Application of Natural Infrastructure: Context, Features and Benefits

NASEM Workshop on Natural Infrastructure



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The Problem and the Solution

The Problem

The number and severity of extreme weather events has increased dramatically and resulted in an unprecedented need for coastal and riverine protection. However, conventional means of shoreline protection can compromise ecological integrity.

The Solution

The design and application of projects featuring Natural Infrastructure can provide the protection needed while preserving and enhancing the ecological integrity of the site.

Natural Infrastructure Solutions Defined

Mangrove Forests
•Storm surge and wave buffer
•Prevent shoreline erosion
•Enhance wildlife sanctuaries

Beach Restoration/ Nourishment
•Storm and hurricane buffer
•Improve land value
•Enhance recreational use

Natural Wetlands
•Supply water and prevent floods
•Upstream water filtration
•Sediment reduction
•Enhance wildlife habitat

Natural or “nature-based infrastructure projects “rely on services produced by ecosystems, often utilizing natural landscapes to minimize flood damages, purify and store water, and reduce urban stormwater runoff.”

- Resources for the Future

Natural Infrastructure – Selected Examples

Methods

- Beneficial Use of Dredged Material
- Living Shorelines
- Marsh and Wetland Creation
- Mangrove Forests
- Barrier Islands

Benefits

- Beach Restoration/ Nourishment
- Storm Surge and Hurricane Buffer
- Flood Damage Reduction
- Erosion/Sediment Loss Reduction
- Water Quality Improvements
- Fish and Wildlife Habitat
- Coastal Community Resiliency
- Increased Land Values

The Unmet Need

Ecological processes and the “built environment” are increasingly at-risk; infrastructure improvements are not keeping pace with needs:

- ✓ ASCE report card (2017): $312B needed over next decade.
- ✓ Business Roundtable (2015): $2B needed for port infrastructure alone.
- ✓ National Waterways Foundation (2014): modernizing locks and dams could lead to 350K new jobs valued at $14B over the next decade.
- ✓ National Research Council (2013): estimated value of USACE water-based infrastructure fell from $237B to $164B over last four decades.
- ✓ USEPA (2017): estimated need for drinking water, wastewater and stormwater infrastructure is $655B over the next two decades.

The Unmet Need

- ✓ Problem exacerbated by increasing frequency of extreme weather events.
- ✓ Natural infrastructure solutions augment traditional approaches by mitigating risks, reducing funding gaps, improving environmental outcomes, and reversing degradation.
- ✓ The Nature Conservancy (2015): Natural Infrastructure solutions can be less expensive than traditional approaches and realize greater benefits.
- ✓ Increasing size of the Natural Infrastructure market: $40B annually in US.

Natural infrastructure is the answer to a pronounced disconnect: in some regions for example, dredged material is a "waste" product and disposal is problematic. In other regions, it is valued for land rebuilding, coastal protection and ecological restoration.

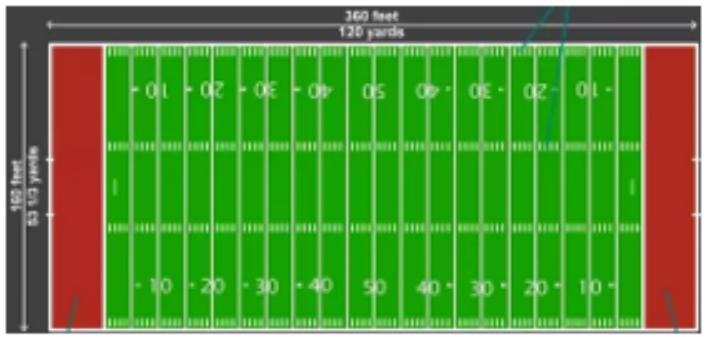
The Unmet Need

- ✓ The USACE navigation program manages approx. 12K miles of shallow-draft and 13K miles of deep draft waterways (spanning approx. 400 ports, harbors and related navigation facilities).
- ✓ Including non-USACE programs, annual dredging totals approx. 200M cubic yards of sediment. Approx. 50M cubic yards are beneficially reused, suggesting an 150M cubic yards opportunity.

