Big Picture Perspective: Setting the Stage

(Random Thoughts on Natural Infrastructure)

May 10, 2022
Athens

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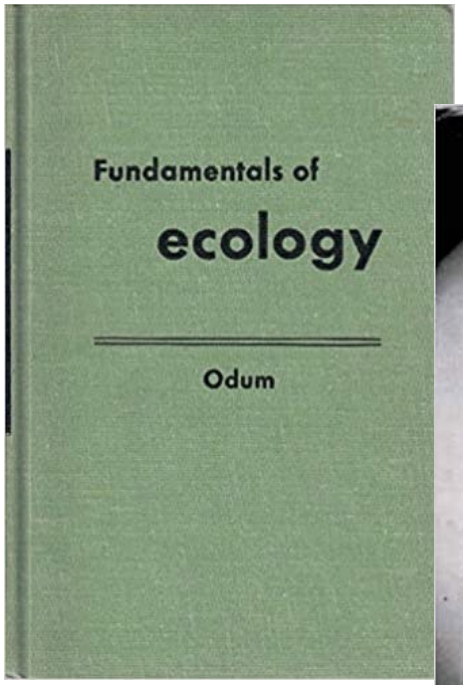
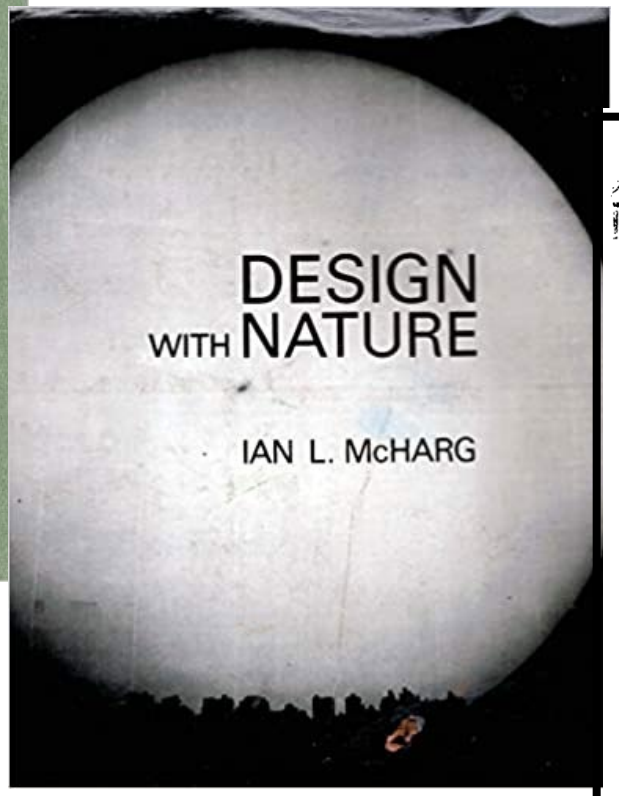


1959

Eugene P. Odum
Howard T. Odum



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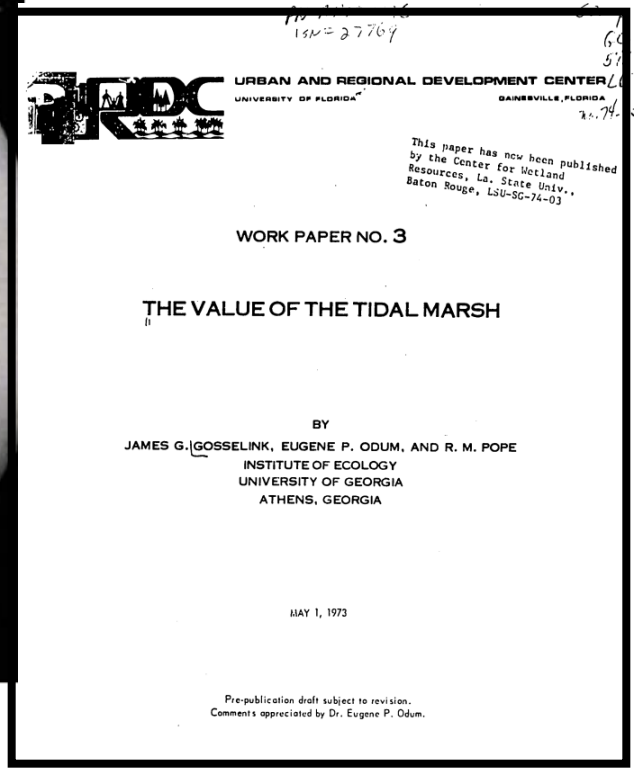

