

Amoco Fish and Wildlife Habitat Project

Engineering with Nature in a Great Lakes Area of Concern

Presented by Dusty Tazelaar

RAMBOLL

Bright ideas.
Sustainable change.

Agenda



- Muskegon Lake AOC
- Stakeholder Engagement
- Former Amoco Tank Farm
- Key Nature-based Design Concepts
- Community and Socioeconomic Benefits
- Conclusions

Muskegon Lake

- 4,149-acre drowned river mouth
- Two municipalities, cities of Muskegon and North Muskegon
- Parks including Muskegon State Park
- Sport fishing, sailing, boating, camping, festivals

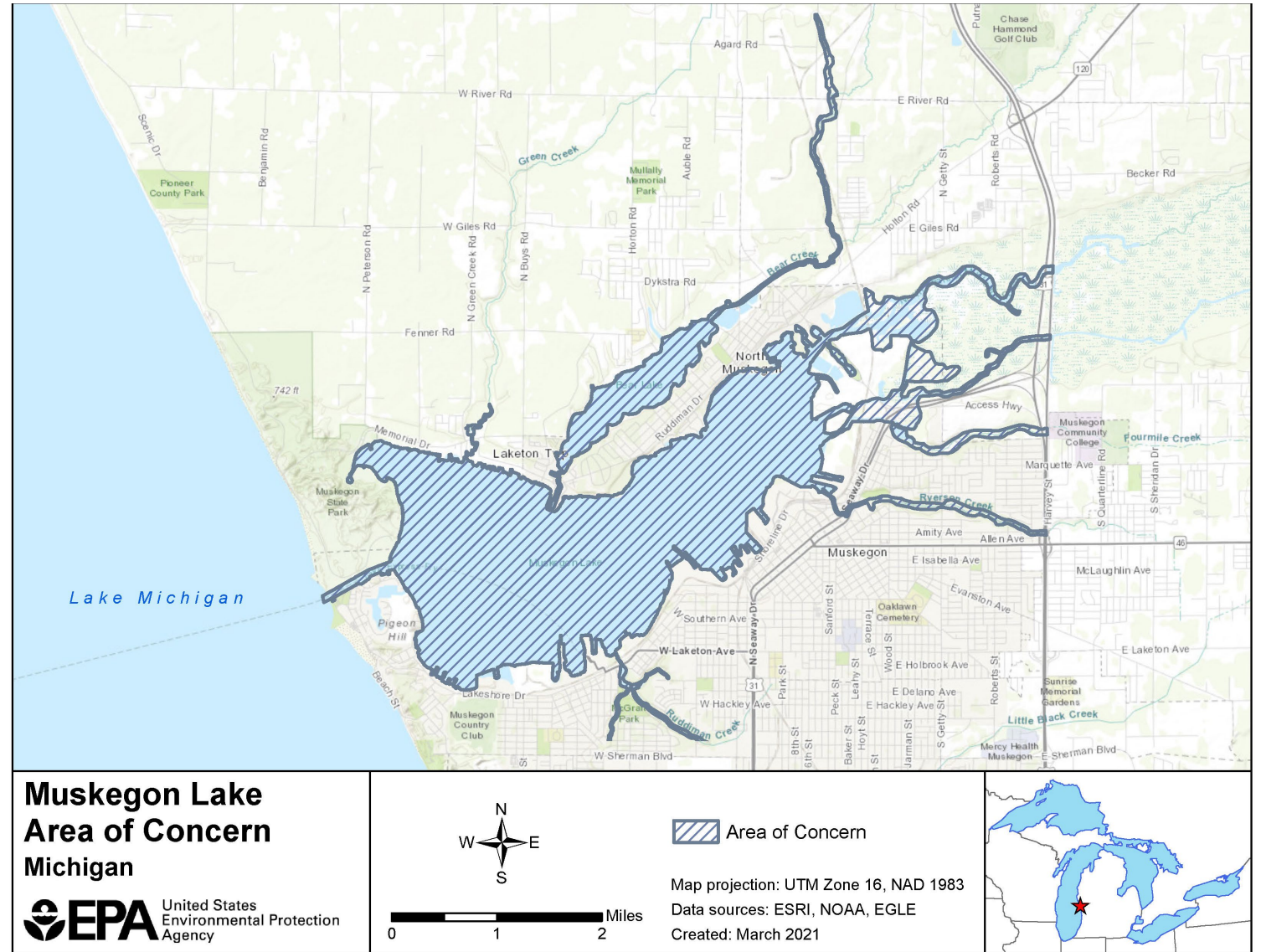


Image from Wikimedia Commons



Muskegon Lake AOC

- One of 14 Michigan-based AOCs
- Designated AOC in 1987
 - Historic pollutant discharge
 - Shoreline hardening
 - Localized groundwater contamination
- Sawmill and foundry fill



Historic fill practices



Muskegon Chronicle file photo



From the collection of Ray Grennan

Muskegon Lake AOC sawmill and industry fill areas



- Grand Valley State University – AWRI
 - ~800 acres, or 27%, of open water filled
 - ~74% of Muskegon Lake shoreline hardened
- BUIs
 - Loss of fish and wildlife habitat
 - Degradation of fish and wildlife populations



Photo: Muskegon Lake Watershed Partnership



Photo: Muskegon Lake Watershed Partnership

Partners and Stakeholders

- Muskegon Lake Watershed Partnership
- West Michigan Shoreline Regional Development Commission
- Grand Valley State University
- US Environmental Protection Agency / Great Lakes National Program Office
- Great Lakes Commission
- National Oceanic and Atmospheric Administration
- Michigan Department of Environment, Great Lakes, and Energy
- Michigan Department of Natural Resources
- Municipalities

Former Amoco Tank Farm

- Identified as candidate parcel for fish and wildlife habitat restoration in 2008
- 23-acre parcel owned by the City of Muskegon
- Former petroleum storage and transfer facility
- Final above ground storage tank razed in 1992
- Remediation commenced
- 5-foot-high, 2,300-foot-long concrete perimeter wall
- Wall left in place, fragmenting and isolating site wetlands from lake



Amoco Fish and Wildlife Habitat Restoration Project

- West Michigan Shoreline Regional Development Commission (WMSRSC) administered project
- WMSRDC selected Ramboll for engineering design and construction management
- NOAA and GLC provided funding via a regional partnership
- Funds were GLRI and USEPA