To place this in perspective, 150 Million cubic yards of sediment would:

Fill the Pentagon (6.6M sq. ft.) to a depth of 625’

Fill a Football Field (120 by 53 yards) to a depth of 60K’



Create approx. 15.5K acres of land (24 sq. mi.)- 6’ depth

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Why are Natural Infrastructure Solutions Important?

Diverse benefits

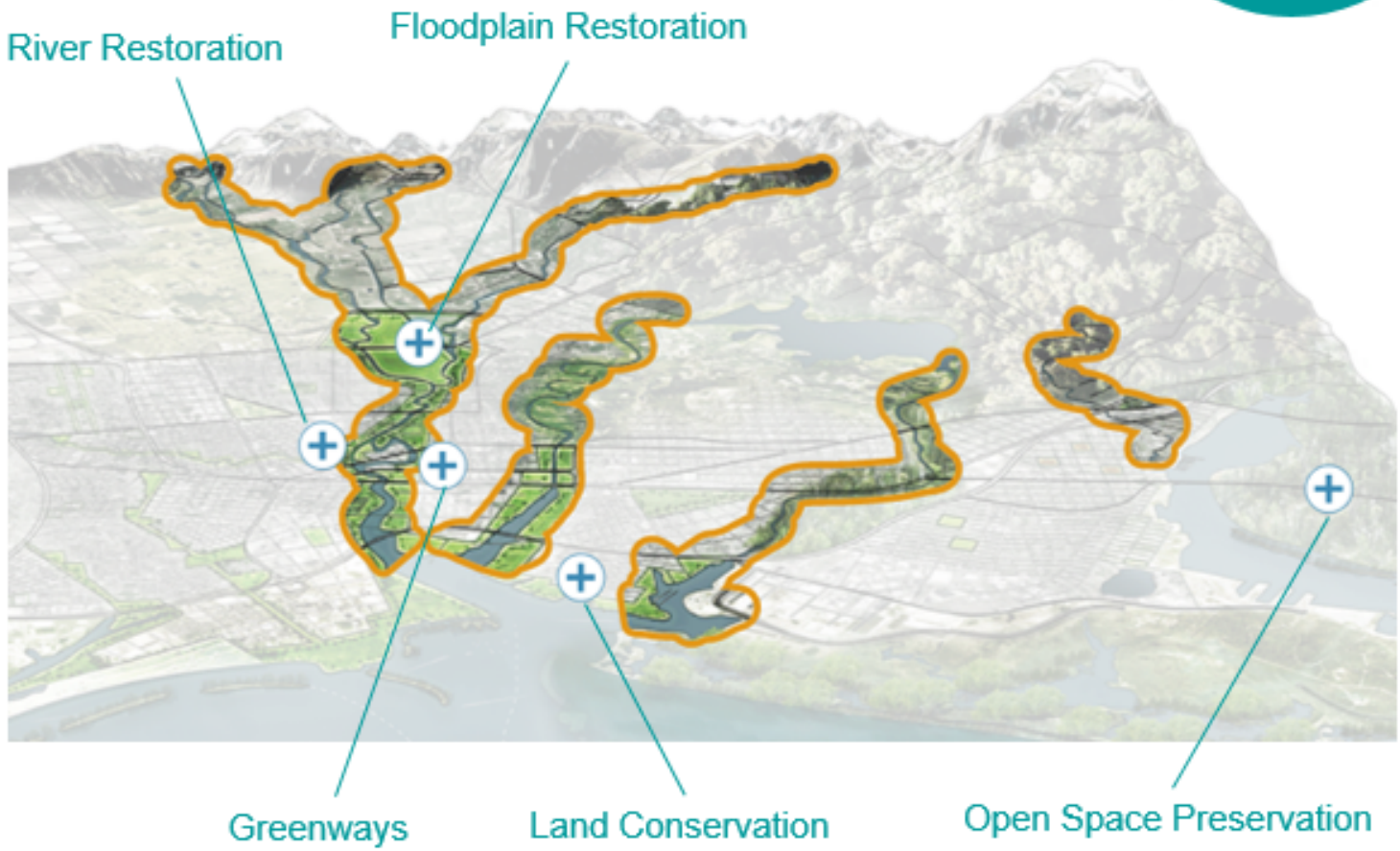
Provide benefits in these categories provide our communities with resilient solutions

