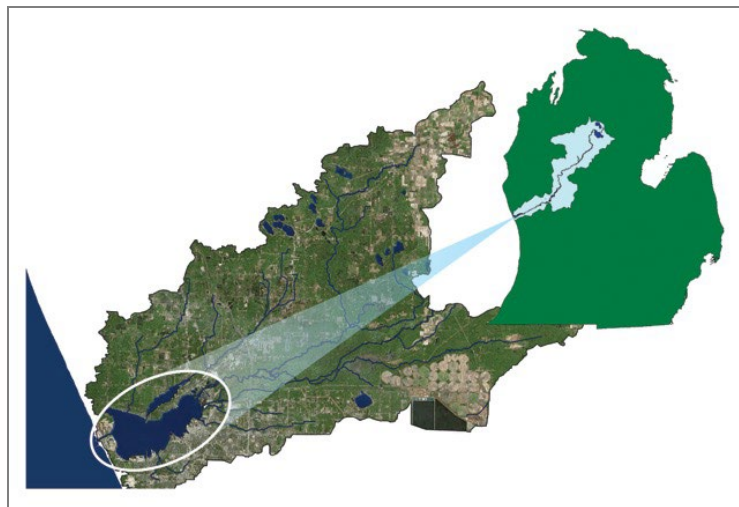


# Muskegon Lake Action Plan

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:

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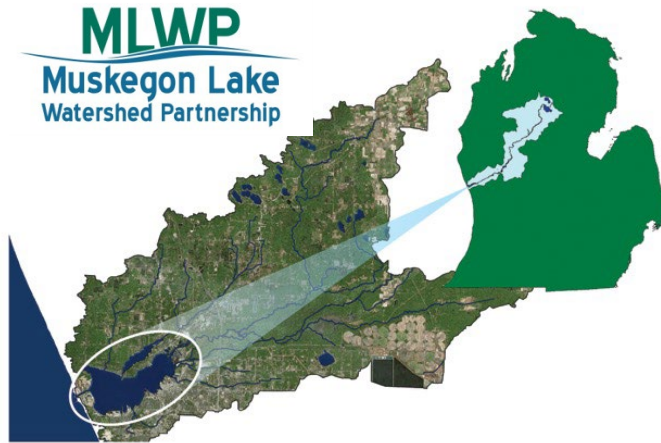
*The Muskegon Lake Action Plan was developed with support from the Michigan Environment, Great Lakes and Energy Area of Concern Public  
 Advisory Council Support Grant Program and the U.S. Environmental Protection Agency and the Great Lakes Restoration Initiative*

**Table of  
Contents**



|                                                                                                             |            |
|-------------------------------------------------------------------------------------------------------------|------------|
| <b>Muskegon Lake Watershed Partnership Background and Mission .....</b>                                     | <b>i</b>   |
| <b>Purpose of the Muskegon Lake Action Plan.....</b>                                                        | <b>ii</b>  |
| <b>Muskegon Lake Watershed – <i>Background and Current Status</i> .....</b>                                 | <b>iii</b> |
| <b>Chapter and Action Plan Overview</b>                                                                     |            |
| <i>Background, Status, Needs, Focus Area Actions Outcomes, Indicators,, Partners .....</i>                  | <i>iv</i>  |
| <b>Focus Area Action Plans</b>                                                                              |            |
| 1. Coastal Resiliency and Sustainability .....                                                              | 1          |
| 2. Great Lakes Literacy and Natural Resources – Based Education .....                                       | 5          |
| 3. Fish and Wildlife Habitat .....                                                                          | 8          |
| 4. Water Quality, Green Infrastructure, and Stormwater.....                                                 | 12         |
| 5. Groundwater Resources .....                                                                              | 16         |
| 6. Site Remediation and Revitalization .....                                                                | 18         |
| 7. Non-Native Invasive Species and Biodiversity.....                                                        | 21         |
| 8. Public Access to Water Resources .....                                                                   | 24         |
| 9. Public Involvement and Input to Decision-making .....                                                    | 27         |
| 10. Scientific Research and Monitoring .....                                                                | 30         |
| 11. Stewardship and Hands-On Opportunities .....                                                            | 34         |
| <b>Overarching Plans - <i>Great Lakes Restoration Plans and State and Federal Funding Programs</i>.....</b> | <b>38</b>  |
| <b>Appendices</b>                                                                                           |            |
| Glossary of Terms and Acronyms                                                                              |            |
| Acknowledgements, Figures, Maps                                                                             |            |

## 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.

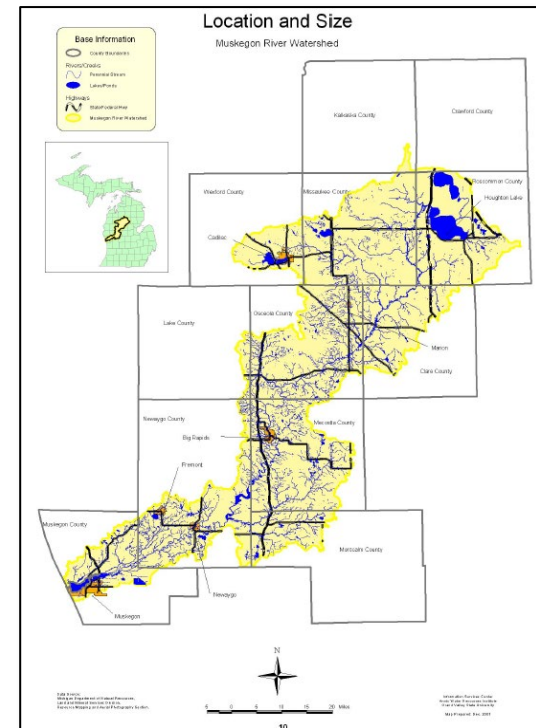
Progress made over the past decade included remediation of contaminated sediments and restoration of fish and wildlife habitat. Over the years, approximately \$80 million has been invested from various funding sources including the Great Lakes Restoration Initiative, Great Lakes Legacy Act, National 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:

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

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.

