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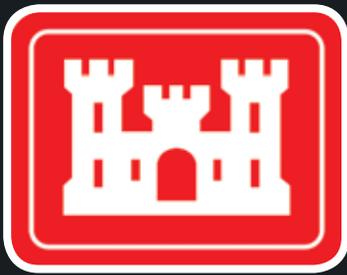


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Corps of Engineers Aims for Environmental Sustainability



**By Thomas J. Fredette, Ph.D.,
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Navigation infrastructure projects all involve human management of some aspect of the natural environment such as current flow, channel depth, or linkages between waterways through, for example, dredged channels, locks, jetties, and canals. While minimizing unintended and adverse impacts from such endeavors is the goal of environmental assessment, there are also environmental enhancements that can be incorporated into the design of projects that are often overlooked.

When identified early, there are many potential environmental features that could be easily incorporated into the planning process. US Army Corps of Engineers (USACE) policy ^{1,2}, supports the concept of incorporating environmental design features as part of USACE projects, but realities associated with funding policies must also be factored into decisions.

Navigation infrastructure projects are prominent features of the nation's waterways and thus provide a considerable opportunity for increasing sustainable features. The USACE is responsible for over 12,000 miles of navigation channel, 195 navigation locks, and hundreds of jetties, breakwaters, and anchorages.

For example, the USACE New England District alone has over 130 breakwaters and jetties with a total length of over 40 miles, over 2,000 acres of anchorage, and over 470 miles of channel. This infrastructure already provides valuable habitat for fisheries and waterfowl, but these habitat features are often "accidental" – as opposed to being deliberately planned into the design.

This article explores opportunities for enhancing life-promoting features of coastal infrastructure. With the use of more creative design, low-cost measures could be implemented as part of routine maintenance, scheduled repairs or new modifications, and would result in improved habitat.

Ongoing USACE Initiatives

Engineering with Nature" (EWN) is an initiative that has been developed within the USACE Dredging Operations and Environmental Research (DOER) Program. The basic concept of EWN involves promoting greater environmental and social sustainability of navigation infrastructure. This will be done by looking for creative ways to apply science, engineering, partnerships, and operational practice leading to expanded environmental and social benefits from navigation infrastructure. One example of this is being conducted under the Great Lakes Restoration Initiative (greatlakesrestoration.us/index.html), where a study is underway to identify pilot projects which can be implemented in association with regularly scheduled maintenance activities of harbor jetties and breakwaters. In the long-term, it is anticipated that these example projects will lead to changes in the way that future structures are planned and designed.

How the Concept of Environmental Sustainability Applies to Coastal Structures

Coastal engineering structures can be made "greener" if they are designed to provide life-promoting habitat for species such as fish and birds and their food sources (insects and aquatic plants), or by modifying design to improve water quality or other environmental factors. Structures like breakwaters and jetties are usually designed to manage some aspect of the natural environment; for example, to improve naviga-



tion, to provide protection from storm waves, or to control erosion or sediment movement.

The first consideration for planners is usually to minimize unintended negative impacts on the environment from a new structure where design is largely driven by the engineering requirements.

However, with planning and forethought, a project can also be designed to create environmental benefits. When they are identified early, it is easier to add these “green” design ideas into coastal projects. In addition, green features can be incorporated into the maintenance and rehabilitation of older or degraded structures.

Current Environmental Benefits of Existing Structures

Existing breakwaters and jetties do provide some environmental benefits. For nearly 30 years, it has been known that rubble-mound breakwaters provide reef-like or rocky shore habitat for a variety of

fish, bird, and mammal species.

Such structures provide a place that many species of algae, aquatic plants such as sedges and rushes, and animals such as crayfish or crabs can call home. Since these species serve as a potential food resource for many fish, some of these structures serve as sheltering, foraging, spawning, or nursery habitat for fish and invertebrates. This is why shoreline rubble-mound structures are such popular recreational fishing spots.

Possible Improvements to Existing Structures

While coastal engineering structures are prominent throughout the nation's waterways, few were designed specifically to provide environmental benefits. Each year, new structures are constructed and existing ones undergo modification or maintenance. Many breakwaters are aging and are in need of substantial repair.