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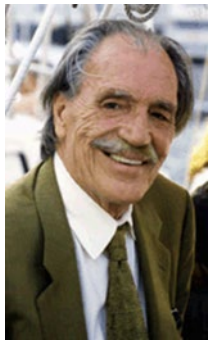


Ian McHarg

Bookends
Swamp Lands Acts
Section 404

IISD
International Institute for Sustainable Development

Natural infrastructure is an area or system that is either naturally occurring or naturalized and then intentionally managed to provide multiple benefits for the environment and human well-being

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Engineering With Nature® is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through nature-based infrastructure and other related terms interchangeably to describe natural systems or engineered systems that mimic natural processes built to minimize flooding, erosion, and runoff.

collaboration.

- **Nature-based solutions (NbS)** involve working with nature to address societal challenges, providing benefits for both human well-being and biodiversity. Specifically, they are actions that involve the protection, restoration or management of natural and semi-natural ecosystems; the sustainable management of aquatic systems and working lands such as croplands or timberlands; or the creation of novel ecosystems in and around cities.
- **Nature-based solutions**…encompass a wide range of approaches—from the restoration of habitats to water resource management, disaster risk reduction, and green infrastructure—to address societal problems.

European Union

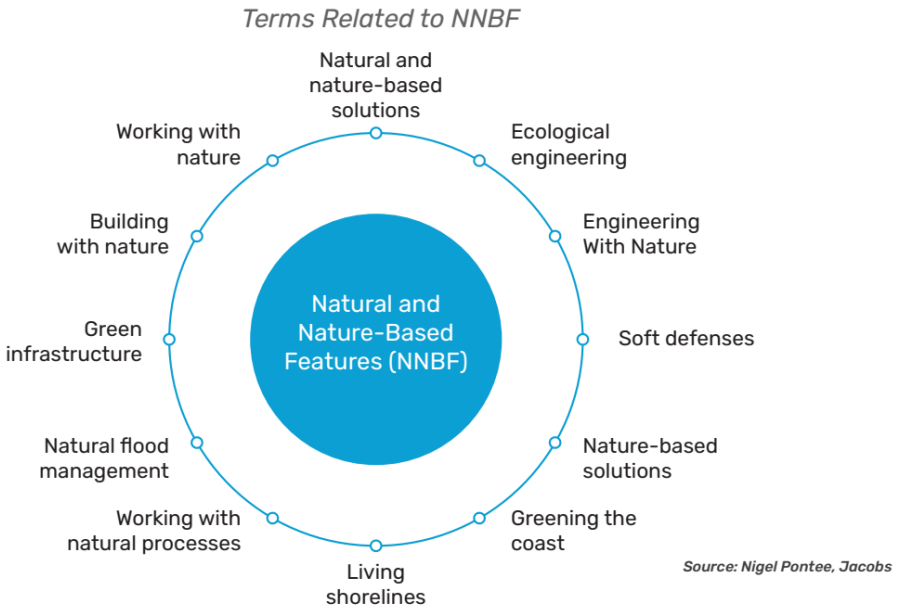
Green infrastructure is a **strategically planned network of natural and semi-natural areas** with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation.

in a nutshell

A healthy network of green infrastructure provides great benefits for both citizens and biodiversity. It also requires careful planning and coordination

Natural and Nature-Based Features (NNBF) are a type of nature-based solution. Different definitions of nature-based solutions for risk reduction and adaptation are in use across the numerous and diverse organizations that are advancing and applying these approaches. The common element among all these definitions is the focus on conserving, restoring, and engineering natural systems for the benefit of people and the ecosystems we inhabit.

Related terms, though not necessarily synonymous, include building with nature, engineering with nature, nature-based solutions, natural flood management, and green infrastructure.

