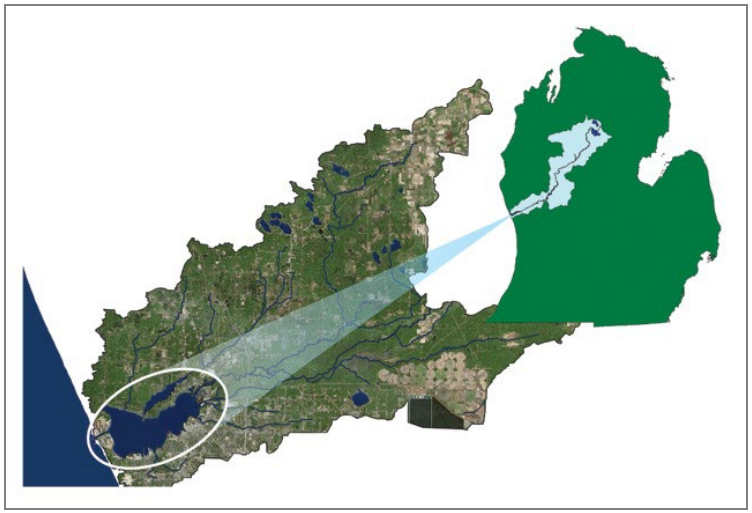
MLWP
Muskegon Lake
Watershed Partnership

Muskegon Lake Action Plan

2025 – 2030 Update



This Action Plan is an update of the 2020 – 2025 Muskegon Lake Action Plan (*Muskegon Lake Watershed Partnership, WMSRDC, Michigan EGLE*)
The Muskegon Lake Action Plan, 2025-2030 was developed with the input and support of
the public, watershed stakeholders, and the following organizations and individuals:

Muskegon Lake Watershed Partnership Board Members:

Dennis Kirksey, Chair; Kim Arter, Vice Chair; Lea Willett LeRoi, Secretary and Public Access to Natural Resources Committee Chair;
Kathy Evans, Treasurer and Habitat Focus Area Lead; Dusty Tazelaar, Technical Committee Lead;
Catherine Swiatek, Social Media Outreach Lead

West Michigan Shoreline Regional Development Commission (WMSRDC) Officers:

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Table of Contents

Page

Muskegon Lake Watershed Partnership – Background, Purpose and Mission

The Muskegon Lake Watershed Partnership (MLWP) is a coalition of community interests dedicated to working cooperatively for the remediation, restoration, and revitalization of the Muskegon Lake Watershed ecosystem.

The MLWP's geographic focus (Watershed) is the lower Muskegon River watershed within Muskegon County, including the immediate drainage area of Muskegon Lake, its local tributaries, and the sub-watersheds of Bear Creek, Ruddiman Creek, Ryerson Creek, Four Mile Creek, Green Creek, Cedar Creek, and Mosquito Creek.

Formed in 1992, the MLWP hosts monthly public meetings and is organized exclusively for charitable, educational, and scientific purposes that support revitalization of the ecosystem. The MLWP partners with local, state, and federal agencies and non-governmental organizations to obtain and disseminate information about topics of ecosystem interest. The MLWP provides a forum for open discussion and initiates and participates in ecosystem improvement plans and actions.

The MLWP strives to maintain a broad variety of participants including voting stakeholders who reflect the nature and the needs of the Watershed ecosystem. Stakeholder voting categories include academia, business and industry, conservation and natural resources, general public, outdoor recreation, public sector, and community service and philanthropic interests. MLWP membership is available to all interested Watershed stakeholders, including but not limited to property owners, municipal staff, elected officials, economists, agriculturalists, scientists, environmentalists,
Recreationalists and representatives of the general public, academic institutions, foundations, utilities, industries, neighborhood associations, churches, businesses, and community service clubs.

Purpose of the Muskegon Lake Action Plan

The Muskegon Lake Action Plan is an ecosystem-based plan, designed to facilitate community engagement for coordinated, natural resources stewardship of the Watershed. It builds upon decades of restoration progress made under the Great Lakes Areas of Concern (AOC) program, Great Lakes Restoration Initiative, and many voluntary and regulatory cleanup programs.

The final large-scale contaminated sediment cleanups and fish and wildlife habitat restoration projects needed to remove Muskegon Lake from the list of Great Lakes AOCs were completed in 2022. The lake was removed from the list in 2025. The ecosystem-based AOC program cleaned up the most highly contaminated hotspots and restored the most severely degraded aquatic habitats and water quality. However, the AOC program did not set long-term targets for everything that will be needed to restore and protect water resources into the future. Great Lakes AOC goals are short term, by design. Progress made under the AOC process brought Muskegon Lake to an environmental condition similar to other non-AOC water bodies with heavy industrial pasts.

The Muskegon Lake Action Plan is the MLWP's guiding document for the restoration and protection of our Watershed's ecosystem over the coming five years.

The Muskegon Lake Action Plan can be used to plan watershed improvement actions and stewardship activities by community organizations, academia, agencies, businesses, conservation groups, general public, local governments, students, watershed groups, and other stakeholders. The Muskegon Lake Watershed Partnership (MLWP) will track progress as the Action Plan's Focus Area Actions are developed and carried out. Monthly public meetings will take public input, collaborate with partners, and report on progress.

The plan can also be referenced by MLWP partner organizations who wish to seek grant funding to design and implement water quality and natural resources improvement projects. Referring to the Action Plan can help demonstrate the Watershed community has provided input on priorities that can be addressed by project proposals. Many Action Plan goals also support the goals of other state and federal Great Lakes restoration plans, including the Great Lakes Action Plan V, Lake Michigan Lake Action Management Plan, Michigan Water Strategy, National Oceanic and Atmospheric Administration Muskegon Lake Habitat Focus Area Implementation Plan, Muskegon River Watershed 319 Management Plan, and Michigan Department of Natural Resources Fisheries Management Plans.

Muskegon Lake Watershed

Background, Current Status, and Progress

Muskegon Lake covers 4,232-acres and is part of the Great Lakes coastal wetlands in the Lake Michigan Watershed. It is a drowned river mouth lake, formed by dynamic interactions of the Muskegon River and Lake Michigan's shifting sand dune shoreline. The Muskegon River discharges to Lake Michigan through Muskegon Lake. Its channel is maintained for recreational and commercial navigation. Muskegon Lake's shoreline along Lake Michigan is within the largest assemblage of freshwater sand dunes in the world.

Muskegon Lake was designated a Great Lakes Area of Concern (AOC) in 1985 by state and federal agencies due to several impaired beneficial uses. Impairments were caused by historic industrial disposal practices and the filling of shallow shoreline waters and wetlands. Although the Muskegon County Wastewater Management System greatly improved water quality during the mid-1970s, ecological problems remained.

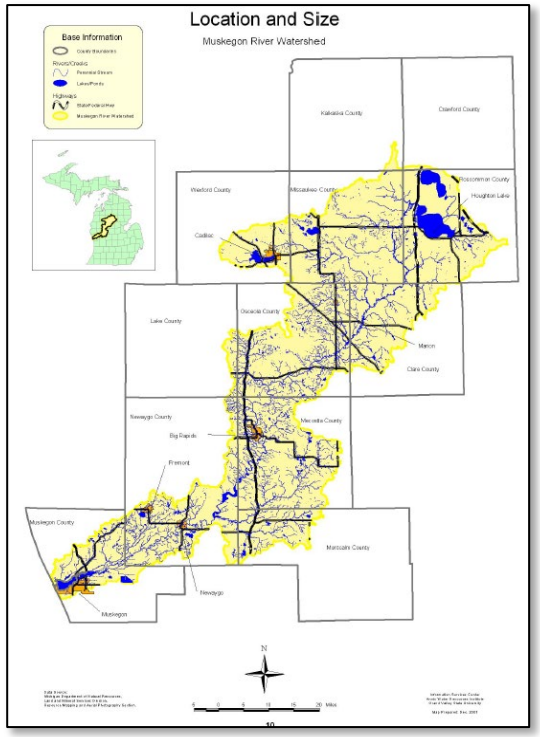
Since 1992, community groups, governmental, and non-governmental organizations have worked collaboratively to improve water quality, remediate contaminated sediments, and restore and protect fish and wildlife species and their habitats. Through the MLWP and the Great Lakes AOC process, strong stakeholder partnerships were developed, and they continue to collaborate to sustain past restoration work - and to develop new projects, including on-the-ground restoration and technical assistance for ecological monitoring. The MLWP has enjoyed strong support from federal, state and local agencies, universities, and conservation groups.

Progress made over the past decade included remediation of contaminated sediments and restoration of fish and wildlife habitat. Over the years, approximately $80 million has been invested from various funding sources including the Great Lakes Restoration Initiative, Great Lakes Legacy Act, National Oceanic and Atmospheric Administration and Great Lakes Commission restoration partnerships, State of Michigan, and local funding.

Muskegon River Watershed

Muskegon Lake is part of the larger Muskegon River, a 219-mile river with a watershed that encompasses 2,700 square miles. Muskegon River is the second longest river and third largest watershed in Michigan. It flows from Higgins and Houghton Lakes to its mouth at Muskegon Lake. Approximately 94 tributaries drain into the Muskegon River.

Muskegon Lake is a drowned river mouth that covers approximately 4,232 acres. Tributaries that drain directly into Muskegon Lake include the Muskegon River, Ruddiman Creek, Ryerson Creek, Green Creek, and Bear Lake. Other tributaries within Muskegon County drain into the lower Muskegon River. They include Four Mile Creek, Mosquito Creek, Cedar Creek, Brooks Creek, and the Maple River.



Non-Point Source Water quality goals for Muskegon Lake and the entire Muskegon River Watershed have been identified in the Muskegon River Section 319 Watershed Management Plan. However, with such a large watershed to encompass, the management plan can provide only a broad overview of designated uses, best management practices, and educational needs. The Muskegon Lake Municipal Stormwater Management Plan and Total Maximum Daily Load Assessments, and other sub-watershed studies address water quality but they lack the funding needed to implement the best management practices needed to improve water quality, fish and wildlife habitat and other ecosystem assets. A Muskegon Lake Watershed sub-watershed management plan is needed to improve the Muskegon Lake Watershed portion of the Muskegon River Watershed. As of 2024, there is a sub-watershed management plan developed for Bear Creek/Bear Lake, and management plan for lower Muskegon River (from Croton Dam down to and including Mosquito Creek) is under development. That leaves Muskegon Lake and Cedar Creek watersheds in need of funds to develop their own watershed management plan.

Action Plan Overview

Focus Areas, Actions, Outcomes, Indicators and Partners

The Muskegon Lake Action Plan identifies watershed improvement activities in an ecosystem format. It provides a framework for planning, prioritization, and implementation of activities that meet local needs and the goals and priorities of overarching statewide and regional plans, including the Great Lakes Restoration Action Plan, Lake Michigan Fisheries Management Plan, Lake Michigan Lake Action Management Plan, West Michigan Great Lakes Stewardship Initiative, Muskegon River 319 Watershed Management Plan, West Michigan Cooperative Invasive Species Management Area, Michigan Water Strategy, NOAA Muskegon Lake Habitat Focus Area Implementation Plan - and others. This document is a tool to assist organizations and individuals in the preservation, protection, and improvement of Muskegon Lake and its watershed resources.

The Muskegon Lake Watershed Partnership determined that Action Plans for each of the following ecosystem Focus Areas will help guide planning, monitoring, and implementation of Best Management Practices for the continued improvement and sustainability of the Muskegon Lake Watershed ecosystem:

1. **Coastal Resiliency**
2. **Education**
3. **Fish and Wildlife Habitat**
4. **Water Quality, Green infrastructure, and Stormwater Management**
5. **Groundwater Resources**
6. **Site Remediation and Revitalization**
7. **Non-Native Invasive Species and Biodiversity**
8. **Public Access to Water Resources**
9. **Public Involvement and Input to Decision-making**
10. **Research and Monitoring**
11. **Stewardship and Hands-On Opportunities**

The following chapters include **Focus Area Action Plans** for each ecosystem component. The action plans were developed with broad community input, through a series of public meetings and focus groups. Each action plan includes outcomes, implementation recommendations, measurable indicators, and potential project partners.

Individuals and organizations can use the Action Plan to identify needs, projects, volunteer involvement, and support for grant proposals.

1. Coastal Resiliency and Sustainability

Background, Need, and Status:

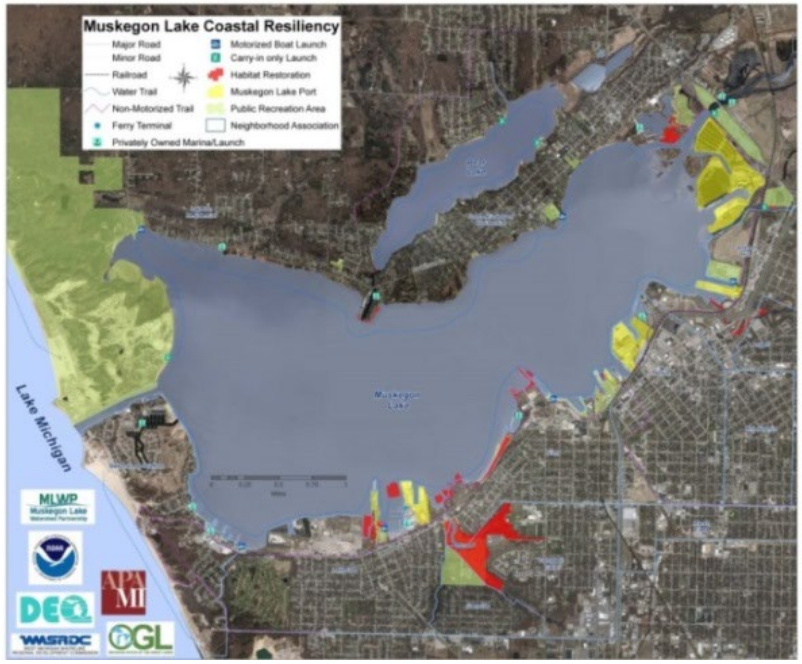
The Muskegon Lake Watershed Partnership (MLWP) determined the need to advance watershed resiliency to protect native habitat along shorelines and tributaries, and the public access and recreational amenities that support public interaction with water resources.

