- Focused on means for accelerating and upscaling NbS across the country
- Outcomes
  - Share information on projects, capabilities, and technologies
  - Identify private sector perspectives, needs, and opportunities
  - Co-develop a 10-year vision and plan of action for national implementation of NbS

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https://iris.uga.edu/industry-summit-on-nature-based-solutions/

NOAA Climate Resilience Regional Challenge

The focus of this grant program is on collaborative projects that increase the resilience of coastal communities to extreme weather (e.g., hurricanes and storm surge) and other impacts of climate change, including sea level rise and drought.

- $575M of IRA funding
- 869 letters-of-intent submitted
- 120 full proposals invited
- UGA-led proposal, $75M
  - Accelerating Development of Nature-based Solutions and System-Scale Resilience
  - GA, SC, NC

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Some Questions…

- What are the big opportunities for making our waterways more sustainable and resilient?
- What challenges and opportunities are there for more BU and NbS?
- What guidance, tools, technologies, materials, etc. are needed support progress?
- What advancements in policy and regulation are needed?
- How should we be training/educating for the future