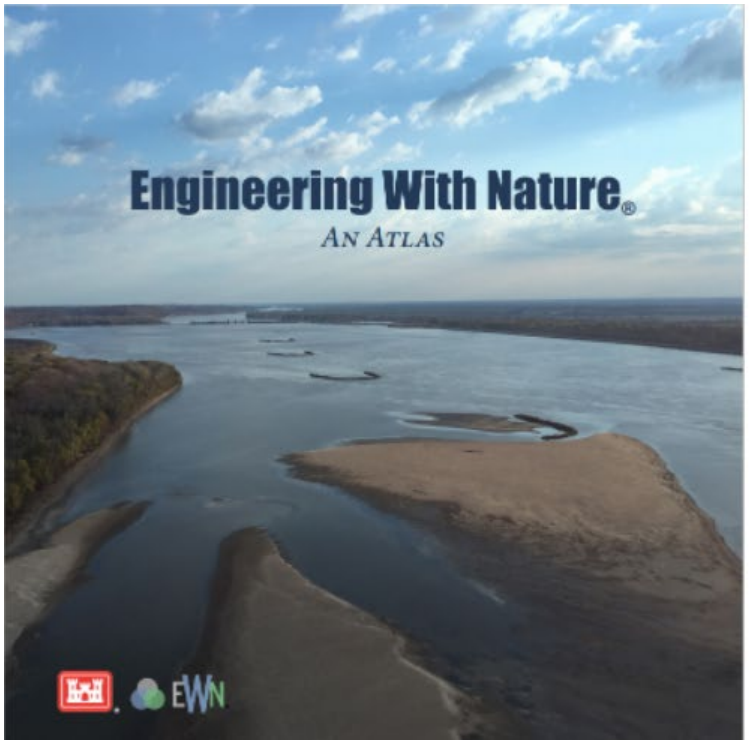


International Guidelines on Natural and Nature-Based Features

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

Note: Logos of the organizations of lead authors and co-authors are shown.

Two Beautiful Books



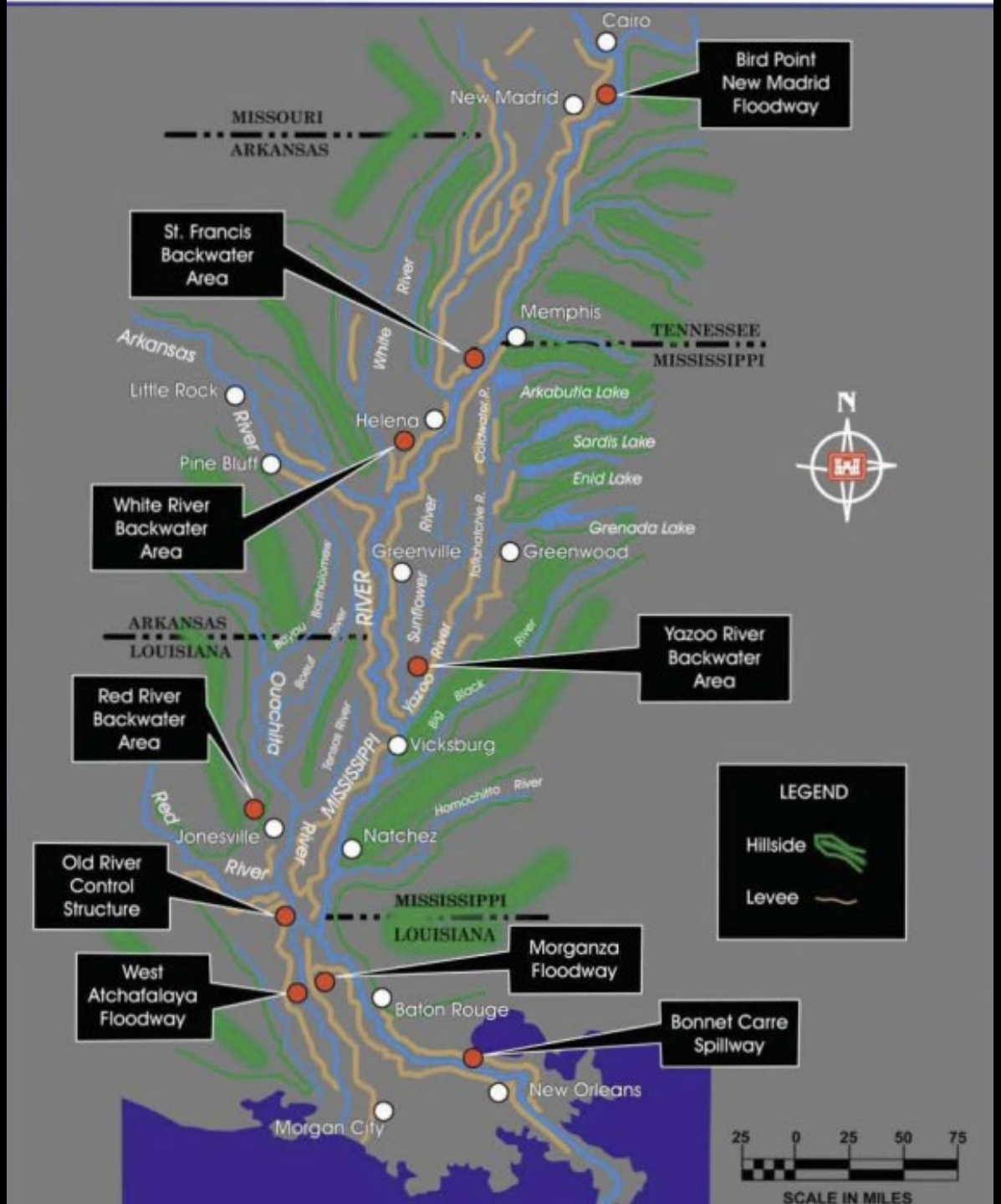
118 CONSTRUCTED NATURE RELATED PROJECTS BUILT AROUND THE WORLD.

