COASTAL NATURE-BASED SOLUTIONS: LESSONS LEARNED

U.S. Department of Transportation
Federal Highway Administration

Sharing Lessons Learned on Coastal Nature-Based Solutions (NBS)

This fact-sheet summarizes emerging practices for planning, designing, and implementing NBS. FHWA published an Implementation Guide in 2019 to help transportation practitioners understand how and where to use NBS for highway resilience to protect coastal roads and bridges from flooding, erosion, storm surge, and sea level rise. In 2021, FHWA conducted follow-up interviews with Coastal NBS pilot projects and other agencies to glean lessons learned from the field. Key findings are presented below along with case examples designed to help engineers, project managers, and other transportation stakeholders interested in NBS.

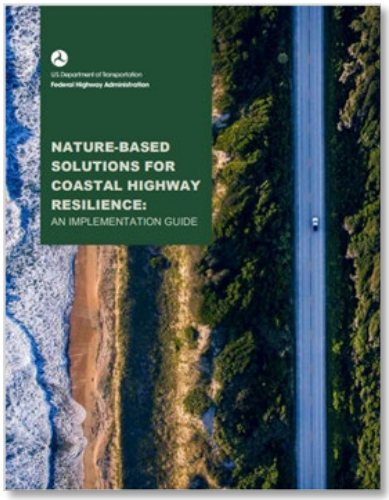

Figure 1. Nature-Based Solutions for Coastal Highway Resilience: An Implementation Guide.

How to Get Started with Coastal NBS

State DOTs can consider the following actions to promote success with NBS. Examples of implementing some of these actions are highlighted on the next page.

- Formalize partnerships with state agencies early and develop agreed-upon definitions and goals to help with approvals
- Pre-identify priority locations for mitigation and conservation
- Identify champions for NBS to advocate for their use
- Identify ways the nature-based project can support the goals and efforts of existing initiatives
- Pursue joint funding with partner agencies and organizations
- Establish a methodology to capture all benefits (monetary and non-monetary) of NBS
- Incentivize NBS via monetary or regulatory action
- Engage with the public early and often to build buy-in

What are Nature-Based Solutions?
NBS use natural materials and processes to reduce erosion, wave damage, and flood risks. NBS often serve as alternatives to, or ecological enhancements of, traditional shoreline stabilization and infrastructure protection.

Ideal Site Characteristics

The following characteristics can help identify ideal sites for successfully implementing NBS:

- A shoreline width of 30+ feet
- Moderate tidal range (<4 feet), though dunes can accommodate more
- Erosion rate of under 4 feet/year
- Shoreline slope of <1:10
- Existing natural shoreline
- Project size, location, and materials are covered by a state general permit
- Partners to help with monitoring and maintenance after construction

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Example: Establish Collaborative Partnerships

Oregon DOT, Statewide

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Regulatory and permitting issues often appear as a barrier to NBS. To address this, ODOT participated in a working group led by Oregon's Department of Land Conservation and Development to review regulations governing shoreline armoring. The working group's efforts resulted in a set of recommendations for how to amend state regulations to allow for construction of nature-based infrastructure along the shore. Specifically, the working group recommended amending policy related to shoreline armoring to re-define what constitutes a "beachfront protective structure" and thus what triggers regulation. By defining NBS as "non-structural," these projects would not be subject to the same regulations as structures, which then increases the chance that NBS projects are allowed along coastlines. Another resulting recommendation is to streamline the permitting process by including a "reasons exception" for at-risk pre-1977 public infrastructure to be eligible for shoreline armoring projects and refine the local exceptions process. ODOT is now seeking research and construction funding to build natural revetment projects along the central coast where erosion issues have been identified.

Figure 2. Evidence of road erosion (Source: Oregon DOT).

Example: Quantify Benefits

Virginia DOT, Belle Isle State Park

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VDOT collected data both to identify suitable sites for nature-based resilience projects and to demonstrate the effectiveness of projects already in the ground. VDOT used short- and long-term erosion rate calculations to prioritize sites for stabilization and justify the need for a nature-based erosion project. After implementing a NBS project in the Chesapeake Bay, VDOT quantified how erosion slowed or reversed by comparing historical and current-day shoreline aerial maps (collected by the Virginia Institute of Marine Science since 1937). Because erosion could reduce property value due to the loss of dry land from the property, understanding the reduced rate of erosion as a result of the project helped to demonstrate the business case for natural infrastructure.