Purpose

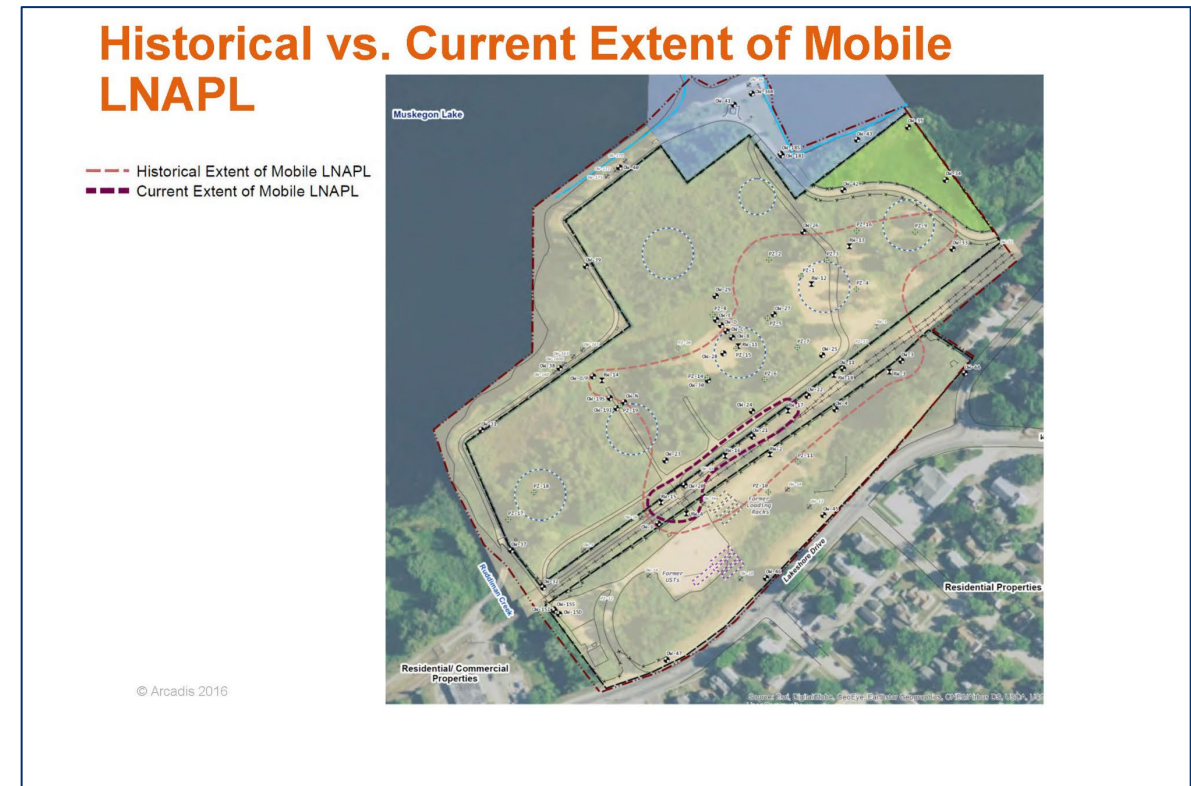
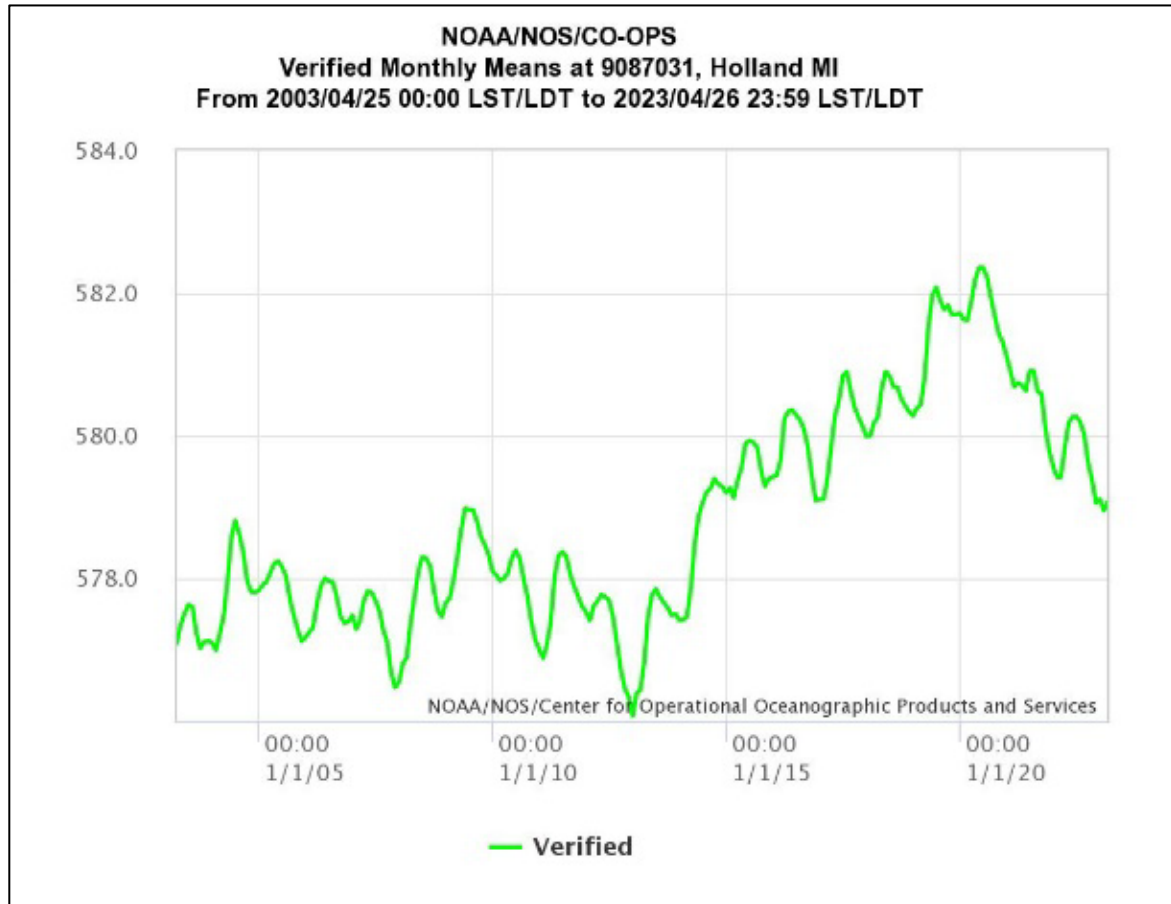
- Restoration and enhancement of Site wetlands
- Reconnect Site wetlands to lake via construction of coastal wetland complex
- Restore and improve nearshore habitat