Barriers and Challenges

- **Organizations developing water resource projects are skeptical that the inclusion of nature Nature-based features will work or will be accepted by decision makers. They:**
  - **Take too long to reach effectiveness – gray is ready now**
  - **Can't handle major hazard events**
  - **Vary in performance**
  - **Take too much land**
- Change and uncertainty surround all development – hydrologic uncertainty (CC); land use modification; design and performance standards
- The process and procedures used to justify water resources projects in general and environmental and social benefits are complex, unwieldy and not transparent. What risk is acceptable/tolerable?
  - BCA (non-quantifiable factors)
  - Justice (environmental and social)
  - Urban complexity
  - Deterministic or statistic (design floods vs recurrence intervals)

Yu the Great, 2025 BC

National Will

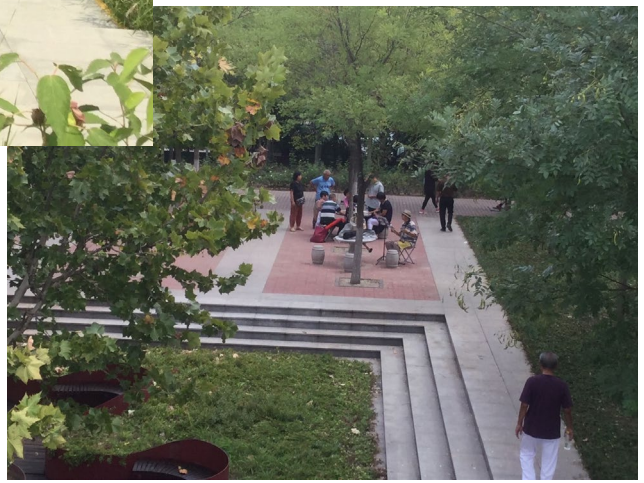


National Will

National Will

Sponge Cities

National Will



Green Infrastructure

Barriers and Challenges

- Organizations developing water resource projects are skeptical that the inclusion of nature Nature-based features will work or will be accepted by decision makers. They:
  - Take too long to reach effectiveness – gray is ready now
  - Can't handle major hazard events (Room for the River?)
  - Vary in performance
  - Take too much land
- **Change and uncertainty surround all development – hydrologic uncertainty (CC); land use modification; design and performance standards**
- **The process and procedures used to justify water resources projects in general and environmental and social benefits are complex, unwieldy and not transparent. What risk is acceptable/tolerable?**
  - **BCA (non-quantifiable factors)**
  - **Justice (environmental and social)**
  - **Urban complexity**
  - **Deterministic or statistic (design floods vs recurrence intervals)**
  - **National Security**