Figure 3. Nature-based solutions projects for shoreline restoration in the Chesapeake Bay, including breakwater in the top picture and vegetation monitoring below (Source: Virginia DOT).

Example: Sometimes Size Matters

Washington DOT, Washaway Beach

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Washaway Beach along State Route (SR) 105 in the community of North Cove in Washington State is a "chronic environmental deficiencies" (CED) site, meaning that it has required repeated maintenance activities, and those activities negatively impacted fish and fish habitat. The CED program at WSDOT applies NBS to build climate resilience, reduce maintenance needs, and improve fish habitat.

In recent studies, several NBS options were considered to protect SR 105 from erosion, reduce maintenance, and improve fish habitat. In 2018 a dynamic revetment, a cobble berm designed to reduce coastal erosion caused by waves and storm surges by gradually dissipating energy, was selected as the preferred NBS option. This was considered a pilot project due to the lack of data on how the solution would perform in this extreme wave climate.

Nature-based work at Washaway Beach has faced some challenges due to project size and the need to replenish cobble. The project size was limited due to funding and timing constraints. So, while the dynamic revetment has generally performed as intended, this pilot project is not widely perceived as a success but rather first step toward a resilient solution.

WSDOT is working with several state, tribal and local entities and the Corps of Engineers on the final design of a full-scale dynamic revetment that will have the dimensions needed to absorb and dissipate wave energy along a 4,000-foot-long section of the coast that will include the area of the pilot project. The revetment will also feature a dune restoration component that will use sand overwash from prior coastline erosion along with all material excavated to place the dynamic revetment.

Example: Select Champions to Advance NBS

Delaware DOT, Statewide

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DelDOT created a Division of Transportation Resilience and Sustainability, to focus on resilience projects and identify funding opportunities. DelDOT uses the division as a central source for funding resilience efforts and streamlining project approval, which has led to more resilience projects. By organizing around and assigning groups or individuals to advance resilience, this notable practice supports better coordination and cohesiveness to drive resilience measures in projects.

DelDOT has already seen successful implementation of some nature-based resilience work, such as the living shoreline and storm drain outfall improvements at Reed Avenue in Dewey Beach pictured below. The goals of this project were to improve drainage capacity and thus stabilize shorelines and reduce chronic localized flooding from hightides and future sea level rise impacts. Other locations are being studied to further improve drainage in the area. DelDOT sees the new division as a success and will continue working on resilience in their projects.

Figure 4. Coastal green infrastructure at Reed Ave to improve drainage and project against flooding (Source: Delaware DOT).

Additional Lessons

- Understand the site vulnerabilities to determine what NBS may provide the most effective risk and resilience benefits.
  - In New Jersey, for example, the Barnegat Bay Partnership developed the beta version of its restoration planner – an information planning tool to identify areas in the greatest need of restoration using GIS data.
- Currently, most state DOT nature-based work focuses on environmental mitigation. Look for ways to use these nature-based mitigation projects to also deliver the benefit of increased local resilience. When implementing such projects, capture lessons learned on implementation and effectiveness of NBS, which can then inform future work that is more specifically targeted to using NBS to increase resilience. Work that generates the co-benefits of both environmental mitigation and resilience provide a better return on investment than solely focusing on mitigation for environmental benefits.
- Regulatory requirements remain a barrier to NBS. To address this, prioritize early collaboration with regulatory agencies to identify needs and narrow down options to focus on projects with a high likelihood of approval.
- Transportation funds and right-of-way areas alone may not be enough to successfully implement a nature-based project. Look for implementation and funding partners with broader jurisdiction. Certain funding programs, particularly at the federal level such as PROTECT and the FEMA BRIC program, as well as non-profits and other resource conservation organizations, encourage the use of NBS.
- Collaborate with your agency's maintenance team to ensure they understand the unique maintenance needs of NBS.

For More Information

Resources

- FHWA Coastal NBS website, including:
  - An Implementation Guide outlining how and where nature-based and hybrid solutions can be used to improve the resiliency of coastal infrastructure
  - The pilot final reports for Maine and New Hampshire, New Jersey, Delaware, Mississippi, and Oregon
- NBS information from NOAA, USACE, and SAGE
- Story map on Caltrans and the California Coastal Commission's nature-based efforts

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Figure 5. Offshore segmented breakwaters and beach nourishment protecting Louisiana Highway 82 in Holly Beach. (Source: FHWA 2019, HEC-25: Highways in the Coastal Environment, 3rd Ed).