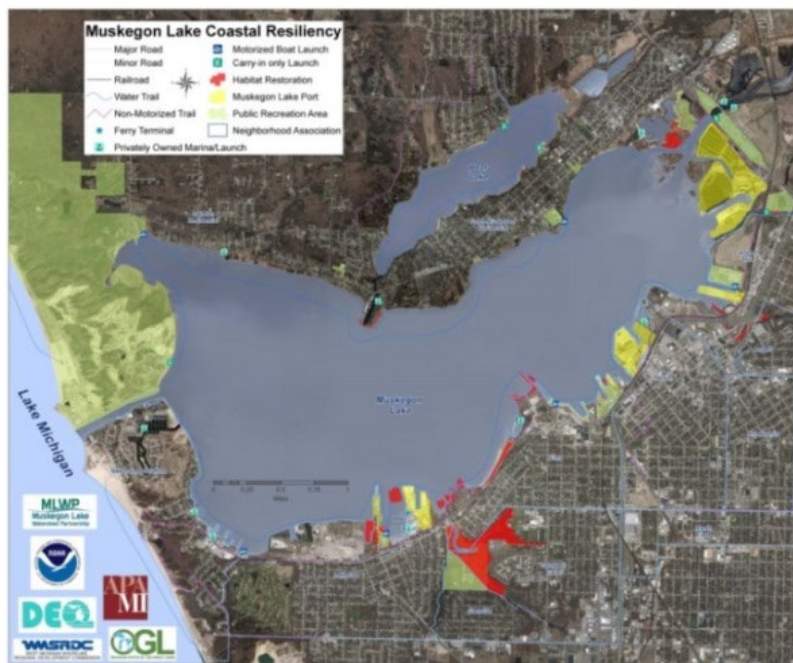
Coastal resiliency and sustainable decision-making were determined to be fundamental planning principles during the development of [Muskegon Lake Vision 2020](#) in 2015. In 2016, the MLWP also supported the development of the [Muskegon Lake Coastal Resiliency Plan](#).

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.

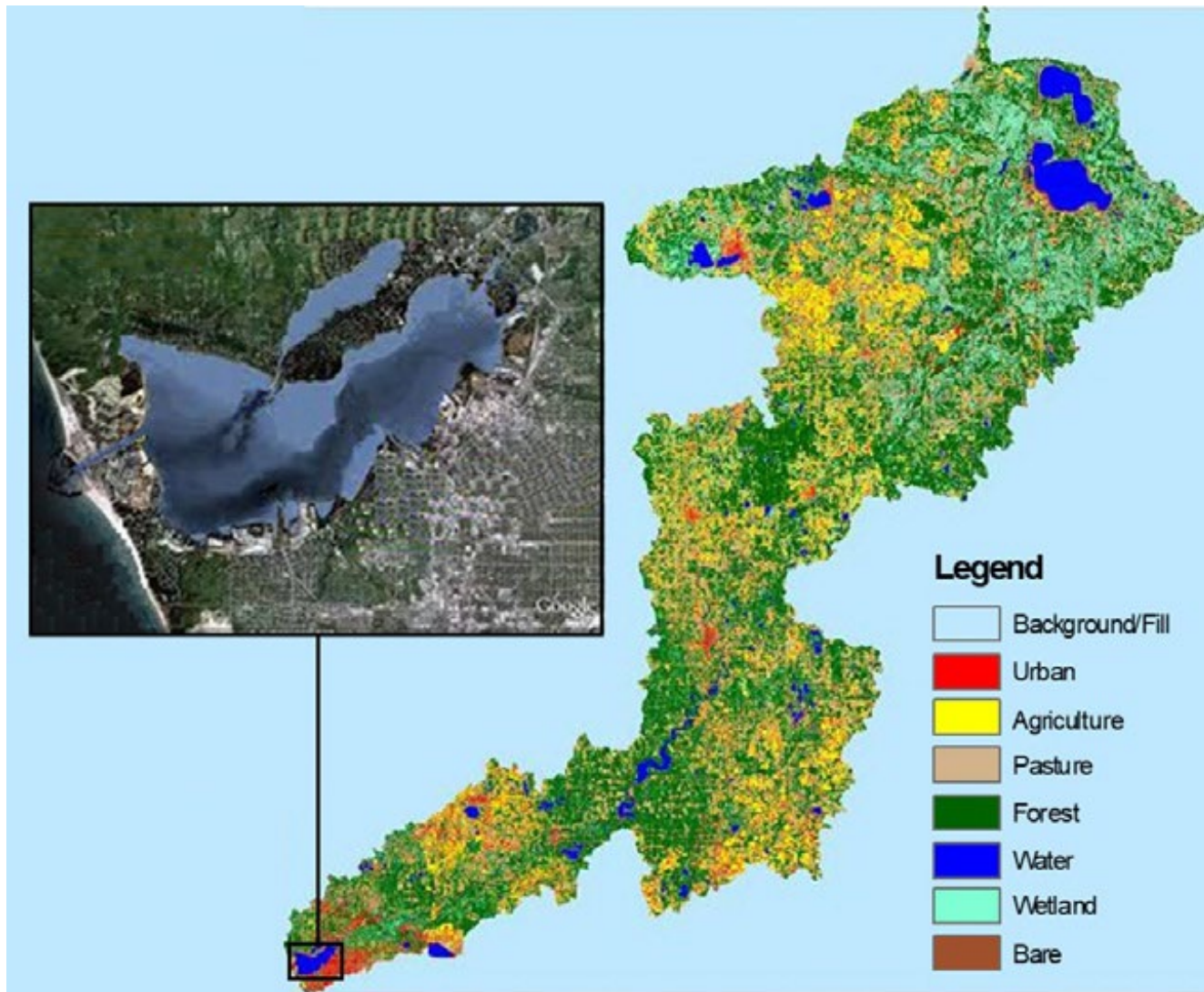
The majority of Muskegon River Watershed communities have received countywide Flood Insurance Rate Map (FIRM) updates under the Federal Emergency Management Agency's (FEMA) Map Modernization Program. Many communities also participate in the National Flood Insurance Program (NFIP), which is designed to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