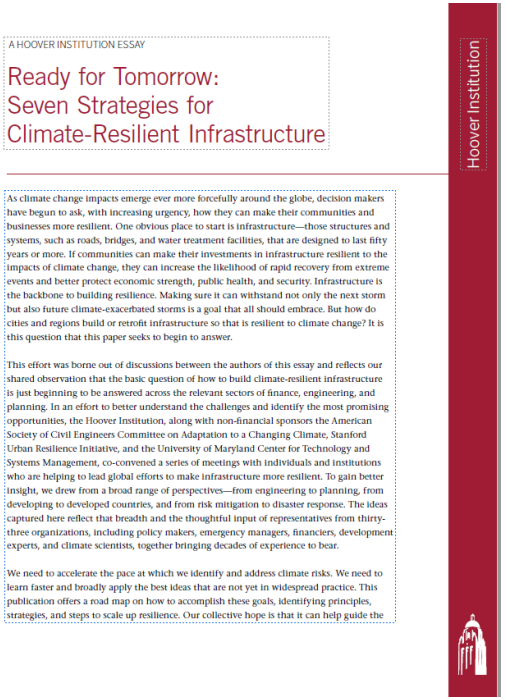
Barriers and Challenges

- **There is a lack of understanding within government agencies at both the Federal and local level concerning the purposes and benefits of NNBF**
- **Efforts to broaden the benefit base for projects to include environmental and social benefits, in many cases, are hampered by the lack of local interest in carrying out such "uneconomic, not-main purpose" approaches.**
- **Much of the work in water resource development is conducted within inefficient and ineffective stovepipes that exist within agencies, committees of the Congress, and academic disciplines and:**

> *the diverse water resources challenges throughout the United States are often studied, planned, and managed in individual "silos," independently of other water areas and projects. Generally, this has resulted in local and narrowly focused project objectives with little consideration of the broader watersheds that surround these projects.*
>
> Congressman Jim Oberstar, former Chair of the House T& I committee

Ready for Tomorrow: Seven Strategies for Climate-Resilient Infrastructure

- Infrastructure is more than individual structures. It is embedded in a complex and interconnected world and includes natural, built, and human systems. There are often strong interdependencies both within and among infrastructure systems. The failure of one infrastructure component can trigger simultaneous failures or a cascading collapse of other critical services.


A HOOVER INSTITUTION ESSAY

Ready for Tomorrow: Seven Strategies for Climate-Resilient Infrastructure

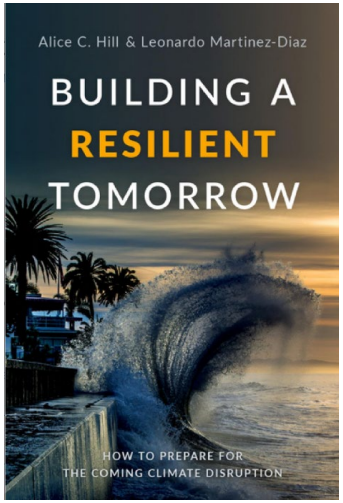
As climate change impacts emerge ever more forcefully around the globe, decision makers have begun to ask, with increasing urgency, how they can make their communities and businesses more resilient. One obvious place to start is infrastructure—those structures and systems, such as roads, bridges, and water treatment facilities, that are designed to last fifty years or more. If communities can make their investments in infrastructure resilient to the impacts of climate change, they can increase the likelihood of rapid recovery from extreme events and better protect economic strength, public health, and security. Infrastructure is the backbone to building resilience. Making sure it can withstand not only the next storm but also future climate-exacerbated storms is a goal that all should embrace. But how do cities and regions build or retrofit infrastructure so that is resilient to climate change? It is this question that this paper seeks to begin to answer.

This effort was borne out of discussions between the authors of this essay and reflects our shared observation that the basic question of how to build climate-resilient infrastructure is just beginning to be answered across the relevant sectors of finance, engineering, and planning. In an effort to better understand the challenges and identify the most promising opportunities, the Hoover Institution, along with non-financial sponsors the American Society of Civil Engineers Committee on Adaptation to a Changing Climate, Stanford Urban Resilience Initiative, and the University of Maryland Center for Technology and Systems Management, co-convened a series of meetings with individuals and institutions who are helping to lead global efforts to make infrastructure more resilient. To gain better insight, we drew from a broad range of perspectives—from engineering to planning, from developing to developed countries, and from risk mitigation to disaster response. The ideas captured here reflect that breadth and the thoughtful input of representatives from thirty-three organizations, including policy makers, emergency managers, financiers, development experts, and climate scientists, together bringing decades of experience to bear.

