In the summer of 2014, USACE Philadelphia District partnered with state, local and non-profit organizations to beneficially use dredged material to restore degraded marsh and create habitat for birds near Stone Harbor N.J., on land owned and managed by the New Jersey Division of Fish & Wildlife. PHOTO BY NEW JERSEY DIVISION OF FISH & WILDLIFE

Engineering With Nature

Advancing System Resilience and Sustainable Development

From research and development to collaboration and partnering, demonstration projects and technology transfer, the U.S. Army Corps of Engineers, through its Engineering With Nature program, is advancing sustainable infrastructure development.

By Todd S. Bridges, Ph.D., M.SAME, Cynthia J. Banks, M.SAME, and Monica A. Chasten, M.SAME

Recent major storm events and severe flooding have elevated discussions about leveraging natural processes and systems to support the resilience of communities and the infrastructure systems upon which those communities rely.

While the responses to Hurricanes Katrina and Superstorm Sandy have highlighted the opportunities to integrate natural systems with conventional infrastructure, aligning natural processes with infrastructure systems can produce benefits across the Civil Works mission of the U.S. Army Corps of Engineers (USACE)—including navigation, water operations, ecosystem restoration and flood risk management.

EFFICIENT AND SUSTAINABLE

In 2010, USACE began its Engineering With Nature (EWN) program with the expressed purpose of promoting "the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes."

The EWN program includes communication, research and development, and demonstration activities that are organized to promote four key elements in infrastructure project development and execution:

- Using science and engineering to produce operational efficiencies;
- Applying natural systems and processes to maximum benefit;
- Broadening and extending the benefits provided by projects to include economic, environmental and social benefits; and
- Employing science-based collaborative processes to engage, organize and focus interests, stakeholders and partners.

EWN initiatives have placed an emphasis on innovative teaming and field-demonstration as a means of developing and illustrating key principles and practices. By drawing together team members from research and development, field practitioners, project owners, academia, and numerous government and private organizations, USACE has been able to combine the creativity and capability that is needed to successfully align natural and engineering processes in order to engineer with nature.

More than a dozen EWN demonstration projects have been initiated across the country since 2010. These projects are being used to illustrate advancing practice, including in the areas of sustainable sediment management through strategic placement and innovative beneficial use; integration of habitat development with infrastructure; engineering with natural materials and plants; and using natural systems to support coastal resilience.

NATURAL AND NATURE-BASED

Following Superstorm Sandy, Public Law 113-2 directed USACE to conduct a thorough review to address flood risks of vulnerable coastal populations in areas that were affected. The report produced by the North Atlantic Coast Comprehensive Study was published in January 2015.

As a part of the report, USACE developed a technical framework for evaluating and implementing the use of natural and nature-based features, in combination with structural and non-structural measures, to reduce flood risks and enhance coastal resilience. Natural and nature-based features include beach-dune complexes, barrier islands (and associated habitats), wetlands, oyster reefs and other features that can be used to address a range of processes impacting coastal systems including sea level rise, shoreline erosion, wave run-up and storm surge.

SETTING AN EXAMPLE

USACE Galveston, Buffalo and Philadelphia Districts have taken on leading roles as EWN proving grounds as a way of transitioning advancements in practice into field implementation. These three districts have committed to applying EWN principles and practices across their portfolio of programs and projects as a means of pursuing sustainable infrastructure development.

"The Galveston District is eager to partner with the broader Corps community in the program," says Col. Richard Pannell, USA, Commander of USACE Galveston District. "Leveraging the principles of EWN will increase the value that our projects deliver by maximizing scarce resources and capitalizing on the latest science."

According to Lt. Col. Karl Jansen, USA, Commander of USACE Buffalo District, association with the EWN program affords an excellent opportunity to exercise the district's regional leadership while demonstrating a commitment to USACE's Environmental Operating Principles: "Stakeholder partnering and collaboration builds trust with the public we serve. Balancing human development with natural systems will preserve the Great Lakes Navigation System's infrastructure and environment for future generations."

A dredging and marsh restoration demonstration project on Mordecai Island near Long Beach Island, N.J., is using dredged material from a shoal in the New Jersey Intracoastal Waterway to restore the eroded area and elevate the adjacent marsh. Planting of the restored area will be done in spring 2016.
USACE PHILADELPHIA DISTRICT BY TIM BOYLE

REBUILDING COASTAL NEW JERSEY

USACE Philadelphia District has been demonstrating the potential to engineer with nature to support and restore natural and nature-based features that contribute to coastal resilience. After Superstorm Sandy, the district partnered with the U.S. Army Engineer Research & Development Center on marsh restoration along the New Jersey Intracoastal Waterway. USACE developed two projects to demonstrate dredging and placement methods to restore marsh. The demonstration projects were completed in partnership with the New Jersey Division of Fish & Wildlife, The Nature Conservancy and the Green Trust Alliance, which operated under a grant from the National Fish & Wildlife Foundation. Work involved dredging critical shoals from the navigation channel and then using the material to restore degraded marsh and create habitat on state-owned marshland.

This methodology is a departure from the traditional practice of dredging and placing material in confined disposal sites that remove sediment from coastal processes. A lack of capacity within the confined disposal sites throughout southern New Jersey, as well as the need to restore marsh and build coastal resilience, necessitated a change in practice. The results have been positive. USACE and its contractor, Barnegat Bay Dredging Co., were able to successfully dredge the shoals from the waterway.

Teams employed different dredging and placement methods on the two projects, which were located near Stone Harbor and Avalon, N.J., respectively. Near Stone Harbor, USACE and its contractor created bird habitat for the black skimmer and other bird species. In Avalon, thin-layer placement of dredged sediments was used to raise low-lying areas and restore the integrity of the wetland. Recent monitoring by the Stone Harbor Wetlands Institute confirms a number of shorebirds are now using the Stone Harbor site and initial reports indicate placement activities have been successful on the Avalon marsh site.

APPLYING LESSONS LEARNED

Lessons learned from the demonstration efforts are being incorporated into two new projects. In December 2015, Philadelphia District was on schedule to begin a full-scale implementation of marsh restoration near Avalon. The district also recently began dredging another section of the Intracoastal Waterway and using the material to restore a section of Mordecai Island behind Long Beach Island, N.J. Mordecai Island serves two key functions in Barnegat Bay: provide habitat for wildlife and augment overall coastal resiliency for the back-bay communities. This work is the result of a partnership between USACE, the New Jersey Department of Environmental Protection, and the Mordecai Island Land Trust.

Going forward, USACE Philadelphia District plans to use these approaches as a model for reusing clean and suitable dredged material in beneficial and cost-effective ways.

"These projects are examples of applying Regional Sediment Management and using EWN principles and practices," according to Lt. Col. Michael Bliss, USA, USACE Philadelphia District Commander. "We balance the need to dredge for navigation purposes with the fact that sediment can be a resource for ecological and shore protection purposes. They are a win-win because we are addressing public safety issues along the waterway and restoring critical habitat and building system resilience."

Going forward, USACE Philadelphia District plans to use these approaches as a model for reusing clean and suitable dredged material in beneficial and cost-effective ways.

ADVANCING ENGINEERING PRACTICES

The sustainability of our infrastructure systems is advanced by seeking ways to align engineering and natural systems in order to extend engineering performance over time, while also producing environmental benefits and promoting the resilience of communities supported by those systems.

EWN provides a means for combining lessons learned, new research, and innovative demonstrations to advance our collective and collaborative engineering practice.

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