|                          |                           |                           |                                 |
|--------------------------|---------------------------|---------------------------|---------------------------------|
| <i>Landowners</i>        | <i>Developers</i>         | <i>Muskegon Community</i> | <i>Philanthropists</i>          |
| <i>Local Governments</i> | <i>Business Community</i> | <i>College</i>            | <i>Recreational User Groups</i> |
| <i>General Public</i>    | <i>K-12 Schools</i>       | <i>Higher Education</i>   |                                 |

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

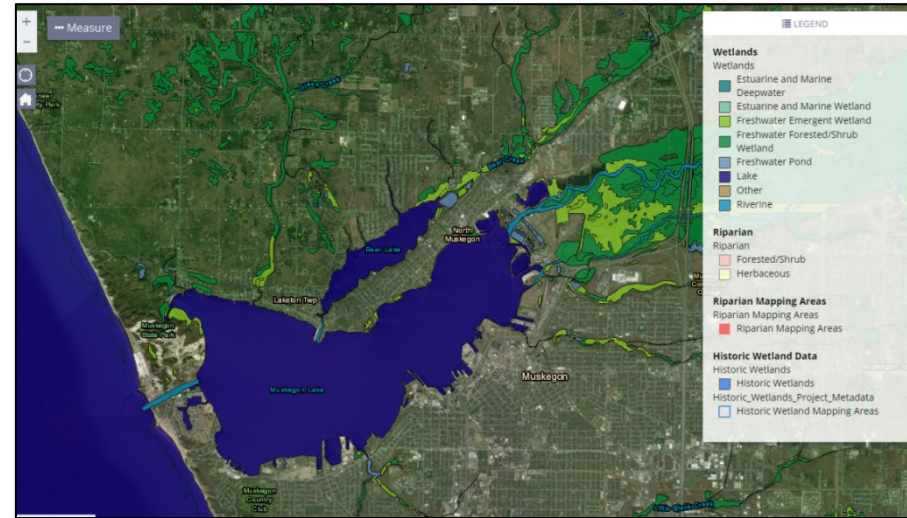
| #  | Implementation Recommendations                                                                                                                  | Indicators                                                                         | MLWP with Partners                                                    |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| 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       |

|           |                                                                           |                                           |                                                     |
|-----------|---------------------------------------------------------------------------|-------------------------------------------|-----------------------------------------------------|
| <b>11</b> | Define and assess a baseline and goal for environmental literacy          | Education level of environmental literacy | GVSU, MAISD, Muskegon Area Sustainability Coalition |
| <b>12</b> | 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.

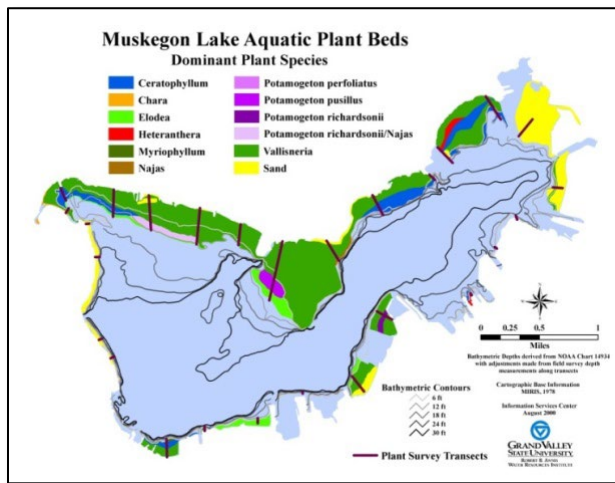


The MLWP determined that the development of a new Muskegon Lake Fish and Wildlife Habitat Restoration and Management Plan is needed to guide future actions for a healthy fishery. The existing [Muskegon Lake AOC Fish & Wildlife Habitat Restoration & BUI Removal Strategy](#) addressed only the AOC needs, 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 [Michigan Lake Sturgeon Rehabilitation Strategy](#) 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,                                         |

|           |                                                                                                                       |                                                                       |                                                                            |
|-----------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>10</b> | 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 |
| <b>11</b> | 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.