Coastal resiliency and sustainable decision-making were determined to be fundamental planning principles during the development of **Muskegon Lake Vision 2020** in 2015. In 2016, the MLWP also supported the development of the **Muskegon Lake Coastal Resiliency Plan**.

Sustainable planning, policy, and management efforts will be needed to ensure coastal resiliency and to protect the integrity of past remediation and restoration investments throughout the Muskegon Lake Watershed.

Resilience means building the ability of a community to "bounce back" after hazardous events such as coastal storms and flooding – rather than simply reacting to impacts. Resistance is the ability to prevent a change in the state of the system. An example of this is preventing a hazard event from turning into a community-wide disaster.

Resilient watersheds and shorelines also provide ecological services that are freely gained from a healthy natural environment such as flood control, clean air, fish production, and cultural, aesthetic, spiritual, recreational, educational, and therapeutic benefits. For instance, services provided by wetlands could include groundwater recharge, flood storage, water supply, water quality benefits through filtration of sediments and absorption of nutrients, wildlife habitat, food production, and a host of other valuable services.



The **Muskegon Lake Coastal Resiliency Plan** identified vulnerabilities and threats to shoreline resiliency. It includes recommendations for the protection of assets in the areas of natural resources, recreation, residential, and commercial/port.

In December 2017, the Federal Emergency Management Agency (FEMA) performed **Risk Mapping, Assessment, and Planning for the Muskegon River Watershed**. The program enables state and local governments to take preemptive measures that will minimize the increasing risk and losses from natural hazards. Many watershed communities expressed interest in mitigation activities to minimize risk. Some expressed an interest in pursuing mitigation efforts on repetitive loss properties. Communities also expressed concerns over roadway and property flooding associated with undersized and/or antiquated stormwater infrastructure. Additionally, concerns were shared about dam safety with regard to structure, as well as a desire to obtain a better understanding of the related risk.

In 2015, WMSRDC completed a **Hazard Mitigation Plan for Muskegon County.** The plan was created to protect the health, safety, and economic interests of residents by reducing the impacts of natural and technological hazards through hazard mitigation planning, awareness, and implementation. Hazard mitigation is any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and technological hazards.

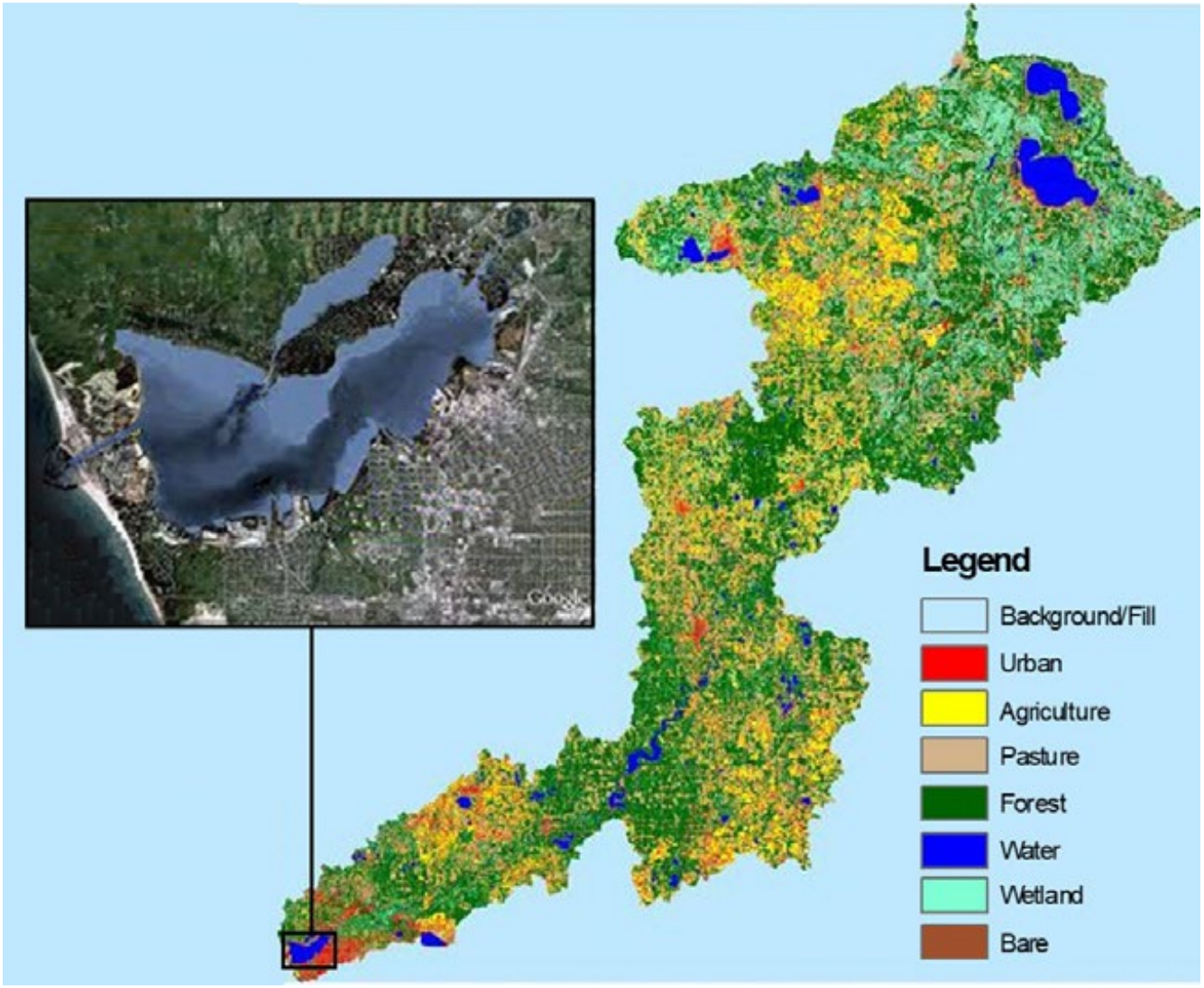
The majority of Muskegon River Watershed communities have received countywide Flood Insurance Rate Map (FIRM) updates under the Federal Emergency Management Agency's (FEMA) Map Modernization Program. Many communities also participate in the National Flood Insurance Program (NFIP), which is designed to make communities more resilient in the face of disaster.

1. Coastal Resiliency and Sustainability – Goal: Land use, recreation, and economic activities are sustainable and supportive of a healthy ecosystem

Outcome: Aquatic ecosystems and natural resources are resilient, diverse, and providing ecological services

#	Implementation Recommendations	Indicators	MLWP with Partners
1	Complete resiliency and adaptive management plans for Muskegon River sub-watersheds and shorelines	Land use policies support resiliency projects; Assets are managed and monitored	Local Governments, WMSRDC, Delta Institute, Michigan Association of Planners
3	Protect and maintain recreational, commercial, port, and green infrastructure assets (built and natural)	Survey results from recreational and port users	Private Landowners, Local Governments, WMSRDC
4	Develop an infrastructure asset management plan to ensure a safe, healthy, resilient harbor (in correspondence with hazard mitigation plan)	Plan is completed and assets are monitored and managed	West Michigan Port Operators, Local Governments, WMSRDC
6	Establish funding for ongoing monitoring and maintenance	Funding availability	Local Governments, Donors, Community Foundations,
7	Update land use policies to provide ecological services through natural resources setbacks/buffers	Amount of development plans with natural features included	Business Community, WMSRDC, Local Governments,
8	Seek Michigan's Natural Rivers designation for the Muskegon River or appropriate sections of river	Protected River Segment	MRWA, MDNR, Townships
9	Utilize Farmland Open Space Preservation Programs & USDA NRCS programs to reduce pollution loading	Acres protected	USDA-NRCS, MDARD, CD, Townships, Landowners
10	Amend and implement zoning ordinances to protect sensitive areas from development-related alterations	Acres of wetlands and lengths of riparian areas protected	Local Governments, Townships, WMSRDC
11	Upgrade stormwater infrastructure to prevent damage from severe weather (vegetative and built)	Storage capacity; Reduced financial and resource impacts	Local Governments, USACE, Developers, MDOT
12	Identify wetland restoration/creation areas; Reduce flashy drainage flows through green infrastructure.	Percent impervious surface; Green infrastructure and wetland effectiveness	Local Planning Commissions, WRC, WMSRDC, EGLE
13	Ensure recreational areas provide for seasonal water flows and storage.	Gallons of water storage capacity at recreational sites	WMSRDC, Planning Commissions, EGLE

14	Develop forest stewardship plans to maintain stable watershed hydrology in urban and rural areas.	Forest stewardship plans for priority sub-watersheds	WMSRDC, GVSU, MRWA, CD
15	Educate shoreline landowners on resilient shoreline practices	Increase in shoreline best management practices	MS4, CD, Landowners, WMSRDC, GVSU, MRWA



Muskegon River Land Use Map and Location of Muskegon Lake, Courtesy GVSU AWRI

2. Great Lakes Literacy and Natural Resource-Based Education

Background, Need, and Status:

Great Lakes Literacy is an understanding of the Great Lakes' influences on you and your influence on the Great Lakes. Natural resources education for a wide audience of watershed stakeholders will help ensure the integrity of the ecosystem and its ability to function in ways that will provide beneficial ecosystem services. The following stakeholders were identified as priority audiences for targeted, continuing education:

Landowners	*Developers*	*Muskegon Community*	*Philanthropists*
Local Governments	*Business Community*	*College*	*Recreational User Groups*
General Public	*K-12 Schools*	*Higher Education*	

Many organizations provide educational programming to serve these audiences. The following are a few examples:

The GVSU Annis Water Resources Institute **Water Resources Outreach Education Program** offers students an educational experience that supports the Michigan K-12 Science Standards. Students experience hands-on science aboard the W.G. Jackson Research Vessel while monitoring Lake Michigan and Muskegon Lake. The Muskegon Area Intermediate School District Math Science Center coordinates the **West Michigan Great Lakes Stewardship Initiative**, offering students a variety of hands-on, real world opportunities to study water, experiment, and restore water quality and natural resources.

The Michigan Department of Natural Resources offers the **Gillette Sand Dune Visitor Center School Programs** on topics that promote awareness of natural resources, an understanding of ecological processes, and a hands-on experience in the sand dunes. The program emphasizes the values of public lands, and it promotes the role of students as resource stewards.

Michigan State University and Michigan Sea Grant, in partnership with Lawrence Technological University, offer **Water School: Essential Resources for Local Officials.** This program targets local elected and appointed officials. It is a policy-neutral, fact-based program. The program's objective is to provide local decision makers with critical, relevant information needed to understand Michigan's water resources, including the fundamentals of water science, in order to support sound water management decisions and increase awareness of current and future local and state water issues.

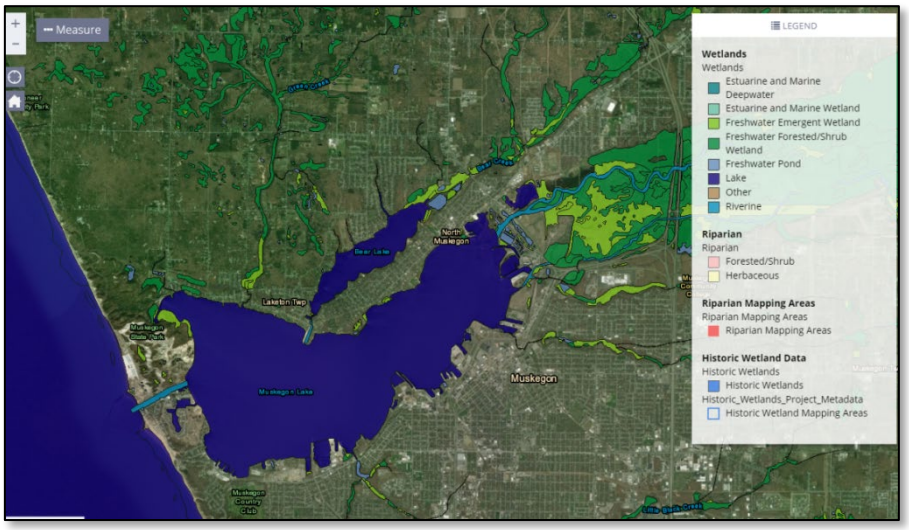
2. Education on Natural Resources - Goal: Increase the number of citizens with knowledge and an understanding of environmental literacy principles including water and Great Lakes principles.			
Outcome: Individuals and communities understand their responsibility for and make informed and responsible decisions regarding water resources			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Provide landowner education and training on natural resources Best Management Practices (BMP)	Number of landowners with shoreline buffers and wetlands	CD, MRWA, ML Nature Preserve
2	Integrate water and Great Lakes literacy and experiential learning into State of Michigan and ISD curriculum standards	Number of K-12 schools in MAISD Math/Science GLSI	MAISD/GLSI, AWRI, Sea Grant, Michigan Legislature, ML Nature Preserve
3	Educate citizens and officials to increase water and Great Lakes literacy knowledge and understanding	Number of people attending educational trainings	CD, MRWA, MSU-E, Sea Grant, Watch Us Go Boating, ML Nature Preserve
4	Educate land use planners on low impact development and green infrastructure policies	Sustained public education for adult decision-makers	Local Governments, WMSRDC, WMEAC, Delta Institute, MSU
5	Sustain public awareness and information on historic locations with known environmental conditions	Topic of an annual, MLWP public meeting presentation	Lakeshore Museum Center, GVSU AWRI, NOAA, WMSRDC
6	Educate landowners and park maintenance staff on non-native, invasive plant management	Community organizations provide education, annually	MCD, WMCN, MERES, MLWP Shoreline Stewards, ML Nature Preserve
7	Provide technical support and secure funding for volunteers and landowners to perform hands-on restoration and maintenance of natural resources	Community organizations provide support, annually	MCD, CFFMC, WMCN, MLWP Partner Grants
8	Promote then W.G. Jackson Research Vessel education programs	Number of K-12 and adult trips, annually	GVSU AWRI, Sea Grant
9	Promote Muskegon Community College environmental curriculum	Number of students registered for Life Science biology classes and summer programs	MCC Life Science Dept., MAISD, High Schools
10	Expand and promote student, natural resource-related internships	Number of students involved	GVSU AWRI, MCC, Schools, WMSRDC, NOAA, NRCS, ML Nature Preserve