Objectives

- Fill removal in the coastal wetland area with relocation of the existing bike path
- Restoration and connection of the coastal wetland by removal of the concrete wall
- Habitat restoration in the nearshore lake bottom
- Placement of appropriate plantings to provide a resilient shoreline

Site conditions



An aerial photograph showing a curved paved path along a lake's edge. The path is bordered by a segmented vegetative slope protection (SVSP) embankment. The lake water is dark, and the shoreline is covered in green vegetation and some rocks. In the background, there are trees and residential houses.

Key design concepts

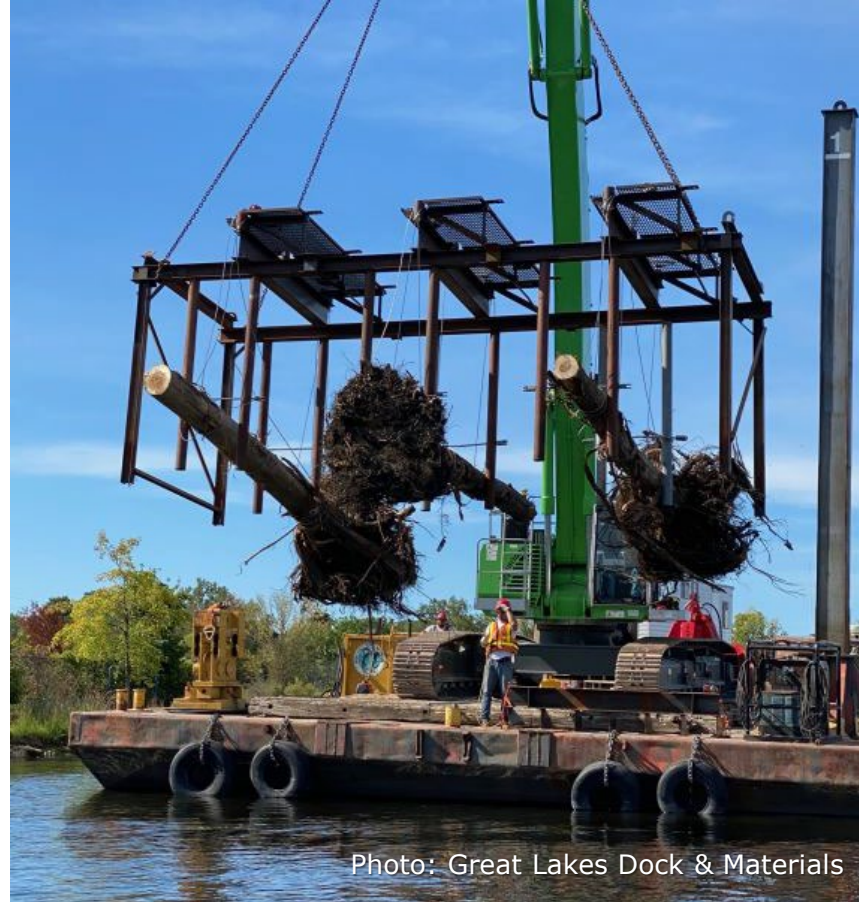
- Removal of wall and eroded path
- Grading of lake connection
- Strategic design approach in consideration of site conditions
- Nature-based solutions
 - Segmented shoal system in the nearshore environment
 - Segmented vegetative slope protection (SVSP) embankment