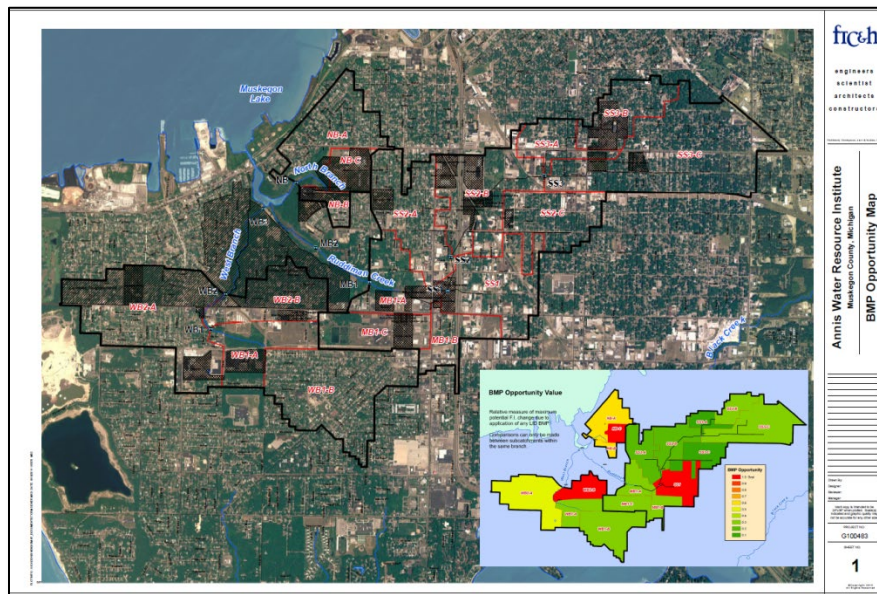
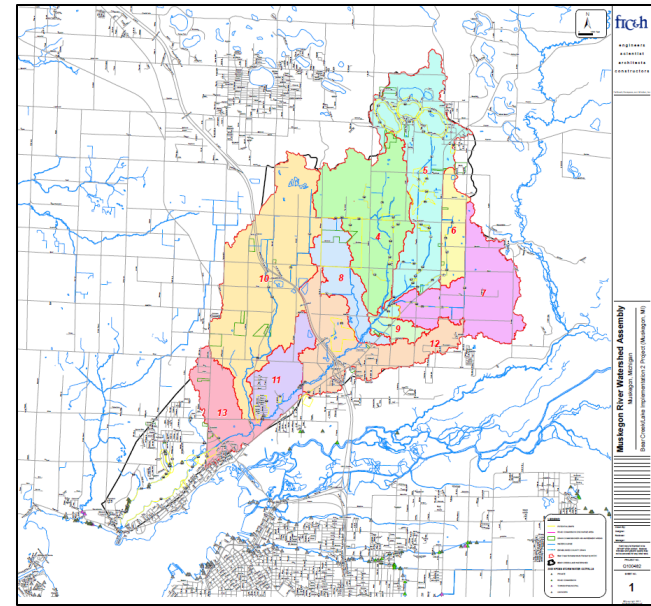
Previous efforts include integration of green infrastructure to manage stormwater runoff have included a 2015-2017 MDEQ Stormwater Asset Planning project and a City of Muskegon U.S. EPA Shoreline Cities Green Infrastructure implementation project.

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. The [Cedar Creek Watershed Land Use Project](#) identifies priorities.



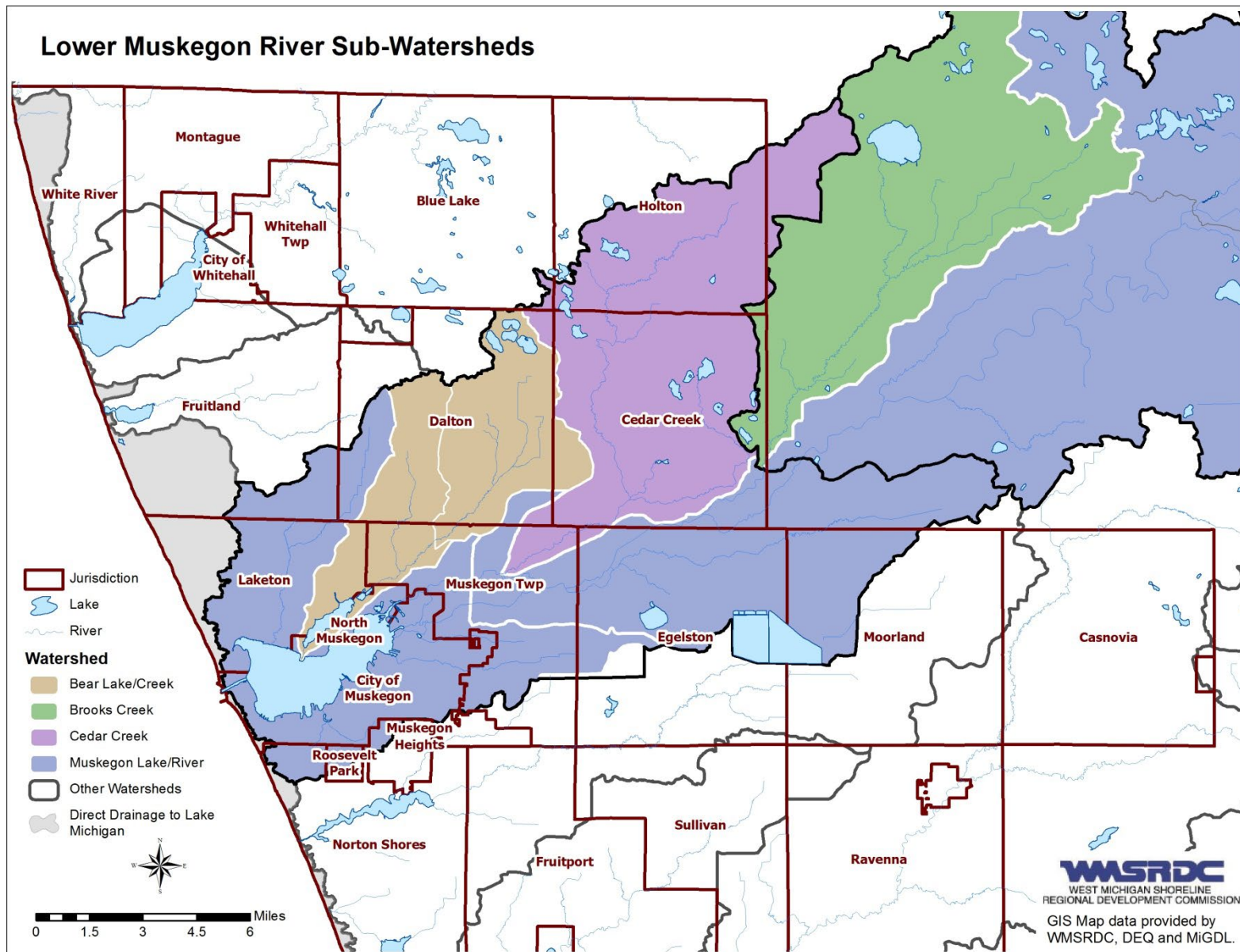
In the Ruddiman Creek watershed, a **Best Management Practice Scoping Tool** was developed to help landowners target specific areas where BMPs would be most effective at reducing flashy stormwater flows. Flashy flows scour out the sandy stream bed and reduce the diversity and abundance of the aquatic 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                                                         |

|           |                                                                                          |                                                                                                  |                                                                                      |
|-----------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>12</b> | 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 |
| <b>13</b> | 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                                      |