11	Define and assess a baseline and goal for environmental literacy	Education level of environmental literacy	GVSU, MAISD, Muskegon Area Sustainability Coalition
12	Develop a speaker's bureau to give presentations throughout the community	Increased educational opportunities	Muskegon County, City of Muskegon

3. Fish and Wildlife Habitat

Background, Need, and Status:

Muskegon Lake has very diverse fisheries. Muskegon Lake and its fish and wildlife habitat are integral to maintaining the fisheries in Muskegon River and Lake Michigan. The connectivity of this system is critical to the native fisheries, including most of the important sport fish that need all three of these areas for survival. Muskegon Lake is part of the Great Lakes coastal wetlands system. According to the Michigan Department of Natural Resources Fisheries Division (MDNR), the primary resource concerns for Muskegon Lake are fisheries habitat protection and restoration and maintaining and improving public access.

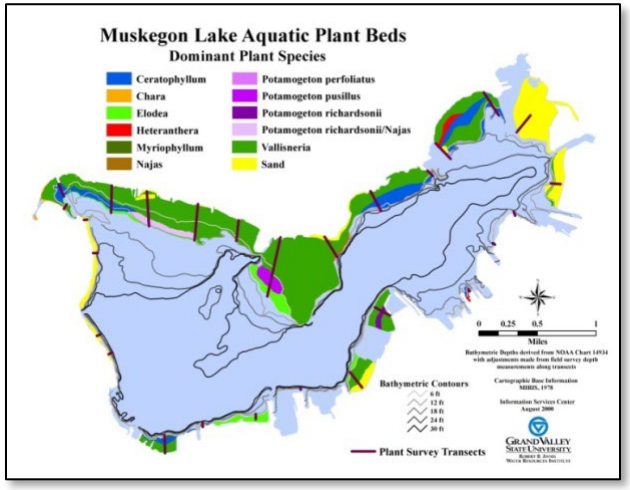


The MLWP determined that the development of a new Muskegon Lake Fish and Wildlife Habitat Restoration and Management Plan is needed to guide future actions for a healthy fishery. The existing **Muskegon Lake AOC Fish & Wildlife Habitat Restoration & BUI Removal Strategy** addressed only the AOC needs, and all of its goals have been reached. Guidance available from the MDNR Fisheries Division and other sources will be used to develop the new plan. It will support objectives contained in the **NOAA Implementation Plan for the Muskegon Lake Habitat Focus Area,** the **Lake Michigan Fisheries Management Plan,** as well as long-term stewardship goals to sustain habitat restored under previous NOAA and EPA **Great Lakes Restoration (GLRI) Initiative** investments. In addition, stakeholders have submitted a proposal to NOAA for **NOAA National Estuarine Research Reserve System** (NERRS) designation for Muskegon Lake and other drowned river mouth coastal wetland estuaries along Lake Michigan's eastern shoreline.

The MDNR conducted angler surveys and dollar estimates in the Muskegon River Watershed in 2015. Estimates are based on $39/angler-day (Lake Michigan) and $29/angler-day (inland waters) from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Fish & Wildlife 2001). **Muskegon Lake Fisheries Resource Summary, June 1, 2015**

The following list includes some of the Muskegon Lake's economically important sport fish:

- Walleye – largest spawning population in Lake Michigan south of Green Bay
- Chinook salmon – greatest amount of natural reproduction in Lake Michigan (Muskegon River)
- Steelhead - very high catch rates compared to other Michigan streams
- Lake Sturgeon – originally very abundant with remnant population in restoration phase
- Yellow Perch – good fisheries and important production of young for Lake Michigan
- Largemouth and Smallmouth Bass – heavily used by anglers including tournaments
- Bluegill, Sunfish, Pumpkinseed, Crappie, and Catfish – Good fisheries for recreational and subsistence fishery for urban and low-income residents



The 2008 **Muskegon Lake AOC Fish and Wildlife Habitat Restoration and BUI Removal Strategy** set targets and criteria for the amounts and types of aquatic habitat restoration needed to remove Muskegon Lake from the list of Great Lakes AOCs. Nearly 800 acres of Muskegon Lake and associated wetlands were filled and converted to land. Additional lake fill (sawmill wood waste) also covers substantial lake bottom areas. Significant progress was made to restore shoreline habitat between 2010 and 2024. This resulted in the restoration of over 134 acres of habitat restoration, more than 6,000 linear feet of shoreline restoration, and removal of over 150,000 tons of debris and sediment

The socio-economic benefits of a $10 million dollar NOAA ARRA investment to restore the south shoreline of Muskegon Lake were studied and quantified in a study by Grand Valley State University, **Muskegon AOC Habitat Restoration Socio-Economic Assessment.** The project yielded a 5.8 to-1 return on the investment in economic benefits, including an increase in the number of recreational visitors, property values, and revenues from increased water-based recreation spending.

Implementation of the **Lake Sturgeon Management** will provide additional benefits to natural resources and the economy.

3. Fish and Wildlife Habitat – Goal: Habitats are healthy, naturally diverse, and sufficient to sustain viable biological communities			
Outcome: Sustainable and abundant aquatic life – habitat and populations are stable or increasing			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Identify, restore, and preserve cold water habitat to support introduced salmonids and native fish species	Coldwater species are present and thriving (amount and biodiversity)	TU, MRWA, Federal Agencies, MDNR Fisheries, Tribes, CD, GVSU AWRI, TU, NOAA GLERL
2	Rehabilitate sturgeon populations in Muskegon Lake and its tributaries (in support of Michigan's Lake Sturgeon Rehabilitation Strategy)	Sturgeon populations are restored and protected	MDNR Fisheries, MRWA, Great Lakes Tribes, Federal Agencies, CD, GVSU AWRI, Sea Grant
3	Regulate dredging, filling, and disposal to prevent degraded bottom habitat and water quality	Aquatic habitat is restored and protected	Local Governments, State and Federal Regulatory Agencies
4	Increase and improve fish and wildlife habitat for warm water, game and forage species	Fish and wildlife meet the subsistence needs of local community and economy; Populations are self-sustaining	Sportfishing associations, MDNR Fisheries, EGLE, Tribes, MRWA, CD, WMSRDC, Federal Agencies
5	Enforce local land and recreational water use policies to protect habitats needed for native fish and wildlife life cycles	Fish and wildlife habitat and travel corridors are identified and critical habitats protected or restored	MSU-E, Sea Grant, WMSRDC, Delta Institute, local governments, Land Conservancies, WMSRDC
6	Track and map the presence and integrity of all habitats & species (wetlands, open water, terrestrial)	Habitat change (integrity, loss/ gain)	WMSRDC, TNC, GVSU AWRI, MRWA, State & Fed. Agencies
7	Coordinate with natural resources agencies to ensure a robust population of fish that is accessible and safe to eat	Public satisfaction of fisheries, (Creel Census and Angler Surveys)	MDHHS/Eat Safe Fish, Health Departments, State & Fed. Agencies, AWRI, Tribes
8	Provide formal and informal educational experiential programs to all watershed stakeholders	A citizenry that is involved and educated on the fundamentals of healthy habitats	GVSU AWRI, MAISD, MLWP CD, MSU, U of M, TNC, MDNR
9	Monitor Muskegon Lake fish species to support a healthy sport fishery	Fisheries diversity and abundance	MDNR Fisheries, GVSU AWRI, NOAA, USFW, MSU, U of M,

10	Implement greenways and wildlife corridors to connect isolated and fragmented habitats, wetlands, and water resources	Shoreline/Stream Corridor Setbacks; Connectivity of natural resources	Local Governments, WMSRDC, Landowners, MDOT, MDNR, Land Conservancies, TNC
11	Identify, prioritize, and protect quality habitats in critical, functioning sub-watershed areas	Biodiversity/floristic quality assessment	Land Conservancies, TNC, Landowners

4. Water Quality, Green infrastructure, & Stormwater

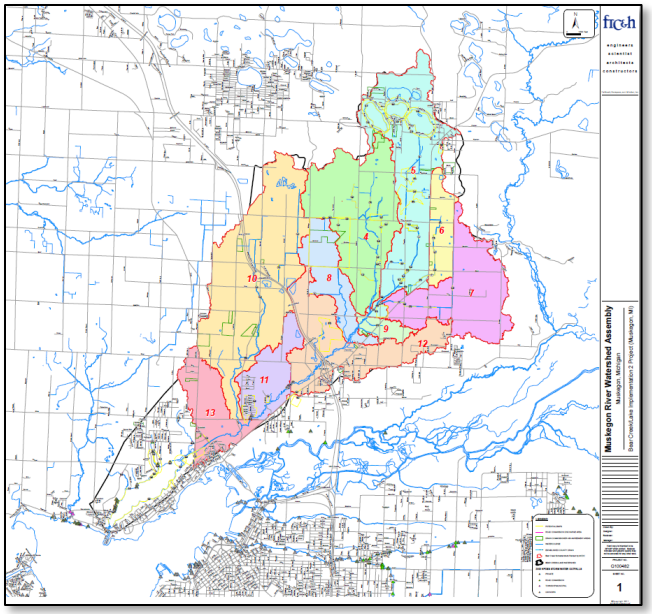
Background, Need, and Status:

The quality of Muskegon Lake and its surface water resources are critical to the region's environmental, social, and economic health. There is a great need to develop a Muskegon Lake scale Watershed Management Plan to determine the needs of the watershed and establish focused goals.

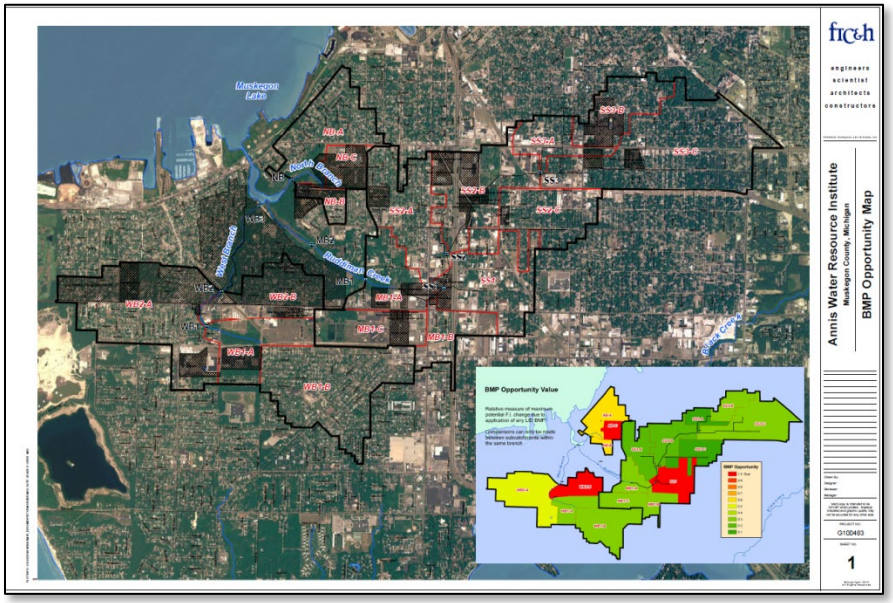
Previous efforts include integration of green infrastructure to manage stormwater runoff have included a 2015-2017 MDEQ Stormwater Asset Planning project and a City of Muskegon U.S. EPA Shoreline Cities Green Infrastructure implementation project.

Along the south side of Muskegon Lake and the Lakeshore Trail bike path, several large-scale NOAA / EPA grant-funded projects were implemented to restore fish and wildlife habitat, while enhancing water quality, scenic views, and recreational opportunities. Native plant rain gardens were established near the Grand Trunk boat launch ramp to control stormwater runoff. GVSU Annis Water Resources Institute, Lakeshore Area Chamber of Commerce, LaFarge, and others have implemented rain gardens, green roofs and native plant landscapes that help infiltrate and filter stormwater on their properties, before it discharges to Muskegon Lake.