- Environmental
- Economic
- Societal

Natural Infrastructure Techniques

Riverine

- Open Space Preservation
- Floodplain Protection
- Floodplain Restoration
- Riparian Buffer
- Stream/River Restoration
- Greenways
- Horizontal Setback Levee
- Dam Removal
- Culvert Upgrades

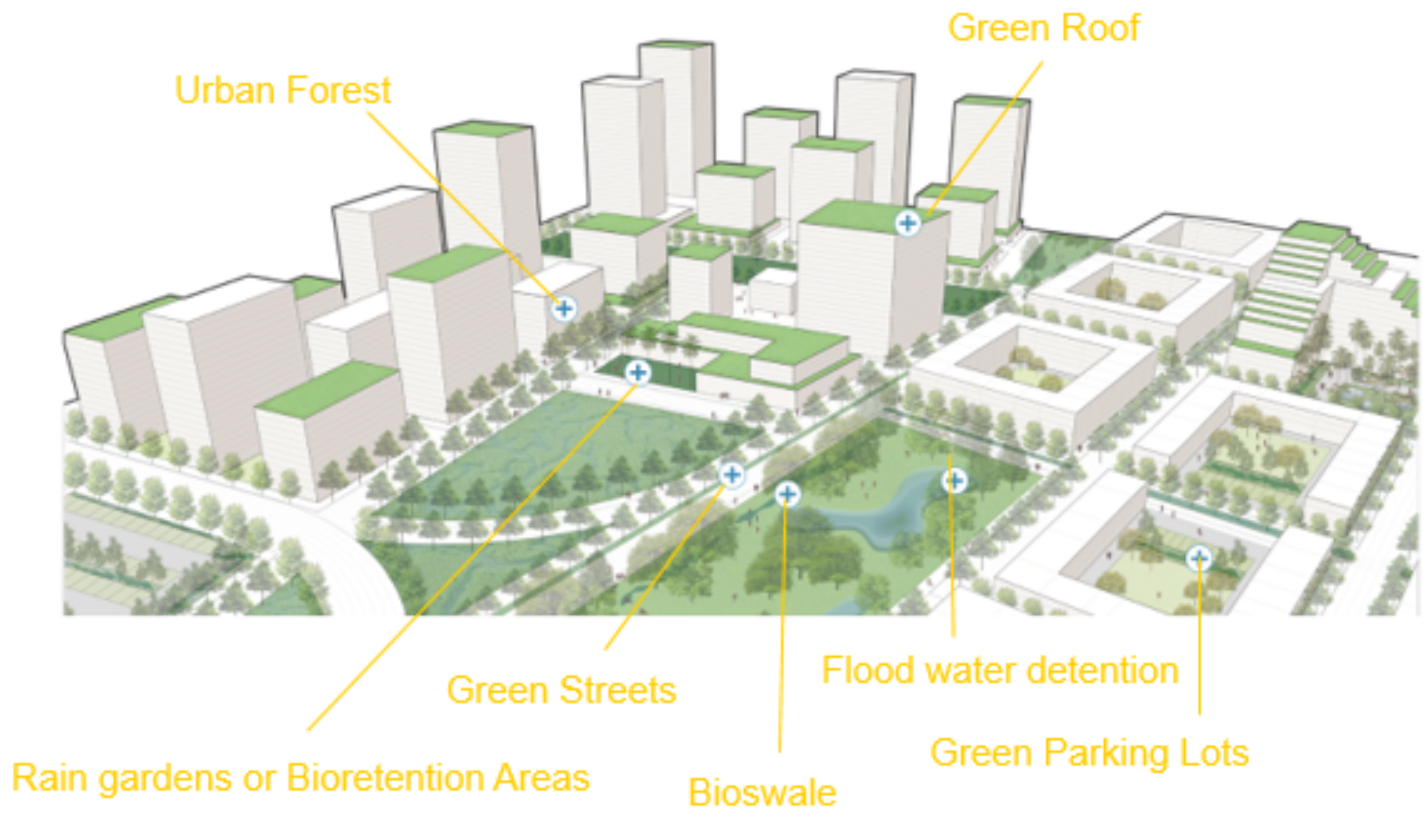


Credit: The Nature Conservancy – Naturally Resilient Communities

Natural Infrastructure Techniques

Urban

- Protected & Enhanced Greenspace & Greenways
- Protected & Enhanced Urban Forest
- Floodplain & Wetlands Restoration
- Constructed Wetlands
- Green Stormwater Infrastructure / Low Impact Development
- Stormwater Parks
- Stream/River Restoration
- Daylighting streams
- Horizontal Setback Levee



Credit: The Nature Conservancy – Naturally Resilient Communities

Natural Infrastructure Techniques

Coastal

- Land Conservation
- Living Shorelines
- Coastal Wetlands Restoration
- Reef Restoration
- Beach and Dunes
- Waterfront Parks
- Tidal Circulation
- Channel Restoration
- Seagrass
- Mangroves

Credit: The Nature Conservancy – Naturally Resilient Communities

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CASE STUDIES



Case Study: Texas Coastal Resiliency Master Plan

- Among the nation's most ambitious comprehensive master plans, addressing approximately 400 miles of coast and 3,300 miles of bays and estuaries.
- Features dozens of recommended "Tier One" projects to address natural and human-induced coastal impacts.
- Strong emphasis on natural as well as conventional infrastructure projects to enhance coastal resiliency while restoring and protecting natural and built assets.
- Highlights eight adverse impact categories and identifies project-specific solutions.

Case Study: International “Changing Course” Design Competition

- Dozens of teams worldwide competed to design a sustainable, 100 year vision for the Lower Mississippi Delta.

- Sea level rise, land subsidence and extreme weather events have resulted in dramatic, continued land loss.