## 5. Groundwater Resources

### *Background, Need, and Status:*

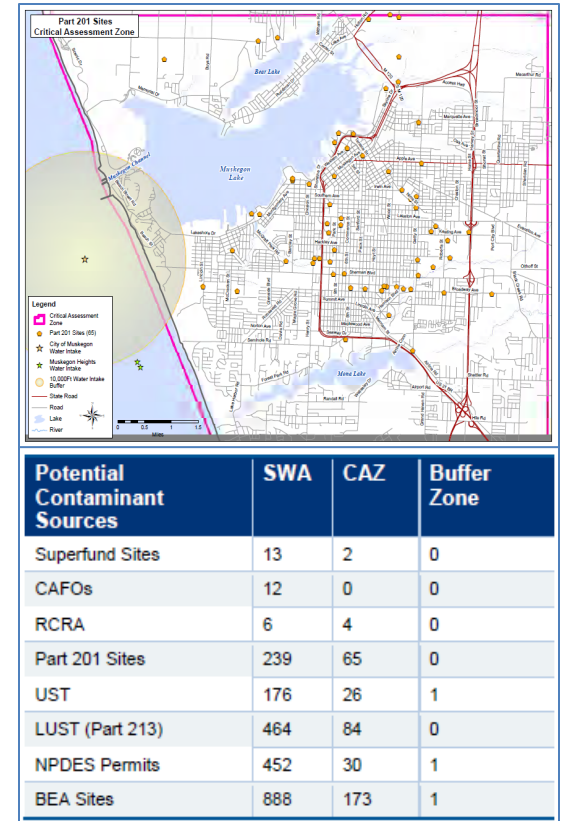
Groundwater is the water stored underground in the cracks and spaces in soil, sand, and rock. Groundwater is fed by precipitation and can resurface to replenish streams, rivers, and lakes. It helps provide cool water that supports aquatic life, and it is used as a source of drinking water.

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.

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<sup>1</sup>, 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](http://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:

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<sup>1</sup>[https://legacyfiles.ijc.org/publications/GreatLakes\\_AreasOfConcern\\_LifeAfterDelisting.pdf](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**

Contaminated sediment cleanups

Shoreline brownfield cleanup and redevelopment

Cleanup of contaminated soils and groundwater

### **Post-AOC Delisting (current) priorities**

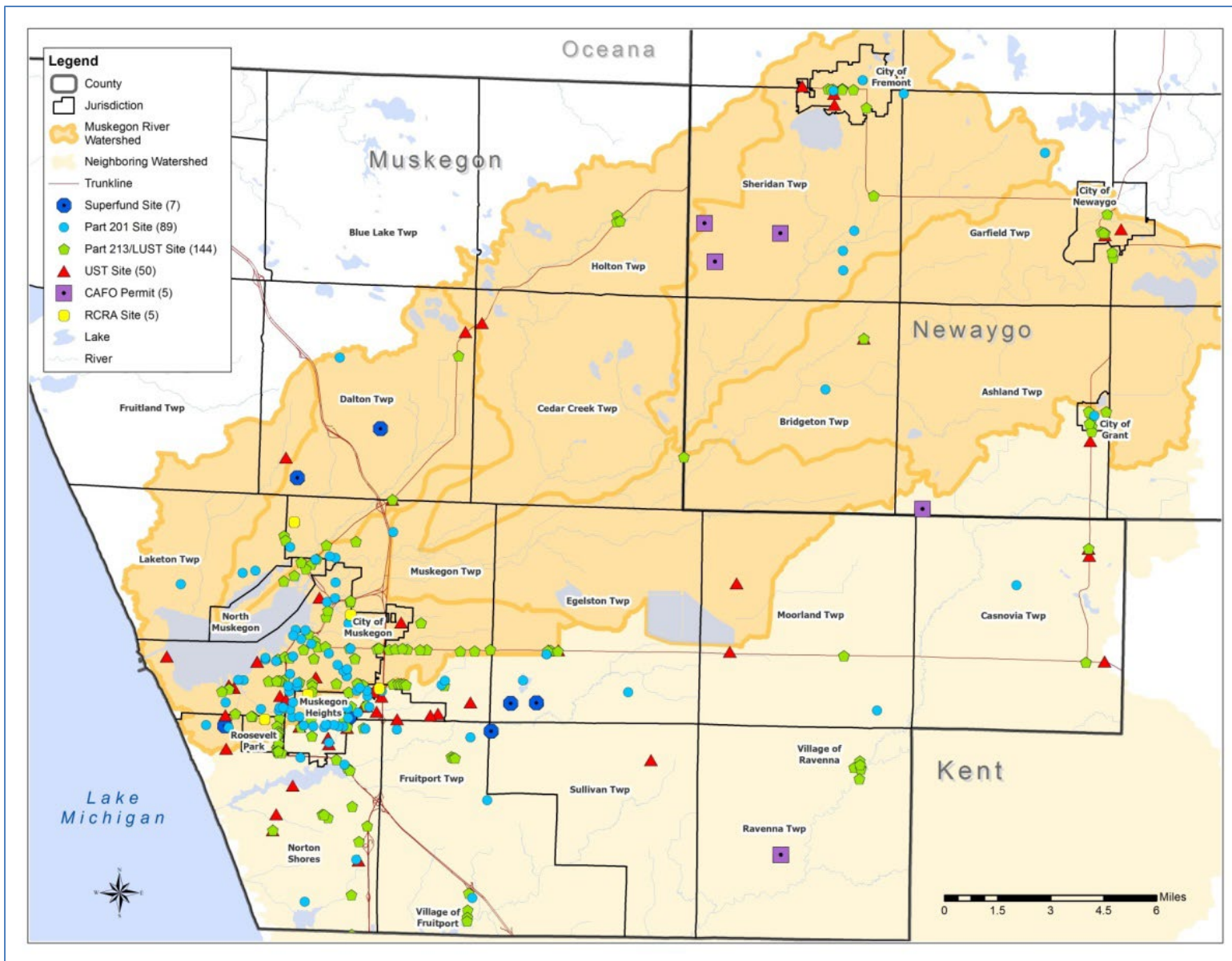
Public health (top priority)