In the Bear Lake watershed, Best Management Practices (BMPs) have been implemented to control stormwater runoff and reduce nutrient inputs to Bear Lake. BMPs have been funded through implementation of the **Bear Creek 319 Watershed Management Plan**, and under a NOAA Great Lakes Restoration Initiative wetland habitat restoration project at a former celery farm, located at the mouth of Bear Creek at Bear Lake. Muskegon County acquired two NOAA/MDEQ land acquisition grants to acquire the former celery farm parcels for the purpose of restoration. GVSU AWRI completed the **Bear Creek Nutrient Monitoring Study** for this project and the USGS completed a related Groundwater Flux and Nutrient Loading Study of Bear Lake in 2015.



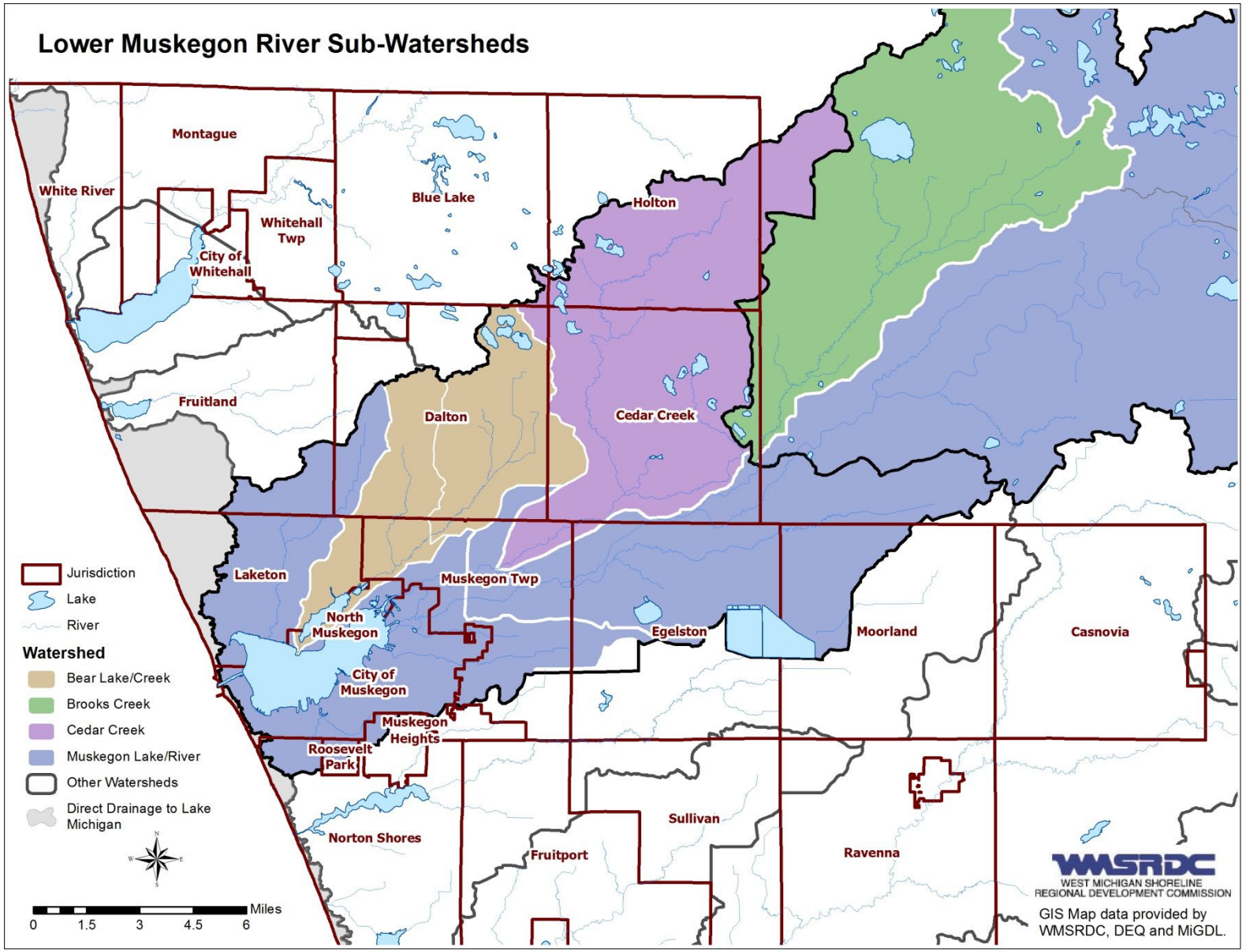
Efforts to integrate stormwater management with land use policies have also been implemented in the Cedar Creek, Brooks Creek and Bear Creek watersheds.



In the Ruddiman Creek watershed, a **Best Management Practice Scoping Tool** was developed to help landowners target specific areas where BMPs would be most effective at reducing flashy stormwater flows. Flashy flows scour out the sandy stream bed and reduce the diversity and abundance of the aquatic life that depend on the creek for their habitat. In addition, the City of Muskegon, Norton Shores, Roosevelt Park, and Muskegon Heights have partnered to correct illicit connections between the sanitary and storm drain system to improve the health of surface waters.

4. Water Quality, Green infrastructure, Stormwater Management – Goal: Surface waters within the watershed are safe for drinking, swimming, and fishing			
Outcome: Surface waters meet water quality standards for being swimmable, fishable, and drinkable			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Reach attainment of water quality standards	Healthy water quality stats. (temperature, E.coli, etc.)	EGLE, AWRI, PHMC
2	Decrease contact restrictions publicly accessible waters	Number of no partial body or full body contact postings	PHMC, EGLE, AWRI
3	Meet Water Quality Standards for swimming, fishing, and drinking	Toxicity of surface water, groundwater, and sediment	EGLE, PHMC, AWRI
4	Reduce soil erosion and sedimentation, flashy flows, nutrient inputs, and unstable hydrology	Percent impervious surface, benthic diversity and water quality of tributary streams	Local Governments, WMSRDC, CD, AWRI, EGLE, EPA, NOAA, MSUE
5	Develop and implement a Muskegon Lake Watershed Management Plan	Number of Best Management Practices Implemented	WMSRDC, CD, AWRI, EGLE, EPA, MSU, Local Governments
6	Correct illicit connections between storm and sanitary sewers	MS4 monitoring is within permit compliance limits	Local Governments
7	Incorporation of green space and native habitats in land use planning and developments	Diversity and abundance of native, aquatic wildlife	WMSRDC, Local Governments, Business community, MSUE
8	Ensure the public drinking water supply is safe	Assessment of Source Water Intake Protection Plans	Water Systems Managers, Local Governments, EGLE
9	Survey public perception of water resources through statistically significant methods	Public Perception of water resources	GVSU, MSU, WMSRDC
10	Promote LID green infrastructure, rain gardens, native landscape lawn alternatives, and green space to restore hydrology and to prevent storm water runoff	Eutrophication and undesirable algae is reduced and surface waters are in attainment with water quality standards	EGLE, Local Governments, Bear Lake Board, GVSU-AWRI, Business Community
11.	Work with agricultural community to track sources of pathogens and address nutrient runoff	Nutrient and microbial levels in surface water bodies	NRCS, MDARD, CD

12	Develop a comprehensive strategy to prevent nuisance and harmful blue green algal blooms	Number, duration, and toxicity of algal blooms, area of impacted waters, residential complaints.	GVSU-AWRI, EGLE, Local governments, Lake Boards, Lake Associations, Landowners, PHMC
13	Develop a strategy for PFAS prevention and clean-up efforts	Increased rates of data collection and decreased foam events	PHMC, ELGE, Local governments, landowners, GVSU


Lower Muskegon River Sub-Watersheds
Montague
White River
Whitehall Twp
City of Whitehall
Blue Lake
Holton
Fruitland
Dalton
Cedar Creek
Laketon
Muskegon Twp
North Muskegon
Egelston
Moorland
Casnovia
City of Muskegon
Muskegon Heights
Roosevelt Park
Norton Shores
Fruitport
Sullivan
Ravenna
Jurisdiction
Lake
River
Watershed
Bear Lake/Creek
Brooks Creek
Cedar Creek
Muskegon Lake/River
Other Watersheds
Direct Drainage to Lake Michigan
Miles
0 1.5 3 4.5 6
WMSRDC
WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COMMISSION
GIS Map data provided by WMSRDC, DEQ and MiGDL.

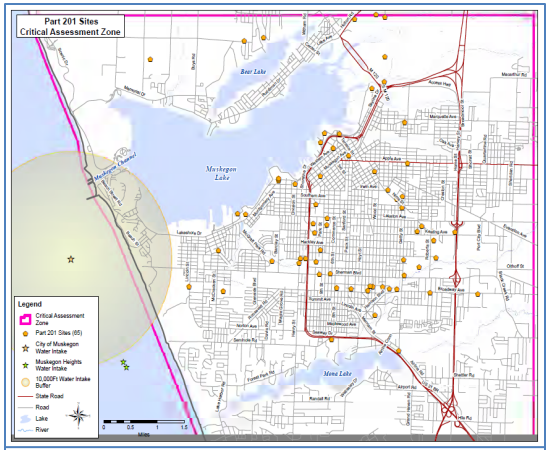
5. Groundwater Resources

Background, Need, and Status:

Groundwater is the water stored underground in the cracks and spaces in soil, sand, and rock. Groundwater is fed by precipitation and can resurface to replenish streams, rivers, and lakes. It helps provide cool water that supports aquatic life, and it is used as a source of drinking water.

The MLWP identified groundwater quality and quantity as important to the health of aquatic habitats, fisheries, and public health throughout the watershed.

The Muskegon Lake watershed's sandy soil provides opportunities to use green infrastructure for filtration of stormwater runoff. But, sandy soil can also facilitate the rapid infiltration of spills and pollutants from the land's surface into the underlying groundwater. Polluted groundwater has the potential to affect the quality and the cost for treatment of drinking water from both public water supplies and from private wells.



Potential Contaminant Sources	SWA	CAZ	Buffer Zone
Superfund Sites	13	2	0
CAFOs	12	0	0
RCRA	6	4	0
Part 201 Sites	239	65	0
UST	176	26	1
LUST (Part 213)	464	84	0
NPDES Permits	452	30	1
BEA Sites	888	173	1

In 2017, the City of Muskegon completed a **Source Water Intake Protection Plan** to protect its public drinking water supply. No such plan exists to protect the Muskegon Lake watershed's groundwater resources. However, municipal wellhead protection zones are established for municipalities that use groundwater as a public water supply.

Efforts to improve groundwater quality include the cleanup of soil and groundwater at two National Priority List Superfund Sites, located to the north of Muskegon and Bear Lakes. Municipalities are also aware of historic oil and gas wells from past exploration activities. Wells plugged in the 1930s do not meet current standards, and some have leaked into surface waters and groundwater. The **Lower Muskegon River Watershed Oil Field Assessment** was developed to provide awareness for those with drinking water wells in the Muskegon Lake and Bear Lake watersheds. Historic wells are often discovered and properly plugged during residential and commercial developments.

5. Groundwater Resources – Goal: The quality of groundwater resources is improving			
Outcome: Groundwater resources support healthy aquatic habitats and drinking water supplies			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Protect drinking and source water from contamination and spills	Assessment of Source Water Protection Plans	Water Systems Managers/Local Governments, EGLE, PHMC
2	Pass a statewide sanitary code and inspection requirements for on-site septic systems	Water Quality	EGLE, PHMC, State Legislature
3	Ensure the integrity and availability of groundwater resources across the watershed	Quantity, availability, functionality	EGLE, Local Governments, Business, Industry, Agriculture, Watershed Stakeholders
4	Maintain a database of landfills, soil, groundwater, and sediment contamination sites	Creation and use of database	EGLE, AWRI, WMSRDC, PHMC
5	Survey, locate, and map abandoned oil wells and historic petroleum infrastructure	Update Westshore Oil Well Report	EGLE, OGMD, WMSRDC
6	Map and track known groundwater plumes, and identify their potential for affecting water resources	Map and database established	GVSU AWRI, EGLE, OGMD, Local Governments, PHMC
7	Assess the effectiveness of Wellhead Protection Programs	Groundwater protected in source water areas	EGLE, Local Governments,
8	Identify and protect groundwater sources to headwater streams and cold-water resources	Maintain adequate temperatures and base flow	MDNR, EGLE, WRC
9	Prevent local water table impacts via mismanagement of large groundwater withdrawals	Sustainable water tables	MDARD, EGLE, MSU-E, NRCS, CD
10	Manage drains to protect year-round base flows	Sustainable water tables	WRC, Road Commissions, Landowners
11	Monitor nutrient loading from groundwater to surface waters and vice versa	Waters do not exceed standards	AWRI, EGLE, WMSRDC, PHMC
12	Utilize green infrastructure for infiltration and protection of groundwater resources	Creation and protection of wetlands, prairies, and BMPS	Local Governments, EGLE, Landowners, WMSRDC
13	Increase groundwater education	General groundwater knowledge	CD, MAISD, MCC, GVSU, local schools

6. Site Remediation and Revitalization

Background, Need, and Status:

As Muskegon Lake transitioned to life after delisting[1], the MLWP updated the site remediation and revitalization priorities from the previous Action Plan iteration. Future action should reflect that MLWP's current priorities are public health, community engagement for development projects, cleanup of contaminated groundwater, understanding PFAS and emerging contaminant issues, long-term monitoring and stewardship of the actions that led to delisting of the AOC, and additional action to support the remediation of environmental conditions that could not be remediated under the AOC.