As plans for the new structures or plans for maintenance of the existing

ones are developed, planners, engineers, designers, ecologists, and stakeholders may be able to identify project design features that will better support wildlife species and that can be incorporated with little to no cost increase to the project. Therefore, with advance planning, the opportunities for adding environmental enhancements could be considerable.

Adding design features that are better for the environment and that support wildlife may serve the needs of other interested parties willing to share the additional costs (cost-sharing). Involving wildlife-focused agencies and non-governmental organizations can create an enhanced project and review dynamic that, in turn, leads to projects that can be supported by a wider component of society due to the multifunctional purposes such projects serve.

Structural Enhancement Possibilities

Environmental enhancements have



Conceptual drawing of a breakwater enhanced using varied slopes, a sinuous toe, caverns, and various stone sizes to attract fish.

already been made to a small number of coastal structures, while others have been suggested as part of the planning process.

There are also opportunities to modify existing structures that can offer additional environmental benefits, such as:

- Adding pea gravel around a breakwater toe to enhance the available fish spawning substrate;
- Scratching hard, featureless structures (such as concrete walls) in freshwater systems to enhance the settlement of aquatic insects;
- Using different sizes of stone (to increase surface complexity) or placing cross-sectional modifications around other coastal structures like revetments to enhance habitat;
- Placing underwater reef segments/prefabricated reef modules as a component of the structure or extending linearly from the ends or placed in concentric arcs;
- Providing terrestrial nesting habitat for birds, such as terns or osprey, on off-shore breakwaters; and,
- Providing habitat shelves by placing additional bedding stone beyond typical limits on the protected side of the structure, then using smaller stone to build different rock levels on an additional bedding base.

Overcoming Implementation Challenges

The primary obstacles to implementing the green infrastructure concept involve complications to future maintenance, cost sharing, and compromising structural integrity and functional performance.

Future maintenance of infrastructure projects is a concern because maintenance would be subject to potential environmental restrictions, thus making the maintenance more complex and costly.

At some projects, apprehension about future maintenance has led to the abandonment of any effort to “green” coastal structures.

Some fear that in the process of “doing good” any future ability to properly and efficiently maintain a project will be hindered.

Cost sharing also is a potential impediment to implementing some green coastal structure projects. For example, Sections 1135 and 204 of the Water Resources Development Act (WRDA) of 1986 and 1992, respectively, require a 25% non-federal cost share toward the costs of USACE-led improvement, protection or restoration of habitats.

Potential Solutions to Overcome the Challenges

The following are potential solutions

to the challenges of implementing the Engineering With Nature infrastructure concept.

- Maximize use of coordination mechanisms. EWN projects will require coordination among multiple stakeholders.
- Document existing projects. The green concept will be more quickly adopted if there are documented projects that demonstrate success and benefits. Identifying and documenting good case studies will help advance the concept.
- Conduct pilot projects. Pilot studies provide an excellent opportunity to conduct field-scale proof-of-concept projects. Pilot projects are a good way to quickly develop and refine innovations. Developing a range of pilot projects, in coordination with construction or maintenance, will help promote the concept.
- Prioritize project sites. A priority list should be developed for the various EWN projects that could be implemented.
- Seek new funding mechanisms for EWN projects. Cost sharing will be an on-going challenge to implementing the concept. Solutions may include developing a special regional program to support these activities. Another possibility would be to promote corporate donations and utilize non-profit funding avenues to sup-

port the concept.

- Develop interagency agreements. Inter-agency agreements that describe long-term policy towards EWN projects have great potential to decrease resistance to project implementation and future misunderstandings. Inter-agency agreements could be project-specific or regional.

Conclusion

The EWN concept provides a relatively new concept to many planners and designers, but offers great potential for creating projects that better serve the environment, society, and the economy and are thus more sustainable. Incorporating this approach into standard business practices within agencies responsible for such infrastructure will take time, but the long-term, broader benefits could be substantial. *IP*

End Notes

1 - USACE Strategic Sustainability Performance Plan FY 2010 - FY 2020, Campaign Plan Goal 3: "Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation."

2 - USACE Environmental Operating Principle #3: "Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another."

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