Community engagement for redevelopment projects

Clean up of groundwater contamination

Understanding PFAS and emerging contaminants

Long-term monitoring and stewardship of all actions



Michigan PFAS Action Response Team– PFAS Sites and Areas of Interest in Muskegon County

|                                                                                                                         | <a href="#"><u>Former S.D. Warren (SAPPI)</u></a> | <a href="#"><u>Muskegon Co. Wastewater Treatment Plant</u></a> | <a href="#"><u>Muskegon Co. Type II</u></a> | <a href="#"><u>Former Teledyne Vehicle Systems (TDY)</u></a> | <a href="#"><u>Former Northside Landfill</u></a> | <a href="#"><u>Former BASF Muskegon</u></a> |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------|--------------------------------------------------|---------------------------------------------|
| 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**

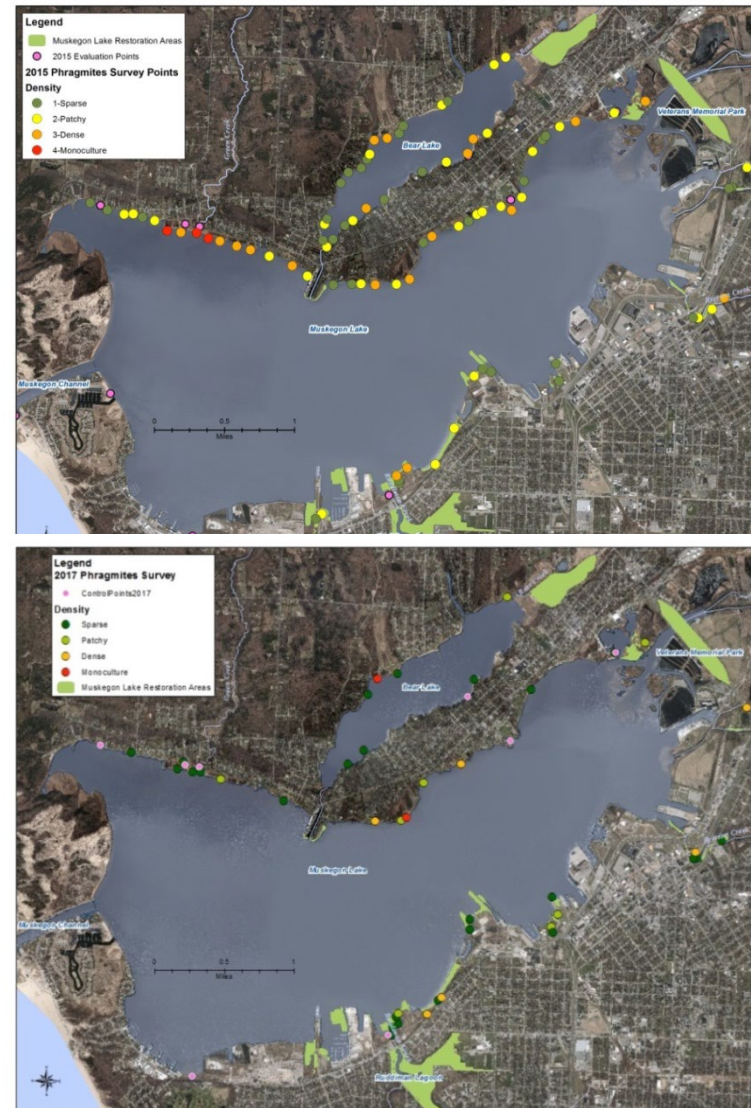


**AFTER Phragmites Control**  
**Muskegon Lake at Mouth of Green Creek - 2015**

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.