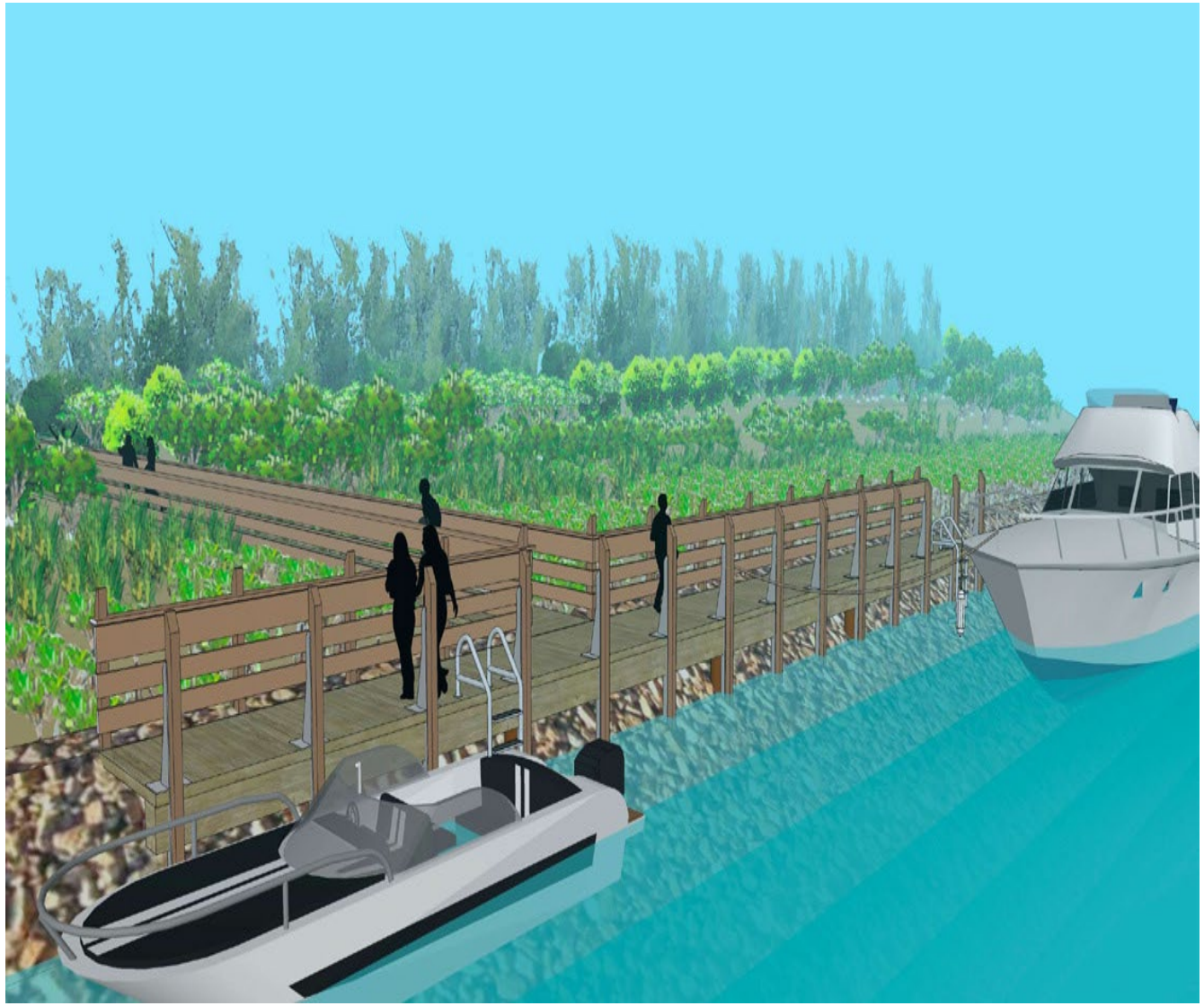
- Each of three winning teams (one included AECOM) independently identified natural infrastructure as a key element in optimizing the economy, ecology and quality of life future of the Lower Mississippi Delta and its people.

Case Study: Mid-Barataria Sediment Diversion Project

- Decades of coastal development, including levee construction, have “starved” the Lower Mississippi Delta of its natural sediment load.
- Resulted in dramatically reduced sediment transport to coastal areas, exacerbating continuing land loss also due to land subsidence, sea level rise and extreme weather events.
- Land loss in the Delta continues at the equivalent of one football field per 100 minutes.
- Project will slow land loss by capturing up to 15% of the approx. 200 million tons of sediment otherwise “lost” to the deep Gulf waters.

Case Study: Jupiter Island Shoreline Restoration

- A 1500’ reach of undeveloped shoreline along Florida’s Indian River with severe shoreline erosion problems due to dredging, wave action, storms and recreational use.
- Designated as the first “Outstanding Natural Area” east of the Mississippi River.
- Partnership with the Bureau of Land Management to design a natural shoreline using ecological restoration techniques.



Case Study: Transmitter Park

- Highly urbanized site in Brooklyn, NY; former location of a radio station and ferry terminal.
- Highly eroded shoreline addressed via rip rap, natural vegetation/bio-filtration and sand filters to treat stormwater.
- Resolved shoreline erosion, brownfield contamination, stormwater runoff and water quality issues, while addressing public access/ parkland needs.