The previous MLWP priorities included: contaminated sediment cleanups, shoreline brownfield cleanup and redevelopment, and the cleanup of contaminated soils and groundwater. The MLWP worked in partnership with the U.S. Environmental Protection Agency (EPA) and the Michigan Department of Environmental Quality (MDEQ) to involve the public and advance the remediation of contaminated sediments in the Muskegon Lake AOC prior to delisting in 2025. Contaminated sediment cleanup projects included Ruddiman Creek and Lagoon during 2006, Muskegon Lake at the Division Street Outfall during 2012, Muskegon River at the former Zephyr Oil Refinery during 2018.

The cleanup of Muskegon Lake sediments at the mouth of Ryerson Creek during 2020. Information about these Great Lakes Legacy Act projects is available at www.greatlakesmud.org. The projects were implemented in partnership with public and private partners, the State of Michigan and the U.S. EPA Great Lakes Legacy Act (GLLA), now part of the Great Lakes Restoration Initiative. As these sediment cleanups are complete, MLWP priorities have been adjusted to focus on the long-term success of those efforts, rather than executing the sediment cleanups.

The MLWP developed a list of sites that will need to be addressed under existing public/private initiatives and state and federal remediation programs. The sites include, but are not limited to, state and federally designated National Priority List Superfund Sites, abandoned oil and gas exploration well fields, Part 201 sites, PFAS sites, LUST sites, and historic municipal and coal combustion residuals landfills. A Technical Focus Area session in 2026 produced the following list of locations and considerations for MLWP Site Remediation and Revitalization prioritization of this Action Plan:

[1]https://legacyfiles.ijc.org/publications/GreatLakes_AreasOfConcern_LifeAfterDelisting.pdf

Former Zephyr Oil Refinery

As of September 2025, EGLE RRD and privately contracted engineers were assessing potential remedial options to enhance current groundwater efforts and to accelerate the pump and treat system to be completed with active environmental management at the site in the relatively near future. The MLWP will request periodic status updates on those items.

Ott Story Cordova

Continue to check in with EPA and EGLE on the current plans to assess the potential for an EPA study on in situ source control to enhance the groundwater pump and treat efforts. Check in on progress made with the 2022 5-Year Review recommendations and find out what the assessment for the 2027 5-Year Review will entail. Provide feedback on the 2027 review if possible. Learn what the new NPDES discharge limits at Muskegon River will be compared to the current concentration limits, given the likelihood for the limits to be raised to current Michigan environmental concentrations.

Grand Trunk

The MLWP should research and review any available information on environmental conditions through the EGLE RIDE online system.

Duell and Gardener Landfill / NPL

NPL Superfund Site in Dalton Township was removed from the NPL list in 2019. The MLWP will clarify with MPART whether the Northside Landfill listed on the MPART PFAS website is the same landfill as Duell and Gardener. The operations and maintenance and 5-Year reviews will continue. The MLWP will request periodic status updates on those items.

City of Muskegon Causeway Dump

The MLWP should research and review any available information on environmental conditions through the EGLE RIDE online system.

Amoco

BP has a consultant providing environmental monitoring to meet Part 201 regulations and ensure that no known environmental conditions are being exacerbated. BP is also considering alternatives on the remaining section of metal sheet pile seawall at the far east end of the parcel. If changes are made, safe public access amenities should be advocated by the MLWP. A regulated sand cap designed to limit lead exposure on an upland area within the wetlands behind the wall/fence is on site. Two large scale, NOAA funded wetland restoration and resiliency projects were completed here within the past 15 years.

Former Farmers Market

The MLWP should research and review any available information on environmental conditions through the EGLE RIDE online system.

Coal Ash Sites

These include the east side of the causeway fly ash landfill, bottom ash ponds on north branch of Muskegon River, and the Verplank legacy site. The MLWP should research and review any available information on environmental conditions through the EGLE RIDE online system.

Fisherman's Landing/Giddings Street Dump

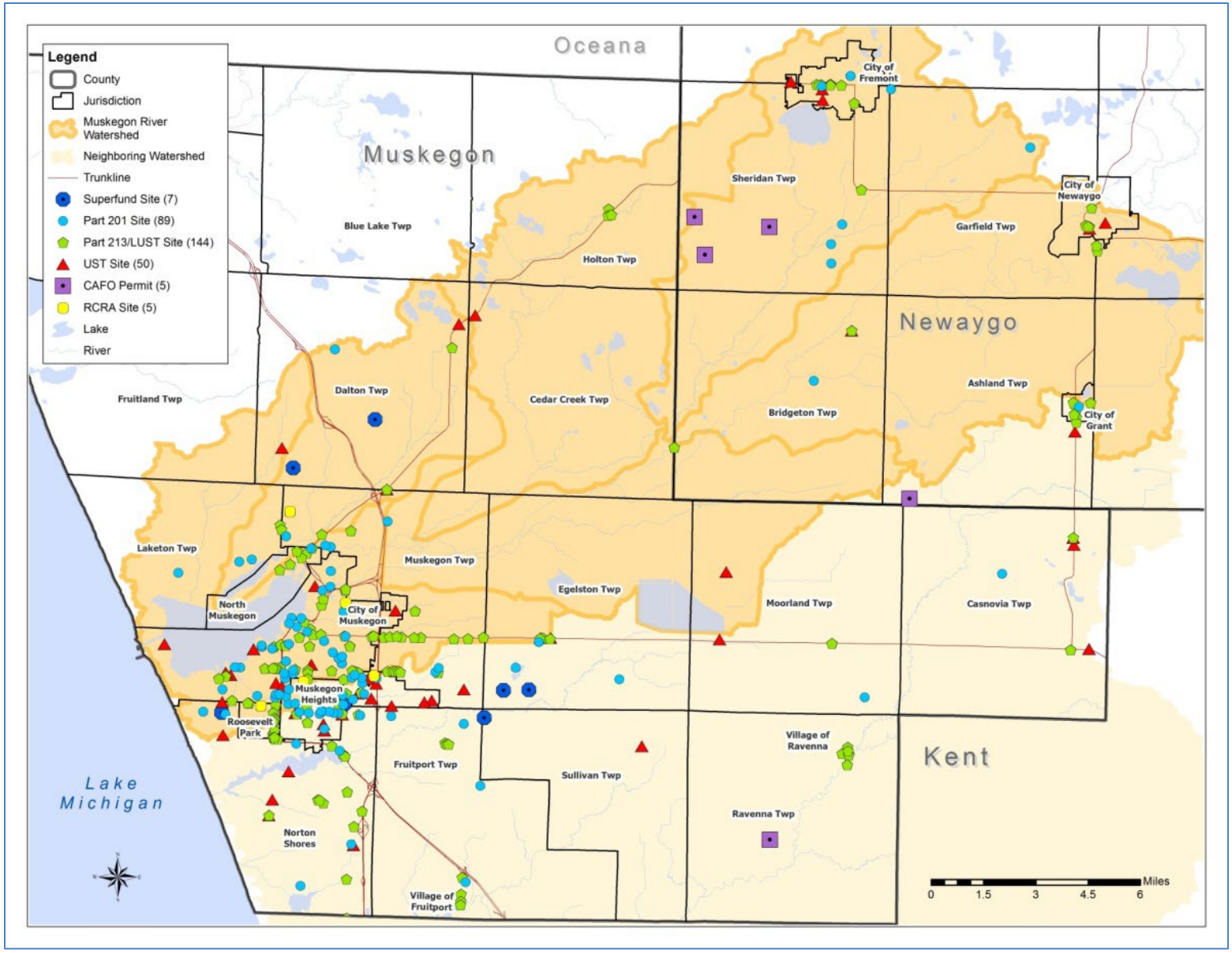
The MLWP should research and review any available information on environmental conditions through the EGLE RIDE online system.

PFAS Sites

The MLWP should review available information on environmental conditions through EGLE MPART online resources and prioritize sites to initiate targeted efforts to advance awareness of and remediation for the protection of public health and other environmental conditions. The MLWP will continue to engage EGLE and other PFAS experts on status updates, surface water quality monitoring and fish tissue analyses related to the PFAS sites

Site Remediation and Revitalization Priorities

Pre-AOC Delisting (previous) priorities	**Post-AOC Delisting (current) priorities**
Contaminated sediment cleanups	Public health (top priority)
Shoreline brownfield cleanup and redevelopment	Community engagement for redevelopment projects
Cleanup of contaminated soils and groundwater	Clean up of groundwater contamination
	Understanding PFAS and emerging contaminants
	Long-term monitoring and stewardship of all actions


Legend
County
Jurisdiction
Muskegon River Watershed
Neighboring Watershed
Trunkline
Superfund Site (7)
Part 201 Site (89)
Part 213/LUST Site (144)
UST Site (50)
CAFO Permit (5)
RCRA Site (5)
Lake
River
Oceana
Muskegon
Newaygo
Kent
Lake Michigan
City of Fremont
Sheridan Twp
City of Newaygo
Blue Lake Twp
Holton Twp
Garfield Twp
Fruitland Twp
Dalton Twp
Cedar Creek Twp
Bridgeton Twp
Ashland Twp
City of Grant
Laketon Twp
Muskegon Twp
Egelston Twp
Moorland Twp
Casnovia Twp
North Muskegon
City of Muskegon
Muskegon Heights
Roosevelt Park
Fruitport Twp
Sullivan Twp
Village of Ravenna
Ravenna Twp
Norton Shores
Village of Fruitport
Miles
0
1.5
3
4.5
6

	Former S.D. Warren (SAPPI)	Muskegon Co. Wastewater Treatment Plant	Muskegon Co. Type II	Former Teledyne Vehicle Systems (TDY)	Former Northside Landfill	Former BASF Muskegon
Known or suspected environmental exposure pathways to humans and/or wildlife (soil, drinking water, surface water, air)						
Orphan Site (No active PRP but some site characterization is on file with EGLE)						
PRP under enforcement action PRP participating in remedial investigations, monitoring or remediation activities)						
PRP is state or federal government or regulated agency vs a local government or private entity						
BEA in Place (Date of BEA on file with EGLE)						
Sites with known Persistent Bioaccumulative Pollutants vs less harmful pollutants						
Potential for re-development for economic benefits (jobs, recreational uses, tourism, housing)						
Sites with vapor intrusion potential						

6. Site Remediation and Revitalization – Goal: Pathways of contamination do not affect ecosystem integrity. People, wildlife, and natural resources are protected from emerging pollutants and legacy pollutants

Outcome: Soil, sediment, and groundwater resources support a healthy ecosystem and do not impact public health

#	Implementation Recommendations	Indicators	MLWP with Partners
1	Maintain integrity of the contaminated sediment cleanup sites (Amoco, Ruddiman Creek, Muskegon Lake/Division Street Outfall, Muskegon River/Zephyr, and Muskegon Lake/Ryerson)	Sediment quality	EPA, EGLE, MDNR OGL, Landowners, PHMC, WMSRDC, GVSU AWRI
2	Prioritize, monitor, and remediate sites with known environmental conditions (e.g., Part 201, LUST, NPL, brownfield redevelopment sites)	Increased knowledge and quality of degraded sites	EPA, EGLE, MDNR OGL, Landowners, PHMC, WMSRDC, GVSU AWRI
3	Map all historic lake and lower river “fill” locations and quantify acreages (including Bear Lake)	Sites quantified and mapped	GVSU AWRI, WMSRDC
4	Map historic dump sites and unregulated landfills for assessment or remediation (private, commercial, and public lands)	Sites identified and public health protected	WMSRDC, EGLE, PHMC, AWRI
5	Integrate stakeholder engagement into planning processes	Community knowledge and participation	Local government, WMSRDC
6	Integrate aesthetics, public access, and habitat BMPs with remedial designs for holistic site cleanup and revitalization (to achieve sustainable results/enhanced quality of life/highest and best use)	Diversity of uses and ecosystem services provided	Developers, EGLE, Landowners, Local Government, WMSRDC
7	Iteratively revisit master plans and community visions to integrate the interests of all stakeholders into site remediation and revitalization.	Review developments and master plans	Developers, EGLE, Landowners, Local Government, WMSRDC

7. Non-Native Invasive Species and Biodiversity

Background, Need, and Status:

There is a need to prevent the spread of the non-native invasive species that threaten to degrade native aquatic and terrestrial habitats. Biodiversity is necessary for the watershed's plant and animal communities that depend upon native plant habitats for their survival.

Past efforts to reduce non-native invasive plant species have focused on the protection of restored habitats and to prevent the spread of non-native invasive plants around the Muskegon Lake and Bear Lake shorelines.

In 2012, the WMSRDC completed a biodiversity protection plan to support the goals of the **Lake Michigan Lake Action Management Plan** (LAMP). The plan included a GIS field survey and ranking of Phragmites Australis.

In 2015, with support from the Great Lakes Restoration Initiative, the 2012 baseline survey was updated and included in the **Muskegon Lake Biodiversity Protection and Phragmites Management Plan**.

