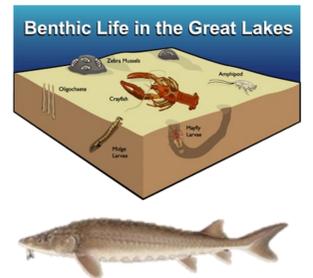
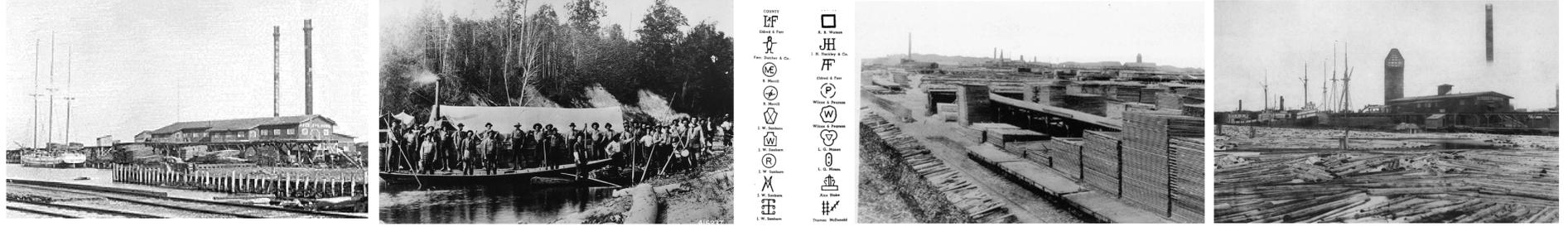
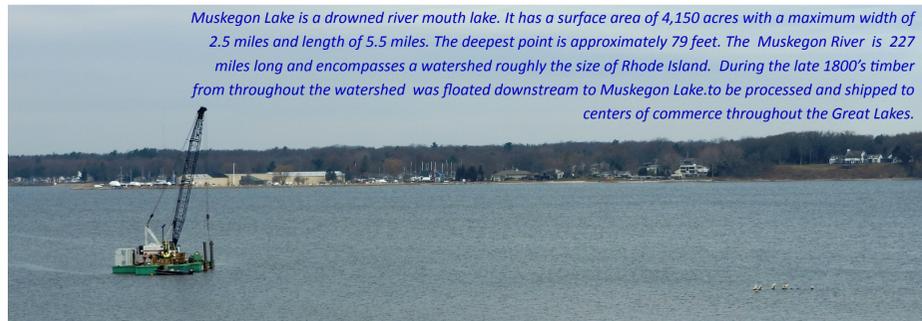




Mill Debris, A Legacy of the Past Whose Ghost Still haunts Muskegon Lake Today



What's the Problem? Whose Problem is it? What's the Answer? What's Being Done?



Muskegon Lake is a drowned river mouth lake. It has a surface area of 4,150 acres with a maximum width of 2.5 miles and length of 5.5 miles. The deepest point is approximately 79 feet. The Muskegon River is 227 miles long and encompasses a watershed roughly the size of Rhode Island. During the late 1800's timber from throughout the watershed was floated downstream to Muskegon Lake to be processed and shipped to centers of commerce throughout the Great Lakes.



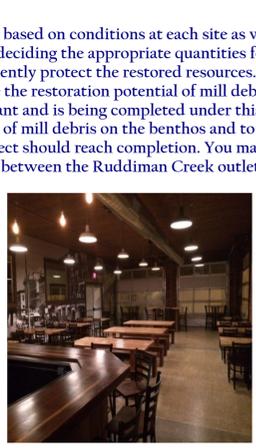
Muskegon Lake AOC Habitat Restoration

Project Highlights: Removal of over 122,673 metric tons of mill debris, over 11 acres of benthic habitat restored, removal of Muskegon Lake from the list of AOC hot spots

Background of the Area of Concern (AOC)
 Within the lower Muskegon River watershed, lies the Muskegon Lake AOC, a drowned river mouth lake that flows into Lake Michigan at a shoreline that is part of the world's largest assemblage of freshwater sand dunes. Muskegon Lake was designated an AOC in 1985 due to ecological problems caused by industrial discharges, shoreline alterations and the filling of open water and coastal wetlands. Since 1992, community groups, governmental and nongovernmental organizations have worked collaboratively to remediate contaminated sediments and to restore and protect fish and wildlife species and their habitats. Historic sawmill debris, foundry sand and slag filled 798 acres of open water and emergent wetlands in the AOC. Nearly 25% of Muskegon Lake's open water and shallow wetlands were filled. Approximately 74 percent of the shoreline was hardened with wood pilings, sheet metal, foundry slag and concrete. This resulted in the loss and degradation of shallow water benthos communities, isolation and fragmentation of coastal wetlands, and the associated degradation of water quality and fish and wildlife populations. With completion of this and several other projects in development, the U.S. Environmental Protection Agency (U.S. EPA) now expects to remove Muskegon Lake from the list of Great Lakes "toxic hotspots" by 2020.

History of the Lake
 Historical deposits of sawmill debris (lumber-era sawmill debris and other types of marine debris) continue to impact the ecological quality of Muskegon Lake. The presence of mill debris is not natural, but is a remnant of the logging industry that dominated the Muskegon Lake shoreline in the late 1800s. During that time, byproducts from 47 sawmill operations (sawdust and slabwood) were routinely dumped into the lake along the south and north shorelines. As a result of these and other industrial impacts, Muskegon Lake became heavily degraded with significant impairments to the native ecological community that persisted for decades.

Project Progress
 Final engineering and construction specifications will be based on conditions at each site as well as the overall impact to Muskegon Lake. Social, economic and environmental benefits will be considered in deciding the appropriate quantities for removal, potential re-use opportunities of wood, restoration activities and the methods to be used to permanently protect the restored resources. This project builds upon the work funded by a NOAA GLRI grant received by WMSRDC in 2010 to investigate the restoration potential of mill debris sites and complete engineering and design for two. One site was partially restored under a previous grant and is being completed under this grant. GVSU AWRI is implementing a pre-post restoration monitoring protocol to help determine the impact of mill debris on the benthos and to determine the impact of restoration. The work is continuing even now. In 2018 the last component of the project should reach completion. You may see the barges and equipment removing slab wood and related debris just off the south shore of Muskegon Lake between the Ruddiman Creek outlet and the Lakeshore Yacht Harbor Property.



A student from the Annis Water Resources Institute samples for benthic organisms in Muskegon Lake. Monitoring Muskegon Lake's benthic community will provide valuable insights into the project success and the future health of aquatic ecosystems.



This win/win restoration project improves lake-bottom habitat and "repurposes" historic, logging-era wood. It provides a variety of beneficial uses from restored habitat to artwork and brew-pub tables, to fill for shoreline brown-field redevelopment projects. Benthic invertebrate habitat is improved providing food sources for many species of fish including sturgeon, white suckers, perch and catfish.



Areas where work is being carried out in 2018



2018 Dredging Operation



- Project Highlights**
- Removal of 122,673 metric tons of mill debris
 - Restoration of 11.4 acres of open water and emergent wetlands
 - Improved habitat for the lake bottom/ native benthic community
 - Complete restoration of Muskegon Lake to remove it from the list of Great Lakes AOCs or "toxic hotspots" by 2017
 - Funding is provided by the GLRI and U.S. EPA through NOAA and the Great Lakes Commission
 - The West Michigan Shoreline Regional Development Commission is implementing this project
 - The Annis Water Resources Institute is developing monitoring protocols to determine the impact of sawmill debris on the aquatic ecosystem