We need to accelerate the pace at which we identify and address climate risks. We need to learn faster and broadly apply the best ideas that are not yet in widespread practice. This publication offers a road map on how to accomplish these goals, identifying principles, strategies, and steps to scale up resilience. Our collective hope is that it can help guide the

Hoover Institution

Hill, Alice C., Douglas Mason, Joanne R. Potter, Molly Hellmuth, Bilal M. Ayyub, and Jack W. Baker. Ready for Tomorrow: Seven Strategies for Climate-Resilient Infrastructure. Hoover Institution, 2019.



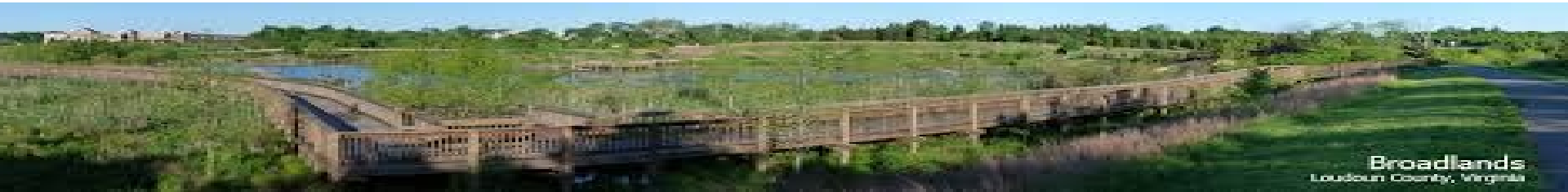
Seven Strategies for Climate-Resilient Infrastructure
1. Make better decisions in the face of uncertainty.
2. View infrastructure systemically.
3. Take an iterative, multi-hazard approach.
4. Improve and inform cost-benefit analysis (CBA).
5. Mainstream nature-based infrastructure.
6. Jump-start resilience with immediate actions.
7. Plan now to build back better.

An International Perspective

- River basins are the most critical areas for countries to deal with climate change – not just small projects.
- Dealing with climate change requires:
  - Understanding importance of uncertainty: assessing the long-term impact of climate change and the short-term impact of disasters and adopting dynamic adaptation and diverse coping strategies.
  - Returning space to rivers based on natural solution concepts
  - Building resilient communities and optimizing; integrating measures such as Sponge Cities and NNBF; attaching importance to comprehensive solutions with "blue, green and gray; developing integrated system solutions to avoid decentralized measures in individual departments.
  - Taking social and gender equity as an important goals to enhance the sustainable development capacity to cope with climate change and increase the attention to social inclusion and gender equity in relevant policies.
  - Strengthening resilient security for women, the elderly, left-behind children and other vulnerable and disaster-prone groups.

TBL: In My Opinion

- NNBF have been and continue to be integral and important elements in the development and wise use of our nation's water resources
- NNBF must be applied in the context of a systems approach that encompasses careful attention to engineering, economic and social and environmental and other factors
- Where NNBF are properly employed, they work physically and financially to the benefit of society, BUT we need to do a better job of explaining that
- Over the last half-century, as seen in legislation, inclusion of environmental approaches {and. more recently, social objectives) to water resource development has been part of national policy, BUT Congress and Administrations have been wishy-washy in full endorsement of the environment and converting words into actions.
- Barriers and challenges have existed and continue to exist that prevent the full employment of NNBF in development of water resources. These barriers and challenges can be and need to be addressed and overcome
- There is an obvious lack of will to move ahead with NNBF (and social approaches) in the face of the unknowns and growing constituent concerns over budgetary pressures




Remember - Nature Bats Last
Thank You

Back-Up/Supplemental Slides

The Congress and the Environment

- 56 years ago the Congress passed the Water Resource Planning Act Of 1965 which stated that

  It is the policy of the United States that all water resources projects should reflect national priorities …protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems

- The 1965 Act was passed in reaction to earlier Federal guidance, which had a primary focus on only supporting Federal water projects based on their economic benefits. Subsequent actions by the Congress have continued to affirm the priority of the environment even though actions by some Administrations and Congresses have attempted to reprioritize or remove environmental considerations.
- In the 2007 and 2020 WRDAs, Congress has continued to emphasize the priority of protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems
- Studies conducted after the great Mississippi for flood of 1993, Hurricane Katrina, super Storm Sandy and Hurricane Harvey emphasized the necessity for full consideration in use of the environment in water resource development.