Segmented shoal system



- Curvilinear orientation in nearshore
- Function as fish foraging, refuge, and spawning habitat
- Wave attenuation for restored and softened shoreline
- Top of shoals were a half foot below typical high water
- Modeling indicated disruption of encroaching waves under typical levels

Segmented shoal system



- 78 habitat logs
- Included root wads
- Hardwood species
- Driven plate and anchor system
- ~1,200 tons of shoal stone
- ~1,100 tons of spawning bed stone mix

Segmented shoal system



Segmented vegetative slope protection

- Wall and path removal connected unimpacted wetlands to lake
- Resiliency during high water; embankment top at 100-year elevation
- Barrier to prevent washing potential future sheen
- Rip rap toe to protect SVSP from wave energy and scour from ice during high water



Segmented vegetative slope protection



- SVSP slope of the embankment was constructed using Envirolok® geobags
- Filled with topsoil and sand
- Bags work in concert with plantings to provide a stabilized slope
- Over 1,700 2-inch plugs planted
- 5H:1V slope and secured with connector pins

Segmented vegetative slope protection

- Seeded with a mesic to dry forbs mix.
 - Species included common milkweed, partridge pea, black-eyed Susan, yellow coneflower, and several others.
- Plantings included prairie cordgrass, switchgrass, and Indiangrass



Before and after



Community and Socioeconomic Benefits



- Improved fishing and wildlife viewing opportunities
- Enhanced and safer recreation along a now ADA compliant path
- Improved viewshed of a softened shoreline of Muskegon Lake
- Isely et al. 2018 travel cost survey and housing valuation to estimate a return on investment of \$60M million from an initial investment of \$10M 2009 ARRA grant
- Isely et al. 2019 posited that improvements to and softening of the shoreline and increased recreational activity based on perceived lake quality resulted in \$7.4M in increased housing value and an additional \$27.9M in annual recreation value

Conclusions



- Construction completed in 2021
- Nature-based engineering solutions supported restoration of soft shoreline and resilient design
- Strategic approach to the consideration of waves and water levels
- Restored and enhanced 2.74 acres of wet meadow and shallow emergent marsh wetland habitat and 8.4 acres of open water habitat
- Provided physical barrier to prevent potential sheen migration from upland
- Community engagement and benefits
- May 16, 2023, removal of *Loss of Fish and Wildlife Habitat* and *Degradation of Fish and Wildlife Populations* BUIs

Thank you!

- Ramboll
- Job Site Services, Inc
- Great Lakes Dock and Materials, LLC
- Cardno
- West Michigan Shoreline Regional Development Commission
- NOAA/GLC Great Lakes Regional Partnership and the Great Lakes Restoration Initiative (NOAA/US EPA)
- City of Muskegon
- Muskegon Lake Watershed Partnership
- Michigan DNR and EGLE

