

5 MINUTE READ

# Amoco



from **Engineering With Nature: An Atlas, Volume 3.**

by US Army Engineer Research and Development Center



## Muskegon, Michigan, United States

### **Placing a shoal system to create a vegetated, yet resilient, shoreline.**

State and federal agencies declared the 1,679-hectare Muskegon Lake, a drowned river mouth connected to Lake Michigan by a navigation channel, a Great Lakes Area of Concern in 1985. Years of industrial waste disposal, shoreline land use, and stormwater management had filled the lake's shallow shoreline waters and wetlands. The Amoco Fish and Wildlife Habitat Restoration Project used Engineering With Nature (EWN) techniques to restore wetlands and improve fish and wildlife habitat at a nine-hectare site on Muskegon Lake where a lumber mill and, later, a petroleum tank farm once stood. A nature-based segmented shoal system in the nearshore provides spawning habitat and protects restored wetlands from wave damage. The top of the shoal is designed to remain above water when Lake Michigan levels are low and below water when lake levels are high. A 427-meter segment of a 701-meter concrete wall separating former wetlands from the lake was removed to promote the creation of new wetlands, and a sloped embankment planted with native vegetation on its lake-facing side now separates contaminated uplands from clean

nearshore environments. A riprap toe protects the embankment from wave energy and ice scour. A recreational path damaged by high water was relocated atop the embankment, above the 100-year-flood elevation.



Above and Article Cover: Aerial view of the restoration site showing multiple benefits, including the trail system compliant with the Americans with Disabilities Act.

(Photo by Ramboll)

## Producing Efficiencies

The project team used multibeam bathymetry and side-scan sonar, confirmed by underwater cameras and probing, to locate debris for removal on the nearshore lake bottom. To keep contaminants in the site's upland area from migrating to the lake, Ramboll designed and Job Site Services, Inc. constructed a berm at the transition area between the upland contamination and the clean nearshore that blocks the intermittent petroleum sheens. The berm also protects the upland contaminants from waves and ice scour and serves as the foundation for a relocated bike path.





Installation of habitat logs and anchors for the segmented shoal system, which provides resiliency and habitat. Portions of the former shoreline were left in place to help protect the restored wetland area, allowing the project team to address the stakeholder goals of resiliency and vegetated shorelines.

(Photo by Great Lakes Dock and Materials, LLC)

## Using Natural Processes

This project fostered the restoration of a coastal wetland complex by removing concrete walls and eroding paths and connected isolated wetlands with the lake. The EWN techniques used at this City of Muskegon Lake property created a soft wetland edge along the shoreline that provides protection from wave forces in quiescent conditions whether lake water levels are low or high. The segmented, nearshore shoal system provides cover and habitat for spawning and foraging fish while attenuating wave energy to protect the restored wetland complex. The vegetated embankment and riprap toe promote coastal resiliency when lake water is high.



Shoal construction with an excavator on a floating pontoon.

(Photo by Great Lakes Dock and Materials, LLC)

## Broadening Benefits

The project improved fishing opportunities in Muskegon Lake by creating cover, spawning, and foraging habitats. The new Americans with Disabilities Act-compliant bike path has better sight lines and makes recreation safer. Enhancements to over one hectare of wet meadow and shallow emergent marsh improved shoreline appearance and habitat functionality. The enhancements are expected to boost the local economy by supporting jobs (e.g., in construction, environmental consulting, and engineering), increasing property values, generating new tax revenues, reducing flood damage, and drawing more tourists to Muskegon Lake. For its positive effects, the project received the American Society of Civil Engineers Michigan Section's 2022 Quality-of-Life Certificate of Merit.





The wetland with compost and plantings over Envirolok with a riprap toe.