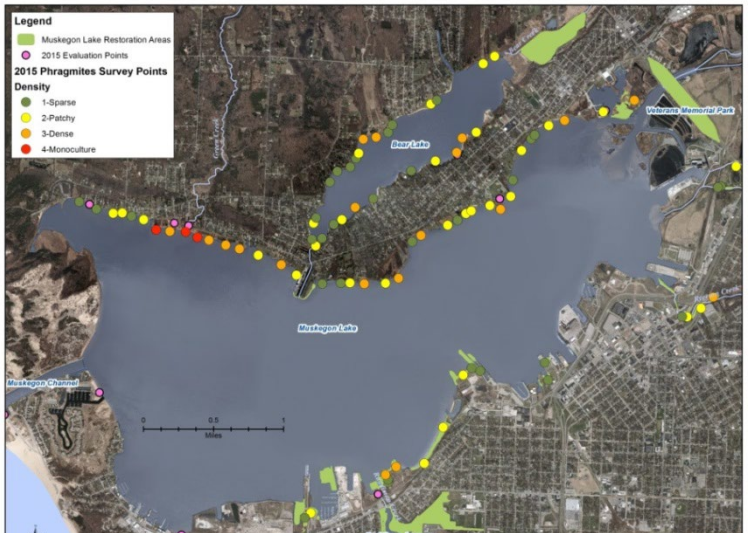
The 2015 project reduced the presence of non-native invasive plants, educated landowners and volunteers, provided experiential learning opportunities for students grades 6-12, and developed a strategy to sustain these efforts. It was recommended that survey be repeated every 3-5 years and that educational and control efforts be expanded throughout the watershed. In addition to the non-native invasive plants in wetlands and shorelines, the MLWP determined the need to address in-lake submerged vegetation and water column non-native invasive species.

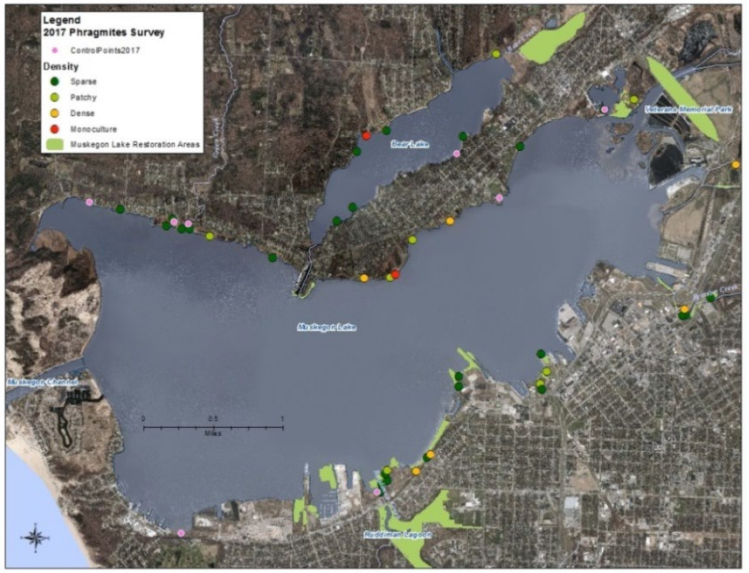
BEFORE Phragmites Control
Muskegon Lake at Mouth of Green Creek - 2013

AFTER Phragmites Control
Muskegon Lake at Mouth of Green Creek - 2015

The reduction and elimination of non-native invasive species in and of itself does not necessarily restore diverse native plant and animal communities. Native plantings have been integral to the effort of restoring habitats to improve fish and wildlife populations. Because native habitats are necessary to maintain a healthy watershed ecosystem, the restoration and protection of habitat is addressed in the fish and wildlife habitat chapter of this plan.

The images (right), illustrate the difference in abundance and density of Phragmites australis on the shorelines of Muskegon Lake and Bear Lake. The image (top right) illustrates the status in 2015. The image (bottom right) illustrates the status in 2017, following two consecutive years of survey and control efforts.





Phragmites Density Values	
	Sparse
	Patchy
	Dense
	Monoculture

7. Non-Native Invasive Species and Biodiversity – Goal: Organizations, landowners, and volunteers coordinate monitoring and management activities to prevent the loss of native plant and animal biodiversity			
Outcome: The Muskegon Lake watershed supports biologically diverse, native plant and animal communities			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Prevent introduction of new Aquatic Invasive Species (AIS) and control established populations.	Varieties and density of identified IS	WMCN, MDNR, MRWA, USFW, NOAA, Tribes, CD
2	Assess the economic impacts of IS and inform the public and stakeholders	Stakeholder awareness and responses	GVSU, Businesses, Local Governments
3	Inventory and map dispersal pathways and introduction mechanisms of targeted IS species	Effectiveness of tools developed to limit IS spread	WMCN, EGLE, MDNR
4	Institutionalize a local framework for partners to prioritize IS control and apply for permits as needed	Ability to manage IS treatments / alternatives	Landowners, Lake Boards, Governments, Tribes, WMCN
6	Provide Early Detection Rapid Response (EDRR) education for volunteers, landowners, students	Ability for community to respond to IS threats	MISIN, GLSI, Lake Boards, CD, WMCN
7	Coordinate management strategies and implementation with local and regional partners	Partnership involvement and effectiveness	MRWA, TNC, EGLE, CD, WMCN, DNR, Governments
8	Monitor and manage existing Aquatic Invasive Species (AIS)	Presence, abundance of AIS in plant communities	WMCN/CISMA, CD, MRWA, WMSRDC, Landowners
9	Maintain a public awareness and education program	Ability for community to respond appropriately to IS	WMCN/CISMA, CD
10	Monitor and manage IS on adjacent uplands and forest habitats	Presence and abundance of invasive species	WMCN/CISMA, CD
11	Restore and enhance habitats and native plant communities	Plant and animal diversity and acres of native habitat	CD, Landowners, TNC, MCC, State Parks, Agencies, Other Partners
13	Effectively train community landowners and local governments in plant ID and control methods	Ability for landowners to effectively control IS	CD, WMCN/ CISMA, Stewardship Network, Phragmites Collaborative, MISIN, MSU-E, Sea Grant

8. Public Access to Natural Resources

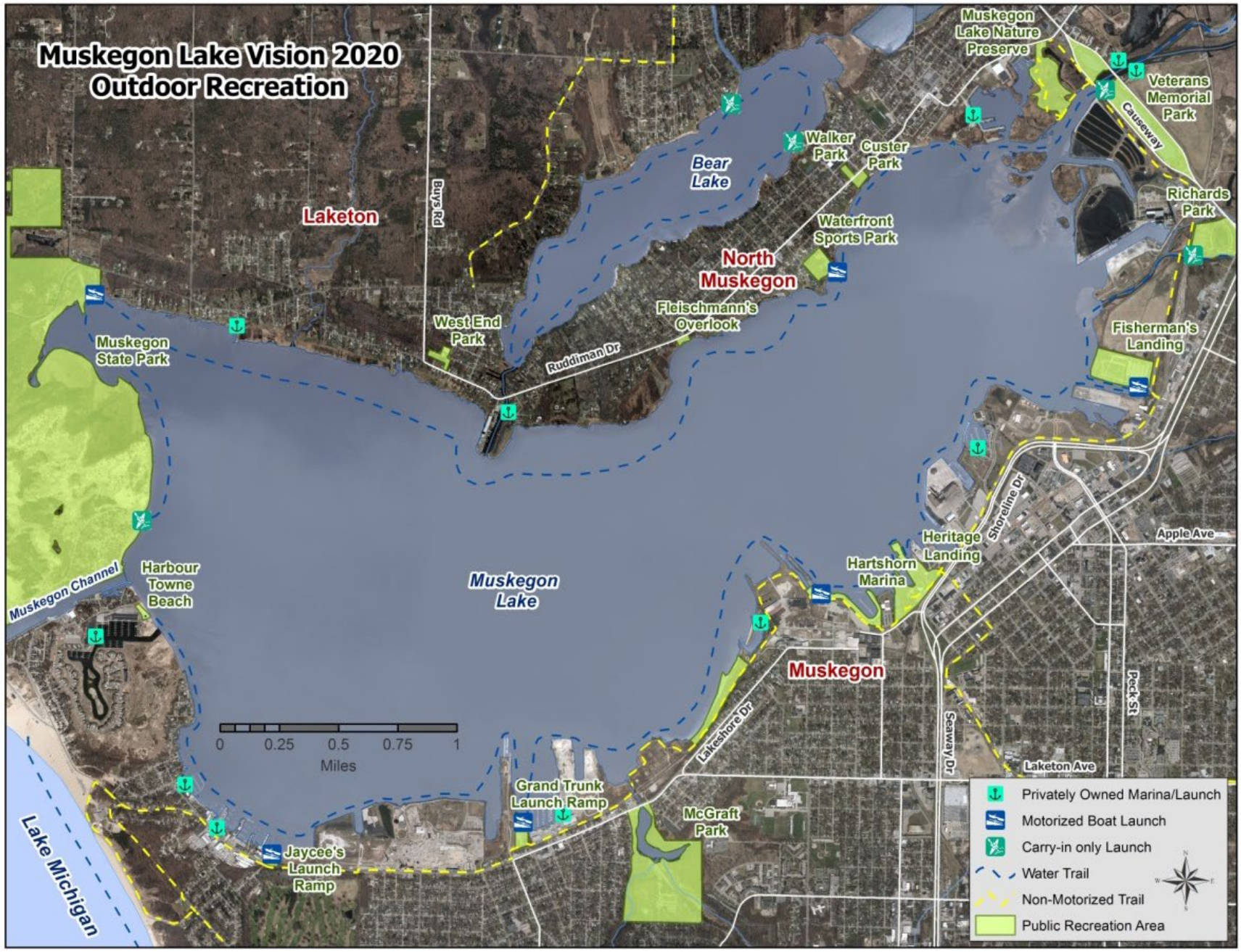
Background, Need, and Status:

Public access to natural resources provides people with an opportunity to appreciate, enjoy, understand, and value the benefits of natural resources. This connection with nature promotes a stewardship ethic for communities, residents, and those who use the resource for recreation and commerce.

The **Muskegon Lake Vision 2020** planning process identified a strong community desire to link the protection of natural resources with enhanced recreational opportunities that would promote human interaction with the lake and its tributaries. The City of Muskegon's 2018 **Imagine Muskegon Lake** plan also identifies public access needs.

The lower Muskegon River/Muskegon Lake coastal wetland marsh was identified in Muskegon Lake Vision 2020 as important for public access and to improve connectivity between the Muskegon River, Muskegon Lake and its former wetland floodplain habitat. The MLWP and WMSRDC are collaborating with Consumers Energy on their plan to clean out the former B.C. Cobb plant coal ash ponds. A full cleanout of the bottom ash settling ponds may facilitate a future wetland restoration.

Access to natural areas, including lakes and wetlands, provides low-income, urban, and minority populations with economical, recreational, educational, stress-reducing and healthy quality-of-life activities. Access improvement needs include areas for shore angling, ADA accessibility, walkability from neighborhoods to shorelines, motorized launches, recreational boating and sailing, small boat, canoe, and kayak launches, public parks and picnic areas, boardwalks, fishing, and birding platforms, bike paths, water trails and hiking trails. Communities that value and prioritize access areas that maintain and enhance natural areas are more resilient and their economies are more sustainable. The availability of public access to Muskegon Lake and the water resources throughout its watershed enhances quality of life, economic, and cultural values.


Muskegon Lake Vision 2020
Outdoor Recreation
Muskegon Lake Nature Preserve
Veterans Memorial Park
Causeway
Walker Park
Custer Park
Bear Lake
Richards Park
Laketon
Buys Rd
Waterfront Sports Park
North Muskegon
Fleischmann's Overlook
West End Park
Ruddiman Dr
Fisherman's Landing
Muskegon State Park
Shoreline Dr
Heritage Landing
Apple Ave
Hartshorn Marina
Harbour Towne Beach
Muskegon Channel
Muskegon Lake
Muskegon
Lakeshore Dr
Seaway Dr
Peck St
Laketon Ave
0 0.25 0.5 0.75 1
Miles
Grand Trunk Launch Ramp
McGraft Park
Lake Michigan
Jaycee's Launch Ramp
Privately Owned Marina/Launch
Motorized Boat Launch
Carry-in only Launch
Water Trail
Non-Motorized Trail
Public Recreation Area