Actions for the Congress

The use of NNBF is not the sole answer to meeting the challenges of 21st Century water resource development, but a failure to promote their use where it makes sense is passing up opportunities that offer long term rewards. Continuing reliance primarily on economic justification of projects makes it difficult for those in rural and low-income areas to justify projects that would give them considerable environmental, social and conceivably health benefits. The recent NASEM studies of affordability of flood insurance gives a very clear picture of the differential level of flood protection under various economic situations and strong reason to consider all factors in project justification

- The Congress identify the use of NNBF and social elements of projects as integral elements of water resource development projects and not require separate authorizations just as the decision on use of flood wall vs, a levee is an engineering decision within the purview of the construction agency. Decisions on use of NNBF or social focused project elements should be left to federal agencies
- Congress, through the relevant congressional committees, recognize and accept the benefits of NNBF and the unknowns that still accompany their use, and support, in committee reports, and in authorization and appropriation legislation, the full use of NNBF where the agencies identify a favorable benefit-cost analysis employing both quantitative and qualitative analyses
- The Congress support the rapid approval of changes to planning documents required under WRDA 2020, section 113
- The Congress, if action has not been taken under section 113 of WRDA 2020, direct, in the next WRDA, Federal agencies and the Administration to simplify procedures for approval of NNBF

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- McHarg, Ian L. Design with Nature. Garden City, N.Y: Published for the American Museum of Natural History [by] the Natural History Press, 1969.
- Gosselink, James G., Odum, Eugene P., and Pope, R. M., The Value of the Tidal Marsh Publication No. LSU-SG-74-03, Center for Wetland Resources, Louisiana State University, Baton Rouge, Louisiana, May 1974.

Identifying Challenges and Opportunities for NNBFs as Flood Risk Reduction Measures: Quantifying the effectiveness and reliability of NNBFs as flood risk reduction measures in different environmental conditions and for different floods and storms is an area of ongoing research. Congressional Research Service

- R46328 , April 27, 2020. Nicole T. Carter Specialist in Natural Resources Policy, Eva Lipiec, Analyst in Natural Resources Policy Examples of Coastal Natural and Nature-Based Features Source: U.S. Army Corps of Engineers, Engineering With Nature. Natural Features and Flood Risk Reduction: NNBFs may provide flood risk reduction and a suite of environmental and social benefits. In other applications, NNBFs may be unable to replicate the level of flood risk reduction provided by traditional structural and nonstructural measures. Congress may consider the following issues for NNBFs in USACE flood risk reduction activities: knowledge gaps in measuring the benefits and limitations of NNBFs and the research to fill these gaps; how USACE processes account for NNBFs' benefits, costs, and performance; and effects of agency practice, Administration guidance, and statutory authority on the consideration and adoption of NNBFs for flood risk reduction. Congress has requested two reports related to NNBFs from USACE.

The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA 2017 (UCSC;TNC, RMS; WCS)

- As exposure to coastal hazards increases there is growing interest in nature-based solutions for risk reduction. This study uses high-resolution flood and loss models to quantify the impacts of coastal wetlands in the northeastern USA on (i) regional flood damages by Hurricane Sandy and (ii) local annual flood losses in Barnegat Bay in Ocean County, New Jersey. Using an extensive database of property exposure, the regional study shows that wetlands avoided $625 Million in direct flood damages during Hurricane Sandy. The local study combines these models with a database of synthetic storms in Ocean County and estimates a 16% average reduction in annual flood losses by salt marshes with higher reductions at lower elevations. Together, the studies quantify the risk reduction ecosystem services of marsh wetlands. Measuring these benefits in collaboration with the risk modelling industry is crucial for assessing risk accurately and, where appropriate, aligning conservation and risk reduction goals.

The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA, 2017, Narayan et al.