(Photo by Ramboll)

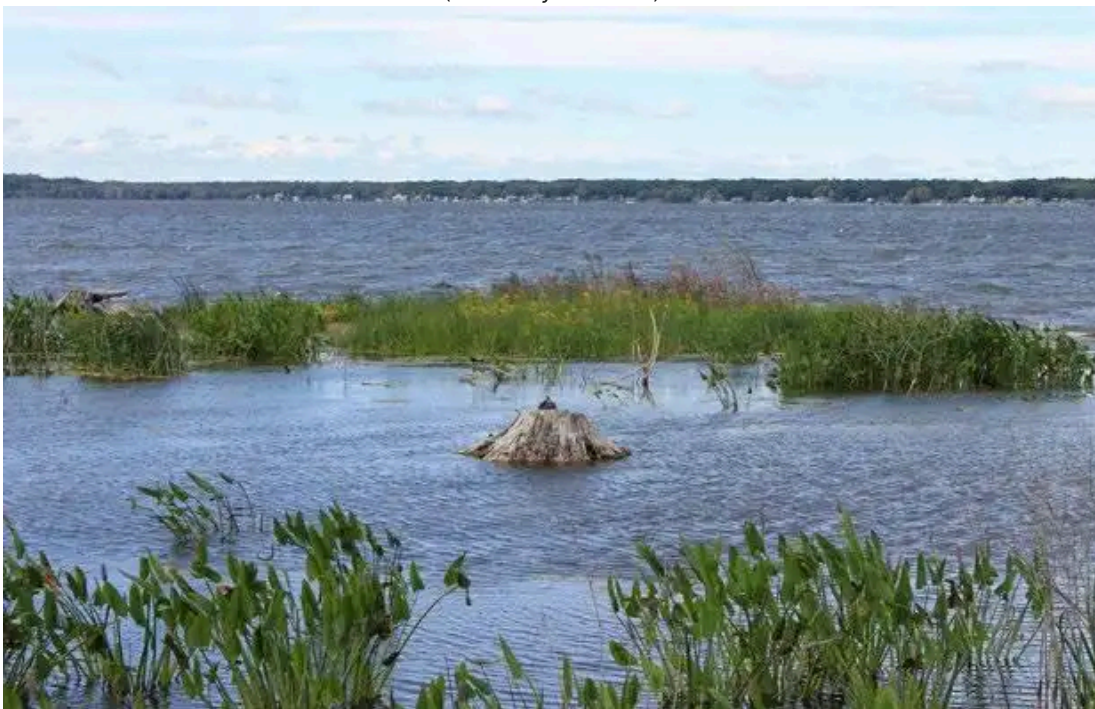
## Promoting Collaboration

Stakeholders wanted a vegetated yet resilient shoreline. Monthly public meetings held by the Muskegon Lake Watershed Partnership (MLWP) kept the Muskegon community actively engaged during all phases of the Amoco Fish and Wildlife Habitat Restoration Project. The MLWP keeps the community involved through the Annual Muskegon Lake Spring Cleanup—where volunteers clear debris from around the lake—and the Shoreline Stewards Program. The Stewards Program encourages volunteer citizen scientists to support the collection of data used in long-term monitoring of the project site.



The restored wetland, depicting native seeding and plant proliferation. Located in a historically industrialized area with legacy contamination, the restoration design was adapted to allow for wetland creation and restoration in areas absent of contamination while constructing a barrier to restrict contaminant exposure and migration.

(Photo by Ramboll)



A mallard duck (*Anas platyrhynchos*) roosting on a placed habitat stump in the restored wetland landward of a softened shoreline.

(Photo by Ramboll)



More articles from this publication:





### Conclusion

4min pages 292-297



### Mayer Ranch

4min pages 288-291



### Kaskaskia River Basin

4min pages 284-287



### Port of Málaga

4min pages 280-283



### Big River at Calico Creek

4min pages 276-279



### Shark River

4min pages 272-275



### Port Lands

5min pages 268-271



### Cape Cod

4min pages 264-267

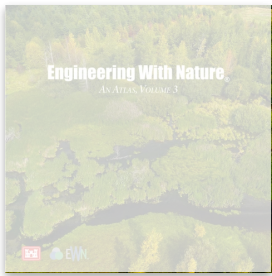


### Newlyn

4min pages 260-263

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