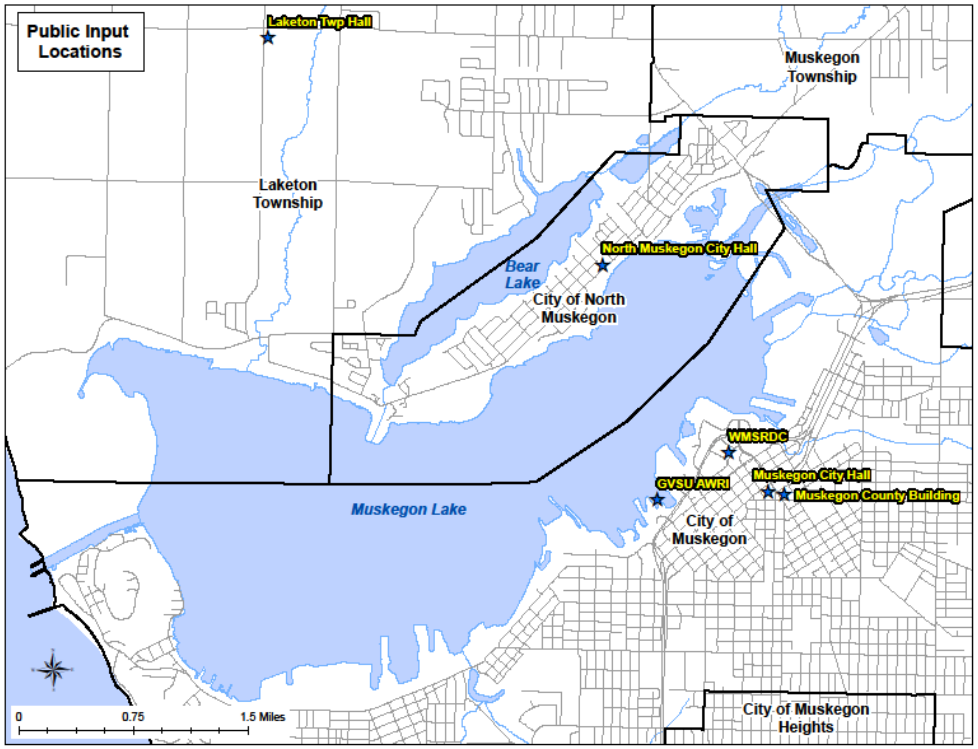
8. Public Access to Natural Resources – Goal: An increase in the public's understanding of, appreciation for, and stewardship of the watershed's natural resources. The public has increased access to natural areas and enhanced opportunities for interaction with the Muskegon Lake/Muskegon River/Lake Michigan ecosystem.			
Outcome: The public has access to abundant open space, shorelines, water resources, and natural features			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Increased public access to abundant open space, shorelines, and natural areas	Number of acres and types of access points available to the public including those with ADA needed	Local governments, Private landowners, Schools
2	Enhanced the public's opportunities for interaction with the Muskegon Lake watershed ecosystem	Attendance and number of events and educational opportunities available to the public	Local governments, MDNR, MERES, educational institutions
3	Expand real-time monitoring and notifications of public access areas with full and partial body contact (E.coli, blue green algal, and PFAS)	Increased monitoring locations, rates of monitoring, and types of data collected. Increased communication of timely and quality data.	PHMC, EGLE, Public landowners, GVSU
4	Develop and implement a water trails system for non-motorized paddle craft	Citizen use Expansion of the Lake Michigan Water Trail to include lower Muskegon River	Lake Michigan Water Trail Partners, Local governments, WMSRDC, MDNR, National Park Service, Businesses
5	Develop a comprehensive strategy to prevent nuisance and harmful blue green algal blooms	Number, duration, and toxicity of algal blooms, the area of impacted waters, and residential complaints.	GVSU-AWRI, EGLE, Local governments, Lake Boards, Lake Associations, Landowners, Health Departments
6	Develop a strategy for PFAS prevention and clean-up efforts	Increased rates of data collection and decreased foam event	PHMC, ELGE, Local governments, landowners, GVSU

7	Increased fishing access points from shorelines and tributaries, as well as, increased knowledge of these sites	Number and quality of locations, angler hours, creel census, data from MDNR and Conservation Officers	Local Governments, MDNR, Great Lakes Fisheries Trust, Michigan Land Trust
8	Increased opportunities are available for non-extractive / non-motorized recreation (e.g., birding, biking, hiking, canoeing, kayaking)	Number and quality of locations, recreational and educational usage	Audubon, Local Governments, MERES, MDNR – State Game Area & State Parks, USFS
9	Increase small public boat access in accordance with ADA needs throughout watershed	Number and quality of public landings, increased signage	General Public, Anglers, Boaters
10	Create an information Clearinghouse for public site & access information	Media hits and inquiries, public access map on Visit Muskegon, a shared layer on GIS, mobile app for parks and recreation	Muskegon County Visitor's Bureau, Lakeshore Chamber of Commerce
11	Increase access signage at key locations including on the water	Signage at locations, increased knowledge of marine rights	Local Governments, Coast Guard, MDOT, Park Service, recreational advocacy groups, neighborhood associations

9. Public Involvement and Input for Sustainable Decision-Making

Background, Need, and Status:

The MLWP provides opportunities for the public to become involved in decision-making for a healthy Muskegon Lake ecosystem. Opportunities include monthly public meetings, committees, planning sessions, hand-on volunteer events, and social media platforms.



Historically, the MLWP has engaged a diverse audience of watershed stakeholders to set achievable targets for the removal of AOC Beneficial Use Impairments and the delisting of Muskegon Lake as a Great Lakes AOC.

As a result of this community engagement process, there have been noticeable increases in local ownership and environmental stewardship among a broad array of stakeholders, including community leaders and shoreline landowners. In fact, during the development of the **Muskegon Lake Vision 2020** plan, the majority of participants stated that the restoration and protection of Muskegon Lake should be a local responsibility.

The MLWP will carry on this legacy and continue to plan for a healthy ecosystem into the future. As part of the planning process, the MLWP will continue to assist community groups with engagement in local resource issues.

The Muskegon Lake Watershed Partnership provides a sustainable community forum for addressing watershed issues and concerns.

9. Public Involvement and Input for Sustainable Decision-Making – Goal: Collaborative ecosystem management is in place and supporting social, environmental, and economic health and ecosystem services			
Outcome: There are opportunities for collaborative decision-making and public input to local, state, and federal agencies and decision-makers			
#	**Implementation Recommendations**	**Indicators**	**MLWP with Partners**
1	Develop an Action Alerts system for timely public input (e-mails, texts, social media)	Number of notifications sent out and responses	MLWP Volunteers, NGOs, Local Government, Media Outlets
2	Increase methods for providing public input (social media, websites, Youtube video)	Number of comments, hits, visitors	Internet, Facebook, Twitter, E-mail
4	Develop an app to engage people to interface, provide input, rank projects	Number of officials, youth, public, using/engaged	MLWP Volunteers
5	Increase face to face engagement opportunities with officials	Number of events and participants	Chamber Breakfasts, Local Governments, Public
6	Support participation in sustainability programming and environmental justice initiatives (social, environmental, economic)	Numbers and diversity of people involved	Local, State, Federal Governments
7	Host an annual State of Muskegon Lake Forum	Number of forums and participants; Evaluations	WMSRDC, GVSU-AWRI, Muskegon County
8	Create integrated water management system at the local level (water quality and quantity)	Establishment of multi-stakeholder system	Local, State, Federal Governments, WMSRDC, Business, Power, NGOs
9	Link to existing public input notifications (public hearings, permits, legislation)	Notifications are timely, fair and legal	Local Government, Partners, Media
10	Attend local government council and board meetings to learn about issues and provide input	Number of participants and officials reached at meetings	Local Government, General Public
11	Pass a statewide sanitary code and inspection requirements	Improved sanitary system	Local, State, Federal Governments
12	Implement outcome-based asset management plans	Progress toward true cost of service for water utilities	Local, State, Federal Governments
13	Provide trainings on effective input and support for elected officials	Number of trainings and participants	Community Foundations, Private Consultants, Universities

10. Research and Monitoring

Background, Need, and Status:

Research and monitoring will be needed to continue to inform natural resource management planning for the restoration and protection of the Muskegon Lake ecosystem. Monitoring is also needed to assess the results of previously implemented AOC remediation and restoration projects. Although each restoration project included short-term, pre and post project monitoring, most will require several years of post-project monitoring to gain a true understanding of a project's long-term ecological benefit. Although funding for long-term monitoring of AOC projects has not been readily available, a number of programs and funding sources have been sought to fill this critical gap. Monitoring is needed to assess how the project goals are being met and what type of adaptive management may be required to ensure their ecological integrity into the future. In 2012, the **Muskegon Lake Habitat Restoration Macrophyte Assessment** was completed by AWRI under a WMSRDC NOAA ARRA grant project. This study will be duplicated to assess long-term restoration progress into the future.

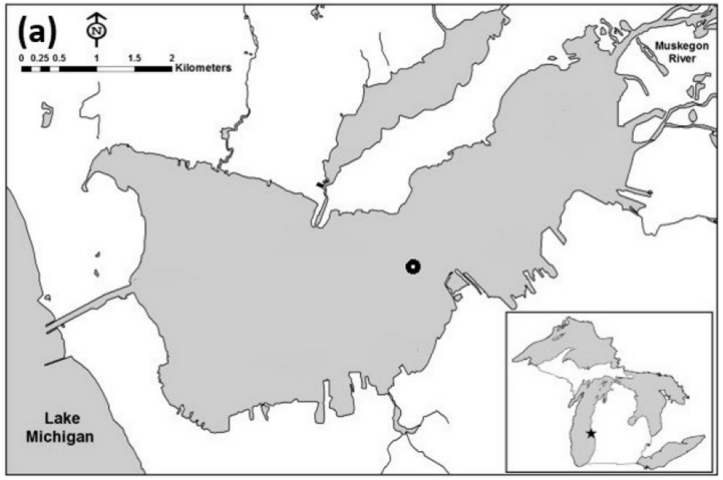
In 2003, GVSU Annis Water Resources Institute (AWRI) initiated a long-term monitoring program to determine the ecological status of Muskegon Lake. The program has indicated that, overall, the water quality of Muskegon Lake has improved over the past 30 years, but environmental challenges still exist, including contaminated sediments, loss of natural habitat, harmful algal blooms, and invasive species.

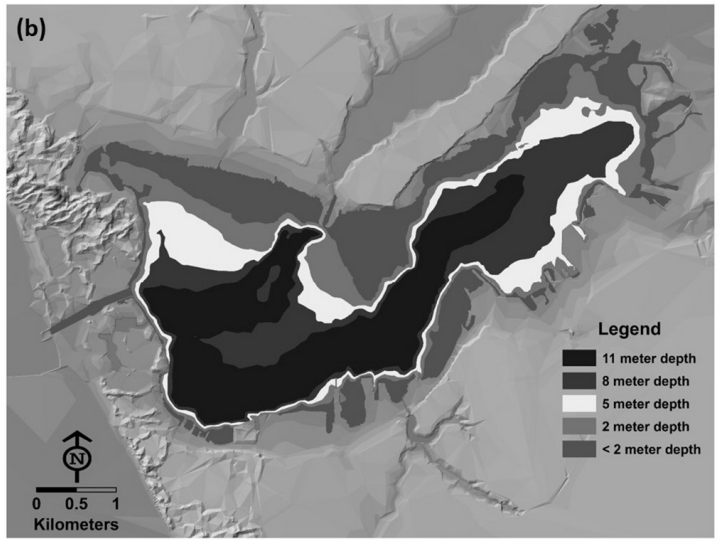
It is also important to understand how Muskegon Lake relates to the nearshore of Lake Michigan. Nearshore monitoring is a key goal of the Lake Michigan Lake Action Management Plan (LAMP. The Lake Michigan Monitoring Coordination Council completed a Lake Michigan Nearshore Monitoring Assessment in 2013.

In 2015, NOAA identified Muskegon Lake as one of 9 **Habitat Focus Areas** in the United States. One of the major NOAA objectives of the **Muskegon Lake Habitat Focus Area Implementation Plan** is the provision of scientific research to fill critical information gaps in our understanding of the Muskegon Watershed ecosystem, including its connection to the adjacent Lake Michigan nearshore area. This objective can be accomplished more effectively through strategic partnerships with other research entities focused on Muskegon. A key activity for NOAA to achieve this objective under this plan is identifying the challenges to develop and maintain a coherent, interdisciplinary, and integrated science program, as well as ideas to overcome these challenges. In particular, emphasis should be given to development and implementation frameworks that will promote collaboration and coordination between

scientists, managers, and stakeholders. As such, NOAA, GVWU AWRI, WMSRDC, and MLWP propose that Habitat Focus Area continue to support the development of a Muskegon Science Collaborative by tracking its progress, providing personnel assistance in organizing workshops and deliverables, and working to connect new NOAA research efforts that emerge in the next five years to the Science Collaborative.

AWRI and WMSRDC partnered to submit a proposal to NOAA for **NOAA National Estuarine Research Reserve System** (NERRS) designation for Muskegon Lake and other drowned river mouth coastal wetland estuaries along Lake Michigan's eastern shoreline. As a major science entity in Muskegon, AWRI research and monitoring activities are compatible with NOAA goals and priorities on several fronts. Coordinating NOAA and AWRI monitoring efforts across the Muskegon River, Muskegon Lake, and Lake Michigan will allow for a comprehensive watershed to nearshore monitoring strategy that leverages resources from both AWRI and NOAA. This will provide more comprehensive data on a broad suite of parameters and advance several research priorities. These include monitoring the long term effects of habitat restoration, potential ecosystem impacts of climate change, and the use of a hydrodynamic model for Muskegon Lake.