Case Study: Brooklyn Bridge Park

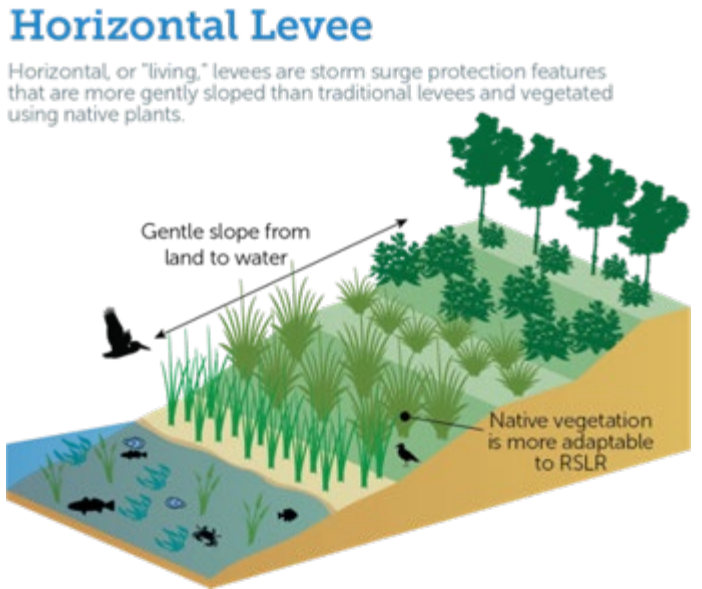
- Design of an 80 acre park along 1.3 miles of shoreline that has been historically underutilized and without public access.
- Natural design (i.e., “living shoreline”) features providing for enhanced shoreline and shallow water habitat.
- Multi-objective design includes floating walkways, connecting piers, recreational harbor, active and passive recreational areas, and extensive public access.

Case Study: Greenpoint Monitor Museum

- Assessed environmentally-beneficial alternatives for shoreline stabilization/protection and related flood control along the Brooklyn , NY waterfront.
- Component of the Museum's Environmental Master Plan.
- Consideration of natural infrastructure alternatives such as gentle slopes , marsh creation, re-vegetation, vegetated buffers, live staking, contour wattling, brush layering, brush matting and erosion control matting.

Case Study: Bolinos Lagoon

- Strong federal/state/local partnership.
- Addressed challenges associated with rising sea levels, storm surge and habitat degradation due to transportation- related development.
- Natural Infrastructure is reflected in project design featuring horizontal or “living” levees with native species vegetation and reconnecting the alluvial fan with natural habitat.
- Excellent example of environmental, social and economic benefits.



Application of Natural Infrastructure: Challenges and Opportunities

- Client awareness and preferences.
- Establish standards of performance and cost.
- Continued education- clients and practitioners.
- Perception of NI Solutions.
- Funding for additional pilot projects.
- Funding for Regional Sediment Management Programs.

- Provide incentives to encourage beneficial re-use of dredged material
- Change “federal standard” requiring least cost, environmentally acceptable dredged material placement.
- Streamline/expedite the permitting process.
- Increase state authority/ flexibility, as appropriate.
- Include Natural Infrastructure Solutions in all investment discussions/decisions.



What Federal Funding Is Out There?

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Natural Infrastructure Resources (Selected)

- USACE - Engineering with Nature Atlas and website (link)
- International Guidelines on Natural and Nature-Based Features for Flood Risk Management (link)
- Naturally Resilient Communities website (link)
- Protecting Open Space and Ourselves: Reducing Flood Risk in the Gulf of Mexico Through Strategic Land Conservation (link)
- The Association of State Floodplain Managers and Coastal States Association's CRS for Community Resilience Green Guide (link)
- Evaluating the effectiveness of local mitigation activities in reducing flood losses (link)