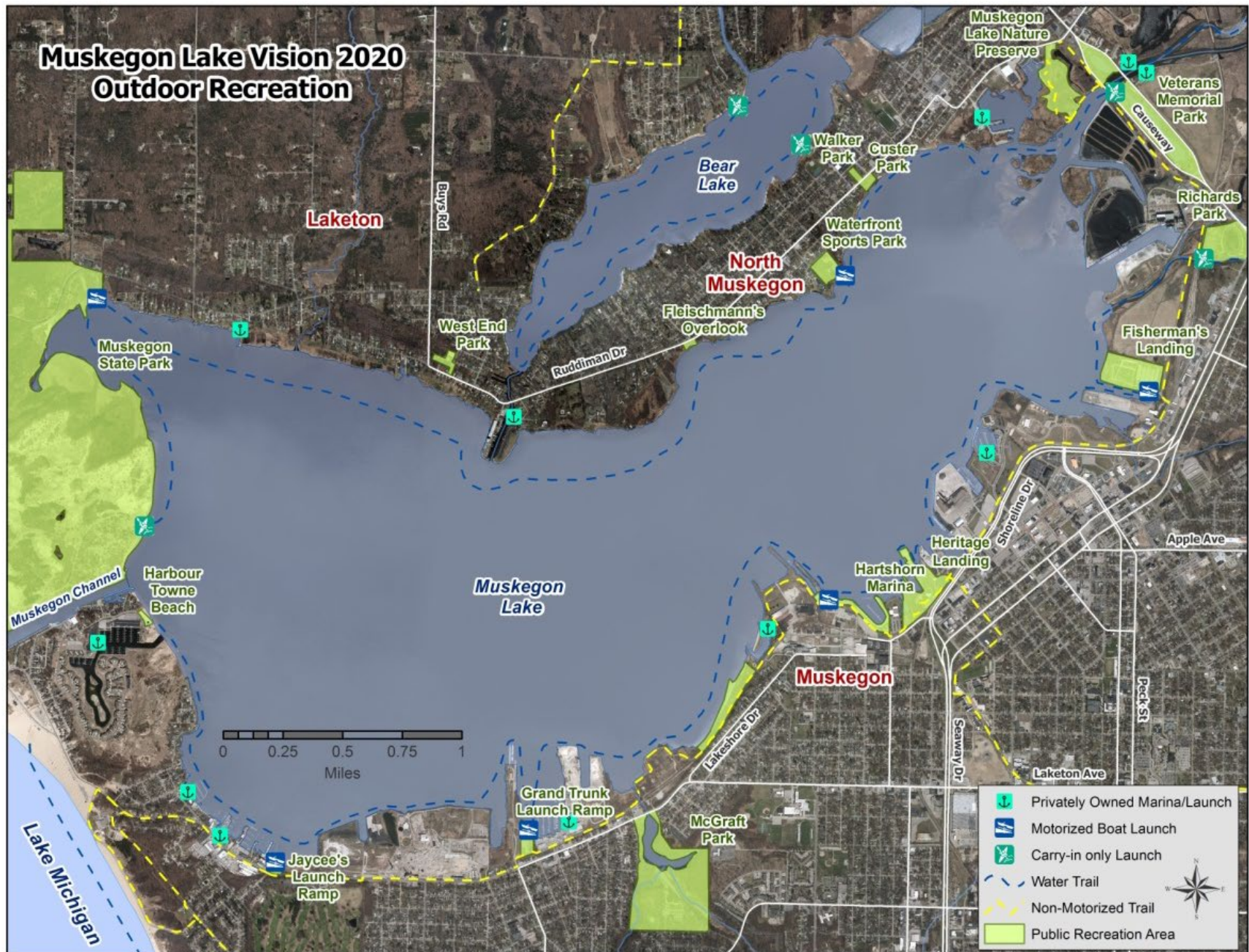
The [Muskegon Lake Vision 2020](#) planning process identified a strong community desire to link the protection of natural resources with enhanced recreational opportunities that would promote human interaction with the lake and its tributaries. The City of Muskegon's 2018 [Imagine Muskegon Lake](#) 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.





**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**

| <b>#</b> | <b>Implementation Recommendations</b>                                                                                                        | <b>Indicators</b>                                                                                                                     | <b>MLWP with Partners</b>                                                                              |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <b>1</b> | 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                                                         |
| <b>2</b> | 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                                               |
| <b>3</b> | 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                                                                    |
| <b>4</b> | Develop and implement a water trails system for non-motorized paddle craft                                                                   | Citizen use<br>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 |
| <b>5</b> | 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     |
| <b>6</b> | 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                                                        |

|           |                                                                                                                                         |                                                                                                                           |                                                                                                             |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>7</b>  | 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                                   |
| <b>8</b>  | 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                               |
| <b>9</b>  | Increase small public boat access in accordance with ADA needs throughout watershed                                                     | Number and quality of public landings, increased signage                                                                  | General Public, Anglers, Boaters                                                                            |
| <b>10</b> | 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                                             |
| <b>11</b> | 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

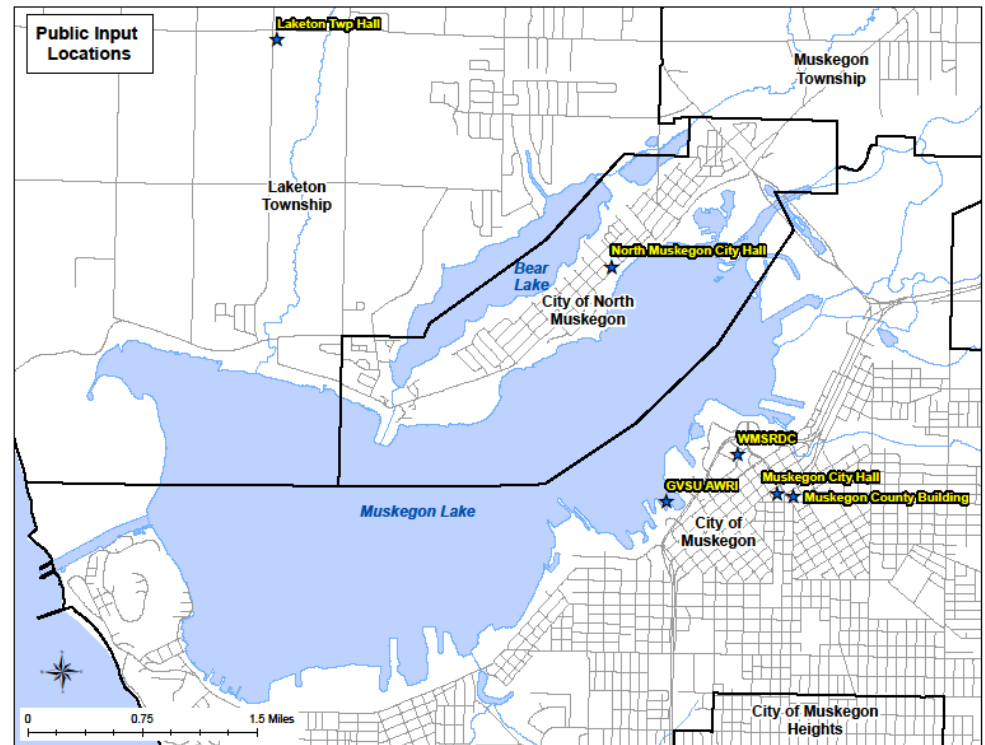
### *Background, Need, and Status:*

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.