Fyke Net Fisheries Monitoring. Photo and Maps, Courtesy of GVSU AWRI

10. Research and Monitoring – Goal: We have enough information, data, understanding, and indicators to inform the decision-making process

Outcome: Research and monitoring in the Muskegon Lake Watershed supports management decision-making

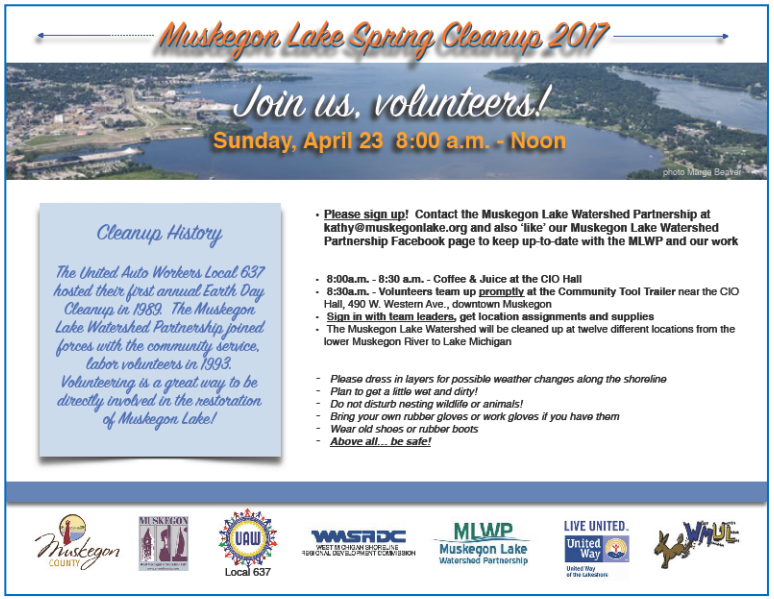
#	Implementation Recommendations	Indicators	MLWP with Partners
1	Ensure monitoring systems are in place at a scale and frequency to maintain diverse uses and values of water quality and quantity	3-D hydrodynamic and water quality model	GVSU, NOAA, GLERL, MDNR
2	Implement real-time monitoring of beaches	Expansion and frequency of existing monitoring	PHMC, GVSU, EGLE
3	Develop a water conservation and reuse strategy	Numbers of large water withdrawals and integrated water systems plans	Local governments, regional planning, water systems managers, universities
4	Ensure groundwater and surface waters are monitored and reported to the public	Public awareness of water quality	EGLE, USGS, GVSU, PHMC
5	Engage volunteers in citizen scientist monitoring programs	Useable data produced, number of volunteers involved	MiCorp, MRWA, WMGLSI, MSU, MSUE, GVSU, MISIN,
6	Establish volunteer invasive plant monitoring and ensure early detection and response to invasive species	Public is engaged and using MISIN	MISIN, MRWA, MLWP, MAISD, MCC
7	Conduct monitoring at habitat restoration sites	Monitoring data determines site status	WMSRDC, GVSU-AWRI, EGLE, USEPA, NOAA, PHMC
8	Track and monitor the amount and integrity of native habitat (natural shorelines, wetlands, forests, fish, wildlife, benthos)	Land coverage change; Community ordinances	USDA-USFS, USDA-USFW, MDNR, AWRI, WMSRDC
9	Research and evaluate the availability and effectiveness of water quality improvement technologies	Stakeholders informed of most cost effective BMPs	MDEQ, NOAA, AWRI, MSU, U of M
10	Establish a NERR designation for Muskegon Lake and other drowned river mouth coastal wetland estuaries along Lake Michigan	Number of integrated meetings with scientists, resource managers, stakeholders	NOAA, GVSU, WMSRDC, MLWP, Public Sector, Private Sector, Universities, LMMCC
11	Provide education on economics – Use and Value (Property, Eco-system Services)	Resource values are understood within community	AWRI, Chamber of Commerce, Realtors
12	Educate on fish and wildlife consumption advisories	General knowledge of Eat Safe Fish and Wild Game guides	MDNR, MDDHS

13	Monitor fish populations	Fish Community Index Netting	MDNR, EGLE
14	Monitor wildlife populations	Migratory bird studies	MDNR
15	Monitor sediment to support dredging activities	Review of sediment data	USEPA, NOAA, academia
16	Conduct research on emerging water quality treats (PFAS, HAB, microplastics, etc.)	Action on emerging issues	Dependent of issue

11. Stewardship and Hands-On Educational Opportunities

Background, Need, and Status:

The Muskegon Lake Ecosystem Action Plan will be used to engage community groups in a variety of meaningful, hands-on, stewardship activities. The annual, ***Muskegon Lake Watershed Spring Cleanup*** (in April) and annual Muskegon River cleanups (in September), are coordinated locally in conjunction with **International Coastal Cleanup** and the **Alliance for the Great Lakes Adopt-a-Beach Program**. Volunteers have participated in the spring cleanup for the past 30 years. It began as an Earth Day event in 1988, under the leadership of local union workers. Many community organizations have since joined the effort.



To volunteer for the Muskegon Lake Watershed Spring Cleanup, contact the MLWP at info@muskegonlake.org or contact the MLWP volunteer leaders through the website at www.muskegonlake.org. To volunteer for the Muskegon River Trash Bash, contact the Muskegon River Watershed Assembly at **http://mrwa.org/mrwa-home/.**

In addition to the annual spring and fall cleanups, the MLWP works with partner organizations to host other hands-on activities, including the year-round, ***Shoreline Stewards*** program and the ***Grand Trunk Restoration Partnership*** event each May. Shoreline Stewards adopt and maintain restored shoreline habitats throughout the year. The Grand Trunk Restoration Partnership is a good example of how volunteer Shoreline Stewards can revitalize a formerly degraded shoreline with restored fish and wildlife habitat, scenic views, and recreational uses.

In addition to these stewardship opportunities, the following is a list of some of the additional programs that volunteers are currently involved with:

- **West Michigan Great Lakes Stewardship Initiative** – *The Muskegon Area Intermediate School District administers this K-12 educational program. Community volunteers provide meaningful, real-world projects for student involvement.*
- **Clean Marina Program** – *Muskegon Lake marinas can become certified to implement Best Management Practices that protect water quality through this program that is supported by Michigan Sea Grant and NOAA.*
- **Bird Studies Canada Great Lakes Marsh Monitoring Program** - *Volunteers learn to monitor the health of wetland marshes, using protocols for amphibians, marsh birds and wetland marsh habitat.*
- **Aquatic Invasive Species (AIS) Educational Events** – *The State of Michigan organizes this program each summer. Volunteers are needed to distribute information and host events at parks with public boat launch sites.*
- **Eat Safe Fish Program** – *This educational program was developed by the Michigan Department of Health and Human Services. Volunteers assist by providing outlets for information at community festivals and other venues.*
- ***Midwest Invasive Species Information Network (MISIN)*** – *Volunteers report the presence of non-native invasive plants to the MISIN website with a phone app or computer. The West Michigan Conservation Network monitors the information and provides trained professionals to implement control measures, when resources are available.*
- ***Michigan Natural Shoreline Partnership*** – *This is a train the trainer program for green, native shoreline landscaping and bio-engineering.*
- ***Michigan Lakes and Streams Association*** – *This organization provides annual training programs for lake management.*

11. Stewardship and Hands On Opportunities – Goal: A culture of environmental stewardship is established, and stewardship activities are common and undertaken by public and private organizations

Outcome: Students and adults have a variety of appropriate opportunities for stewardship-related education

#	Implementation Recommendations	Indicators	MLWP with Partners
1	Form a stewardship committee to develop a strategy and establish a dedicated fund for activities	Dedicated funds are available for stewardship	CFFMC, MLNP, Neighborhood Associations
2	Organize watershed cleanups, native plantings, and monitoring activities	Volunteer hours and public participation increases	United Way, Neighborhood Associations, MRWA, CD
3	Identify critical land protection and land restoration locations and opportunities	Natural areas restored and resources are protected	WMSRDC, GVSU AWRI, TNC, MDNR, Land Conservancy
4	Hold monthly MLWP public meetings to engage partner organizations and the public	Community meetings are held for education and engagement	WMSRDC, GVSU, MRWA, MCECC, WMEAC, MLNP, CD
5	Complete baseline land coverage surveys on a sub-watershed and/or neighborhood scale	Land coverage shows “no net gain” of impervious surface	GVSU, WMSRDC, Muskegon County, MCC, Students
6	Evaluate recreation plans for public access, stewardship opportunities, and community input	Residents and volunteers engaged in stewardship	Neighborhood Associations, Recreational User Groups
7	Host planning meetings to implement Muskegon Lake Vision 2020	Multi-stakeholder, land use planning meetings	Port Operators, Local Governments, Neighborhoods
8	Survey public perception every 3-5 years	Public perception of environmental quality	GVSU, MCC, Lakeshore Chamber of Commerce
9	Establish landowner incentives for development setbacks	Development setbacks protect water resources	Local Governments
10	Conduct site maintenance via community groups and volunteers adopt sites activities	Number of areas adopted and number of volunteers involved	K-12, Rotary, Northside Lions, Jay Cees, Businesses
11	Monitor public notices for state and federal land and water wetland permit applications	Comments are submitted for proposed permit applications	WMSRDC, EGLE, Local Governments
12	Monitor and control non-native invasive plants	Species are controlled	WMSRDC, CD, TNC, MCC

Correlation of Muskegon Lake Ecosystem Master Plan Goals and Outcomes with Overarching Great Lakes Restoration and Protection Plans

Goals	Great Lakes Action Plan GLRI	Lake Mich Action Plan LAMP	MI Water Strategy	Muskegon River 319 Plan	Bear Creek Bear Lake 319 Plan	Muskegon Lake Watershed Plan Phase II MS4 Storm Water	Ruddiman Creek Ecological Restoration Master Plan - 2008	Muskegon Lake Vision 2020	Muskegon River Fisheries Mgt. Plan	Lake Michigan Water Trail Plan	NOAA Habitat Focus Area	Muskegon Lake Coastal Resiliency	Lake Michigan Fisheries Mgt. Plan
1	X	X	X			X		X			X	X	
2	X		X										
3	X	X		X			X	X	X		X	X	X
4			X	X	X		X					X	
5			X	X	X							X	
6	X	X		X	X	X	X					X	
7	X	X									X	X	X
8	X								X	X	X		X
9	X		X					X				X	
10	X	X		X	X						X	X	X
11	X	X		X	X			X	X	X	X	X	

Action Plans Focus Areas and Related Goals and Outcomes:

1. **Coastal Resiliency & Sustainability**:
   Goal: Land use, recreation, and economic activities are sustainable and supportive of a healthy ecosystem
   Outcome: Aquatic ecosystems and natural resources are resilient, diverse and providing ecological services

2. **Great Lakes Literacy and Natural Resources-Based Education**:
   Goal: Increase the number of citizens with knowledge and an understanding of water literacy principles.
   Outcome: Individuals and communities understand their responsibility for and make informed and responsible decisions regarding water resources.

3. **Fish and Wildlife Habitat**:
   Goal: Habitats healthy, naturally diverse, and sufficient to sustain viable biological communities
   Outcome: Sustainable and abundant aquatic life – habitat and populations are stable or increasing

4. **Water Quality, Green infrastructure and Stormwater Management**:
   Goal: Surface waters within the watershed are safe for drinking, swimming, and fishing
   Outcome: Surface waters meet water quality standards for being swimmable, fishable, and drinkable

5. **Groundwater Resources**:
   Goal: The quality of groundwater resources improves
   Outcome: Groundwater resources support healthy aquatic habitats and drinking water supplies

6. **Site Remediation and Revitalization**:
   Goal: Pathways of contamination do not affect the integrity of the ecosystem. People, wildlife, and natural resources are protected from emerging pollutants and legacy pollutants
   Outcome: Soil, sediment, and groundwater resources support a healthy ecosystem

7. **Non-Native Invasive Species and Biodiversity**:
   Goal: Organizations, landowners, and volunteers coordinate monitoring and management activities to prevent the loss of native plant and animal biodiversity in the watershed
   Outcome: Muskegon Lake watershed supports biologically diverse, native plant and animal communities

8. **Public Access to Water Resources**:
   Goal: An increase in the public's understanding of, appreciation for, and stewardship of the watershed's natural resources. The public has increased access to natural areas and enhanced opportunities for interaction with the Muskegon Lake/Muskegon River/Lake Michigan ecosystem.
   Outcome: The public has access to abundant open space, shorelines, water resources, and natural features

9. **Public Involvement and Input for Sustainable Decision-making**:
   Goal: Collaborative ecosystem management is in place and results in social, environmental, and economic health and an increase in ecosystem services
   Outcome: There are opportunities for public input to local, state, and federal agencies and decision-makers

10. **Research and Monitoring**:
    Goal: We have enough information, data, understanding, and indicators to inform the decision-making process
    Outcome: Research and monitoring in Muskegon Lake support management decision-making

11. **Stewardship and Hands-on Opportunities**:
    Goal: A watershed-wide community culture of environmental stewardship is established, and ecosystem stewardship activities are common and undertaken by public and private organizations
    Outcome: Students and adults have a variety of appropriate opportunities for stewardship-related education

Guide to Frequently Used Acronyms

Federal Agencies

EPA – Environmental Protection Agency
NOAA – National Oceanic and Atmospheric Administration
USACE – U.S. Army Corps of Engineers
USFWS – U.S. Fish & Wildlife Service
USDA-NRCS – U.S. Department of Agriculture, Natural Resources Conservation Service
USDA-USFS – U.S. Department of Agriculture, U.S. Forest Service
USGS – U.S. Geological Survey
USRD - U.S. Rural Development

State Agencies

EGLE – Michigan Department of Environment, Great Lakes, and Energy (formally DEQ)
MDNR – Michigan Department of Natural Resources
MDARD – Michigan Department of Agriculture and Rural Development
MDOT – Michigan Department of Transportation
MDHHS – Michigan Department of Health and Human Services
OGL – Office of the Great Lakes

Local, County, and Regional Governmental Agencies and Organizations

GLC – Great Lakes Commission
MCD – Muskegon Conservation District
MSUE- Michigan State University Extension
PHMC – Public Health Muskegon County
WMSRDC – West Michigan Shoreline Regional Development Commission
WRC – Water Resources Commissioner

Non-Governmental Organizations

BSC – Bird Studies Canada
CD – Conservation Districts
IWL – Isaac Walton League

TNC – The Nature Conservancy
TU – Trout Unlimited
MAISD – Muskegon Area Intermediate School District
MERES – Muskegon Environment Research and Education Society
MRWA – Muskegon River Watershed Assembly
MLWP – Muskegon Lake Watershed Partnership
MISIN – Midwest Invasive Species Information Network
SN – Stewardship Network
WMCN – West Michigan Conservation Network
WMGLSI – West Michigan Great Lakes Stewardship Initiative

Colleges and Universities

CMU – Central Michigan University
FSU – Ferris State University
GVSU-AWRI – Grand Valley State University Annis Water Resources Institute
MCC – Muskegon Community College
MSU – Michigan State University
UM – University of Michigan