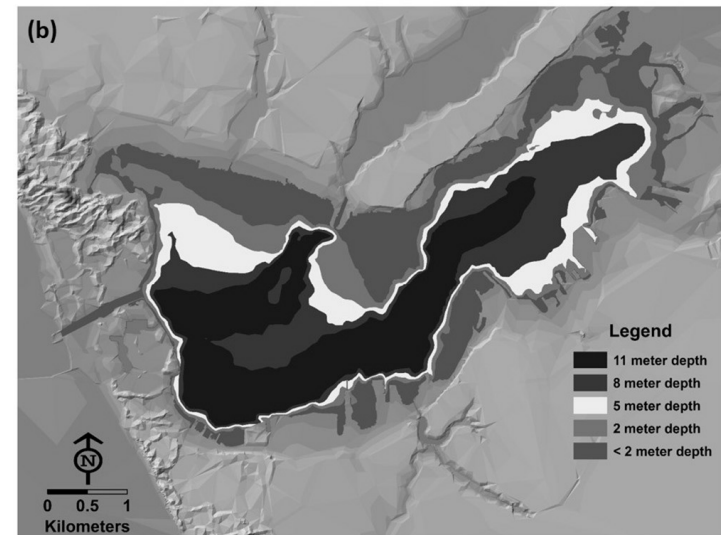
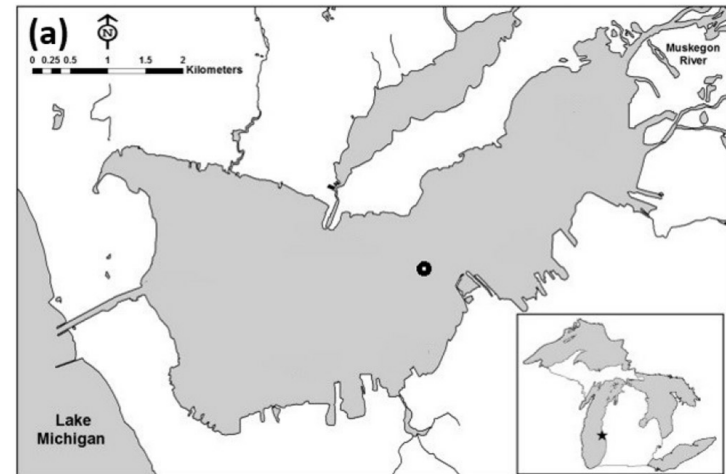
In 2003, GVSU Annis Water Resources Institute (AWRI) initiated a long-term monitoring program to determine the ecological status of Muskegon Lake. The program has indicated that, overall, the water quality of Muskegon Lake has improved over the past 30 years, but environmental challenges still exist, 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.



## 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                                                                  |

|           |                                                                                    |                              |                       |
|-----------|------------------------------------------------------------------------------------|------------------------------|-----------------------|
| <b>13</b> | Monitor fish populations                                                           | Fish Community Index Netting | MDNR, EGLE            |
| <b>14</b> | Monitor wildlife populations                                                       | Migratory bird studies       | MDNR                  |
| <b>15</b> | Monitor sediment to support dredging activities                                    | Review of sediment data      | USEPA, NOAA, academia |
| <b>16</b> | 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](mailto:info@muskegonlake.org) or contact the MLWP volunteer leaders through the website at [www.muskegonlake.org](http://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.



**Muskegon Lake Spring Cleanup 2017**

*Join us, volunteers!*  
**Sunday, April 23 8:00 a.m. - Noon**

*Cleanup History*  
The United Auto Workers Local 637 hosted their first annual Earth Day Cleanup in 1989. The Muskegon Lake Watershed Partnership joined forces with the community service, labor volunteers in 1993. Volunteering is a great way to be directly involved in the restoration of Muskegon Lake!

- Please sign up! Contact the Muskegon Lake Watershed Partnership at [kathy@muskegonlake.org](mailto:kathy@muskegonlake.org) and also 'like' our Muskegon Lake Watershed Partnership Facebook page to keep up-to-date with the MLWP and our work
- 8:00a.m. - 8:30 a.m. - Coffee & Juice at the CIO Hall
- 8:30a.m. - Volunteers team up promptly at the Community Tool Trailer near the CIO Hall, 490 W. Western Ave., downtown Muskegon
- Sign in with team leaders, get location assignments and supplies
- The Muskegon Lake Watershed will be cleaned up at twelve different locations from the lower Muskegon River to Lake Michigan
- Please dress in layers for possible weather changes along the shoreline
- Plan to get a little wet and dirty!
- Do not disturb nesting wildlife or animals!
- Bring your own rubber gloves or work gloves if you have them
- Wear old shoes or rubber boots
- Above all... be safe!

Muskegon County Muskegon UAW Local 637 WMSADC WESTERN MICHIGAN SPECIAL DISTRICT DEVELOPMENT CORPORATION MLWP Muskegon Lake Watershed Partnership LIVE UNITED. United Way United Way of the Lakeshores

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

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

OGLE – 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